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at&t

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LTE 3C

Antenna Mount Analysis

Site Name: CTL01054
FA #: 10035333
Crown Castle Site Number: 876333
Site Address: 10 Sparks Street
Plainville, CT 06062
Hartford County
Maser Project Number: 15946039A

December 9, 2015

Analysis Type	Antenna Platform
Pass/Fail	Pass
Member Utilization	90.5 %

STATE OF CONNECTICUT
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No. 28188
LICENSED
PROFESSIONAL ENGINEER

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Connecticut Professional Engineer
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Objective:

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

Introduction:

Maser Consulting Connecticut has reviewed the following documents in completing this report:

- RFDS 709257, provided by Smartlink, dated July 06, 2015
- Mount Mapping Report prepared by Cat5 Resources, LLC, dated November 14, 2015

The existing AT&T equipment is supported on an existing platform frame constructed of structural steel pipes, angles, and steel grating at a centerline of approximately 115-0" above ground level. This report is based upon this information.

Discrete and Linear Appurtenances:

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

- (3) Powerwave 7770 Antennas
- (3) CCI OPA-65R-LCUU-H8 Antennas
- (3) KMW AM-X-CD-16-65-00T-RET
- (6) Powerwave LGP 21401 TMAs
- (2) Raycap DC6-48-60-18-8F
- (6) Ericsson RRUS-11
- (3) Ericsson RRUS-32

Codes, Standards and Loading:

Maser Consulting Connecticut utilized the following codes and standards:

- 2005 CT State Building Code
- Structural Standards for Antenna Supporting Structures and Antennas ANSI/TIA-222-F
    - Basic Wind Speed – 80 mph
- Specification for Structural Steel Buildings ANSI/AISC 360-05, American Institute of Steel Construction (AISC) 9th Edition
- ASCE/SEI 7-05: Minimum Design Loads for Buildings and Other Structures (Ice Loading Only)

Analysis Approach & Assumptions:

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

The following assumptions were utilized in this report:

- Structural Steel Pipes are constructed of A53 Grade B Steel.
- Structural Steel Angles are constructed of A36 Steel.
- Hollow Structural Steel members are constructed of A500 Grade B46 Steel.

Calculations:
The calculations are found in Appendix A of this report.

Conclusion:
The existing sector frame was analyzed for the loading in the applicable codes and standards. The sector frame platform has been determined to be structurally **ADEQUATE** to support the proposed panel antennas, based upon the aforementioned assumptions. The sector frame platform has been determined to be stressed to a maximum of **90.5%** of its structural capacity with the maximum usage occurring at one of the horizontal angles along the edge of the platform. The bolts attaching the platform to the existing monopole are stressed to a maximum of **8.8%** of their capacity. Therefore, the proposed **AT&T** installation **CAN** be placed as intended.

The conclusions reached by Maser Consulting Connecticut in this evaluation are only applicable for the existing 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.

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

Frank Pazden, P.E.
Telecommunications Department Manager

Daniel Guadron
Structural Design Engineer

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APPENDIX A
Calculations

Structural analysis of antenna mounts supporting the existing and proposed AT&T appurtenances at 10 Sparks Street Plainville, CT

Final AT&T Appurtenance Configuration:

- (3) Powerwave 7770 Antennas
- (3) CCI OPA-65R-LCUU-H8 Antennas
- (3) KMW AM-X-CD-16-65-00T-RET
- (6) Powerwave LGP 21401 TMAs
- (2) Raycap DC6-48-60-18-8F
- (6) Ericsson RRUS-11
- (3) Ericsson RRUS-32

Design Wind Load On Appurtenances:

Inputs:

TIA-222-F Reference

Location: **Plainville, CT**

Basic Wind Speed : $V := 80$ MPH — Section 16 (CT County listings of minimum basic wind speeds, P. 28)

Antenna Centerline: $z := 115$ ft — (Section 2.3.3, P. 4)

Gust Effect Factors: — (Section 2.3.4, P. 5)

$$G_H(z) := \begin{cases} 1.25 & \text{if } 0.65 + \dfrac{0.60}{\left(\dfrac{z}{33}\right)^{\frac{1}{7}}} > 1.25 \\ 1.0 & \text{if } 0.65 + \dfrac{0.60}{\left(\dfrac{z}{33}\right)^{\frac{1}{7}}} < 1.0 \\ 0.65 + \dfrac{0.60}{\left(\dfrac{z}{33}\right)^{\frac{1}{7}}} & \text{otherwise} \end{cases}$$

Gust Effect Factor: $G_h := G_H(z) = 1.152$

Force Coefficient: — (Table 3, P. 8)

Square Members

$$C_{f_square}(h, w) := \begin{cases} 1.4 & \text{if } \dfrac{h}{w} \le 7 \\ \left[1.4 + \dfrac{0.6}{18} \cdot \left(\dfrac{h}{w} - 7\right)\right] & \text{if } \dfrac{h}{w} > 7 \wedge \dfrac{h}{w} \le 25 \\ 2.0 & \text{otherwise} \end{cases}$$

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

(Table 3, P. 8)

Round Members

Velocity Pressure Coefficients:

$$K_z(z) := \begin{cases} 2.58 & \text{if } \left(\frac{z}{33}\right)^{\frac{2}{7}} > 2.58 \\ 1.0 & \text{if } \left(\frac{z}{33}\right)^{\frac{2}{7}} < 1.0 \\ \left(\frac{z}{33}\right)^{\frac{2}{7}} & \text{otherwise} \end{cases}$$

(Section 2.3.3, P. 4)

Velocity Pressure Coefficient: $K_z := K_z(z) = 1.429$ (Section 2.3.3, P. 4)

$K_{zt} := 1$ ASCE 7-05 (Section 10.4.5, P. 4)

Velocity Pressure: $q_z := 0.00256\cdot K_z\cdot V^2\cdot psf = 23.406\cdot psf$ (Section 2.3.3, P. 4)

AT&T Wind Loading:

OPA-65R-LCUU-H8

Dimensions: $h_{ant1} := 92.7 \cdot in$ $w_{ant1} := 14.4 \cdot in$ $d_{ant1} := 7.0 \cdot in$

Weight: $DL_{ant1} := 88 lb$

Mounting Pipe: $L_{p1} := 108 in$ $d_{p1} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant1} \cdot w_{ant1} = 9.27\ ft^2$

