From: Jack Andrews [mailto:jandrews@empiretelecomm.com]
Sent: Thursday, April 05, 2018 11:56 AM
To: Galligan, Coleen
Cc: CSC-DL Siting Council
Subject: RE: Incomplete - EM-ATT-052-180322 - New Britain Ave

Please accept my sincere apologies for not submitting the Mount Analysis with my Exempt Modification application. I submitted one a few years ago for another site, and was advised that the CSC only wanted the tower report; since then I have avoided submitting any mount analyses. I can see why you want one in this instance; it won't happen again.

Regardless, attached is a copy of the passing mount analysis for your review. I will mail 3 hard copies to you this afternoon.

Do you want me to send copies to the municipality and property owners? Thanks for your patience. Jack

From: Galligan, Coleen [mailto:Coleen.Galligan@ct.gov]
Sent: Thursday, April 05, 2018 10:38 AM
To: Jack Andrews <jandrews@empiretelecomm.com>
Cc: CSC-DL Siting Council <Siting.Council@ct.gov>
Subject: Incomplete - EM-ATT-052-180322 - New Britain Ave

Please see the attached correspondence.

Coleen Galligan
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051
(860) 827-2935
Coleen.Galligan@ct.gov

331 Newman Springs Road, Suite 203
Red Bank, NJ 07701
T: 732.383.1950
www.maserconsulting.com

Multi Carrier Add

Antenna Mount Analysis

Site Name: *CT5404: Unionville-Farmington*
FA #: *10071289*
Site Address: *319-321 New Britain Avenue*
Farmington, CT 06085
Hartford County
Maser Project Number: *17963003A*

October 12, 2017

Analysis Type	Sector Mount
Pass/Fail	Pass
Member Utilization	55.9%

Petros E Tsoukalas, P.E.
Connecticut Professional Engineer
License No. 32577

Objective:

In accordance with your request, Maser Consulting Connecticut has evaluated the structural impact of the final **AT&T** equipment on the proposed antenna support mounts at the above referenced address.

Introduction:

Maser Consulting Connecticut has performed limited field observations on August 27, 2017 to verify the existing condition of the structure and to locate and quantify the existing wireless appurtenances, where possible. This structural analysis is only valid for the appurtenances on the site at the time of the field visit. Additionally, Maser Consulting P.A. has reviewed the following documents in completing this report:

- RFDS ID 1765230, provided by Smartlink, dated July 13, 2017

The existing **AT&T** equipment is supported on existing sector frames at a centerline of approximately 150'-0" above ground level. Maser Consulting Connecticut analyzed the existing sector frames and found them to be inadequate to support the proposed installation. Therefore, it is proposed that the existing sector frames be replaced with one (1) SitePro1 mount P/n: RMV-12-396 monopole triple T-Arm and one (1) SitePro1 mount P/n: RMV-12-NP monopole triple T-Arm. The proposed T-Arms are constructed of structural steel pipes which are supported by standoff tubes. This report is based only upon this information as well as information obtained from the field.

Appurtenances:

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

- **(3) CCI HPA-65R-BUU-H8 antennas (Proposed, per RFDS)**
- **(3) CCI TPA-65R-LCUUUU-H8 antennas (Proposed, per RFDS)**
- **(3) RRUS-32 B2 (Proposed, per RFDS)**
- **(3) RRUS-32 (Proposed, per RFDS)**
- **(1) DC/Fiber Squid (Proposed, per RFDS)**
- *(3) Kathrein 800-10121 antennas (Existing, per RFDS)*
- *(3) RRUS-11 (Existing, per RFDS)*
- *(6) TMA (Existing, per RFDS)*
- *(1) DC/Fiber Squid (Existing, per RFDS)*

Codes, Standards and Loading:

Maser Consulting Connecticut utilized the following codes and standards:

- 2016 Connecticut State Building Code, Incorporating the 2012 IBC
- Structural Standards for Antenna Supporting Structures and Antennas ANSI/TIA-222-G
    - Basic Wind Speed – 98 mph (3 Second Gust)
    - Exposure Category - C
    - Structure Class – II
    - Topographic Category - I

Analysis Approach:

The analysis approach used in this structural analysis is based on the premise that if the proposed antenna mounts are structurally adequate to support the existing and 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. Risa-3D, a 3D finite element modeling and analysis program, was used to determine the capacity and usage of the proposed antenna mounts.

Design Parameters:

The following design parameters were utilized in this report:

- Structural Steel Pipes are constructed of A53 Grade B Steel.
- Structural Steel Tubes are constructed of A500 Grade B 46 Steel.
- The existing installation shall be relocated to and the proposed installation shall be installed on one (1) SitePro1 mount P/n: RMV-12-396 monopole triple T-Arm and one (1) SitePro1 mount P/n: RMV-12-NP monopole triple T-Arm
- The two (2) monopole triple T-Arms shall be installed on the monopole at a vertical distance of 6’-0” from each other
- The proposed RRUS-32 B2 shall be installed with the existing relocated RRUS-11 on proposed Commscope MTC3326DHD dual mounting bracket, one (1) per sector, three (3) total
- The proposed DC-6 shall be installed on the stand-off tubes in each sector

Calculations:

The calculations are found in Appendix A of this report.

Conclusion:

Maser Consulting Connecticut has determined the proposed antenna mounts have **ADEQUATE** structural capacity to support the proposed and existing loading. The proposed antenna mounts have been determined to be stressed to a maximum of **55.9%** of their structural capacity with the maximum usage occurring at the horizontal pipe. Therefore, the proposed **AT&T** installation **CAN** be installed as intended.

The conclusions reached by Maser Consulting Connecticut in this evaluation are only applicable for the proposed structural members supporting the proposed **AT&T** telecommunications installation described herein. Further, no structural qualifications are made or implied by this document for the existing tower structure.

Maser Consulting Connecticut reserves the right to amend this report if additional information about the proposed frames 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.

If you have any questions or comments, or require additional information, please do not hesitate to contact me.

