STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL
Ten Franklin Square, New Britain, CT 06051
Phone: (860) 827-2935 Fax: (860) 827-2950
E-Mail: siting.council@ct.gov
www.ct.gov/csc

VIA ELECTRONIC MAIL

October 29, 2018

Romina Kirchmaier
Real Estate Specialist
Smartlink
85 Rangeway Road
Building 3, Suite 102
Billerica, MA 01862

RE: **EM-AT&T-146-180912** - AT&T notice of intent to modify an existing telecommunications facility located at 47 Main St. Vernon, Connecticut.

Dear Ms. Kirchmaier:

The Connecticut Siting Council (Council) is in receipt of your correspondence dated October 22, 2018 submitted in response to the Council's September 13, 2018 notification of an incomplete request for exempt modification with regard to the above-referenced matter.

The submission renders the request for exempt modification complete and the Council will process the request in accordance with the Federal Communications Commission 60-day timeframe.

Thank you for your attention and cooperation.

Sincerely,

Melanie A. Bachman
Executive Director

MAB/IN/emr

not emailed

smartlink

RECEIVED
OCT 29 2018
Connecticut Siting Council

October 22nd, 2018

Melanie A. Bachman Executive
Director Connecticut Siting Council
10 10 Franklin Square
New Britain, CT 06051

Re:	**Notice of Exempt Modification – Antenna Swap and RRU Add**
Property Address:	**47 Main St. Vernon, CT 06066**
Applicant:	**AT&T Mobility, LLC**

Dear Ms. Bachman:

I am submitting the attached Water Tank Analysis prepared by Maser Consulting, dated October 16th, 2018, as a supplement to the Exempt Modification Filing **EM-AT&T-146-180912** originally submitted September 10th, 2018. This report fully evaluates the water tank's ability to support AT&T's proposed equipment, as requested by the Connecticut Siting Council. Please feel free to reach out if you have any questions.

Sincerely,

Romina Kirchmaier

CC w/enclosures:
David Kalinowski, Zoning Official, Town of Wolcott
Thomas G. Dunn, Town of Wolcott
Agostinho & Joanne Rodrigues, Land Owner
Crown Castle, Tower Company

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Ten Franklin Square, New Britain, CT 06051
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September 13, 2018

Romina Kirchmaier
Real Estate Specialist for Smartlink
85 Rangeway Road
Building 3, Suite 102
Billerica, MA 01862

RE: **EM-AT&T-146-180912** - AT&T notice of intent to modify an existing telecommunications facility located at 47 Main St. Vernon, Connecticut.

Dear Ms. Kirchmaier:

The Connecticut Siting Council (Council) received a notice of intent to modify the above-referenced facility on September 12, 2018.

According to Section 16-50j-71 of the Regulations of Connecticut State Agencies, "...any modification, as defined in Section 16-50j-2a of the Regulations of Connecticut State Agencies, to an existing tower site, except as specified in Sections 16-50j-72 and 16-50j-88 of the Regulations of Connecticut State Agencies, may have a substantial adverse environmental effect."

Staff has reviewed this exempt modification request for completeness and has identified a deficiency in the request. The Mount Utilization Report provided in the exempt modification request only assesses the capacity of the existing antenna mounts to support the proposed equipment and not the capacity of the water tank structure supporting that equipment as well as other carrier equipment.

The request for exempt modification does not contain a Structural Analysis report.

Therefore, the exempt modification request is incomplete at this time. The Council recommends that Smartlink provide a Structural Analysis Report which includes the total proposed and existing loading, including that of other carriers, on the water tank structure on or before October 16, 2018. If additional time is needed to gather the requested information, please submit a written request for an extension of time prior to October 16, 2018.

This notice of incompletion shall have the effect of tolling the Federal Communications Commission (FCC) 60-day timeframe in accordance with Paragraph 217 of the FCC Wireless Infrastructure Report and Order issued on October 21, 2014 (FCC 14-153).

Thank you for your attention to this matter. Should you have any questions, please feel free to contact me at 860-827-2951.

Sincerely,

Melanie Bachman
Executive Director

MAB/FOC/IN

c: The Honorable Daniel A. Champagne, Mayor, Town of Vernon
Andrew Marchese, Zoning Enforcement Officer, Town of Vernon

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Engineers Planners Surveyors Landscape Architects Environmental Scientists

MASER CONSULTING
— CONNECTICUT —

Water Tank Analysis

FOR

CTL01093

10035090 – Talcottville
47 Main Street
Vernon, CT 06066
Tolland County

Finite Water Tank Utilization: 96.9%

October 16, 2018

Prepared For

AT&T
550 Cochituate Road
Framingham, MA 01701

Prepared By

Maser Consulting Connecticut
331 Newman Springs Road, Suite 203
Red Bank, NJ 07701
T: 732.383.1950

Petros E. Tsoukalas, P.E.
Geographic Discipline Leader
Connecticut License No. 32557

MC Project No. 17946061A

www.maserconsulting.com

Objective:

The objective of this report is to determine the capacity of the existing water tank at the subject facility for the final wireless telecommunications configuration, per the applicable codes and standards.

Introduction:

Maser Consulting Connecticut has performed limited field observations on September 21, 2017 to verify the existing condition of the structure and to locate and quantify the existing wireless appurtenances where possible. This structural analysis is valid for the appurtenances on the site at the time of the field visit. Additionally, Maser Consulting Connecticut has reviewed the following documents in completing this report:

- RFDS 1811300 Version 3.00, provided by Smartlink LLC, dated January 16, 2018
- Construction Drawings, prepared by Com Ex Consultants, dated May 27, 2016
- Structural Analysis, prepared by Destek Engineering LLC, dated June 1, 2016
- Mount Mapping, provided by Tower Engineering Professionals, dated October 5, 2018

The existing **AT&T** equipment is supported on the water tank handrail constructed of structural steel angles, pipes, and plates at a centerline of approximately 119' above ground level. This report is based upon this information, as well as the information obtained in the field.

