PAUL J. FORD & COMPANY

EVERSOURCE

Structural Analysis Report

Transmission Tower #1102
Line 1880

CT356/CL&P Tower - RT. 123 Site #CT11356C

Prepared on behalf of:

T-Mobile

35 Griffin Road South
Bloomfield, CT 06002

PJF Project #A31216-0025.003.6090

REVISION	DATE	DESCRIPTION	ENGINEER	PJF TRACKING
0	08/08/2016	ORIGINAL ISSUE DATE	CBH	.001.6000 .001.6090 .001.6050
1	08/29/2016	REVISED TO INCUDE TOWER MODS	JRA	.002.6125
2	11/11/2016	REVISED ANTENNA MOUNT CALCULATIONS FOR REV. G	KAT/CBH	.003.6090

Columbus
250 E Broad St, Suite 600
Columbus, OH 43215
Phone 614.221.6679

50 Years 1965 - 2015

Orlando
1801 Lee Rd, Suite 230
Winter Park, FL 32789
Phone 407.898.9039

Founded in 1965 **www.PaulJFord.com** **100% Employee Owned**

Report Date: November 11, 2016

Client: T-Mobile
35 Griffin Road South
Bloomfield, CT 06002

Attention: Mark Richard
(860) 692-7143
mark.richard64@t-mobile.com

Utility Name:	Eversource Energy
Structure ID:	Transmission Tower #1102
Line Reference:	1880 - 115kV Line
Site Name and/or Reference:	T-Mobile - CT356/CL&P Tower - RT. 123 Site #CT11356C
Site Address:	2 Willruss St
City, County, State:	Norwalk, Fairfield County, CT
Latitude, Longitude:	41.12576, -73.4327

PJF Project: A31216-0025.003.6090

Paul J. Ford and Company is pleased to submit this "**Structural Analysis Report**". The purpose of this analysis is to determine if the modified structure has sufficient capacity to support the proposed equipment along with the existing wire loads described herein.

Analysis Criteria:

Reference Standards:
IEEE Standards Association, "National Electrical Safety Code" (NESC) C2-2007
ANSI/TIA-222-G-2005 Standard, "Structural Standard for Antenna Supporting Structures and Antennas" with ANSI/TIA-222-G-1-2007 and ANSI/TIA-222-G-2-2009 Addenda
ASCE Standard 10-15, "Design of Latticed Steel Transmission Structures"

Utility Specification: Northeast Utilities OTRM 059.1 (3/12/2014)

Proposed Appurtenance Loads:

The structure was analyzed with the addition of the proposed appurtenance loads shown in Table 1 combined with the existing and reserved loads shown in Tables 2 and 3 of this report.

Summary of Analysis Results:

Modified Structure:	**Sufficient**
Existing Foundation:	**Sufficient**
Existing Antenna Mount	**Sufficient**

We at Paul J. Ford and Company appreciate the opportunity to provide our professional services to you and T-Mobile. If you have any questions or need further assistance on this or any other projects please feel free to contact us.

Respectfully submitted by:
Paul J. Ford and Company

Chad Hines, P.E., S.E.
Engineering Manager
chines@pjfweb.com

TABLE OF CONTENTS

1) INTRODUCTION

The purpose of this analysis is to determine if the modified structure has sufficient capacity to support the proposed equipment along with the existing wire loads described herein. The modified structure is a 94' tall quad circuit steel transmission tower designated as a 115kV type "D". The modified tower consists of a 70'-4" tall "Standard Tower" body plus (4) 23'-8" Leg Extensions.

The existing antenna mounting system consists of a flush mount installed on an existing antenna mast. Refer to Tables 1 and 2 below and the structure modification drawings located in Appendix A for further antenna equipment and mount information.

2) ANALYSIS CRITERIA

Reference Standards: IEEE Standards Association, "National Electrical Safety Code" (NESC) C2-2007
ANSI/TIA-222-G-2005 Standard, "Structural Standard for Antenna Supporting Structures and Antennas" with ANSI/TIA-222-G-1-2007 and ANSI/TIA-222-G-2-2009 Addenda
ASCE Standard 10-15, "Design of Latticed Steel Transmission Structures"

Utility Specification: Northeast Utilities OTRM 059.1 (3/12/2014)

Table 1 – Proposed Antenna and Cable Information[1]

Mounting Level (feet)	Center Line Elevation (feet)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (inches)	Note
114	114	3	Commscope	RV4PX306R (Penta)	18	1-1/4	2

Notes:
1) See drawing SK-1 in "Appendix A – Structure Profile Sheet" for further details.
2) South Mast

Table 2 – Existing and Reserved Antenna and Cable Information[1]

Mounting Level (feet)	Center Line Elevation (feet)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (inches)	Note
114	114	3	RFS	APX16DWV-16DWV-S-E-A20	12	1-1/4	3
114	114	-	-	-	6	1-1/4	2
114	114	1	Microflect	Tri-Sector Mount	-	-	2
105	105	3	KMW	AM-X-CD-14-65	6	1-1/4	2
105	105	3	Powerwave	TTAW-07BP111-001 (TMA)	-	-	2
105	105	1	Microflect	Tri-Sector Mount	-	-	2
104	104	3	Powerwave	7770	6	1-1/4	3
104	104	3	Powerwave	TT19-08BP111-001 (TMA)	-	-	3
104	104	1	Microflect	Tri-Sector Mount	-	-	3

Notes:
1) See drawing SK-1 in "Appendix A – Structure Profile Sheet" for further details.
2) South Mast
3) North Mast

Table 3 – Existing Electrical Utility Wire Information[1]

Wire Designation	Wire Type	Tension Angle (degrees)	Wind Span		Weight Span	
			Back (feet)	Ahead (feet)	Back (feet)	Ahead (feet)
Shield Wire #1	0.438 Comp	26	409	409	415	415
Shield Wire #2	OPGW-120 (6-Groove)-10/9 FOCAS	26	409	409	415	415
Conductor #1	(12) 795.0 kcmil 45/7 ACSR (Tern)	26	409	409	415	415

Notes:
1) Wire loads provided by the utility – See "Appendix B – Load Calculations" for further details.

Table 4a – Utility Tower Analysis - Load Case Information[1]

Load Case Name	Radial Ice (inches)	Wind Speed (mph)	Overload Capacity Factors				Note
			Vertical	Wind	Wire Tension		
					Long.	Trans.	
NESC 250B (Heavy)	0.5	39.5	1.5	2.5	1.65	1.65	-
NESC 250C (Extreme Wind)	0	110	1.0	1.0	1.0	1.0	2
NESC 250B (Broken)	0.5	39.5	1.5	2.5	1.65	1.65	

Notes:

1) As per the requirements of NU Design Criteria Table, NESC C2-2007 – Construction Grade B, and ASCE 10-15, "Design of Latticed Steel Transmission Structures".
2) Apply a 1.25 X Gust Response Factor to all telecommunication equipment projected above top of tower/pole and a 1.0 x Gust Response Factor to the tower/pole structure as per NU Design Criteria Table.

Table 4b – Antenna Mount Analysis - Load Case Information[1]

Load Case Name	Radial Ice (inches)	Wind Speed (mph)	Note
TIA/EIA – High Wind	0	110 Ultimate 97 Nominal	Str. Class 3, Exp. C, Topo 1, Crest Height=0
TIA/EIA – Wind and Ice	0.75	50	-

Notes:

1) As per the requirements of TIA/EIA-222-G and AISC-LRFD standards.

3) ANALYSIS PROCEDURE

Table 5 – Documents Provided

Document	Remarks	Reference	Source
Structure Erection Drawings	Bethlehem Steel, 07/11/1958	01135-50006 (E5-E6)	Eversource
Structure Fabrication Drawings	Bethlehem Steel, 07/11/1958	01135-50006 (17-24, 32)	Eversource
Foundation Drawing	CL&P, 5/16/1958	01135-60003 (1)	Eversource
Construction Documents (CD's)	Atlantis Design Group, 06/27/2016	CT11356C, Rev 0	T-Mobile
RF Data Sheet	793D Outdoor (Evolved from 3A), 6/23/16	A&L Template 793D_3QP	T-Mobile
Previous SA Report	Natcomm Consulting Engineers, 7/9/2009	08174.CO.05	Eversource
Previous SA Report	Centek Engineering, 6/10/2011	11021.CO34	Eversource
Previous SA Report	Paul J Ford and Company, 1/14/2016	31215-0012.002	PJF
Photos	N/A	N/A	Eversource
Structure Modification Drawings	PJF, 08/29/2016	31215-0025.002.6125	PJF

3.1) Analysis Method

Tower™ is a commercially available analysis software package made by Powerline Systems, Inc. Tower™ was used to create a three-dimensional model of the tower and calculate member stresses for various load cases. Equipment and wire load calculations were completed using Microsoft Excel or MathCAD and applied to the structure model as point loads. Load Calculations are included in Appendix B. Selected output from the analysis is included in Appendix C.

Risa-3D is a commercially available analysis software package made by Risa Technologies, LLC. For this analysis, Risa-3D was used to create a three dimensional model of the antenna mast and calculate member stresses and reactions for various load cases. Those reactions were then applied to the tower model as point loads. Equipment and wire load calculations were completed using Microsoft Excel or MathCAD and applied to the antenna mast and tower models as point loads. Load Calculations are included in Appendix B. Select output from the Risa-3D and Tower™ analyses are included in Appendix C.

The existing foundation has been analyzed for stability using MathCAD calculations.

3.2) Assumptions

1. *The structure was built in accordance with the manufacturer's specifications.*
2. *The structure has been maintained in accordance with the manufacturer's specifications.*
3. *No allowance was made for any damaged, missing, or rusted members. The analysis assumes that no physical deterioration has occurred in any of the structural components and that all members have the same load carrying capacity as the day it was installed.*
4. *All bolts have been torqued to the snug-tight condition as defined by AISC.*
5. *No residual stresses exist due to incorrect tower erection.*
6. *All welds conform to the requirements of AWS D1.1.*
7. *The configuration of antennas, cables, mounts and other appurtenances are as specified in Tables 1 and 2 of this report and as per the referenced documents in Table 5.*
8. *The wind loads applied to the tower due to the antenna installations are based on the full projected area of all antenna equipment in all directions (i.e. no shielding used).*
9. *Pipe mast and utility tower will be in plumb condition.*
10. *Tower steel material assumed to be A7 with minimum yield stress of 33 ksi.*
11. *Tower bolts assumed to be 3/4" A394-55T with a minimum shear capacity of 13.6 kips.*
12. *The mount has been installed per the referenced documents.*
13. *The structure modifications included in Appendix A of this report have been installed.*
14. *No further modifications to the structure or mount have been made other than those referenced herein.*

If any of the above assumptions are found to be inaccurate, invalid or incomplete, Paul J. Ford and Company shall be informed of these discrepancies to determine the validity of the conclusions stated in this report.

4) ANALYSIS RESULTS

The following table provides the maximum usages for each structure element type and the loading condition in which they occur:

Table 6 – Maximum Structure Element Usages[1,2]

Tower – Analysis			
Element Type	**Member Designation**	**Load Case**	**Usage (%)**
Leg Members	1P	SWR Broken: 250B	72
Vertical "X" Bracing / Diagonal Members	54P	TCL Broken: 250B	89
Horizontal Members & Hangers	130P	250B: NESC Heavy	87
Tower – Supplemental Analysis – Direct Mount			
Element Type		**Load Case**	**Usage (%)**
Leg Members Supporting Antenna Mounts		250C: Extreme Wind	71
		Maximum Structure Element Usage =	**89**
		Structure Result =	**Sufficient**

Notes:
1) See "Appendix C – Computer Output" for further detailed information.
2) See "Appendix D – Supplemental Calculations" for calculations supporting the % capacity used.

Table 7 – Maximum Structure Foundation Usages

Foundation Analysis		
	Load Case	**Usage (%)**
Uplift Check	Envelope	48
Bearing Check	Envelope	55
Overturning Check	Envelope	66
	Maximum Foundation Usage =	**66**
	Foundation Result =	**Sufficient**

Notes:
1) See "Appendix D – Supplemental Calculations" for calculations supporting the % capacity used.

Table 8 – Maximum Antenna Mount Usages[1,2]

Antenna Mount – Analysis		
Member	**Load Case**	**Usage (%)**
North Mast, Member M2, Pipe 12.0X	TIA/EIA – High Wind	93.4
South Mast, Member M2, Pipe 12.0X	TIA/EIA – High Wind	98.6
Mast Connection to CL&P Tower	TIA/EIA – High Wind	81.4
	Maximum Antenna Mount Usage =	**98.6**
	Antenna Mount Result =	**Sufficient**

Notes:
1) See "Appendix C – Computer Output" for further detailed information.
2) See "Appendix D – Supplemental Calculations" for calculations supporting the % capacity used.

4.1) Requirements

Install the modifications included in Appendix A of this report.

5) CONCLUSION

The modified transmission tower has **sufficient** capacity to support the proposed equipment along with the existing wire loads described herein. The existing antenna mounts have **sufficient** capacity to support the proposed equipment described herein. The existing foundation has **sufficient** capacity to support the proposed equipment along with the existing wire loads described herein.

This analysis is presented based upon the assumptions listed herein and information provided by the utility and the wireless carrier. If the existing conditions are different than those presented here, Paul J. Ford and Company should be contacted to verify the validity of the conclusions presented here.

STANDARD CONDITIONS FOR FURNISHING OF PROFESSIONAL ENGINEERING SERVICES ON EXISTING STRUCTURES BY PAUL J. FORD AND COMPANY

1) It is the responsibility of the client to ensure that the information provided to Paul J. Ford and Company and used in the performance of our engineering services is correct and complete. All engineering services are performed on the basis that the information used is current and correct.

2) Paul J. Ford and Company has not performed a site visit to verify the details regarding structure or the antenna/coax loading. If the existing conditions are not as represented on the referenced drawings and/or documents, we should be contacted immediately to evaluate the significance of the deviation.

3) It is not possible to have all of the detailed information to perform a very thorough analysis of every sub-component of the structure. The structural analysis by Paul J. Ford and Company verifies the adequacy of the main structural members. Paul J. Ford and Company provides a limited scope of service in that we cannot verify the adequacy of every weld, bolt, plate connection, etc.

4) The structural integrity of the existing foundation can only be verified if exact foundation sizes and soil conditions are known. Paul J. Ford and Company will not accept any responsibility for the adequacy of the existing foundations unless the foundation sizes and a soils report are provided.

5) The structure has been analyzed according to the minimum design loads recommended by the codes referenced in this report. We do not imply to meet any other codes or requirements unless explicitly agreed in writing. If the owner or local or state agencies require a higher design wind speed or a higher ice load, Paul J. Ford and Company should be made aware of this requirement prior to the start of the project.

6) This analysis does not imply to meet any serviceability criteria such as deflections, twist, sway, etc. unless expressly agreed to in writing. If the owner or local or state agencies require a higher design wind load or specific serviceability requirements, Paul J. Ford and Company should be made aware of this requirement prior to the start of the project.

7) All Services are performed, results obtained, and recommendations made in accordance with generally accepted engineering principles and practices. Paul J. Ford and Company is not responsible for the conclusion, opinions and/or recommendations made by others based on the information we supply.

APPENDIX A

STRUCTURE PHOTOS / MOD DRAWING PACKAGE

South Mast

North Mast

MODIFIED 94'-0" TRANSMISSION TOWER
CL&P TOWER #1102
LINE #1880

T-MOBILE CT356/CL&P TOWER - RT. 123 SITE #CT11356C

2 WILLRUSS STREET
NORWALK, FAIRFIELD COUNTY, CONNECTICUT
LAT: 41.12576° ; LONG: -73.43270°

PROJECT CONTACTS

STRUCTURE OWNER:
EVERSOURCE
CONTACT: ROBERT GRAY AT ROBERT.GRAY@EVERSOURCE.COM
PH: (860) 728-6125

CARRIER INFO:
T-MOBILE
CONTACT: SAM SIMONS AT SAM.SIMONS@T-MOBILE.COM
PH: (203) 482-5156

ENGINEER OF RECORD:
PJFMOD@PJFWEB.COM

THIS PROJECT INCLUDES THE FOLLOWING ITEMS
STRUCTURE REINFORCEMENT

SHEET INDEX

SHEET NUMBER	DESCRIPTION
T-1	TITLE SHEET
N-1	GENERAL NOTES
MI-1	MI CHECKLIST
S-1	TOWER ELEVATION AND DETAILS

DESIGN DATA - MOUNT

REFERENCE STANDARD	TIA/EIA-222-F NUSCO OTRM 059.1
LOCAL CODE	2003 IBC
BASIC WIND SPEED (FASTEST-MILE)	85 MPH *
ICE THICKNESS	0.5 IN
ICE WIND SPEED	74 MPH

* PER EXCEPTION IN NUSCO OTRM 059.1

DESIGN DATA - TOWER

REFERENCE STANDARD	NESC 2007 NUSCO OTRM 059.1
BASIC WIND SPEED (3-SECOND GUST)	110 MPH
ICE THICKNESS	0.5 IN
ICE WIND SPEED	40 MPH

STATE OF CONNECTICUT
JAMES R. ANTOSZEWSKI
31499
LICENSED
PROFESSIONAL ENGINEER
8/29/2016

PJF PAUL J. FORD & COMPANY
250 E Broad St, Ste 600 · Columbus, OH 43215
Phone 614.221.6679 www.pauljford.com

T-MOBILE
35 GRIFFIN ROAD SOUTH BLOOMFIELD, CONNECTICUT 06002

CL&P TOWER #1102
LINE #1880
2 WILLRUSS STREET
NORWALK, FAIRFIELD COUNTY, CONNECTICUT
CT356/CL&P TOWER - RT. 123 SITE #CT11356C

PROJECT No:	31216-0025.002.6125
DRAWN BY:	FE
DESIGNED BY:	JRA
CHECKED BY:	CBL
DATE:	8-29-2016

TITLE SHEET

T-1

SHEET NO. 1 OF 4

31216-0025.002.6125.DWG

EVERSOURCE PROJECT: 2 WILLRUSS STREET; NORWALK, FAIRFIELD COUNTY, CONNECTICUT
UTILITY PROJECT MASTER NOTES DOCUMENT (REV. 0, 2/17/2016)

1. **GENERAL NOTES**

1.1. THE STRUCTURAL ANALYSIS ASSUMES THAT ALL TOWER COMPONENTS ARE IN BRAND-NEW CONDITION. NO ALLOWANCE WAS MADE FOR ANY DAMAGED, MISSING OR RUSTED MEMBERS. IF ANY OF THESE CONDITIONS ARE DISCOVERED, THE CONTRACTOR SHALL BRING THEM TO THE ATTENTION OF THE OWNERS REPRESENTATIVE.

1.2. THESE DRAWINGS WERE PREPARED FROM INFORMATION AND DOCUMENTS PROVIDED BY OWNER. THE INFORMATION PROVIDED HAS NOT BEEN FIELD VERIFIED BY THE ENGINEER OF RECORD (EOR) FOR ACCURACY AND THEREFORE DISCREPANCIES BETWEEN THESE DRAWINGS AND ACTUAL SITE CONDITIONS SHOULD BE ANTICIPATED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY ALL EXISTING CONDITIONS AND DIMENSIONS AND COORDINATE WITH THE AVAILABLE SOURCES OF INFORMATION ABOVE AND WITH THE PROJECT DRAWINGS BEFORE PROCEEDING WITH THE WORK. CONTRACTOR SHALL IMMEDIATELY REPORT ANY AND ALL DISCREPANCIES TO THE EOR AND OWNER FIELD PERSONNEL BEFORE PROCEEDING WITH THE WORK.

1.3. IF MATERIALS, QUANTITIES, STRENGTHS OR SIZES INDICATED BY THE DRAWINGS OR SPECIFICATIONS ARE NOT IN AGREEMENT WITH THESE NOTES, THE BETTER QUALITY AND/OR GREATER QUANTITY, STRENGTH OR SIZE INDICATED, SPECIFIED OR NOTED SHALL BE PROVIDED.

1.4. THIS STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE INSTALLATION OF THE MODIFICATIONS DESCRIBED HEREIN. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO ENSURE THE SAFETY AND STABILITY OF THE STRUCTURE AND ITS COMPONENT PARTS DURING FIELD MODIFICATIONS. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.

1.5. ALL CONSTRUCTION MEANS AND METHODS; INCLUDING BUT NOT LIMITED TO, ERECTION PLANS, RIGGING PLANS, CLIMBING PLANS AND RESCUE PLANS SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR RESPONSIBLE FOR THE EXECUTION OF THE WORK CONTAINED HEREIN AND SHALL MEET OSHA AND GENERAL INDUSTRY STANDARDS.

1.6. OBSERVATION VISITS TO THE SITE BY OWNER AND/OR THE EOR SHALL NOT INCLUDE INSPECTIONS OF THE PROTECTIVE MEASURES OR THE CONSTRUCTION PROCEDURES.

1.7. ANY SUPPORT SERVICES PERFORMED BY THE EOR DURING CONSTRUCTION ARE SOLELY FOR THE PURPOSE OF ASSISTING IN QUALITY CONTROL AND IN ACHIEVING GENERAL CONFORMANCE WITH CONTRACT DOCUMENTS. THEY DO NOT GUARANTEE CONTRACTOR'S PERFORMANCE AND SHALL NOT BE CONSTRUED AS SUPERVISION OF CONSTRUCTION.

1.8. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS AND IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY OWNER AND EOR PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF MATERIALS AND EQUIPMENT BEING SUBSTITUTED.

1.9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING, AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK AS WELL AS OWNER SAFETY GUIDELINES.

1.10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING ALL EXISTING AND NEW EQUIPMENT DURING CONSTRUCTION.

1.11. ANY EXISTING ATTACHMENTS AND/OR PROJECTIONS ON THE STRUCTURE THAT MAY INTERFERE WITH THE INSTALLATION OF THE MODIFICATION SYSTEM WILL HAVE TO BE REMOVED AND RELOCATED, REPLACED, OR RE-INSTALLED AS REQUIRED AFTER THE MODIFICATION IS SUCCESSFULLY COMPLETED. THE CONTRACTOR SHALL IDENTIFY AND COORDINATE THESE ITEMS PRIOR TO CONSTRUCTION WITH OWNER, TESTING AGENCY, AND EOR.

1.12. THE CLIMBING FACILITIES, SAFETY CLIMB AND ALL PARTS THEREOF SHALL NOT BE IMPEDED, MODIFIED OR ALTERED WITHOUT THE EXPRESS APPROVAL OF THE EOR.

2. **STRUCTURAL STEEL**

2.1. SHOP DRAWINGS SHALL BE SUBMITTED TO ENGINEER FOR APPROVAL. DRAWINGS MUST BEAR THE CHECKERS INITIALS BEFORE SUBMITTING TO ENGINEER. CONTRACTOR SHALL REVIEW THE SHOP DRAWINGS FOR GENERAL CONFORMANCE TO THE PLANS PRIOR TO SUBMITTING TO ENGINEER. SHOP DRAWINGS SHALL INCLUDE ERECTION DRAWINGS, ELEVATIONS AND SECTIONS. SHOP DRAWINGS SHALL ALSO INCLUDE SECTION PROFILES, SIZES, CONNECTIONS, ATTACHMENTS, REINFORCING, ANCHORAGE SIZE AND TYPE OF FASTENERS AND ASSEMBLIES.

2.2. STRUCTURAL STEEL MATERIALS, FABRICATION, DETAILING, AND WORKMANSHIP SHALL CONFORM TO THE LATEST EDITION OF THE FOLLOWING REFERENCE STANDARDS:

2.2.1. BY THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC):

2.2.1.1. "SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS."

2.2.1.2. SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM HIGH STRENGTH BOLTS," AS APPROVED BY THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS.

2.2.1.3. "CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES"

2.2.2. BY THE AMERICAN WELDING SOCIETY (AWS):

2.2.2.1. "STRUCTURAL WELDING CODE – STEEL D1.1."

2.2.2.2. "STANDARD SYMBOLS FOR WELDING, BRAZING, AND NONDESTRUCTIVE EXAMINATION"

2.2.3. BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS:

2.2.3.1. DESIGN OF LATTICED STEEL TRANSMISSION STRUCTURES (ASCE 10-XX)

2.2.3.2. DESIGN OF STEEL TRANSMISSION POLE STRUCTURES (ASCE 48-XX)

2.3. NEW STEEL (UNLESS NOTED OTHERWISE) SHALL CONFORM TO THE REQUIREMENTS OF THE ASTM STANDARD SPECIFICATION FOR STRUCTURAL STEEL AS NOTED BELOW:
M, S, C, MC, L, PLATES & BARS - ASTM A36 (36 KSI YIELD POINT MATERIAL)
W - ASTM A992 (50 KSI YIELD POINT MATERIAL)
HSS RECTANGULAR - ASTM A500, GRADE B (46 KSI YIELD POINT MATERIAL)
HSS ROUND - ASTM A500, GRADE B (42 KSI YIELD POINT MATERIAL)
PIPE - ASTM A53, GRADE B (35 KSI YIELD POINT MATERIAL)

2.4. NEW BOLTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM A325, TYPE "X" UNLESS NOTED OTHERWISE. ALL HOLES FOR BOLTS SHALL BE 1/16" LARGER THAN THE BOLT DIAMETER WITH AN EDGE DISTANCE OF AT LEAST 1 3/4 TIMES THE BOLT DIAMETER AND A SPACING OF AT LEAST 3 TIMES THE BOLT DIAMETER UNLESS NOTED OTHERWISE. ALL BOLTS SHALL BE PROVIDED WITH LOCK WASHERS, PALNUTS, OR LOCK NUTS.

2.5. ALL STRUCTURAL BOLTS SHALL BE INSTALLED AND TIGHTENED TO A SNUG TIGHT CONDITION ACCORDING TO THE REQUIREMENTS OF THE AISC 'SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS',UNLESS NOTED OTHERWISE ON DRAWINGS.

2.6. ALL U-BOLTS SHALL BE A307 UNLESS NOTED OTHERWISE.

2.7. ANY MATERIAL OR WORKMANSHIP WHICH IS OBSERVED TO BE DEFECTIVE OR INCONSISTENT WITH THE CONTRACT DOCUMENTS SHALL BE CORRECTED, MODIFIED, OR REPLACED AT THE CONTRACTOR'S EXPENSE.

2.8. WELDED CONNECTIONS SHALL CONFORM TO THE LATEST REVISED CODE OF THE AMERICAN WELDING SOCIETY, AWS D1.1. ALL WELD ELECTRODES SHALL BE E70XX UNLESS NOTED OTHERWISE ON THE DRAWINGS.

2.9. ALL WELDED CONNECTIONS SHALL BE MADE BY WELDERS CERTIFIED BY AWS. CONTRACTOR SHALL SUBMIT WELDERS' CERTIFICATION AND QUALIFICATION DOCUMENTATION TO OWNER'S TESTING AGENCY FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.

2.10. ALL SURFACES MUST BE CLEAN AND FREE OF WELD SPATTER. ALL EDGES SHALL BE DEBURRED.

2.11. ALL PARTS ARE TO BE MARKED WITH ITEM NUMBERS USING 3/4" HIGH STEEL STENCILS.

2.12. SHOP SHALL ASSEMBLE AND VERIFY FIT AND GAPS BEFORE BREAKDOWN FOR GALVANIZING.

2.13. NO FIELD WELDING SHALL BE DONE TO THE EXISTING STRUCTURE.

2.14. FIELD CUTTING OF STEEL:

2.14.1. IMPORTANT CUTTING SAFETY GUIDELINES: THE CONTRACTOR SHALL FOLLOW ALL OWNER CUTTING, FIRE PREVENTION AND SAFETY GUIDELINES. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL OBTAIN A COPY OF THE CURRENT OWNER GUIDELINES. ANY DAMAGE TO THE COAX CABLES, AND/OR OTHER EQUIPMENT AND/OR THE STRUCTURE, RESULTING FROM THE CONTRACTOR'S ACTIVITIES SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE. THE INSPECTION/TESTING AGENCY SHALL CLOSELY AND CONTINUOUSLY MONITOR THIS ACTIVITY.

2.14.2. ALL REQUIRED CUTS SHALL BE CUT WITHIN THE DIMENSIONS SHOWN ON THE DRAWINGS. NO CUTS SHALL EXTEND BEYOND THE OUTLINE OF THE DIMENSIONS SHOWN ON THE DRAWINGS. ALL CUT EDGES SHALL BE GROUND SMOOTH AND DE-BURRED. CONTRACTOR TO AVOID 90 DEGREE CORNERS. IT MAY BE NECESSARY TO DRILL STARTER HOLES AS REQUIRED TO MAKE THE CUTS.

2.14.3. FIELD HOLES SHALL BE PUNCHED OR DRILLED. BURNING OF MEMBERS SHALL NOT BE PERMITTED.

3. **BASE PLATE GROUT**

3.1. NEW GROUT FOR THE POLE BASE SHALL BE NON-SHRINK, NON-METALLIC, GROUT (NS GROUT BY EUCLID, OR APPROVED EQUAL) WITH A 7500 PSI MINIMUM COMPRESSIVE STRENGTH. CONTRACTOR SHALL SUBMIT PROPOSED GROUT SPECIFICATION INFORMATION TO OWNER FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION. CONTRACTOR SHALL FOLLOW GROUT MANUFACTURER'S SPECIFICATIONS FOR COLD WEATHER GROUTING PROCEDURES (IF NECESSARY) AND THE TESTING AGENCY SHALL PREPARE GROUT SAMPLE SPECIMENS FOR COMPRESSIVE STRENGTH TESTING AND VERIFICATION.

3.2. GROUT SHALL BE INSTALLED TIGHT UNDER THE BASE PLATE AND BEARING PLATE REGION WITH NO VOIDS REMAINING BETWEEN THE TOP OF THE EXISTING CONCRETE AND THE UNDERSIDE OF THE EXISTING BASE PLATE AND BEARING PLATE.

3.3. CAULK AROUND ANCHOR RODS WHEN GROUTING.

4. **FOUNDATION WORK**

4.1. THE CONTRACTOR SHALL PROTECT THE EXISTING STRUCTURE, AS WELL AS ANY OTHER NEARBY EXISTING FOUNDATIONS FOR OTHER STRUCTURES OR EQUIPMENT, FROM LOSS OF SOIL AROUND AND/OR BENEATH FOOTINGS DURING ANY EXCAVATION. THE CONTRACTOR SHALL BRACE THE SITES OF THE OPEN EXCAVATION AS REQUIRED.

4.2. THE EFFECT OF ADDITIONAL EXCAVATION FOR FOUNDATION AUGMENTATION AND REINFORCING, WHERE REQUIRED, MAY HAVE IMPACT ON EXISTING EQUIPMENT AND/OR OTHER EXISTING STRUCTURES NEAR THE EXCAVATION. THE EOR HAS NOT BEEN PROVIDED WITH ANY SPECIFIC INFORMATION OR DETAILS REGARDING EXISTING EQUIPMENT OR OTHER EXISTING STRUCTURES ON THE SITE. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE THE EFFECT THAT ANY EXCAVATION WORK HAS ON EXISTING NEARBY EQUIPMENT AND/OR STRUCTURES. CONTRACTOR SHALL COORDINATE THIS SITE-SPECIFIC INFORMATION WITH OWNER AND THE TESTING AGENCY PRIOR TO CONSTRUCTION AND FOUNDATION WORK. AFTER OBTAINING THE PRIOR WRITTEN PERMISSION OF OWNER, THE CONTRACTOR SHALL ADEQUATELY BRACE, SHORE, AND/OR RELOCATE THE INTERFERING EXISTING NEARBY EQUIPMENT AND/OR STRUCTURES AS NECESSARY.

5. **CAST-IN-PLACE CONCRETE**

5.1. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS.

5.2. CONCRETE EXPOSED TO WEATHER SHALL BE AIR ENTRAINED (6% +/- 1.5%).

5.3. WATER CEMENT RATION = 0.45 (MAXIMUM).

5.4. ALL REINFORCING STEEL SHALL BE NEW DOMESTIC DEFORMED BILLET STEEL CONFORMING TO ASTM A615 GRADE 60.

5.5. ALL CONCRETE WORK SHALL BE IN ACCORDANCE WITH "THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" ACI 318, LATEST EDITION. CONTRACTOR SHALL FOLLOW ALL APPLICABLE ACI PROCEDURES FOR COLD WEATHER AND HOT WEATHER CONCRETE PLACEMENT.

5.6. ALL REINFORCING DETAILS SHALL CONFORM TO "DETAILS AND DETAILING OF CONCRETE REINFORCING" ACI 315, LATEST EDITION, UNLESS DETAILED OTHERWISE ON THE DRAWINGS.

5.7. CONTRACTOR SHALL VERIFY LOCATIONS OF ALL OPENINGS, SLEEVES, ANCHOR RODS, INSERTS, ETC., AS REQUIRED BEFORE CONCRETE IS PLACED.

5.8. WHERE BAR LENGTHS ARE GIVEN ON THE DRAWINGS, THE LENGTH OF ANY HOOK, IF REQUIRED, IS NOT INCLUDED.

5.9. CONTRACTOR SHALL PROVIDE SPACERS, CHAIRS, BOLSTERS, ETC., NECESSARY TO SUPPORT REINFORCING STEEL. CHAIRS WHICH BEAR ON EXPOSED CONCRETE SURFACES SHALL HAVE ENDS WHICH ARE PLASTIC TIPPED OR STAINLESS STEEL.

5.10. ALL STRUCTURAL MEMBERS SHALL BE POURED MONOLITHICALLY, EXCEPT FOR REQUIRED CONSTRUCTION JOINTS. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION JOINT LOCATIONS AND DETAILS TO THE EOR FOR REVIEW.

5.11. CONTRACTOR SHALL PROVIDE ¾-INCH CHAMFER ON ALL EXPOSED CORNERS UNLESS OTHERWISE INDICATED ON THE DRAWINGS. MINIMUM CLEARANCES FOR REINFORCING STEEL SHALL BE MAINTAINED AS SPECIFIED BY ACI.

5.12. THE FOLLOWING MINIMUM CONCRETE COVER SHALL BE PROVIDED FOR REINFORCEMENT:
3" .... CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH.
2" .... CONCRETE EXPOSED TO EARTH OR WEATHER, #6 THROUGH #18 BARS.
1-1/2"... CONCRETE EXPOSED TO EARTH OR WEATHER, #5 BAR AND SMALLER.

5.13. FOOTING BARS SHALL BE BENT 1'-6" AROUND CORNERS, OR PROVIDE CORNER BARS WITH A 2'-0" LAP ON EACH LEG.

5.14. TESTING LABORATORY SHALL SUBMIT ONE COPY OF ALL CONCRETE TEST REPORTS DIRECTLY TO THE EOR.

5.15. CONTRACTOR SHALL KEEP A COPY OF "FIELD REFERENCE MANUAL" (ACI PUBLICATION SP-15, LATEST EDITION) AT THE PROJECT FIELD OFFICE.

5.16. FLY ASH SHALL BE PERMITTED. FLY ASH CONTENT SHALL BE A MAXIMUM OF 25% OF CEMENT WEIGHT.

6. **EPOXY GROUTED REINFORCING ANCHOR RODS**

6.1. UNLESS OTHERWISE NOTED, REINFORCING ANCHOR RODS SHALL BE 150 KSI ALL-THREAD BARS CONFORMING TO ASTM A722. RECOMMENDED MANUFACTURERS/SUPPLIERS OF 150 KSI ALL-THREAD BARS ARE WILLIAMS FORM ENGINEERING CORPORATION AND DYWIDAG SYSTEMS INTERNATIONAL.

6.2. ALL REINFORCING ANCHOR RODS SHALL BE HOT DIP GALVANIZED PER ASTM A123. ALTERNATIVELY, ALL REINFORCING ANCHOR RODS MAY BE EPOXY COATED PER ASTM A775.

6.3. THE CORE-DRILLED HOLES IN THE CONCRETE FOR THE ANCHOR RODS SHALL BE CLEAN AND DRY, AND OTHERWISE PROPERLY PREPARED ACCORDING TO THE ANCHOR ROD AND EPOXY MANUFACTURERS' INSTRUCTIONS, PRIOR TO PLACEMENT OF ANCHOR RODS AND EPOXY. CONTRACTOR SHALL FOLLOW ALL ANCHOR ROD AND EPOXY MANUFACTURER RECOMMENDATIONS REGARDING HANDLING OF RODS, EPOXY, ACCEPTABLE AMBIENT TEMPERATURE RANGE DURING INSTALLATION AND POST-INSTALLATION CURING, THE EFFECT OF TEMPERATURE ON EPOXY CURING TIME, PREPARATION OF HOLE, ETC.

6.4. HILTI HIT RE-500 SD OR ITW RED HEAD EPCON G5 EPOXY SHALL BE USED TO ANCHOR THE BAR IN THE DRILL HOLES. IF THE DESIGNED EMBEDMENT IS GREATER THAN 12 FT, CONTRACTOR HAS THE OPTION TO USE PILE ANCHOR GROUT BY E-CHEM AS AN ALTERNATE. IF CONTRACTOR WISHES TO USE A DIFFERENT EPOXY, A REQUEST INCLUDING THE EPOXY TECHNICAL DATA SHEET(S) SHALL BE SUBMITTED TO THE EOR FOR REVIEW PRIOR TO CONSTRUCTION.

6.5. ONCE THE REINFORCING ANCHOR RODS HAVE BEEN INSTALLED AND ALL EPOXY AND GROUT HAVE CURED (IF BASE PLATE AND/OR BEARING PLATES HAVE BEEN GROUTED PRIOR TO TESTING), ALL REINFORCING ANCHORS SHALL BE LOAD TESTED. REFER TO THE NEW ANCHOR & BRACKET DETAIL ON FOLLOWING SHEETS FOR SPECIFIED ANCHOR ROD TARGET TENSION LOAD.

6.6. ONCE THE REINFORCING ANCHOR RODS HAVE BEEN SUCCESSFULLY LOAD TESTED AND APPROVED THE CONTRACTOR SHALL TIGHTEN ALL HEAVY HEX ANCHOR NUTS TO SNUG TIGHT PLUS 1/8 TURN OF NUT.

7. **TOUCH UP OF GALVANIZING**

7.1. THE CONTRACTOR SHALL TOUCH UP ANY AND ALL AREAS OF GALVANIZING ON THE EXISTING STRUCTURE OR NEW COMPONENTS THAT ARE DAMAGED OR ABRADED DURING CONSTRUCTION. GALVANIZED SURFACES DAMAGED DURING TRANSPORTATION OR ERECTION AND ASSEMBLY AS WELL AS ANY AND ALL ABRASIONS, CUTS AND FIELD DRILLING SHALL BE TOUCHED UP WITH TWO (2) COATS OF ZRC COLD GALVANIZING COMPOUND. FILM THICKNESS PER COAT SHALL BE: WET 3.0 MILS; DRY 1.5 MILS. APPLY PER ZRC (MANUFACTURER) RECOMMENDED PROCEDURES. CONTACT ZRC AT 1-800-831-3275 FOR PRODUCT INFORMATION.

7.2. CONTRACTOR SHALL CLEAN AND PREPARE ALL FIELD WELDS ON GALVANIZED AND PRIME PAINTED SURFACES FOR TOUCH-UP COATING IN ACCORDANCE WITH AWS D1.1. OWNER'S TESTING AGENCY SHALL VERIFY THE PREPARED SURFACE PRIOR TO APPLICATION OF THE TOUCH-UP COATING.

7.3. OWNER'S TESTING AGENCY SHALL TEST AND VERIFY THE COATING THICKNESS AFTER THE CONTRACTOR HAS APPLIED THE ZRC COLD GALVANIZING COMPOUND AND IT HAS SUFFICIENTLY DRIED. AREAS FOUND TO BE ADEQUATELY COATED, SHALL BE RE-COATED BY THE CONTRACTOR AND RE-TESTED BY THE TESTING AGENCY.

8. **HOT-DIP GALVANIZING**

8.1. HOT-DIP GALVANIZE ALL STRUCTURAL STEEL MEMBERS AND ALL STEEL ACCESSORIES, BOLTS, WASHERS, ETC. PER ASTM A123, ASTM A386 OR PER ASTM A153, AS APPROPRIATE.

8.2. PROPERLY PREPARE STEEL ITEMS FOR GALVANIZING.

8.3. DRILL OR PUNCH WEEP AND/OR DRAINAGE HOLES WITH EOR APPROVAL OF LOCATIONS.

8.4. ALL GALVANIZING SHALL BE DONE AFTER FABRICATION IS COMPLETED AND PRIOR TO FIELD INSTALLATION.

9. **PERPETUAL INSPECTION AND MAINTENANCE BY THE OWNER**

9.1. AFTER THE CONTRACTOR HAS SUCCESSFULLY COMPLETED THE INSTALLATION OF THE MODIFICATION SYSTEM AND THE WORK HAS BEEN ACCEPTED BY OWNER, OWNER WILL BE RESPONSIBLE FOR THE LONG TERM AND PERPETUAL INSPECTION AND MAINTENANCE OF THE STRUCTURE AND MODIFICATION SYSTEM.

STATE OF CONNECTICUT
JAMES R. ANTOSZEWSKI
31499
LICENSED
PROFESSIONAL ENGINEER
8/29/2016

PAUL J. FORD & COMPANY
250 E Broad St, Ste 600 · Columbus, OH 43215
Phone 614.221.6679 www.pauljford.com

T-MOBILE
35 GRIFFIN ROAD SOUTH BLOOMFIELD, CONNECTICUT 06002

CL&P TOWER #1102
LINE #1880
2 WILLRUSS STREET
NORWALK, FAIRFIELD COUNTY, CONNECTICUT
CT356/CL&P TOWER - RT. 123 SITE #CT11356C

PROJECT No:	31216-0025.002.6125
DRAWN BY:	FE
DESIGNED BY:	JRA
CHECKED BY:	CBH
DATE:	8-29-2016

GENERAL NOTES

N-1

SHEET NO. 2 OF 4

31216-0025.002.6125.DWG

MODIFICATION INSPECTION NOTES:

1. **INSPECTION AND TESTING**
   - 1.1. INSPECTION SERVICES WHICH ARE FURNISHED BY OTHERS ARE STILL REQUIRED WHEN THE EOR PERFORMS SUPPORT SERVICES DURING CONSTRUCTION.
   - 1.2. OBSERVED DISCREPANCIES BETWEEN THE WORK AND THE CONTRACT DOCUMENTS SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST.
   - 1.3. AN INDEPENDENT QUALIFIED INSPECTION/TESTING AGENCY SHALL BE SELECTED, RETAINED AND PAID FOR BY OWNER FOR THE SOLE PURPOSE OF INSPECTING, TESTING, DOCUMENTING, AND APPROVING ALL WELDING AND FIELD WORK PERFORMED BY THE CONTRACTOR.
     - 1.3.1. ACCESS TO ANY PLACE WHERE WORK IS BEING DONE SHALL BE PERMITTED AT ALL TIMES.
     - 1.3.2. THE INSPECTION AGENCY SHALL SO SCHEDULE THIS WORK AS TO CAUSE A MINIMUM OF INTERRUPTION TO, AND COORDINATE WITH, THE WORK IN PROGRESS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE THE WORK SCHEDULE WITH THE TESTING AGENCY. THE CONTRACTOR SHALL ALLOW FOR ADEQUATE TIME AND ACCESS FOR THE TESTING AGENCY TO PERFORM THEIR DUTIES.

1.4. **GENERAL**
- 1.4.1. PERFORM PERIODIC ON-SITE OBSERVATION, INSPECTION, VERIFICATION, AND TESTING DURING THE TIME THE CONTRACTOR IS WORKING ON-SITE. AGENCY SHALL NOTIFY OWNER AND THE EOR IMMEDIATELY WHEN FIELD PROBLEMS OR DISCREPANCIES OCCUR.

1.5. **FOUNDATIONS AND SOIL PREPARATION**
- 1.5.1. VERIFY MATERIALS AT BOTTOM OF EXCAVATION ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY.
- 1.5.2. VERIFY THAT EXCAVATIONS HAVE EXTENDED TO PROPER DEPTH AND ARE FOUNDED ON PROPER MATERIAL.
- 1.5.3. PERFORM CLASSIFICATION AND TESTING OF COMPACTED FILL MATERIALS AS SPECIFIED.
- 1.5.4. VERIFY USE OF PROPER MATERIALS, DENSITIES AND LIFT THICKNESS DURING PLACEMENT AND COMPACTION OF COMPACTED FILL.
- 1.5.5. PRIOR TO PLACEMENT OF COMPACTED FILL, OBSERVE SUBGRADE AND VERIFY SITE HAS BEEN PREPARED PROPERLY.

1.6. **CONCRETE TESTING PER ACI**
- 1.6.1. INSPECT PLACEMENT OF REINFORCING STEEL.
- 1.6.2. INSPECT BOLTS TO BE INSTALLED IN CONCRETE PRIOR TO AND DURING PLACEMENT OF CONCRETE.
- 1.6.3. VERIFY USE OF REQUIRED MIX DESIGN.
- 1.6.4. AT THE TIME FRESH CONCRETE IS SAMPLED FABRICATE SPECIMENS FOR STRENGTH TEST, PERFORM SLUMP AND AIR CONTENT TEST AND DETERMINE TEMPERATURE OF THE CONCRETE.
- 1.6.5. INSPECT CONCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUE.
- 1.6.6. INSPECT SPECIFIED CURING AND TEMPERATURE TECHNIQUES.

1.7. **STRUCTURAL STEEL**
- 1.7.1. CHECK STEEL ON THE JOB WITH THE PLANS.
- 1.7.2. CHECK MILL CERTIFICATIONS. CALL FOR LABORATORY TEST REPORTS WHEN MILL CERTIFICATION IS IN QUESTION.
- 1.7.3. CHECK GRADE OF STEEL MEMBERS, AND BOLTS FOR CONFORMANCE WITH DRAWINGS.
- 1.7.4. INSPECT STEEL MEMBERS FOR DISTORTION, EXCESSIVE RUST, FLAWS AND BURNED HOLES.
- 1.7.5. CHECK STEEL MEMBERS FOR SIZES, SWEEP AND DIMENSIONAL TOLERANCES.
- 1.7.6. CHECK FOR SURFACE FINISH SPECIFIED, GALVANIZED.
- 1.7.7. CHECK THAT BOLTS HAVE BEEN TIGHTENED PROPERLY.
- 1.7.8. PRIOR TO ANY FIELD CUTTING THE CONTRACTOR SHALL MARK THE CUTOUT LINES ON THE STEEL AND THE INSPECTION/TESTING AGENCY SHALL VERIFY PROPOSED LAYOUT, LOCATION, AND DIMENSIONS. THE INSPECTION/TESTING AGENCY SHALL CLOSELY AND CONTINUOUSLY MONITOR THIS ACTIVITY.

1.8. **WELDING:**
- 1.8.1. VERIFY FIELD WELDING PROCEDURES, WELDERS, AND WELDING OPERATORS, NOT DEEMED PREQUALIFIED, IN ACCORDANCE WITH AWS D1.1.
- 1.8.2. INSPECT FIELD WELDED CONNECTIONS IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED AND WITH AWS D1.1.
- 1.8.3. APPROVE FIELD WELDING SEQUENCE.
- 1.8.4. INSPECT WELDED CONNECTIONS AS FOLLOWS AND IN ACCORDANCE WITH AWS D1.1:
  - 1.8.4.1. INSPECT WELDING EQUIPMENT FOR CAPACITY, MAINTENANCE, AND WORKING CONDITIONS.
  - 1.8.4.2. VERIFY SPECIFIED ELECTRODES AND HANDLING AND STORAGE OF ELECTRODES FOR CONFORMANCE TO SPECIFICATIONS.
  - 1.8.4.3. INSPECT PREHEATING AND INTERPASS TEMPERATURES FOR CONFORMANCE WITH AWS D1.1.
  - 1.8.4.4. VISUALLY INSPECT ALL WELDS AND VERIFY THAT QUALITY OF WELDS MEETS THE REQUIREMENTS OF AWS D1.1. OTHER TESTS MAY ALSO BE PERFORMED ON THE WELDS BY THE TESTING AGENCY IN ORDER FOR THEM TO PERFORM THEIR DUTIES FOR THIS PROJECT.
  - 1.8.4.5. SPOT TEST AT LEAST ONE FILLET WELD OF EACH MEMBER USING MAGNETIC PARTICLE.
  - 1.8.4.6. INSPECT FOR SIZE, SPACING, TYPE AND LOCATION AS PER APPROVED DRAWINGS.
  - 1.8.4.7. VERIFY THAT THE BASE METAL CONFORMS TO THE DRAWINGS.
  - 1.8.4.8. REVIEW THE REPORTS BY TESTING LABS.
  - 1.8.4.9. CHECK TO SEE THAT WELDS ARE CLEAN AND FREE FROM SLAG.
  - 1.8.4.10. INSPECT RUST PROTECTION OF WELDS AS PER SPECIFICATIONS.
  - 1.8.4.11. CHECK THAT DEFECTIVE WELDS ARE CLEARLY MARKED AND HAVE BEEN ADEQUATELY REPAIRED.
  - 1.8.4.12. FULL PENETRATION WELDS IN THE VICINITY OF THE BASE OF THE TOWER ARE REQUIRED TO BE 100% NDE INSPECTED BY UT IN ACCORDANCE WITH AWS D1.1.
  - 1.8.4.13. PARTIAL PENETRATION AND FILLET WELDS IN THE VICINITY OF THE BASE OF THE TOWER ARE REQUIRED TO BE 50% NDE INSPECTED BY MP IN ACCORDANCE WITH AWS D1.1.

1.9. **REPORTS:**
- 1.9.1. COMPILE AND PERIODICALLY SUBMIT DAILY INSPECTION REPORTS TO OWNER.
- 1.9.2. THE INSPECTION PLAN OUTLINED HEREIN IS INTENDED AS A DESCRIPTION OF GENERAL AND SPECIFIC ITEMS OF CONCERN. IT IS NOT INTENDED TO BE ALL-INCLUSIVE. IT DOES NOT LIMIT THE TESTING AND INSPECTION AGENCY TO THE ITEMS LISTED. ADDITIONAL TESTING, INSPECTION, AND CHECKING MAY BE REQUIRED AND SHOULD BE ANTICIPATED. THE TESTING AGENCY SHALL USE THEIR PROFESSIONAL JUDGMENT AND KNOWLEDGE OF THE JOB SITE CONDITIONS AND THE CONTRACTOR'S PERFORMANCE TO DECIDE WHAT OTHER ITEMS REQUIRE ADDITIONAL ATTENTION. THE TESTING AGENCY'S JUDGMENT MUST PREVAIL ON ITEMS NOT SPECIFICALLY COVERED. ANY DISCREPANCIES OR PROBLEMS SHALL BE BROUGHT IMMEDIATELY TO OWNER'S ATTENTION. RESOLUTIONS ARE NOT TO BE MADE WITHOUT OWNER'S REVIEW AND SPECIFIC WRITTEN CONSENT. OWNER RESERVES THE RIGHT TO DETERMINE WHETHER OR NOT A RESOLUTION IS ACCEPTABLE.
- 1.9.3. AFTER EACH INSPECTION, THE TESTING AGENCY WILL PREPARE A WRITTEN ACCEPTANCE OR REJECTION WHICH WILL BE GIVEN TO THE CONTRACTOR AND FILED AS DAILY REPORTS TO OWNER. THIS WRITTEN ACTION WILL GIVE THE CONTRACTOR A LIST OF ITEMS TO BE CORRECTED, PRIOR TO CONTINUING CONSTRUCTION, AND/OR LOADING OF STRUCTURAL ITEMS.
- 1.9.4. THE TESTING AGENCY DOES NOT RELIEVE THE CONTRACTOR'S CONTRACTUAL OR STATUTORY OBLIGATIONS. THE CONTRACTOR HAS THE SOLE RESPONSIBILITY FOR ANY DEVIATIONS FROM THE OFFICIAL CONTRACT DOCUMENTS. THE TESTING AGENCY WILL NOT REPLACE THE CONTRACTOR'S QUALITY CONTROL PERSONNEL.

