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November 9, 2022

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

Re: **Sub-Petition No. 1133-VER-20220228 – Approved Modifications to the Flagpole Tower at 541 Broadbridge Road, Bridgeport, Connecticut**

Dear Attorney Bachman:

On April 8, 2022, the Siting Council ("Council") approved the Cellco Partnership d/b/a Verizon Wireless ("Cellco") Eligible Facilities Request ("EFR") for modifications to the existing wireless base station at 541 Broadridge Road in Bridgeport. The modifications involved the replacement Cellco's antennas and the expansion of the antenna screening shroud around the antennas at the top of the tower.

Following the Council's approval of the EFR and the hand-off of the project to Cellco's construction team, project construction engineers discovered that the diameter of the antenna mounting shaft and certain antenna mount designs referenced in the original November 19, 2021 Structural Analysis ("SA") and January 12, 2022 Mounts Analysis ("MA") were incorrect. Upon discovery of this error, Centek Engineering completed a new SA, dated November 1, 2022, and a new MA, dated October 21, 2022. The new SA and MA came to the same overall conclusion, confirming that the tower can accommodate the proposed facility modifications.

To avoid confusion during the Council's "close out" of this project, I am enclosing copies of the November 1, 2022 corrected SA and the October 21, 2022 corrected MA for your records. Also enclosed is a set of Construction Drawings for the proposed facility modifications and facility improvements.

We respectfully request that Council staff acknowledge receipt of this modified information and, according to Condition No. 1 of the April 8, 2022 Council approval, approve this minor project change.

Please contact me with any questions.

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Joseph Ganim, Bridgeport Mayor
Lynn Haig, Director of Planning
Aleksey Tyurin

CENTEK engineering

Centered on Solutions℠

# Structural Analysis Report

98-ft Existing Flagpole

Proposed Verizon
Antenna Upgrade

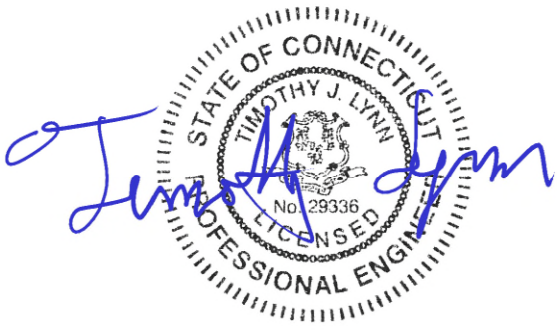
Site Ref: Bridgeport NE CT

541 Broadbridge Road
Bridgeport, CT

Centek Project No. 21007.69

~~Date: November 19, 2021~~
Rev 1: November 1, 2022

Max Stress Ratio = 93%




**Prepared for:**

Verizon Wireless
20 Alexander Drive
Wallingford, CT 06492

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## *Introduction*

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna upgrade proposed by Verizon on the existing flagpole (tower) located in Bridgeport, Connecticut.

The host tower consists of three (3) 10-ft concealment canister sections supported on a 68.0-ft tall, two-section, eighteen sided, tapered monopole original designed by EEI jo no. 18280-D01 dated 04/25/2018. The tower geometry and structure member sizes were obtained the original design documents.

Antenna and appurtenance information were obtained from a Verizon RF data sheet.

The tower is made up of two (2) tapered vertical sections consisting of A572-65 sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 35.5-in at the top and 45.00-in at the base.

## *Antenna and Appurtenance Summary*

The existing, proposed and future loads considered in this analysis consist of the following:

- **VERIZON( EXISTING TO REMOVE):**
  **Antennas: Six (6) Commscope SBJAHH-1D65B-DL panel antennas with rad center elevation of ±92&82-ft above grade level.**
  **Appurtenances: Three(3) Nokia B13 RRH 4x30 radio head units, three (3) Nokia B25 RRH 4x30 radio head units, three (3) Nokia B66A RRH 4x45 radio head units and twenty four (24) Kaelus QBC0002F1V51-1 Quadplexer.**
- **VERIZON (Proposed):**
  **Antennas: Three (3) Commscope NNH4-65B-R6 panel antennas and three (3) JMA MX08FIT265-01 panel antennas mounted within a concealment canister with rad center elevations of ±92&82-ft above grade level.**
  **Appurtenances: Three(3) Samsung RT-8808-77A radio head units, six (6) Commscope CBC61923T-DS-43 diplexers and one 6 OVP box.**

## Primary Assumptions Used in the Analysis

- The tower structure's theoretical capacity not including any assessment of the condition of the tower.
- The tower carries the horizontal and vertical loads due to the weight of antennas, ice load and wind.
- Tower is properly installed and maintained.
- Tower is in plumb condition.
- Tower loading for antennas and mounts as listed in this report.
- All bolts are appropriately tightened providing the necessary connection continuity.
- All welds are fabricated with ER-70S-6 electrodes.
- All members are assumed to be as specified in the original tower design documents or reinforcement drawings.
- All members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
- All member protective coatings are in good condition.
- All tower members were properly designed, detailed, fabricated, installed and have been properly maintained since erection.
- Any deviation from the analyzed antenna loading will require a new analysis for verification of structural adequacy.
- All coax cables to be installed as indicated in this report.

## *Analysis*

The existing tower was analyzed using a comprehensive computer program entitled tnxTower. The program analyzes the tower, considering the worst case loading condition. The tower is considered as loaded by concentric forces along the tower, and the model assumes that the tower members are subjected to bending, axial, and shear forces.

The existing tower was analyzed for the controlling basic wind speed with no ice and the applicable wind and ice combination to determine stresses in members as per guidelines of TIA-222-H entitled "Structural Standard for Antenna Support Structures, Antennas and Small Wind Turbine Support Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Load and Resistance Factor Design (LRFD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix P of the CSBC[1] and the wind speed data available in the TIA-222-H Standard.

## *Tower Loading*

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA-222-H, gravity loads of the tower structure and its components, and the application of 1.0" radial ice on the tower structure and its components.

| | | |
|---|---|---|
| Load Cases: | Load Case 1; 120 mph (Risk Cat II) wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation. | *[Appendix P of the 2022 CT Building Code]* |
| | Load Case 2; 50 mph wind speed w/ 1.00" radial ice plus gravity load – used in calculation of tower stresses. | *[Annex B of TIA-222-H]* |

[1] The 2021 International Building Code as amended by the 2022 Connecticut State Building Code (CSBC).

## Tower Capacity

- Calculated stresses were found to be within allowable limits.

| Tower Section | Elevation (AGL) | Stress Ratio (percentage of capacity) | Result |
|---|---|---|---|
| Antenna Pole (Inside Canister – L3) | 68.5' - 78.0' | 93.1% | **PASS** |
| Pole Shaft (L6) | 1.0' - 38.3' | 35.5% | **PASS** |

## Foundation and Anchors

The existing foundation consists of a one (1) 6-ft Ø round x 18.75-ft tall pier. The existing foundation properties were obtained from the aforementioned design documents. The base of the tower is connected to the foundation by means of (6) 1.75"∅, ASTM A615-75 anchor bolts embedded approximately 5.17-ft into the concrete foundation structure.

- The tower base reactions developed from the governing Load Case were used in the verification of the foundation and its anchors:

| Location | Vector | Proposed Reactions |
|---|---|---|
| Base | Shear | 12 kips |
| | Compression | 14 kips |
| | Moment | 668 kip-ft |

- The foundation was found to be within allowable limits.

| Foundation | Design Limit | Proposed Loading | Result |
|---|---|---|---|
| Reinforced Concrete Caisson | Moment Capacity | 23.2% | **PASS** |
| | Lateral Deflection | 0.27 in. | **PASS** |

- The anchor bolts and base plate were found to be within allowable limits.

| Tower Component | Design Limit | Stress Ratio (percentage of capacity) | Result |
|---|---|---|---|
| Anchor Bolts | Combined Axial and Bending | 63.5% | **PASS** |
| Base Plate | Bending | 60.8% | **PASS** |

## *Conclusion*

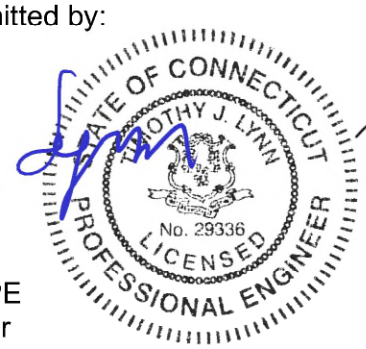
This analysis shows that the subject tower **is adequate** to support the proposed modified antenna configuration.

- Replacement of the top two (2) 10-ft concealment canisters with 10-ft x 48" diameter canisters (designed by others) is required to accommodate the proposed antennas.

The analysis is based, in part, on the information provided to this office by Verizon. If the existing conditions are different than the information in this report, Centek Engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:




Timothy J. Lynn, PE
Structural Engineer

Prepared by:

Pablo Perez-Gomez
Engineer

# *Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures*

All engineering services are performed on the basis that the information used is current and correct. This information may consist of, but is not necessarily limited to:

- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information provided to Centek Engineering, Inc. and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that all structures were constructed in accordance with the drawings and specifications and are in an un-corroded condition and have not deteriorated. It is therefore assumed that its capacity has not significantly changed from the "as new" condition.
- All services will be performed to the codes specified by the client, and we do not imply to meet any other codes or requirements unless explicitly agreed in writing. If wind and ice loads or other relevant parameters are to be different from the minimum values recommended by the codes, the client shall specify the exact requirement. In the absence of information to the contrary, all work will be performed in accordance with the latest revision of ANSI/ASCE10 & ANSI/EIA-222
- All services performed, results obtained, and recommendations made are in accordance with generally accepted engineering principles and practices. Centek Engineering, Inc. is not responsible for the conclusions, opinions and recommendations made by others based on the information we supply.

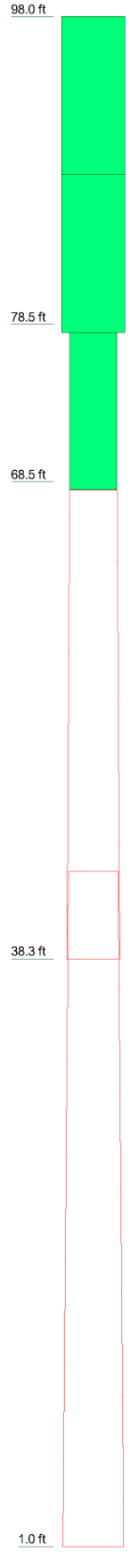
# GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

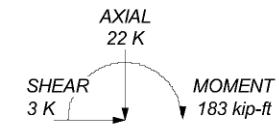
tnxTower Features:

- tnxTower can analyze and design 3- and 4-sided guyed towers, 3- and 4-sided self-supporting towers and either round or tapered ground mounted poles with or without guys.
- The program analyzes towers using the TIA-222-G (2005) standard or any of the previous TIA/EIA standards back to RS-222 (1959). Steel design is checked using the AISC ASD 9th Edition or the AISC LRFD specifications.
- Linear and non-linear (P-delta) analyses can be used in determining displacements and forces in the structure. Wind pressures and forces are automatically calculated.
- Extensive graphics plots include material take-off, shear-moment, leg compression, displacement, twist, feed line, guy anchor and stress plots.
- tnxTower contains unique features such as True Cable behavior, hog rod take-up, foundation stiffness and much more.

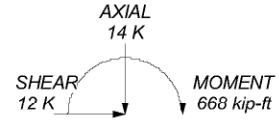
| Section | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Length (ft) | 19.500 | 0.500 | 9.500 | 0.500 | 29.750 | 42.750 |
| Number of Sides | 1 | 1 | 1 | 1 | 18 | 18 |
| Thickness (in) | 0.403 | 0.465 | 0.465 | 0.465 | 0.250 | 0.250 |
| Socket Length (ft) | | | | | 5.500 | |
| Top Dia (in) | 6.625 | 6.625 | 10.750 | 10.750 | 35.500 | 38.684 |
| Bot Dia (in) | 6.625 | 10.750 | 10.750 | 35.500 | 40.020 | 45.000 |
| Grade | A500-42 | | | | | A572-65 |
| Weight (K) | 0.5 | 0.0 | 0.5 | 0.1 | 3.0 | 4.8 |




*ALL REACTIONS ARE FACTORED*




*TORQUE 0 kip-ft*
*50 mph WIND - 1.000 in ICE*




*TORQUE 1 kip-ft*
*REACTIONS - 120 mph WIND*

## DESIGNED APPURTENANCE LOADING

| TYPE | ELEVATION | TYPE | ELEVATION |
|---|---|---|---|
| 10'x48" Canister | 98 - 88 | RRFDC-3315-PF-48 (Verizon - Proposed) | 92 |
| NNH4-65B-R6 (Verizon - Proposed) | 92 | 10'x48" Canister | 88 - 78 |
| NNH4-65B-R6 (Verizon - Proposed) | 92 | RT-8808-77A (Verizon - Proposed) | 82 |
| NNH4-65B-R6 (Verizon - Proposed) | 92 | RT-8808-77A (Verizon - Proposed) | 82 |
| (2) CBC61923T-DS-43 - Diplexer (Verizon - Proposed) | 92 | RT-8808-77A (Verizon - Proposed) | 82 |
| (2) CBC61923T-DS-43 - Diplexer (Verizon - Proposed) | 92 | MX08FIT265-01 (Verizon - Proposed) | 82 |
| | | MX08FIT265-01 (Verizon - Proposed) | 82 |
| (2) CBC61923T-DS-43 - Diplexer (Verizon - Proposed) | 92 | MX08FIT265-01 (Verizon - Proposed) | 82 |
| | | 10'x36" Canister | 78 - 68 |

## MATERIAL STRENGTH

| GRADE | Fy | Fu | GRADE | Fy | Fu |
|---|---|---|---|---|---|
| A500-42 | 42 ksi | 58 ksi | A572-65 | 65 ksi | 80 ksi |

## TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-H Standard.
2. Tower designed for a 120 mph basic wind in accordance with the TIA-222-H Standard.
3. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Risk Category II.
6. Topographic Category 1 with Crest Height of 0.000 ft
7. TOWER RATING: 93.1%


*Centek Engineering Inc.*
63-2 North Branford Rd.
Branford, CT 06405
Phone: (203) 488-0580
FAX: (203) 488-8587


| | | | |
|---|---|---|---|
| Job: ***21007.69 vZw Bridgeport NE CT*** | | | |
| Project: ***98-ft Flag pole- 541 Broadbridge Road \| Bridgeport, CT 06610*** | | | |
| Client: Verizon Wireless | Drawn by: TJL | App'd: | |
| Code: TIA-222-H | Date: 11/01/22 | Scale: NTS | |
| Path: | | Dwg No. E-1 | |

## Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

Tower base elevation above sea level: 71.000 ft.
Basic wind speed of 120 mph.
Risk Category II.
Exposure Category C.
Simplified Topographic Factor Procedure for wind speed-up calculations is used.
Topographic Category: 1.
Crest Height: 0.000 ft.
Nominal ice thickness of 1.000 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 50 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

## Options

| | | | | | |
|---|---|---|---|---|---|
| | Consider Moments - Legs | | Distribute Leg Loads As Uniform | | Use ASCE 10 X-Brace Ly Rules |
| | Consider Moments - Horizontals | | Assume Legs Pinned | | Calculate Redundant Bracing Forces |
| | Consider Moments - Diagonals | √ | Assume Rigid Index Plate | | Ignore Redundant Members in FEA |
| | Use Moment Magnification | | Use Clear Spans For Wind Area | | SR Leg Bolts Resist Compression |
| √ | Use Code Stress Ratios | | Use Clear Spans For KL/r | | All Leg Panels Have Same Allowable |
| √ | Use Code Safety Factors - Guys | | Retension Guys To Initial Tension | | Offset Girt At Foundation |
| | Escalate Ice | √ | Bypass Mast Stability Checks | √ | Consider Feed Line Torque |
| | Always Use Max Kz | | Use Azimuth Dish Coefficients | | Include Angle Block Shear Check |
| | Use Special Wind Profile | √ | Project Wind Area of Appurt. | | Use TIA-222-H Bracing Resist. Exemption |
| | Include Bolts In Member Capacity | | Autocalc Torque Arm Areas | | Use TIA-222-H Tension Splice Exemption |
| | Leg Bolts Are At Top Of Section | | Add IBC .6D+W Combination | | Poles |
| | Secondary Horizontal Braces Leg | √ | Sort Capacity Reports By Component | √ | Include Shear-Torsion Interaction |
| | Use Diamond Inner Bracing (4 Sided) | | Triangulate Diamond Inner Bracing | | Always Use Sub-Critical Flow |
| | SR Members Have Cut Ends | | Treat Feed Line Bundles As Cylinder | | Use Top Mounted Sockets |
| | SR Members Are Concentric | | Ignore KL/ry For 60 Deg. Angle Legs | | Pole Without Linear Attachments |
| | | | | | Pole With Shroud Or No Appurtenances |
| | | | | | Outside and Inside Corner Radii Are Known |

## Tapered Pole Section Geometry

| Section | Elevation<br>ft | Section Length<br>ft | Splice Length<br>ft | Number of Sides | Top Diameter<br>in | Bottom Diameter<br>in | Wall Thickness<br>in | Bend Radius<br>in | Pole Grade |
|---|---|---|---|---|---|---|---|---|---|

| Section | Elevation<br>ft | Section Length<br>ft | Splice Length<br>ft | Number of Sides | Top Diameter<br>in | Bottom Diameter<br>in | Wall Thickness<br>in | Bend Radius<br>in | Pole Grade |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 98.000-78.500 | 19.500 | 0.000 | Round | 6.625 | 6.625 | 0.403 | | A500-42 (42 ksi) |
| L2 | 78.500-78.000 | 0.500 | 0.000 | Round | 6.625 | 10.750 | 0.465 | | A500-42 (42 ksi) |
| L3 | 78.000-68.500 | 9.500 | 0.000 | Round | 10.750 | 10.750 | 0.465 | | A500-42 (42 ksi) |
| L4 | 68.500-68.000 | 0.500 | 0.000 | Round | 10.750 | 35.500 | 0.465 | | A500-42 (42 ksi) |
| L5 | 68.000-38.250 | 29.750 | 5.500 | 18 | 35.500 | 40.020 | 0.250 | 1.000 | A572-65 (65 ksi) |
| L6 | 38.250-1.000 | 42.750 | | 18 | 38.684 | 45.000 | 0.250 | 1.000 | A572-65 (65 ksi) |

## Tapered Pole Properties

| Section | Tip Dia.<br>in | Area<br>$in^2$ | I<br>$in^4$ | r<br>in | C<br>in | I/C<br>$in^3$ | J<br>$in^4$ | It/Q<br>$in^2$ | w<br>in | w/t |
|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 6.625 | 7.877 | 38.280 | 2.204 | 3.313 | 11.556 | 76.560 | 3.936 | 0.000 | 0 |
| | 6.625 | 7.877 | 38.280 | 2.204 | 3.313 | 11.556 | 76.560 | 3.936 | 0.000 | 0 |
| L2 | 6.625 | 8.999 | 42.926 | 2.184 | 3.313 | 12.959 | 85.852 | 4.497 | 0.000 | 0 |
| | 10.750 | 15.025 | 199.073 | 3.640 | 5.375 | 37.037 | 398.146 | 7.508 | 0.000 | 0 |
| L3 | 10.750 | 15.025 | 199.073 | 3.640 | 5.375 | 37.037 | 398.146 | 7.508 | 0.000 | 0 |
| | 10.750 | 15.025 | 199.073 | 3.640 | 5.375 | 37.037 | 398.146 | 7.508 | 0.000 | 0 |
| L4 | 10.750 | 15.025 | 199.073 | 3.640 | 5.375 | 37.037 | 398.146 | 7.508 | 0.000 | 0 |
| | 35.500 | 51.181 | 7854.087 | 12.388 | 17.750 | 442.484 | 15708.174 | 25.575 | 0.000 | 0 |
| L5 | 36.009 | 27.971 | 4390.983 | 12.514 | 18.034 | 243.484 | 8787.744 | 13.988 | 5.808 | 23.232 |
| | 40.599 | 31.557 | 6305.959 | 14.118 | 20.330 | 310.178 | 12620.216 | 15.782 | 6.604 | 26.414 |
| L6 | 40.068 | 30.498 | 5691.722 | 13.644 | 19.652 | 289.631 | 11390.933 | 15.252 | 6.368 | 25.474 |
| | 45.656 | 35.509 | 8983.871 | 15.886 | 22.860 | 392.995 | 17979.563 | 17.758 | 7.480 | 29.92 |

| Tower Elevation<br>ft | Gusset Area (per face)<br>$ft^2$ | Gusset Thickness<br>in | Gusset Grade | Adjust. Factor $A_f$ | Adjust. Factor $A_r$ | Weight Mult. | Double Angle Stitch Bolt Spacing Diagonals<br>in | Double Angle Stitch Bolt Spacing Horizontals<br>in | Double Angle Stitch Bolt Spacing Redundants<br>in |
|---|---|---|---|---|---|---|---|---|---|
| L1<br>98.000-78.500 | | | | 0 | 1 | 1 | | | |
| L2<br>78.500-78.000 | | | | 0 | 1 | 1 | | | |
| L3<br>78.000-68.500 | | | | 0 | 1 | 1 | | | |
| L4<br>68.500-68.000 | | | | 0 | 1 | 1 | | | |
| L5<br>68.000-38.250 | | | | 1 | 1 | 1 | | | |
| L6<br>38.250-1.000 | | | | 1 | 1 | 1 | | | |

## Feed Line/Linear Appurtenances - Entered As Area

| Description | Face or Leg | Allow Shield | Exclude From Torque Calculation | Component Type | Placement ft | Total Number | | $C_AA_A$ $ft^2/ft$ | Weight klf |
|---|---|---|---|---|---|---|---|---|---|
| LDF5-50A (7/8 FOAM) (Verizon) | C | No | Yes | Inside Pole | 93.000 - 5.000 | 18 | No Ice | 0.000 | 0.000 |
| | | | | | | | 1/2" Ice | 0.000 | 0.000 |
| | | | | | | | 1" Ice | 0.000 | 0.000 |
| LDF5-50A (7/8 FOAM) (Verizon) | C | No | Yes | Inside Pole | 83.000 - 5.000 | 18 | No Ice | 0.000 | 0.000 |
| | | | | | | | 1/2" Ice | 0.000 | 0.000 |
| | | | | | | | 1" Ice | 0.000 | 0.000 |
| LDF5-50A (7/8 FOAM) (Verizon) | C | No | Yes | Inside Pole | 73.000 - 5.000 | 18 | No Ice | 0.000 | 0.000 |
| | | | | | | | 1/2" Ice | 0.000 | 0.000 |
| | | | | | | | 1" Ice | 0.000 | 0.000 |

## Feed Line/Linear Appurtenances Section Areas

| Tower Section | Tower Elevation ft | Face | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight K |
|---|---|---|---|---|---|---|---|
| L1 | 98.000-78.500 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.113 |
| L2 | 78.500-78.000 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 |
| L3 | 78.000-68.500 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.140 |
| L4 | 68.500-68.000 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.009 |
| L5 | 68.000-38.250 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.530 |
| L6 | 38.250-1.000 | A | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | 0.000 | 0.000 | 0.000 | 0.000 | 0.593 |

## Feed Line/Linear Appurtenances Section Areas - With Ice

| Tower Section | Tower Elevation ft | Face or Leg | Ice Thickness in | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight K |
|---|---|---|---|---|---|---|---|---|
| L1 | 98.000-78.500 | A | 1.103 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.113 |
| L2 | 78.500-78.000 | A | 1.090 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 |
| L3 | 78.000-68.500 | A | 1.083 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.140 |
| L4 | 68.500-68.000 | A | 1.075 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.009 |

| Tower Section | Tower Elevation ft | Face or Leg | Ice Thickness in | $A_R$ $ft^2$ | $A_F$ $ft^2$ | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ | Weight K |
|---|---|---|---|---|---|---|---|---|
| L5 | 68.000-38.250 | A | 1.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.530 |
| L6 | 38.250-1.000 | A | 0.950 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | B | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | C | | 0.000 | 0.000 | 0.000 | 0.000 | 0.593 |

## Feed Line Center of Pressure

| Section | Elevation ft | $CP_X$ in | $CP_Z$ in | $CP_X$ Ice in | $CP_Z$ Ice in |
|---|---|---|---|---|---|
| L1 | 98.000-78.500 | 0.000 | 0.000 | 0.000 | 0.000 |
| L2 | 78.500-78.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L3 | 78.000-68.500 | 0.000 | 0.000 | 0.000 | 0.000 |
| L4 | 68.500-68.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| L5 | 68.000-38.250 | 0.000 | 0.000 | 0.000 | 0.000 |
| L6 | 38.250-1.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: For pole sections, center of pressure calculations do not consider feed line shielding.

## Discrete Tower Loads

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft / Vert ft / ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight K |
|---|---|---|---|---|---|---|---|---|---|
| MX08FIT265-01 (Verizon - Proposed) | A | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 82.000 | No Ice<br>1/2" Ice<br>1" Ice | 3.123<br>3.359<br>3.603 | 1.411<br>1.613<br>1.821 | 0.027<br>0.047<br>0.070 |
| MX08FIT265-01 (Verizon - Proposed) | B | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 82.000 | No Ice<br>1/2" Ice<br>1" Ice | 3.123<br>3.359<br>3.603 | 1.411<br>1.613<br>1.821 | 0.027<br>0.047<br>0.070 |
| MX08FIT265-01 (Verizon - Proposed) | C | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 82.000 | No Ice<br>1/2" Ice<br>1" Ice | 3.123<br>3.359<br>3.603 | 1.411<br>1.613<br>1.821 | 0.027<br>0.047<br>0.070 |
| NNH4-65B-R6 (Verizon - Proposed) | A | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 92.000 | No Ice<br>1/2" Ice<br>1" Ice | 12.268<br>12.763<br>13.265 | 5.721<br>6.178<br>6.642 | 0.083<br>0.155<br>0.234 |
| NNH4-65B-R6 (Verizon - Proposed) | B | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 92.000 | No Ice<br>1/2" Ice<br>1" Ice | 12.268<br>12.763<br>13.265 | 5.721<br>6.178<br>6.642 | 0.083<br>0.155<br>0.234 |
| NNH4-65B-R6 (Verizon - Proposed) | C | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 92.000 | No Ice<br>1/2" Ice<br>1" Ice | 12.268<br>12.763<br>13.265 | 5.721<br>6.178<br>6.642 | 0.083<br>0.155<br>0.234 |
| (2) CBC61923T-DS-43 - Diplexer (Verizon - Proposed) | A | From Face | 0.500<br>0.000<br>0.000 | 0.000 | 92.000 | No Ice<br>1/2" Ice<br>1" Ice | 0.449<br>0.534<br>0.627 | 0.265<br>0.332<br>0.407 | 0.014<br>0.019<br>0.025 |

| Description | Face or Leg | Offset Type | Offsets: Horz Lateral ft / Vert ft | Azimuth Adjustment ° | Placement ft | | $C_AA_A$ Front $ft^2$ | $C_AA_A$ Side $ft^2$ | Weight K |
|---|---|---|---|---|---|---|---|---|---|
| (2) CBC61923T-DS-43 - Diplexer | B | From Face | 0.500 | 0.000 | 92.000 | No Ice | 0.449 | 0.265 | 0.014 |
| | | | 0.000 | | | 1/2" Ice | 0.534 | 0.332 | 0.019 |
| (Verizon - Proposed) | | | 0.000 | | | 1" Ice | 0.627 | 0.407 | 0.025 |
| (2) CBC61923T-DS-43 - Diplexer | C | From Face | 0.500 | 0.000 | 92.000 | No Ice | 0.449 | 0.265 | 0.014 |
| | | | 0.000 | | | 1/2" Ice | 0.534 | 0.332 | 0.019 |
| (Verizon - Proposed) | | | 0.000 | | | 1" Ice | 0.627 | 0.407 | 0.025 |
| RT-8808-77A | A | From Face | 0.500 | 0.000 | 82.000 | No Ice | 1.875 | 0.850 | 0.060 |
| (Verizon - Proposed) | | | 0.000 | | | 1/2" Ice | 2.045 | 0.975 | 0.075 |
| | | | 0.000 | | | 1" Ice | 2.223 | 1.107 | 0.092 |
| RT-8808-77A | B | From Face | 0.500 | 0.000 | 82.000 | No Ice | 1.875 | 0.850 | 0.060 |
| (Verizon - Proposed) | | | 0.000 | | | 1/2" Ice | 2.045 | 0.975 | 0.075 |
| | | | 0.000 | | | 1" Ice | 2.223 | 1.107 | 0.092 |
| RT-8808-77A | C | From Face | 0.500 | 0.000 | 82.000 | No Ice | 1.875 | 0.850 | 0.060 |
| (Verizon - Proposed) | | | 0.000 | | | 1/2" Ice | 2.045 | 0.975 | 0.075 |
| | | | 0.000 | | | 1" Ice | 2.223 | 1.107 | 0.092 |
| 10'x48" Canister | C | From Face | 0.000 | 0.000 | 98.000 - 88.000 | No Ice | 20.000 | 20.000 | 0.400 |
| | | | 0.000 | | | 1/2" Ice | 28.822 | 28.822 | 0.757 |
| | | | 0.000 | | | 1" Ice | 29.653 | 29.653 | 1.126 |
| 10'x48" Canister | C | From Face | 0.000 | 0.000 | 88.000 - 78.000 | No Ice | 20.000 | 20.000 | 0.400 |
| | | | 0.000 | | | 1/2" Ice | 28.822 | 28.822 | 0.757 |
| | | | 0.000 | | | 1" Ice | 29.653 | 29.653 | 1.126 |
| 10'x36" Canister | C | From Face | 0.000 | 0.000 | 78.000 - 68.000 | No Ice | 15.556 | 15.556 | 0.350 |
| | | | 0.000 | | | 1/2" Ice | 22.295 | 22.295 | 0.608 |
| | | | 0.000 | | | 1" Ice | 23.044 | 23.044 | 0.876 |
| RRFDC-3315-PF-48 | C | From Face | 0.500 | 0.000 | 92.000 | No Ice | 3.015 | 1.965 | 0.025 |
| (Verizon - Proposed) | | | 0.000 | | | 1/2" Ice | 3.234 | 2.153 | 0.051 |
| | | | 0.000 | | | 1" Ice | 3.460 | 2.349 | 0.081 |

## Tower Pressures - No Ice

$G_H = 1.100$

| Section Elevation ft | z ft | $K_Z$ | $q_z$ ksf | $A_G$ $ft^2$ | Face | $A_F$ $ft^2$ | $A_R$ $ft^2$ | $A_{leg}$ $ft^2$ | Leg % | $C_AA_A$ In Face $ft^2$ | $C_AA_A$ Out Face $ft^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 88.250 | 1.233 | 0.043 | 10.766 | A | 0.000 | 10.766 | 10.766 | 100.00 | 0.000 | 0.000 |
| 98.000-78.500 | | | | | B | 0.000 | 10.766 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 10.766 | | 100.00 | 0.000 | 0.000 |
| L2 | 78.230 | 1.202 | 0.042 | 0.362 | A | 0.000 | 0.362 | 0.362 | 100.00 | 0.000 | 0.000 |
| 78.500-78.000 | | | | | B | 0.000 | 0.362 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 0.362 | | 100.00 | 0.000 | 0.000 |
| L3 | 73.250 | 1.185 | 0.041 | 8.510 | A | 0.000 | 8.510 | 8.510 | 100.00 | 0.000 | 0.000 |
| 78.000-68.500 | | | | | B | 0.000 | 8.510 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 8.510 | | 100.00 | 0.000 | 0.000 |
| L4 | 68.205 | 1.168 | 0.041 | 0.964 | A | 0.000 | 0.964 | 0.964 | 100.00 | 0.000 | 0.000 |
| 68.500-68.000 | | | | | B | 0.000 | 0.964 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 0.964 | | 100.00 | 0.000 | 0.000 |
| L5 | 52.828 | 1.107 | 0.039 | 94.962 | A | 0.000 | 94.962 | 94.962 | 100.00 | 0.000 | 0.000 |
| 68.000-38.250 | | | | | B | 0.000 | 94.962 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ ksf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | 0.000 | 94.962 | | 100.00 | 0.000 | 0.000 |
| L6 | 19.854 | 0.9 | 0.032 | 133.050 | A | 0.000 | 133.050 | 133.050 | 100.00 | 0.000 | 0.000 |
| 38.250-1.000 | | | | | B | 0.000 | 133.050 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 133.050 | | 100.00 | 0.000 | 0.000 |