Discrete and Linear Appurtenances:

Maser Consulting Connecticut understands the existing & proposed **AT&T** loading to be as follows:

- *(3) 800-10121 Antennas (Existing)*
- *(3) AM-X-CD-16-65-00T-RET Antennas (Existing)*
- **(1) HPA-65R-BUU-H8 Antenna (Existing)**
- **(2) HPA-65R-BUU-H6 Antennas (Existing)**
- **(1) EPBQ-654L8H8-L2 Antenna (Proposed)**
- **(2) EPBQ-654L8H6-L2 Antennas (Proposed)**
- *(6) TMAs (Existing)*
- *(3) RRUS 11 (Existing)*
- **(3) RRUS 12 (Proposed)**
- **(3) RRUS 32 (Proposed)**
- **(3) RRUS B14 4478 (Proposed)**
- *(3) DC2 (Existing)*
- *(1) FC12 (Existing)*
- **(3) DC6 (Proposed)**
- **(3) 6-Pair Fiber Trunks (Proposed)**
- **(3) 6/C DC Power Cables (Proposed)**

Codes, Standards and Loading:

Maser Consulting Connecticut utilized the following codes and standards:

- 2016 Connecticut State Building Code, Incorporating the 2012 IBC
- Welded Carbon Steel Tanks for Water Storage, ANSI/AWWA D100, American Water Works Association (AWWA)
  - Basic Wind Speed – 90 mph (3 Second Gust)
  - Exposure Category - C
- Specification for Structural Steel Buildings ANSI/AISC 360-05, American Institute of Steel Construction (AISC)
- Structural Standards for Antenna Supporting Structures and Antennas ANSI/TIA-222-G
  - Nominal Wind Speed – 105 mph
  - Exposure Category – B
  - Structural Class – II

Analysis Approach & Assumptions:

The analysis approach used in this structural analysis is based on the premise that if the existing water tank are structurally adequate to support the proposed equipment per the aforementioned codes and standards, or if the increase in the forces in the structure is deemed to be negligible or acceptable, then the proposed equipment can be installed as intended.

General Site Design Assumption:

- All engineering services are performed on the basis that the information used is current and correct.
- It is assumed that the telecommunication equipment supports, antenna supports, and existing structure have been designed by a registered licensed professional engineer for the existing loads acting on the structure, as required by all applicable codes, prior to the proposed modifications listed within this report, if any.
- It is assumed that information provided by the client regarding the structure itself, the antenna models, feed lines, and other relevant information is current and correct.
- It is the responsibility of the client to ensure that the information provided to Maser Consulting Connecticut and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that the original design, material production, fabrication, and erection of the existing structure was performed in accordance with accepted industry design standards and in accordance with all applicable codes. Further, it is assumed that the existing structure and appurtenances have been properly maintained in accordance with all applicable codes and manufacturer's specifications and no structural defects and/or deterioration to the structural members has occurred.
- It is assumed all other existing appurtenances, antennas, cables, etc. belonging to others have been installed and supported per code and per specifications so as not to damage any existing structural support members, and that any contributing loads from adjacent equipment has been taken into consideration for their design.
- All services are performed, results obtained, and recommendations made in accordance with generally accepted engineering principles and practices. Maser Consulting Connecticut is not responsible for the conclusion, opinions, and recommendations made by others based on the information we supply.

Site Specific Design Parameters:

The following design assumptions and parameters have been utilized in this report:

- *Structural Steel Angles and Plates are assumed to be constructed of A36 Steel*
- *Structural Steel Pipes are assumed to be constructed of A53 Grade B Steel*
- *The volume of the tank is 75,000 gallons*

Calculations:

The calculations are found in Appendix A of this report.

Conclusion:

Maser Consulting P.A. has determined the existing water tank has **ADEQUATE** structural capacity to support the proposed loading. The existing water tank has been determined to be stressed to a maximum of **96.4%** of its structural capacity. Therefore, the proposed **AT&T** equipment **CAN** be installed as intended.

Maser Consulting Connecticut reserves the right to amend this report if additional information about the existing members is provided. The conclusions reached by Maser Consulting Connecticut in this report are only valid for the appurtenances listed in this report. Any change to the installation will require a revision to this structural analysis.

We appreciate the opportunity to be of service on this project. If you should have any questions or require any additional information, please do not hesitate to call our office.

Sincerely,
Maser Consulting Connecticut

Petros E. Tsoukalas, P.E.
Geographic Discipline Leader

Lauren Luzier, E.I.T.
Engineer

\\maserconsulting.com\luj\Projects\2017\17946000A\17946061A\Structural\Water Tank Analysis\Rev 1\Word\10035090.CTL01093.SA.Rev 0.docx

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APPENDIX A

Dead Load:

Water Tank:

Height of Elevated Tank: $H_{tank} := 137$

Diameter of Elevated Tank: $D_{tank} := 26ft$

Volume of Stored Water: $V_{tank} := (75000gal)$ (Approximate)

Weight of Water: $W := V_{tank} \cdot 62.4 \cdot pcf = 625.6 \cdot kip$

$$W_{legs} := \frac{(W \cdot 0.75)}{4} = 117304.7 \cdot lbf$$

$$W_{riser} := W \cdot 0.25 = 156406.3 \cdot lbf$$

Existing Discrete and Linear Appurtenances:

Antenna Weight:

3 Panel Antennas at 44.1 lbs ea.
3 Panel Antennas at 48.5 lbs. ea.
12 Panel Antennas at 40 lbs. ea.
9 Panel Antennas at 100 lbs. ea.
9 RRU at 50 lb. ea.
3 DC2's at 16 lbs ea.
1 FC12's at 28 lbs ea.

$$D_{ant} := (3) \cdot 44.1 \cdot lbf + (3) \cdot 48.5lbf + (12) \cdot 40lbf + (9) \cdot 100lbf \ldots + (9) \cdot 50lbf + (3) \cdot 16lbf + (1) \cdot 28lbf = 2183.8\,lbf$$

Mount Weight:

36 8' Pipes at 3.65 lbs/ft
9 10' Pipe at 8 lbs/ft

$$D_{mount} := [(36) \cdot 8ft] \cdot 3.65 \frac{lbf}{ft} + [(9) \cdot 10ft] \cdot 8 \frac{lbf}{ft} = 1771.2\,lbf$$

Cable Weight:

28 Cables at 120' Long
9 Cables at 130' Long

$$D_{coax} := 1 \cdot plf \cdot (28 \cdot 120ft + 9 \cdot 130ft) = 4530\,lbf$$

Total Weight: $D_{ext} := D_{ant} + D_{mount} + D_{coax} = 8485\,lbf$

Proposed AT&T Discrete and Linear Appurtenances

Antenna Weight:

$$D_{ant} := (1) \cdot (68 \cdot lbf) + (2) \cdot (50.7lbf) + (2) \cdot (72.8 \cdot lbf) + (1) \cdot (86lbf) \ldots + (3) \cdot (58lbf) + (3) \cdot (60lbf) + (3) \cdot (26lbf) = 833\,lbf$$

1 Panel Antenna at 68 lb.
2 Panel Antenna at 50.7 lb. ea.
2 Panel Antennas at 72.8 lb. ea.
1 Panel Antenna at 86 lb. ea.
3 RRU at 58 lb. ea.
3 RRU at 60 lb. ea.
3 DC6 at 26 lb. ea.

