

Date: July 13, 2018

Jessica Lemmerman
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1600 Utica Avenue South
St. Louis Park, MN 55416

 **BLACK & VEATCH**
Building a world of difference.[®]
Black & Veatch Corp.
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Subject: Structural Analysis Report

Carrier Designation: **Sprint PCS Co-Locate**
Carrier Site Number: MS90XC545

Crown Castle Designation: **Crown Castle BU Number:** 844362
Crown Castle Site Name: LYNDAL
Crown Castle JDE Job Number: 508435
Crown Castle Work Order Number: 1596869
Crown Castle Order Number: 442917 Rev. 2

Engineering Firm Designation: **Black & Veatch Corp. Project Number:** 194393

Site Data: **8801 Lyndale Avenue South, Bloomington, Hennepin County, MN**
Latitude 44° 50' 39.43", Longitude -93° 17' 13.71"
95 Foot - Monopole Tower

Dear Jessica Lemmerman,

Black & Veatch Corp. is pleased to submit this "Structural Analysis Report" to determine the structural integrity of the above mentioned tower. This analysis has been performed in accordance with the Crown Castle Structural 'Statement of Work' and the terms of Crown Castle Purchase Order Number 1216618, in accordance with order 442917, revision 2.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the tower stress level for the structure and foundation, under the following load case, to be:

LC5: Existing + Proposed Equipment

Sufficient Capacity

Note: See Table I and Table II for the proposed and existing loading, respectively.

This analysis has been performed in accordance with the 2012 International Building Code based upon an ultimate 3-second gust wind speed of 115 mph converted to a nominal 3-second gust wind speed of 89 mph per section 1609.3.1 as required for use in the TIA-222-G Standard per Exception #5 of Section 1609.1.1. Exposure Category C and Risk Category II were used in this analysis.

We at Black & Veatch Corp. appreciate the opportunity of providing our continuing professional services to you and Crown Castle. If you have any questions or need further assistance on this or any other projects please give us a call.

Structural analysis prepared by: Anirudha Telang / Vishal Muley

Respectfully submitted by:

Ping Jiang, P.E.

Professional Engineer

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE MINNESOTA.

PRINT NAME: PING JIANG

SIGNATURE: 

DATE: Jul 13, 2018 LICENSE # 54790 EXP. 06/2020

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1) INTRODUCTION

This is a 95 ft Monopole tower, mapped by Unknown in March of 2008. The original design standard and wind speed are unavailable.

2) ANALYSIS CRITERIA

The structural analysis was performed for this tower in accordance with the requirements of TIA-222-G Structural Standard for Antenna Supporting Structures and Antennas using a 3-second gust wind speed of 89 mph with no ice, 50 mph with 0.75 inch ice thickness and 60 mph under service loads, exposure category C with topographic category 1 and crest height of 0 feet.

Table 1 - Proposed Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
79.0	79.0	1	perfect vision	Kicker Support [NA 509-3]	3	1 3/8	-
		1	perfect vision	PV-LPP12-M-HR-B			
		3	rfs celwave	APXVBBLL20X_43-C-I20 w/ Mount Pipe			
		3	samsung telecommunications	800MHZ RRU			
		3	samsung telecommunications	M-MIMO AAU w/ Mount Pipe			
		3	samsung telecommunications	RRH-P4			

Table 2 - Existing and Reserved Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
95.0	100.0	3	alcatel lucent	RRH2X40-AWS w/RDEM	2 3 12	3/8 3/4 1 5/8	1
		3	alcatel lucent	RRH4x25-B30			
		6	powerwave technologies	TT19-08BP111-001			
		2	raycap	DC6-48-60-0-RM			
		4	cci antennas	HPA-65R-BUU-H4 w/ Mount Pipe			
		2	cci antennas	HPA-65R-BUU-H8 w/ Mount Pipe			
		6	kathrein	800 10764 w/ Mount Pipe			
	95.0	1	cci tower mounts	Platform Mount [LP 602-1]			
		6	cci tower mounts	Side Arm Mount [SO 203-1]			
		6	cci tower mounts	Side Arm Mount [SO 702-1]			
89.0	90.0	6	andrew	ETT19VS12UB	18	7/8	1
		6	andrew	ETW200VS12UB			
		3	andrew	LNx-6514DS-A1M w/ Mount Pipe			
		3	andrew	TMBXX-6517-A2M w/			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
				Mount Pipe			
	89.0	1	cci tower mounts	T-Arm Mount [TA 901-3]			
74.0	74.0	1	tower mounts	Side Arm Mount [SO 104-3]	-	-	1
63.0	65.0	1	ericsson	UKY 210 73/SC15	2	3/8	2
	63.0	1	cci tower mounts	Pipe Mount [PM 601-1]			

Note:

- 1) Existing Equipment
- 2) Abandoned Equipment; Considered In This Analysis

Table 3 - Design Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
-	-	-	-	-	-	-

3) ANALYSIS PROCEDURE**Table 4 - Documents Provided**

Document	Remarks	Reference	Source
4-GEOTECHNICAL REPORTS	Braun Engineering Testing, Inc.	4536573	CCISITES
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	Tower Engineering Professionals, Inc.	7632221	CCISITES
4-TOWER MANUFACTURER DRAWINGS	Unknown (Mapped)	5163802	CCISITES

3.1) Analysis Method

tnxTower (version 7.0.5.1), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

- 1) Tower and structures were built in accordance with the manufacturer's specifications.
- 2) The tower and structures have been maintained in accordance with the manufacturer's specification.
- 3) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
- 4) This analysis was performed under the assumption that all information provided to Black & Veatch is current and correct. This is to include site data, existing/proposed appurtenance loading, tower/foundation details, and geotechnical data. The existing/proposed loading on the structure is based on CAD level drawings and carrier orders provided by the owner. If any of this information is not current and correct, this report should be considered obsolete and further analysis will be required.

This analysis may be affected if any assumptions are not valid or have been made in error. Black & Veatch Corp. should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 5 - Section Capacity (Monopole Tower) (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P _{allow} (K)	% Capacity	Pass / Fail
L1	95 - 71.5	Pole	TP28.538x24.5x0.4125	1	-13.17	2694.76	21.9	Pass
L2	71.5 - 31.5	Pole	TP34.587x27.1116x0.5	2	-23.20	3958.54	44.4	Pass
L3	31.5 - 0	Pole	TP39x32.8566x0.5	3	-33.88	4568.91	58.7	Pass
							Summary	
						Pole (L3)	58.7	Pass
						Rating =	58.7	Pass

Table 6 - Tower Component Stresses vs. Capacity - LC5

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	95.8	Pass
1	Base Plate		49.8	Pass
1	Base Foundation	0	55.8	Pass
1	Base Foundation Soil Interaction		45.7	Pass
Structure Rating (max from all components) =				95.8%

Note:

- 1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity consumed.

4.1) Recommendations

The tower and its foundation have sufficient capacity to carry the proposed load configuration. No modifications are required at this time.

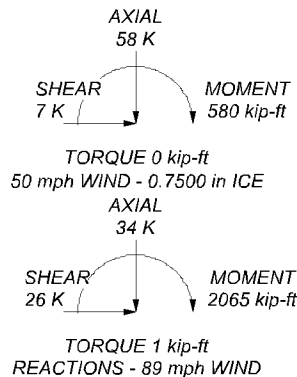
APPENDIX A
TNXTOWER OUTPUT

MATERIAL STRENGTH

TOWER DESIGN NOTES

1. Tower is located in Hennepin County, Minnesota.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 89 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 50 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 58.7%

ALL REACTIONS
ARE FACTORED



Section	3			1
Length (ft)	35.75		43.50	23.50
Number of Sides	12		12	12
Thickness (in)	0.5000		0.5000	0.4125
Socket Length (ft)			4.25	3.50
Top Dia (in)	32.8566		27.1116	24.5000
Bot Dia (in)	39.0000		34.5870	28.5380
Grade			A572-65	
Weight (K)	6.9		7.2	2.8

Tower Input Data

There is a pole section.

This tower is designed using the TIA-222-G standard.

The following design criteria apply:

- 1) Tower is located in Hennepin County, Minnesota.
- 2) Basic wind speed of 89 mph.
- 3) Structure Class II.
- 4) Exposure Category C.
- 5) Topographic Category 1.
- 6) Crest Height 0.00 ft.
- 7) Nominal ice thickness of 0.7500 in.
- 8) Ice thickness is considered to increase with height.
- 9) Ice density of 56 pcf.
- 10) A wind speed of 50 mph is used in combination with ice.
- 11) Temperature drop of 50 °F.
- 12) Deflections calculated using a wind speed of 60 mph.
- 13) A non-linear (P-delta) analysis was used.
- 14) Pressures are calculated at each section.
- 15) Stress ratio used in pole design is 1.
- 16) Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Horizontals	Assume Legs Pinned	Calculate Redundant Bracing Forces
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Ignore Redundant Members in FEA
Use Moment Magnification	√ Use Clear Spans For Wind Area	SR Leg Bolts Resist Compression
√ Use Code Stress Ratios	Use Clear Spans For KL/r	All Leg Panels Have Same Allowable
√ Use Code Safety Factors - Guys	Retension Guys To Initial Tension	Offset Girt At Foundation
Escalate Ice	√ Bypass Mast Stability Checks	√ Consider Feed Line Torque
Always Use Max Kz	√ Use Azimuth Dish Coefficients	Include Angle Block Shear Check
Use Special Wind Profile	√ Project Wind Area of Appurt.	Use TIA-222-G Bracing Resist.
		Exemption
Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Use TIA-222-G Tension Splice
		Exemption
Leg Bolts Are At Top Of Section	Add IBC .6D+W Combination	Poles
Secondary Horizontal Braces Leg	Sort Capacity Reports By Component	√ Include Shear-Torsion Interaction
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Always Use Sub-Critical Flow
SR Members Have Cut Ends	Treat Feed Line Bundles As Cylinder	Use Top Mounted Sockets
SR Members Are Concentric		

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	95.00-71.50	23.50	3.50	12	24.5000	28.5380	0.4125	1.6500	A572-65 (65 ksi)
L2	71.50-31.50	43.50	4.25	12	27.1116	34.5870	0.5000	2.0000	A572-65 (65 ksi)
L3	31.50-0.00	35.75		12	32.8566	39.0000	0.5000	2.0000	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	I/Q in ²	w in	w/t
L1	25.3643	31.9942	2369.4140	8.6233	12.6910	186.7003	4801.0752	15.7466	5.4605	13.238
	29.5447	37.3577	3771.9552	10.0689	14.7827	255.1604	7643.0039	18.3863	6.5427	15.861

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
L2	28.6907	42.8447	3872.7957	9.5270	14.0438	275.7654	7847.3341	21.0868	5.9259	11.852
	35.8071	54.8801	8139.1334	12.2031	17.9161	454.2924	16492.0910	27.0103	7.9293	15.859
L3	34.7718	52.0942	6961.4906	11.5837	17.0197	409.0245	14105.8672	25.6392	7.4656	14.931
	40.3758	61.9850	11727.1914	13.7830	20.2020	580.4966	23762.4693	30.5071	9.1120	18.224

Tower Elevation	Gusset Area (per face)	Gusset Thickness	Gusset Grade	Adjust. Factor A _r	Adjust. Factor A _r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontal in	Double Angle Stitch Bolt Spacing Redundants in
ft	ft ²	in							
L1 95.00-71.50				1	1	1			
L2 71.50-31.50				1	1	1			
L3 31.50-0.00				1	1	1			

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Section	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight plf
79									
HS-0-120(1-3/8)	A	Surface Ar (CaAa)	79.00 - 8.00	3	3	0.100 0.200	1.3760		1.35

Safety Line 3/8	B	Surface Ar (CaAa)	95.00 - 10.00	1	1	0.000 0.000	0.3750		0.22

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C _A A _A ft²/ft	Weight plf
95*								
FB-L98B-034-XXXXXX(3/8)	C	No	Inside Pole	95.00 - 8.00	2	No Ice	0.00	0.05
						1/2" Ice	0.00	0.05
						1" Ice	0.00	0.05
WR-VG86T(3/4)	C	No	Inside Pole	95.00 - 8.00	3	No Ice	0.00	0.53
						1/2" Ice	0.00	0.53
						1" Ice	0.00	0.53
LDF7-50A(1-5/8")	C	No	Inside Pole	95.00 - 8.00	12	No Ice	0.00	0.82
						1/2" Ice	0.00	0.82
						1" Ice	0.00	0.82
89*								
LDF5-50A(7/8)	B	No	Inside Pole	89.00 - 8.00	18	No Ice	0.00	0.33
						1/2" Ice	0.00	0.33
						1" Ice	0.00	0.33
63*								
LDF2-50(3/8)	C	No	Inside Pole	63.00 - 8.00	2	No Ice	0.00	0.08
						1/2" Ice	0.00	0.08
						1" Ice	0.00	0.08

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A _R ft ²	A _F ft ²	C _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
L1	95.00-71.50	A	0.000	0.000	3.096	0.000	0.03
		B	0.000	0.000	0.881	0.000	0.11
		C	0.000	0.000	0.000	0.000	0.27

Tower Section n	Tower Elevation ft	Face	A _R ft ²	A _F ft ²	C _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
L2	71.50-31.50	A	0.000	0.000	16.512	0.000	0.16
		B	0.000	0.000	1.500	0.000	0.25
		C	0.000	0.000	0.000	0.000	0.47
L3	31.50-0.00	A	0.000	0.000	9.701	0.000	0.10
		B	0.000	0.000	0.806	0.000	0.14
		C	0.000	0.000	0.000	0.000	0.27

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section n	Tower Elevation ft	Face or Leg	Ice Thickness in	A _R ft ²	A _F ft ²	C _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
L1	95.00-71.50	A	1.645	0.000	0.000	6.954	0.000	0.10
		B		0.000	0.000	8.612	0.000	0.20
		C		0.000	0.000	0.000	0.000	0.27
L2	71.50-31.50	A	1.567	0.000	0.000	37.088	0.000	0.56
		B		0.000	0.000	14.659	0.000	0.41
		C		0.000	0.000	0.000	0.000	0.47
L3	31.50-0.00	A	1.393	0.000	0.000	21.334	0.000	0.31
		B		0.000	0.000	7.546	0.000	0.22
		C		0.000	0.000	0.000	0.000	0.27

Feed Line Center of Pressure

Section	Elevation ft	CP _X in	CP _Z in	CP _X Ice in	CP _Z Ice in
L1	95.00-71.50	-0.0868	-0.1714	0.1004	-0.4165
L2	71.50-31.50	-0.3171	-0.4211	-0.2629	-0.7282
L3	31.50-0.00	-0.2463	-0.3219	-0.2466	-0.6053

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K _a No Ice	K _a Ice
L1	8	HS-0-120(1-3/8)	71.50 - 79.00	1.0000	1.0000
L1	12	Safety Line 3/8	71.50 - 95.00	1.0000	1.0000
L2	8	HS-0-120(1-3/8)	31.50 - 71.50	1.0000	1.0000
L2	12	Safety Line 3/8	31.50 - 71.50	1.0000	1.0000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustmen t °	Placement ft	C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
95' AT&T								
14" x 2' Top Hat	C	From Face	0.00	0.0000	95.00	No Ice	1.17	0.11
			0.00			1/2"	1.82	0.13
			1.00			Ice	2.02	0.16
						1" Ice		
Platform Mount [LP 602-1]	C	None		0.0000	95.00	No Ice	0.00	1.34
						1/2"	0.00	1.80
						Ice	0.00	2.26
						1" Ice		
Side Arm Mount [SO 203-	A	From Face	3.00	0.0000	95.00	No Ice	2.96	0.13

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustmen t °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
1]			-2.00 0.00			1/2" Ice 1" Ice	4.10 5.24	4.68 6.00	0.15 0.18
Side Arm Mount [SO 203-1]	A	From Face	3.00 2.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.96 4.10 5.24	3.36 4.68 6.00	0.13 0.15 0.18
Side Arm Mount [SO 203-1]	B	From Face	3.00 -2.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.96 4.10 5.24	3.36 4.68 6.00	0.13 0.15 0.18
Side Arm Mount [SO 203-1]	B	From Face	3.00 2.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.96 4.10 5.24	3.36 4.68 6.00	0.13 0.15 0.18
Side Arm Mount [SO 203-1]	C	From Face	3.00 -2.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.96 4.10 5.24	3.36 4.68 6.00	0.13 0.15 0.18
Side Arm Mount [SO 203-1]	C	From Face	3.00 2.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.96 4.10 5.24	3.36 4.68 6.00	0.13 0.15 0.18
(2) T-Arm Mount [TA 702-1]	A	From Face	0.00 0.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.78 3.39 4.00	2.23 2.43 2.63	0.11 0.14 0.17
(2) T-Arm Mount [TA 702-1]	B	From Face	0.00 0.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.78 3.39 4.00	2.23 2.43 2.63	0.11 0.14 0.17
(2) T-Arm Mount [TA 702-1]	C	From Face	0.00 0.00 0.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.78 3.39 4.00	2.23 2.43 2.63	0.11 0.14 0.17
Stealth panel (12'x4')	A	From Face	3.00 0.00 3.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	67.20 68.40 69.60	1.70 1.99 2.28	0.20 0.45 0.70
Stealth panel (12'x4')	B	From Face	3.00 0.00 3.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	67.20 68.40 69.60	1.70 1.99 2.28	0.20 0.45 0.70
Stealth panel (12'x4')	C	From Face	3.00 0.00 3.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	67.20 68.40 69.60	1.70 1.99 2.28	0.20 0.45 0.70
(2) 800 10764 w/ Mount Pipe	A	From Face	3.00 0.00 5.00	-10.0000	95.00	No Ice 1/2" Ice 1" Ice	6.10 6.54 6.97	4.72 5.49 6.19	0.07 0.12 0.17
(2) 800 10764 w/ Mount Pipe	B	From Face	3.00 0.00 5.00	-15.0000	95.00	No Ice 1/2" Ice 1" Ice	6.10 6.54 6.97	4.72 5.49 6.19	0.07 0.12 0.17
(2) 800 10764 w/ Mount Pipe	C	From Face	3.00 0.00 5.00	-35.0000	95.00	No Ice 1/2" Ice 1" Ice	6.10 6.54 6.97	4.72 5.49 6.19	0.07 0.12 0.17
HPA-65R-BUU-H4 w/ Mount Pipe	A	From Face	3.00 -2.00 5.00	-10.0000	95.00	No Ice 1/2" Ice 1" Ice	6.32 6.72 7.13	5.17 5.78 6.41	0.05 0.11 0.17
HPA-65R-BUU-H8 w/ Mount Pipe	B	From Face	3.00 -2.00 5.00	-15.0000	95.00	No Ice 1/2" Ice 1" Ice	13.21 13.90 14.59	9.58 11.05 12.50	0.10 0.20 0.30

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustmen t °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
HPA-65R-BUU-H4 w/ Mount Pipe	C	From Face	3.00 -2.00 5.00	-35.0000	95.00	No Ice 1/2" Ice 1" Ice	6.32 6.72 7.13	5.17 5.78 6.41	0.05 0.11 0.17
HPA-65R-BUU-H4 w/ Mount Pipe	A	From Face	3.00 2.00 5.00	-10.0000	95.00	No Ice 1/2" Ice 1" Ice	6.32 6.72 7.13	5.17 5.78 6.41	0.05 0.11 0.17
HPA-65R-BUU-H8 w/ Mount Pipe	B	From Face	3.00 2.00 5.00	-15.0000	95.00	No Ice 1/2" Ice 1" Ice	13.21 13.90 14.59	9.58 11.05 12.50	0.10 0.20 0.30
HPA-65R-BUU-H4 w/ Mount Pipe	C	From Face	3.00 2.00 5.00	-35.0000	95.00	No Ice 1/2" Ice 1" Ice	6.32 6.72 7.13	5.17 5.78 6.41	0.05 0.11 0.17
RRH2X40-AWS w/RDEM	A	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	3.23 3.46 3.70	1.93 2.12 2.31	0.05 0.07 0.10
RRH2X40-AWS w/RDEM	B	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	3.23 3.46 3.70	1.93 2.12 2.31	0.05 0.07 0.10
RRH2X40-AWS w/RDEM	C	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	3.23 3.46 3.70	1.93 2.12 2.31	0.05 0.07 0.10
(2) TT19-08BP111-001	A	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	0.55 0.65 0.75	0.45 0.53 0.63	0.02 0.02 0.03
(2) TT19-08BP111-001	B	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	0.55 0.65 0.75	0.45 0.53 0.63	0.02 0.02 0.03
(2) TT19-08BP111-001	C	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	0.55 0.65 0.75	0.45 0.53 0.63	0.02 0.02 0.03
DC6-48-60-0-RM	B	From Face	1.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	0.46 0.57 0.68	2.14 2.33 2.52	0.03 0.04 0.06
DC6-48-60-0-RM	C	From Face	1.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	0.46 0.57 0.68	2.14 2.33 2.52	0.03 0.04 0.06
RRH4x25-B30	A	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.90 3.13 3.37	2.03 2.24 2.45	0.07 0.09 0.12
RRH4x25-B30	B	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.90 3.13 3.37	2.03 2.24 2.45	0.07 0.09 0.12
RRH4x25-B30	C	From Face	3.00 0.00 5.00	0.0000	95.00	No Ice 1/2" Ice 1" Ice	2.90 3.13 3.37	2.03 2.24 2.45	0.07 0.09 0.12
89' T-Mobile T-Arm Mount [TA 901-3]	C	None		0.0000	89.00	No Ice 1/2" Ice 1" Ice	17.50 20.70 23.90	17.50 20.70 23.90	0.75 1.00 1.26
6' x 2" Mount Pipe	A	From Face	3.00 0.00	0.0000	89.00	No Ice 1/2"	1.43 1.92	1.43 1.92	0.02 0.03

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustmen t °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
			0.00			Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	B	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	1.43	1.43	0.02
			0.00			1/2"	1.92	1.92	0.03
			0.00			Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	C	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	1.43	1.43	0.02
			0.00			1/2"	1.92	1.92	0.03
			0.00			Ice	2.29	2.29	0.05
TMBXX-6517-A2M w/ Mount Pipe	A	From Face	3.00	0.0000	89.00	1" Ice			
			-5.00			No Ice	8.77	6.96	0.07
			1.00			1/2"	9.34	8.18	0.14
						Ice	9.89	9.14	0.22
TMBXX-6517-A2M w/ Mount Pipe	B	From Face	3.00	0.0000	89.00	1" Ice			
			-5.00			No Ice	8.77	6.96	0.07
			1.00			1/2"	9.34	8.18	0.14
						Ice	9.89	9.14	0.22
TMBXX-6517-A2M w/ Mount Pipe	C	From Face	3.00	0.0000	89.00	1" Ice			
			-5.00			No Ice	8.77	6.96	0.07
			1.00			1/2"	9.34	8.18	0.14
						Ice	9.89	9.14	0.22
LNx-6514DS-A1M w/ Mount Pipe	A	From Face	3.00	0.0000	89.00	1" Ice			
			-2.00			No Ice	8.41	7.08	0.06
			1.00			1/2"	8.97	8.27	0.13
						Ice	9.50	9.18	0.21
LNx-6514DS-A1M w/ Mount Pipe	B	From Face	3.00	0.0000	89.00	1" Ice			
			-2.00			No Ice	8.41	7.08	0.06
			1.00			1/2"	8.97	8.27	0.13
						Ice	9.50	9.18	0.21
LNx-6514DS-A1M w/ Mount Pipe	C	From Face	3.00	0.0000	89.00	1" Ice			
			-2.00			No Ice	8.41	7.08	0.06
			1.00			1/2"	8.97	8.27	0.13
						Ice	9.50	9.18	0.21
(2) ETT19VS12UB	A	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.28	0.57	0.01
			1.00			1/2"	0.35	0.67	0.02
						Ice	0.43	0.77	0.02
(2) ETT19VS12UB	B	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.28	0.57	0.01
			1.00			1/2"	0.35	0.67	0.02
						Ice	0.43	0.77	0.02
(2) ETT19VS12UB	C	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.28	0.57	0.01
			1.00			1/2"	0.35	0.67	0.02
						Ice	0.43	0.77	0.02
(2) ETW200VS12UB	A	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.40	0.16	0.01
			1.00			1/2"	0.49	0.22	0.01
						Ice	0.57	0.28	0.02
(2) ETW200VS12UB	B	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.40	0.16	0.01
			1.00			1/2"	0.49	0.22	0.01
						Ice	0.57	0.28	0.02
(2) ETW200VS12UB	C	From Face	3.00	0.0000	89.00	1" Ice			
			0.00			No Ice	0.40	0.16	0.01
			1.00			1/2"	0.49	0.22	0.01
						Ice	0.57	0.28	0.02
79' Sprint PV-LPP12-M-HR-B	C	None		0.0000	79.00	1" Ice			
						No Ice	34.40	34.40	1.52
						1/2"	43.00	43.00	2.13
						Ice	51.60	51.60	2.74
Kicker Support [NA 509-3]	C	None		0.0000	79.00	1" Ice			
						No Ice	11.84	11.84	0.28
						1/2"	16.96	16.96	0.30
						Ice	22.08	22.08	0.32
						1" Ice			

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustmen t °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
M-MIMO AAU w/ Mount Pipe	A	From Face	3.00 -2.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	7.01 7.42 7.83	3.24 3.78 4.32	0.16 0.21 0.27
M-MIMO AAU w/ Mount Pipe	B	From Face	3.00 -2.00 0.00	-20.0000	79.00	No Ice 1/2" Ice 1" Ice	7.01 7.42 7.83	3.24 3.78 4.32	0.16 0.21 0.27
M-MIMO AAU w/ Mount Pipe	C	From Face	3.00 -2.00 0.00	-30.0000	79.00	No Ice 1/2" Ice 1" Ice	7.01 7.42 7.83	3.24 3.78 4.32	0.16 0.21 0.27
APXVBLL20X_43-C-I20 w/ Mount Pipe	A	From Face	3.00 2.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	14.59 15.24 15.88	9.14 10.48 11.65	0.11 0.22 0.33
APXVBLL20X_43-C-I20 w/ Mount Pipe	B	From Face	3.00 2.00 0.00	-20.0000	79.00	No Ice 1/2" Ice 1" Ice	14.59 15.24 15.88	9.14 10.48 11.65	0.11 0.22 0.33
APXVBLL20X_43-C-I20 w/ Mount Pipe	C	From Face	3.00 2.00 0.00	-30.0000	79.00	No Ice 1/2" Ice 1" Ice	14.59 15.24 15.88	9.14 10.48 11.65	0.11 0.22 0.33
800MHZ RRU	A	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	1.65 1.81 1.99	2.31 2.50 2.70	0.06 0.08 0.11
800MHZ RRU	B	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	1.65 1.81 1.99	2.31 2.50 2.70	0.06 0.08 0.11
800MHZ RRU	C	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	1.65 1.81 1.99	2.31 2.50 2.70	0.06 0.08 0.11
RRH-P4	A	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	2.74 2.95 3.17	1.79 1.97 2.16	0.06 0.08 0.11
RRH-P4	B	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	2.74 2.95 3.17	1.79 1.97 2.16	0.06 0.08 0.11
RRH-P4	C	From Face	3.00 0.00 0.00	0.0000	79.00	No Ice 1/2" Ice 1" Ice	2.74 2.95 3.17	1.79 1.97 2.16	0.06 0.08 0.11
74 Side Arm Mount [SO 104- 3]	C	None		0.0000	74.00	No Ice 1/2" Ice 1" Ice	3.30 4.13 4.96	3.30 4.13 4.96	0.29 0.32 0.35
63' Crown Castle Pipe Mount [PM 601-1]	A	From Face	1.50 0.00 0.00	0.0000	63.00	No Ice 1/2" Ice 1" Ice	3.00 3.74 4.48	0.90 1.12 1.34	0.07 0.08 0.09

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft	Aperture Area ft²	Weight K	
63											
UKY 210 73/SC15	A	Paraboloid w/Shroud (HP)	From Face	2.00	10.0000		63.00	1.25	No Ice	1.23	0.02
				0.00					1/2" Ice	1.40	0.03
				2.00					1" Ice	1.57	0.03