## Tower Pressure - With Ice

$G_H = 1.100$

| Section Elevation ft | z ft | $K_Z$ | $q_z$ ksf | $t_Z$ in | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 88.250 | 1.233 | 0.007 | 1.103 | 14.352 | A | 0.000 | 14.352 | 14.352 | 100.00 | 0.000 | 0.000 |
| 98.000-78.500 | | | | | | B | 0.000 | 14.352 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 14.352 | | 100.00 | 0.000 | 0.000 |
| L2 | 78.230 | 1.202 | 0.007 | 1.090 | 0.453 | A | 0.000 | 0.453 | 0.453 | 100.00 | 0.000 | 0.000 |
| 78.500-78.000 | | | | | | B | 0.000 | 0.453 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 0.453 | | 100.00 | 0.000 | 0.000 |
| L3 | 73.250 | 1.185 | 0.007 | 1.083 | 10.225 | A | 0.000 | 10.225 | 10.225 | 100.00 | 0.000 | 0.000 |
| 78.000-68.500 | | | | | | B | 0.000 | 10.225 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 10.225 | | 100.00 | 0.000 | 0.000 |
| L4 | 68.205 | 1.168 | 0.007 | 1.075 | 1.053 | A | 0.000 | 1.053 | 1.053 | 100.00 | 0.000 | 0.000 |
| 68.500-68.000 | | | | | | B | 0.000 | 1.053 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 1.053 | | 100.00 | 0.000 | 0.000 |
| L5 | 52.828 | 1.107 | 0.007 | 1.048 | 100.159 | A | 0.000 | 100.159 | 100.159 | 100.00 | 0.000 | 0.000 |
| 68.000-38.250 | | | | | | B | 0.000 | 100.159 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 100.159 | | 100.00 | 0.000 | 0.000 |
| L6 38.250-1.000 | 19.854 | 0.9 | 0.006 | 0.950 | 139.557 | A | 0.000 | 139.557 | 139.557 | 100.00 | 0.000 | 0.000 |
| | | | | | | B | 0.000 | 139.557 | | 100.00 | 0.000 | 0.000 |
| | | | | | | C | 0.000 | 139.557 | | 100.00 | 0.000 | 0.000 |

## Tower Pressure - Service

$G_H = 1.100$

| Section Elevation ft | z ft | $K_Z$ | $q_z$ ksf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 88.250 | 1.233 | 0.010 | 10.766 | A | 0.000 | 10.766 | 10.766 | 100.00 | 0.000 | 0.000 |
| 98.000-78.500 | | | | | B | 0.000 | 10.766 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 10.766 | | 100.00 | 0.000 | 0.000 |
| L2 | 78.230 | 1.202 | 0.009 | 0.362 | A | 0.000 | 0.362 | 0.362 | 100.00 | 0.000 | 0.000 |
| 78.500-78.000 | | | | | B | 0.000 | 0.362 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 0.362 | | 100.00 | 0.000 | 0.000 |
| L3 | 73.250 | 1.185 | 0.009 | 8.510 | A | 0.000 | 8.510 | 8.510 | 100.00 | 0.000 | 0.000 |
| 78.000-68.500 | | | | | B | 0.000 | 8.510 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 8.510 | | 100.00 | 0.000 | 0.000 |
| L4 | 68.205 | 1.168 | 0.009 | 0.964 | A | 0.000 | 0.964 | 0.964 | 100.00 | 0.000 | 0.000 |
| 68.500-68.000 | | | | | B | 0.000 | 0.964 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 0.964 | | 100.00 | 0.000 | 0.000 |

| Section Elevation ft | z ft | $K_Z$ | $q_z$ ksf | $A_G$ ft² | Face | $A_F$ ft² | $A_R$ ft² | $A_{leg}$ ft² | Leg % | $C_AA_A$ In Face ft² | $C_AA_A$ Out Face ft² |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L5 | 52.828 | 1.107 | 0.009 | 94.962 | A | 0.000 | 94.962 | 94.962 | 100.00 | 0.000 | 0.000 |
| 68.000-38.250 | | | | | B | 0.000 | 94.962 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 94.962 | | 100.00 | 0.000 | 0.000 |
| L6 | 19.854 | 0.9 | 0.007 | 133.050 | A | 0.000 | 133.050 | 133.050 | 100.00 | 0.000 | 0.000 |
| 38.250-1.000 | | | | | B | 0.000 | 133.050 | | 100.00 | 0.000 | 0.000 |
| | | | | | C | 0.000 | 133.050 | | 100.00 | 0.000 | 0.000 |

## Tower Forces - No Ice - Wind Normal To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 0.637 | 0.043 | 1 | 1 | 10.766 | 0.325 | 0.017 | C |
| 98.000-78.500 | | | B | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.6 | 0.042 | 1 | 1 | 0.362 | 0.010 | 0.020 | C |
| 78.500-78.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.6 | 0.041 | 1 | 1 | 8.510 | 0.233 | 0.024 | C |
| 78.000-68.500 | | | B | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.041 | 1 | 1 | 0.964 | 0.026 | 0.052 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.039 | 1 | 1 | 94.962 | 2.947 | 0.099 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.032 | 1 | 1 | 133.050 | 3.396 | 0.091 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 264.463 kip-ft | 6.937 | | |

## Tower Forces - No Ice - Wind 45 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 0.637 | 0.043 | 1 | 1 | 10.766 | 0.325 | 0.017 | C |
| 98.000-78.500 | | | B | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.6 | 0.042 | 1 | 1 | 0.362 | 0.010 | 0.020 | C |
| 78.500-78.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.6 | 0.041 | 1 | 1 | 8.510 | 0.233 | 0.024 | C |
| 78.000-68.500 | | | B | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.041 | 1 | 1 | 0.964 | 0.026 | 0.052 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.039 | 1 | 1 | 94.962 | 2.947 | 0.099 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.032 | 1 | 1 | 133.050 | 3.396 | 0.091 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 264.463 kip-ft | 6.937 | | |

## Tower Forces - No Ice - Wind 60 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 0.637 | 0.043 | 1 | 1 | 10.766 | 0.325 | 0.017 | C |
| 98.000-78.500 | | | B | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.6 | 0.042 | 1 | 1 | 0.362 | 0.010 | 0.020 | C |
| 78.500-78.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.6 | 0.041 | 1 | 1 | 8.510 | 0.233 | 0.024 | C |
| 78.000-68.500 | | | B | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.041 | 1 | 1 | 0.964 | 0.026 | 0.052 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.039 | 1 | 1 | 94.962 | 2.947 | 0.099 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.032 | 1 | 1 | 133.050 | 3.396 | 0.091 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 264.463 kip-ft | 6.937 | | |

## Tower Forces - No Ice - Wind 90 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ $ft^2$ | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 0.637 | 0.043 | 1 | 1 | 10.766 | 0.325 | 0.017 | C |
| 98.000-78.500 | | | B | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 0.637 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.6 | 0.042 | 1 | 1 | 0.362 | 0.010 | 0.020 | C |
| 78.500-78.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.362 | | | |

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L3 | 0.140 | 0.486 | A | 1 | 0.6 | 0.041 | 1 | 1 | 8.510 | 0.233 | 0.024 | C |
| 78.000-68.500 | | | B | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.041 | 1 | 1 | 0.964 | 0.026 | 0.052 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.039 | 1 | 1 | 94.962 | 2.947 | 0.099 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.032 | 1 | 1 | 133.050 | 3.396 | 0.091 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 264.463 kip-ft | 6.937 | | |

## Tower Forces - With Ice - Wind Normal To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.726 | A | 1 | 1.2 | 0.007 | 1 | 1 | 14.352 | 0.142 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| L2 | 0.006 | 0.027 | A | 1 | 1.2 | 0.007 | 1 | 1 | 0.453 | 0.004 | 0.009 | C |
| 78.500-78.000 | | | B | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| L3 | 0.140 | 0.634 | A | 1 | 1.2 | 0.007 | 1 | 1 | 10.225 | 0.097 | 0.010 | C |
| 78.000-68.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| L4 | 0.009 | 0.072 | A | 1 | 1.2 | 0.007 | 1 | 1 | 1.053 | 0.010 | 0.020 | C |
| 68.500-68.000 | | | B | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| L5 | 0.530 | 4.507 | A | 1 | 1.2 | 0.007 | 1 | 1 | 100.159 | 0.887 | 0.030 | C |
| 68.000-38.250 | | | B | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| L6 | 0.593 | 6.689 | A | 1 | 1.2 | 0.006 | 1 | 1 | 138.950 | 1.012 | 0.027 | C |
| 38.250-1.000 | | | B | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| Sum Weight: | 1.390 | 12.655 | | | | | | OTM | 85.433 kip-ft | 2.152 | | |

## Tower Forces - With Ice - Wind 45 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.726 | A | 1 | 1.2 | 0.007 | 1 | 1 | 14.352 | 0.142 | 0.007 | C |

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| L2 | 0.006 | 0.027 | A | 1 | 1.2 | 0.007 | 1 | 1 | 0.453 | 0.004 | 0.009 | C |
| 78.500-78.000 | | | B | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| L3 | 0.140 | 0.634 | A | 1 | 1.2 | 0.007 | 1 | 1 | 10.225 | 0.097 | 0.010 | C |
| 78.000-68.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| L4 | 0.009 | 0.072 | A | 1 | 1.2 | 0.007 | 1 | 1 | 1.053 | 0.010 | 0.020 | C |
| 68.500-68.000 | | | B | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| L5 | 0.530 | 4.507 | A | 1 | 1.2 | 0.007 | 1 | 1 | 100.159 | 0.887 | 0.030 | C |
| 68.000-38.250 | | | B | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| L6 | 0.593 | 6.689 | A | 1 | 1.2 | 0.006 | 1 | 1 | 138.950 | 1.012 | 0.027 | C |
| 38.250-1.000 | | | B | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| Sum Weight: | 1.390 | 12.655 | | | | | | OTM | 85.433 kip-ft | 2.152 | | |

## Tower Forces - With Ice - Wind 60 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.726 | A | 1 | 1.2 | 0.007 | 1 | 1 | 14.352 | 0.142 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| L2 | 0.006 | 0.027 | A | 1 | 1.2 | 0.007 | 1 | 1 | 0.453 | 0.004 | 0.009 | C |
| 78.500-78.000 | | | B | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| L3 | 0.140 | 0.634 | A | 1 | 1.2 | 0.007 | 1 | 1 | 10.225 | 0.097 | 0.010 | C |
| 78.000-68.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| L4 | 0.009 | 0.072 | A | 1 | 1.2 | 0.007 | 1 | 1 | 1.053 | 0.010 | 0.020 | C |
| 68.500-68.000 | | | B | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| L5 | 0.530 | 4.507 | A | 1 | 1.2 | 0.007 | 1 | 1 | 100.159 | 0.887 | 0.030 | C |
| 68.000-38.250 | | | B | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| L6 | 0.593 | 6.689 | A | 1 | 1.2 | 0.006 | 1 | 1 | 138.950 | 1.012 | 0.027 | C |
| 38.250-1.000 | | | B | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| Sum Weight: | 1.390 | 12.655 | | | | | | OTM | 85.433 kip-ft | 2.152 | | |

## Tower Forces - With Ice - Wind 90 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.726 | A | 1 | 1.2 | 0.007 | 1 | 1 | 14.352 | 0.142 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 14.352 | | | |
| L2 | 0.006 | 0.027 | A | 1 | 1.2 | 0.007 | 1 | 1 | 0.453 | 0.004 | 0.009 | C |
| 78.500-78.000 | | | B | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 0.453 | | | |
| L3 | 0.140 | 0.634 | A | 1 | 1.2 | 0.007 | 1 | 1 | 10.225 | 0.097 | 0.010 | C |
| 78.000-68.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.225 | | | |
| L4 | 0.009 | 0.072 | A | 1 | 1.2 | 0.007 | 1 | 1 | 1.053 | 0.010 | 0.020 | C |
| 68.500-68.000 | | | B | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 1.053 | | | |
| L5 | 0.530 | 4.507 | A | 1 | 1.2 | 0.007 | 1 | 1 | 100.159 | 0.887 | 0.030 | C |
| 68.000-38.250 | | | B | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 100.159 | | | |
| L6 | 0.593 | 6.689 | A | 1 | 1.2 | 0.006 | 1 | 1 | 138.950 | 1.012 | 0.027 | C |
| 38.250-1.000 | | | B | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 138.950 | | | |
| Sum Weight: | 1.390 | 12.655 | | | | | | OTM | 85.433 kip-ft | 2.152 | | |

## Tower Forces - Service - Wind Normal To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 1.2 | 0.010 | 1 | 1 | 10.766 | 0.137 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.984 | 0.009 | 1 | 1 | 0.362 | 0.004 | 0.007 | C |
| 78.500-78.000 | | | B | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.801 | 0.009 | 1 | 1 | 8.510 | 0.069 | 0.007 | C |
| 78.000-68.500 | | | B | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.009 | 1 | 1 | 0.964 | 0.006 | 0.012 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.009 | 1 | 1 | 94.962 | 0.659 | 0.022 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.007 | 1 | 1 | 133.050 | 0.760 | 0.020 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 66.127 kip-ft | 1.635 | | |

## Tower Forces - Service - Wind 45 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 1.2 | 0.010 | 1 | 1 | 10.766 | 0.137 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.984 | 0.009 | 1 | 1 | 0.362 | 0.004 | 0.007 | C |
| 78.500-78.000 | | | B | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.801 | 0.009 | 1 | 1 | 8.510 | 0.069 | 0.007 | C |
| 78.000-68.500 | | | B | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.009 | 1 | 1 | 0.964 | 0.006 | 0.012 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.009 | 1 | 1 | 94.962 | 0.659 | 0.022 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.007 | 1 | 1 | 133.050 | 0.760 | 0.020 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 66.127 kip-ft | 1.635 | | |

## Tower Forces - Service - Wind 60 To Face

| Section Elevation ft | Add Weight K | Self Weight K | Face | e | $C_F$ | $q_z$ ksf | $D_F$ | $D_R$ | $A_E$ ft² | F K | w klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 1.2 | 0.010 | 1 | 1 | 10.766 | 0.137 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.984 | 0.009 | 1 | 1 | 0.362 | 0.004 | 0.007 | C |
| 78.500-78.000 | | | B | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.801 | 0.009 | 1 | 1 | 8.510 | 0.069 | 0.007 | C |
| 78.000-68.500 | | | B | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.009 | 1 | 1 | 0.964 | 0.006 | 0.012 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.009 | 1 | 1 | 94.962 | 0.659 | 0.022 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.007 | 1 | 1 | 133.050 | 0.760 | 0.020 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 66.127 kip-ft | 1.635 | | |

## Tower Forces - Service - Wind 90 To Face

| Section Elevation<br>ft | Add Weight<br>K | Self Weight<br>K | Face | e | $C_F$ | $q_z$<br>ksf | $D_F$ | $D_R$ | $A_E$<br>ft² | F<br>K | w<br>klf | Ctrl. Face |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L1 | 0.113 | 0.523 | A | 1 | 1.2 | 0.010 | 1 | 1 | 10.766 | 0.137 | 0.007 | C |
| 98.000-78.500 | | | B | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| | | | C | 1 | 1.2 | | 1 | 1 | 10.766 | | | |
| L2 | 0.006 | 0.020 | A | 1 | 0.984 | 0.009 | 1 | 1 | 0.362 | 0.004 | 0.007 | C |
| 78.500-78.000 | | | B | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| | | | C | 1 | 0.984 | | 1 | 1 | 0.362 | | | |
| L3 | 0.140 | 0.486 | A | 1 | 0.801 | 0.009 | 1 | 1 | 8.510 | 0.069 | 0.007 | C |
| 78.000-68.500 | | | B | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| | | | C | 1 | 0.801 | | 1 | 1 | 8.510 | | | |
| L4 | 0.009 | 0.056 | A | 1 | 0.6 | 0.009 | 1 | 1 | 0.964 | 0.006 | 0.012 | C |
| 68.500-68.000 | | | B | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| | | | C | 1 | 0.6 | | 1 | 1 | 0.964 | | | |
| L5 | 0.530 | 3.013 | A | 1 | 0.73 | 0.009 | 1 | 1 | 94.962 | 0.659 | 0.022 | C |
| 68.000-38.250 | | | B | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 94.962 | | | |
| L6 | 0.593 | 4.801 | A | 1 | 0.73 | 0.007 | 1 | 1 | 133.050 | 0.760 | 0.020 | C |
| 38.250-1.000 | | | B | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| | | | C | 1 | 0.73 | | 1 | 1 | 133.050 | | | |
| Sum Weight: | 1.390 | 8.899 | | | | | | OTM | 66.127<br>kip-ft | 1.635 | | |

## Force Totals

| Load Case | Vertical Forces<br>K | Sum of Forces X<br>K | Sum of Forces Z<br>K | Sum of Overturning Moments, $M_x$<br>kip-ft | Sum of Overturning Moments, $M_z$<br>kip-ft | Sum of Torques<br>kip-ft |
|---|---|---|---|---|---|---|
| Leg Weight | 8.899 | | | | | |
| Bracing Weight | 0.000 | | | | | |
| Total Member Self-Weight | 8.899 | | | 0.408 | 0.000 | |
| Total Weight | 12.058 | | | 0.408 | 0.000 | |
| Wind 0 deg - No Ice | | 0.000 | -11.582 | -660.739 | 0.000 | 0.000 |
| Wind 30 deg - No Ice | | 5.766 | -10.030 | -572.162 | -328.290 | 0.467 |
| Wind 45 deg - No Ice | | 8.154 | -8.190 | -467.093 | -464.272 | 0.661 |
| Wind 60 deg - No Ice | | 9.987 | -5.791 | -330.165 | -568.614 | 0.810 |
| Wind 90 deg - No Ice | | 11.532 | 0.000 | 0.408 | -656.579 | 0.935 |
| Wind 120 deg - No Ice | | 9.987 | 5.791 | 330.981 | -568.614 | 0.810 |
| Wind 135 deg - No Ice | | 8.154 | 8.190 | 467.909 | -464.272 | 0.661 |
| Wind 150 deg - No Ice | | 5.766 | 10.030 | 572.977 | -328.290 | 0.467 |
| Wind 180 deg - No Ice | | 0.000 | 11.582 | 661.554 | 0.000 | 0.000 |
| Wind 210 deg - No Ice | | -5.766 | 10.030 | 572.977 | 328.290 | -0.467 |
| Wind 225 deg - No Ice | | -8.154 | 8.190 | 467.909 | 464.272 | -0.661 |
| Wind 240 deg - No Ice | | -9.987 | 5.791 | 330.981 | 568.614 | -0.810 |
| Wind 270 deg - No Ice | | -11.532 | 0.000 | 0.408 | 656.579 | -0.935 |
| Wind 300 deg - No Ice | | -9.987 | -5.791 | -330.165 | 568.614 | -0.810 |
| Wind 315 deg - No Ice | | -8.154 | -8.190 | -467.093 | 464.272 | -0.661 |
| Wind 330 deg - No Ice | | -5.766 | -10.030 | -572.162 | 328.290 | -0.467 |
| Member Ice | 3.756 | | | | | |
| Total Weight Ice | 18.901 | | | 1.176 | 0.000 | |
| Wind 0 deg - Ice | | 0.000 | -3.240 | -176.747 | 0.000 | 0.000 |
| Wind 30 deg - Ice | | 1.615 | -2.806 | -152.910 | -88.539 | 0.119 |

| Load Case | Vertical Forces K | Sum of Forces X K | Sum of Forces Z K | Sum of Overturning Moments, $M_x$ kip-ft | Sum of Overturning Moments, $M_z$ kip-ft | Sum of Torques kip-ft |
|---|---|---|---|---|---|---|
| Wind 45 deg - Ice | | 2.284 | -2.291 | -124.634 | -125.214 | 0.169 |
| Wind 60 deg - Ice | | 2.798 | -1.620 | -87.785 | -153.355 | 0.207 |
| Wind 90 deg - Ice | | 3.231 | 0.000 | 1.176 | -177.079 | 0.238 |
| Wind 120 deg - Ice | | 2.798 | 1.620 | 90.137 | -153.355 | 0.207 |
| Wind 135 deg - Ice | | 2.284 | 2.291 | 126.986 | -125.214 | 0.169 |
| Wind 150 deg - Ice | | 1.615 | 2.806 | 155.262 | -88.539 | 0.119 |
| Wind 180 deg - Ice | | 0.000 | 3.240 | 179.099 | 0.000 | 0.000 |
| Wind 210 deg - Ice | | -1.615 | 2.806 | 155.262 | 88.539 | -0.119 |
| Wind 225 deg - Ice | | -2.284 | 2.291 | 126.986 | 125.214 | -0.169 |
| Wind 240 deg - Ice | | -2.798 | 1.620 | 90.137 | 153.355 | -0.207 |
| Wind 270 deg - Ice | | -3.231 | 0.000 | 1.176 | 177.079 | -0.238 |
| Wind 300 deg - Ice | | -2.798 | -1.620 | -87.785 | 153.355 | -0.207 |
| Wind 315 deg - Ice | | -2.284 | -2.291 | -124.634 | 125.214 | -0.169 |
| Wind 330 deg - Ice | | -1.615 | -2.806 | -152.910 | 88.539 | -0.119 |
| Total Weight | 12.058 | | | 0.408 | 0.000 | |
| Wind 0 deg - Service | | 0.000 | -2.674 | -154.452 | 0.000 | 0.000 |
| Wind 30 deg - Service | | 1.331 | -2.316 | -133.704 | -76.919 | 0.105 |
| Wind 45 deg - Service | | 1.883 | -1.891 | -109.094 | -108.780 | 0.148 |
| Wind 60 deg - Service | | 2.306 | -1.337 | -77.022 | -133.227 | 0.181 |
| Wind 90 deg - Service | | 2.663 | 0.000 | 0.408 | -153.838 | 0.209 |
| Wind 120 deg - Service | | 2.306 | 1.337 | 77.837 | -133.227 | 0.181 |
| Wind 135 deg - Service | | 1.883 | 1.891 | 109.910 | -108.780 | 0.148 |
| Wind 150 deg - Service | | 1.331 | 2.316 | 134.520 | -76.919 | 0.105 |
| Wind 180 deg - Service | | 0.000 | 2.674 | 155.267 | 0.000 | 0.000 |
| Wind 210 deg - Service | | -1.331 | 2.316 | 134.520 | 76.919 | -0.105 |
| Wind 225 deg - Service | | -1.883 | 1.891 | 109.910 | 108.780 | -0.148 |
| Wind 240 deg - Service | | -2.306 | 1.337 | 77.837 | 133.227 | -0.181 |
| Wind 270 deg - Service | | -2.663 | 0.000 | 0.408 | 153.838 | -0.209 |
| Wind 300 deg - Service | | -2.306 | -1.337 | -77.022 | 133.227 | -0.181 |
| Wind 315 deg - Service | | -1.883 | -1.891 | -109.094 | 108.780 | -0.148 |
| Wind 330 deg - Service | | -1.331 | -2.316 | -133.704 | 76.919 | -0.105 |

## Load Combinations

| Comb. No. | Description |
|---|---|
| 1 | Dead Only |
| 2 | 1.2 Dead+1.0 Wind 0 deg - No Ice |
| 3 | 0.9 Dead+1.0 Wind 0 deg - No Ice |
| 4 | 1.2 Dead+1.0 Wind 30 deg - No Ice |
| 5 | 0.9 Dead+1.0 Wind 30 deg - No Ice |
| 6 | 1.2 Dead+1.0 Wind 45 deg - No Ice |
| 7 | 0.9 Dead+1.0 Wind 45 deg - No Ice |
| 8 | 1.2 Dead+1.0 Wind 60 deg - No Ice |
| 9 | 0.9 Dead+1.0 Wind 60 deg - No Ice |
| 10 | 1.2 Dead+1.0 Wind 90 deg - No Ice |
| 11 | 0.9 Dead+1.0 Wind 90 deg - No Ice |
| 12 | 1.2 Dead+1.0 Wind 120 deg - No Ice |
| 13 | 0.9 Dead+1.0 Wind 120 deg - No Ice |
| 14 | 1.2 Dead+1.0 Wind 135 deg - No Ice |
| 15 | 0.9 Dead+1.0 Wind 135 deg - No Ice |
| 16 | 1.2 Dead+1.0 Wind 150 deg - No Ice |
| 17 | 0.9 Dead+1.0 Wind 150 deg - No Ice |
| 18 | 1.2 Dead+1.0 Wind 180 deg - No Ice |
| 19 | 0.9 Dead+1.0 Wind 180 deg - No Ice |
| 20 | 1.2 Dead+1.0 Wind 210 deg - No Ice |

| Comb. No. | Description |
|---|---|
| 21 | 0.9 Dead+1.0 Wind 210 deg - No Ice |
| 22 | 1.2 Dead+1.0 Wind 225 deg - No Ice |
| 23 | 0.9 Dead+1.0 Wind 225 deg - No Ice |
| 24 | 1.2 Dead+1.0 Wind 240 deg - No Ice |
| 25 | 0.9 Dead+1.0 Wind 240 deg - No Ice |
| 26 | 1.2 Dead+1.0 Wind 270 deg - No Ice |
| 27 | 0.9 Dead+1.0 Wind 270 deg - No Ice |
| 28 | 1.2 Dead+1.0 Wind 300 deg - No Ice |
| 29 | 0.9 Dead+1.0 Wind 300 deg - No Ice |
| 30 | 1.2 Dead+1.0 Wind 315 deg - No Ice |
| 31 | 0.9 Dead+1.0 Wind 315 deg - No Ice |
| 32 | 1.2 Dead+1.0 Wind 330 deg - No Ice |
| 33 | 0.9 Dead+1.0 Wind 330 deg - No Ice |
| 34 | 1.2 Dead+1.0 Ice+1.0 Temp |
| 35 | 1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp |
| 36 | 1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp |
| 37 | 1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Temp |
| 38 | 1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp |
| 39 | 1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp |
| 40 | 1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp |
| 41 | 1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Temp |
| 42 | 1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp |
| 43 | 1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp |
| 44 | 1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp |
| 45 | 1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Temp |
| 46 | 1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp |
| 47 | 1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp |
| 48 | 1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp |
| 49 | 1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Temp |
| 50 | 1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp |
| 51 | Dead+Wind 0 deg - Service |
| 52 | Dead+Wind 30 deg - Service |
| 53 | Dead+Wind 45 deg - Service |
| 54 | Dead+Wind 60 deg - Service |
| 55 | Dead+Wind 90 deg - Service |
| 56 | Dead+Wind 120 deg - Service |
| 57 | Dead+Wind 135 deg - Service |
| 58 | Dead+Wind 150 deg - Service |
| 59 | Dead+Wind 180 deg - Service |
| 60 | Dead+Wind 210 deg - Service |
| 61 | Dead+Wind 225 deg - Service |
| 62 | Dead+Wind 240 deg - Service |
| 63 | Dead+Wind 270 deg - Service |
| 64 | Dead+Wind 300 deg - Service |
| 65 | Dead+Wind 315 deg - Service |
| 66 | Dead+Wind 330 deg - Service |

## Maximum Member Forces

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial K | Major Axis Moment kip-ft | Minor Axis Moment kip-ft |
|---|---|---|---|---|---|---|---|
| L1 | 98 - 78.5 | Pole | Max Tension | 35 | 0.000 | 0.000 | -0.000 |
| | | | Max. Compression | 34 | -5.120 | 0.000 | -0.807 |
| | | | Max. Mx | 10 | -2.292 | -44.335 | -0.282 |
| | | | Max. My | 18 | -2.288 | 0.000 | -45.314 |
| | | | Max. Vy | 10 | 4.249 | -44.335 | -0.282 |
| | | | Max. Vx | 18 | 4.300 | 0.000 | -45.314 |
| | | | Max. Torque | 10 | | | -0.580 |

| Section No. | Elevation ft | Component Type | Condition | Gov. Load Comb. | Axial K | Major Axis Moment kip-ft | Minor Axis Moment kip-ft |
|---|---|---|---|---|---|---|---|
| L2 | 78.5 - 78 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 34 | -5.222 | 0.000 | -0.831 |
| | | | Max. Mx | 10 | -2.359 | -46.470 | -0.290 |
| | | | Max. My | 18 | -2.355 | 0.000 | -47.484 |
| | | | Max. Vy | 10 | 4.300 | -46.470 | -0.290 |
| | | | Max. Vx | 18 | 4.352 | 0.000 | -47.484 |
| | | | Max. Torque | 10 | | | -0.597 |
| L3 | 78 - 68.5 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 34 | -7.064 | 0.000 | -1.264 |
| | | | Max. Mx | 10 | -3.558 | -91.573 | -0.468 |
| | | | Max. My | 18 | -3.556 | 0.000 | -93.252 |
| | | | Max. Vy | 10 | 5.188 | -91.573 | -0.468 |
| | | | Max. Vx | 18 | 5.239 | 0.000 | -93.252 |
| | | | Max. Torque | 10 | | | -0.898 |
| L4 | 68.5 - 68 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 34 | -7.207 | 0.000 | -1.312 |
| | | | Max. Mx | 10 | -3.662 | -94.180 | -0.487 |
| | | | Max. My | 18 | -3.661 | 0.000 | -95.904 |
| | | | Max. Vy | 10 | 5.247 | -94.180 | -0.487 |
| | | | Max. Vx | 18 | 5.298 | 0.000 | -95.904 |
| | | | Max. Torque | 10 | | | -0.932 |
| L5 | 68 - 38.25 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 34 | -11.858 | 0.000 | -1.312 |
| | | | Max. Mx | 10 | -7.086 | -250.157 | -0.496 |
| | | | Max. My | 18 | -7.084 | 0.000 | -253.116 |
| | | | Max. Vy | 10 | 7.651 | -250.157 | -0.496 |
| | | | Max. Vx | 18 | 7.702 | 0.000 | -253.116 |
| | | | Max. Torque | 10 | | | -0.932 |
| L6 | 38.25 - 1 | Pole | Max Tension | 1 | 0.000 | 0.000 | 0.000 |
| | | | Max. Compression | 34 | -21.592 | 0.000 | -1.312 |
| | | | Max. Mx | 10 | -14.466 | -663.331 | -0.502 |
| | | | Max. My | 18 | -14.466 | 0.000 | -668.460 |
| | | | Max. Vy | 10 | 11.537 | -663.331 | -0.502 |
| | | | Max. Vx | 18 | 11.587 | 0.000 | -668.460 |
| | | | Max. Torque | 10 | | | -0.932 |

## Maximum Reactions

| Location | Condition | Gov. Load Comb. | Vertical K | Horizontal, X K | Horizontal, Z K |
|---|---|---|---|---|---|
| Pole | Max. Vert | 34 | 21.592 | 0.000 | -0.000 |
| | Max. $H_x$ | 27 | 10.852 | 11.532 | 0.000 |
| | Max. $H_z$ | 2 | 14.470 | 0.000 | 11.582 |
| | Max. $M_x$ | 2 | 667.455 | 0.000 | 11.582 |
| | Max. $M_z$ | 10 | 663.331 | -11.532 | 0.000 |
| | Max. Torsion | 26 | 0.932 | 11.532 | 0.000 |
| | Min. Vert | 31 | 10.852 | 8.154 | 8.190 |
| | Min. $H_x$ | 10 | 14.470 | -11.532 | 0.000 |
| | Min. $H_z$ | 18 | 14.470 | 0.000 | -11.582 |
| | Min. $M_x$ | 18 | -668.460 | 0.000 | -11.582 |
| | Min. $M_z$ | 26 | -663.331 | 11.532 | 0.000 |
| | Min. Torsion | 10 | -0.932 | -11.532 | 0.000 |