Very truly yours,
Maser Consulting Connecticut

Petros E Tsoukalas, P.E.
Geographic Discipline Leader

Tapan Pandey, E.I.T.
Structural Engineer

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APPENDIX A

Design Wind Load On Appurtenances:

Inputs:

ANSI/TIA-222-G Reference

Location:	**Unionville, CT**	
Basic Wind Speed :	$V := 98$ **MPH**	(Figure A1-1e, p. 232)
Antenna Centerline:	$z := 150\text{ft}$	
Structure Class:	Class := "II"	(Table 2-1, P. 39)
Exposure Category:	Exp := "C"	(Section 2.6.5.1, p. 12)
Gust Effect Factor:	$G_h := 1.0$	(Section 2.6.9, p. 16)
Wind Directionality Factor:	$K_d := 0.95$	(Table 2-2, P. 39)
Topographic Category:	Topo := "1"	(Section 2.6.6.2, p. 13)
Crest Height:	$CH := 0\text{ft}$	(Section 2.6.6.4, p. 14)
Importance Factor:	$I := \begin{cases} 1.0 & \text{if Class = "II"} \\ 1.15 & \text{if Class = "III"} \end{cases} = 1$	(Table 2-3, P. 39)

Force Coefficient:

$$C_{f\_square}(h,w) := \begin{cases} 1.2 & \text{if } \frac{h}{w} \le 2.5 \\ \left[1.2 + \frac{0.2}{4.5}\cdot\left(\frac{h}{w} - 2.5\right)\right] & \text{if } \frac{h}{w} > 2.5 \wedge \frac{h}{w} \le 7 \\ \left[1.4 + \frac{0.6}{18}\cdot\left(\frac{h}{w} - 7\right)\right] & \text{if } \frac{h}{w} > 7 \wedge \frac{h}{w} \le 25 \\ 2.0 & \text{otherwise} \end{cases}$$

Table 2-8, P. 42

Square Members

$$C_{f\_round}(h,w) := \begin{cases} 0.7 & \text{if } \frac{h}{w} \le 2.5 \\ \left[0.7 + \frac{0.1}{4.5}\cdot\left(\frac{h}{w} - 2.5\right)\right] & \text{if } \frac{h}{w} > 2.5 \wedge \frac{h}{w} \le 7 \\ \left[0.8 + \frac{0.4}{18}\cdot\left(\frac{h}{w} - 7\right)\right] & \text{if } \frac{h}{w} > 7 \wedge \frac{h}{w} \le 25 \\ 1.2 & \text{otherwise} \end{cases}$$

Table 2-8, P. 42

Round Members

Terrain Exposure Constants:

$$\alpha := \begin{cases} 7.0 & \text{if } Exp = \text{"B"} \\ 9.5 & \text{if } Exp = \text{"C"} \\ 11.5 & \text{if } Exp = \text{"D"} \end{cases} \quad Z_g := \begin{cases} 1200ft & \text{if } Exp = \text{"B"} \\ 900ft & \text{if } Exp = \text{"C"} \\ 700ft & \text{if } Exp = \text{"D"} \end{cases} \quad K_{zmin} := \begin{cases} 0.70 & \text{if } Exp = \text{"B"} \\ 0.85 & \text{if } Exp = \text{"C"} \\ 1.03 & \text{if } Exp = \text{"D"} \end{cases}$$

Table 2-4, P. 40

Velocity Pressure Coefficient:

$$Kz(z) := \begin{vmatrix} K_z \leftarrow \max\left[2.01\cdot\left(\frac{z}{Z_g}\right)^{\frac{2}{\alpha}}, K_{zmin}\right] \\ K_z \leftarrow \min(K_z, 2.01) \end{vmatrix}$$

Velocity Pressure Coefficient: $K_z := Kz(z) = 1.378$ (Section 2.6.5, P. 13)

Velocity Pressure Coefficient:

$$Kzt(z) := K_{zt} \leftarrow \begin{cases} 1.0 \text{ if } Topo = \text{"1"} \\ \text{otherwise} \\ \quad K_e \leftarrow \begin{cases} 0.90 & \text{if } Exp = \text{"B"} \\ 1.00 & \text{if } Exp = \text{"C"} \\ 1.10 & \text{if } Exp = \text{"D"} \end{cases} \\ \quad K_t \leftarrow \begin{cases} 0.43 & \text{if } Topo = \text{"2"} \\ 0.53 & \text{if } Topo = \text{"3"} \\ 0.72 & \text{if } Topo = \text{"4"} \end{cases} \\ \quad f \leftarrow \begin{cases} 1.25 & \text{if } Topo = \text{"2"} \\ 2.00 & \text{if } Topo = \text{"3"} \\ 1.50 & \text{if } Topo = \text{"4"} \end{cases} \\ \quad K_h \leftarrow e^{\left(\frac{f\cdot z}{CH}\right)} \\ \quad \left(1 + \frac{K_e\cdot K_t}{K_h}\right)^2 \end{cases}$$

(Section 2.6.6.4, p. 14)

(Table 2-4 p. 40)

(Table 2-5 p. 40)

(Table 2-5 p. 40)

(Section 2.6.6.4, P. 14)

(Section 2.6.6.4, P. 14)

$K_{zt} := Kzt(z) = 1$

Velocity Pressure: $q_z := 0.00256\cdot K_z\cdot K_{zt}\cdot K_d\cdot V^2\cdot I\cdot psf = 32.195\cdot psf$ (Section 2.6.9.6, P. 25)

AT&T Wind Loading (No Ice):

HPA-65R-BUU-H8

Dimensions: $h_{ant1} := 92.4 \cdot in$ $w_{ant1} := 14.8 \cdot in$ $d_{ant1} := 7.4 \cdot in$

Weight: $DL_{ant1} := 68lb$

Mounting Pipe: $L_{p1} := 96in$ $d_{p1} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant1} \cdot w_{ant1} = 9.497\ ft^2$

Area (Side): $A_{Ta} := h_{ant1} \cdot d_{ant1} = 4.748\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}(h_{ant1}, w_{ant1}) = 1.366$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}(h_{ant1}, d_{ant1}) = 1.583$

Pipe Area (Normal): $A_{Np} := \max[(L_{p1} - h_{ant1}) \cdot (d_{p1}), 0] = 0.059\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{p1} \cdot d_{p1} = 1.583\ ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}(L_{p1}, d_{p1}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f\_N\_a} \cdot A_{Na}) + (C_{f\_p} \cdot A_{Np}) = 13.047\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f\_T\_a} \cdot A_{Ta}) + (C_{f\_p} \cdot A_{Tp}) = 9.416\ ft^2$

Normal Wind Force: $F_{ant1\_N} := q_z \cdot G_h \cdot EPA_N = 420.056 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ant1\_T} := q_z \cdot G_h \cdot EPA_T = 303.151 \cdot lbf$ (Section 2.6.9.2, P. 20)