Total Weight: $D_{prop} := D_{ant} = 833\,lbf$

Dead Load Summary:

Existing Dead Weight: $D_{existing} := W$ $\quad D_{existing} = 625.6 \cdot kip$

Additional Dead Weight: $D_{additional} := D_{ext} + D_{prop}$ $\quad D_{additional} = 9.3 \cdot kip$

Dead Weight Ratio: $Ratio := \frac{D_{additional}}{D_{existing}}$ $\quad Ratio = 1.49 \cdot \%$

Design Wind Load on Tank:

Inputs:

		AWWA Reference
Location:	Location	
Exposure Category:	$Exp := "C"$	(Section 3.1.4.2.1, P. 13)
Basic Wind Speed:	$V := 90$ MPH	(Figure 1, p. 14-18)
Gust Effect Factor:	$G_h := 1$	(Section 3.1.4, p. 11)
Importance Factor:	$I := 1.15$	(Section 3.1.4, P. 12)

Terrain Exposure Constants:

$$\alpha := \begin{cases} 7.0 & \text{if } Exp = "B" \\ 9.5 & \text{if } Exp = "C" \\ 11.5 & \text{if } Exp = "D" \end{cases}$$

$$Z_g := \begin{cases} 1200 & \text{if } Exp = "B" \\ 900 & \text{if } Exp = "C" \\ 700 & \text{if } Exp = "D" \end{cases}$$

Table 6-2, P. 78 (ASCE 7-05)

Velocity Pressure Coefficients:

$$K_{zv}(z) := \begin{cases} \left[2.01 \cdot \left(\frac{z}{Z_g}\right)^{\frac{2}{\alpha}}\right] & \text{if } z > 15 \\ \left[2.01 \cdot \left(\frac{15}{Z_g}\right)^{\frac{2}{\alpha}}\right] & \text{otherwise} \end{cases}$$

Table 6-3, P. 79
(ASCE 7-05)

Force Coefficient:

$$C_f(Shape) := \left(\begin{cases} 1.0 & \text{if } Shape = "Flat" \\ 0.6 & \text{if } Shape = "Round" \end{cases} \right)$$

Table 2 P. 12

Tank Loading:

Tank Bulb:

Bulb Depth of Existing Tank: $BH_{tank} := 26ft$

Height: $z := 124$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 31.579 \cdot psf$ (Section 3.1.4 p.11)

Area: $A_a := \pi \cdot \frac{BH_{tank}}{2} \cdot \frac{D_{tank}}{2} = 530.929\ ft^2$

Shape: Shape := Round — Table 2 P. 12

Wind Load: $F_{tank} := q_z \cdot G_h \cdot C_f(Shape) = 18.9 \cdot psf$

Legs:

Height: $z := \left(\frac{2}{3}\right) \cdot 104$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 27.941 \cdot psf$ (Section 3.1.4 p.11)

Legs Loading:

Height: $h := 104ft = 104\ ft$

Width: $w := 22 \cdot in$

$A_a := h \cdot w = 190.67\ ft^2$

Shape: Shape := Round — Table 2 P. 12

Wind Load: $F_{supportleg} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 30.7 \cdot plf$

Riser:

Height: $z := \left(\frac{2}{3}\right) \cdot 98$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 27.593 \cdot psf$ (Section 3.1.4 p.11)

Riser Loading:

Height: $h := 98ft$

Width: $w := 36 \cdot in$

$A_a := h \cdot w = 294\ ft^2$

Shape: Shape := Round — Table 2, P. 11

Wind Load: $F_{supportriser} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 49.7 \cdot plf$

Tank Cross Brace 1:

Height: $z := \frac{35}{2}$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 20.911 \cdot psf$ (Section 3.1.4 p.11)

Cross Brace Loading:

Height: $h := 35ft$

Width: $w := 1.375 \cdot in$

$A_a := h \cdot w = 4.01\ ft^2$

Shape: Shape := Round

Wind Load: $F_{xbrc1} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 1.4 \cdot plf$

$F_{xbrc} := F_{xbrc1} \cdot h = 50.3 \cdot lbf$

Tank Cross Brace 2:

Height: $z := 70$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 27.997 \cdot psf$ (Section 3.1.4 p.11)

Cross Brace Loading:

Height: $h := 35ft$

Width: $w := 1.375 \cdot in$

$A_a := h \cdot w = 4.01\ ft^2$

Shape: Shape := Round

Wind Load: $F_{xbrc2} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 1.9 \cdot plf$

$F_{xbrc} := F_{xbrc2} \cdot h = 67.4 \cdot lbf$

Tank Cross Brace 3:

Height: $z := 98$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 30.052 \cdot psf$ (Section 3.1.4 p.11)

Cross Brace Loading:

Height: $h := 28ft$

Width: $w := 1.125 \cdot in$

$A_a := h \cdot w = 2.63\ ft^2$

Shape: Shape := Round

Wind Load: $F_{xbrc3} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 1.7 \cdot plf$

$F_{xbrc} := F_{xbrc3} \cdot h = 47.3 \cdot lbf$

Tank Struts:

Horizontal 1:

Height: $z := 70$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 27.997 \cdot psf$ (Section 3.1.4 p.11)

Horizontal Loading:

Height: $h := 20ft$

Width: $w := 7.5 \cdot in$

$A_a := h \cdot w = 12.5\ ft^2$

Shape: Shape := Flat

Wind Load: $F_{horz1} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 17.5 \cdot plf$ (Section 3.1.4.2.2)

$w_{strut1} := F_{horz1} \cdot .5 = 8.7 \cdot plf$ (Section 3.1.4.2.2)

Horizontal 2:

Height: $z := 35$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 24.196 \cdot psf$ (Section 3.1.4 p.11)

Horizontal Loading:

Height: $h := 22ft$

Width: $w := 7.5 \cdot in$

$A_a := h \cdot w = 13.75\, ft^2$

Shape: Shape := Flat

Wind Load: $F_{horz2} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 15.1 \cdot plf$

$w_{strut2} := F_{horz2} \cdot .5 = 7.6 \cdot plf$

Catwalk Mount Loading:

Top Rail

Height: $z := 123$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 31.525 \cdot psf$ (Section 3.1.4 p.11)

Height: $h := 72in$

Width: $w := 2 \cdot in$

$A_a := h \cdot w = 1\, ft^2$

Shape: Shape := Flat

Wind Load: $F_{trail} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 5.3 \cdot plf$

Diagonal Posts

Height: $z := 121$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 31.416 \cdot psf$ (Section 3.1.4 p.11)