# Tower Mast Reaction Summary

| Load Combination | Vertical | $Shear_x$ | $Shear_z$ | Overturning Moment, $M_x$ | Overturning Moment, $M_z$ | Torque |
|---|---|---|---|---|---|---|
| | K | K | K | kip-ft | kip-ft | kip-ft |
| Dead Only | 12.058 | 0.000 | 0.000 | 0.413 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 0 deg - No Ice | 14.470 | 0.000 | -11.582 | -667.455 | 0.000 | 0.000 |
| 0.9 Dead+1.0 Wind 0 deg - No Ice | 10.852 | 0.000 | -11.582 | -665.833 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 30 deg - No Ice | 14.470 | 5.766 | -10.030 | -577.966 | -331.664 | 0.466 |
| 0.9 Dead+1.0 Wind 30 deg - No Ice | 10.852 | 5.766 | -10.030 | -576.579 | -330.797 | 0.466 |
| 1.2 Dead+1.0 Wind 45 deg - No Ice | 14.470 | 8.154 | -8.190 | -471.816 | -469.044 | 0.659 |
| 0.9 Dead+1.0 Wind 45 deg - No Ice | 10.852 | 8.154 | -8.190 | -470.707 | -467.818 | 0.659 |
| 1.2 Dead+1.0 Wind 60 deg - No Ice | 14.470 | 9.987 | -5.791 | -333.478 | -574.460 | 0.807 |
| 0.9 Dead+1.0 Wind 60 deg - No Ice | 10.852 | 9.987 | -5.791 | -332.731 | -572.958 | 0.807 |
| 1.2 Dead+1.0 Wind 90 deg - No Ice | 14.470 | 11.532 | 0.000 | 0.502 | -663.331 | 0.932 |
| 0.9 Dead+1.0 Wind 90 deg - No Ice | 10.852 | 11.532 | 0.000 | 0.373 | -661.596 | 0.932 |
| 1.2 Dead+1.0 Wind 120 deg - No Ice | 14.470 | 9.987 | 5.791 | 334.482 | -574.461 | 0.807 |
| 0.9 Dead+1.0 Wind 120 deg - No Ice | 10.852 | 9.987 | 5.791 | 333.478 | -572.959 | 0.807 |
| 1.2 Dead+1.0 Wind 135 deg - No Ice | 14.470 | 8.154 | 8.190 | 472.820 | -469.045 | 0.659 |
| 0.9 Dead+1.0 Wind 135 deg - No Ice | 10.852 | 8.154 | 8.190 | 471.454 | -467.818 | 0.659 |
| 1.2 Dead+1.0 Wind 150 deg - No Ice | 14.470 | 5.766 | 10.030 | 578.971 | -331.665 | 0.466 |
| 0.9 Dead+1.0 Wind 150 deg - No Ice | 10.852 | 5.766 | 10.030 | 577.326 | -330.797 | 0.466 |
| 1.2 Dead+1.0 Wind 180 deg - No Ice | 14.470 | 0.000 | 11.582 | 668.460 | 0.000 | 0.000 |
| 0.9 Dead+1.0 Wind 180 deg - No Ice | 10.852 | 0.000 | 11.582 | 666.581 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 210 deg - No Ice | 14.470 | -5.766 | 10.030 | 578.971 | 331.665 | -0.466 |
| 0.9 Dead+1.0 Wind 210 deg - No Ice | 10.852 | -5.766 | 10.030 | 577.326 | 330.797 | -0.466 |
| 1.2 Dead+1.0 Wind 225 deg - No Ice | 14.470 | -8.154 | 8.190 | 472.820 | 469.045 | -0.659 |
| 0.9 Dead+1.0 Wind 225 deg - No Ice | 10.852 | -8.154 | 8.190 | 471.454 | 467.818 | -0.659 |
| 1.2 Dead+1.0 Wind 240 deg - No Ice | 14.470 | -9.987 | 5.791 | 334.482 | 574.461 | -0.807 |
| 0.9 Dead+1.0 Wind 240 deg - No Ice | 10.852 | -9.987 | 5.791 | 333.478 | 572.959 | -0.807 |
| 1.2 Dead+1.0 Wind 270 deg - No Ice | 14.470 | -11.532 | 0.000 | 0.502 | 663.331 | -0.932 |
| 0.9 Dead+1.0 Wind 270 deg - No Ice | 10.852 | -11.532 | 0.000 | 0.373 | 661.596 | -0.932 |
| 1.2 Dead+1.0 Wind 300 deg - No Ice | 14.470 | -9.987 | -5.791 | -333.478 | 574.460 | -0.807 |
| 0.9 Dead+1.0 Wind 300 deg - No Ice | 10.852 | -9.987 | -5.791 | -332.731 | 572.958 | -0.807 |
| 1.2 Dead+1.0 Wind 315 deg - | 14.470 | -8.154 | -8.190 | -471.816 | 469.044 | -0.659 |

| Load Combination | Vertical K | $Shear_x$ K | $Shear_z$ K | Overturning Moment, $M_x$ kip-ft | Overturning Moment, $M_z$ kip-ft | Torque kip-ft |
|---|---|---|---|---|---|---|
| No Ice 0.9 Dead+1.0 Wind 315 deg - No Ice | 10.852 | -8.154 | -8.190 | -470.707 | 467.818 | -0.659 |
| 1.2 Dead+1.0 Wind 330 deg - No Ice | 14.470 | -5.766 | -10.030 | -577.966 | 331.664 | -0.466 |
| 0.9 Dead+1.0 Wind 330 deg - No Ice | 10.852 | -5.766 | -10.030 | -576.579 | 330.797 | -0.466 |
| 1.2 Dead+1.0 Ice+1.0 Temp | 21.592 | 0.000 | 0.000 | 1.312 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp | 21.592 | 0.000 | -3.240 | -179.838 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp | 21.592 | 1.615 | -2.806 | -155.565 | -90.154 | 0.119 |
| 1.2 Dead+1.0 Wind 45 deg+1.0 Ice+1.0 Temp | 21.592 | 2.284 | -2.291 | -126.773 | -127.497 | 0.169 |
| 1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp | 21.592 | 2.798 | -1.620 | -89.251 | -156.151 | 0.207 |
| 1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp | 21.592 | 3.231 | 0.000 | 1.336 | -180.308 | 0.239 |
| 1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp | 21.592 | 2.798 | 1.620 | 91.923 | -156.151 | 0.207 |
| 1.2 Dead+1.0 Wind 135 deg+1.0 Ice+1.0 Temp | 21.592 | 2.284 | 2.291 | 129.445 | -127.497 | 0.169 |
| 1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp | 21.592 | 1.615 | 2.806 | 158.237 | -90.154 | 0.119 |
| 1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp | 21.592 | 0.000 | 3.240 | 182.510 | 0.000 | 0.000 |
| 1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp | 21.592 | -1.615 | 2.806 | 158.237 | 90.154 | -0.119 |
| 1.2 Dead+1.0 Wind 225 deg+1.0 Ice+1.0 Temp | 21.592 | -2.284 | 2.291 | 129.445 | 127.497 | -0.169 |
| 1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp | 21.592 | -2.798 | 1.620 | 91.923 | 156.151 | -0.207 |
| 1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp | 21.592 | -3.231 | 0.000 | 1.336 | 180.308 | -0.239 |
| 1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp | 21.592 | -2.798 | -1.620 | -89.251 | 156.151 | -0.207 |
| 1.2 Dead+1.0 Wind 315 deg+1.0 Ice+1.0 Temp | 21.592 | -2.284 | -2.291 | -126.773 | 127.497 | -0.169 |
| 1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp | 21.592 | -1.615 | -2.806 | -155.565 | 90.154 | -0.119 |
| Dead+Wind 0 deg - Service | 12.058 | 0.000 | -2.674 | -155.797 | 0.000 | 0.000 |
| Dead+Wind 30 deg - Service | 12.058 | 1.331 | -2.316 | -134.868 | -77.591 | 0.105 |
| Dead+Wind 45 deg - Service | 12.058 | 1.883 | -1.891 | -110.043 | -109.730 | 0.148 |
| Dead+Wind 60 deg - Service | 12.058 | 2.306 | -1.337 | -77.690 | -134.391 | 0.181 |
| Dead+Wind 90 deg - Service | 12.058 | 2.663 | 0.000 | 0.418 | -155.181 | 0.209 |
| Dead+Wind 120 deg - Service | 12.058 | 2.306 | 1.337 | 78.525 | -134.391 | 0.181 |
| Dead+Wind 135 deg - Service | 12.058 | 1.883 | 1.891 | 110.879 | -109.730 | 0.148 |
| Dead+Wind 150 deg - Service | 12.058 | 1.331 | 2.316 | 135.704 | -77.591 | 0.105 |
| Dead+Wind 180 deg - Service | 12.058 | 0.000 | 2.674 | 156.633 | 0.000 | 0.000 |
| Dead+Wind 210 deg - Service | 12.058 | -1.331 | 2.316 | 135.704 | 77.591 | -0.105 |
| Dead+Wind 225 deg - Service | 12.058 | -1.883 | 1.891 | 110.879 | 109.730 | -0.148 |
| Dead+Wind 240 deg - Service | 12.058 | -2.306 | 1.337 | 78.525 | 134.391 | -0.181 |
| Dead+Wind 270 deg - Service | 12.058 | -2.663 | 0.000 | 0.418 | 155.181 | -0.209 |
| Dead+Wind 300 deg - Service | 12.058 | -2.306 | -1.337 | -77.690 | 134.391 | -0.181 |
| Dead+Wind 315 deg - Service | 12.058 | -1.883 | -1.891 | -110.043 | 109.730 | -0.148 |
| Dead+Wind 330 deg - Service | 12.058 | -1.331 | -2.316 | -134.868 | 77.591 | -0.105 |

## Solution Summary

| | Sum of Applied Forces | | | Sum of Reactions | | | |
|---|---|---|---|---|---|---|---|
| Load Comb. | PX K | PY K | PZ K | PX K | PY K | PZ K | % Error |
| 1 | 0.000 | -12.058 | 0.000 | 0.000 | 12.058 | 0.000 | 0.000% |
| 2 | 0.000 | -14.470 | -11.582 | 0.000 | 14.470 | 11.582 | 0.000% |
| 3 | 0.000 | -10.852 | -11.582 | 0.000 | 10.852 | 11.582 | 0.000% |
| 4 | 5.766 | -14.470 | -10.030 | -5.766 | 14.470 | 10.030 | 0.000% |
| 5 | 5.766 | -10.852 | -10.030 | -5.766 | 10.852 | 10.030 | 0.000% |
| 6 | 8.154 | -14.470 | -8.190 | -8.154 | 14.470 | 8.190 | 0.000% |
| 7 | 8.154 | -10.852 | -8.190 | -8.154 | 10.852 | 8.190 | 0.000% |
| 8 | 9.987 | -14.470 | -5.791 | -9.987 | 14.470 | 5.791 | 0.000% |
| 9 | 9.987 | -10.852 | -5.791 | -9.987 | 10.852 | 5.791 | 0.000% |
| 10 | 11.532 | -14.470 | 0.000 | -11.532 | 14.470 | 0.000 | 0.000% |
| 11 | 11.532 | -10.852 | 0.000 | -11.532 | 10.852 | 0.000 | 0.000% |
| 12 | 9.987 | -14.470 | 5.791 | -9.987 | 14.470 | -5.791 | 0.000% |
| 13 | 9.987 | -10.852 | 5.791 | -9.987 | 10.852 | -5.791 | 0.000% |
| 14 | 8.154 | -14.470 | 8.190 | -8.154 | 14.470 | -8.190 | 0.000% |
| 15 | 8.154 | -10.852 | 8.190 | -8.154 | 10.852 | -8.190 | 0.000% |
| 16 | 5.766 | -14.470 | 10.030 | -5.766 | 14.470 | -10.030 | 0.000% |
| 17 | 5.766 | -10.852 | 10.030 | -5.766 | 10.852 | -10.030 | 0.000% |
| 18 | 0.000 | -14.470 | 11.582 | 0.000 | 14.470 | -11.582 | 0.000% |
| 19 | 0.000 | -10.852 | 11.582 | 0.000 | 10.852 | -11.582 | 0.000% |
| 20 | -5.766 | -14.470 | 10.030 | 5.766 | 14.470 | -10.030 | 0.000% |
| 21 | -5.766 | -10.852 | 10.030 | 5.766 | 10.852 | -10.030 | 0.000% |
| 22 | -8.154 | -14.470 | 8.190 | 8.154 | 14.470 | -8.190 | 0.000% |
| 23 | -8.154 | -10.852 | 8.190 | 8.154 | 10.852 | -8.190 | 0.000% |
| 24 | -9.987 | -14.470 | 5.791 | 9.987 | 14.470 | -5.791 | 0.000% |
| 25 | -9.987 | -10.852 | 5.791 | 9.987 | 10.852 | -5.791 | 0.000% |
| 26 | -11.532 | -14.470 | 0.000 | 11.532 | 14.470 | 0.000 | 0.000% |
| 27 | -11.532 | -10.852 | 0.000 | 11.532 | 10.852 | 0.000 | 0.000% |
| 28 | -9.987 | -14.470 | -5.791 | 9.987 | 14.470 | 5.791 | 0.000% |
| 29 | -9.987 | -10.852 | -5.791 | 9.987 | 10.852 | 5.791 | 0.000% |
| 30 | -8.154 | -14.470 | -8.190 | 8.154 | 14.470 | 8.190 | 0.000% |
| 31 | -8.154 | -10.852 | -8.190 | 8.154 | 10.852 | 8.190 | 0.000% |
| 32 | -5.766 | -14.470 | -10.030 | 5.766 | 14.470 | 10.030 | 0.000% |
| 33 | -5.766 | -10.852 | -10.030 | 5.766 | 10.852 | 10.030 | 0.000% |
| 34 | 0.000 | -21.592 | 0.000 | 0.000 | 21.592 | -0.000 | 0.000% |
| 35 | 0.000 | -21.592 | -3.240 | 0.000 | 21.592 | 3.240 | 0.000% |
| 36 | 1.615 | -21.592 | -2.806 | -1.615 | 21.592 | 2.806 | 0.000% |
| 37 | 2.284 | -21.592 | -2.291 | -2.284 | 21.592 | 2.291 | 0.000% |
| 38 | 2.798 | -21.592 | -1.620 | -2.798 | 21.592 | 1.620 | 0.000% |
| 39 | 3.231 | -21.592 | 0.000 | -3.231 | 21.592 | 0.000 | 0.000% |
| 40 | 2.798 | -21.592 | 1.620 | -2.798 | 21.592 | -1.620 | 0.000% |
| 41 | 2.284 | -21.592 | 2.291 | -2.284 | 21.592 | -2.291 | 0.000% |
| 42 | 1.615 | -21.592 | 2.806 | -1.615 | 21.592 | -2.806 | 0.000% |
| 43 | 0.000 | -21.592 | 3.240 | 0.000 | 21.592 | -3.240 | 0.000% |
| 44 | -1.615 | -21.592 | 2.806 | 1.615 | 21.592 | -2.806 | 0.000% |
| 45 | -2.284 | -21.592 | 2.291 | 2.284 | 21.592 | -2.291 | 0.000% |
| 46 | -2.798 | -21.592 | 1.620 | 2.798 | 21.592 | -1.620 | 0.000% |
| 47 | -3.231 | -21.592 | 0.000 | 3.231 | 21.592 | 0.000 | 0.000% |
| 48 | -2.798 | -21.592 | -1.620 | 2.798 | 21.592 | 1.620 | 0.000% |
| 49 | -2.284 | -21.592 | -2.291 | 2.284 | 21.592 | 2.291 | 0.000% |
| 50 | -1.615 | -21.592 | -2.806 | 1.615 | 21.592 | 2.806 | 0.000% |
| 51 | 0.000 | -12.058 | -2.674 | 0.000 | 12.058 | 2.674 | 0.000% |
| 52 | 1.331 | -12.058 | -2.316 | -1.331 | 12.058 | 2.316 | 0.000% |
| 53 | 1.883 | -12.058 | -1.891 | -1.883 | 12.058 | 1.891 | 0.000% |
| 54 | 2.306 | -12.058 | -1.337 | -2.306 | 12.058 | 1.337 | 0.000% |
| 55 | 2.663 | -12.058 | 0.000 | -2.663 | 12.058 | 0.000 | 0.000% |
| 56 | 2.306 | -12.058 | 1.337 | -2.306 | 12.058 | -1.337 | 0.000% |
| 57 | 1.883 | -12.058 | 1.891 | -1.883 | 12.058 | -1.891 | 0.000% |
| 58 | 1.331 | -12.058 | 2.316 | -1.331 | 12.058 | -2.316 | 0.000% |
| 59 | 0.000 | -12.058 | 2.674 | 0.000 | 12.058 | -2.674 | 0.000% |
| 60 | -1.331 | -12.058 | 2.316 | 1.331 | 12.058 | -2.316 | 0.000% |

| | Sum of Applied Forces | | | Sum of Reactions | | | |
|---|---|---|---|---|---|---|---|
| Load Comb. | PX K | PY K | PZ K | PX K | PY K | PZ K | % Error |
| 61 | -1.883 | -12.058 | 1.891 | 1.883 | 12.058 | -1.891 | 0.000% |
| 62 | -2.306 | -12.058 | 1.337 | 2.306 | 12.058 | -1.337 | 0.000% |
| 63 | -2.663 | -12.058 | 0.000 | 2.663 | 12.058 | 0.000 | 0.000% |
| 64 | -2.306 | -12.058 | -1.337 | 2.306 | 12.058 | 1.337 | 0.000% |
| 65 | -1.883 | -12.058 | -1.891 | 1.883 | 12.058 | 1.891 | 0.000% |
| 66 | -1.331 | -12.058 | -2.316 | 1.331 | 12.058 | 2.316 | 0.000% |

## Non-Linear Convergence Results

| Load Combination | Converged? | Number of Cycles | Displacement Tolerance | Force Tolerance |
|---|---|---|---|---|
| 1 | Yes | 4 | 0.00000001 | 0.00000001 |
| 2 | Yes | 4 | 0.00000001 | 0.00001204 |
| 3 | Yes | 4 | 0.00000001 | 0.00000001 |
| 4 | Yes | 4 | 0.00000001 | 0.00058211 |
| 5 | Yes | 4 | 0.00000001 | 0.00035768 |
| 6 | Yes | 4 | 0.00000001 | 0.00060299 |
| 7 | Yes | 4 | 0.00000001 | 0.00036894 |
| 8 | Yes | 4 | 0.00000001 | 0.00043194 |
| 9 | Yes | 4 | 0.00000001 | 0.00026469 |
| 10 | Yes | 4 | 0.00000001 | 0.00029062 |
| 11 | Yes | 4 | 0.00000001 | 0.00018099 |
| 12 | Yes | 4 | 0.00000001 | 0.00066378 |
| 13 | Yes | 4 | 0.00000001 | 0.00040924 |
| 14 | Yes | 4 | 0.00000001 | 0.00060442 |
| 15 | Yes | 4 | 0.00000001 | 0.00036830 |
| 16 | Yes | 4 | 0.00000001 | 0.00044238 |
| 17 | Yes | 4 | 0.00000001 | 0.00026782 |
| 18 | Yes | 4 | 0.00000001 | 0.00001210 |
| 19 | Yes | 4 | 0.00000001 | 0.00000001 |
| 20 | Yes | 4 | 0.00000001 | 0.00044238 |
| 21 | Yes | 4 | 0.00000001 | 0.00026782 |
| 22 | Yes | 4 | 0.00000001 | 0.00060442 |
| 23 | Yes | 4 | 0.00000001 | 0.00036830 |
| 24 | Yes | 4 | 0.00000001 | 0.00066378 |
| 25 | Yes | 4 | 0.00000001 | 0.00040924 |
| 26 | Yes | 4 | 0.00000001 | 0.00029062 |
| 27 | Yes | 4 | 0.00000001 | 0.00018099 |
| 28 | Yes | 4 | 0.00000001 | 0.00043194 |
| 29 | Yes | 4 | 0.00000001 | 0.00026469 |
| 30 | Yes | 4 | 0.00000001 | 0.00060299 |
| 31 | Yes | 4 | 0.00000001 | 0.00036894 |
| 32 | Yes | 4 | 0.00000001 | 0.00058211 |
| 33 | Yes | 4 | 0.00000001 | 0.00035768 |
| 34 | Yes | 4 | 0.00000001 | 0.00003414 |
| 35 | Yes | 4 | 0.00000001 | 0.00098302 |
| 36 | Yes | 5 | 0.00000001 | 0.00004215 |
| 37 | Yes | 5 | 0.00000001 | 0.00004266 |
| 38 | Yes | 5 | 0.00000001 | 0.00004269 |
| 39 | Yes | 5 | 0.00000001 | 0.00004296 |
| 40 | Yes | 5 | 0.00000001 | 0.00004509 |
| 41 | Yes | 5 | 0.00000001 | 0.00004581 |
| 42 | Yes | 5 | 0.00000001 | 0.00004584 |
| 43 | Yes | 5 | 0.00000001 | 0.00004528 |
| 44 | Yes | 5 | 0.00000001 | 0.00004584 |
| 45 | Yes | 5 | 0.00000001 | 0.00004581 |

| | | | | |
|---|---|---|---|---|
| 46 | Yes | 5 | 0.00000001 | 0.00004509 |
| 47 | Yes | 5 | 0.00000001 | 0.00004296 |
| 48 | Yes | 5 | 0.00000001 | 0.00004269 |
| 49 | Yes | 5 | 0.00000001 | 0.00004266 |
| 50 | Yes | 5 | 0.00000001 | 0.00004215 |
| 51 | Yes | 4 | 0.00000001 | 0.00000001 |
| 52 | Yes | 4 | 0.00000001 | 0.00001584 |
| 53 | Yes | 4 | 0.00000001 | 0.00001703 |
| 54 | Yes | 4 | 0.00000001 | 0.00001480 |
| 55 | Yes | 4 | 0.00000001 | 0.00001892 |
| 56 | Yes | 4 | 0.00000001 | 0.00002221 |
| 57 | Yes | 4 | 0.00000001 | 0.00001739 |
| 58 | Yes | 4 | 0.00000001 | 0.00000001 |
| 59 | Yes | 4 | 0.00000001 | 0.00000001 |
| 60 | Yes | 4 | 0.00000001 | 0.00000001 |
| 61 | Yes | 4 | 0.00000001 | 0.00001739 |
| 62 | Yes | 4 | 0.00000001 | 0.00002221 |
| 63 | Yes | 4 | 0.00000001 | 0.00001892 |
| 64 | Yes | 4 | 0.00000001 | 0.00001480 |
| 65 | Yes | 4 | 0.00000001 | 0.00001703 |
| 66 | Yes | 4 | 0.00000001 | 0.00001584 |

## Maximum Tower Deflections - Service Wind

| Section No. | Elevation<br>ft | Horz. Deflection<br>in | Gov. Load Comb. | Tilt<br>° | Twist<br>° |
|---|---|---|---|---|---|
| L1 | 98 - 78.5 | 6.075 | 59 | 0.985 | 0.017 |
| L2 | 78.5 - 78 | 2.578 | 59 | 0.455 | 0.004 |
| L3 | 78 - 68.5 | 2.531 | 59 | 0.447 | 0.004 |
| L4 | 68.5 - 68 | 1.844 | 59 | 0.219 | 0.001 |
| L5 | 68 - 38.25 | 1.821 | 59 | 0.218 | 0.001 |
| L6 | 43.75 - 1 | 0.834 | 59 | 0.165 | 0.000 |

## Critical Deflections and Radius of Curvature - Service Wind

| Elevation<br>ft | Appurtenance | Gov. Load Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|---|---|---|---|---|---|---|
| 98.000 | 10'x48" Canister | 59 | 6.075 | 0.985 | 0.017 | 3688 |
| 93.000 | 10'x48" Canister | 59 | 4.986 | 0.822 | 0.012 | 3688 |
| 92.000 | NNH4-65B-R6 | 59 | 4.775 | 0.791 | 0.012 | 3073 |
| 88.000 | 10'x48" Canister | 59 | 3.978 | 0.671 | 0.009 | 1844 |
| 83.000 | 10'x48" Canister | 59 | 3.133 | 0.542 | 0.006 | 1231 |
| 82.000 | MX08FIT265-01 | 59 | 2.990 | 0.520 | 0.005 | 1188 |
| 78.000 | 10'x48" Canister | 59 | 2.531 | 0.447 | 0.004 | 1620 |
| 73.000 | 10'x36" Canister | 59 | 2.115 | 0.308 | 0.002 | 2445 |
| 68.000 | 10'x36" Canister | 59 | 1.821 | 0.218 | 0.001 | 4329 |

## Maximum Tower Deflections - Design Wind

| Section No. | Elevation ft | Horz. Deflection in | Gov. Load Comb. | Tilt ° | Twist ° |
|---|---|---|---|---|---|
| L1 | 98 - 78.5 | 25.438 | 18 | 4.085 | 0.074 |
| L2 | 78.5 - 78 | 10.902 | 18 | 1.904 | 0.017 |
| L3 | 78 - 68.5 | 10.705 | 18 | 1.871 | 0.017 |
| L4 | 68.5 - 68 | 7.821 | 18 | 0.925 | 0.004 |
| L5 | 68 - 38.25 | 7.724 | 18 | 0.923 | 0.004 |
| L6 | 43.75 - 1 | 3.545 | 18 | 0.699 | 0.002 |

## Critical Deflections and Radius of Curvature - Design Wind

| Elevation ft | Appurtenance | Gov. Load Comb. | Deflection in | Tilt ° | Twist ° | Radius of Curvature ft |
|---|---|---|---|---|---|---|
| 98.000 | 10'x48" Canister | 18 | 25.438 | 4.085 | 0.074 | 901 |
| 93.000 | 10'x48" Canister | 18 | 20.916 | 3.416 | 0.055 | 901 |
| 92.000 | NNH4-65B-R6 | 18 | 20.041 | 3.286 | 0.052 | 751 |
| 88.000 | 10'x48" Canister | 18 | 16.730 | 2.794 | 0.038 | 450 |
| 83.000 | 10'x48" Canister | 18 | 13.215 | 2.264 | 0.025 | 300 |
| 82.000 | MX08FIT265-01 | 18 | 12.622 | 2.173 | 0.023 | 289 |
| 78.000 | 10'x48" Canister | 18 | 10.705 | 1.871 | 0.017 | 393 |
| 73.000 | 10'x36" Canister | 18 | 8.960 | 1.294 | 0.008 | 590 |
| 68.000 | 10'x36" Canister | 18 | 7.724 | 0.923 | 0.004 | 1045 |

## *Compression Checks*

## Pole Design Data

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ K | $\phi P_n$ K | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 98 - 96.9737 | TP6.625x6.625x0.403 | 19.500 | 0.000 | 0.0 | 7.877 | -0.081 | 297.767 | 0.000 |
| | 96.9737 - 95.9474 | | | | | 7.877 | -0.162 | 297.767 | 0.001 |
| | 95.9474 - 94.9211 | | | | | 7.877 | -0.243 | 297.767 | 0.001 |
| | 94.9211 - 93.8947 | | | | | 7.877 | -0.324 | 297.767 | 0.001 |
| | 93.8947 - 92.8684 | | | | | 7.877 | -0.405 | 297.767 | 0.001 |
| | 92.8684 - 91.8421 | | | | | 7.877 | -0.806 | 297.767 | 0.003 |
| | 91.8421 - 90.8158 | | | | | 7.877 | -0.888 | 297.767 | 0.003 |
| | 90.8158 - 89.7895 | | | | | 7.877 | -0.971 | 297.767 | 0.003 |
| | 89.7895 - 88.7632 | | | | | 7.877 | -1.054 | 297.767 | 0.004 |
| | 88.7632 - 87.7368 | | | | | 7.877 | -1.140 | 297.767 | 0.004 |
| | 87.7368 - 86.7105 | | | | | 7.877 | -1.226 | 297.767 | 0.004 |

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ K | $\phi P_n$ K | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| | 86.7105 - 85.6842 | | | | | 7.877 | -1.314 | 297.767 | 0.004 |
| | 85.6842 - 84.6579 | | | | | 7.877 | -1.404 | 297.767 | 0.005 |
| | 84.6579 - 83.6316 | | | | | 7.877 | -1.496 | 297.767 | 0.005 |
| | 83.6316 - 82.6053 | | | | | 7.877 | -1.590 | 297.767 | 0.005 |
| | 82.6053 - 81.5789 | | | | | 7.877 | -1.974 | 297.767 | 0.007 |
| | 81.5789 - 80.5526 | | | | | 7.877 | -2.075 | 297.767 | 0.007 |
| | 80.5526 - 79.5263 | | | | | 7.877 | -2.179 | 297.767 | 0.007 |
| | 79.5263 - 78.5 | | | | | 7.877 | -2.288 | 297.767 | 0.008 |
| L2 | 78.5 - 78 (2) | TP10.75x6.625x0.465 | 0.500 | 0.000 | 0.0 | 8.999 | -2.328 | 340.154 | 0.007 |
| L3 | 78 - 76.9444 | TP10.75x10.75x0.465 | 9.500 | 0.000 | 0.0 | 15.025 | -2.484 | 567.935 | 0.004 |
| | 76.9444 - 75.8889 | | | | | 15.025 | -2.614 | 567.935 | 0.005 |
| | 75.8889 - 74.8333 | | | | | 15.025 | -2.746 | 567.935 | 0.005 |
| | 74.8333 - 73.7778 | | | | | 15.025 | -2.878 | 567.935 | 0.005 |
| | 73.7778 - 72.7222 | | | | | 15.025 | -3.012 | 567.935 | 0.005 |
| | 72.7222 - 71.6667 | | | | | 15.025 | -3.146 | 567.935 | 0.006 |
| | 71.6667 - 70.6111 | | | | | 15.025 | -3.282 | 567.935 | 0.006 |
| | 70.6111 - 69.5556 | | | | | 15.025 | -3.418 | 567.935 | 0.006 |
| | 69.5556 - 68.5 | | | | | 15.025 | -3.556 | 567.935 | 0.006 |
| L4 | 68.5 - 68 (4) | TP35.5x10.75x0.465 | 0.500 | 0.000 | 0.0 | 15.025 | -3.612 | 567.935 | 0.006 |
| L5 | 68 - 66.7237 | TP40.02x35.5x0.25 | 29.750 | 0.000 | 0.0 | 28.125 | -3.833 | 1645.300 | 0.002 |
| | 66.7237 - 65.4474 | | | | | 28.279 | -4.006 | 1654.300 | 0.002 |
| | 65.4474 - 64.1711 | | | | | 28.433 | -4.180 | 1663.300 | 0.003 |
| | 64.1711 - 62.8947 | | | | | 28.586 | -4.355 | 1672.300 | 0.003 |
| | 62.8947 - 61.6184 | | | | | 28.740 | -4.531 | 1681.300 | 0.003 |
| | 61.6184 - 60.3421 | | | | | 28.894 | -4.707 | 1690.300 | 0.003 |
| | 60.3421 - 59.0658 | | | | | 29.048 | -4.885 | 1699.310 | 0.003 |
| | 59.0658 - 57.7895 | | | | | 29.202 | -5.063 | 1708.310 | 0.003 |
| | 57.7895 - 56.5132 | | | | | 29.356 | -5.242 | 1717.310 | 0.003 |
| | 56.5132 - 55.2368 | | | | | 29.510 | -5.422 | 1726.310 | 0.003 |
| | 55.2368 - 53.9605 | | | | | 29.663 | -5.604 | 1735.310 | 0.003 |
| | 53.9605 - 52.6842 | | | | | 29.817 | -5.785 | 1744.310 | 0.003 |
| | 52.6842 - 51.4079 | | | | | 29.971 | -5.968 | 1753.320 | 0.003 |
| | 51.4079 - 50.1316 | | | | | 30.125 | -6.152 | 1762.320 | 0.003 |

| Section No. | Elevation ft | Size | L ft | $L_u$ ft | Kl/r | A $in^2$ | $P_u$ K | $\phi P_n$ K | Ratio $\frac{P_u}{\phi P_n}$ |
|---|---|---|---|---|---|---|---|---|---|
| | 50.1316 - 48.8553 | | | | | 30.279 | -6.337 | 1771.320 | 0.004 |
| | 48.8553 - 47.5789 | | | | | 30.433 | -6.522 | 1780.320 | 0.004 |
| | 47.5789 - 46.3026 | | | | | 30.587 | -6.709 | 1789.320 | 0.004 |
| | 46.3026 - 45.0263 | | | | | 30.741 | -6.896 | 1798.320 | 0.004 |
| | 45.0263 - 43.75 | | | | | 30.894 | -7.084 | 1807.320 | 0.004 |
| | 43.75 - 38.25 | | | | | 31.558 | -4.352 | 1846.110 | 0.002 |
| L6 | 43.75 - 38.25 | TP45x38.684x0.25 | 42.750 | 0.000 | 0.0 | 31.142 | -4.240 | 1821.830 | 0.002 |
| | 38.25 - 36.2895 | | | | | 31.372 | -8.882 | 1835.280 | 0.005 |
| | 36.2895 - 34.3289 | | | | | 31.602 | -9.174 | 1848.720 | 0.005 |
| | 34.3289 - 32.3684 | | | | | 31.832 | -9.468 | 1862.170 | 0.005 |
| | 32.3684 - 30.4079 | | | | | 32.062 | -9.764 | 1875.610 | 0.005 |
| | 30.4079 - 28.4474 | | | | | 32.292 | -10.062 | 1889.060 | 0.005 |
| | 28.4474 - 26.4868 | | | | | 32.521 | -10.362 | 1902.500 | 0.005 |
| | 26.4868 - 24.5263 | | | | | 32.751 | -10.665 | 1915.950 | 0.006 |
| | 24.5263 - 22.5658 | | | | | 32.981 | -10.969 | 1929.390 | 0.006 |
| | 22.5658 - 20.6053 | | | | | 33.211 | -11.276 | 1942.840 | 0.006 |
| | 20.6053 - 18.6447 | | | | | 33.441 | -11.585 | 1956.280 | 0.006 |
| | 18.6447 - 16.6842 | | | | | 33.671 | -11.897 | 1969.730 | 0.006 |
| | 16.6842 - 14.7237 | | | | | 33.900 | -12.210 | 1983.170 | 0.006 |
| | 14.7237 - 12.7632 | | | | | 34.130 | -12.526 | 1996.610 | 0.006 |
| | 12.7632 - 10.8026 | | | | | 34.360 | -12.843 | 2010.060 | 0.006 |
| | 10.8026 - 8.84211 | | | | | 34.590 | -13.164 | 2023.500 | 0.007 |
| | 8.84211 - 6.88158 | | | | | 34.820 | -13.486 | 2036.950 | 0.007 |
| | 6.88158 - 4.92105 | | | | | 35.049 | -13.810 | 2050.390 | 0.007 |
| | 4.92105 - 2.96053 | | | | | 35.279 | -14.137 | 2063.840 | 0.007 |
| | 2.96053 - 1 | | | | | 35.509 | -14.466 | 2077.280 | 0.007 |