TPA-65R-LCUUUU-H8

Dimensions: $h_{ant2} := 96 \cdot in$ $w_{ant2} := 14.4 \cdot in$ $d_{ant2} := 8.6 \cdot in$

Weight: $DL_{ant2} := 94.2lb$

Mounting Pipe: $L_{p2} := 96in$ $d_{p2} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant2} \cdot w_{ant2} = 9.6\,ft^2$

Area (Side): $A_{Ta} := h_{ant2} \cdot d_{ant2} = 5.733\,ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}\left(h_{ant2}, w_{ant2}\right) = 1.385$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}\left(h_{ant2}, d_{ant2}\right) = 1.539$

Pipe Area (Normal): $A_{Np} := \max\left[\left(L_{p2} - h_{ant2}\right) \cdot \left(d_{p2}\right), 0\right] = 0\,ft^2$

Pipe Area (Side): $A_{Tp} := L_{p2} \cdot d_{p2} = 1.583\,ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}\left(L_{p2}, d_{p2}\right) = 1.2$

Normal Effective Projected Area: $EPA_N := \left(C_{f\_N\_a} \cdot A_{Na}\right) + \left(C_{f\_p} \cdot A_{Np}\right) = 13.298\,ft^2$

Side Effective Projected Area: $EPA_T := \left(C_{f\_T\_a} \cdot A_{Ta}\right) + \left(C_{f\_p} \cdot A_{Tp}\right) = 10.722\,ft^2$

Normal Wind Force: $F_{ant2\_N} := q_z \cdot G_h \cdot EPA_N = 428.124 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ant2\_T} := q_z \cdot G_h \cdot EPA_T = 345.204 \cdot lbf$ (Section 2.6.9.2, P. 20)

800-10121

Dimensions: $h_{ant3} := 54.5 \cdot in$ $w_{ant3} := 10.3 \cdot in$ $d_{ant3} := 5.9 \cdot in$

Weight: $DL_{ant3} := 44.1lb$

Mounting Pipe: $L_{p3} := 96in$ $d_{p3} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant3} \cdot w_{ant3} = 3.898\ ft^2$

Area (Side): $A_{Ta} := h_{ant3} \cdot d_{ant3} = 2.233\ ft^2$

Force Coefficient (Normal): $C_{f\_N\_a} := C_{f\_square}\left(h_{ant3}, w_{ant3}\right) = 1.324$

Force Coefficient (Side): $C_{f\_T\_a} := C_{f\_square}\left(h_{ant3}, d_{ant3}\right) = 1.475$

Pipe Area (Normal): $A_{Np} := \max\left[\left(L_{p3} - h_{ant3}\right) \cdot \left(d_{p3}\right), 0\right] = 0.684\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{p3} \cdot d_{p3} = 1.583\ ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}\left(L_{p3}, d_{p3}\right) = 1.2$

Normal Effective Projected Area: $EPA_N := \left(C_{f\_N\_a} \cdot A_{Na}\right) + \left(C_{f\_p} \cdot A_{Np}\right) = 5.983\ ft^2$

Side Effective Projected Area: $EPA_T := \left(C_{f\_T\_a} \cdot A_{Ta}\right) + \left(C_{f\_p} \cdot A_{Tp}\right) = 5.193\ ft^2$

Normal Wind Force: $F_{ant3\_N} := q_z \cdot G_h \cdot EPA_N = 192.62 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ant3\_T} := q_z \cdot G_h \cdot EPA_T = 167.18 \cdot lbf$ (Section 2.6.9.2, P. 20)

RRUS-32 B2

Dimensions: $h_{a1} := 27.1 \cdot in$ $w_{a1} := 12 \cdot in$ $d_{a1} := 7 \cdot in$

Weight: $DL_{a1} := 53lbf$

Area (Normal): $A_N := h_{a1} \cdot w_{a1} = 2.258\ ft^2$

Area (Side): $A_T := h_{a1} \cdot d_{a1} = 1.317\ ft^2$

Force Coefficient (Normal): $C_{f\_N} := C_{f\_square}(h_{a1}, w_{a1}) = 1.2$

Force Coefficient (Side): $C_{f\_T} := C_{f\_square}(h_{a1}, d_{a1}) = 1.261$

Front Effective Projected Area: $EPA_N := C_{f\_N} \cdot A_N = 2.71\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f\_T} \cdot A_T = 1.661\ ft^2$

Normal Wind Force: $F_{a1\_N} := q_z \cdot G_h \cdot EPA_N = 87.249 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{a1\_T} := q_z \cdot G_h \cdot EPA_T = 53.48 \cdot lbf$ (Section 2.6.9.2, P. 20)

RRUS-11

Dimensions: $h_{a2} := 17.8 \cdot in$ $w_{a2} := 17 \cdot in$ $d_{a2} := 7.2 \cdot in$

Weight: $DL_{a2} := 50lbf$

Area (Normal): $A_N := h_{a2} \cdot w_{a2} = 2.101\ ft^2$

Area (Side): $A_T := h_{a1} \cdot d_{a1} = 1.317\ ft^2$

Force Coefficient (Normal): $C_{f\_N} := C_{f\_square}(h_{a2}, w_{a2}) = 1.2$

Force Coefficient (Side): $C_{f\_T} := C_{f\_square}(h_{a2}, d_{a2}) = 1.2$

Front Effective Projected Area: $EPA_N := C_{f\_N} \cdot A_N = 2.522\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f\_T} \cdot A_T = 1.581\ ft^2$

Normal Wind Force: $F_{a2\_N} := q_z \cdot G_h \cdot EPA_N = 81.185 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{a2\_T} := q_z \cdot G_h \cdot EPA_T = 50.895 \cdot lbf$ (Section 2.6.9.2, P. 20)

DC6

Dimensions: $h_{a3} := 31.41 \cdot in$ $w_{a3} := 10.24 \cdot in$ $d_{a3} := 10.24 \cdot in$

Weight: $DL_{a3} := 26.2lbf$

Area (Normal): $A_N := h_{a3} \cdot w_{a3} = 2.234\ ft^2$

Area (Side): $A_T := h_{a3} \cdot d_{a3} = 2.234\ ft^2$

Force Coefficient (Normal): $C_{f\_N} := C_{f\_round}(h_{a3}, w_{a3}) = 0.713$

Force Coefficient (Side): $C_{f\_T} := C_{f\_round}(h_{a3}, d_{a3}) = 0.713$

Front Effective Projected Area: $EPA_N := C_{f\_N} \cdot A_N = 1.592\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f\_T} \cdot A_T = 1.592\ ft^2$