1.10. **CORRECTION OF FAILING MI'S**
- 1.10.1. IF THE MODIFICATION INSTALLATION WOULD FAIL THE MI ("FAILED MI"), THE GC SHALL WORK WITH THE OWNER TO COORDINATE A REMEDIATION PLAN IN ONE OF TWO WAYS:
  - 1.10.1.1. CORRECT FAILING ISSUES TO COMPLY WITH THE SPECIFICATIONS CONTAINED IN THE ORIGINAL CONTRACT DOCUMENTS AND COORDINATE A SUPPLEMENT MI.
  - 1.10.1.2. OR, WITH THE OWNERS APPROVAL, THE GC MAY WORK WITH THE EOR TO RE-ANALYZE THE MODIFICATION/REINFORCEMENT USING THE AS-BUILT CONDITION

1.11. **PHOTOGRAPHS**
- 1.11.1. BETWEEN THE GC AND THE MI INSPECTOR THE FOLLOWING PHOTOGRAPHS, AT A MINIMUM, ARE TO BE TAKEN AND INCLUDED IN THE MI REPORT:
  - 1.11.1.1. PRE-CONSTRUCTION GENERAL SITE CONDITION
  - 1.11.1.2. PHOTOGRAPHS DURING THE REINFORCEMENT MODIFICATION CONSTRUCTION/ERECTION AND INSPECTION
    - 1.11.1.2.1. RAW MATERIALS
    - 1.11.1.2.2. PHOTOS OF ALL CRITICAL DETAILS
    - 1.11.1.2.3. FOUNDATION MODIFICATIONS
    - 1.11.1.2.4. WELD PREPARATION
    - 1.11.1.2.5. BOLT INSTALLATION AND TORQUE
    - 1.11.1.2.6. FINAL INSTALLED CONDITION
    - 1.11.1.2.7. SURFACE COATING REPAIR
  - 1.11.1.3. POST CONSTRUCTION PHOTOGRAPHS
    - 1.11.1.3.1. FINAL INFIELD CONDITION
- 1.11.2. PHOTOS OF ELEVATED MODIFICATIONS TAKEN FROM THE GROUND SHALL BE CONSIDERED INADEQUATE.

POST-MODIFICATION CHECKLIST

REQUIRED	REPORT ITEM	BRIEF DESCRIPTION
		PRE-CONSTRUCTION
X	MI CHECKLIST DRAWING	THIS CHECKLIST SHALL BE INCLUDED IN THE MI REPORT
X	EOR APPROVED SHOP DRAWINGS	FABRICATION DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR REVIEW. THE CONTRACTOR SHALL PROVIDE THE APPROVED SHOP DRAWINGS TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	FABRICATION INSPECTION	A LETTER FROM THE FABRICATOR, STATING THAT THE WORK WAS PERFORMED IN ACCORDANCE WITH INDUSTRY STANDARDS AND THE CONTRACT DOCUMENTS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	FABRICATOR CERTIFIED WELD INSPECTION	CRITICAL SHOP WELDS THAT REQUIRE TESTING ARE NOTED ON THESE CONTRACT DRAWINGS. A CERTIFIED WELD INSPECTOR SHALL PERFORM NON-DESTRUCTIVE TESTING AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	MATERIAL TEST REPORT (MTR)	MILL CERTIFICATION SHALL BE PROVIDED FOR ALL STEEL WITH A YIELD STRENGTH GREATER THAN 36 KSI AND THIS DOCUMENTATION SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	FABRICATOR NDE INSPECTION	A VISUAL OBSERVATION OF A PORTION OF THE EXISTING STRUCTURE (AS NOTED ON THESE DRAWINGS) IS REQUIRED AND A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	NDE REPORT OF MONOPOLE BASE PLATE (AS REQUIRED)	A VISUAL OBSERVATION OF THE POLE TO BASE PLATE CONNECTION IS REQUIRED AND A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	PACKING SLIPS	THE MATERIAL SHIPPING LIST SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
		CONSTRUCTION
X	CONSTRUCTION INSPECTIONS	A LETTER FROM THE GENERAL CONTRACTOR STATING THAT THE WORKMANSHIP WAS PERFORMED IN ACCORDANCE WITH INDUSTRY STANDARDS AND THESE CONTRACT DRAWINGS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	FOUNDATION INSPECTIONS	A VISUAL OBSERVATION OF THE EXCAVATION AND REBAR SHALL BE PERFORMED BEFORE PLACING THE CONCRETE. A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	CONCRETE COMP. STRENGTH AND SLUMP TESTS	THE CONCRETE MIX DESIGN, SLUMP TEST, AND COMPRESSIVE STRENGTH TESTS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	POST INSTALLED ANCHOR ROD VERIFICATION	ANCHOR ROD INSTALLATION SHALL INCLUDE VERIFICATION BY LETTER AND PHOTOGRAPHIC DOCUMENTATION.
NA	BASE PLATE GROUT VERIFICATION	A LETTER FROM THE GENERAL CONTRACTOR SHALL BE PROVIDED TO THE MI INSPECTOR THAT CERTIFIES THAT THE GROUT WAS INSTALLED IN ACCORDANCE WITH SPECIFICATIONS FOR INCLUSION IN THE MI REPORT.
NA	CONTRACTOR'S CERTIFIED WELD INSPECTION	A CERTIFIED WELD INSPECTOR SHALL INSPECT AND TEST AS NECESSARY ALL FIELD WELDS AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT. PRE, DURING AND POST WELD INSPECTION IS REQUIRED.
NA	EARTHWORK: LIFT AND DENSITY	FOUNDATION SUB-GRADES SHALL BE INSPECTED AND APPROVED BY A GEOTECHNICAL ENGINEER AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	ON SITE COLD GALVANIZING VERIFICATION	THE GENERAL CONTRACTOR SHALL PROVIDE DOCUMENTATION TO THE MI INSPECTOR VERIFYING THAT ANY ON-SITE COLD GALVANIZING WAS APPLIED IN ACCORDANCE WITH SPECIFICATIONS.
NA	GUY WIRE TENSION REPORT	THE GENERAL CONTRACTOR SHALL PROVIDE A REPORT TO THE MI INSPECTOR INDICATING THE TEMPERATURE AND TENSION IN EVERY GUY CABLE FOR INCLUSION IN THE MI REPORT.
X	GC AS-BUILT DOCUMENTS	THE GENERAL CONTRACTOR SHALL SUBMIT A COPY OF THE CONTRACT DRAWINGS EITHER STATING "INSTALLED AS DESIGNED" OR NOTING ANY CHANGES THAT WERE REQUIRED AND APPROVED BY THE ENGINEER OF RECORD DUE TO FIELD CONDITIONS.
NA	MICROPILE / ROCK ANCHOR	THE GENERAL CONTRACTOR SHALL PROVIDE INSTALLER'S DRILLING AND INSTALLATION LOGS AND QA/QC DOCUMENTATION TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
		POST-CONSTRUCTION
X	MI INSPECTOR REDLINE OR RECORD DRAWING(S)	THE MI INSPECTOR SHALL OBSERVE AND REPORT ANY DISCREPANCIES BETWEEN THE CONTRACTORS REDLINE DRAWING AND THE ACTUAL COMPLETED INSTALLATION.
NA	POST INSTALLED ANCHOR ROD PULL TESTING	POST INSTALLED ANCHOR RODS SHALL BE TESTED IN ACCORDANCE WITH SPECIFICATIONS AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	PHOTOGRAPHS	PHOTOGRAPHS SHALL BE SUBMITTED TO THE MI WHICH DOCUMENT ALL PHASES OF THE CONSTRUCTION. THE PHOTOS SHALL BE ORGANIZED IN A MANNER THAT EASILY IDENTIFIES THE EXACT LOCATION OF THE PHOTO.
NA	POST INSTALLED MICROPILE / ROCK ANCHOR TESTING	POST INSTALLED ANCHORS SHALL BE TESTED AND INSPECTED IN ACCORDANCE WITH SPECIFICATION STATED ON MICROPILE/ROCK ANCHOR NOTES.

NOTE: X DENOTES A DOCUMENT NEEDED FROM THE CONTRACTOR FOR THE MI REPORT
NA DENOTES A DOCUMENT THAT IS NOT REQUIRED FOR THE MI REPORT

STATE OF CONNECTICUT
JAMES R. ANTOSZEWSKI
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PAUL J. FORD & COMPANY
250 E Broad St, Ste 600 · Columbus, OH 43215
Phone 614.221.6679 www.pauljford.com

T-MOBILE
35 GRIFFIN ROAD SOUTH BLOOMFIELD, CONNECTICUT 06002

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PROJECT No:	31216-0025.002.6125
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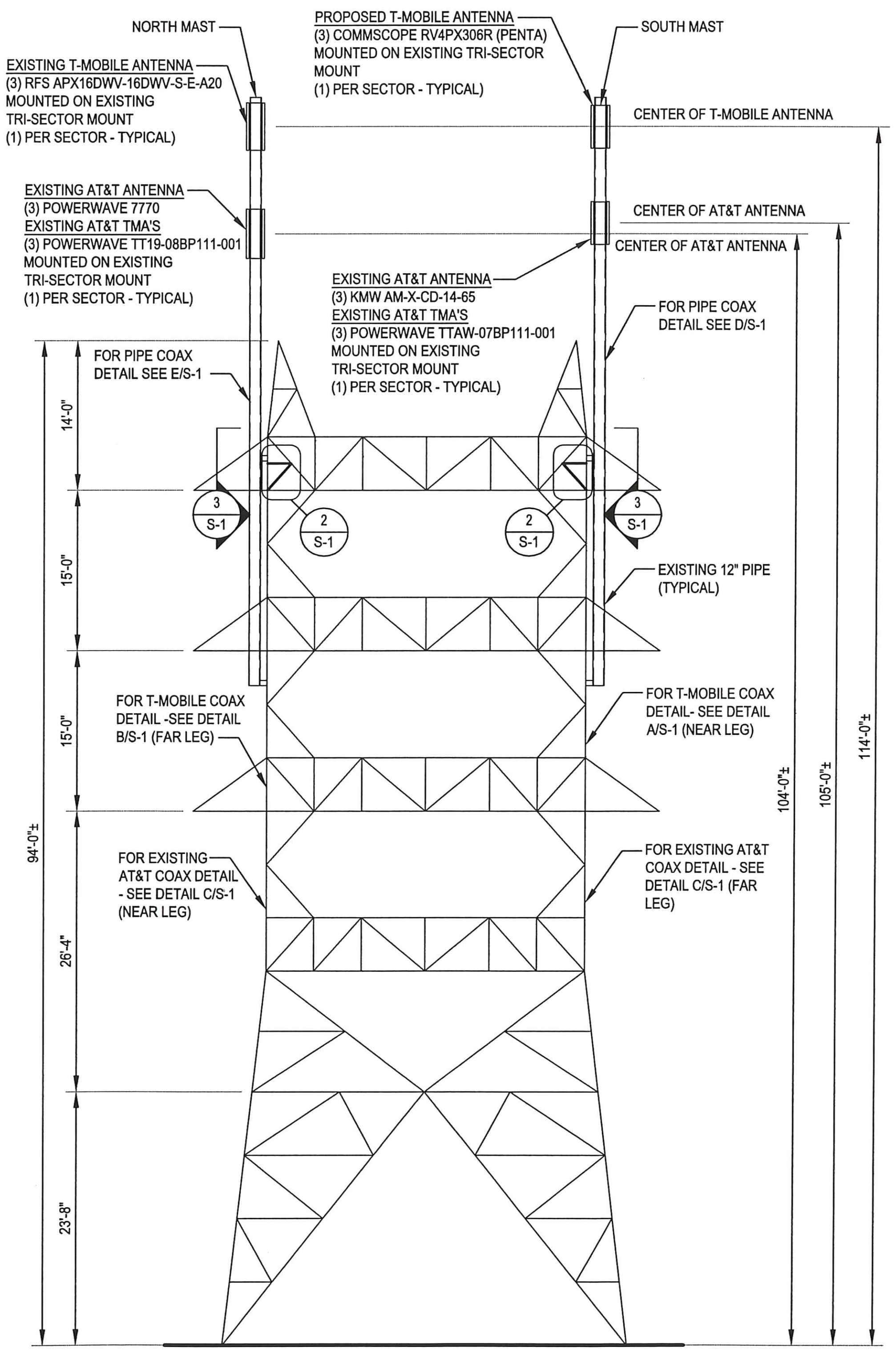
DATE:	8-29-2016

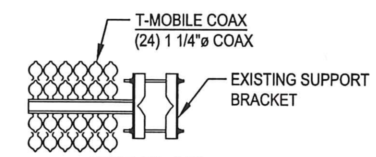
MI CHECKLIST AND NOTES

MI-1

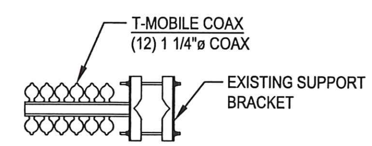
31216-0025.002.6125.DWG



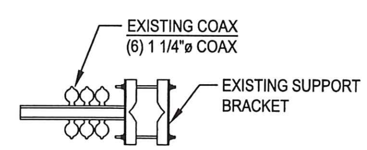
TOWER ELEVATION 1/S-1



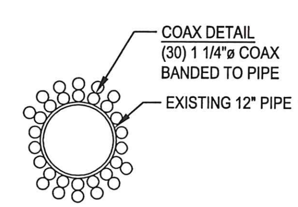
DETAIL "A"
COAX DETAIL



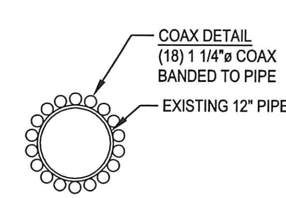
DETAIL "B"
COAX DETAIL



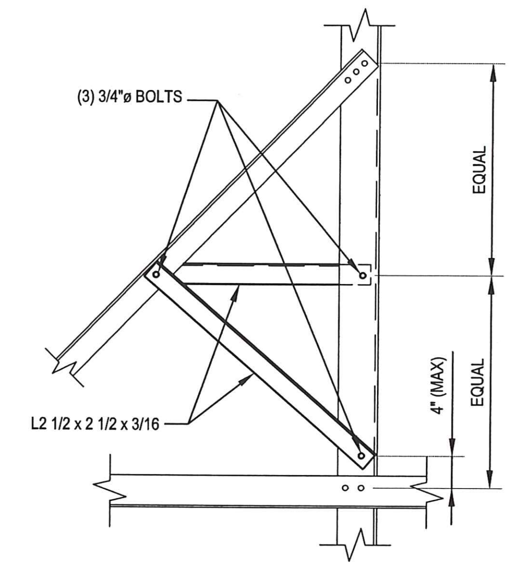
DETAIL "C"
COAX DETAIL



DETAIL "D"
COAX DETAIL

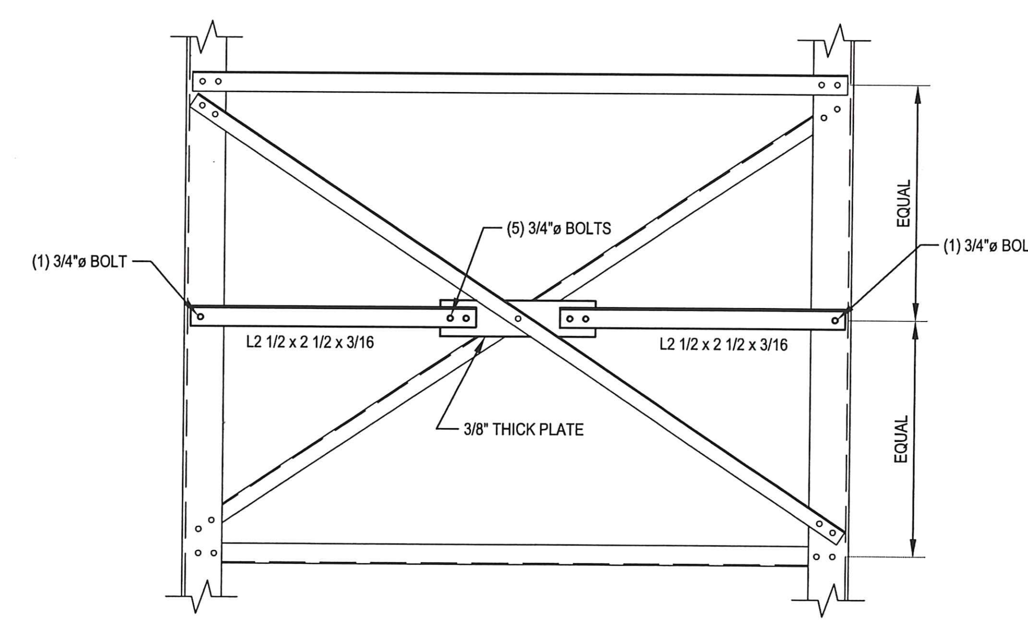


DETAIL "E"
COAX DETAIL



ELEVATION 2/S-1

NOTE:
ANTENNA MOUNT NOT SHOWN
IN ELEVATIONS 2/S-1 AND 3/S-1
FOR CLARITY



ELEVATION 3/S-1

PAUL J. FORD & COMPANY
250 E Broad St, Ste 600 · Columbus, OH 43215
Phone 614.221.6679 www.pauljford.com

T-MOBILE
35 GRIFFIN ROAD SOUTH BLOOMFIELD, CONNECTICUT 06002

CL&P TOWER #1102

LINE #1880
2 WILLRUSS STREET
NORWALK, FAIRFIELD COUNTY, CONNECTICUT
CT356/CL&P TOWER - RT. 123 SITE #CT11356C

PROJECT No:	31216-0025.002.6125
DRAWN BY:	FE
DESIGNED BY:	JRA
CHECKED BY:	CBH
DATE:	8-29-2016

TOWER ELEVATIONS AND DETAILS

S-1

31216-0025.002.6125.DWG

APPENDIX B

LOAD CALCULATIONS

INPUT DATA

TOWER ID: 1102

Structure Height (ft) : 94

Wind Zone : Central CT (green) **Wind Speed :** 110 mph

Tower Type : ○ Suspension ◉ Strain **Extreme Wind Model :** PCS Addition

Shield Wire Properties:

	BACK	AHEAD
NAME =	*0.438 COMP*	*0.438 COMP*
DESCRIPTION =	0.438	0.438
STRANDING =	9/3 Cu/Cal Brz	9/3 Cu/Cal Brz
DIAMETER =	0.438 in	0.438 in
WEIGHT =	0.408 lb/ft	0.408 lb/ft

Conductor Properties:

	BACK	AHEAD
NAME =	*TERN*	*TERN*
Number of Conductors per phase	1	1
	795.000	795.000
	45/7 ACSR	45/7 ACSR
DIAMETER =	1.063 in	1.063 in
WEIGHT =	0.895 lb/ft	0.895 lb/ft

Insulator Weight = 200 lbs Broken Wire Side = AHEAD SPAN

Horizontal Line Tensions:

	BACK		AHEAD	
	Shield	Conductor	Shield	Conductor
NESC HEAVY =	3,800	7,000	3,800	7,000
EXTREME WIND =	3,140	7,568	3,140	7,568
LONG. WIND =	na	na	na	na
250D COMBINED =	na	na	na	na
NESC W/O OLF =	na	na	na	na
60 DEG F NO WIND =	1,412	2,734	1,412	2,734

Line Geometry:

					SUM
LINE ANGLE (deg) =	BACK:	13	AHEAD:	13	**26**
WIND SPAN (ft) =	BACK:	409	AHEAD:	409	**818**
WEIGHT SPAN (ft) =	BACK:	415	AHEAD:	415	**830**

Northeast Utilities System

Job :	AT&T Norwalk, CT-5046			Page	of
		Spec. Number		Sheet	of
Description:		Computed by		Date	7/21/08
		Checked by		Date	

WIRE LOADING AT ATTACHMENTS

TOWER ID: 1102

Wind Span = 818 ft
Weight Span = 830 ft
Total Angle = 26 degrees

Broken Wire Span = AHEAD SPAN
Type of Insulator Attachment = STRAIN

1. NESC RULE 250B Heavy Loading:

	INTACT CONDITION			BROKEN WIRE CONDITION		
	Horizontal	Longitudinal	Vertical	Horizontal	Longitudinal	Vertical
Shield Wire =	3,810 lb	0 lb	1,234 lb	1,905 lb	6,108 lb	617 lb
Conductor =	6,618 lb	0 lb	2,924 lb	3,309 lb	11,252 lb	1,462 lb

2. NESC RULE 250C Transverse Extreme Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	2,270 lb	0 lb	339 lb
Conductor =	5,486 lb	0 lb	1,143 lb

3. NESC RULE 250C Longitudinal Extreme Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	339 lb
Conductor =	#VALUE!	#VALUE!	1,143 lb

4. NESC RULE 250D Extreme Ice & Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	1,823 lb
Conductor =	#VALUE!	#VALUE!	3,272 lb

5. NESC RULE 250B w/o OLF's

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	823 lb
Conductor =	#VALUE!	#VALUE!	1,949 lb

6. 60 Deg. F, No Wind

	Horizontal	Longitudinal	Vertical
Shield Wire =	637 lb	0 lb	339 lb
Conductor =	1,234 lb	0 lb	1,143 lb

7. Construction

	Horizontal	Longitudinal	Vertical
Shield Wire =	956 lb	0 lb	508 lb
Conductor =	1,851 lb	0 lb	1,714 lb

NOTE: All loads include required overload factors (OLF's).

Northeast Utilities System

Job :	AT&T Norwalk, CT-5046		Page	of
		Spec. Number	Sheet	of
Description:		Computed by	Date	7/21/08
		Checked by	Date	

INPUT DATA

TOWER ID: 1102

Structure Height (ft) : 94

Wind Zone : Central CT (green)

Wind Speed : 110 mph

Tower Type : ○ Suspension ◉ Strain

Extreme Wind Model : PCS Addition

Shield Wire Properties:

	BACK	AHEAD
NAME =	*OPGW-120*	*OPGW-120*
DESCRIPTION =	6-Groove	6-Groove
STRANDING =	10/9 FOCAS	10/9 FOCAS
DIAMETER =	0.738 in	0.738 in
WEIGHT =	0.518 lb/ft	0.518 lb/ft

Conductor Properties:

	BACK	AHEAD
NAME =	*NONE*	*NONE*
	-	-
	- -	- -
DIAMETER =	0.000 in	0.000 in
WEIGHT =	0.000 lb/ft	0.000 lb/ft

Number of Conductors per phase (BACK): 1

Number of Conductors per phase (AHEAD): 1

Insulator Weight = 200 lbs

Broken Wire Side = AHEAD SPAN

Horizontal Line Tensions:

	BACK		AHEAD	
	Shield	Conductor	Shield	Conductor
NESC HEAVY =	6,000	na	6,000	na
EXTREME WIND =	7,760	na	7,760	na
LONG. WIND =	na	na	na	na
250D COMBINED =	na	na	na	na
NESC W/O OLF =	na	na	na	na
60 DEG F NO WIND =	2,076	na	2,076	na

Line Geometry:

					SUM
LINE ANGLE (deg) =	BACK:	13	AHEAD:	13	**26**
WIND SPAN (ft) =	BACK:	409	AHEAD:	409	**818**
WEIGHT SPAN (ft) =	BACK:	415	AHEAD:	415	**830**

WIRE LOADING AT ATTACHMENTS

TOWER ID: 1102

Wind Span =	818 ft
Weight Span =	830 ft
Total Angle =	26 degrees

Broken Wire Span =	AHEAD SPAN
Type of Insulator Attachment =	STRAIN

1. NESC RULE 250B Heavy Loading:

	INTACT CONDITION			BROKEN WIRE CONDITION		
	Horizontal	Longitudinal	Vertical	Horizontal	Longitudinal	Vertical
Shield Wire =	5,652 lb	0 lb	1,603 lb	2,826 lb	9,645 lb	802 lb
Conductor =	#VALUE!	#VALUE!	987 lb	#VALUE!	#VALUE!	494 lb

2. NESC RULE 250C Transverse Extreme Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	4,939 lb	0 lb	430 lb
Conductor =	#VALUE!	#VALUE!	400 lb

3. NESC RULE 250C Longitudinal Extreme Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	430 lb
Conductor =	#VALUE!	#VALUE!	400 lb

4. NESC RULE 250D Extreme Ice & Wind Loading:

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	2,224 lb
Conductor =	#VALUE!	#VALUE!	1,432 lb

5. NESC RULE 250B w/o OLF's

	Horizontal	Longitudinal	Vertical
Shield Wire =	#VALUE!	#VALUE!	1,069 lb
Conductor =	#VALUE!	#VALUE!	658 lb

6. 60 Deg. F, No Wind

	Horizontal	Longitudinal	Vertical
Shield Wire =	937 lb	0 lb	430 lb
Conductor =	#VALUE!	#VALUE!	400 lb

7. Construction

	Horizontal	Longitudinal	Vertical
Shield Wire =	1,405 lb	0 lb	645 lb
Conductor =	#VALUE!	#VALUE!	600 lb

NOTE: All loads include required overload factors (OLF's).

Equipment Loads (Tubular Pole on Lattice Structure) - South Mast - T-Mobile

Constants

$h_{lattice} := 94 \cdot ft$ height of lattice structure

$h_{mast} := 117 \cdot ft$ Top of Mast AGL

$b_{mast} := 62 \cdot ft$ Bot. of Mast AGL

$b_{coax} := 85 \cdot ft$ Bot. of Coax AGL (on mast)

$z_{equip} := 114 \cdot ft$ elevation of equip.

$z_{coax} := 90.5 \cdot ft$ elevation to CL of coax section for TIA wind (linear appurtance)

$z_{pipe} := 90.5 \cdot ft$ elevation to CL of pipe section for TIA wind

$r_{ice} := 0.75 \cdot in$ Radial Ice, TIA

$r_{ice.nesc} := 0.5 \cdot in$ Radial Ice, NESC

NESC Shape Factors:

$Cd_R := 1.3$ $Cd_F := 1.6$ $Cd_{coax} := 1.45$

NESC Overload Factors:

$OLF250B_V := 1.5$ 250B Vertical OLF

$OLF250B_T := 2.5$ 250B Transverse Wind OLF

$OLF250C_V := 1.0$ 250C Vertical OLF

$OLF250C_T := 1.0$ 250C Transverse Wind OLF

$I_d := 57 \cdot pcf$ Ice Density

TIA/EIA Wind

$V_{Ult} := 125$ TIA Ultimate Wind Speed

$V_{tia} := V_{Ult} \cdot \sqrt{0.6} = 96.825$ TIA Nominal Wind Speed

$V_{i.tia} := 50$ TIA Basic Wind Speed with Ice

$Exp_{tia} := \text{“C”}$ TIA Exposure Category

$Topo_{tia} := 1$ TIA Topographic Category

$SC_{tia} := 3$ TIA Structure Class

$Crest_{tia} := 0$ Height of Crest, ft

$K_d := 0.95$ TIA Table 2-2

$G_H := 1.35$ TIA Sec. 2.6

$$I_{wind} := \begin{cases} 0.87 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.15 & \text{if } SC_{tia} = 3 \end{cases} = 1.15$$

$$I_{ice} := \begin{cases} 1 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.25 & \text{if } SC_{tia} = 3 \end{cases} = 1.25$$

$I_{icewind} := 1$ TIA Importance Factor Table 2-3

NESC Wind

$V_{nesc} := 110$ NESC 250C 3 sec Gust Speed per OTRM 060

$V_{i.nesc} := 39.5$ NESC 250B 3 sec Gust Speed with Ice

$I := 1.0$ NESC Importance Factor

$$E_s := 0.346 \cdot \left(\frac{33}{\left(0.67 \cdot \frac{h_{mast}}{ft}\right)} \right)^{\frac{1}{7}} = 0.306$$ NESC Factors, Table 250-3

$$B_s := \frac{1}{\left(1 + \frac{0.56 \cdot \left(0.67 \cdot \frac{h_{mast}}{ft}\right)}{220}\right)} = 0.834$$ NESC Factors, Table 250-3

$k_v := 1.43$ NESC Constant, Table 250-3

$$G_{RF} := \frac{\left(1 + \left(2.7 \cdot E_s \cdot B_s^{0.5}\right)\right)}{k_v^{\,2}} = 0.858$$ Calculated GRF, Table 250-3

$m_{grf} := 1.25$ NEU specified multiplier for 250C (OTRM 059.1, Attachment A)

$G'_{RF} := G_{RF} \cdot m_{grf} = 1.072$ Calculated GRF for 250C

TIA/EIA Topographc Coefficients:

$K_t :=$ if $Topo_{tia} = 2$: 0.43; if $Topo_{tia} = 3$: 0.53; if $Topo_{tia} = 4$: 0.72; else 1.0 $= 1$

$f_{tia} :=$ if $Topo_{tia} = 2$: 1.25; if $Topo_{tia} = 3$: 2.00; if $Topo_{tia} = 4$: 1.50; else 1.0 $= 1$

$K_e :=$ if $Exp_{tia} =$ "B": 0.9; if $Exp_{tia} =$ "D": 1.1; else 1.0 $= 1$

$K_{h.equip} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{equip}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{h.coax} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{coax}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{h.pipe} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{pipe}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{zt.equip} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.equip}}\right)^{\langle 2 \rangle}$ $= 1$

$K_{zt.coax} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.coax}}\right)^{\langle 2 \rangle}$ $= 1$

$K_{zt.pipe} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.pipe}}\right)^{\langle 2 \rangle}$ $= 1$

TIA/EIA Exposure Coefficients:

$K_{z.min} :=$ if $Exp_{tia} =$ "B": 0.7; if $Exp_{tia} =$ "D": 1.03; else 0.85 $= 0.85$

$z_g :=$ if $Exp_{tia} =$ "B": 1200; if $Exp_{tia} =$ "D": 700; else 900 $= 900$

$alpha_{tia} :=$ if $Exp_{tia} =$ "B": 7; if $Exp_{tia} =$ "D": 11.5; else 9.5 $= 9.5$

NESC Exposure Coefficient:

$$k_z := 2.01 \cdot \left(\frac{h_{mast}}{900 \cdot ft}\right)^{\left(\frac{2}{9.5}\right)} = 1.308$$

Calculated kz per Table 250-2

$$Kz_{equip} := 2.01 \cdot \left(\frac{\frac{z_{equip}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.301 \qquad Kz_{coax} := 2.01 \cdot \left(\frac{\frac{z_{coax}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239 \qquad Kz_{pipe} := 2.01 \cdot \left(\frac{\frac{z_{pipe}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239$$

$$Kz_{equip} := \begin{Vmatrix} \text{if } Kz_{equip} \le K_{z.min} \\ \quad \| Kz_{equip} = K_{z.min} \\ \text{if } Kz_{equip} > 2.01 \\ \quad \| 2.01 \\ \text{else} \\ \quad \| Kz_{equip} \end{Vmatrix} = 1.301 \qquad Kz_{coax} := \begin{Vmatrix} \text{if } Kz_{coax} \le K_{z.min} \\ \quad \| Kz_{coax} = K_{z.min} \\ \text{if } Kz_{coax} > 2.01 \\ \quad \| 2.01 \\ \text{else} \\ \quad \| Kz_{coax} \end{Vmatrix} = 1.239 \qquad Kz_{pipe} := \begin{Vmatrix} \text{if } Kz_{pipe} \le K_{z.min} \\ \quad \| Kz_{pipe} = K_{z.min} \\ \text{if } Kz_{pipe} > 2.01 \\ \quad \| 2.01 \\ \text{else} \\ \quad \| Kz_{pipe} \end{Vmatrix} = 1.239$$

Section Average Height Above Ground for Wind Load

Section Average Height Above Ground for Wind Load

TIA/EIA Wind Pressure:

$$qzice_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.9\ psf$$

$$qz_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 34.1\ psf$$

$$qzice_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

NESC Wind Pressure:

$$qz_{250B} := 0.00256 \cdot V_{i.nesc}^2 \cdot I \cdot psf = 4.0\ psf$$

$$qz_{250C} := 0.00256 \cdot k_z \cdot V_{nesc}^2 \cdot I \cdot psf = 40.5\ psf$$

TIA/EIA Design Ice Thickness:

$$K_{iz.equip} := \left(\frac{\frac{z_{equip}}{ft}}{33}\right)^{0.1} = 1.132 \qquad K_{iz.pipe} := \left(\frac{\frac{z_{pipe}}{ft}}{33}\right)^{0.1} = 1.106 \qquad K_{iz.coax} := \left(\frac{\frac{z_{coax}}{ft}}{33}\right)^{0.1} = 1.106$$

$$t_{iz.equip} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.equip} \cdot K_{zt.equip}^{0.35} = 2.122\ in$$

$$t_{iz.pipe} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.pipe} \cdot K_{zt.pipe}^{0.35} = 2.074\ in$$

$$t_{iz.coax} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.coax} \cdot K_{zt.coax}^{0.35} = 2.074\ in$$

Pipe Extension Loads

Constants

$OD := 12.75 \cdot in$ outer diameter of pipe riser

$L_{pipe} := 55\ ft$ Length of pipe riser

$MemberLabel_{pipe} := \text{"M2"}$ Member Label in Risa

$$Weight.ice_{pipe} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot t_{iz.pipe}\right)^2 - OD^2\right) = 38.2\ plf$$

$$Weight.ice_{pipe.nesc} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot r_{ice.nesc}\right)^2 - OD^2\right) = 8.2\ plf$$

$SA_{pipe} := OD = 1.063\ ft$ Projected Surface Area of Pipe

$SAice_{pipe} := OD + \left(2 \cdot t_{iz.pipe}\right) = 1.408\ ft$ Projected Surface Area of Pipe with Ice (TIA)

$SAice_{pipe.nesc} := OD + \left(2 \cdot r_{ice.nesc}\right) = 1.146\ ft$ Projected Surface Area of Pipe with Ice (NESC)

TIA/EIA Wind:

$$Ar_{pipe} := \frac{L_{pipe}}{OD} = 51.765$$

$$Ca_{pipe} := \begin{cases} 0.7 & \text{if } Ar_{pipe} \le 2.5 \\ 0.7 + \frac{\left(Ar_{pipe} - 2.5\right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{pipe} < 7 \\ 0.8 + \frac{\left(Ar_{pipe} - 7\right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{pipe} < 25 \\ 1.2 & \text{if } Ar_{pipe} \ge 25 \end{cases} = 1.2$$

Table 2-8

$$Wind.TIA_{pipe} := qz_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SA_{pipe} = 55.9\ plf$$

$$IceWind.TIA_{pipe} := qzice_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SAice_{pipe} = 17.2\ plf$$

NESC Wind:

$$Wind.250B_{pipe} := qz_{250B} \cdot Cd_R \cdot SAice_{pipe.nesc} = 5.9\ plf$$

Wind Pressure Above Top of Tower:

$$Wind.250C_{pipe.Above} := qz_{250C} \cdot G'_{RF} \cdot Cd_R \cdot SA_{pipe} = 60.0\ plf$$

Wind Pressure Below Top of Tower:

$$Wind.250C_{pipe.Below} := qz_{250C} \cdot G_{RF} \cdot Cd_R \cdot SA_{pipe} = 48.0\ plf$$

Mast Component Loads

$a := 1..4$ <----- input number of component slots used

Component Description

1. 6x6x1/4 Hor Tube	$Cd_{comp_1} := Cd_F$	$W_{comp_1} := 6\ in$	$H_{comp_1} := 6 \cdot in$	$L_{comp_1} := 7\ ft$	$MemLabel_{comp_1} :=$ "M4"
2. 6x6x1/4 Hor Tube	$Cd_{comp_2} := Cd_F$	$W_{comp_2} := 6 \cdot in$	$H_{comp_2} := 6 \cdot in$	$L_{comp_2} := 7\ ft$	$MemLabel_{comp_2} :=$ "M7"
3. 6x6x1/4 Hor Tube	$Cd_{comp_3} := Cd_F$	$W_{comp_3} := 6 \cdot in$	$H_{comp_3} := 6 \cdot in$	$L_{comp_3} := 1.08\ ft$	$MemLabel_{comp_3} :=$ "M9"
4. 6x6x1/4 Hor Tube	$Cd_{comp_4} := Cd_F$	$W_{comp_4} := 6 \cdot in$	$H_{comp_4} := 6 \cdot in$	$L_{comp_4} := 1.08\ ft$	$MemLabel_{comp_4} :=$ "M10"
5. Not Used	$Cd_{comp_5} := Cd_F$	$W_{comp_5} := 0 \cdot in$	$H_{comp_5} := 0 \cdot in$	$L_{comp_5} := 0\ ft$	$MemLabel_{comp_5} :=$ "M4"
6. Not Used	$Cd_{comp_6} := Cd_F$	$W_{comp_6} := 0 \cdot in$	$H_{comp_6} := 0 \cdot in$	$L_{comp_6} := 0\ ft$	$MemLabel_{comp_6} :=$ "M4"

$$Weight.ice_{comp_a} := I_d \cdot \pi \cdot t_{iz.pipe} \cdot \left(\max\left(H_{comp_a}, W_{comp_a}\right) + t_{iz.pipe}\right) = \begin{bmatrix} 20.8 \\ 20.8 \\ 20.8 \\ 20.8 \end{bmatrix} plf$$

$$Weight.ice_{comp.nesc_a} := I_d \cdot \left(\left(W_{comp_a} + 2 \cdot r_{ice.nesc}\right) \cdot \left(H_{comp_a} + 2 \cdot r_{ice.nesc}\right) - W_{comp_a} \cdot H_{comp_a}\right) = \begin{bmatrix} 5.1 \\ 5.1 \\ 5.1 \\ 5.1 \end{bmatrix} plf$$

$$SA_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) = \begin{bmatrix} 0.5 \\ 0.5 \\ 0.5 \\ 0.5 \end{bmatrix} ft$$

$$SAice_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe} = \begin{bmatrix} 0.8 \\ 0.8 \\ 0.8 \\ 0.8 \end{bmatrix} ft$$

$$Ar_{comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a}}{\max\left(W_{comp_a}, H_{comp_a}\right)} & \text{else} \end{cases} = \begin{bmatrix} 14 \\ 14 \\ 2.2 \\ 2.2 \end{bmatrix}$$

$$Ar_{ice.comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a} + 2 \cdot t_{iz.pipe}}{\max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe}} & \text{else} \end{cases} = \begin{bmatrix} 8.7 \\ 8.7 \\ 1.7 \\ 1.7 \end{bmatrix}$$

$$Ca_{comp_a} := \begin{cases} 1.2 & \text{if } Ar_{comp_a} \le 2.5 \\ 1.2 + \dfrac{\left(Ar_{comp_a} - 2.5\right)\cdot(1.4 - 1.2)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{comp_a} < 7 \\ 1.4 + \dfrac{\left(Ar_{comp_a} - 7\right)\cdot(2.0 - 1.4)}{(25 - 7)} & \text{if } 7 \le Ar_{comp_a} < 25 \\ 2.0 & \text{if } Ar_{comp_a} \ge 25 \end{cases} = \begin{bmatrix} 1.633 \\ 1.633 \\ 1.2 \\ 1.2 \end{bmatrix}$$

$$Ca_{ice.comp_a} := \begin{cases} 0.7 & \text{if } Ar_{ice.comp_a} \le 2.5 \\ 0.7 + \dfrac{\left(Ar_{ice.comp_a} - 2.5\right)\cdot(0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{ice.comp_a} < 7 \\ 0.8 + \dfrac{\left(Ar_{comp_a} - 7\right)\cdot(1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{ice.comp_a} < 25 \\ 1.2 & \text{if } Ar_{ice.comp_a} \ge 25 \end{cases} = \begin{bmatrix} 0.956 \\ 0.956 \\ 0.7 \\ 0.7 \end{bmatrix}$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{comp_a} := qzice_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} + qzice_{comp} \cdot G_H \cdot Ca_{ice.comp_a} \cdot \left(SAice_{comp_a} - SA_{comp_a}\right) = \begin{bmatrix} 11.7 \\ 11.7 \\ 8.6 \\ 8.6 \end{bmatrix} \textbf{plf}$$

$$Wind.TIA_{comp_a} := qz_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} = \begin{bmatrix} 35.8 \\ 35.8 \\ 26.3 \\ 26.3 \end{bmatrix} \textbf{plf}$$

NESC Wind:

$$Wind.250B_{comp_a} := qz_{250B} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = \begin{bmatrix} 3.2 \\ 3.2 \\ 3.2 \\ 3.2 \end{bmatrix} \textbf{plf}$$

$$Wind.250C_{comp_a} := qz_{250C} \cdot G_{RF} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = \begin{bmatrix} 27.8 \\ 27.8 \\ 27.8 \\ 27.8 \end{bmatrix} \textbf{plf}$$

Mount Load

$b := 1..2$ <----- input number of mount slots used

TIA/EIA-222-G Table 2-8 | NESC Shape Factor

1. Microflect Tri-Sector Mount

$A_{mount_1} := 3.0 \cdot ft^2$ | $Aice_{mount_1} := 9.1 \cdot ft^2$ | $WT_{mount_1} := 101 \cdot lb$ | $WTice_{mount_1} := 346 \cdot lb$ | $Ca_{mount_1} := 1.2$ | $Cd_{mount_1} := Cd_F$

$Aice_{mount.nesc_1} := 4.22 \cdot ft^2$ | $WTice_{mount.nesc_1} := 150 \cdot lb$

2. (3) 2.375" OD Pipe Mounts

$A_{mount_2} := 0 \cdot ft^2$ | $Aice_{mount_2} := 0 \cdot ft^2$ | $WT_{mount_2} := 66 \cdot lb$ | $WTice_{mount_2} := 190 \cdot lb$ | $Ca_{mount_2} := 1.2$ | $Cd_{mount_2} := Cd_F$

$Aice_{mount.nesc_2} := 0 \cdot ft^2$ | $WTice_{mount.nesc_2} := 97 \cdot lb$

3. Not Used

$A_{mount_3} := 0 \cdot ft^2$ | $Aice_{mount_3} := 0 \cdot ft^2$ | $WT_{mount_3} := 0 \cdot lb$ | $WTice_{mount_3} := 0 \cdot lb$ | $Ca_{mount_3} := 1.2$ | $Cd_{mount_3} := Cd_F$

4. Not Used

$A_{mount_4} := 0 \cdot ft^2$ | $Aice_{mount_4} := 0 \cdot ft^2$ | $WT_{mount_4} := 0 \cdot lb$ | $WTice_{mount_4} := 0 \cdot lb$ | $Ca_{mount_4} := 1.2$ | $Cd_{mount_4} := Cd_F$

TIA/EIA Wind:

$$IceWind.TIA_{mount_b} := qzice_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot Aice_{mount_b} = \begin{bmatrix} 116.6 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.TIA_{mount_b} := qz_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 165.8 \\ 0.0 \end{bmatrix} lbf$$

NESC Wind:

$$Wind.250B_{mount_b} := qz_{250B} \cdot Cd_{mount_b} \cdot Aice_{mount.nesc_b} = \begin{bmatrix} 27.0 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.250C_{mount_b} := qz_{250C} \cdot G'_{RF} \cdot Cd_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 208.5 \\ 0.0 \end{bmatrix} lbf$$

Equipment Loads

Equipment Description $i := 1..1$ <----- input number of equip slots used

1. RV4PX306R (Penta)	$QTY_{eq_1} := 3$	$L_{eq_1} := 63 \cdot in$	$W_{eq_1} := 13.9 \cdot in$	$t_{eq_1} := 8.2 \cdot in$	$WT_{eq_1} := 52.9 \cdot lbf$
2. Not Used	$QTY_{eq_2} := 0$	$L_{eq_2} := 0 \cdot in$	$W_{eq_2} := 0 \cdot in$	$t_{eq_2} := 0 \cdot in$	$WT_{eq_2} := 0 \cdot lbf$
3. Not Used	$QTY_{eq_3} := 0$	$L_{eq_3} := 0 \cdot in$	$W_{eq_3} := 0 \cdot in$	$t_{eq_3} := 0 \cdot in$	$WT_{eq_3} := 0 \cdot lbf$
4. Not Used	$QTY_{eq_4} := 0$	$L_{eq_4} := 0 \cdot in$	$W_{eq_4} := 0 \cdot in$	$t_{eq_4} := 0 \cdot in$	$WT_{eq_4} := 0 \cdot lbf$
5. Not Used	$QTY_{eq_5} := 0$	$L_{eq_5} := 0 \cdot in$	$W_{eq_5} := 0 \cdot in$	$t_{eq_5} := 0 \cdot in$	$WT_{eq_5} := 0 \cdot lbf$
6. Not Used	$QTY_{eq_6} := 0$	$L_{eq_6} := 0 \cdot in$	$W_{eq_6} := 0 \cdot in$	$t_{eq_6} := 0 \cdot in$	$WT_{eq_6} := 0 \cdot lbf$

$$Weight_{equip_i} := WT_{eq_i} \cdot QTY_{eq_i} = [158.7]\ lbf$$

$$Weight.Ice_{equip_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(t_{eq_i} + 2 \cdot t_{iz.equip}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right)\right) = [792.1]\ lbf$$

$$Weight.Ice_{equip.nesc_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(t_{eq_i} + 2 \cdot r_{ice.nesc}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right)\right) = [157.6]\ lbf$$

$$SA_{eq_i} := L_{eq_i} \cdot W_{eq_i} = [6.1]\ ft^2 \qquad A_{eq_i} := SA_{eq_i} \cdot QTY_{eq_i} = [18.2]\ ft^2$$

$$SAice_{eq_i} := \left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) = [8.5]\ ft^2 \qquad Aice_{eq_i} := SAice_{eq_i} \cdot QTY_{eq_i} = [25.4]\ ft^2$$

$$SAice_{eq.nesc_i} := \left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) = [6.6]\ ft^2 \qquad Aice_{eq.nesc_i} := SAice_{eq.nesc_i} \cdot QTY_{eq_i} = [19.9]\ ft^2$$

$$Ar_{eq_i} := \frac{L_{eq_i}}{W_{eq_i}} = [4.5] \qquad Ar_{ice.eq_i} := \frac{L_{eq_i} + 2 \cdot t_{iz.equip}}{W_{eq_i} + 2 \cdot t_{iz.equip}} = [3.7]$$

$$Ca_{eq_i} := \begin{cases} 1.2 & \text{if } Ar_{eq_i} \le 2.5 \\ 1.2 + \frac{\left(Ar_{eq_i} - 2.5\right) \cdot (1.4 - 1.2)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{eq_i} < 7 \\ 1.4 + \frac{\left(Ar_{eq_i} - 7\right) \cdot (2.0 - 1.4)}{(25 - 7)} & \text{if } 7 \le Ar_{eq_i} < 25 \\ 2.0 & \text{if } Ar_{eq_i} \ge 25 \end{cases} = [1.29]$$

$$Ca_{ice.eq_i} := \begin{cases} 0.7 & \text{if } Ar_{ice.eq_i} \le 2.5 \\ 0.7 + \frac{\left(Ar_{ice.eq_i} - 2.5\right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{ice.eq_i} < 7 \\ 0.8 + \frac{\left(Ar_{comp_a} - 7\right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{ice.eq_i} < 25 \\ 1.2 & \text{if } Ar_{ice.eq_i} \ge 25 \end{cases} = [0.727]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{equip_i} := qzice_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} + qzice_{equip} \cdot G_H \cdot Ca_{ice.eq_i} \cdot \left(Aice_{eq_i} - A_{eq_i}\right) = [307.1] \; \mathbf{lbf}$$

$$Wind.TIA_{equip_i} := qz_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} = [1084.1] \; \mathbf{lbf}$$

NESC Wind:

$$Wind.250B_{equip_i} := qz_{250B} \cdot Cd_F \cdot Aice_{eq.nesc_i} = [127.0] \; \mathbf{lbf}$$

$$Wind.250C_{equip_i} := qz_{250C} \cdot G'_{RF} \cdot Cd_F \cdot A_{eq_i} = [1268.0] \; \mathbf{lbf}$$

Coax Loads - Southwest Leg

Coax Cable Description $k := 1..1$ <----- input number of coax cable slots used

1. Heliax 1-1/4"ø	$QTY_{coax_1} := 24$	$NP_{coax_1} := 6$	$OD_{coax_1} := 1.48 \cdot in$	$WT_{coax_1} := 0.50 \cdot plf$	$L_{coax_1} := 20 \cdot ft$
2. Not Used	$QTY_{coax_2} := 0$	$NP_{coax_2} := 0$	$OD_{coax_2} := 0 \cdot in$	$WT_{coax_2} := 0 \cdot plf$	$L_{coax_2} := 0 \cdot ft$
3. Not Used	$QTY_{coax_3} := 0$	$NP_{coax_3} := 0$	$OD_{coax_3} := 0 \cdot in$	$WT_{coax_3} := 0 \cdot plf$	$L_{coax_3} := 0 \cdot ft$
4. Not Used	$QTY_{coax_4} := 0$	$NP_{coax_4} := 0$	$OD_{coax_4} := 0 \cdot in$	$WT_{coax_4} := 0 \cdot plf$	$L_{coax_4} := 0 \cdot ft$
5. Not Used	$QTY_{coax_5} := 0$	$NP_{coax_5} := 0$	$OD_{coax_5} := 0 \cdot in$	$WT_{coax_5} := 0 \cdot plf$	$L_{coax_5} := 0 \cdot ft$
6. Not Used	$QTY_{coax_6} := 0$	$NP_{coax_6} := 0$	$OD_{coax_6} := 0 \cdot in$	$WT_{coax_6} := 0 \cdot plf$	$L_{coax_6} := 0 \cdot ft$

$$SA_{coax_k} := NP_{coax_k} \cdot OD_{coax_k} = [0.7]\ ft$$

$$coaxspan := \begin{bmatrix} 29 \\ 13 \\ 15 \\ 15 \\ 12.5 \end{bmatrix} \cdot ft$$

Input coax vertical span between attachment joints for PLS Loads

$$SAice_{coax_k} := \begin{cases} \text{if } NP_{coax_k} = 0 \\ \quad 0 \\ \text{else} \\ \quad \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot t_{iz.coax}\right)\right) \end{cases} = [1.1]\ ft$$

$$Weight_{coax_k} := WT_{coax_k} \cdot QTY_{coax_k} = [12.0]\ plf$$

$$SAice_{coax.nesc_k} := \begin{cases} \text{if } NP_{coax_k} = 0 \\ \quad 0 \\ \text{else} \\ \quad \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot r_{ice.nesc}\right)\right) \end{cases} = [0.8]\ ft$$

$$Weight.Ice_{coax_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot t_{iz.coax}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [220.0]\ plf$$

$$Weight.Ice_{coax.nesc_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot r_{ice.nesc}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [29.5]\ plf$$

$$Ar_{coax_k} := \frac{L_{coax_k}}{OD_{coax_k}} = [162.2]$$

Aspect Ratio of Coax

$$Ca_{coax_k} := \begin{cases} 0.7 & \text{if } Ar_{coax_k} \le 2.5 \\ 0.7 + \dfrac{(Ar_{coax_k} - 2.5) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{coax_k} < 7 \\ 0.8 + \dfrac{(Ar_{coax_k} - 7) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{coax_k} < 25 \\ 1.2 & \text{if } Ar_{coax_k} \ge 25 \end{cases} = [1.2]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{coax_k} := qzice_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SAice_{coax_k} = [13.3]\ \mathbf{plf}$$

$$Wind.TIA_{coax_k} := qz_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SA_{coax_k} = [39.0]\ \mathbf{plf}$$

NESC Wind for Coax on Pipe Mast Risa Model:

$$Wind.250B_{coax.pipe_k} := qz_{250B} \cdot Cd_{coax} \cdot SAice_{coax.nesc_k} = [4.8] \; plf$$

$$Wind.250C_{coax.pipe.Above_k} := qz_{250C} \cdot G'_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [46.6] \; plf$$

$$Wind.250C_{coax.pipe.Below_k} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [37.3] \; plf$$