Area (Side): $A_{Ta} := h_{ant1} \cdot d_{ant1} = 4.506\ ft^2$

Force Coefficient (Normal): $C_{f_N_a} := C_{f_square}(h_{ant1}, w_{ant1}) = 1.4$

Force Coefficient (Side): $C_{f_T_a} := C_{f_square}(h_{ant1}, d_{ant1}) = 1.608$

Pipe Area (Normal): $A_{Np} := \max[(L_{p1} - h_{ant1}) \cdot (d_{p1}), 0] = 0.252\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{p1} \cdot d_{p1} = 1.781\ ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{p1}, d_{p1}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f_N_a} \cdot A_{Na}) + (C_{f_p} \cdot A_{Np}) = 13.281\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f_T_a} \cdot A_{Ta}) + (C_{f_p} \cdot A_{Tp}) = 9.384\ ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 13.281\ ft^2$

Wind Force: $F_{ant1} := q_z \cdot G_h \cdot EPA_a = 358.099 \cdot lbf$ (Section 2.3.2, P. 4)

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

Dimensions: $h_{ant2} := 72 \cdot in$ $w_{ant2} := 11.8 \cdot in$ $d_{ant2} := 5.9 \cdot in$

Weight: $DL_{ant2} := 48.5 lb$

Mounting Pipe: $L_{p2} := 108 in$ $d_{p2} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant2} \cdot w_{ant2} = 5.9\, ft^2$

Area (Side): $A_{Ta} := h_{ant2} \cdot d_{ant2} = 2.95\, ft^2$

Force Coefficient (Normal): $C_{f_N_a} := C_{f_square}(h_{ant2}, w_{ant2}) = 1.4$

Force Coefficient (Side): $C_{f_T_a} := C_{f_square}(h_{ant2}, d_{ant2}) = 1.573$

Pipe Area (Normal): $A_{Np} := \max[(L_{p2} - h_{ant2}) \cdot (d_{p2}), 0] = 0.594\, ft^2$

Pipe Area (Side): $A_{Tp} := L_{p2} \cdot d_{p2} = 1.781\, ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{p2}, d_{p2}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f_N_a} \cdot A_{Na}) + (C_{f_p} \cdot A_{Np}) = 8.972\, ft^2$

Side Effective Projected Area: $EPA_T := (C_{f_T_a} \cdot A_{Ta}) + (C_{f_p} \cdot A_{Tp}) = 6.779\, ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 8.972\, ft^2$

Wind Force: $F_{ant2} := q_z \cdot G_h \cdot EPA_a = 241.931 \cdot lbf$ (Section 2.3.2, P. 4)

Powerwave 7770

Dimensions: $h_{ant3} := 55 \cdot in$ $w_{ant3} := 11 \cdot in$ $d_{ant3} := 5 \cdot in$

Weight: $DL_{ant3} := 35lb$

Mounting Pipe: $L_{p3} := 72in$ $d_{p3} := 2.375 \cdot in$

Area (Normal): $A_{Na} := h_{ant3} \cdot w_{ant3} = 4.201\ ft^2$

Area (Side): $A_{Ta} := h_{ant3} \cdot d_{ant3} = 1.91\ ft^2$

Force Coefficient (Normal): $C_{f_N_a} := C_{f_square}(h_{ant3}, w_{ant3}) = 1.4$

Force Coefficient (Side): $C_{f_T_a} := C_{f_square}(h_{ant3}, d_{ant3}) = 1.533$

Pipe Area (Normal): $A_{Np} := \max[(L_{p3} - h_{ant3}) \cdot (d_{p3}), 0] = 0.28\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{p3} \cdot d_{p3} = 1.187\ ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{p3}, d_{p3}) = 1.2$

Normal Effective Projected Area: $EPA_N := (C_{f_N_a} \cdot A_{Na}) + (C_{f_p} \cdot A_{Np}) = 6.218\ ft^2$

Side Effective Projected Area: $EPA_T := (C_{f_T_a} \cdot A_{Ta}) + (C_{f_p} \cdot A_{Tp}) = 4.353\ ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 6.218\ ft^2$

Wind Force: $F_{ant3} := q_z \cdot G_h \cdot EPA_a = 167.671 \cdot lbf$ (Section 2.3.2, P. 4)

TMA

Dimensions: $h_{a1} := 9.9 \cdot in$ $w_{a1} := 6.7 \cdot in$ $d_{a1} := 5.4 \cdot in$

Weight: $DL_{a1} := 16 lbf$

Area (Normal): $A_N := h_{a1} \cdot w_{a1} = 0.461\ ft^2$

Area (Side): $A_T := h_{a1} \cdot d_{a1} = 0.371\ ft^2$

Force Coefficient (Normal): $C_{f_N} := C_{f_square}(h_{a1}, w_{a1}) = 1.4$

Force Coefficient (Side): $C_{f_T} := C_{f_square}(h_{a1}, d_{a1}) = 1.4$

Front Effective Projected Area: $EPA_N := C_{f_N} \cdot A_N = 0.645\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f_T} \cdot A_T = 0.52\ ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 0.645\ ft^2$

Wind Force: $F_{a1} := q_z \cdot G_h \cdot EPA_a = 17.388 \cdot lbf$ (Section 2.3.2, P. 4)

RRUS-11

Dimensions: $h_{a2} := 19.8 \cdot in$ $w_{a2} := 17 \cdot in$ $d_{a2} := 7.2 \cdot in$

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

Area (Normal): $A_N := h_{a2} \cdot w_{a2} = 2.337\ ft^2$

Area (Side): $A_T := h_{a2} \cdot d_{a2} = 0.99\ ft^2$

Force Coefficient (Normal): $C_{f_N} := C_{f_square}(h_{a2}, w_{a2}) = 1.4$

Force Coefficient (Side): $C_{f_T} := C_{f_square}(h_{a2}, d_{a2}) = 1.4$

Front Effective Projected Area: $EPA_N := C_{f_N} \cdot A_N = 3.272\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f_T} \cdot A_T = 1.386\ ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 3.272\ ft^2$

Wind Force: $F_{a2} := q_z \cdot G_h \cdot EPA_a = 88.239 \cdot lbf$ (Section 2.3.2, P. 4)

RRUS-32

Dimensions: $h_{a3} := 26.7 \cdot in$ $w_{a3} := 12.1 \cdot in$ $d_{a3} := 6.7 \cdot in$