Normal Wind Force: $F_{a3\_N} := q_z \cdot G_h \cdot EPA_N = 51.244 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{a3\_T} := q_z \cdot G_h \cdot EPA_T = 51.244 \cdot lbf$ (Section 2.6.9.2, P. 20)

TMA LGP 21401

Dimensions: $h_{a4} := 15 \cdot in$ $w_{a4} := 10 \cdot in$ $d_{a4} := 5 \cdot in$

Weight: $DL_{a4} := 20lbf$

Area (Normal): $A_N := h_{a4} \cdot \left(w_{a4} - \frac{w_{ant3}}{2} \right) = 0.505\ ft^2$ (Consider Shielded by Antenna)

Area (Side): $A_T := h_{a4} \cdot d_{a4} = 0.521\ ft^2$

Force Coefficient (Normal): $C_{f\_N} := C_{f\_square}(h_{a4}, w_{a4}) = 1.2$

Force Coefficient (Side): $C_{f\_T} := C_{f\_square}(h_{a4}, d_{a4}) = 1.222$

Front Effective Projected Area: $EPA_N := C_{f\_N} \cdot A_N = 0.606\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f\_T} \cdot A_T = 0.637\ ft^2$

Normal Wind Force: $F_{a4\_N} := q_z \cdot G_h \cdot EPA_N = 19.518 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{a4\_T} := q_z \cdot G_h \cdot EPA_T = 20.495 \cdot lbf$ (Section 2.6.9.2, P. 20)

Antenna Mount Loading:

3.0 STD Pipe:

Height: $h_{m1} := 12ft + 6in$

Width: $w_{m1} := 3.5 \cdot in$

Area: $A_a := h_{m1} \cdot w_{m1} = 3.646\ ft^2$

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

Wind Load: $f_{m1} := q_z \cdot G_h \cdot C_f \cdot w_{m1} = 11.268 \cdot plf$ (Section 2.6.9.2, P. 20)

2.0 STD Pipe:

Height: $h_{m2} := 8ft$

Width: $w_{m2} := 2.375 \cdot in$

Area: $A_a := h_{m2} \cdot w_{m2} = 1.583\ ft^2$

Force Coefficient: $C_f := C_{f\_round}(h_{m2}, w_{m2}) = 1.2$

Wind Load: $f_{m2} := q_z \cdot G_h \cdot C_f \cdot w_{m2} = 7.646 \cdot plf$ (Section 2.6.9.2, P. 20)

HSS4X4X1/4:

Height: $h_{m3} := 36in$

Width: $w_{m3} := 4 \cdot in$

Area: $A_a := h_{m3} \cdot w_{m3} = 1\ ft^2$

Force Coefficient: $C_f := C_{f\_square}(h_{m3}, w_{m3}) = 1.467$

Wind Load: $f_{m3} := q_z \cdot G_h \cdot C_f \cdot w_{m3} = 15.74 \cdot plf$ (Section 2.6.9.2, P. 20)

Design Wind Load On Appurtenances With Ice:

Inputs:

ANSI/TIA-222-G Reference

Basic Wind Speed With Ice: $V_i := 40$ **MPH** (Figure a5-2a, p. 233)

Design Ice thickness: $t_i := 1.0in$ (Figure A1-2a, p. 233)

Ice Density: $\rho_i := 56pcf$ (Section 2.6.8, p. 16)

Importance Factor: $I_{wind} := 1.00$ (Table 2-3, P. 39)

Ice Importance Factor: (Table 2-3, P. 39)

$$I_{ice} := \begin{cases} 1.00 & \text{if Class = "II"} \\ 1.25 & \text{if Class = "III"} \end{cases}$$

Factored Ice Thickness: (Section 2.6.8, p. 16)

$$t_{iz.}(z) := \left| \begin{array}{l} K_{iz.} \leftarrow \left(\frac{z}{33ft}\right)^{0.10} \\ K_{iz} \leftarrow \min\left(K_{iz.}, 1.4\right) \\ 2.0 \cdot t_i \cdot I_{ice} \cdot K_{iz} \cdot \left(K_{zt}\right)^{0.35} \end{array} \right.$$

$$t_{iz} := t_{iz.}(z) = 2.327 \cdot in$$

Velocity Pressure: (Section 2.6.9.6, P. 25)

$$q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V_i^2 \cdot I_{wind} \cdot psf = 5.364 \cdot psf$$

AT&T Wind Loading (With Ice):

HPA-65R-BUU-H8

Dimensions: $h_{i\_ant1} := h_{ant1} + 2 \cdot t_{iz} = 8.088\ ft$

$w_{i\_ant1} := w_{ant1} + 2 \cdot t_{iz} = 1.621\ ft$

$d_{i\_ant1} := d_{ant1} + 2 \cdot t_{iz} = 1.004\ ft$

Mounting Pipe: $L_{i\_p1} := L_{p1} + 2 \cdot t_{iz} = 8.388\ ft$

$d_{i\_p1} := d_{p1} + 2 \cdot t_{iz} = 0.586\ ft$

Area (Normal): $A_{iN} := h_{i\_ant1} \cdot w_{i\_ant1} = 13.112\ ft^2$

Area (Side): $A_{iT} := h_{i\_ant1} \cdot d_{i\_ant1} = 8.124\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}\left(h_{i\_ant1}, w_{i\_ant1}\right) = 1.311$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}\left(h_{i\_ant1}, d_{i\_ant1}\right) = 1.435$

Pipe Area (Normal): $A_{Np} := \max\left[\left(L_{i\_p1} - h_{i\_ant1}\right) \cdot \left(d_{i\_p1}\right), 0\right] = 0.176\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i\_p1} \cdot d_{i\_p1} = 4.913\ ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}\left(L_{i\_p1}, d_{i\_p1}\right) = 0.963$

Normal Effective Projected Area: $EPA_{iN} := \left(C_{if\_N} \cdot A_{iN}\right) + \left(C_{f\_p} \cdot A_{Np}\right) = 17.354\ ft^2$

