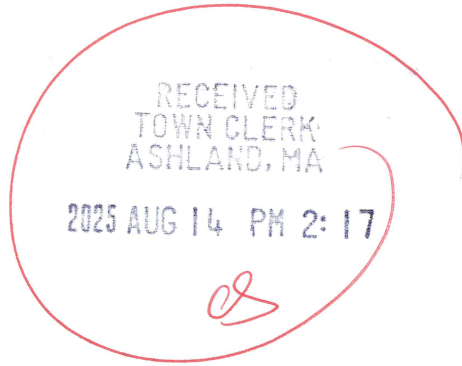


Date: **July 31, 2025**



Crown Castle
2000 Corporate Drive
Canonsburg, PA 15317
(724) 416-2000

Subject: **Structural Analysis Report**

Carrier Designation:

T-Mobile Co-Locate

Site Number:

4BN0510A

Site Name:

BN510/Oregon Club

Crown Castle Designation:

BU Number:

822710

Site Name:

BN510/Oregon Club

JDE Job Number:

2102347

Work Order Number:

2414601

Order Number:

657779 Rev. 7

Engineering Firm Designation:

Crown Castle Project Number

2414601

Site Data:

117 Oregon Rd, Ashland, Middlesex County, MA

Latitude: 42° 17' 5.25" Longitude: -71° 29' 26.55"

75.0 ft - (Top of Steel) Concealment Tower

Crown Castle is pleased to submit this "**Structural Analysis Report**" to determine the structural integrity of the above-mentioned tower.

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: Proposed Equipment Configuration

Sufficient Capacity

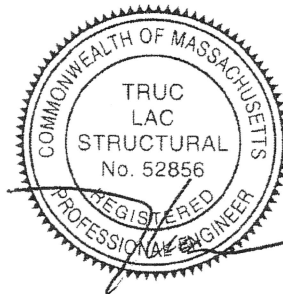
This analysis utilizes an ultimate 3-second gust wind speed of 119 mph as required by the 2021 International Building Code as amended by the Massachusetts State Building Code, Tenth Edition. Applicable standard references and design criteria are listed in Section 2 - Analysis Criteria.

Structural analysis prepared by: Steven Hu

08/01/25

Respectfully submitted by:

Truc Lac, P.E., S.E.
Senior Project Engineer



Truc
Lac

Digitally signed
by Truc Lac
Date:
2025.08.11
15:18:17 -05'00'

TABLE OF CONTENTS

1) INTRODUCTION

2) ANALYSIS CRITERIA

Table 1 - Proposed Equipment Configuration

Table 2 - Other Considered Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

3.1) Analysis Method

3.2) Assumptions

4) ANALYSIS RESULTS

Table 4 - Section Capacity (Summary)

Table 5 - Tower Component Stresses vs. Capacity - LC5

4.1) Recommendations

5) APPENDIX A

tnxTower Output

6) APPENDIX B

Base Level Drawing

7) APPENDIX C

Additional Calculations

1) INTRODUCTION

This tower is a 75.0 ft (Top of Steel) Concealment Tower designed by Pennsummit Tubular, Llc. The base tower is 45 ft, and the concealment section is from 35 ft to 75 ft. The tower has been modified in the past to accommodate additional loading.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	II
Wind Speed:	119 mph
Exposure Category:	B
Topographic Factor:	1
Ice Thickness:	1.00 in
Wind Speed with Ice:	50 mph
Service Wind Speed:	60 mph

Table 1 - Proposed Equipment Configuration

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
70	71	3	commscope	VV-65B-R1_TMO	12	7/8
60	61	3	commscope	FVV-65B-R3	6	7/8

Table 2 - Other Considered Equipment

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
70	70	1	-	Concealment Canister (24.625"x10')	-	-
60	60	1	-	Concealment Canister (25.625"x10')	-	-
50	50	1	-	Concealment Canister (26.625"x10')	-	-
40	40	1	-	Concealment Canister (52"x10')	3	1/4
		3	commscope	SBNHH-1D65B	18	7/8

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Reference	Source
4-GEOTECHNICAL REPORTS	3477027	CCISITES
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	3907716	CCISITES
4-TOWER MANUFACTURER DRAWINGS	3477028	CCISITES
4-TOWER REINFORCEMENT DESIGN/DRAWINGS/DATA	5743265	CCISITES
4-POST-MODIFICATION INSPECTION	6119037	CCISITES

3.1) Analysis Method

tnxTower (version 8.3.0.5), 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. When applicable, Crown Castle has calculated and provided the effective area for panel antennas using approved methods following the intent of the TIA-222 standard.

3.2) Assumptions

- 1) Tower and structures were maintained in accordance with the TIA-222 Standard.
- 2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.

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

4) ANALYSIS RESULTS

Table 4 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass/Fail
L1	75 - 65	Pole	TP6x6x0.75	1	-1.09	841.66	4.3	Pass
L2	65 - 55	Pole	TP6x6x0.75	2	-2.57	841.66	11.6	Pass
L3	55 - 45	Pole	TP6x6x0.75	3	-3.86	841.66	21.4	Pass
L4	45 - 35	Pole	TP28.0261x26.625x0.2188	4	-5.68	1185.93	5.7	Pass
L5	35 - 0	Pole	TP32.93x28.0261x0.2188	5	-9.40	1395.07	14.5	Pass
							Summary	
						Pole (L3)	21.4	Pass
						RATING =	21.4	Pass

Table 5 - Tower Component Stresses vs. Capacity - LC5

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Flange Bolts	45	12.8	Pass
1	Flange Plate	45	51.9	Pass
1	Anchor Rods	0	16.4	Pass
1	Base Plate	0	18.6	Pass
1	Base Foundation (Structural)	0	8.3	Pass
1	Base Foundation (Soil)	0	14.8	Pass

Structure Rating (max from all components) =	51.9%
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Notes:

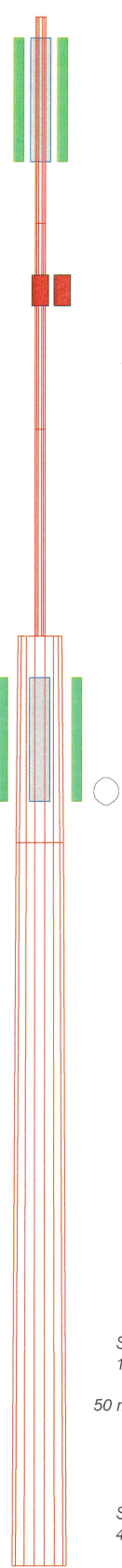
- 1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity consumed

4.1) Recommendations

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

APPENDIX A
TNXTOWER OUTPUT

Section	5	4	3	2	1
Length (ft)	35.0000	10.0000	10.0000	10.0000	10.0000
Number of Sides	18	18	0	0	0
Thickness (in)	0.2188	0.2188	0.7500	0.7500	0.7500
Top Dia (in)	28.0261	26.6250	6.0000	6.0000	6.0000
Bot Dia (in)	32.9300	28.0261	6.0000	6.0000	6.0000
Grade	A572-65	A572-65	A519 Type 1026	A519 Type 1026	A519 Type 1026
Weight (K)	4.4	2.5	0.4	0.4	0.4



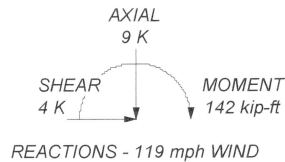
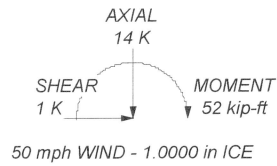
MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A519 Type 1026	72 ksi	87 ksi	A572-65	65 ksi	80 ksi

TOWER DESIGN NOTES

1. Tower is located in Middlesex County, Massachusetts.
2. Tower designed for Exposure B to the TIA-222-H Standard.
3. Tower designed for a 119 mph basic wind in accordance with the TIA-222-H Standard.
4. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Risk Category II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 21.4%

ALL REACTIONS ARE FACTORED



<p>CROWN CASTLE The Pathway to Possible</p>	<p>Crown Castle 2000 Corporate Dr Canonsburg, PA Phone: (724) 416-2000 FAX:</p>		<p>Job: 822710</p>
	<p>Project:</p>		
	<p>Client: Crown Castle</p>	<p>Drawn by: SHu</p>	<p>App'd:</p>
	<p>Code: TIA-222-H</p>	<p>Date: 07/31/25</p>	<p>Scale: NTS</p>
	<p>Path: C:\SAPI Work Area\822710\WO 2414601 - SA\Prod\822710.dwg</p>	<p>Dwg No: E-1</p>	

Tower Input Data

The tower is a monopole.

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

The following design criteria apply:

Tower is located in Middlesex County, Massachusetts.

Tower base elevation above sea level: 308.08 ft.

Basic wind speed of 119 mph.

Risk Category II.

Exposure Category B.

Simplified Topographic Factor Procedure for wind speed-up calculations is used.

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 56.00 pcf.

A wind speed of 50 mph is used in combination with ice.

Temperature drop of 50 °F.

Deflections calculated using a wind speed of 60 mph.