Weight: $DL_{a3} := 60 lbf$

Area (Normal): $A_N := h_{a3} \cdot w_{a3} = 2.244\ ft^2$

Area (Side): $A_T := h_{a3} \cdot d_{a3} = 1.242\ ft^2$

Force Coefficient (Side): $C_{f_T} := C_{f_square}(h_{a3}, d_{a3}) = 1.4$

Side Effective Projected Area: $EPA_T := C_{f_T} \cdot A_T = 1.739\ ft^2$

Effective Projected Area: $EPA_a := (EPA_T) = 1.739\ ft^2$

Wind Force: $F_{a3} := q_z \cdot G_h \cdot EPA_a = 46.895 \cdot lbf$ (Section 2.3.2, P. 4)

DC6

Dimensions: $h_{a5} := 31.25 \cdot in$ $w_{a5} := 11 \cdot in$ $d_{a5} := 11 \cdot in$

Weight: $DL_{a5} := 32.8 lbf$

Area (Normal): $A_N := h_{a5} \cdot w_{a5} = 2.387\ ft^2$

Area (Side): $A_T := h_{a5} \cdot d_{a5} = 2.387\ ft^2$

Force Coefficient (Normal): $C_{f_N} := C_{f_round}(h_{a5}, w_{a5}) = 0.8$

Force Coefficient (Side): $C_{f_T} := C_{f_round}(h_{a5}, d_{a5}) = 0.8$

Front Effective Projected Area: $EPA_N := C_{f_N} \cdot A_N = 1.91\ ft^2$

Side Effective Projected Area: $EPA_T := C_{f_T} \cdot A_T = 1.91\ ft^2$

Effective Projected Area: $EPA_a := \max(EPA_N, EPA_T) = 1.91\ ft^2$

Wind Force: $F_{a5} := q_z \cdot G_h \cdot EPA_a = 51.493 \cdot lbf$ (Section 2.3.2, P. 4)

Antenna Mount Loading:

Antenna Pipe Loading:

Height: $h_{m1} := 6ft$

Width: $w_{m1} := 2.375 \cdot in$

Area: $A_a := h_{m1} \cdot w_{m1} = 1.188\ ft^2$

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

Wind Load: $f_{m1} := q_z \cdot G_h \cdot C_f \cdot w_{m1} = 6.404 \cdot plf$ (Section 2.3.2, P. 4)

Horizontal Angle Loading:

Height: $h_{m4} := 156in$

Width: $w_{m4} := 3in$

Area: $A_a := h_{m4} \cdot w_{m4} = 3.25\ ft^2$

Force Coefficient: $C_f := C_{f_square}(h_{m4}, w_{m4}) = 2$

Wind Load: $f_{m4} := q_z \cdot G_h \cdot C_f \cdot w_{m4} = 13.482 \cdot plf$ (Section 2.3.2, P. 4)

Design Wind Load On Appurtenances With Ice:

Inputs:

ASCE 7-05 Reference (Ice Only)

TIA-222-F Reference (As Specified)

Basic Wind Speed With Ice: $V_i := 40$ MPH (Figure 10-2, P. 105)

Design Ice thickness: $t_i := 1in$ (Figure 10-2, P. 105)

Ice Density: $\rho_i := 56pcf$ (Section 10.4.1, P. 100)

Importance Factor: $I_{wind} := 1.00$ (Table 10-1, P. 100)

Importance Factor: $I_{ice} := 1.0$ (Table 10-1, P. 100)

Importance Factor: (Section 10.4.3, P. 100)

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

(Section 10.4.6, P. 100)

$$t_{iz} := t_{iz.}(z) = 2.266 \cdot in$$

Velocity Pressure: $q_z := 0.00256 \cdot K_z \cdot V_i^2 \cdot psf = 5.852 \cdot psf$ (TIA Section 2.3.3, P. 4)

AT&T Wind Loading (With Ice):

ANT 1

Dimensions: $h_{i_ant1} := h_{ant1} + 2 \cdot t_{iz} = 8.103\ ft$

$w_{i_ant1} := w_{ant1} + 2 \cdot t_{iz} = 1.578\ ft$

$d_{i_ant1} := d_{ant1} + 2 \cdot t_{iz} = 0.961\ ft$

Mounting Pipe $L_{i_p1} := L_{p1} + 2 \cdot t_{iz} = 9.378\ ft$

$d_{i_p1} := d_{p1} + 2 \cdot t_{iz} = 0.576\ ft$

Area (Normal): $A_{iN} := h_{i_ant1} \cdot w_{i_ant1} = 12.783\ ft^2$

Area (Side): $A_{iT} := h_{i_ant1} \cdot d_{i_ant1} = 7.787\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_ant1}, w_{i_ant1}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_ant1}, d_{i_ant1}) = 1.448$

Pipe Area (Normal): $A_{Np} := \max[(L_{i_p1} - h_{i_ant1}) \cdot (d_{i_p1}), 0] = 0.734\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i_p1} \cdot d_{i_p1} = 5.398\ ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{i_p1}, d_{i_p1}) = 1.007$

Normal Effective Projected Area: $EPA_{iN} := (C_{if_N} \cdot A_{iN}) + (C_{f_p} \cdot A_{Np}) = 18.635\ ft^2$

Side Effective Projected Area: $EPA_{iT} := (C_{if_T} \cdot A_{iT}) + C_{f_p} \cdot A_{Tp} = 16.705\ ft^2$

Effective Projected Area: $EPA_i := \max(EPA_{iN}, EPA_{iT}) = 18.635\ ft^2$

Wind Force: $F_{iant1} := q_z \cdot G_h \cdot EPA_i = 125.618 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_ant1} := \sqrt{w_{ant1}^2 + d_{ant1}^2} = 1.334\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_ant1} := \pi \cdot t_{iz} \cdot (D_{c_ant1} + t_{iz}) = 0.904\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_ant1} := (A_{iz_ant1} \cdot h_{i_ant1}) \cdot \rho_i = 409.978\ lbf$