Side Effective Projected Area: $EPA_{iT} := \left(C_{if\_T} \cdot A_{iT}\right) + C_{f\_p} \cdot A_{Tp} = 16.388\ ft^2$

Normal Wind Force: $F_{iant1\_N} := q_z \cdot G_h \cdot EPA_{iN} = 93.078 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{iant1\_T} := q_z \cdot G_h \cdot EPA_{iT} = 87.901 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_ant1} := \sqrt{w_{ant1}^2 + d_{ant1}^2} = 1.379\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_ant1} := \pi \cdot t_{iz} \cdot \left(D_{c\_ant1} + t_{iz}\right) = 0.958\ ft^2$

Total Ice Dead Load: $DL_{iz\_ant1} := \left(A_{iz\_ant1} \cdot h_{i\_ant1}\right) \cdot \rho_i = 433.966\ lbf$

TPA-65R-LCUUUU-H8

Dimensions: $h_{i\_ant2} := h_{ant2} + 2 \cdot t_{iz} = 8.388\ ft$

$w_{i\_ant2} := w_{ant2} + 2 \cdot t_{iz} = 1.588\ ft$

$d_{i\_ant2} := d_{ant2} + 2 \cdot t_{iz} = 1.104\ ft$

Mounting Pipe: $L_{i\_p2} := L_{p2} + 2 \cdot t_{iz} = 8.388\ ft$

$d_{i\_p2} := d_{p2} + 2 \cdot t_{iz} = 0.586\ ft$

Area (Normal): $A_{iN} := h_{i\_ant2} \cdot w_{i\_ant2} = 13.318\ ft^2$

Area (Side): $A_{iT} := h_{i\_ant2} \cdot d_{i\_ant2} = 9.264\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}\left(h_{i\_ant2}, w_{i\_ant2}\right) = 1.324$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}\left(h_{i\_ant2}, d_{i\_ant2}\right) = 1.42$

Pipe Area (Normal): $A_{Np} := \max\left[\left(L_{i\_p2} - h_{i\_ant2}\right) \cdot \left(d_{i\_p2}\right), 0\right] = 0\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i\_p2} \cdot d_{i\_p2} = 4.913\ ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}\left(L_{i\_p2}, d_{i\_p2}\right) = 0.963$

Normal Effective Projected Area: $EPA_{iN} := \left(C_{if\_N} \cdot A_{iN}\right) + \left(C_{f\_p} \cdot A_{Np}\right) = 17.629\ ft^2$

Side Effective Projected Area: $EPA_{iT} := \left(C_{if\_T} \cdot A_{iT}\right) + C_{f\_p} \cdot A_{Tp} = 17.883\ ft^2$

Normal Wind Force: $F_{iant2\_N} := q_z \cdot G_h \cdot EPA_{iN} = 94.556 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{iant2\_T} := q_z \cdot G_h \cdot EPA_{iT} = 95.919 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_ant2} := \sqrt{w_{ant2}^2 + d_{ant2}^2} = 1.398\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_ant2} := \pi \cdot t_{iz} \cdot \left(D_{c\_ant2} + t_{iz}\right) = 0.97\ ft^2$

Total Ice Dead Load: $DL_{iz\_ant2} := \left(A_{iz\_ant2} \cdot h_{i\_ant2}\right) \cdot \rho_i = 455.445\ lbf$

800-10121

Dimensions: $h_{i\_ant3} := h_{ant3} + 2 \cdot t_{iz} = 4.929\ ft$

$w_{i\_ant3} := w_{ant3} + 2 \cdot t_{iz} = 1.246\ ft$

$d_{i\_ant3} := d_{ant3} + 2 \cdot t_{iz} = 0.879\ ft$

Mounting Pipe: $L_{i\_p3} := L_{p3} + 2 \cdot t_{iz} = 8.388\ ft$

$d_{i\_p3} := d_{p3} + 2 \cdot t_{iz} = 0.586\ ft$

Area (Normal): $A_{iN} := h_{i\_ant3} \cdot w_{i\_ant3} = 6.143\ ft^2$

Area (Side): $A_{iT} := h_{i\_ant3} \cdot d_{i\_ant3} = 4.335\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}(h_{i\_ant3}, w_{i\_ant3}) = 1.265$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}(h_{i\_ant3}, d_{i\_ant3}) = 1.338$

Pipe Area (Normal): $A_{Np} := \max\left[(L_{i\_p3} - h_{i\_ant3}) \cdot (d_{i\_p3}), 0\right] = 2.026\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i\_p3} \cdot d_{i\_p3} = 4.913\ ft^2$

Force Coefficient (Normal): $C_{f\_p} := C_{f\_round}(L_{i\_p3}, d_{i\_p3}) = 0.963$

Normal Effective Projected Area: $EPA_{iN} := (C_{if\_N} \cdot A_{iN}) + (C_{f\_p} \cdot A_{Np}) = 9.719\ ft^2$

Side Effective Projected Area: $EPA_{iT} := (C_{if\_T} \cdot A_{iT}) + C_{f\_p} \cdot A_{Tp} = 10.53\ ft^2$

Normal Wind Force: $F_{iant3\_N} := q_z \cdot G_h \cdot EPA_{iN} = 52.129 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{iant3\_T} := q_z \cdot G_h \cdot EPA_{iT} = 56.482 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_ant3} := \sqrt{w_{ant3}^2 + d_{ant3}^2} = 0.989\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_ant3} := \pi \cdot t_{iz} \cdot (D_{c\_ant3} + t_{iz}) = 0.721\ ft^2$

Total Ice Dead Load: $DL_{iz\_ant3} := (A_{iz\_ant3} \cdot h_{i\_ant3}) \cdot \rho_i = 198.959\ lbf$

RRUS-32 B2

Dimensions: $h_{i\_a1} := h_{a1} + 2 \cdot t_{iz} = 2.646\ ft$

$w_{i\_a1} := w_{a1} + 2 \cdot t_{iz} = 1.388\ ft$

$d_{i\_a1} := d_{a1} + 2 \cdot t_{iz} = 0.971\ ft$

Area (Normal): $A_{iN} := h_{i\_a1} \cdot w_{i\_a1} = 3.672\ ft^2$

Area (Side): $A_{iT} := h_{i\_a1} \cdot d_{i\_a1} = 2.57\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}(h_{i\_a1}, w_{i\_a1}) = 1.2$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}(h_{i\_a1}, d_{i\_a1}) = 1.21$

