HPC Wireless Services
22 Shelter Rock Lane.
Building C
Danbury, CT, 06810
P.: 203.797.1112

HPC WIRELESS SERVICES

January 8, 2013

VIA OVERNIGHT COURIER

Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051
Attn: Ms. Melanie Bachman, Acting Executive Director

Re: Sprint Spectrum, L.P. –Exempt Modification
100 Quarry Road (aka 200 Quarry Road), Trumbull, Connecticut

Dear Ms. Bachman:

This letter and attachments are submitted on behalf of Sprint Spectrum, L.P. ("Sprint"). Sprint is undertaking modifications to certain existing sites in its Connecticut system in order to implement updated technology. Please accept this letter and attachments as notification, pursuant to R.C.S.A. Section 16-50j-73, of construction that constitutes an exempt modification pursuant to R.C.S.A. Section 16-50j-72(b)(2). In compliance with R.C.S.A. Section 16-50j-73, a copy of this letter and attachments is being sent to the First Selectman of the Town of Trumbull.

Sprint plans to modify the existing wireless communications facility owned by the Connecticut Light and Power Company and located at 100 Quarry Road (aka 200 Quarry Road), Trumbull (coordinates 41°-13'-56.91" N, 73°-11'-9.32" W). Attached are plan and elevation drawings depicting the planned changes, and documentation of the structural sufficiency of the structure to accommodate the revised antenna configuration. Also included is a power density report reflecting the modification to Sprint's operations at the site.

The changes to the facility do not constitute a modification as defined in Connecticut General Statutes ("C.G.S.") Section 16-50i(d) because the general physical characteristics of the facility will not be significantly changed. Rather, the planned changes to the facility fall squarely within those activities explicitly provided for in R.C.S.A. Section 16-50j-72(b)(2).

1. Sprint will remove the existing three (3) CMDA antennas and add three (3) dual-band panel LTE antennas to the existing pipe masts, at a centerline height of approximately 100' AGL. Sprint will also install fiber and power cables along the existing coaxial cable run, and the existing coaxial cable will be replaced as part of the

Final Configuration. *There will not be an Interim Period of this Modification.* The proposed modifications will not extend the height of the approximately 150' AGL structure.

2. Sprint will replace one (1) of the two (2) existing cabinets with a similar cabinet, add a third cabinet, add a DC Fiber/Power Distribution Management Enclosure, and add six (6) RRHs (remote radio heads) and one (1) Notch filter on a new Unistrut Frame, all on the existing Concrete Equipment Pad. The existing GPS antenna will be replaced by another GPS antenna. These changes will have no effect on the site boundaries.

3. The proposed changes will not increase the noise level at the existing facility by six decibels or more. The incremental effect of the proposed changes will be negligible.

4. The changes to the facility will not increase the calculated "worst case" power density for the combined operations at the site to a level at or above the applicable standard for uncontrolled environments as calculated for a mixed frequency site. As indicated on the attached report prepared by EBI Consulting, Sprint's operations will result in a power density of power density of approximately 25.163%; the combined site operations will result in a total power density of approximately 30.283%.

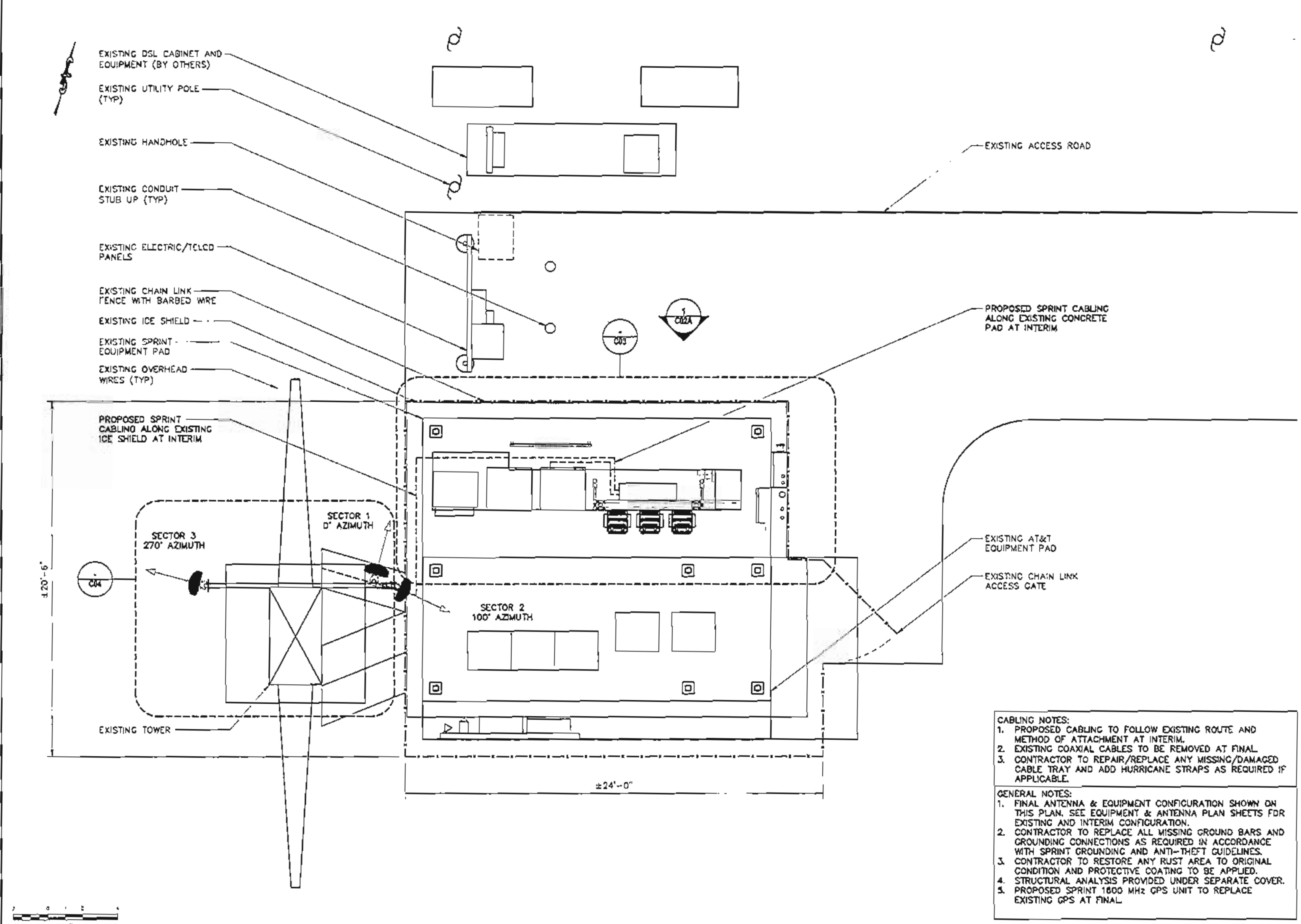
Please contact me by phone at (203) 610-1071 or by e-mail at mjhowlett@optonline.net with questions concerning this matter. Thank you for your consideration.

