STRUCTURAL ANALYSIS REPORT

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PLANNING BOARD
GRAFTON, MA

For

4WL0904F
GRAFTON UPTON ST

160 REAR UPTON STREET
GRAFTON, MA 01519

100 ft. Monopole

Prepared for:

Industrial Communications.

T · · Mobile ·

COMMONWEALTH OF MASSACHUSETTS
DANIEL P. HAMM
CIVIL
No. 40720
REGISTERED PROFESSIONAL ENGINEER

Dated: June 17, 2019

Prepared by:

HDG HUDSON Design Group LLC

45 Beechwood Drive
North Andover, MA 01845
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HUDSON
Design Group LLC

SCOPE OF WORK:

Hudson Design Group LLC (HDG) has been authorized by Industrial Communications to conduct a structural evaluation of the 100' monopole supporting the proposed T-Mobile's antennas located at elevation 99' above the ground level.

This report represents this office's findings, conclusions and recommendations pertaining to the support of T-Mobile's existing and proposed antennas listed below.

Record drawings of the existing monopole prepared by Nello Corporation, dated August 8, 2007, were available for our use. The existing and proposed appurtenance information was provided by Industrial Communications.

CONCLUSION SUMMARY:

Based on our evaluation, we have determined that the existing monopole, base plate, anchor bolts and foundation **are in conformance** with the ANSI/TIA-222-G Standard for the loading considered under the criteria listed in this report. The monopole structure is rated at **44.6%** - (Base Plate at EL.0' Controlling).

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APPURTENANCES CONFIGURATION: (AT&T RFDS 10/17/2018)

Tenant	Appurtenances	Elev.	Mount
T-Mobile	(6) AIR 21 Antennas	99'	Low Profile Platform
T-Mobile	(3) TMAs	99'	Low Profile Platform
T-Mobile	***(3) APXVAARR24 Antennas***	99'	Low Profile Platform
T-Mobile	***(3) 4449 RRH***	99'	Low Profile Platform
VERIZON	(1) LNX-6514DS Antenna	88'	Low Profile Platform
VERIZON	(1) X7C FRO-660 Antenna	88'	Low Profile Platform
VERIZON	(1) X7C FRO-440 Antenna	88'	Low Profile Platform
VERIZON	(2) WPA-80080-4CF Antennas	88'	Low Profile Platform
VERIZON	(4) WPA-80063-4CF Antennas	88'	Low Profile Platform
VERIZON	(3) AXP18-60 Antennas	88'	Low Profile Platform
VERIZON	(3) RRHs	88'	Low Profile Platform
VERIZON	Junction Box DB-B1-6C-12AB	88'	Low Profile Platform
AT&T	(3) 800 10121 Antennas	76'	Low Profile Platform
AT&T	(3) 800 10966 Antennas	76'	Low Profile Platform
AT&T	(3) OPA65R-BU8B Antennas	76'	Low Profile Platform
AT&T	(3) B2/B66A 8843	76'	Low Profile Platform
AT&T	(3) B5/B12 4449	76'	Low Profile Platform
AT&T	(6) LGP21401	76'	Low Profile Platform
AT&T	(6) DBCT108F1V92	76'	Low Profile Platform
AT&T	(1) DC6-48-60-18-8F	76'	Low Profile Platform
AT&T	(1) DC6-48-60-18-8C	76'	Low Profile Platform

****Proposed T-Mobile Appurtenances shown in Bold.***

T-MOBILE EXISTING/PROPOSED COAX CABLES:

Tenant	Coax Cables	Elev.	Mount
T-Mobile	(12) 7/8" Cables	99'	Inside Monopole
T-Mobile	(1) Hybrid Cables	99'	Inside Monopole
T-Mobile	***(1) Hybrid Cable***	99'	Inside Monopole

****Proposed T-Mobile Coax Cables shown in Bold.***

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ANALYSIS RESULTS SUMMARY:

Component	Max. Stress Ratio	Elev. of Component (ft)	Pass/Fail	Comments
Pole Section-L1	24.4 %	55 – 100	PASS	
Pole Section-L2	33.0 %	16 – 55	PASS	
Pole Section-L3	41.1 %	0 – 16	PASS	
Base Plate	**44.6 %**	0	PASS	**Controlling**

FOUNDATION ANALYSIS RESULTS SUMMARY:

	Design Reactions	Base Reactions	Pass/Fail	Comments
AXIAL	**41.1 k**	34.4 k	PASS	
SHEAR	**30.7 k**	24.5 k	PASS	
MOMENT	**2595 ft-k**	1776.4 ft-k	PASS	

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DESIGN CRITERIA:

1. EIA/TIA-222-G Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

   County: Worcester
   Wind Load: 105 mph (3 second gust)
   Structural Class: II
   Exposure Category: B
   Topographic Category: 1
   Nominal Ice Thickness: 1.0 inch

2. Approximate height above grade to proposed antennas: 99'

***Calculations and referenced documents are attached.**

ASSUMPTIONS:

1. The appurtenances configuration is as stated in this report. All antennas, coax cables and waveguide cables are assumed to be properly installed and supported as per the manufacturer's requirements.

2. The tower and foundation are properly constructed and maintained. All structural members and their connections are assumed to be in good condition and are free from defects with no deterioration to its member capacities.

3. The support mounts and platforms are not analyzed and are considered adequate to support the loading. The analysis is limited to the primary support structure itself.

4. All prior structural modification, if any, are assumed to be as per the data supplied (if available), and installed properly.

SUPPORT RECOMMENDATIONS:

HDG recommends that the proposed antennas, diplexers, RRHs and surge arrestor be mounted on the existing steel platform supported by the monopole.