## Pole Bending Design Data

| Section No. | Elevation ft | Size | $M_{ux}$ kip-ft | $\phi M_{nx}$ kip-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ kip-ft | $\phi M_{ny}$ kip-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 98 - 96.9737 | TP6.625x6.625x0.403 | 0.076 | 49.213 | 0.002 | 0.000 | 49.213 | 0.000 |

| Section No. | Elevation ft | Size | $M_{ux}$ kip-ft | $\phi M_{nx}$ kip-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ kip-ft | $\phi M_{ny}$ kip-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| | 96.9737 - 95.9474 | | 0.276 | 49.213 | 0.006 | 0.000 | 49.213 | 0.000 |
| | 95.9474 - 94.9211 | | 0.602 | 49.213 | 0.012 | 0.000 | 49.213 | 0.000 |
| | 94.9211 - 93.8947 | | 1.052 | 49.213 | 0.021 | 0.000 | 49.213 | 0.000 |
| | 93.8947 - 92.8684 | | 1.626 | 49.213 | 0.033 | 0.000 | 49.213 | 0.000 |
| | 92.8684 - 91.8421 | | 2.596 | 49.213 | 0.053 | 0.000 | 49.213 | 0.000 |
| | 91.8421 - 90.8158 | | 5.022 | 49.213 | 0.102 | 0.000 | 49.213 | 0.000 |
| | 90.8158 - 89.7895 | | 7.573 | 49.213 | 0.154 | 0.000 | 49.213 | 0.000 |
| | 89.7895 - 88.7632 | | 10.247 | 49.213 | 0.208 | 0.000 | 49.213 | 0.000 |
| | 88.7632 - 87.7368 | | 13.045 | 49.213 | 0.265 | 0.000 | 49.213 | 0.000 |
| | 87.7368 - 86.7105 | | 15.962 | 49.213 | 0.324 | 0.000 | 49.213 | 0.000 |
| | 86.7105 - 85.6842 | | 18.999 | 49.213 | 0.386 | 0.000 | 49.213 | 0.000 |
| | 85.6842 - 84.6579 | | 22.154 | 49.213 | 0.450 | 0.000 | 49.213 | 0.000 |
| | 84.6579 - 83.6316 | | 25.426 | 49.213 | 0.517 | 0.000 | 49.213 | 0.000 |
| | 83.6316 - 82.6053 | | 28.814 | 49.213 | 0.585 | 0.000 | 49.213 | 0.000 |
| | 82.6053 - 81.5789 | | 32.536 | 49.213 | 0.661 | 0.000 | 49.213 | 0.000 |
| | 81.5789 - 80.5526 | | 36.687 | 49.213 | 0.745 | 0.000 | 49.213 | 0.000 |
| | 80.5526 - 79.5263 | | 40.947 | 49.213 | 0.832 | 0.000 | 49.213 | 0.000 |
| | 79.5263 - 78.5 | | 45.314 | 49.213 | 0.921 | 0.000 | 49.213 | 0.000 |
| L2 | 78.5 - 78 (2) | TP10.75x6.625x0.465 | 45.314 | 55.686 | 0.814 | 0.000 | 55.686 | 0.000 |
| L3 | 78 - 76.9444 | TP10.75x10.75x0.465 | 52.150 | 155.048 | 0.336 | 0.000 | 155.048 | 0.000 |
| | 76.9444 - 75.8889 | | 56.923 | 155.048 | 0.367 | 0.000 | 155.048 | 0.000 |
| | 75.8889 - 74.8333 | | 61.801 | 155.048 | 0.399 | 0.000 | 155.048 | 0.000 |
| | 74.8333 - 73.7778 | | 66.786 | 155.048 | 0.431 | 0.000 | 155.048 | 0.000 |
| | 73.7778 - 72.7222 | | 71.874 | 155.048 | 0.464 | 0.000 | 155.048 | 0.000 |
| | 72.7222 - 71.6667 | | 77.066 | 155.048 | 0.497 | 0.000 | 155.048 | 0.000 |
| | 71.6667 - 70.6111 | | 82.360 | 155.048 | 0.531 | 0.000 | 155.048 | 0.000 |
| | 70.6111 - 69.5556 | | 87.756 | 155.048 | 0.566 | 0.000 | 155.048 | 0.000 |
| | 69.5556 - 68.5 | | 93.252 | 155.048 | 0.601 | 0.000 | 155.048 | 0.000 |
| L4 | 68.5 - 68 (4) | TP35.5x10.75x0.465 | 93.252 | 155.048 | 0.601 | 0.000 | 155.048 | 0.000 |
| L5 | 68 - 66.7237 | TP40.02x35.5x0.25 | 102.743 | 1345.617 | 0.076 | 0.000 | 1345.617 | 0.000 |
| | 66.7237 - 65.4474 | | 109.738 | 1357.442 | 0.081 | 0.000 | 1357.442 | 0.000 |
| | 65.4474 - 64.1711 | | 116.888 | 1369.275 | 0.085 | 0.000 | 1369.275 | 0.000 |
| | 64.1711 - 62.8947 | | 124.196 | 1381.125 | 0.090 | 0.000 | 1381.125 | 0.000 |

| Section No. | Elevation ft | Size | $M_{ux}$ kip-ft | $\phi M_{nx}$ kip-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ kip-ft | $\phi M_{ny}$ kip-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| | 62.8947 - 61.6184 | | 131.661 | 1392.983 | 0.095 | 0.000 | 1392.983 | 0.000 |
| | 61.6184 - 60.3421 | | 139.284 | 1404.867 | 0.099 | 0.000 | 1404.867 | 0.000 |
| | 60.3421 - 59.0658 | | 147.067 | 1416.750 | 0.104 | 0.000 | 1416.750 | 0.000 |
| | 59.0658 - 57.7895 | | 155.009 | 1428.658 | 0.108 | 0.000 | 1428.658 | 0.000 |
| | 57.7895 - 56.5132 | | 163.112 | 1440.575 | 0.113 | 0.000 | 1440.575 | 0.000 |
| | 56.5132 - 55.2368 | | 171.375 | 1452.500 | 0.118 | 0.000 | 1452.500 | 0.000 |
| | 55.2368 - 53.9605 | | 179.801 | 1464.442 | 0.123 | 0.000 | 1464.442 | 0.000 |
| | 53.9605 - 52.6842 | | 188.389 | 1476.392 | 0.128 | 0.000 | 1476.392 | 0.000 |
| | 52.6842 - 51.4079 | | 197.141 | 1488.350 | 0.132 | 0.000 | 1488.350 | 0.000 |
| | 51.4079 - 50.1316 | | 206.056 | 1500.317 | 0.137 | 0.000 | 1500.317 | 0.000 |
| | 50.1316 - 48.8553 | | 215.136 | 1512.292 | 0.142 | 0.000 | 1512.292 | 0.000 |
| | 48.8553 - 47.5789 | | 224.382 | 1524.283 | 0.147 | 0.000 | 1524.283 | 0.000 |
| | 47.5789 - 46.3026 | | 233.792 | 1536.275 | 0.152 | 0.000 | 1536.275 | 0.000 |
| | 46.3026 - 45.0263 | | 243.371 | 1548.283 | 0.157 | 0.000 | 1548.283 | 0.000 |
| | 45.0263 - 43.75 | | 253.116 | 1560.292 | 0.162 | 0.000 | 1560.292 | 0.000 |
| | 43.75 - 38.25 | | 151.582 | 1612.108 | 0.094 | 0.000 | 1612.108 | 0.000 |
| L6 | 43.75 - 38.25 | TP45x38.684x0.25 | 145.493 | 1579.658 | 0.092 | 0.000 | 1579.658 | 0.000 |
| | 38.25 - 36.2895 | | 313.500 | 1597.617 | 0.196 | 0.000 | 1597.617 | 0.000 |
| | 36.2895 - 34.3289 | | 330.284 | 1615.592 | 0.204 | 0.000 | 1615.592 | 0.000 |
| | 34.3289 - 32.3684 | | 347.426 | 1633.575 | 0.213 | 0.000 | 1633.575 | 0.000 |
| | 32.3684 - 30.4079 | | 364.923 | 1651.558 | 0.221 | 0.000 | 1651.558 | 0.000 |
| | 30.4079 - 28.4474 | | 382.774 | 1669.558 | 0.229 | 0.000 | 1669.558 | 0.000 |
| | 28.4474 - 26.4868 | | 400.975 | 1687.550 | 0.238 | 0.000 | 1687.550 | 0.000 |
| | 26.4868 - 24.5263 | | 419.525 | 1705.550 | 0.246 | 0.000 | 1705.550 | 0.000 |
| | 24.5263 - 22.5658 | | 438.422 | 1723.550 | 0.254 | 0.000 | 1723.550 | 0.000 |
| | 22.5658 - 20.6053 | | 457.662 | 1741.542 | 0.263 | 0.000 | 1741.542 | 0.000 |
| | 20.6053 - 18.6447 | | 477.244 | 1759.533 | 0.271 | 0.000 | 1759.533 | 0.000 |
| | 18.6447 - 16.6842 | | 497.165 | 1777.525 | 0.280 | 0.000 | 1777.525 | 0.000 |
| | 16.6842 - 14.7237 | | 517.423 | 1795.500 | 0.288 | 0.000 | 1795.500 | 0.000 |
| | 14.7237 - 12.7632 | | 538.017 | 1813.475 | 0.297 | 0.000 | 1813.475 | 0.000 |
| | 12.7632 - 10.8026 | | 558.942 | 1831.433 | 0.305 | 0.000 | 1831.433 | 0.000 |

| Section No. | Elevation ft | Size | $M_{ux}$ kip-ft | $\phi M_{nx}$ kip-ft | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | $M_{uy}$ kip-ft | $\phi M_{ny}$ kip-ft | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ |
|---|---|---|---|---|---|---|---|---|
| | 10.8026 - 8.84211 | | 580.196 | 1849.375 | 0.314 | 0.000 | 1849.375 | 0.000 |
| | 8.84211 - 6.88158 | | 601.778 | 1867.308 | 0.322 | 0.000 | 1867.308 | 0.000 |
| | 6.88158 - 4.92105 | | 623.683 | 1885.225 | 0.331 | 0.000 | 1885.225 | 0.000 |
| | 4.92105 - 2.96053 | | 645.912 | 1903.125 | 0.339 | 0.000 | 1903.125 | 0.000 |
| | 2.96053 - 1 | | 668.460 | 1921.000 | 0.348 | 0.000 | 1921.000 | 0.000 |

## Pole Shear Design Data

| Section No. | Elevation ft | Size | Actual $V_u$ K | $\phi V_n$ K | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ kip-ft | $\phi T_n$ kip-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| L1 | 98 - 96.9737 | TP6.625x6.625x0.403 | 0.121 | 89.330 | 0.001 | 0.000 | 48.866 | 0.000 |
| | 96.9737 - 95.9474 | | 0.243 | 89.330 | 0.003 | 0.000 | 48.866 | 0.000 |
| | 95.9474 - 94.9211 | | 0.364 | 89.330 | 0.004 | 0.000 | 48.866 | 0.000 |
| | 94.9211 - 93.8947 | | 0.486 | 89.330 | 0.005 | 0.000 | 48.866 | 0.000 |
| | 93.8947 - 92.8684 | | 0.607 | 89.330 | 0.007 | 0.000 | 48.866 | 0.000 |
| | 92.8684 - 91.8421 | | 2.291 | 89.330 | 0.026 | 0.000 | 48.866 | 0.000 |
| | 91.8421 - 90.8158 | | 2.412 | 89.330 | 0.027 | 0.000 | 48.866 | 0.000 |
| | 90.8158 - 89.7895 | | 2.533 | 89.330 | 0.028 | 0.000 | 48.866 | 0.000 |
| | 89.7895 - 88.7632 | | 2.653 | 89.330 | 0.030 | 0.000 | 48.866 | 0.000 |
| | 88.7632 - 87.7368 | | 2.772 | 89.330 | 0.031 | 0.000 | 48.866 | 0.000 |
| | 87.7368 - 86.7105 | | 2.889 | 89.330 | 0.032 | 0.000 | 48.866 | 0.000 |
| | 86.7105 - 85.6842 | | 3.005 | 89.330 | 0.034 | 0.000 | 48.866 | 0.000 |
| | 85.6842 - 84.6579 | | 3.120 | 89.330 | 0.035 | 0.000 | 48.866 | 0.000 |
| | 84.6579 - 83.6316 | | 3.234 | 89.330 | 0.036 | 0.000 | 48.866 | 0.000 |
| | 83.6316 - 82.6053 | | 3.347 | 89.330 | 0.037 | 0.000 | 48.866 | 0.000 |
| | 82.6053 - 81.5789 | | 3.981 | 89.330 | 0.045 | 0.000 | 48.866 | 0.000 |
| | 81.5789 - 80.5526 | | 4.090 | 89.330 | 0.046 | 0.000 | 48.866 | 0.000 |
| | 80.5526 - 79.5263 | | 4.196 | 89.330 | 0.047 | 0.000 | 48.866 | 0.000 |
| | 79.5263 - 78.5 | | 4.300 | 89.330 | 0.048 | 0.000 | 48.866 | 0.000 |
| L2 | 78.5 - 78 (2) | TP10.75x6.625x0.465 | 4.352 | 170.381 | 0.026 | 0.000 | 55.266 | 0.000 |
| L3 | 78 - 76.9444 | TP10.75x10.75x0.465 | 4.454 | 170.381 | 0.026 | 0.000 | 154.065 | 0.000 |
| | 76.9444 - 75.8889 | | 4.555 | 170.381 | 0.027 | 0.000 | 154.065 | 0.000 |
| | 75.8889 - | | 4.655 | 170.381 | 0.027 | 0.000 | 154.065 | 0.000 |

| Section No. | Elevation ft | Size | Actual $V_u$ K | $\phi V_n$ K | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ kip-ft | $\phi T_n$ kip-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| | 74.8333 | | | | | | | |
| | 74.8333 - 73.7778 | | 4.755 | 170.381 | 0.028 | 0.000 | 154.065 | 0.000 |
| | 73.7778 - 72.7222 | | 4.854 | 170.381 | 0.028 | 0.000 | 154.065 | 0.000 |
| | 72.7222 - 71.6667 | | 4.952 | 170.381 | 0.029 | 0.000 | 154.065 | 0.000 |
| | 71.6667 - 70.6111 | | 5.049 | 170.381 | 0.030 | 0.000 | 154.065 | 0.000 |
| | 70.6111 - 69.5556 | | 5.144 | 170.381 | 0.030 | 0.000 | 154.065 | 0.000 |
| | 69.5556 - 68.5 | | 5.239 | 170.381 | 0.031 | 0.000 | 154.065 | 0.000 |
| L4 | 68.5 - 68 (4) | TP35.5x10.75x0.465 | 5.298 | 580.387 | 0.009 | 0.000 | 154.065 | 0.000 |
| L5 | 68 - 66.7237 | TP40.02x35.5x0.25 | 5.420 | 493.589 | 0.011 | 0.000 | 1532.100 | 0.000 |
| | 66.7237 - 65.4474 | | 5.542 | 496.290 | 0.011 | 0.000 | 1548.908 | 0.000 |
| | 65.4474 - 64.1711 | | 5.664 | 498.990 | 0.011 | 0.000 | 1565.817 | 0.000 |
| | 64.1711 - 62.8947 | | 5.787 | 501.691 | 0.012 | 0.000 | 1582.808 | 0.000 |
| | 62.8947 - 61.6184 | | 5.911 | 504.391 | 0.012 | 0.000 | 1599.892 | 0.000 |
| | 61.6184 - 60.3421 | | 6.036 | 507.091 | 0.012 | 0.000 | 1617.067 | 0.000 |
| | 60.3421 - 59.0658 | | 6.161 | 509.792 | 0.012 | 0.000 | 1634.342 | 0.000 |
| | 59.0658 - 57.7895 | | 6.286 | 512.492 | 0.012 | 0.000 | 1651.700 | 0.000 |
| | 57.7895 - 56.5132 | | 6.412 | 515.193 | 0.012 | 0.000 | 1669.150 | 0.000 |
| | 56.5132 - 55.2368 | | 6.539 | 517.893 | 0.013 | 0.000 | 1686.692 | 0.000 |
| | 55.2368 - 53.9605 | | 6.666 | 520.594 | 0.013 | 0.000 | 1704.333 | 0.000 |
| | 53.9605 - 52.6842 | | 6.793 | 523.294 | 0.013 | 0.000 | 1722.058 | 0.000 |
| | 52.6842 - 51.4079 | | 6.922 | 525.995 | 0.013 | 0.000 | 1739.875 | 0.000 |
| | 51.4079 - 50.1316 | | 7.050 | 528.695 | 0.013 | 0.000 | 1757.783 | 0.000 |
| | 50.1316 - 48.8553 | | 7.180 | 531.395 | 0.014 | 0.000 | 1775.792 | 0.000 |
| | 48.8553 - 47.5789 | | 7.309 | 534.096 | 0.014 | 0.000 | 1793.883 | 0.000 |
| | 47.5789 - 46.3026 | | 7.440 | 536.796 | 0.014 | 0.000 | 1812.067 | 0.000 |
| | 46.3026 - 45.0263 | | 7.571 | 539.497 | 0.014 | 0.000 | 1830.350 | 0.000 |
| | 45.0263 - 43.75 | | 7.702 | 542.197 | 0.014 | 0.000 | 1848.717 | 0.000 |
| | 43.75 - 38.25 | | 4.366 | 553.834 | 0.008 | 0.000 | 1928.925 | 0.000 |
| L6 | 43.75 - 38.25 | TP45x38.684x0.25 | 3.922 | 546.550 | 0.007 | 0.000 | 1878.517 | 0.000 |
| | 38.25 - 36.2895 | | 8.472 | 550.583 | 0.015 | 0.000 | 1906.342 | 0.000 |
| | 36.2895 - 34.3289 | | 8.655 | 554.616 | 0.016 | 0.000 | 1934.375 | 0.000 |
| | 34.3289 - 32.3684 | | 8.837 | 558.650 | 0.016 | 0.000 | 1962.617 | 0.000 |
| | 32.3684 - 30.4079 | | 9.018 | 562.683 | 0.016 | 0.000 | 1991.058 | 0.000 |

| Section No. | Elevation ft | Size | Actual $V_u$ K | $\phi V_n$ K | Ratio $\frac{V_u}{\phi V_n}$ | Actual $T_u$ kip-ft | $\phi T_n$ kip-ft | Ratio $\frac{T_u}{\phi T_n}$ |
|---|---|---|---|---|---|---|---|---|
| | 30.4079 - 28.4474 | | 9.197 | 566.717 | 0.016 | 0.000 | 2019.708 | 0.000 |
| | 28.4474 - 26.4868 | | 9.376 | 570.750 | 0.016 | 0.000 | 2048.558 | 0.000 |
| | 26.4868 - 24.5263 | | 9.553 | 574.784 | 0.017 | 0.000 | 2077.617 | 0.000 |
| | 24.5263 - 22.5658 | | 9.730 | 578.817 | 0.017 | 0.000 | 2106.875 | 0.000 |
| | 22.5658 - 20.6053 | | 9.905 | 582.851 | 0.017 | 0.000 | 2136.342 | 0.000 |
| | 20.6053 - 18.6447 | | 10.078 | 586.884 | 0.017 | 0.000 | 2166.008 | 0.000 |
| | 18.6447 - 16.6842 | | 10.251 | 590.918 | 0.017 | 0.000 | 2195.883 | 0.000 |
| | 16.6842 - 14.7237 | | 10.422 | 594.951 | 0.018 | 0.000 | 2225.967 | 0.000 |
| | 14.7237 - 12.7632 | | 10.593 | 598.984 | 0.018 | 0.000 | 2256.250 | 0.000 |
| | 12.7632 - 10.8026 | | 10.762 | 603.018 | 0.018 | 0.000 | 2286.742 | 0.000 |
| | 10.8026 - 8.84211 | | 10.929 | 607.051 | 0.018 | 0.000 | 2317.433 | 0.000 |
| | 8.84211 - 6.88158 | | 11.096 | 611.085 | 0.018 | 0.000 | 2348.325 | 0.000 |
| | 6.88158 - 4.92105 | | 11.261 | 615.118 | 0.018 | 0.000 | 2379.433 | 0.000 |
| | 4.92105 - 2.96053 | | 11.425 | 619.152 | 0.018 | 0.000 | 2410.742 | 0.000 |
| | 2.96053 - 1 | | 11.587 | 623.185 | 0.019 | 0.000 | 2442.250 | 0.000 |

## Pole Interaction Design Data

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| L1 | 98 - 96.9737 | 0.000 | 0.002 | 0.000 | 0.001 | 0.000 | 0.002 ✔ | 1.000 | 4.8.2 ✔ |
| | 96.9737 - 95.9474 | 0.001 | 0.006 | 0.000 | 0.003 | 0.000 | 0.006 ✔ | 1.000 | 4.8.2 ✔ |
| | 95.9474 - 94.9211 | 0.001 | 0.012 | 0.000 | 0.004 | 0.000 | 0.013 ✔ | 1.000 | 4.8.2 ✔ |
| | 94.9211 - 93.8947 | 0.001 | 0.021 | 0.000 | 0.005 | 0.000 | 0.022 ✔ | 1.000 | 4.8.2 ✔ |
| | 93.8947 - 92.8684 | 0.001 | 0.033 | 0.000 | 0.007 | 0.000 | 0.034 ✔ | 1.000 | 4.8.2 ✔ |
| | 92.8684 - 91.8421 | 0.003 | 0.053 | 0.000 | 0.026 | 0.000 | 0.056 ✔ | 1.000 | 4.8.2 ✔ |
| | 91.8421 - 90.8158 | 0.003 | 0.102 | 0.000 | 0.027 | 0.000 | 0.106 ✔ | 1.000 | 4.8.2 ✔ |
| | 90.8158 - 89.7895 | 0.003 | 0.154 | 0.000 | 0.028 | 0.000 | 0.158 ✔ | 1.000 | 4.8.2 ✔ |
| | 89.7895 - | 0.004 | 0.208 | 0.000 | 0.030 | 0.000 | 0.213 | 1.000 | 4.8.2 ✔ |

| Section No. | Elevation ft | Ratio $P_u/\phi P_n$ | Ratio $M_{ux}/\phi M_{nx}$ | Ratio $M_{uy}/\phi M_{ny}$ | Ratio $V_u/\phi V_n$ | Ratio $T_u/\phi T_n$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| | 88.7632 | | | | | | ✓ | | |
| | 88.7632 - 87.7368 | 0.004 | 0.265 | 0.000 | 0.031 | 0.000 | 0.270 ✓ | 1.000 | 4.8.2 ✓ |
| | 87.7368 - 86.7105 | 0.004 | 0.324 | 0.000 | 0.032 | 0.000 | 0.330 ✓ | 1.000 | 4.8.2 ✓ |
| | 86.7105 - 85.6842 | 0.004 | 0.386 | 0.000 | 0.034 | 0.000 | 0.392 ✓ | 1.000 | 4.8.2 ✓ |
| | 85.6842 - 84.6579 | 0.005 | 0.450 | 0.000 | 0.035 | 0.000 | 0.456 ✓ | 1.000 | 4.8.2 ✓ |
| | 84.6579 - 83.6316 | 0.005 | 0.517 | 0.000 | 0.036 | 0.000 | 0.523 ✓ | 1.000 | 4.8.2 ✓ |
| | 83.6316 - 82.6053 | 0.005 | 0.585 | 0.000 | 0.037 | 0.000 | 0.592 ✓ | 1.000 | 4.8.2 ✓ |
| | 82.6053 - 81.5789 | 0.007 | 0.661 | 0.000 | 0.045 | 0.000 | 0.670 ✓ | 1.000 | 4.8.2 ✓ |
| | 81.5789 - 80.5526 | 0.007 | 0.745 | 0.000 | 0.046 | 0.000 | 0.755 ✓ | 1.000 | 4.8.2 ✓ |
| | 80.5526 - 79.5263 | 0.007 | 0.832 | 0.000 | 0.047 | 0.000 | 0.842 ✓ | 1.000 | 4.8.2 ✓ |
| | 79.5263 - 78.5 | 0.008 | 0.921 | 0.000 | 0.048 | 0.000 | 0.931 ✓ | 1.000 | 4.8.2 ✓ |
| L2 | 78.5 - 78 (2) | 0.007 | 0.814 | 0.000 | 0.026 | 0.000 | 0.821 ✓ | 1.000 | 4.8.2 ✓ |
| L3 | 78 - 76.9444 | 0.004 | 0.336 | 0.000 | 0.026 | 0.000 | 0.341 ✓ | 1.000 | 4.8.2 ✓ |
| | 76.9444 - 75.8889 | 0.005 | 0.367 | 0.000 | 0.027 | 0.000 | 0.372 ✓ | 1.000 | 4.8.2 ✓ |
| | 75.8889 - 74.8333 | 0.005 | 0.399 | 0.000 | 0.027 | 0.000 | 0.404 ✓ | 1.000 | 4.8.2 ✓ |
| | 74.8333 - 73.7778 | 0.005 | 0.431 | 0.000 | 0.028 | 0.000 | 0.437 ✓ | 1.000 | 4.8.2 ✓ |
| | 73.7778 - 72.7222 | 0.005 | 0.464 | 0.000 | 0.028 | 0.000 | 0.470 ✓ | 1.000 | 4.8.2 ✓ |
| | 72.7222 - 71.6667 | 0.006 | 0.497 | 0.000 | 0.029 | 0.000 | 0.503 ✓ | 1.000 | 4.8.2 ✓ |
| | 71.6667 - 70.6111 | 0.006 | 0.531 | 0.000 | 0.030 | 0.000 | 0.538 ✓ | 1.000 | 4.8.2 ✓ |
| | 70.6111 - 69.5556 | 0.006 | 0.566 | 0.000 | 0.030 | 0.000 | 0.573 ✓ | 1.000 | 4.8.2 ✓ |
| | 69.5556 - 68.5 | 0.006 | 0.601 | 0.000 | 0.031 | 0.000 | 0.609 ✓ | 1.000 | 4.8.2 ✓ |
| L4 | 68.5 - 68 (4) | 0.006 | 0.601 | 0.000 | 0.009 | 0.000 | 0.608 ✓ | 1.000 | 4.8.2 ✓ |
| L5 | 68 - 66.7237 | 0.002 | 0.076 | 0.000 | 0.011 | 0.000 | 0.079 ✓ | 1.000 | 4.8.2 ✓ |
| | 66.7237 - 65.4474 | 0.002 | 0.081 | 0.000 | 0.011 | 0.000 | 0.083 ✓ | 1.000 | 4.8.2 ✓ |
| | 65.4474 - 64.1711 | 0.003 | 0.085 | 0.000 | 0.011 | 0.000 | 0.088 ✓ | 1.000 | 4.8.2 ✓ |
| | 64.1711 - 62.8947 | 0.003 | 0.090 | 0.000 | 0.012 | 0.000 | 0.093 ✓ | 1.000 | 4.8.2 ✓ |
| | 62.8947 - | 0.003 | 0.095 | 0.000 | 0.012 | 0.000 | 0.097 | 1.000 | 4.8.2 ✓ |

| Section No. | Elevation ft | Ratio $P_u/\phi P_n$ | Ratio $M_{ux}/\phi M_{nx}$ | Ratio $M_{uy}/\phi M_{ny}$ | Ratio $V_u/\phi V_n$ | Ratio $T_u/\phi T_n$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| | 61.6184 | | | | | | ✓ | | |
| | 61.6184 - 60.3421 | 0.003 | 0.099 | 0.000 | 0.012 | 0.000 | 0.102 ✓ | 1.000 | 4.8.2 ✓ |
| | 60.3421 - 59.0658 | 0.003 | 0.104 | 0.000 | 0.012 | 0.000 | 0.107 ✓ | 1.000 | 4.8.2 ✓ |
| | 59.0658 - 57.7895 | 0.003 | 0.108 | 0.000 | 0.012 | 0.000 | 0.112 ✓ | 1.000 | 4.8.2 ✓ |
| | 57.7895 - 56.5132 | 0.003 | 0.113 | 0.000 | 0.012 | 0.000 | 0.116 ✓ | 1.000 | 4.8.2 ✓ |
| | 56.5132 - 55.2368 | 0.003 | 0.118 | 0.000 | 0.013 | 0.000 | 0.121 ✓ | 1.000 | 4.8.2 ✓ |
| | 55.2368 - 53.9605 | 0.003 | 0.123 | 0.000 | 0.013 | 0.000 | 0.126 ✓ | 1.000 | 4.8.2 ✓ |
| | 53.9605 - 52.6842 | 0.003 | 0.128 | 0.000 | 0.013 | 0.000 | 0.131 ✓ | 1.000 | 4.8.2 ✓ |
| | 52.6842 - 51.4079 | 0.003 | 0.132 | 0.000 | 0.013 | 0.000 | 0.136 ✓ | 1.000 | 4.8.2 ✓ |
| | 51.4079 - 50.1316 | 0.003 | 0.137 | 0.000 | 0.013 | 0.000 | 0.141 ✓ | 1.000 | 4.8.2 ✓ |
| | 50.1316 - 48.8553 | 0.004 | 0.142 | 0.000 | 0.014 | 0.000 | 0.146 ✓ | 1.000 | 4.8.2 ✓ |
| | 48.8553 - 47.5789 | 0.004 | 0.147 | 0.000 | 0.014 | 0.000 | 0.151 ✓ | 1.000 | 4.8.2 ✓ |
| | 47.5789 - 46.3026 | 0.004 | 0.152 | 0.000 | 0.014 | 0.000 | 0.156 ✓ | 1.000 | 4.8.2 ✓ |
| | 46.3026 - 45.0263 | 0.004 | 0.157 | 0.000 | 0.014 | 0.000 | 0.161 ✓ | 1.000 | 4.8.2 ✓ |
| | 45.0263 - 43.75 | 0.004 | 0.162 | 0.000 | 0.014 | 0.000 | 0.166 ✓ | 1.000 | 4.8.2 ✓ |
| | 43.75 - 38.25 | 0.002 | 0.094 | 0.000 | 0.008 | 0.000 | 0.096 ✓ | 1.000 | 4.8.2 ✓ |
| L6 | 43.75 - 38.25 | 0.002 | 0.092 | 0.000 | 0.007 | 0.000 | 0.094 ✓ | 1.000 | 4.8.2 ✓ |
| | 38.25 - 36.2895 | 0.005 | 0.196 | 0.000 | 0.015 | 0.000 | 0.201 ✓ | 1.000 | 4.8.2 ✓ |
| | 36.2895 - 34.3289 | 0.005 | 0.204 | 0.000 | 0.016 | 0.000 | 0.210 ✓ | 1.000 | 4.8.2 ✓ |
| | 34.3289 - 32.3684 | 0.005 | 0.213 | 0.000 | 0.016 | 0.000 | 0.218 ✓ | 1.000 | 4.8.2 ✓ |
| | 32.3684 - 30.4079 | 0.005 | 0.221 | 0.000 | 0.016 | 0.000 | 0.226 ✓ | 1.000 | 4.8.2 ✓ |
| | 30.4079 - 28.4474 | 0.005 | 0.229 | 0.000 | 0.016 | 0.000 | 0.235 ✓ | 1.000 | 4.8.2 ✓ |
| | 28.4474 - 26.4868 | 0.005 | 0.238 | 0.000 | 0.016 | 0.000 | 0.243 ✓ | 1.000 | 4.8.2 ✓ |
| | 26.4868 - 24.5263 | 0.006 | 0.246 | 0.000 | 0.017 | 0.000 | 0.252 ✓ | 1.000 | 4.8.2 ✓ |
| | 24.5263 - 22.5658 | 0.006 | 0.254 | 0.000 | 0.017 | 0.000 | 0.260 ✓ | 1.000 | 4.8.2 ✓ |
| | 22.5658 - 20.6053 | 0.006 | 0.263 | 0.000 | 0.017 | 0.000 | 0.269 ✓ | 1.000 | 4.8.2 ✓ |
| | 20.6053 - | 0.006 | 0.271 | 0.000 | 0.017 | 0.000 | 0.277 | 1.000 | 4.8.2 ✓ |

| Section No. | Elevation ft | Ratio $\frac{P_u}{\phi P_n}$ | Ratio $\frac{M_{ux}}{\phi M_{nx}}$ | Ratio $\frac{M_{uy}}{\phi M_{ny}}$ | Ratio $\frac{V_u}{\phi V_n}$ | Ratio $\frac{T_u}{\phi T_n}$ | Comb. Stress Ratio | Allow. Stress Ratio | Criteria |
|---|---|---|---|---|---|---|---|---|---|
| | 18.6447 | | | | | | ✔ | | |
| | 18.6447 - 16.6842 | 0.006 | 0.280 | 0.000 | 0.017 | 0.000 | 0.286 ✔ | 1.000 | 4.8.2 ✔ |
| | 16.6842 - 14.7237 | 0.006 | 0.288 | 0.000 | 0.018 | 0.000 | 0.295 ✔ | 1.000 | 4.8.2 ✔ |
| | 14.7237 - 12.7632 | 0.006 | 0.297 | 0.000 | 0.018 | 0.000 | 0.303 ✔ | 1.000 | 4.8.2 ✔ |
| | 12.7632 - 10.8026 | 0.006 | 0.305 | 0.000 | 0.018 | 0.000 | 0.312 ✔ | 1.000 | 4.8.2 ✔ |
| | 10.8026 - 8.84211 | 0.007 | 0.314 | 0.000 | 0.018 | 0.000 | 0.321 ✔ | 1.000 | 4.8.2 ✔ |
| | 8.84211 - 6.88158 | 0.007 | 0.322 | 0.000 | 0.018 | 0.000 | 0.329 ✔ | 1.000 | 4.8.2 ✔ |
| | 6.88158 - 4.92105 | 0.007 | 0.331 | 0.000 | 0.018 | 0.000 | 0.338 ✔ | 1.000 | 4.8.2 ✔ |
| | 4.92105 - 2.96053 | 0.007 | 0.339 | 0.000 | 0.018 | 0.000 | 0.347 ✔ | 1.000 | 4.8.2 ✔ |
| | 2.96053 - 1 | 0.007 | 0.348 | 0.000 | 0.019 | 0.000 | 0.355 ✔ | 1.000 | 4.8.2 ✔ |