Respectfully yours,

Melanie J. Howlett

Attachments

cc: Honorable Timothy M. Herbst, First Selectman, Town of Trumbull
The Connecticut Light & Power Company and NU Utilities (underlying property owners)



CABLING NOTES:
1. PROPOSED CABLING TO FOLLOW EXISTING ROUTE AND METHOD OF ATTACHMENT AT INTERIM.
2. EXISTING COAXIAL CABLES TO BE REMOVED AT FINAL.
3. CONTRACTOR TO REPAIR/REPLACE ANY MISSING/DAMAGED CABLE TRAY AND ADD HURRICANE STRAPS AS REQUIRED IF APPLICABLE.

GENERAL NOTES:
1. FINAL ANTENNA & EQUIPMENT CONFIGURATION SHOWN ON THIS PLAN. SEE EQUIPMENT & ANTENNA PLAN SHEETS FOR EXISTING AND INTERIM CONFIGURATION.
2. CONTRACTOR TO REPLACE ALL MISSING GROUND BARS AND GROUNDING CONNECTIONS AS REQUIRED IN ACCORDANCE WITH SPRINT GROUNDING AND ANTI-THEFT GUIDELINES.
3. CONTRACTOR TO RESTORE ANY RUST AREA TO ORIGINAL CONDITION AND PROTECTIVE COATING TO BE APPLIED.
4. STRUCTURAL ANALYSIS PROVIDED UNDER SEPARATE COVER.
5. PROPOSED SPRINT 1900 MHz GPS UNIT TO REPLACE EXISTING GPS AT FINAL.

1 COMPOUND PLAN
11x17 SCALE: 3/16" = 1'-0" | 24x36 SCALE: 3/8" = 1'-0"

Sprint
Alcatel·Lucent

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHKD. BY
0	12-21-12	ISSUED FOR CONSTRUCTION	DPG	AMR

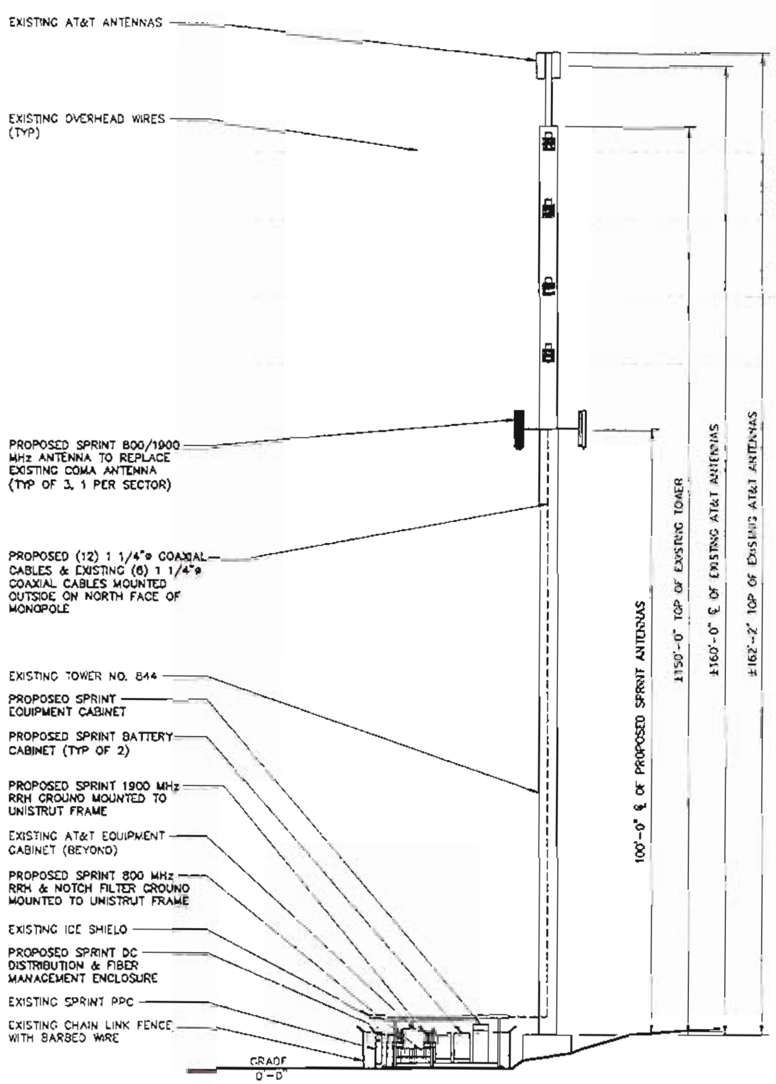
KMB DESIGN GROUP

Stephen A. Bray
PROFESSIONAL ENGINEER
CT LICENSE: 28057 12/31/13

PROJECT NUMBER: 332.1522

SITE INFORMATION:
124 QUARRY RD
TRUMBULL, CT 06611
FAIRFIELD COUNTY
CT43XC811

PROJECT TYPE: NETWORK VISION
DRAWN BY: JLS | CHECKED BY: | DATE: 03-27-12
SHEET TITLE: COMPOUND PLAN
SHEET NUMBER: C02 | REV.: 0



