

A BUSINESS OF FDH VELOCITEL

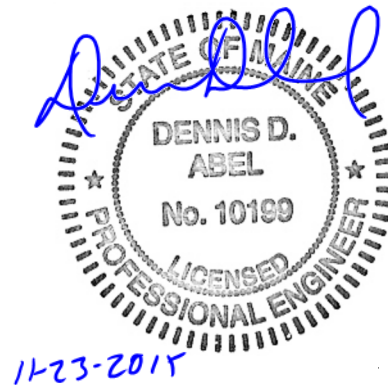
REPORT T063300

DATE: 11/20/2015

RIGOROUS STRUCTURAL ANALYSIS FOR A
230' HEIGHT ROHN SELF-SUPPORTING TOWER
PORTLAND, ME

PREPARED BY: PCC
CHECKED BY: BDM 11/23/2015

APPROVED: DDA 11/23/2015



Date	Pages	Remarks
------	-------	---------

Rev.	Date	Description
------	------	-------------

SECTION PAGE

A. AUTHORIZATION/PURPOSE 1

B. TOWER HISTORY 1

C. CONDITIONS INVESTIGATED 1

D. LOADS AND STRESSES 3

E. METHOD OF ANALYSIS 4

F. RESULTS 4

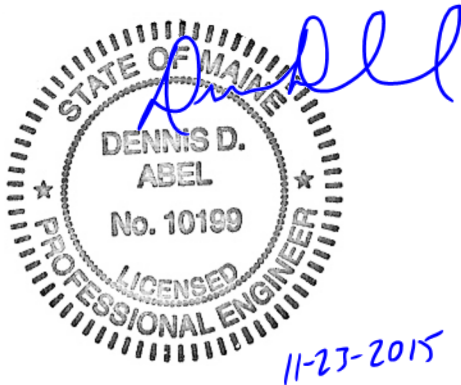
G. CONCLUSIONS AND RECOMMENDATIONS 6

H. PROVISIONS OF ANALYSIS 6

APPENDIX

GENERAL ARRANGEMENT E-1

LINEAR APPURTENANCES A-2



Rev.	Date	Description
------	------	-------------

A. AUTHORIZATION/PURPOSE

As authorized by Craig Clark of Sinclair Broadcast Group and Brain Ross of Structure Consulting Group, a structural analysis was performed to investigate the adequacy of a 230' height ROHN self-supporting tower in Portland, Maine to support specified equipment.

B. TOWER HISTORY

The tower was originally designed and furnished in 1977 by ROHN. The design standard and original design wind speed are unavailable.

The tower was analyzed by ROHN Products, Radian Communication Services in 2007, ROHN File number 08117EH, Radian Job Number 060-3713. The analysis report indicated that the following bracing members were replaced by higher capacity members.

- Replaced existing tower diagonal bracing members with new, large size members at the following bays:

Location	No. of bays
220' – 230'	2
180' – 200'	3
160' – 180'	3
120' – 140'	2

Stainless does not have any other record of modifications to the tower or its foundations.

C. CONDITIONS INVESTIGATED

The analysis was performed for the tower supporting specified equipment based upon the following sources:

- Stainless Proposal P15_N5037_001 dated 07/13/2015.
- An analysis report by ROHN Products of Radian Communication Services, Radian Job No 060-3713, dated 04/25/2007.
- Tower original elevation drawing, no date.
- Tower foundation erection drawing, drawing No. C-770254, dated 04/11/1977.
- Tower mapping report by Stainless, Job Number T063300, dated 10/09/2015, for the existing equipment on tower and tower cross section.
- Email from Dick Man of Nanepashemet Project Management, Inc. to Jon Marcusse of Stainless, dated 08/12/2015, with details of proposed equipment.
- T-Mobile Construction Design package, Site No: 4PB-1288-A, by Chappell Engineering Associates, LLC, dated 03/30/2015, for the proposed equipment.