## Section Capacity Table

| Section No. | Elevation ft | Component Type | Size | Critical Element | P K | $\phi P_{allow}$ K | % Capacity | Pass Fail |
|---|---|---|---|---|---|---|---|---|
| L1 | 98 - 78.5 | Pole | TP6.625x6.625x0.403 | 1 | -2.288 | 297.767 | 93.1 | Pass |
| L2 | 78.5 - 78 | Pole | TP10.75x6.625x0.465 | 2 | -2.328 | 340.154 | 82.1 | Pass |
| L3 | 78 - 68.5 | Pole | TP10.75x10.75x0.465 | 3 | -3.556 | 567.935 | 60.9 | Pass |
| L4 | 68.5 - 68 | Pole | TP35.5x10.75x0.465 | 4 | -3.612 | 567.935 | 60.8 | Pass |
| L5 | 68 - 38.25 | Pole | TP40.02x35.5x0.25 | 5 | -7.084 | 1807.320 | 16.6 | Pass |
| L6 | 38.25 - 1 | Pole | TP45x38.684x0.25 | 6 | -14.466 | 2077.280 | 35.5 | Pass |
| | | | | | | | Summary | |
| | | | | | | Pole (L1) | 93.1 | Pass |
| | | | | | | **RATING =** | **93.1** | **Pass** |

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Subject: Anchor Bolt and Baseplate Analysis

Location: 98-FT Flagpole
Bridgeport, CT

Rev. 1: 10/21/21

Prepared by: T.J.L. Checked by: C.F.C.
Job No. 21007.69

## Anchor Bolt and Base Plate Analysis :

### Input Data:

Tower Reactions :

| | | |
|---|---|---|
| Overturning Moment = | $M_u := 668 \cdot ft \cdot kips$ | (Input From tnxTower) |
| Shear Force = | $Shear := 12 \cdot kips$ | (Input From tnxTower) |
| Axial Force = | $R_u := 14 \cdot kips$ | (Input From tnxTower) |

Anchor Bolt Data :

ASTM A615 Grade 75

| | | |
|---|---|---|
| Number of Anchor Bolts = | $N := 6$ | (User Input) |
| Diameter of Bolt Circle = | $D_{BC} := 51.25 \cdot in$ | (User Input) |
| Bolt "Column" Distance = | $l := 3.0 \cdot in$ | (User Input) |
| Bolt Ultimate Strength = | $F_u := 100 \cdot ksi$ | (User Input) |
| Bolt Yield Strength = | $F_y := 75 \cdot ksi$ | (User Input) |
| Bolt Modulus = | $E := 29000 \cdot ksi$ | (User Input) |
| Diameter of Anchor Bolts = | $D := 1.75 \cdot in$ | (User Input) |
| Threads per Inch = | $n := 5$ | (User Input) |
| Top of Concrete to Bot Leveling Nut = | $l_{ar} := 2 \cdot in$ | (User Input) |
| Anchor Rod Force Correction Factor = | $n_c := 1.1$ | |

Base Plate Data:

Use ASTM A572 Grade 50

| | | |
|---|---|---|
| Plate Yield Strength = | $F_{yf} := 50 \cdot ksi$ | (User Input) |
| Base Plate Thickness = | $t_{TP} := 1.75 \cdot in$ | (User Input) |
| Base Plate Diameter = | $D_{OD} := 56.25 \cdot in$ | (User Input) |
| Outer Pole Diameter = | $D_T := 45.5 \cdot in$ | (User Input) |
| Pole Wall Thickness = | $t_T := 0.25 \cdot in$ | (User Input) |
| Pole Design Yield Strength = | $F_{yp} := 65 \cdot ksi$ | (User Input) |
| | $\eta := 0.5$ | For Ungrouted Base Plate per TIA-222-G Section 4.9.9 |

## Anchor Bolt Analysis :

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 2.405\ in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 1.899\ in^2$

Tensile Root Diameter = $d_{rt} := D - \frac{0.9743 \cdot in}{n} = 1.555\ in$

Plastic Section Modulus = $Z := \frac{d_{rt}^3}{6} = 0.627\ in^3$

Maximum Anchor Rod Force = $P_u := \frac{n_c \cdot \pi \cdot M_u}{N \cdot D_{BC}} + \frac{R_u}{N} = 92.4\ kip$

Maximum Shear Force = $V_u := \frac{Shear}{N} = 2\ kip$

Design Tensile Strength = $\Phi R_{nt} := 0.8 \cdot F_u \cdot A_n = 151.956\ kip$

Bolt % of Capacity = $\frac{\left(P_u + \frac{V_u}{\eta}\right)}{\Phi R_{nt}} = 63.5\%$

Condition1 = $Condition1 := \text{if}\left(\frac{\left(P_u + \frac{V_u}{\eta}\right)}{\Phi R_{nt}} \le 1.00\ ,\ \text{“OK”}\ ,\ \text{“Overstressed”}\right)$

$Condition1 = \text{“OK”}$

Design Shear Strength = $\Phi R_{nv} := 0.75 \cdot 0.45 \cdot F_u \cdot A_g = 81.178\ kip$

Design Flexural Strength = $\Phi R_{nm} := 0.9 \cdot F_y \cdot Z = 42.312\ in \cdot kip$

$M_u := \left\| \begin{array}{l} \text{if } l_{ar} < D \\ \quad \| \ 0 \\ \text{else} \\ \quad \| \ 0.65 \cdot l_{ar} \cdot V_u \end{array} \right\| = 2.6\ in \cdot kip$

Bolt % of Capacity = $\left(\left(\frac{V_u}{\Phi R_{nv}}\right)^2 + \left(\frac{P_u}{\Phi R_{nt}} + \frac{M_u}{\Phi R_{nm}}\right)^2\right) = 44.9\%$

Condition 2 = $Condition2 := \text{if}\left(\left(\frac{V_u}{\Phi R_{nv}}\right)^2 + \left(\frac{P_u}{\Phi R_{nt}} + \frac{M_u}{\Phi R_{nm}}\right)^2 \le 1.00\ ,\ \text{“OK”}\ ,\ \text{“OS”}\right)$

$Condition2 = \text{“OK”}$

## Base Plate Analysis :

Strength Resistance Factor for Yielding due to Bending = $\phi_b := 0.9$

Strength Resistance Factor for Yielding due to Shear = $\phi_v := 1.0$

Outside Fillet Horizontal Leg Dimension = $w_1 := 0.25 \cdot in$

Effective Pole Outside Diameter = $D_e := D_T + w_1 = 45.75\ in$

Effective Base Plate Outside Diameter =

$$D_{oe} := \left\| \begin{array}{l} \text{if } D_{OD} \le \left(D_{BC} + 6 \cdot t_{TP}\right) \\ \quad \left\| D_{OD} \right. \\ \text{else} \\ \quad \left\| \left(D_{BC} + 6 \cdot t_{TP}\right) \right. \end{array} \right\| = 56.25 \ in$$

Half-Angle Between Radial Lines Extending from Pole Centerline Through Midpoints Between Adjacent Anchor Rods =

$$\theta_1 := \frac{\pi}{N} = 0.524$$

Angle Defining Limiting Effective Base Plate Width Based on Plate Thickness =

$$\theta_2 := \operatorname{asin}\left(\frac{12 \cdot t_{TP}}{D_{BC}}\right) = 0.422$$

Angle Defining Limiting Effective Base Plate Width Based on Distance Between Anchor Rod Bolt Circle and Effective Pole Outside Diameter =

$$\theta_3 := \operatorname{acos}\left(\frac{D_{BC} + D_e}{2 \cdot D_{BC}}\right) = 0.329$$

Governing Angle Defining Effective Base Plate Width Resisting Bending =

$$\theta := min\left(\theta_1, \theta_2, \theta_3\right) = 0.329$$

Effective Moment Arm of Anchor Rod Force =

$$x := 0.5 \cdot \left(D_{BC} - D_e\right) = 2.75 \ in$$

Effective Base Plate Width Resisting Bending from Transverse Bend Line =

$$B_{et} := D_{BC} \cdot \sin\left(\theta\right) = 16.562 \ in$$

Effective Base Plate Width Resisting Bending from Radial Bend Lines =

$$B_{er} := \left(D_{oe} - D_e\right) \cdot \sin\left(\theta\right) = 3.393 \ in$$

Total Effective Base Plate Width Resisting Bending =

$$B_{eff} := B_{et} + B_{er} = 19.956 \ in$$

Required Base Plate Thickness =

$$t_{TP.Req} := \sqrt{\frac{4 \cdot P_u \cdot x}{\phi_b \cdot F_{yf} \cdot B_{eff}}} = 1.064 \ in$$

Plate Bending Stress % of Capacity =

$$\frac{t_{TP.Req}}{t_{TP}} = 60.8\%$$

Condition 2 =

$$Condition3 := \text{if}\left(\frac{t_{TP.Req}}{t_{TP}} < 1.00, \text{“Ok”}, \text{“Overstressed”}\right)$$

$Condition3 = \text{“Ok”}$

Required Base Plate Thickness =

$$t_{TP.Req} := \frac{\phi_b \cdot t_T \cdot F_{yp}}{\phi_v \cdot 0.6 \cdot F_{yf}} = 0.488 \ in$$

Plate Bending Stress % of Capacity =

$$\frac{t_{TP.Req}}{t_{TP}} = 27.9\%$$

Condition 2 =

$$Condition4 := \text{if}\left(\frac{t_{TP.Req}}{t_{TP}} < 1.00, \text{“Ok”}, \text{“Overstressed”}\right)$$

$Condition4 = \text{“Ok”}$

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| | |
|---|---|
| Subject: | CAISSON FOUNDATION |
| Location: | 98-ft EEI Flagpole<br>Bridgeport, CT |
| Rev. 1: 11/1/22 | Prepared by: TJL Checked by: C.F.C.<br>Job No. 21007.69 |

## Caisson Foundation:

Input Data:

| | | |
|---|---|---|
| Shear Force = | $S := 12k$ | *USER INPUT-FROM tnxTower* |
| Overturning Moment = | $M := 668ft \cdot k$ | *USER INPUT-FROM tnxTower* |
| Applied Axial Load = | $A1 := 14k$ | *USER INPUT-FROM tnxTower* |
| Bending Moment = | $Mu := 701ft \cdot k$ | *USER INPUT–FROM LPILE* |
| Moment Capacity = | $Mn := 3322ft \cdot k$ | *USER INPUT–FROM LPILE* |
| Foundation Diameter = | $d := 6ft$ | *USER INPUT* |
| Overall Length of Caisson = | $L_c := 18.75ft$ | *USER INPUT* |
| Depth From Top of Caisson to Grade = | $L_{pag} := 0.75ft$ | *USER INPUT* |
| Number of Rebar = | $n := 26$ | *USER INPUT* |
| Area of Rebar = | $Ar := 0.785in^2$ | *USER INPUT* |
| Rebar Yield Strength = | $fy := 60ksi$ | *USER INPUT* |
| Concrete Comp Strength = | $f'c := 4ksi$ | *USER INPUT* |

Check Moment Capacity:

Factor of Safety = $FS := \frac{0.9Mn}{Mu} = 4.3$

Factor of Safety Required = $FS_{reqd} := 1$

$FOSCheck := if(FS \geq FS_{reqd}, "OK", "NO GOOD")$

FOSCheck = "OK"

```
================================================================================

                 LPILE Plus for Windows, Version 5.0 (5.0.47)

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

                         (c) 1985-2010 by Ensoft, Inc.
                              All Rights Reserved

================================================================================

This program is licensed to:

TJL
Centek Engineering

--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:      J:\Jobs\2100700.WI\69_Bridgeport NE
CT\05_Structural\Tower Analysis\Rev 1\Backup Documentation\LPile\
Name of input data file:     Caisson.lpd
Name of output file:         Caisson.lpo
Name of plot output file:    Caisson.lpp
Name of runtime file:        Caisson.lpr


--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  November  1, 2022     Time:  15:33:50


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

21007.69 Bridgeport NE


--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:
```

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output summary table of values for pile-head deflection, maximum
bending moment, and shear force only
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Only summary tables of pile-head deflection, maximum bending moment,
  and maximum shear force are to be printed in output file.

---

Pile Structural Properties and Geometry

---

Pile Length                                =     225.00 in

Depth of ground surface below top of pile =       9.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

| Point No. | Point Depth in | Pile Diameter in | Moment of Inertia in**4 | Pile Area Sq.in | Modulus of Elasticity lbs/Sq.in |
|---|---|---|---|---|---|
| 1 | 0.0000 | 72.00000000 | 1319167. | 4071.5000 | 3604996. |
| 2 | 225.0000 | 72.00000000 | 1319167. | 4071.5000 | 3604996. |

Please note that because this analysis makes computations of ultimate
moment capacity and pile response using nonlinear bending stiffness
that the above values of moment of inertia and modulus of are not used
for any computations other than total stress due to combined axial
loading and bending.

---

## Soil and Rock Layering Information

---

The soil profile is modelled using  2 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =        9.000 in
Distance from top of pile to bottom of layer =      210.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      210.000 in
Distance from top of pile to bottom of layer =      240.000 in
p-y subgrade modulus k for top of soil layer =        0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =        0.000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for the above soil layer.

(Depth of lowest layer extends   15.00 in below pile tip)

---

## Effective Unit Weight of Soil vs. Depth

---

Effective unit weight of soil with depth defined using  4 points

| Point No. | Depth X in | Eff. Unit Weight lbs/in**3 |
|---|---|---|
| 1 | 9.00 | 0.07200 |
| 2 | 210.00 | 0.07200 |
| 3 | 210.00 | 0.08100 |
| 4 | 240.00 | 0.08100 |

---

## Shear Strength of Soils

---

Shear strength parameters with depth defined using  4 points

| Point No. | Depth X in | Cohesion c lbs/in**2 | Angle of Friction Deg. | E50 or k_rm | RQD % |
|---|---|---|---|---|---|
| 1 | 9.000 | 0.00000 | 32.00 | ------ | ------ |
| 2 | 210.000 | 0.00000 | 32.00 | ------ | ------ |
| 3 | 210.000 | 0.00000 | 40.00 | ------ | ------ |
| 4 | 240.000 | 0.00000 | 40.00 | ------ | ------ |

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

## Loading Type

---

Static loading criteria was used for computation of p-y curves.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 12000.000 lbs
Bending moment at pile head = 8016000.000 in-lbs
Axial load at pile head = 14000.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No.  1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 72.0000 in

Material Properties:

| | | | |
|---|---|---|---|
| Compressive Strength of Concrete | = | 4.000 | kip/in**2 |
| Yield Stress of Reinforcement | = | 60. | kip/in**2 |
| Modulus of Elasticity of Reinforcement | = | 29000. | kip/in**2 |
| Number of Reinforcing Bars | = | 26 | |
| Area of Single Bar | = | 0.79000 | in**2 |
| Number of Rows of Reinforcing Bars | = | 13 | |
| Area of Steel | = | 20.540 | in**2 |
| Area of Shaft | = | 4071.504 | in**2 |
| Percentage of Steel Reinforcement | = | 0.504 | percent |
| Cover Thickness (edge to bar center) | = | 3.000 | in |

Unfactored Axial Squash Load Capacity = 15005.68 kip

Distribution and Area of Steel Reinforcement

| Row Number | Area of Reinforcement in**2 | Distance to Centroidal Axis in |
|---|---|---|
| 1 | 1.580 | 32.759 |
| 2 | 1.580 | 30.856 |
| 3 | 1.580 | 27.158 |
| 4 | 1.580 | 21.883 |
| 5 | 1.580 | 15.336 |
| 6 | 1.580 | 7.897 |
| 7 | 1.580 | 0.000 |
| 8 | 1.580 | -7.897 |
| 9 | 1.580 | -15.336 |
| 10 | 1.580 | -21.883 |
| 11 | 1.580 | -27.158 |
| 12 | 1.580 | -30.856 |
| 13 | 1.580 | -32.759 |

Axial Thrust Force = 14000.00 lbs

| Bending Moment | Bending Stiffness | Bending Curvature | Maximum Strain | Neutral Axis Position | Max. Concrete Stress | Max. Steel Stress |
|---|---|---|---|---|---|---|
| in-lbs | lb-in2 | rad/in | in/in | inches | psi | |

| psi | | | | | | |
|---|---|---|---|---|---|---|
| 4256294. | 5.107553E+12 | 8.333333E-07 | 0.00003102 | 37.22090185 | 110.07460 | 821.19046 |
| 8469486. | 5.081691E+12 | 0.00000167 | 0.00006115 | 36.68742979 | 215.20931 | 1616.59643 |
| 12638584. | 5.055434E+12 | 0.00000250 | 0.00009125 | 36.50106347 | 318.56283 | 2411.38308 |
| 16763960. | 5.029188E+12 | 0.00000333 | 0.00012136 | 36.40777409 | 420.21034 | 3206.15947 |
| 16763960. | 4.023350E+12 | 0.00000417 | 0.00006697 | 16.07253349 | 230.40717 | 6366.32884 |
| 16763960. | 3.352792E+12 | 0.00000500 | 0.00007944 | 15.88787091 | 272.29897 | 7666.37068 |
| 16763960. | 2.873822E+12 | 0.00000583 | 0.00009192 | 15.75834811 | 313.96017 | 8966.01007 |
| 16763960. | 2.514594E+12 | 0.00000667 | 0.00010442 | 15.66329706 | 355.39001 | 10265.24519 |
| 16763960. | 2.235195E+12 | 0.00000750 | 0.00011700 | 15.59999907 | 396.81238 | 11562.16815 |
| 16763960. | 2.011675E+12 | 0.00000833 | 0.00012990 | 15.58800423 | 439.04401 | 12849.75225 |
| 16763960. | 1.828796E+12 | 0.00000917 | 0.00014245 | 15.53953135 | 479.78238 | 14147.61318 |
| 16763960. | 1.676396E+12 | 0.00001000 | 0.00015501 | 15.50071013 | 520.29120 | 15445.01799 |
| 16763960. | 1.547442E+12 | 0.00001083 | 0.00016758 | 15.46932399 | 560.56975 | 16741.96330 |
| 16763960. | 1.436911E+12 | 0.00001167 | 0.00018018 | 15.44378936 | 600.61728 | 18038.44584 |
| 16763960. | 1.341117E+12 | 0.00001250 | 0.00019279 | 15.42294323 | 640.43296 | 19334.46298 |
| 16763960. | 1.257297E+12 | 0.00001333 | 0.00020541 | 15.40591657 | 680.01609 | 20630.01083 |
| 16763960. | 1.183338E+12 | 0.00001417 | 0.00021805 | 15.39204204 | 719.36585 | 21925.08662 |
| 16763960. | 1.117597E+12 | 0.00001500 | 0.00023071 | 15.38080251 | 758.48146 | 23219.68679 |
| 16763960. | 1.058776E+12 | 0.00001583 | 0.00024339 | 15.37179029 | 797.36219 | 24513.80751 |
| 16763960. | 1.005838E+12 | 0.00001667 | 0.00025608 | 15.36467493 | 836.00706 | 25807.44699 |
| 16763960. | 9.579406E+11 | 0.00001750 | 0.00026879 | 15.35919678 | 874.41550 | 27100.59950 |
| 16763960. | 9.143978E+11 | 0.00001833 | 0.00028151 | 15.35513484 | 912.58645 | 28393.26384 |
| 16763960. | 8.746414E+11 | 0.00001917 | 0.00029425 | 15.35231316 | 950.51922 | 29685.43512 |
| 16763960. | 8.381980E+11 | 0.00002000 | 0.00030701 | 15.35058153 | 988.21291 | 30977.11056 |

16763960. 8.046701E+11 0.00002083 0.00031979 15.34981549 1025.66668
32268.28632
16763960. 7.737212E+11 0.00002167 0.00033258 15.34990990 1062.87971
33558.95845
16763960. 7.450649E+11 0.00002250 0.00034539 15.35077465 1099.85113
34849.12338
16978523. 7.276510E+11 0.00002333 0.00035822 15.35233247 1136.58005
36138.77752
17566049. 7.268710E+11 0.00002417 0.00037107 15.35451686 1173.06556
37427.91725
18152998. 7.261199E+11 0.00002500 0.00038393 15.35726988 1209.30674
38716.53915
18739371. 7.253950E+11 0.00002583 0.00039681 15.36054432 1245.30287
40004.63735
19325160. 7.246935E+11 0.00002667 0.00040971 15.36429298 1281.05279
41292.21056
19910366. 7.240133E+11 0.00002750 0.00042263 15.36848152 1316.55588
42579.25178
20494979. 7.233522E+11 0.00002833 0.00043557 15.37307131 1351.81081
43865.76086
21079001. 7.227086E+11 0.00002917 0.00044853 15.37803662 1386.81696
45151.73048
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46437.15581
22245256. 7.214678E+11 0.00003083 0.00047449 15.38898861 1456.07893
47722.03645
22827476. 7.208677E+11 0.00003167 0.00048751 15.39492810 1490.33258
49006.36679
23409094. 7.202798E+11 0.00003250 0.00050054 15.40115511 1524.33374
50290.13906
24570489. 7.191363E+11 0.00003417 0.00052666 15.41439450 1591.57354
52856.00253
25729408. 7.180300E+11 0.00003583 0.00055286 15.42859089 1657.79018
55419.59169
26885821. 7.169552E+11 0.00003750 0.00057914 15.44365203 1722.97551
57980.86813
27993152. 7.147188E+11 0.00003917 0.00060513 15.45009363 1786.19805
60000.00000
28847651. 7.064731E+11 0.00004083 0.00062918 15.40858161 1843.44422
60000.00000
29563825. 6.956194E+11 0.00004250 0.00065217 15.34514201 1897.06995
60000.00000
30172680. 6.831550E+11 0.00004417 0.00067426 15.26626790 1947.63357
60000.00000
30694204. 6.696917E+11 0.00004583 0.00069563 15.17729366 1995.63609
60000.00000
31214585. 6.571492E+11 0.00004750 0.00071703 15.09543908 2042.92754
60000.00000
31651760. 6.437646E+11 0.00004917 0.00073765 15.00314748 2087.63376
60000.00000
32010039. 6.297057E+11 0.00005083 0.00075752 14.90212691 2129.92175

60000.00000
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60000.00000
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60000.00000
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60000.00000
   33581073.  5.675674E+11    0.00005917    0.00085490   14.44901597    2326.94307
60000.00000
   33941665.  5.579452E+11    0.00006083    0.00087600   14.40000021    2367.61443
60000.00000
   34068323.  5.450932E+11    0.00006250    0.00089618   14.33886945    2405.69048
60000.00000
   34293983.  5.344517E+11    0.00006417    0.00091426   14.24815500    2438.99129
60000.00000
   34519024.  5.243396E+11    0.00006583    0.00093236   14.16246164    2471.77846
60000.00000
   34743442.  5.147177E+11    0.00006750    0.00095050   14.08142030    2504.04952
60000.00000
   34967234.  5.055504E+11    0.00006917    0.00096866   14.00469840    2535.80212
60000.00000
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   35241826.  4.860942E+11    0.00007250    0.00100218   13.82318580    2592.63053
60000.00000
   35377329.  4.769977E+11    0.00007417    0.00101896   13.73877132    2620.34888
60000.00000
   35512352.  4.682947E+11    0.00007583    0.00103576   13.65837371    2647.62282
60000.00000
   35646898.  4.599600E+11    0.00007750    0.00105258   13.58173764    2674.45070
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60000.00000
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60000.00000
   36180270.  4.298646E+11    0.00008417    0.00112012   13.30837333    2777.26256
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   36312396.  4.149988E+11    0.00008750    0.00115500   13.19999921    2827.38227
60000.00000
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   36732320.  4.043925E+11    0.00009083    0.00119495   13.15535867    2882.61220
60000.00000
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60000.00000

| | | | | | |
|---|---|---|---|---|---|
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| 60000.00000 | | | | | |
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| 60000.00000 | | | | | |
| 37017692. | 3.796686E+11 | 0.00009750 | 0.00125503 | 12.87212598 | 2959.11967 |
| 60000.00000 | | | | | |
| 37088214. | 3.739988E+11 | 0.00009917 | 0.00127010 | 12.80775940 | 2977.35307 |
| 60000.00000 | | | | | |
| 37228247. | 3.632024E+11 | 0.00010250 | 0.00130030 | 12.68587983 | 3012.73693 |
| 60000.00000 | | | | | |
| 37366925. | 3.530733E+11 | 0.00010583 | 0.00133058 | 12.57242668 | 3046.66712 |
| 60000.00000 | | | | | |
| 37504244. | 3.435503E+11 | 0.00010917 | 0.00136094 | 12.46663821 | 3079.13179 |
| 60000.00000 | | | | | |
| 37640188. | 3.345794E+11 | 0.00011250 | 0.00139138 | 12.36784065 | 3110.11854 |
| 60000.00000 | | | | | |
| 37774738. | 3.261128E+11 | 0.00011583 | 0.00142190 | 12.27543747 | 3139.61471 |
| 60000.00000 | | | | | |
| 37907873. | 3.181080E+11 | 0.00011917 | 0.00145251 | 12.18889868 | 3167.60739 |
| 60000.00000 | | | | | |
| 38039592. | 3.105273E+11 | 0.00012250 | 0.00148320 | 12.10775650 | 3194.08397 |
| 60000.00000 | | | | | |
| 38169862. | 3.033366E+11 | 0.00012583 | 0.00151397 | 12.03158605 | 3219.03077 |
| 60000.00000 | | | | | |
| 38489907. | 2.979864E+11 | 0.00012917 | 0.00155000 | 12.00000036 | 3246.45226 |
| 60000.00000 | | | | | |
| 38489907. | 2.904899E+11 | 0.00013250 | 0.00158619 | 11.97128141 | 3271.74171 |
| 60000.00000 | | | | | |
| 38489907. | 2.833613E+11 | 0.00013583 | 0.00161312 | 11.87571752 | 3288.74162 |
| 60000.00000 | | | | | |
| 38528336. | 2.768503E+11 | 0.00013917 | 0.00164011 | 11.78521979 | 3304.57483 |
| 60000.00000 | | | | | |
| 38587619. | 2.707903E+11 | 0.00014250 | 0.00166717 | 11.69943631 | 3319.23171 |
| 60000.00000 | | | | | |
| 38645936. | 2.650007E+11 | 0.00014583 | 0.00169430 | 11.61805165 | 3332.70284 |
| 60000.00000 | | | | | |
| 38703270. | 2.594633E+11 | 0.00014917 | 0.00172150 | 11.54077399 | 3344.97822 |
| 60000.00000 | | | | | |
| 38759604. | 2.541613E+11 | 0.00015250 | 0.00174877 | 11.46733725 | 3356.04777 |
| 60000.00000 | | | | | |
| 38814943. | 2.490799E+11 | 0.00015583 | 0.00177611 | 11.39750326 | 3365.90154 |
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| 38869269. | 2.442048E+11 | 0.00015917 | 0.00180353 | 11.33104885 | 3374.52908 |
| 60000.00000 | | | | | |
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| 60000.00000 | | | | | |
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| 39026042. | 2.306958E+11 | 0.00016917 | 0.00188621 | 11.15001047 | 3392.94809 |
| 60000.00000 | | | | | |
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60000.00000
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60000.00000
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60000.00000
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60000.00000

```
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  60000.00000
    40171630.  1.118468E+11    0.00035917    0.00344800    9.60000050    3381.60139
  60000.00000
    40276552.  1.100954E+11    0.00036583    0.00351200    9.60000050    3372.08908
  60000.00000
    40377738.  1.083966E+11    0.00037250    0.00357600    9.60000050    3362.57678
  60000.00000
    40475188.  1.067477E+11    0.00037917    0.00364000    9.60000050    3353.06447
  60000.00000
    40568901.  1.051462E+11    0.00038583    0.00370400    9.60000050    3343.55216
  60000.00000
    40658879.  1.035895E+11    0.00039250    0.00376800    9.60000050    3352.34735
  60000.00000
    40745120.  1.020755E+11    0.00039917    0.00383200    9.60000050    3363.63978
  60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 =   39865.91434
in-kip



---------------------------------------------------------------------------
             Computed Values of Load Distribution and Deflection
                 for Lateral Loading for Load Case Number  1
---------------------------------------------------------------------------

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head  =       12000.000 lbs
Specified moment at pile head       =     8016000.000 in-lbs
```

Specified axial load at pile head = 14000.000 lbs

Output Verification:

Computed forces and moments are within specified convergence limits.

---

Summary of Pile Response(s)

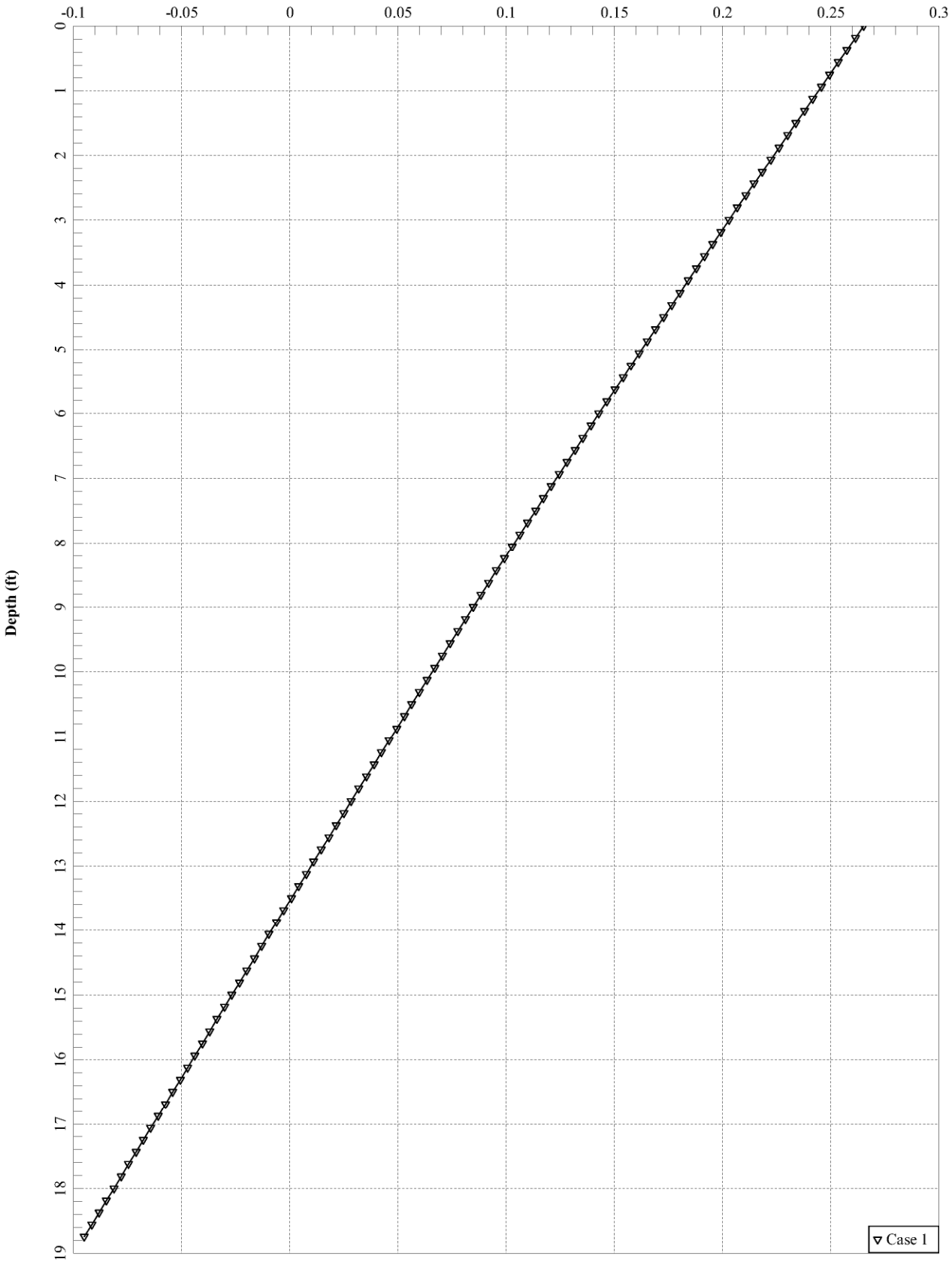
---

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

| Load Type | Pile-Head Condition 1 | Pile-Head Condition 2 | Axial Load lbs | Pile-Head Deflection in | Maximum Moment in-lbs | Maximum Shear lbs |
|---|---|---|---|---|---|---|
| 1 | V= 12000. | M= 8.02E+06 | 14000.0000 | 0.2651897 | 8404896. | -73107.4055 |

The analysis ended normally.


