



**STRUCTURAL ANALYSIS REPORT
160' SELF-SUPPORTING TOWER
MIDDLEBURY, VERMONT**

Prepared for
Airosmith Development

VELCO Site: Middlebury

August 29, 2018



APT Project #VT418140

**STRUCTURAL ANALYSIS REPORT
160' SELF-SUPPORTING TOWER
MIDDLEBURY, VERMONT
prepared for
Airosmith Development**

EXECUTIVE SUMMARY:

All-Points Technology Corporation, P.C. (APT) performed a structural analysis of this 160-foot self-supporting tower. The analysis was performed for VELCO's proposed installation of two high-performance microwave dishes and two Kathrein 769 006 dipoles at 120' as detailed below. The equipment is to be fed by one EW-90 line, one EW-63 line and two 7/8" lines.

APT's analysis indicates the tower and corresponding base foundation meet the requirements of the Vermont State Building Code with the proposed equipment.

INTRODUCTION:

A structural analysis was performed on the above-mentioned communications tower by APT for Airosmith Development. The tower is located at 328 Springside Road on Chipman Hill in Middlebury, Vermont.

APT visited the tower site on July 30, 2018 to record physical and dimensional properties of the structure, as well as obtain the existing inventory and assess the condition of the tower. The corresponding analysis also utilized information provided by others, which included Sabre tower and foundation drawings (Job #165452, dated June 22, 2017) and construction drawings by Infinigy (dated March 16, 2018). A site visit was not conducted for this particular analysis. The analysis relied solely on previous information, as well as a listing of proposed equipment changes for VELCO.

The structure is a Sabre Model S3TL, three-legged, galvanized steel self-supporting tower. The tower features pipe leg members with angle steel bracing arranged in an X-braced pattern from 0'-140'. The lattice structure is topped by a 20' steel pole, resulting in a total tower height of 160'.

The analysis was performed in accordance with TIA-222 using the following antenna inventory (proposed equipment shown in **bold** text, future equipment shown in *italic* text):

Carrier	Antenna	Elev.	Mount	Coax.
Middlebury	10' 2-bay dipole, 12' omnidirectional whip	159'	6' C12 horizontal	(2) 7/8"
Middlebury	Scala PR900 grid	136'	4' x 2-3/8" pipe on leg	7/8"
Verizon Wireless	(6) LPA-80080/6CF, (6) SBNHH-1D65B panels, (12) RRHs, (6) TMAs, (3) D-boxes	128'	(3) 13' sector mounts	(6) 1-5/8", (3) hybrid
VELCO	VHLP2-180 high-performance dish, VHLPX6-6W high-performance dish, (2) Kathrein 769 006 dipoles	120'	4' x 2-3/8" pipe on leg, 6' x 4-1/2" pipe on leg, 3' T-arm	EW-90, EW-63, (2) 7/8"
AT&T	(3) SBNHH-1D85A, (3) HPA-65R-BUU-H6, (3) QS66512-2, (3) 800-10965 panel antennas, (12) 860-10025 RCUs, (3) DTMABP7819VG12A Twin TMAs, (3) RRUS-11 RRHs, (9) RRUS-32 RRHs, (3) B14 4478 RRHs, (3) DC6-48-60-18-8F 'Squid' D-boxes	110'	(3) Sabre C10857001 sector mounts	(6) 1-5/8", (6) power, (2) fiber
Middlebury	10' 4-bay dipole	92'	6' sidearm	7/8"
Middlebury	(2) 20' 4-bay dipoles	83'	(2) 6' sidearms	(2) 7/8"
-	Vacant mount	63'	6' x 2-3/8" pipe on leg	N.A.
-	Vacant mount	43'	6' x 2-3/8" pipe on leg	N.A.

STRUCTURAL ANALYSIS:

Methodology:

The structural analysis was done in accordance with the Vermont State Building Code and TIA-222, Revision G (TIA), Structural Standard for Antenna Supporting Structures and Antennas.

The analysis was conducted using a 3-second gust wind speed of 90 miles per hour with no ice and 40-mph with 3/4" radial ice in accordance with the TIA-222-G standard for Addison County, Vermont. The following additional design criteria were used:

Structure Class:	II
Topographic Category:	3
Exposure Category:	B
Crest Height:	400'

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:

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116 Grandview Road
 Conway, NH 03818
 (603) 496-5853

3 Saddlebrook Drive
 Killingworth, CT 06419
 (860) 663-1697

Elevation	Legs	Bracing
Pole	25%	
120'-140'	19%	38%
100'-120'	24%	31%
80'-100'	34%	24%
60'-80'	27%	32%
40'-60'	35%	53%
20'-40'	34%	56%
0'-20'	40%	62%

Bracing, Splice and Anchor Bolts:

Connection bolts were evaluated under the proposed loading. All bolts were found to be adequately sized to support the proposed loads.

Base Foundation:

Evaluation of the base foundation was performed from original Sabre design drawings. The foundations were found to be adequately sized to support the proposed equipment.