NESC Loads For PLS Model:

$$Weight.250B_{coax.twr} := \left(\sum Weight_{coax} + \sum Weight.Ice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_V$$

$$Wind.250B_{coax.twr} := qz_{250B} \cdot Cd_{coax} \cdot \left(\sum SAice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_T$$

$$Weight.250C_{coax.twr} := \left(\sum Weight_{coax} \right) \cdot coaxspan \cdot OLF250C_V$$

$$Wind.250C_{coax.twr} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot \left(\sum SA_{coax} \right) \cdot coaxspan \cdot OLF250C_T$$

Summary of Loads - PLS Coax Load Inputs

NESC 250B_X-dir - Wind w/ Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1	1807	346	0	Coax Load
C2	810	155	0	Coax Load
C3	935	179	0	Coax Load
C4	935	179	0	Coax Load
C5	779	149	0	Coax Load

NESC 250C_X-dir - Wind w/o Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1	348	1081	0	Coax Load
C2	156	485	0	Coax Load
C3	180	559	0	Coax Load
C4	180	559	0	Coax Load
C5	150	466	0	Coax Load

Summary of Loads - Risa Loads Inputs

BLC 2 Weight of Equipment
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-101.0	52.0	**Mount 1**
M2	Y	-66.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-158.7	52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
M2	Y		52.0	**Equipment 6**

Member Distributed Loads - Rows 1-6: Coax 1-6 Weight

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-12.0	-12.0	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0

BLC 3 Weight of Ice on Mast & Equipment - TIA
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-346.0	52.0	**Mount 1**
M2	Y	-190.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-792.1	52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
M2	Y		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-38.2	-38.2	0.0	0.0
M2	Y	-220.0	-220.0	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M4	Y	-20.8	-20.8	0.0	0.0
M7	Y	-20.8	-20.8	0.0	0.0
M9	Y	-20.8	-20.8	0.0	0.0
M10	Y	-20.8	-20.8	0.0	0.0
M4	Y			0.0	0.0
M4	Y			0.0	0.0

BLC 4 TIA_X-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	116.6	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	307.1	52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
M2	X		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	17.2	17.2	0.0	0.0
M2	PX	13.3	13.3	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	11.7	11.7	0.0	0.0
M7	PX	11.7	11.7	0.0	0.0
M9	PX	8.6	8.6	0.0	0.0
M10	PX	8.6	8.6	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 5 TIA_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]
M2	X	165.8	52.0
M2	X	0.0	52.0
M2	X		52.0
M2	X		52.0
M2	X	1084.1	52.0
M2	X		52.0
M2	X		52.0
M2	X		52.0
M2	X		52.0
M2	X		52.0

Mount 1
Mount 2
Mount 3
Mount 4

Equipment 1
Equipment 2
Equipment 3
Equipment 4
Equipment 5
Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	55.9	55.9	0.0	0.0
M2	PX	39.0	39.0	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	35.8	35.8	0.0	0.0
M7	PX	35.8	35.8	0.0	0.0
M9	PX	26.3	26.3	0.0	0.0
M10	PX	26.3	26.3	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 6 TIA_Z-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	116.6	52.0	**Mount 1**
M2	Z	0.0	52.0	**Mount 2**
M2	Z		52.0	**Mount 3**
M2	Z		52.0	**Mount 4**
M2	Z	307.1	52.0	**Equipment 1**
M2	Z		52.0	**Equipment 2**
M2	Z		52.0	**Equipment 3**
M2	Z		52.0	**Equipment 4**
M2	Z		52.0	**Equipment 5**
M2	Z		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	17.2	17.2	0.0	0.0
M2	PZ	13.3	13.3	23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M4	PZ	11.7	11.7	0.0	0.0
M7	PZ	11.7	11.7	0.0	0.0
M9	PZ	8.6	8.6	0.0	0.0
M10	PZ	8.6	8.6	0.0	0.0
M4	PZ			0.0	0.0
M4	PZ			0.0	0.0

BLC 7 TIA_Z-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	165.8	52.0	**Mount 1**
M2	Z	0.0	52.0	**Mount 2**
M2	Z		52.0	**Mount 3**
M2	Z		52.0	**Mount 4**
M2	Z	1084.1	52.0	**Equipment 1**
M2	Z		52.0	**Equipment 2**
M2	Z		52.0	**Equipment 3**
M2	Z		52.0	**Equipment 4**
M2	Z		52.0	**Equipment 5**
M2	Z		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	55.9	55.9	0.0	0.0
M2	PZ	39.0	39.0	23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M4	PZ	35.8	35.8	0.0	0.0
M7	PZ	35.8	35.8	0.0	0.0
M9	PZ	26.3	26.3	0.0	0.0
M10	PZ	26.3	26.3	0.0	0.0
M4	PZ			0.0	0.0
M4	PZ			0.0	0.0

3LC 8 NESC 250B_X-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	27.0	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	127.0	52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
M2	X		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	5.9	5.9	0.0	0.0
M2	PX	4.8	4.8	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	3.2	3.2	0.0	0.0
M7	PX	3.2	3.2	0.0	0.0
M9	PX	3.2	3.2	0.0	0.0
M10	PX	3.2	3.2	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 9 NESC 250C_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	208.5	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	1268.0	52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
M2	X		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast Above Top of Tower
Row 2-7: Wind on Coax 1-6 Above Top of Tower
Row 8: Wind on Mast Below Top of Tower
Row 9-14: Wind on Coax 1-6 Below Top of Tower
Row 15-20: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	60.0	60.0	32.0	55.0
M2	PX	46.6	46.6	32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX	48.0	48.0	0.0	32.0
M2	PX	37.3	37.3	23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M4	PX	27.8	27.8	0.0	0.0
M7	PX	27.8	27.8	0.0	0.0
M9	PX	27.8	27.8	0.0	0.0
M10	PX	27.8	27.8	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 10 Weight of Ice on Mast & Equipment - NESC
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-150.0	52.0	**Mount 1**
M2	Y	-97.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-157.6	52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
M2	Y		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-8.2	-8.2	0.0	0.0
M2	Y	-29.5	-29.5	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M4	Y	-5.1	-5.1	0.0	0.0
M7	Y	-5.1	-5.1	0.0	0.0
M9	Y	-5.1	-5.1	0.0	0.0
M10	Y	-5.1	-5.1	0.0	0.0
M4	Y			0.0	0.0
M4	Y			0.0	0.0

Equipment Loads (Tubular Pole on Lattice Structure) - South Mast - AT&T

Constants

$h_{lattice} := 94 \cdot ft$	height of lattice structure
$h_{mast} := 117 \cdot ft$	Top of Mast AGL
$b_{mast} := 62 \cdot ft$	Bot. of Mast AGL
$b_{coax} := 85 \cdot ft$	Bot. of Coax AGL (on mast)
$z_{equip} := 105 \cdot ft$	elevation of equip.
$z_{coax} := 90.5 \cdot ft$	elevation to CL of coax section for TIA wind (linear appurtance)
$z_{pipe} := 90.5 \cdot ft$	elevation to CL of pipe section for TIA wind
$r_{ice} := 0.75 \cdot in$	Radial Ice, TIA
$r_{ice.nesc} := 0.5 \cdot in$	Radial Ice, NESC

NESC Shape Factors:

$Cd_R := 1.3$ $Cd_F := 1.6$ $Cd_{coax} := 1.45$

NESC Overload Factors:

$OLF250B_V := 1.5$	250B Vertical OLF
$OLF250B_T := 2.5$	250B Transverse Wind OLF
$OLF250C_V := 1.0$	250C Vertical OLF
$OLF250C_T := 1.0$	250C Transverse Wind OLF

$I_d := 57 \cdot pcf$ Ice Density

TIA/EIA Wind

$V_{Ult} := 125$	TIA Ultimate Wind Speed
$V_{tia} := V_{Ult} \cdot \sqrt{0.6} = 96.825$	TIA Nominal Wind Speed
$V_{i.tia} := 50$	TIA Basic Wind Speed with Ice
$Exp_{tia} := \text{"C"}$	TIA Exposure Category
$Topo_{tia} := 1$	TIA Topographic Category
$SC_{tia} := 3$	TIA Structure Class
$Crest_{tia} := 0$	Height of Crest, ft
$K_d := 0.95$	TIA Table 2-2
$G_H := 1.35$	TIA Sec. 2.6

$$I_{wind} := \begin{cases} 0.87 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.15 & \text{if } SC_{tia} = 3 \end{cases} = 1.15$$

$$I_{ice} := \begin{cases} 1 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.25 & \text{if } SC_{tia} = 3 \end{cases} = 1.25$$

$I_{icewind} := 1$ TIA Importance Factor Table 2-3

NESC Wind

$V_{nesc} := 110$	NESC 250C 3 sec Gust Speed per OTRM 060
$V_{i.nesc} := 39.5$	NESC 250B 3 sec Gust Speed with Ice
$I := 1.0$	NESC Importance Factor

$$E_s := 0.346 \cdot \left(\frac{33}{\left(0.67 \cdot \frac{h_{mast}}{ft}\right)} \right)^{\frac{1}{7}} = 0.306$$

NESC Factors, Table 250-3

$$B_s := \frac{1}{\left(1 + \frac{0.56 \cdot \left(0.67 \cdot \frac{h_{mast}}{ft}\right)}{220}\right)} = 0.834$$

NESC Factors, Table 250-3

$k_v := 1.43$ NESC Constant, Table 250-3

$$G_{RF} := \frac{\left(1 + \left(2.7 \cdot E_s \cdot B_s^{0.5}\right)\right)}{k_v^{2}} = 0.858$$

Calculated GRF, Table 250-3

$m_{grf} := 1.25$ NEU specified multiplier for 250C (OTRM 059.1, Attachment A)

$G'_{RF} := G_{RF} \cdot m_{grf} = 1.072$ Calculated GRF for 250C

TIA/EIA Topographc Coefficients:

$$K_t := \begin{cases} 0.43 & \text{if } Topo_{tia} = 2 \\ 0.53 & \text{if } Topo_{tia} = 3 \\ 0.72 & \text{if } Topo_{tia} = 4 \\ 1.0 & \text{else} \end{cases} = 1$$

$$f_{tia} := \begin{cases} 1.25 & \text{if } Topo_{tia} = 2 \\ 2.00 & \text{if } Topo_{tia} = 3 \\ 1.50 & \text{if } Topo_{tia} = 4 \\ 1.0 & \text{else} \end{cases} = 1$$

$$K_e := \begin{cases} 0.9 & \text{if } Exp_{tia} = \text{“B”} \\ 1.1 & \text{if } Exp_{tia} = \text{“D”} \\ 1.0 & \text{else} \end{cases} = 1$$

$$K_{h.equip} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{equip}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{h.coax} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{coax}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{h.pipe} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{pipe}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{zt.equip} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.equip}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

$$K_{zt.coax} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.coax}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

$$K_{zt.pipe} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.pipe}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

TIA/EIA Exposure Coefficients:

$$K_{z.min} := \begin{cases} 0.7 & \text{if } Exp_{tia} = \text{“B”} \\ 1.03 & \text{if } Exp_{tia} = \text{“D”} \\ 0.85 & \text{else} \end{cases} = 0.85$$

$$z_g := \begin{cases} 1200 & \text{if } Exp_{tia} = \text{“B”} \\ 700 & \text{if } Exp_{tia} = \text{“D”} \\ 900 & \text{else} \end{cases} = 900$$

$$alpha_{tia} := \begin{cases} 7 & \text{if } Exp_{tia} = \text{“B”} \\ 11.5 & \text{if } Exp_{tia} = \text{“D”} \\ 9.5 & \text{else} \end{cases} = 9.5$$

NESC Exposure Coefficient:

$$k_z := 2.01 \cdot \left(\frac{h_{mast}}{900 \cdot ft}\right)^{\left(\frac{2}{9.5}\right)} = 1.308$$

Calculated kz per Table 250-2

$$Kz_{equip} := 2.01 \cdot \left(\frac{\frac{z_{equip}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.279 \qquad Kz_{coax} := 2.01 \cdot \left(\frac{\frac{z_{coax}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239 \qquad Kz_{pipe} := 2.01 \cdot \left(\frac{\frac{z_{pipe}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239$$

$$Kz_{equip} := \begin{cases} \text{if } Kz_{equip} \le K_{z.min} & Kz_{equip} = K_{z.min} \\ \text{if } Kz_{equip} > 2.01 & 2.01 \\ \text{else} & Kz_{equip} \end{cases} = 1.279$$

$$Kz_{coax} := \begin{cases} \text{if } Kz_{coax} \le K_{z.min} & Kz_{coax} = K_{z.min} \\ \text{if } Kz_{coax} > 2.01 & 2.01 \\ \text{else} & Kz_{coax} \end{cases} = 1.239$$

$$Kz_{pipe} := \begin{cases} \text{if } Kz_{pipe} \le K_{z.min} & Kz_{pipe} = K_{z.min} \\ \text{if } Kz_{pipe} > 2.01 & 2.01 \\ \text{else} & Kz_{pipe} \end{cases} = 1.239$$

Section Average Height Above Ground for Wind Load

Section Average Height Above Ground for Wind Load

TIA/EIA Wind Pressure:

$$qzice_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.8\ psf$$

$$qz_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 33.5\ psf$$

$$qzice_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^2 \cdot I_{wind} = 32.5\ psf$$

NESC Wind Pressure:

$$qz_{250B} := 0.00256 \cdot V_{i.nesc}^2 \cdot I \cdot psf = 4.0\ psf$$

$$qz_{250C} := 0.00256 \cdot k_z \cdot V_{nesc}^2 \cdot I \cdot psf = 40.5\ psf$$

TIA/EIA Design Ice Thickness:

$$K_{iz.equip} := \left(\frac{\frac{z_{equip}}{ft}}{33}\right)^{0.1} = 1.123 \qquad K_{iz.pipe} := \left(\frac{\frac{z_{pipe}}{ft}}{33}\right)^{0.1} = 1.106 \qquad K_{iz.coax} := \left(\frac{\frac{z_{coax}}{ft}}{33}\right)^{0.1} = 1.106$$

$$t_{iz.pipe} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.pipe} \cdot K_{zt.pipe}^{0.35} = 2.074\ in$$

$$t_{iz.equip} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.equip} \cdot K_{zt.equip}^{0.35} = 2.105\ in$$

$$t_{iz.coax} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.coax} \cdot K_{zt.coax}^{0.35} = 2.074\ in$$

Pipe Extension Loads

Constants

$OD := 12.75 \cdot in$ outer diameter of pipe riser

$L_{pipe} := 55\ ft$ Length of pipe riser

$MemberLabel_{pipe} := \text{"M2"}$ Member Label in Risa

See T-Mobile Calcs for Pipe Extension Loads

$$Weight.ice_{pipe} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot t_{iz.pipe} \right)^2 - OD^2 \right) \cdot 0 = 0\ plf$$

$$Weight.ice_{pipe.nesc} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot r_{ice.nesc} \right)^2 - OD^2 \right) \cdot 0 = 0\ plf$$

$SA_{pipe} := OD = 1.063\ ft$ Projected Surface Area of Pipe

$SAice_{pipe} := OD + \left(2 \cdot t_{iz.pipe} \right) = 1.408\ ft$ Projected Surface Area of Pipe with Ice (TIA)

$SAice_{pipe.nesc} := OD + \left(2 \cdot r_{ice.nesc} \right) = 1.146\ ft$ Projected Surface Area of Pipe with Ice (NESC)

TIA/EIA Wind:

$$Ar_{pipe} := \frac{L_{pipe}}{OD} = 51.765$$

$$Ca_{pipe} := \begin{cases} 0.7 & \text{if } Ar_{pipe} \le 2.5 \\ 0.7 + \frac{\left(Ar_{pipe} - 2.5 \right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{pipe} < 7 \\ 0.8 + \frac{\left(Ar_{pipe} - 7 \right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{pipe} < 25 \\ 1.2 & \text{if } Ar_{pipe} \ge 25 \end{cases} = 1.2$$

Table 2-8

$$Wind.TIA_{pipe} := qz_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SA_{pipe} \cdot 0 = 0\ plf$$

$$IceWind.TIA_{pipe} := qzice_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SAice_{pipe} \cdot 0 = 0\ plf$$

NESC Wind:

$$Wind.250B_{pipe} := qz_{250B} \cdot Cd_R \cdot SAice_{pipe.nesc} \cdot 0 = 0.0\ plf$$

Wind Pressure Above Top of Tower:

$$Wind.250C_{pipe.Above} := qz_{250C} \cdot G'_{RF} \cdot Cd_R \cdot SA_{pipe} \cdot 0 = 0.0\ plf$$

Wind Pressure Below Top of Tower:

$$Wind.250C_{pipe.Below} := qz_{250C} \cdot G_{RF} \cdot Cd_R \cdot SA_{pipe} \cdot 0 = 0.0\ plf$$

Mast Component Loads - NOT USED

$a := 1..1$ <----- input number of component slots used

Component Description

1. 6x6x1/4 Hor Tube	$Cd_{comp_1} := Cd_F$	$W_{comp_1} := 0\ in$	$H_{comp_1} := 0 \cdot in$	$L_{comp_1} := 0\ ft$	$MemLabel_{comp_1} :=$ "NA"
2. 6x6x1/4 Hor Tube	$Cd_{comp_2} := Cd_F$	$W_{comp_2} := 0 \cdot in$	$H_{comp_2} := 0 \cdot in$	$L_{comp_2} := 0\ ft$	$MemLabel_{comp_2} :=$ "NA"
3. 6x6x1/4 Hor Tube	$Cd_{comp_3} := Cd_F$	$W_{comp_3} := 0 \cdot in$	$H_{comp_3} := 0 \cdot in$	$L_{comp_3} := 0\ ft$	$MemLabel_{comp_3} :=$ "NA"
4. 6x6x1/4 Hor Tube	$Cd_{comp_4} := Cd_F$	$W_{comp_4} := 0 \cdot in$	$H_{comp_4} := 0 \cdot in$	$L_{comp_4} := 0\ ft$	$MemLabel_{comp_4} :=$ "NA"
5. Not Used	$Cd_{comp_5} := Cd_F$	$W_{comp_5} := 0 \cdot in$	$H_{comp_5} := 0 \cdot in$	$L_{comp_5} := 0\ ft$	$MemLabel_{comp_5} :=$ "NA"
6. Not Used	$Cd_{comp_6} := Cd_F$	$W_{comp_6} := 0 \cdot in$	$H_{comp_6} := 0 \cdot in$	$L_{comp_6} := 0\ ft$	$MemLabel_{comp_6} :=$ "NA"

$$Weight.ice_{comp_a} := I_d \cdot \pi \cdot t_{iz.pipe} \cdot \left(\max\left(H_{comp_a}, W_{comp_a}\right) + t_{iz.pipe}\right) \cdot 0 = [0.0]\ plf$$

$$Weight.ice_{comp.nesc_a} := I_d \cdot \left(\left(W_{comp_a} + 2 \cdot r_{ice.nesc}\right) \cdot \left(H_{comp_a} + 2 \cdot r_{ice.nesc}\right) - W_{comp_a} \cdot H_{comp_a}\right) \cdot 0 = [0.0]\ plf$$

$$SA_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) = [0]\ ft$$

$$SAice_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe} = [0.3]\ ft$$

$$Ar_{comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a}}{\max\left(W_{comp_a}, H_{comp_a}\right)} & \text{else} \end{cases} = [0]$$

$$Ar_{ice.comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a} + 2 \cdot t_{iz.pipe}}{\max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe}} & \text{else} \end{cases} = [0]$$

$$Ca_{comp_a} := \begin{cases} \text{if } Ar_{comp_a} \le 2.5 \\ \quad 1.2 \\ \text{if } 2.5 < Ar_{comp_a} < 7 \\ \quad 1.2 + \frac{\left(Ar_{comp_a} - 2.5\right)\cdot(1.4-1.2)}{(7-2.5)} \\ \text{if } 7 \le Ar_{comp_a} < 25 \\ \quad 1.4 + \frac{\left(Ar_{comp_a} - 7\right)\cdot(2.0-1.4)}{(25-7)} \\ \text{if } Ar_{comp_a} \ge 25 \\ \quad 2.0 \end{cases} = [1.2]$$

$$Ca_{ice.comp_a} := \begin{cases} \text{if } Ar_{ice.comp_a} \le 2.5 \\ \quad 0.7 \\ \text{if } 2.5 < Ar_{ice.comp_a} < 7 \\ \quad 0.7 + \frac{\left(Ar_{ice.comp_a} - 2.5\right)\cdot(0.8-0.7)}{(7-2.5)} \\ \text{if } 7 \le Ar_{ice.comp_a} < 25 \\ \quad 0.8 + \frac{\left(Ar_{comp_a} - 7\right)\cdot(1.2-0.8)}{(25-7)} \\ \text{if } Ar_{ice.comp_a} \ge 25 \\ \quad 1.2 \end{cases} = [0.7]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{comp_a} := qzice_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} + qzice_{comp} \cdot G_H \cdot Ca_{ice.comp_a} \cdot \left(SAice_{comp_a} - SA_{comp_a}\right) \cdot 0 = [0.0] \ \textbf{plf}$$

$$Wind.TIA_{comp_a} := qz_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} = [0.0] \ \textbf{plf}$$

NESC Wind:

$$Wind.250B_{comp_a} := qz_{250B} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = [0.0] \ \textbf{plf}$$

$$Wind.250C_{comp_a} := qz_{250C} \cdot G_{RF} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = [0.0] \ \textbf{plf}$$

Mount Load

$b := 1..2$ <----- input number of mount slots used

TIA/EIA-222-G Table 2-8 | NESC Shape Factor

1. Microflect Tri-Sector Mount

$A_{mount_1} := 3.0 \cdot ft^2$ $Aice_{mount_1} := 9.1 \cdot ft^2$ $WT_{mount_1} := 101 \cdot lb$ $WTice_{mount_1} := 346 \cdot lb$ $Ca_{mount_1} := 1.2$ $Cd_{mount_1} := Cd_F$

$Aice_{mount.nesc_1} := 4.22 \cdot ft^2$ $WTice_{mount.nesc_1} := 150 \cdot lb$

2. (3) 2.375" OD Pipe Mounts

$A_{mount_2} := 0 \cdot ft^2$ $Aice_{mount_2} := 0 \cdot ft^2$ $WT_{mount_2} := 66 \cdot lb$ $WTice_{mount_2} := 190 \cdot lb$ $Ca_{mount_2} := 1.2$ $Cd_{mount_2} := Cd_F$

$Aice_{mount.nesc_2} := 0 \cdot ft^2$ $WTice_{mount.nesc_2} := 97 \cdot lb$

3. Not Used

$A_{mount_3} := 0 \cdot ft^2$ $Aice_{mount_3} := 0 \cdot ft^2$ $WT_{mount_3} := 0 \cdot lb$ $WTice_{mount_3} := 0 \cdot lb$ $Ca_{mount_3} := 1.2$ $Cd_{mount_3} := Cd_F$

4. Not Used

$A_{mount_4} := 0 \cdot ft^2$ $Aice_{mount_4} := 0 \cdot ft^2$ $WT_{mount_4} := 0 \cdot lb$ $WTice_{mount_4} := 0 \cdot lb$ $Ca_{mount_4} := 1.2$ $Cd_{mount_4} := Cd_F$

TIA/EIA Wind:

$$IceWind.TIA_{mount_b} := qzice_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot Aice_{mount_b} = \begin{bmatrix} 114.6 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.TIA_{mount_b} := qz_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 162.9 \\ 0.0 \end{bmatrix} lbf$$

NESC Wind:

$$Wind.250B_{mount_b} := qz_{250B} \cdot Cd_{mount_b} \cdot Aice_{mount.nesc_b} = \begin{bmatrix} 27.0 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.250C_{mount_b} := qz_{250C} \cdot G'_{RF} \cdot Cd_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 208.5 \\ 0.0 \end{bmatrix} lbf$$

Equipment Loads

Equipment Description $i := 1..2$ <----- input number of equip slots used

1. KMW AM-X-CD-14-65	$QTY_{eq_1} := 3$	$L_{eq_1} := 48 \cdot in$	$W_{eq_1} := 11.8 \cdot in$	$t_{eq_1} := 5.9 \cdot in$	$WT_{eq_1} := 36.4 \cdot lbf$
2TTAW-07BP111-001	$QTY_{eq_2} := 3$	$L_{eq_2} := 9.9 \cdot in$	$W_{eq_2} := 6.7 \cdot in$	$t_{eq_2} := 5.4 \cdot in$	$WT_{eq_2} := 18 \cdot lbf$
3. Not Used	$QTY_{eq_3} := 0$	$L_{eq_3} := 0 \cdot in$	$W_{eq_3} := 0 \cdot in$	$t_{eq_3} := 0 \cdot in$	$WT_{eq_3} := 0 \cdot lbf$
4. Not Used	$QTY_{eq_4} := 0$	$L_{eq_4} := 0 \cdot in$	$W_{eq_4} := 0 \cdot in$	$t_{eq_4} := 0 \cdot in$	$WT_{eq_4} := 0 \cdot lbf$
5. Not Used	$QTY_{eq_5} := 0$	$L_{eq_5} := 0 \cdot in$	$W_{eq_5} := 0 \cdot in$	$t_{eq_5} := 0 \cdot in$	$WT_{eq_5} := 0 \cdot lbf$
6. Not Used	$QTY_{eq_6} := 0$	$L_{eq_6} := 0 \cdot in$	$W_{eq_6} := 0 \cdot in$	$t_{eq_6} := 0 \cdot in$	$WT_{eq_6} := 0 \cdot lbf$

$$Weight_{equip_i} := WT_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 109.2 \\ 54.0 \end{bmatrix} lbf$$

$$Weight.Ice_{equip_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot t_{iz.equip} \right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip} \right) \cdot \left(t_{eq_i} + 2 \cdot t_{iz.equip} \right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i} \right) \right) = \begin{bmatrix} 505.6 \\ 111.0 \end{bmatrix} lbf$$

$$Weight.Ice_{equip.nesc_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot r_{ice.nesc} \right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc} \right) \cdot \left(t_{eq_i} + 2 \cdot r_{ice.nesc} \right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i} \right) \right) = \begin{bmatrix} 97.6 \\ 17.7 \end{bmatrix} lbf$$

$$SA_{eq_i} := L_{eq_i} \cdot W_{eq_i} = \begin{bmatrix} 3.9 \\ 0.5 \end{bmatrix} ft^2 \qquad A_{eq_i} := SA_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 11.8 \\ 1.4 \end{bmatrix} ft^2$$

$$SAice_{eq_i} := \left(L_{eq_i} + 2 \cdot t_{iz.equip} \right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip} \right) = \begin{bmatrix} 5.8 \\ 1.1 \end{bmatrix} ft^2 \qquad Aice_{eq_i} := SAice_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 17.4 \\ 3.2 \end{bmatrix} ft^2$$

$$SAice_{eq.nesc_i} := \left(L_{eq_i} + 2 \cdot r_{ice.nesc} \right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc} \right) = \begin{bmatrix} 4.4 \\ 0.6 \end{bmatrix} ft^2 \qquad Aice_{eq.nesc_i} := SAice_{eq.nesc_i} \cdot QTY_{eq_i} = \begin{bmatrix} 13.1 \\ 1.7 \end{bmatrix} ft^2$$

$$Ar_{eq_i} := \frac{L_{eq_i}}{W_{eq_i}} = \begin{bmatrix} 4.1 \\ 1.5 \end{bmatrix} \qquad Ar_{ice.eq_i} := \frac{L_{eq_i} + 2 \cdot t_{iz.equip}}{W_{eq_i} + 2 \cdot t_{iz.equip}} = \begin{bmatrix} 3.3 \\ 1.3 \end{bmatrix}$$

$$Ca_{eq_i} := \begin{cases} 1.2 & \text{if } Ar_{eq_i} \le 2.5 \\ 1.2 + \frac{(Ar_{eq_i} - 2.5)\cdot(1.4 - 1.2)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{eq_i} < 7 \\ 1.4 + \frac{(Ar_{eq_i} - 7)\cdot(2.0 - 1.4)}{(25 - 7)} & \text{if } 7 \le Ar_{eq_i} < 25 \\ 2.0 & \text{if } Ar_{eq_i} \ge 25 \end{cases} = \begin{bmatrix} 1.27 \\ 1.2 \end{bmatrix}$$

$$Ca_{ice.eq_i} := \begin{cases} 0.7 & \text{if } Ar_{ice.eq_i} \le 2.5 \\ 0.7 + \frac{(Ar_{ice.eq_i} - 2.5)\cdot(0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{ice.eq_i} < 7 \\ 0.8 + \frac{(Ar_{comp_a} - 7)\cdot(1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{ice.eq_i} < 25 \\ 1.2 & \text{if } Ar_{ice.eq_i} \ge 25 \end{cases} = \begin{bmatrix} 0.717 \\ 0.7 \end{bmatrix}$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{equip_i} := qzice_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} + qzice_{equip} \cdot G_H \cdot Ca_{ice.eq_i} \cdot \left(Aice_{eq_i} - A_{eq_i}\right) = \begin{bmatrix} 199.5 \\ 30.8 \end{bmatrix} \mathbf{lbf}$$

$$Wind.TIA_{equip_i} := qz_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} = \begin{bmatrix} 678.1 \\ 75.1 \end{bmatrix} \mathbf{lbf}$$

NESC Wind:

$$Wind.250B_{equip_i} := qz_{250B} \cdot Cd_F \cdot Aice_{eq.nesc_i} = \begin{bmatrix} 83.5 \\ 11.2 \end{bmatrix} \mathbf{lbf}$$

$$Wind.250C_{equip_i} := qz_{250C} \cdot G'_{RF} \cdot Cd_F \cdot A_{eq_i} = \begin{bmatrix} 820.2 \\ 96.0 \end{bmatrix} \mathbf{lbf}$$

Coax Loads - Southeast Leg

Coax Cable Description $k := 1..1$ <----- input number of coax cable slots used

1. Heliax 1-1/4"ø	$QTY_{coax_1} := 6$	$NP_{coax_1} := 3$	$OD_{coax_1} := 1.48 \cdot in$	$WT_{coax_1} := 0.50 \cdot plf$	$L_{coax_1} := 20 \cdot ft$
2. Not Used	$QTY_{coax_2} := 0$	$NP_{coax_2} := 0$	$OD_{coax_2} := 0 \cdot in$	$WT_{coax_2} := 0 \cdot plf$	$L_{coax_2} := 0 \cdot ft$
3. Not Used	$QTY_{coax_3} := 0$	$NP_{coax_3} := 0$	$OD_{coax_3} := 0 \cdot in$	$WT_{coax_3} := 0 \cdot plf$	$L_{coax_3} := 0 \cdot ft$
4. Not Used	$QTY_{coax_4} := 0$	$NP_{coax_4} := 0$	$OD_{coax_4} := 0 \cdot in$	$WT_{coax_4} := 0 \cdot plf$	$L_{coax_4} := 0 \cdot ft$
5. Not Used	$QTY_{coax_5} := 0$	$NP_{coax_5} := 0$	$OD_{coax_5} := 0 \cdot in$	$WT_{coax_5} := 0 \cdot plf$	$L_{coax_5} := 0 \cdot ft$
6. Not Used	$QTY_{coax_6} := 0$	$NP_{coax_6} := 0$	$OD_{coax_6} := 0 \cdot in$	$WT_{coax_6} := 0 \cdot plf$	$L_{coax_6} := 0 \cdot ft$

$$coaxspan := \begin{bmatrix} 29 \\ 13 \\ 15 \\ 15 \\ 12.5 \end{bmatrix} \cdot ft$$

Input coax vertical span between attachment joints for PLS Loads

$$SA_{coax_k} := NP_{coax_k} \cdot OD_{coax_k} = [0.4]\ ft$$

$$SAice_{coax_k} := \begin{cases} 0 & \text{if } NP_{coax_k} = 0 \\ \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot t_{iz.coax}\right)\right) & \text{else} \end{cases} = [0.7]\ ft$$

$$Weight_{coax_k} := WT_{coax_k} \cdot QTY_{coax_k} = [3.0]\ plf$$

$$SAice_{coax.nesc_k} := \begin{cases} 0 & \text{if } NP_{coax_k} = 0 \\ \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot r_{ice.nesc}\right)\right) & \text{else} \end{cases} = [0.5]\ ft$$

$$Weight.Ice_{coax_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot t_{iz.coax}\right)^2 - OD_{coax_k}{}^2\right) \cdot QTY_{coax_k} \cdot I_d\right) = [55.0]\ plf$$

$$Weight.Ice_{coax.nesc_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot r_{ice.nesc}\right)^2 - OD_{coax_k}{}^2\right) \cdot QTY_{coax_k} \cdot I_d\right) = [7.4]\ plf$$

$$Ar_{coax_k} := \frac{L_{coax_k}}{OD_{coax_k}} = [162.2]$$

Aspect Ratio of Coax

$$Ca_{coax_k} := \begin{cases} 0.7 & \text{if } Ar_{coax_k} \le 2.5 \\ 0.7 + \dfrac{(Ar_{coax_k} - 2.5) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{coax_k} < 7 \\ 0.8 + \dfrac{(Ar_{coax_k} - 7) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{coax_k} < 25 \\ 1.2 & \text{if } Ar_{coax_k} \ge 25 \end{cases} = [1.2]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{coax_k} := qzice_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SAice_{coax_k} = [8.7] \; plf$$

$$Wind.TIA_{coax_k} := qz_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SA_{coax_k} = [19.5] \; plf$$

NESC Wind for Coax on Pipe Mast Risa Model:

$$Wind.250B_{coax.pipe_k} := qz_{250B} \cdot Cd_{coax} \cdot SAice_{coax.nesc_k} = [2.6]\ \mathbf{plf}$$

$$Wind.250C_{coax.pipe.Above_k} := qz_{250C} \cdot G'_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [23.3]\ \mathbf{plf}$$

$$Wind.250C_{coax.pipe.Below_k} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [18.6]\ \mathbf{plf}$$

NESC Loads For PLS Model:

$$Weight.250B_{coax.twr} := \left(\sum Weight_{coax} + \sum Weight.Ice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_V$$

$$Wind.250B_{coax.twr} := qz_{250B} \cdot Cd_{coax} \cdot \left(\sum SAice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_T$$

$$Weight.250C_{coax.twr} := \left(\sum Weight_{coax} \right) \cdot coaxspan \cdot OLF250C_V$$

$$Wind.250C_{coax.twr} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot \left(\sum SA_{coax} \right) \cdot coaxspan \cdot OLF250C_T$$

Summary of Loads - PLS Coax Load Inputs

NESC 250B_X-dir - Wind w/ Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1	452	190	0	Coax Load
C2	203	85	0	Coax Load
C3	234	98	0	Coax Load
C4	234	98	0	Coax Load
C5	195	82	0	Coax Load

NESC 250C_X-dir - Wind w/o Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1	87	541	0	Coax Load
C2	39	242	0	Coax Load
C3	45	280	0	Coax Load
C4	45	280	0	Coax Load
C5	38	233	0	Coax Load

Summary of Loads - Risa Loads Inputs

BLC 2 Weight of Equipment
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]
M2	Y	-101.0	43.0
M2	Y	-66.0	43.0
M2	Y	0.0	43.0
M2	Y	0.0	43.0
M2	Y	-109.2	43.0
M2	Y	-54.0	43.0
M2	Y		43.0
M2	Y		43.0
M2	Y		43.0
M2	Y		43.0

Mount 1
Mount 2
Mount 3
Mount 4

Equipment 1
Equipment 2
Equipment 3
Equipment 4
Equipment 5
Equipment 6

Member Distributed Loads - Rows 1-6: Coax 1-6 Weight

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-3.0	-3.0	23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0

BLC 3 Weight of Ice on Mast & Equipment - TIA
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-346.0	43.0	**Mount 1**
M2	Y	-190.0	43.0	**Mount 2**
M2	Y	0.0	43.0	**Mount 3**
M2	Y	0.0	43.0	**Mount 4**
M2	Y	-505.6	43.0	**Equipment 1**
M2	Y	-111.0	43.0	**Equipment 2**
M2	Y		43.0	**Equipment 3**
M2	Y		43.0	**Equipment 4**
M2	Y		43.0	**Equipment 5**
M2	Y		43.0	**Equipment 6**

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	0.0	0.0	0.0	0.0
M2	Y	-55.0	-55.0	23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
NA	Y	0.0	0.0	0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0

BLC 4 TIA_X-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	114.6	43.0	**Mount 1**
M2	X	0.0	43.0	**Mount 2**
M2	X		43.0	**Mount 3**
M2	X		43.0	**Mount 4**
M2	X	199.5	43.0	**Equipment 1**
M2	X	30.8	43.0	**Equipment 2**
M2	X		43.0	**Equipment 3**
M2	X		43.0	**Equipment 4**
M2	X		43.0	**Equipment 5**
M2	X		43.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	8.7	8.7	23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 5 TIA_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]
M2	X	162.9	43.0
M2	X	0.0	43.0
M2	X		43.0
M2	X		43.0
M2	X	678.1	43.0
M2	X	75.1	43.0
M2	X		43.0
M2	X		43.0
M2	X		43.0
M2	X		43.0

Mount 1
Mount 2
Mount 3
Mount 4

Equipment 1
Equipment 2
Equipment 3
Equipment 4
Equipment 5
Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	19.5	19.5	23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 6 TIA_Z-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]
M2	Z	114.6	43.0
M2	Z	0.0	43.0
M2	Z		43.0
M2	Z		43.0
M2	Z	199.5	43.0
M2	Z	30.8	43.0
M2	Z		43.0
M2	Z		43.0
M2	Z		43.0
M2	Z		43.0

Mount 1
Mount 2
Mount 3
Mount 4

Equipment 1
Equipment 2
Equipment 3
Equipment 4
Equipment 5
Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	0.0	0.0	0.0	0.0
M2	PZ	8.7	8.7	23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
NA	PZ	0.0	0.0	0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0

BLC 7 TIA_Z-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	162.9	43.0	**Mount 1**
M2	Z	0.0	43.0	**Mount 2**
M2	Z		43.0	**Mount 3**
M2	Z		43.0	**Mount 4**
M2	Z	678.1	43.0	**Equipment 1**
M2	Z	75.1	43.0	**Equipment 2**
M2	Z		43.0	**Equipment 3**
M2	Z		43.0	**Equipment 4**
M2	Z		43.0	**Equipment 5**
M2	Z		43.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	0.0	0.0	0.0	0.0
M2	PZ	19.5	19.5	23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
M2	PZ			23.0	43.0
NA	PZ	0.0	0.0	0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0

BLC 8 NESC 250B_X-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]
M2	X	27.0	43.0
M2	X	0.0	43.0
M2	X		43.0
M2	X		43.0
M2	X	83.5	43.0
M2	X	11.2	43.0
M2	X		43.0
M2	X		43.0
M2	X		43.0
M2	X		43.0

Mount 1
Mount 2
Mount 3
Mount 4

Equipment 1
Equipment 2
Equipment 3
Equipment 4
Equipment 5
Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	2.6	2.6	23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
M2	PX			23.0	43.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 9 NESC 250C_X-dir - Wind w/o Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	208.5	43.0	**Mount 1**
M2	X	0.0	43.0	**Mount 2**
M2	X		43.0	**Mount 3**
M2	X		43.0	**Mount 4**
M2	X	820.2	43.0	**Equipment 1**
M2	X	96.0	43.0	**Equipment 2**
M2	X		43.0	**Equipment 3**
M2	X		43.0	**Equipment 4**
M2	X		43.0	**Equipment 5**
M2	X		43.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast Above Top of Tower
Row 2-7: Wind on Coax 1-6 Above Top of Tower
Row 8: Wind on Mast Below Top of Tower
Row 9-14: Wind on Coax 1-6 Below Top of Tower
Row 15-20: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	32.0	55.0
M2	PX	23.3	23.3	32.0	43.0
M2	PX			32.0	43.0
M2	PX			32.0	43.0
M2	PX			32.0	43.0
M2	PX			32.0	43.0
M2	PX			32.0	43.0
M2	PX	0.0	0.0	0.0	32.0
M2	PX	18.6	18.6	23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 10 Weight of Ice on Mast & Equipment - NESC
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-150.0	43.0	Mount 1
M2	Y	-97.0	43.0	Mount 2
M2	Y	0.0	43.0	Mount 3
M2	Y	0.0	43.0	Mount 4
M2	Y	-97.6	43.0	Equipment 1
M2	Y	-17.7	43.0	Equipment 2
M2	Y		43.0	Equipment 3
M2	Y		43.0	Equipment 4
M2	Y		43.0	Equipment 5
M2	Y		43.0	Equipment 6

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	0.0	0.0	0.0	0.0
M2	Y	-7.4	-7.4	23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
M2	Y			23.0	43.0
NA	Y	0.0	0.0	0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0

Equipment Loads (Tubular Pole on Lattice Structure) - North Mast - T-Mobile

Constants

$h_{lattice} := 94 \cdot ft$ — height of lattice structure

$h_{mast} := 117 \cdot ft$ — Top of Mast AGL

$b_{mast} := 62 \cdot ft$ — Bot. of Mast AGL

$b_{coax} := 85 \cdot ft$ — Bot. of Coax AGL (on mast)

$z_{equip} := 114 \cdot ft$ — elevation of equip.

$z_{coax} := 90.5 \cdot ft$ — elevation to CL of coax section for TIA wind (linear appurtance)

$z_{pipe} := 90.5 \cdot ft$ — elevation to CL of pipe section for TIA wind

$r_{ice} := 0.75 \cdot in$ — Radial Ice, TIA

$r_{ice.nesc} := 0.5 \cdot in$ — Radial Ice, NESC

NESC Shape Factors:

$Cd_R := 1.3$ $Cd_F := 1.6$ $Cd_{coax} := 1.45$

NESC Overload Factors:

$OLF250B_V := 1.5$ — 250B Vertical OLF

$OLF250B_T := 2.5$ — 250B Transverse Wind OLF

$OLF250C_V := 1.0$ — 250C Vertical OLF

$OLF250C_T := 1.0$ — 250C Transverse Wind OLF

$I_d := 57 \cdot pcf$ — Ice Density

TIA/EIA Wind

$V_{Ult} := 125$ — TIA Ultimate Wind Speed

$V_{tia} := V_{Ult} \cdot \sqrt{0.6} = 96.825$ — TIA Nominal Wind Speed

$V_{i.tia} := 50$ — TIA Basic Wind Speed with Ice

$Exp_{tia} := \text{"C"}$ — TIA Exposure Category

$Topo_{tia} := 1$ — TIA Topographic Category

$SC_{tia} := 3$ — TIA Structure Class

$Crest_{tia} := 0$ — Height of Crest, ft

$K_d := 0.95$ — TIA Table 2-2

$G_H := 1.35$ — TIA Sec. 2.6

$$I_{wind} := \begin{cases} 0.87 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.15 & \text{if } SC_{tia} = 3 \end{cases} = 1.15$$

$$I_{ice} := \begin{cases} 1 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.25 & \text{if } SC_{tia} = 3 \end{cases} = 1.25$$

$I_{icewind} := 1$ — TIA Importance Factor Table 2-3

NESC Wind

$V_{nesc} := 110$ — NESC 250C 3 sec Gust Speed per OTRM 060

$V_{i.nesc} := 39.5$ — NESC 250B 3 sec Gust Speed with Ice

$I := 1.0$ — NESC Importance Factor

$$E_s := 0.346 \cdot \left(\frac{33}{\left(0.67 \cdot \frac{h_{mast}}{ft}\right)} \right)^{\frac{1}{7}} = 0.306$$

NESC Factors, Table 250-3

$$B_s := \frac{1}{\left(1 + \frac{0.56 \cdot \left(0.67 \cdot \frac{h_{mast}}{ft}\right)}{220}\right)} = 0.834$$

NESC Factors, Table 250-3

$k_v := 1.43$ — NESC Constant, Table 250-3

$$G_{RF} := \frac{\left(1 + \left(2.7 \cdot E_s \cdot B_s^{0.5}\right)\right)}{k_v^{2}} = 0.858$$

Calculated GRF, Table 250-3

$m_{grf} := 1.25$ — NEU specified multiplier for 250C (OTRM 059.1, Attachment A)

$G'_{RF} := G_{RF} \cdot m_{grf} = 1.072$ — Calculated GRF for 250C

TIA/EIA Topographc Coefficients:

$$K_t := \begin{cases} 0.43 & \text{if } Topo_{tia} = 2 \\ 0.53 & \text{if } Topo_{tia} = 3 \\ 0.72 & \text{if } Topo_{tia} = 4 \\ 1.0 & \text{else} \end{cases} = 1$$

$$f_{tia} := \begin{cases} 1.25 & \text{if } Topo_{tia} = 2 \\ 2.00 & \text{if } Topo_{tia} = 3 \\ 1.50 & \text{if } Topo_{tia} = 4 \\ 1.0 & \text{else} \end{cases} = 1$$

$$K_e := \begin{cases} 0.9 & \text{if } Exp_{tia} = \text{"B"} \\ 1.1 & \text{if } Exp_{tia} = \text{"D"} \\ 1.0 & \text{else} \end{cases} = 1$$

$$K_{h.equip} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{equip}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{h.coax} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{coax}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{h.pipe} := \begin{cases} 1 & \text{if } Crest_{tia} = 0 \\ e^{\left(\frac{f_{tia} \cdot \frac{z_{pipe}}{ft}}{Crest_{tia}}\right)} & \text{else} \end{cases} = 1$$

$$K_{zt.equip} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.equip}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

$$K_{zt.coax} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.coax}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

$$K_{zt.pipe} := \begin{cases} 1.0 & \text{if } Topo_{tia} = 1 \\ \left(1 + \frac{K_e \cdot K_t}{K_{h.pipe}}\right)^{\langle 2 \rangle} & \text{else} \end{cases} = 1$$

TIA/EIA Exposure Coefficients:

$$K_{z.min} := \begin{cases} 0.7 & \text{if } Exp_{tia} = \text{"B"} \\ 1.03 & \text{if } Exp_{tia} = \text{"D"} \\ 0.85 & \text{else} \end{cases} = 0.85$$

$$z_g := \begin{cases} 1200 & \text{if } Exp_{tia} = \text{"B"} \\ 700 & \text{if } Exp_{tia} = \text{"D"} \\ 900 & \text{else} \end{cases} = 900$$

$$alpha_{tia} := \begin{cases} 7 & \text{if } Exp_{tia} = \text{"B"} \\ 11.5 & \text{if } Exp_{tia} = \text{"D"} \\ 9.5 & \text{else} \end{cases} = 9.5$$

NESC Exposure Coefficient:

$$k_z := 2.01 \cdot \left(\frac{h_{mast}}{900 \cdot ft}\right)^{\left(\frac{2}{9.5}\right)} = 1.308$$

Calculated kz per Table 250-2

$$Kz_{equip} := 2.01 \cdot \left(\frac{\frac{z_{equip}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.301 \qquad Kz_{coax} := 2.01 \cdot \left(\frac{\frac{z_{coax}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239 \qquad Kz_{pipe} := 2.01 \cdot \left(\frac{\frac{z_{pipe}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239$$

$$Kz_{equip} := \begin{array}{l} \text{if } Kz_{equip} \le K_{z.min} \\ \quad Kz_{equip} = K_{z.min} \\ \text{if } Kz_{equip} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{equip} \end{array} = 1.301 \qquad Kz_{coax} := \begin{array}{l} \text{if } Kz_{coax} \le K_{z.min} \\ \quad Kz_{coax} = K_{z.min} \\ \text{if } Kz_{coax} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{coax} \end{array} = 1.239 \qquad Kz_{pipe} := \begin{array}{l} \text{if } Kz_{pipe} \le K_{z.min} \\ \quad Kz_{pipe} = K_{z.min} \\ \text{if } Kz_{pipe} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{pipe} \end{array} = 1.239$$

Section Average Height Above Ground for Wind Load

Section Average Height Above Ground for Wind Load

TIA/EIA Wind Pressure:

$$qzice_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{i.tia}{}^2 \cdot I_{icewind} = 7.9\ psf$$

$$qz_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{tia}{}^2 \cdot I_{wind} = 34.1\ psf$$

$$qzice_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{i.tia}{}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{tia}{}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}{}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}{}^2 \cdot I_{wind} = 32.5\ psf$$

$$qzice_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}{}^2 \cdot I_{icewind} = 7.5\ psf$$

$$qz_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}{}^2 \cdot I_{wind} = 32.5\ psf$$

NESC Wind Pressure:

$$qz_{250B} := 0.00256 \cdot V_{i.nesc}{}^2 \cdot I \cdot psf = 4.0\ psf$$

$$qz_{250C} := 0.00256 \cdot k_z \cdot V_{nesc}{}^2 \cdot I \cdot psf = 40.5\ psf$$

TIA/EIA Design Ice Thickness:

$$K_{iz.equip} := \left(\frac{\frac{z_{equip}}{ft}}{33}\right)^{0.1} = 1.132 \qquad K_{iz.pipe} := \left(\frac{\frac{z_{pipe}}{ft}}{33}\right)^{0.1} = 1.106 \qquad K_{iz.coax} := \left(\frac{\frac{z_{coax}}{ft}}{33}\right)^{0.1} = 1.106$$

$$t_{iz.pipe} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.pipe} \cdot K_{zt.pipe}{}^{0.35} = 2.074\ in$$

$$t_{iz.equip} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.equip} \cdot K_{zt.equip}{}^{0.35} = 2.122\ in$$

$$t_{iz.coax} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.coax} \cdot K_{zt.coax}{}^{0.35} = 2.074\ in$$

Pipe Extension Loads

Constants

$OD := 12.75 \cdot in$ outer diameter of pipe riser

$L_{pipe} := 55\ ft$ Length of pipe riser

$MemberLabel_{pipe} := \text{"M2"}$ Member Label in Risa

$$Weight.ice_{pipe} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot t_{iz.pipe} \right)^2 - OD^2 \right) = 38.2\ plf$$

$$Weight.ice_{pipe.nesc} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot r_{ice.nesc} \right)^2 - OD^2 \right) = 8.2\ plf$$

$SA_{pipe} := OD = 1.063\ ft$ Projected Surface Area of Pipe

$SAice_{pipe} := OD + \left(2 \cdot t_{iz.pipe}\right) = 1.408\ ft$ Projected Surface Area of Pipe with Ice (TIA)

$SAice_{pipe.nesc} := OD + \left(2 \cdot r_{ice.nesc}\right) = 1.146\ ft$ Projected Surface Area of Pipe with Ice (NESC)

TIA/EIA Wind:

$$Ar_{pipe} := \frac{L_{pipe}}{OD} = 51.765$$

$$Ca_{pipe} := \begin{cases} 0.7 & \text{if } Ar_{pipe} \le 2.5 \\ 0.7 + \frac{\left(Ar_{pipe} - 2.5\right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{pipe} < 7 \\ 0.8 + \frac{\left(Ar_{pipe} - 7\right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{pipe} < 25 \\ 1.2 & \text{if } Ar_{pipe} \ge 25 \end{cases} = 1.2$$

Table 2-8

$$Wind.TIA_{pipe} := qz_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SA_{pipe} = 55.9\ plf$$

$$IceWind.TIA_{pipe} := qzice_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SAice_{pipe} = 17.2\ plf$$

NESC Wind:

$$Wind.250B_{pipe} := qz_{250B} \cdot Cd_R \cdot SAice_{pipe.nesc} = 5.9\ plf$$

Wind Pressure Above Top of Tower:

$$Wind.250C_{pipe.Above} := qz_{250C} \cdot G'_{RF} \cdot Cd_R \cdot SA_{pipe} = 60.0\ plf$$