Rev.	Date	Description
------	------	-------------

- Email from Dick Man of Nanepashemet Project Management, Inc. to Changfei Chen of Stainless, dated 11/20/2015, with details of proposed equipment.
1. One beacon on tower top.
 2. One abandoned rotating mount on tower top.
 3. One (1) ENG antenna at the 230' level, fed by one (1) 7/8" line and one (1) 3/4" control cable.
 4. One (1) ENG antenna at the 230' level, fed by one (1) 1-5/8" line and one (1) 3/4" control cable.
 5. One (1) 8' dish with radome at the 225' level, azimuth 330 degree, fed by one (1) EW63 cable.
 6. One (1) 8' grid dish at the 223' level, azimuth 20 degree at the 223' level, fed by one (1) 7/8" line.
 7. One (1) 8' dish with radome at the 190' level, azimuth 235 degree. Fed by one (1) EW63 cable.
 8. One (1) 8' grid dish at the 178' level, azimuth 210 degree, fed by one (1) 7/8" line.
 9. One (1) 12' whip antenna on a standoff mount at the 165' level, fed by one (1) 3/8" line.
 10. Six (6) Cellmax BDHH/6520/E0-8 panel antennas, three (3) Andrew LNX-6515DS-VTM panel antennas, nine (9) RRUS-11 units, and one (1) Radio Waves SP2-5.2 dish with 189.11 degree azimuth on three (3) sector frame mounts at the 157' level, fed by twelve (12) 1-5/8" lines and three (3) 7/8" hybrid cables and one (1) 0.405" OD cable.
(Proposed)
 11. Six (6) panel antennas on three sector frame mounts at the 150' level, fed by six (6) 1-5/8" lines.
 12. One (1) panel type antenna at the 125' level, fed by one (1) 3/8" diameter RG cable.
 13. One (1) 4' Yagi antenna at the 120' level, fed by one (1) 1/4" line.
 14. Two (2) Obstruction lights at the 115' level.
 15. One (1) 6' dish with radome at the 102', azimuth 332 degree, fed by one (1) EW63 cable. (This dish and line will be removed and will not included in the analysis)
 16. One (1) ENG receiver antenna at the 100' level, fed by one (1) 7/8" line and one (1) 3/8" control cable.
 17. One (1) 6' dish with radome at the 95' level, fed by one (1) EW63 cable.
 18. One (1) dipole antenna on standoff mount at the 90' level, fed by one (1) 7/8" line.
 19. One (1) low band VFH antenna at the 85' level, fed by one (1) 1/4" line. (Not in use and will not included in the analysis)
 20. One (1) 4' solid dish antenna at the 82' level, azimuth 140 degree, fed by one (1) 7/8" line.
 21. One (1) Yagi antenna at the 30' level, fed by one (1) 1/2" line.
 22. One (1) waveguide rack to 150' level.
 23. One (1) 1" conduit to tower top.

Rev.	Date	Description
------	------	-------------

24. One (1) inside climbing ladder with safety for the full height of the tower.

25. One (1) waveguide ladder to the 157' level (**Proposed**)

The locations of the existing transmission lines are based upon tower mapping report by Stainless Job No T063300, dated 10/09/2015. The locations of all transmission lines are shown on page A-2 of this Report. Deviating from this appurtenance arrangement may invalidate the results presented in this Report.

The azimuths of the tower legs were based upon a partial original design sheet showing the azimuth of Leg A with respect to true north. The tower leg azimuths are 57, 117 and 297 degrees for the A, B and C legs respectively.

Tower leg, diagonal and horizontal bracing member capacities are based on an analysis report by ROHN Products of Radian Communication Services, Radian Job No 060-3713, dated 04/25/2007.

All unused antennas and lines shall be removed prior to installation of the proposed equipment, and have not been included in the analysis.