Lateral Deflection (in)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Case 1

CENTEK engineering

Centered on Solutions℠

# Structural Analysis Report

Antenna Mount Analysis

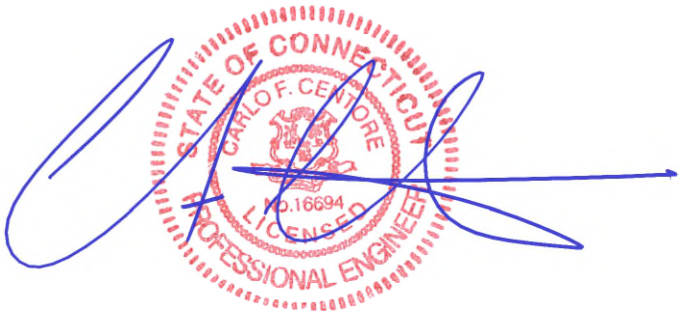
Verizon Site Ref: Bridgeport NE CT

541 Broadbridge Road
Bridgeport, CT

Centek Project No. 21007.69

~~Date: January 17, 2022~~

Rev. 1: October 21, 2022




**Prepared for:**

Verizon Wireless
20 Alexander Drive
Wallingford, CT 06492

63-2 North Branford Road, Branford, CT 06405 203.488.0580 Fax 203.488.8587 www.CentekEng.com

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- STRUCTURAL LETTER
- LOADING

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- GRAVITY AND LATERAL LOADS ON APPURTENANCES
- RISA3D OUTPUT REPORT
- CONNECTION TO HOST STRUCTURE

**SECTION 3 – REFERENCE MATERIALS**

- RF DATA SHEET, DATED 11/19/2021

CENTEK engineering

Centered on Solutions℠

October 21, 2022

Mr. Andrew Leone
Verizon Wireless
20 Alexander Drive
Wallingford, CT 06492

*Re: Structural Letter ~ Antenna Mount Rev. 1*
*Verizon – Site Ref: Bridgeport NE CT*
*541 Broadbridge Road*
*Bridgeport, CT 06610*

*Centek Project No. 21007.69*

Dear Mr. Leone,

Centek Engineering, Inc. has reviewed the Verizon antenna installation at the above-referenced site. The purpose of the review is to determine the structural adequacy of the proposed three (3) antenna masts, Pipe 2.0 STD X 8- FT and three (3) antenna masts, Pipe 2.0 STD X 3- FT as detailed on the Centek Engineering construction drawings entitled "Verizon, Bridgeport NE CT, 541 Broadbridge Road Bridgeport, CT" issued 10/21/2022 (Rev. 1). The antennas are being proposed inside concealment canisters in an existing flagpole. The review considered the effects of dead load and ice load in accordance with the 2021 International Building Code as modified by the 2022 Connecticut State Building Code (CSBC), including ASCE 7-16 and ANSI/TIA-222-H *Structural Standards for Steel Antenna Towers and Supporting Structures*.

The loads considered in this analysis consist of the following:

- **Verizon:**
  **Antenna Masts: Three (3) Commscope NNH4-65B-R6 panel antennas, three (3) JMA MX08FIT265-01 panel antenna, three(3) Samsung RT-8808-77A RRU's and six (6) Commscope CBC61923T-DS-43 diplexers the proposed antenna mounts inside concealments canisters with RAD center elevations of 92 ft +/- & 82 ft +/- AGL.**

The antenna mount was analyzed per the requirements of the 2021 International Building Code as modified by the 2022 Connecticut State Building Code, considering a design ice thickness of 1.0 inch for Bridgeport as required in Annex B of the ANSI/TIA-222-H *Structural Standards for Steel Antenna Towers and Supporting Structures*.

Based on our review of the installation, it is our opinion that **the proposed antenna masts have sufficient capacity** to support the aforementioned antenna configuration. If there are any questions regarding this matter, please feel free to call.

Respectfully Submitted by:

STATE OF CONNECTICUT CARLO F. CENTORE No.16694 LICENSED PROFESSIONAL ENGINEER

Carlo F. Centore, PE
Principal ~ Structural Engineer

Prepared by:

Pablo Perez-Gomez
Engineer

# ***Section 2 - Calculations***

CENTEK engineering
Centered on Solutions℠ www.centekeng.com
63-2 North Branford Road P: (203) 488-0580
Branford, CT 06405 F: (203) 488-8587

Subject: Loads on Equipment

Location: Bridgeport , CT

Rev. 1: 10/21/2022 Prepared by: PPG Checked by: T.J.L.
Job No. 21007.69

## Development of Design Heights of Ice on Equipment Per TIA-222-G

**Input**

| | | | |
|---|---|---|---|
| Structure Type = | $Structure_Type := Pole$ | | (User Input) |
| Structure Category = | $SC := II$ | | (User Input) |
| Height to Center of Antennas = | $z := 92$ | ft | (User Input) |
| Radial Ice Thickness = | $t_i := 1.0$ | in | (User Input per Annex B of TIA-222-G) |
| Radial Ice Density = | $Id := 56.00$ | pcf | (User Input) |
| Topographic Factor = | $K_{zt} := 1.0$ | | (User Input) |

**Output**

Ice Importance factor=

$$I_{ice} := \begin{cases} \text{if } SC = 1 \\ \quad 0 \\ \text{if } SC = 2 \\ \quad 1.00 \\ \text{if } SC = 3 \\ \quad 1.25 \end{cases} = 1$$

(TIA 222-G, Table 2-3)

Height escalation factor for ice thickness=

$$K_{iz} := \left(\frac{z}{33}\right)^{0.1} = 1.108$$

(TIA 222-G, Sec, 2.6.8)

Nominal thickness of radial glaze ice at height z=

$$t_{iz} := t_i \cdot I_{ice} \cdot K_{iz} \cdot {K_{zt}}^{0.35} = 1.108 \text{ in}$$

(TIA 222-G, Sec, 2.6.8)

## Development of Ice Load on Antennas

### Antenna Data:

| | | | |
|---|---|---|---|
| Antenna Model = | Commscope NNH4-65B-R6 | | |
| Antenna Shape = | Flat | | (User Input) |
| Antenna Height = | $L_{ant} := 72.0$ | in | (User Input) |
| Antenna Width = | $W_{ant} := 19.6$ | in | (User Input) |
| Antenna Thickness = | $T_{ant} := 7.8$ | in | (User Input) |
| Antenna Weight = | $WT_{ant} := 83.1$ | lbs | (User Input) |
| Number of Antennas = | $N_{ant} := 1$ | | (User Input) |
| Antenna Aspect Ratio = | $Ar_{ant} := \frac{L_{ant}}{W_{ant}} = 3.7$ | | |

**Gravity Load (without ice)**

Weight of All Antennas = $WT_{ant} \cdot N_{ant} = 83$ lbs

**Gravity Loads (ice only)**

Volume of Each Antenna = $V_{ant} := L_{ant} \cdot W_{ant} \cdot T_{ant} = 1 \cdot 10^4$ cu in

Volume of Ice on Each Antenna = $V_{ice} := (L_{ant} + 2 \cdot t_{iz}) \cdot (W_{ant} + 2 \cdot t_{iz}) \cdot (T_{ant} + 2 \cdot t_{iz}) - V_{ant} = 5209$ cu in

Weight of Ice on Each Antenna = $W_{ICEant} := \frac{V_{ice}}{1728} \cdot Id = 169$ lbs

Weight of Ice on All Antennas = $W_{ICEant} \cdot N_{ant} = 169$ lbs

## Development of Ice Load on Antennas

### Antenna Data:

| | | | |
|---|---|---|---|
| Antenna Model = | JMA MX08FIT265-01 | | |
| Antenna Shape = | Flat | | (User Input) |
| Antenna Height = | $L_{ant} := 33.1$ | in | (User Input) |
| Antenna Width = | $W_{ant} := 11.6$ | in | (User Input) |
| Antenna Thickness = | $T_{ant} := 4.5$ | in | (User Input) |
| Antenna Weight = | $WT_{ant} := 26.5$ | lbs | (User Input) |
| Number of Antennas = | $N_{ant} := 1$ | | (User Input) |
| Antenna Aspect Ratio = | $Ar_{ant} := \frac{L_{ant}}{W_{ant}} = 2.9$ | | |

**Gravity Load (without ice)**

Weight of All Antennas = $WT_{ant} \cdot N_{ant} = 27$ lbs

**Gravity Loads (ice only)**

Volume of Each Antenna = $V_{ant} := L_{ant} \cdot W_{ant} \cdot T_{ant} = 1728$ cu in

Volume of Ice on Each Antenna = $V_{ice} := (L_{ant} + 2 \cdot t_{iz}) \cdot (W_{ant} + 2 \cdot t_{iz}) \cdot (T_{ant} + 2 \cdot t_{iz}) - V_{ant} = 1549$ cu in

Weight of Ice on Each Antenna = $W_{ICEant} := \frac{V_{ice}}{1728} \cdot Id = 50$ lbs

Weight of Ice on All Antennas = $W_{ICEant} \cdot N_{ant} = 50$ lbs

## Development of Ice Load on RRUS's

### RRUS Data:

| | | | |
|---|---|---|---|
| RRUS Model = | Samsung RT-8808-77A | | |
| RRUS Shape = | Flat | | (User Input) |
| RRUS Height = | $L_{RRUS} := 15$ | in | (User Input) |
| RRUS Width = | $W_{RRUS} := 15$ | in | (User Input) |
| RRUS Thickness = | $T_{RRUS} := 6.8$ | in | (User Input) |
| RRUS Weight = | $WT_{RRUS} := 59.5$ | lbs | (User Input) |
| Number of RRUS's = | $N_{RRUS} := 1$ | | |

**Gravity Load (without ice)**

Weight of All RRUSs = $WT_{RRUS} \cdot N_{RRUS} = 60$ lbs

**Gravity Loads (ice only)**

Volume of Each RRUS = $V_{RRUS} := L_{RRUS} \cdot W_{RRUS} \cdot T_{RRUS} = 1530$ cu in

Volume of Ice on Each RRUS = $V_{ice} := (L_{RRUS} + 2 \cdot t_{iz}) \cdot (W_{RRUS} + 2 \cdot t_{iz}) \cdot (T_{RRUS} + 2 \cdot t_{iz}) - V_{RRUS} = 1142$ cu in

Weight of Ice on Each RRUS = $W_{ICERRUS} := \frac{V_{ice}}{1728} \cdot Id = 37$ lbs

Weight of Ice on All RRUSs = $W_{ICERRUS} \cdot N_{RRUS} = 37$ lbs

## Development of Ice Load on Diplexers

### Diplexer Data:

| | | | |
|---|---|---|---|
| Diplexer Model = | Commscope CBC61923T-DS-43 | | |
| Diplexer Shape = | Flat | | (User Input) |
| Diplexer Height = | $L_{Dipl} := 6.9$ | in | (User Input) |
| Diplexer Width = | $W_{Dipl} := 7.8$ | in | (User Input) |
| Diplexer Thickness = | $T_{Dipl} := 4.6$ | in | (User Input) |
| Diplexer Weight = | $WT_{Dipl} := 14.3$ | lbs | (User Input) |
| Number of Diplexer = | $N_{Dipl} := 2$ | | (User Input) |

**Gravity Load (without ice)**

Weight of All Diplexer = $WT_{Dipl} \cdot N_{Dipl} = 29$ lbs

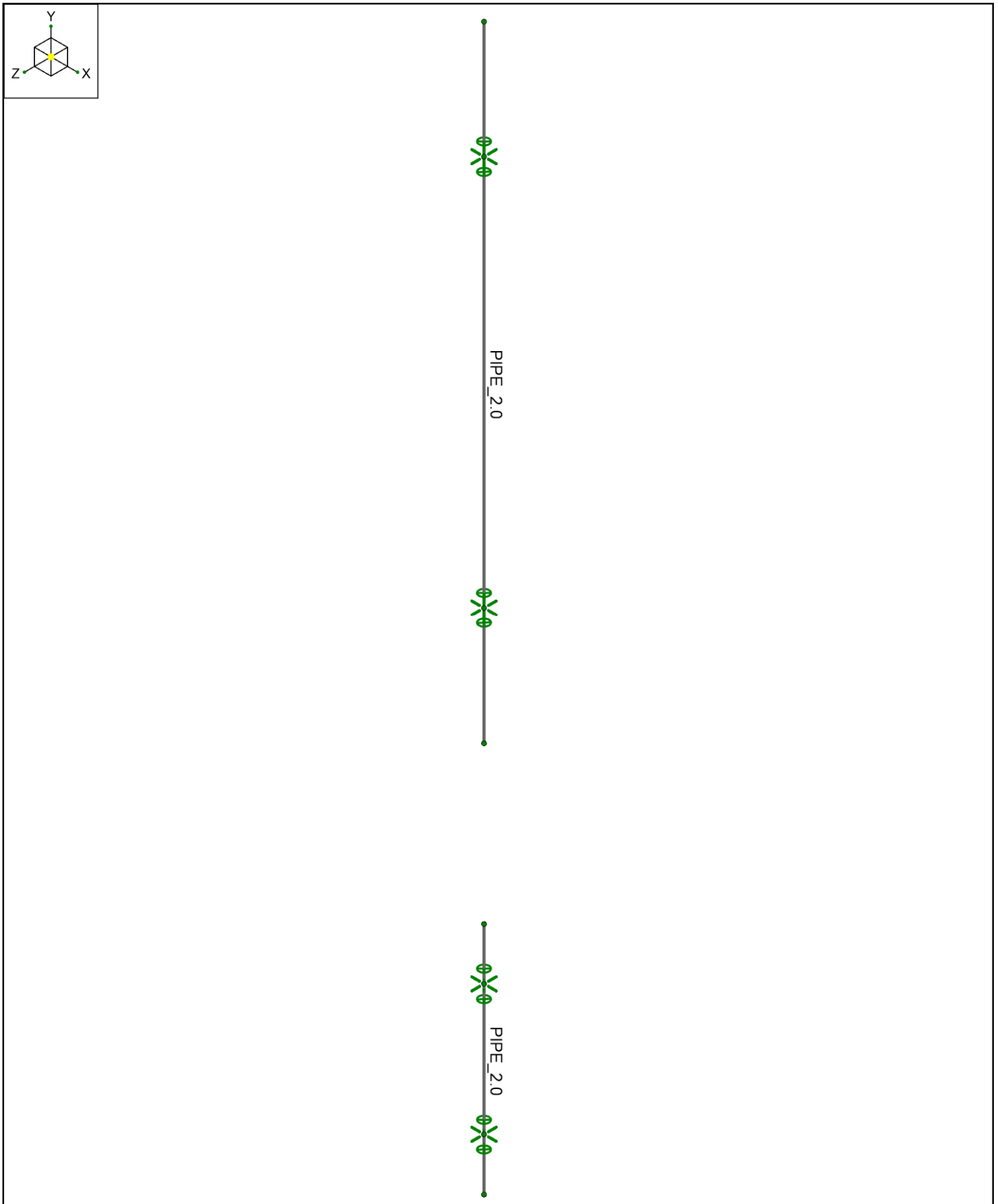
**Gravity Loads (ice only)**

Volume of Each Diplexer = $V_{Dipl} := L_{Dipl} \cdot W_{Dipl} \cdot T_{Dipl} = 248$ cu in

Volume of Ice on Each Diplexer = $V_{ice} := (L_{Dipl} + 2 \cdot t_{iz}) \cdot (W_{Dipl} + 2 \cdot t_{iz}) \cdot (T_{Dipl} + 2 \cdot t_{iz}) - V_{Dipl} = 375$ cu in

Weight of Ice on Each Diplexer = $W_{ICEDipl} := \frac{V_{ice}}{1728} \cdot Id = 12$ lbs

Weight of Ice on All Diplexer = $W_{ICEDipl} \cdot N_{Dipl} = 24$ lbs




Envelope Only Solution

| | | |
|---|---|---|
| Centek Engineering | Bridgeport NE CT - Mount | SK-1 |
| PPG | | Oct 20, 2022 |
| 21007.69 | | Bridgeprt NE CT_AMA.r3d |

### Nodes

| | Label | X [ft] | Y [ft] | Z [ft] | Temp [deg F] | Detach From Dia… |
|---|---|---|---|---|---|---|
| 1 | N10 | 0 | -8 | -0. | | |
| 2 | N12 | 0 | 0 | -0. | | |
| 3 | N3 | 0 | -1.5 | -0. | | |
| 4 | N4 | 0 | -6.5 | -0. | | |
| 5 | N5 | 0 | -13 | -0. | | |
| 6 | N6 | 0 | -10 | -0. | | |
| 7 | N7 | 0 | -10.666667 | -0. | | |
| 8 | N8 | 0 | -12.333333 | -0. | | |

### Boundary Conditions

| | Node Label | X [k/in] | Y [k/in] | Z [k/in] | X Rot [k-ft/rad] | Y Rot [k-ft/rad] | Z Rot [k-ft/rad] |
|---|---|---|---|---|---|---|---|
| 1 | N3 | Reaction | Reaction | Reaction | | Reaction | |
| 2 | N4 | Reaction | Reaction | Reaction | | Reaction | |
| 3 | N7 | Reaction | Reaction | Reaction | | Reaction | |
| 4 | N8 | Reaction | Reaction | Reaction | | Reaction | |

### Hot Rolled Steel Properties

| | Label | E [ksi] | G [ksi] | Nu | Therm. C… | Density [k… | Yield [ksi] | Ry | Fu [ksi] | Rt |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A36 Gr.36 | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 36 | 1.5 | 58 | 1.2 |
| 2 | A572 Gr.50 | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 50 | 1.1 | 58 | 1.2 |
| 3 | A992 | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 50 | 1.1 | 58 | 1.2 |
| 4 | A500 Gr.42 | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 42 | 1.3 | 58 | 1.1 |
| 5 | A500 Gr.46 | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 46 | 1.2 | 58 | 1.1 |
| 6 | A53 Grad… | 29000 | 11154 | 0.3 | 0.65 | 0.49 | 35 | 1.5 | 58 | 1.2 |

### Hot Rolled Member Properties

| | Label | Shape | Length [ft] | Lb y-y [ft] | Lb z-z [ft] | Lcomp t… | Lcomp… | L-Torqu… | K y-y | K z-z | Cb | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | (P) Ante… | 8 | | | Lbyy | | | | | | Lateral |
| 2 | M2 | (P) Ante… | 3 | | | | | | | | | Lateral |

### Hot Rolled Steel Section Sets

| | Label | Shape | Type | Design List | Material | Design Rule | Area [in²] | Iyy [in⁴] | Izz [in⁴] | J [in⁴] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | (P) Anten… | PIPE_2.0 | Column | None | A53 Grad… | Typical | 1.02 | 0.627 | 0.627 | 1.25 |
| 2 | (P)Folded… | Folded Pl… | Column | None | A36 Gr.36 | Typical | 2.626 | 5.835 | 26.377 | 0.021 |
| 3 | HR3 | L3.5X3X4 | Column | None | A36 Gr.36 | Typical | 1.58 | 1.3 | 1.92 | 0.036 |

### General Section Sets

| | Label | Shape | Type | Material | Area [in²] | Iyy [in⁴] | Izz [in⁴] | J [in⁴] |
|---|---|---|---|---|---|---|---|---|
| 1 | GEN1A | RE4X4 | Beam | gen_Conc3NW | 16 | 21.333 | 21.333 | 31.573 |
| 2 | RIGID | | None | RIGID | 1e+06 | 1e+06 | 1e+06 | 1e+06 |

### Member Point Loads (BLC 2 : Dead Load)

| | Member Label | Direction | Magnitude [k, k-ft] | Location [(ft, %)] | Inactive [(k, k-ft), (in,… |
|---|---|---|---|---|---|
| 1 | M1 | Y | -0.042 | 1 | Active |
| 2 | M1 | Y | -0.042 | 7 | Active |
| 3 | M2 | Y | -0.014 | 0.25 | Active |
| 4 | M2 | Y | -0.014 | 2.75 | Active |

### Basic Load Cases

| | BLC Desc… | Category | X Gravity | Y Gravity | Z Gravity | Nodal | Point | Distributed | Area(Me… | Surface(P… |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Self Weight | None | | -1 | | | | | | |
| 2 | Dead Load | None | | | | | 4 | | | |

### Load Combinations

| | De… | So… | PD… | SR… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… | BLC | Fa… |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2… | Yes | Y | | 1 | 1.2 | 2 | 1.2 | 5 | 1.6 | | | | | | | | | | | | | | |
| 2 | 0.9… | Yes | Y | | 1 | 0.9 | 2 | 0.9 | 5 | 1.6 | | | | | | | | | | | | | | |
| 3 | 1.2… | Yes | Y | | 1 | 1.2 | 2 | 1.2 | 3 | 1 | 4 | 1 | | | | | | | | | | | | |
| 4 | 1.2… | Yes | Y | | 1 | 1.2 | 2 | 1.2 | 7 | 1.6 | | | | | | | | | | | | | | |
| 5 | 0.9… | Yes | Y | | 1 | 0.9 | 2 | 0.9 | 7 | 1.6 | | | | | | | | | | | | | | |
| 6 | 1.2… | Yes | Y | | 1 | 1.2 | 2 | 1.2 | 3 | 1 | 6 | 1 | | | | | | | | | | | | |

### Node Reactions

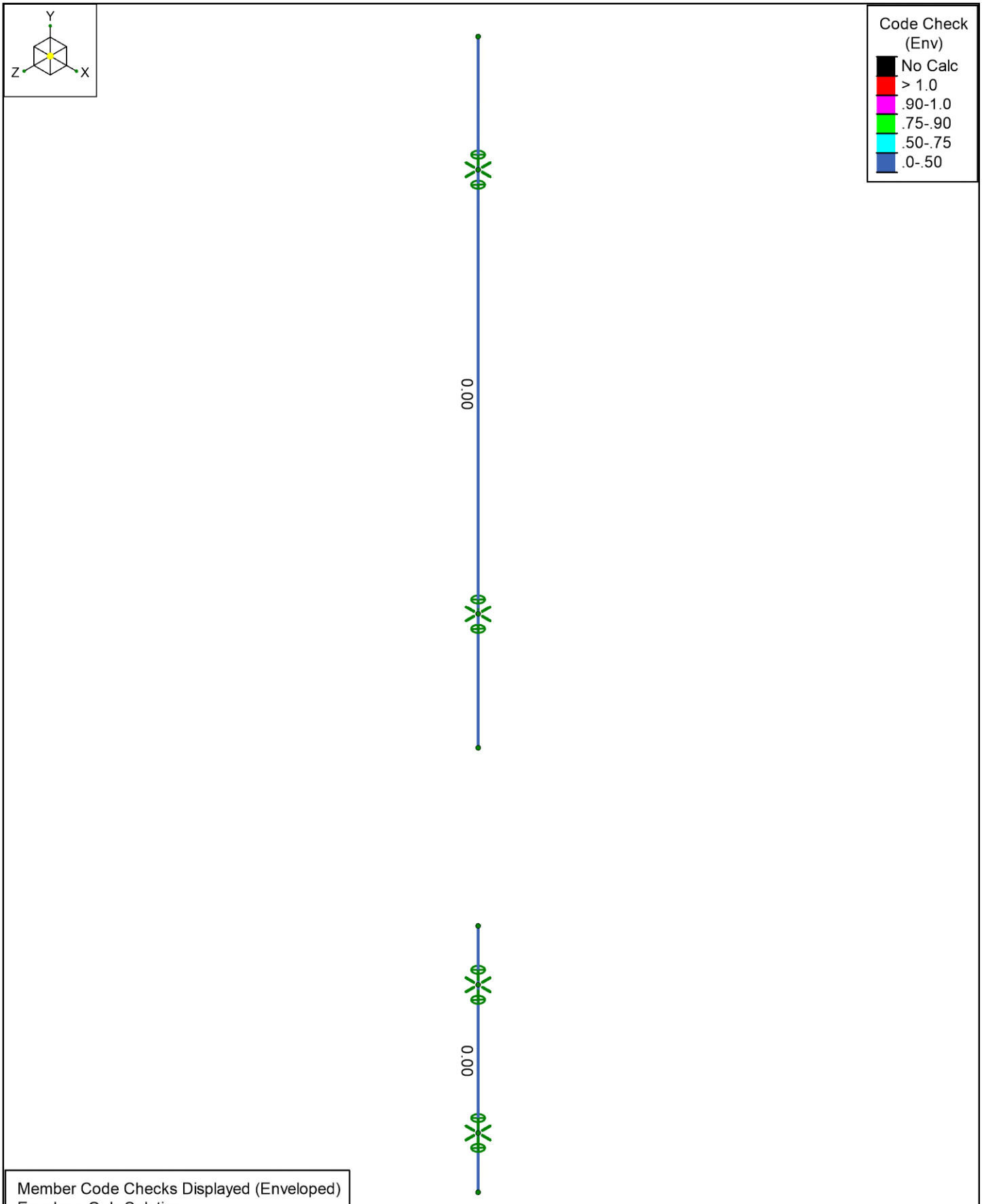
| | Node… | | X [k] | LC | Y [k] | LC | Z [k] | LC | MX [k-ft] | LC | MY [k-ft] | LC | MZ [k-ft] | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N3 | max | 0 | 6 | 0.067 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 2 | | min | 0 | 1 | 0.05 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 3 | N4 | max | 0 | 6 | 0.067 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 4 | | min | 0 | 1 | 0.05 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 5 | N7 | max | 0 | 6 | 0.023 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 6 | | min | 0 | 1 | 0.017 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 7 | N8 | max | 0 | 6 | 0.023 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 8 | | min | 0 | 1 | 0.017 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 9 | Totals: | max | 0 | 6 | 0.18 | 6 | 0 | 6 | | | | | | |
| 10 | | min | 0 | 1 | 0.135 | 2 | 0 | 1 | | | | | | |

### Node Displacements

| | Node… | | X [in] | LC | Y [in] | LC | Z [in] | LC | X Rota… | LC | Y Rota… | LC | Z Rota… | LC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N10 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 2 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 3 | N12 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 4 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 5 | N3 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 6 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 7 | N4 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 8 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 9 | N5 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 10 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 11 | N6 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 12 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 13 | N7 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 14 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 15 | N8 | max | 0 | 6 | 0 | 5 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 |
| 16 | | min | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

### LRFD

| | Member | Shape | Code… | Loc [ft] | LC | Shear… | Loc [ft] | Dir | LC | phi*P… | phi*P… | phi*M… | phi*M… | Cb | Eqn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M1 | PIPE… | 0.004 | 1.5 | 6 | 0.000 | 8 | | 6 | 14.916 | 32.13 | 1.872 | 1.872 | 1 | H1-1b* |
| 2 | M2 | PIPE… | 0.000 | 0.656 | 6 | 0.000 | 3 | | 6 | 28.843 | 32.13 | 1.872 | 1.872 | 1 | H1-1b |




Member Code Checks Displayed (Enveloped)
Envelope Only Solution

| | | |
|---|---|---|
| Centek Engineering | Bridgeport NE CT - Mount | SK-2 |
| PPG | | Oct 20, 2022 |
| 21007.69 | | Bridgeprt NE CT_AMA.r3d |

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Subject: Connection to Host Structure

Location: Bridgeport, CT

Rev. 1: 10/20/2022 Prepared by: PPG; Checked by: T.J.L.
Job No. 21007.69

# Proposed Connection to Host Structure for Mounts Supporting Antenna at 92 - ft Rad. Elevation

Bolts Grade $A325$

Number of Bolts = $n_b := 2$ (User Input)

Bolt Diameter = $d\phi := \frac{1}{2}\ in$ (User Input)

Nominal Tensile Strength= $F_{nt} := 90\ ksi$ (AISC, Steel construction manual 14th ed., Table J3.2)

Nominal Shear Strength= $F_{nv} := 54\ ksi$ (AISC, Steel construction manual 14th ed., Table J3.2)

Safety Factor= $\phi := 0.75$ (User Input)

Horizontal Spacing Between Bolts= $S := 3\ in$ (User Input)

**Reactions at Connection:** (User Input)

Shear X = $Shear_x := 0\ kip$

Vertical= $Vertical := 0.067\ kip$ (User Input)

Shear Z = $Shear_z := 0\ kip$ (User Input)

Moment X= $M_X := 0\ kip \cdot ft$ (User Input)

Moment Y= $M_Y := 0\ kip \cdot ft$ (User Input)

Moment Z= $M_Z := 0\ kip \cdot ft$ (User Input)

**Anchor Check:**

Bolt Area= $a_b := \pi \cdot \left(\frac{d\phi}{2}\right)^2 = 0.196\ in^2$

Shear Strength= $R_{nv} := F_{nv} \cdot a_b \cdot \phi = 7.952\ kip$ (AISC, Steel construction manual 14th ed., Formula J3-1)

Shear Stress per Bolt= $V_{act} := \frac{\sqrt{Shear_x^2 + Vertical^2}}{n_b} + \frac{M_Z}{S \cdot \frac{n_b}{2}} = 0.034\ kip$

$Condition1 := \text{if}\left(V_{act} \le R_{nv}, \text{“OK”}, \text{“Overstressed”}\right) = \text{“OK”}$ $\frac{V_{act}}{R_{nv}} = 0.4\%$

$Condition1 = \text{“OK”}$

$f_v := \frac{V_{act}}{a_b} = 0.171\ ksi$

Tensile Stress Adjusted for Shear= $F'_{nt} := \left\| \begin{array}{l} \text{if } \left(1.3\ F_{nt} - \frac{F_{nt}}{\phi \cdot F_{nv}} \cdot f_v\right) \le F_{nt} \\ \quad \left\| 1.3\ F_{nt} - \frac{F_{nt}}{\phi \cdot F_{nv}} \cdot f_v \right. \\ \text{else} \\ \quad \left\| F_{nt} \right. \end{array} \right\| = 90\ ksi$ (AISC, Steel construction manual 14th ed., Formula J3-3A)

Tensile Strength= $R_{nt} := F'_{nt} \cdot a_b \cdot \phi = 13.254\ kip$ (AISC, Steel construction manual 14th ed., Formula J3-2)

Tension Force Each Bolt= $T_{act} := \frac{Shear_z}{n_b} + \frac{M_Y}{S \cdot \frac{n_b}{2}} + \frac{M_X}{S \cdot \frac{n_b}{2}} = 0\ kip$

Tension Stress Each Bolt= $f_t := \frac{T_{act}}{a_b} = 0\ ksi$

$Condition2 := \text{if}\left(f_t \le F'_{nt} \cdot \phi, \text{“OK”}, \text{“Overstressed”}\right) = \text{“OK”}$ $\frac{T_{act}}{R_{nt}} = 0$

$Condition2 = \text{“OK”}$

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Subject: Connection to Host Structure

Location: Bridgeport, CT

Rev. 1: 10/20/2022 Prepared by: PPG; Checked by: T.J.L.
Job No. 21007.69

# Proposed Connection to Host Structure for Mounts Supporting Antenna at 82 - ft Rad. Elevation

Bolts Grade $A325$

Number of Bolts = $n_b := 2$ (User Input)

Bolt Diameter = $d\phi := \frac{1}{2}\ in$ (User Input)

Nominal Tensile Strength= $F_{nt} := 90\ ksi$ (AISC, Steel construction manual 14th ed., Table J3.2)

Nominal Shear Strength= $F_{nv} := 54\ ksi$ (AISC, Steel construction manual 14th ed., Table J3.2)

Safety Factor= $\phi := 0.75$ (User Input)

Horizontal Spacing Between Bolts= $S := 3\ in$ (User Input)

**Reactions at Connection:** (User Input)

Shear X = $Shear_x := 0 \cdot kip$

Vertical= $Vertical := 0.023\ kip$ (User Input)