Wind Pressure Below Top of Tower:

$$Wind.250C_{pipe.Below} := qz_{250C} \cdot G_{RF} \cdot Cd_R \cdot SA_{pipe} = 48.0\ plf$$

Mast Component Loads

$a := 1..4$ <----- input number of component slots used

Component Description

1. 6x6x1/4 Hor Tube	$Cd_{comp_1} := Cd_F$	$W_{comp_1} := 6\ in$	$H_{comp_1} := 6 \cdot in$	$L_{comp_1} := 7\ ft$	$MemLabel_{comp_1} :=$ "M4"
2. 6x6x1/4 Hor Tube	$Cd_{comp_2} := Cd_F$	$W_{comp_2} := 6 \cdot in$	$H_{comp_2} := 6 \cdot in$	$L_{comp_2} := 7\ ft$	$MemLabel_{comp_2} :=$ "M7"
3. 6x6x1/4 Hor Tube	$Cd_{comp_3} := Cd_F$	$W_{comp_3} := 6 \cdot in$	$H_{comp_3} := 6 \cdot in$	$L_{comp_3} := 1.08\ ft$	$MemLabel_{comp_3} :=$ "M9"
4. 6x6x1/4 Hor Tube	$Cd_{comp_4} := Cd_F$	$W_{comp_4} := 6 \cdot in$	$H_{comp_4} := 6 \cdot in$	$L_{comp_4} := 1.08\ ft$	$MemLabel_{comp_4} :=$ "M10"
5. Not Used	$Cd_{comp_5} := Cd_F$	$W_{comp_5} := 0 \cdot in$	$H_{comp_5} := 0 \cdot in$	$L_{comp_5} := 0\ ft$	$MemLabel_{comp_5} :=$ "M4"
6. Not Used	$Cd_{comp_6} := Cd_F$	$W_{comp_6} := 0 \cdot in$	$H_{comp_6} := 0 \cdot in$	$L_{comp_6} := 0\ ft$	$MemLabel_{comp_6} :=$ "M4"

$$Weight.ice_{comp_a} := I_d \cdot \pi \cdot t_{iz.pipe} \cdot \left(\max\left(H_{comp_a}, W_{comp_a}\right) + t_{iz.pipe}\right) = \begin{bmatrix} 20.8 \\ 20.8 \\ 20.8 \\ 20.8 \end{bmatrix} plf$$

$$Weight.ice_{comp.nesc_a} := I_d \cdot \left(\left(W_{comp_a} + 2 \cdot r_{ice.nesc}\right) \cdot \left(H_{comp_a} + 2 \cdot r_{ice.nesc}\right) - W_{comp_a} \cdot H_{comp_a}\right) = \begin{bmatrix} 5.1 \\ 5.1 \\ 5.1 \\ 5.1 \end{bmatrix} plf$$

$$SA_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) = \begin{bmatrix} 0.5 \\ 0.5 \\ 0.5 \\ 0.5 \end{bmatrix} ft$$

$$SAice_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe} = \begin{bmatrix} 0.8 \\ 0.8 \\ 0.8 \\ 0.8 \end{bmatrix} ft$$

$$Ar_{comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a}}{\max\left(W_{comp_a}, H_{comp_a}\right)} & \text{else} \end{cases} = \begin{bmatrix} 14 \\ 14 \\ 2.2 \\ 2.2 \end{bmatrix}$$

$$Ar_{ice.comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a} + 2 \cdot t_{iz.pipe}}{\max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe}} & \text{else} \end{cases} = \begin{bmatrix} 8.7 \\ 8.7 \\ 1.7 \\ 1.7 \end{bmatrix}$$

$$Ca_{comp_a} := \begin{cases} \text{if } Ar_{comp_a} \le 2.5 \\ \quad 1.2 \\ \text{if } 2.5 < Ar_{comp_a} < 7 \\ \quad 1.2 + \dfrac{(Ar_{comp_a} - 2.5) \cdot (1.4 - 1.2)}{(7 - 2.5)} \\ \text{if } 7 \le Ar_{comp_a} < 25 \\ \quad 1.4 + \dfrac{(Ar_{comp_a} - 7) \cdot (2.0 - 1.4)}{(25 - 7)} \\ \text{if } Ar_{comp_a} \ge 25 \\ \quad 2.0 \end{cases} = \begin{bmatrix} 1.633 \\ 1.633 \\ 1.2 \\ 1.2 \end{bmatrix}$$

$$Ca_{ice.comp_a} := \begin{cases} \text{if } Ar_{ice.comp_a} \le 2.5 \\ \quad 0.7 \\ \text{if } 2.5 < Ar_{ice.comp_a} < 7 \\ \quad 0.7 + \dfrac{(Ar_{ice.comp_a} - 2.5) \cdot (0.8 - 0.7)}{(7 - 2.5)} \\ \text{if } 7 \le Ar_{ice.comp_a} < 25 \\ \quad 0.8 + \dfrac{(Ar_{comp_a} - 7) \cdot (1.2 - 0.8)}{(25 - 7)} \\ \text{if } Ar_{ice.comp_a} \ge 25 \\ \quad 1.2 \end{cases} = \begin{bmatrix} 0.956 \\ 0.956 \\ 0.7 \\ 0.7 \end{bmatrix}$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{comp_a} := qzice_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} + qzice_{comp} \cdot G_H \cdot Ca_{ice.comp_a} \cdot (SAice_{comp_a} - SA_{comp_a}) = \begin{bmatrix} 11.7 \\ 11.7 \\ 8.6 \\ 8.6 \end{bmatrix} plf$$

$$Wind.TIA_{comp_a} := qz_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} = \begin{bmatrix} 35.8 \\ 35.8 \\ 26.3 \\ 26.3 \end{bmatrix} plf$$

NESC Wind:

$$Wind.250B_{comp_a} := qz_{250B} \cdot Cd_{comp_a} \cdot \max(W_{comp_a}, H_{comp_a}) = \begin{bmatrix} 3.2 \\ 3.2 \\ 3.2 \\ 3.2 \end{bmatrix} plf$$

$$Wind.250C_{comp_a} := qz_{250C} \cdot G_{RF} \cdot Cd_{comp_a} \cdot \max(W_{comp_a}, H_{comp_a}) = \begin{bmatrix} 27.8 \\ 27.8 \\ 27.8 \\ 27.8 \end{bmatrix} plf$$

Mount Load

$b := 1..2$ <----- input number of mount slots used

TIA/EIA-222-G Table 2-8 | NESC Shape Factor

1. Microflect Tri-Sector Mount

$A_{mount_1} := 3.0 \cdot ft^2$ $Aice_{mount_1} := 9.1 \cdot ft^2$ $WT_{mount_1} := 101 \cdot lb$ $WTice_{mount_1} := 346 \cdot lb$ $Ca_{mount_1} := 1.2$ $Cd_{mount_1} := Cd_F$

$Aice_{mount.nesc_1} := 4.22 \cdot ft^2$ $WTice_{mount.nesc_1} := 150 \cdot lb$

2. (3) 2.375" OD Pipe Mounts

$A_{mount_2} := 0 \cdot ft^2$ $Aice_{mount_2} := 0 \cdot ft^2$ $WT_{mount_2} := 66 \cdot lb$ $WTice_{mount_2} := 190 \cdot lb$ $Ca_{mount_2} := 1.2$ $Cd_{mount_2} := Cd_F$

$Aice_{mount.nesc_2} := 0 \cdot ft^2$ $WTice_{mount.nesc_2} := 97 \cdot lb$

3. Not Used

$A_{mount_3} := 0 \cdot ft^2$ $Aice_{mount_3} := 0 \cdot ft^2$ $WT_{mount_3} := 0 \cdot lb$ $WTice_{mount_3} := 0 \cdot lb$ $Ca_{mount_3} := 1.2$ $Cd_{mount_3} := Cd_F$

4. Not Used

$A_{mount_4} := 0 \cdot ft^2$ $Aice_{mount_4} := 0 \cdot ft^2$ $WT_{mount_4} := 0 \cdot lb$ $WTice_{mount_4} := 0 \cdot lb$ $Ca_{mount_4} := 1.2$ $Cd_{mount_4} := Cd_F$

TIA/EIA Wind:

$$IceWind.TIA_{mount_b} := qzice_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot Aice_{mount_b} = \begin{bmatrix} 116.6 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.TIA_{mount_b} := qz_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 165.8 \\ 0.0 \end{bmatrix} lbf$$

NESC Wind:

$$Wind.250B_{mount_b} := qz_{250B} \cdot Cd_{mount_b} \cdot Aice_{mount.nesc_b} = \begin{bmatrix} 27.0 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.250C_{mount_b} := qz_{250C} \cdot G'_{RF} \cdot Cd_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 208.5 \\ 0.0 \end{bmatrix} lbf$$

Equipment Loads

Equipment Description $i := 1..1$ <----- input number of equip slots used

1. APX16DWV-16DWVS-E-A20	$QTY_{eq_1} := 3$	$L_{eq_1} := 55.9 \cdot in$	$W_{eq_1} := 13.0 \cdot in$	$t_{eq_1} := 3.15 \cdot in$	$WT_{eq_1} := 40.7 \cdot lbf$
2. Not Used	$QTY_{eq_2} := 0$	$L_{eq_2} := 0 \cdot in$	$W_{eq_2} := 0 \cdot in$	$t_{eq_2} := 0 \cdot in$	$WT_{eq_2} := 0 \cdot lbf$
3. Not Used	$QTY_{eq_3} := 0$	$L_{eq_3} := 0 \cdot in$	$W_{eq_3} := 0 \cdot in$	$t_{eq_3} := 0 \cdot in$	$WT_{eq_3} := 0 \cdot lbf$
4. Not Used	$QTY_{eq_4} := 0$	$L_{eq_4} := 0 \cdot in$	$W_{eq_4} := 0 \cdot in$	$t_{eq_4} := 0 \cdot in$	$WT_{eq_4} := 0 \cdot lbf$
5. Not Used	$QTY_{eq_5} := 0$	$L_{eq_5} := 0 \cdot in$	$W_{eq_5} := 0 \cdot in$	$t_{eq_5} := 0 \cdot in$	$WT_{eq_5} := 0 \cdot lbf$
6. Not Used	$QTY_{eq_6} := 0$	$L_{eq_6} := 0 \cdot in$	$W_{eq_6} := 0 \cdot in$	$t_{eq_6} := 0 \cdot in$	$WT_{eq_6} := 0 \cdot lbf$

$$Weight_{equip_i} := WT_{eq_i} \cdot QTY_{eq_i} = [122.1]\ lbf$$

$$Weight.Ice_{equip_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(t_{eq_i} + 2 \cdot t_{iz.equip}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right)\right) = [532.5]\ lbf$$

$$Weight.Ice_{equip.nesc_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(t_{eq_i} + 2 \cdot r_{ice.nesc}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right)\right) = [100.6]\ lbf$$

$$SA_{eq_i} := L_{eq_i} \cdot W_{eq_i} = [5.0]\ ft^2 \qquad A_{eq_i} := SA_{eq_i} \cdot QTY_{eq_i} = [15.1]\ ft^2$$

$$SAice_{eq_i} := \left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) = [7.2]\ ft^2 \qquad Aice_{eq_i} := SAice_{eq_i} \cdot QTY_{eq_i} = [21.6]\ ft^2$$

$$SAice_{eq.nesc_i} := \left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) = [5.5]\ ft^2 \qquad Aice_{eq.nesc_i} := SAice_{eq.nesc_i} \cdot QTY_{eq_i} = [16.6]\ ft^2$$

$$Ar_{eq_i} := \frac{L_{eq_i}}{W_{eq_i}} = [4.3] \qquad Ar_{ice.eq_i} := \frac{L_{eq_i} + 2 \cdot t_{iz.equip}}{W_{eq_i} + 2 \cdot t_{iz.equip}} = [3.5]$$

$$Ca_{eq_i} := \begin{cases} 1.2 & \text{if } Ar_{eq_i} \le 2.5 \\ 1.2 + \frac{\left(Ar_{eq_i} - 2.5\right) \cdot (1.4 - 1.2)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{eq_i} < 7 \\ 1.4 + \frac{\left(Ar_{eq_i} - 7\right) \cdot (2.0 - 1.4)}{(25 - 7)} & \text{if } 7 \le Ar_{eq_i} < 25 \\ 2.0 & \text{if } Ar_{eq_i} \ge 25 \end{cases} = [1.28]$$

$$Ca_{ice.eq_i} := \begin{cases} 0.7 & \text{if } Ar_{ice.eq_i} \le 2.5 \\ 0.7 + \frac{\left(Ar_{ice.eq_i} - 2.5\right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{ice.eq_i} < 7 \\ 0.8 + \frac{\left(Ar_{comp_a} - 7\right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{ice.eq_i} < 25 \\ 1.2 & \text{if } Ar_{ice.eq_i} \ge 25 \end{cases} = [0.722]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{equip_i} := qzice_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} + qzice_{equip} \cdot G_H \cdot Ca_{ice.eq_i} \cdot \left(Aice_{eq_i} - A_{eq_i}\right) = [256.8]\ \mathbf{lbf}$$

$$Wind.TIA_{equip_i} := qz_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} = [892.4]\ \mathbf{lbf}$$

NESC Wind:

$$Wind.250B_{equip_i} := qz_{250B} \cdot Cd_F \cdot Aice_{eq.nesc_i} = [106.1]\ \mathbf{lbf}$$

$$Wind.250C_{equip_i} := qz_{250C} \cdot G'_{RF} \cdot Cd_F \cdot A_{eq_i} = [1052.3]\ \mathbf{lbf}$$

Coax Loads - Northeast Leg

Coax Cable Description $k := 1..1$ <----- input number of coax cable slots used

1. Heliax 1-1/4"ø	$QTY_{coax_1} := 12$	$NP_{coax_1} := 6$	$OD_{coax_1} := 1.48 \cdot in$	$WT_{coax_1} := 0.50 \cdot plf$	$L_{coax_1} := 20 \cdot ft$
2. Not Used	$QTY_{coax_2} := 0$	$NP_{coax_2} := 0$	$OD_{coax_2} := 0 \cdot in$	$WT_{coax_2} := 0 \cdot plf$	$L_{coax_2} := 0 \cdot ft$
3. Not Used	$QTY_{coax_3} := 0$	$NP_{coax_3} := 0$	$OD_{coax_3} := 0 \cdot in$	$WT_{coax_3} := 0 \cdot plf$	$L_{coax_3} := 0 \cdot ft$
4. Not Used	$QTY_{coax_4} := 0$	$NP_{coax_4} := 0$	$OD_{coax_4} := 0 \cdot in$	$WT_{coax_4} := 0 \cdot plf$	$L_{coax_4} := 0 \cdot ft$
5. Not Used	$QTY_{coax_5} := 0$	$NP_{coax_5} := 0$	$OD_{coax_5} := 0 \cdot in$	$WT_{coax_5} := 0 \cdot plf$	$L_{coax_5} := 0 \cdot ft$
6. Not Used	$QTY_{coax_6} := 0$	$NP_{coax_6} := 0$	$OD_{coax_6} := 0 \cdot in$	$WT_{coax_6} := 0 \cdot plf$	$L_{coax_6} := 0 \cdot ft$

$$coaxspan := \begin{bmatrix} 29 \\ 13 \\ 15 \\ 15 \\ 12.5 \end{bmatrix} \cdot ft$$

Input coax vertical span between attachment joints for PLS Loads

$$SA_{coax_k} := NP_{coax_k} \cdot OD_{coax_k} = [0.7]\ ft$$

$$SAice_{coax_k} := \begin{cases} 0 & \text{if } NP_{coax_k} = 0 \\ \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot t_{iz.coax}\right)\right) & \text{else} \end{cases} = [1.1]\ ft$$

$$Weight_{coax_k} := WT_{coax_k} \cdot QTY_{coax_k} = [6.0]\ plf$$

$$SAice_{coax.nesc_k} := \begin{cases} 0 & \text{if } NP_{coax_k} = 0 \\ \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot r_{ice.nesc}\right)\right) & \text{else} \end{cases} = [0.8]\ ft$$

$$Weight.Ice_{coax_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot t_{iz.coax}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [110.0]\ plf$$

$$Weight.Ice_{coax.nesc_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot r_{ice.nesc}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [14.8]\ plf$$

$$Ar_{coax_k} := \frac{L_{coax_k}}{OD_{coax_k}} = [162.2]$$

Aspect Ratio of Coax

$$Ca_{coax_k} := \begin{cases} 0.7 & \text{if } Ar_{coax_k} \le 2.5 \\ 0.7 + \dfrac{(Ar_{coax_k} - 2.5) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{coax_k} < 7 \\ 0.8 + \dfrac{(Ar_{coax_k} - 7) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{coax_k} < 25 \\ 1.2 & \text{if } Ar_{coax_k} \ge 25 \end{cases} = [1.2]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{coax_k} := qzice_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SAice_{coax_k} = [13.3] \ \mathbf{plf}$$

$$Wind.TIA_{coax_k} := qz_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SA_{coax_k} = [39.0] \ \mathbf{plf}$$

NESC Wind for Coax on Pipe Mast Risa Model:

$$Wind.250B_{coax.pipe_k} := qz_{250B} \cdot Cd_{coax} \cdot SAice_{coax.nesc_k} = [4.8]\ \mathbf{plf}$$

$$Wind.250C_{coax.pipe.Above_k} := qz_{250C} \cdot G'_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [46.6]\ \mathbf{plf}$$

$$Wind.250C_{coax.pipe.Below_k} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [37.3]\ \mathbf{plf}$$

NESC Loads For PLS Model:

$$Weight.250B_{coax.twr} := \left(\sum Weight_{coax} + \sum Weight.Ice_{coax.nesc}\right) \cdot coaxspan \cdot OLF250B_V$$

$$Wind.250B_{coax.twr} := qz_{250B} \cdot Cd_{coax} \cdot \left(\sum SAice_{coax.nesc}\right) \cdot coaxspan \cdot OLF250B_T$$

$$Weight.250C_{coax.twr} := \left(\sum Weight_{coax}\right) \cdot coaxspan \cdot OLF250C_V$$

$$Wind.250C_{coax.twr} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot \left(\sum SA_{coax}\right) \cdot coaxspan \cdot OLF250C_T$$

Summary of Loads - PLS Coax Load Inputs

NESC 250B_X-dir - Wind w/ Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1XY	904	346	0	Coax Load
C2XY	405	155	0	Coax Load
C3XY	467	179	0	Coax Load
C4XY	467	179	0	Coax Load
C5XY	390	149	0	Coax Load

NESC 250C_X-dir - Wind w/o Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1XY	174	1081	0	Coax Load
C2XY	78	485	0	Coax Load
C3XY	90	559	0	Coax Load
C4XY	90	559	0	Coax Load
C5XY	75	466	0	Coax Load

Summary of Loads - Risa Loads Inputs

BLC 2 Weight of Equipment

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-101.0	52.0	**Mount 1**
M2	Y	-66.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-122.1	52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
M2	Y		52.0	**Equipment 6**

Member Distributed Loads - Rows 1-6: Coax 1-6 Weight

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-6.0	-6.0	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0

BLC 3 Weight of Ice on Mast & Equipment - TIA
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-346.0	52.0	**Mount 1**
M2	Y	-190.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-532.5	52.0	
M2	Y		52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
				Equipment 6

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-38.2	-38.2	0.0	0.0
M2	Y	-110.0	-110.0	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M4	Y	-20.8	-20.8	0.0	0.0
M7	Y	-20.8	-20.8	0.0	0.0
M9	Y	-20.8	-20.8	0.0	0.0
M10	Y	-20.8	-20.8	0.0	0.0
M4	Y			0.0	0.0
M4	Y			0.0	0.0

BLC 4 TIA_X-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	116.6	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	256.8	52.0	
M2	X		52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
				Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	17.2	17.2	0.0	0.0
M2	PX	13.3	13.3	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	11.7	11.7	0.0	0.0
M7	PX	11.7	11.7	0.0	0.0
M9	PX	8.6	8.6	0.0	0.0
M10	PX	8.6	8.6	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 5 TIA_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	165.8	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	892.4	52.0	
M2	X		52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
				Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	55.9	55.9	0.0	0.0
M2	PX	39.0	39.0	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	35.8	35.8	0.0	0.0
M7	PX	35.8	35.8	0.0	0.0
M9	PX	26.3	26.3	0.0	0.0
M10	PX	26.3	26.3	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 6 TIA_Z-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	116.6	52.0	**Mount 1**
M2	Z	0.0	52.0	**Mount 2**
M2	Z		52.0	**Mount 3**
M2	Z		52.0	**Mount 4**
M2	Z	256.8	52.0	**Equipment 1**
M2	Z		52.0	**Equipment 2**
M2	Z		52.0	**Equipment 3**
M2	Z		52.0	**Equipment 4**
M2	Z		52.0	**Equipment 5**
M2	Z		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	17.2	17.2	0.0	0.0
M2	PZ	13.3	13.3	23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M4	PZ	11.7	11.7	0.0	0.0
M7	PZ	11.7	11.7	0.0	0.0
M9	PZ	8.6	8.6	0.0	0.0
M10	PZ	8.6	8.6	0.0	0.0
M4	PZ			0.0	0.0
M4	PZ			0.0	0.0

BLC 7 TIA_Z-dir - Wind w/o Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	165.8	52.0	**Mount 1**
M2	Z	0.0	52.0	**Mount 2**
M2	Z		52.0	**Mount 3**
M2	Z		52.0	**Mount 4**
M2	Z	892.4	52.0	
M2	Z		52.0	**Equipment 1**
M2	Z		52.0	**Equipment 2**
M2	Z		52.0	**Equipment 3**
M2	Z		52.0	**Equipment 4**
M2	Z		52.0	**Equipment 5**
				Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	55.9	55.9	0.0	0.0
M2	PZ	39.0	39.0	23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M2	PZ			23.0	52.0
M4	PZ	35.8	35.8	0.0	0.0
M7	PZ	35.8	35.8	0.0	0.0
M9	PZ	26.3	26.3	0.0	0.0
M10	PZ	26.3	26.3	0.0	0.0
M4	PZ			0.0	0.0
M4	PZ			0.0	0.0

3LC 8 NESC 250B_X-dir - Wind w/ Ice

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	27.0	52.0	Mount 1
M2	X	0.0	52.0	Mount 2
M2	X		52.0	Mount 3
M2	X		52.0	Mount 4
M2	X	106.1	52.0	Equipment 1
M2	X		52.0	Equipment 2
M2	X		52.0	Equipment 3
M2	X		52.0	Equipment 4
M2	X		52.0	Equipment 5
M2	X		52.0	Equipment 6

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	5.9	5.9	0.0	0.0
M2	PX	4.8	4.8	23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M2	PX			23.0	52.0
M4	PX	3.2	3.2	0.0	0.0
M7	PX	3.2	3.2	0.0	0.0
M9	PX	3.2	3.2	0.0	0.0
M10	PX	3.2	3.2	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 9 NESC 250C_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	208.5	52.0	**Mount 1**
M2	X	0.0	52.0	**Mount 2**
M2	X		52.0	**Mount 3**
M2	X		52.0	**Mount 4**
M2	X	1052.3	52.0	**Equipment 1**
M2	X		52.0	**Equipment 2**
M2	X		52.0	**Equipment 3**
M2	X		52.0	**Equipment 4**
M2	X		52.0	**Equipment 5**
M2	X		52.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast Above Top of Tower
Row 2-7: Wind on Coax 1-6 Above Top of Tower
Row 8: Wind on Mast Below Top of Tower
Row 9-14: Wind on Coax 1-6 Below Top of Tower
Row 15-20: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	60.0	60.0	32.0	55.0
M2	PX	46.6	46.6	32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX			32.0	52.0
M2	PX	48.0	48.0	0.0	32.0
M2	PX	37.3	37.3	23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M4	PX	27.8	27.8	0.0	0.0
M7	PX	27.8	27.8	0.0	0.0
M9	PX	27.8	27.8	0.0	0.0
M10	PX	27.8	27.8	0.0	0.0
M4	PX			0.0	0.0
M4	PX			0.0	0.0

BLC 10 Weight of Ice on Mast & Equipment - NESC
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-150.0	52.0	**Mount 1**
M2	Y	-97.0	52.0	**Mount 2**
M2	Y	0.0	52.0	**Mount 3**
M2	Y	0.0	52.0	**Mount 4**
M2	Y	-100.6	52.0	
M2	Y		52.0	**Equipment 1**
M2	Y		52.0	**Equipment 2**
M2	Y		52.0	**Equipment 3**
M2	Y		52.0	**Equipment 4**
M2	Y		52.0	**Equipment 5**
				Equipment 6

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-8.2	-8.2	0.0	0.0
M2	Y	-14.8	-14.8	23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M2	Y			23.0	52.0
M4	Y	-5.1	-5.1	0.0	0.0
M7	Y	-5.1	-5.1	0.0	0.0
M9	Y	-5.1	-5.1	0.0	0.0
M10	Y	-5.1	-5.1	0.0	0.0
M4	Y			0.0	0.0
M4	Y			0.0	0.0

Equipment Loads (Tubular Pole on Lattice Structure) - North Mast - AT&T

Constants

$h_{lattice} := 94 \cdot ft$ height of lattice structure

$h_{mast} := 117 \cdot ft$ Top of Mast AGL

$b_{mast} := 62 \cdot ft$ Bot. of Mast AGL

$b_{coax} := 85 \cdot ft$ Bot. of Coax AGL (on mast)

$z_{equip} := 104 \cdot ft$ elevation of equip.

$z_{coax} := 90.5 \cdot ft$ elevation to CL of coax section for TIA wind (linear appurtance)

$z_{pipe} := 90.5 \cdot ft$ elevation to CL of pipe section for TIA wind

$r_{ice} := 0.75 \cdot in$ Radial Ice, TIA

$r_{ice.nesc} := 0.5 \cdot in$ Radial Ice, NESC

NESC Shape Factors:

$Cd_R := 1.3$ $Cd_F := 1.6$ $Cd_{coax} := 1.45$

NESC Overload Factors:

$OLF250B_V := 1.5$ 250B Vertical OLF

$OLF250B_T := 2.5$ 250B Transverse Wind OLF

$OLF250C_V := 1.0$ 250C Vertical OLF

$OLF250C_T := 1.0$ 250C Transverse Wind OLF

$I_d := 57 \cdot pcf$ Ice Density

TIA/EIA Wind

$V_{Ult} := 125$ TIA Ultimate Wind Speed

$V_{tia} := V_{Ult} \cdot \sqrt{0.6} = 96.825$ TIA Nominal Wind Speed

$V_{i.tia} := 50$ TIA Basic Wind Speed with Ice

$Exp_{tia} := \text{“C”}$ TIA Exposure Category

$Topo_{tia} := 1$ TIA Topographic Category

$SC_{tia} := 3$ TIA Structure Class

$Crest_{tia} := 0$ Height of Crest, ft

$K_d := 0.95$ TIA Table 2-2

$G_H := 1.35$ TIA Sec. 2.6

$$I_{wind} := \begin{cases} 0.87 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.15 & \text{if } SC_{tia} = 3 \end{cases} = 1.15$$

$$I_{ice} := \begin{cases} 1 & \text{if } SC_{tia} = 1 \\ 1.0 & \text{if } SC_{tia} = 2 \\ 1.25 & \text{if } SC_{tia} = 3 \end{cases} = 1.25$$

$I_{icewind} := 1$ TIA Importance Factor Table 2-3

NESC Wind

$V_{nesc} := 110$ NESC 250C 3 sec Gust Speed per OTRM 060

$V_{i.nesc} := 39.5$ NESC 250B 3 sec Gust Speed with Ice

$I := 1.0$ NESC Importance Factor

$$E_s := 0.346 \cdot \left(\frac{33}{\left(0.67 \cdot \frac{h_{mast}}{ft}\right)} \right)^{\frac{1}{7}} = 0.306$$ NESC Factors, Table 250-3

$$B_s := \frac{1}{\left(1 + \frac{0.56 \cdot \left(0.67 \cdot \frac{h_{mast}}{ft}\right)}{220}\right)} = 0.834$$ NESC Factors, Table 250-3

$k_v := 1.43$ NESC Constant, Table 250-3

$$G_{RF} := \frac{\left(1 + \left(2.7 \cdot E_s \cdot B_s^{0.5}\right)\right)}{k_v^2} = 0.858$$ Calculated GRF, Table 250-3

$m_{grf} := 1.25$ NEU specified multiplier for 250C (OTRM 059.1, Attachment A)

$G'_{RF} := G_{RF} \cdot m_{grf} = 1.072$ Calculated GRF for 250C

TIA/EIA Topographc Coefficients:

$K_t :=$ if $Topo_{tia} = 2$: 0.43; if $Topo_{tia} = 3$: 0.53; if $Topo_{tia} = 4$: 0.72; else 1.0 $= 1$

$f_{tia} :=$ if $Topo_{tia} = 2$: 1.25; if $Topo_{tia} = 3$: 2.00; if $Topo_{tia} = 4$: 1.50; else 1.0 $= 1$

$K_e :=$ if $Exp_{tia} =$ "B": 0.9; if $Exp_{tia} =$ "D": 1.1; else 1.0 $= 1$

$K_{h.equip} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{equip}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{h.coax} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{coax}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{h.pipe} :=$ if $Crest_{tia} = 0$: 1; else $e^{\left(\frac{f_{tia} \cdot \frac{z_{pipe}}{ft}}{Crest_{tia}}\right)}$ $= 1$

$K_{zt.equip} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.equip}}\right)^{\langle 2 \rangle}$ $= 1$

$K_{zt.coax} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.coax}}\right)^{\langle 2 \rangle}$ $= 1$

$K_{zt.pipe} :=$ if $Topo_{tia} = 1$: 1.0; else $\left(1 + \frac{K_e \cdot K_t}{K_{h.pipe}}\right)^{\langle 2 \rangle}$ $= 1$

TIA/EIA Exposure Coefficients:

$K_{z.min} :=$ if $Exp_{tia} =$ "B": 0.7; if $Exp_{tia} =$ "D": 1.03; else 0.85 $= 0.85$

$z_g :=$ if $Exp_{tia} =$ "B": 1200; if $Exp_{tia} =$ "D": 700; else 900 $= 900$

$alpha_{tia} :=$ if $Exp_{tia} =$ "B": 7; if $Exp_{tia} =$ "D": 11.5; else 9.5 $= 9.5$

NESC Exposure Coefficient:

$$k_z := 2.01 \cdot \left(\frac{h_{mast}}{900 \cdot ft}\right)^{\left(\frac{2}{9.5}\right)} = 1.308$$

Calculated kz
per Table 250-2

$$Kz_{equip} := 2.01 \cdot \left(\frac{\frac{z_{equip}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.276 \qquad Kz_{coax} := 2.01 \cdot \left(\frac{\frac{z_{coax}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239 \qquad Kz_{pipe} := 2.01 \cdot \left(\frac{\frac{z_{pipe}}{ft}}{z_g}\right)^{\frac{2}{alpha_{tia}}} = 1.239$$

$$Kz_{equip} := \begin{array}{l} \text{if } Kz_{equip} \le K_{z.min} \\ \quad Kz_{equip} = K_{z.min} \\ \text{if } Kz_{equip} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{equip} \end{array} = 1.276 \qquad Kz_{coax} := \begin{array}{l} \text{if } Kz_{coax} \le K_{z.min} \\ \quad Kz_{coax} = K_{z.min} \\ \text{if } Kz_{coax} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{coax} \end{array} = 1.239 \qquad Kz_{pipe} := \begin{array}{l} \text{if } Kz_{pipe} \le K_{z.min} \\ \quad Kz_{pipe} = K_{z.min} \\ \text{if } Kz_{pipe} > 2.01 \\ \quad 2.01 \\ \text{else} \\ \quad Kz_{pipe} \end{array} = 1.239$$

Section Average Height Above Ground for Wind Load

Section Average Height Above Ground for Wind Load

TIA/EIA Wind Pressure:

$$qzice_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{i.tia}^{\ 2} \cdot I_{icewind} = 7.8\ psf$$

$$qz_{equip} := 0.00256 \cdot psf \cdot Kz_{equip} \cdot K_{zt.equip} \cdot K_d \cdot V_{tia}^{\ 2} \cdot I_{wind} = 33.5\ psf$$

$$qzice_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{i.tia}^{\ 2} \cdot I_{icewind} = 7.5\ psf$$

$$qz_{coax} := 0.00256 \cdot psf \cdot Kz_{coax} \cdot K_{zt.coax} \cdot K_d \cdot V_{tia}^{\ 2} \cdot I_{wind} = 32.5\ psf$$

$$qzice_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^{\ 2} \cdot I_{icewind} = 7.5\ psf$$

$$qz_{pipe} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^{\ 2} \cdot I_{wind} = 32.5\ psf$$

$$qzice_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{i.tia}^{\ 2} \cdot I_{icewind} = 7.5\ psf$$

$$qz_{comp} := 0.00256 \cdot psf \cdot Kz_{pipe} \cdot K_{zt.pipe} \cdot K_d \cdot V_{tia}^{\ 2} \cdot I_{wind} = 32.5\ psf$$

NESC Wind Pressure:

$$qz_{250B} := 0.00256 \cdot V_{i.nesc}^{\ 2} \cdot I \cdot psf = 4.0\ psf$$

$$qz_{250C} := 0.00256 \cdot k_z \cdot V_{nesc}^{\ 2} \cdot I \cdot psf = 40.5\ psf$$

TIA/EIA Design Ice Thickness:

$$K_{iz.equip} := \left(\frac{\frac{z_{equip}}{ft}}{33}\right)^{0.1} = 1.122 \qquad K_{iz.pipe} := \left(\frac{\frac{z_{pipe}}{ft}}{33}\right)^{0.1} = 1.106 \qquad K_{iz.coax} := \left(\frac{\frac{z_{coax}}{ft}}{33}\right)^{0.1} = 1.106$$

$$t_{iz.equip} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.equip} \cdot K_{zt.equip}^{\ 0.35} = 2.103\ in$$

$$t_{iz.pipe} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.pipe} \cdot K_{zt.pipe}^{\ 0.35} = 2.074\ in$$

$$t_{iz.coax} := 2.0 \cdot r_{ice} \cdot I_{ice} \cdot K_{iz.coax} \cdot K_{zt.coax}^{\ 0.35} = 2.074\ in$$

Pipe Extension Loads

Constants

$OD := 12.75 \cdot in$ outer diameter of pipe riser

$L_{pipe} := 55\ ft$ Length of pipe riser

$MemberLabel_{pipe} := \text{"M2"}$ Member Label in Risa

See T-Mobile Calcs for Pipe Extension Loads

$$Weight.ice_{pipe} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot t_{iz.pipe} \right)^2 - OD^2 \right) \cdot 0 = 0\ plf$$

$$Weight.ice_{pipe.nesc} := I_d \cdot \frac{\pi}{4} \cdot \left(\left(OD + 2 \cdot r_{ice.nesc} \right)^2 - OD^2 \right) \cdot 0 = 0\ plf$$

$SA_{pipe} := OD = 1.063\ ft$ Projected Surface Area of Pipe

$SAice_{pipe} := OD + \left(2 \cdot t_{iz.pipe} \right) = 1.408\ ft$ Projected Surface Area of Pipe with Ice (TIA)

$SAice_{pipe.nesc} := OD + \left(2 \cdot r_{ice.nesc} \right) = 1.146\ ft$ Projected Surface Area of Pipe with Ice (NESC)

TIA/EIA Wind:

$$Ar_{pipe} := \frac{L_{pipe}}{OD} = 51.765$$

$$Ca_{pipe} := \begin{cases} 0.7 & \text{if } Ar_{pipe} \le 2.5 \\ 0.7 + \frac{\left(Ar_{pipe} - 2.5 \right) \cdot (0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{pipe} < 7 \\ 0.8 + \frac{\left(Ar_{pipe} - 7 \right) \cdot (1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{pipe} < 25 \\ 1.2 & \text{if } Ar_{pipe} \ge 25 \end{cases} = 1.2$$

Table 2-8

$$Wind.TIA_{pipe} := qz_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SA_{pipe} \cdot 0 = 0\ plf$$

$$IceWind.TIA_{pipe} := qzice_{pipe} \cdot G_H \cdot Ca_{pipe} \cdot SAice_{pipe} \cdot 0 = 0\ plf$$

NESC Wind:

$$Wind.250B_{pipe} := qz_{250B} \cdot Cd_R \cdot SAice_{pipe.nesc} \cdot 0 = 0.0\ plf$$

Wind Pressure Above Top of Tower:

$$Wind.250C_{pipe.Above} := qz_{250C} \cdot G'_{RF} \cdot Cd_R \cdot SA_{pipe} \cdot 0 = 0.0\ plf$$

Wind Pressure Below Top of Tower:

$$Wind.250C_{pipe.Below} := qz_{250C} \cdot G_{RF} \cdot Cd_R \cdot SA_{pipe} \cdot 0 = 0.0\ plf$$

Mast Component Loads - NOT USED

$a := 1..1$ <----- input number of component slots used

Component Description

1. 6x6x1/4 Hor Tube	$Cd_{comp_1} := Cd_F$	$W_{comp_1} := 0\ in$	$H_{comp_1} := 0 \cdot in$	$L_{comp_1} := 0\ ft$	$MemLabel_{comp_1} :=$ "NA"
2. 6x6x1/4 Hor Tube	$Cd_{comp_2} := Cd_F$	$W_{comp_2} := 0 \cdot in$	$H_{comp_2} := 0 \cdot in$	$L_{comp_2} := 0\ ft$	$MemLabel_{comp_2} :=$ "NA"
3. 6x6x1/4 Hor Tube	$Cd_{comp_3} := Cd_F$	$W_{comp_3} := 0 \cdot in$	$H_{comp_3} := 0 \cdot in$	$L_{comp_3} := 0\ ft$	$MemLabel_{comp_3} :=$ "NA"
4. 6x6x1/4 Hor Tube	$Cd_{comp_4} := Cd_F$	$W_{comp_4} := 0 \cdot in$	$H_{comp_4} := 0 \cdot in$	$L_{comp_4} := 0\ ft$	$MemLabel_{comp_4} :=$ "NA"
5. Not Used	$Cd_{comp_5} := Cd_F$	$W_{comp_5} := 0 \cdot in$	$H_{comp_5} := 0 \cdot in$	$L_{comp_5} := 0\ ft$	$MemLabel_{comp_5} :=$ "NA"
6. Not Used	$Cd_{comp_6} := Cd_F$	$W_{comp_6} := 0 \cdot in$	$H_{comp_6} := 0 \cdot in$	$L_{comp_6} := 0\ ft$	$MemLabel_{comp_6} :=$ "NA"

$$Weight.ice_{comp_a} := I_d \cdot \pi \cdot t_{iz.pipe} \cdot \left(\max\left(H_{comp_a}, W_{comp_a}\right) + t_{iz.pipe}\right) \cdot 0 = [0.0]\ plf$$

$$Weight.ice_{comp.nesc_a} := I_d \cdot \left(\left(W_{comp_a} + 2 \cdot r_{ice.nesc}\right) \cdot \left(H_{comp_a} + 2 \cdot r_{ice.nesc}\right) - W_{comp_a} \cdot H_{comp_a}\right) \cdot 0 = [0.0]\ plf$$

$$SA_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) = [0]\ ft$$

$$SAice_{comp_a} := \max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe} = [0.3]\ ft$$

$$Ar_{comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a}}{\max\left(W_{comp_a}, H_{comp_a}\right)} & \text{else} \end{cases} = [0]$$

$$Ar_{ice.comp_a} := \begin{cases} 0 & \text{if } \max\left(W_{comp_a}, H_{comp_a}\right) = 0 \\ \dfrac{L_{comp_a} + 2 \cdot t_{iz.pipe}}{\max\left(W_{comp_a}, H_{comp_a}\right) + 2 \cdot t_{iz.pipe}} & \text{else} \end{cases} = [0]$$

$$Ca_{comp_a} := \begin{cases} \text{if } Ar_{comp_a} \le 2.5 \\ \quad 1.2 \\ \text{if } 2.5 < Ar_{comp_a} < 7 \\ \quad 1.2 + \dfrac{\left(Ar_{comp_a} - 2.5\right) \cdot (1.4 - 1.2)}{(7 - 2.5)} \\ \text{if } 7 \le Ar_{comp_a} < 25 \\ \quad 1.4 + \dfrac{\left(Ar_{comp_a} - 7\right) \cdot (2.0 - 1.4)}{(25 - 7)} \\ \text{if } Ar_{comp_a} \ge 25 \\ \quad 2.0 \end{cases} = [1.2]$$

$$Ca_{ice.comp_a} := \begin{cases} \text{if } Ar_{ice.comp_a} \le 2.5 \\ \quad 0.7 \\ \text{if } 2.5 < Ar_{ice.comp_a} < 7 \\ \quad 0.7 + \dfrac{\left(Ar_{ice.comp_a} - 2.5\right) \cdot (0.8 - 0.7)}{(7 - 2.5)} \\ \text{if } 7 \le Ar_{ice.comp_a} < 25 \\ \quad 0.8 + \dfrac{\left(Ar_{comp_a} - 7\right) \cdot (1.2 - 0.8)}{(25 - 7)} \\ \text{if } Ar_{ice.comp_a} \ge 25 \\ \quad 1.2 \end{cases} = [0.7]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{comp_a} := qzice_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} + qzice_{comp} \cdot G_H \cdot Ca_{ice.comp_a} \cdot \left(SAice_{comp_a} - SA_{comp_a}\right) \cdot 0 = [0.0]\ \textit{plf}$$

$$Wind.TIA_{comp_a} := qz_{comp} \cdot G_H \cdot Ca_{comp_a} \cdot SA_{comp_a} = [0.0]\ \textit{plf}$$

NESC Wind:

$$Wind.250B_{comp_a} := qz_{250B} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = [0.0]\ \textit{plf}$$

$$Wind.250C_{comp_a} := qz_{250C} \cdot G_{RF} \cdot Cd_{comp_a} \cdot \max\left(W_{comp_a}, H_{comp_a}\right) = [0.0]\ \textit{plf}$$

Mount Load

$b := 1..2$ <----- input number of mount slots used

TIA/EIA-222-G Table 2-8 | NESC Shape Factor

1. Microflect Tri-Sector Mount

$A_{mount_1} := 3.0 \cdot ft^2$ | $Aice_{mount_1} := 9.1 \cdot ft^2$ | $WT_{mount_1} := 101 \cdot lb$ | $WTice_{mount_1} := 346 \cdot lb$ | $Ca_{mount_1} := 1.2$ | $Cd_{mount_1} := Cd_F$

$Aice_{mount.nesc_1} := 4.22 \cdot ft^2$ | $WTice_{mount.nesc_1} := 150 \cdot lb$

2. (3) 2.375" OD Pipe Mounts

$A_{mount_2} := 0 \cdot ft^2$ | $Aice_{mount_2} := 0 \cdot ft^2$ | $WT_{mount_2} := 66 \cdot lb$ | $WTice_{mount_2} := 190 \cdot lb$ | $Ca_{mount_2} := 1.2$ | $Cd_{mount_2} := Cd_F$

$Aice_{mount.nesc_2} := 0 \cdot ft^2$ | $WTice_{mount.nesc_2} := 97 \cdot lb$

3. Not Used

$A_{mount_3} := 0 \cdot ft^2$ | $Aice_{mount_3} := 0 \cdot ft^2$ | $WT_{mount_3} := 0 \cdot lb$ | $WTice_{mount_3} := 0 \cdot lb$ | $Ca_{mount_3} := 1.2$ | $Cd_{mount_3} := Cd_F$

4. Not Used

$A_{mount_4} := 0 \cdot ft^2$ | $Aice_{mount_4} := 0 \cdot ft^2$ | $WT_{mount_4} := 0 \cdot lb$ | $WTice_{mount_4} := 0 \cdot lb$ | $Ca_{mount_4} := 1.2$ | $Cd_{mount_4} := Cd_F$

TIA/EIA Wind:

$$IceWind.TIA_{mount_b} := qzice_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot Aice_{mount_b} = \begin{bmatrix} 114.4 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.TIA_{mount_b} := qz_{equip} \cdot G_H \cdot Ca_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 162.6 \\ 0.0 \end{bmatrix} lbf$$

NESC Wind:

$$Wind.250B_{mount_b} := qz_{250B} \cdot Cd_{mount_b} \cdot Aice_{mount.nesc_b} = \begin{bmatrix} 27.0 \\ 0.0 \end{bmatrix} lbf$$

$$Wind.250C_{mount_b} := qz_{250C} \cdot G'_{RF} \cdot Cd_{mount_b} \cdot A_{mount_b} = \begin{bmatrix} 208.5 \\ 0.0 \end{bmatrix} lbf$$

Equipment Loads

Equipment Description $i := 1..2$ <----- input number of equip slots used

1. Powerwave 7770	$QTY_{eq_1} := 3$	$L_{eq_1} := 55 \cdot in$	$W_{eq_1} := 11 \cdot in$	$t_{eq_1} := 5 \cdot in$	$WT_{eq_1} := 35 \cdot lbf$
2. TT19-08BP111-001	$QTY_{eq_2} := 3$	$L_{eq_2} := 9.9 \cdot in$	$W_{eq_2} := 6.7 \cdot in$	$t_{eq_2} := 5.4 \cdot in$	$WT_{eq_2} := 16 \cdot lbf$
3. Not Used	$QTY_{eq_3} := 0$	$L_{eq_3} := 0 \cdot in$	$W_{eq_3} := 0 \cdot in$	$t_{eq_3} := 0 \cdot in$	$WT_{eq_3} := 0 \cdot lbf$
4. Not Used	$QTY_{eq_4} := 0$	$L_{eq_4} := 0 \cdot in$	$W_{eq_4} := 0 \cdot in$	$t_{eq_4} := 0 \cdot in$	$WT_{eq_4} := 0 \cdot lbf$
5. Not Used	$QTY_{eq_5} := 0$	$L_{eq_5} := 0 \cdot in$	$W_{eq_5} := 0 \cdot in$	$t_{eq_5} := 0 \cdot in$	$WT_{eq_5} := 0 \cdot lbf$
6. Not Used	$QTY_{eq_6} := 0$	$L_{eq_6} := 0 \cdot in$	$W_{eq_6} := 0 \cdot in$	$t_{eq_6} := 0 \cdot in$	$WT_{eq_6} := 0 \cdot lbf$

$$Weight_{equip_i} := WT_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 105.0 \\ 48.0 \end{bmatrix} lbf$$

$$Weight.Ice_{equip_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(t_{eq_i} + 2 \cdot t_{iz.equip}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right) \right) = \begin{bmatrix} 520.8 \\ 110.8 \end{bmatrix} lbf$$

$$Weight.Ice_{equip.nesc_i} := I_d \cdot QTY_{eq_i} \cdot \left(\left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(t_{eq_i} + 2 \cdot r_{ice.nesc}\right) - \left(L_{eq_i} \cdot W_{eq_i} \cdot t_{eq_i}\right) \right) = \begin{bmatrix} 99.7 \\ 17.7 \end{bmatrix} lbf$$

$$SA_{eq_i} := L_{eq_i} \cdot W_{eq_i} = \begin{bmatrix} 4.2 \\ 0.5 \end{bmatrix} ft^2 \qquad A_{eq_i} := SA_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 12.6 \\ 1.4 \end{bmatrix} ft^2$$

$$SAice_{eq_i} := \left(L_{eq_i} + 2 \cdot t_{iz.equip}\right) \cdot \left(W_{eq_i} + 2 \cdot t_{iz.equip}\right) = \begin{bmatrix} 6.3 \\ 1.1 \end{bmatrix} ft^2 \qquad Aice_{eq_i} := SAice_{eq_i} \cdot QTY_{eq_i} = \begin{bmatrix} 18.8 \\ 3.2 \end{bmatrix} ft^2$$

$$SAice_{eq.nesc_i} := \left(L_{eq_i} + 2 \cdot r_{ice.nesc}\right) \cdot \left(W_{eq_i} + 2 \cdot r_{ice.nesc}\right) = \begin{bmatrix} 4.7 \\ 0.6 \end{bmatrix} ft^2 \qquad Aice_{eq.nesc_i} := SAice_{eq.nesc_i} \cdot QTY_{eq_i} = \begin{bmatrix} 14.0 \\ 1.7 \end{bmatrix} ft^2$$

$$Ar_{eq_i} := \frac{L_{eq_i}}{W_{eq_i}} = \begin{bmatrix} 5.0 \\ 1.5 \end{bmatrix} \qquad Ar_{ice.eq_i} := \frac{L_{eq_i} + 2 \cdot t_{iz.equip}}{W_{eq_i} + 2 \cdot t_{iz.equip}} = \begin{bmatrix} 3.9 \\ 1.3 \end{bmatrix}$$

$$Ca_{eq_i} := \begin{cases} 1.2 & \text{if } Ar_{eq_i} \le 2.5 \\ 1.2 + \dfrac{(Ar_{eq_i} - 2.5)\cdot(1.4-1.2)}{(7-2.5)} & \text{if } 2.5 < Ar_{eq_i} < 7 \\ 1.4 + \dfrac{(Ar_{eq_i} - 7)\cdot(2.0-1.4)}{(25-7)} & \text{if } 7 \le Ar_{eq_i} < 25 \\ 2.0 & \text{if } Ar_{eq_i} \ge 25 \end{cases} = \begin{bmatrix} 1.311 \\ 1.2 \end{bmatrix}$$

$$Ca_{ice.eq_i} := \begin{cases} 0.7 & \text{if } Ar_{ice.eq_i} \le 2.5 \\ 0.7 + \dfrac{(Ar_{ice.eq_i} - 2.5)\cdot(0.8-0.7)}{(7-2.5)} & \text{if } 2.5 < Ar_{ice.eq_i} < 7 \\ 0.8 + \dfrac{(Ar_{comp_a} - 7)\cdot(1.2-0.8)}{(25-7)} & \text{if } 7 \le Ar_{ice.eq_i} < 25 \\ 1.2 & \text{if } Ar_{ice.eq_i} \ge 25 \end{cases} = \begin{bmatrix} 0.731 \\ 0.7 \end{bmatrix}$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{equip_i} := qzice_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} + qzice_{equip} \cdot G_H \cdot Ca_{ice.eq_i} \cdot \left(Aice_{eq_i} - A_{eq_i}\right) = \begin{bmatrix} 220.2 \\ 30.7 \end{bmatrix} \textbf{lbf}$$

$$Wind.TIA_{equip_i} := qz_{equip} \cdot G_H \cdot Ca_{eq_i} \cdot A_{eq_i} = \begin{bmatrix} 746.5 \\ 74.9 \end{bmatrix} \textbf{lbf}$$

NESC Wind:

$$Wind.250B_{equip_i} := qz_{250B} \cdot Cd_F \cdot Aice_{eq.nesc_i} = \begin{bmatrix} 89.5 \\ 11.2 \end{bmatrix} \textbf{lbf}$$

$$Wind.250C_{equip_i} := qz_{250C} \cdot G'_{RF} \cdot Cd_F \cdot A_{eq_i} = \begin{bmatrix} 876.1 \\ 96.0 \end{bmatrix} \textbf{lbf}$$