THE STRUCTURAL ENGINEERING CONCERNING THE STRUCTURAL STABILITY OF THE TOWER/POLE, FOUNDATION, ANTENNAS, MOUNTS AND ALL ASSOCIATED ANCILLARY RADIO EQUIPMENT IS BEING COMPLETED BY OTHERS. KMB DESIGN GROUP, LLC HAS NOT BEEN REQUESTED TO PERFORM ANY STRUCTURAL ANALYSIS SERVICES TO VERIFY THAT THE TOWER/POLE AND/OR FOUNDATION IS CAPABLE OF SUPPORTING THE PROPOSED EQUIPMENT DEPICTED WITHIN THESE SIGNED AND SEALED DRAWINGS. FURTHERMORE KMB DESIGN GROUP, LLC HAS NOT BEEN REQUESTED TO PHYSICALLY CONFIRM THE EXISTING MOUNT CONFIGURATION AND PERFORM A STRUCTURAL ANALYSIS TO VERIFY THAT THE EXISTING, INTERIM AND PROPOSED ANTENNAS, MOUNTS AND ALL ASSOCIATED ANCILLARY RADIO EQUIPMENT CAN BE SAFELY SUPPORTED. SIGNED AND SEALED DRAWINGS REVISED TO STATE "ISSUED FOR CONSTRUCTION" SHALL BE PROVIDED TO THE PROFESSIONAL ENGINEERS RESPONSIBLE FOR THE STRUCTURAL ANALYSIS OF THE TOWER/POLE, ANTENNAS, MOUNTS AND ALL ASSOCIATED ANCILLARY RADIO EQUIPMENT. KMB DESIGN GROUP, LLC SHALL BE NOTIFIED SHOULD THE STRUCTURAL ANALYSIS RESULT IN SOME ELEMENTS NOT BEING STRUCTURALLY CAPABLE OF SUPPORTING THE PROPOSED DESIGN DEPICTED. THE CONTRACTOR SHALL NOT COMMENCE CONSTRUCTION WITHOUT OBTAINING (A) A SIGNED AND SEALED COPY OF THE PLANS "ISSUED FOR CONSTRUCTION"; (B) STRUCTURAL ANALYSIS REPORT STATING THAT THE TOWER/POLE/FOUNDATION IS CAPABLE OF SUPPORTING THE PROPOSED LOADING REFERENCING THE SIGNED AND SEALED PLANS BY KMB DESIGN GROUP, LLC; (C) SPRINT PLATFORM ANALYSIS STATING THAT THE SPRINT PLATFORM IS CAPABLE OF SUPPORTING THE PROPOSED DESIGN AS REFERENCED WITHIN THE SIGNED AND SEALED PLANS BY KMB DESIGN GROUP, LLC.

NOTES:
1. FINAL ANTENNA & EQUIPMENT CONFIGURATION SHOWN ON THIS PLAN. SEE EQUIPMENT & ANTENNA PLAN SHEETS FOR EXISTING AND INTERIM CONFIGURATION.

1 NORTHWEST ELEVATION
11x17 SCALE: 1" = 20' | 24x36 SCALE: 1" = 10'

Sprint

Alcatel·Lucent

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHKD. BY
0	12/31/13	ISSUED FOR CONSTRUCTION	DPD	AHB

KMB DESIGN GROUP

Stephen A. Bray
PROFESSIONAL ENGINEER

CT LICENSE: 28657 12/31/13

PROJECT NUMBER: 332.1522

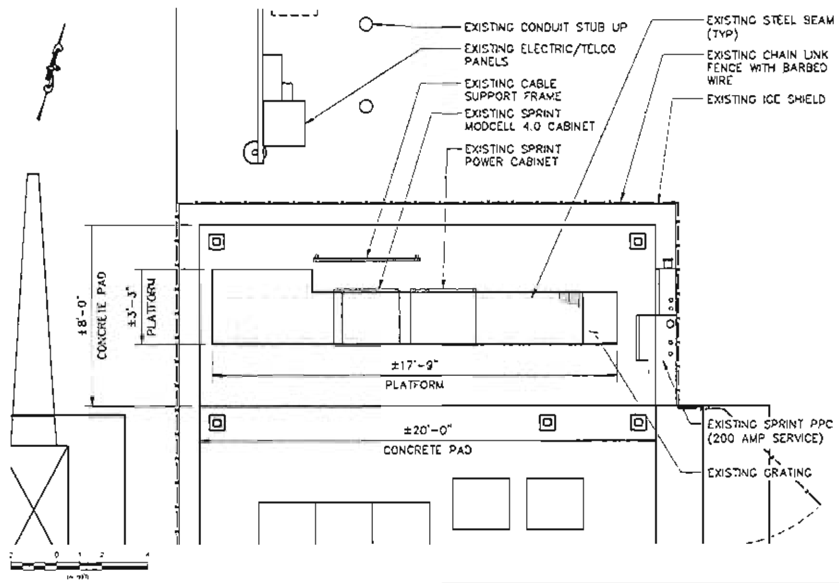
SITE INFORMATION:
124 QUARRY RD
TRUMBULL, CT 06611
FAIRFIELD COUNTY
CT43XC811

PROJECT TYPE: NETWORK VISION

DRAWN BY: JLS | CHECKED BY: | DATE: 03-27-12

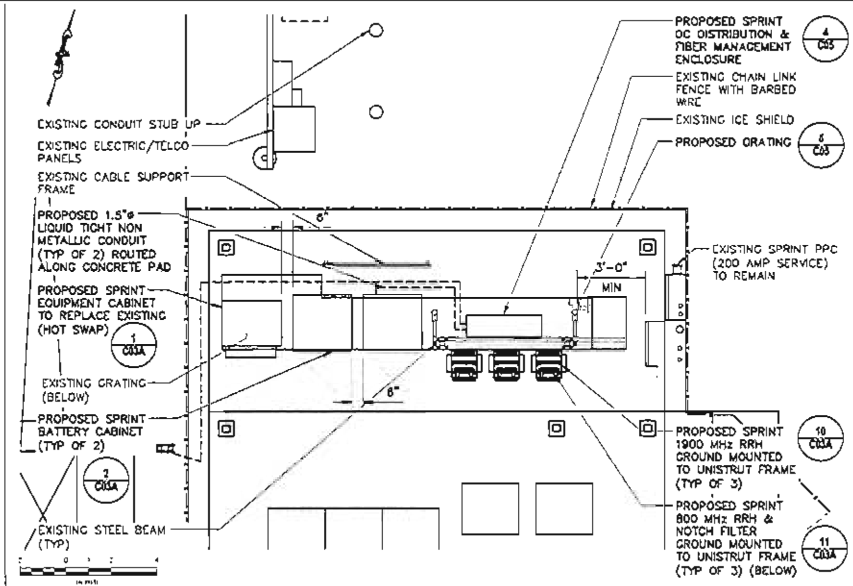
SHEET TITLE: ELEVATION

SHEET NUMBER: C02A | REV.: 0



1 EXISTING EQUIPMENT PLAN

11x17 SCALE: 3/16" = 1'-0" | 24x36 SCALE: 3/8" = 1'-0"