Factored base reactions imposed with the equipment changes were calculated as follows:

Reactions	Calculated
Compression (kips)	278.9
Uplift (kips)	239.9
Shear (kips)	32.9
Overturning Moment (ft-kips)	4315

CONCLUSIONS AND RECOMMENDATIONS:

APT's structural analysis indicates that the 160-foot self-supporting tower and base foundation located at 328 Springside Road in Middlebury, Vermont meets the requirements of the Vermont State Building Code with VELCO's proposed equipment.

All-Points Technology Corporation

LIMITATIONS:

This report is based on the following:

1. Tower is properly installed and maintained.
2. All members are in an undeteriorated 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.

All-Points Technology Corporation

116 Grandview Road
Conway, NH 03818
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Appendix A

Tower Schematic

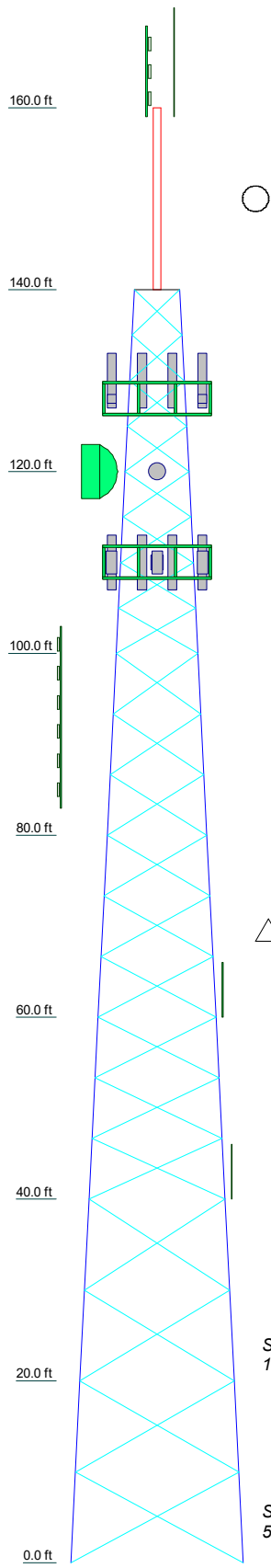
DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
10' 2-bay dipole	159	QS66512-2	110
12' x 2" omni whip	159	800-10765	110
6' C12 x 20.7 horiz.	159	800-10765	110
PR-900	136	800-10765	110
4x2 3/8" Pipe Mount	136	(4) 860-10025 RCU	110
(2) LPA-80080/6	128	(4) 860-10025 RCU	110
(2) LPA-80080/6	128	(4) 860-10025 RCU	110
(2) LPA-80080/6	128	DTMABP7819VG12A twin TMA	110
(2) SBNHH-1D65B	128	DTMABP7819VG12A twin TMA	110
(2) SBNHH-1D65B	128	DTMABP7819VG12A twin TMA	110
(2) SBNHH-1D65B	128	Ericsson RRUS-11	110
(2) ALU B13 RRH4x30-4R	128	Ericsson RRUS-11	110
(2) ALU B13 RRH4x30-4R	128	Ericsson RRUS-11	110
(2) ALU B13 RRH4x30-4R	128	(3) Ericsson RRUS-32	110
(2) ALU B25 RRH4x30-4R	128	(3) Ericsson RRUS-32	110
(2) ALU B25 RRH4x30-4R	128	(3) Ericsson RRUS-32	110
(2) ALU B25 RRH4x30-4R	128	Ericsson RRUS B14 4478	110
(2) Clear Gain DD1900/800 TMA	128	Ericsson RRUS B14 4478	110
(2) Clear Gain DD1900/800 TMA	128	Ericsson RRUS B14 4478	110
(2) Clear Gain DD1900/800 TMA	128	Raycap DC6-48-60-18-8F surge suppressor	110
RFS DB-B1-6C-12AB-0Z D-box	128	Raycap DC6-48-60-18-8F surge suppressor	110
RFS DB-B1-6C-12AB-0Z D-box	128	Raycap DC6-48-60-18-8F surge suppressor	110
RFS DB-B1-6C-12AB-0Z D-box	128	Raycap DC6-48-60-18-8F surge suppressor	110
13' sector mount	128	Sabre C10857001C sector mount	110
13' sector mount	128	Sabre C10857001C sector mount	110
13' sector mount	128	Sabre C10857001C sector mount	110
(2) 769-006 dipole	120	SBNHH-1D85A	110
3' T-arm	120	SBNHH-1D85A	110
4x2 3/8" Pipe Mount	120	10' 4-bay dipole	92
6'x4 1/2" Pipe Mount	120	6' sidearm	92
2' HP dish	120	20' 4-Bay Dipole	83
6' HP dish	120	6' sidearm	83
SBNHH-1D85A	110	20' 4-Bay Dipole	83
HPA-65R-BUU-H6	110	6' sidearm	83
HPA-65R-BUU-H6	110	6'x2 3/8" Pipe Mount	63
HPA-65R-BUU-H6	110	6'x2 3/8" Pipe Mount	43
QS66512-2	110		
QS66512-2	110		