Non-linear (P-delta) analysis was used.

Pressures are calculated at each section.

Stress ratio used in pole design is 1.

Tower analysis based on target reliabilities in accordance with Annex S.

Load Modification Factors used: $K_{es}(F_w) = 0.95$, $K_{es}(t_i) = 0.85$.

Maximum demand-capacity ratio is: 1.05.

Local bending stresses due to climbing loads, feed line 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 Kz In Exposure D Hurricane Region Include Bolts In Member Capacity Leg Bolts Are At Top Of Section Secondary Horizontal Braces Leg Use Diamond Inner Bracing (4 Sided) SR Members Have Cut Ends SR Members Are Concentric Distribute Leg Loads As Uniform Use Special Wind Profile	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 Appurtenances ✓ Alternative Appurt. EPA Calculation Autocalc Torque Arm Areas Add IBC .6D+W Combination Sort Capacity Reports By Component Triangulate Diamond Inner Bracing Treat Feed Line Bundles As Cylinder Ignore KL/ry For 60 Deg. Angle Legs 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 Feed Line Torque Include Angle Block Shear Check Use TIA-222-H Bracing Resist. Exemption Use TIA-222-H Tension Splice Exemption <div style="background-color: #e0e0e0; text-align: center; padding: 2px; margin: 5px 0;">Poles</div> ✓ Include Shear-Torsion Interaction Always Use Sub-Critical Flow Use Top Mounted Sockets Pole Without Linear Attachments ✓ Pole With Shroud Or No Appurtenances Outside and Inside Corner Radii Are Known
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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	75.0000- 65.0000	10.0000	0.00	Round	6.0000	6.0000	0.7500		A519 Type 1026 (72 ksi)
L2	65.0000- 55.0000	10.0000	0.00	Round	6.0000	6.0000	0.7500		A519 Type 1026 (72 ksi)
L3	55.0000- 45.0000	10.0000	0.00	Round	6.0000	6.0000	0.7500		A519 Type 1026 (72 ksi)
L4	45.0000- 35.0000	10.0000	0.00	18	26.6250	28.0261	0.2188	0.8750	A572-65 (65 ksi)
L5	35.0000-0.0000	35.0000		18	28.0261	32.9300	0.2188	0.8750	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	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
L2	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
L3	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
	6.0000	12.3700	43.4884	1.8750	3.0000	14.4961	86.9767	6.1813	0.0000	0
L4	27.0020	18.3342	1615.1491	9.3742	13.5255	119.4151	3232.4235	9.1688	4.3010	19.662
	28.4247	19.3070	1886.1304	9.8716	14.2373	132.4784	3774.7426	9.6553	4.5476	20.789
L5	28.4247	19.3070	1886.1304	9.8716	14.2373	132.4784	3774.7426	9.6553	4.5476	20.789
	33.4043	22.7118	3070.3215	11.6125	16.7284	183.5390	6144.6830	11.3581	5.4107	24.735

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 75.0000- 65.0000				1	0	1			
L2 65.0000- 55.0000				1	0	1			
L3 55.0000- 45.0000				1	0	1			
L4 45.0000- 35.0000				1	0	1			
L5 35.0000- 0.0000				1	1	1			

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Sector	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight plf
***** ***** *****										
AL5-50(7/8)	A	No	Surface Ar	35.0000 -	18	6	0.084	1.1000		0.26

Description	Sector	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight plf
CC-05-025-FM(1/4)	A	No	(CaAa) Surface Ar (CaAa)	0.0000 35.0000 - 0.0000	3	1	0.084 0.092 0.259	0.2400		0.13
***** *****										

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C _A A _A ft ² /ft	Weight plf
LDF5-50A(7/8")	C	No	No	Inside Pole	70.0000 - 0.0000	12	No Ice 1/2" Ice 1" Ice	0.0000 0.0000 0.0000	0.33 0.33 0.33
***** ***** *****									
LDF5-50A(7/8)	C	No	No	Inside Pole	60.0000 - 0.0000	6	No Ice 1/2" Ice 1" Ice	0.0000 0.0000 0.0000	0.33 0.33 0.33
***** *****									
AL5-50(7/8)	A	No	No	Inside Pole	40.0000 - 35.0000	18	No Ice 1/2" Ice 1" Ice	0.0000 0.0000 0.0000	0.26 0.26 0.26
CC-05-025-FM(1/4)	A	No	No	Inside Pole	40.0000 - 35.0000	3	No Ice 1/2" Ice 1" Ice	0.0000 0.0000 0.0000	0.13 0.13 0.13
***** *****									

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	75.0000-65.0000	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.02
L2	65.0000-55.0000	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.05
L3	55.0000-45.0000	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.06
L4	45.0000-35.0000	A	0.000	0.000	0.000	0.000	0.03
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.06
L5	35.0000-0.0000	A	0.000	0.000	23.940	0.000	0.18
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.21

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 _a A _a In Face ft ²	C _a A _a Out Face ft ²	Weight K
L1	75.0000-65.0000	A	0.916	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.02
L2	65.0000-55.0000	A	0.902	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.05
L3	55.0000-45.0000	A	0.886	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.06
L4	45.0000-35.0000	A	0.866	0.000	0.000	0.000	0.000	0.03
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.06
L5	35.0000-0.0000	A	0.796	0.000	0.000	42.246	0.000	0.57
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.21

Feed Line Center of Pressure

Section	Elevation ft	CP _x in	CP _z in	CP _x Ice in	CP _z Ice in
L1	75.0000-65.0000	0.0000	0.0000	0.0000	0.0000
L2	65.0000-55.0000	0.0000	0.0000	0.0000	0.0000
L3	55.0000-45.0000	0.0000	0.0000	0.0000	0.0000
L4	45.0000-35.0000	0.0000	0.0000	0.0000	0.0000
L5	35.0000-0.0000	-3.4167	-2.9127	-3.1340	-2.7866

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
L5	9	AL5-50(7/8)	0.00 - 35.00	1.0000	1.0000
L5	11	CC-05-025-FM(1/4)	0.00 - 35.00	1.0000	1.0000

User Defined Loads

Description	Elevation	Offset From Centroid	Azimuth Angle		Weight	F _x	F _z	Wind Force	C _A A _c
	ft	ft	°		K	K	K	K	ft ²
Truck Ball 18" dia.	75.7500	0.00	0.00	No Ice	0.05	0.00	0.00	0.03	0.8836
				Ice	0.08	0.00	0.00	0.01	1.5040
				Service	0.05	0.00	0.00	0.01	0.8836
Flag (18'x12')	75.0000	0.00	0.00	No Ice	0.02	0.00	0.00	0.27	8.0374
				Ice	0.21	0.00	0.00	0.05	8.1232
				Service	0.02	0.00	0.00	0.06	8.0374
Concealment Canister (24.625"x10')-top	75.0000	0.00	0.00	No Ice	0.29	0.00	0.00	0.15	4.5271
				Ice	0.43	0.00	0.00	0.07	12.0714
				Service	0.29	0.00	0.00	0.04	4.5271
Concealment Canister (24.625"x10')-bottom	65.0000	0.00	0.00	No Ice	0.29	0.00	0.00	0.15	4.7160
				Ice	0.43	0.00	0.00	0.07	12.5752
				Service	0.29	0.00	0.00	0.04	4.7160
Concealment Canister (25.625"x10')-top	65.0000	0.00	0.00	No Ice	0.31	0.00	0.00	0.15	4.6960
				Ice	0.45	0.00	0.00	0.07	12.4726
				Service	0.31	0.00	0.00	0.03	4.6960
Concealment Canister (25.625"x10')-bottom	55.0000	0.00	0.00	No Ice	0.31	0.00	0.00	0.15	4.9256
				Ice	0.45	0.00	0.00	0.07	13.0823
				Service	0.31	0.00	0.00	0.03	4.9256
Concealment Canister (26.625"x10')-top	55.0000	0.00	0.00	No Ice	0.27	0.00	0.00	0.15	4.8581
				Ice	0.42	0.00	0.00	0.07	12.8527
				Service	0.27	0.00	0.00	0.03	4.8581
Concealment Canister (26.625"x10')-bottom	45.0000	0.00	0.00	No Ice	0.27	0.00	0.00	0.15	5.1448
				Ice	0.42	0.00	0.00	0.07	13.6112
				Service	0.27	0.00	0.00	0.03	5.1448
Concealment Canister (52"x10')- top	45.0000	0.00	0.00	No Ice	0.20	0.00	0.00	0.39	13.1983
				Ice	0.48	0.00	0.00	0.13	24.1565
				Service	0.20	0.00	0.00	0.09	13.1983
Concealment Canister (52"x10')- bottom	35.0000	0.00	0.00	No Ice	0.20	0.00	0.00	0.39	14.1808
				Ice	0.48	0.00	0.00	0.13	25.9548
				Service	0.20	0.00	0.00	0.09	14.1809

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement
			Horz Lateral	Vert		
			ft	ft	°	ft