Height: $h := 84in$

Width: $w := 2 \cdot in$

$A_a := h \cdot w = 1.17\, ft^2$

Shape: Shape := Flat

Wind Load: $F_{posts} := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 5.2 \cdot plf$

Toe Plate

Height: $z := 118$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 31.251 \cdot psf$ (Section 3.1.4 p.11)

Height: $h := 48in$

Width: $w := 3 \cdot in$

$A_a := h \cdot w = 1\ ft^2$

Shape: Shape := Flat

Wind Load: $F_t := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 7.8 \cdot plf$

Vertical Post

Height: $z := 119$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 31.306 \cdot psf$ (Section 3.1.4 p.11)

Height: $h := 36ft$

Width: $w := 3 \cdot in$

$A_a := h \cdot w = 9\ ft^2$

Shape: Shape := Flat

Wind Load: $F_t := q_z \cdot G_h \cdot C_f(Shape) \cdot w = 7.8 \cdot plf$

ASCE 7-05 Reference

Design Wind Load:

Equipment Centerline:	$z := 119$ ft	
Basic Wind Speed:	$V := 105$ *mph*	(Figure 6-1, p. 33)
Wind Directionality Factor:	$K_d :=$ 0.85	(Table 6-4, P. 80)
Exposure Category:	$Exp :=$ B	(Section 6.5.6.2, p. 25)
Topographic Category:	$Topo :=$ No Topo	(Section 6.5.7.2, p. 26)
Gust Effect Factor:	$G_h := 0.85$	(Section 6.5.8, p. 26)
Topographic Factor:	$K_{zt} := 1.0$	(Section 6.5.7.2, p. 26)
Importance Factor:	$I := 1$	(Table 6-1, P. 77)

Terrain Exposure Constants:

$$\alpha := \begin{cases} 7.0 & \text{if } Exp = \text{"B"} \\ 9.5 & \text{if } Exp = \text{"C"} \\ 11.5 & \text{if } Exp = \text{"D"} \end{cases} \qquad Z_g := \begin{cases} 1200 & \text{if } Exp = \text{"B"} \\ 900 & \text{if } Exp = \text{"C"} \\ 700 & \text{if } Exp = \text{"D"} \end{cases}$$

(Table 6-3, P. 79)

$$K_{zmin} := \begin{cases} 0.70 & \text{if } Exp = \text{"B"} \\ 0.85 & \text{if } Exp = \text{"C"} \\ 1.03 & \text{if } Exp = \text{"D"} \end{cases}$$

Velocity Pressure Coefficient:

$$Kz(z) := \left| \begin{array}{l} K_z \leftarrow \max\left[2.01 \cdot \left(\frac{z}{Z_g}\right)^{\frac{2}{\alpha}}, K_{zmin}\right] \text{ if } z \geq 15 \wedge z \leq Z_g \\ K_z \leftarrow \max\left[2.01 \cdot \left(\frac{15}{Z_g}\right)^{\frac{2}{\alpha}}, K_{zmin}\right] \text{ if } z < 15 \\ K_z \leftarrow \min(K_z, 2.01) \end{array} \right.$$

$Kz(z) = 1.039$

Velocity Pressure: $q_z := 0.00256 \cdot Kz(z) \cdot K_{zt} \cdot K_d \cdot V^2 \cdot psf \cdot I = 24.916 \cdot psf$ (Equation 6-15, P. 27)

Force Coefficient:

Figure 6-21, P. 74

Square Members
(Wind Normal to Face)

$$C_{f\_square}(h,w) := \begin{cases} 1.3 & \text{if } \frac{h}{w} \le 1.0 \\ \left[1.3 + \frac{0.1}{6.0}\cdot\left(\frac{h}{w} - 1.0\right)\right] & \text{if } \frac{h}{w} > 1.0 \wedge \frac{h}{w} \le 7 \\ \left[1.4 + \frac{0.6}{18}\cdot\left(\frac{h}{w} - 7\right)\right] & \text{if } \frac{h}{w} > 7 \wedge \frac{h}{w} \le 25 \\ 2.0 & \text{otherwise} \end{cases}$$

Figure 6-21, P. 74

Round Members
(Wind Normal to Face)

$$C_{f\_round}(h,d) := \begin{cases} \text{if } \frac{d}{ft}\cdot\sqrt{\frac{q_z}{psf}} \le 2.5 \\ \quad \begin{cases} 0.7 & \text{if } \frac{h}{d} \le 1.0 \\ \left[0.7 + \frac{0.1}{6.0}\cdot\left(\frac{h}{d} - 1.0\right)\right] & \text{if } \frac{h}{d} > 1.0 \wedge \frac{h}{d} \le 7 \\ \left[0.8 + \frac{0.4}{18}\cdot\left(\frac{h}{d} - 7\right)\right] & \text{if } \frac{h}{d} > 7 \wedge \frac{h}{d} \le 25 \\ 1.2 & \text{otherwise} \end{cases} \\ \text{if } \frac{d}{ft}\cdot\sqrt{\frac{q_z}{psf}} > 2.5 \\ \quad \begin{cases} 0.5 & \text{if } \frac{h}{d} \le 1.0 \\ \left[0.6 + \frac{0.1}{6.0}\cdot\left(\frac{h}{d} - 1.0\right)\right] & \text{if } \frac{h}{d} > 1.0 \wedge \frac{h}{d} \le 7 \\ \left[0.7 + \frac{0.1}{18}\cdot\left(\frac{h}{d} - 7\right)\right] & \text{if } \frac{h}{d} > 7 \wedge \frac{h}{d} \le 25 \\ 0.7 & \text{otherwise} \end{cases} \end{cases}$$

AT&T Wind Loading:

800-10121

Dimensions: $h_{ant1} := 54.5 \cdot in$ $w_{ant1} := 10.3 \cdot in$ $d_{ant1} := 5.9 \cdot in$

Weight: $DL_{ant1} := 44.1lb$

Area (Normal): $A_{Na} := h_{ant1} \cdot w_{ant1} = 3.898\, ft^2$

Area (Side): $A_{Ta} := h_{ant1} \cdot d_{ant1} = 2.233\, ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant1}, w_{ant1}) = 1.372$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant1}, d_{ant1}) = 1.475$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 5.347\, ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 3.293\, ft^2$

Wind Force: $F_{ant1f} := q_z \cdot G_h \cdot EPA_N = 113.233 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant1s} := q_z \cdot G_h \cdot EPA_T = 69.735 \cdot lbf$

HPA-65R-BUU-H6

Dimensions: $h_{ant2} := 72 \cdot in$ $w_{ant2} := 14.8 \cdot in$ $d_{ant2} := 9 \cdot in$