Front Effective Wind Area: $EPA_{iN} := C_{if\_N} \cdot A_{iN} = 4.407\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if\_T} \cdot A_{iT} = 3.109\ ft^2$

Normal Wind Force: $F_{ia1\_N} := q_z \cdot G_h \cdot EPA_{iN} = 23.637 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ia1\_T} := q_z \cdot G_h \cdot EPA_{iT} = 16.678 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_a1} := \sqrt{w_{a1}^2 + d_{a1}^2} = 1.158\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_a1} := \pi \cdot t_{iz} \cdot (D_{c\_a1} + t_{iz}) = 0.823\ ft^2$

Total Ice Dead Load: $DL_{iz\_a1} := (A_{iz\_a1} \cdot h_{i\_a1}) \cdot \rho_i = 122.015\ lbf$

RRUS-11

Dimensions: $h_{i\_a2} := h_{a2} + 2 \cdot t_{iz} = 1.871\ ft$

$w_{i\_a2} := w_{a2} + 2 \cdot t_{iz} = 1.804\ ft$

$d_{i\_a2} := d_{a2} + 2 \cdot t_{iz} = 0.988\ ft$

Area (Normal): $A_{iN} := h_{i\_a2} \cdot w_{i\_a2} = 3.376\ ft^2$

Area (Side): $A_{iT} := h_{i\_a2} \cdot d_{i\_a2} = 1.848\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}\left(h_{i\_a2}, w_{i\_a2}\right) = 1.2$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}\left(h_{i\_a2}, d_{i\_a2}\right) = 1.2$

Front Effective Wind Area: $EPA_{iN} := C_{if\_N} \cdot A_{iN} = 4.052\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if\_T} \cdot A_{iT} = 2.218\ ft^2$

Normal Wind Force: $F_{ia2\_N} := q_z \cdot G_h \cdot EPA_{iN} = 21.732 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ia2\_T} := q_z \cdot G_h \cdot EPA_{iT} = 11.897 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_a2} := \sqrt{{w_{a2}}^2 + {d_{a2}}^2} = 1.538\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_a2} := \pi \cdot t_{iz} \cdot \left(D_{c\_a2} + t_{iz}\right) = 1.055\ ft^2$

Total Ice Dead Load: $DL_{iz\_a2} := \left(A_{iz\_a2} \cdot h_{i\_a2}\right) \cdot \rho_i = 110.587\ lbf$

DC6

Dimensions: $h_{i\_a3} := h_{a3} + 2 \cdot t_{iz} = 3.005\,ft$

$w_{i\_a3} := w_{a3} + 2 \cdot t_{iz} = 1.241\,ft$

$d_{i\_a3} := d_{a3} + 2 \cdot t_{iz} = 1.241\,ft$

Area (Normal): $A_{iN} := h_{i\_a3} \cdot w_{i\_a3} = 3.73\,ft^2$

Area (Side): $A_{iT} := h_{i\_a3} \cdot d_{i\_a3} = 3.73\,ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_round}(h_{i\_a3}, w_{i\_a3}) = 0.7$

Force Coefficient (Side): $C_{if\_T} := C_{f\_round}(h_{i\_a3}, d_{i\_a3}) = 0.7$

Front Effective Wind Area: $EPA_{iN} := C_{if\_N} \cdot A_{iN} = 2.611\,ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if\_T} \cdot A_{iT} = 2.611\,ft^2$

Normal Wind Force: $F_{ia3\_N} := q_z \cdot G_h \cdot EPA_{iN} = 14.005 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ia3\_T} := q_z \cdot G_h \cdot EPA_{iT} = 14.005 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_a3} := w_{a3} = 0.853\,ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_a3} := \pi \cdot t_{iz} \cdot (D_{c\_a3} + t_{iz}) = 0.638\,ft^2$

Total Ice Dead Load: $DL_{iz\_a3} := (A_{iz\_a3} \cdot h_{i\_a3}) \cdot \rho_i = 107.37\,lbf$

TMA LGP 21401)

Dimensions: $h_{i\_a4} := h_{a4} + 2 \cdot t_{iz} = 1.638\ ft$

$w_{i\_a4} := w_{a4} + 2 \cdot t_{iz} = 1.221\ ft$

$d_{i\_a4} := d_{a4} + 2 \cdot t_{iz} = 0.804\ ft$

Area (Normal): $A_{iN} := h_{i\_a4} \cdot \left(w_{i\_a4} - \frac{w_{i\_ant3}}{2} \right) = 0.98\ ft^2$ (Consider Shielded by Antenna)

Area (Side): $A_{iT} := h_{i\_a4} \cdot d_{i\_a4} = 1.318\ ft^2$

Force Coefficient (Normal): $C_{if\_N} := C_{f\_square}(h_{i\_a4}, w_{i\_a4}) = 1.2$

Force Coefficient (Side): $C_{if\_T} := C_{f\_square}(h_{i\_a4}, d_{i\_a4}) = 1.2$

Front Effective Wind Area: $EPA_{iN} := C_{if\_N} \cdot A_{iN} = 1.175\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if\_T} \cdot A_{iT} = 1.581\ ft^2$

Normal Wind Force: $F_{ia4\_N} := q_z \cdot G_h \cdot EPA_{iN} = 6.305 \cdot lbf$ (Section 2.6.9.2, P. 20)

Side Wind Force: $F_{ia4\_T} := q_z \cdot G_h \cdot EPA_{iT} = 8.481 \cdot lbf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_a4} := \sqrt{{w_{a4}}^2 + {d_{a4}}^2} = 0.932\ ft$ (Figure 2-2, P. 47)

Cross Sectional Area of Ice: $A_{iz\_a4} := \pi \cdot t_{iz} \cdot (D_{c\_a4} + t_{iz}) = 0.686\ ft^2$

Total Ice Dead Load: $DL_{iz\_a4} := (A_{iz\_a4} \cdot h_{i\_a4}) \cdot \rho_i = 62.893\ lbf$

Antenna Mount Loading With Ice:

3.0 STD Pipe:

Height: $h_{im1} := h_{m1} + 2 \cdot t_{iz}$

Width: $w_{im1} := w_{m1} + 2 \cdot t_{iz}$

Area: $A_a := h_{im1} \cdot w_{im1} = 8.757\ ft^2$

Force Coefficient: $C_f := C_{f\_round}(h_{im1}, w_{im1}) = 1.066$

Wind Load: $f_{im1} := q_z \cdot G_h \cdot C_f \cdot w_{im1} = 3.885 \cdot plf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_m1} := w_{m1} = 0.292\ ft$