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
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 Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	95 - 71.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-31.61	-1.63	0.67
			Max. M _x	8	-13.17	-321.57	-0.09
			Max. M _y	2	-13.18	-0.21	318.14
			Max. V _y	8	19.35	-321.57	-0.09
			Max. V _x	2	-19.27	-0.21	318.14
			Max. Torque	2			-1.47
L2	71.5 - 31.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-44.75	-0.91	1.57
			Max. M _x	8	-23.21	-1167.52	-5.59
			Max. M _y	2	-23.22	5.87	1160.15
			Max. V _y	8	23.50	-1167.52	-5.59
			Max. V _x	14	23.37	-6.26	-1159.46
			Max. Torque	4			-1.36
L3	31.5 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-57.73	-0.64	2.09
			Max. M _x	8	-33.88	-2059.18	-11.30
			Max. M _y	2	-33.88	11.75	2047.34
			Max. V _y	8	26.24	-2059.18	-11.30
			Max. V _x	14	26.12	-12.20	-2046.58
			Max. Torque	4			-1.16

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	38	57.73	3.59	6.17
	Max. H _x	20	33.90	26.20	0.16
	Max. H _z	2	33.90	0.16	26.08
	Max. M _x	2	2047.34	0.16	26.08
	Max. M _z	8	2059.18	-26.21	-0.16
	Max. Torsion	16	1.14	12.97	-22.52
	Min. Vert	17	25.42	12.97	-22.52
	Min. H _x	8	33.90	-26.21	-0.16
	Min. H _z	14	33.90	-0.17	-26.09
	Min. M _x	14	-2046.58	-0.17	-26.09
	Min. M _z	20	-2058.65	26.20	0.16
	Min. Torsion	4	-1.16	-12.97	22.52

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	28.25	0.00	0.00	-0.49	0.05	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	33.90	-0.16	-26.08	-2047.34	11.75	1.16
0.9 Dead+1.6 Wind 0 deg - No Ice	25.42	-0.16	-26.08	-2032.70	11.66	1.15
1.2 Dead+1.6 Wind 30 deg - No Ice	33.90	12.97	-22.52	-1768.02	-1019.41	1.16
0.9 Dead+1.6 Wind 30 deg - No Ice	25.42	12.97	-22.52	-1755.35	-1012.19	1.16
1.2 Dead+1.6 Wind 60 deg - No Ice	33.90	22.63	-12.90	-1013.64	-1777.87	0.90
0.9 Dead+1.6 Wind 60 deg - No Ice	25.42	22.63	-12.90	-1006.31	-1765.29	0.90
1.2 Dead+1.6 Wind 90 deg - No Ice	33.90	26.21	0.16	11.30	-2059.18	0.37
0.9 Dead+1.6 Wind 90 deg - No Ice	25.42	26.21	0.16	11.38	-2044.61	0.37
1.2 Dead+1.6 Wind 120 deg	33.90	22.78	13.18	1032.69	-1788.74	-0.26

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
- No Ice						
0.9 Dead+1.6 Wind 120 deg	25.42	22.78	13.18	1025.54	-1776.09	-0.26
- No Ice						
1.2 Dead+1.6 Wind 150 deg	33.90	13.24	22.67	1777.83	-1039.41	-0.80
- No Ice						
0.9 Dead+1.6 Wind 150 deg	25.42	13.24	22.67	1765.40	-1032.07	-0.80
- No Ice						
1.2 Dead+1.6 Wind 180 deg	33.90	0.17	26.09	2046.58	-12.20	-1.13
- No Ice						
0.9 Dead+1.6 Wind 180 deg	25.42	0.17	26.09	2032.24	-12.13	-1.12
- No Ice						
1.2 Dead+1.6 Wind 210 deg	33.90	-12.97	22.52	1766.61	1019.67	-1.14
- No Ice						
0.9 Dead+1.6 Wind 210 deg	25.42	-12.97	22.52	1754.25	1012.42	-1.13
- No Ice						
1.2 Dead+1.6 Wind 240 deg	33.90	-22.63	12.91	1012.83	1777.78	-0.88
- No Ice						
0.9 Dead+1.6 Wind 240 deg	25.42	-22.63	12.91	1005.81	1765.17	-0.87
- No Ice						
1.2 Dead+1.6 Wind 270 deg	33.90	-26.20	-0.16	-12.18	2058.65	-0.39
- No Ice						
0.9 Dead+1.6 Wind 270 deg	25.42	-26.20	-0.16	-11.96	2044.06	-0.39
- No Ice						
1.2 Dead+1.6 Wind 300 deg	33.90	-22.77	-13.17	-1033.36	1788.21	0.24
- No Ice						
0.9 Dead+1.6 Wind 300 deg	25.42	-22.77	-13.17	-1025.90	1775.53	0.24
- No Ice						
1.2 Dead+1.6 Wind 330 deg	33.90	-13.23	-22.66	-1778.40	1038.91	0.80
- No Ice						
0.9 Dead+1.6 Wind 330 deg	25.42	-13.23	-22.66	-1765.66	1031.54	0.80
- No Ice						
1.2 Dead+1.0 Ice+1.0 Temp	57.73	0.00	-0.00	-2.09	-0.64	0.00
1.2 Dead+1.0 Wind 0	57.73	-0.04	-7.10	-578.38	2.20	0.38
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 30	57.73	3.53	-6.14	-499.94	-287.29	0.28
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 60	57.73	6.16	-3.52	-287.72	-500.12	0.11
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 90	57.73	7.13	0.04	0.76	-578.93	-0.09
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 120	57.73	6.19	3.58	288.33	-502.80	-0.27
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 150	57.73	3.60	6.17	498.23	-292.25	-0.38
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 180	57.73	0.04	7.11	574.08	-3.78	-0.38
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 210	57.73	-3.53	6.13	495.46	285.91	-0.28
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 240	57.73	-6.15	3.52	283.41	498.65	-0.11
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 270	57.73	-7.13	-0.04	-5.09	577.32	0.09
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 300	57.73	-6.19	-3.58	-292.60	501.19	0.27
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 330	57.73	-3.59	-6.17	-502.47	290.66	0.38
deg+1.0 Ice+1.0 Temp						
Dead+Wind 0 deg - Service	28.25	-0.04	-6.63	-518.54	3.01	0.29
Dead+Wind 30 deg - Service	28.25	3.30	-5.72	-447.84	-257.98	0.29
Dead+Wind 60 deg - Service	28.25	5.75	-3.28	-256.91	-449.95	0.23
Dead+Wind 90 deg - Service	28.25	6.66	0.04	2.51	-521.16	0.10
Dead+Wind 120 deg - Service	28.25	5.79	3.35	261.03	-452.71	-0.06
Dead+Wind 150 deg - Service	28.25	3.37	5.76	449.63	-263.05	-0.20
Dead+Wind 180 deg - Service	28.25	0.04	6.63	517.65	-3.05	-0.29
Dead+Wind 210 deg - Service	28.25	-3.30	5.72	446.79	258.12	-0.29
Dead+Wind 240 deg - Service	28.25	-5.75	3.28	256.00	450.00	-0.22
Dead+Wind 270 deg - Service	28.25	-6.66	-0.04	-3.43	521.09	-0.10

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
Service						
Dead+Wind 300 deg - Service	28.25	-5.79	-3.35	-261.90	452.65	0.06
Dead+Wind 330 deg - Service	28.25	-3.36	-5.76	-450.48	262.99	0.20

Solution Summary

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
1	0.00	-28.25	0.00	0.00	28.25	0.00	0.000%
2	-0.16	-33.90	-26.08	0.16	33.90	26.08	0.000%
3	-0.16	-25.42	-26.08	0.16	25.42	26.08	0.000%
4	12.97	-33.90	-22.52	-12.97	33.90	22.52	0.000%
5	12.97	-25.42	-22.52	-12.97	25.42	22.52	0.000%
6	22.63	-33.90	-12.90	-22.63	33.90	12.90	0.000%
7	22.63	-25.42	-12.90	-22.63	25.42	12.90	0.000%
8	26.21	-33.90	0.16	-26.21	33.90	-0.16	0.000%
9	26.21	-25.42	0.16	-26.21	25.42	-0.16	0.000%
10	22.78	-33.90	13.18	-22.78	33.90	-13.18	0.000%
11	22.78	-25.42	13.18	-22.78	25.42	-13.18	0.000%
12	13.24	-33.90	22.67	-13.24	33.90	-22.67	0.000%
13	13.24	-25.42	22.67	-13.24	25.42	-22.67	0.000%
14	0.17	-33.90	26.09	-0.17	33.90	-26.09	0.000%
15	0.17	-25.42	26.09	-0.17	25.42	-26.09	0.000%
16	-12.97	-33.90	22.52	12.97	33.90	-22.52	0.000%
17	-12.97	-25.42	22.52	12.97	25.42	-22.52	0.000%
18	-22.63	-33.90	12.91	22.63	33.90	-12.91	0.000%
19	-22.63	-25.42	12.91	22.63	25.42	-12.91	0.000%
20	-26.20	-33.90	-0.16	26.20	33.90	0.16	0.000%
21	-26.20	-25.42	-0.16	26.20	25.42	0.16	0.000%
22	-22.77	-33.90	-13.17	22.77	33.90	13.17	0.000%
23	-22.77	-25.42	-13.17	22.77	25.42	13.17	0.000%
24	-13.23	-33.90	-22.66	13.23	33.90	22.66	0.000%
25	-13.23	-25.42	-22.66	13.23	25.42	22.66	0.000%
26	0.00	-57.73	0.00	-0.00	57.73	0.00	0.000%
27	-0.04	-57.73	-7.10	0.04	57.73	7.10	0.000%
28	3.53	-57.73	-6.14	-3.53	57.73	6.14	0.000%
29	6.16	-57.73	-3.52	-6.16	57.73	3.52	0.000%
30	7.13	-57.73	0.04	-7.13	57.73	-0.04	0.000%
31	6.19	-57.73	3.58	-6.19	57.73	-3.58	0.000%
32	3.60	-57.73	6.17	-3.60	57.73	-6.17	0.000%
33	0.04	-57.73	7.11	-0.04	57.73	-7.11	0.000%
34	-3.53	-57.73	6.13	3.53	57.73	-6.13	0.000%
35	-6.15	-57.73	3.52	6.15	57.73	-3.52	0.000%
36	-7.13	-57.73	-0.04	7.13	57.73	0.04	0.000%
37	-6.19	-57.73	-3.58	6.19	57.73	3.58	0.000%
38	-3.59	-57.73	-6.17	3.59	57.73	6.17	0.000%
39	-0.04	-28.25	-6.63	0.04	28.25	6.63	0.000%
40	3.30	-28.25	-5.72	-3.30	28.25	5.72	0.000%
41	5.75	-28.25	-3.28	-5.75	28.25	3.28	0.000%
42	6.66	-28.25	0.04	-6.66	28.25	-0.04	0.000%
43	5.79	-28.25	3.35	-5.79	28.25	-3.35	0.000%
44	3.37	-28.25	5.76	-3.37	28.25	-5.76	0.000%
45	0.04	-28.25	6.63	-0.04	28.25	-6.63	0.000%
46	-3.30	-28.25	5.72	3.30	28.25	-5.72	0.000%
47	-5.75	-28.25	3.28	5.75	28.25	-3.28	0.000%
48	-6.66	-28.25	-0.04	6.66	28.25	0.04	0.000%
49	-5.79	-28.25	-3.35	5.79	28.25	3.35	0.000%
50	-3.36	-28.25	-5.76	3.36	28.25	5.76	0.000%

Non-Linear Convergence Results

<i>Load Combination</i>	<i>Converged?</i>	<i>Number of Cycles</i>	<i>Displacement Tolerance</i>	<i>Force Tolerance</i>
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00063776
3	Yes	4	0.00000001	0.00040066
4	Yes	5	0.00000001	0.00029222
5	Yes	5	0.00000001	0.00013101
6	Yes	5	0.00000001	0.00027123
7	Yes	5	0.00000001	0.00012093
8	Yes	4	0.00000001	0.00030668
9	Yes	4	0.00000001	0.00019193
10	Yes	5	0.00000001	0.00028201
11	Yes	5	0.00000001	0.00012563
12	Yes	5	0.00000001	0.00029427
13	Yes	5	0.00000001	0.00013152
14	Yes	4	0.00000001	0.00085487
15	Yes	4	0.00000001	0.00053607
16	Yes	5	0.00000001	0.00026770
17	Yes	5	0.00000001	0.00011943
18	Yes	5	0.00000001	0.00028852
19	Yes	5	0.00000001	0.00012927
20	Yes	4	0.00000001	0.00010487
21	Yes	4	0.00000001	0.00006157
22	Yes	5	0.00000001	0.00028880
23	Yes	5	0.00000001	0.00012882
24	Yes	5	0.00000001	0.00027647
25	Yes	5	0.00000001	0.00012306
26	Yes	4	0.00000001	0.00000590
27	Yes	5	0.00000001	0.00016505
28	Yes	5	0.00000001	0.00020686
29	Yes	5	0.00000001	0.00020501
30	Yes	5	0.00000001	0.00016471
31	Yes	5	0.00000001	0.00020478
32	Yes	5	0.00000001	0.00020787
33	Yes	5	0.00000001	0.00016360
34	Yes	5	0.00000001	0.00020059
35	Yes	5	0.00000001	0.00020228
36	Yes	5	0.00000001	0.00016361
37	Yes	5	0.00000001	0.00020776
38	Yes	5	0.00000001	0.00020474
39	Yes	4	0.00000001	0.00005675
40	Yes	4	0.00000001	0.00022396
41	Yes	4	0.00000001	0.00017810
42	Yes	4	0.00000001	0.00002372
43	Yes	4	0.00000001	0.00019124
44	Yes	4	0.00000001	0.00021952
45	Yes	4	0.00000001	0.00006069
46	Yes	4	0.00000001	0.00017327
47	Yes	4	0.00000001	0.00021405
48	Yes	4	0.00000001	0.00002088
49	Yes	4	0.00000001	0.00020612
50	Yes	4	0.00000001	0.00018253

Maximum Tower Deflections - Service Wind

<i>Section No.</i>	<i>Elevation ft</i>	<i>Horz. Deflection in</i>	<i>Gov. Load Comb.</i>	<i>Tilt °</i>	<i>Twist °</i>
L1	95 - 71.5	10.170	49	0.8461	0.0020
L2	75 - 31.5	6.752	49	0.7693	0.0011
L3	35.75 - 0	1.682	49	0.4221	0.0004

Critical Deflections and Radius of Curvature - Service Wind

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
95.00	14" x 2' Top Hat	49	10.170	0.8461	0.0021	42145
89.00	T-Arm Mount [TA 901-3]	49	9.124	0.8273	0.0018	35120
79.00	PV-LPP12-M-HR-B	49	7.414	0.7891	0.0013	13171
74.00	Side Arm Mount [SO 104-3]	49	6.589	0.7638	0.0011	10156
65.00	UKY 210 73/SC15	49	5.182	0.7045	0.0009	7464
63.00	Pipe Mount [PM 601-1]	49	4.885	0.6891	0.0008	7052

Maximum Tower Deflections - Design Wind

Section No.	Elevation	Horz. Deflection	Gov. Load Comb.	Tilt	Twist
	ft	in		°	°
L1	95 - 71.5	40.187	10	3.3436	0.0079
L2	75 - 31.5	26.676	10	3.0418	0.0045
L3	35.75 - 0	6.646	10	1.6682	0.0015

Critical Deflections and Radius of Curvature - Design Wind

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
95.00	14" x 2' Top Hat	10	40.187	3.3436	0.0082	10779
89.00	T-Arm Mount [TA 901-3]	10	36.052	3.2701	0.0070	8983
79.00	PV-LPP12-M-HR-B	10	29.293	3.1201	0.0052	3368
74.00	Side Arm Mount [SO 104-3]	10	26.032	3.0200	0.0044	2594
65.00	UKY 210 73/SC15	10	20.472	2.7849	0.0034	1901
63.00	Pipe Mount [PM 601-1]	10	19.301	2.7239	0.0033	1795

Compression Checks**Pole Design Data**

Section No.	Elevation	Size	L	L _u	KI/r	A	P _u	φP _n	Ratio P _u / φP _n
	ft		ft	ft		in ²	K	K	
L1	95 - 71.5 (1)	TP28.538x24.5x0.4125	23.50	0.00	0.0	36.558 9	-13.17	2694.76	0.005
L2	71.5 - 31.5 (2)	TP34.587x27.1116x0.5	43.50	0.00	0.0	53.704 2	-23.20	3958.54	0.006
L3	31.5 - 0 (3)	TP39x32.8566x0.5	35.75	0.00	0.0	61.985 0	-33.88	4568.91	0.007

Pole Bending Design Data

Section No.	Elevation	Size	M _{ux}	φM _{rx}	Ratio M _{ux} / φM _{rx}	M _{uy}	φM _{ry}	Ratio M _{uy} / φM _{ry}
	ft		kip-ft	kip-ft		kip-ft	kip-ft	
L1	95 - 71.5 (1)	TP28.538x24.5x0.4125	321.57	1500.54	0.214	0.00	1500.54	0.000
L2	71.5 - 31.5 (2)	TP34.587x27.1116x0.5	1170.29	2671.35	0.438	0.00	2671.35	0.000
L3	31.5 - 0 (3)	TP39x32.8566x0.5	2065.44	3565.70	0.579	0.00	3565.70	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u K	ϕV_n K	Ratio V_u ϕV_n	Actual T_u kip-ft	ϕT_n kip-ft	Ratio T_u ϕT_n
L1	95 - 71.5 (1)	TP28.538x24.5x0.4125	19.35	1347.38	0.014	0.43	3042.63	0.000
L2	71.5 - 31.5 (2)	TP34.587x27.1116x0.5	23.60	1979.27	0.012	0.26	5416.66	0.000
L3	31.5 - 0 (3)	TP39x32.8566x0.5	26.34	2284.46	0.012	0.26	7230.12	0.000

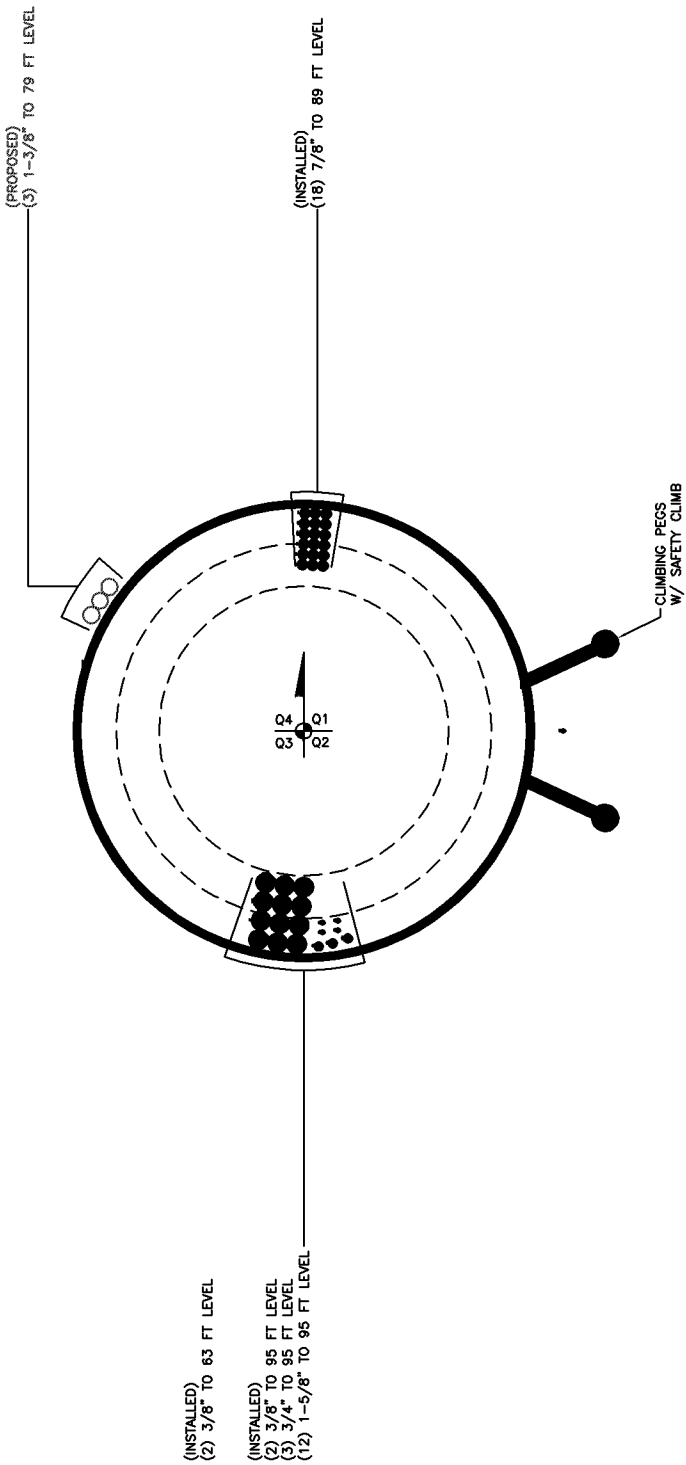
Pole Interaction Design Data

Section No.	Elevation ft	Ratio P_u ϕP_n	Ratio M_{ux} ϕM_{nx}	Ratio M_{uy} ϕM_{ny}	Ratio V_u ϕV_n	Ratio T_u ϕT_n	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	95 - 71.5 (1)	0.005	0.214	0.000	0.014	0.000	0.219	1.000	4.8.2
L2	71.5 - 31.5 (2)	0.006	0.438	0.000	0.012	0.000	0.444	1.000	4.8.2
L3	31.5 - 0 (3)	0.007	0.579	0.000	0.012	0.000	0.587	1.000	4.8.2