MATERIAL STRENGTH

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

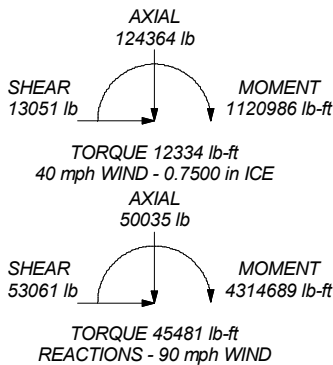
Section	T1	T2	T3	T4	T5	T6	T7
L1	ROHN 3 EH	ROHN 5 EH	P5 563x.500	ROHN 8 EH	ROHN 10 EH	ROHN 10 EH	
P10x.375							
A53-B-35							
N.A.	L2x2x3/16	L2 1/2x2 1/2x5/16	L3x3 1/2x3/8	A572-50	L3x3x3/8	L3 1/2x4x5/16	L3 1/2x4x3/8
N.A.				A36			
N.A.	L2x2x3/16			N.A.			
0.8333333							
N.A.		8 @ 5		9 @ 6.66667	4 @ 10		
771.7	1106.9	2375.5	3486.3	4771.7	5277.9	5814.9	



ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 278898 lb
SHEAR: 32951 lb

UPLIFT: -239866 lb
SHEAR: 29204 lb



All-Points Technology Corporation
116 Grandview Road
Conway, NH 03818
Phone: (603) 496-5853
FAX: (603) 447-2124

Job: **160' Sabre Self-Supporting Tower**
Project: **VT418140 Middlebury**
Client: **Airosmith; VELCO Site: Middlebury** Drawn by: **Rob Adair** App'd:
Code: **TIA-222-G** Date: **08/29/18** Scale: **NTS**
Path: **Z:\Shared\NH Office\Jobs\VT418140 Middlebury\VT418140 Middlebury.dwg** Dwg No. **E-1**

Appendix B

Calculations

tnxTower All-Points Technology Corporation 116 Grandview Road Conway, NH 03818 Phone: (603) 496-5853 FAX: (603) 447-2124	Job	160' Sabre Self-Supporting Tower	Page	1 of 7
	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 160.00 ft above the ground line.

The face width of the tower is 5.00 ft at the top and 19.00 ft at the base.

An index plate is provided at the 3x free standing -tower connection.

There is a pole section.

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

The following design criteria apply:

Basic wind speed of 90 mph.

Structure Class II.

Exposure Category B.

Topographic Category 3.

Crest Height 400.00 ft.

Nominal ice thickness of 0.7500 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.

Pressures are calculated at each section.

Stress ratio used in pole design is 1.

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.

Feed Line/Linear Appurtenances

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
7/8	C	No	Ar (CaAa)	140.00 - 8.00	0.0000	0.3	2	2	0.5000	1.1100		0.54
7/8	C	No	Ar (CaAa)	136.00 - 8.00	0.0000	0.33	1	1	0.5000	1.1100		0.54
1 5/8	A	No	Ar (CaAa)	128.00 - 8.00	0.0000	-0.35	6	3	0.5000	1.9800		1.04
1-1/4" Hybrid fiber-power cable	A	No	Ar (CaAa)	128.00 - 8.00	0.0000	-0.35	3	3	0.5000	1.2500		0.66
7/8	C	No	Ar (CaAa)	92.00 - 8.00	0.0000	0.35	1	1	0.5000	1.1100		0.54
7/8	C	No	Ar (CaAa)	83.00 - 8.00	0.0000	0.39	2	2	0.5000	1.1100		0.54
7/8	C	No	Ar (CaAa)	43.00 - 8.00	0.0000	0.41	1	1	0.5000	1.1100		0.54
Feedline Ladder (Af)	A	No	Af (CaAa)	130.00 - 0.00	0.0000	-0.3	1	1	3.0000	3.0000		8.40
Feedline Ladder (Af)	C	No	Af (CaAa)	140.00 - 0.00	0.0000	0.35	1	1	3.0000	3.0000		8.40
Safety Line 3/8	C	No	Ar (CaAa)	140.00 - 0.00	4.0000	0.5	1	1	0.3750	0.3750		0.22
1 5/8	A	No	Ar (CaAa)	110.00 - 8.00	0.0000	0.35	6	6	0.5000	1.9800		1.04
1.34" fiber cable	A	No	Ar (CaAa)	110.00 - 8.00	0.0000	0.3	2	2	0.5000	1.3400		0.66
5/8 power	A	No	Ar (CaAa)	110.00 - 8.00	0.0000	0.3	6	6	0.5000	0.6450		0.40
Feedline Ladder (Af)	A	No	Ar (CaAa)	110.00 - 0.00	0.0000	0.35	1	1	3.0000	3.0000		8.40
EW90	C	No	Af (CaAa)	120.00 - 8.00	0.0000	-0.3	1	1	0.5000	0.9869		0.32
EW63	C	No	Af (CaAa)	120.00 - 8.00	0.0000	-0.3	1	1	0.5000	1.5742		0.51
7/8	C	No	Ar (CaAa)	120.00 - 8.00	0.0000	-0.33	2	2	1.1100	1.1100		0.54

