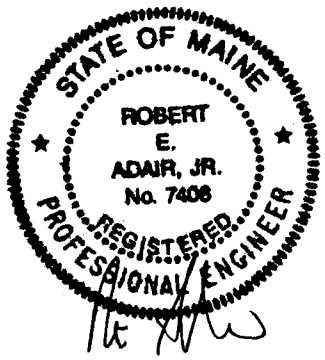
ALL-POINTS TECHNOLOGY CORPORATION, P.C.

STRUCTURAL ANALYSIS REPORT
230' ROHN SELF-SUPPORTING TOWER
WASHINGTON AVENUE
PORTLAND, MAINE

Prepared for
U.S.Cellular

USCC Site #853408

August 9, 2004



APT Project #ME101840

☐ 3 SADDLEBROOK DRIVE • KILLINGWORTH, CONNECTICUT 06419 • PHONE: 860-663-1697 • FAX: 860-663-0935
☒ 150 OLD WESTSIDE ROAD • NORTH CONWAY, NEW HAMPSHIRE 03860 • PHONE/FAX: 603-356-5214

STRUCTURAL ANALYSIS REPORT
230' ROHN SELF-SUPPORTING TOWER
PORTLAND, MAINE
prepared for
U.S. Cellular

EXECUTIVE SUMMARY:

All-Points Technology Corporation, P.C. (APT) performed a condition assessment and structural analysis of this 230-foot ROHN Model SSVMW self-supporting tower. The analysis was performed with the addition of six Antel BSA185065 panel antennas on three 12' sector mounts at 150'.

Waveguide cables are to be six 1-5/8" cables. Waveguide cables must be installed in a 3-wide by 2-deep stacked arrangement. APT recommends that unused waveguide cables be removed from the tower to minimize unnecessary wind load. A small section of ladder used for changing light bulbs on the top-mounted beacon should be more securely fixed to the tower.

Our analysis indicates the tower and foundations are capable of supporting the proposed antennas.

INTRODUCTION:

A condition assessment and structural analysis was performed on the above-mentioned communications tower by APT for U.S. Cellular. The tower is located at the WGME offices on Washington Avenue in Portland, Maine.

Robert E. Adair, P.E. visited the tower site on August 4, 2004 to record information regarding physical and dimensional properties of the structure and its appurtenances. Mr. Adair climbed the structure in its entirety to compile data necessary to perform the structural analysis. The analysis also relied on information provided by WGME, which included ROHN tower and foundation drawings.

The structure is a 230-foot ROHN Model SSVMW three-legged, galvanized steel, self-supporting tower. The tower was apparently erected in 1977.

The analysis was performed in accordance with EIA/TIA-222-F using the following antenna inventory (proposed antennas shown in **bold** text):

Antenna	Elev.	Mount	Coax.
Beacon	236'	Pipe extension	1" conduit
Rotatable grid	233'	Pipe extension	7/8", 3/8"
Rotatable grid	230'	Pipe	7/8", 3/8"
8' dish with radome	225'	Pipe on leg	EW-63
18" yagi	224'	Pipe	1-5/8"
8' grid dish	222'	Pipe on leg	7/8"
8' dish with radome	191'	Pipe on leg	EW-63
8' grid dish	177'	Leg	7/8"
15' omnidirectional	158'	3' sidearm	3/8"
(6) BSA 185065 panels	**150'**	**(3) 12' sector mounts**	**(6) 1-5/8"**
Empty 3' sidearm	142'	N.A.	N.A.
(2) obstruction lights	115'	Legs	1" conduit
6' dish with radome	101'	Pipe on leg	EW-63
(2) ground plane omnidirectionals	86'	Pipes on rest platform	(2) 1/4"
8-bay dipole	86'	3' sidearm	7/8"
4' yagi	86'	On above sidearm	1/2"
6' dish with radome	83'	Pipe on leg	EW-63
4' dish	82'	Pipe on leg	7/8"
3' yagi	30'	Pipe on bracing	1/2"

CONDITION ASSESSMENT:

- **General Observations:** The tower, a galvanized steel structure, appeared to be in very good condition. No signs of movement or overstress of the tower were observed. A small section of ladder, presumably used to access the top-mounted beacon, was observed to be attached to the tower with rope and hose clamps. APT recommends this ladder section be securely fixed to the tower.

- **Legs:** Leg member sizes were verified by ultrasonic thickness measurements. Legs are comprised of 50 ksi steel, according to ROHN specifications. Leg members appeared to be in good condition.

- **Bracing:** Bracing connections were visually inspected to the maximum extent practicable. All connections that were observed appeared to be sound, with no loose or missing bolts noted.

- **Antenna Connections:** Antenna mounting hardware was in fair condition, with rusting observed on some antenna mounts.

- **Splice Connections:** Observed splice bolts and connections were in good condition. No loose or missing bolts or nuts were observed.

STRUCTURAL ANALYSIS:

Methodology:

The structural analysis was done in accordance with EIA/TIA-222-F, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures (EIA); and the American Institute of Steel Construction (AISC), Manual of Steel Construction, Allowable Stress Design, Ninth Edition.