D. LOADS AND STRESSES

The feasibility analysis was performed using the following design parameters in accordance with the 2009 IBC and ANSI/TIA 222-G-2005, Structural Standard for Antenna Supporting Structures and Antennas, effective 2005, including Addenda G-1 and G-2 dated 2007 and 2009 respectively:

- Structure Classification II
- 117 mph ultimate design wind speed with no ice
- 40 mph wind speed with 1" design ice thickness
- 60 mph service wind speed with no ice.
- Exposure Category C
- Topographic Category 1
- 0.32 earthquake spectral response acceleration at short periods (S_s)
- Earthquake Site Class D

The wind loading used is 117 mph ultimate design wind speed (wind load factor =1.0) with no ice as determined per ASCE 7-10, Minimum Design Loads for Buildings and Other Structures, and 40 mph with 1" design ice thickness as determined per ANSI/TIA 222-G. The ANSI/TIA 222-G code refers to ASCE 7-05, under which a nominal design wind speed of 98 mph (with a wind load factor =1.6) with no ice is prescribed for the tower. The ultimate design wind speed of 117 mph is equivalent to a nominal design wind speed of approximately 98 mph.

The wind speed with no ice as determined per ASCE 7-10 represents the latest state of the art research and findings in the field of wind loading for hurricane prone regions of the US. The TIA Committee has approved the revised references which use statistical analysis of wind

Rev.	Date	Description
------	------	-------------

climatic data, and form the basis of the wind speed methodology of ASCE 7-10. It is anticipated that the next revision of the TIA code will incorporate ASCE 7-10.

The ultimate design wind speed was converted to a nominal design wind speed for use with ANSI/TIA 222-G based upon the following formula:

$$\begin{aligned}
 V_{asd} &= V_{ult} * (0.6)^{1/2} \\
 &= 117 * (0.6)^{1/2} \\
 &= 90.7 \text{ mph, use 91 mph}
 \end{aligned}$$

Seismic effects need not be considered as the value of Ss is less than 1.0 per Section 2.7.3 of ANSI/TIA 222-G

Load and resistance factors used to evaluate the adequacy of the structure were also in accordance with ANSI/TIA 222-G.

E. METHOD OF ANALYSIS

The analysis was performed using tnxTower, a computerized program which idealizes the tower as a structure consisting of finite elements, and subjected to simultaneous transverse (wind) and axial (dead and ice) loads.

F. RESULTS

The results of the analysis show the following ratings:

LOCATION	SPAN	RATING-%
Leg compression	220' to 230'	11
	200' to 220'	29
	180' to 200'	56
	160' to 180'	73
	140' to 160'	84
	120' to 140'	85
	100' to 120'	93
	80' to 100'	83
	60' to 80'	99
	40' to 60'	69
	20' to 40'	78
0' to 20'	87	
Leg tension	220' to 230'	3
	200' to 220'	16
	180' to 200'	30
	160' to 180'	39

STAINLESS
A BUSINESS OF FDH VELOCITEL

Rev.	Date	Description
------	------	-------------

	140' to 160'	49
	120' to 140'	52
	100' to 120'	57
	80' to 100'	65
	60' to 80'	78
	40' to 60'	81
	20' to 40'	92
	0' to 20'	102
Diagonals	220' to 230'	44
	200' to 220'	38
	180' to 200'	60
	160' to 180'	74
	140' to 160'	104.1
	120' to 140'	87
	100' to 120'	95
	80' to 100'	84
	60' to 80'	89
	40' to 60'	33
	20' to 40'	35
	0' to 20'	35
Horizontals	220' to 230'	16
	40' to 60'	29
	20' to 40'	31
	0' to 20'	32
Foundations	Compression	100
	Uplifting	100

Ratings of up to 105% are considered acceptable due to tolerances in calculating the applied loads on the tower as well as member design capacities.

The tower twist and sway at the elevations of the various dishes under a service wind speed of 60 mph are as follows:

Dish	Elevation, ft.	Sway, degrees	Twist, degrees
8' dish/radome	225'	0.21	0.02
8' grid dish	223'	0.21	0.02
8' dish/radome	190'	0.19	0.02
8' grid dish	178'	0.18	0.02
SP2-5.2 dish	157'	0.15	0.02
6' dish/radome	95'	0.09	0.01
4' standard	82'	0.08	0.01

Rev.	Date	Description
------	------	-------------

G. CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding results, the following conclusions may be drawn:

1. The tower with equipment as specified in Section C is adequate to achieve an ultimate design wind speed of 117 mph with no ice, 40 mph with 1" design ice thickness and 60 mph service wind speed with no ice in accordance with IBC 2009 and ANSI/TIA 222-G and the analysis parameters of Section D.