Weight: $DL_{ant2} := 50.7lb$

Area (Normal): $A_{Na} := h_{ant2} \cdot w_{ant2} = 7.4\, ft^2$

Area (Side): $A_{Ta} := h_{ant2} \cdot d_{ant2} = 4.5\, ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant2}, w_{ant2}) = 1.364$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant2}, d_{ant2}) = 1.433$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 10.097\, ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 6.45\, ft^2$

Wind Force: $F_{ant2f} := q_z \cdot G_h \cdot EPA_N = 213.835 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant2s} := q_z \cdot G_h \cdot EPA_T = 136.603 \cdot lbf$

HPA-65R-BUU-H8

Dimensions: $h_{ant3} := 92.4 \cdot in$ $w_{ant3} := 14.8 \cdot in$ $d_{ant3} := 7.4 \cdot in$

Weight: $DL_{ant3} := 68lb$

Area (Normal): $A_{Na} := h_{ant3} \cdot w_{ant3} = 9.497\,ft^2$

Area (Side): $A_{Ta} := h_{ant3} \cdot d_{ant3} = 4.748\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant3}, w_{ant3}) = 1.387$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant3}, d_{ant3}) = 1.583$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 13.176\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 7.516\,ft^2$

Wind Force: $F_{ant3f} := q_z \cdot G_h \cdot EPA_N = 279.041 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant3s} := q_z \cdot G_h \cdot EPA_T = 159.18 \cdot lbf$

EPBQ-654L8H6-L2

Dimensions: $h_{ant4} := 73 \cdot in$ $w_{ant4} := 72 \cdot in$ $d_{ant4} := 6.3 \cdot in$

Weight: $DL_{ant4} := 72.8lb$

Area (Normal): $A_{Na} := h_{ant4} \cdot w_{ant4} = 36.5\,ft^2$

Area (Side): $A_{Ta} := h_{ant4} \cdot d_{ant4} = 3.194\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant4}, w_{ant4}) = 1.3$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant4}, d_{ant4}) = 1.553$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 47.458\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 4.96\,ft^2$

Wind Force: $F_{ant4f} := q_z \cdot G_h \cdot EPA_N = 1.005 \times 10^3 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant4s} := q_z \cdot G_h \cdot EPA_T = 105.038 \cdot lbf$

EPBQ-654L8H8-L2

Dimensions: $h_{ant5} := 96 \cdot in$ $w_{ant5} := 21 \cdot in$ $d_{ant5} := 6.39 \cdot in$

Weight: $DL_{ant5} := 86lb$

Area (Normal): $A_{Na} := h_{ant5} \cdot w_{ant5} = 14\,ft^2$

Area (Side): $A_{Ta} := h_{ant5} \cdot d_{ant5} = 4.26\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant5}, w_{ant5}) = 1.36$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant5}, d_{ant5}) = 1.667$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 19.033\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 7.103\,ft^2$

Wind Force: $F_{ant5f} := q_z \cdot G_h \cdot EPA_N = 403.102 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant5s} := q_z \cdot G_h \cdot EPA_T = 150.44 \cdot lbf$

AM-X-CD-16-65-00T-RET

Dimensions: $h_{ant6} := 72 \cdot in$ $w_{ant6} := 11.8 \cdot in$ $d_{ant6} := 5.9 \cdot in$

Weight: $DL_{ant6} := 48.5lb$

Area (Normal): $A_{Na} := h_{ant6} \cdot w_{ant6} = 5.9\,ft^2$

Area (Side): $A_{Ta} := h_{ant6} \cdot d_{ant6} = 2.95\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant6}, w_{ant6}) = 1.385$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant6}, d_{ant6}) = 1.573$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 8.172\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 4.642\,ft^2$

Wind Force: $F_{ant6f} := q_z \cdot G_h \cdot EPA_N = 173.065 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant6s} := q_z \cdot G_h \cdot EPA_T = 98.305 \cdot lbf$

SBNH-1D6565C

Dimensions: $h_{ant7} := 96.4 \cdot in$ $w_{ant7} := 11.9 \cdot in$ $d_{ant7} := 7.1 \cdot in$

Weight: $DL_{ant7} := 48.5lb$

Area (Normal): $A_{Na} := h_{ant7} \cdot w_{ant7} = 7.966\,ft^2$

Area (Side): $A_{Ta} := h_{ant7} \cdot d_{ant7} = 4.753\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant7}, w_{ant7}) = 1.437$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant7}, d_{ant7}) = 1.619$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 11.445\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 7.696\,ft^2$

Wind Force: $F_{ant7f} := q_z \cdot G_h \cdot EPA_N = 242.396 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant7s} := q_z \cdot G_h \cdot EPA_T = 163 \cdot lbf$

RRUS 11

Dimensions: $h_1 := 19.7 \cdot in$ $w_1 := 17 \cdot in$ $d_1 := 7.2 \cdot in$

Weight: $DL_1 := 50lb$

Area (Normal): $A_{Na} := h_1 \cdot w_1 = 2.326\,ft^2$

Area (Side): $A_{Ta} := h_1 \cdot d_1 = 0.985\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_1, w_1) = 1.303$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_1, d_1) = 1.329$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 3.03\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 1.309\,ft^2$

Wind Force: $F_{1f} := q_z \cdot G_h \cdot EPA_N = 64.162 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{1s} := q_z \cdot G_h \cdot EPA_T = 27.723 \cdot lbf$

RRUS 12

Dimensions: $h_2 := 20.4 \cdot in$ $w_2 := 18.5 \cdot in$ $d_2 := 7.5 \cdot in$

Weight: $DL_2 := 58lb$

Area (Normal): $A_{Na} := h_2 \cdot w_2 = 2.621\,ft^2$

Area (Side): $A_{Ta} := h_2 \cdot d_2 = 1.062\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_2, w_2) = 1.302$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_2, d_2) = 1.329$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 3.412\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 1.412\,ft^2$

Wind Force: $F_{2f} := q_z \cdot G_h \cdot EPA_N = 72.253 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{2s} := q_z \cdot G_h \cdot EPA_T = 29.898 \cdot lbf$

RRUS 32

Dimensions: $h_3 := 29.9 \cdot in$ $w_3 := 0.1 \cdot in$ $d_3 := 9.5 \cdot in$ Shielded by Antenna

Weight: $DL_3 := 52.9lb$

Area (Normal): $A_{Na} := h_3 \cdot w_3 = 0.021\,ft^2$

Area (Side): $A_{Ta} := h_3 \cdot d_3 = 1.973\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_3, w_3) = 2$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_3, d_3) = 1.336$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 0.042\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 2.635\,ft^2$