The analysis was conducted using a wind speed of 80 miles per hour and one-half inch of radial ice over the entire structure and all appurtenances. The EIA/TIA Standard requires a basic wind speed of 80 miles per hour for Cumberland County, Maine. The tower was analyzed by applying the wind and ice loading and calculating the resultant maximum bending moments, shear forces, and axial loads. The moments and forces were used to calculate stresses in leg and bracing members, which were compared to allowable stresses according to AISC.

Two loading conditions were evaluated in accordance with EIA/TIA-222-F to determine the tower's capacity. The more demanding of the two cases is used to calculate the tower capacity:

- Case 1 = Wind Load (without ice) + Tower Dead Load
- Case 2 = 0.75 Wind Load (with ice) + Ice Load + Tower Dead Load

The TIA/EIA standard permits a one-third increase in allowable stresses for towers less than 700-feet tall. Allowable stresses of tower members were increased by one-third when computing the load capacity values shown below.

Analysis Results:

Analysis of the tower was conducted in accordance with the criteria outlined herein with antenna changes as previously described.

The following table summarizes the results of the analysis based on stresses of individual leg and bracing members:

Elevation	Legs	Bracing
220'-230'	5%	29%
200'-220'	19%	40%
180'-200'	39%	87%
160'-180'	54%	69%
140'-160'	59%	78%
120'-140'	58%	99%
100'-120'	64%	61%
80'-100'	56%	52%
60'-80'	67%	63%
40'-60'	47%	37%
20'-40'	53%	37%
0'-20'	59%	38%

Base Foundations:

Evaluation of the existing base foundations, reinforced concrete piers with drilled rock anchors, was performed from ROHN drawings provided by WGME. Our evaluation indicates the existing foundations are capable of supporting the proposed loads.

Base reactions imposed with the additional antennas were calculated as follows:

Uplift:	136.7 kips
Compression:	174.5 kips
Total Shear:	37.3 kips
Overturning Moment:	4585 ft-kips

CONCLUSIONS AND RECOMMENDATIONS:

Our structural analysis indicates that WGME's 230-foot ROHN self-supporting tower located on Washington Avenue in Portland, Maine is capable of supporting the proposed antennas. Waveguide cables must be installed in a 3-wide by 2-deep stacked arrangement.

APT recommends that all unused waveguide cables be removed from the tower to minimize unnecessary wind loads. APT recommends the small ladder section at the top of the tower, apparently used to access the tower's beacon, be securely fastened to the tower.

LIMITATIONS:

This report is based on the following:

1. Tower is properly installed and maintained.
2. All members are in new condition.
3. All required members are in place.
4. All bolts are in place and are properly tightened.
5. Tower is in plumb condition.
6. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.

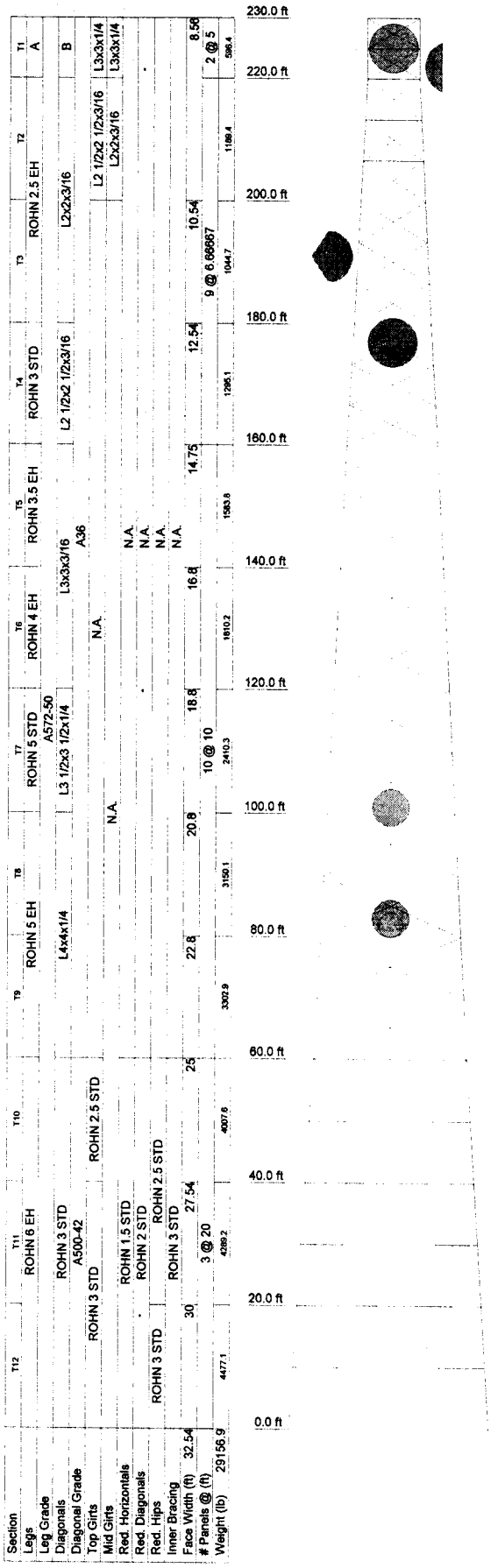
All-Points Technology Corporation, P.C. (APT) is not responsible for modifications completed prior to or hereafter which APT is not or was not directly involved. Modifications include but are not limited to:

1. Replacing or strengthening bracing members.
2. Reinforcing vertical members in any manner.
3. Adding or relocating torque arms or guys.
4. Installing antenna mounting gates or side arms.