H. PROVISIONS OF ANALYSIS

The analysis performed and the conclusions contained herein are based on the assumption that the tower has been properly installed and maintained, including, but not limited to the following:

1. Proper alignment and plumbness.
2. Correct bolt tightness.
3. No significant deterioration or damage to any component.

Furthermore, the information and conclusions contained in this Report were determined by application of the current "state-of-the-arts" engineering and analysis procedures and formulae, and Stainless assumes no obligations to revise any of the information or conclusions contained in this Report in the event that such engineering and analysis procedures and formulae are hereafter modified or revised. In addition, under no circumstances will Stainless have any obligation or responsibility whatsoever for or on account of consequential or incidental damages sustained by any person, firm or organization as a result of any information or conclusions contained in the Report, and the maximum liability of Stainless, if any, pursuant to this Report shall be limited to the total funds actually received by Stainless for preparation of this Report.

Customer has requested Stainless to prepare and submit to Customer an engineering analysis with respect to the Subject Tower and has further requested Stainless to make appropriate recommendations regarding suggested structural modifications and changes to the Subject Tower. In making such request of Stainless, Customer has informed Stainless that Customer will make a determination as to whether or not to implement any of the changes or modifications which may be suggested by Stainless and that Customer will have any such changes or modifications made by riggers, erectors and other subcontractors of Customer's choice.

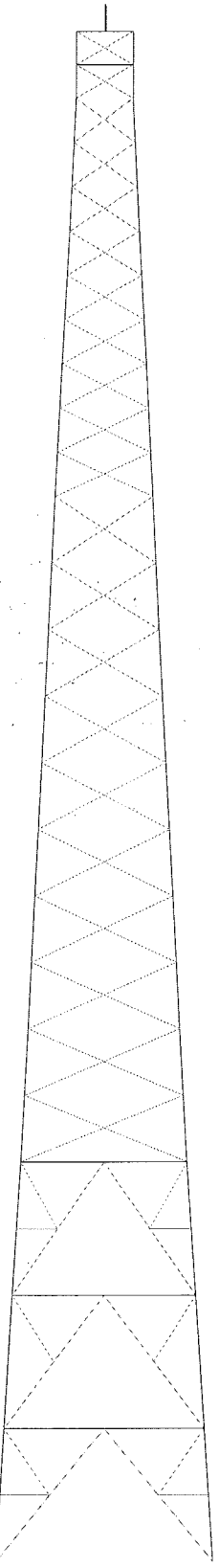
Customer hereby agrees and acknowledges that Stainless shall have no liability whatsoever to Customer or to others for any work or services performed by any persons other than Stainless in connection with the implementation of any structural changes or modifications recommended by Stainless including but not limited to any services rendered for Customer or

Rev.	Date	Description
------	------	-------------

for others by riggers, erectors or other subcontractors. Customer acknowledges and agrees that any riggers, erectors or subcontractors retained or employed by Customer shall be solely responsible to Customer and to others for the quality of work performed by them and that Stainless shall have no liability or responsibility whatsoever as a result of any negligence or breach of contract by any such rigger, erector or subcontractor.

Section	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
Legs	PIPE6.0E.H	PIPE6.0E.H	PIPE5.0E.H	PIPE5.0E.H	PIPE5.0STD	PIPE4.0E.H	PIPE3.5E.H	PIPE3.0STD	PIPE3.0E.H	PIPE2.5E.H	PIPE2.5E.H	A	A
Diagonal Grade	PIPE3.0STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	L4x4x1/4	L3 1/2x3 1/2x1/4	L3x3x1/4	L2x2x3/16	L3x3x3/16	L2x2x3/16	L2x2x3/16	B	B
Top Girts	PIPE3.0STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	PIPE2.5STD	B	B
Red. Horizontals	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD		
Red. Diagonals	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD		
Red. Hips	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD	PIPE1.5STD		
Inner Bracing	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16	L2x2x3/16		
Face Width (ft)	32.625	27.63	24.96	22.78	20.87	18.7	16.7	14.66	12.6	10.56	8.54		
# Panels @ (ft)	30.13	3 @ 20	10 @ 10	10 @ 10	10 @ 10	10 @ 10	10 @ 10	10 @ 10	10 @ 10	9 @ 6.66667	2 @ 5		
Weight (lb)	29538.9	496.9	3817.5	3734.9	3404.0	3256.1	2813.0	2200.3	1853.8	1572.4	1063.1	300.8	277.9

234.0 ft
230.0 ft
225.0 ft
220.0 ft
200.0 ft
180.0 ft
160.0 ft
140.0 ft
120.0 ft
100.0 ft
80.0 ft
60.0 ft
40.0 ft
20.0 ft
0.0 ft



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Beacon, misc on top	230	6 panel antenna on Sector Frames	150
ENG antenna	230	Panel type antenna	125
ENG antenna	230	Yagi antenna	120
8' dish	225	OB light	115
8' grid dish	223	ENG Receive antenna	100
8' dish radome	190	6' dish with radome	95
8' grid dish	178	Dipole antenna	90
12' whip antenna	165	4' dish	82
Proposed T-Mobile Equipment (w/dish)	157	Rest Platform	80
		Yagi antenna	30

SYMBOL LIST

MARK	SIZE	MARK	SIZE
A	PIPE2.5STD	B	L1 3/4x1 3/4x1/8

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

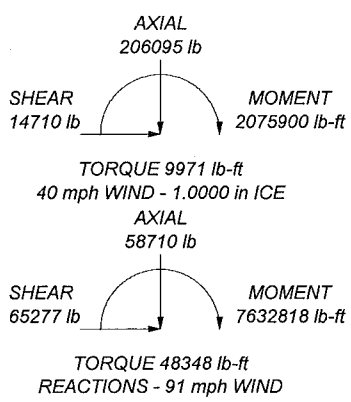
1. Tower is located in Cumberland County, Maine.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 91 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 40 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness 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