ANT 2

Dimensions: $h_{i_ant2} := h_{ant2} + 2 \cdot t_{iz} = 6.378\ ft$

$w_{i_ant2} := w_{ant2} + 2 \cdot t_{iz} = 1.361\ ft$

$d_{i_ant2} := d_{ant2} + 2 \cdot t_{iz} = 0.869\ ft$

Mounting Pipe $L_{i_p2} := L_{p2} + 2 \cdot t_{iz} = 9.378\ ft$

$d_{i_p2} := d_{p2} + 2 \cdot t_{iz} = 0.576\ ft$

Area (Normal): $A_{iN} := h_{i_ant2} \cdot w_{i_ant2} = 8.68\ ft^2$

Area (Side): $A_{iT} := h_{i_ant2} \cdot d_{i_ant2} = 5.544\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_ant2}, w_{i_ant2}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_ant2}, d_{i_ant2}) = 1.411$

Pipe Area (Normal): $A_{Np} := \max[(L_{i_p2} - h_{i_ant2}) \cdot (d_{i_p2}), 0] = 1.727\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i_p2} \cdot d_{i_p2} = 5.398\ ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{i_p2}, d_{i_p2}) = 1.007$

Normal Effective Projected Area: $EPA_{iN} := (C_{if_N} \cdot A_{iN}) + (C_{f_p} \cdot A_{Np}) = 13.89\ ft^2$

Side Effective Projected Area: $EPA_{iT} := (C_{if_T} \cdot A_{iT}) + C_{f_p} \cdot A_{Tp} = 13.257\ ft^2$

Effective Projected Area: $EPA_i := \max(EPA_{iN}, EPA_{iT}) = 13.89\ ft^2$

Wind Force: $F_{iant2} := q_z \cdot G_h \cdot EPA_i = 93.63 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_ant2} := \sqrt{w_{ant2}^2 + d_{ant2}^2} = 1.099\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_ant2} := \pi \cdot t_{iz} \cdot (D_{c_ant2} + t_{iz}) = 0.764\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_ant2} := (A_{iz_ant2} \cdot h_{i_ant2}) \cdot \rho_i = 272.935\ lbf$

ANT 3

Dimensions: $h_{i_ant3} := h_{ant3} + 2 \cdot t_{iz} = 4.961\ ft$

$w_{i_ant3} := w_{ant3} + 2 \cdot t_{iz} = 1.294\ ft$

$d_{i_ant3} := d_{ant3} + 2 \cdot t_{iz} = 0.794\ ft$

Mounting Pipe $L_{i_p3} := L_{p3} + 2 \cdot t_{iz} = 6.378\ ft$

$d_{i_p3} := d_{p3} + 2 \cdot t_{iz} = 0.576\ ft$

Area (Normal): $A_{iN} := h_{i_ant3} \cdot w_{i_ant3} = 6.421\ ft^2$

Area (Side): $A_{iT} := h_{i_ant3} \cdot d_{i_ant3} = 3.941\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_ant3}, w_{i_ant3}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_ant3}, d_{i_ant3}) = 1.4$

Pipe Area (Normal): $A_{Np} := \max[(L_{i_p3} - h_{i_ant3}) \cdot (d_{i_p3}), 0] = 0.815\ ft^2$

Pipe Area (Side): $A_{Tp} := L_{i_p3} \cdot d_{i_p3} = 3.671\ ft^2$

Force Coefficient (Normal): $C_{f_p} := C_{f_round}(L_{i_p3}, d_{i_p3}) = 0.891$

Normal Effective Projected Area: $EPA_{iN} := (C_{if_N} \cdot A_{iN}) + (C_{f_p} \cdot A_{Np}) = 9.716\ ft^2$

Side Effective Projected Area: $EPA_{iT} := (C_{if_T} \cdot A_{iT}) + C_{f_p} \cdot A_{Tp} = 8.786\ ft^2$

Effective Projected Area: $EPA_i := \max(EPA_{iN}, EPA_{iT}) = 9.716\ ft^2$

Wind Force: $F_{iant3} := q_z \cdot G_h \cdot EPA_i = 65.494 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_ant3} := \sqrt{w_{ant3}^2 + d_{ant3}^2} = 1.007\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_ant3} := \pi \cdot t_{iz} \cdot (D_{c_ant3} + t_{iz}) = 0.709\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_ant3} := (A_{iz_ant3} \cdot h_{i_ant3}) \cdot \rho_i = 197.067\ lbf$

TMA

Dimensions:

$h_{i_a1} := h_{a1} + 2 \cdot t_{iz} = 1.203\ ft$

$w_{i_a1} := w_{a1} + 2 \cdot t_{iz} = 0.936\ ft$

$d_{i_a1} := d_{a1} + 2 \cdot t_{iz} = 0.828\ ft$

Area (Normalt): $A_{iN} := h_{i_a1} \cdot w_{i_a1} = 1.126\ ft^2$

Area (Side): $A_{iT} := h_{i_a1} \cdot d_{i_a1} = 0.995\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_a1}, w_{i_a1}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_a1}, d_{i_a1}) = 1.4$

Front Effective Wind Area: $EPA_{iN} := C_{if_N} \cdot A_{iN} = 1.576\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if_T} \cdot A_{iT} = 1.394\ ft^2$

Side Effective Wind Area: $EPA_{ia} := \max(EPA_{iN}, EPA_{iT}) = 1.576\ ft^2$

Wind Force: $F_{ia1} := q_z \cdot G_h \cdot EPA_{ia} = 10.623 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_a1} := \sqrt{w_{a1}^2 + d_{a1}^2} = 0.717\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_a1} := \pi \cdot t_{iz} \cdot (D_{c_a1} + t_{iz}) = 0.537\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_a1} := (A_{iz_a1} \cdot h_{i_a1}) \cdot \rho_i = 36.194\ lbf$

RRUS-11

Dimensions: $h_{i_a2} := h_{a2} + 2 \cdot t_{iz} = 2.028\ ft$

$w_{i_a2} := w_{a2} + 2 \cdot t_{iz} = 1.794\ ft$

$d_{i_a2} := d_{a2} + 2 \cdot t_{iz} = 0.978\ ft$

Area (Normalt): $A_{iN} := h_{i_a2} \cdot w_{i_a2} = 3.638\ ft^2$

Area (Side): $A_{iT} := h_{i_a2} \cdot d_{i_a2} = 1.982\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_a2}, w_{i_a2}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_a2}, d_{i_a2}) = 1.4$

Front Effective Wind Area: $EPA_{iN} := C_{if_N} \cdot A_{iN} = 5.094\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if_T} \cdot A_{iT} = 2.775\ ft^2$