Coax Loads - Northwest Leg

Coax Cable Description $k := 1..1$ <----- input number of coax cable slots used

1. Heliax 1-1/4"ø	$QTY_{coax_1} := 6$	$NP_{coax_1} := 3$	$OD_{coax_1} := 1.48 \cdot in$	$WT_{coax_1} := 0.50 \cdot plf$	$L_{coax_1} := 20 \cdot ft$
2. Not Used	$QTY_{coax_2} := 0$	$NP_{coax_2} := 0$	$OD_{coax_2} := 0 \cdot in$	$WT_{coax_2} := 0 \cdot plf$	$L_{coax_2} := 0 \cdot ft$
3. Not Used	$QTY_{coax_3} := 0$	$NP_{coax_3} := 0$	$OD_{coax_3} := 0 \cdot in$	$WT_{coax_3} := 0 \cdot plf$	$L_{coax_3} := 0 \cdot ft$
4. Not Used	$QTY_{coax_4} := 0$	$NP_{coax_4} := 0$	$OD_{coax_4} := 0 \cdot in$	$WT_{coax_4} := 0 \cdot plf$	$L_{coax_4} := 0 \cdot ft$
5. Not Used	$QTY_{coax_5} := 0$	$NP_{coax_5} := 0$	$OD_{coax_5} := 0 \cdot in$	$WT_{coax_5} := 0 \cdot plf$	$L_{coax_5} := 0 \cdot ft$
6. Not Used	$QTY_{coax_6} := 0$	$NP_{coax_6} := 0$	$OD_{coax_6} := 0 \cdot in$	$WT_{coax_6} := 0 \cdot plf$	$L_{coax_6} := 0 \cdot ft$

$$SA_{coax_k} := NP_{coax_k} \cdot OD_{coax_k} = [0.4]\ ft$$

$$coaxspan := \begin{bmatrix} 29 \\ 13 \\ 15 \\ 15 \\ 12.5 \end{bmatrix} \cdot ft$$

Input coax vertical span between attachment joints for PLS Loads

$$SAice_{coax_k} := \begin{cases} \text{if } NP_{coax_k} = 0 \\ \quad 0 \\ \text{else} \\ \quad \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot t_{iz.coax}\right)\right) \end{cases} = [0.7]\ ft$$

$$Weight_{coax_k} := WT_{coax_k} \cdot QTY_{coax_k} = [3.0]\ plf$$

$$SAice_{coax.nesc_k} := \begin{cases} \text{if } NP_{coax_k} = 0 \\ \quad 0 \\ \text{else} \\ \quad \left(\left(NP_{coax_k} \cdot OD_{coax_k}\right) + \left(2 \cdot r_{ice.nesc}\right)\right) \end{cases} = [0.5]\ ft$$

$$Weight.Ice_{coax_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot t_{iz.coax}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [55.0]\ plf$$

$$Weight.Ice_{coax.nesc_k} := \left(\frac{\pi}{4} \cdot \left(\left(OD_{coax_k} + 2 \cdot r_{ice.nesc}\right)^2 - OD_{coax_k}^{\ 2}\right) \cdot QTY_{coax_k} \cdot I_d\right) = [7.4]\ plf$$

$$Ar_{coax_k} := \frac{L_{coax_k}}{OD_{coax_k}} = [162.2]$$ Aspect Ratio of Coax

$$Ca_{coax_k} := \begin{cases} 0.7 & \text{if } Ar_{coax_k} \le 2.5 \\ 0.7 + \dfrac{\left(Ar_{coax_k} - 2.5\right)\cdot(0.8 - 0.7)}{(7 - 2.5)} & \text{if } 2.5 < Ar_{coax_k} < 7 \\ 0.8 + \dfrac{\left(Ar_{coax_k} - 7\right)\cdot(1.2 - 0.8)}{(25 - 7)} & \text{if } 7 \le Ar_{coax_k} < 25 \\ 1.2 & \text{if } Ar_{coax_k} \ge 25 \end{cases} = [1.2]$$

TIA/EIA-222-G, Table 2-8

TIA/EIA Wind:

$$IceWind.TIA_{coax_k} := qzice_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SAice_{coax_k} = [8.7]\ plf$$

$$Wind.TIA_{coax_k} := qz_{coax} \cdot G_H \cdot Ca_{coax_k} \cdot SA_{coax_k} = [19.5]\ plf$$

NESC Wind for Coax on Pipe Mast Risa Model:

$$Wind.250B_{coax.pipe_k} := qz_{250B} \cdot Cd_{coax} \cdot SAice_{coax.nesc_k} = [2.6] \ \boldsymbol{plf}$$

$$Wind.250C_{coax.pipe.Above_k} := qz_{250C} \cdot G'_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [23.3] \ \boldsymbol{plf}$$

$$Wind.250C_{coax.pipe.Below_k} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot SA_{coax_k} = [18.6] \ \boldsymbol{plf}$$

NESC Loads For PLS Model:

$$Weight.250B_{coax.twr} := \left(\sum Weight_{coax} + \sum Weight.Ice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_V$$

$$Wind.250B_{coax.twr} := qz_{250B} \cdot Cd_{coax} \cdot \left(\sum SAice_{coax.nesc} \right) \cdot coaxspan \cdot OLF250B_T$$

$$Weight.250C_{coax.twr} := \left(\sum Weight_{coax} \right) \cdot coaxspan \cdot OLF250C_V$$

$$Wind.250C_{coax.twr} := qz_{250C} \cdot G_{RF} \cdot Cd_{coax} \cdot \left(\sum SA_{coax} \right) \cdot coaxspan \cdot OLF250C_T$$

Summary of Loads - PLS Coax Load Inputs

NESC 250B_X-dir - Wind w/ Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1X	452	190	0	Coax Load
C2X	203	85	0	Coax Load
C3X	234	98	0	Coax Load
C4X	234	98	0	Coax Load
C5X	195	82	0	Coax Load

NESC 250C_X-dir - Wind w/o Ice

Joint Label	Vertical Load (lbs)	Transverse Load (lbs)	Longitudinal Load (lbs)	Load Comment
C1X	87	541	0	Coax Load
C2X	39	242	0	Coax Load
C3X	45	280	0	Coax Load
C4X	45	280	0	Coax Load
C5X	38	233	0	Coax Load

Summary of Loads - Risa Loads Inputs

BLC 2 Weight of Equipment

Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-101.0	42.0	**Mount 1**
M2	Y	-66.0	42.0	**Mount 2**
M2	Y	0.0	42.0	**Mount 3**
M2	Y	0.0	42.0	**Mount 4**
M2	Y	-105.0	42.0	**Equipment 1**
M2	Y	-48.0	42.0	**Equipment 2**
M2	Y		42.0	**Equipment 3**
M2	Y		42.0	**Equipment 4**
M2	Y		42.0	**Equipment 5**
M2	Y		42.0	**Equipment 6**

Member Distributed Loads - Rows 1-6: Coax 1-6 Weight

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	-3.0	-3.0	23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0

BLC 3 Weight of Ice on Mast & Equipment - TIA
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-346.0	42.0	**Mount 1**
M2	Y	-190.0	42.0	**Mount 2**
M2	Y	0.0	42.0	**Mount 3**
M2	Y	0.0	42.0	**Mount 4**
M2	Y	-520.8	42.0	**Equipment 1**
M2	Y	-110.8	42.0	**Equipment 2**
M2	Y		42.0	**Equipment 3**
M2	Y		42.0	**Equipment 4**
M2	Y		42.0	**Equipment 5**
M2	Y		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	0.0	0.0	0.0	0.0
M2	Y	-55.0	-55.0	23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
NA	Y	0.0	0.0	0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0

BLC 4 TIA_X-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	114.4	42.0	**Mount 1**
M2	X	0.0	42.0	**Mount 2**
M2	X		42.0	**Mount 3**
M2	X		42.0	**Mount 4**
M2	X	220.2	42.0	**Equipment 1**
M2	X	30.7	42.0	**Equipment 2**
M2	X		42.0	**Equipment 3**
M2	X		42.0	**Equipment 4**
M2	X		42.0	**Equipment 5**
M2	X		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	8.7	8.7	23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 5 TIA_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	162.6	42.0	**Mount 1**
M2	X	0.0	42.0	**Mount 2**
M2	X		42.0	**Mount 3**
M2	X		42.0	**Mount 4**
M2	X	746.5	42.0	**Equipment 1**
M2	X	74.9	42.0	**Equipment 2**
M2	X		42.0	**Equipment 3**
M2	X		42.0	**Equipment 4**
M2	X		42.0	**Equipment 5**
M2	X		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	19.5	19.5	23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 6 TIA_Z-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	114.4	42.0	**Mount 1**
M2	Z	0.0	42.0	**Mount 2**
M2	Z		42.0	**Mount 3**
M2	Z		42.0	**Mount 4**
M2	Z	220.2	42.0	**Equipment 1**
M2	Z	30.7	42.0	**Equipment 2**
M2	Z		42.0	**Equipment 3**
M2	Z		42.0	**Equipment 4**
M2	Z		42.0	**Equipment 5**
M2	Z		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	0.0	0.0	0.0	0.0
M2	PZ	8.7	8.7	23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
NA	PZ	0.0	0.0	0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0

BLC 7 TIA_Z-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Z	162.6	42.0	**Mount 1**
M2	Z	0.0	42.0	**Mount 2**
M2	Z		42.0	**Mount 3**
M2	Z		42.0	**Mount 4**
M2	Z	746.5	42.0	**Equipment 1**
M2	Z	74.9	42.0	**Equipment 2**
M2	Z		42.0	**Equipment 3**
M2	Z		42.0	**Equipment 4**
M2	Z		42.0	**Equipment 5**
M2	Z		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PZ	0.0	0.0	0.0	0.0
M2	PZ	19.5	19.5	23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
M2	PZ			23.0	42.0
NA	PZ	0.0	0.0	0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0
NA	PZ			0.0	0.0

BLC 8 NESC 250B_X-dir - Wind w/ Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	27.0	42.0	**Mount 1**
M2	X	0.0	42.0	**Mount 2**
M2	X		42.0	**Mount 3**
M2	X		42.0	**Mount 4**
M2	X	89.5	42.0	**Equipment 1**
M2	X	11.2	42.0	**Equipment 2**
M2	X		42.0	**Equipment 3**
M2	X		42.0	**Equipment 4**
M2	X		42.0	**Equipment 5**
M2	X		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast
Rows 2-7: Wind on Coax 1-6
Rows 8-13: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	0.0	0.0
M2	PX	2.6	2.6	23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
M2	PX			23.0	42.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 9 NESC 250C_X-dir - Wind w/o Ice
Member Point Loads

Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	X	208.5	42.0	**Mount 1**
M2	X	0.0	42.0	**Mount 2**
M2	X		42.0	**Mount 3**
M2	X		42.0	**Mount 4**
M2	X	876.1	42.0	**Equipment 1**
M2	X	96.0	42.0	**Equipment 2**
M2	X		42.0	**Equipment 3**
M2	X		42.0	**Equipment 4**
M2	X		42.0	**Equipment 5**
M2	X		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Wind on Mast Above Top of Tower
Row 2-7: Wind on Coax 1-6 Above Top of Tower
Row 8: Wind on Mast Below Top of Tower
Row 9-14: Wind on Coax 1-6 Below Top of Tower
Row 15-20: Wind on Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	PX	0.0	0.0	32.0	55.0
M2	PX	23.3	23.3	32.0	42.0
M2	PX			32.0	42.0
M2	PX			32.0	42.0
M2	PX			32.0	42.0
M2	PX			32.0	42.0
M2	PX			32.0	42.0
M2	PX	0.0	0.0	0.0	32.0
M2	PX	18.6	18.6	23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
M2	PX			23.0	32.0
NA	PX	0.0	0.0	0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0
NA	PX			0.0	0.0

BLC 10 Weight of Ice on Mast & Equipment - NESC
Member Point Loads

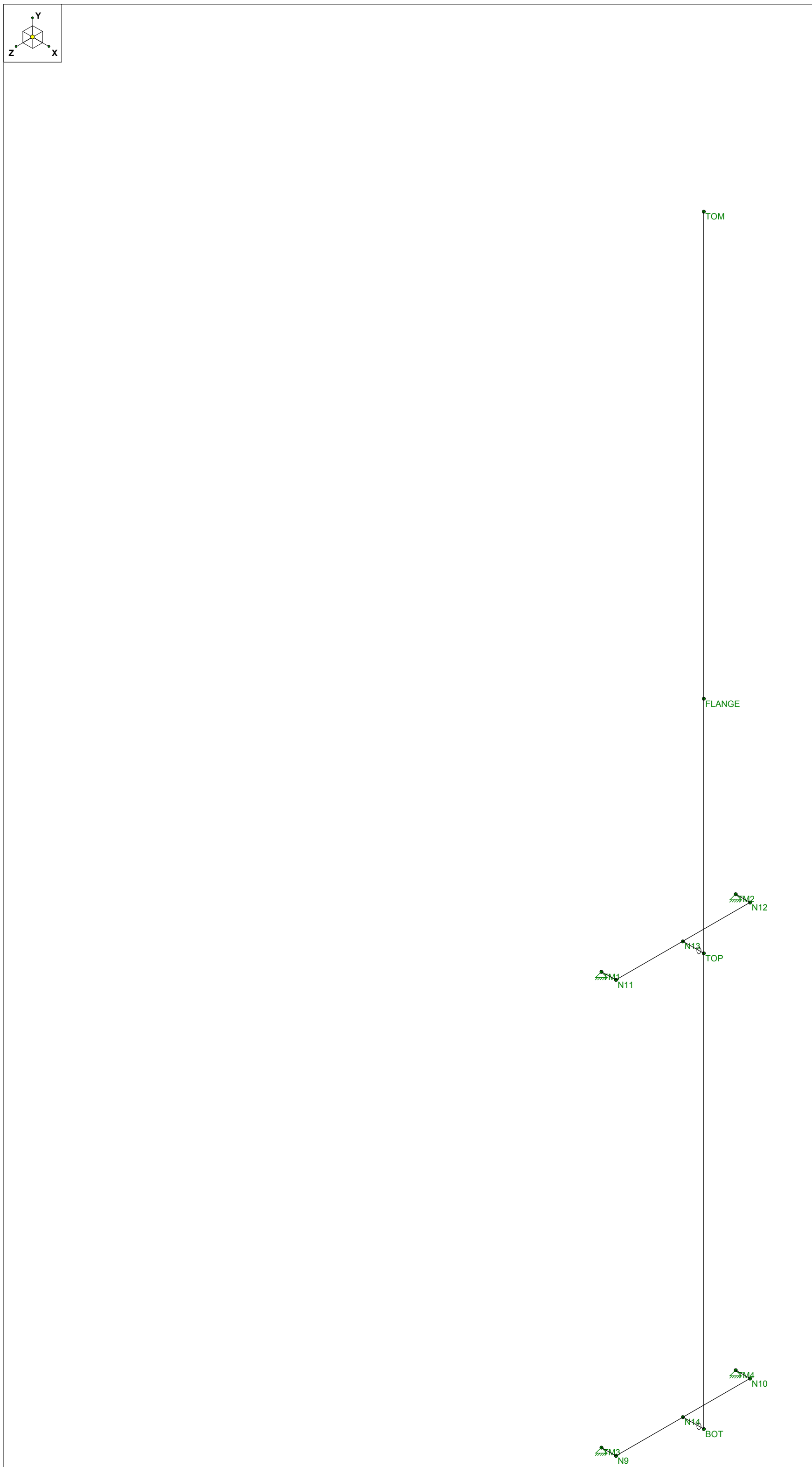
Member Label	Direction	Magnitude [lb,k-ft]	Location [ft,%]	
M2	Y	-150.0	42.0	**Mount 1**
M2	Y	-97.0	42.0	**Mount 2**
M2	Y	0.0	42.0	**Mount 3**
M2	Y	0.0	42.0	**Mount 4**
M2	Y	-99.7	42.0	**Equipment 1**
M2	Y	-17.7	42.0	**Equipment 2**
M2	Y		42.0	**Equipment 3**
M2	Y		42.0	**Equipment 4**
M2	Y		42.0	**Equipment 5**
M2	Y		42.0	**Equipment 6**

Member Distributed Loads
Row 1: Weight of Ice on Mast
Rows 2-7: Coax 1-6
Rows 8-13: Mast Components 1-6

Member Label	Direction	Start Magnitude [lb/ft]	End Magnitude [lb/ft]	Start Location [ft,%]	End Location [ft,%]
M2	Y	0.0	0.0	0.0	0.0
M2	Y	-7.4	-7.4	23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
M2	Y			23.0	42.0
NA	Y	0.0	0.0	0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0
NA	Y			0.0	0.0

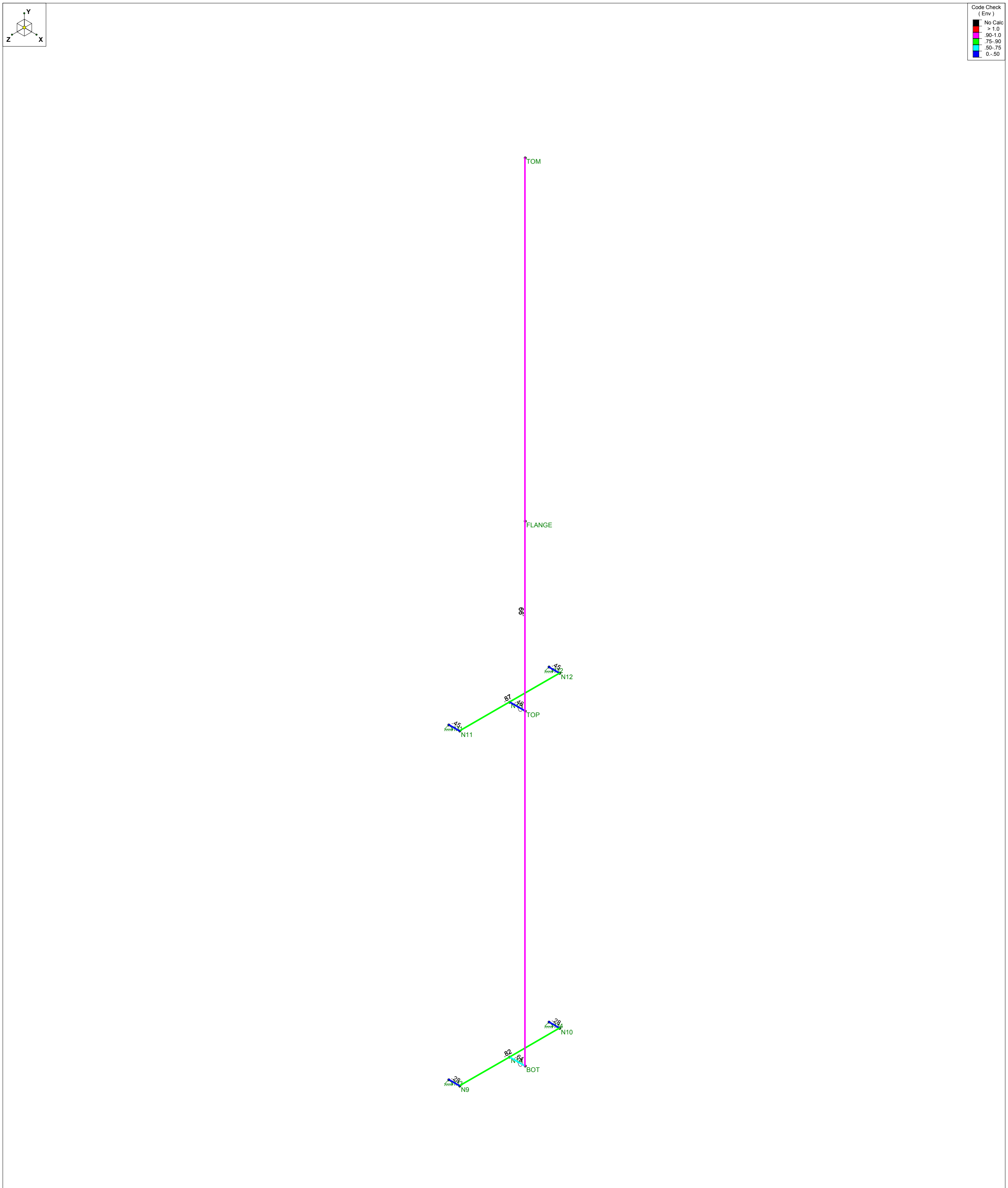
APPENDIX C

COMPUTER OUTPUT



Envelope Only Solution

Paul J Ford and Company	South Mast on Eversource Tower # 1102	M - 1
CBH		Nov 11, 2016 at 8:10 PM
31216-0025.003.6090		31216-0025.003.6090 - South Mas...



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Paul J Ford and Company	South Mast on Eversource Tower # 1102	M - 2
CBH		Nov 11, 2016 at 8:11 PM
31216-0025.003.6090		31216-0025.003.6090 - South Mas...

(Global) Model Settings

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation?	Yes
Increase Nailing Capacity for Wind?	Yes
Include Warping?	Yes
Trans Load Btwn Intersecting Wood Wall?	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Include P-Delta for Walls?	Yes
Automatically Iterate Stiffness for Walls?	No
Max Iterations for Wall Stiffness	3
Gravity Acceleration (ft/sec^2)	32.2
Wall Mesh Size (in)	12
Eigensolution Convergence Tol. (1.E-)	4
Vertical Axis	Y
Global Member Orientation Plane	XZ
Static Solver	Sparse Accelerated
Dynamic Solver	Standard Solver

Hot Rolled Steel Code	AISC 14th(360-10): LRFD
Adjust Stiffness?	Yes(Iterative)
RISAConnection Code	None
Cold Formed Steel Code	None
Wood Code	None
Wood Temperature	< 100F
Concrete Code	None
Masonry Code	None
Aluminum Code	None - Building

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	PCA Load Contour
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections?	Yes
Use Cracked Sections Slab?	Yes
Bad Framing Warnings?	No
Unused Force Warnings?	Yes
Min 1 Bar Diam. Spacing?	No
Concrete Rebar Set	REBAR_SET_ASTMA615
Min % Steel for Column	1
Max % Steel for Column	8

(Global) Model Settings, Continued

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Add Base Weight?	No
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ca	.36
Cv	.54
Nv	1
Occupancy Category	4
Seismic Zone	3
Om Z	1
Om X	1
Rho Z	1
Rho X	1

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	BOT	1.833	0	-0.	0	
2	TOP	1.833	21.5	-0.	0	
3	FLANGE	1.833	33	-0.	0	
4	TOM	1.833	55	-0.	0	
5	TM3	0.	0	3.5	0	
6	TM4	0	0	-3.5	0	
7	TM1	0.	21.5	3.5	0	
8	TM2	0	21.5	-3.5	0	
9	N9	.75	0	3.5	0	
10	N10	.75	0	-3.5	0	
11	N11	.75	21.5	3.5	0	
12	N12	.75	21.5	-3.5	0	
13	N13	.75	21.5	-0.	0	
14	N14	.75	0	-0.	0	

Joint Boundary Conditions

	Joint 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	BOT						
2	TOP						
3	FLANGE						
4	TOM						
5	TM3	Reaction	Reaction	Reaction			
6	TM4	Reaction	Reaction	Reaction			
7	TM1	Reaction	Reaction	Reaction			
8	TM2	Reaction	Reaction	Reaction			
9	N9						
10	N10						
11	N11						
12	N12						

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	65	1.2
2	A992	29000	11154	.3	.65	.49	50	1.1	65	1.2
3	A500 Gr.B (42)	29000	11154	.3	.65	.49	42	1.3	58	1.1
4	A500 Gr. B (46)	29000	11154	.3	.65	.49	46	1.5	58	1.2
5	A500 Gr. C (46)	29000	11154	.3	.65	.49	46	1.5	62	1.2
6	A500 Gr. C (50)	29000	11154	.3	.65	.49	50	1.5	62	1.2
7	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	60	1.2
8	A36	29000	11154	.3	.65	.49	36	1.5	58	1.2

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	MAST	PIPE_12.0X	Beam	Pipe	A53 Gr. B	Typical	17.5	339	339	678
2	Brace	HSS6x6x4	Beam	Tube	A500 Gr. B (...	Typical	5.24	28.6	28.6	45.6

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M2	BOT	TOM			MAST	Beam	Pipe	A53 Gr. B	Typical
2	M3	TM2	N12			Brace	Beam	Tube	A500 Gr. ...	Typical
3	M4	N12	N11			Brace	Beam	Tube	A500 Gr. ...	Typical
4	M5	N11	TM1			Brace	Beam	Tube	A500 Gr. ...	Typical
5	M6	TM4	N10			Brace	Beam	Tube	A500 Gr. ...	Typical
6	M7	N10	N9			Brace	Beam	Tube	A500 Gr. ...	Typical
7	M8	N9	TM3			Brace	Beam	Tube	A500 Gr. ...	Typical
8	M9	N13	TOP			Brace	Beam	Tube	A500 Gr. ...	Typical
9	M10	N14	BOT			Brace	Beam	Tube	A500 Gr. ...	Typical

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribut..	Area(M...	Surface...
1	Self Weight (Mast Members)	None		-1.07						
2	Weight of Equipment	None					20	12		
3	Weight of Ice on Mast and Equip.	None					20	20		
4	TIA_X-dir - Wind w/ Ice	None					20	20		
5	TIA_X-dir - Wind w/o Ice	None					20	20		
6	TIA_Z-dir - Wind w/ Ice	None					20	20		
7	TIA_Z-dir - Wind w/o Ice	None					20	20		
8	NESC 250B_X-dir - Wind w/ Ice	None					20	15		
9	NESC 250C_X-dir - Wind w/o Ice	None					20	29		
10	NESC Weight of Ice on Mast and E	None					20	20		

Load Combinations

	Description	So..	P...	S...	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	TIA_X-dir - Wind w/ I...	Yes	Y		1	1.2	2	1.2	3	1	4	1												
2	TIA_X-dir - Wind w/o...	Yes	Y		1	1.2	2	1.2	5	1.6														
3	TIA_Z-dir - Wind w/ I...	Yes	Y		1	1.2	2	1.2	3	1	6	1												
4	TIA_Z-dir - Wind w/o...	Yes	Y		1	1.2	2	1.2	7	1.6														
5	NESC 250B_X-dir - ...		Y		1	1.5	2	1.5	10	1.5	8	2.5												
6	NESC 250C_X-dir - ...		Y		1	1	2	1	9	1														

Member Point Loads (BLC 2 : Weight of Equipment)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-101	52
2	M2	Y	-66	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-158.7	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-101	43
12	M2	Y	-66	43
13	M2	Y	0	43
14	M2	Y	0	43
15	M2	Y	-109.2	43
16	M2	Y	-54	43
17	M2	Y	0	43
18	M2	Y	0	43
19	M2	Y	0	43
20	M2	Y	0	43

Member Point Loads (BLC 3 : Weight of Ice on Mast and Equip.)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-346	52
2	M2	Y	-190	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-792.1	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-346	43
12	M2	Y	-190	43
13	M2	Y	0	43
14	M2	Y	0	43
15	M2	Y	-505.6	43
16	M2	Y	-111	43
17	M2	Y	0	43
18	M2	Y	0	43
19	M2	Y	0	43
20	M2	Y	0	43

Member Point Loads (BLC 4 : TIA X-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	116.6	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	307.1	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52

Member Point Loads (BLC 4 : TIA X-dir - Wind w/ Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
10	M2	X	0	52
11	M2	X	114.6	43
12	M2	X	0	43
13	M2	X	0	43
14	M2	X	0	43
15	M2	X	199.5	43
16	M2	X	30.8	43
17	M2	X	0	43
18	M2	X	0	43
19	M2	X	0	43
20	M2	X	0	43

Member Point Loads (BLC 5 : TIA X-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	165.8	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	1084.1	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	162.9	43
12	M2	X	0	43
13	M2	X	0	43
14	M2	X	0	43
15	M2	X	678.1	43
16	M2	X	75.1	43
17	M2	X	0	43
18	M2	X	0	43
19	M2	X	0	43
20	M2	X	0	43

Member Point Loads (BLC 6 : TIA Z-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Z	116.6	52
2	M2	Z	0	52
3	M2	Z	0	52
4	M2	Z	0	52
5	M2	Z	307.1	52
6	M2	Z	0	52
7	M2	Z	0	52
8	M2	Z	0	52
9	M2	Z	0	52
10	M2	Z	0	52
11	M2	Z	114.6	43
12	M2	Z	0	43
13	M2	Z	0	43
14	M2	Z	0	43
15	M2	Z	199.5	43
16	M2	Z	30.8	43
17	M2	Z	0	43
18	M2	Z	0	43
19	M2	Z	0	43

Member Point Loads (BLC 6 : TIA Z-dir - Wind w/ Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
20	M2	Z	0	43

Member Point Loads (BLC 7 : TIA Z-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Z	165.8	52
2	M2	Z	0	52
3	M2	Z	0	52
4	M2	Z	0	52
5	M2	Z	1084.1	52
6	M2	Z	0	52
7	M2	Z	0	52
8	M2	Z	0	52
9	M2	Z	0	52
10	M2	Z	0	52
11	M2	Z	162.9	43
12	M2	Z	0	43
13	M2	Z	0	43
14	M2	Z	0	43
15	M2	Z	678.1	43
16	M2	Z	75.1	43
17	M2	Z	0	43
18	M2	Z	0	43
19	M2	Z	0	43
20	M2	Z	0	43

Member Point Loads (BLC 8 : NESC 250B X-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	27	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	127	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	27	43
12	M2	X	0	43
13	M2	X	0	43
14	M2	X	0	43
15	M2	X	83.5	43
16	M2	X	11.2	43
17	M2	X	0	43
18	M2	X	0	43
19	M2	X	0	43
20	M2	X	0	43

Member Point Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	208.5	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	1268	52

Member Point Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	208.5	43
12	M2	X	0	43
13	M2	X	0	43
14	M2	X	0	43
15	M2	X	820.2	43
16	M2	X	96	43
17	M2	X	0	43
18	M2	X	0	43
19	M2	X	0	43
20	M2	X	0	43

Member Point Loads (BLC 10 : NESC Weight of Ice on Mast and E)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-150	52
2	M2	Y	-97	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-157.6	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-150	43
12	M2	Y	-97	43
13	M2	Y	0	43
14	M2	Y	0	43
15	M2	Y	-97.6	43
16	M2	Y	-17.7	43
17	M2	Y	0	43
18	M2	Y	0	43
19	M2	Y	0	43
20	M2	Y	0	43

Member Distributed Loads (BLC 2 : Weight of Equipment)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-12	-12	23	52
2	M2	Y	0	0	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52
7	M2	Y	-3	-3	23	43
8	M2	Y	0	0	23	43
9	M2	Y	0	0	23	43
10	M2	Y	0	0	23	43
11	M2	Y	0	0	23	43
12	M2	Y	0	0	23	43

Member Distributed Loads (BLC 3 : Weight of Ice on Mast and Equip.)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-38.2	-38.2	0	0
2	M2	Y	-220	-220	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52
7	M2	Y	0	0	23	52
8	M4	Y	-20.8	-20.8	0	0
9	M7	Y	-20.8	-20.8	0	0
10	M9	Y	-20.8	-20.8	0	0
11	M10	Y	-20.8	-20.8	0	0
12	M4	Y	0	0	0	0
13	M4	Y	0	0	0	0
14	M2	Y	0	0	0	0
15	M2	Y	-55	-55	23	43
16	M2	Y	0	0	23	43
17	M2	Y	0	0	23	43
18	M2	Y	0	0	23	43
19	M2	Y	0	0	23	43
20	M2	Y	0	0	23	43

Member Distributed Loads (BLC 4 : TIA X-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	17.2	17.2	0	0
2	M2	PX	13.3	13.3	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	11.7	11.7	0	0
9	M7	PX	11.7	11.7	0	0
10	M9	PX	8.6	8.6	0	0
11	M10	PX	8.6	8.6	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	8.7	8.7	23	43
16	M2	PX	0	0	23	43
17	M2	PX	0	0	23	43
18	M2	PX	0	0	23	43
19	M2	PX	0	0	23	43
20	M2	PX	0	0	23	43

Member Distributed Loads (BLC 5 : TIA X-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	55.9	55.9	0	0
2	M2	PX	39	39	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	35.8	35.8	0	0
9	M7	PX	35.8	35.8	0	0
10	M9	PX	26.3	26.3	0	0

Member Distributed Loads (BLC 5 : TIA X-dir - Wind w/o Ice) (Continued)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
11	M10	PX	26.3	26.3	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	19.5	19.5	23	43
16	M2	PX	0	0	23	43
17	M2	PX	0	0	23	43
18	M2	PX	0	0	23	43
19	M2	PX	0	0	23	43
20	M2	PX	0	0	23	43

Member Distributed Loads (BLC 6 : TIA Z-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PZ	17.2	17.2	0	0
2	M2	PZ	13.3	13.3	23	52
3	M2	PZ	0	0	23	52
4	M2	PZ	0	0	23	52
5	M2	PZ	0	0	23	52
6	M2	PZ	0	0	23	52
7	M2	PZ	0	0	23	52
8	M4	PZ	11.7	11.7	0	0
9	M7	PZ	11.7	11.7	0	0
10	M9	PZ	8.6	8.6	0	0
11	M10	PZ	8.6	8.6	0	0
12	M4	PZ	0	0	0	0
13	M4	PZ	0	0	0	0
14	M2	PZ	0	0	0	0
15	M2	PZ	8.7	8.7	23	43
16	M2	PZ	0	0	23	43
17	M2	PZ	0	0	23	43
18	M2	PZ	0	0	23	43
19	M2	PZ	0	0	23	43
20	M2	PZ	0	0	23	43

Member Distributed Loads (BLC 7 : TIA Z-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PZ	55.9	55.9	0	0
2	M2	PZ	39	39	23	52
3	M2	PZ	0	0	23	52
4	M2	PZ	0	0	23	52
5	M2	PZ	0	0	23	52
6	M2	PZ	0	0	23	52
7	M2	PZ	0	0	23	52
8	M4	PZ	35.8	35.8	0	0
9	M7	PZ	35.8	35.8	0	0
10	M9	PZ	26.3	26.3	0	0
11	M10	PZ	26.3	26.3	0	0
12	M4	PZ	0	0	0	0
13	M4	PZ	0	0	0	0
14	M2	PZ	0	0	0	0
15	M2	PZ	19.5	19.5	23	43
16	M2	PZ	0	0	23	43
17	M2	PZ	0	0	23	43
18	M2	PZ	0	0	23	43
19	M2	PZ	0	0	23	43
20	M2	PZ	0	0	23	43

Member Distributed Loads (BLC 8 : NESC 250B X-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	5.9	5.9	0	0
2	M2	PX	4.8	4.8	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	3.2	3.2	0	0
9	M7	PX	3.2	3.2	0	0
10	M9	PX	3.2	3.2	0	0
11	M10	PX	3.2	3.2	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	2.6	2.6	23	43

Member Distributed Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	60	60	32	55
2	M2	PX	46.6	46.6	32	52
3	M2	PX	0	0	32	52
4	M2	PX	0	0	32	52
5	M2	PX	0	0	32	52
6	M2	PX	0	0	32	52
7	M2	PX	0	0	32	52
8	M2	PX	48	48	0	32
9	M2	PX	37.3	37.3	23	32
10	M2	PX	0	0	23	32
11	M2	PX	0	0	23	32
12	M2	PX	0	0	23	32
13	M2	PX	0	0	23	32
14	M2	PX	0	0	23	32
15	M4	PX	27.8	27.8	0	0
16	M7	PX	27.8	27.8	0	0
17	M9	PX	27.8	27.8	0	0
18	M10	PX	27.8	27.8	0	0
19	M4	PX	0	0	0	0
20	M4	PX	0	0	0	0
21	M2	PX	0	0	32	55
22	M2	PX	23.3	23.3	32	43
23	M2	PX	0	0	32	43
24	M2	PX	0	0	32	43
25	M2	PX	0	0	32	43
26	M2	PX	0	0	32	43
27	M2	PX	0	0	32	43
28	M2	PX	0	0	0	32
29	M2	PX	18.6	18.6	23	32

Member Distributed Loads (BLC 10 : NESC Weight of Ice on Mast and E)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-8.2	-8.2	0	0
2	M2	Y	-29.5	-29.5	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52

Member Distributed Loads (BLC 10 : NESC Weight of Ice on Mast and E) (Continued)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
7	M2	Y	0	0	23	52
8	M4	Y	-5.1	-5.1	0	0
9	M7	Y	-5.1	-5.1	0	0
10	M9	Y	-5.1	-5.1	0	0
11	M10	Y	-5.1	-5.1	0	0
12	M4	Y	0	0	0	0
13	M4	Y	0	0	0	0
14	M2	Y	0	0	0	0
15	M2	Y	-7.4	-7.4	23	43
16	M2	Y	0	0	23	43
17	M2	Y	0	0	23	43
18	M2	Y	0	0	23	43
19	M2	Y	0	0	23	43
20	M2	Y	0	0	23	43

Envelope AISC 14th(360-10): LRFD Steel Code Checks

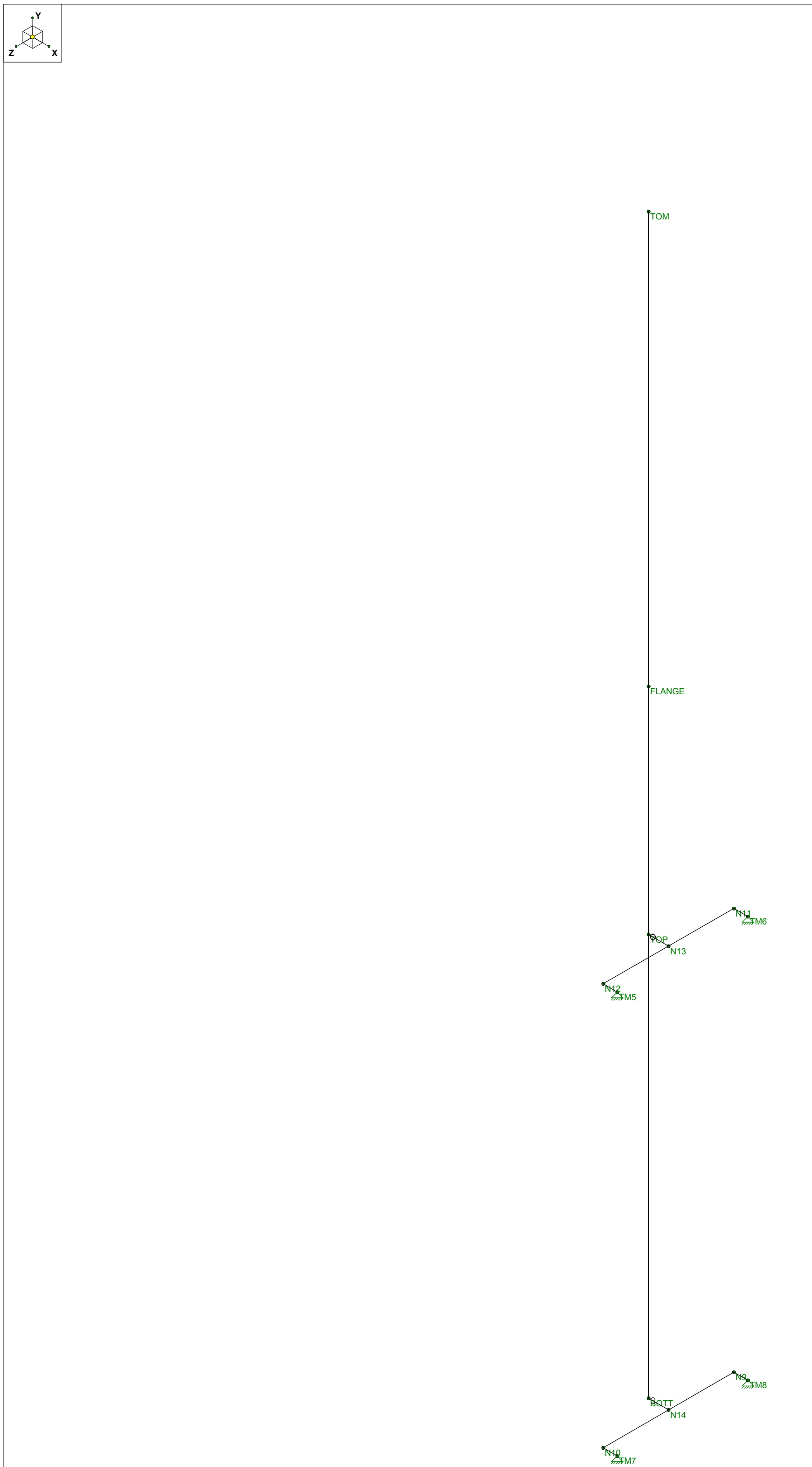
	Member	Shape	Code Che...	Loc[ft]	LC	Shear Ch...	Loc[ft]	Dir	LC	phi*Pnc ...	phi*Pnt [l...	phi*M...	phi*M...	Cb	Eqn
1	M2	PIPE_12....	.986	21.771	4	.087	21.198		4	175813....	551250	184.275	184.2...	3.691	H1-1b
2	M3	HSS6x6x4	.451	.75	2	.299	0	z	2	216719....	216936	38.64	38.64	1.668	H1-1b
3	M4	HSS6x6x4	.869	3.5	2	.244	0	z	2	198867....	216936	38.64	38.64	1.318	H1-1b
4	M5	HSS6x6x4	.451	0	2	.299	0	z	2	216719....	216936	38.64	38.64	1.668	H1-1b
5	M6	HSS6x6x4	.282	.75	2	.122	0	z	2	216719....	216936	38.64	38.64	1.666	H1-1b
6	M7	HSS6x6x4	.822	3.5	2	.262	0	y	2	198867....	216936	38.64	38.64	1.315	H1-1b
7	M8	HSS6x6x4	.282	0	2	.122	0	z	2	216719....	216936	38.64	38.64	1.666	H1-1b
8	M9	HSS6x6x4	.459	1.083	3	.299	0	z	4	216484....	216936	38.64	38.64	1.303	H1-1b
9	M10	HSS6x6x4	.637	1.083	2	.211	0	y	2	216484....	216936	38.64	38.64	1.306	H1-1b

Envelope Joint Reactions

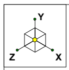
	Joint		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	TM3	max	3783.036	2	6588.054	2	3265.688	4	0	1	0	1	0	1
2		min	-983.587	4	1477.077	4	-7481.868	2	0	1	0	1	0	1
3	TM4	max	3783.036	2	6588.054	2	7481.868	2	0	1	0	1	0	1
4		min	1058.663	3	1467.254	4	2353.481	3	0	1	0	1	0	1
5	TM1	max	3834.088	4	4598.93	3	18328.5...	2	0	1	0	1	0	1
6		min	-9593.196	2	-3627.655	2	-8713.01	4	0	1	0	1	0	1
7	TM2	max	-1658.212	3	4615.696	3	-3498.575	3	0	1	0	1	0	1
8		min	-9593.196	2	-3627.655	2	-18328....	2	0	1	0	1	0	1
9	Totals:	max	0	3	18318.75	1	0	1						
10		min	-11620.32	2	5920.798	4	-10909....	4						

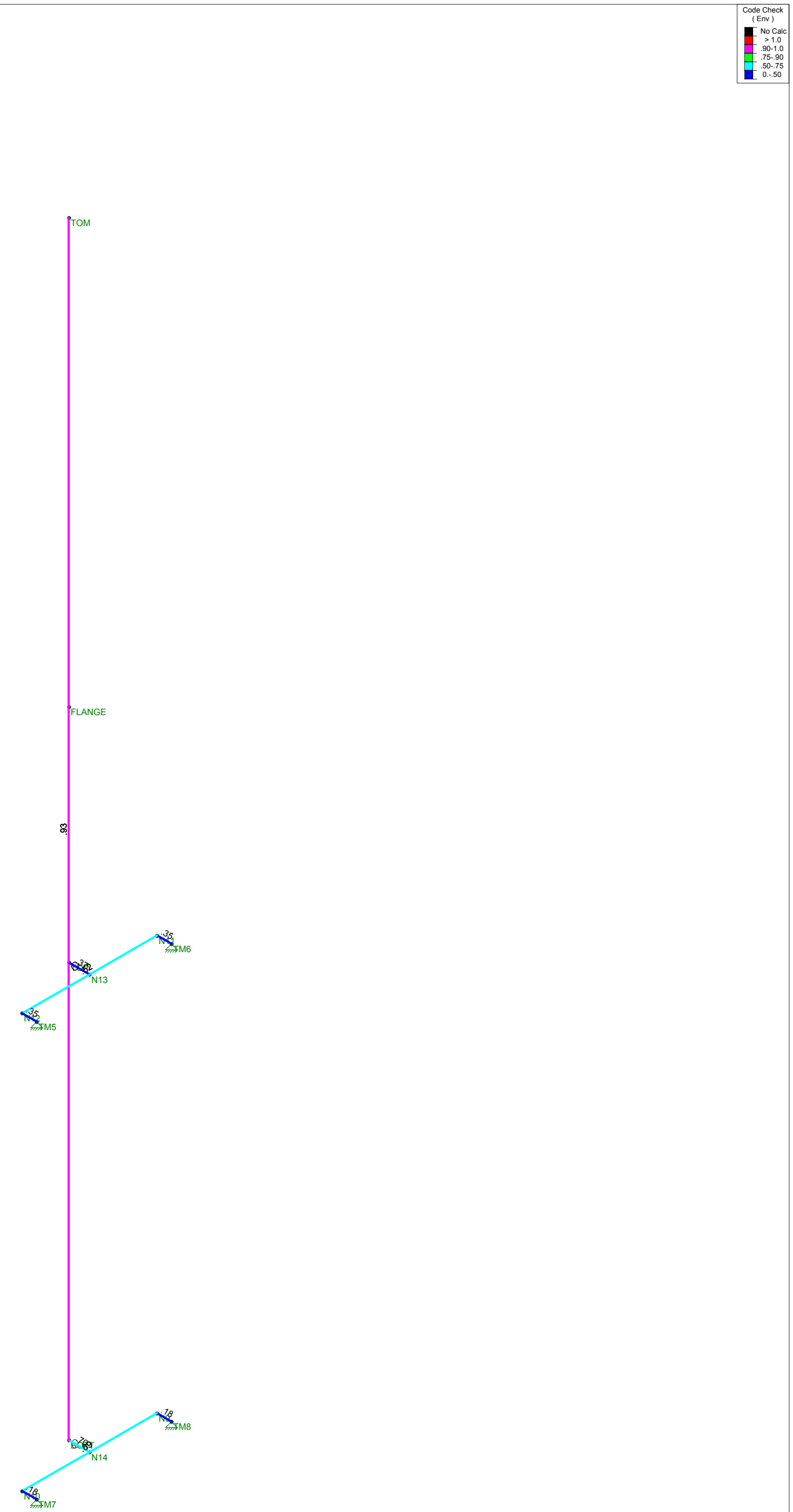
Joint Reactions

	LC	Joint Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	5	TM3	1153.752	3689.857	1.988	0	0	0
2	5	TM4	1154.566	3689.85	0	0	0	0
3	5	TM1	-2198.999	1738.528	-1.988	0	0	0
4	5	TM2	-2199.819	1738.531	0	0	0	0
5	5	Totals:	-2090.5	10856.767	0			
6	5	COG (ft):	X: 1.767	Y: 32.239	Z: 0			
7	6	TM3	2876.219	4931.523	5.17	0	0	0
8	6	TM4	2878.327	4931.5	0	0	0	0
9	6	TM1	-6675.097	-2464.506	-5.17	0	0	0
10	6	TM2	-6677.25	-2464.518	0	0	0	0
11	6	Totals:	-7597.8	4933.998	0			
12	6	COG (ft):	X: 1.753	Y: 29.685	Z: 0			



Paul J Ford and Company	North Mast on Eversource Tower # 1102	M2 - 1
CBH		Nov 11, 2016 at 8:24 PM
31216-0025.003.6090		31216-0025.003.6090 - North Mast...





Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Paul J Ford and Company	North Mast on Eversource Tower # 1102	M2 - 2
CBH		Nov 11, 2016 at 8:25 PM
31216-0025.003.6090		31216-0025.003.6090 - North Mast...