VV-65B-R1_TMO	A	From Leg	1.0000	0.00	0.00	70.0000
			0.00			
			1.00			
VV-65B-R1_TMO	B	From Leg	1.0000	0.00	0.00	70.0000
			0.00			
			1.00			
VV-65B-R1_TMO	C	From Leg	1.0000	0.00	0.00	70.0000
			0.00			
			1.00			

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft

FVV-65B-R3	A	From Leg	1.0000 0.00 1.00	0.00	60.0000
FVV-65B-R3	B	From Leg	1.0000 0.00 1.00	0.00	60.0000
FVV-65B-R3	C	From Leg	1.0000 0.00 1.00	0.00	60.0000

SBNHH-1D65B	A	From Leg	1.0000 0.00 0.00	0.00	40.0000
SBNHH-1D65B	B	From Leg	1.0000 0.00 0.00	0.00	40.0000
SBNHH-1D65B	C	From Leg	1.0000 0.00 0.00	0.00	40.0000
Pipe Mount [PM 601-3]	C	None		0.00	40.0000

Concealment Canister (24.625"x10')	C	None		0.00	70.0000
Concealment Canister (25.625"x10')	C	None		0.00	60.0000
Concealment Canister (26.625"x10')	C	None		0.00	50.0000
Concealment Canister (52"x10')	C	None		0.00	40.0000

Tower Pressures - No Ice

$G_H = 1.100$

Section Elevation ft	z ft	K _z	q _z psf	A _G ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 75.0000- 65.0000	70.0000	0.892	30.40	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.00	0.000	0.000	
					C	0.000	0.000	0.00	0.000	0.000	
L2 65.0000- 55.0000	60.0000	0.854	29.09	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.00	0.000	0.000	
					C	0.000	0.000	0.00	0.000	0.000	
L3 55.0000- 45.0000	50.0000	0.811	27.61	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.00	0.000	0.000	
					C	0.000	0.000	0.00	0.000	0.000	
L4 45.0000- 35.0000	39.9573	0.760	25.90	23.094	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.00	0.000	0.000	

Section Elevation ft	z ft	K _z	q _z psf	A _G ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L5 35.0000-0.0000	17.0302	0.700	23.84	90.167	C	0.000	0.000	90.167	0.00	0.000	0.000
					A	0.000	90.167		100.00	23.940	0.000
					B	0.000	90.167		100.00	0.000	0.000
					C	0.000	90.167		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.100$

Section Elevation ft	z ft	K _z	q _z psf	t _z in	A _G ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 75.0000-65.0000	70.0000	0.892	5.37	0.9164	6.527	A	0.000	0.000	0.000	0.00	0.000	0.000
						B	0.000	0.000	0.000	0.00	0.000	0.000
						C	0.000	0.000	0.000	0.00	0.000	0.000
L2 65.0000-55.0000	60.0000	0.854	5.13	0.9024	6.504	A	0.000	0.000	0.000	0.00	0.000	0.000
						B	0.000	0.000	0.000	0.00	0.000	0.000
						C	0.000	0.000	0.000	0.00	0.000	0.000
L3 55.0000-45.0000	50.0000	0.811	4.87	0.8861	6.477	A	0.000	0.000	0.000	0.00	0.000	0.000
						B	0.000	0.000	0.000	0.00	0.000	0.000
						C	0.000	0.000	0.000	0.00	0.000	0.000
L4 45.0000-35.0000	39.9573	0.760	4.57	0.8664	24.538	A	0.000	0.000	0.000	0.00	0.000	0.000
						B	0.000	0.000	0.000	0.00	0.000	0.000
						C	0.000	0.000	0.000	0.00	0.000	0.000
L5 35.0000-0.0000	17.0302	0.700	4.21	0.7956	94.808	A	0.000	94.808	94.808	100.00	42.246	0.000
						B	0.000	94.808		100.00	0.000	0.000
						C	0.000	94.808		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.100$

Section Elevation ft	z ft	K _z	q _z psf	A _G ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 75.0000-65.0000	70.0000	0.892	6.91	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.000	0.00	0.000	0.000
					C	0.000	0.000	0.000	0.00	0.000	0.000
L2 65.0000-55.0000	60.0000	0.854	6.62	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.000	0.00	0.000	0.000
					C	0.000	0.000	0.000	0.00	0.000	0.000
L3 55.0000-45.0000	50.0000	0.811	6.28	5.000	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.000	0.00	0.000	0.000
					C	0.000	0.000	0.000	0.00	0.000	0.000
L4 45.0000-35.0000	39.9573	0.760	5.89	23.094	A	0.000	0.000	0.000	0.00	0.000	0.000
					B	0.000	0.000	0.000	0.00	0.000	0.000
					C	0.000	0.000	0.000	0.00	0.000	0.000
L5 35.0000-0.0000	17.0302	0.700	5.42	90.167	A	0.000	90.167	90.167	100.00	23.940	0.000
					B	0.000	90.167		100.00	0.000	0.000
					C	0.000	90.167		100.00	0.000	0.000

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.0 Wind 0 deg - No Ice
3	0.9 Dead+1.0 Wind 0 deg - No Ice
4	1.2 Dead+1.0 Wind 30 deg - No Ice
5	0.9 Dead+1.0 Wind 30 deg - No Ice
6	1.2 Dead+1.0 Wind 60 deg - No Ice
7	0.9 Dead+1.0 Wind 60 deg - No Ice
8	1.2 Dead+1.0 Wind 90 deg - No Ice
9	0.9 Dead+1.0 Wind 90 deg - No Ice
10	1.2 Dead+1.0 Wind 120 deg - No Ice
11	0.9 Dead+1.0 Wind 120 deg - No Ice
12	1.2 Dead+1.0 Wind 150 deg - No Ice
13	0.9 Dead+1.0 Wind 150 deg - No Ice
14	1.2 Dead+1.0 Wind 180 deg - No Ice
15	0.9 Dead+1.0 Wind 180 deg - No Ice
16	1.2 Dead+1.0 Wind 210 deg - No Ice
17	0.9 Dead+1.0 Wind 210 deg - No Ice
18	1.2 Dead+1.0 Wind 240 deg - No Ice
19	0.9 Dead+1.0 Wind 240 deg - No Ice
20	1.2 Dead+1.0 Wind 270 deg - No Ice
21	0.9 Dead+1.0 Wind 270 deg - No Ice
22	1.2 Dead+1.0 Wind 300 deg - No Ice
23	0.9 Dead+1.0 Wind 300 deg - No Ice
24	1.2 Dead+1.0 Wind 330 deg - No Ice
25	0.9 Dead+1.0 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	75 - 65	Pole	Max Tension	36	0.00	-0.00	-0.00
			Max. Compression	26	-1.80	0.00	0.00
			Max. M _x	20	-1.09	4.92	0.00
			Max. M _y	2	-1.09	0.00	4.92
			Max. V _y	20	-0.50	4.92	0.00
			Max. V _x	2	-0.50	0.00	4.92
L2	65 - 55	Pole	Max. Torque	4			-0.00
			Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-3.94	0.00	0.00
			Max. M _x	20	-2.57	13.34	0.00
			Max. M _y	2	-2.57	0.00	13.34
			Max. V _y	20	-0.85	9.96	0.00
L3	55 - 45	Pole	Max. V _x	2	-0.85	0.00	9.96
			Max. Torque	5			-0.00
			Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-5.58	0.00	0.00
			Max. M _x	20	-3.86	24.72	0.00
			Max. M _y	2	-3.86	0.00	24.72
L4	45 - 35	Pole	Max. V _y	20	-1.16	14.50	0.00
			Max. V _x	2	-1.16	0.00	14.50
			Max. Torque	5			-0.00
			Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-8.48	0.00	0.00
			Max. M _x	20	-5.68	41.17	0.00
L5	35 - 0	Pole	Max. M _y	2	-5.68	0.00	41.17
			Max. V _y	20	-1.65	37.88	0.00
			Max. V _x	2	-1.65	0.00	37.88
			Max. Torque	5			-0.00
			Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-13.94	0.73	0.42
			Max. M _x	20	-9.40	141.70	0.15
			Max. M _y	2	-9.40	0.26	141.59
			Max. V _y	20	-3.73	141.70	0.15
			Max. V _x	2	-3.73	0.26	141.59
			Max. Torque	5			-0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	26	13.94	0.00	0.00
	Max. H _x	20	9.40	3.73	-0.00
	Max. H _z	2	9.40	-0.00	3.73
	Max. M _x	2	141.59	-0.00	3.73
	Max. M _z	8	141.18	-3.73	-0.00
	Max. Torsion	19	0.00	3.23	-1.86
	Min. Vert	21	7.05	3.73	-0.00
	Min. H _x	8	9.40	-3.73	-0.00
	Min. H _z	14	9.40	-0.00	-3.73
	Min. M _x	14	-141.29	-0.00	-3.73
	Min. M _z	20	-141.70	3.73	-0.00
	Min. Torsion	5	-0.00	-1.89	3.28