Side Effective Wind Area: $EPA_{ia} := \max(EPA_{iN}, EPA_{iT}) = 5.094\ ft^2$

Wind Force: $F_{ia2} := q_z \cdot G_h \cdot EPA_{ia} = 34.335 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_a2} := \sqrt{w_{a2}^2 + d_{a2}^2} = 1.538\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_a2} := \pi \cdot t_{iz} \cdot (D_{c_a2} + t_{iz}) = 1.025\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_a2} := (A_{iz_a2} \cdot h_{i_a2}) \cdot \rho_i = 116.351\ lbf$

RRUS-32

Dimensions: $h_{i_a3} := h_{a3} + 2 \cdot t_{iz} = 2.603\ ft$

$w_{i_a3} := w_{a3} + 2 \cdot t_{iz} = 1.386\ ft$

$d_{i_a3} := d_{a3} + 2 \cdot t_{iz} = 0.936\ ft$

Area (Normalt): $A_{iN} := h_{i_a3} \cdot w_{i_a3} = 3.607\ ft^2$

Area (Side): $A_{iT} := h_{i_a3} \cdot d_{i_a3} = 2.436\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_square}(h_{i_a3}, w_{i_a3}) = 1.4$

Force Coefficient (Side): $C_{if_T} := C_{f_square}(h_{i_a3}, d_{i_a3}) = 1.4$

Front Effective Wind Area: $EPA_{iN} := C_{if_N} \cdot A_{iN} = 5.05\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if_T} \cdot A_{iT} = 3.41\ ft^2$

Side Effective Wind Area: $EPA_{ia} := \max(EPA_{iN}, EPA_{iT}) = 5.05\ ft^2$

Wind Force: $F_{ia3} := q_z \cdot G_h \cdot EPA_{ia} = 34.043 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_a3} := \sqrt{w_{a3}^2 + d_{a3}^2} = 1.153\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_a3} := \pi \cdot t_{iz} \cdot (D_{c_a3} + t_{iz}) = 0.796\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_a3} := (A_{iz_a3} \cdot h_{i_a3}) \cdot \rho_i = 115.981\ lbf$

DC6

Dimensions: $h_{i_a5} := h_{a5} + 2 \cdot t_{iz} = 2.982\ ft$

$w_{i_a5} := w_{a5} + 2 \cdot t_{iz} = 1.294\ ft$

$d_{i_a5} := d_{a5} + 2 \cdot t_{iz} = 1.294\ ft$

Area (Normalt): $A_{iN} := h_{i_a5} \cdot w_{i_a5} = 3.859\ ft^2$

Area (Side): $A_{iT} := h_{i_a5} \cdot d_{i_a5} = 3.859\ ft^2$

Force Coefficient (Normal): $C_{if_N} := C_{f_round}(h_{i_a5}, w_{i_a5}) = 0.8$

Force Coefficient (Side): $C_{if_T} := C_{f_round}(h_{i_a5}, d_{i_a5}) = 0.8$

Front Effective Wind Area: $EPA_{iN} := C_{if_N} \cdot A_{iN} = 3.088\ ft^2$

Side Effective Wind Area: $EPA_{iT} := C_{if_T} \cdot A_{iT} = 3.088\ ft^2$

Side Effective Wind Area: $EPA_{ia} := \max(EPA_{iN}, EPA_{iT}) = 3.088\ ft^2$

Wind Force: $F_{ia5} := q_z \cdot G_h \cdot EPA_{ia} = 20.813 \cdot lbf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_a5} := w_{a5} = 0.917\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_a5} := \pi \cdot t_{iz} \cdot (D_{c_a5} + t_{iz}) = 0.656\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_a5} := (A_{iz_a5} \cdot h_{i_a5}) \cdot \rho_i = 109.507\ lbf$

Antenna Mount Loading With Ice:

Antenna Pipe Loading:

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

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

Area: $A_a := h_{im1} \cdot w_{im1} = 3.671\ ft^2$

Force Coefficient: $C_f := C_{f_round}(h_{im1}, w_{im1}) = 0.891$

Wind Load: $f_{im1} := q_z \cdot G_h \cdot C_f \cdot w_{im1} = 3.456 \cdot plf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_m1} := w_{m1} = 0.198\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_m1} := \pi \cdot t_{iz} \cdot (D_{c_m1} + t_{iz}) = 0.229\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_m1} := (A_{iz_m1}) \cdot \rho_i = 12.848 \cdot plf$

Horizontal Angle Loading:

Height: $h_{im4} := h_{m4} + 2 \cdot t_{iz}$

Width: $w_{im4} := w_{m4} + 2 \cdot t_{iz}$

Area: $A_a := h_{im4} \cdot w_{im4} = 8.397\ ft^2$

Force Coefficient: $C_f := C_{f_square}(h_{im4}, w_{im4}) = 1.877$

Wind Load: $f_{im4} := q_z \cdot G_h \cdot C_f \cdot w_{im4} = 7.942 \cdot plf$ (TIA Section 2.3.2, P. 4)

Additional Ice Dead Load

Largest Out-to-Out Dimension: $D_{c_m4} := \sqrt{w_{m4}^2 + w_{m4}^2} = 0.354\ ft$ (Figure 10-1, P. 102)

Cross Sectional Area of Ice: $A_{iz_m4} := \pi \cdot t_{iz} \cdot (D_{c_m4} + t_{iz}) = 0.322\ ft^2$ (Section 10.4.1, P. 100)

Total Ice Dead Load: $DL_{iz_m4} := (A_{iz_m4}) \cdot \rho_i = 18.018 \cdot plf$

Platform Bar Grating Loading:

Additional Ice Dead Load

Total Ice Dead Load: $DL_{iz_gr1} := (0.50 \cdot in + 2 \cdot t_{iz}) \cdot \rho_i = 23.482 \cdot psf$