(Global) Model Settings

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation?	Yes
Increase Nailing Capacity for Wind?	Yes
Include Warping?	Yes
Trans Load Btwn Intersecting Wood Wall?	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Include P-Delta for Walls?	Yes
Automatically Iterate Stiffness for Walls?	No
Max Iterations for Wall Stiffness	3
Gravity Acceleration (ft/sec^2)	32.2
Wall Mesh Size (in)	12
Eigensolution Convergence Tol. (1.E-)	4
Vertical Axis	Y
Global Member Orientation Plane	XZ
Static Solver	Sparse Accelerated
Dynamic Solver	Standard Solver

Hot Rolled Steel Code	AISC 14th(360-10): LRFD
Adjust Stiffness?	Yes(Iterative)
RISAConnection Code	None
Cold Formed Steel Code	None
Wood Code	None
Wood Temperature	< 100F
Concrete Code	None
Masonry Code	None
Aluminum Code	None - Building

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	PCA Load Contour
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections?	Yes
Use Cracked Sections Slab?	Yes
Bad Framing Warnings?	No
Unused Force Warnings?	Yes
Min 1 Bar Diam. Spacing?	No
Concrete Rebar Set	REBAR_SET_ASTMA615
Min % Steel for Column	1
Max % Steel for Column	8

(Global) Model Settings, Continued

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Add Base Weight?	No
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ca	.36
Cv	.54
Nv	1
Occupancy Category	4
Seismic Zone	3
Om Z	1
Om X	1
Rho Z	1
Rho X	1

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	BOTT	-1.833	0	0.	0	
2	TOP	-1.833	21.5	0.	0	
3	FLANGE	-1.833	33	0.	0	
4	TOM	-1.833	55	0.	0	
5	TM8	0	0	-3.5	0	
6	TM7	0	0	3.5	0	
7	TM6	0	21.5	-3.5	0	
8	TM5	0	21.5	3.5	0	
9	N9	-.75	0	-3.5	0	
10	N10	-.75	0	3.5	0	
11	N11	-.75	21.5	-3.5	0	
12	N12	-.75	21.5	3.5	0	
13	N13	-.75	21.5	0.	0	
14	N14	-.75	0	0.	0	

Joint Boundary Conditions

	Joint 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	BOTT						
2	TOP						
3	FLANGE						
4	TOM						
5	TM8	Reaction	Reaction	Reaction			
6	TM7	Reaction	Reaction	Reaction			
7	TM6	Reaction	Reaction	Reaction			
8	TM5	Reaction	Reaction	Reaction			
9	N9						
10	N10						
11	N11						
12	N12						

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	65	1.2
2	A992	29000	11154	.3	.65	.49	50	1.1	65	1.2
3	A500 Gr.B (42)	29000	11154	.3	.65	.49	42	1.3	58	1.1
4	A500 Gr. B (46)	29000	11154	.3	.65	.49	46	1.5	58	1.2
5	A500 Gr. C (46)	29000	11154	.3	.65	.49	46	1.5	62	1.2
6	A500 Gr. C (50)	29000	11154	.3	.65	.49	50	1.5	62	1.2
7	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	60	1.2
8	A36	29000	11154	.3	.65	.49	36	1.5	58	1.2

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	MAST	PIPE_12.0X	Beam	Pipe	A53 Gr. B	Typical	17.5	339	339	678
2	Brace	HSS6x6x4	Beam	Tube	A500 Gr. B (...	Typical	5.24	28.6	28.6	45.6

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M2	BOTT	TOM			MAST	Beam	Pipe	A53 Gr. B	Typical
2	M3	TM5	N12			Brace	Beam	Tube	A500 Gr. ...	Typical
3	M4	N12	N11			Brace	Beam	Tube	A500 Gr. ...	Typical
4	M5	N11	TM6			Brace	Beam	Tube	A500 Gr. ...	Typical
5	M6	TM7	N10			Brace	Beam	Tube	A500 Gr. ...	Typical
6	M7	N10	N9			Brace	Beam	Tube	A500 Gr. ...	Typical
7	M8	N9	TM8			Brace	Beam	Tube	A500 Gr. ...	Typical
8	M9	N13	TOP			Brace	Beam	Tube	A500 Gr. ...	Typical
9	M10	N14	BOTT			Brace	Beam	Tube	A500 Gr. ...	Typical

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribut...	Area(M...	Surface...
1	Self Weight (Mast Members)	None		-1.07						
2	Weight of Equipment	None					20	12		
3	Weight of Ice on Mast and Equip.	None					20	20		
4	TIA_X-dir - Wind w/ Ice	None					20	20		
5	TIA_X-dir - Wind w/o Ice	None					20	20		
6	TIA_Z-dir - Wind w/ Ice	None					20	20		
7	TIA_Z-dir - Wind w/o Ice	None					20	20		
8	NESC 250B_X-dir - Wind w/ Ice	None					20	20		
9	NESC 250C_X-dir - Wind w/o Ice	None					20	34		
10	NESC Weight of Ice on Mast and E	None					20	20		

Load Combinations

	Description	So..	P...	S...	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	TIA_X-dir - Wind w/ I...	Yes	Y		1	1.2	2	1.2	3	1	4	1												
2	TIA_X-dir - Wind w/o...	Yes	Y		1	1.2	2	1.2	5	1.6														
3	TIA_Z-dir - Wind w/ I...	Yes	Y		1	1.2	2	1.2	3	1	6	1												
4	TIA_Z-dir - Wind w/o...	Yes	Y		1	1.2	2	1.2	7	1.6														
5	NESC 250B_X-dir - ...		Y		1	1.5	2	1.5	10	1.5	8	2.5												
6	NESC 250C_X-dir - ...		Y		1	1	2	1	9	1														

Member Point Loads (BLC 2 : Weight of Equipment)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-101	52
2	M2	Y	-66	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-122.1	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-101	42
12	M2	Y	-66	42
13	M2	Y	0	42
14	M2	Y	0	42
15	M2	Y	-105	42
16	M2	Y	-48	42
17	M2	Y	0	42
18	M2	Y	0	42
19	M2	Y	0	42
20	M2	Y	0	42

Member Point Loads (BLC 3 : Weight of Ice on Mast and Equip.)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-346	52
2	M2	Y	-190	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-532.5	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-346	42
12	M2	Y	-190	42
13	M2	Y	0	42
14	M2	Y	0	42
15	M2	Y	-520.8	42
16	M2	Y	-110.8	42
17	M2	Y	0	42
18	M2	Y	0	42
19	M2	Y	0	42
20	M2	Y	0	42

Member Point Loads (BLC 4 : TIA X-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	116.6	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	256.8	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52

Member Point Loads (BLC 4 : TIA X-dir - Wind w/ Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
10	M2	X	0	52
11	M2	X	114.4	42
12	M2	X	0	42
13	M2	X	0	42
14	M2	X	0	42
15	M2	X	220.2	42
16	M2	X	30.7	42
17	M2	X	0	42
18	M2	X	0	42
19	M2	X	0	42
20	M2	X	0	42

Member Point Loads (BLC 5 : TIA X-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	165.8	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	892.4	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	162.6	42
12	M2	X	0	42
13	M2	X	0	42
14	M2	X	0	42
15	M2	X	746.5	42
16	M2	X	74.9	42
17	M2	X	0	42
18	M2	X	0	42
19	M2	X	0	42
20	M2	X	0	42

Member Point Loads (BLC 6 : TIA Z-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Z	116.6	52
2	M2	Z	0	52
3	M2	Z	0	52
4	M2	Z	0	52
5	M2	Z	256.8	52
6	M2	Z	0	52
7	M2	Z	0	52
8	M2	Z	0	52
9	M2	Z	0	52
10	M2	Z	0	52
11	M2	Z	114.4	42
12	M2	Z	0	42
13	M2	Z	0	42
14	M2	Z	0	42
15	M2	Z	220.2	42
16	M2	Z	30.7	42
17	M2	Z	0	42
18	M2	Z	0	42
19	M2	Z	0	42

Member Point Loads (BLC 6 : TIA Z-dir - Wind w/ Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
20	M2	Z	0	42

Member Point Loads (BLC 7 : TIA Z-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Z	165.8	52
2	M2	Z	0	52
3	M2	Z	0	52
4	M2	Z	0	52
5	M2	Z	892.4	52
6	M2	Z	0	52
7	M2	Z	0	52
8	M2	Z	0	52
9	M2	Z	0	52
10	M2	Z	0	52
11	M2	Z	162.6	42
12	M2	Z	0	42
13	M2	Z	0	42
14	M2	Z	0	42
15	M2	Z	746.5	42
16	M2	Z	74.9	42
17	M2	Z	0	42
18	M2	Z	0	42
19	M2	Z	0	42
20	M2	Z	0	42

Member Point Loads (BLC 8 : NESC 250B X-dir - Wind w/ Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	27	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	106.1	52
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	27	42
12	M2	X	0	42
13	M2	X	0	42
14	M2	X	0	42
15	M2	X	89.5	42
16	M2	X	11.2	42
17	M2	X	0	42
18	M2	X	0	42
19	M2	X	0	42
20	M2	X	0	42

Member Point Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	X	208.5	52
2	M2	X	0	52
3	M2	X	0	52
4	M2	X	0	52
5	M2	X	1052.3	52

Member Point Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice) (Continued)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
6	M2	X	0	52
7	M2	X	0	52
8	M2	X	0	52
9	M2	X	0	52
10	M2	X	0	52
11	M2	X	208.5	42
12	M2	X	0	42
13	M2	X	0	42
14	M2	X	0	42
15	M2	X	876.1	42
16	M2	X	96	42
17	M2	X	0	42
18	M2	X	0	42
19	M2	X	0	42
20	M2	X	0	42

Member Point Loads (BLC 10 : NESC Weight of Ice on Mast and E)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M2	Y	-150	52
2	M2	Y	-97	52
3	M2	Y	0	52
4	M2	Y	0	52
5	M2	Y	-100.6	52
6	M2	Y	0	52
7	M2	Y	0	52
8	M2	Y	0	52
9	M2	Y	0	52
10	M2	Y	0	52
11	M2	Y	-150	42
12	M2	Y	-97	42
13	M2	Y	0	42
14	M2	Y	0	42
15	M2	Y	-99.7	42
16	M2	Y	-17.7	42
17	M2	Y	0	42
18	M2	Y	0	42
19	M2	Y	0	42
20	M2	Y	0	42

Member Distributed Loads (BLC 2 : Weight of Equipment)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-6	-6	23	52
2	M2	Y	0	0	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52
7	M2	Y	-3	-3	23	42
8	M2	Y	0	0	23	42
9	M2	Y	0	0	23	42
10	M2	Y	0	0	23	42
11	M2	Y	0	0	23	42
12	M2	Y	0	0	23	42

Member Distributed Loads (BLC 3 : Weight of Ice on Mast and Equip.)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-38.2	-38.2	0	0
2	M2	Y	-110	-110	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52
7	M2	Y	0	0	23	52
8	M4	Y	-20.8	-20.8	0	0
9	M7	Y	-20.8	-20.8	0	0
10	M9	Y	-20.8	-20.8	0	0
11	M10	Y	-20.8	-20.8	0	0
12	M4	Y	0	0	0	0
13	M4	Y	0	0	0	0
14	M2	Y	0	0	0	0
15	M2	Y	-55	-55	23	42
16	M2	Y	0	0	23	42
17	M2	Y	0	0	23	42
18	M2	Y	0	0	23	42
19	M2	Y	0	0	23	42
20	M2	Y	0	0	23	42

Member Distributed Loads (BLC 4 : TIA X-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	17.2	17.2	0	0
2	M2	PX	13.3	13.3	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	11.7	11.7	0	0
9	M7	PX	11.7	11.7	0	0
10	M9	PX	8.6	8.6	0	0
11	M10	PX	8.6	8.6	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	8.7	8.7	23	42
16	M2	PX	0	0	23	42
17	M2	PX	0	0	23	42
18	M2	PX	0	0	23	42
19	M2	PX	0	0	23	42
20	M2	PX	0	0	23	42

Member Distributed Loads (BLC 5 : TIA X-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	55.9	55.9	0	0
2	M2	PX	39	39	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	35.8	35.8	0	0
9	M7	PX	35.8	35.8	0	0
10	M9	PX	26.3	26.3	0	0

Member Distributed Loads (BLC 5 : TIA X-dir - Wind w/o Ice) (Continued)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
11	M10	PX	26.3	26.3	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	19.5	19.5	23	42
16	M2	PX	0	0	23	42
17	M2	PX	0	0	23	42
18	M2	PX	0	0	23	42
19	M2	PX	0	0	23	42
20	M2	PX	0	0	23	42

Member Distributed Loads (BLC 6 : TIA Z-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PZ	17.2	17.2	0	0
2	M2	PZ	13.3	13.3	23	52
3	M2	PZ	0	0	23	52
4	M2	PZ	0	0	23	52
5	M2	PZ	0	0	23	52
6	M2	PZ	0	0	23	52
7	M2	PZ	0	0	23	52
8	M4	PZ	11.7	11.7	0	0
9	M7	PZ	11.7	11.7	0	0
10	M9	PZ	8.6	8.6	0	0
11	M10	PZ	8.6	8.6	0	0
12	M4	PZ	0	0	0	0
13	M4	PZ	0	0	0	0
14	M2	PZ	0	0	0	0
15	M2	PZ	8.7	8.7	23	42
16	M2	PZ	0	0	23	42
17	M2	PZ	0	0	23	42
18	M2	PZ	0	0	23	42
19	M2	PZ	0	0	23	42
20	M2	PZ	0	0	23	42

Member Distributed Loads (BLC 7 : TIA Z-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PZ	55.9	55.9	0	0
2	M2	PZ	39	39	23	52
3	M2	PZ	0	0	23	52
4	M2	PZ	0	0	23	52
5	M2	PZ	0	0	23	52
6	M2	PZ	0	0	23	52
7	M2	PZ	0	0	23	52
8	M4	PZ	35.8	35.8	0	0
9	M7	PZ	35.8	35.8	0	0
10	M9	PZ	26.3	26.3	0	0
11	M10	PZ	26.3	26.3	0	0
12	M4	PZ	0	0	0	0
13	M4	PZ	0	0	0	0
14	M2	PZ	0	0	0	0
15	M2	PZ	19.5	19.5	23	42
16	M2	PZ	0	0	23	42
17	M2	PZ	0	0	23	42
18	M2	PZ	0	0	23	42
19	M2	PZ	0	0	23	42
20	M2	PZ	0	0	23	42

Member Distributed Loads (BLC 8 : NESC 250B X-dir - Wind w/ Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	5.9	5.9	0	0
2	M2	PX	4.8	4.8	23	52
3	M2	PX	0	0	23	52
4	M2	PX	0	0	23	52
5	M2	PX	0	0	23	52
6	M2	PX	0	0	23	52
7	M2	PX	0	0	23	52
8	M4	PX	3.2	3.2	0	0
9	M7	PX	3.2	3.2	0	0
10	M9	PX	3.2	3.2	0	0
11	M10	PX	3.2	3.2	0	0
12	M4	PX	0	0	0	0
13	M4	PX	0	0	0	0
14	M2	PX	0	0	0	0
15	M2	PX	2.6	2.6	23	42
16	M2	PX	0	0	23	42
17	M2	PX	0	0	23	42
18	M2	PX	0	0	23	42
19	M2	PX	0	0	23	42
20	M2	PX	0	0	23	42

Member Distributed Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	PX	60	60	32	55
2	M2	PX	46.6	46.6	32	52
3	M2	PX	0	0	32	52
4	M2	PX	0	0	32	52
5	M2	PX	0	0	32	52
6	M2	PX	0	0	32	52
7	M2	PX	0	0	32	52
8	M2	PX	48	48	0	32
9	M2	PX	37.3	37.3	23	32
10	M2	PX	0	0	23	32
11	M2	PX	0	0	23	32
12	M2	PX	0	0	23	32
13	M2	PX	0	0	23	32
14	M2	PX	0	0	23	32
15	M4	PX	27.8	27.8	0	0
16	M7	PX	27.8	27.8	0	0
17	M9	PX	27.8	27.8	0	0
18	M10	PX	27.8	27.8	0	0
19	M4	PX	0	0	0	0
20	M4	PX	0	0	0	0
21	M2	PX	0	0	32	55
22	M2	PX	23.3	23.3	32	42
23	M2	PX	0	0	32	42
24	M2	PX	0	0	32	42
25	M2	PX	0	0	32	42
26	M2	PX	0	0	32	42
27	M2	PX	0	0	32	42
28	M2	PX	0	0	0	32
29	M2	PX	18.6	18.6	23	32
30	M2	PX	0	0	23	32
31	M2	PX	0	0	23	32
32	M2	PX	0	0	23	32
33	M2	PX	0	0	23	32

Member Distributed Loads (BLC 9 : NESC 250C X-dir - Wind w/o Ice) (Continued)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
34	M2	PX	0	0	23	32

Member Distributed Loads (BLC 10 : NESC Weight of Ice on Mast and E)

	Member Label	Direction	Start Magnitude[lb/ft,F]	End Magnitude[lb/ft,F]	Start Location[ft,%]	End Location[ft,%]
1	M2	Y	-8.2	-8.2	0	0
2	M2	Y	-14.8	-14.8	23	52
3	M2	Y	0	0	23	52
4	M2	Y	0	0	23	52
5	M2	Y	0	0	23	52
6	M2	Y	0	0	23	52
7	M2	Y	0	0	23	52
8	M4	Y	-5.1	-5.1	0	0
9	M7	Y	-5.1	-5.1	0	0
10	M9	Y	-5.1	-5.1	0	0
11	M10	Y	-5.1	-5.1	0	0
12	M4	Y	0	0	0	0
13	M4	Y	0	0	0	0
14	M2	Y	0	0	0	0
15	M2	Y	-7.4	-7.4	23	42
16	M2	Y	0	0	23	42
17	M2	Y	0	0	23	42
18	M2	Y	0	0	23	42
19	M2	Y	0	0	23	42
20	M2	Y	0	0	23	42

Envelope AISC 14th(360-10): LRFD Steel Code Checks

	Member	Shape	Code Che...	Loc[ft]	LC	Shear Ch...	Loc[ft]	Dir	LC	phi*Pnc ...	phi*Pnt [l...	phi*M...	phi*M...	Cb	Eqn
1	M2	PIPE_12....	.934	21.198	2	.083	21.198		4	175813....	551250	184.275	184.2...	1.587	H1-1b
2	M3	HSS6x6x4	.352	.75	2	.277	0	z	2	216719....	216936	38.64	38.64	1.6	H1-1b
3	M4	HSS6x6x4	.519	3.5	2	.146	0	z	2	198867....	216936	38.64	38.64	1.37	H1-1b
4	M5	HSS6x6x4	.352	0	2	.277	0	z	2	216719....	216936	38.64	38.64	1.6	H1-1b
5	M6	HSS6x6x4	.181	.75	2	.117	0	y	1	216719....	216936	38.64	38.64	1.665	H1-1b
6	M7	HSS6x6x4	.685	3.5	3	.285	0	y	1	198867....	216936	38.64	38.64	1.314	H1-1b
7	M8	HSS6x6x4	.181	0	2	.117	.75	y	1	216719....	216936	38.64	38.64	1.665	H1-1b
8	M9	HSS6x6x4	.372	0	4	.288	0	z	4	216484....	216936	38.64	38.64	1.595	H1-1b
9	M10	HSS6x6x4	.700	1.083	3	.229	0	y	1	216484....	216936	38.64	38.64	1.305	H1-1b

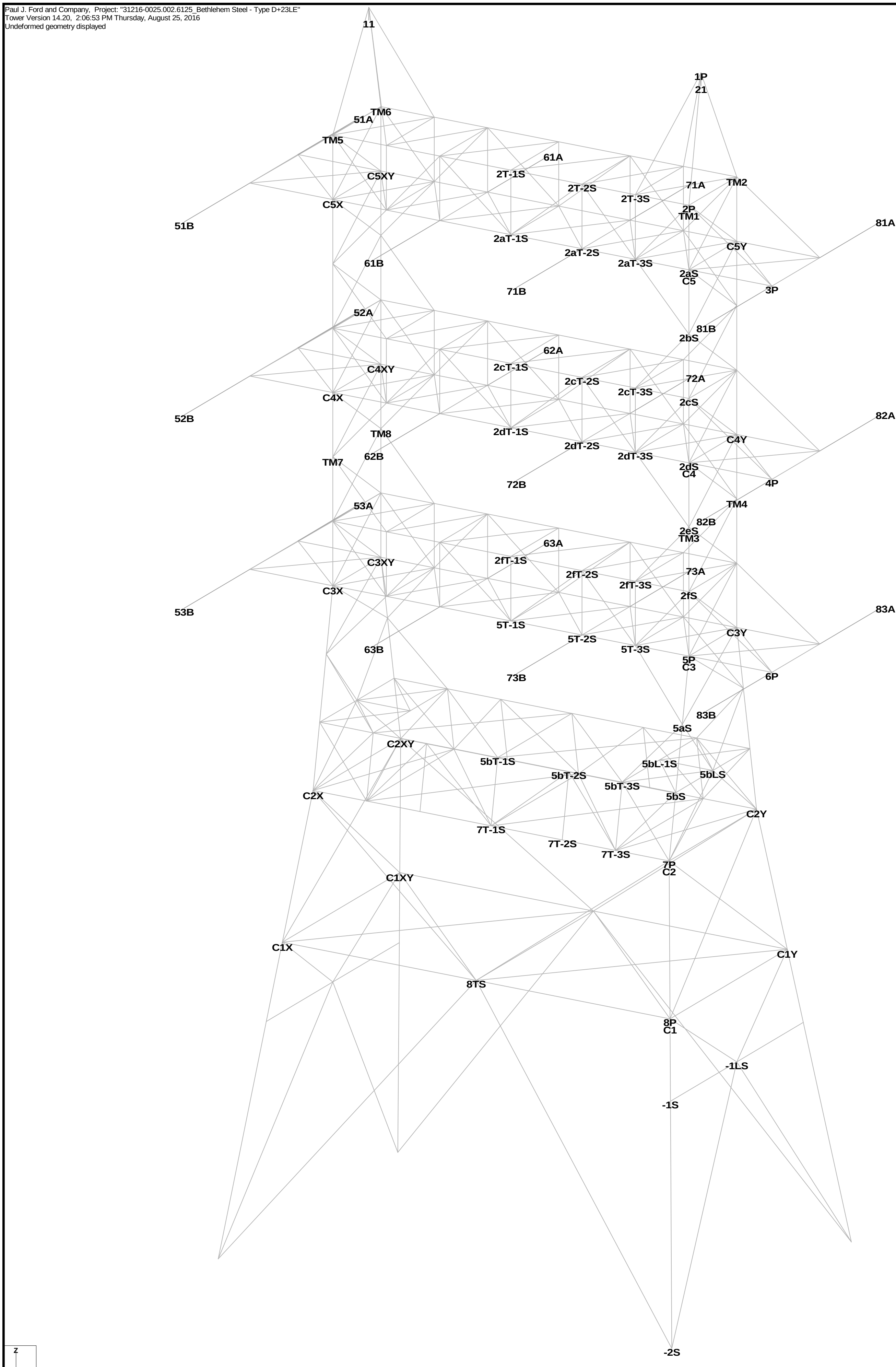
Envelope Joint Reactions

	Joint		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	TM8	max	3094.008	2	7202.394	1	3951.859	4	0	1	0	1	0	1
2		min	-1368.902	4	2750.769	4	-6110.15	2	0	1	0	1	0	1
3	TM7	max	3094.008	2	7202.394	1	6110.15	2	0	1	0	1	0	1
4		min	-328.154	3	2768.345	4	-349.289	3	0	1	0	1	0	1
5	TM6	max	4159.287	4	124.271	3	17014.7...	2	0	1	0	1	0	1
6		min	-8789.528	2	-99.775	2	-9298.86	4	0	1	0	1	0	1
7	TM5	max	-261.135	3	124.089	3	-778.572	3	0	1	0	1	0	1
8		min	-8789.528	2	-99.775	2	-17014....	2	0	1	0	1	0	1
9	Totals:	max	0	3	14560.59	3	0	1						
10		min	-11391.04	2	5652.238	2	-10680....	4						

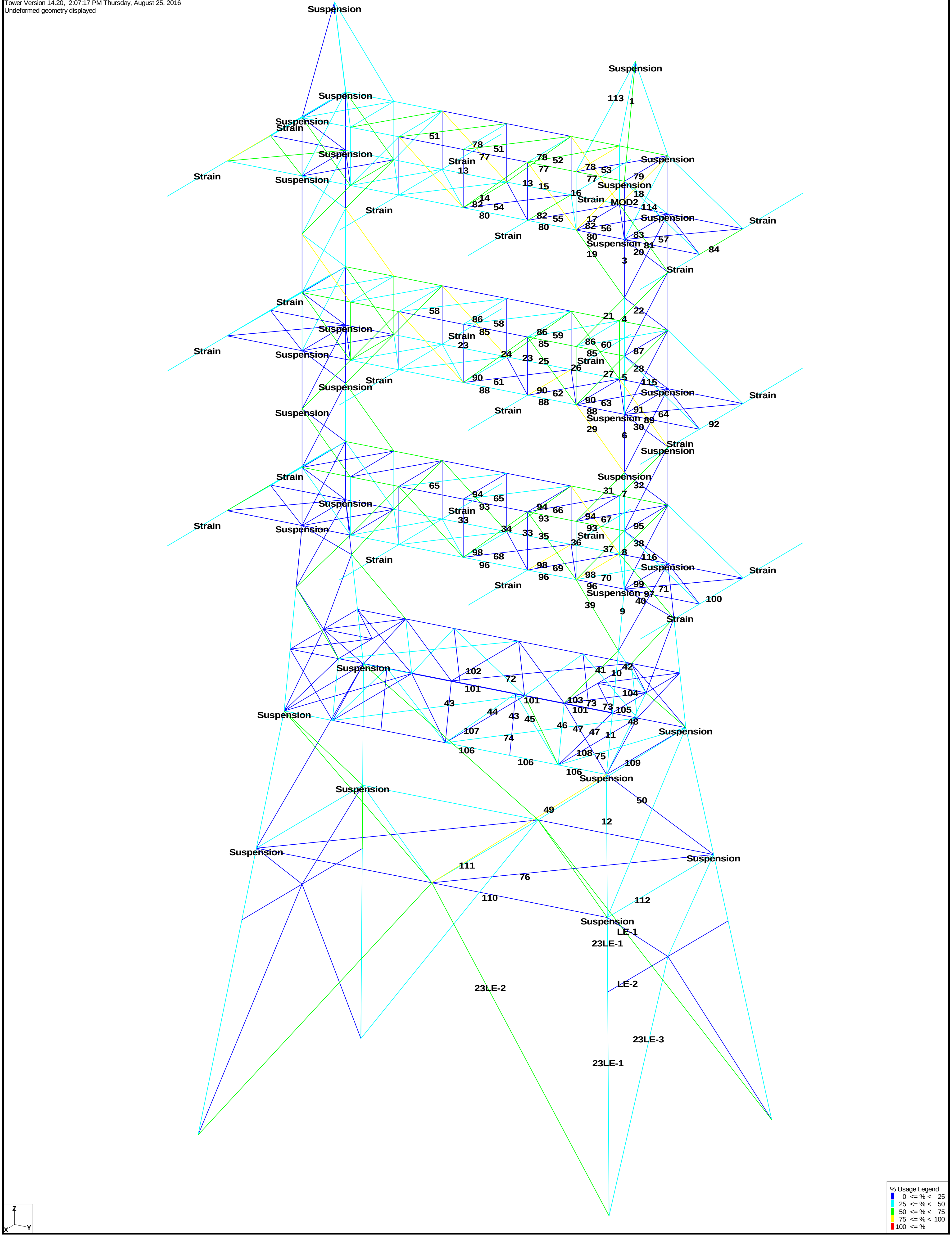
Joint Reactions

	LC	Joint Label	X [lb]	Y [lb]	Z [lb]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	5	TM8	263.016	4817.327	0	0	0	0
2	5	TM7	262.6	4817.323	-1.013	0	0	0
3	5	TM6	-1286.39	76.758	0	0	0	0
4	5	TM5	-1285.976	76.758	1.013	0	0	0
5	5	Totals:	-2046.75	9788.167	0			
6	5	COG (ft):	X: -1.76	Y: 31.337	Z: 0			
7	6	TM8	2317.198	2383.572	0	0	0	0
8	6	TM7	2316.175	2383.567	-2.482	0	0	0
9	6	TM6	-6024.538	-28.471	0	0	0	0
10	6	TM5	-6023.534	-28.471	2.482	0	0	0
11	6	Totals:	-7414.7	4710.198	0			
12	6	COG (ft):	X: -1.749	Y: 29.118	Z: 0			

Paul J. Ford and Company, Project: "31216-0025.002.6125_Bethlehem Steel - Type D+23LE"
Tower Version 14.20, 2:06:53 PM Thursday, August 25, 2016
Undeformed geometry displayed



Paul J. Ford and Company, Project: "31216-0025.002.6125_Bethlehem Steel - Type D+23LE"
Tower Version 14.20, 2:07:17 PM Thursday, August 25, 2016
Undeformed geometry displayed



Project Name : Eversource; 104'-0" Bethlehem Steel - Type D+33LE
Project Notes: Based on erection drawing CE 4324-C, Sheets E5 & E6; w/ PJF 2016 MODS
Project File : G:\Transmission\Eversource\2016\312-T-Mobile\31216-0025 TMobile_CT11356C_CLP 1102_2 Willruss St\31216-0025.002.6125 (6000_6050_6090)\31216-0025.002.6125_6000\31216-0025.002.6125_Bethlehem Steel - Type D+23LE.tow
Date run : 2:20:56 PM Thursday, August 25, 2016
by : Tower Version 14.20
Licensed to : Paul J. Ford and Company

Successfully performed nonlinear analysis

Member check option: ASCE 10
Connection rupture check: Not Checked
Crossing diagonal check: ASCE 10 [Alternate Unsupported RLOUT = 1]
Included angle check: None
Climbing load check: None
Redundant members checked with: Actual Force

Loads from file: g:\transmission\eversource\2016\312-t-mobile\31216-0025 tmobile_ct11356c_clp 1102_2 willruss st\31216-0025.002.6125 (6000_6050_6090)\31216-0025.002.6125_6000\31216-0025.002.6125-broken.lca

*** Analysis Results:

Maximum element usage is 89.40% for Angle "54P" in load case "TCL Broken: 250B"
Maximum insulator usage is 39.40% for Strain "51A" in load case "250B: NESC Heavy"

Summary of Joint Support Reactions For All Load Cases:

Load Case	Joint Label	Long. Force (kips)	Tran. Force (kips)	Vert. Force (kips)	Shear Force (kips)	Tran. Moment (ft-k)	Long. Moment (ft-k)	Bending Moment (ft-k)	Vert. Moment (ft-k)	Found. Usage %
250B: NESC Heavy	-2S	-24.03	-33.04	-123.55	40.85	0.00	0.00	0.00	0.00	0.00
250B: NESC Heavy	-2X	13.95	-20.62	64.06	24.89	0.00	0.00	0.00	0.00	0.00
250B: NESC Heavy	-2XY	-12.50	-18.63	59.46	22.44	0.00	0.00	0.00	0.00	0.00
250B: NESC Heavy	-2Y	22.58	-30.79	-117.82	38.18	0.00	0.00	0.00	0.00	0.00
250C: Extreme Wind (Trans.)	-2S	-22.53	-32.99	-117.55	39.95	0.00	0.00	0.00	0.00	0.00
250C: Extreme Wind (Trans.)	-2X	18.75	-26.69	88.10	32.62	0.00	0.00	0.00	0.00	0.00
250C: Extreme Wind (Trans.)	-2XY	-18.67	-26.59	88.00	32.49	0.00	0.00	0.00	0.00	0.00
250C: Extreme Wind (Trans.)	-2Y	22.45	-32.86	-117.22	39.80	0.00	0.00	0.00	0.00	0.00
SWL Broken: 250B	-2S	-24.85	-36.90	-130.93	44.48	0.00	0.00	0.00	0.00	0.00
SWL Broken: 250B	-2X	12.10	-19.43	49.83	22.89	0.00	0.00	0.00	0.00	0.00
SWL Broken: 250B	-2XY	-13.46	-18.89	69.53	23.20	0.00	0.00	0.00	0.00	0.00
SWL Broken: 250B	-2Y	20.10	-25.95	-105.67	32.83	0.00	0.00	0.00	0.00	0.00
SWR Broken: 250B	-2S	-26.95	-36.59	-144.89	45.44	0.00	0.00	0.00	0.00	0.00
SWR Broken: 250B	-2X	12.67	-16.09	51.21	20.47	0.00	0.00	0.00	0.00	0.00
SWR Broken: 250B	-2XY	-12.28	-21.69	65.47	24.92	0.00	0.00	0.00	0.00	0.00
SWR Broken: 250B	-2Y	16.91	-25.89	-88.83	30.92	0.00	0.00	0.00	0.00	0.00
TCL Broken: 250B	-2S	-14.75	-11.70	-101.90	18.83	0.00	0.00	0.00	0.00	0.00
TCL Broken: 250B	-2X	1.49	-24.50	8.58	24.55	0.00	0.00	0.00	0.00	0.00
TCL Broken: 250B	-2XY	-23.26	-29.53	109.61	37.59	0.00	0.00	0.00	0.00	0.00
TCL Broken: 250B	-2Y	25.27	-34.03	-132.67	42.39	0.00	0.00	0.00	0.00	0.00

Summary of Joint Support Reactions For All Load Cases in Direction of Leg:

Load Case	Support Joint	Origin Joint	Leg Member	Force In Leg Dir. (kips)	Residual Shear Perpendicular To Leg (kips)	Residual Shear Horizontal To Leg - Res. (kips)	Residual Shear Horizontal To Leg - Long. (kips)	Residual Shear Horizontal To Leg - Tran. (kips)	Total Long. Force (kips)	Total Tran. Force (kips)	Total Vert. Force (kips)
250B: NESC Heavy	-2S	-1S	157P	128.821	18.377	18.506	0.273	18.504	-24.03	-33.04	-123.55
250B: NESC Heavy	-2X	-1X	157X	-67.478	13.059	13.184	-1.633	13.082	13.95	-20.62	64.06
250B: NESC Heavy	-2XY	-1XY	157XY	-62.492	11.588	11.689	1.068	11.640	-12.50	-18.63	59.46
250B: NESC Heavy	-2Y	-1Y	157Y	122.709	16.821	16.931	0.076	16.931	22.58	-30.79	-117.82
250C: Extreme Wind (Trans.)	-2S	-1S	157P	122.682	19.043	19.168	-0.071	19.168	-22.53	-32.99	-117.55
250C: Extreme Wind (Trans.)	-2X	-1X	157X	-92.527	16.275	16.425	-1.810	16.325	18.75	-26.69	88.10
250C: Extreme Wind (Trans.)	-2XY	-1XY	157XY	-92.395	16.185	16.333	1.752	16.239	-18.67	-26.59	88.00
250C: Extreme Wind (Trans.)	-2Y	-1Y	157Y	122.328	18.953	19.077	0.086	19.077	22.45	-32.86	-117.22
SWL Broken: 250B	-2S	-1S	157P	136.615	21.364	21.499	-0.325	21.497	-24.85	-36.90	-130.93
SWL Broken: 250B	-2X	-1X	157X	-53.113	13.650	13.800	-2.514	13.569	12.10	-19.43	49.83
SWL Broken: 250B	-2XY	-1XY	157XY	-72.525	10.642	10.715	0.089	10.714	-13.46	-18.89	69.53
SWL Broken: 250B	-2Y	-1Y	157Y	109.833	13.440	13.525	0.215	13.523	20.10	-25.95	-105.67
SWR Broken: 250B	-2S	-1S	157P	150.597	19.457	19.567	-0.913	19.545	-26.95	-36.59	-144.89
SWR Broken: 250B	-2X	-1X	157X	-54.180	10.314	10.450	-2.819	10.063	12.67	-16.09	51.21
SWR Broken: 250B	-2XY	-1XY	157XY	-68.656	13.907	13.993	-0.311	13.989	-12.28	-21.69	65.47
SWR Broken: 250B	-2Y	-1Y	157Y	92.799	15.344	15.442	0.168	15.441	16.91	-25.89	-88.83
TCL Broken: 250B	-2S	-1S	157P	103.519	4.759	4.851	-4.843	-0.283	-14.75	-11.70	-101.90
TCL Broken: 250B	-2X	-1X	157X	-11.462	23.343	23.494	0.160	23.494	1.49	-24.50	8.58
TCL Broken: 250B	-2XY	-1XY	157XY	-114.684	16.621	16.782	2.186	16.639	-23.26	-29.53	109.61
TCL Broken: 250B	-2Y	-1Y	157Y	138.072	18.309	18.426	0.239	18.424	25.27	-34.03	-132.67

Overturning Moment Summary For All Load Cases:

Load Case	Transverse Moment (ft-k)	Longitudinal Moment (ft-k)	Resultant Moment (ft-k)
250B: NESC Heavy	6975.686	14.733	6975.702
250C: Extreme Wind (Trans.)	7854.334	2.936	7854.335
SWL Broken: 250B	6804.878	589.561	6830.369
SWR Broken: 250B	6698.499	922.150	6761.675
TCL Broken: 250B	6743.891	921.456	6806.552

Sections Information:

Section Label	Top Z (ft)	Bottom Z (ft)	Joint Count	Member Count	Tran. Face Top Width (ft)	Tran. Face Bot Width (ft)	Tran. Face Gross Area (ft^2)	Long. Face Top Width (ft)	Long. Face Bot Width (ft)	Long. Face Gross Area (ft^2)
SWpeak	70.333	61.333	10	8	0.00	7.00	31.500	28.00	30.00	261.000
TBridge	61.333	56.333	28	86	7.00	7.00	35.000	30.00	30.00	150.000
MBridge	46.333	41.333	28	86	7.00	7.00	35.000	30.00	30.00	150.000
LBridge	31.333	26.333	28	86	7.00	7.00	35.000	30.00	30.00	150.000
Tarm	61.333	56.333	12	14	7.00	7.00	35.000	30.00	44.00	185.000
Marm	46.333	41.333	12	14	7.00	7.00	35.000	30.00	44.00	185.000
Barm	31.333	26.333	12	14	7.00	7.00	35.000	30.00	44.00	185.000
U Std Body	56.333	46.333	20	24	7.00	7.00	70.000	30.00	30.00	300.000
M Std Body	41.333	31.333	20	24	7.00	7.00	70.000	30.00	30.00	300.000
L Std Body	26.333	11.333	44	118	7.00	12.77	148.275	30.00	30.00	450.000
L2 Std Body	11.333	-5.917	16	31	12.77	19.40	277.495	30.00	34.06	552.500
23LE	0.000	-23.667	16	16	17.13	26.23	513.064	32.67	38.23	838.989

*** Overall summary for all load cases - Usage = Maximum Stress / Allowable Stress
Printed capacities do not include the strength factor entered for each load case.
The Group Summary reports on the member and load case that resulted in maximum usage
which may not necessarily be the same as that which produces maximum force.

Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (ksi)	Max Usage %	Usage Cont-rol	Max Use In Comp. %	Comp. Control Member	Comp. Force (kips)	Comp. Control Load Case	L/r Capacity (kips)	Comp. Connect. Shear Capacity (kips)	Comp. Connect. Bearing Capacity (kips)	RLX	RLY	RLZ	L/r	KL/r	Length Comp. Member (ft)	Curve No.	No. Of Bolts Comp.
1	LEG-D331	SAE	2.5X2.5X0.1875	33.0	72.12	Comp	72.12	1P	-12.728	SWR Brok	17.649	27.200	25.312	0.500	0.500	0.500	117.68	118.84	9.708	3	2
2	LEG-D251	SAE	5X5X0.375	33.0	0.00		0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
3	LEG-D251	SAE	5X5X0.375	33.0	24.14	Tens	23.79	3X	-25.337	SWL Brok	106.517	0.000	0.000	1.000	1.000	1.000	60.61	60.61	5.000	1	0
4	LEG-D251	SAE	5X5X0.375	33.0	41.99	Comp	41.99	4P	-44.724	SWR Brok	106.517	0.000	0.000	1.000	1.000	1.000	60.61	60.61	5.000	1	0
5	LEG-D251	SAE	5X5X0.375	33.0	34.01	Comp	34.01	5P	-36.230	SWR Brok	106.517	136.000	253.125	1.000	1.000	1.000	60.61	60.61	5.000	1	10
6	LEG-D222	SAE	8X8X0.5	33.0	17.66	Comp	17.66	6P	-43.316	SWR Brok	245.252	0.000	0.000	1.000	1.000	1.000	37.74	37.74	5.000	1	0
7	LEG-D222	SAE	8X8X0.5	33.0	34.64	Comp	34.64	7P	-84.954	SWR Brok	245.252	0.000	0.000	1.000	1.000	1.000	37.74	37.74	5.000	1	0
8	LEG-D222	SAE	8X8X0.5	33.0	29.01	Comp	29.01	8P	-71.146	SWR Brok	245.252	272.000	337.499	1.000	1.000	1.000	37.74	37.74	5.000	1	10
9	LEG-D220	SAE	8X8X0.5	33.0	30.78	Comp	30.78	9P	-75.379	SWR Brok	244.864	0.000	0.000	1.000	1.000	1.000	38.43	38.43	5.092	1	0
10	LEG-D220	SAE	8X8X0.5	33.0	47.99	Comp	47.99	10P	-117.503	SWR Brok	244.864	380.800	944.999	1.000	1.000	1.000	38.43	38.43	5.092	1	28
11	LEG-D125	SAE	8X8X0.5	33.0	44.21	Tens	44.11	11P	-108.014	SWR Brok	244.864	0.000	0.000	1.000	1.000	1.000	38.43	38.43	5.092	1	0
12	LEG-D125	SAE	8X8X0.5	33.0	48.77	Comp	48.77	12P	-117.824	SWR Brok	241.582	380.800	944.999	0.500	0.500	0.500	43.84	43.84	11.617	1	28
13	VBR-D324	SAE	2X2X0.1875	33.0	9.91	Tens	1.34	13Y	-0.117	TCL Brok	8.763	27.200	25.312	1.000	1.000	1.000	152.28	152.28	5.000	4	2
14	VBR-D320	SAE	3X3X0.1875	33.0	89.18	Comp	89.18	15X	-13.622	250C: Ex	15.275	27.200	25.312	1.000	1.000	1.000	157.25	142.91	7.810	6	2
15	VBR-D322	SAE	3X3X0.1875	33.0	83.13	Comp	83.13	16Y	-14.139	SWR Brok	17.007	27.200	25.312	1.000	1.000	1.000	135.44	135.44	6.727	4	2
16	VBR-D271	SAE	2X2X0.1875	33.0	49.42	Comp	49.42	17XY	-4.331	SWR Brok	8.763	27.200	25.312	1.000	1.000	1.000	152.28	152.28	5.000	4	2
17	VBR-D259	SAE	3X3X0.1875	33.0	80.39	Comp	80.39	18Y	-14.437	250C: Ex	17.958	40.800	37.969	1.000	1.000	1.000	135.44	131.80	6.727	5	3
18	VBR-D267	SAE	2X2X0.1875	33.0	33.14	Comp	33.14	19Y	-4.074	SWR Brok	12.292	27.200	25.312	0.500	0.500	0.500	131.00	128.42	8.602	5	2
19	VBR-D257	SAE	3X3X0.3125	33.0	74.13	Comp	74.13	20P	-21.340	250C: Ex	28.788	40.800	63.281	1.000	1.000	1.000	137.05	133.03	6.727	5	3
20	VBR-D265	SAE	2.5X2.5X0.25	33.0	32.77	Comp	32.77	21XY	-8.475	TCL Brok	25.861	27.200	33.750	0.500	0.500	0.500	105.12	108.84	8.602	2	2
21	VBR-D255	SAE	3X3X0.3125	33.0	75.86	Comp	75.86	22XY	-21.838	250C: Ex	28.788	40.800	63.281	1.000	1.000	1.000	137.05	133.03	6.727	5	3
22	VBR-D263	SAE	2.5X2.5X0.25	33.0	31.57	Tens	28.08	23XY	-7.261	TCL Brok	25.861	27.200	33.750	0.500	0.500	0.500	105.12	108.84	8.602	2	2
23	VBR-D310	SAE	2X2X0.1875	33.0	10.13	Tens	1.41	24Y	-0.123	TCL Brok	8.763	27.200	25.312	1.000	1.000	1.000	152.28	152.28	5.000	4	2
24	VBR-D306	SAU	4X3.5X0.25	33.0	83.43	Comp	83.43	26XY	-26.413	250C: Ex	31.660	40.800	50.625	1.000	1.000	1.000	127.69	127.69	7.810	4	3
25	VBR-D308	SAE	3.5X3.5X0.25	33.0	72.29	Comp	72.29	27P	-24.093	TCL Brok	33.327	40.800	50.625	1.000	1.000	1.000	116.31	118.16	6.727	3	3
26	VBR-D269	SAU	3X2.5X0.25	33.0	60.60	Comp	60.60	28XY	-15.893	250C: Ex	26.226	27.200	33.750	1.000	1.000	1.000	113.64	116.82	5.000	3	2
27	VBR-D253	SAE	4X4X0.25	33.0	67.50	Comp	67.50	29P	-27.932	250C: Ex	41.379	54.400	67.500	1.000	1.000	1.000	101.54	110.77	6.727	3	4
28	VBR-D261	SAE	2.5X2.5X0.25	33.0	30.07	Comp	30.07	30XY	-7.776	TCL Brok	25.861	27.200	33.750	0.500	0.500	0.500	105.12	108.84	8.602	2	2
29	VBR-D230	SAE	4X4X0.25	33.0	77.65	Comp	77.65	31Y	-32.131	250C: Ex	41.379	54.400	67.500	1.000	1.000	1.000	101.54	110.77	6.727	3	4
30	VBR-D238	SAE	3X3X0.3125	33.0	21.39	Comp	21.39	32XY	-8.726	TCL Brok	43.226	40.800	63.281	0.500	0.500	0.500	87.63	95.72	8.602	2	3
31	VBR-D228	SAE	4X4X0.25	33.0	61.78	Comp	61.78	33X	-25.563	250C: Ex	41.379	54.400	67.500	1.000	1.000	1.000	101.54	110.77	6.727	3	4
32	VBR-D236	SAE	3X3X0.3125	33.0	21.91	Tens	18.72	34XY	-7.637	TCL Brok	43.226	40.800	63.281	0.500	0.500	0.500	87.63	95.72	8.602	2	3
33	VBR-D295	SAE	2X2X0.1875	33.0	10.49	Tens	1.52	35P	-0.133	TCL Brok	8.763	27.200	25.312	1.000	1.000	1.000	152.28	152.28	5.000	4	2
34	VBR-D291	SAE	4X4X0.3125	33.0	71.97	Comp	71.97	37XY	-33.638	SWR Brok	46.740	54.400	84.375	1.000	1.000	1.000	118.49	119.24	7.810	3	4
35	VBR-D293	SAE	4X4X0.25	33.0	75.45	Comp	75.45	38Y	-31.219	SWR Brok	41.379	54.400	67.500	1.000	1.000	1.000	101.54	110.77	6.727	3	4
36	VBR-D244	SAE	3.5X3.5X0.25	33.0	48.40	Comp	48.40	39X	-18.701	250C: Ex	38.640	40.800	50.625	1.000	1.000	1.000	86.46	103.23	5.000	3	3

37	VBR-D226	SAE	4X4X0.375	33.0	52.23	Comp	52.23	40P	-31.716250C: Ex	60.729	68.000	126.562	1.000	1.000	1.000	102.44	111.22	6.727	3	5
38	VBR-D234	SAE	3X3X0.3125	33.0	19.32	Comp	19.32	41XY	-7.881TCL Brok	43.226	40.800	63.281	0.500	0.500	0.500	87.63	95.72	8.602	2	3
39	VBR-D224	SAE	4X4X0.375	33.0	68.45	Comp	68.45	42P	-37.235250C: Ex	60.413	54.400	101.250	1.000	1.000	1.000	103.48	111.74	6.795	3	4
40	VBR-D232	SAE	2.5X2.5X0.25	33.0	18.57	Comp	18.57	43X	-3.921SWR Brok	21.114	27.200	33.750	0.560	0.560	0.560	128.67	126.65	9.401	5	2
41	VBR-D138	SAE	4X4X0.375	33.0	66.87	Comp	66.87	44X	-40.400TCL Brok	60.413	68.000	126.562	1.000	1.000	1.000	103.48	111.74	6.795	3	5
42	VBR-D145	SAE	3X3X0.1875	33.0	39.32	Comp	39.32	45P	-7.103SWR Brok	18.065	27.200	25.312	1.000	1.000	1.000	134.92	131.41	6.701	5	2
43	VBR-D155	SAE	2X2X0.1875	33.0	4.93	Comp	4.93	46P	-0.500SWR Brok	10.139	27.200	25.312	1.000	1.000	1.000	155.08	141.57	5.092	6	2
44	VBR-D137	SAE	4X4X0.375	33.0	49.25	Comp	49.25	48XY	-27.214250C: Ex	55.259	68.000	126.562	1.000	1.000	1.000	119.84	119.92	7.869	3	5
45	VBR-D135	SAE	4X4X0.375	33.0	38.12	Comp	38.12	49Y	-23.028SWR Brok	60.413	68.000	126.562	1.000	1.000	1.000	103.48	111.74	6.795	3	5
46	VBR-D153	SAE	4X4X0.3125	33.0	45.66	Tens	41.15	50XY	-22.384250C: Ex	56.996	54.400	84.375	1.000	1.000	1.000	77.24	98.62	5.092	3	4
47	VBR-D151	SAU	7X4X0.4375	33.0	15.56	Cross	15.56	51X	-17.368TCL Brok	111.619	149.600	324.843	0.500	1.000	0.500	72.81	96.40	6.795	3	11
48	VBR-D143	SAE	3X3X0.1875	33.0	53.60	Comp	53.60	53Y	-7.141SWR Brok	13.323	27.200	25.312	1.000	1.000	1.000	163.28	153.02	8.110	5	2
49	VBR-D127	DAS	3.5X3X0.25	33.0	89.40	Tens	65.83	54X	-33.098SWL Brok	50.279	54.400	67.500	0.500	1.000	0.500	137.64	133.48	18.926	5	2
50	VBR-D141	SAU	2.5X2X0.1875	33.0	56.17	Comp	56.17	55X	-1.691SWR Brok	3.010	27.200	25.312	0.573	1.000	0.573	376.13	277.52	18.807	6	2
51	HBR-D197	SAE	2.5X2.5X0.1875	33.0	72.94	Comp	72.94	56P	-3.770SWR Brok	5.168	13.600	12.656	1.000	1.000	1.000	223.50	223.50	9.220	4	1
52	HBR-D198	SAE	2.5X2.5X0.1875	33.0	53.74	Comp	53.74	58AR	-3.409SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
53	HBR-D199	SAE	2.5X2.5X0.1875	33.0	47.43	Comp	47.43	59AR	-3.009SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
54	HBR-D201	SAE	2X2X0.1875	33.0	35.92	Tens	13.84	60P	-1.427TCL Brok	10.309	13.600	12.656	0.500	0.500	0.500	140.40	140.40	9.220	4	1
55	HBR-D203	SAE	2X2X0.25	33.0	40.57	Tens	0.00	61Y	0.000	16.440	13.600	16.875	0.500	0.500	0.500	127.70	127.70	8.322	4	1
56	HBR-D205	SAE	2X2X0.25	33.0	20.97	Cross	20.97	62X	-2.098SWR Brok	10.006	13.600	16.875	0.500	1.000	0.500	163.97	163.97	8.322	4	1
57	HBR-D189	SAE	2X2X0.25	33.0	63.84	Comp	63.84	63X	-7.443TCL Brok	11.659	13.600	16.875	0.500	0.500	0.500	151.91	151.91	9.899	4	1
58	HBR-D197	SAE	2.5X2.5X0.1875	33.0	41.57	Comp	41.57	64P	-2.148SWR Brok	5.168	13.600	12.656	1.000	1.000	1.000	223.50	223.50	9.220	4	1
59	HBR-D198	SAE	2.5X2.5X0.1875	33.0	30.79	Comp	30.79	66AR	-1.953SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
60	HBR-D199	SAE	2.5X2.5X0.1875	33.0	29.51	Comp	29.51	67AR	-1.872SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
61	HBR-D201	SAE	2X2X0.1875	33.0	33.96	Tens	18.06	68Y	-1.141250C: Ex	6.320	13.600	12.656	0.500	1.000	0.500	179.31	179.31	9.220	4	1
62	HBR-D203	SAE	2X2X0.25	33.0	37.04	Tens	0.00	69Y	0.000	16.440	13.600	16.875	0.500	0.500	0.500	127.70	127.70	8.322	4	1
63	HBR-D205	SAE	2X2X0.25	33.0	22.95	Cross	22.95	70XY	-2.296TCL Brok	10.006	13.600	16.875	0.500	1.000	0.500	163.97	163.97	8.322	4	1
64	HBR-D189	SAE	2X2X0.25	33.0	11.50	Tens	0.00	71Y	0.000	11.659	13.600	16.875	0.500	0.500	0.500	151.91	151.91	9.899	4	1
65	HBR-D197	SAE	2.5X2.5X0.1875	33.0	33.05	Comp	33.05	72P	-1.708SWR Brok	5.168	13.600	12.656	1.000	1.000	1.000	223.50	223.50	9.220	4	1
66	HBR-D198	SAE	2.5X2.5X0.1875	33.0	24.32	Comp	24.32	74AR	-1.543SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
67	HBR-D199	SAE	2.5X2.5X0.1875	33.0	23.17	Comp	23.17	75AR	-1.470SWR Brok	6.344	13.600	12.656	1.000	1.000	1.000	201.74	201.74	8.322	4	1
68	HBR-D201	SAE	2X2X0.1875	33.0	33.42	Tens	15.72	76P	-0.993250C: Ex	6.320	13.600	12.656	0.500	1.000	0.500	179.31	179.31	9.220	4	1
69	HBR-D203	SAE	2X2X0.25	33.0	43.21	Tens	5.55	77P	-0.555250C: Ex	10.006	13.600	16.875	0.500	1.000	0.500	163.97	163.97	8.322	4	1
70	HBR-D205	SAE	2X2X0.25	33.0	31.01	Cross	31.01	78P	-3.103TCL Brok	10.006	13.600	16.875	0.500	1.000	0.500	163.97	163.97	8.322	4	1
71	HBR-D189	SAE	2X2X0.25	33.0	9.87	Tens	0.00	79Y	0.000	11.659	13.600	16.875	0.500	0.500	0.500	151.91	151.91	9.899	4	1
72	HBR-D179	SAE	2X2X0.1875	33.0	38.25	Comp	38.25	80XY	-1.872TCL Brok	4.894	27.200	25.312	0.500	0.500	0.500	229.89	203.78	15.096	5	2
73	HBR-D180	SAU	2.5X1.5X0.25	33.0	8.15	Comp	8.15	81XY	-0.939TCL Brok	11.519	40.800	50.625	0.500	0.750	0.500	152.83	152.83	7.047	4	3
74	HBR-D177	SAE	2X2X0.1875	33.0	65.03	Comp	65.03	83Y	-1.278250B: NE	1.966	13.600	12.656	1.000	0.500	0.500	321.54	321.54	16.532	4	1
75	HBR-D178	SAE	2X2X0.1875	33.0	48.28	Cross	48.28	84P	-1.415TCL Brok	2.931	13.600	12.656	0.500	1.000	0.500	263.33	263.33	13.540	4	1
76	HBR-D30	SAE	2X2X0.1875	33.0	56.16	Comp	56.16	85Y	-0.539SWL Brok	0.959	13.600	12.656	1.000	0.500	0.500	460.30	460.30	23.667	4	1
77	HRZ-D314	SAE	3X3X0.25	33.0	60.74	Tens	45.98	87X	-16.611250C: Ex	36.123	0.000	0.000	1.000	1.000	1.000	91.22	91.22	4.500	1	0
78	HRZ-D207	SAE	2X2X0.1875	33.0	82.60	Comp	82.60	91P	-3.693TCL Brok	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
79	HRZ-D278	SAE	2.5X2.5X0.1875	33.0	11.68	Comp	11.68	92X	-1.331TCL Brok	11.388	27.200	25.312	1.000	1.000	1.000	169.70	150.56	7.000	6	2
80	HRZ-D317	SAE	3X3X0.25	33.0	47.65	Tens	45.37	93P	-12.367TCL Brok	27.259	54.400	67.500	1.000	1.000	1.000	121.62	121.62	6.000	4	4
81	HRZ-D186	SAE	4X4X0.25	33.0	41.43	Comp	41.43	96X	-11.268TCL Brok	40.528	27.200	33.750	1.000	1.000	1.000	105.66	112.83	7.000	3	2
82	HRZ-D208	SAE	2X2X0.1875	33.0	74.26	Tens	52.01	97P	-2.325TCL Brok	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
83	HRZ-D277	SAE	2.5X2.5X0.1875	33.0	13.73	Comp	13.73	100P	-1.564250C: Ex	11.388	27.200	25.312	1.000	1.000	1.000	169.70	150.56	7.000	6	2
84	HRZ-D188	SAU	3.5X2.5X0.25	33.0	75.43	Tens	0.00	101X	0.000	17.286	27.200	33.750	1.000	1.000	1.000	154.41	154.41	7.000	4	2
85	HRZ-D300	SAE	4X4X0.25	33.0	71.30	Tens	64.10	103XY	-35.578250C: Ex	55.506	0.000	0.000	1.000	1.000	1.000	67.92	67.92	4.500	1	0
86	HRZ-D207	SAE	2X2X0.1875	33.0	33.07	Comp	33.07	106X	-1.479TCL Brok	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
87	HRZ-D276	SAE	2X2X0.1875	33.0	13.87	Comp	13.87	108X	-0.620250C: Ex	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
88	HRZ-D303	SAE	4X4X0.25	33.0	43.66	Tens	42.19	110Y	-23.416250C: Ex	55.506	0.000	0.000	1.000	1.000	1.000	67.92	67.92	4.500	1	0
89	HRZ-D184	SAE	4X4X0.25	33.0	22.04	Comp	22.04	112XY	-5.996TCL Brok	40.528	27.200	33.750	1.000	1.000	1.000	105.66	112.83	7.000	3	2
90	HRZ-D208	SAE	2X2X0.1875	33.0	79.45	Tens	50.15	115X	-2.242250B: NE	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
91	HRZ-D250	SAE	2.5X2.5X0.1875	33.0	8.32	Comp	8.32	116P	-0.947250C: Ex	11.388	27.200	25.312	1.000	1.000	1.000	169.70	150.56	7.000	6	2
92	HRZ-D188	SAU	3.5X2.5X0.25	33.0	49.68	Tens	0.00	117X	0.000	17.286	27.200	33.750	1.000	1.000	1.000	154.41	154.41	7.000	4	2
93	HRZ-D285	SAE	4X4X0.3125	33.0	72.64	Tens	63.82	120XY	-26.038250C: Ex	64.147	40.800	63.281	1.000	1.000	1.000	68.27	81.20	4.500	2	3
94	HRZ-D207	SAE	2X2X0.1875	33.0	24.62	Comp	24.62	123P	-1.101TCL Brok	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
95	HRZ-D249	SAE	2X2X0.1875	33.0	21.28	Comp	21.28	124X	-0.951250C: Ex	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
96	HRZ-D288	SAE	4X4X0.3125	33.0	45.52	Comp	45.52	125Y	-24.765SWR Brok	60.285	54.400	84.375	1.000	1.000	1.000	91.02	91.02	6.000	1	4
97	HRZ-D184	SAE	4X4X0.25	33.0	21.39	Comp	21.39	128XY	-5.818TCL Brok	40.528	27.200	33.750	1.000	1.000	1.000	105.66	112.83	7.000	3	2
98	HRZ-D208	SAE	2X2X0.1875	33.0	86.92	Tens	77.36	131P	-3.459250B: NE	4.471	13.600	12.656	1.000	1.000	1.000	213.20	213.20	7.000	4	1
99	HRZ-D248	SAE	3.5X3.5X0.3125	33.0	9.15	Comp	9.15	132P	-3.645250B: NE	39.830	40.800	63.281	1.000	1.000	1.000	121.74	121.07	7.000	6	3
100	HRZ-D188	SAU	3.5X2.5X0.25	33.0	50.55	Tens	0.00	133X	0.000	17.286	27.200	33.750	1.000	1.000	1.000	154.41	154.41	7.000	4	2
101	HRZ-D166	SAE	8X8X0.5	33.0	18.87	Tens	15.14	135X	-37.435TCL Brok	247.247	0.000	0.000	1.000	1.000	1.000	33.96	33.96	4.500	1	0
102	HRZ-D174	SAE	3.5X3.5X0.25	33.0	0.30	Tens	0.15	137P	-0.027SWR Brok	18.536	27.200	33.750	1.000	1.000	1.000	187.55	161.54	10.847	6	2
103	HRZ-D170	SAU	3X2.5X0.25	33.0	5.13	Comp	5.13	138P	-1.122TCL Brok	21.876	40.800	50.625	2.000	1.000	1.000	137.74	130.91	5.423	6	3
104	HRZ-D176	SAE	2X2X0.25	33.0	1.48	Comp	1.48	139P	-0.209TCL Brok	14.106	27.200	33.750	1.000	1.000	1.000	138.11	138.11	4.500	4	2
105	HRZ-D168	SAU	3.5X3X0.25	33.0	4.34	Tens	3.28	140XY	-1.083TCL Brok	33.009	40.800	50.625	1.000	1.000	1.000	103.14	111.57	5.423	3	3
106	HRZ-D165	SAE	6X6X0.5	33.0	40.61	Comp	40.61	143P	-49.711TCL Brok	167.121	122.400	303.750	1.000	1.000	1.000	45.76	64.32	4.500	2	9
107	HRZ-D173	SAE	3X3X0.1875	33.0	19.48	Comp	19.48	144P	-1.456SWR Brok	7.473	27.200	25.312	1.000	1.000	1.000	257.11	204.33	12.770	6	2
108	HRZ-D169	SAE	3X3X0.25	33.0	3.24	Comp	3.24	145X	-0.614250B: NE	18.935	27.200	33.750	1.000	0.500	0.500	164.77	147.54	12.770	6	2
109	HRZ-D167	SAU	3.5X3X0.25	33.0	10.13	Comp	10.13	146X	-2.632250C: Ex	25.975	27.200	33.750	1.000	0.500	0.500	138.05	131.10	12.770	6	2
110	HRZ-D24	SAE	3X3X0.1875	33.0	33.30	Comp	33.30	147XY	-4.386TCL Brok	13.173	40.800	37.969	0.500	0.500	0.500	164.43	153.89	16.333	5	3
111	HRZ-D28	SAE	3X3X0.1875	33.0	48.13	Comp	48.13	148P	-3.134TCL Brok	6.511	13.600	12.656	1.000	0.500	0.500	218.89	218.89	17.128	4	1
112	HRZ-D26	SAE	3.5X3.5X0.25	33.0	40.41	Comp	40.41	149P	-10.373TCL Brok	25.671	40.800	50.625	0.500	0.500	0.500	148.08	137.27	17.128	6	3
113	HRZ-D329	SAE	2.5X2.5X0.1875	33.0	43.69	Tens	30.65	150XY	-5.047SWR Brok	16.467	27.200	25.312	0.500	0.500	0.500	124.50	124.50	10.271	4	2
114	STR-D194	BAR	2X0.1875X0.1875	33.0	39.69	Tens	0.00	151Y	0.000	0.049	27.200	25.312	1.000	1.000	1.000	1908.09	1482.57	8.602	5	2
115	STR-D195	BAR	2X0.1875X0.1875	33.0	40.18	Tens	0.00	152Y	0.000	0.049	27.200	25.312	1.000	1.000	1.000	1908.09	1482.57	8.602	5	2
116	STR-D196	BAR	2X0.1875X0.1875	33.0	39.00	Tens	0.00	153Y	0.000	0.049	27.200	25.312	1.000	1.000	1.000	1908.09	1482.57	8.602	5	2
LE-1	VBR-D14	SAU	3X2X0.25	33.0	43.85	Tens	26.03	154Y	-1.443250B: NE	5.542	40.800	50.625	1.000	1.000	1.000	287.79	247.90	10.433	5	3