2 FINAL EQUIPMENT PLAN

11x17 SCALE: 3/16" = 1'-0" | 24x36 SCALE: 3/8" = 1'-0"

NOTE:
1. CONTRACTOR TO REPLACE ALL MISSING GROUND BARS AND GROUNDING CONNECTIONS AS REQUIRED IN ACCORDANCE WITH SPRINT GROUNDING AND ANTI-THEFT GUIDELINES. CONTRACTOR SHALL PROVIDE BEFORE & AFTER PHOTOS.

Sprint

Alcatel·Lucent

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHKD. BY
0	12/31/13	ISSUED FOR CONSTRUCTION	DPG	AMX

KMB DESIGN GROUP

Stephen A. Bray
PROFESSIONAL ENGINEER

CT LICENSE: 20867 12/31/13

PROJECT NUMBER: 332.1522

SITE INFORMATION:
124 QUARRY RD
TRUMBULL, CT 06611
FAIRFIELD COUNTY
CT43XC811

PROJECT TYPE: NETWORK VISION

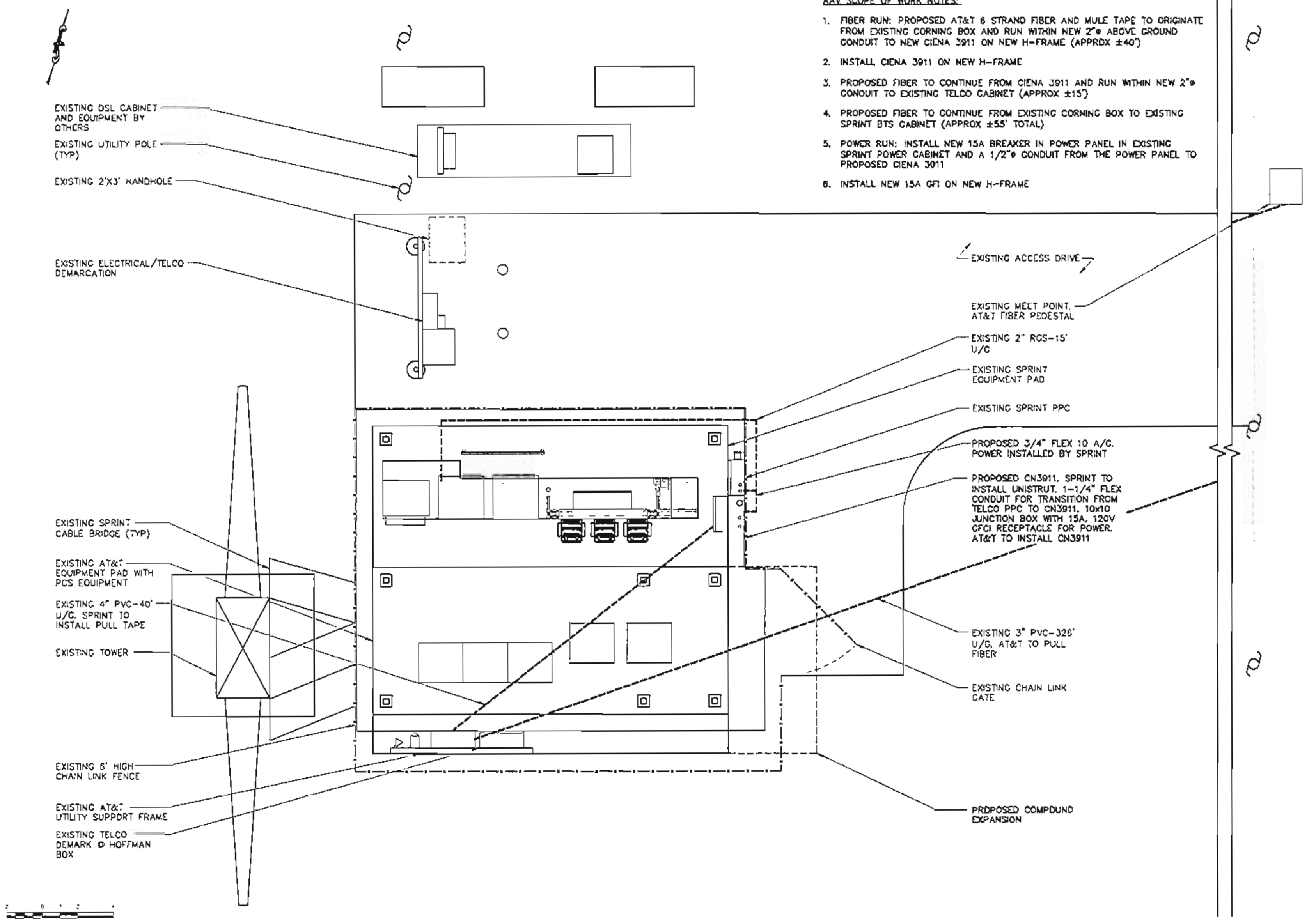
DRAWN BY: JLS | CHECKED BY: | DATE: 03-27-12

SHEET TITLE: EQUIPMENT PLANS

SHEET NUMBER: C03 | REV.: 0

AAV SCOPE OF WORK NOTES:

1. FIBER RUN: PROPOSED AT&T 6 STRAND FIBER AND MULE TAPE TO ORIGINATE FROM EXISTING CORNING BOX AND RUN WITHIN NEW 2"ø ABOVE GROUND CONDUIT TO NEW CIENA 3911 ON NEW H-FRAME (APPROX ±40')
2. INSTALL CIENA 3911 ON NEW H-FRAME
3. PROPOSED FIBER TO CONTINUE FROM CIENA 3911 AND RUN WITHIN NEW 2"ø CONDUIT TO EXISTING TELCO CABINET (APPROX ±15')
4. PROPOSED FIBER TO CONTINUE FROM EXISTING CORNING BOX TO EXISTING SPRINT BTS CABINET (APPROX ±55' TOTAL)
5. POWER RUN: INSTALL NEW 15A BREAKER IN POWER PANEL IN EXISTING SPRINT POWER CABINET AND A 1/2"ø CONDUIT FROM THE POWER PANEL TO PROPOSED CIENA 3011
6. INSTALL NEW 15A GFI ON NEW H-FRAME



1 EQUIPMENT PLAN

11x17 SCALE: 3/16"=1'-0" | 24x36 SCALE: 3/8"=1'-0"

Sprint

Alcatel·Lucent

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHKD. BY
0	12-21-13	ISSUED FOR CONSTRUCTION	DPG	AMB

KMB DESIGN GROUP

Stephen A. Bray
PROFESSIONAL ENGINEER

CT LICENSE: 20657 12/01/13

PROJECT NUMBER: 332.1522

SITE INFORMATION:
124 QUARRY RD
TRUMBULL, CT 06611
FAIRFIELD COUNTY

CT43XC811

PROJECT TYPE: NETWORK VISION

DRAWN BY: JLS | CHECKED BY: | DATE: 03-27-12

SHEET TITLE: AAV DRAWINGS EQUIPMENT PLAN

SHEET NUMBER: C07A | REV.: 0

Centered on Solutions℠

Structural Analysis of PCS Mast and CL&P Tower

Sprint Site Ref: CT43XC811

CL&P Structure No. 844
150' Electric Transmission Lattice Tower

124 Quarry Road
Trumbull, CT

CENTEK Project No. 12047.CO11

Date: April 9, 2013

Prepared for:
Sprint Nextel
8 Airline Drive, Suite 105
Albany, NY 12205

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

Table of Contents

Introduction

The purpose of this report is to analyze the existing PCS mast and 150' CL&P tower located at 124 Quarry Road in Trumbull, CT for the proposed antenna and equipment upgrade by Sprint.

The proposed loads consist of the following:

- AT&T (Existing):
  Antennas: Three (3) Powerwave P65-15-XHL-RR panel antennas and three (3) CCI DTMABP7819VG12A TMA's flush mounted on the existing PCS mast with a RAD center elevation of 160-ft above grade.
  Coax Cables: Six (6) 1-5/8" Ø coax cables running on the exterior of the existing CL&P tower.
  Mast: HSS 6.625"x0.432" x 21-ft long.
- SPRINT (Existing to Remain):
  Coax Cables: Six (6) 1-5/8" Ø coax cables running on the exterior of the existing CL&P tower.
- SPRINT (Existing to Remove):
  Antennas: Three (3) EMS RR65-18-02DP panel antennas mounted to the existing PCS mast with a RAD center elevation of 100-ft above grade.
- **SPRINT (Proposed):**
  Antennas: Three (3) RFS APXVSPP18-C panel antennas mounted to the existing PCS mast with a RAD center elevation of 100-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" Ø coax cables mounted on the exterior of the existing tower as indicated in section 4 of this report.

Primary assumptions used in the analysis

- Allowable steel stresses are defined by AISC-ASD 9th edition for design of the pcs mast and antenna supporting elements.
- ASCE Manual No. 10-97, "Design of Latticed Steel Transmission Structures", defines allowable steel stresses for evaluation of the CL&P utility tower.
- All utility tower members are adequately protected to prevent corrosion of steel members.
- All proposed antenna mounts are modeled as listed above.
- PCS mast will be properly installed and maintained.
- No residual stresses exist due to incorrect tower erection.
- All bolts are appropriately tightened providing the necessary connection continuity.
- All welds conform to the requirements of AWS D1.1.
- PCS mast and utility tower will be in plumb condition.
- Utility tower was properly installed and maintained and all members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
- Any deviation from the analyzed loading will require a new analysis for verification of structural adequacy.

Analysis

Structural analysis of the existing *PCS Mast* was independently completed using the current version of RISA-3D computer program licensed to CENTEK Engineering, Inc.

The existing mast consisting of a HSS2.875x0.203 x 10-ft long pipe connected at one location to the existing pole was analyzed for its ability to resist loads prescribed by the TIA/EIA standard. Section 5 of this report details these gravity and lateral wind loads. NESC prescribed loads were also applied to the mast structure in order to obtain reactions needed for analyzing the CL&P pole structure. These loads are developed in Section 7 of this report. Load cases and combinations used in RISA-3D for TIA/EIA loading and for NESC/NU loading are listed in report Sections 6 and 8, respectively.

An envelope solution was first made to determine maximum and minimum forces, stresses, and deflections to confirm the selected section as adequate. Additional analyses were then made to determine the NESC forces to be applied to the CL&P tower structure.

The RISA-3D program contains a library of all AISC shapes and corresponding section properties are computed and applied directly within the program. The program's Steel Code Check option was also utilized.

Design Basis

Our analysis was performed in accordance with EIA-222-F-1996, ASCE Manual No. 10-97, "Design of Latticed Steel Transmission Structures", NESC C2-2007 and Northeast Utilities Design Criteria.

The CL&P tower structure, considering existing and future conductor and shield wire loading, with the proposed antenna mast was analyzed under two conditions:

- UTILITY TOWER ANALYSIS

  The purpose of this analysis is to determine the adequacy of the existing utility structure to support the proposed antenna loads. The loading and design requirements were analyzed in accordance with the NU Design Criteria Table, NESC C2-2007 ~ Construction Grade B, and ASCE Manual No. 10-97, "Design of Latticed Steel Transmission Structures".