Summary:	**Dead Load (No Ice)**	**Wind Load (No Ice)**	**Wind Load (With Ice)**	**Dead Load (With Ice)**
A 1	$DL_{ant1} = 88\,lb$	$F_{ant1} = 358\,lbf$	$F_{iant1} = 126\,lbf$	$DL_{iz_ant1} = 410\,lbf$
A 2	$DL_{ant2} = 49\,lb$	$F_{ant2} = 242\,lbf$	$F_{iant2} = 94\,lbf$	$DL_{iz_ant2} = 273\,lbf$
A 3	$DL_{ant3} = 35\,lb$	$F_{ant3} = 168\,lbf$	$F_{iant3} = 65\,lbf$	$DL_{iz_ant3} = 197\,lbf$
TMA	$DL_{a1} = 16\,lbf$	$F_{a1} = 17\,lbf$	$F_{ia1} = 11\,lbf$	$DL_{iz_a1} = 36\,lbf$
RRUS-11	$DL_{a2} = 50\,lbf$	$F_{a2} = 88\,lbf$	$F_{ia2} = 34\,lbf$	$DL_{iz_a2} = 116\,lbf$
RRUS-32	$DL_{a3} = 60\,lbf$	$F_{a3} = 47\,lbf$	$F_{ia3} = 34\,lbf$	$DL_{iz_a3} = 116\,lbf$
DC6	$DL_{a5} = 33\,lbf$	$F_{a5} = 51\,lbf$	$F_{ia5} = 21\,lbf$	$DL_{iz_a5} = 110\,lbf$
Antenna Pipe Loading:		$f_{m1} = 6 \cdot plf$	$f_{im1} = 3 \cdot plf$	$DL_{iz_m1} = 13 \cdot plf$
Horizontal Angle Loading:		$f_{m4} = 13 \cdot plf$	$f_{im4} = 8 \cdot plf$	$DL_{iz_m4} = 18 \cdot plf$
Grating:	$DL_{gr} := -10psf$			$DL_{iz_gr1} = 23 \cdot psf$

3/4" DIA. Rod Check, Loads From RISA

Controlling Moment at Mount Connection Point $M_c := 1.664\,ft\cdot kip$

Moment Arm (Assumed height of clamp ring from top to bottom) $M_a := .8333\,ft$

Force couple (Compression forces supported by bearing against monopole, tension forces by threaded rods) $F_m := \frac{M_c}{M_a} = 1997\,lbf$

Resolve force Into Threaded Rods (Two rods per top connection) $F_r := \frac{F_m}{2\cos(30deg)} = 1152.9\cdot lbf$

Maximum Connection Tension Force $T_c := 630\,lbf$

Tension Per Rod from axial force $F_{tr} := \frac{T_c}{6\cos(30deg)} = 121.24\cdot lbf$

Total Max Tension Force Per Rod 6 Rods Total $T_{max} := F_r + F_{tr} = 1274.14\,lbf$

Applied Tension: $x := T_{max} = 1274.14\,lbf$ From Risa 3D

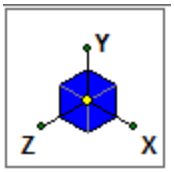
Applied Shear: (Assume shear forces are supported by friction force of clamp ring at monopole)

$y := 0\,lbf$ From Risa 3D

$z := 0\cdot lbf$ From Risa 3D

$P_{a.t} := x = 1274.1\,lbf$

$P_{a.v} := \sqrt{y^2 + z^2} = 0$



Bolt Type Used: **A325** (ASSUMED)

Bolt Yield Strength: $F_y := 36\cdot ksi$

Bolt Ultimate Strength: $F_u := 58\cdot ksi$

Nominal Tensile Stress, Fnt: $F_{n.t} := 0.75\cdot F_u = 43.5\cdot ksi$ AISC, Table J3-2, P. 16.1-104

Nominal Shear Stress, Fnv: $F_{n.v} := 0.4\cdot F_u = 23.2\cdot ksi$ AISC, Table J3-2, P. 16.1-104

Nominal Bolt Diameter: $d_b := \frac{3}{4}in$ (ASSUMED)

Gross Area of the Bolt: $A_{b.g} := 0.442\,in^2$ AISC, Table 7-17, P. 7-81

Net Area of the Bolt: $A_{b.n} := 0.323\,in^2$ AISC, Table 7-17, P. 7-81

Strength Reduction Factor, ϕ: $\phi := 0.75$

Combined Tension And Shear Check

Nominal Tensile Stress, Fnt $F_{n.t} = 43.5\cdot ksi$

Nominal Shear Stress, Fnv $F_{n.v} = 23.2\cdot ksi$

Nominal Tensile Reduced Fntr

$$F_{n.t.r} := 1.3 \cdot F_{n.t} - \frac{F_{n.t}}{\phi \cdot F_{n.v}} \cdot \frac{P_{a.v}}{A_{b.g}} = 56.55 \cdot ksi$$

AISC Eq. J3-3a, P. 16.1-109

$$F_{n.t} := \begin{cases} F_{n.t.r} & \text{if } F_{n.t.r} \le F_{n.t} \\ F_{n.t} & \text{otherwise} \end{cases} = 43.5 \cdot ksi$$

Nominal Shear Reduced Fntv

$$F_{n.v.r} := 1.3 \cdot F_{n.v} - \frac{F_{n.v}}{\phi \cdot F_{n.t}} \cdot \frac{P_{a.t}}{A_{b.g}} = 28.11 \cdot ksi$$

AISC Eq. J3-3a, P. 16.1-109

$$F_{n.v} := \begin{cases} F_{n.v.r} & \text{if } F_{n.v.r} \le F_{n.v} \\ F_{n.v} & \text{otherwise} \end{cases} = 23.2 \cdot ksi$$

Bolt Nominal Tensive Strength

$$R_{n.t} := F_{n.t} \cdot A_{b.g} \qquad R_{n.t} = 19.227 \cdot kip$$

Tension Check

$$Check := \begin{cases} \text{"OK"} & \text{if } \phi \cdot R_{n.t} \ge P_{a.t} \\ \text{"NOT GOOD"} & \text{otherwise} \end{cases}$$