Tower Mast Reaction Summary

Load Combination	Vertical	Shear _x	Shear _z	Overturing Moment, M _x	Overturing Moment, M _z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead Only	7.84	0.00	0.00	-0.12	0.22	0.00
1.2 Dead+1.0 Wind 0 deg - No Ice	9.40	0.00	-3.73	-141.59	0.26	0.00
0.9 Dead+1.0 Wind 0 deg - No Ice	7.05	0.00	-3.73	-140.79	0.19	0.00
1.2 Dead+1.0 Wind 30 deg - No Ice	9.40	1.89	-3.28	-123.50	-70.96	0.00
0.9 Dead+1.0 Wind 30 deg - No Ice	7.05	1.89	-3.28	-122.80	-70.64	0.00
1.2 Dead+1.0 Wind 60 deg - No Ice	9.40	3.23	-1.86	-70.87	-122.23	-0.00
0.9 Dead+1.0 Wind 60 deg - No Ice	7.05	3.23	-1.86	-70.45	-121.63	-0.00
1.2 Dead+1.0 Wind 90 deg - No Ice	9.40	3.73	0.00	-0.15	-141.18	0.00
0.9 Dead+1.0 Wind 90 deg - No Ice	7.05	3.73	0.00	-0.11	-140.48	0.00
1.2 Dead+1.0 Wind 120 deg - No Ice	9.40	3.23	1.86	70.57	-122.23	0.00
0.9 Dead+1.0 Wind 120 deg - No Ice	7.05	3.23	1.86	70.22	-121.63	0.00
1.2 Dead+1.0 Wind 150 deg - No Ice	9.40	1.86	3.23	122.34	-70.46	-0.00
0.9 Dead+1.0 Wind 150 deg - No Ice	7.05	1.86	3.23	121.72	-70.14	-0.00
1.2 Dead+1.0 Wind 180 deg - No Ice	9.40	0.00	3.73	141.29	0.26	-0.00
0.9 Dead+1.0 Wind 180 deg - No Ice	7.05	0.00	3.73	140.56	0.19	-0.00
1.2 Dead+1.0 Wind 210 deg - No Ice	9.40	-1.89	3.28	123.20	71.48	0.00
0.9 Dead+1.0 Wind 210 deg - No Ice	7.05	-1.89	3.28	122.58	71.03	0.00
1.2 Dead+1.0 Wind 240 deg - No Ice	9.40	-3.23	1.86	70.57	122.75	-0.00
0.9 Dead+1.0 Wind 240 deg - No Ice	7.05	-3.23	1.86	70.22	122.02	-0.00
1.2 Dead+1.0 Wind 270 deg - No Ice	9.40	-3.73	0.00	-0.15	141.70	-0.00
0.9 Dead+1.0 Wind 270 deg - No Ice	7.05	-3.73	0.00	-0.11	140.87	-0.00
1.2 Dead+1.0 Wind 300 deg - No Ice	9.40	-3.23	-1.86	-70.87	122.75	0.00
0.9 Dead+1.0 Wind 300 deg - No Ice	7.05	-3.23	-1.86	-70.45	122.02	0.00
1.2 Dead+1.0 Wind 330 deg - No Ice	9.40	-1.86	-3.23	-122.64	70.98	-0.00
0.9 Dead+1.0 Wind 330 deg - No Ice	7.05	-1.86	-3.23	-121.94	70.53	-0.00
1.2 Dead+1.0 Ice+1.0 Temp	13.94	-0.00	-0.00	-0.42	0.73	0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	13.94	0.00	-1.27	-51.28	0.74	-0.00
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	13.94	0.63	-1.10	-44.47	-24.68	-0.00
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	13.94	1.10	-0.63	-25.85	-43.30	-0.00
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	13.94	1.27	0.00	-0.43	-50.11	-0.00
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	13.94	1.10	0.63	25.00	-43.30	0.00
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	13.94	0.63	1.10	43.61	-24.68	0.00

Load Combination	Vertical	Shear _x	Shear _z	Overturning Moment, M _x	Overturning Moment, M _z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 180 deg+1.0	13.94	0.00	1.27	50.42	0.74	0.00
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 210 deg+1.0	13.94	-0.63	1.10	43.61	26.17	0.00
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 240 deg+1.0	13.94	-1.10	0.63	25.00	44.78	0.00
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 270 deg+1.0	13.94	-1.27	0.00	-0.43	51.59	0.00
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 300 deg+1.0	13.94	-1.10	-0.63	-25.85	44.78	0.00
Ice+1.0 Temp						
1.2 Dead+1.0 Wind 330 deg+1.0	13.94	-0.63	-1.10	-44.47	26.17	-0.00
Ice+1.0 Temp						
Dead+Wind 0 deg - Service	7.84	0.00	-0.85	-32.15	0.22	-0.00
Dead+Wind 30 deg - Service	7.84	0.43	-0.75	-28.06	-15.91	-0.00
Dead+Wind 60 deg - Service	7.84	0.73	-0.42	-16.14	-27.52	-0.00
Dead+Wind 90 deg - Service	7.84	0.85	0.00	-0.13	-31.81	-0.00
Dead+Wind 120 deg - Service	7.84	0.73	0.42	15.89	-27.52	0.00
Dead+Wind 150 deg - Service	7.84	0.42	0.73	27.61	-15.80	0.00
Dead+Wind 180 deg - Service	7.84	0.00	0.85	31.90	0.22	0.00
Dead+Wind 210 deg - Service	7.84	-0.43	0.75	27.81	16.34	0.00
Dead+Wind 240 deg - Service	7.84	-0.73	0.42	15.89	27.95	0.00
Dead+Wind 270 deg - Service	7.84	-0.85	0.00	-0.13	32.24	0.00
Dead+Wind 300 deg - Service	7.84	-0.73	-0.42	-16.14	27.95	0.00
Dead+Wind 330 deg - Service	7.84	-0.42	-0.73	-27.86	16.23	-0.00

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	-7.84	0.00	0.00	7.84	0.00	0.000%
2	0.00	-9.40	-3.73	-0.00	9.40	3.73	0.004%
3	0.00	-7.05	-3.73	-0.00	7.05	3.73	0.007%
4	1.89	-9.40	-3.28	-1.89	9.40	3.28	0.004%
5	1.89	-7.05	-3.28	-1.89	7.05	3.28	0.007%
6	3.23	-9.40	-1.86	-3.23	9.40	1.86	0.004%
7	3.23	-7.05	-1.86	-3.23	7.05	1.86	0.007%
8	3.73	-9.40	0.00	-3.73	9.40	-0.00	0.004%
9	3.73	-7.05	0.00	-3.73	7.05	-0.00	0.007%
10	3.23	-9.40	1.86	-3.23	9.40	-1.86	0.004%
11	3.23	-7.05	1.86	-3.23	7.05	-1.86	0.007%
12	1.86	-9.40	3.23	-1.86	9.40	-3.23	0.004%
13	1.86	-7.05	3.23	-1.86	7.05	-3.23	0.007%
14	0.00	-9.40	3.73	-0.00	9.40	-3.73	0.004%
15	0.00	-7.05	3.73	-0.00	7.05	-3.73	0.007%
16	-1.89	-9.40	3.28	1.89	9.40	-3.28	0.004%
17	-1.89	-7.05	3.28	1.89	7.05	-3.28	0.007%
18	-3.23	-9.40	1.86	3.23	9.40	-1.86	0.004%
19	-3.23	-7.05	1.86	3.23	7.05	-1.86	0.007%
20	-3.73	-9.40	0.00	3.73	9.40	-0.00	0.004%
21	-3.73	-7.05	0.00	3.73	7.05	-0.00	0.007%
22	-3.23	-9.40	-1.86	3.23	9.40	1.86	0.004%
23	-3.23	-7.05	-1.86	3.23	7.05	1.86	0.007%
24	-1.86	-9.40	-3.23	1.86	9.40	3.23	0.004%
25	-1.86	-7.05	-3.23	1.86	7.05	3.23	0.007%
26	0.00	-13.94	0.00	0.00	13.94	0.00	0.000%
27	0.00	-13.94	-1.27	-0.00	13.94	1.27	0.004%
28	0.63	-13.94	-1.10	-0.63	13.94	1.10	0.004%
29	1.10	-13.94	-0.63	-1.10	13.94	0.63	0.004%

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
30	1.27	-13.94	0.00	-1.27	13.94	-0.00	0.004%
31	1.10	-13.94	0.63	-1.10	13.94	-0.63	0.004%
32	0.63	-13.94	1.10	-0.63	13.94	-1.10	0.004%
33	0.00	-13.94	1.27	-0.00	13.94	-1.27	0.004%
34	-0.63	-13.94	1.10	0.63	13.94	-1.10	0.004%
35	-1.10	-13.94	0.63	1.10	13.94	-0.63	0.004%
36	-1.27	-13.94	0.00	1.27	13.94	-0.00	0.004%
37	-1.10	-13.94	-0.63	1.10	13.94	0.63	0.004%
38	-0.63	-13.94	-1.10	0.63	13.94	1.10	0.004%
39	0.00	-7.84	-0.85	-0.00	7.84	0.85	0.007%
40	0.43	-7.84	-0.75	-0.43	7.84	0.75	0.007%
41	0.73	-7.84	-0.42	-0.73	7.84	0.42	0.007%
42	0.85	-7.84	0.00	-0.85	7.84	-0.00	0.007%
43	0.73	-7.84	0.42	-0.73	7.84	-0.42	0.007%
44	0.42	-7.84	0.73	-0.42	7.84	-0.73	0.007%
45	0.00	-7.84	0.85	-0.00	7.84	-0.85	0.007%
46	-0.43	-7.84	0.75	0.43	7.84	-0.75	0.007%
47	-0.73	-7.84	0.42	0.73	7.84	-0.42	0.007%
48	-0.85	-7.84	0.00	0.85	7.84	-0.00	0.007%
49	-0.73	-7.84	-0.42	0.73	7.84	0.42	0.007%
50	-0.42	-7.84	-0.73	0.42	7.84	0.73	0.007%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	15	0.00000001	0.00006505
3	Yes	14	0.00000001	0.00011380
4	Yes	15	0.00000001	0.00008532
5	Yes	14	0.00000001	0.00013923
6	Yes	15	0.00000001	0.00008528
7	Yes	14	0.00000001	0.00013925
8	Yes	15	0.00000001	0.00006501
9	Yes	14	0.00000001	0.00011375
10	Yes	15	0.00000001	0.00008522
11	Yes	14	0.00000001	0.00013919
12	Yes	15	0.00000001	0.00008522
13	Yes	14	0.00000001	0.00013919
14	Yes	15	0.00000001	0.00006502
15	Yes	14	0.00000001	0.00011376
16	Yes	15	0.00000001	0.00008537
17	Yes	14	0.00000001	0.00013927
18	Yes	15	0.00000001	0.00008530
19	Yes	14	0.00000001	0.00013928
20	Yes	15	0.00000001	0.00006507
21	Yes	14	0.00000001	0.00011381
22	Yes	15	0.00000001	0.00008535
23	Yes	14	0.00000001	0.00013934
24	Yes	15	0.00000001	0.00008536
25	Yes	14	0.00000001	0.00013934
26	Yes	6	0.00000001	0.00000001
27	Yes	14	0.00000001	0.00009467
28	Yes	14	0.00000001	0.00009630
29	Yes	14	0.00000001	0.00009616
30	Yes	14	0.00000001	0.00009420
31	Yes	14	0.00000001	0.00009595
32	Yes	14	0.00000001	0.00009599

33	Yes	14	0.00000001	0.00009433
34	Yes	14	0.00000001	0.00009635
35	Yes	14	0.00000001	0.00009649
36	Yes	14	0.00000001	0.00009480
37	Yes	14	0.00000001	0.00009670
38	Yes	14	0.00000001	0.00009666
39	Yes	12	0.00000001	0.00009925
40	Yes	12	0.00000001	0.00009770
41	Yes	12	0.00000001	0.00009753
42	Yes	12	0.00000001	0.00009902
43	Yes	12	0.00000001	0.00009745
44	Yes	12	0.00000001	0.00009748
45	Yes	12	0.00000001	0.00009908
46	Yes	12	0.00000001	0.00009769
47	Yes	12	0.00000001	0.00009770
48	Yes	12	0.00000001	0.00009931
49	Yes	12	0.00000001	0.00009777
50	Yes	12	0.00000001	0.00009774

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	75 - 65	3.05	49	0.54	0.00
L2	65 - 55	1.94	49	0.50	0.00
L3	55 - 45	1.01	49	0.37	0.00
L4	45 - 35	0.50	49	0.09	0.00
L5	35 - 0	0.32	49	0.08	0.00

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
75.7500	Truck Ball 18" dia.	49	3.05	0.54	0.00	19233
75.0000	Flag (18'x12')	49	3.05	0.54	0.00	19233
70.0000	VV-65B-R1_TMO	49	2.49	0.53	0.00	19233
65.0000	Concealment Canister (24.625"x10')-bottom	49	1.94	0.50	0.00	8167
60.0000	FVV-65B-R3	49	1.43	0.46	0.00	3750
55.0000	Concealment Canister (25.625"x10')-bottom	49	1.01	0.37	0.00	2550
50.0000	Concealment Canister (26.625"x10')	49	0.70	0.22	0.00	2714
45.0000	Concealment Canister (26.625"x10')-bottom	49	0.50	0.09	0.00	3412
40.0000	SBNHH-1D65B	49	0.38	0.06	0.00	6241
35.0000	Concealment Canister (52"x10')-bottom	49	0.32	0.08	0.00	26818

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	75 - 65	13.54	4	2.40	0.00
L2	65 - 55	8.62	4	2.24	0.00
L3	55 - 45	4.45	4	1.65	0.00
L4	45 - 35	2.19	4	0.40	0.00
L5	35 - 0	1.41	4	0.34	0.00

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
75.7500	Truck Ball 18" dia.	4	13.54	2.40	0.00	4348
75.0000	Flag (18'x12')	4	13.54	2.40	0.00	4348
70.0000	VV-65B-R1_TMO	4	11.04	2.34	0.00	4348
65.0000	Concealment Canister (24.625"x10')-bottom	4	8.62	2.24	0.00	1843
60.0000	FVV-65B-R3	4	6.36	2.05	0.00	843
55.0000	Concealment Canister (25.625"x10')-bottom	4	4.45	1.65	0.00	573
50.0000	Concealment Canister (26.625"x10')	4	3.07	0.97	0.00	609
45.0000	Concealment Canister (26.625"x10')-bottom	4	2.19	0.40	0.00	766
40.0000	SBNHH-1D65B	4	1.69	0.25	0.00	1402
35.0000	Concealment Canister (52"x10')-bottom	4	1.41	0.34	0.00	6078

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L _u ft	Kl/r	A in ²	P _u K	φP _n K	Ratio P _u / φP _n
L1	75 - 65 (1)	TP6x6x0.75	10.0000	0.0000	0.0	12.3700	-1.09	801.58	0.001
L2	65 - 55 (2)	TP6x6x0.75	10.0000	0.0000	0.0	12.3700	-2.57	801.58	0.003
L3	55 - 45 (3)	TP6x6x0.75	10.0000	0.0000	0.0	12.3700	-3.86	801.58	0.005
L4	45 - 35 (4)	TP28.0261x26.625x0.2188	10.0000	0.0000	0.0	19.3070	-5.68	1129.46	0.005
L5	35 - 0 (5)	TP32.93x28.0261x0.2188	35.0000	0.0000	0.0	22.7118	-9.40	1328.64	0.007

Pole Bending Design Data

Section No.	Elevation ft	Size	M _{ux} kip-ft	φM _{ux} kip-ft	Ratio M _{ux} / φM _{ux}	M _{uy} kip-ft	φM _{uy} kip-ft	Ratio M _{uy} / φM _{uy}
L1	75 - 65 (1)	TP6x6x0.75	4.92	112.39	0.044	0.00	112.39	0.000
L2	65 - 55 (2)	TP6x6x0.75	13.34	112.39	0.119	0.00	112.39	0.000
L3	55 - 45 (3)	TP6x6x0.75	24.72	112.39	0.220	0.00	112.39	0.000
L4	45 - 35 (4)	TP28.0261x26.625x0.2188	41.17	754.27	0.055	0.00	754.27	0.000

Section No.	Elevation ft	Size	M_{ux} kip-ft	ϕM_{nx} kip-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} kip-ft	ϕM_{ny} kip-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L5	35 - 0 (5)	TP32.93x28.0261x0.2188	142.44	981.11	0.145	0.00	981.11	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u K	ϕV_n K	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u kip-ft	ϕT_n kip-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	75 - 65 (1)	TP6x6x0.75	0.50	240.47	0.002	0.00	111.00	0.000
L2	65 - 55 (2)	TP6x6x0.75	0.84	240.47	0.004	0.00	111.00	0.000
L3	55 - 45 (3)	TP6x6x0.75	1.10	240.47	0.005	0.00	111.00	0.000
L4	45 - 35 (4)	TP28.0261x26.625x0.2188	1.65	338.84	0.005	0.00	825.15	0.000
L5	35 - 0 (5)	TP32.93x28.0261x0.2188	3.79	398.59	0.010	0.00	1141.84	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio P_u	Ratio M_{ux}	Ratio M_{uy}	Ratio V_u	Ratio T_u	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
		ϕP_n	ϕM_{nx}	ϕM_{ny}	ϕV_n	ϕT_n			
L1	75 - 65 (1)	0.001	0.044	0.000	0.002	0.000	0.045	1.050	
L2	65 - 55 (2)	0.003	0.119	0.000	0.004	0.000	0.122	1.050	
L3	55 - 45 (3)	0.005	0.220	0.000	0.005	0.000	0.225	1.050	
L4	45 - 35 (4)	0.005	0.055	0.000	0.005	0.000	0.060	1.050	
L5	35 - 0 (5)	0.007	0.145	0.000	0.010	0.000	0.152	1.050	

Section Capacity Table

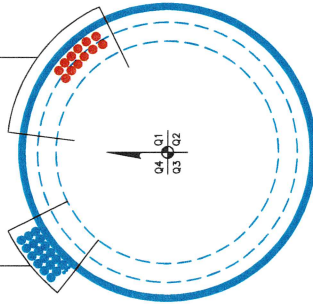
Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
L1	75 - 65	Pole	TP6x6x0.75	1	-1.09	841.66	4.3	Pass
L2	65 - 55	Pole	TP6x6x0.75	2	-2.57	841.66	11.6	Pass
L3	55 - 45	Pole	TP6x6x0.75	3	-3.86	841.66	21.4	Pass
L4	45 - 35	Pole	TP28.0261x26.625x0.2188	4	-5.68	1185.93	5.7	Pass
L5	35 - 0	Pole	TP32.93x28.0261x0.2188	5	-9.40	1395.07	14.5	Pass
Summary								
Pole (L3)							21.4	Pass
RATING =							21.4	Pass

APPENDIX B
BASE LEVEL DRAWING



(PROPOSED EQUIPMENT CONFIGURATION)
(6) 7/8" TO 60 FT LEVEL
(12) 7/8" TO 70 FT LEVEL

(OTHER CONSIDERED EQUIPMENT)
(3) 1/4" TO 40 FT LEVEL
(18) 7/8" TO 40 FT LEVEL



APPENDIX C
ADDITIONAL CALCULATIONS

Site Data	
BU#:	822710
Site Name:	BNS10/Oregon Club
Order #:	

File Path: C:\SAPI Work Area\822710\WO 2414801 - SAPIProd\20250513_APP657779_WO_2385910_BU_822710_SA_TNX_T-M

[Import trnTower File](#) [Export trnTower File](#)

Code	
Code:	TIA-222-H
Ice Thickness:	1 in
Windspeed:	119 mph
Ice Wind Speed:	50 mph
Service Wind Speed:	60 mph
Exposure Category:	B
Topographic Feature:	N/A
Risk Category:	II
Ground Elevation (z):	308.08 ft

- Use Target Reliabilities
- No External Appurtenances (Kd=1.0)
- Topo Downwind

Truck Ball	
Truck Ball on Tower:	Yes
Diameter:	18 in
Weight:	0.05 kip

Flag	
Flag on Tower:	Yes
Flag Width:	18 ft
Flag Height:	12 ft
Flag Elevation(z):	75 ft

Pole Geometry										
ID	Pole Height Above Base (ft)	Section Length (ft)	Lap Splice Length (ft)	Number of Sides	Top Diameter (in)	Bottom Diameter (in)	Wall Thickness (in)	Bend Radius (in)	Pole Material	Delete
1	75	10	0	0	6	6	0.75	n/a	AS19 Type 1026	[x]
2	65	10	0	0	6	6	0.75	n/a	AS19 Type 1026	[x]
3	55	10	0	0	6	6	0.75	n/a	AS19 Type 1026	[x]
4	45	10	0	18	26.625	28.02611	0.21875	0.875	AS72-65	[x]
5	35	35	0	18	28.02611	32.93	0.21875	0.875	AS72-65	[x]

Default Plate Type to 0.75 Solidity Ratio

Canisters Enter from highest elevation to lowest elevation													
ID ¹	Top Elevation (ft)	Classification Category	Canister Assembly Length (ft)	Canister Assembly Diameter (in)	Ventilated Canister	Manufacturer ²	Number of Sides Canister Section	Plate Type	Flange Plate Thickness (in) ³	Flange Plate Diameter (in)	Solidity Ratio	Plate Weight (Kip)	Vent Length (ft)
1	75	Existing	10	24.625	No		Round	4	3.00	24.625	0.55	0.446	0-0
2	65	Existing	10	25.625	No		Round	4	3.00	25.625	0.55	0.483	0-0
3	55	Existing	10	26.625	No		Round	4	2.50	25.75	0.55	0.406	0-0
4	45	Existing	10	52	No		18	1	0.25	52	0.45	0.135	0-0

¹ Double-click respective ID to auto-populate top elevation. Elevation will reference the previously entered canister's bottom elevation.
² Select manufacturer if available for vented canister. Leave blank to autocalculate CF values.
³ Accounts for the flange at the top and bottom of the canister. Enter larger dimensions.

Deflection Check	
Deflection Check Required:	No

Canister assembly spine deflection check is NOT required per Section 4.1.4, ENG-SOW-10134 Structural Analysis of Flagpole and Concealment Towers.

User Forces							
Name	Elev. (ft)	Shear (kip)	Weight (kip)	Shear _{CE} (kip)	Weight _{CE} (kip)	Shear _{SERVICE} (kip)	Weight _{SERVICE} (kip)
Truck Ball 18" dia.	75.75	0.030217	0.050000	0.009080	0.083702	0.006873	0.050000
Flag (18"x12")	75	0.274084	0.022680	0.048904	0.208702	0.062343	0.022680
Concealment Canister (24.625"x10")-top	75	0.154378	0.287301	0.072673	0.430278	0.035115	0.287301
Concealment Canister (24.625"x10")-bottom	65	0.154378	0.287301	0.072673	0.430278	0.035115	0.287301
Concealment Canister (25.625"x10")-top	65	0.153725	0.308384	0.072080	0.454609	0.034966	0.308384
Concealment Canister (25.625"x10")-bottom	55	0.153725	0.308384	0.072080	0.454609	0.034966	0.308384
Concealment Canister (26.625"x10")-top	55	0.151617	0.272752	0.070815	0.421660	0.034487	0.272752
Concealment Canister (26.625"x10")-bottom	45	0.151617	0.272752	0.070815	0.421660	0.034487	0.272752
Concealment Canister (52"x10")-top	45	0.388956	0.203884	0.125679	0.483718	0.088472	0.203884
Concealment Canister (52"x10")-bottom	35	0.388956	0.203884	0.125679	0.483718	0.088472	0.203884

Monopole Flange Plate Connection

Elevation = 45 ft.



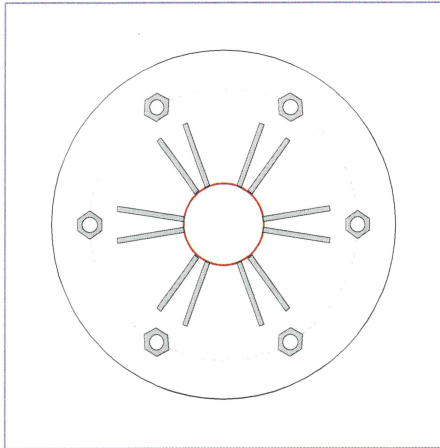
BU #	822710
Site Name	BN510/Oregon Club
Order #	657779 REV. 7

Applied Loads	
Moment (kip-ft)	24.72
Axial Force (kips)	3.86
Shear Force (kips)	1.10

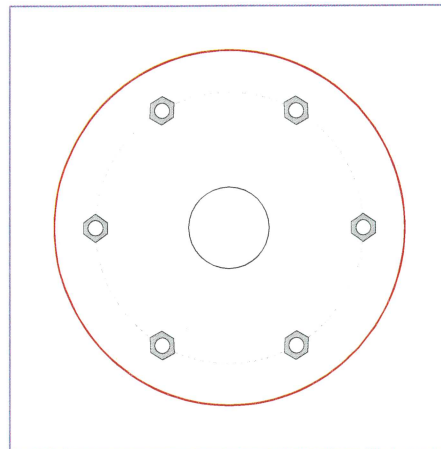
TIA-222 Revision	H
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*TIA-222-H Section 15.5 Applied

Top Plate - External



Bottom Plate - Internal



Connection Properties

Bolt Data

(6) 1-1/8" ϕ bolts (A325 N; Fy=81 ksi, Fu=120 ksi) on 20" BC

Top Plate Data

25.75" OD x 2.5" Plate (A572-50; Fy=50 ksi, Fu=65 ksi)

Bottom Plate Data

6" ID x 2.5" Plate (A572-50; Fy=50 ksi, Fu=65 ksi)

Top Stiffener Data

(12) 5"H x 5"W x 0.375"T, Notch: 1.5"
plate: Fy= 36 ksi ; weld: Fy= 80 ksi
horiz. weld: 0.3125" fillet
vert. weld: 0.3125" fillet

Bottom Stiffener Data

N/A

Top Pole Data

6" x 0.75" round pole (A519 Type 1026; Fy=72 ksi, Fu=87 ksi)

Bottom Pole Data

26.625" x 0.21875" 18-sided pole (A572-65; Fy=65 ksi, Fu=80 ksi)

Analysis Results

Bolt Capacity

Max Load (kips)	9.23
Allowable (kips)	68.67
Stress Rating:	12.8% Pass

Bottom Plate Capacity

Max Stress (ksi):	-
Allowable Stress (ksi):	-
Stress Rating:	N/A
Tension Side Stress Rating:	N/A

Top Stiffener Capacity

Horizontal Weld:	16.1%	Pass
Vertical Weld:	20.5%	Pass
Plate Flexure+Shear:	27.6%	Pass
Plate Tension+Shear:	20.3%	Pass
Plate Compression:	51.9%	Pass

Bottom Stiffener Capacity

Horizontal Weld:	N/A
Vertical Weld:	N/A
Plate Flexure+Shear:	N/A
Plate Tension+Shear:	N/A
Plate Compression:	N/A

Top Pole Capacity

Punching Shear:	4.1%	Pass
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Bottom Pole Capacity

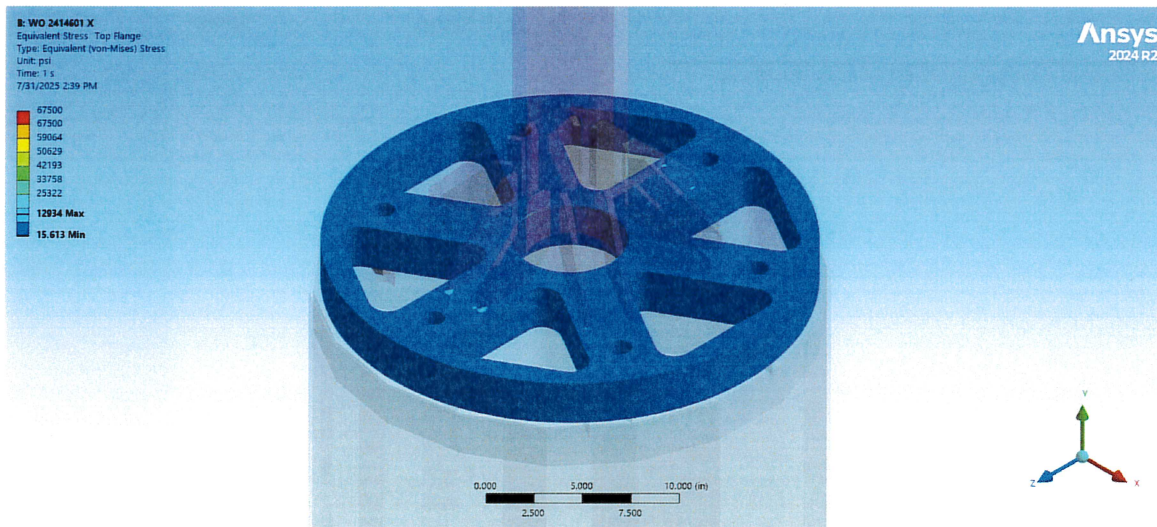
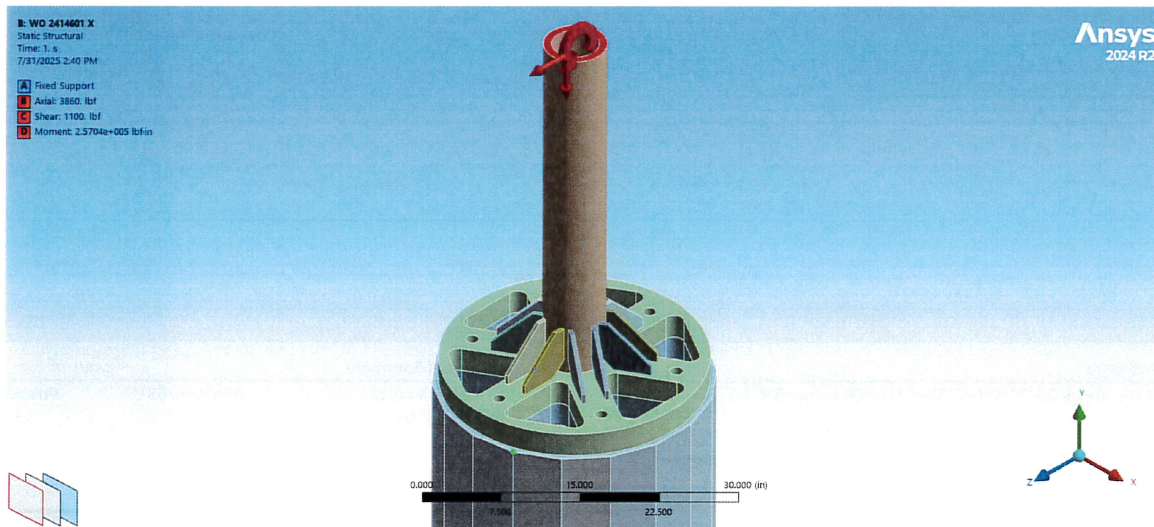
Punching Shear:	N/A
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Finite Element Analysis- 45' Flange Plate Connection

A finite element analysis was completed on the 45ft flange plate connection. The purpose of this analysis was to determine the suitability of the tower's flange plate connection using the corresponding level reactions provided by tnxTower (see Appendix A). A 3D solid model was created of the 45ft flange plate connection using SpaceClaim. A full analysis was performed of all components of the flange plate connection using ANSYS Structural (version 2024 R2). The images illustrate the controlling force direction and stress gradient of the controlling component.

Controlling Component: Top Flange

Status: Pass



Monopole Base Plate Connection

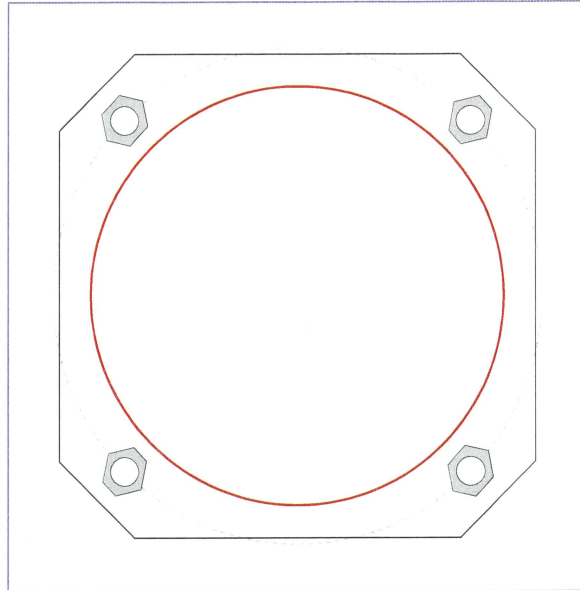


Site Info	
BU #	822710
Site Name	BN510/Oregon Club
Order #	657779 REV. 7

Analysis Considerations	
TIA-222 Revision	H
Grout Considered:	No
l_{ar} (in)	1.125

Applied Loads	
Moment (kip-ft)	142.44
Axial Force (kips)	9.40
Shear Force (kips)	3.79

*TIA-222-H Section 15.5 Applied



Connection Properties	Analysis Results
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Anchor Rod Data
(4) 2-1/4" ϕ bolts (A615-75 N; $F_y=75$ ksi, $F_u=100$ ksi) on 39" BC
Base Plate Data
38" W x 1.75" Plate (A572-50; $F_y=50$ ksi, $F_u=65$ ksi); Clip: 6 in
Stiffener Data
N/A
Pole Data
32.93" x 0.21875" 18-sided pole (A572-65; $F_y=65$ ksi, $F_u=80$ ksi)

Anchor Rod Summary	<i>(units of kips, kip-in)</i>	
$Pu_c = 46.12$	$\phi Pn_c = 268.39$	Stress Rating
$Vu = 0.95$	$\phi Vn = 120.77$	16.4%
$Mu = n/a$	$\phi Mn = n/a$	Pass
Base Plate Summary		
Max Stress (ksi):	8.78	(Flexural)
Allowable Stress (ksi):	45	
Stress Rating:	18.6%	Pass

Pier and Pad Foundation



BU #: 822710
 Site Name: BN510/Oregon Clu
 App. Number: 657779 REV. 7

TIA-222 Revision: H
 Tower Type: Monopole

Top & Bot. Pad Rein. Different?:
 Block Foundation?:
 Rectangular Pad?:

Superstructure Analysis Reactions		
Compression, P_{comp} :	9.4	kips
Base Shear, V_u_{comp} :	3.79	kips
Moment, M_u :	142.43	ft-kips
Tower Height, H :	75	ft
BP Dist. Above Fdn, bp_{dist} :	3.375	in

Foundation Analysis Checks				
	Capacity	Demand	Rating*	Check
<i>Lateral (Sliding) (kips)</i>	69.21	3.79	5.2%	Pass
<i>Bearing Pressure (ksf)</i>	11.72	1.17	9.5%	Pass
<i>Overtuning (kip*ft)</i>	1136.06	168.13	14.8%	Pass
<i>Pier Flexure (Comp.) (kip*ft)</i>	1971.43	159.49	7.7%	Pass
<i>Pier Compression (kip)</i>	9372.94	25.30	0.3%	Pass
<i>Pad Flexure (kip*ft)</i>	721.95	51.41	6.8%	Pass
<i>Pad Shear - 1-way (kips)</i>	271.74	14.67	5.1%	Pass
<i>Pad Shear - 2-way (Comp) (ksi)</i>	0.164	0.009	5.4%	Pass
<i>Flexural 2-way (Comp) (kip*ft)</i>	1099.49	95.69	8.3%	Pass
<i>Pad Shear - 2-way (Uplift) (ksi)</i>	0.164	0.000	0.0%	Pass

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, $dpier$:	5	ft
Ext. Above Grade, E :	0.5	ft
Pier Rebar Size, Sc :	7	
Pier Rebar Quantity, mc :	30	
Pier Tie/Spiral Size, St :	5	
Pier Tie/Spiral Quantity, mt :	10	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, cc_{pier} :	3	in

Pad Properties		
Depth, D :	6	ft
Pad Width, W_1 :	14	ft
Pad Thickness, T :	2	ft
Pad Rebar Size (Bottom dir. 2), Sp_2 :	7	
Pad Rebar Quantity (Bottom dir. 2), mp_2 :	14	
Pad Clear Cover, cc_{pad} :	3	

Material Properties		
Pier Rebar Grade, F_y :	60	ksi
Concrete Compressive Strength, F'_c :	3	ksi
Dry Concrete Density, δ_c :	150	pcf

Soil Properties		
Total Soil Unit Weight, γ :	115	pcf
Ultimate Net Bearing, Q_{net} :	15,000	ksf
Cohesion, C_u :	0.000	ksf
Friction Angle, ϕ :	40	degrees
SPT Blow Count, N_{blows} :	29	
Base Friction, μ :	0.4	
Neglected Depth, N :	5.00	ft
Foundation Bearing on Rock?	No	
Groundwater Depth, gw :	5	ft

*Rating per TIA-222-H Section 15.5

Structural Rating*:	8.3%
Soil Rating*:	14.8%

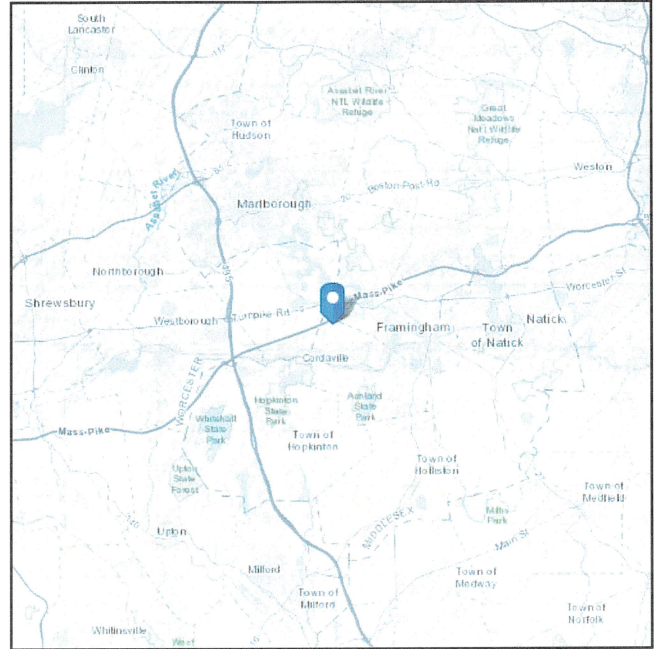
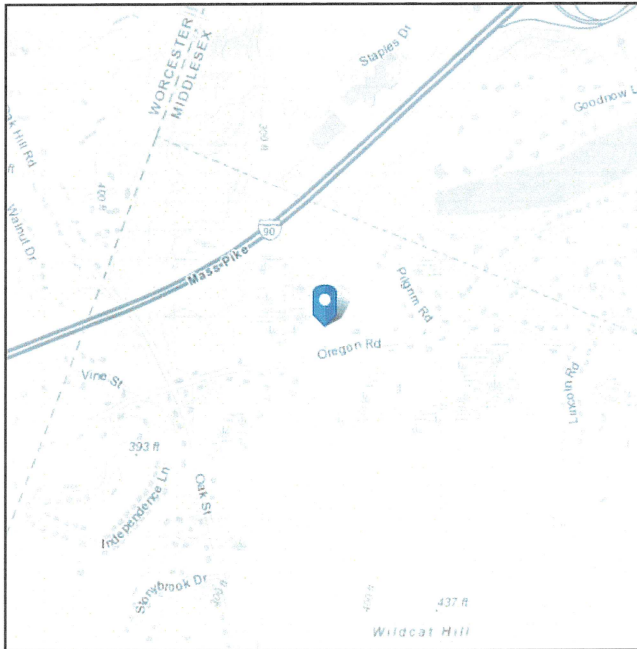
← Toggle between Gross and Net

ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Latitude: 42.284792
Longitude: -71.490708
Elevation: 308.0856992517867 ft (NAVD 88)



Wind

Results:

Wind Speed	119 Vmph
10-year MRI	75 Vmph
25-year MRI	84 Vmph
50-year MRI	91 Vmph
100-year MRI	98 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2

Date Accessed: Thu Jan 30 2025

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2. Glazed openings need not be protected against wind-borne debris.

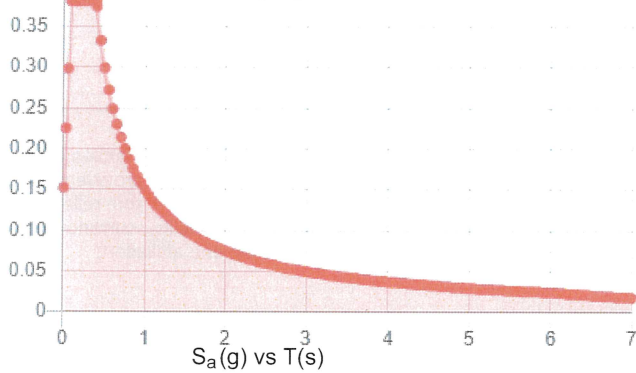
Seismic

Site Soil Class: D - Default (see Section 11.4.3)

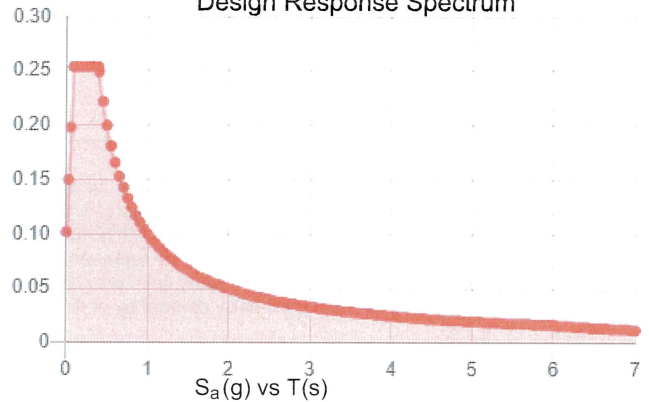
Results:

S_s :	0.238	S_{D1} :	0.1
S_1 :	0.062	T_L :	6
F_a :	1.6	PGA :	0.137
F_v :	2.4	PGA _M :	0.209
S_{MS} :	0.381	F_{PGA} :	1.526
S_{M1} :	0.15	I_e :	1
S_{DS} :	0.254	C_v :	0.776

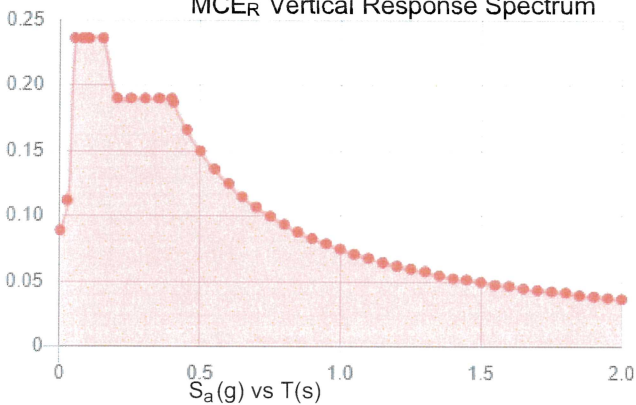
Seismic Design Category: B MCE_R Response Spectrum



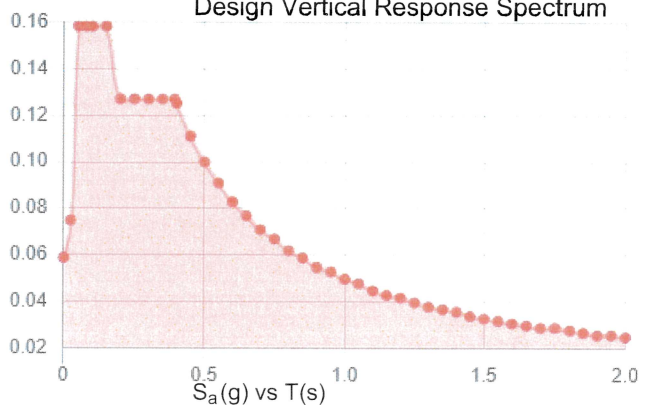
Design Response Spectrum



MCE_R Vertical Response Spectrum



Design Vertical Response Spectrum



Data Accessed: Thu Jan 30 2025

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.



Ice

Results:

Ice Thickness:	1.00 in.
Concurrent Temperature:	15 F
Gust Speed	50 mph

Data Source: Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8

Date Accessed: Thu Jan 30 2025

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

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