ALL REACTIONS ARE FACTORED

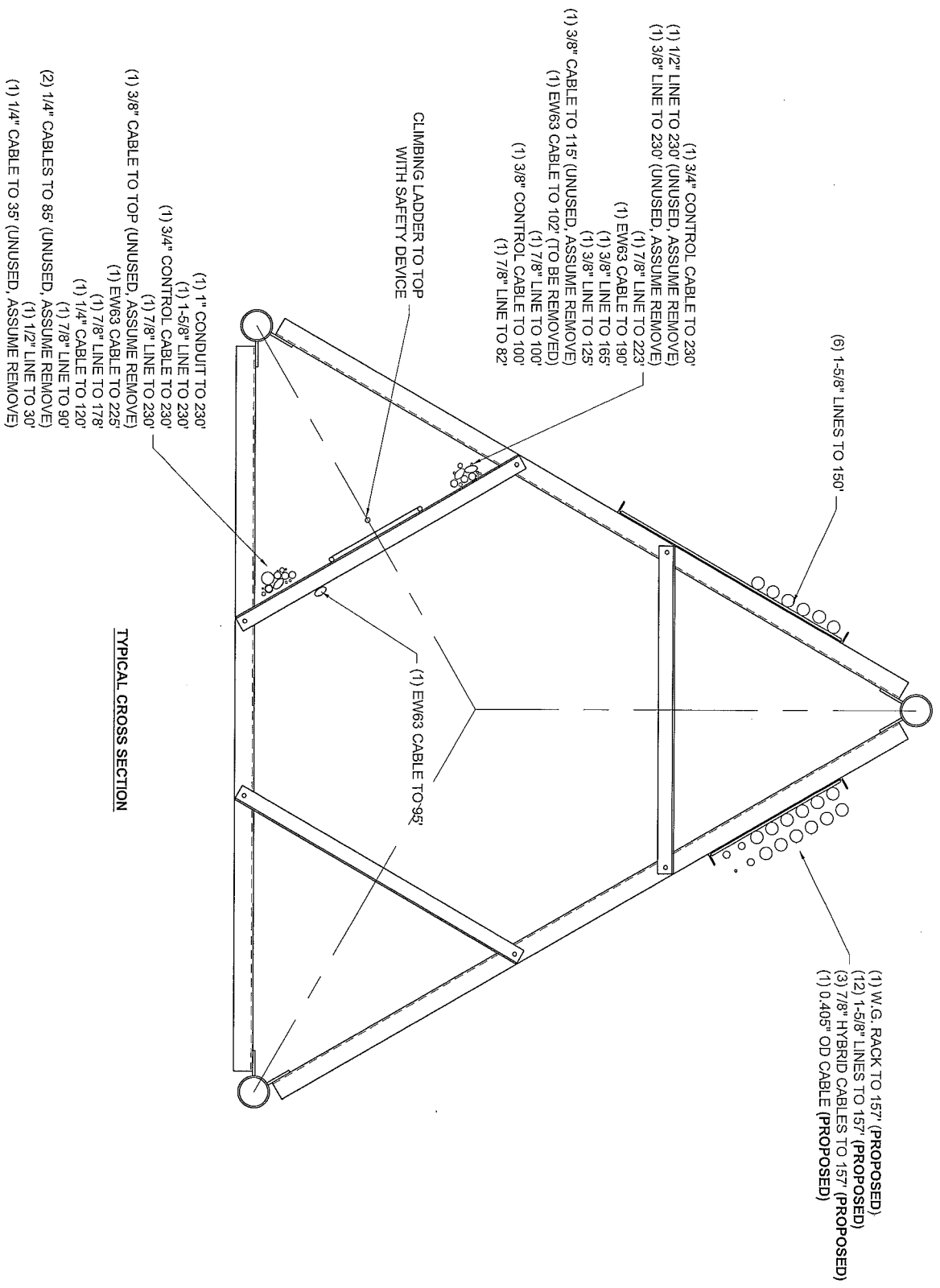
MAX. CORNER REACTIONS AT BASE:

DOWN: 289358 lb
SHEAR: 38637 lb


UPLIFT: -238033 lb
SHEAR: 33219 lb



<p>Stainless Tower Engineers</p>	<p>100 West Main Street Lansdale, PA 19446 Phone: (215)631-1400 FAX: (215)631-1425</p>	<p>Job: T063300, PORTLAND, ME</p>	<p>Project: 230-ft ROHN SELF SUPPORTING TOWER</p>	<p>Client: SBG/ STRUCTURE CONSULTING GROUP</p>	<p>Drawn by: Changfei Chen</p>	<p>App'd:</p>
		<p>Code: TIA-222-G</p>	<p>Date: 11/22/15</p>	<p>Scale: NTS</p>	<p>Dwg No. E-1</p>	



TYPICAL CROSS SECTION

 <p>STAINLESS A BUSINESS OF PDH VELOCITY 100 West Main Street, Suite 400 Langhorne, PA 19046</p>		PREPARED BY CHECKED BY ENGINEER REVIEW PROJECT NUMBER DRAWING NUMBER	PCC 10/31/2015
LINEAR APPURTENANCES PORTLAND, ME		T063300	A-2
THIS DRAWING IS THE PROPERTY OF STAINLESS AND TRANSMITTED IN CONFIDENCE. AND THE REPRODUCTION, USE OR DISCLOSURE, IN WHOLE OR IN PART, OF THE DESIGN AND DETAILS CONTAINED HEREIN IS PROHIBITED WITHOUT THE PRIOR WRITTEN PERMISSION OF STAINLESS.	REV BY DATE	REVISION DESCRIPTION	D.OK DATE E.CK DATE