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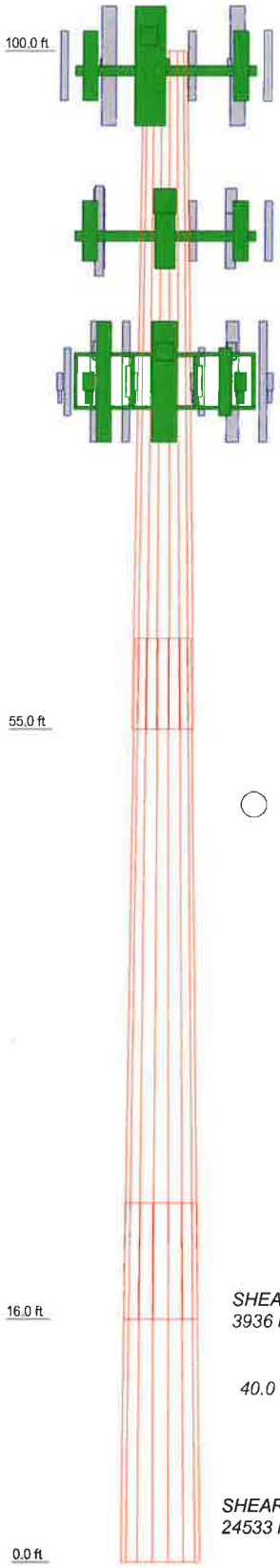
CALCULATIONS

Section	1	2	3
Length (ft)	45.00	45.00	23.63
Number of Sides	18	18	18
Thickness (in)	0.2500	0.3125	0.3125
Socket Length (ft)	6.00	7.63	
Top Dia (in)	33.2500	44.8161	55.5506
Bot Dia (in)	47.1724	58.4949	62.6250
Grade	A572-65		
Weight (lb)	4855.5	7798.1	4687.6
17341.1			



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
PiROD 13' Low Profile Platform (T-Mobile)	99	AXP18-60 Antenna w/Mounting Pipe	88
		RRH2x40	88
(2) AIR21 Antenna	99	WPA-80080-4CF Antenna w/Mounting Pipe	88
(2) AIR21 Antenna	99		
(2) AIR21 Antenna	99	(2) WPA-80063-4CF Antenna w/Mounting Pipe	88
Gen. TMA	99		
Gen. TMA	99	AXP18-60 Antenna w/Mounting Pipe	88
Gen. TMA	99	RRH2x40	88
APXVAA24_43-U-A20 Antenna w/Mounting Pipe (T-Mobile - Proposed)	99	PiROD 15' Platform w/handrails (Monopole) (ATT)	78
		800-10121 w/Mounting Pipe	78
APXVAA24_43-U-A20 Antenna w/Mounting Pipe (T-Mobile - Proposed)	99	800-10966 Antenna w/mounting pipe	78
		OPA65R-BU8B w/Mounting Pipe	78
		8843 RRH	78
APXVAA24_43-U-A20 Antenna w/Mounting Pipe (T-Mobile - Proposed)	99	4449 RRH	78
		(2) LGP21400 TMA	78
4449 RRH	99	(2) Diplexer DBCT108F1V92	78
4449 RRH	99	800-10121 w/Mounting Pipe	78
4449 RRH	99	800-10966 Antenna w/mounting pipe	78
PiROD 13' Low Profile Platform (Verizon)	88	OPA65R-BU8B w/Mounting Pipe	78
		8843 RRH	78
LNX-6514DS Antenna w/Mounting Pipe	88	4449 RRH	78
		(2) LGP21400 TMA	78
X7C-FRO-660 Antenna w/Mounting Pipe	88	(2) Diplexer DBCT108F1V92	78
		800-10121 w/Mounting Pipe	78
X7C-FRO-440 Antenna w/Mounting Pipe	88	800-10966 Antenna w/mounting pipe	78
		OPA65R-BU8B w/Mounting Pipe	78
AXP18-60 Antenna w/Mounting Pipe	88	8843 RRH	78
RRH2x40	88	4449 RRH	78
Junction Box	88	(2) LGP21400 TMA	78
WPA-80080-4CF Antenna w/Mounting Pipe	88	(2) Diplexer DBCT108F1V92	78
(2) WPA-80063-4CF Antenna w/Mounting Pipe	88	Squid Surge DC6-48-60-18-8C	78
		Squid Surge DC6-48-60-18-8F	78

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Worcester County, Massachusetts.
2. Tower designed for Exposure B to the TIA-222-G Standard.
3. Tower designed for a 105.0 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 40.0 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60.0 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 44.6%

ALL REACTIONS ARE FACTORED

AXIAL 70087 lb

SHEAR 3936 lb *MOMENT 286411 lb-ft*

TORQUE 326 lb-ft
40.0 mph WIND - 1.0000 in ICE

AXIAL 34380 lb

SHEAR 24533 lb *MOMENT 1776430 lb-ft*

TORQUE 2753 lb-ft
REACTIONS - 105.0 mph WIND

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Job: **Grafton MA**			
Project: **100 ft monopole**			
Client: Industrial Communications (T-Mobile)	Drawn by: SO	App'd:	
Code: TIA-222-G	Date: 06/17/19	Scale: NTS	
Path:		Dwg No. E-1	

Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Worcester County, Massachusetts.
Basic wind speed of 105.0 mph.
Structure Class II.
Exposure Category B.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 1.0000 in.
Ice thickness is considered to increase with height.
Ice density of 56.0 pcf.
A wind speed of 40.0 mph is used in combination with ice.
Temperature drop of 50.0 °F.
Deflections calculated using a wind speed of 60.0 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