Shear Z = $Shear_z := 0 \cdot kip$ (User Input)

Moment X= $M_X := 0 \cdot kip \cdot ft$ (User Input)

Moment Y= $M_Y := 0 \cdot kip \cdot ft$ (User Input)

Moment Z= $M_Z := 0\ kip \cdot ft$ (User Input)

**Anchor Check:**

Bolt Area= $a_b := \pi \cdot \left(\frac{d\phi}{2}\right)^2 = 0.196\ in^2$

Shear Strength= $R_{nv} := F_{nv} \cdot a_b \cdot \phi = 7.952\ kip$ (AISC, Steel construction manual 14th ed., Formula J3-1)

Shear Stress per Bolt= $V_{act} := \frac{\sqrt{Shear_z^{\,2} + Vertical^2}}{n_b} + \frac{M_Z}{S \cdot \frac{n_b}{2}} = 0.012\ kip$

$Condition1 := \text{if}\left(V_{act} \le R_{nv}, \text{“OK”}, \text{“Overstressed”}\right) = \text{“OK”}$ $\frac{V_{act}}{R_{nv}} = 0.1\%$

$Condition1 = \text{“OK”}$

$f_v := \frac{V_{act}}{a_b} = 0.059\ ksi$

Tensile Stress Adjusted for Shear= $F'_{nt} := \left\| \begin{array}{l} \text{if } \left(1.3\ F_{nt} - \frac{F_{nt}}{\phi \cdot F_{nv}} \cdot f_v\right) \le F_{nt} \\ \quad \left\| 1.3\ F_{nt} - \frac{F_{nt}}{\phi \cdot F_{nv}} \cdot f_v \right. \\ \text{else} \\ \quad \left\| F_{nt} \right. \end{array} \right\| = 90\ ksi$ (AISC, Steel construction manual 14th ed., Formula J3-3A)

Tensile Strength= $R_{nt} := F'_{nt} \cdot a_b \cdot \phi = 13.254\ kip$ (AISC, Steel construction manual 14th ed., Formula J3-2)

Tension Force Each Bolt= $T_{act} := \frac{Shear_x}{n_b} + \frac{M_Y}{S \cdot \frac{n_b}{2}} + \frac{M_X}{S \cdot \frac{n_b}{2}} = 0\ kip$

Tension Stress Each Bolt= $f_t := \frac{T_{act}}{a_b} = 0\ ksi$

$Condition2 := \text{if}\left(f_t \le F'_{nt} \cdot \phi, \text{“OK”}, \text{“Overstressed”}\right) = \text{“OK”}$ $\frac{T_{act}}{R_{nt}} = 0$

$Condition2 = \text{“OK”}$

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Subject: Flange Bolts and Flange Plate Analysis

Location: Bridgeport, CT

Rev. 0: 01/31/22

Prepared by: PPG Checked by: C.F.C.
Job No. 21007.69

## Flange Bolt and Flange Plate Analysis:

### Input Data:

Tower Reactions:

| | | |
|---|---|---|
| Overturning Moment = | $OM := 93.272 \cdot ft \cdot kips$ | (Input From RisaTower) |
| Shear Force = | $Shear := 5.241 \cdot kips$ | (Input From RisaTower) |
| Axial Force = | $Axial := 7.153 \cdot kips$ | (Input From RisaTower) |

Flange Bolt Data:

Use ASTM A325

| | | |
|---|---|---|
| Number of Flange Bolts = | $N := 12$ | (User Input) |
| Diameter of Bolt Circle = | $D_{bc} := 32 \cdot in$ | (User Input) |
| Bolt Minimum Tensile Strength = | $F_{ub} := 120 \cdot ksi$ | (User Input) |
| Bolt Modulus = | $E := 29000 \cdot ksi$ | (User Input) |
| Diameter of Flange Bolts = | $D := 1.00 \cdot in$ | (User Input) |
| Threads per Inch = | $n := 8$ | (User Input) |

Flange Plate Data:

Use ASTM A572 Grade 50

| | | |
|---|---|---|
| Plate Yield Strength = | $Fy_{bp} := 50 \cdot ksi$ | (User Input) |
| Flange Plate Thickness = | $t_{bp} := 1.25 \cdot in$ | (User Input) |
| Flange Plate Diameter = | $D_{bp} := 35 \cdot in$ | (User Input) |
| Outer Pole Diameter = | $D_{pole} := 10. \cdot in$ | (User Input) |

**Geometric Layout Data:**

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle = $R_{bc} := \frac{D_{bc}}{2} = 16\ in$

Distance to Bolts = $i := 1 .. N$

$$d_i := \left\| \begin{array}{l} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{array} \right|$$

$d_1 = 8.00\ in$ $d_7 = -8.00\ in$

$d_2 = 13.86\ in$ $d_8 = -13.86\ in$

$d_3 = 16.00\ in$ $d_9 = -16.00\ in$

$d_4 = 13.86\ in$ $d_{10} = -13.86\ in$

$d_5 = 8.00\ in$ $d_{11} = -8.00\ in$

$d_6 = 0.00\ in$ $d_{12} = 0.00\ in$

$$d = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} in$$

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 5\ in$

Moment Arms of Bolts about Neutral Axis = $MA_i := \mathbf{if}\left(d_i \geq R_{pole}, d_i - R_{pole}, 0 \cdot in\right)$

$MA_1 = 3.00\ in$ $MA_7 = 0.00\ in$

$MA_2 = 8.86\ in$ $MA_8 = 0.00\ in$

$MA_3 = 11.00\ in$ $MA_9 = 0.00\ in$

$MA_4 = 8.86\ in$ $MA_{10} = 0.00\ in$

$MA_5 = 3.00\ in$ $MA_{11} = 0.00\ in$

$MA_6 = 0.00\ in$ $MA_{12} = 0.00\ in$

$$MA = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} in$$

Effective Width of Flange plate for Bending = $B_{eff} := 0.8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 26.8\ in$

## Flange Bolt Analysis:

Calculated Flange Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = \left(1.536 \cdot 10^3\right)\ in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 0.785\ in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 0.606\ in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 0.878\ in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.22\ in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot {D_n}^3}{32} = 0.066\ in^3$

Check Flange Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 11.1\ kips$

Maximum Shear Force = $V_{Max} := \frac{Shear}{N} = 0.44\ kips$

Design Tensile Strength = $\Phi R_{nt} := \left(0.75 \cdot F_{ub} \cdot 0.75 \cdot A_g\right) = 53\ kips$

Bolt Tension % of Capacity = $\frac{T_{Max}}{\Phi R_{nt}} = 20.87\%$

Condition1 = $Condition1 := \mathbf{if}\left(\frac{T_{Max}}{\Phi R_{nt}} \le 1.00\ ,\ \text{“OK”}\ ,\ \text{“Overstressed”}\right)$

$Condition1 = \text{“OK”}$

Design Shear Strength = $\Phi R_{nv} := \left(0.75 \cdot 0.45 \cdot F_{ub} \cdot A_g\right) = 31.8\ kips$

Bolt Shear % of Capacity = $\frac{V_{Max}}{\Phi R_{nv}} = 1.37\%$

Condition2 = $Condition2 := \mathbf{if}\left(\left(\frac{V_{Max}}{\Phi R_{nv}}\right)^2 + \left(\frac{T_{Max}}{\Phi R_{nt}}\right)^2 \le 1.00\ ,\ \text{“OK”}\ ,\ \text{“Overstressed”}\right) = \text{“OK”}$

$Condition2 = \text{“OK”}$

## Flange Plate Analysis:

Force from Bolts =

$$C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$$

$C_1 = 6.4\ kips$ $C_7 = -5.2\ kips$

$C_2 = 10.7\ kips$ $C_8 = -9.5\ kips$

$C_3 = 12.3\ kips$ $C_9 = -11.1\ kips$

$C_4 = 10.7\ kips$ $C_{10} = -9.5\ kips$ $C = \begin{bmatrix} 0 \\ \vdots \end{bmatrix} kips$

$C_5 = 6.4\ kips$ $C_{11} = -5.2\ kips$

$C_6 = 0.6\ kips$ $C_{12} = 0.6\ kips$

Maximum Bending Stress in Plate =

$$f_{bp} := \sum_i \frac{4 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}{}^2\right)} = 34.6\ ksi$$

$$F_{bp} := 0.9 \cdot Fy_{bp} = 45\ ksi$$

Allowable Bending Stress in Plate =

$$\frac{f_{bp}}{F_{bp}} = 76.9\%$$

Plate Bending Stress % of Capacity =

$$Condition3 := \mathbf{if}\left(\frac{f_{bp}}{F_{bp}} < 1.00\ ,\ \text{“Ok”}\ ,\ \text{“Overstressed”}\right)$$

Condition3 =

$$Condition3 = \text{“Ok”}$$

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# BRIDGEPORT NE CT
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# BRIDGEPORT, CT 06610

## GENERAL NOTES AND SPECIFICATIONS

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE 2021 INTERNATIONAL BUILDING CODE AS MODIFIED BY THE 2022 CONNECTICUT SUPPLEMENT, INCLUDING THE TIA/EIA-222 REVISION "H" STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND SUPPORTING STRUCTURES, 2022 CONNECTICUT FIRE SAFETY CODE, NATIONAL ELECTRICAL CODE, AND LOCAL CODES.
2. SHOULD ANY FIELD CONDITIONS PRECLUDE COMPLIANCE WITH THE DRAWINGS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER AND SHALL NOT PROCEED WITH ANY AFFECTED WORK.
3. CONTRACTOR SHALL REVIEW ALL DRAWINGS AND SPECIFICATIONS IN THE CONTRACT DOCUMENT SET. CONTRACTOR SHALL COORDINATE ALL WORK SHOWN IN THE SET OF DRAWINGS. THE CONTRACTOR SHALL PROVIDE A COMPLETE SET OF DRAWINGS TO ALL SUBCONTRACTORS AND ALL RELATED PARTIES. THE SUBCONTRACTORS SHALL EXAMINE ALL THE DRAWINGS AND SPECIFICATIONS FOR THE INFORMATION THAT AFFECTS THEIR WORK.
4. CONTRACTOR SHALL PROVIDE A COMPLETE BUILD-OUT WITH ALL FINISHES, STRUCTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS AND PROVIDE ALL ITEMS AS SHOWN OR INDICATED ON THE DRAWINGS OR IN THE WRITTEN SPECIFICATIONS.
5. CONTRACTOR SHALL FURNISH ALL MATERIAL, LABOR AND EQUIPMENT TO COMPLETE THE WORK AND FURNISH A COMPLETED JOB ALL IN ACCORDANCE WITH LOCAL AND STATE GOVERNING AUTHORITIES AND OTHER AUTHORITIES HAVING LAWFUL JURISDICTION OVER THE WORK.
6. CONTRACTOR SHALL SECURE AND PAY FOR ALL PERMITS AND ALL INSPECTIONS REQUIRED AND SHALL ALSO PAY FEES REQUIRED FOR THE GENERAL CONSTRUCTION, AND ALL TRADES AS APPLICABLE PERMITS SHALL BE PAID FOR BY THE RESPECTIVE SUBCONTRACTORS.
7. CONTRACTOR SHALL MAINTAIN A CURRENT SET OF DRAWINGS AND SPECIFICATIONS ON SITE AT ALL TIMES AND INSURE DISTRIBUTION OF NEW DRAWINGS TO SUBCONTRACTORS AND OTHER RELEVANT PARTIES AS SOON AS THEY ARE MADE AVAILABLE. ALL OLD DRAWINGS SHALL BE MARKED VOID AND REMOVED FROM THE CONTRACT AREA. THE CONTRACTOR SHALL FURNISH AN "AS-BUILT" SET OF DRAWINGS TO OWNER UPON COMPLETION OF PROJECT.
8. LOCATION OF EQUIPMENT, AND WORK SUPPLIED BY OTHERS THAT IS DIAGRAMMATICALLY INDICATED ON THE DRAWINGS SHALL BE DETERMINED BY THE CONTRACTOR. THE CONTRACTOR SHALL DETERMINE LOCATIONS AND DIMENSIONS SUBJECT TO STRUCTURAL CONDITIONS AND WORK OF THE SUBCONTRACTORS.
9. THE CONTRACTOR IS SOLELY RESPONSIBLE TO DETERMINE CONSTRUCTION PROCEDURE AND SEQUENCE, AND TO ENSURE THE SAFETY OF THE EXISTING STRUCTURES AND ITS COMPONENT PARTS DURING CONSTRUCTION. THIS INCLUDES THE ADDITION OF WHATEVER SHORING, BRACING, UNDERPINNING, ETC. THAT MAY BE NECESSARY. MAINTAIN EXISTING BUILDING'S/PROPERTY'S OPERATIONS, COORDINATE WORK WITH BUILDING/PROPERTY OWNER.
10. DRAWINGS INDICATE THE MINIMUM STANDARDS, BUT IF ANY WORK SHOULD BE INDICATED TO BE SUBSTANDARD TO ANY ORDINANCES, LAWS, CODES, RULES, OR REGULATIONS BEARING ON THE WORK, THE CONTRACTOR SHALL INCLUDE IN HIS WORK AND SHALL EXECUTE THE WORK CORRECTLY IN ACCORDANCE WITH SUCH ORDINANCES, LAWS, CODES, RULES OR REGULATIONS WITH NO INCREASE IN COSTS.
11. ALL UTILITY WORK SHALL BE IN ACCORDANCE WITH LOCAL UTILITY COMPANY REQUIREMENTS AND SPECIFICATIONS.
12. ALL EQUIPMENT AND PRODUCTS PURCHASED ARE TO BE REVIEWED BY CONTRACTOR AND ALL APPLICABLE SUBCONTRACTORS FOR ANY CONDITION PER MFR.'S RECOMMENDATIONS. CONTRACTOR TO SUPPLY THESE ITEMS AT NO COST TO OWNER OR CONSTRUCTION MANAGER.
13. ANY AND ALL ERRORS, DISCREPANCIES, AND "MISSED" ITEMS ARE TO BE BROUGHT TO THE ATTENTION OF THE VERIZON WIRELESS CONSTRUCTION MANAGER DURING THE BIDDING PROCESS BY THE CONTRACTOR. ALL THESE ITEMS ARE TO BE INCLUDED IN THE BID. NO 'EXTRA' WILL BE ALLOWED FOR MISSED ITEMS.
14. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ON-SITE SAFETY FROM THE TIME THE JOB IS AWARDED UNTIL ALL WORK IS COMPLETE AND ACCEPTED BY THE OWNER.
15. CONTRACTOR TO REVIEW ALL SHOP DRAWINGS AND SUBMIT COPY TO ENGINEER FOR APPROVAL. DRAWINGS MUST BEAR THE CHECKER'S INITIALS BEFORE SUBMITTING TO THE CONSTRUCTION MANAGER FOR REVIEW.
16. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS, ELEVATIONS, ANGLES, AND EXISTING CONDITIONS AT THE SITE, PRIOR TO FABRICATION AND/OR INSTALLATION OF ANY WORK IN THE CONTRACT AREA.
17. COORDINATION, LAYOUT, FURNISHING AND INSTALLATION OF CONDUIT AND ALL APPURTENANCES REQUIRED FOR PROPER INSTALLATION OF ELECTRICAL AND TELECOMMUNICATION SERVICE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
18. ALL EQUIPMENT AND PRODUCTS PURCHASED ARE TO BE REVIEWED BY CONTRACTOR AND ALL APPLICABLE SUB- CONTRACTORS FOR ANY CONDITION PER THE MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR TO SUPPLY THESE ITEMS AT NO COST TO OWNER OR CONSTRUCTION MANAGER.
19. ALL DAMAGE CAUSED TO ANY EXISTING STRUCTURE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE HELD LIABLE FOR ALL REPAIRS REQUIRED FOR EXISTING STRUCTURES IF DAMAGED DURING CONSTRUCTION ACTIVITIES.
20. THE CONTRACTOR SHALL CONTACT "CALL BEFORE YOU DIG" AT LEAST 48 HOURS PRIOR TO ANY EXCAVATIONS AT 1-800-922-4455. ALL UTILITIES SHALL BE IDENTIFIED AND CLEARLY MARKED PRIOR TO ANY EXCAVATION WORK. CONTRACTOR SHALL MAINTAIN AND PROTECT MARKED UTILITIES THROUGHOUT PROJECT COMPLETION.
21. ALL CONSTRUCTION SHALL BE IN COMPLIANCE WITH THE GOVERNING BUILDING CODE.
22. BEFORE BEGINNING THE WORK, THE CONTRACTOR IS RESPONSIBLE FOR MAKING SUCH INVESTIGATIONS CONCERNING PHYSICAL CONDITIONS (SURFACE AND SUBSURFACE) AT OR CONTIGUOUS TO THE SITE WHICH MAY AFFECT PERFORMANCE AND COST OF THE WORK.
23. ALL DIMENSIONS, ELEVATIONS, AND OTHER REFERENCES TO EXISTING STRUCTURES, SURFACE, AND SUBSURFACE CONDITIONS ARE APPROXIMATE. NO GUARANTEE IS MADE FOR THE ACCURACY OR COMPLETENESS OF THE INFORMATION SHOWN. THE CONTRACTOR SHALL VERIFY AND COORDINATE ALL DIMENSIONS, ELEVATIONS, ANGLES WITH EXISTING CONDITIONS AND WITH ARCHITECTURAL AND SITE DRAWINGS BEFORE PROCEEDING WITH ANY WORK.
24. AS THE WORK PROGRESSES, THE CONTRACTOR SHALL NOTIFY THE OWNER OF ANY CONDITIONS WHICH ARE IN CONFLICT OR OTHERWISE NOT CONSISTENT WITH THE CONSTRUCTION DOCUMENTS AND SHALL NOT PROCEED WITH SUCH WORK UNTIL THE CONFLICT IS SATISFACTORILY RESOLVED.

## SITE DIRECTIONS

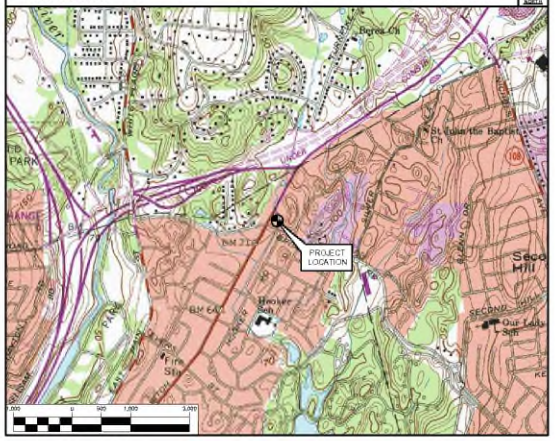
**FROM:** 20 ALEXANDER DRIVE, WALLINGFORD, CONNECTICUT

**TO:** 541 BROADBRIDGE RD, BRIDGEPORT, CT 06610

| | | |
|---|---|---|
| 1. | START OUT GOING NORTH ON ALEXANDER DR TOWARD BARNES INDUSTRIAL RD. | 0.18 MI |
| 2. | TURN RIGHT ONTO BARNES INDUSTRIAL RD. | 0.11 MI |
| 3. | TAKE THE 1ST LEFT ONTO CT-68. | 0.35 MI |
| 4. | TURN RIGHT ONTO RAMP. | 0.17 MI |
| 5. | TURN RIGHT ONTO N COLONY RD/US-5 N. | 0.40 MI |
| 6. | MERGE ONTO CT-15 S TOWARD NEW HAVEN. | 0.30 MI |
| 7. | MERGE ONTO CT-15 S. | 26.20 MI |
| 8. | TAKE EXIT 52 FOR STATE ROUTE 108S/STATE ROUTE 8 S TOWARD BRIDGEPORT. | 0.50 MI |
| 9. | KEEP RIGHT, FOLLOW SIGNS FOR CT-108/STRATFORD. | 0.30 MI |
| 10. | TURN LEFT ONTO CT-108 W/NICHOLS AVE. | 0.20 MI |
| 11. | TURN RIGHT ONTO PENNY AVE. | 0.50 MI |
| 12. | CONTINUE ONTO HUNTINGTON TURNPIKE. | 0.30 MI |
| 13. | TURN LEFT ONTO BROADBRIDGE RD. | 0.06 MI |
| 14. | TURN LEFT AT THE 1ST CROSS STREET ONTO HOOKER RD. | 0.03 MI |
| 15. | ARRIVE AT 541 BROADBRIDGE RD BRIDGEPORT, CT. | |

## VICINITY MAP

SCALE: 1" = 1000'




## PROJECT SUMMARY

1. THE PROPOSED UPGRADE SCOPE OF WORK AT THE EXISTING UNMANNED TELECOMMUNICATIONS FACILITY GENERALLY INCLUDES THE FOLLOWING:

A. AT THE EXISTING FLAGPOLE MOUNTED ANTENNA SECTORS:

- REMOVE (6) EXISTING ANDREW – SBJAHH-1D65B-DL ANTENNAS.
- REMOVE (9) EXISTING NOKIA RADIOS.
- REMOVE (24) EXISTING KAELUS QUADPLEXERS.
- REPLACE THE UPPER 20-FT SECTION OF THE EXISTING CONCEALMENT TOWER RADOME WITH THAT OF LARGER DIAMETER AS DESCRIBED HEREIN (DESIGN BY OTHERS AS REFERENCED HEREIN).
- INSTALL ANTENNA MOUNT ASSEMBLIES AT THE UPPER AND LOWER TIER ANTENNA CANISTER LEVELS AS PER DESIGN HEREIN.
- INSTALL (6) COMMSCOPE – CBC61923T-DS-43 DIPLEXERS.
- RETAIN (12) COAX CABLES.
- INSTALL (3) COMMSCOPE – NNH4-65B-R6 ANTENNAS.
- INSTALL (3) JMA – MX08FIT265-01 ANTENNAS.
- INSTALL (1) OVP-6 BOX.
- INSTALL (1) 6x12 HYBRID CABLE.
- INSTALL (1) PRE-FABRICATED SITE PRO – UTSM-L UNIVERSAL TRI SECTOR MOUNT KIT AT THE UPPER TIER ANTENNA LEVEL.

B. AT THE EXISTING VERIZON WIRELESS EQUIPMENT AREA:

- INSTALL (3) SAMSUNG – B2/B66A RRH ORAN (RF4439d-25A).
- INSTALL (3) SAMSUNG – B5/B13 B5/B13 RRH ORAN (RF4440d-13A).
- INSTALL (3) SAMSUNG – RT-8808-77A RRUs.
- INSTALL (6) COMMSCOPE – CBC61923T-DS-43 DIPLEXERS.

## PROJECT INFORMATION

| | |
|---|---|
| SITE NAME: | BRIDGEPORT NE CT |
| SITE ADDRESS: | 541 BROADBRIDGE RD<br>BRIDGEPORT, CT 06610 |
| LESSEE/TENANT: | CELLCO PARTNERSHIP<br>d.b.a. VERIZON WIRELESS<br>20 ALEXANDER DRIVE<br>WALLINGFORD, CT 06492 |
| CONTACT PERSON: | WALTER CHARCZNSKI (CONSTRUCTION MANAGER)<br>VERIZON WIRELESS<br>(860) 306-1806 |
| ENGINEER: | CENTEK ENGINEERING, INC.<br>63-2 NORTH BRANFORD RD.<br>BRANFORD, CT. 06405<br>(203) 488-0580 |
| PROJECT COORDINATES: | LATITUDE: 41° 13' 19.494"N<br>LONGITUDE: 73° 10' 2.504"W<br><br>(COORDINATES REFERENCED FROM VERIZON WIRELESS RFDS DATED 11/19/2021) |

## SHEET INDEX

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| | | |
| B-1 | RF BILL OF MATERIALS | 1 |
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| C-1 | PARTIAL SITE PLAN AND ELEVATION | 1 |
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| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| A | 11/19/21 | JLD | DMD | CONSTRUCTION DRAWINGS – ISSUED FOR CLIENT REVIEW |
| B | 11/22/21 | AHC | DMD | CONSTRUCTION DRAWINGS – REVISED PER RFDS DATED 11/19/2021 |
| 0 | 02/03/22 | DMD | AHC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
| 1 | 10/21/22 | TJB | DMD | CONSTRUCTION DRAWINGS – REVISED CLIENT ANTENNA MOUNT DESIGN |

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DATE: 11/18/21
SCALE: AS NOTED
JOB NO. 21007.69

TITLE SHEET

T-1

Sheet No. 1 of 1

## NOTES AND SPECIFICATIONS

### DESIGN BASIS

GOVERNING CODE: 2021 INTERNATIONAL BUILDING (IBC) AS MODIFIED BY THE 2022 CT STATE BUILDING CODE AND AMENDMENTS.

1. DESIGN CRITERIA:
   - RISK CATEGORY: II (BASED ON TABLE 1604.5 OF THE 2015 IBC)
   - NOMINAL DESIGN SPEED (TOWER): 125 MPH (Vasd) (EXPOSURE B/IMPORTANCE FACTOR 1.0 BASED ON ASCE 7-16) PER 2021 INTERNATIONAL BUILDING CODE (IBC) AS MODIFIED BY THE 2022 CONNECTICUT STATE BUILDING CODE.
   - SEISMIC LOAD (DOES NOT CONTROL): PER ASCE 7-10 MINIMUM DESIGN LOADS FOR BUILDING AND OTHER STRUCTURES.

### STRUCTURAL STEEL

1. ALL STRUCTURAL STEEL IS DESIGNED BY ALLOWABLE STRESS DESIGN (ASD)

   A. STRUCTURAL STEEL (W SHAPES)-----ASTM A992 (FY = 50 KSI)
   B. STRUCTURAL STEEL (OTHER SHAPES)-----ASTM A36 (FY = 36 KSI)
   C. STRUCTURAL HSS (RECTANGULAR SHAPES)----ASTM A500 GRADE B, (FY = 46 KSI)
   D. STRUCTURAL HSS (ROUND SHAPES)----ASTM A500 GRADE B, (FY = 42 KSI)
   E. PIPE----ASTM A53 (FY = 35 KSI)
   F. CONNECTION BOLTS----ASTM A325-N
   G. U-BOLTS----ASTM A36
   H. ANCHOR RODS----ASTM F 1554
   I. WELDING ELECTRODE----ASTM E 70XX

2. CONTRACTOR TO REVIEW ALL SHOP DRAWINGS AND SUBMIT COPY TO ENGINEER FOR APPROVAL. DRAWINGS MUST BEAR THE CHECKER'S INITIALS BEFORE SUBMITTING TO THE ENGINEER FOR REVIEW. SHOP DRAWINGS SHALL INCLUDE THE FOLLOWING: SECTION PROFILES, SIZES, CONNECTION ATTACHMENTS, REINFORCING, ANCHORAGE, SIZE AND TYPE OF FASTENERS AND ACCESSORIES. INCLUDE ERECTION DRAWINGS, ELEVATIONS AND DETAILS.
3. STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE LATEST PROVISIONS OF AISC MANUAL OF STEEL CONSTRUCTION.
4. PROVIDE ALL PLATES, CLIP ANGLES, CLOSURE PIECES, STRAP ANCHORS, MISCELLANEOUS PIECES AND HOLES REQUIRED TO COMPLETE THE STRUCTURE.
5. FIT AND SHOP ASSEMBLE FABRICATIONS IN THE LARGEST PRACTICAL SECTIONS FOR DELIVERY TO SITE.
6. INSTALL FABRICATIONS PLUMB AND LEVEL, ACCURATELY FITTED, AND FREE FROM DISTORTIONS OR DEFECTS.
7. AFTER ERECTION OF STRUCTURES, TOUCHUP ALL WELDS, ABRASIONS AND NON-GALVANIZED SURFACES WITH A 95% ORGANIC ZINC RICH PAINT IN ACCORDANCE WITH ASTM 780.
8. ALL STEEL MATERIAL (EXPOSED TO WEATHER) SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A123 "ZINC (HOT DIPPED GALVANIZED) COATINGS" ON IRONS AND STEEL PRODUCTS.
9. ALL BOLTS, ANCHORS AND MISCELLANEOUS HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153 "ZINC COATING (HOT-DIP) ON IRON AND STEEL HARDWARE".
10. THE ENGINEER SHALL BE NOTIFIED OF ANY INCORRECTLY FABRICATED, DAMAGED OR OTHERWISE MISFITTING OR NON CONFORMING MATERIALS OR CONDITIONS TO REMEDIAL OR CORRECTIVE ACTION. ANY SUCH ACTION SHALL REQUIRE ENGINEER REVIEW.
11. CONNECTION ANGLES SHALL HAVE A MINIMUM THICKNESS OF 1/4 INCHES.
12. STRUCTURAL CONNECTION BOLTS SHALL CONFORM TO ASTM A325. ALL BOLTS SHALL BE 3/4" DIAMETER MINIMUM AND SHALL HAVE A MINIMUM OF TWO BOLTS, UNLESS OTHERWISE ON THE DRAWINGS.
13. LOCK WASHER ARE NOT PERMITTED FOR A325 STEEL ASSEMBLIES.
14. SHOP CONNECTIONS SHALL BE WELDED OR HIGH STRENGTH BOLTED.
15. MILL BEARING ENDS OF COLUMNS, STIFFENERS, AND OTHER BEARING SURFACES TO TRANSFER LOAD OVER ENTIRE CROSS SECTION.
16. FABRICATE BEAMS WITH MILL CAMBER UP.
17. LEVEL AND PLUMB INDIVIDUAL MEMBERS OF THE STRUCTURE TO AN ACCURACY OF 1:500, BUT NOT TO EXCEED 1/4" IN THE FULL HEIGHT OF THE COLUMN.
18. COMMENCEMENT OF STRUCTURAL STEEL WORK WITHOUT NOTIFYING THE ENGINEER OF ANY DISCREPANCIES WILL BE CONSIDERED ACCEPTANCE OF PRECEDING WORK.
19. INSPECTION AND TESTING OF ALL WELDING AND HIGH STRENGTH BOLTING SHALL BE PERFORMED BY AN INDEPENDENT TESTING LABORATORY.
20. FOUR COPIES OF ALL INSPECTION TEST REPORTS SHALL BE SUBMITTED TO THE ENGINEER WITHIN TEN (10) WORKING DAYS OF THE DATE OF INSPECTION.

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| A | 11/19/21 | JLD | DMD | CONSTRUCTION DRAWINGS – ISSUED FOR CLIENT REVIEW |
| B | 11/22/21 | AMC | DMD | CONSTRUCTION DRAWINGS – REVISED PER RFDS DATED 11/19/2021 |
| 0 | 02/03/22 | DMD | AMC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
| 1 | 10/31/22 | TJR | DMD | CONSTRUCTION DRAWINGS – REVISED CUSTOM ANTENNA MOUNT DESIGN |

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NOTES AND SPECIFICATIONS

N-1

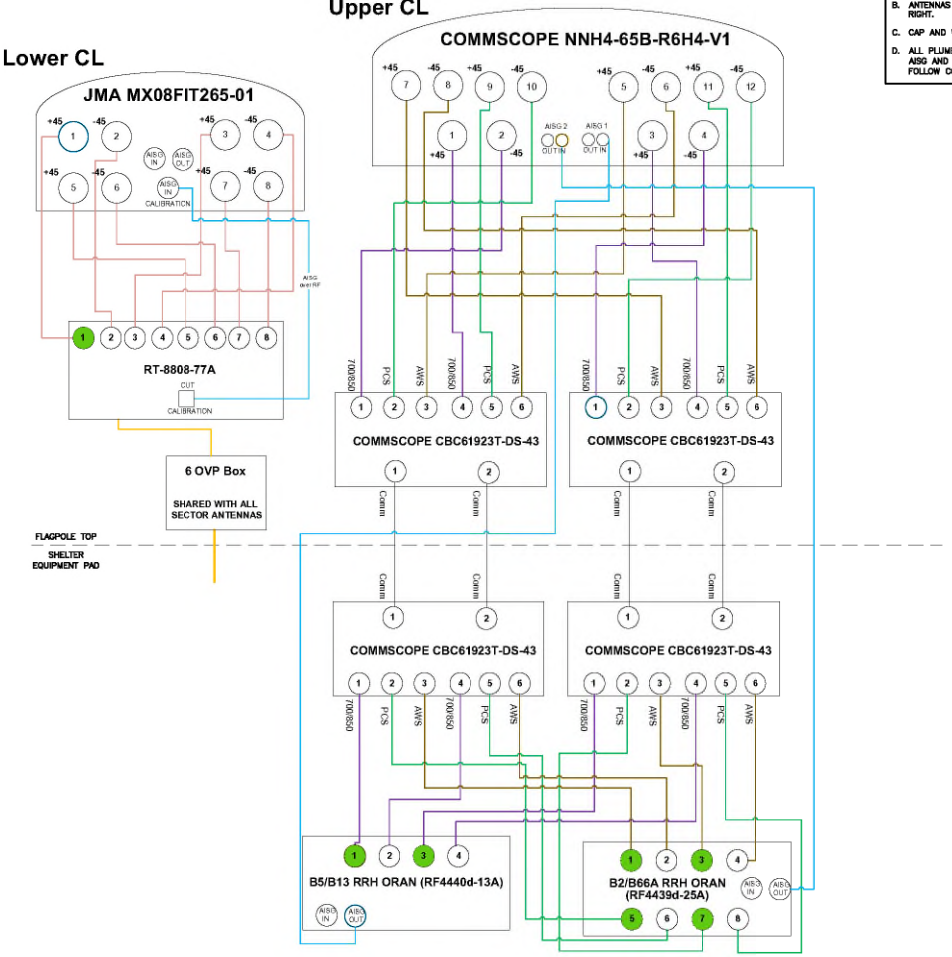
Sheet No. 2 of 7

COMMSCOPE NNH4-65B-R6H4-V1

JMA MX08FIT265-01

Upper CL

Lower CL




**PLUMBING DIAGRAM NOTES:**

1. PORTS 1, 2, 3 & 4 ARE FOR LOW BAND (698–898 MHz).
2. PORTS 5, 6, 7, 8, 9, 10, 11 & 12 ARE FOR HIGH BAND (1695–2360 MHz).
3. SMART BIAS TEE (SBT) IS THROUGH ANTENNA PORTS 1 & 4 FOR LOW BAND AND 5, 7, 10 & 12 FOR HIGH BAND.
4. AISG CABLE IS ONLY NEEDED WHEN DRAWN IN THE DIAGRAMS BELOW. IF IT IS NOT DRAWN THEN SBT IS ENOUGH TO CONTROL ALL RET MOTORS.
5. NOT ALL SBT PORTS ARE NEEDED TO CONTROL RET. ONLY GREEN PORT CONNECTION TO GREEN PORT WILL CONTROL RET.