APT hereby states that this document represents the entire report and that it assumes no liability for any factual changes that may occur after the date of this report. All representations, recommendations, and conclusions are based upon the information contained and set forth herein. If you are aware of any information which is contrary to that which is contained herein, or you are aware of any defects arising from the original design, material, fabrication and erection deficiencies, you should disregard this report and immediately contact APT. APT disclaims all liability for any representation, recommendation, or conclusion not expressly stated herein.

Appendix A

Tower Schematic



APPURTENANCES

TYPE	ELEVATION	TYPE	ELEVATION
Flash Beacon Lighting	230	12' T-frame APT	150
Rotatable grid	230	12' T-frame APT	150
Rotatable grid	230	12' T-frame APT	150
8' dish with radome	225	Obstruction lights	115
18" yagi	224	6' dish with radome	101
8' grid dish	222	(2) omnis on rest platform	86
8' dish with radome	191	8-bay dipole	86
8' grid dish	177	4' yagi	86
15' omni	158	6' dish with radome	83
(2) BSA-185065/12	150	4' dish	82
(2) BSA-185065/12	150	3' yagi	30
(2) BSA-185065/12	150		

SYMBOL LIST

MARK	SIZE	MARK	SIZE
A	ROHN 2.5 STD	B	L1 3/4x1 3/4x1/8

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A500-42	42 ksi	58 ksi
A36	36 ksi	58 ksi			

TOWER DESIGN NOTES

1. Tower is located in Cumberland County, Maine.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 103%

MAX PIER FORCES:
DOWN: 174510 lb
UPLIFT: -136685 lb
SHEAR: 22593 lb

AXIAL
50193 lb

SHEAR
35707 lb

MOMENT
4447800 lb-ft

TORQUE 6145 lb-ft
69 mph WIND - 0.5000 in ICE

AXIAL
34270 lb

MOMENT
4585539 lb-ft

SHEAR
37324 lb

TORQUE 9063 lb-ft
REACTIONS - 80 mph WIND

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Job: *230' ROHN SSVMW*			
Project: *ME101860 Portland WGME*			
Client: US Cellular; Site #	Drawn by: REA	App'd:	
Code: TIA/EIA-222-F	Date: 08/09/04	Scale: NTS	
Path: C:\My Documents\Jobs\ME101840 Portland\ME101860 Portland.eri		Dwg No. E-1	

Appendix B

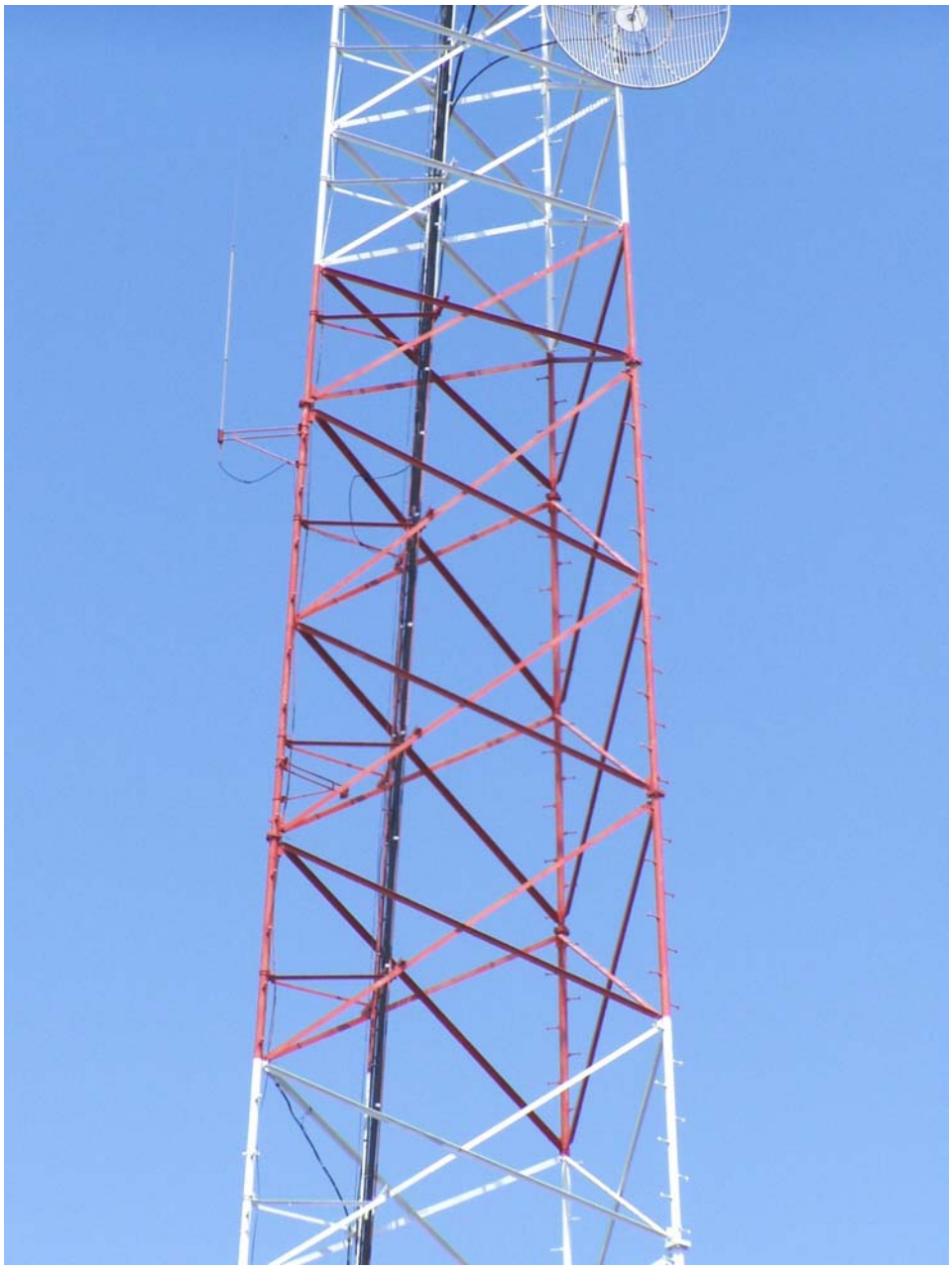
Photographs

U.S. CELLULAR
230' SELF-SUPPORTING TOWER
WGME 13
PORTLAND, MAINE

Photo showing overview of 230' ROHN SSVMW self-supporting tower.

Photos taken by All-Points Technology Corporation on August 4, 2004

U.S. CELLULAR
230' SELF-SUPPORTING TOWER
WGME 13
PORTLAND, MAINE



Telephoto view showing existing antennas from 120' to 180' on the tower.

Photos taken by All-Points Technology Corporation on August 4, 2004

Appendix C

Calculations

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Tower Input Data

The main tower is a 3x free standing tower with an overall height of 230.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 8.56 ft at the top and 32.54 ft at the base.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

- Tower is located in Cumberland County, Maine.
- Basic wind speed of 80 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Deflections calculated using a wind speed of 50 mph.
- Pressures are calculated at each section.
- Stress ratio used in tower member design is 1.333.

Tower Section Geometry

Tower Section	*Tower Elevation*	*Assembly Database*	*Description*	*Section Width*	*Number of Sections*	*Section Length*
	ft			*ft*		*ft*
T1	230.00-220.00			8.56	1	10.00
T2	220.00-200.00			8.56	1	20.00
T3	200.00-180.00			10.54	1	20.00
T4	180.00-160.00			12.54	1	20.00
T5	160.00-140.00			14.75	1	20.00
T6	140.00-120.00			16.80	1	20.00
T7	120.00-100.00			18.80	1	20.00
T8	100.00-80.00			20.80	1	20.00
T9	80.00-60.00			22.80	1	20.00
T10	60.00-40.00			25.00	1	20.00
T11	40.00-20.00			27.54	1	20.00
T12	20.00-0.00			30.00	1	20.00