Wind Force: $F_{3f} := q_z \cdot G_h \cdot EPA_N = 0.88 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{3s} := q_z \cdot G_h \cdot EPA_T = 55.805 \cdot lbf$

RRUS B14 4478

Dimensions: $h_4 := 15 \cdot in$ $w_4 := 0.1 \cdot in$ $d_4 := 8 \cdot in$ Shielded by Antenna

Weight: $DL_4 := 60lb$

Area (Normal): $A_{Na} := h_4 \cdot w_4 = 0.01\ ft^2$

Area (Side): $A_{Ta} := h_4 \cdot d_4 = 0.833\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_4, w_4) = 2$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_4, d_4) = 1.315$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 0.021\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 1.095\ ft^2$

Wind Force: $F_{4f} := q_z \cdot G_h \cdot EPA_N = 0.441 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{4s} := q_z \cdot G_h \cdot EPA_T = 23.201 \cdot lbf$

DC 2

Dimensions: $h_5 := 11.5 \cdot in$ $w_5 := 10.38 \cdot in$ $d_5 := 6.29 \cdot in$

Weight: $DL_5 := 16lb$

Area (Normal): $A_{Na} := h_5 \cdot w_5 = 0.829\ ft^2$

Area (Side): $A_{Ta} := h_5 \cdot d_5 = 0.502\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_5, w_5) = 1.302$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_5, d_5) = 1.314$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 1.079\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 0.66\ ft^2$

Wind Force: $F_{5f} := q_z \cdot G_h \cdot EPA_N = 22.855 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{5s} := q_z \cdot G_h \cdot EPA_T = 13.977 \cdot lbf$

FC 12

Dimensions: $h_6 := 14 \cdot in$ $w_6 := 16.25 \cdot in$ $d_6 := 6.64 \cdot in$

Weight: $DL_6 := 20.5lb$

Area (Normal): $A_{Na} := h_6 \cdot w_6 = 1.58\,ft^2$

Area (Side): $A_{Ta} := h_6 \cdot d_6 = 0.646\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_6, w_6) = 1.3$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_6, d_6) = 1.318$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 2.054\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 0.851\,ft^2$

Wind Force: $F_{6f} := q_z \cdot G_h \cdot EPA_N = 43.497 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{6s} := q_z \cdot G_h \cdot EPA_T = 18.026 \cdot lbf$

DC6

Dimensions: $h_7 := 17.5 \cdot in$ $w_7 := 9.25 \cdot in$ $d_7 := 9.25 \cdot in$

Weight: $DL_7 := 26lb$

Area (Normal): $A_{Na} := h_7 \cdot w_7 = 1.124\,ft^2$

Area (Side): $A_{Ta} := h_7 \cdot d_7 = 1.124\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_round}(h_7, w_7) = 0.615$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_round}(h_7, d_7) = 0.615$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 0.691\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 0.691\,ft^2$

Wind Force: $F_{7f} := q_z \cdot G_h \cdot EPA_N = 14.639 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{7s} := q_z \cdot G_h \cdot EPA_T = 14.639 \cdot lbf$

Verizon Loading:

Antennas

Dimensions: $h_{ant8} := 72 \cdot in$ $w_{ant8} := 12 \cdot in$ $d_{ant8} := 6 \cdot in$

Weight: $DL_{ant8} := 40lb$

Area (Normal): $A_{Na} := h_{ant8} \cdot w_{ant8} = 6\ ft^2$

Area (Side): $A_{Ta} := h_{ant8} \cdot d_{ant8} = 3\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant8}, w_{ant8}) = 1.383$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant8}, d_{ant8}) = 1.567$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 8.3\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 4.7\ ft^2$

Wind Force: $F_{ant8f} := q_z \cdot G_h \cdot EPA_N = 175.783 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant8s} := q_z \cdot G_h \cdot EPA_T = 99.54 \cdot lbf$

Antennas

Dimensions: $h_{ant8} := 72 \cdot in$ $w_{ant8} := 8 \cdot in$ $d_{ant8} := 5 \cdot in$

Weight: $DL_{ant8} := 40lb$

Area (Normal): $A_{Na} := h_{ant8} \cdot w_{ant8} = 4\ ft^2$

Area (Side): $A_{Ta} := h_{ant8} \cdot d_{ant8} = 2.5\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant8}, w_{ant8}) = 1.467$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant8}, d_{ant8}) = 1.647$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 5.867\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 4.117\ ft^2$

Wind Force: $F_{ant8f} := q_z \cdot G_h \cdot EPA_N = 124.249 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{ant8s} := q_z \cdot G_h \cdot EPA_T = 87.186 \cdot lbf$

RRH

Dimensions: $h_7 := 20 \cdot in$ $w_7 := 10 \cdot in$ $d_7 := 9 \cdot in$

Weight: $DL_7 := 60lb$

Area (Normal): $A_{Na} := h_7 \cdot w_7 = 1.389\,ft^2$

Area (Side): $A_{Ta} := h_7 \cdot d_7 = 1.25\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_7, w_7) = 1.317$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_7, d_7) = 1.32$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 1.829\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 1.65\,ft^2$

Wind Force: $F_{7f} := q_z \cdot G_h \cdot EPA_N = 38.73 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{7s} := q_z \cdot G_h \cdot EPA_T = 34.955 \cdot lbf$

T-Mobile Loading:

Height: $z := 116$ ft

Velocity Pressure: $q_z := 0.00256 \cdot K_{zv}(z) \cdot V^2 \cdot I \cdot psf = 36.855 \cdot psf$ (Section 3.1.4 p.11)

AIR21

Dimensions: $h_7 := 56 \cdot in$ $w_7 := 12.1 \cdot in$ $d_7 := 7.9 \cdot in$

Weight: $DL_7 := 117.5lb$

Area (Normal): $A_{Na} := h_7 \cdot w_7 = 4.706\,ft^2$

Area (Side): $A_{Ta} := h_7 \cdot d_7 = 3.072\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_7, w_7) = 1.36$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_7, d_7) = 1.403$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 6.402\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 4.31\,ft^2$

Wind Force: $F_{7f} := q_z \cdot G_h \cdot EPA_N = 200.544 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{7s} := q_z \cdot G_h \cdot EPA_T = 135.023 \cdot lbf$

RFS

Dimensions: $h_7 := 73 \cdot in$ $w_7 := 6.5 \cdot in$ $d_7 := 3.25 \cdot in$

Weight: $DL_7 := 60lb$

Area (Normal): $A_{Na} := h_7 \cdot w_7 = 3.295\,ft^2$

Area (Side): $A_{Ta} := h_7 \cdot d_7 = 1.648\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_7, w_7) = 1.541$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_7, d_7) = 1.915$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) = 5.078\,ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) = 3.156\,ft^2$

Wind Force: $F_{7f} := q_z \cdot G_h \cdot EPA_N = 159.072 \cdot lbf$ (Section 2.6.9.2, P. 20)

$F_{7s} := q_z \cdot G_h \cdot EPA_T = 98.858 \cdot lbf$

Member Loading:

Antenna Pipes 2.0

Dimensions: $h_{m1} := 96 \cdot in$ $w_{m1} := 2.375 \cdot in$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_round}(h_{m1}, w_{m1}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot w_{m1}) = 0.237 ft$

Wind Force: $F_{m1} := q_z \cdot G_h \cdot EPA_N = 7.44 \cdot plf$ (Section 2.6.9.2, P. 20)

Antenna Pipes 2.5

Dimensions: $h_{m1} := 109 \cdot in$ $w_{m1} := 2.875 \cdot in$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_round}(h_{m1}, w_{m1}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot w_{m1}) = 0.287 ft$

Wind Force: $F_{m1} := q_z \cdot G_h \cdot EPA_N = 9.006 \cdot plf$ (Section 2.6.9.2, P. 20)

Antenna Pipes 3.0

Dimensions: $h_{m1} := 108 \cdot in$ $w_{m1} := 3.5 \cdot in$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_round}(h_{m1}, w_{m1}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot w_{m1}) = 0.35 ft$

Wind Force: $F_{m1} := q_z \cdot G_h \cdot EPA_N = 10.964 \cdot plf$ (Section 2.6.9.2, P. 20)

Coax Loading Leg B:

Height: $z := \left(\frac{2}{3}\right)\cdot 116$ ft

Velocity Pressure: $q_z := 0.00256\cdot K_{zv}(z)\cdot V^2\cdot I\cdot psf = 33.839\cdot psf$

Cable Area: $h_{m1} := 9\cdot in$ $w_{m1} := 1.625\cdot in\cdot 3 = 0.406\ ft$ (3 row of cables)

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_round}(h_{m1}, w_{m1}) = 0.714$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a}\cdot w_{m1}) = 0.29\ ft$

Wind Force: $F_{m1} := q_z\cdot G_h\cdot EPA_N = 8.344\cdot plf$ (Section 2.6.9.2, P. 20)

Coax Loading Leg C:

Height: $z := \left(\frac{2}{3}\right)\cdot 105.5$ ft

Velocity Pressure: $q_z := 0.00256\cdot K_{zv}(z)\cdot V^2\cdot I\cdot psf = 33.17\cdot psf$

Cable Area: $h_{m1} := 23\cdot in$ $w_{m1} := 1.625\cdot in\cdot 2 = 0.271\ ft$ (2 row of cables)

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{m1}, w_{m1}) = 1.403$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a}\cdot w_{m1}) = 0.38\ ft$

Wind Force: $F_{m1} := q_z\cdot G_h\cdot EPA_N = 10.71\cdot plf$ (Section 2.6.9.2, P. 20)

Coax Loading Leg D:

Height: $z := \left(\frac{2}{3}\right)\cdot 105.5$ ft

Velocity Pressure: $q_z := 0.00256\cdot K_{zv}(z)\cdot V^2\cdot I\cdot psf = 33.17\cdot psf$

Cable Area: $h_{m1} := 9\cdot in$ $w_{m1} := 1.625\cdot in = 0.135\ ft$ (1 row of cables)

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{m1}, w_{m1}) = 1.376$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a}\cdot w_{m1}) = 0.186\ ft$

Wind Force: $F_{m1} := q_z\cdot G_h\cdot EPA_N = 5.252\cdot plf$ (Section 2.6.9.2, P. 20)

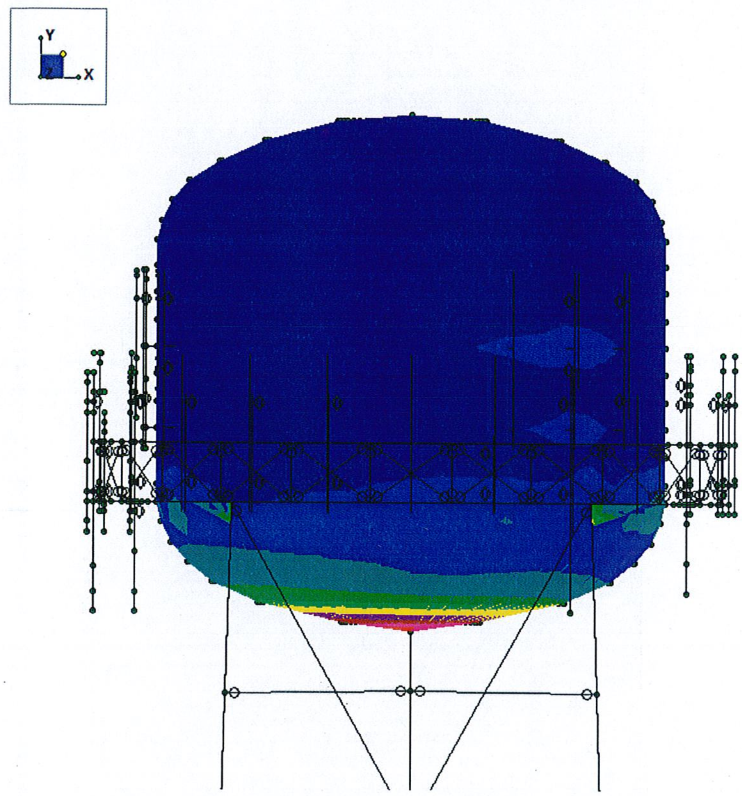
Snow Loads:

		AWWA Reference
Minimum Snow Load AWWA (lbs/ft^2):	$P_{fAWWA} := 25psf$	(Section 3.1.3.1, p. 11)
		ASCE 7-05 Reference
Ground Snow Load (lbs/ft^2):	$p_g := 20psf$	Figure 7-1, Pg. 85
Thermal Factor:	$C_t := 1.0$	Table 7-3, Pg. 93
Exposure Factor:	$C_e := .9$	Table 7-2, Pg. 92
Importance Factor:	$I_s := 1.1$	Table 7-4, Pg. 93
Flat Snow Load (lbs/ft^2):	$P_f := p_g \cdot I_s \cdot C_e \cdot C_t \cdot 0.7$	Equation 7-1, Pg. 81
Minimum Snow Load (lbs/ft^2):	$p_{f\_min} := \begin{cases} (I_s \cdot p_g) & \text{if } p_g \le 20 \cdot psf \\ (I_s \cdot 20psf) & \text{otherwise} \end{cases}$	Section 7.3.4, Pg. 81
	$P_f := \max(P_f, p_{f\_min}, P_{fAWWA})$	$P_f = 25 \cdot psf$