RET DC SIGNAL PASS FOR RET (PORT THAT WILL CONTROL RET)

**PLUMBING DIAGRAM COMMENTS:**

A. DIAGRAMS SHOW ANTENNA PORT CONFIGURATIONS AS VIEWED FROM STANDING BEHIND THE ANTENNAS.

B. ANTENNAS WILL BE INSTALLED IN THAT ORDER FROM LEFT TO RIGHT.

C. CAP AND WEATHERPROOF UNUSED ANTENNA PORTS.

D. ALL PLUMBING DIAGRAM COLORS ARE IRRELEVANT EXCEPT FOR AISG AND HYBRIFLEX CABLE. (FOR THE COAX COLORS, FOLLOW COAX COLORS GUIDE ABOVE)

DC SIGNAL CAPABLE PORT

AISG CABLE

RET DC SIGNAL PASS FOR RET (PORT THAT WILL CONTROL RET)

HYBRIFLEX CABLES

**NOTES:**

1. INFORMATION SHOWN HEREIN IS FOR USE BY VERIZON WIRELESS EQUIPMENT OPERATIONS.
2. THIS B.O.M. DRAWING IS BASED ON FACILITY UPGRADE DESIGN DRAWINGS PREPARED BY CENTEK ENGINEERING (REV.1 DATED: 10/21/2022), & VERIZON WIRELESS RF ANTENNA EQUIPMENT RECOMMENDATION (DATED 11/19/2021).

**BILL OF MATERIALS**

| TECHNOLOGY | QUANTITY | ANTENNA |
|---|---|---|
| LTE 700<br>LTE 850<br>LTE PCS 1900<br>LTE AWS 2100<br>5G | 3 | COMMSCOPE ANTENNA MODEL: NNH4-65B-R6 |
| 5G | 3 | JMA ANTENNA MODEL: MX08FIT265-01 |

| CABLES | QUANTITY | LENGTH EA | COMMENTS |
|---|---|---|---|
| HYBRID CABLE | 1 | ±110 FT EA | 6X12 HYBRID CABLE |

| RADIOS | QUANTITY | COMMENTS |
|---|---|---|
| LTE 700<br>LTE 850 5G<br>LTE PCS 1900<br>LTE AWS 2100 | 3 | SAMSUNG: B5/B13 RRH ORAN (RF4440d-13A) |
| 5G | 3 | SAMSUNG: B2/B66A RRH ORAN (RF4439d-25A) |
| 5G | 3 | SAMSUNG MODEL: RT-8808-77A |

| DIPLEXERS | QUANTITY | COMMENTS |
|---|---|---|
| QUADRUPLEXER | 12 | CBC61923T-DS-43 |

| OVP BOXES | QUANTITY | COMMENTS |
|---|---|---|
| OVP | 1 | OVP-6 |

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| 1 | 10/21/22 | TJB | DMD | CONSTRUCTION DRAWINGS – REVISED CLIENT'S ANTENNA MOUNT DESIGN |
| 0 | 02/03/22 | DMD | ANC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
| A | 11/22/21 | ANC | DMD | CONSTRUCTION DRAWINGS – REVISED PER RFDS DATED 11/19/2021 |
| | 11/19/21 | JLD | DMD | CONSTRUCTION DRAWINGS – ISSUED FOR CLIENT REVIEW |

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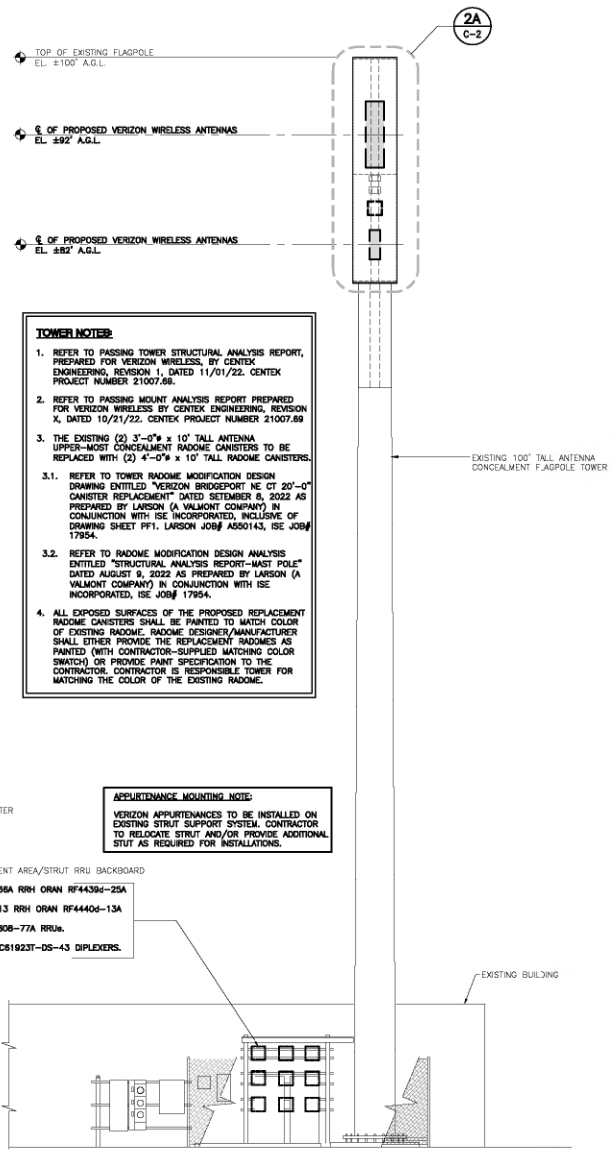
RF BILL OF MATERIALS

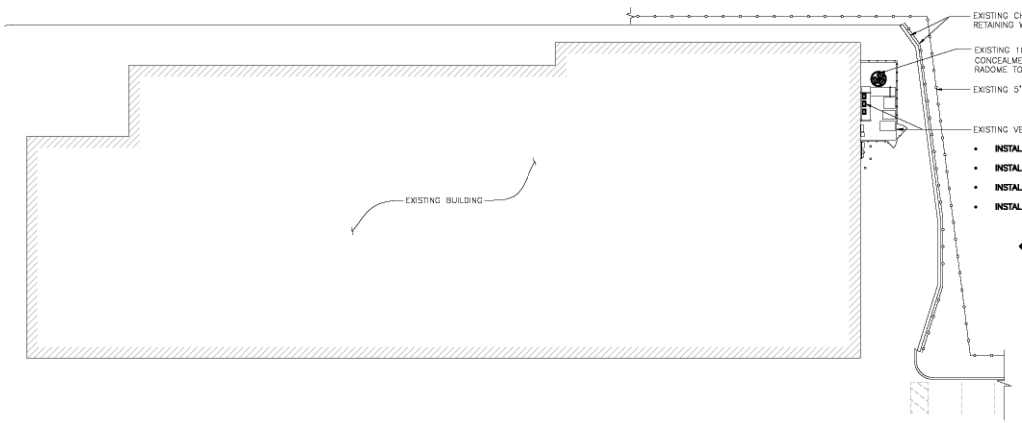
B-1

Sheet No. 2 of 2




**TOWER NOTES:**

1. REFER TO PASSING TOWER STRUCTURAL ANALYSIS REPORT, PREPARED FOR VERIZON WIRELESS, BY CENTEK ENGINEERING, REVISION 1, DATED 11/01/22. CENTEK PROJECT NUMBER 21007.68.
2. REFER TO PASSING MOUNT ANALYSIS REPORT PREPARED FOR VERIZON WIRELESS BY CENTEK ENGINEERING, REVISION X, DATED 10/21/22. CENTEK PROJECT NUMBER 21007.69
3. THE EXISTING (2) 3'-0"ø x 10' TALL ANTENNA UPPER-MOST CONCEALMENT RADOME CANISTERS TO BE REPLACED WITH (2) 4'-0"ø x 10' TALL RADOME CANISTERS.
   - 3.1. REFER TO TOWER RADOME MODIFICATION DESIGN DRAWING ENTITLED "VERIZON BRIDGEPORT NE CT 20'-0" CANISTER REPLACEMENT" DATED SETEMBER 8, 2022 AS PREPARED BY LARSON (A VALMONT COMPANY) IN CONJUNCTION WITH ISE INCORPORATED, INCLUSIVE OF DRAWING SHEET PF1. LARSON JOB# A550143, ISE JOB# 17954.
   - 3.2. REFER TO RADOME MODIFICATION DESIGN ANALYSIS ENTITLED "STRUCTURAL ANALYSIS REPORT-MAST POLE" DATED AUGUST 9, 2022 AS PREPARED BY LARSON (A VALMONT COMPANY) IN CONJUNCTION WITH ISE INCORPORATED, ISE JOB# 17954.
4. ALL EXPOSED SURFACES OF THE PROPOSED REPLACEMENT RADOME CANISTERS SHALL BE PAINTED TO MATCH COLOR OF EXISTING RADOME. RADOME DESIGNER/MANUFACTURER SHALL EITHER PROVIDE THE REPLACEMENT RADOMES AS PAINTED (WITH CONTRACTOR-SUPPLIED MATCHING COLOR SWATCH) OR PROVIDE PAINT SPECIFICATION TO THE CONTRACTOR. CONTRACTOR IS RESPONSIBLE TOWER FOR MATCHING THE COLOR OF THE EXISTING RADOME.




**APPURTENANCE MOUNTING NOTE:**

VERIZON APPURTENANCES TO BE INSTALLED ON EXISTING STRUT SUPPORT SYSTEM. CONTRACTOR TO RELOCATE STRUT AND/OR PROVIDE ADDITIONAL STUT AS REQUIRED FOR INSTALLATIONS.

1 C-1 **PARTIAL SITE PLAN**
SCALE: 1/16" = 1'

APPROXIMATE NORTH

2 C-1 **SOUTHEAST ELEVATION - PROPOSED**
SCALE: 3/16" = 1'

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| 1 | 10/31/22 | TJB | DMD | CONSTRUCTION DRAWINGS – REVISED CUSTOM ANTENNA MOUNT DESIGN |
| 0 | 02/03/22 | DMD | ANC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
| A | 11/22/21 | ANC | DMD | CONSTRUCTION DRAWINGS – REVISED PER RFDS DATED 11/19/2021 |
| | 11/18/21 | JLD | DMD | CONSTRUCTION DRAWINGS – ISSUED FOR CLIENT REVIEW |

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# BRIDGEPORT NE CT

541 BROADBRIDGE RD
BRIDGEPORT, CT 06610

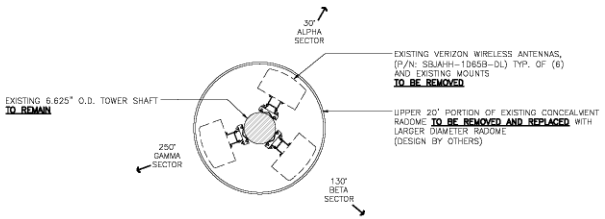
DATE: 11/18/21
SCALE: AS NOTED
JOB NO. 21007.69

PARTIAL SITE PLAN AND ELEVATION

C-1

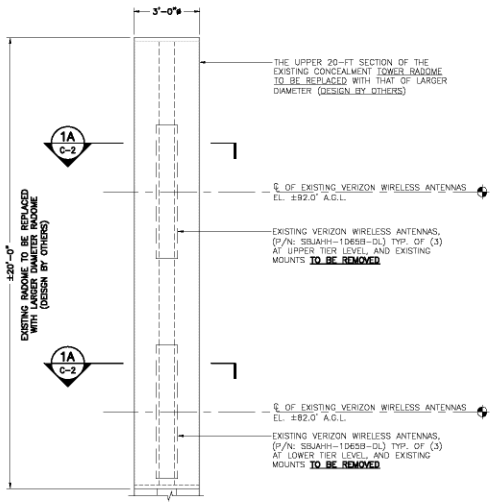
Sheet No. 1 of 1

## EXISTING ANTENNA CONFIGURATIONS



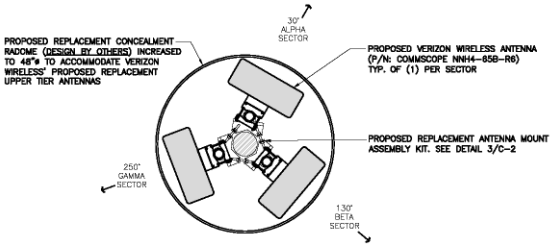

82' and 92' ELEVATION

**1A / C-2 EXISTING SECTOR CONFIGURATION PLAN**
SCALE: 3/4" = 1'-0"



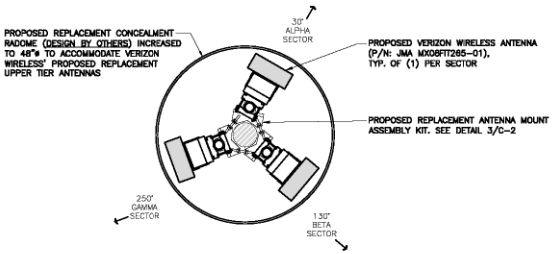

**2 / C-2 EXISTING SECTOR CONFIGURATION ELEVATION**
SCALE: 3/8" = 1'- 0"

## PROPOSED ANTENNA CONFIGURATIONS



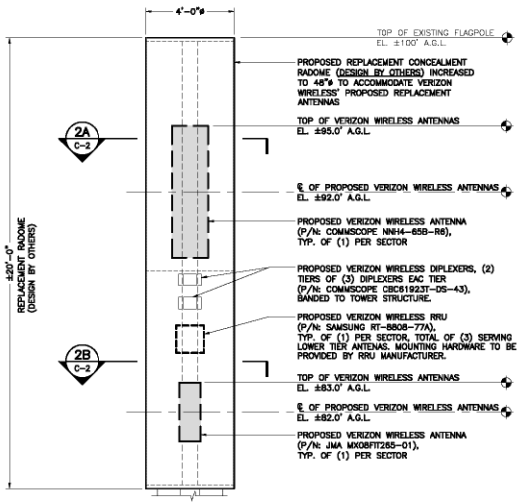

92' ELEVATION

**2A / C-2 PROPOSED SECTOR CONFIGURATION SECTION**
SCALE: 3/4" = 1'- 0"

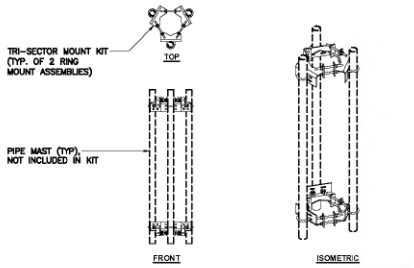



82' ELEVATION

**2B / C-2 PROPOSED SECTOR CONFIGURATION SECTION**
SCALE: 3/4" = 1'- 0"




**2 / C-2 PROPOSED SECTOR CONFIGURATION ELEVATION**
SCALE: 3/8" = 1'- 0"




| TRI-SECTOR MOUNT KIT | | | |
|---|---|---|---|
| EQUIPMENT | DESCRIPTION/QTY | PIPE MASTS QTY & SIZE | WEIGHT |
| MAKE: SITE PRO<br>MODEL: UTSM-L | UNIVERSAL MOUNT KIT FOR LARGER LEGS (8"ø TO 10"ø) /(2) KITS REQ'D | (8) 2-3/8"ø x 96" (SCHEDULE 40) SEE NOTE 1 BELOW | 49.87 LBS/KIT |

NOTES:
1. TRI-SECTOR MOUNT KIT INCLUDES (2) RING MOUNT ASSEMBLIES. (1) KIT REQUIRED FOR UPPER TIER ANTENNA CANISTER, AND (1) KIT REQUIRED FOR LOWER TIER ANTENNA CANISTER.
2. PIPE MASTS SIZES AND QUANTITIES ARE SHOWN AS COURTESY. PIPES ARE NOT INCLUDED IN KIT.

**3 / C-2 ANTENNA REPLACEMENT MOUNT KIT DETAIL**
SCALE: 1/2" = 1'

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| 1 | 10/31/22 | TJB | DMD | CONSTRUCTION DRAWINGS – REVISED CLIENT'S ANTENNA MOUNT DESIGN |
| 0 | 02/03/22 | DMD | ANC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
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ANTENNA SECTOR CONFIGURATION DETAILS

**C-2**
Sheet No. 2 of 3

| DIPLEXER | | | |
|---|---|---|---|
| EQUIPMENT | DESCRIPTION | DIMENSIONS | WEIGHT |
| MAKE: COMMSCOPE<br>MODEL: CBC61923T-DS-43 | DIPLEXER 700MHz/850MHz/1900MHz | 6.9"H x 7.8"W x 4.6"D | 14.3 LBS.<br>(W/MNTG HDWR) |

NOTES:
1. CONTRACTOR TO COORDINATE FINAL EQUIPMENT MODEL SELECTION WITH VERIZON WIRELESS CONSTRUCTION MANAGER PRIOR TO ORDERING.

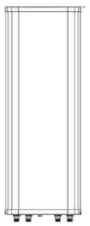
1 / C-3 **DIPLEXER DETAIL**
NOT TO SCALE

ELEVATION

NNH4-65B-R6 (BOTTOM VIEW)

| 12-PORT SECTOR ANTENNA | | |
|---|---|---|
| EQUIPMENT | DIMENSIONS | WEIGHT |
| MAKE: COMMSCOPE<br>MODEL: NNH4-65B-R6 | 72.0"L x 19.6"W x 7.8"D | 83.1 LBS. |

2 / C-3 **ANTENNA DETAIL**
NOT TO SCALE



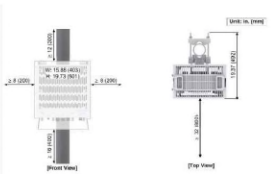
ELEVATION

MX08FIT265-01 (BOTTOM VIEW)

| 8-PORT SECTOR ANTENNA | | |
|---|---|---|
| EQUIPMENT | DIMENSIONS | WEIGHT |
| MAKE: JMA<br>MODEL: MX08FIT265-01 | 32.0"L x 11.8"W x 4.5"D | 26.5 LBS. |

3 / C-3 **ANTENNA DETAIL**
NOT TO SCALE

RRH - ISOMETRIC



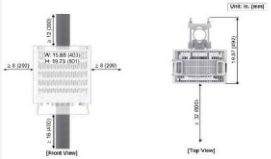

RRH CLEARANCES

| DUAL BAND RRU (REMOTE RADIO UNIT) | | | |
|---|---|---|---|
| EQUIPMENT | BANDS | DIMENSIONS | WEIGHT |
| MAKE: SAMSUNG<br>MODEL: RF4439d-25A | B25: PCS (1900 MHz)<br>B66: AWS (2100 MHz) | 15.0"H x 15.0"W x 10.0"D | 74.7 LBS. |

NOTES:
1. CONTRACTOR TO COORDINATE FINAL EQUIPMENT MODEL SELECTION WITH VERIZON WIRELESS CONSTRUCTION MANAGER PRIOR TO ORDERING.

4 / C-3 **DUAL-BAND AWS/PCS MACRO RADIO UNIT DETAIL**
NOT TO SCALE

RRH - ISOMETRIC

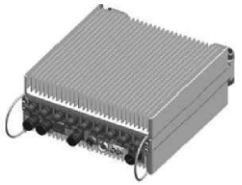



RRH CLEARANCES

| DUAL BAND RRU (REMOTE RADIO UNIT) | | | |
|---|---|---|---|
| EQUIPMENT | BANDS | DIMENSIONS | WEIGHT |
| MAKE: SAMSUNG<br>MODEL: RF440d-13A | B5: 850 MHz<br>B13: 700 MHz | 15.0"H x 15.0"W x 9.0"D | 70.3 LBS. |

NOTES:
1. CONTRACTOR TO COORDINATE FINAL EQUIPMENT MODEL SELECTION WITH VERIZON WIRELESS CONSTRUCTION MANAGER PRIOR TO ORDERING.

5 / C-3 **DUAL-BAND 700/850 MHZ MACRO RADIO UNIT DETAIL**
NOT TO SCALE



RRH - ISOMETRIC

| C BAND 8T8R 320W RRU (REMOTE RADIO UNIT) | | | |
|---|---|---|---|
| EQUIPMENT | BANDS | DIMENSIONS | WEIGHT |
| MAKE: SAMSUNG<br>MODEL: RT-8808-77A | N77: 3700 MHz | 15.0"H x 15.0"W x 6.8"D | 59.5 LBS. |

NOTES:
1. CONTRACTOR TO COORDINATE FINAL EQUIPMENT MODEL SELECTION WITH VERIZON WIRELESS CONSTRUCTION MANAGER PRIOR TO ORDERING.

6 / C-3 **C-BAND 8T8R 320W RADIO UNIT DETAIL**
NOT TO SCALE

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| 1 | 10/21/22 | TJR | DMD | CONSTRUCTION DRAWINGS – REVISED CUSTOM ANTENNA MOUNT DESIGN |
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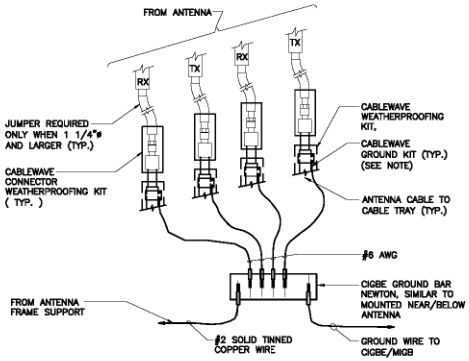
RF DETAILS

C-3

Sheet No. 4 of 7

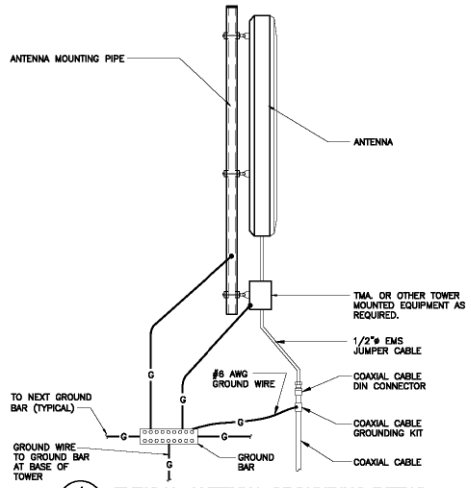



**NOTES:**

1. DO NOT INSTALL CABLE GROUND KIT AT A BEND AND ALWAYS DIRECT GROUND WIRE DOWN TO CIGBE

## 1 E-1 CONNECTION OF GROUND WIRES TO GROUND BAR

NOT TO SCALE

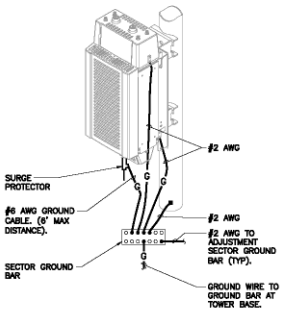



## 4 E-1 TYPICAL ANTENNA GROUNDING DETAIL

NOT TO SCALE

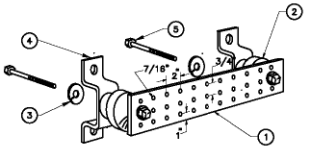
EACH RRH CABINET SHALL BE GROUNDED IN THE FOLLOWING MANNER:

1. AT TOP OF THE CABINET
2. AT RIGHT SIDE OF THE CABINET.




## 2 E-1 RRH POLE MOUNT GROUNDING

NOT TO SCALE

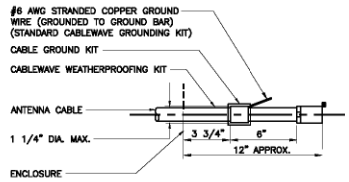



### NOTES

1. TINNED COPPER GROUND BAR, 1/4" x 4" x 20", NEWTON INSTRUMENT CO. HOLE CENTERS TO MATCH NEMA DOUBLE LUG CONFIGURATION.
2. INSULATORS, NEWTON INSTRUMENT CAT. NO. 3061-4.
3. 5/8" LOCK WASHERS, NEWTON INSTRUMENT CO. CAT. NO. 3015-8.
4. WALL MOUNTING BRACKET, NEWTON INSTRUMENT CO. CAT NO. A-6056.
5. 5/8-11 x 1" STAINLESS STEEL TRUSS SPANNER MACHINE SCREWS.

## 5 E-1 GROUND BAR DETAIL

NOT TO SCALE




**NOTES:**

1. DO NOT INSTALL CABLE GROUND KIT AT A BEND AND ALWAYS DIRECT GROUND WIRE DOWN TO GROUND BAR.

## 3 E-1 ANTENNA CABLE GROUNDING DETAIL

NOT TO SCALE

## ELECTRICAL SPECIFICATIONS

### SECTION 16010

1.01. SCOPE OF WORK

A. WORK SHALL INCLUDE ALL LABOR, EQUIPMENT AND SERVICES REQUIRED TO COMPLETE (MAKE READY FOR OPERATION) ALL THE ELECTRICAL WORK INCLUDING, BUT NOT LIMITED TO, THE FOLLOWING:

1. CELLULAR GROUNDING SYSTEMS CONSISTING OF ANTENNA GROUNDING, GROUND BARS, ETC.

1.02. GENERAL REQUIREMENTS

A. THE ENTIRE ELECTRICAL INSTALLATION SHALL BE MADE IN STRICT ACCORDANCE WITH ALL LOCAL, STATE AND NATIONAL CODES AND REGULATIONS WHICH MAY APPLY AND NOTHING IN THE DRAWINGS OR SPECIFICATIONS SHALL BE INTERPRETED AS AN INFRINGEMENT OF SUCH CODES OR REGULATIONS.

B. THE ELECTRICAL CONTRACTOR IS TO BE RESPONSIBLE FOR THE COMPLETE INSTALLATION AND COORDINATION OF THE ENTIRE ELECTRICAL SERVICE. ALL ACTIVITIES TO BE COORDINATED THROUGH OWNERS REPRESENTATIVE, DESIGN ENGINEER AND OTHER AUTHORITIES HAVING JURISDICTION OF TRADES.

C. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL PERMITS AND PAY ALL FEES THAT MAY BE REQUIRED FOR THE ELECTRICAL WORK AND FOR SCHEDULING OF ALL INSPECTIONS THAT MAY BE REQUIRED BY THE LOCAL AUTHORITY.

D. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION WITH THE BUILDING OWNER FOR NEW AND/OR DEMOLITION WORK INVOLVED.

E. NO MATERIAL OTHER THAN THAT CONTAINED IN THE "LATEST LIST OF ELECTRICAL FITTINGS" APPROVED BY THE UNDERWRITERS' LABORATORIES, SHALL BE USED IN ANY PART OF THE WORK. ALL MATERIAL FOR WHICH LABEL SERVICE HAS BEEN ESTABLISHED SHALL BEAR THE U.L. LABEL.

F. THE CONTRACTOR SHALL GUARANTEE ALL NEW WORK FOR A PERIOD OF ONE YEAR FROM THE ACCEPTANCE DATE BY THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING WARRANTIES FROM ALL EQUIPMENT MANUFACTURERS FOR SUBMISSION TO THE OWNER.

G. DRAWINGS INDICATE GENERAL ARRANGEMENT OF WORK INCLUDED IN CONTRACT. CONTRACTOR SHALL, WITHOUT EXTRA CHARGE, MAKE MODIFICATIONS TO THE LAYOUT OF THE WORK TO PREVENT CONFLICT WITH WORK OF OTHER TRADES AND FOR THE PROPER INSTALLATION OF WORK. CHECK ALL DRAWINGS AND VISIT JOB SITE TO VERIFY SPACE AND TYPE OF EXISTING CONDITIONS IN WHICH WORK WILL BE DONE, PRIOR TO SUBMITTAL OF BID.

H. THE ELECTRICAL CONTRACTOR SHALL SUPPLY THREE (3) COMPLETE SETS OF APPROVED DRAWINGS, ENGINEERING DATA SHEETS, MAINTENANCE AND OPERATING INSTRUCTION MANUALS FOR ALL SYSTEMS AND THEIR RESPECTIVE EQUIPMENT. THESE MANUALS SHALL BE INSERTED IN VINYL COVERED 3-RING BINDERS AND TURNED OVER TO OWNER'S REPRESENTATIVE ONE (1) WEEK PRIOR TO FINAL PUNCH LIST.

I. ALL WORK SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER AND WILL BE SUBJECT TO THE APPROVAL OF THE OWNER'S REPRESENTATIVE.

J. ALL EQUIPMENT AND MATERIALS TO BE INSTALLED SHALL BE NEW, UNLESS OTHERWISE NOTED.

K. BEFORE FINAL PAYMENT, THE CONTRACTOR SHALL PROVIDE A COMPLETE SET OF PRINTS (AS-BUILTS), LEGIBLY MARKED IN RED PENCIL TO SHOW ALL CHANGES FROM THE ORIGINAL PLANS.

L. ENTIRE ELECTRICAL INSTALLATION SHALL BE IN ACCORDANCE WITH OWNER'S SPECIFICATIONS, AND REQUIREMENTS OF ALL LOCAL AUTHORITIES HAVING JURISDICTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE WITH APPROPRIATE INDIVIDUALS TO OBTAIN ALL SUCH SPECIFICATIONS AND REQUIREMENTS. NOTHING CONTAINED IN, OR OMITTED FROM, THESE DOCUMENTS SHALL RELIEVE CONTRACTOR FROM THIS OBLIGATION.

### SECTION 16450

1.01. GROUNDING

A. ALL NON-CURRENT CARRYING PARTS OF THE ELECTRICAL AND TELEPHONE CONDUIT SYSTEMS SHALL BE MECHANICALLY AND ELECTRICALLY CONNECTED TO PROVIDE AN INDEPENDENT RETURN PATH TO THE EQUIPMENT GROUNDING SOURCES.

B. GROUNDING SYSTEM WILL BE IN ACCORDANCE WITH THE LATEST ACCEPTABLE EDITION OF THE NATIONAL ELECTRICAL CODE AND REQUIREMENTS PER LOCAL INSPECTOR HAVING JURISDICTION.

C. EQUIPMENT GROUNDING CONDUCTOR:

1. EACH EQUIPMENT GROUND CONDUCTOR SHALL BE SIZED IN ACCORDANCE WITH THE N.E.C. ARTICLE 250-122.

2. THE MINIMUM SIZE OF EQUIPMENT GROUND CONDUCTOR SHALL BE #12 AWG COPPER.

D. CELLULAR GROUNDING SYSTEM:

PROVIDE THE CELLULAR GROUNDING SYSTEM AS SPECIFIED ON DRAWINGS, INCLUDING, BUT NOT LIMITED TO:

1. GROUND BARS
2. ANTENNA GROUND CONNECTIONS AND PLATES.

E. ALL EQUIPMENT SHALL BE BONDED TO GROUND AS REQUIRED BY N.E.C., MFG. SPECIFICATIONS, AND OWNER'S SPECIFICATIONS.

| REV. | DATE | DRAWN BY | CHK'D BY | DESCRIPTION |
|---|---|---|---|---|
| 1 | 10/31/22 | TJR | DMD | CONSTRUCTION DRAWINGS – REVISED CLIENT# ANTENNA MOUNT DESIGN |
| 0 | 02/03/22 | DMD | ANC | CONSTRUCTION DRAWINGS – ISSUED FOR CONSTRUCTION |
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ELECTRICAL DETAILS AND SPECIFICATIONS

E-1

Sheet No. 7 of 7