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	100.00-55.00	45.00	6.00	18	33.2500	47.1724	0.2500	1.0000	A572-65 (65 ksi)
L2	55.00-16.00	45.00	7.63	18	44.8161	58.4949	0.3125	1.2500	A572-65 (65 ksi)
L3	16.00-0.00	23.63		18	55.5506	62.6250	0.3125	1.2500	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	33.7244	26.1855	3602.6843	11.7150	16.8910	213.2902	7210.1090	13.0952	5.4120	21.648
	47.8615	37.2329	10356.7867	16.6575	23.9636	432.1886	20727.2012	18.6200	7.8623	31.449
L2	47.3112	44.1420	11045.3438	15.7988	22.7666	485.1563	22105.2214	22.0752	7.3376	23.48
	59.3491	57.7097	24681.3715	20.6548	29.7154	830.5917	49395.2194	28.8603	9.7451	31.184
L3	58.6789	54.7893	21120.7880	19.6095	28.2197	748.4414	42269.3674	27.3998	9.2269	29.526
	63.5429	61.8062	30319.3524	22.1209	31.8135	953.0342	60678.5998	30.9090	10.4720	33.51

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	Double Angle Stitch Bolt Spacing Redundants in
L1 100.00-55.00				1	1	1			
L2 55.00-16.00				1	1	1			
L3 16.00-0.00				1	1	1			

Monopole Base Plate Data

Base Plate Data	
Base plate is square	
Base plate is grouted	
Anchor bolt grade	A615-75
Anchor bolt size	2.2500 in
Number of bolts	12
Embedment length	60.0000 in
f'_c	4.0 ksi
Grout space	3.3750 in
Base plate grade	A572-50
Base plate thickness	3.0000 in
Bolt circle diameter	69.5000 in
Outer diameter	76.7500 in
Inner diameter	59.0000 in
Base plate type	Plain Plate

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
**********											

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
7/8 (T-Mobile - existing)	A	No	No	Inside Pole	99.00 - 8.00	12	No Ice	0.00	0.54
							1/2" Ice	0.00	0.54
							1" Ice	0.00	0.54
Hybrid Cable	A	No	No	Inside Pole	99.00 - 8.00	1	No Ice	0.00	1.70
							1/2" Ice	0.00	1.70
							1" Ice	0.00	1.70
**********									
Hybrid Cable (T-Mobile - Proposed)	A	No	No	Inside Pole	99.00 - 8.00	1	No Ice	0.00	1.70
							1/2" Ice	0.00	1.70
							1" Ice	0.00	1.70
**********									
1 5/8	A	No	No	Inside Pole	88.00 - 8.00	12	No Ice	0.00	1.04

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
(Verizon - existing)							1/2" Ice	0.00	1.04
							1" Ice	0.00	1.04
Fiber Cable	A	No	No	Inside Pole	88.00 - 8.00	1	No Ice	0.00	0.48
							1/2" Ice	0.00	0.48
							1" Ice	0.00	0.48
**********									
1 5/8 Fiber Cable (AT&T - existing)	A	No	No	Inside Pole	76.00 - 8.00	12	No Ice	0.00	1.04
							1/2" Ice	0.00	1.04
							1" Ice	0.00	1.04
WR-VG122ST-BRD A	A	No	No	Inside Pole	76.00 - 8.00	4	No Ice	0.00	0.25
							1/2" Ice	0.00	0.25
							1" Ice	0.00	0.25
FB-L98B-002	A	No	No	Inside Pole	76.00 - 8.00	2	No Ice	0.00	0.25
							1/2" Ice	0.00	0.25
							1" Ice	0.00	0.25
**********									

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 lb
L1	100.00-55.00	A	0.000	0.000	0.000	0.000	1156.11
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
L2	55.00-16.00	A	0.000	0.000	0.000	0.000	1436.14
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
L3	16.00-0.00	A	0.000	0.000	0.000	0.000	294.59
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	100.00-55.00	A	2.176	0.000	0.000	0.000	0.000	1156.11
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
L2	55.00-16.00	A	2.014	0.000	0.000	0.000	0.000	1436.14
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00
L3	16.00-0.00	A	1.733	0.000	0.000	0.000	0.000	294.59
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	100.00-55.00	0.0000	0.0000	0.0000	0.0000
L2	55.00-16.00	0.0000	0.0000	0.0000	0.0000
L3	16.00-0.00	0.0000	0.0000	0.0000	0.0000

Note: For pole sections, center of pressure calculations do not consider feed line shielding.

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice

Discrete Tower Loads

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 lb
PiROD 13' Low Profile Platform (T - Mobile)	A	None		0.0000	99.00	No Ice	15.70	15.70	1300.00
						1/2" Ice	20.10	20.10	1765.00
						1" Ice	24.50	24.50	2230.00
(2) AIR21 Antenna	A	From Face	3.50	0.0000	99.00	No Ice	6.13	5.54	101.25
			0.00			1/2" Ice	6.52	6.20	156.43
			0.00			1" Ice	6.92	6.87	218.21
(2) AIR21 Antenna	B	From Face	3.50	0.0000	99.00	No Ice	6.13	5.54	101.25
			0.00			1/2" Ice	6.52	6.20	156.43
			0.00			1" Ice	6.92	6.87	218.21
(2) AIR21 Antenna	C	From Face	3.50	0.0000	99.00	No Ice	6.13	5.54	101.25
			0.00			1/2" Ice	6.52	6.20	156.43
			0.00			1" Ice	6.92	6.87	218.21
Gen. TMA	A	From Face	3.50	0.0000	99.00	No Ice	0.56	0.37	16.00
			0.00			1/2" Ice	0.66	0.45	21.11
			0.00			1" Ice	0.76	0.55	27.78
Gen. TMA	B	From Face	3.50	0.0000	99.00	No Ice	0.56	0.37	16.00
			0.00			1/2" Ice	0.66	0.45	21.11
			0.00			1" Ice	0.76	0.55	27.78
Gen. TMA	C	From Face	3.50	0.0000	99.00	No Ice	0.56	0.37	16.00
			0.00			1/2" Ice	0.66	0.45	21.11
			0.00			1" Ice	0.76	0.55	27.78
**********									
APXVAA24_43-U-A20 Antenna w/Mounting Pipe (T-Mobile - Proposed)	A	From Face	3.50	0.0000	99.00	No Ice	20.24	10.79	120.20
			1.00			1/2" Ice	20.89	12.21	253.89
			0.00			1" Ice	21.55	13.49	398.20
APXVAA24_43-U-A20 Antenna w/Mounting Pipe (T-Mobile - Proposed)	B	From Face	3.50	0.0000	99.00	No Ice	20.24	10.79	120.20
			1.00			1/2" Ice	20.89	12.21	253.89
			0.00			1" Ice	21.55	13.49	398.20
APXVAA24_43-U-A20	C	From Face	3.50	0.0000	99.00	No Ice	20.24	10.79	120.20

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 lb
Antenna w/Mounting Pipe			1.00			1/2" Ice	20.89	12.21	253.89
(T-Mobile - Proposed)			0.00			1" Ice	21.55	13.49	398.20
4449 RRH	A	From Face	3.50	0.0000	99.00	No Ice	1.63	1.16	74.00
			1.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
4449 RRH	B	From Face	3.50	0.0000	99.00	No Ice	1.63	1.16	74.00
			1.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
4449 RRH	C	From Face	3.50	0.0000	99.00	No Ice	1.63	1.16	74.00
			1.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
**********									
PiROD 13' Low Profile	A	None		0.0000	88.00	No Ice	15.70	15.70	1300.00
Platform						1/2" Ice	20.10	20.10	1765.00
(Verizon)						1" Ice	24.50	24.50	2230.00
LNX-6514DS Antenna	A	From Face	3.50	0.0000	88.00	No Ice	8.20	6.85	53.20
w/Mounting Pipe			0.00			1/2" Ice	8.66	7.81	119.72
			0.00			1" Ice	9.13	8.64	194.08
X7C-FRO-660 Antenna	A	From Face	3.50	0.0000	88.00	No Ice	9.55	7.41	70.90
w/Mounting Pipe			0.00			1/2" Ice	10.02	8.37	146.97
			0.00			1" Ice	10.50	9.20	231.06
X7C-FRO-440 Antenna	A	From Face	3.50	0.0000	88.00	No Ice	8.39	4.55	64.90
w/Mounting Pipe			0.00			1/2" Ice	8.91	5.38	127.96
			0.00			1" Ice	9.41	6.08	197.78
AXP18-60 Antenna	A	From Face	3.50	0.0000	88.00	No Ice	5.00	5.00	77.10
w/Mounting Pipe			0.00			1/2" Ice	7.22	7.22	151.92
			0.00			1" Ice	7.96	7.96	233.28
RRH2x40	A	From Face	3.50	0.0000	88.00	No Ice	2.83	1.67	51.00
			0.00			1/2" Ice	3.04	1.84	75.56
			2.00			1" Ice	3.26	2.01	103.37
Junction Box	A	From Face	3.50	0.0000	88.00	No Ice	3.01	1.97	27.00
			0.00			1/2" Ice	3.23	2.16	53.24
			0.00			1" Ice	3.45	2.36	82.85
WPA-80080-4CF Antenna	B	From Face	3.50	0.0000	88.00	No Ice	5.19	3.67	31.80
w/Mounting Pipe			0.00			1/2" Ice	5.68	4.47	75.51
			0.00			1" Ice	6.14	5.15	125.19
(2) WPA-80063-4CF	B	From Face	3.50	0.0000	88.00	No Ice	5.41	3.44	33.90
Antenna w/Mounting Pipe			0.00			1/2" Ice	5.90	4.24	77.47
			0.00			1" Ice	6.36	4.91	127.01
AXP18-60 Antenna	B	From Face	3.50	0.0000	88.00	No Ice	5.00	5.00	77.10
w/Mounting Pipe			0.00			1/2" Ice	7.22	7.22	151.92
			0.00			1" Ice	7.96	7.96	233.28
RRH2x40	B	From Face	3.50	0.0000	88.00	No Ice	2.83	1.67	51.00
			0.00			1/2" Ice	3.04	1.84	75.56
			2.00			1" Ice	3.26	2.01	103.37
WPA-80080-4CF Antenna	C	From Face	3.50	0.0000	88.00	No Ice	5.19	3.67	31.80
w/Mounting Pipe			0.00			1/2" Ice	5.68	4.47	75.51
			0.00			1" Ice	6.14	5.15	125.19
(2) WPA-80063-4CF	C	From Face	3.50	0.0000	88.00	No Ice	5.41	3.44	33.90
Antenna w/Mounting Pipe			0.00			1/2" Ice	5.90	4.24	77.47
			0.00			1" Ice	6.36	4.91	127.01
AXP18-60 Antenna	C	From Face	3.50	0.0000	88.00	No Ice	5.00	5.00	77.10
w/Mounting Pipe			0.00			1/2" Ice	7.22	7.22	151.92
			0.00			1" Ice	7.96	7.96	233.28
RRH2x40	C	From Face	3.50	0.0000	88.00	No Ice	2.83	1.67	51.00
			0.00			1/2" Ice	3.04	1.84	75.56
			2.00			1" Ice	3.26	2.01	103.37

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 lb
**********									
PiROD 15' Platform w/handrails (Monopole) (AT&T)	A	None		0.0000	78.00	No Ice	33.80	33.80	2043.00
						1/2" Ice	43.60	43.60	2748.00
						1" Ice	53.40	53.40	3453.00
800-10121 w/Mounting Pipe	A	From Face	3.50	0.0000	78.00	No Ice	5.51	4.72	66.90
			-4.00			1/2" Ice	5.98	5.56	115.69
			0.00			1" Ice	6.43	6.29	170.94
800-10966 Antenna w/mounting pipe	A	From Face	3.50	0.0000	78.00	No Ice	17.84	9.88	151.50
			0.00			1/2" Ice	18.67	11.49	269.99
			0.00			1" Ice	19.52	13.13	399.12
OPA65R-BU8B w/Mounting Pipe	A	From Face	3.50	0.0000	78.00	No Ice	11.22	10.56	98.20
			4.00			1/2" Ice	11.84	11.98	188.74
			0.00			1" Ice	12.46	13.26	289.08
8843 RRH	A	From Face	3.50	0.0000	78.00	No Ice	1.64	1.35	72.00
			0.00			1/2" Ice	1.80	1.50	89.60
			2.00			1" Ice	1.97	1.65	109.91
4449 RRH	A	From Face	3.50	0.0000	78.00	No Ice	1.63	1.16	74.00
			0.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
(2) LGP21400 TMA	A	From Face	3.50	0.0000	78.00	No Ice	1.08	0.36	19.00
			0.00			1/2" Ice	1.21	0.45	26.13
			0.00			1" Ice	1.35	0.56	35.14
(2) Diplexer DBCT108F1V92	A	From Face	3.50	0.0000	78.00	No Ice	0.61	0.64	29.00
			0.00			1/2" Ice	0.71	0.75	36.27
			-1.00			1" Ice	0.82	0.86	45.34
800-10121 w/Mounting Pipe	B	From Face	3.50	0.0000	78.00	No Ice	5.51	4.72	66.90
			-4.00			1/2" Ice	5.98	5.56	115.69
			0.00			1" Ice	6.43	6.29	170.94
800-10966 Antenna w/mounting pipe	B	From Face	3.50	0.0000	78.00	No Ice	17.84	9.88	151.50
			0.00			1/2" Ice	18.67	11.49	269.99
			0.00			1" Ice	19.52	13.13	399.12
OPA65R-BU8B w/Mounting Pipe	B	From Face	3.50	0.0000	78.00	No Ice	11.22	10.56	98.20
			4.00			1/2" Ice	11.84	11.98	188.74
			0.00			1" Ice	12.46	13.26	289.08
8843 RRH	B	From Face	3.50	0.0000	78.00	No Ice	1.64	1.35	72.00
			0.00			1/2" Ice	1.80	1.50	89.60
			2.00			1" Ice	1.97	1.65	109.91
4449 RRH	A	From Face	3.50	0.0000	78.00	No Ice	1.63	1.16	74.00
			0.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
(2) LGP21400 TMA	B	From Face	3.50	0.0000	78.00	No Ice	1.08	0.36	19.00
			0.00			1/2" Ice	1.21	0.45	26.13
			0.00			1" Ice	1.35	0.56	35.14
(2) Diplexer DBCT108F1V92	B	From Face	3.50	0.0000	78.00	No Ice	0.61	0.64	29.00
			0.00			1/2" Ice	0.71	0.75	36.27
			-1.00			1" Ice	0.82	0.86	45.34
800-10121 w/Mounting Pipe	C	From Face	3.50	0.0000	78.00	No Ice	5.51	4.72	66.90
			-4.00			1/2" Ice	5.98	5.56	115.69
			0.00			1" Ice	6.43	6.29	170.94
800-10966 Antenna w/mounting pipe	C	From Face	3.50	0.0000	78.00	No Ice	17.84	9.88	151.50
			0.00			1/2" Ice	18.67	11.49	269.99
			0.00			1" Ice	19.52	13.13	399.12
OPA65R-BU8B w/Mounting Pipe	C	From Face	3.50	0.0000	78.00	No Ice	11.22	10.56	98.20
			4.00			1/2" Ice	11.84	11.98	188.74
			0.00			1" Ice	12.46	13.26	289.08
8843 RRH	C	From Face	3.50	0.0000	78.00	No Ice	1.64	1.35	72.00
			0.00			1/2" Ice	1.80	1.50	89.60

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 lb
			2.00			1" Ice	1.97	1.65	109.91
4449 RRH	A	From Face	3.50	0.0000	78.00	No Ice	1.63	1.16	74.00
			0.00			1/2" Ice	1.78	1.29	89.95
			2.00			1" Ice	1.95	1.44	108.51
(2) LGP21400 TMA	C	From Face	3.50	0.0000	78.00	No Ice	1.08	0.36	19.00
			0.00			1/2" Ice	1.21	0.45	26.13
			0.00			1" Ice	1.35	0.56	35.14
(2) Diplexer DBCT108F1V92	C	From Face	3.50	0.0000	78.00	No Ice	0.61	0.64	29.00
			0.00			1/2" Ice	0.71	0.75	36.27
			-1.00			1" Ice	0.82	0.86	45.34
Squid Surge	A	From Face	1.00	0.0000	78.00	No Ice	0.81	0.81	33.00
DC6-48-60-18-8C			0.00			1/2" Ice	1.30	1.30	48.38
			0.00			1" Ice	1.48	1.48	66.11
Squid Surge	B	From Face	1.00	0.0000	78.00	No Ice	0.81	0.81	33.00
DC6-48-60-18-8F			0.00			1/2" Ice	1.30	1.30	48.38
			0.00			1" Ice	1.48	1.48	66.11

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp

Comb. No.	Description
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Pole	Max. Vert	26	70087.42	0.00	0.00
	Max. H_x	20	34380.46	24492.74	70.00
	Max. H_z	2	34380.46	70.00	24411.91
	Max. M_x	2	1764835.30	70.00	24411.91
	Max. M_z	8	1768898.39	-24492.74	-70.00
	Max. Torsion	5	2752.75	-12185.74	21106.33
	Min. Vert	17	25785.35	12185.74	-21106.33
	Min. H_x	8	34380.46	-24492.74	-70.00
	Min. H_z	14	34380.46	-70.00	-24411.91
	Min. M_x	14	-1762505.08	-70.00	-24411.91
	Min. M_z	20	-1772562.35	24492.74	70.00
	Min. Torsion	17	-2752.75	12185.74	-21106.33

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
Dead Only	28650.39	0.00	0.00	-955.17	1501.85	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	34380.46	-70.00	-24411.91	-1764835.30	7946.63	-2342.97
0.9 Dead+1.6 Wind 0 deg - No Ice	25785.35	-70.00	-24411.91	-1760276.62	7467.41	-2343.54
1.2 Dead+1.6 Wind 30 deg - No Ice	34380.46	12185.74	-21106.33	-1525490.86	-878238.57	-2752.04
0.9 Dead+1.6 Wind 30 deg - No Ice	25785.35	12185.74	-21106.33	-1521511.26	-876574.84	-2752.75
1.2 Dead+1.6 Wind 60 deg - No Ice	34380.46	21176.33	-12145.33	-877703.88	-1528609.04	-2423.69

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
0.9 Dead+1.6 Wind 60 deg - No Ice	25785.35	21176.33	-12145.33	-875290.67	-1525372.45	-2424.35
1.2 Dead+1.6 Wind 90 deg - No Ice	34380.46	24492.74	70.00	4950.35	-1768898.39	-1445.93
0.9 Dead+1.6 Wind 90 deg - No Ice	25785.35	24492.74	70.00	5229.64	-1765080.45	-1446.37
1.2 Dead+1.6 Wind 120 deg - No Ice	34380.46	21246.34	12266.58	885965.13	-1534722.65	-80.76
0.9 Dead+1.6 Wind 120 deg - No Ice	25785.35	21246.34	12266.58	884114.73	-1531470.57	-80.85
1.2 Dead+1.6 Wind 150 deg - No Ice	34380.46	12307.00	21176.33	1529274.66	-888829.33	1306.05
0.9 Dead+1.6 Wind 150 deg - No Ice	25785.35	12307.00	21176.33	1525869.36	-887138.69	1306.32
1.2 Dead+1.6 Wind 180 deg - No Ice	34380.46	70.00	24411.91	1762505.08	-4283.67	2342.93
0.9 Dead+1.6 Wind 180 deg - No Ice	25785.35	70.00	24411.91	1758536.29	-4731.74	2343.50
1.2 Dead+1.6 Wind 210 deg - No Ice	34380.46	-12185.74	21106.33	1523161.23	881901.53	2752.04
0.9 Dead+1.6 Wind 210 deg - No Ice	25785.35	-12185.74	21106.33	1519771.38	879310.51	2752.75
1.2 Dead+1.6 Wind 240 deg - No Ice	34380.46	-21176.33	12145.33	875374.56	1532272.50	2423.73
0.9 Dead+1.6 Wind 240 deg - No Ice	25785.35	-21176.33	12145.33	873551.01	1528108.49	2424.40
1.2 Dead+1.6 Wind 270 deg - No Ice	34380.46	-24492.74	-70.00	-7279.95	1772562.35	1445.97
0.9 Dead+1.6 Wind 270 deg - No Ice	25785.35	-24492.74	-70.00	-6969.50	1767816.86	1446.41
1.2 Dead+1.6 Wind 300 deg - No Ice	34380.46	-21246.34	-12266.58	-888295.32	1538386.61	80.76
0.9 Dead+1.6 Wind 300 deg - No Ice	25785.35	-21246.34	-12266.58	-885855.03	1534206.97	80.85
1.2 Dead+1.6 Wind 330 deg - No Ice	34380.46	-12307.00	-21176.33	-1531605.16	892492.79	-1306.09
0.9 Dead+1.6 Wind 330 deg - No Ice	25785.35	-12307.00	-21176.33	-1527609.89	889874.73	-1306.37
1.2 Dead+1.0 Ice+1.0 Temp	70087.42	-0.00	-0.00	-3468.28	5408.50	-0.01
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	70087.42	-4.54	-3928.30	-282709.22	5921.69	-273.60
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	70087.42	1962.84	-3399.74	-245109.07	-133944.68	-326.05
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	70087.42	3404.28	-1960.22	-142781.31	-236440.53	-291.13
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	70087.42	3933.54	4.54	-3144.58	-274102.19	-178.21
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	70087.42	3408.82	1968.08	136385.58	-236838.26	-17.54
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	70087.42	1970.70	3404.28	238422.16	-134633.57	147.83
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	70087.42	4.54	3928.30	275624.57	5126.22	273.58
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	70087.42	-1962.84	3399.74	238024.44	144992.59	326.03
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	70087.42	-3404.28	1960.22	135696.69	247488.45	291.11
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	70087.42	-3933.54	-4.54	-3940.05	285150.13	178.19
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	70087.42	-3408.82	-1968.08	-143470.22	247886.19	17.52

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	70087.42	-1970.70	-3404.28	-245506.81	145681.49	-147.85
Dead+Wind 0 deg - Service	28650.39	-12.78	-4457.60	-322511.40	2637.77	-428.08
Dead+Wind 30 deg - Service	28650.39	2225.11	-3854.00	-278875.43	-158926.61	-502.83
Dead+Wind 60 deg - Service	28650.39	3866.78	-2217.73	-160774.55	-277498.64	-442.85
Dead+Wind 90 deg - Service	28650.39	4472.36	12.78	146.20	-321307.05	-264.20
Dead+Wind 120 deg - Service	28650.39	3879.57	2239.87	160768.23	-278613.41	-14.77
Dead+Wind 150 deg - Service	28650.39	2247.25	3866.78	278053.02	-160857.47	238.63
Dead+Wind 180 deg - Service	28650.39	12.78	4457.60	320574.20	408.19	428.08
Dead+Wind 210 deg - Service	28650.39	-2225.11	3854.00	276938.25	161972.57	502.83
Dead+Wind 240 deg - Service	28650.39	-3866.78	2217.73	158837.37	280544.62	442.85
Dead+Wind 270 deg - Service	28650.39	-4472.36	-12.78	-2083.38	324353.04	264.20
Dead+Wind 300 deg - Service	28650.39	-3879.57	-2239.87	-162705.43	281659.41	14.76
Dead+Wind 330 deg - Service	28650.39	-2247.25	-3866.78	-279990.23	163903.45	-238.63

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
1	0.00	-28650.39	0.00	0.00	28650.39	0.00	0.000%
2	-70.00	-34380.46	-24411.91	70.00	34380.46	24411.91	0.000%
3	-70.00	-25785.35	-24411.91	70.00	25785.35	24411.91	0.000%
4	12185.74	-34380.46	-21106.33	-12185.74	34380.46	21106.33	0.000%
5	12185.74	-25785.35	-21106.33	-12185.74	25785.35	21106.33	0.000%
6	21176.33	-34380.46	-12145.33	-21176.33	34380.46	12145.33	0.000%
7	21176.33	-25785.35	-12145.33	-21176.33	25785.35	12145.33	0.000%
8	24492.74	-34380.46	70.00	-24492.74	34380.46	-70.00	0.000%
9	24492.74	-25785.35	70.00	-24492.74	25785.35	-70.00	0.000%
10	21246.34	-34380.46	12266.58	-21246.34	34380.46	-12266.58	0.000%
11	21246.34	-25785.35	12266.58	-21246.34	25785.35	-12266.58	0.000%
12	12307.00	-34380.46	21176.33	-12307.00	34380.46	-21176.33	0.000%
13	12307.00	-25785.35	21176.33	-12307.00	25785.35	-21176.33	0.000%
14	70.00	-34380.46	24411.91	-70.00	34380.46	-24411.91	0.000%
15	70.00	-25785.35	24411.91	-70.00	25785.35	-24411.91	0.000%
16	-12185.74	-34380.46	21106.33	12185.74	34380.46	-21106.33	0.000%
17	-12185.74	-25785.35	21106.33	12185.74	25785.35	-21106.33	0.000%
18	-21176.33	-34380.46	12145.33	21176.33	34380.46	-12145.33	0.000%
19	-21176.33	-25785.35	12145.33	21176.33	25785.35	-12145.33	0.000%
20	-24492.74	-34380.46	-70.00	24492.74	34380.46	70.00	0.000%
21	-24492.74	-25785.35	-70.00	24492.74	25785.35	70.00	0.000%
22	-21246.34	-34380.46	-12266.58	21246.34	34380.46	12266.58	0.000%
23	-21246.34	-25785.35	-12266.58	21246.34	25785.35	12266.58	0.000%
24	-12307.00	-34380.46	-21176.33	12307.00	34380.46	21176.33	0.000%
25	-12307.00	-25785.35	-21176.33	12307.00	25785.35	21176.33	0.000%
26	0.00	-70087.42	0.00	0.00	70087.42	0.00	0.000%
27	-4.54	-70087.42	-3928.29	4.54	70087.42	3928.30	0.000%
28	1962.84	-70087.42	-3399.73	-1962.84	70087.42	3399.74	0.000%
29	3404.27	-70087.42	-1960.22	-3404.28	70087.42	1960.22	0.000%
30	3933.53	-70087.42	4.54	-3933.54	70087.42	-4.54	0.000%
31	3408.81	-70087.42	1968.08	-3408.82	70087.42	-1968.08	0.000%
32	1970.70	-70087.42	3404.27	-1970.70	70087.42	-3404.28	0.000%
33	4.54	-70087.42	3928.29	-4.54	70087.42	-3928.30	0.000%
34	-1962.84	-70087.42	3399.73	1962.84	70087.42	-3399.74	0.000%
35	-3404.27	-70087.42	1960.22	3404.28	70087.42	-1960.22	0.000%
36	-3933.53	-70087.42	-4.54	3933.54	70087.42	4.54	0.000%
37	-3408.81	-70087.42	-1968.08	3408.82	70087.42	1968.08	0.000%
38	-1970.70	-70087.42	-3404.27	1970.70	70087.42	3404.28	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
39	-12.78	-28650.39	-4457.60	12.78	28650.39	4457.60	0.000%
40	2225.11	-28650.39	-3854.00	-2225.11	28650.39	3854.00	0.000%
41	3866.78	-28650.39	-2217.73	-3866.78	28650.39	2217.73	0.000%
42	4472.36	-28650.39	12.78	-4472.36	28650.39	-12.78	0.000%
43	3879.57	-28650.39	2239.87	-3879.57	28650.39	-2239.87	0.000%
44	2247.25	-28650.39	3866.78	-2247.25	28650.39	-3866.78	0.000%
45	12.78	-28650.39	4457.60	-12.78	28650.39	-4457.60	0.000%
46	-2225.11	-28650.39	3854.00	2225.11	28650.39	-3854.00	0.000%
47	-3866.78	-28650.39	2217.73	3866.78	28650.39	-2217.73	0.000%
48	-4472.36	-28650.39	-12.78	4472.36	28650.39	12.78	0.000%
49	-3879.57	-28650.39	-2239.87	3879.57	28650.39	2239.87	0.000%
50	-2247.25	-28650.39	-3866.78	2247.25	28650.39	3866.78	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	0.00001869
3	Yes	4	0.00000001	0.00001167
4	Yes	4	0.00000001	0.00003022
5	Yes	4	0.00000001	0.00001875
6	Yes	4	0.00000001	0.00004351
7	Yes	4	0.00000001	0.00002763
8	Yes	4	0.00000001	0.00001272
9	Yes	4	0.00000001	0.00000756
10	Yes	4	0.00000001	0.00003329
11	Yes	4	0.00000001	0.00002073
12	Yes	4	0.00000001	0.00003066
13	Yes	4	0.00000001	0.00001897
14	Yes	4	0.00000001	0.00001820
15	Yes	4	0.00000001	0.00001135
16	Yes	4	0.00000001	0.00004524
17	Yes	4	0.00000001	0.00002878
18	Yes	4	0.00000001	0.00002990
19	Yes	4	0.00000001	0.00001849
20	Yes	4	0.00000001	0.00001316
21	Yes	4	0.00000001	0.00000785
22	Yes	4	0.00000001	0.00003420
23	Yes	4	0.00000001	0.00002126
24	Yes	4	0.00000001	0.00003890
25	Yes	4	0.00000001	0.00002444
26	Yes	4	0.00000001	0.00000001
27	Yes	4	0.00000001	0.00010820
28	Yes	4	0.00000001	0.00010591
29	Yes	4	0.00000001	0.00010350
30	Yes	4	0.00000001	0.00010147
31	Yes	4	0.00000001	0.00010097
32	Yes	4	0.00000001	0.00010145
33	Yes	4	0.00000001	0.00010285
34	Yes	4	0.00000001	0.00010552
35	Yes	4	0.00000001	0.00010806
36	Yes	4	0.00000001	0.00010984
37	Yes	4	0.00000001	0.00011095
38	Yes	4	0.00000001	0.00011035
39	Yes	4	0.00000001	0.00000001

40	Yes	4	0.00000001	0.00000001
41	Yes	4	0.00000001	0.00000001
42	Yes	4	0.00000001	0.00000001
43	Yes	4	0.00000001	0.00000001
44	Yes	4	0.00000001	0.00000001
45	Yes	4	0.00000001	0.00000001
46	Yes	4	0.00000001	0.00000001
47	Yes	4	0.00000001	0.00000001
48	Yes	4	0.00000001	0.00000001
49	Yes	4	0.00000001	0.00000001
50	Yes	4	0.00000001	0.00000001

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 55	2.5876	49	0.2043	0.0012
L2	61 - 16	1.0466	49	0.1542	0.0005
L3	23.63 - 0	0.1695	49	0.0603	0.0001

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
99.00	PiROD 13' Low Profile Platform	49	2.5451	0.2034	0.0012	199411
88.00	PiROD 13' Low Profile Platform	49	2.0803	0.1926	0.0010	83088
78.00	PiROD 15' Platform w/handrails (Monopole)	49	1.6725	0.1811	0.0008	45321

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 55	14.0740	22	1.1086	0.0068
L2	61 - 16	5.7062	22	0.8397	0.0030
L3	23.63 - 0	0.9254	22	0.3293	0.0008

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
99.00	PiROD 13' Low Profile Platform	22	13.8431	1.1036	0.0067	37105
88.00	PiROD 13' Low Profile Platform	22	11.3211	1.0459	0.0055	15460

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
78.00	PiROD 15' Platform w/handrails (Monopole)	22	9.1076	0.9846	0.0045	8432

Base Plate Design Data

Plate Thickness in	Number of Anchor Bolts	Anchor Bolt Size in	Actual / Allowable Ratio Bolt Tension lb	Actual / Allowable Ratio Bolt Compression lb	Actual / Allowable Ratio Plate Stress ksi	Actual / Allowable Ratio Stiffener Stress ksi	Controlling Condition	Ratio
3.0000	12	2.2500	99813.52 223654.40 0.45	105105.29 371266.30 0.28	9.794 45.000 0.22		Bolt T	0.45 ✔

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 55 (1)	TP47.1724x33.25x0.25	45.00	0.00	0.0	35.7599	-15968.20	2122470.00	0.008
L2	55 - 16 (2)	TP58.4949x44.8161x0.3125	45.00	0.00	0.0	55.4092	-26170.20	3304220.00	0.008
L3	16 - 0 (3)	TP62.625x55.5506x0.3125	23.63	0.00	0.0	61.8062	-34376.90	3448050.00	0.010

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	100 - 55 (1)	TP47.1724x33.25x0.25	465280.83	1971425.00	0.236	0.00	1971425.00	0.000
L2	55 - 16 (2)	TP58.4949x44.8161x0.3125	1224950.00	3804200.00	0.322	0.00	3804200.00	0.000
L3	16 - 0 (3)	TP62.625x55.5506x0.3125	1776433.33	4430666.67	0.401	0.00	4430666.67	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	100 - 55 (1)	TP47.1724x33.25x0.25	18458.50	1061230.00	0.017	80.78	3950983.33	0.000

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L2	55 - 16 (2)	TP58.4949x44.8161x0.3125	22154.40	1652110.00	0.013	80.76	7624150.00	0.000
L3	16 - 0 (3)	TP62.625x55.5506x0.3125	24538.20	1724030.00	0.014	80.76	8878916.67	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	100 - 55 (1)	0.008	0.236	0.000	0.017	0.000	0.244 ✔	1.000	4.8.2 ✔
L2	55 - 16 (2)	0.008	0.322	0.000	0.013	0.000	0.330 ✔	1.000	4.8.2 ✔
L3	16 - 0 (3)	0.010	0.401	0.000	0.014	0.000	0.411 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	100 - 55	Pole	TP47.1724x33.25x0.25	1	-15968.20	2122470.00	24.4	Pass
L2	55 - 16	Pole	TP58.4949x44.8161x0.3125	2	-26170.20	3304220.00	33.0	Pass
L3	16 - 0	Pole	TP62.625x55.5506x0.3125	3	-34376.90	3448050.00	41.1	Pass
							Summary	
						Pole (L3)	41.1	Pass
						Base Plate	44.6	Pass
						RATING =	**44.6**	**Pass**