Live Loads:

Catwalk Live Load AWWA (lbs/ft^2): $P_{Live} := 15psf$

Plate Check:



Envelope Plate/Shell Principal Stresses

	Plate		S...	Sigma1 [...	L...	Sigma2 [...	L...	Tau Max ...	L...	An...	LC	Von Mises [ksi]	LC
1	P276	max	T	.889	19	-4.31	34	4.197	18	1.518	30	7.993	9
2		min		.512	33	-7.531	9	2.419	34	1.486	29	4.597	34
3		max	B	.254	27	-4.82	31	4.16	19	1.529	29	8.714	10
4		min		-.876	10	-9.119	10	2.465	31	1.477	30	4.875	31

Maximum Applied Stress: $\sigma_{app} := 8.714 \cdot ksi$ (Obtained from Risa 3D)

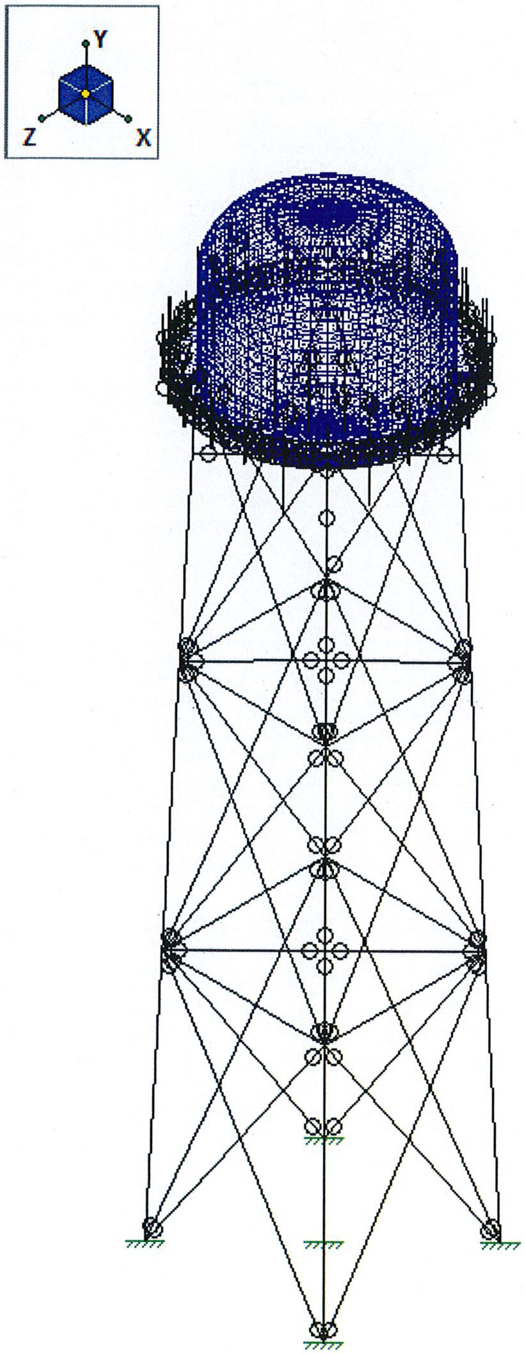
Design Stress: $\sigma_d := 15 \cdot ksi \cdot 0.9 = 13.5 \cdot ksi$ (Per AWWA)

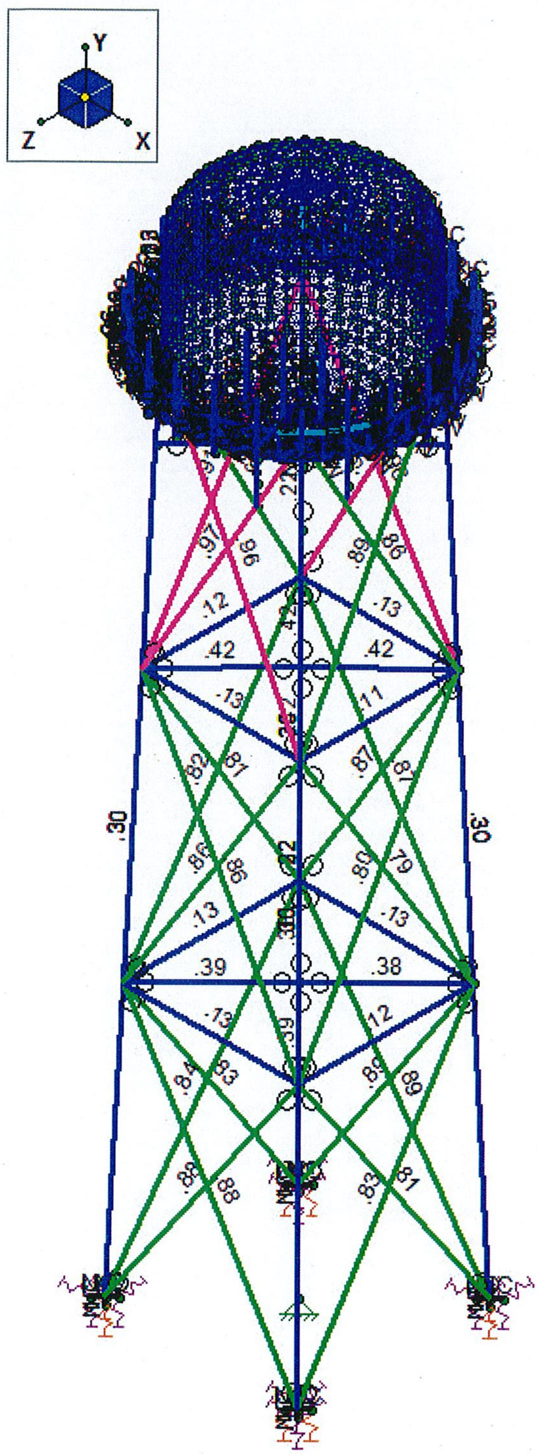
Stress Check:

$$Check := \begin{cases} \text{"OK"} & \text{if } \sigma_{app} \le \sigma_d \\ \text{"NO GOOD"} & \text{otherwise} \end{cases}$$

Check = "OK"

RISA 3D:




Y
Z
X
.97
.96
.89
.86
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.11
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.81