$$Check = \text{"OK"}$$

Tension Ratio

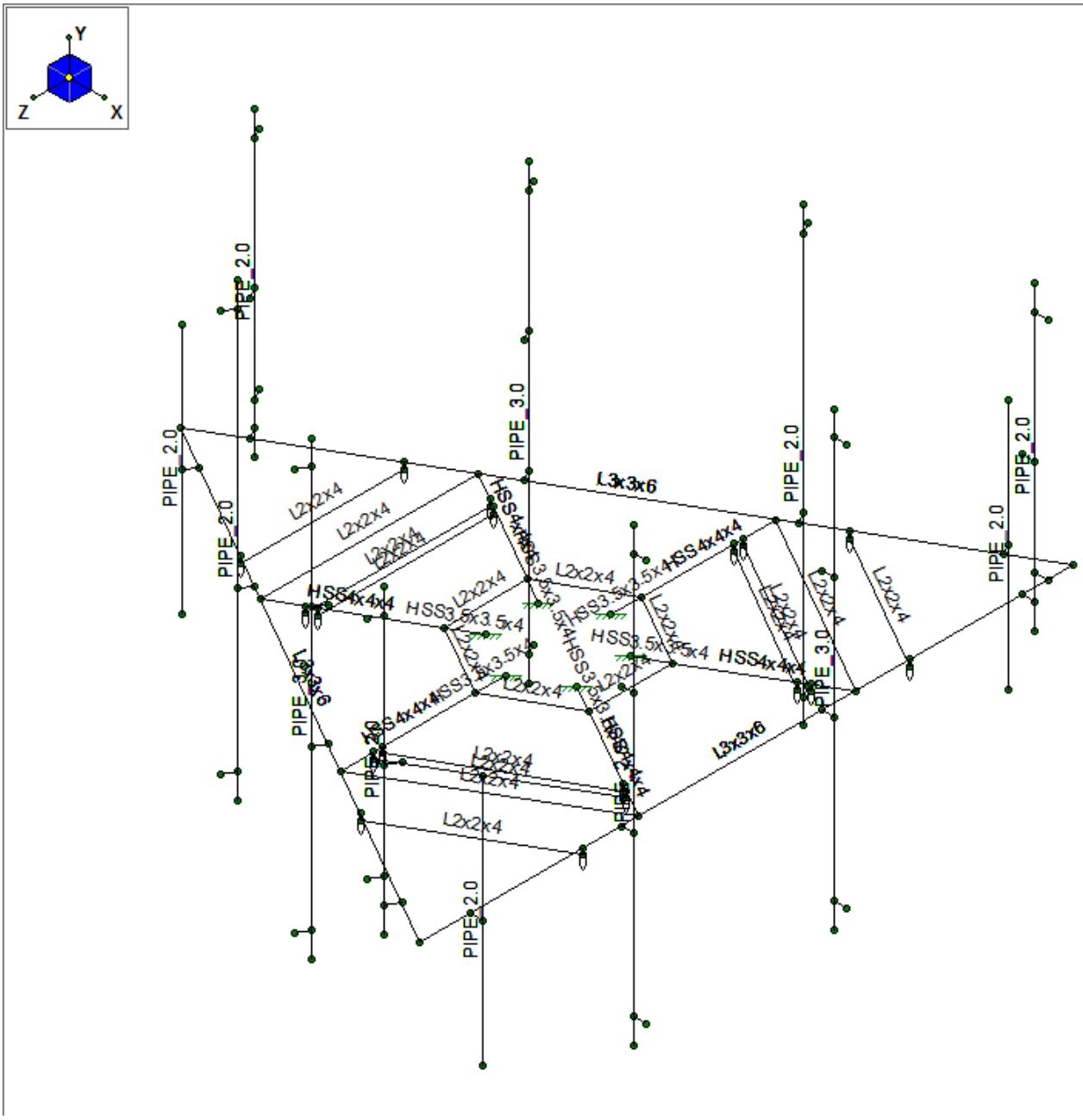
$$Ratio_t := \frac{P_{a.t}}{\phi \cdot R_{n.t}} \qquad Ratio_t = 8.8 \cdot \%$$

Bolt Nominal Shear Strength

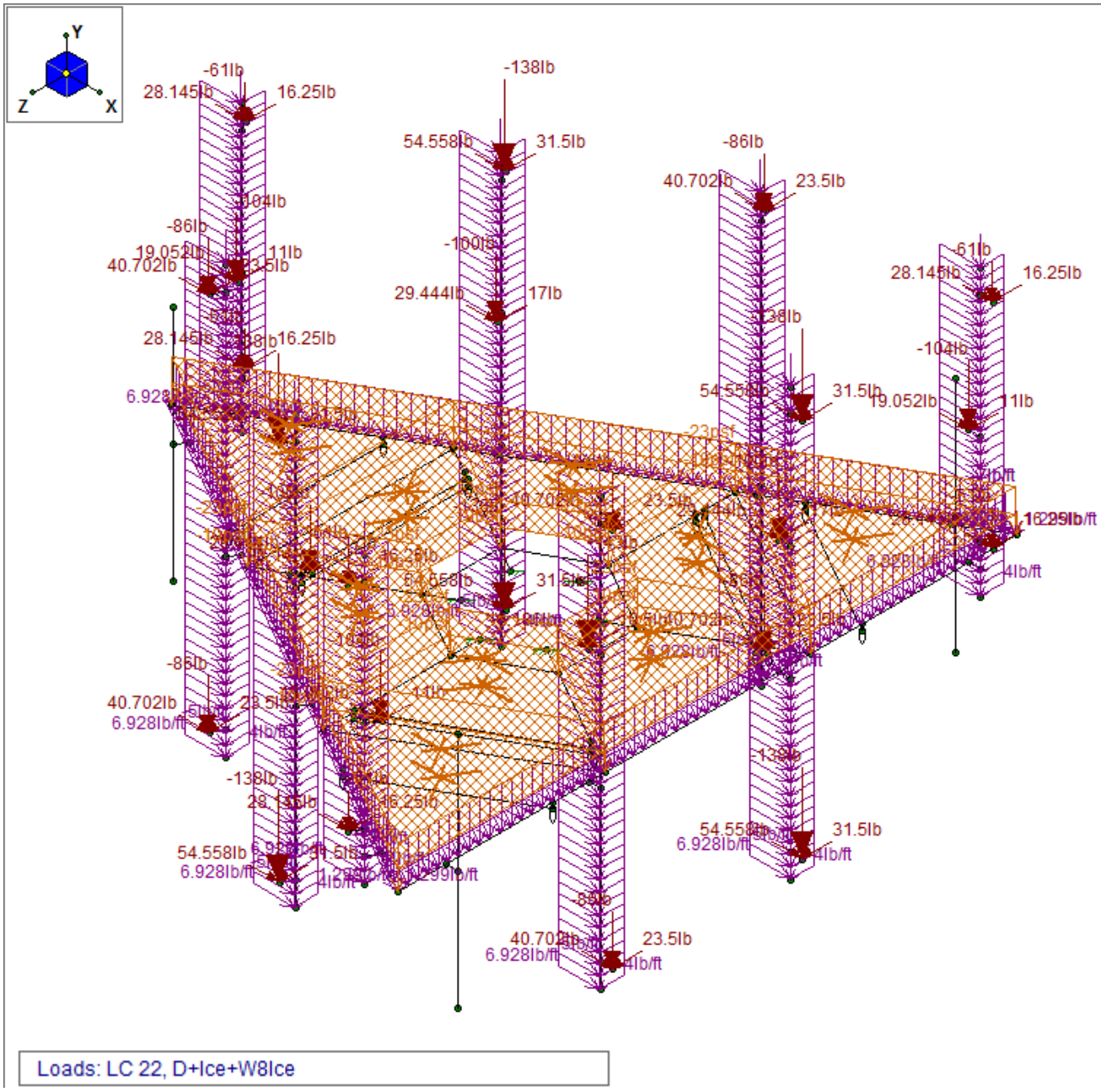
$$R_{n.v} := F_{n.v} \cdot A_{b.g} = 10.254 \cdot kip$$