tnxTower All-Points Technology Corporation 116 Grandview Road Conway, NH 03818 Phone: (603) 496-5853 FAX: (603) 447-2124	Job	160' Sabre Self-Supporting Tower	Page	2 of 7
	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement	C _A A _A Front	C _A A _A Side	Weight
			Horz Lateral	Vert					
			ft	ft	°	ft	ft ²	ft ²	lb
10' 2-bay dipole	B	From Leg	0.00	0.0000	159.00	No Ice	2.50	2.50	75.00
			3.00			1/2" Ice	3.53	3.53	93.64
			5.00			1" Ice	4.58	4.58	118.79
12' x 2" omni whip	B	From Leg	0.00	0.0000	159.00	No Ice	2.40	2.40	70.00
			-3.00			1/2" Ice	3.63	3.63	88.56
			6.00			1" Ice	4.87	4.87	114.80
6' C12 x 20.7 horiz.	B	None		0.0000	159.00	No Ice	7.20	0.32	124.20
						1/2" Ice	7.67	0.40	163.22
						1" Ice	8.15	0.49	208.07
PR-900	B	From Leg	0.50	0.0000	136.00	No Ice	6.35	6.35	38.00
			0.00			1/2" Ice	11.43	11.43	49.40
			0.00			1" Ice	16.51	16.51	60.80
4'x2 3/8" Pipe Mount	B	None		0.0000	136.00	No Ice	0.87	0.87	14.60
						1/2" Ice	1.11	1.11	21.91
						1" Ice	1.36	1.36	32.07
(2) LPA-80080/6	A	From Leg	4.00	0.0000	128.00	No Ice	4.32	8.63	25.00
			0.00			1/2" Ice	4.76	9.08	73.26
			2.00			1" Ice	5.21	9.55	127.51
(2) LPA-80080/6	B	From Leg	4.00	0.0000	128.00	No Ice	4.32	8.63	25.00
			0.00			1/2" Ice	4.76	9.08	73.26
			2.00			1" Ice	5.21	9.55	127.51
(2) LPA-80080/6	C	From Leg	4.00	0.0000	128.00	No Ice	4.32	8.63	25.00
			0.00			1/2" Ice	4.76	9.08	73.26
			2.00			1" Ice	5.21	9.55	127.51
(2) SBNHH-1D65B	A	From Leg	4.00	0.0000	128.00	No Ice	8.08	5.34	45.00
			0.00			1/2" Ice	8.53	5.79	95.05
			2.00			1" Ice	9.00	6.26	151.20
(2) SBNHH-1D65B	B	From Leg	4.00	0.0000	128.00	No Ice	8.08	5.34	45.00
			0.00			1/2" Ice	8.53	5.79	95.05
			2.00			1" Ice	9.00	6.26	151.20
(2) SBNHH-1D65B	C	From Leg	4.00	0.0000	128.00	No Ice	8.08	5.34	45.00
			0.00			1/2" Ice	8.53	5.79	95.05
			2.00			1" Ice	9.00	6.26	151.20
(2) ALU B13 RRH4x30-4R	A	From Leg	3.50	0.0000	128.00	No Ice	2.16	1.62	60.00
			0.00			1/2" Ice	2.35	1.79	79.61
			1.00			1" Ice	2.55	1.97	102.18
(2) ALU B13 RRH4x30-4R	B	From Leg	3.50	0.0000	128.00	No Ice	2.16	1.62	60.00
			0.00			1/2" Ice	2.35	1.79	79.61
			1.00			1" Ice	2.55	1.97	102.18
(2) ALU B13 RRH4x30-4R	C	From Leg	3.50	0.0000	128.00	No Ice	2.16	1.62	60.00
			0.00			1/2" Ice	2.35	1.79	79.61
			1.00			1" Ice	2.55	1.97	102.18
(2) ALU B25 RRH4x30-4R	A	From Leg	3.50	0.0000	128.00	No Ice	2.20	1.74	55.00
			0.00			1/2" Ice	2.39	1.92	75.47
			1.00			1" Ice	2.59	2.11	98.94
(2) ALU B25 RRH4x30-4R	B	From Leg	3.50	0.0000	128.00	No Ice	2.20	1.74	55.00
			0.00			1/2" Ice	2.39	1.92	75.47
			1.00			1" Ice	2.59	2.11	98.94
(2) ALU B25 RRH4x30-4R	C	From Leg	3.50	0.0000	128.00	No Ice	2.20	1.74	55.00
			0.00			1/2" Ice	2.39	1.92	75.47
			1.00			1" Ice	2.59	2.11	98.94
(2) Clear Gain DD1900/800 TMA	A	From Leg	3.50	0.0000	128.00	No Ice	1.10	0.29	15.00
			0.00			1/2" Ice	1.23	0.37	22.21
			0.00			1" Ice	1.37	0.46	31.28

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	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	Placement ft	C _{AA} Front ft ²	C _{AA} Side ft ²	Weight lb
(2) Clear Gain DD1900/800 TMA	B	From Leg	3.50 0.00 0.00	0.0000	128.00	No Ice 1.10 1/2" Ice 1.23 1" Ice 1.37	0.29 0.37 0.46	15.00 22.21 31.28
(2) Clear Gain DD1900/800 TMA	C	From Leg	3.50 0.00 0.00	0.0000	128.00	No Ice 1.10 1/2" Ice 1.23 1" Ice 1.37	0.29 0.37 0.46	15.00 22.21 31.28
RFS DB-B1-6C-12AB-0Z D-box	A	From Leg	1.00 0.00 0.00	0.0000	128.00	No Ice 2.52 1/2" Ice 2.71 1" Ice 2.92	1.64 1.81 1.98	27.00 49.89 75.90
RFS DB-B1-6C-12AB-0Z D-box	B	From Leg	1.00 0.00 0.00	0.0000	128.00	No Ice 2.52 1/2" Ice 2.71 1" Ice 2.92	1.64 1.81 1.98	27.00 49.89 75.90
RFS DB-B1-6C-12AB-0Z D-box	C	From Leg	1.00 0.00 0.00	0.0000	128.00	No Ice 2.52 1/2" Ice 2.71 1" Ice 2.92	1.64 1.81 1.98	27.00 49.89 75.90
13' sector mount	A	None		0.0000	128.00	No Ice 9.80 1/2" Ice 14.70 1" Ice 16.70	4.90 7.35 8.35	325.00 425.00 575.00
13' sector mount	B	None		0.0000	128.00	No Ice 9.80 1/2" Ice 14.70 1" Ice 16.70	4.90 7.35 8.35	325.00 425.00 575.00
13' sector mount	C	None		0.0000	128.00	No Ice 9.80 1/2" Ice 14.70 1" Ice 16.70	4.90 7.35 8.35	325.00 425.00 575.00
(2) 769-006 dipole	A	From Leg	3.00 0.00 0.00	0.0000	120.00	No Ice 2.28 1/2" Ice 3.15 1" Ice 3.60	2.28 3.15 3.60	45.00 65.52 91.02
3' T-arm	A	None		0.0000	120.00	No Ice 2.65 1/2" Ice 3.56 1" Ice 4.48	4.96 6.81 8.66	140.00 240.00 340.00
4x2 3/8" Pipe Mount	A	None		0.0000	120.00	No Ice 0.87 1/2" Ice 1.11 1" Ice 1.36	0.87 1.11 1.36	14.60 21.91 32.07
6x4 1/2" Pipe Mount	C	None		0.0000	120.00	No Ice 1.79 1/2" Ice 2.62 1" Ice 3.00	1.79 2.62 3.00	64.70 83.80 107.17
SBNHH-1D85A	A	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 5.03 1/2" Ice 5.36 1" Ice 5.69	3.29 3.59 3.90	35.00 69.50 108.53
SBNHH-1D85A	B	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 5.03 1/2" Ice 5.36 1" Ice 5.69	3.29 3.59 3.90	35.00 69.50 108.53
SBNHH-1D85A	C	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 5.03 1/2" Ice 5.36 1" Ice 5.69	3.29 3.59 3.90	35.00 69.50 108.53
HPA-65R-BUU-H6	A	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 9.66 1/2" Ice 10.13 1" Ice 10.61	6.45 6.91 7.38	55.00 117.99 187.38
HPA-65R-BUU-H6	B	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 9.66 1/2" Ice 10.13 1" Ice 10.61	6.45 6.91 7.38	55.00 117.99 187.38
HPA-65R-BUU-H6	C	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 9.66 1/2" Ice 10.13 1" Ice 10.61	6.45 6.91 7.38	55.00 117.99 187.38
QS66512-2	A	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 8.13 1/2" Ice 8.59 1" Ice 9.05	6.80 7.27 7.72	111.00 168.20 231.66
QS66512-2	B	From Leg	4.00 0.00 0.00	0.0000	110.00	No Ice 8.13 1/2" Ice 8.59 1" Ice 9.05	6.80 7.27 7.72	111.00 168.20 231.66

tnxTower All-Points Technology Corporation 116 Grandview Road Conway, NH 03818 Phone: (603) 496-5853 FAX: (603) 447-2124	Job	160' Sabre Self-Supporting Tower	Page	4 of 7
	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