Tower Section	*Tower Elevation*	*Diagonal Spacing*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset*	*Bottom Girt Offset*
	ft	*ft*				*in*	*in*
T1	230.00-220.00	5.00	X Brace	No	No	0.0000	0.0000
T2	220.00-200.00	6.67	X Brace	No	No	0.0000	0.0000
T3	200.00-180.00	6.67	X Brace	No	No	0.0000	0.0000
T4	180.00-160.00	6.67	X Brace	No	No	0.0000	0.0000
T5	160.00-140.00	10.00	X Brace	No	No	0.0000	0.0000
T6	140.00-120.00	10.00	X Brace	No	No	0.0000	0.0000
T7	120.00-100.00	10.00	X Brace	No	No	0.0000	0.0000
T8	100.00-80.00	10.00	X Brace	No	No	0.0000	0.0000
T9	80.00-60.00	10.00	X Brace	No	No	0.0000	0.0000
T10	60.00-40.00	20.00	K1 Down	No	Yes	0.0000	0.0000
T11	40.00-20.00	20.00	K1 Down	No	Yes	0.0000	0.0000
T12	20.00-0.00	20.00	K1 Down	No	Yes	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 230.00-220.00	Pipe	ROHN 2.5 STD	A572-50 (50 ksi)	Equal Angle	L1 3/4x1 3/4x1/8	A36 (36 ksi)
T2 220.00-200.00	Pipe	ROHN 2.5 EH	A572-50 (50 ksi)	Equal Angle	L2x2x3/16	A36 (36 ksi)
T3 200.00-180.00	Pipe	ROHN 2.5 EH	A572-50 (50 ksi)	Equal Angle	L2x2x3/16	A36 (36 ksi)
T4 180.00-160.00	Pipe	ROHN 3 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T5 160.00-140.00	Pipe	ROHN 3.5 EH	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)
T6 140.00-120.00	Pipe	ROHN 4 EH	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)
T7 120.00-100.00	Pipe	ROHN 5 STD	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A36 (36 ksi)
T8 100.00-80.00	Pipe	ROHN 5 EH	A572-50 (50 ksi)	Equal Angle	L4x4x1/4	A36 (36 ksi)
T9 80.00-60.00	Pipe	ROHN 5 EH	A572-50 (50 ksi)	Equal Angle	L4x4x1/4	A36 (36 ksi)
T10 60.00-40.00	Pipe	ROHN 6 EH	A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)
T11 40.00-20.00	Pipe	ROHN 6 EH	A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)
T12 20.00-0.00	Pipe	ROHN 6 EH	A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 230.00-220.00	Equal Angle	L3x3x1/4	A36 (36 ksi)			
T2 220.00-200.00	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)			
T10 60.00-40.00	Pipe	ROHN 2.5 STD	A500-42 (42 ksi)			
T11 40.00-20.00	Pipe	ROHN 3 STD	A500-42 (42 ksi)			
T12 20.00-0.00	Pipe	ROHN 3 STD	A500-42 (42 ksi)			

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 230.00-220.00	1	Equal Angle	L3x3x1/4	A36 (36 ksi)			A572-50 (50 ksi)
T2 220.00-200.00	2	Equal Angle	L2x2x3/16	A36 (36 ksi)			A572-50 (50 ksi)
T10 60.00-40.00	None			A36 (36 ksi)	Pipe	ROHN 1.5 STD	A500-42 (42 ksi)
T11 40.00-20.00	None			A36 (36 ksi)	Pipe	ROHN 1.5 STD	A500-42 (42 ksi)
T12 20.00-0.00	None			A36 (36 ksi)	Pipe	ROHN 1.5 STD	A500-42 (42 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Secondary Horizontal Type	Secondary Horizontal Size	Secondary Horizontal Grade	Inner Bracing Type	Inner Bracing Size	Inner Bracing Grade
T10 60.00-40.00			A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)
T11 40.00-20.00			A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)
T12 20.00-0.00			A572-50 (50 ksi)	Pipe	ROHN 3 STD	A500-42 (42 ksi)

Tower Elevation ft	Redundant Bracing Grade		Redundant Type	Redundant Size	K Factor
T10 60.00-40.00	A36 (36 ksi)	Horizontal (1)	Pipe	ROHN 1.5 STD	1
		Diagonal (1)	Pipe	ROHN 2 STD	1
		Hip (1)	Pipe	ROHN 2.5 STD	1
T11 40.00-20.00	A36 (36 ksi)	Horizontal (1)	Pipe	ROHN 1.5 STD	1
		Diagonal (1)	Pipe	ROHN 2 STD	1
		Hip (1)	Pipe	ROHN 2.5 STD	1
T12 20.00-0.00	A36 (36 ksi)	Horizontal (1)	Pipe	ROHN 1.5 STD	1
		Diagonal (1)	Pipe	ROHN 2 STD	1
		Hip (1)	Pipe	ROHN 3 STD	1

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number	Number Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
7/8	A	Yes	Ar (CfAe)	230.00 - 8.00	2	2	0.0000	1.1100		0.54
EW63	B	Yes	Af (CfAe)	230.00 - 8.00	3	3	0.0000	1.5742	5.0668	0.51
1/2	A	Yes	Ar (CfAe)	86.00 - 8.00	2	2	0.0000	0.5800		0.25
3/8	B	Yes	Ar (CfAe)	225.00 - 8.00	3	3	0.0000	0.4400		0.08
1 5/8	C	Yes	Ar (CfAe)	150.00 - 6.00	6	3	0.0000	1.9800		1.04

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
Flash Beacon Lighting	B	From Leg	0.00 0.00 6.00	0.0000	230.00	No Ice 1/2" Ice	2.70 3.10	2.70 3.10	50.00 70.00
Rotatable grid	A	From Leg	0.00 0.00 3.00	0.0000	230.00	No Ice 1/2" Ice	0.60 1.20	0.20 0.40	40.00 60.00
Rotatable grid	A	From Leg	0.00 0.00	0.0000	230.00	No Ice 1/2" Ice	0.60 1.20	0.20 0.40	40.00 60.00

Description	Face or Leg	Offset Type	Offsets: Horz Lateral / Vert (ft / ft / ft)	Azimuth Adjustment (°)	Placement (ft)		C_AA_A Front (ft^2)	C_AA_A Side (ft^2)	Weight (lb)
18" yagi	A	None	0.00	0.0000	224.00	No Ice	0.19	0.19	15.00
						1/2" Ice	0.48	0.48	25.00
15' omni	C	From Leg	3.00 0.00 0.00	0.0000	158.00	No Ice 1/2" Ice	1.57 2.91	1.57 2.91	75.00 125.00
Obstruction lights	C	From Face	0.00 0.00 0.00	0.0000	115.00	No Ice 1/2" Ice	1.69 3.13	1.69 3.13	25.00 40.00
(2) omnis on rest platform	A	None		0.0000	86.00	No Ice	1.90	1.90	150.00
						1/2" Ice	3.38	3.38	225.00
8-bay dipole	A	From Leg	3.00 0.00 0.00	0.0000	86.00	No Ice 1/2" Ice	4.31 6.56	4.31 6.56	125.00 200.00
4' yagi	A	From Leg	3.00 0.00 0.00	0.0000	86.00	No Ice 1/2" Ice	0.50 1.50	0.50 1.50	25.00 40.00
3' yagi	A	None		0.0000	30.00	No Ice	1.39	1.39	35.00
						1/2" Ice	2.80	2.80	50.00
(2) BSA-185065/12	A	From Leg	2.50 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	4.78 5.23	1.97 2.65	10.60 32.68
(2) BSA-185065/12	B	From Leg	2.50 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	4.78 5.23	1.97 2.65	10.60 32.68
(2) BSA-185065/12	C	From Leg	2.50 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	4.78 5.23	1.97 2.65	10.60 32.68
12' T-frame APT	A	None		0.0000	150.00	No Ice	5.80	2.90	350.00
						1/2" Ice	8.17	4.08	450.00
12' T-frame APT	B	None		0.0000	150.00	No Ice	5.80	2.90	350.00
						1/2" Ice	8.17	4.08	450.00
12' T-frame APT	C	None		0.0000	150.00	No Ice	5.80	2.90	350.00
						1/2" Ice	8.17	4.08	450.00

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 (ft^2)	Weight (lb)
8' dish with radome	A	Paraboloid w/Radome	From Leg	1.00 0.00 0.00	30.0000		225.00	8.00	No Ice 1/2" Ice	0.00 0.00	450.00 975.00
8' grid dish	B	Grid	From Leg	1.00 0.00 0.00	-40.0000		222.00	8.00	No Ice 1/2" Ice	0.00 0.00	150.00 300.00
8' dish with radome	C	Paraboloid w/Radome	From Leg	1.00 0.00 0.00	30.0000		191.00	8.00	No Ice 1/2" Ice	0.00 0.00	450.00 975.00
8' grid dish		Grid	None		0.0000		177.00	8.00	No Ice 1/2" Ice	0.00 0.00	150.00 300.00
6' dish with radome	A	Paraboloid w/Radome	From Leg	1.00 0.00	40.0000		101.00	6.00	No Ice 1/2" Ice	0.00 0.00	250.00 500.00

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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 (ft^2)	Weight (lb)
6' dish with radome	A	Paraboloid w/Radome	From Leg	0.00 1.00 0.00	10.0000		83.00	6.00	No Ice 1/2" Ice	0.00 0.00	250.00 500.00
4' dish	A	Paraboloid w/o Radome	From Leg	0.00 1.00 0.00	90.0000		82.00	4.00	No Ice 1/2" Ice	0.00 0.00	150.00 250.00

Maximum Tower Deflections - Design Wind

Section No.	Elevation (ft)	Horz. Deflection (in)	Gov. Load Comb.	Tilt (°)	Twist (°)
T1	230 - 220	12.507	2	0.4724	0.0355
T2	220 - 200	11.508	2	0.4704	0.0319
T3	200 - 180	9.530	2	0.4527	0.0149
T4	180 - 160	7.655	2	0.4138	0.0135
T5	160 - 140	5.972	2	0.3540	0.0097
T6	140 - 120	4.518	2	0.3073	0.0072
T7	120 - 100	3.247	2	0.2599	0.0061
T8	100 - 80	2.215	2	0.2029	0.0076
T9	80 - 60	1.393	2	0.1582	0.0075
T10	60 - 40	0.757	2	0.1094	0.0055
T11	40 - 20	0.346	2	0.0741	0.0032
T12	20 - 0	0.093	2	0.0376	0.0014

Bolt Design Data

Section No.	Elevation (ft)	Component Type	Bolt Grade	Bolt Size (in)	Number Of Bolts	Maximum Load per Bolt (lb)	Allowable Load (lb)	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	230	Leg	A325N	0.6250	4	14.64	13499.00	0.001 ✔	1.333	Bolt Tension
T2	220	Leg	A325N	0.6250	4	610.09	13499.00	0.045 ✔	1.333	Bolt Tension
T3	200	Leg	A325N	0.7500	4	2692.77	19438.60	0.139 ✔	1.333	Bolt Tension
T4	180	Leg	A325N	0.8750	4	5210.43	26457.90	0.197 ✔	1.333	Bolt Tension
T5	160	Leg	A325N	0.8750	4	8353.58	26458.10	0.316 ✔	1.333	Bolt Tension
T6	140	Leg	A325N	1.0000	4	11581.30	34557.50	0.335 ✔	1.333	Bolt Tension
T7	120	Leg	A325N	1.0000	4	14956.20	34557.50	0.433 ✔	1.333	Bolt Tension
T8	100	Leg	A325N	1.0000	4	18335.90	34557.50	0.531 ✔	1.333	Bolt Tension
T9	80	Leg	A325N	1.0000	6	14529.80	34557.50	0.420 ✔	1.333	Bolt Tension
T10	60	Leg	A325N	1.0000	6	16168.60	34557.40	0.468 ✔	1.333	Bolt Tension
T11	40	Leg	A325N	1.0000	6	18106.00	34557.20	0.524 ✔	1.333	Bolt Tension
T12	20	Leg	A325N	1.0000	6	20039.00	34557.20	0.580 ✔	1.333	Bolt Tension

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	230 - 220	ROHN 2.5 STD	10.00	5.00	63.3 K=1.00	22.141	1.7040	-2433.65	37729.30	0.065 ✔
T2	220 - 200	ROHN 2.5 EH	20.03	6.68	86.7 K=1.00	17.636	2.2535	-10054.00	39743.20	0.253 ✔
T3	200 - 180	ROHN 2.5 EH	20.03	6.68	86.7 K=1.00	17.635	2.2535	-20647.50	39741.80	0.520 ✔
T4	180 - 160	ROHN 3 STD	20.04	6.68	68.9 K=1.00	21.142	2.2285	-33869.10	47114.10	0.719 ✔
T5	160 - 140	ROHN 3.5 EH	20.03	10.02	92.0 K=1.00	16.505	3.6784	-47637.70	60710.30	0.785 ✔
T6	140 - 120	ROHN 4 EH	20.03	10.02	81.4 K=1.00	18.731	4.4074	-64018.70	82556.10	0.775 ✔
T7	120 - 100	ROHN 5 STD	20.03	10.02	64.0 K=1.00	22.021	4.2999	-81157.50	94688.30	0.857 ✔
T8	100 - 80	ROHN 5 EH	20.03	10.02	65.4 K=1.00	21.782	6.1120	-99767.90	133128.00	0.749 ✔
T9	80 - 60	ROHN 5 EH	20.04	10.02	65.4 K=1.00	21.777	6.1120	-118359.00	133103.00	0.889 ✔
T10	60 - 40	ROHN 6 EH	20.05	10.03	54.8 K=1.00	23.582	8.4049	-123117.00	198206.00	0.621 ✔
T11	40 - 20	ROHN 6 EH	20.05	10.03	54.8 K=1.00	23.584	8.4049	-139025.00	198218.00	0.701 ✔
T12	20 - 0	ROHN 6 EH	20.05	10.03	54.8 K=1.00	23.582	8.4049	-155140.00	198206.00	0.783 ✔

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	230 - 220	L1 3/4x1 3/4x1/8	9.91	4.82	166.7 K=1.00	5.374	0.4219	-887.81	2266.96	0.392 ✔
T2	220 - 200	L2x2x3/16	12.20	6.15	187.4 K=1.00	4.254	0.7150	-1618.64	3041.60	0.532 ✔
T3	200 - 180	L2x2x3/16	13.91	7.01	213.5 K=1.00	3.278	0.7150	-2711.58	2343.44	1.157 ✔
T4	180 - 160	KL/R > 200 (C) - 56 L2 1/2x2 1/2x3/16	15.85	7.97	193.2 K=1.00	4.001	0.9020	-3333.96	3609.23	0.924 ✔
T5	160 - 140	L3x3x3/16	19.11	9.66	194.5 K=1.00	3.946	1.0900	-4469.85	4300.60	1.039 ✔