  Load cases considered:

  Load Case 1: NESC Heavy
  Wind Pressure.................................... 4.0 psf
  Radial Ice Thickness............................ 0.5"
  Vertical Overload Capacity Factor............ 1.50
  Wind Overload Capacity Factor............... 2.50
  Wire Tension Overload Capacity Factor...... 1.65

  Load Case 2: NESC Extreme
  Wind Speed...................................... 110 mph (1)
  Radial Ice Thickness............................ 0"

  Note 1: NESC C2-2007, Section25, Rule 250C: Extreme Wind Loading, 1.25 x Gust Response Factor (wind speed: 3-second gust)

- PIPE MAST ANALYSIS

  PCS mast, appurtenances and connections to the utility tower were analyzed and designed in accordance with the NU Design Criteria Table, TIA/EIA-222-F, and AISC-ASD standards.

  Load cases considered:

  Load Case 1:
  Wind Speed.. 85 mph [(2)]
  Radial Ice Thickness............................. 0"

  Load Case 2:
  Wind Pressure.................................... 75% of 85 mph wind pressure
  Radial Ice Thickness.............................. 0.5"

  Note 2: Per NU Mast Design Criteria Exception 1.

Results

- PIPE MAST

  The existing mast was determined to be structurally **adequate**.

Component	Stress Ratio (% of capacity)	Result
HSS 2.875x0.203[(1)]	83.8%	**PASS**

Note 1 – 1/3 Increase in allowable stress used for mast.

- UTILITY TOWER

  This analysis finds that the subject utility structure is adequate to support the existing mast and related appurtenances. The tower stresses meet the requirements set forth by the ASCE Manual No. 10-97, "Design of Latticed Steel Transmission Structures", for the applied NESC Heavy and Hi-Wind load cases. The detailed analysis results are provided in Section 9 of this report. The analysis results are summarized as follows:

  A maximum usage of **81.3%** occurs in the utility tower under the **NESC Extreme** loading condition.

  TOWER SECTION:

  The utility tower was found to be within allowable limits.

Tower Section	Stress Ratio (% of capacity)	Result
Base	81.3%	**PASS**

- FOUNDATION AND ANCHORS

  The existing foundation consists of a 8-ft x 8-ft x 8.0-ft long reinforced concrete pier with twelve (12) rock anchors embedded 13-ft into rock. The base of the tower is connected to the foundation by means of twenty-six (26) 2.25"Ø, ASTM A615-75 anchor bolts embedded into the concrete foundation structure. Foundation information was obtained from Northeast Utilities drawing 01064-60000.

Review of the foundation and anchor design consisted of verification of applied loads obtained from the tower design calculations and code checks of allowable stresses:

BASE REACTIONS:

From analysis of CL&P pole based on NESC/NU prescribed loads.

Load Case	Transverse	Axial	Overturning Moment
NESC Heavy Wind x-direction	19.3 kips	95.1 kips	2197.6 ft-kips
NESC Extreme Wind x-direction	40.7 kips	47.0 kips	4081.7 ft-kips
NESC Heavy Wind y-direction	10.4 kips	95.1 kips	767.9 ft-kips
NESC Extreme Wind y-direction	36.8 kips	47.0 kips	2699.2 ft-kips

ANCHOR BOLTS:

The anchor bolts were found to be within allowable limits.

Pole Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Tension	62.1%	**PASS**

BASE PLATE:

The base plate was found to be within allowable limits.

Pole Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Base Plate	Bending	72.3%	**PASS**

FOUNDATION:

The foundation was found to be within allowable limits.

Foundation	Design Limit	Allowable Limit	Proposed Loading	Result
Reinf. Conc. Pier w/ Rock Anchors	OTM [(1)]	1.0 FS [(2)]	1.15 FS [(2)]	**PASS**

Note 1: OTM denote overturning moment.
Note 2: FS denotes Factor of Safety

Conclusions and Recommendations

This analysis shows that the subject utility tower **is adequate** to support the proposed Sprint equipment upgrade.

The analysis is based, in part on the information provided to this office by Northeast Utilities and Sprint. If the existing conditions are different than the Information in this report, CENTEK engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Carlo F. Centore, PE
Principal ~ Structural Engineer

STATE OF CONNECTICUT CARLO F. CENTORE No.16091 LICENSED PROFESSIONAL ENGINEER

Prepared by:

Timothy J. Lynn, EIT
Structural Engineer

STANDARD CONDITIONS FOR FURNISHING OF PROFESSIONAL ENGINEERING SERVICES ON EXISTING STRUCTURES

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

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

GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM ~ RISA-3D

RISA-3D Structural Analysis Program is an integrated structural analysis and design software package for buildings, bridges, tower structures, etc.

Modeling Features:

- Comprehensive CAD-like graphic drawing/editing capabilities that let you draw, modify and load elements as well as snap, move, rotate, copy, mirror, scale, split, merge, mesh, delete, apply, etc.
- Versatile drawing grids (orthogonal, radial, skewed)
- Universal snaps and object snaps allow drawing without grids
- Versatile general truss generator
- Powerful graphic select/unselect tools including box, line, polygon, invert, criteria, spreadsheet selection, with locking
- Saved selections to quickly recall desired selections
- Modification tools that modify single items or entire selections
- Real spreadsheets with cut, paste, fill, math, sort, find, etc.
- Dynamic synchronization between spreadsheets and views so you can edit or view any data in the plotted views or in the spreadsheets
- Simultaneous view of multiple spreadsheets
- Constant in-stream error checking and data validation
- Unlimited undo/redo capability
- Generation templates for grids, disks, cylinders, cones, arcs, trusses, tanks, hydrostatic loads, etc.
- Support for all units systems & conversions at any time
- Automatic interaction with RISASection libraries
- Import DXF, RISA-2D, STAAD and ProSteel 3D files
- Export DXF, SDNF and ProSteel 3D files

Analysis Features:

- Static analysis and P-Delta effects
- Multiple simultaneous dynamic and response spectra analysis using Gupta, CQC or SRSS mode combinations
- Automatic inclusion of mass offset (5% or user defined) for dynamic analysis
- Physical member modeling that does not require members to be broken up at intermediate joints
- State of the art 3 or 4 node plate/shell elements
- High-end automatic mesh generation — draw a polygon with any number of sides to create a mesh of well-formed quadrilateral (NOT triangular) elements.
- Accurate analysis of tapered wide flanges - web, top and bottom flanges may all taper independently
- Automatic rigid diaphragm modeling
- Area loads with one-way or two-way distributions
- Multiple simultaneous moving loads with standard AASHTO loads and custom moving loads for bridges, cranes, etc.
- Torsional warping calculations for stiffness, stress and design
- Automatic Top of Member offset modeling
- Member end releases & rigid end offsets
- Joint master-slave assignments
- Joints detachable from diaphragms
- Enforced joint displacements
- 1-Way members, for tension only bracing, slipping, etc.