Cross Sectional Area of Ice: $A_{iz\_m1} := \pi \cdot t_{iz} \cdot (D_{c\_m1} + t_{iz}) = 0.296\ ft^2$

Total Ice Dead Load: $DL_{iz\_m1} := (A_{iz\_m1}) \cdot \rho_i = 16.566 \cdot plf$

2.0 STD Pipe:

Height: $h_{im2} := h_{m2} + 2 \cdot t_{iz}$

Width: $w_{im2} := w_{m2} + 2 \cdot t_{iz}$

Area: $A_a := h_{im2} \cdot w_{im2} = 4.913\ ft^2$

Force Coefficient: $C_f := C_{f\_round}(h_{im2}, w_{im2}) = 0.963$

Wind Load: $f_{im2} := q_z \cdot G_h \cdot C_f \cdot w_{im2} = 3.024 \cdot plf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_m2} := w_{m2} = 0.198\ ft$

Cross Sectional Area of Ice: $A_{iz\_m2} := \pi \cdot t_{iz} \cdot (D_{c\_m2} + t_{iz}) = 0.239\ ft^2$

Total Ice Dead Load: $DL_{iz\_m2} := (A_{iz\_m2}) \cdot \rho_i = 13.367 \cdot plf$

HSS4X4X1/2:

Height: $h_{im3} := h_{m3} + 2 \cdot t_{iz}$

Width: $w_{im3} := w_{m3} + 2 \cdot t_{iz}$

Area: $A_a := h_{im3} \cdot w_{im3} = 2.443\ ft^2$

Force Coefficient: $C_f := C_{f\_square}(h_{im3}, w_{im3}) = 1.298$

Wind Load: $f_{im3} := q_z \cdot G_h \cdot C_f \cdot w_{im3} = 5.019 \cdot plf$ (Section 2.6.9.2, P. 20)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c\_m3} := \sqrt{(w_{m3})^2 + (w_{m3})^2} = 0.471\ ft$

Cross Sectional Area of Ice: $A_{iz\_m3} := \pi \cdot t_{iz} \cdot (D_{c\_m3} + t_{iz}) = 0.405\ ft^2$

Total Ice Dead Load: $DL_{iz\_m3} := (A_{iz\_m3}) \cdot \rho_i = 22.697 \cdot plf$

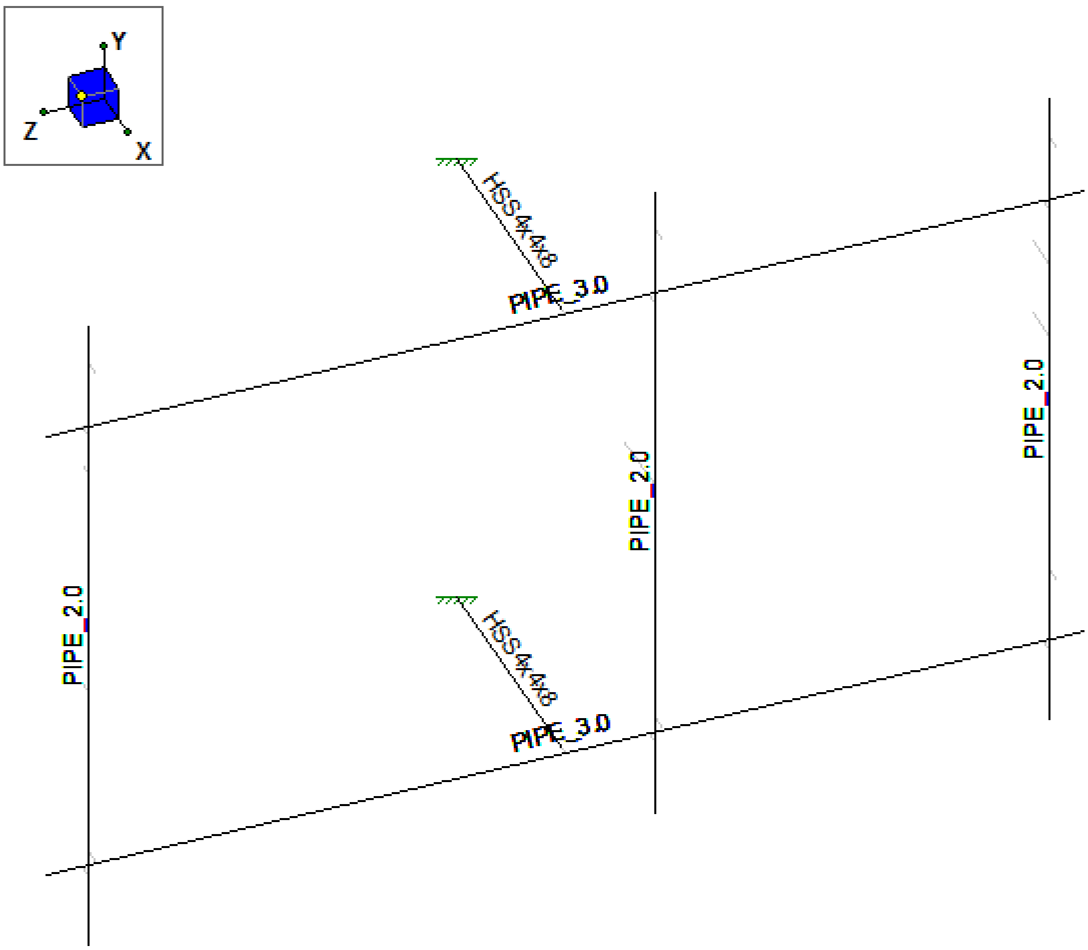
Summary:

	Dead Load (No Ice)	Normal Wind Load (No Ice)	Side Wind Load (No Ice)
HPA-65R-BUU-H8	$DL_{ant1} = 68\,lb$	$F_{ant1\_N} = 420\,lbf$	$F_{ant1\_T} = 303\,lbf$
TPA-65R-LCUUUU-H8	$DL_{ant2} = 94\,lb$	$F_{ant2\_N} = 428\,lbf$	$F_{ant2\_T} = 345\,lbf$
800-10121	$DL_{ant3} = 44\,lb$	$F_{ant3\_N} = 193\,lbf$	$F_{ant3\_T} = 167\,lbf$
RRUS-32	$DL_{a1} = 53\,lbf$	$F_{a1\_N} = 87\,lbf$	$F_{a1\_T} = 53\,lbf$
RRUS-11	$DL_{a2} = 50\,lbf$	$F_{a2\_N} = 81\,lbf$	$F_{a2\_T} = 51\,lbf$
DC6	$DL_{a3} = 26\,lbf$	$F_{a3\_N} = 51\,lbf$	$F_{a3\_T} = 51\,lbf$
TMA	$DL_{a4} = 20\,lbf$	$F_{a4\_N} = 20\,lbf$	$F_{a4\_T} = 20\,lbf$

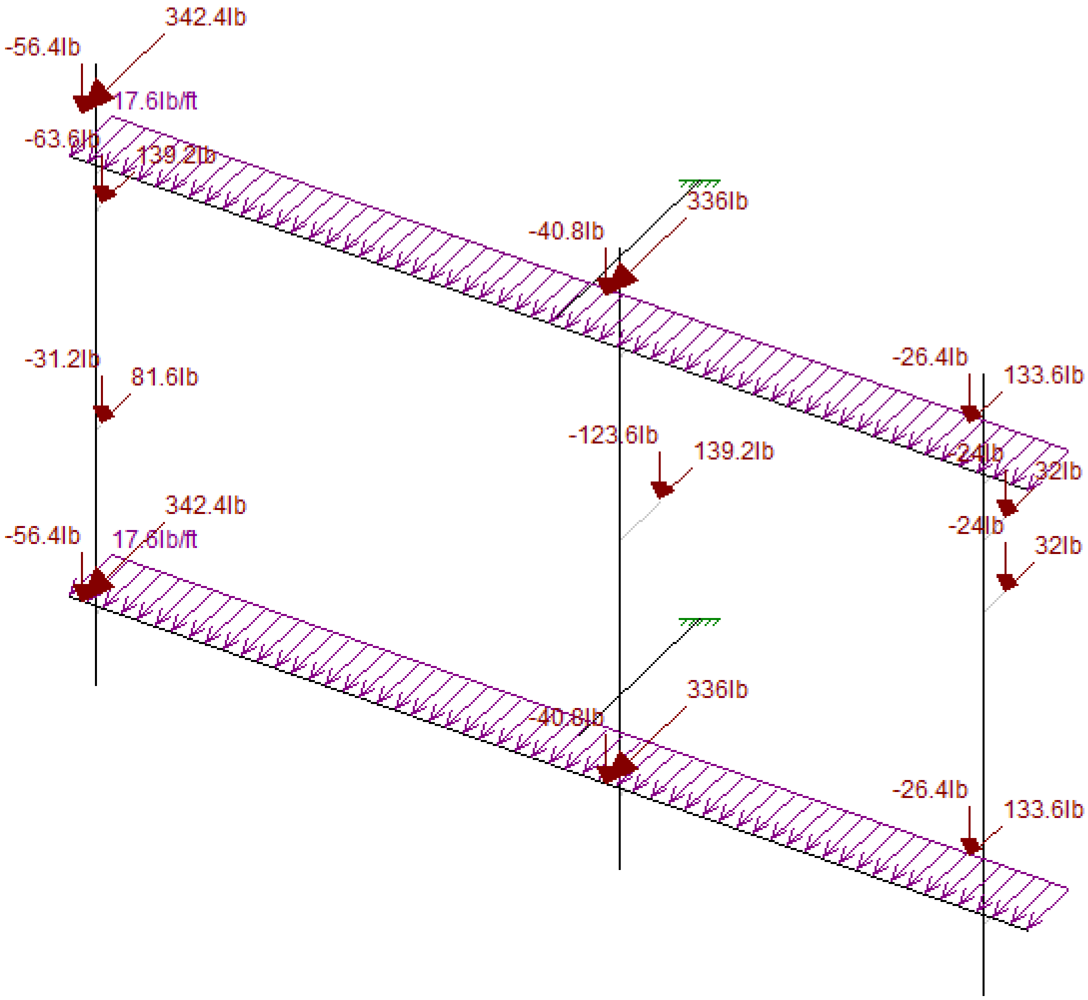
	Dead Load (With Ice)	Normal Wind Load (With Ice)	Side Wind Load (With Ice)
HPA-65R-BUU-H8	$DL_{iz\_ant1} = 434\,lbf$	$F_{iant1\_N} = 93\,lbf$	$F_{iant1\_T} = 88\,lbf$
TPA-65R-LCUUUU-H8	$DL_{iz\_ant2} = 455\,lbf$	$F_{iant2\_N} = 95\,lbf$	$F_{iant2\_T} = 96\,lbf$
800-10121	$DL_{iz\_ant3} = 199\,lbf$	$F_{iant3\_N} = 52\,lbf$	$F_{iant3\_T} = 56\,lbf$
RRUS-32	$DL_{iz\_a1} = 122\,lbf$	$F_{ia1\_N} = 24\,lbf$	$F_{ia1\_T} = 17\,lbf$
RRUS-11	$DL_{iz\_a2} = 111\,lbf$	$F_{ia2\_N} = 22\,lbf$	$F_{ia2\_T} = 12\,lbf$
DC6	$DL_{iz\_a3} = 107\,lbf$	$F_{ia3\_N} = 14\,lbf$	$F_{ia3\_T} = 14\,lbf$
TMA	$DL_{iz\_a4} = 63\,lbf$	$F_{ia4\_N} = 6\,lbf$	$F_{ia4\_T} = 8\,lbf$

	Dead Load (With Ice)	Wind Load (No Ice)	Wind Load (With Ice)
3.0 STD Pipe:	$DL_{iz\_m1} = 17 \cdot plf$	$f_{m1} = 11 \cdot plf$	$f_{im1} = 4 \cdot plf$
2.0 STD Pipe:	$DL_{iz\_m2} = 13 \cdot plf$	$f_{m2} = 8 \cdot plf$	$f_{im2} = 3 \cdot plf$
HSS4X4X1/2:	$DL_{iz\_m3} = 23 \cdot plf$	$f_{m3} = 16 \cdot plf$	$f_{im3} = 5 \cdot plf$

Risa Model:



Worse Case Loading:



Loads: LC 8, 1.2D+1.6W7
Envelope Only Solution

Risa Member Code Check: