

STRUCTURAL ANALYSIS REPORT

For

ME5001
SONESTA

157 High Street
Portland, ME 04101

Antennas Mounted to the Tower



Prepared for:



Dated: April 26, 2016

Prepared by:



1600 Osgood Street Bldg. 20N Suite 3090
North Andover, MA 01845
(P) 978.557.5553 (F) 978.336.5586
www.hudsondesigngroupllc.com





SCOPE OF WORK:

Hudson Design Group LLC (HDG) has been authorized by AT&T to conduct a structural evaluation of the 25' self-supporting tower supporting the proposed AT&T antennas located at elevation 181' above the ground level.

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

Record drawings of the existing tower were not available for our use. The previous structural analysis report prepared by Malouf Engineering Intl., Inc., dated September 2, 2008, was available and obtained for our use. Tower mapping report prepared by ProVertic LLC, dated April 22, 2016, was provided to this office.

CONCLUSION SUMMARY:

Based on our evaluation, we have determined that the existing tower is in conformance with the ANSI/TIA-222-G Standard for the loading considered under the criteria listed in this report. The tower structure is rated at 31.5% - (Diagonal at Tower Section T5 from EL.156' to EL.161' Controlling).



APPURTENANCES CONFIGURATION:

Tenant	Appurtenances	Elev.	Mount
<i>AT&T</i>	(6) Powerwave 7770 Antennas	181'	T - Frame
<i>AT&T</i>	(3) Powerwave 7333 Antennas	181'	T - Frame
<i>AT&T</i>	(6) Powerwave LGP21401	181'	T - Frame
<i>AT&T</i>	(6) Powerwave LGP21901	181'	T - Frame
<i>AT&T</i>	(3) SBNHH-1D65A Antennas	181'	T - Frame
<i>AT&T</i>	(3) RRUS-11	181'	T - Frame
<i>AT&T</i>	DC6-48-60-18-8F	181'	Tower Leg
	3' Dish	163'	Tower Leg
	6' Dish	162'	Side Mount Standoff

**Proposed AT&T Appurtenances shown in Bold.*

AT&T EXISTING/PROPOSED COAX CABLES:

Tenant	Coax Cables	Elev.	Mount
<i>AT&T</i>	(12) 7/8" Cables	181'	Tower Face
<i>AT&T</i>	(2) DC Power Cables	181'	Tower Face
<i>AT&T</i>	(1) Fiber Cable	181'	Tower Face

**Proposed AT&T Coax Cables shown in Bold.*

ANALYSIS RESULTS SUMMARY:

Component	Max. Stress Ratio	Elev. of Component (ft)	Pass/Fail	Notes/Comments
Legs	8.8 %	156 – 161	PASS	
Diagonals	31.5 %	156 – 161	PASS	Controlling
Top Girts	15.1 %	176 – 181.4	PASS	
Bottom Girts	5.5 %	176 – 181.4	PASS	
Inner Bracing	3.3 %	161 – 166	PASS	



DESIGN CRITERIA:

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

County: Cumberland
Wind Load: 100 mph (3 second gust)
Structural Class: II
Exposure Category: B
Topographic Category: 1
Ice Thickness: 1.0 inch

2. Approximate height above grade to proposed antennas: 181'

Calculations and referenced documents are attached

ASSUMPTIONS:

1. Material strength of the existing structure was not available for structural analysis, and was assumed as follows:
Pipes: $F_y=50$ ksi
Angles: $F_y=36$ ksi
2. The Tower and support are properly constructed and maintained. All structural members and their connections are assumed to be in good condition and are free from defects with no deterioration to its member capacities.
3. The appurtenances configuration is as stated in this report. All antennas, coax cables and waveguide cables are assumed to be properly installed and supported as per the manufacturer's requirements.
4. The support mounts and platforms are not analyzed and are considered adequate to support the loading. The analysis is limited to the primary support structure itself.
5. All prior structural modification, if any, are assumed to be as per the data supplied (if available), and installed properly.



SUPPORT RECOMMENDATIONS:

HDG recommends that the proposed antennas and RRHs be mounted on the existing T-frame supported by the tower; the proposed surge arrestor be mounted on the tower leg.

Reference HDG's Latest Construction Drawings for all component and connection requirements (attached).

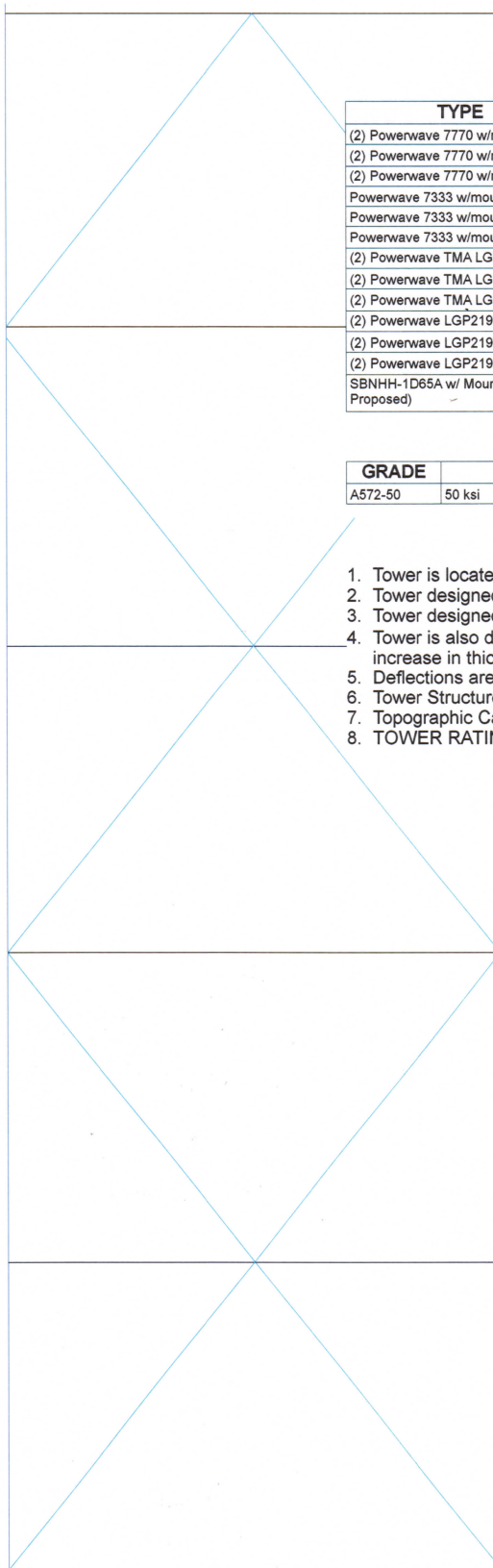


Photo 1: Photo illustrating the Tower with Appurtenances shown.



CALCULATIONS

Section	T1	T2	T3	T4	T5
Legs	P4x.237	A572-50	P1.5x.145	A572-50	N.A.
Leg Grade					
Diagonals					
Top Girts	L1 3/4x1 3/4x3/16				
Bottom Girts	L1 3/4x1 3/4x3/16				
Inner Bracing					
Face Width (ft)	176.0	171.0	166.0	161.0	156.0
# Panels @ (ft)	1 @ 5.04167	4 @ 5	8		
Weight (lb)	603.2	400.2	400.6	586.3	400.6
	181.4				



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
(2) Powerwave 7770 w/mount pipe	181	SBNHH-1D65A w/ Mount Pipe	181
(2) Powerwave 7770 w/mount pipe	181	SBNHH-1D65A w/ Mount Pipe	181
(2) Powerwave 7770 w/mount pipe	181	Ericsson RRUS-11	181
Powerwave 7333 w/mount pipe	181	Ericsson RRUS-11	181
Powerwave 7333 w/mount pipe	181	Ericsson RRUS-11	181
Powerwave 7333 w/mount pipe	181	DC6-48-60-18-8F	181
(2) Powerwave TMA LGP21401	181	PIROD 14' T-Frame	180
(2) Powerwave TMA LGP21401	181	PIROD 14' T-Frame	180
(2) Powerwave TMA LGP21401	181	PIROD 14' T-Frame (ATI - Existing)	180
(2) Powerwave LGP21900	181	P3F-52	163
(2) Powerwave LGP21900	181	1' Side Mount Standoff	162
(2) Powerwave LGP21900	181	UHX6-59	162
SBNHH-1D65A w/ Mount Pipe (ATI - Proposed)	181		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi			

TOWER DESIGN NOTES

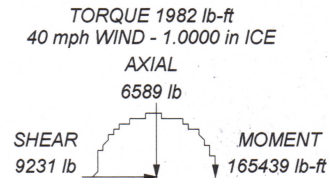
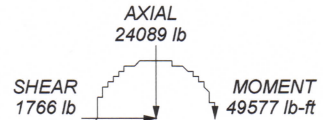
1. Tower is located in Cumberland County, Maine.
2. Tower designed for Exposure B to the TIA-222-G Standard.
3. Tower designed for a 100 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 40 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 31.5%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:


DOWN: 16270 lb
SHEAR: 2895 lb

UPLIFT: -13266 lb
SHEAR: 2803 lb



TORQUE 10591 lb-ft
REACTIONS - 100 mph WIND

<p>Hudson Design Group LLC 1600 Osgood Street Bldg. 20N Suite 3090 North Andover, MA 01845 Phone: (978) 557-5553 FAX: (978) 336-5586</p>	<p>Job: ME5001 Portland, ME</p>
	<p>Project: 25 ft Self Supporting Tower</p>
	<p>Client: AT&T</p>
	<p>Code: TIA-222-G</p>
	<p>Path: C:\Users\kward\Documents\HUDSON DESIGN GROUP\AAAME5001 - SST (AT&T SA)\ME5001\ME5001.dwg</p>
<p>Drawn by: kw</p>	<p>App'd:</p>
<p>Date: 04/26/16</p>	<p>Scale: NTS</p>
<p>Dwg No. E-1</p>	<p>Dwg No. NTS</p>

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	Client	AT&T	Designed by	kw

Tower Input Data

The main tower is a 4x free standing tower with an overall height of 181.38 ft above the ground line.

The base of the tower is set at an elevation of 156.00 ft above the ground line.

The face width of the tower is 8.00 ft at the top and 8.00 ft at the base.

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

The following design criteria apply:

Tower is located in Cumberland County, Maine.

Basic wind speed of 100 mph.

Structure Class II.

Exposure Category B.

Topographic Category 1.

Crest Height 0.00 ft.

Nominal ice thickness of 1.0000 in.

Ice thickness is considered to increase with height.

Ice density of 56 pcf.

A wind speed of 40 mph is used in combination with ice.

Temperature drop of 50 °F.

Deflections calculated using a wind speed of 60 mph.

A non-linear (P-delta) analysis was used.

Pressures are calculated at each section.

Stress ratio used in tower member design is 1.

Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Tower Section Geometry

<i>Tower Section</i>	<i>Tower Elevation</i>	<i>Assembly Database</i>	<i>Description</i>	<i>Section Width</i>	<i>Number of Sections</i>	<i>Section Length</i>
	<i>ft</i>			<i>ft</i>		<i>ft</i>
T1	181.38-176.00			8.00	1	5.38
T2	176.00-171.00			8.00	1	5.00
T3	171.00-166.00			8.00	1	5.00
T4	166.00-161.00			8.00	1	5.00
T5	161.00-156.00			8.00	1	5.00

Tower Section Geometry (cont'd)

<i>Tower Section</i>	<i>Tower Elevation</i>	<i>Diagonal Spacing</i>	<i>Bracing Type</i>	<i>Has K Brace End Panels</i>	<i>Has Horizontals</i>	<i>Top Girt Offset</i>	<i>Bottom Girt Offset</i>
	<i>ft</i>	<i>ft</i>				<i>in</i>	<i>in</i>
T1	181.38-176.00	5.04	K Brace Down	No	Yes	2.0000	2.0000
T2	176.00-171.00	5.00	K Brace Up	No	Yes	0.0000	0.0000
T3	171.00-166.00	5.00	K Brace Down	No	Yes	0.0000	0.0000
T4	166.00-161.00	5.00	K Brace Up	No	Yes	0.0000	0.0000
T5	161.00-156.00	5.00	K Brace Down	No	Yes	0.0000	0.0000



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Tower Section Geometry (cont'd)

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 181.38-176.00	Pipe	P4x.237	A572-50 (50 ksi)	Pipe	P1.5x.145	A572-50 (50 ksi)
T2 176.00-171.00	Pipe	P4x.237	A572-50 (50 ksi)	Pipe	P1.5x.145	A572-50 (50 ksi)
T3 171.00-166.00	Pipe	P4x.237	A572-50 (50 ksi)	Pipe	P1.5x.145	A572-50 (50 ksi)
T4 166.00-161.00	Pipe	P4x.237	A572-50 (50 ksi)	Pipe	P1.5x.145	A572-50 (50 ksi)
T5 161.00-156.00	Pipe	P4x.237	A572-50 (50 ksi)	Pipe	P1.5x.145	A572-50 (50 ksi)

Tower Section Geometry (cont'd)

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 181.38-176.00	Single Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T3 171.00-166.00	Double Equal Angle	2L1 3/4x1 3/4x3/16	A36 (36 ksi)	Equal Angle		A36 (36 ksi)
T4 166.00-161.00	Double Equal Angle	2L1 3/4x1 3/4x3/16	A36 (36 ksi)	Equal Angle		A36 (36 ksi)
T5 161.00-156.00	Double Equal Angle	2L1 3/4x1 3/4x3/16	A36 (36 ksi)	Equal Angle		A36 (36 ksi)

Tower Section Geometry (cont'd)

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 181.38-176.00	None	Equal Angle		A36 (36 ksi)	Pipe	ROHN 25G	A36 (36 ksi)
T2 176.00-171.00	None	Equal Angle		A36 (36 ksi)	Pipe	ROHN 25G	A36 (36 ksi)
T3 171.00-166.00	None	Equal Angle		A36 (36 ksi)	Pipe	ROHN 25G	A36 (36 ksi)
T4 166.00-161.00	None	Equal Angle		A36 (36 ksi)	Pipe	ROHN 25G	A36 (36 ksi)
T5 161.00-156.00	None	Equal Angle		A36 (36 ksi)	Pipe	ROHN 25G	A36 (36 ksi)

Tower Section Geometry (cont'd)



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Tower Elevation	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
ft						
T1 181.38-176.00	Equal Angle		A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T2 176.00-171.00	Equal Angle		A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T4 166.00-161.00	Equal Angle		A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T5 161.00-156.00	Equal Angle		A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement	Face Offset	Lateral Offset	#	# Per Row	Clear Spacing	Width or Diameter	Perimeter	Weight
				ft	in	(Frac FW)			in	in	in	plf
EW52	A	No	Ar (CaAa)	163.00 - 156.00	0.0000	0	1	1	0.0000	1.7426		0.59
EW52	D	No	Ar (CaAa)	162.00 - 156.00	0.0000	0	1	1	0.0000	1.7426		0.59
***** 7/8 (AT&T - existing) *****	B	No	Ar (CaAa)	181.00 - 156.00	0.0000	0	12	6	0.0000	1.1100		0.54
WR-VG122S T-BRDA (AT&T - proposed)	B	No	Ar (CaAa)	181.00 - 156.00	0.0000	0.2	2	2	0.0000	0.4000		0.25
FB-L98B-002	B	No	Ar (CaAa)	181.00 - 156.00	0.0000	0.25	1	1	0.0000	0.4000		0.25

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert	Azimuth Adjustment	Placement	CAAA Front	CAAA Side	Weight
			ft ft ft	°	ft	ft ²	ft ²	lb
PiROD 14' T-Frame (AT&T - Existing)	A	From Leg	1.00 0.00 0.00	0.0000	180.00	No Ice 1/2" Ice 1" Ice	15.00 20.60 26.20	500.00 650.00 800.00
PiROD 14' T-Frame	C	From Leg	1.00 0.00 0.00	0.0000	180.00	No Ice 1/2" Ice 1" Ice	15.00 20.60 26.20	500.00 650.00 800.00
PiROD 14' T-Frame	D	From Leg	1.00 0.00 0.00	0.0000	180.00	No Ice 1/2" Ice 1" Ice	15.00 20.60 26.20	500.00 650.00 800.00
(2) Powerwave 7770 w/mount pipe	A	From Leg	2.00 0.00 0.00	0.0000	181.00	No Ice 1/2" Ice 1" Ice	6.02 6.47 6.94	57.25 103.17 155.38
(2) Powerwave 7770 w/mount pipe	C	From Leg	2.00 0.00 0.00	0.0000	181.00	No Ice 1/2" Ice 1" Ice	6.02 6.47 6.94	57.25 103.17 155.38
(2) Powerwave 7770 w/mount	D	From Leg	2.00	0.0000	181.00	No Ice	6.02	57.25



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Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement	C _{AA} Front	C _{AA} Side	Weight
			Horz	Lateral					
			ft	ft	°	ft	ft ²	ft ²	lb
pipe			0.00			1/2" Ice	6.47	4.75	103.17
			0.00			1" Ice	6.94	5.42	155.38
Powerwave 7333 w/mount pipe	A	From Leg	2.00		0.0000	No Ice	6.04	4.22	54.90
			0.00			1/2" Ice	6.60	5.06	102.32
			0.00			1" Ice	7.12	5.77	156.08
Powerwave 7333 w/mount pipe	C	From Leg	2.00		0.0000	No Ice	6.04	4.22	54.90
			0.00			1/2" Ice	6.60	5.06	102.32
			0.00			1" Ice	7.12	5.77	156.08
Powerwave 7333 w/mount pipe	D	From Leg	2.00		0.0000	No Ice	6.04	4.22	54.90
			0.00			1/2" Ice	6.60	5.06	102.32
			0.00			1" Ice	7.12	5.77	156.08
(2) Powerwave TMA LGP21401	A	From Leg	1.00		0.0000	No Ice	1.23	0.41	14.10
			0.00			1/2" Ice	1.38	0.52	21.29
			0.00			1" Ice	1.54	0.65	30.37
(2) Powerwave TMA LGP21401	C	From Leg	1.00		0.0000	No Ice	1.23	0.41	14.10
			0.00			1/2" Ice	1.38	0.52	21.29
			0.00			1" Ice	1.54	0.65	30.37
(2) Powerwave TMA LGP21401	D	From Leg	1.00		0.0000	No Ice	1.23	0.41	14.10
			0.00			1/2" Ice	1.38	0.52	21.29
			0.00			1" Ice	1.54	0.65	30.37
(2) Powerwave LGP21900	A	From Leg	1.00		0.0000	No Ice	0.23	0.12	5.50
			0.00			1/2" Ice	0.30	0.17	7.70
			0.00			1" Ice	0.38	0.22	10.94
(2) Powerwave LGP21900	C	From Leg	1.00		0.0000	No Ice	0.23	0.12	5.50
			0.00			1/2" Ice	0.30	0.17	7.70
			0.00			1" Ice	0.38	0.22	10.94
(2) Powerwave LGP21900	D	From Leg	1.00		0.0000	No Ice	0.23	0.12	5.50
			0.00			1/2" Ice	0.30	0.17	7.70
			0.00			1" Ice	0.38	0.22	10.94

SBNHH-1D65A w/ Mount Pipe	A	From Leg	2.00		0.0000	No Ice	6.76	5.34	55.90
			0.00			1/2" Ice	7.31	6.20	111.21
			0.00			1" Ice	7.85	6.96	173.23
(AT&T - Proposed)			0.00			1" Ice	7.85	6.96	173.23
SBNHH-1D65A w/ Mount Pipe	C	From Leg	2.00		0.0000	No Ice	6.76	5.34	55.90
			0.00			1/2" Ice	7.31	6.20	111.21
			0.00			1" Ice	7.85	6.96	173.23
SBNHH-1D65A w/ Mount Pipe	D	From Leg	2.00		0.0000	No Ice	6.76	5.34	55.90
			0.00			1/2" Ice	7.31	6.20	111.21
			0.00			1" Ice	7.85	6.96	173.23
Ericsson RRUS-11	A	From Leg	1.00		0.0000	No Ice	3.26	1.38	50.70
			0.00			1/2" Ice	3.50	1.56	71.57
			0.00			1" Ice	3.75	1.74	95.48
Ericsson RRUS-11	C	From Leg	1.00		0.0000	No Ice	3.26	1.38	50.70
			0.00			1/2" Ice	3.50	1.56	71.57
			0.00			1" Ice	3.75	1.74	95.48
Ericsson RRUS-11	D	From Leg	1.00		0.0000	No Ice	3.26	1.38	50.70
			0.00			1/2" Ice	3.50	1.56	71.57
			0.00			1" Ice	3.75	1.74	95.48
DC6-48-60-18-8F	B	From Leg	1.00		0.0000	No Ice	1.27	1.27	20.00
			0.00			1/2" Ice	1.46	1.46	35.12
			0.00			1" Ice	1.66	1.66	52.57

1' Side Mount Standoff	C	From Leg	1.00		0.0000	No Ice	1.00	1.00	30.00
			0.00			1/2" Ice	1.50	1.50	50.00
			0.00			1" Ice	2.00	2.00	70.00



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Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert	Azimuth Adjustment	3 dB Beam Width	Elevation	Outside Diameter	Aperture Area	Weight	
				ft	°	°	ft	ft	ft ²	lb	
P3F-52	A	Paraboloid w/o Radome	From Leg	1.00	0.0000		163.00	3.00	No Ice	7.10	90.00
				0.00					1/2" Ice	7.46	128.31
				0.00					1" Ice	7.83	166.62
UHX6-59	C	Paraboloid w/Shroud (HP)	From Leg	2.00	0.0000		162.00	6.00	No Ice	28.27	143.00
				0.00					1/2" Ice	29.05	292.13
				0.00					1" Ice	29.83	441.25