The existing platform threaded rods have been determined to have **ADEQUATE** structural capacity to support the proposed equipment.

Risa Model:



Most Critical Loading:

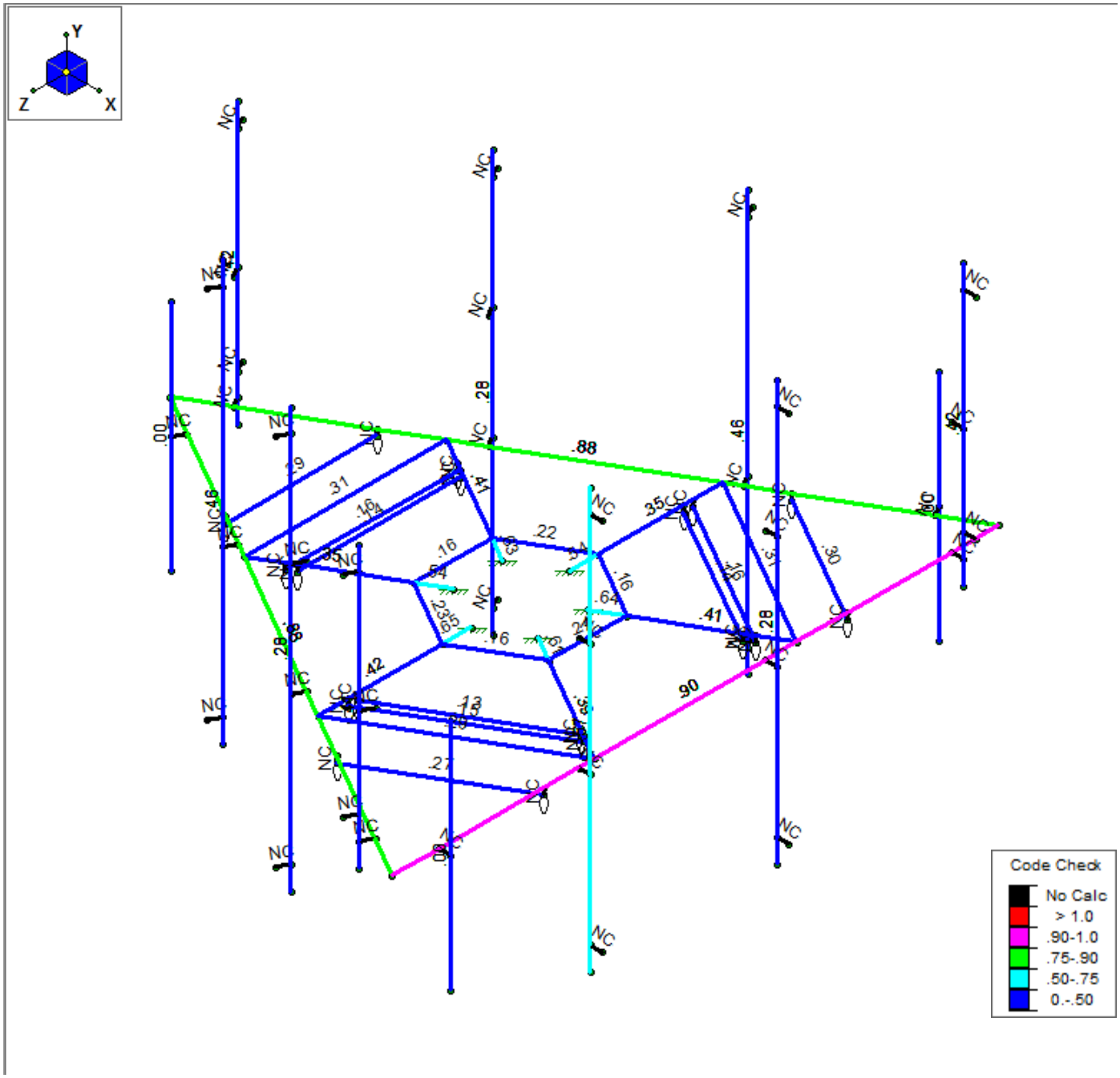


Loads: LC 22, D+Ice+W8Ice

Allowable Stress Design
Basic Load Combinations

1) Dead Load
2) Dead Load + Wind Load (No Ice)
3) Dead Load + Ice Load + Wind Load (With Ice)

Member Code Check:



The existing platform mount was analyzed for the loading in the applicable codes and standards. The platform mount has been determined to be structurally **ADEQUATE** to support the proposed panel antennas, based upon the aforementioned assumptions. The platform mount has been determined to be stressed to a maximum of **90.5%** of its structural capacity with the maximum usage occurring at one of the horizontal angles. Therefore, the proposed **AT&T** installation **CAN** be placed as intended.

APPENDIX B
DESIGN ASSUMPTIONS

All engineering services are performed on the basis that the information used is current and correct. The following design assumptions have been utilized to prepare this report:

1. 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.

2. 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.

3. It is the responsibility of the client to ensure that the information provided to Maser Consulting 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.

4. 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.

5. All Services are performed, results obtained, and recommendations made in accordance with generally accepted engineering principles and practices. Maser Consulting P.A. is not responsible for the conclusion, opinions, and recommendations made by others based on the information we supply.