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T6	140 - 120	L3x3x3/16	20.86	10.50	211.4 K=1.00	3.342	1.0900	-4784.65	3642.42	1.314 ✔
		KL/R > 200 (C) - 113								
T7	120 - 100	L3 1/2x3 1/2x1/4	22.63	11.34	196.0 K=1.00	3.887	1.6900	-5293.14	6568.69	0.806 ✔
T8	100 - 80	L4x4x1/4	24.44	12.24	184.8 K=1.00	4.374	1.9400	-5848.58	8486.33	0.689 ✔
T9	80 - 60	L4x4x1/4	26.42	13.26	200.1 K=1.00	3.730	1.9400	-6080.36	7236.41	0.840 ✔
		KL/R > 200 (C) - 161								
T10	60 - 40	ROHN 3 STD	24.29	12.15	125.3 K=1.00	9.516	2.2285	-9710.16	21207.20	0.458 ✔
T11	40 - 20	ROHN 3 STD	25.01	12.51	129.0 K=1.00	8.979	2.2285	-9860.89	20008.60	0.493 ✔
T12	20 - 0	ROHN 3 STD	25.79	12.90	133.0 K=1.00	8.442	2.2285	-9462.95	18813.10	0.503 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	$SF*P_{allow}$ lb	% Capacity	Pass Fail
T1	230 - 220	Leg	ROHN 2.5 STD	3	-2433.65	50293.16	4.8	Pass
		Diagonal	L1 3/4x1 3/4x1/8	13	-887.81	3021.86	29.4	Pass
		Top Girt	L3x3x1/4	4	-42.59	10077.08	0.4	Pass
		Mid Girt	L3x3x1/4	7	-289.20	10077.08	2.9	Pass
T2	220 - 200	Leg	ROHN 2.5 EH	24	-10054.00	52977.68	19.0	Pass
		Diagonal	L2x2x3/16	34	-1618.64	4054.45	39.9	Pass
		Top Girt	L2 1/2x2 1/2x3/16	26	-60.37	4413.12	1.4	Pass
		Mid Girt	L2x2x3/16	37	-112.07	1902.50	5.9	Pass
T3	200 - 180	Leg	ROHN 2.5 EH	54	-20647.50	52975.82	39.0	Pass
		Diagonal	L2x2x3/16	56	-2711.58	3123.81	86.8	Pass
T4	180 - 160	Leg	ROHN 3 STD	75	-33869.10	62803.09	53.9	Pass
		Diagonal	L2 1/2x2 1/2x3/16	77	-3333.96	4811.10	69.3	Pass
T5	160 - 140	Leg	ROHN 3.5 EH	96	-47637.70	80926.83	58.9	Pass
		Diagonal	L3x3x3/16	98	-4469.85	5732.70	78.0	Pass
T6	140 - 120	Leg	ROHN 4 EH	111	-64018.70	110047.28	58.2	Pass
		Diagonal	L3x3x3/16	113	-4784.65	4855.35	98.5	Pass
T7	120 - 100	Leg	ROHN 5 STD	126	-81157.50	126219.49	64.3	Pass
		Diagonal	L3 1/2x3 1/2x1/4	128	-5293.14	8756.06	60.5	Pass
T8	100 - 80	Leg	ROHN 5 EH	141	-99767.90	177459.62	56.2	Pass
		Diagonal	L4x4x1/4	146	-5848.58	11312.28	51.7	Pass
T9	80 - 60	Leg	ROHN 5 EH	156	-118359.00	177426.29	66.7	Pass
		Diagonal	L4x4x1/4	161	-6080.36	9646.13	63.0	Pass
T10	60 - 40	Leg	ROHN 6 EH	171	-123117.00	264208.59	46.6	Pass
		Diagonal	ROHN 3 STD	188	-9710.16	28269.20	34.3	Pass
		Top Girt	ROHN 2.5 STD	174	-5170.80	14048.22	36.8	Pass
		Redund Horz 1 Bracing	ROHN 1.5 STD	189	-1851.19	11688.57	15.8	Pass
		Redund Diag 1 Bracing	ROHN 2 STD	186	-1699.31	7603.32	22.3	Pass
		Redund Hip 1 Bracing	ROHN 2.5 STD	194	-14.73	35090.56	0.2	Pass
		Inner Bracing	ROHN 3 STD	197	-95.93	26692.92	0.4	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	SF*P_{allow} lb	% Capacity	Pass Fail
T11	40 - 20	Leg	ROHN 6 EH	201	-139025.00	264224.58	52.6	Pass
		Diagonal	ROHN 3 STD	218	-9860.89	26671.46	37.0	Pass
		Top Girt	ROHN 3 STD	204	-5533.41	22905.34	24.2	Pass
		Redund Horz 1 Bracing	ROHN 1.5 STD	215	-2096.14	9807.68	21.4	Pass
		Redund Diag 1 Bracing	ROHN 2 STD	216	-1792.54	7220.83	24.8	Pass
		Redund Hip 1 Bracing	ROHN 2.5 STD	224	-14.53	33013.61	0.2	Pass
		Inner Bracing	ROHN 3 STD	227	-103.22	21996.23	0.5	Pass
T12	20 - 0	Leg	ROHN 6 EH	231	-155140.00	264208.59	58.7	Pass
		Diagonal	ROHN 3 STD	238	-9462.95	25077.86	37.7	Pass
		Top Girt	ROHN 3 STD	234	-5637.50	19238.39	29.3	Pass
		Redund Horz 1 Bracing	ROHN 1.5 STD	245	-2332.51	8208.84	28.4	Pass
		Redund Diag 1 Bracing	ROHN 2 STD	246	-1887.03	6783.14	27.8	Pass
		Redund Hip 1 Bracing	ROHN 3 STD	247	-9.55	34870.70	0.2	Pass
		Inner Bracing	ROHN 3 STD	257	-105.60	18536.83	0.6	Pass
						Summary		
						Leg (T9)	66.7	Pass
						Diagonal (T6)	98.5	Pass
						Top Girt (T10)	36.8	Pass
						Mid Girt (T2)	5.9	Pass
						Redund Horz 1 Bracing (T12)	28.4	Pass
						Redund Diag 1 Bracing (T12)	27.8	Pass
						Redund Hip 1 Bracing (T12)	0.2	Pass
						Inner Bracing (T12)	0.6	Pass
						Bolt Checks	43.5	Pass
						RATING =	**98.5**	**Pass**