<i>Description</i>	<i>Face or Leg</i>	<i>Offset Type</i>	<i>Offsets: Horz Lateral Vert</i>	<i>Azimuth Adjustment</i>	<i>Placement</i>	<i>C_{AA} Front</i>	<i>C_{AA} Side</i>	<i>Weight</i>	
			<i>ft</i>	<i>°</i>	<i>ft</i>	<i>ft²</i>	<i>ft²</i>	<i>lb</i>	
			0.00			1" Ice	9.05	7.72	231.66
QS66512-2	C	From Leg	4.00	0.0000	110.00	No Ice	8.13	6.80	111.00
			0.00			1/2" Ice	8.59	7.27	168.20
			0.00			1" Ice	9.05	7.72	231.66
800-10765	A	From Leg	4.00	0.0000	110.00	No Ice	8.50	4.99	52.00
			0.00			1/2" Ice	8.97	5.46	100.90
			0.00			1" Ice	9.45	5.93	156.05
800-10765	B	From Leg	4.00	0.0000	110.00	No Ice	8.50	4.99	52.00
			0.00			1/2" Ice	8.97	5.46	100.90
			0.00			1" Ice	9.45	5.93	156.05
800-10765	C	From Leg	4.00	0.0000	110.00	No Ice	8.50	4.99	52.00
			0.00			1/2" Ice	8.97	5.46	100.90
			0.00			1" Ice	9.45	5.93	156.05
(4) 860-10025 RCU	A	From Leg	4.00	0.0000	110.00	No Ice	0.12	0.10	3.00
			0.00			1/2" Ice	0.17	0.15	4.36
			0.00			1" Ice	0.23	0.20	6.59
(4) 860-10025 RCU	B	From Leg	4.00	0.0000	110.00	No Ice	0.12	0.10	3.00
			0.00			1/2" Ice	0.17	0.15	4.36
			0.00			1" Ice	0.23	0.20	6.59
(4) 860-10025 RCU	C	From Leg	4.00	0.0000	110.00	No Ice	0.12	0.10	3.00
			0.00			1/2" Ice	0.17	0.15	4.36
			0.00			1" Ice	0.23	0.20	6.59
DTMABP7819VG12A twin TMA	A	From Leg	3.50	0.0000	110.00	No Ice	1.36	0.51	19.18
			0.00			1/2" Ice	1.51	0.61	28.95
			0.00			1" Ice	1.66	0.72	40.85
DTMABP7819VG12A twin TMA	B	From Leg	3.50	0.0000	110.00	No Ice	1.36	0.51	19.18
			0.00			1/2" Ice	1.51	0.61	28.95
			0.00			1" Ice	1.66	0.72	40.85
DTMABP7819VG12A twin TMA	C	From Leg	3.50	0.0000	110.00	No Ice	1.36	0.51	19.18
			0.00			1/2" Ice	1.51	0.61	28.95
			0.00			1" Ice	1.66	0.72	40.85
Ericsson RRUS-11	A	From Leg	3.50	0.0000	110.00	No Ice	2.78	1.19	55.00
			0.00			1/2" Ice	2.99	1.33	75.80
			0.00			1" Ice	3.21	1.49	99.63
Ericsson RRUS-11	B	From Leg	3.50	0.0000	110.00	No Ice	2.78	1.19	55.00
			0.00			1/2" Ice	2.99	1.33	75.80
			0.00			1" Ice	3.21	1.49	99.63
Ericsson RRUS-11	C	From Leg	3.50	0.0000	110.00	No Ice	2.78	1.19	55.00
			0.00			1/2" Ice	2.99	1.33	75.80
			0.00			1" Ice	3.21	1.49	99.63
(3) Ericsson RRUS-32	A	From Leg	3.50	0.0000	110.00	No Ice	3.31	2.42	80.00
			0.00			1/2" Ice	3.56	2.64	107.93
			0.00			1" Ice	3.81	2.86	139.47
(3) Ericsson RRUS-32	B	From Leg	3.50	0.0000	110.00	No Ice	3.31	2.42	80.00
			0.00			1/2" Ice	3.56	2.64	107.93
			0.00			1" Ice	3.81	2.86	139.47
(3) Ericsson RRUS-32	C	From Leg	3.50	0.0000	110.00	No Ice	3.31	2.42	80.00
			0.00			1/2" Ice	3.56	2.64	107.93
			0.00			1" Ice	3.81	2.86	139.47
Ericsson RRUS B14 4478	A	From Leg	3.50	0.0000	110.00	No Ice	2.02	1.25	59.40
			0.00			1/2" Ice	2.20	1.40	77.01
			0.00			1" Ice	2.39	1.55	97.40
Ericsson RRUS B14 4478	B	From Leg	3.50	0.0000	110.00	No Ice	2.02	1.25	59.40
			0.00			1/2" Ice	2.20	1.40	77.01
			0.00			1" Ice	2.39	1.55	97.40
Ericsson RRUS B14 4478	C	From Leg	3.50	0.0000	110.00	No Ice	2.02	1.25	59.40
			0.00			1/2" Ice	2.20	1.40	77.01
			0.00			1" Ice	2.39	1.55	97.40
Raycap DC6-48-60-18-8F	A	From Leg	1.00	0.0000	110.00	No Ice	0.74	0.74	30.00

tnxTower All-Points Technology Corporation 116 Grandview Road Conway, NH 03818 Phone: (603) 496-5853 FAX: (603) 447-2124	Job	160' Sabre Self-Supporting Tower	Page	5 of 7
	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	Placement ft	C _{AA} Front ft ²	C _{AA} Side ft ²	Weight lb
surge suppressor			0.00			1/2" Ice 1.20	1.20	44.34
			0.00			1" Ice 1.37	1.37	60.93
Raycap DC6-48-60-18-8F surge suppressor	B	From Leg	1.00	0.0000	110.00	No Ice 0.74	0.74	30.00
			0.00			1/2" Ice 1.20	1.20	44.34
			0.00			1" Ice 1.37	1.37	60.93
Raycap DC6-48-60-18-8F surge suppressor	C	From Leg	1.00	0.0000	110.00	No Ice 0.74	0.74	30.00
			0.00			1/2" Ice 1.20	1.20	44.34
			0.00			1" Ice 1.37	1.37	60.93
Sabre C10857001C sector mount	A	None		0.0000	110.00	No Ice 9.12	4.97	600.00
						1/2" Ice 13.79	7.89	780.00
						1" Ice 18.46	10.81	960.00
Sabre C10857001C sector mount	B	None		0.0000	110.00	No Ice 9.12	4.97	600.00
						1/2" Ice 13.79	7.89	780.00
						1" Ice 18.46	10.81	960.00
Sabre C10857001C sector mount	C	None		0.0000	110.00	No Ice 9.12	4.97	600.00
						1/2" Ice 13.79	7.89	780.00
						1" Ice 18.46	10.81	960.00
10' 4-bay dipole	A	From Leg	6.00	0.0000	92.00	No Ice 2.50	2.50	75.00
			0.00			1/2" Ice 3.53	3.53	93.64
			5.00			1" Ice 4.58	4.58	118.79
6' sidearm	A	None		0.0000	92.00	No Ice 4.17	2.09	75.00
						1/2" Ice 6.17	3.09	125.00
						1" Ice 8.17	4.09	200.00
20' 4-Bay Dipole	A	From Leg	6.00	0.0000	83.00	No Ice 4.00	4.00	55.00
			0.00			1/2" Ice 6.00	6.00	100.00
			10.00			1" Ice 8.00	8.00	145.00
6' sidearm	A	None		0.0000	83.00	No Ice 4.17	2.09	75.00
						1/2" Ice 6.17	3.09	125.00
						1" Ice 8.17	4.09	200.00
20' 4-Bay Dipole	C	From Leg	6.00	0.0000	83.00	No Ice 4.00	4.00	55.00
			0.00			1/2" Ice 6.00	6.00	100.00
			10.00			1" Ice 8.00	8.00	145.00
6' sidearm	C	None		0.0000	83.00	No Ice 4.17	2.09	75.00
						1/2" Ice 6.17	3.09	125.00
						1" Ice 8.17	4.09	200.00
6'x2 3/8" Pipe Mount	B	From Leg	1.00	0.0000	63.00	No Ice 1.43	1.43	21.90
			0.00			1/2" Ice 1.92	1.92	32.73
			0.00			1" Ice 2.29	2.29	47.61
6'x2 3/8" Pipe Mount	B	From Leg	1.00	0.0000	43.00	No Ice 1.43	1.43	21.90
			0.00			1/2" Ice 1.92	1.92	32.73
			0.00			1" Ice 2.29	2.29	47.61

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
2' HP dish	A	Paraboloid w/Shroud (HP)	From Leg	1.00	0.0000		120.00	2.00	No Ice 3.14	50.00
				0.00					1/2" Ice 3.41	67.50
				0.00					1" Ice 3.68	85.00
6' HP dish	C	Paraboloid w/Shroud (HP)	From Leg	1.00	0.0000		120.00	6.00	No Ice 28.27	250.00
				0.00					1/2" Ice 29.07	400.00
				0.00					1" Ice 29.86	550.00

tnxTower All-Points Technology Corporation 116 Grandview Road Conway, NH 03818 Phone: (603) 496-5853 FAX: (603) 447-2124	Job	160' Sabre Self-Supporting Tower	Page	6 of 7
	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Solution Summary

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 140	9.160	18	0.8388	0.0694
T1	140 - 120	6.278	18	0.3782	0.0730
T2	120 - 100	4.713	18	0.3416	0.0723
T3	100 - 80	3.309	18	0.2899	0.0588
T4	80 - 60	2.175	18	0.2213	0.0488
T5	60 - 40	1.289	18	0.1680	0.0365
T6	40 - 20	0.621	18	0.1073	0.0225
T7	20 - 0	0.194	18	0.0553	0.0103

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
159.00	10' 2-bay dipole	18	8.999	0.8101	0.0696	9203
136.00	PR-900	18	5.878	0.3443	0.0737	3020
128.00	(2) LPA-80080/6	18	5.248	0.3306	0.0742	8015
120.00	2' HP dish	18	4.713	0.3416	0.0723	18303
110.00	SBNHH-1D85A	18	4.007	0.3270	0.0661	158346
92.00	10' 4-bay dipole	18	2.815	0.2599	0.0543	13641
83.00	20' 4-Bay Dipole	18	2.326	0.2302	0.0502	19754
63.00	6'x2 3/8" Pipe Mount	18	1.408	0.1763	0.0386	22272
43.00	6'x2 3/8" Pipe Mount	18	0.706	0.1162	0.0245	20723

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load per Bolt lb	Ratio Load Allowable	Allowable Ratio	Criteria	
T1	140	Leg	A325N	1.0000	6	2806.43	53014.40	0.053	✓	1	Bolt Tension
		Diagonal	A325N	0.6250	1	3700.91	7830.00	0.473	✓	1	Member Bearing
		Top Girt	A325N	0.6250	1	0.00	7830.00	0.000	✓	1	Member Bearing
T2	120	Leg	A325N	1.0000	6	8512.06	53014.40	0.161	✓	1	Bolt Tension
		Diagonal	A325N	0.7500	1	6856.37	15768.80	0.435	✓	1	Member Bearing
T3	100	Leg	A325N	1.2500	6	15002.90	82835.00	0.181	✓	1	Bolt Tension
		Diagonal	A325N	0.7500	1	8267.11	17892.40	0.462	✓	1	Bolt Shear
T4	80	Leg	A325N	1.2500	6	21452.30	82835.00	0.259	✓	1	Bolt Tension
		Diagonal	A325N	0.7500	1	9250.20	17892.40	0.517	✓	1	Bolt Shear
T5	60	Leg	A325N	1.5000	8	20673.00	119282.00	0.173	✓	1	Bolt Tension
		Diagonal	A325N	0.7500	1	9879.51	17892.40	0.552	✓	1	Bolt Shear
T6	40	Leg	A325N	1.5000	8	24691.20	119282.00	0.207	✓	1	Bolt Tension
		Diagonal	A325N	0.7500	1	11703.90	15768.80	0.742	✓	1	Member Bearing

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	Project	VT418140 Middlebury	Date	09:59:32 08/29/18
	Client	Airosmith; VELCO Site: Middlebury	Designed by	Rob Adair

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load per Bolt lb	Ratio Load Allowable	Allowable Ratio	Criteria
T7	20	Leg	F1554-105	1.5000	6	38534.70	124252.00	0.310	✓	1 Bolt Tension
		Diagonal	A325N	0.7500	1	12984.80	17892.40	0.726	✓	1 Bolt Shear

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail	
L1	160 - 140	Pole	P10x.375	1	-1249.08	277010.00	25.3	Pass	
T1	140 - 120	Leg	ROHN 3 EH	2	-20476.10	110613.00	18.5	Pass	
		Diagonal	L2x2x3/16	8	-3711.93	9890.33	37.5	Pass	
		Top Girt	L2x2x3/16	5	0.00	0.00	0.5	Pass	
T2	120 - 100	Leg	ROHN 5 EH	32	-60917.60	254378.00	23.9	Pass	
		Diagonal	L2 1/2x2 1/2x5/16	39	-6821.24	21983.50	31.0	Pass	
							43.5 (b)		
T3	100 - 80	Leg	P5.563x.500	59	-104040.00	309541.00	33.6	Pass	
		Diagonal	L3x3 1/2x3/8	66	-8267.11	35228.90	23.5	Pass	
							46.2 (b)		
T4	80 - 60	Leg	ROHN 8 EH	80	-147948.00	542674.00	27.3	Pass	
		Diagonal	L3x3 1/2x3/8	87	-9250.20	29265.20	31.6	Pass	
							51.7 (b)		
T5	60 - 40	Leg	ROHN 8 EH	101	-190481.00	542674.00	35.1	Pass	
		Diagonal	L3x3x3/8	108	-9872.28	18536.60	53.3	Pass	
							55.2 (b)		
T6	40 - 20	Leg	ROHN 10 EH	122	-228328.00	668659.00	34.1	Pass	
		Diagonal	L3 1/2x4x5/16	129	-11841.10	21213.80	55.8	Pass	
							74.2 (b)		
T7	20 - 0	Leg	ROHN 10 EH	137	-268496.00	668659.00	40.2	Pass	
		Diagonal	L3 1/2x4x3/8	144	-12984.80	20904.90	62.1	Pass	
							72.6 (b)		
							Summary		
							Pole (L1)	25.3	Pass
							Leg (T7)	40.2	Pass
							Diagonal (T6)	74.2	Pass
							Top Girt (T1)	0.5	Pass
							Bolt Checks	74.2	Pass
							RATING =	74.2	Pass

All-Points Technology Corp., P.C.

116 Grandview Road
Conway, NH 03818
(603) 496-5853

Client: **Airosmith Development**
Job: **Middlebury**
Calculated By: **R. Adair**

Site: **Middlebury**
Job No.: **VT418140**
Date: **29-Aug-18**

Program assumes:

Mat is square in plan view.
Water table is below bottom of mat.
Unit weight of concrete = 150 pcf
Unit weight of soil = 100 pcf
Monopole tower with center pier

Information to be provided:

Pier is round or square in plan dimension ("R" or "S")	Shape =	R
OTM = Overturning Moment to be resisted	OTM =	4315 ft-kips
H = Height from ground surface to top of mat (if buried)	H =	4.5 ft.
P _M = Projection of pier above mat	P _M =	5.0 ft.
y = Thickness of mat	y =	1.50 ft.
x = Width of mat	x =	33.00 ft.
d = Diameter of round pier	d =	5.5 ft.
S = Size of tension bars	S =	7

Mass of tower and appurtenances (below)

Results:

<u>Component</u>	<u>Mass</u>	<u>Moment Arm</u>	<u>Moment Resist.</u>
Pier	17.8 kips	16.5 ft.	294.0 ft-kips
Overburden	562.5 kips	16.5 ft.	9282.0 ft-kips
Mat	245.0 kips	16.5 ft.	4042.9 ft-kips

Overturning Moment Resistance : 13618.87 ft-kips
Factor of Safety = 3.16 SATISFACTORY
Concrete Quantity = 73.7 c.y.