- 1-Way springs, for modeling soils and other effects
- Euler members that take compression up to their buckling load, then turn off.
- Stress calculations on any arbitrary shape
- Inactive members, plates, and diaphragms allows you to quickly remove parts of structures from consideration
- Story drift calculations provide relative drift and ratio to height
- Automatic self-weight calculations for members and plates
- Automatic subgrade soil spring generator

Graphics Features:

- Unlimited simultaneous model view windows
- Extraordinary "true to scale" rendering, even when drawing
- High-speed redraw algorithm for instant refreshing
- Dynamic scrolling stops right where you want
- Plot & print virtually everything with color coding & labeling
- Rotate, zoom, pan, scroll and snap views
- Saved views to quickly restore frequent or desired views
- Full render or wire-frame animations of deflected model and dynamic mode shapes with frame and speed control
- Animation of moving loads with speed control
- High quality customizable graphics printing

Design Features:

- Designs concrete, hot rolled steel, cold formed steel and wood
- ACI 1999/2002, BS 8110-97, CSA A23.3-94, IS456:2000,EC 2-1992 with consistent bar sizes through adjacent spans
- Exact integration of concrete stress distributions using parabolic or rectangular stress blocks
- Concrete beam detailing (Rectangular, T and L)
- Concrete column interaction diagrams
- Steel Design Codes: AISC ASD 9th, LRFD 2nd & 3rd, HSS Specification, CAN/CSA-S16.1-1994 & 2004, BS 5950-1-2000, IS 800-1984, Euro 3-1993 including local shape databases
- AISI 1999 cold formed steel design
- NDS 1991/1997/2001 wood design, including Structural Composite Lumber, multi-ply, full sawn
- Automatic spectra generation for UBC 1997, IBC 2000/2003
- Generation of load combinations: ASCE, UBC, IBC, BOCA, SBC, ACI
- Unbraced lengths for physical members that recognize connecting elements and full lengths of members
- Automatic approximation of K factors
- Tapered wide flange design with either ASD or LRFD codes
- Optimization of member sizes for all materials and all design codes, controlled by standard or user-defined lists of available sizes and criteria such as maximum depths
- Automatic calculation of custom shape properties
- Steel Shapes: AISC, HSS, CAN, ARBED, British, Euro, Indian, Chilean
- Light Gage Shapes: AISI, SSMA, Dale / Incor, Dietrich, Marino\WARE
- Wood Shapes: Complete NDS species/grade database
- Full seamless integration with RISAFoot (Ver 2 or better) for advanced footing design and detailing
- Plate force summation tool

Results Features:

- Graphic presentation of color-coded results and plotted designs
- Color contours of plate stresses and forces with quadratic smoothing, the contours may also be animated
- Spreadsheet results with sorting and filtering of: reactions, member & joint deflections, beam & plate forces/stresses, optimized sizes, code designs, concrete reinforcing, material takeoffs, frequencies and mode shapes
- Standard and user-defined reports
- Graphic member detail reports with force/stress/deflection diagrams and detailed design calculations and expanded diagrams that display magnitudes at any dialed location
- Saved solutions quickly restore analysis and design results.

GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM ~ PLS-TOWER

PLS-TOWER is a Microsoft Windows program for the analysis and design of steel latticed towers used in electric power lines or communication facilities. Both self-supporting and guyed towers can be modeled. The program performs design checks of structures under user specified loads. For electric power structures it can also calculate maximum allowable wind and weight spans and interaction diagrams between different ratios of allowable wind and weight spans.·

Modeling Features:

- Powerful graphics module (stress usages shown in different colors)
- Graphical selection of joints and members allows graphical editing and checking
- Towers can be shown as lines, wire frames or can be rendered as 3-d polygon surfaces
- Can extract geometry and connectivity information from a DXF CAD drawing
- CAD design drawings, title blocks, drawing borders or photos can be tied to structure model
- XML based post processor interface
- Steel Detailing Neutral File (SDNF) export to link with detailing packages
- Can link directly to line design program PLS-CADD
- Automatic generation of structure files for PLS-CADD
- Databases of steel angles, rounds, bolts, guys, etc.
- Automatic generation of joints and members by symmetries and interpolations
- Automated mast generation (quickly builds model for towers that have regular repeating sections) via graphical copy/paste
- Steel angles and rounds modeled either as truss, beam or tension-only elements
- Guys are easily handled (can be modeled as exact cable elements)

Analysis Features:

- Automatic handling of tension-only members
- Automatic distribution of loads in 2-part suspension insulators (v-strings, horizontal vees, etc.)
- Automatic calculation of tower dead, ice, and wind loads as well as drag coefficients according to:
  - ASCE 74-1991
  - NESC 2002
  - NESC 2007
  - IEC 60826:2003
  - EN50341-1:2001 (CENELEC)
  - EN50341-3-9:2001 (UK NNA)
  - EN50341-3-17:2001 (Portugal NNA)
  - ESAA C(b)1-2003 (Australia)
  - TPNZ (New Zealand)
  - REE (Spain)
  - EIA/TIA 222-F
  - ANSI/TIA 222-G
  - CSA S37-01
- Automated microwave antenna loading as per EIA/TIA 222-F and ANSI/TIA 222-G
- Minimization of problems caused by unstable joints and mechanisms
- Automatic bandwidth minimization and ability to solve large problems
- Design checks according to (other standards can be added easily):
  - ASCE Standard 10-90

- AS 3995 (Australian Standard 3995)
- BS 8100 (British Standard 8100)
- EN50341-1 (CENELEC, both empirical and analytical methods are available)
- ECCS 1985
- NGT-ECCS
- PN-90/B-03200
- EIA/TIA 222-F
- ANSI/TIA 222-G
- CSA S37-01
- EDF/RTE Resal
- IS 802 (India Standard 802)

Results Features:

- Design summaries printed for each group of members
- Easy to interpret text, spreadsheet and graphics design summaries
- Automatic determination of allowable wind and weight spans
- Automatic determination of interaction diagrams between allowable wind and weight spans
- Capability to batch run multiple tower configurations and consolidate the results
- Automated optimum angle member size selection and bolt quantity determination

Tool for interactive angle member sizing and bolt quantity determination.