LE-2	HRZ-D18	SAE	3X3X0.1875	33.0	15.03	Comp	15.03	155Y	-1.188TCL Brok	7.902	27.200	25.312	2.000	1.000	1.000	247.97	198.70	9.702	6	2 A potentially

damaging moment exists in the following members (make sure your system is well triangulated to minimize moments): 155P 155X 155XY 155Y ??

13LE-1	LEG-D4	SAE	8X8X0.5	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
13LE-2	VBR-D6	DAS	4X3X0.25	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
13LE-3	VBR-D12	SAU	2.5X2X0.1875	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
23LE-1	LEG-D35	SAE	8X8X0.5	33.0	51.22	Tens	49.69	157P	-119.414SWR Brok	240.335	380.800	944.999	0.333	0.333	0.333	45.73	45.73	18.195	1	28
23LE-2	VBR-D37	DAS	4X3X0.4375	33.0	74.33	Comp	74.33	158P	-40.873SWL Brok	54.989	81.600	177.187	0.250	1.000	0.250	189.30	172.85	30.762	5	3
23LE-3	VBR-D48	SAE	3X3X0.1875	33.0	39.02	Tens	21.27	159XY	-1.110SWR Brok	5.220	40.800	37.969	1.000	0.333	0.333	283.29	244.47	22.168	5	3
33LE-1	LEG-D75	SAE	8X8X0.5	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
33LE-2	VBR-D77	DAS	5X3.5X0.25	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
33LE-3	VBR-D91	SAE	3X3X0.1875	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0	0
MOD2	LEG-D251 (PJF-2016)	SAE	5X5X0.375	33.0	18.42	Comp	18.42	2X	-21.369SWL Brok	115.977	0.000	0.000	0.500	0.500	0.500	30.30	30.30	5.000	1	0

Group Summary (Tension Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (ksi)	Max Usage %	Usage Cont-rol	Max Use In Tens. %	Tension Control Member	Tension Force (kips) / Tension Control Load Case	Net Section Capacity (kips)	Tension Connect. Shear Capacity (kips)	Tension Connect. Bearing Capacity (kips)	Tension Connect. Rupture Capacity (kips)	Length Tens. Member (ft)	No. Of Bolts Tens.	No. Of Holes	Hole Diameter (in)
1	LEG-D331	SAE	2.5X2.5X0.1875	33.0	72.12	Comp	45.49	1XY	7.753SWL Brok	17.044	27.200	25.312	0.000	9.708	2	2.000	0.875
2	LEG-D251	SAE	5X5X0.375	33.0	0.00		0.00		0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0
3	LEG-D251	SAE	5X5X0.375	33.0	24.14	Tens	24.14	3Y	18.305SWR Brok	75.817	0.000	0.000	0.000	5.000	0	4.000	0.875
4	LEG-D251	SAE	5X5X0.375	33.0	41.99	Comp	26.51	4XY	22.974SWL Brok	86.645	0.000	0.000	0.000	5.000	0	3.000	0.875
5	LEG-D251	SAE	5X5X0.375	33.0	34.01	Comp	22.48	5Y	17.043SWR Brok	75.817	136.000	253.125	0.000	5.000	10	4.000	0.875
6	LEG-D222	SAE	8X8X0.5	33.0	17.66	Comp	10.79	6Y	21.361SWR Brok	198.000	0.000	0.000	0.000	5.000	0	4.000	0.875
7	LEG-D222	SAE	8X8X0.5	33.0	34.64	Comp	26.95	7XY	53.370TCL Brok	198.000	0.000	0.000	0.000	5.000	0	4.000	0.875
8	LEG-D222	SAE	8X8X0.5	33.0	29.01	Comp	20.55	8XY	37.728TCL Brok	183.562	272.000	337.499	0.000	5.000	10	5.000	0.875
9	LEG-D220	SAE	8X8X0.5	33.0	30.78	Comp	22.91	9XY	40.882TCL Brok	178.466	0.000	0.000	0.000	5.092	0	5.353	0.875
10	LEG-D220	SAE	8X8X0.5	33.0	47.99	Comp	42.56	10XY	84.271TCL Brok	198.000	380.800	944.999	0.000	5.092	28	4.000	0.875
11	LEG-D125	SAE	8X8X0.5	33.0	44.21	Tens	44.21	11XY	74.767TCL Brok	169.125	0.000	0.000	0.000	5.092	0	6.000	0.875
12	LEG-D125	SAE	8X8X0.5	33.0	48.77	Comp	44.51	12XY	88.189TCL Brok	198.130	380.800	944.999	0.000	11.617	28	3.991	0.875
13	VBR-D324	SAE	2X2X0.1875	33.0	9.91	Tens	9.91	14XY	1.607SWR Brok	16.214	27.200	25.312	0.000	5.000	2	1.000	0.875
14	VBR-D320	SAE	3X3X0.1875	33.0	89.18	Comp	55.30	15Y	13.997SWR Brok	27.500	27.200	25.312	0.000	7.810	2	1.000	0.875
15	VBR-D322	SAE	3X3X0.1875	33.0	83.13	Comp	41.88	16X	10.601250C: Ex	27.500	27.200	25.312	0.000	6.727	2	1.000	0.875
16	VBR-D271	SAE	2X2X0.1875	33.0	49.42	Comp	37.71	17Y	6.114SWR Brok	16.214	27.200	25.312	0.000	5.000	2	1.000	0.875
17	VBR-D259	SAE	3X3X0.1875	33.0	80.39	Comp	63.47	18X	17.455TCL Brok	27.500	40.800	37.969	0.000	6.727	3	1.000	0.875
18	VBR-D267	SAE	2X2X0.1875	33.0	33.14	Comp	25.68	19P	4.164SWR Brok	16.214	27.200	25.312	0.000	8.602	2	1.000	0.875
19	VBR-D257	SAE	3X3X0.3125	33.0	74.13	Comp	54.09	20XY	22.071250C: Ex	44.745	40.800	63.281	0.000	6.727	3	1.000	0.875
20	VBR-D265	SAE	2.5X2.5X0.25	33.0	32.77	Comp	26.31	21X	7.155TCL Brok	28.846	27.200	33.750	0.000	8.602	2	1.000	0.875
21	VBR-D255	SAE	3X3X0.3125	33.0	75.86	Comp	51.76	22P	21.117250C: Ex	44.745	40.800	63.281	0.000	6.727	3	1.000	0.875
22	VBR-D263	SAE	2.5X2.5X0.25	33.0	31.57	Tens	31.57	23X	8.586TCL Brok	28.846	27.200	33.750	0.000	8.602	2	1.000	0.875
23	VBR-D310	SAE	2X2X0.1875	33.0	10.13	Tens	10.13	25XY	1.642SWR Brok	16.214	27.200	25.312	0.000	5.000	2	1.000	0.875
24	VBR-D306	SAU	4X3.5X0.25	33.0	83.43	Comp	65.55	26Y	26.745250C: Ex	44.284	40.800	50.625	0.000	7.810	3	1.458	0.875
25	VBR-D308	SAE	3.5X3.5X0.25	33.0	72.29	Comp	52.78	27XY	21.237250C: Ex	40.240	40.800	50.625	0.000	6.727	3	1.532	0.875
26	VBR-D269	SAU	3X2.5X0.25	33.0	60.60	Comp	54.36	28P	14.785250C: Ex	32.410	27.200	33.750	0.000	5.000	2	1.000	0.875
27	VBR-D253	SAE	4X4X0.25	33.0	67.50	Comp	63.91	29XY	29.883250C: Ex	46.755	54.400	67.500	0.000	6.727	4	1.672	0.875
28	VBR-D261	SAE	2.5X2.5X0.25	33.0	30.07	Comp	22.49	30X	6.118TCL Brok	28.846	27.200	33.750	0.000	8.602	2	1.000	0.875
29	VBR-D230	SAE	4X4X0.25	33.0	77.65	Comp	63.37	31X	30.043250C: Ex	47.411	54.400	67.500	0.000	6.727	4	1.571	0.875
30	VBR-D238	SAE	3X3X0.3125	33.0	21.39	Comp	18.79	32X	7.666TCL Brok	44.745	40.800	63.281	0.000	8.602	3	1.000	0.875
31	VBR-D228	SAE	4X4X0.25	33.0	61.78	Comp	56.57	33P	26.450TCL Brok	46.755	54.400	67.500	0.000	6.727	4	1.672	0.875
32	VBR-D236	SAE	3X3X0.3125	33.0	21.91	Tens	21.91	34X	8.937TCL Brok	44.745	40.800	63.281	0.000	8.602	3	1.000	0.875
33	VBR-D295	SAE	2X2X0.1875	33.0	10.49	Tens	10.49	36XY	1.701SWR Brok	16.214	27.200	25.312	0.000	5.000	2	1.000	0.875
34	VBR-D291	SAE	4X4X0.3125	33.0	71.97	Comp	63.07	37Y	34.309SWR Brok	59.439	54.400	84.375	0.000	7.810	4	1.458	0.875
35	VBR-D293	SAE	4X4X0.25	33.0	75.45	Comp	55.02	38X	26.488250C: Ex	48.145	54.400	67.500	0.000	6.727	4	1.458	0.875
36	VBR-D244	SAE	3.5X3.5X0.25	33.0	48.40	Comp	45.82	39P	18.696TCL Brok	43.696	40.800	50.625	0.000	5.000	3	1.000	0.875
37	VBR-D226	SAE	4X4X0.375	33.0	52.23	Comp	49.39	40XY	33.587SWR Brok	68.648	68.000	126.562	0.000	6.727	5	1.672	0.875
38	VBR-D234	SAE	3X3X0.3125	33.0	19.32	Comp	15.76	41X	6.428TCL Brok	44.745	40.800	63.281	0.000	8.602	3	1.000	0.875
39	VBR-D224	SAE	4X4X0.375	33.0	68.45	Comp	65.17	42XY	35.451SWR Brok	68.833	54.400	101.250	0.000	6.795	4	1.653	0.875
40	VBR-D232	SAE	2.5X2.5X0.25	33.0	18.57	Comp	17.82	43Y	4.846SWR Brok	28.846	27.200	33.750	0.000	9.401	2	1.000	0.875
41	VBR-D138	SAE	4X4X0.375	33.0	66.87	Comp	58.62	44Y	39.865SWR Brok	68.355	68.000	126.562	0.000	6.795	5	1.702	0.875
42	VBR-D145	SAE	3X3X0.1875	33.0	39.32	Comp	17.35	45XY	4.391SWL Brok	27.500	27.200	25.312	0.000	6.701	2	1.000	0.875
43	VBR-D155	SAE	2X2X0.1875	33.0	4.93	Comp	2.87	47X	0.465TCL Brok	16.214	27.200	25.312	0.000	5.092	2	1.000	0.875
44	VBR-D137	SAE	4X4X0.375	33.0	49.25	Comp	43.32	48Y	28.354SWR Brok	65.451	68.000	126.562	0.000	7.869	5	2.000	0.875
45	VBR-D135	SAE	4X4X0.375	33.0	38.12	Comp	32.09	49XY	21.001250C: Ex	65.451	68.000	126.562	0.000	6.795	5	2.000	0.875
46	VBR-D153	SAE	4X4X0.3125	33.0	45.66	Tens	45.66	50P	24.838TCL Brok	59.407	54.400	84.375	0.000	5.092	4	1.462	0.875
47	VBR-D151	SAU	7X4X0.4375	33.0	15.56	Cross	10.11	52XY	10.429TCL Brok	103.105	149.600	324.843	0.000	6.795	11	3.000	0.875
48	VBR-D143	SAE	3X3X0.1875	33.0	53.60	Comp	16.30	53X	4.125SWL Brok	27.500	27.200	25.312	0.000	8.110	2	1.000	0.875
49	VBR-D127	DAS	3.5X3X0.25	33.0	89.40	Tens	89.40	54P	48.633TCL Brok	72.542	54.400	67.500	0.000	18.926	2	2.000	0.875
50	VBR-D141	SAU	2.5X2X0.1875	33.0	56.17	Comp	26.28	55Y	5.041TCL Brok	19.184	27.200	25.312	0.000	18.807	2	1.000	0.875
51	HBR-D197	SAE	2.5X2.5X0.1875	33.0	72.94	Comp	16.39	57P	2.074SWL Brok	21.917	13.600	12.656	0.000	9.220	1	1.000	0.875
52	HBR-D198	SAE	2.5X2.5X0.1875	33.0	53.74	Comp	14.75	58P	1.867SWL Brok	21.917	13.600	12.656	0.000	8.322	1	1.000	0.875
53	HBR-D199	SAE	2.5X2.5X0.1875	33.0	47.43	Comp	15.88	59P	2.010TCL Brok	21.917	13.600	12.656	0.000	8.322	1	1.000	0.875
54	HBR-D201	SAE	2X2X0.1875	33.0	35.92	Tens	35.92	60X	4.546TCL Brok	16.214	13.600	12.656	0.000	9.220	1	1.000	0.875
55	HBR-D203	SAE	2X2X0.25	33.0	40.57	Tens	40.57	61X	5.517TCL Brok	21.421	13.600	16.875	0.000	8.322	1	1.000	0.875
56	HBR-D205	SAE	2X2X0.25	33.0	20.97	Cross	8.61	62Y	1.171TCL Brok	21.421	13.600	16.875	0.000	8.322	1	1.000	0.875
57	HBR-D189	SAE	2X2X0.25	33.0	63.84	Comp	61.85	63XY	8.411TCL Brok	21.421	13.600	16.875	0.000	9.899	1	1.000	0.875
58	HBR-D197	SAE	2.5X2.5X0.1875	33.0	41.57	Comp	15.56	65P	1.969TCL Brok	21.917	13.600	12.656	0.000	9.220	1	1.000	0.875
59	HBR-D198	SAE	2.5X2.5X0.1875	33.0	30.79	Comp	14.15	66P	1.791TCL Brok	21.917	13.600	12.656	0.000	8.322	1	1.000	0.875

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 60       HBR-D199  SAE  2.5X2.5X0.1875   33.0 29.51  Comp 14.11   67AR   1.786TCL Brok   21.917   13.600   12.656   0.000  8.322   1 1.000   0.875
 61       HBR-D201  SAE      2X2X0.1875   33.0 33.96  Tens 33.96    68X   4.298TCL Brok   16.214   13.600   12.656   0.000  9.220   1 1.000   0.875
 62       HBR-D203  SAE        2X2X0.25   33.0 37.04  Tens 37.04    69X   5.037TCL Brok   21.421   13.600   16.875   0.000  8.322   1 1.000   0.875
 63       HBR-D205  SAE        2X2X0.25   33.0 22.95 Cross  5.55    70Y   0.755TCL Brok   21.421   13.600   16.875   0.000  8.322   1 1.000   0.875
 64       HBR-D189  SAE        2X2X0.25   33.0 11.50  Tens 11.50    71Y   1.564TCL Brok   21.421   13.600   16.875   0.000  9.899   1 1.000   0.875
 65       HBR-D197  SAE  2.5X2.5X0.1875   33.0 33.05  Comp 11.04    73P   1.398TCL Brok   21.917   13.600   12.656   0.000  9.220   1 1.000   0.875
 66       HBR-D198  SAE  2.5X2.5X0.1875   33.0 24.32  Comp 10.09    74P   1.277TCL Brok   21.917   13.600   12.656   0.000  8.322   1 1.000   0.875
 67       HBR-D199  SAE  2.5X2.5X0.1875   33.0 23.17  Comp  9.87    75P   1.249TCL Brok   21.917   13.600   12.656   0.000  8.322   1 1.000   0.875
 68       HBR-D201  SAE      2X2X0.1875   33.0 33.42  Tens 33.42    76X   4.230TCL Brok   16.214   13.600   12.656   0.000  9.220   1 1.000   0.875
 69       HBR-D203  SAE        2X2X0.25   33.0 43.21  Tens 43.21    77X   5.876TCL Brok   21.421   13.600   16.875   0.000  8.322   1 1.000   0.875
 70       HBR-D205  SAE        2X2X0.25   33.0 31.01 Cross  8.69   78XY   1.182SWR Brok   21.421   13.600   16.875   0.000  8.322   1 1.000   0.875
 71       HBR-D189  SAE        2X2X0.25   33.0  9.87  Tens  9.87    79Y   1.342TCL Brok   21.421   13.600   16.875   0.000  9.899   1 1.000   0.875
 72       HBR-D179  SAE      2X2X0.1875   33.0 38.25  Comp  9.59    80Y   1.555TCL Brok   16.214   27.200   25.312   0.000 15.096   2 1.000   0.875
 73       HBR-D180  SAU    2.5X1.5X0.25   33.0  8.15  Comp  4.59    81Y   0.983TCL Brok   21.421   40.800   50.625   0.000  7.047   3 1.000   0.875
 74       HBR-D177  SAE      2X2X0.1875   33.0 65.03  Comp 14.99    83P   1.897SWR Brok   16.214   13.600   12.656   0.000 16.532   1 1.000   0.875
 75       HBR-D178  SAE      2X2X0.1875   33.0 48.28 Cross  5.46   84XY   0.691SWR Brok   16.214   13.600   12.656   0.000 13.540   1 1.000   0.875
 76        HBR-D30  SAE      2X2X0.1875   33.0 56.16  Comp 31.38    85Y   3.972TCL Brok   16.214   13.600   12.656   0.000 23.667   1 1.000   0.875
 77       HRZ-D314  SAE        3X3X0.25   33.0 60.74  Tens 60.74    87Y  20.095250C: Ex   33.082    0.000    0.000   0.000  4.500   0 2.000   0.875
 78       HRZ-D207  SAE      2X2X0.1875   33.0 82.60  Comp 33.56    91X   4.248SWR Brok   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 79       HRZ-D278  SAE  2.5X2.5X0.1875   33.0 11.68  Comp  9.99    92P   2.190250B: NE   21.917   27.200   25.312   0.000  7.000   2 1.000   0.875
 80       HRZ-D317  SAE        3X3X0.25   33.0 47.65  Tens 47.65   94XY  15.763TCL Brok   33.082    0.000    0.000   0.000  4.500   0 2.000   0.875
 81       HRZ-D186  SAE        4X4X0.25   33.0 41.43  Comp 18.66   96XY   5.075TCL Brok   43.624   27.200   33.750   0.000  7.000   2 2.154   0.875
 82       HRZ-D208  SAE      2X2X0.1875   33.0 74.26  Tens 74.26    98P   9.398250B: NE   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 83       HRZ-D277  SAE  2.5X2.5X0.1875   33.0 13.73  Comp  7.50   100X   1.644250B: NE   21.917   27.200   25.312   0.000  7.000   2 1.000   0.875
 84       HRZ-D188  SAU    3.5X2.5X0.25   33.0 75.43  Tens 75.43   101X  10.751SWR Brok   14.254   27.200   33.750   0.000  7.000   2 3.246   0.875
 85       HRZ-D300  SAE        4X4X0.25   33.0 71.30  Tens 71.30   103P  35.354250C: Ex   49.582    0.000    0.000   0.000  4.500   0 2.000   0.875
 86       HRZ-D207  SAE      2X2X0.1875   33.0 33.07  Comp 12.71   106X   1.609SWR Brok   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 87       HRZ-D276  SAE      2X2X0.1875   33.0 13.87  Comp 12.72   108P   1.610SWR Brok   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 88       HRZ-D303  SAE        4X4X0.25   33.0 43.66  Tens 43.66   110X  21.648250C: Ex   49.582    0.000    0.000   0.000  4.500   0 2.000   0.875
 89       HRZ-D184  SAE        4X4X0.25   33.0 22.04  Comp  3.95   112Y   1.074250C: Ex   43.624   27.200   33.750   0.000  7.000   2 2.154   0.875
 90       HRZ-D208  SAE      2X2X0.1875   33.0 79.45  Tens 79.45   114P  10.055250B: NE   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 91       HRZ-D250  SAE  2.5X2.5X0.1875   33.0  8.32  Comp  6.24   116X   1.369SWL Brok   21.917   27.200   25.312   0.000  7.000   2 1.000   0.875
 92       HRZ-D188  SAU    3.5X2.5X0.25   33.0 49.68  Tens 49.68   117X  10.771SWR Brok   21.679   27.200   33.750   0.000  7.000   2 3.246   0.875
 93       HRZ-D285  SAE      4X4X0.3125   33.0 72.64  Tens 72.64   119Y  44.421SWR Brok   61.153    0.000    0.000   0.000  4.500   0 2.000   0.875
 94       HRZ-D207  SAE      2X2X0.1875   33.0 24.62  Comp 10.47   123X   1.326SWR Brok   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 95       HRZ-D249  SAE      2X2X0.1875   33.0 21.28  Comp 15.03   124P   1.903SWR Brok   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 96       HRZ-D288  SAE      4X4X0.3125   33.0 45.52  Comp 45.25   125X  24.616TCL Brok   61.153   54.400   84.375   0.000  6.000   4 2.000   0.875
 97       HRZ-D184  SAE        4X4X0.25   33.0 21.39  Comp  4.36   128Y   1.185250C: Ex   43.624   27.200   33.750   0.000  7.000   2 2.154   0.875
 98       HRZ-D208  SAE      2X2X0.1875   33.0 86.92  Tens 86.92   130P  11.001250B: NE   16.214   13.600   12.656   0.000  7.000   1 1.000   0.875
 99       HRZ-D248  SAE  3.5X3.5X0.3125   33.0  9.15  Comp  3.26   132X   1.328250C: Ex   53.952   40.800   63.281   0.000  7.000   3 1.000   0.875
100       HRZ-D188  SAU    3.5X2.5X0.25   33.0 50.55  Tens 50.55   133X  10.959SWR Brok   21.679   27.200   33.750   0.000  7.000   2 3.246   0.875
101       HRZ-D166  SAE         8X8X0.5   33.0 18.87  Tens 18.87   135P  34.639250C: Ex  183.562    0.000    0.000   0.000  4.500   0 5.000   0.875
102       HRZ-D174  SAE    3.5X3.5X0.25   33.0  0.30  Tens  0.30   137P   0.082TCL Brok   43.696   27.200   33.750   0.000 10.847   2 1.000   0.875
103       HRZ-D170  SAU      3X2.5X0.25   33.0  5.13  Comp  3.28   138X   0.941TCL Brok   28.698   40.800   50.625   0.000  5.423   3 1.000   0.875
104       HRZ-D176  SAE        2X2X0.25   33.0  1.48  Comp  0.71   139X   0.152250C: Ex   21.421   27.200   33.750   0.000  4.500   2 1.000   0.875
105       HRZ-D168  SAU      3.5X3X0.25   33.0  4.34  Tens  4.34   140Y   1.730TCL Brok   39.835   40.800   50.625   0.000  5.423   3 1.000   0.875
106       HRZ-D165  SAE         6X6X0.5   33.0 40.61  Comp 30.10   143X  35.762SWL Brok  118.800  122.400  303.750   0.000  4.500   9 4.000   0.875
107       HRZ-D173  SAE      3X3X0.1875   33.0 19.48  Comp  0.00   144P   0.000           27.500   27.200   25.312   0.000 12.770   2 1.000   0.875
108       HRZ-D169  SAE        3X3X0.25   33.0  3.24  Comp  1.56   145P   0.425SWL Brok   36.271   27.200   33.750   0.000 12.770   2 1.000   0.875
109       HRZ-D167  SAU      3.5X3X0.25   33.0 10.13  Comp  7.76   146P   2.112250C: Ex   33.338   27.200   33.750   0.000 12.770   2 2.000   0.875
110        HRZ-D24  SAE      3X3X0.1875   33.0 33.30  Comp 10.05   147P   2.274250C: Ex   22.628   40.800   37.969   0.000 16.333   3 2.000   0.875
111        HRZ-D28  SAE      3X3X0.1875   33.0 48.13  Comp  0.00   148P   0.000           27.500   13.600   12.656   0.000 17.128   1 1.000   0.875
112        HRZ-D26  SAE    3.5X3.5X0.25   33.0 40.41  Comp  1.45   149P   0.541250B: NE   37.199   40.800   50.625   0.000 17.128   3 2.000   0.875
113       HRZ-D329  SAE  2.5X2.5X0.1875   33.0 43.69  Tens 43.69   150Y   7.446SWR Brok   17.044   27.200   25.312   0.000 10.271   2 2.000   0.875
114       STR-D194  BAR 2X0.1875X0.1875   33.0 39.69  Tens 39.69   151Y   2.763SWR Brok    6.961   27.200   25.312   0.000  8.602   2 1.000   0.875
115       STR-D195  BAR 2X0.1875X0.1875   33.0 40.18  Tens 40.18   152Y   2.797SWR Brok    6.961   27.200   25.312   0.000  8.602   2 1.000   0.875
116       STR-D196  BAR 2X0.1875X0.1875   33.0 39.00  Tens 39.00   153Y   2.715SWR Brok    6.961   27.200   25.312   0.000  8.602   2 1.000   0.875
LE-1       VBR-D14  SAU       3X2X0.25    33.0 43.85  Tens 43.85   154Y  12.648TCL Brok   28.846   40.800   50.625   0.000 10.433   3 1.000   0.875
LE-2       HRZ-D18  SAE      3X3X0.1875   33.0 15.03  Comp  1.78   155P   0.452TCL Brok   27.500   27.200   25.312   0.000  9.702   2 1.000   0.875 A potentially damaging moment
exists in the following members (make sure your system is well triangulated to minimize moments): 155P 155X 155XY 155Y  ??
13LE-1      LEG-D4  SAE         8X8X0.5   33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
13LE-2      VBR-D6  DAS      4X3X0.25     33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
13LE-3     VBR-D12  SAU  2.5X2X0.1875     33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
23LE-1     LEG-D35  SAE         8X8X0.5   33.0 51.22  Tens 51.22  156XY  86.624TCL Brok  169.125    0.000    0.000   0.000  6.065   0 6.000   0.875
23LE-2     VBR-D37  DAS      4X3X0.4375   33.0 74.33  Comp 52.85   158X  43.125TCL Brok  121.751   81.600  177.187   0.000 30.762   3 2.000   0.875
23LE-3     VBR-D48  SAE      3X3X0.1875   33.0 39.02  Tens 39.02   159P  10.731TCL Brok   27.500   40.800   37.969   0.000 22.168   3 1.000   0.875
33LE-1     LEG-D75  SAE         8X8X0.5   33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
33LE-2     VBR-D77  DAS      5X3.5X0.25   33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
33LE-3     VBR-D91  SAE      3X3X0.1875   33.0  0.00        0.00          0.000            0.000    0.000    0.000   0.000  0.000   0 0.000       0
MOD2 LEG-D251 (PJF-2016)  SAE  5X5X0.375  33.0 18.42  Comp 17.99     2Y  13.636SWR Brok   75.817    0.000    0.000   0.000  5.000   0 4.000   0.875
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*** Maximum Stress Summary for Each Load Case

Summary of Maximum Usages by Load Case:

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Load Case Maximum Element Element
          Usage %   Label   Type
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250B: NESC Heavy	86.92	130P	Angle
250C: Extreme Wind (Trans.)	89.18	15X	Angle
SWL Broken: 250B	86.37	130P	Angle
SWR Broken: 250B	88.79	15XY	Angle
TCL Broken: 250B	89.40	54P	Angle

Summary of Insulator Usages:

Insulator Label	Insulator Type	Maximum Usage %	Load Case	Weight (lbs)
51A	Strain	39.40	250B: NESC Heavy	40.0
51B	Strain	39.40	250B: NESC Heavy	40.0
52A	Strain	39.40	250B: NESC Heavy	40.0
52B	Strain	39.40	250B: NESC Heavy	40.0
53A	Strain	39.40	250B: NESC Heavy	40.0
53B	Strain	39.40	250B: NESC Heavy	40.0
61A	Strain	39.40	250B: NESC Heavy	40.0
61B	Strain	39.40	250B: NESC Heavy	40.0
62A	Strain	39.40	250B: NESC Heavy	40.0
62B	Strain	39.40	250B: NESC Heavy	40.0
63A	Strain	39.40	250B: NESC Heavy	40.0
63B	Strain	39.40	250B: NESC Heavy	40.0
71A	Strain	39.40	250B: NESC Heavy	40.0
71B	Strain	39.40	250B: NESC Heavy	40.0
72A	Strain	39.40	250B: NESC Heavy	40.0
72B	Strain	39.40	250B: NESC Heavy	40.0
73A	Strain	39.40	250B: NESC Heavy	40.0
73B	Strain	39.40	250B: NESC Heavy	40.0
81A	Strain	39.40	250B: NESC Heavy	40.0
81B	Strain	39.40	250B: NESC Heavy	40.0
82A	Strain	39.40	250B: NESC Heavy	40.0
82B	Strain	39.40	250B: NESC Heavy	40.0
83A	Strain	39.40	250B: NESC Heavy	40.0
83B	Strain	39.40	250B: NESC Heavy	40.0
11	Suspension	12.86	SWL Broken: 250B	10.0
21	Suspension	20.16	SWR Broken: 250B	10.0
TM1	Suspension	14.09	250C: Extreme Wind (Trans.)	0.0
TM2	Suspension	14.18	250C: Extreme Wind (Trans.)	0.0
TM3	Suspension	11.38	250C: Extreme Wind (Trans.)	0.0
TM4	Suspension	11.01	250C: Extreme Wind (Trans.)	0.0
TM5	Suspension	15.04	250C: Extreme Wind (Trans.)	0.0
TM6	Suspension	15.22	250C: Extreme Wind (Trans.)	0.0
TM7	Suspension	6.56	250C: Extreme Wind (Trans.)	0.0
TM8	Suspension	6.28	250C: Extreme Wind (Trans.)	0.0
C1	Suspension	3.68	250B: NESC Heavy	0.0
C2	Suspension	1.65	250B: NESC Heavy	0.0
C3	Suspension	1.90	250B: NESC Heavy	0.0
C4	Suspension	1.90	250B: NESC Heavy	0.0
C5	Suspension	1.59	250B: NESC Heavy	0.0
C1Y	Suspension	1.10	250C: Extreme Wind (Trans.)	0.0
C2Y	Suspension	0.49	250C: Extreme Wind (Trans.)	0.0
C3Y	Suspension	0.57	250C: Extreme Wind (Trans.)	0.0
C4Y	Suspension	0.57	250C: Extreme Wind (Trans.)	0.0
C5Y	Suspension	0.47	250C: Extreme Wind (Trans.)	0.0
C1X	Suspension	1.10	250C: Extreme Wind (Trans.)	0.0
C2X	Suspension	0.49	250C: Extreme Wind (Trans.)	0.0
C3X	Suspension	0.57	250C: Extreme Wind (Trans.)	0.0
C4X	Suspension	0.57	250C: Extreme Wind (Trans.)	0.0
C5X	Suspension	0.47	250C: Extreme Wind (Trans.)	0.0
C1XY	Suspension	2.19	250C: Extreme Wind (Trans.)	0.0
C2XY	Suspension	0.98	250C: Extreme Wind (Trans.)	0.0
C3XY	Suspension	1.13	250C: Extreme Wind (Trans.)	0.0
C4XY	Suspension	1.13	250C: Extreme Wind (Trans.)	0.0
C5XY	Suspension	0.94	250C: Extreme Wind (Trans.)	0.0

*** Weight of structure (lbs):

Weight of Angles*Section DLF:	32492.8
Weight of Strains:	960.0
Weight of Suspensions:	20.0
Total:	33472.8

*** End of Report

APPENDIX D

SUPPLEMENTAL CALCULATIONS

Mast Connection at Tower

RISA Reactions

Envelope Joint Reactions

	Joint		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	TM3	max	3783.036	2	6588.054	2	3265.688	4	0	1	0	1	0	1
2		min	-983.587	4	1477.077	4	-7481.868	2	0	1	0	1	0	1
3	TM4	max	3783.036	2	6588.054	2	7481.868	2	0	1	0	1	0	1
4		min	1058.663	3	1467.254	4	2353.481	3	0	1	0	1	0	1
5	TM1	max	3834.088	4	4598.93	3	18328.542	2	0	1	0	1	0	1
6		min	-9593.196	2	-3627.655	2	-8713.01	4	0	1	0	1	0	1
7	TM2	max	-1658.212	3	4615.696	3	-3498.575	3	0	1	0	1	0	1
8		min	-9593.196	2	-3627.655	2	-18328.542	2	0	1	0	1	0	1
9	Totals:	max	0	3	18318.75	1	0	1						
10		min	-11620.32	2	5920.798	4	-10909.545	4						

RISA Reactions

$Vert := 6.6 \cdot kip$ Worst Case (Envelope) of North Mast & South Mast

$H_x := 9.6\ kip$ Worst Case (Envelope) of North Mast & South Mast

$H_z := 18.3\ kip$ Worst Case (Envelope) of North Mast & South Mast

Bolt Input:

Assumes ASTM A325 type N

$N := 4$ Number of Bolts at Connection

$D_{bolt} := 0.75 \cdot in$ Diameter of Bolts

$F_{t.bolt} := 29.8\ kip$ AISC 14th Table 7-2

$F_{v.bolt} := 17.9\ kip$ AISC 14th Table 7-1

$\mu := 0.4$ Coefficient of Friction - Steel on Steel

Calculations:

$$f_v := \frac{\sqrt{H_x^2 + Vert^2}}{N} = 2.912\ kip \qquad Usage_{shear} := \frac{f_v}{F_{v.bolt}} = 0.163$$

$$Status_{shear} := \begin{cases} \text{if } Usage_{shear} \le 1 & \text{“OK”} \\ \text{else} & \text{“NG”} \end{cases} = \text{“OK”}$$

$T_{bolt} := 0.3 \cdot F_{t.bolt} = 8.94\ kip$ Assumed installed bolt tension

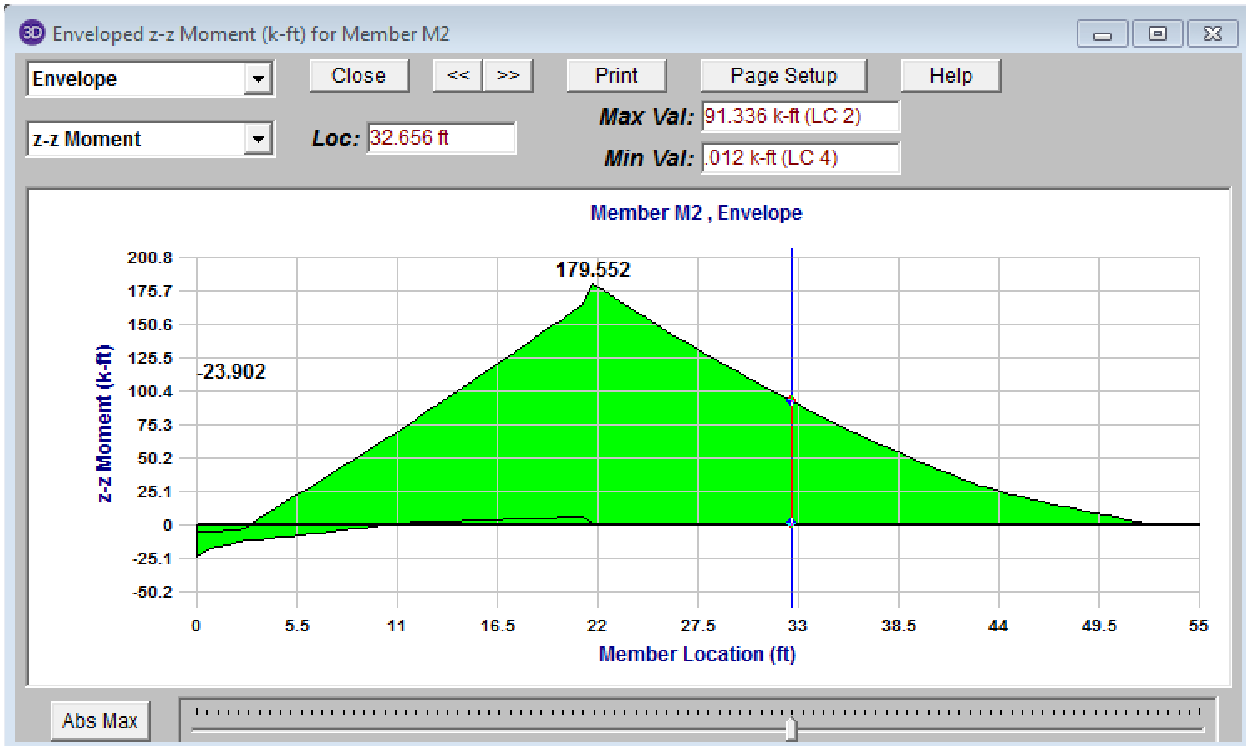
$F_{slip} := T_{bolt} \cdot N \cdot \mu = 14.304\ kip$ Assumed friction connection slip capacity

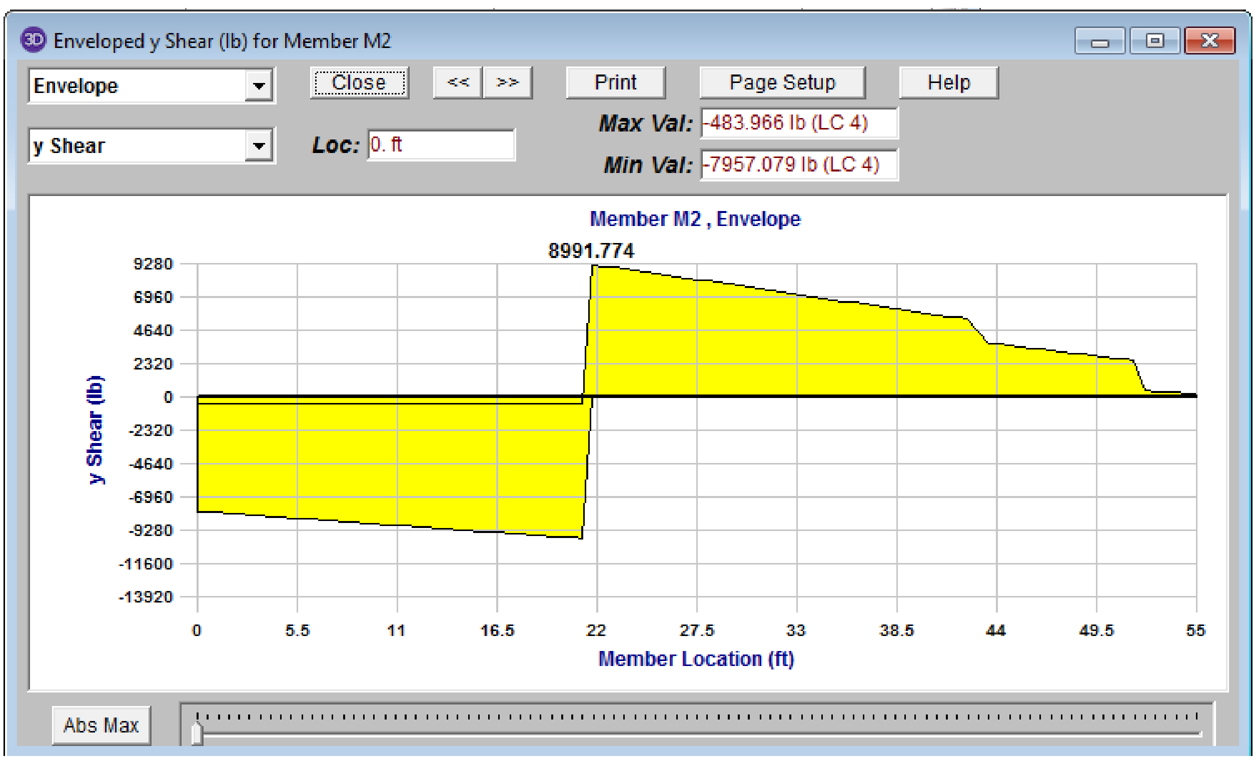
$$Usage_{slip} := \frac{\sqrt{H_x^2 + Vert^2}}{F_{slip}} = 0.814$$

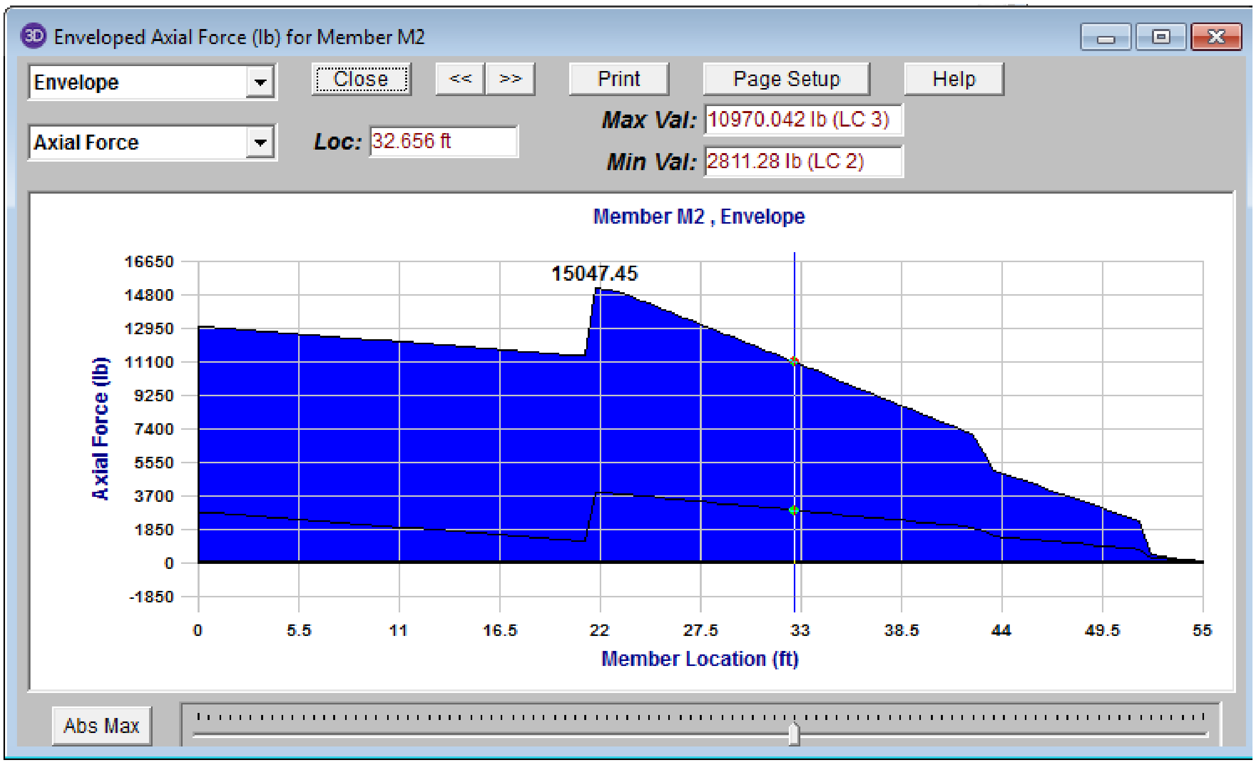
$$Status_{slip} := \begin{cases} \text{if } Usage_{slip} \le 1 & \text{“OK”} \\ \text{else} & \text{“NG”} \end{cases} = \text{“OK”}$$

Flange Bolt and Flange Plate Analysis

RISA Forces: (Envelope)







$OM := 91.3 \cdot ft \cdot kip$ North Mast, Envelope

$V := 7.1 \cdot kip$ North Mast, Envelope

$A := 11 \cdot kip$ North Mast, Envelope

Flange Bolt Input:

Assumes ASTM A325 bolts

$N := 8$ Number of Bolts

$BC := 17 \cdot in$

$Fu_{bolt} := 105 \cdot ksi$

$Fy_{bolt} := 81\ ksi$

$E := 29000 \cdot ksi$

$D_{bolt} := 1.125 \cdot in$

$n := 7$ Threads per inch

Flange Plate Input:

Assumes ASTM A36

$Fy_{plate} := 36 \cdot ksi$

$t_{Plate} := 1.5 \cdot in$

$t_{Plate} := 1.5 \cdot in$

$D_{Plate} := 20 \cdot in$

$D_{Pole} := 12.75 \cdot in$

Distance from Bolts to Centroid of Pole:

$R_{BC} := \frac{BC}{2} = 8.5\ in$

$i := 1..N$

$$d_i := \left\| \begin{array}{l} \Theta \leftarrow 2 \cdot \pi \cdot \frac{i}{N} \\ d \leftarrow R_{BC} \cdot \sin(\Theta) \end{array} \right. \qquad d = \begin{bmatrix} 6.01 \\ 8.5 \\ 6.01 \\ 0 \\ -6.01 \\ -8.5 \\ -6.01 \\ 0 \end{bmatrix} in$$

Determine Distances For Bending in Plate:

$R_{Pole} := \frac{D_{Pole}}{2} = 6.375\ in$

$$MA_i := \text{if } d_i \geq R_{Pole} \ \| \ d_i - R_{Pole} \ \text{else} \ \| \ 0 \cdot in \qquad MA_i = \begin{bmatrix} 0 \\ 2.125 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} in$$

$$B_{eff} := 0.8 \cdot 2 \cdot \sqrt{\left(\frac{D_{Plate}}{2}\right)^2 - \left(\frac{D_{Pole}}{2}\right)^2} = 12.327\ in$$

Flange Bolt Properties and Check:

$I_p := \sum_i d_i^{\,2} = 289\ in^2$

$A_g := \frac{\pi \cdot D_{bolt}^{\,2}}{4} = 0.994\ in^2$

$A_n := \frac{\pi}{4} \cdot \left(D_{bolt} - \frac{0.9743\ in}{n}\right)^2 = 0.763\ in^2$

$D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 0.986\ in$

$$r_{bolt} := \frac{D_n}{4} = 0.246\ \mathbf{in}$$

$$S_{bolt} := \pi \cdot \frac{{D_n}^3}{32} = 0.094\ \mathbf{in}^3$$

$$T_{max} := OM \cdot \frac{R_{BC}}{I_p} - \frac{A}{N} = 30.849\ \mathbf{kip}$$

$$T_{allow} := 0.75 \cdot A_n \cdot Fu_{bolt} = 60.108\ \mathbf{kip}$$

$$Bolt_{usage} := \frac{T_{max}}{T_{allow}} = 0.513$$

$Status_{bolt} :=$ if $Bolt_{usage} \le 1$ "OK" else "NG" $=$ "OK"

Flange Plate Check:

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

$$C = \begin{bmatrix} 24.16 \\ 33.599 \\ 24.16 \\ 1.375 \\ -21.41 \\ -30.849 \\ -21.41 \\ 1.375 \end{bmatrix} \mathbf{kip}$$

Bolt Forces

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{B_{eff} \cdot {t_{Plate}}^2} = 15.445\ \mathbf{ksi}$$

$$F_{bp} := 0.9 \cdot Fy_{plate} = 32.4\ \mathbf{ksi}$$

$$Plate_{usage} := \frac{f_{bp}}{F_{bp}} = 0.477$$

$Status_{plate} :=$ if $Plate_{usage} \le 1$ "OK" else "NG" $=$ "OK"

Antenna Support Moment Frame Bolted To Lattice Structure - NESC 2007 Local Analysis Check (OTRM 059.1 Section E.2.e) Top Support Reactions

Maximum Reactions

Compression Force =	$P_c := 13.8\ kip$	Input from PLS-TOWER (Load Case 250C)
Vertical Force =	$P_v := 0 \cdot kip$	Vertical Reaction Input from Risa (Reaction is Tension so used 0, Conservative)
Horizontal Force, x =	$H_x := 6.7\ kip$	Horizontal Reaction Input from RISA Rx (250C)
Horizontal Force, y =	$H_y := 0.063\ kip$	Horizontal Reaction Input from RISA Rz (250C)

Member Properties (Equal Leg Angle)

Member Type =	L 5x5x3/8	User Input
Width of Member =	$w := 5\ in$	User Input
Member Thickness =	$t := 0.375\ in$	User Input
k(heel to toe of fillet) =	$k_{des} := 0.875\ in$	User Input
Member Area =	$A := 3.61\ in^2$	User Input
Unbraced Length =	$L := 2.5\ ft$	User Input
Distance to Load along member =	$a := 1.25 \cdot ft$	User Input
Effective Length Factor =	$K := 1$	User Input
Radius of Gyration =	$r_x := 1.56\ in$	User Input
Radius of Gyration =	$r_y := 1.56\ in$	User Input
Radius of Gyration =	$r_z := 0.99\ in$	User Input
Section Modulus =	$S_x := 2.42\ in^3$	User Input
Section Modulus =	$S_y := 2.42\ in^3$	User Input
Moment of Inertia =	$I_x := 8.74\ in^4$	User Input
Moment of Inertia =	$I_y := 8.74\ in^4$	User Input
Yield Stress =	$F_y := 33\ ksi$	User Input
Modulus of Elasticity =	$E := 29000\ ksi$	User Input

Calculate the Compression Capacity Per ASCE 10-97 Section 3.6 and 3.7)

Width to Thickness Ratio = $w_t := \frac{(w - k_{des})}{t} = 11$ (3.7-1)

Limits

$$\frac{80}{\sqrt{\frac{F_y}{ksi}}} = 13.926$$

$$\frac{144}{\sqrt{\frac{F_y}{ksi}}} = 25.0672$$

$$Fcr := \begin{array}{l} \text{if } w_t < \frac{80}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } F_y \\ \text{else if } \frac{80}{\sqrt{\frac{F_y}{ksi}}} \le w_t \le \frac{144}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } \left(1.677 - 0.677 \cdot \frac{w_t}{\left(\frac{80}{\sqrt{\frac{F_y}{ksi}}}\right)}\right) \cdot F_y \quad (3.7\text{-}2) \\ \text{else if } w_t > \frac{144}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } \frac{0.0332 \cdot \pi^2 \cdot E}{w_t^2} \quad (3.7\text{-}3) \end{array} = 33\ ksi$$

$Fcr = 33\ ksi$

$r := min(r_x, r_y, r_z)$

$C_c := \pi \cdot \sqrt{\frac{2 \cdot E}{F_y}} = 131.706$ (3.6-3)

Determine Compression Capacity, Fa =

$$F_a := \begin{array}{l} \text{if } \left(\frac{K \cdot L}{r}\right) \le C_c \\ \quad \left(1 - \frac{1}{2} \cdot \left(\frac{\left(\frac{K \cdot L}{r}\right)}{C_c}\right)^2\right) \cdot Fcr \quad (3.6\text{-}1) \\ \text{else} \\ \quad \frac{\pi^2 \cdot E}{\left(\frac{K \cdot L}{r}\right)^2} \quad (3.6\text{-}2) \end{array} = 32.127\ ksi$$

$\frac{K \cdot L}{r} = 30.303$

$F_a = 32.127\ ksi$

Determine the Bending capacity (per ASCE 10-97 Section 3.14.8)

$$b := w - \frac{t}{2} = 4.813\ in$$

$$M_{yx} := F_y \cdot S_x = 79.86\ kip \cdot in$$ (Yield Moment X direction)

$$M_{yy} := F_y \cdot S_y = 79.86\ kip \cdot in$$ (Yield Moment Y direction)

$$M_{yc} := min\left(M_{yx}, M_{yy}\right) = 79.86\ kip \cdot in$$ (Compressive Yield Moment, 3.14.8)

$$M_{e.pos} := \frac{\left(0.66 \cdot E \cdot b^4 \cdot t\right)}{(K \cdot L)^2} \cdot \left(\sqrt{1 + \frac{0.81 \cdot (K \cdot L)^2 \cdot t^2}{b^4}} + 1\right) = 8946.385\ kip \cdot in$$ (Elastic Critical Moment + direction, 3.14-7)

$$M_{e.neg} := \frac{\left(0.66 \cdot E \cdot b^4 \cdot t\right)}{(K \cdot L)^2} \cdot \left(\sqrt{1 + \frac{0.81 \cdot (K \cdot L)^2 \cdot t^2}{b^4}} - 1\right) = 390.919\ kip \cdot in$$ (Elastic Critical Moment - direction, 3.14-7)

$$M_e := min\left(M_{e.pos}, M_{e.neg}\right) = 390.919\ kip \cdot in$$

$$M_b := \begin{cases} M_e & \text{if } M_e \le 0.5 \cdot M_{yc} \\ M_{yc} \cdot \left(1 - \frac{M_{yc}}{4 \cdot M_e}\right) & \text{else if } M_e > 0.5 \cdot M_{yc} \end{cases} = 75.781\ kip \cdot in$$

$$M_a := min\left(M_b, M_{yc}\right) = 75.781\ kip \cdot in$$ (Allowable Bending Moment, 3.14.8)

$M_{ax} := M_a$ $M_{ay} := M_a$

Check Combined Axial and Bending

$C_m := 0.85$ (Restrained Ends)

$P := P_c + P_v = 13.8 \; kip$ (Total Axial Load)

$P_a := F_a \cdot A = 115.977 \; kip$ (Design Axial Load)

$P_y := F_y \cdot A = 119.13 \; kip$ (Axial Compression at Yield)

$L_x := 2 \; ft + 2.8125 \; in$ (Bending Length)

$L_y := 2 \; ft + 1.4375 \; in$ (Bending Length)

(Re: Tower Dwgs. sht. 23)

$$P_{ex} := \frac{\pi^2 \cdot E \cdot I_x}{(K \cdot L_x)^2} = 3479.642 \; kip$$

$$P_{ey} := \frac{\pi^2 \cdot E \cdot I_y}{(K \cdot L_y)^2} = 3865.986 \; kip$$

$$M_x := \frac{H_x \cdot a \cdot (L_x - a)}{L_x} = 44.276 \; kip \cdot in$$

$$M_y := \frac{H_y \cdot a \cdot (L_y - a)}{L_y} = 0.388 \; kip \cdot in$$

$$Check_1 := \frac{P}{P_a} + \frac{C_m \cdot M_x}{M_{ax}} \cdot \left(\frac{1}{1 - \frac{P}{P_{ex}}} \right) + \frac{C_m \cdot M_y}{M_{ay}} \cdot \left(\frac{1}{1 - \frac{P}{P_{ey}}} \right) = 0.622 \qquad (3.12\text{-}1)$$

$$Check_2 := \frac{P}{P_y} + \frac{M_x}{M_{ax}} + \frac{M_y}{M_{ay}} = 0.705 \qquad (3.12\text{-}2)$$

$Status_1 :=$ if $Check_1 \le 1$ "OK" else "NG" $=$ "OK"

$Status_2 :=$ if $Check_2 \le 1$ "OK" else "NG" $=$ "OK"

Antenna Support Moment Frame Bolted To Lattice Structure - NESC 2007 Local Analysis Check (OTRM 059.1 Section E.2.e) Bottom Support Reactions

Maximum Reactions

Compression Force =	$P_c := 5.4\ kip$	Input from PLS-TOWER, 250C
Vertical Force =	$P_v := 4.9 \cdot kip$	Vertical Reaction Input from Risa 3D
Horizontal Force, x =	$H_x := 2.9\ kip$	Horizontal Reaction Input from Risa 3D
Horizontal Force, y =	$H_y := 0.063\ kip$	Horizontal Reaction Input from Risa 3D

Member Properties (Equal Leg Angle)

Member Type=	L 8x8x1/2	User Input
Width of Member =	$w := 8\ in$	User Input
Member Thickness =	$t := 0.5\ in$	User Input
k(heel to toe of fillet) =	$k_{des} := 1.125\ in$	User Input
Member Area =	$A := 7.75\ in^2$	User Input
Unbraced Length =	$L := 5\ ft$	User Input
Distance to Load along member =	$a := 1.25 \cdot ft$	User Input
Effective Length Factor =	$K := 1$	User Input
Radius of Gyration =	$r_x := 2.5\ in$	User Input
Radius of Gyration =	$r_y := 2.5\ in$	User Input
Radius of Gyration =	$r_z := 1.59\ in$	User Input
Section Modulus =	$S_x := 8.36\ in^3$	User Input
Section Modulus =	$S_y := 8.36\ in^3$	User Input
Moment of Inertia =	$I_x := 48.6\ in^4$	User Input
Moment of Inertia =	$I_y := 48.6\ in^4$	User Input
Yield Stress =	$F_y := 33\ ksi$	User Input
Modulus of Elasticity =	$E := 29000\ ksi$	User Input

Calculate the Compression Capacity Per ASCE 10-97 Section 3.6 and 3.7)

Width to Thickness Ratio = $w_t := \frac{(w - k_{des})}{t} = 13.75$ (3.7-1)

Limits

$$\frac{80}{\sqrt{\frac{F_y}{ksi}}} = 13.926$$

$$\frac{144}{\sqrt{\frac{F_y}{ksi}}} = 25.0672$$

$$Fcr := \begin{cases} \text{if } w_t < \frac{80}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } F_y \\ \text{else if } \frac{80}{\sqrt{\frac{F_y}{ksi}}} \le w_t \le \frac{144}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } \left(1.677 - 0.677 \cdot \frac{w_t}{\left(\frac{80}{\sqrt{\frac{F_y}{ksi}}}\right)}\right) \cdot F_y \quad (3.7\text{-}2) \\ \text{else if } w_t > \frac{144}{\sqrt{\frac{F_y}{ksi}}} \\ \quad \text{return } \frac{0.0332 \cdot \pi^2 \cdot E}{w_t^2} \quad (3.7\text{-}3) \end{cases} = 33\ ksi$$

$Fcr = 33\ ksi$

$r := min(r_x, r_y, r_z)$

$C_c := \pi \cdot \sqrt{\frac{2 \cdot E}{F_y}} = 131.706$ (3.6-3)

Determine Compression Capacity, Fa =

$$F_a := \begin{cases} \text{if } \left(\frac{K \cdot L}{r}\right) \le C_c \\ \quad \left(1 - \frac{1}{2} \cdot \left(\frac{\left(\frac{K \cdot L}{r}\right)}{C_c}\right)^2\right) \cdot Fcr \quad (3.6\text{-}1) \\ \text{else} \\ \quad \frac{\pi^2 \cdot E}{\left(\frac{K \cdot L}{r}\right)^2} \quad (3.6\text{-}2) \end{cases} = 31.646\ ksi$$

$\frac{K \cdot L}{r} = 37.736$

$F_a = 31.646\ ksi$

Determine the Bending capacity (per ASCE 10-97 Section 3.14.8)

$$b := w - \frac{t}{2} = 7.75\ in$$

$$M_{yx} := F_y \cdot S_x = 275.88\ kip \cdot in$$ (Yield Moment)

$$M_{yy} := F_y \cdot S_y = 275.88\ kip \cdot in$$ (Yield Moment)

$$M_{yc} := min\left(M_{yx}, M_{yy}\right) = 275.88\ kip \cdot in$$ (Compressive Yield Moment, 3.14.8)

$$M_{e.pos} := \frac{\left(0.66 \cdot E \cdot b^4 \cdot t\right)}{(K \cdot L)^2} \cdot \left(\sqrt{1 + \frac{0.81 \cdot (K \cdot L)^2 \cdot t^2}{b^4}} + 1\right) = 20104.305\ kip \cdot in$$ (Elastic Critical Moment + direction, 3.14-7)

$$M_{e.neg} := \frac{\left(0.66 \cdot E \cdot b^4 \cdot t\right)}{(K \cdot L)^2} \cdot \left(\sqrt{1 + \frac{0.81 \cdot (K \cdot L)^2 \cdot t^2}{b^4}} - 1\right) = 924.409\ kip \cdot in$$ (Elastic Critical Moment - direction, 3.14-7)

$$M_e := min\left(M_{e.pos}, M_{e.neg}\right) = 924.409\ kip \cdot in$$

$$M_b := \begin{cases} M_e & \text{if } M_e \le 0.5 \cdot M_{yc} \\ M_{yc} \cdot \left(1 - \frac{M_{yc}}{4 \cdot M_e}\right) & \text{else if } M_e > 0.5 \cdot M_{yc} \end{cases} = 255.297\ kip \cdot in$$

$$M_a := min\left(M_b, M_{yc}\right) = 255.297\ kip \cdot in$$ (Allowable Bending Moment, 3.14.8)

$$M_{ax} := M_a \qquad M_{ay} := M_a$$

Check Combined Axial and Bending

$C_m := 0.85$ (Restrained Ends)

$L_x := L$

$L_y := L$

$P := P_c + P_v = 10.3\ kip$ (Total Axial Load)

$P_a := F_a \cdot A = 245.253\ kip$ (Design Axial Load)

$P_y := F_y \cdot A = 255.75\ kip$ (Axial Compression at Yield)

$$P_{ex} := \frac{\pi^2 \cdot E \cdot I_x}{(K \cdot L_x)^2} = 3863.95\ kip$$

$$P_{ey} := \frac{\pi^2 \cdot E \cdot I_y}{(K \cdot L_y)^2} = 3863.95\ kip$$

$$M_x := \frac{H_x \cdot a \cdot (L_x - a)}{L_x} = 32.625\ kip \cdot in$$

$$M_y := \frac{H_y \cdot a \cdot (L_y - a)}{L_y} = 0.709\ kip \cdot in$$

$$Check_1 := \frac{P}{P_a} + \frac{C_m \cdot M_x}{M_{ax}} \cdot \left(\frac{1}{1 - \frac{P}{P_{ex}}}\right) + \frac{C_m \cdot M_y}{M_{ay}} \cdot \left(\frac{1}{1 - \frac{P}{P_{ey}}}\right) = 0.153 \qquad (3.12\text{-}1)$$

$$Check_2 := \frac{P}{P_y} + \frac{M_x}{M_{ax}} + \frac{M_y}{M_{ay}} = 0.171 \qquad (3.12\text{-}2)$$

$Status_1 :=$ if $Check_1 \le 1$ "OK" else "NG" = "OK"

$Status_2 :=$ if $Check_2 \le 1$ "OK" else "NG" = "OK"

Foundation Analysis (OTRM 059.1)

Reactions

Summary of Joint Support Reactions For All Load Cases

	Load Case	Joint Label	Long. Force (kips)	Tran. Force (kips)	Vert. Force (kips)	Shear Force (kips)	Tran. Moment (ft-k)	Long. Moment (ft-k)	Bending Moment (ft-k)	Vert. Moment (ft-k)	Found. Usage %
1	250B: NESC Heavy	-2S	-24.03	-33.04	-123.55	40.85	0.00	0.00	0.00	0.00	0.00
2	250B: NESC Heavy	-2X	13.95	-20.62	64.06	24.89	0.00	0.00	0.00	0.00	0.00
3	250B: NESC Heavy	-2XY	-12.50	-18.63	59.46	22.44	0.00	0.00	0.00	0.00	0.00
4	250B: NESC Heavy	-2Y	22.58	-30.79	-117.82	38.18	0.00	0.00	0.00	0.00	0.00
5	250C: Extreme Wind (Trans.)	-2X	18.75	-26.69	88.10	32.62	0.00	0.00	0.00	0.00	0.00
6	250C: Extreme Wind (Trans.)	-2Y	22.45	-32.86	-117.22	39.80	0.00	0.00	0.00	0.00	0.00
7	250C: Extreme Wind (Trans.)	-2XY	-18.67	-26.59	88.00	32.49	0.00	0.00	0.00	0.00	0.00
8	250C: Extreme Wind (Trans.)	-2S	-22.53	-32.99	-117.55	39.95	0.00	0.00	0.00	0.00	0.00
9	SWL Broken: 250B	-2Y	20.10	-25.95	-105.67	32.83	0.00	0.00	0.00	0.00	0.00
10	SWL Broken: 250B	-2S	-24.85	-36.90	-130.93	44.48	0.00	0.00	0.00	0.00	0.00
11	SWL Broken: 250B	-2X	12.10	-19.43	49.83	22.89	0.00	0.00	0.00	0.00	0.00
12	SWL Broken: 250B	-2XY	-13.46	-18.89	69.53	23.20	0.00	0.00	0.00	0.00	0.00
13	SWR Broken: 250B	-2S	-26.95	-36.59	-144.89	45.44	0.00	0.00	0.00	0.00	0.00
14	SWR Broken: 250B	-2XY	-12.28	-21.69	65.47	24.92	0.00	0.00	0.00	0.00	0.00
15	SWR Broken: 250B	-2X	12.67	-16.09	51.21	20.47	0.00	0.00	0.00	0.00	0.00
16	SWR Broken: 250B	-2Y	16.91	-25.89	-88.83	30.92	0.00	0.00	0.00	0.00	0.00
17	TCL Broken: 250B	-2XY	-23.26	-29.53	109.61	37.59	0.00	0.00	0.00	0.00	0.00
18	TCL Broken: 250B	-2Y	25.27	-34.03	-132.67	42.39	0.00	0.00	0.00	0.00	0.00
19	TCL Broken: 250B	-2X	1.49	-24.50	8.58	24.55	0.00	0.00	0.00	0.00	0.00
20	TCL Broken: 250B	-2S	-14.75	-11.70	-101.90	18.83	0.00	0.00	0.00	0.00	0.00

$H_{shear} := 45.4\ \mathbf{kip} \cdot 1.1 = 49.94\ \mathbf{kip}$ Maximum Shear Force

$P_{comp} := 144.9\ \mathbf{kip} \cdot 1.1 = 159.39\ \mathbf{kip}$ Maximum Compression Force

$P_{tens} := 109.6\ \mathbf{kip} \cdot 1.1 = 120.56\ \mathbf{kip}$ Maximum Tension Force

Foundation Properties

$Pier_{height} := 9.5\ \mathbf{ft}$

$Pier_{width.top} := 3\ \mathbf{ft}$

$Pier_{width.bot} := 6\ \mathbf{ft}$

$Pier_{projection} := 0.5\ \mathbf{ft}$

$Ftg_{width} := 11\ \mathbf{ft}$

$Ftg_{thick} := 3\ \mathbf{ft}$

Geotechnical Properties

$\gamma_{conc} := 150\ \mathbf{pcf}$

$\gamma_{water} := 62.4\ \mathbf{pcf}$

$\gamma_{soil} := 100\ \mathbf{pcf}$

$\phi_{soil} := 30\ \mathbf{deg}$

$q_{soil} := 9\ \mathbf{ksf}$

Calculations

$V_{ftg} := Ftg_{width}^{2} \cdot Ftg_{thick} = 363\ ft^{3}$

$V_{pier} := \frac{Pier_{height}}{3} \cdot \left(Pier_{width.top}^{2} + Pier_{width.bot}^{2} + \sqrt{Pier_{width.top}^{2} \cdot Pier_{width.bot}^{2}}\right) = 199.5\ ft^{3}$

$Base_{1} := Pier_{width.bot}^{2} = 36\ ft^{2}$ Resisting Pyramid Base 1

$Base_{2} := \left(2 \cdot \tan\left(\phi_{soil}\right) \cdot \left(Pier_{height} - Pier_{projection}\right) + Ftg_{width}\right)^{2} = 457.631\ ft^{2}$ Resisting Pyramid Base 2

$V_{soil} := \left(\left(\frac{Pier_{height} - Pier_{projection}}{3}\right) \cdot \left(Base_{1} + Base_{2} + \sqrt{Base_{1} \cdot Base_{2}}\right)\right) - V_{pier} = 1666.454\ ft^{3}$

$V_{conc} := V_{ftg} + V_{pier} = 562.5\ ft^{3}$

$W_{conc} := V_{conc} \cdot \gamma_{conc} = 84.375\ kip$

$W_{soil} := V_{soil} \cdot \gamma_{soil} = 166.645\ kip$

$W_{tot} := W_{conc} + W_{soil} = 251.02\ kip$

Uplift Check

$Usage_{uplift} := \frac{P_{tens}}{W_{tot}} = 0.48$

$Status_{uplift} :=$ if $Usage_{uplift} \le 1$ "OK" else "NG" = "OK"

Overturning Check

$M_{ot} := H_{shear} \cdot \left(Pier_{height} + Pier_{projection} + Ftg_{thick}\right) = 649.22\ kip \cdot ft$

$M_{res} := \left(W_{conc} + \left(\gamma_{soil} \cdot \left(\left(Ftg_{width}^{2} \cdot Pier_{height}\right) - V_{pier}\right)\right)\right) \cdot \frac{Ftg_{width}}{2} = 986.563\ kip \cdot ft$

$Usage_{OT} := \frac{M_{ot}}{M_{res}} = 0.658$

$Status_{ot} :=$ if $Usage_{OT} \le 1$ "OK" else "NG" = "OK"

Soil Bearing Check

$$A_{ftg} := Ftg_{width}^{\ 2} = 121\ ft^2$$

$$S_{ftg} := \frac{Ftg_{width}^{\ 3}}{6} = 221.833\ ft^3$$

$$q_{brg} := \frac{P_{comp} + W_{conc}}{A_{ftg}} + \frac{H_{shear} \cdot \left(Pier_{height} + Pier_{projection} + Ftg_{thick}\right)}{S_{ftg}} = 4.941\ ksf$$

$$Usage_{bearing} := \frac{q_{brg}}{q_{soil}} = 0.549$$

$$Status_{bearing} := \begin{array}{l} \text{if } Usage_{bearing} \le 1 \\ \quad \text{"OK"} \\ \text{else} \\ \quad \text{"NG"} \end{array} = \text{"OK"}$$

APPENDIX E

SUPPLEMENTAL INFORMATION

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Section 1 - Site Information

Site ID: CT11356C
Status: Draft
Version: 0.1
Project Type: Capacity
Approved: Not Approved
Approved By: Not Approved
Last Modified: 6/23/2016 12:13:35 PM
Last Modified By: GSM1900\AMurill9

Site Name: CT356/CL&P Tower - Rt.123
Site Class: Utility Lattice Tower
Site Type: Structure Non Building
Solution Type:
Plan Year:
Market: CONNECTICUT
Vendor: Ericsson
Landlord: CL&P

Latitude: 41.12576000
Longitude: -73.43270000
Address: 2 Willruss Street Pole #1102 Line # 1880
City, State: Norwalk, CT
Region: NORTHEAST

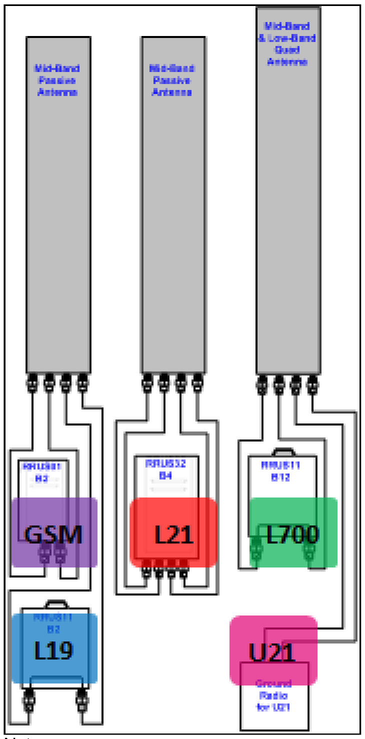
RAN Template: 793D Outdoor (evolved from 3A)		**AL Template:** 793D_3QP		
Sector Count: 3	**Antenna Count:** 6	**Line Count:** 36	**TMA Count:** 0	**RRU Count:** 0

Section 2 - Existing Template Images

----- This section is intentionally blank. -----

Section 3 - Proposed Template Images

793D_A&L_evolved_from_3B.png



Notes:

Section 4 - Siteplan Images

----- This section is intentionally blank. -----

RAN Template: 793D Outdoor (evolved from 3A)	A&L Template: 793D_3QP

CT11356C_0.1_Capacity

Section 5 - RAN Equipment

Existing RAN Equipment

Template: Custom

Enclosure	1	2
Enclosure Type	RBS 6102	RBS 3106
Baseband	DUW30 **(x2)**, DUS41, DUG20	
Radio	RUS01 B2 **(x6)**, RUS01 B4 **(x6)**, RRUS11 B12 **(x3)** L700	

Proposed RAN Equipment

Template: 793D Outdoor (evolved from 3A)

Enclosure	1	2
Enclosure Type	RBS 6102	Ancillary Equipment
Baseband	DUS41 **(x2)**, DUG20, DUW30	
Multiplexer	XMU	
Radio	RUS01 B4 **(x3)** U2100, RRUS32 B4 **(x3)** L2100, RRUS11 B12 **(x3)** L700, RRUS11 B2 **(x3)** L1900, RUS01 B2 **(x3)** G1900	

RAN Scope of Work:

Swap DUL20 with DUS41 and Add XMU. All RRU's will be ground based.

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Section 6 - A&L Equipment

Existing Template: Custom
Proposed Template: 793D_3QP

Sector 1 (Existing) view from behind			
Coverage Type	A - Outdoor Macro		
Antenna	1		2
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		LNX-6512DS-A1M (Dual)
Azimuth	45		45
M. Tilt	0		0
Height	114		114
Ports	P1	P2	P3
Active Tech.	U1900 G1900	U2100 L2100	L700
Dark Tech.			
Restricted Tech.			
Decomm. Tech.			
E. Tilt	3	3	2
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.
TMAs			
Diplexers / Combiners			
Radio			
Sector Equipment			

Unconnected Equipment:

Scope of Work:

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Sector 1 (Proposed) view from behind							
Coverage Type	A - Outdoor Macro						
Antenna	1		2				
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		RV4PX306R (Penta)				
Azimuth	45		45				
M. Tilt	0		0				
Height	114		114				
Ports	P1	P2	P3	P4	P5	P6	P7
Active Tech.	G1900	L1900	L2100	L2100	L700	U2100	
Dark Tech.							
Restricted Tech.							
Decomm. Tech.							
E. Tilt							
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	
TMAs							
Diplexers / Combiners							
Radio							
Sector Equipment							

Unconnected Equipment:

Scope of Work:

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Sector 2 (Existing) view from behind			
Coverage Type	A - Outdoor Macro		
Antenna	1		2
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		LNX-6512DS-A1M (Dual)
Azimuth	165		165
M. Tilt	0		0
Height	114		114
Ports	P1	P2	P3
Active Tech.	U1900 G1900	U2100 L2100	L700
Dark Tech.			
Restricted Tech.			
Decomm. Tech.			
E. Tilt	4	4	2
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.
TMAs			
Diplexers / Combiners			
Radio			
Sector Equipment			

Unconnected Equipment:

Scope of Work:

RAN Template: 793D Outdoor (evolved from 3A)	A&L Template: 793D_3QP

CT11356C_0.1_Capacity

Sector 2 (Proposed) view from behind							
Coverage Type	A - Outdoor Macro						
Antenna	1		2				
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		RV4PX306R (Penta)				
Azimuth	165		165				
M. Tilt	0		0				
Height	114		114				
Ports	P1	P2	P3	P4	P5	P6	P7
Active Tech.	G1900	L1900	L2100	L2100	L700	U2100	
Dark Tech.							
Restricted Tech.							
Decomm. Tech.							
E. Tilt							
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	
TMAs							
Diplexers / Combiners							
Radio							
Sector Equipment							

Unconnected Equipment:

Scope of Work:

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Sector 3 (Existing) view from behind

Coverage Type	A - Outdoor Macro		
Antenna	1		2
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		LNX-6512DS-A1M (Dual)
Azimuth	285		285
M. Tilt	0		0
Height	114		114
Ports	P1	P2	P3
Active Tech.	U1900 G1900	U2100 L2100	L700
Dark Tech.			
Restricted Tech.			
Decomm. Tech.			
E. Tilt	1	1	2
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.
TMAs			
Diplexers / Combiners			
Radio			
Sector Equipment			

Unconnected Equipment:

Scope of Work:

RAN Template:	A&L Template:
793D Outdoor (evolved from 3A)	793D_3QP

CT11356C_0.1_Capacity

Sector 3 (Proposed) view from behind

Coverage Type	A - Outdoor Macro						
Antenna	1		2				
Antenna Model	APX16DWV-16DWV-S-E-A20 (Quad)		RV4PX306R (Penta)				
Azimuth	285		285				
M. Tilt	0		0				
Height	114		114				
Ports	P1	P2	P3	P4	P5	P6	P7
Active Tech.	G1900	L1900	L2100	L2100	L700	U2100	
Dark Tech.							
Restricted Tech.							
Decomm. Tech.							
E. Tilt							
Cables	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	1-1/4" Coax - 170 ft. 1-1/4" Coax - 170 ft.	
TMAs							
Diplexers / Combiners							
Radio							
Sector Equipment							

Unconnected Equipment:

Scope of Work:

RV4PX306R

Multiband Antenna, 698–960 and 4x 1710–2690 MHz, 65° horizontal beamwidth, internal electrical tilt with manual override.

Electrical Specifications

Frequency Band, MHz	**698–790**	**790–890**	**890–960**	**1710–1920**	**1920–2180**	**2300–2690**
Gain, dBi	14.2	14.4	14.9	14.7	15.2	16.1
Beamwidth, Horizontal, degrees	68	69	63	63	63	62
Beamwidth, Vertical, degrees	16.4	14.9	13.6	13.7	12.2	9.7
Beam Tilt, degrees	0–10	0–10	0–10	0–10	0–10	0–10
USLS (First Lobe), dB	18	18	18	18	18	18
Null Fill, dB	-22	-22	-22	-22	-22	-22
Front-to-Back Ratio at 180°, dB	23	23	23	27	28	28
CPR at Boresight, dB	16	12	12	17	15	14
CPR at Sector, dB	8	8	6	5	3	2
Isolation, dB	25	25	25	25	25	25
Isolation, Intersystem, dB	30	30	30	30	30	30
VSWR | Return Loss, dB	1.43 | 15.0	1.43 | 15.0	1.43 | 15.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-150	-150	-150	-150	-150	-150
Input Power per Port, maximum, watts	300	300	300	250	250	250
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–790**	**790–890**	**890–960**	**1710–1920**	**1920–2180**	**2300–2690**
Gain by all Beam Tilts, average, dBi	14.0	14.2	14.6	14.6	15.0	15.8
Gain by all Beam Tilts Tolerance, dB	±0.2	±0.2	±0.3	±0.5	±0.4	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 14.0 5 ° | 14.0 10 ° | 14.0	0 ° | 14.2 5 ° | 14.2 10 ° | 14.1	0 ° | 14.6 5 ° | 14.6 10 ° | 14.6	0 ° | 14.6 5 ° | 14.6 10 ° | 14.6	0 ° | 15.0 5 ° | 15.0 10 ° | 15.1	0 ° | 16.0 5 ° | 15.8 10 ° | 15.6
Beamwidth, Horizontal Tolerance, degrees	±1.4	±1.2	±1.6	±2.5	±3.5	±6.4
Beamwidth, Vertical Tolerance, degrees	±0.8	±0.8	±0.5	±0.9	±1	±0.9
USLS, beampeak to 20° above beampeak, dB	18	18	18	18	18	18
Front-to-Back Total Power at 180° ± 30°, dB	25	23	23	23	25	25
CPR at Boresight, dB	17	13	13	20	17	18
CPR at Sector, dB	10	10	8	7	5	4

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Antenna Type	Sector with internal RET
Band	Multiband
Brand	DualPol®
Operating Frequency Band	1710 – 2690 MHz | 698 – 960 MHz
Performance Note	Outdoor usage

Mechanical Specifications

Lightning Protection	dc Ground inner/outer conductor
Radome Material	ASA, UV stabilized
Reflector Material	Aluminum
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	10
Wind Loading, maximum	681.0 N @ 150 km/h 153.1 lbf @ 150 km/h
Wind Speed, maximum	250 km/h | 155 mph

Dimensions

Depth	209.0 mm | 8.2 in
Length	1599.0 mm | 63.0 in
Width	353.0 mm | 13.9 in
Net Weight, without mounting kit	24.0 kg | 52.9 lb

Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Internal RET	High band (4) | Low band (1)
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	13.0 W
Protocol	3GPP/AISG 2.0 (Single RET)
RET Interface	8-pin DIN Female | 8-pin DIN Male
RET Interface, quantity	1 female | 1 male

Packed Dimensions

Depth	325.0 mm | 12.8 in
Length	1787.0 mm | 70.4 in
Width	427.0 mm | 16.8 in
Shipping Weight	39.0 kg | 86.0 lb

Regulatory Compliance/Certifications

Agency	**Classification**
RoHS 2011/65/EU	
China RoHS SJ/T 11364-2006	
ISO 9001:2008	

Included Products

T-041-GL-E — Argus® Adjustable Tilt Pipe Mounting Kit for 2.0"-4.5" (50-115mm) OD round members for panel antennas. Includes 2 clamp sets.

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

AM-X-CD-14-65-00T-RET (4' 65˚ Dual Broadband Antenna)

Dual Band Electrical DownTilt Antenna

698 ~ 894MHz, X-pol., H65˚ / V17.0˚

1710 ~ 2170MHz, X-pol., H65˚ / V8.5˚

Electrical Specification

Frequency Range		698~894MHz	1710~2170MHz
Impedance		50Ω	
Polarization		Dual, Slant ±45˚	
Gain		14.0dBi / 11.85dBd @ 698-806MHz 14.8dBi / 12.65dBd @ 824-894MHz	16.1dBi / 13.95dBd @1710-1755MHz 16.3dBi / 14.15dBd @1850-1900MHz 16.0dBi / 13.85dBd @2110-2155MHz
Beamwidth	Horizontal	67˚ @ 698-806MHz 65˚ @ 824-894MHz	60˚ @ 1710-1755MHz 61˚ @ 1850-1900MHz 64˚ @ 2110-2155MHz
	Vertical	17.5 @ 698-806MHz 16.5˚ @ 824-894MHz	8.8˚ @ 1710-1755MHz 8.5˚ @ 1850-1900MHz 8.0˚ @ 2110-2155MHz
VSWR		≤1.5:1	
Front-to-Back Ratio		≥28 dB	
Electrical Downtilt Range		2˚ ~ 16˚	0˚ ~ 10˚
Isolation Between Ports		≥30 dB	
Isolation Between Ports of Different Frequency Elements		≥35 dB	
Cross Pole Discrimination		10.0 dB @ ±60˚ 15.0 dBi @ 0˚	
First Upper Side Lobe Suppression		16dB	
Side Lobe Suppression		> 16 dB @ 0-6˚ Tilt > 18 dB @ 7-12˚ Tilt (Up to 15˚ from Boresight)	> 16 dB @ 0-6˚ Tilt > 18 dB @ 7-10˚ Tilt (Up to 15˚ from Boresight)
Passive Intermodulation		≤ -150 dBc @ 2x20w	
Input Maximum CW Power		500 W	300 W
Environmental Compliance		IP65 for Radome IP67 for Connectors	
RET Motor Configuration		Field Replaceable RET Electronic Control Module / RET Motor is internal to antenna & not field replaceable	
Compliant with AISG 1.1 and 2.0		AISG 1.1 and 2.0	

Mechanical Specification

Dimension (W×D×H)	11.8×5.9×48 inches (300×150×1219mm)
Weight (Without clamp)	36.4 lbs (16.5 kg)
Connector	4 x 7/16 DIN(F), Long Neck
Max Wind Speed	150 mph
Wind Load (@150 mph)	1260 N

TTAW-07BP111-001 TMA Twin Dual Band AWS with 700 Bypass 13 dB AISG

ELECTRICAL SPECIFICATIONS*	
UL Frequency Range (MHz)	1710-1770 with 698-746 bypass
UL Rejection	>80 dB TX rejection, >25 dB rejection at 1700 and 1800 MHz
UL Gain (dB)	13
UL Return Loss	>18 dB
UL Noise Figure	<1.6 dB
UL Output 3rd Order Intercept Point (dBm)	>+23 (Input IP3 >+11)
UL Bypass Loss (dB)	<1.9
UL Max Input Power (dBm)	+14 dBm
DL Frequency Range (MHz)	2110-2170 with 698-746 bypass
DL Return Loss	>18 dB
DL Insertion Loss (dB)	<0.4
Intermodulation	<-155 dBc (2x43 dBm TX)
Input Voltage (V)	8.0-30V (AISG Mode 10-30V; Current Alarm Mode 8-17)
Alarm Functionality	AISG compatible or in case of no AISG command received, current alarm mode 170-190 mA
Power Consumption	<1.5 W
Power Handling, RMS	700: 500 W; AWS 300W
AISG Compatibility	AISG 1.1 fully upgreadable to AISG 2.0 (AISG version only depended on loaded SW version) TTAW-07BP112-001 has AISG 2.0 loaded from factory

MECHANICAL SPECIFICATIONS*	
Dimensions HxWxD mm(ft)	250x169x139 (9.9”x6.7”x5.4”)
Weight (lbs)	<18 (<8 kg)
Colors	Off white (NCS 1502-R)
RF Connectors	Female 7/16 DIN, long neck
Mounting Kit	Mounting kit for pole and wall is included

ENVIRONMENTAL SPECIFICATIONS*	
Temperature Range	-40 to +65°C
Operational	ETS 300 019-1-4
Transportation	ETS 300 019-1-2
Storage	ETS 300 019-1-1
Lightning Protection	IEC 61312-1: 2 kA 8/20 µs, 3 kA 10/350 µs
Housing	Aluminium
MTBF	>1 million hours
Ingress Protection	IP67 minimum

APPROVALS AND TESTS*	
Safety	UL 60950; UL 1950, TUV
EMC	FCC part 15

*All specifications subject to change without notice. Please contact your Powerwave representative for complete performance data.

Updated: Dec 2 2010 4:48AM

Optimizer® Side-by-Side Dual Polarized Antenna, 1710-2200, 65deg, 18.4dBi, 1.4m, VET, 0-10deg RET

Product Description

A combination of two X-Polarized antennas in a single radome, this pair of variable tilt antennas provides exceptional suppression of all upper sidelobes at all downtilt angles. It also features a wide downtilt range. This antenna is optimized for performance across the entire frequency band (1710-2200 MHz). The antenna comes pre-connected with two antenna control units (ACU).

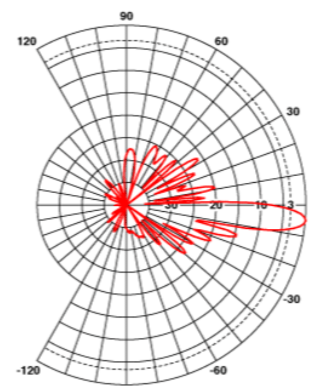
Features/Benefits

- **Variable electrical downtilt - provides enhanced precision in controlling intercell interference. The tilt is infield adjustable 0-10 deg.**
- **High Suppression of all Upper Sidelobes (Typically <-20dB).**
- **Gain tracking – difference between AWS UL (1710-1755 MHz) and DL (2110-2155 MHz) <1dB.**
- **Two X-Polarised panels in a single radome.**
- **Azimuth horizontal beamwidth difference <4deg between AWS UL (1710-1755 MHz) and DL (2110-2155 MHz).**
- **Low profile for low visual impact.**
- **Dual polarization; Broadband design.**
- **Includes (2) AISG 2.0 Compatible ACU-A20-N antenna control units.**

Technical Specifications

Electrical Specifications

Frequency Range, MHz	1710-2200
Horizontal Beamwidth, deg	65
Vertical Beamwidth, deg	5.9 to 7.7
Electrical Downtilt, deg	0-10
Gain, dBi (dBd)	18.4 (16.3)
1st Upper Sidelobe Suppression, dB	> 18 (typically > 20)
Upper Sidelobe Suppression, dB	> 18 all (typically > 20)
Front-To-Back Ratio, dB	>26 (typically 28)
Polarization	Dual pol +/-45°
VSWR	< 1.5:1
Isolation between Ports, dB	> 30
3rd Order IMP @ 2 x 43 dBm, dBc	> 150 (155 Typical)
Impedance, Ohms	50
Maximum Power Input, W	300
Lightning Protection	Direct Ground
Connector Type	(4) 7-16 Long Neck Female



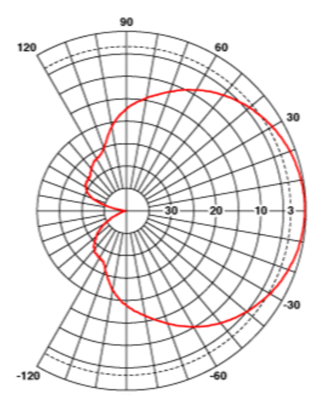
Vertical Pattern

Mechanical Specifications

Dimensions - HxWxD, mm (in)	1420 x 331 x 80 (55.9 x 13 x 3.15)
Weight w/o Mtg Hardware, kg (lb)	18.5 (40.7)
Survival Wind Speed, km/h (mph)	200 (125)
Rated Wind Speed, km/h (mph)	160 (100)
Max Wind Loading Area, m² (ft²)	0.47 (5.03)
Front Thrust @ Rated Wind, N (lbf)	756 (170)
Maximum Thrust @ Rated Wind, N (lbf)	756 (170)
Wind Load - Side @ Rated Wind, N (lbf)	231 (52)
Wind Load - Rear @ Rated Wind, N (lbf)	408 (92)
Radome Material	Fiberglass
Radome Color	Light Grey RAL7035
Mounting Hardware Material	Diecasted Aluminum
Shipping Weight, kg (lb)	24.5 (53.9)
Packing Dimensions, HxWxD, mm (in)	1520 x 408 x 198 (59.8 x 16 x 7.8)

Ordering Information

Mounting Hardware	APM40-2 + APM40-E2



Horizontal Pattern

Other Documentation

APM40 Series Datasheet
APM40 Series Installation Instructions

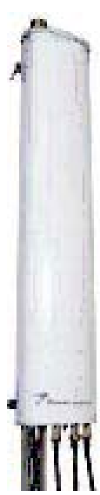
Dual Broadband Antenna

90° 1.4 m MET Antenna

806-960/1710-2170 MHz

Part Number: 7770.00	Horizontal Beamwidth: 90˚ Gain: 13.5/16 dBi	Electrical Downtilt: Adjustable Connector Type: 7/16 female

The Powerwave dual band dual polarized broadband antenna has individual adjustable electrical downtilt per band (upgradeable to Remote Electrical Tilt (RET). Four connector ports allow separate tilts on each frequency band and ensure the use of diversity concepts. The phase shifter technology, based on a patented sliding dielectric, minimizes intermodulation distortion and maximizes efficiency. The slant +/- 45° dual polarization system provides the independent fading signals needed for achieving top-quality coverage via diversity concepts. The Powerwave Broadband antenna design is based on a patented stacked aperture-coupled patch technology, which provides high isolation performance and a wide VSWR bandwidth. The antennas have superior radiation patterns due to a unique reflector design which provides a very small variation of the –3dB horizontal beam width over the frequency band as well as a high front-to-back ratio.



Key Benefits

- Excellent broad- and multi-band capabilities
- Polarization purity makes good diversity gain
- Excellent pattern performance and high gain over frequency
- High passive intermodulation performance
- Light, slim and robust design

Preliminary

ANTENNA SYSTEMS

BASE STATION SYSTEMS

COVERAGE SYSTEMS

806-960/1710-2170 MHz

Dual Broadband Antenna

Electrical Specifications (Preliminary)

Frequency band (MHz)	806-960		1710-2170
Gain, ± 0.5dB (dBi)	13.5		16.0
Polarization		Dual linear ±45°	
Nominal Impedance (Ohm)		50	
VSWR	1.5:1		
VSWR			1.5:1
Isolation between inputs (dB)	30		
Isolation between inputs (dB)			30
Inter band isolation (dB)		40	
Horizontal -3 dB beamwidth	85 ± 5°		85 ± 5°
Tracking, Horizontal plane, ±60° (dB)	<2.0		
Tracking, Horizontal plane, ±60° (dB)			<2.0
Electrical downtilt range (adjustable)	0° to 10°		0° to 8°
Vertical -3 dB beamwidth	14.3 ± 2.0°		6.6 ± 1°
Sidelobe suppression, Vertical 1 st upper (dB)	>17,16,15 x=0, 5, 10° MET		> 17, 16,15 x=0, 4, 8° MET
Vertical beam squint	<0.8°		<0.5°
First null-fill (dB)	<-25		<-25
Front-to-back ratio (dB)	>25		>27
Front-to-back ratio, total power (dB)	>20		>23
IM3, 2Tx@43dBm (dBc)	<-153		
IM3, 2Tx@43dBm (dBc)			<-153
IM7, 2Tx@43dBm (dBc)			<-160
Power Handling, Average per input (W)	400		250
Power Handling, Average total (W)	800		500

All specifications are subject to change without notice.
Contact your Powerwave representative for complete performance data.

Mechanical Specifications

Connector Type	4 x 7/16 DIN female
Connector Position	Bottom
Dimensions, HxWxD	1408mm x 280mm x 125mm (55”x11”x5”)
Weight Including Brackets	15.8 kg (35 lbs)
Wind Load, Frontal, 42m/s Cd=1	435N (98 lbf)
Survival Wind Speed (m/s)	70 (156mph)
Lightning Protection	DC grounded
Radome Material	GRP
Radome Color	Light Gray
Mounting	Pre-mounted Standard Brackets
Packing Size	1550mm x 355mm x 255mm (61”x14”x10”)

Corporate Headquarters
Powerwave Technologies, Inc.
1801 East St. Andrew Place
Santa Ana, CA 92705 USA
Tel: 714-466-1000
Fax: 714-466-5800
www.powerwave.com

Main European Office
Antennvägen 6
SE-187 80 Täby
Sweden
Tel: +46 8 540 822 00
Fax: +46 8 540 823 40

Main Asia Pacific Office
23 F Tai Yau Building
181 Johnston Road
Wanchai, Hong Kong
Tel: +852 2512 6123
Fax: +852 2575 4860

Powerwave technologies

COVERAGE AND CAPACITY | TECHNOLOGY LEADERSHIP | GLOBAL PARTNER | INTEGRATED SOLUTIONS | QUALITY AND RELIABILITY

TT19-08BP111-001 TMA Twin 1900 with 850 Bypass 12 dB AISG 1.1

ELECTRICAL SPECIFICATIONS	
UL Frequency Range (MHz)	1850-1910 with 824-894 bypass
UL Rejection	>77 dB
UL Gain(dB)	12
UL Return Loss	>18
UL Noise Figure	<1.7 dB, Typical
UL Output 3rd Order Intercept Point(dBm)	>+23
UL Bypass Loss(dB)	2.5, Typical
UL Max Input Power (dBm)	+14 dBm
DL Frequency Range (MHz)	1930-1990 with 824-894 bypass
DL Return Loss	>18
DL Insertion Loss (dB)	850 MHz, <0.3; 1900 MHz, <0.5
Intermodulation	@ 2 x +43 dBm TX carriers, in receive band, <160 dBc, reffered to antenna port
Input Voltage (V)	AISG Mode: 10-30; Current alarm mode: 8 -17
Alarm Functionality	AISG compatible or in case of no AISG command received, current alarm mode 170-190 mA
Power Consumption	<1.1W @12V
Power Handling, RMS	850: >57 dBm; 1900: >55 dBm
AISG Compatibility	AISG 1.1 fully upgreadable to AISG 2.0 (AISG version only dependent on loaded SW version) TT19-08BP112-001 has AISG 2.0 loaded from factory

MECHANICAL SPECIFICATIONS	
Dimension HxWxD mm(ft)	250x169x137 mm (9.9”x6.7”x5.4”)
Weight(lbs)	<16
Colors	Off white (NCS 1502-R)
RF Connectors	DIN 7/16 female, long neck
Mounting Kit	Mounting kit for pole and wall is included

ENVIRONMENTAL SPECIFICATIONS	
Temperature Range	-40° C to +65° C (-40° F to +149° F)
Operational	ETS 300 019-1-4
Transportation	ETS 300 019-1-2
Storage	ETS 300 019-1-1
Lightning Protection	3 kA 10/350 µs; 20 kA (Shield)
Housing	Aluminum
MTBF	>1 million hours per TMA
Ingress Protection	IP65 and IP68

APPROVAL AND TESTS	
Safety	EN60950
EMC	3GPP: TS 25.113

*All specifications subject to change without notice. Contact your Powerwave representative for complete performance data.