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 45 deg - No Ice
5	0.9 Dead+1.6 Wind 45 deg - No Ice
6	1.2 Dead+1.6 Wind 90 deg - No Ice
7	0.9 Dead+1.6 Wind 90 deg - No Ice
8	1.2 Dead+1.6 Wind 135 deg - No Ice
9	0.9 Dead+1.6 Wind 135 deg - No Ice
10	1.2 Dead+1.6 Wind 180 deg - No Ice
11	0.9 Dead+1.6 Wind 180 deg - No Ice
12	1.2 Dead+1.6 Wind 225 deg - No Ice
13	0.9 Dead+1.6 Wind 225 deg - No Ice
14	1.2 Dead+1.6 Wind 270 deg - No Ice
15	0.9 Dead+1.6 Wind 270 deg - No Ice
16	1.2 Dead+1.6 Wind 315 deg - No Ice
17	0.9 Dead+1.6 Wind 315 deg - No Ice
18	1.2 Dead+1.0 Ice+1.0 Temp
19	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
20	1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Temp
21	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
22	1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Temp
23	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
24	1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Temp
25	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
26	1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 45 deg - Service
29	Dead+Wind 90 deg - Service
30	Dead+Wind 135 deg - Service
31	Dead+Wind 180 deg - Service
32	Dead+Wind 225 deg - Service
33	Dead+Wind 270 deg - Service
34	Dead+Wind 315 deg - Service

Maximum Reactions



Hudson Design Group LLC
 1600 Osgood Street Bldg. 20N Suite 3090
 North Andover, MA 01845
 Phone: (978) 557-5553
 FAX: (978) 336-5586

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Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Leg D	Max. Vert	12	16269.86	2154.56	-1933.76
	Max. H _x	14	11988.98	2590.96	-313.35
	Max. H _z	3	-8178.04	-119.76	2292.98
	Min. Vert	5	-12458.78	-1947.28	1655.22
	Min. H _x	7	-8106.91	-2377.14	-7.25
	Min. H _z	10	11917.83	380.84	-2480.74
Leg C	Max. Vert	8	16135.69	-2493.83	-1791.66
	Max. H _x	15	-8986.38	2352.98	378.66
	Max. H _z	3	-8986.51	820.20	1911.09
	Min. Vert	17	-13266.38	2272.40	1640.41
	Min. H _x	6	11956.77	-2627.27	-543.58
	Min. H _z	10	11956.66	-1056.05	-2115.22
Leg B	Max. Vert	4	15209.87	-1893.47	2114.29
	Max. H _x	15	-8973.11	1851.31	-622.07
	Max. H _z	4	15209.87	-1893.47	2114.29
	Min. Vert	13	-13253.77	1685.78	-1977.86
	Min. H _x	6	10857.72	-1969.01	812.26
	Min. H _z	13	-13253.77	1685.78	-1977.86
Leg A	Max. Vert	16	16144.96	1812.15	2514.33
	Max. H _x	14	11864.76	2028.53	1123.37
	Max. H _z	2	11864.90	610.87	2540.59
	Min. Vert	9	-13246.79	-1619.89	-2251.89
	Min. H _x	7	-9068.06	-1803.35	-947.56
	Min. H _z	9	-13246.79	-1619.89	-2251.89

Tower Mast Reaction Summary

Load Combination	Vertical lb	Shear _x lb	Shear _z lb	Overturning Moment, M _x lb-ft	Overturning Moment, M _z lb-ft	Torque lb-ft
Dead Only	5490.90	-0.00	0.00	3670.33	3394.92	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	6589.08	-566.56	-8762.98	-155993.79	7487.62	-6670.01
0.9 Dead+1.6 Wind 0 deg - No Ice	4941.81	-566.56	-8762.98	-157083.69	6468.37	-6669.67
1.2 Dead+1.6 Wind 45 deg - No Ice	6589.08	6051.61	-5908.78	-107909.20	-109093.31	4102.72
0.9 Dead+1.6 Wind 45 deg - No Ice	4941.81	6051.61	-5908.78	-109002.72	-110104.12	4102.72
1.2 Dead+1.6 Wind 90 deg - No Ice	6589.08	8715.89	686.13	8791.78	-156159.64	9781.81
0.9 Dead+1.6 Wind 90 deg - No Ice	4941.81	8715.89	686.13	7689.89	-157166.94	9782.15
1.2 Dead+1.6 Wind 135 deg - No Ice	6589.08	6446.08	6446.08	120148.56	-111666.55	10590.98
0.9 Dead+1.6 Wind 135 deg - No Ice	4941.81	6446.08	6446.08	119038.63	-112676.92	10590.56
1.2 Dead+1.6 Wind 180 deg - No Ice	6589.08	686.13	8715.89	164639.57	-309.73	5317.49
0.9 Dead+1.6 Wind 180 deg - No Ice	4941.81	686.13	8715.89	163526.59	-1328.11	5317.15
1.2 Dead+1.6 Wind 225 deg - No Ice	6589.08	-5908.78	6051.61	117573.18	116389.42	-4102.83
0.9 Dead+1.6 Wind 225 deg - No Ice	4941.81	-5908.78	6051.61	116463.75	115362.61	-4102.83



Hudson Design Group LLC
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 North Andover, MA 01845
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Load Combination	Vertical lb	Shear _x lb	Shear _z lb	Overturning Moment, M _x lb-ft	Overturning Moment, M _z lb-ft	Torque lb-ft
1.2 Dead+1.6 Wind 270 deg - No Ice	6589.08	-8762.98	-566.56	994.29	164473.58	-8429.98
0.9 Dead+1.6 Wind 270 deg - No Ice	4941.81	-8762.98	-566.56	-106.73	163443.20	-8429.64
1.2 Dead+1.6 Wind 315 deg - No Ice	6589.08	-6527.46	-6527.46	-111740.75	120222.65	-10590.97
0.9 Dead+1.6 Wind 315 deg - No Ice	4941.81	-6527.46	-6527.46	-112833.70	119195.33	-10590.55
1.2 Dead+1.0 Ice+1.0 Temp	24089.08	-0.00	0.00	14928.04	11188.50	-0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	24089.08	-64.11	-1648.06	-15391.04	11574.70	-1275.04
1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Temp	24089.08	1193.79	-1177.70	-6942.58	-10778.17	517.86
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	24089.08	1644.04	80.43	15443.84	-19121.16	1702.85
1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Temp	24089.08	1240.61	1240.61	37217.45	-11089.96	1981.98
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	24089.08	80.43	1644.04	45266.55	10679.95	1114.47
1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Temp	24089.08	-1177.70	1193.79	36921.76	33086.03	-517.87
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	24089.08	-1648.06	-64.11	14549.43	41536.44	-1542.54
1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Temp	24089.08	-1248.87	-1248.87	-7387.16	33512.17	-1982.00
Dead+Wind 0 deg - Service	5490.90	-127.48	-1971.67	-32412.28	4162.48	-1500.51
Dead+Wind 45 deg - Service	5490.90	1361.61	-1329.48	-21593.38	-22060.71	923.12
Dead+Wind 90 deg - Service	5490.90	1961.08	154.38	4656.87	-32650.58	2200.80
Dead+Wind 135 deg - Service	5490.90	1450.37	1450.37	29709.10	-22643.44	2382.76
Dead+Wind 180 deg - Service	5490.90	154.38	1961.08	39717.16	2408.94	1196.27
Dead+Wind 225 deg - Service	5490.90	-1329.48	1361.61	29129.31	28662.06	-923.12
Dead+Wind 270 deg - Service	5490.90	-1971.67	-127.48	2903.36	39478.71	-1896.59
Dead+Wind 315 deg - Service	5490.90	-1468.68	-1468.68	-22459.09	29524.71	-2382.72

Solution Summary

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	
1	0.00	-5490.90	0.00	0.00	5490.90	-0.00	0.000%
2	-566.56	-6589.08	-8762.98	566.56	6589.08	8762.98	0.000%
3	-566.56	-4941.81	-8762.98	566.56	4941.81	8762.98	0.000%
4	6051.61	-6589.08	-5908.78	-6051.61	6589.08	5908.78	0.000%
5	6051.61	-4941.81	-5908.78	-6051.61	4941.81	5908.78	0.000%
6	8715.89	-6589.08	686.13	-8715.89	6589.08	-686.13	0.000%
7	8715.89	-4941.81	686.13	-8715.89	4941.81	-686.13	0.000%
8	6446.08	-6589.08	6446.08	-6446.08	6589.08	-6446.08	0.000%
9	6446.08	-4941.81	6446.08	-6446.08	4941.81	-6446.08	0.000%
10	686.13	-6589.08	8715.89	-686.13	6589.08	-8715.89	0.000%
11	686.13	-4941.81	8715.89	-686.13	4941.81	-8715.89	0.000%
12	-5908.78	-6589.08	6051.61	5908.78	6589.08	-6051.61	0.000%
13	-5908.78	-4941.81	6051.61	5908.78	4941.81	-6051.61	0.000%
14	-8762.98	-6589.08	-566.56	8762.98	6589.08	566.56	0.000%
15	-8762.98	-4941.81	-566.56	8762.98	4941.81	566.56	0.000%
16	-6527.46	-6589.08	-6527.46	6527.46	6589.08	6527.46	0.000%
17	-6527.46	-4941.81	-6527.46	6527.46	4941.81	6527.46	0.000%
18	0.00	-24089.08	0.00	0.00	24089.08	-0.00	0.000%



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Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	
19	-64.11	-24089.08	-1648.06	64.11	24089.08	1648.06	0.000%
20	1193.79	-24089.08	-1177.70	-1193.79	24089.08	1177.70	0.000%
21	1644.04	-24089.08	80.43	-1644.04	24089.08	-80.43	0.000%
22	1240.61	-24089.08	1240.61	-1240.61	24089.08	-1240.61	0.000%
23	80.43	-24089.08	1644.04	-80.43	24089.08	-1644.04	0.000%
24	-1177.70	-24089.08	1193.79	1177.70	24089.08	-1193.79	0.000%
25	-1648.06	-24089.08	-64.11	1648.06	24089.08	64.11	0.000%
26	-1248.87	-24089.08	-1248.87	1248.87	24089.08	1248.87	0.000%
27	-127.48	-5490.90	-1971.67	127.48	5490.90	1971.67	0.000%
28	1361.61	-5490.90	-1329.48	-1361.61	5490.90	1329.48	0.000%
29	1961.08	-5490.90	154.38	-1961.08	5490.90	-154.38	0.000%
30	1450.37	-5490.90	1450.37	-1450.37	5490.90	-1450.37	0.000%
31	154.38	-5490.90	1961.08	-154.38	5490.90	-1961.08	0.000%
32	-1329.48	-5490.90	1361.61	1329.48	5490.90	-1361.61	0.000%
33	-1971.67	-5490.90	-127.48	1971.67	5490.90	127.48	0.000%
34	-1468.68	-5490.90	-1468.68	1468.68	5490.90	1468.68	0.000%

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	181.375 - 176	0.031	32	0.0046	0.0041
T2	176 - 171	0.023	32	0.0043	0.0031
T3	171 - 166	0.016	32	0.0036	0.0023
T4	166 - 161	0.010	34	0.0028	0.0015
T5	161 - 156	0.004	34	0.0014	0.0008

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
181.00	(2) Powerwave 7770 w/mount pipe	32	0.031	0.0046	0.0040	974942
180.00	PiROD 14' T-Frame	32	0.029	0.0046	0.0038	974942
163.00	P3F-52	34	0.007	0.0020	0.0011	251811
162.00	UHX6-59	34	0.005	0.0017	0.0009	163436

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
T1	181.375 - 176	Leg	P4x.237	1	-5478.46	127004.00	4.3	Pass
T2	176 - 171	Leg	P4x.237	27	-5728.83	127250.00	4.5	Pass
T3	171 - 166	Leg	P4x.237	47	-5797.40	127250.00	4.6	Pass
T4	166 - 161	Leg	P4x.237	59	-11188.10	127250.00	8.8	Pass
T5	161 - 156	Leg	P4x.237	85	-11258.30	127250.00	8.8	Pass
T1	181.375 - 176	Diagonal	P1.5x.145	26	-2163.07	12921.10	16.7	Pass



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Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail	
T2	176 - 171	Diagonal	P1.5x.145	42	-2976.02	13052.90	22.8	Pass	
T3	171 - 166	Diagonal	P1.5x.145	58	-2977.82	13052.90	22.8	Pass	
T4	166 - 161	Diagonal	P1.5x.145	70	-3442.60	13052.90	26.4	Pass	
T5	161 - 156	Diagonal	P1.5x.145	90	-4106.30	13052.90	31.5	Pass	
T1	181.375 - 176	Top Girt	L1 3/4x1 3/4x3/16	8	-1320.16	8725.51	15.1	Pass	
T3	171 - 166	Top Girt	2L1 3/4x1 3/4x3/16	37	-25.88	23123.10	0.4	Pass	
T4	166 - 161	Top Girt	2L1 3/4x1 3/4x3/16	66	-695.97	12307.30	5.7	Pass	
T5	161 - 156	Top Girt	2L1 3/4x1 3/4x3/16	72	-398.99	23123.10	1.7	Pass	
T1	181.375 - 176	Bottom Girt	L1 3/4x1 3/4x3/16	16	-173.61	3180.32	5.5	Pass	
T1	181.375 - 176	Inner Bracing	L1 3/4x1 3/4x3/16	13	157.22	20123.40	1.5	Pass	
T2	176 - 171	Inner Bracing	L1 3/4x1 3/4x3/16	44	0.16	20123.40	0.7	Pass	
T4	166 - 161	Inner Bracing	L1 3/4x1 3/4x3/16	64	-32.17	960.56	3.3	Pass	
							Summary		
							Leg (T5)	8.8	Pass
							Diagonal (T5)	31.5	Pass
							Top Girt (T1)	15.1	Pass
							Bottom Girt (T1)	5.5	Pass
							Inner Bracing (T4)	3.3	Pass
							RATING =	31.5	Pass