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
L1	95 - 71.5	Pole	TP28.538x24.5x0.4125	1	-13.17	2694.76	21.9	Pass
L2	71.5 - 31.5	Pole	TP34.587x27.1116x0.5	2	-23.20	3958.54	44.4	Pass
L3	31.5 - 0	Pole	TP39x32.8566x0.5	3	-33.88	4568.91	58.7	Pass
							Summary	
							Pole (L3)	58.7
							RATING =	58.7
								Pass

APPENDIX B
BASE LEVEL DRAWING



APPENDIX C
ADDITIONAL CALCULATIONS

Stiffened or Unstiffened, UngROUTed, Circular Base Plate - Any Rod Material

TIA Rev G

Assumption: Clear space between bottom of leveling nut and top of concrete **not** exceeding (1)*(Rod Diameter)

Site Data

BU#: 844362	
Site Name: LYNDALe	
App #: 442917 Rev. 2	
Pole Manufacturer:	Other

Anchor Rod Data

Qty:	12	
Diam:	2	
Rod Material:	A615-J	
Strength (Fu):	100	
Yield (Fy):	75	
Bolt Circle:	44.7846	in

Plate Data

Diam:	51	in
Thick:	2.5	in
Grade:	50	ksi
Single-Rod B-eff:	10.45	in

Stiffener Data (Welding at both sides)

Config:	0	*
Weld Type:		
Groove Depth:		<-- Disregard
Groove Angle:		<-- Disregard
Fillet H. Weld:		in
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

Pole Data

Diam:	39	in
Thick:	0.5	in
Grade:	65	ksi
# of Sides:	12	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Reactions

Mu:	2065	ft-kips
Axial, Pu:	34	kips
Shear, Vu:	26	kips
Eta Factor, η	0.5	TIA G (Fig. 4-4)

If No stiffeners, Criteria: AISC LRFD <-Only Applicable to Unstiffened Cases

Anchor Rod Results

Max Rod (Cu+ Vu/η): 191.7 Kips
Allowable Axial, Φ*Fu*Anet: 200.0 Kips
Anchor Rod Stress Ratio: 95.8% Pass

Rigid

AISC LRFD

φ*Tn

Base Plate Results

Base Plate Stress: 22.4 ksi
Allowable Plate Stress: 45.0 ksi
Base Plate Stress Ratio: 49.8% Pass

Flexural Check

Rigid

AISC LRFD

φ*Fy

Y.L. Length:

22.02

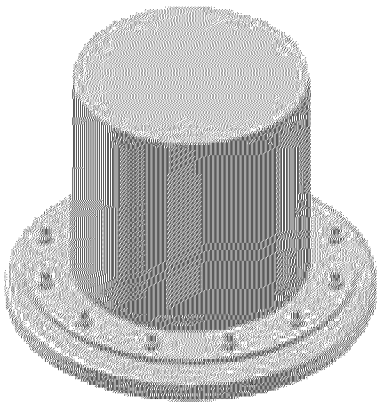
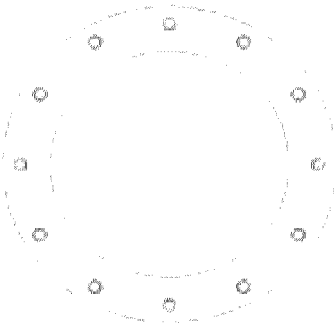
n/a

Stiffener Results

Horizontal Weld : n/a
Vertical Weld: n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2: n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2: n/a
Plate Comp. (AISC Bracket): n/a

Pole Results

Pole Punching Shear Check: n/a



* 0 = none, 1 = every bolt, 2 = every 2 bolts, 3 = 2 per bolt

** Note: for complete joint penetration groove welds the groove depth must be exactly 1/2 the stiffener thickness for calculation purposes

Drilled Pier Foundation

BU # :	844362
Site Name:	LYNDALE
App. Number:	442917 rev. 2

TIA-222 Revision:	G
Tower Type:	Monopole

Applied Loads		
	Comp.	Uplift
Moment (kip-ft)	2065	
Axial Force (kips)	34	
Shear Force (kips)	26	

Material Properties	
Concrete Strength, f'c:	3 ksi
Rebar Strength, Fy:	60 ksi

Pier Design Data	
Depth	26.83 ft
Ext. Above Grade	0.16 ft
Pier Section 1	
From 0.16' above grade to 26.83' below grade	
Pier Diameter	5.5 ft
Rebar Quantity	36
Rebar Size	9
Clear Cover to Ties	4.5 in
Tie Size	4

Soil Profile

Groundwater Depth	12	ft
# of Layers	5	

Layer	Top (ft)	Bottom (ft)	Thickness (ft)	V _{soil} (pcf)	V _{concrete} (pcf)	Cohesion (ksf)	Angle of Friction (degrees)	Calculated Ultimate Skin Friction Comp (ksf)	Calculated Ultimate Skin Friction Uplift (ksf)	Ultimate Skin Friction Comp Override (ksf)	Ultimate Skin Friction Uplift Override (ksf)	Ult. Gross Bearing Capacity (ksf)	SPT Blow Count	Soil Type
1	0	6.667	6.667	120	150	0	0	0.000	0.000	0.00	0.00			Cohesionless
2	6.667	12	5.333	120	150		30	1.056	1.056				13	Cohesionless
3	12	20	8	60	87.6		30	1.505	1.505				14	Cohesionless
4	20	24	4	60	87.6	0.6		0.330	0.330					Cohesive
5	24	26.83	2.83	70	87.6		35	1.851	1.851			0	19	Cohesionless



Analysis Results			
Soil Lateral Capacity		Compression	Uplift
D _{v=0} (ft from TOC)		8.52	-
Soil Safety Factor		2.91	-
Max Moment (kip-ft)		2268.23	-
Rating		45.7%	-
Soil Vertical Capacity		Compression	Uplift
Skin Friction (kips)		314.01	-
End Bearing (kips)		0.00	-
Weight of Concrete (kips)		89.04	-
Total Capacity (kips)		314.01	-
Axial (kips)		123.04	-
Rating		39.2%	-
Reinforced Concrete Capacity		Compression	Uplift
Critical Depth (ft from TOC)		8.61	-
Critical Moment (kip-ft)		2268.15	-
Critical Moment Capacity		4063.93	-
Rating		55.8%	-
Soil Interaction Rating		45.7%	
Structural Foundation Rating		55.8%	