Criteria for Design of PCS Facilities On or Extending Above Metal Electric Transmission Towers & Analysis of Transmission Towers Supporting PCS Masts [(1)]

Introduction

This criteria is the result from an evaluation of the methods and loadings specified by the separate standards, which are used in designing telecommunications towers and electric transmission towers. That evaluation is detailed elsewhere, but in summary; the methods and loadings are significantly different. This criteria specifies the manner in which the appropriate standard is used to design PCS facilities including masts and brackets (hereafter referred to as "masts"), and to evaluate the electric transmission towers to support PCS masts. The intent is to achieve an equivalent level of safety and security under the extreme design conditions expected in Connecticut and Massachusetts.

ANSI Standard TIA/EIA-222 covering the design of telecommunications structures specifies a working strength/allowable stress design approach. This approach applies the loads from extreme weather loading conditions, and designs the structure so that it does not exceed some defined percentage of failure strength (allowable stress).

ANSI Standard C2-2007 (National Electrical Safety Code) covering the design of electric transmission metal structures is based upon an ultimate strength/yield stress design approach. This approach applies a multiplier (overload capacity factor) to the loads possible from extreme weather loading conditions, and designs the structure so that it does not exceed its ultimate strength (yield stress).

Each standard defines the details of how loads are to be calculated differently. Most of the NU effort in "unifying" both codes was to establish what level of strength each approach would provide, and then increasing the appropriate elements of each to achieve a similar level of security under extreme weather loadings.

Two extreme weather conditions are considered. The first is an extreme wind condition (hurricane) based upon a 50-year recurrence (2% annual probability). The second is a winter condition combining wind and ice loadings.

The following sections describe the design criteria for any PCS mast extending above the top of an electric transmission tower, and the analysis criteria for evaluating the loads on the transmission tower from such a mast from the lower portions of such a mast, and loads on the pre-existing electric lower portions of such a mast, and loads on the pre-existing electric transmission tower and the conductors it supports.

Note 1: Prepared from documentation provide from Northeast Utilities.

P C S M a s t

The PCS facility (mast, external cable/trays, including the initial and any planned future support platforms, antennas, etc. extending the full height above the top level of the electric transmission structure) shall be designed in accordance with the provisions of TIA/EIA Standard 222 with two exceptions:

1. An 85 mph extreme wind speed shall be used for locations in all counties throughout the NU system.
2. The stress increase of TIA Section 3.1.1.1 is disallowed. The combined wind and ice condition shall consider ½" radial ice in combination with the wind load (0.75 Wi) as specified in TIA section 2.3.16.

E L E C T R I C T R A N S M I S S I O N T O W E R

The electric transmission tower shall be analyzed using yield stress theory in accordance with the attached table titled "NU Design Criteria". This specifies uniform loadings (different from the TIA loadings) on the each of the following components of the installed facility:

- PCS mast for its total height above ground level, including the initial and planned future support platforms, antennas, etc. above the top of an electric transmission structure.
- Conductors are related devices and hardware.
- Electric transmission structure. The loads from the PCS facility and from the electric conductors shall be applied to the structure at conductor and PCS mast attachment points, where those load transfer to the tower.

The uniform loadings and factors specified for the above components in the table are based upon the National Electrical Safety Code 2007 Edition Extreme Wind (Rule 250C) and Combined Ice and Wind (Rule 250B-Heavy) Loadings. These provide equivalent loadings compared to TIA and its loads and factors with the exceptions noted above. (Note that the NESC does not require the projected wind surfaces of structures and equipment to be increased by the ice covering.)

In the event that the electric transmission tower is not sufficient to support the additional loadings of the PCS mast, reinforcement will be necessary to upgrade the strength of the overstressed members.

Attachment A

NU Design Criteria

Condition	Standard	Analysis	Basic Wind Speed V (MPH)	Pressure Q (PSF)	Height Factor Kz	Gust Factor Gh	Load or Stress Factor	Force Coef - Shape Factor
Ice Condition	TIA/EIA	Antenna Mount	TIA	TIA (.75Wi)	TIA	TIA	TIA, Section 3.1.1.1 disallowed for connection design	TIA
Ice Condition	NESC Heavy	Tower/Pole Analysis with antennas extending above top of Tower/Pole (Yield Stress)	----	4	1.00	1.00	2.50	1.6 Flat Surfaces 1.3 Round Surfaces
Ice Condition	NESC Heavy	Tower/Pole Analysis with Antennas below top of Tower/Pole (on two faces)	----	4	1.00	1.00	2.50	1.6 Flat Surfaces 1.3 Round Surfaces
Ice Condition		Conductors:	Conductor loads provided by NU					
High Wind Condtion	TIA/EIA	Antenna Mount	85	TIA	TIA	TIA	TIA, Section 3.1.1.1 disallowed for connection design	TIA
High Wind Condtion	NESC Extreme Wind	Tower/Pole Analysis with antennas extending above top of Tower/Pole	Use NESC C2-2007, Section 25, Rule 250C: Extreme Wind Loading 1.25 x Gust Response Factor Height above ground level based on top of Mast/Antenna					1.6 Flat Surfaces 1.3 Round Surfaces
High Wind Condtion	NESC Extreme Wind	Tower/Pole Analysis with Antennas below top of Tower/Pole	Use NESC C2-2007, Section 25, Rule 250C: Extreme Wind Loading Height above ground level based on top of Tower/Pole					1.6 Flat Surfaces 1.3 Round Surfaces
High Wind Condtion		Conductors:	Conductor loads provided by NU					
NESC Extreme Ice with Wind Conditon*		Tower/Pole Analysis with antennas extending above top of Tower/Pole	Use NESC C2-2007, Section 25, Rule 250D: Extreme Ice with Wind Loading 4PSF Wind Load 1.25 x Gust Response Factor Height above ground level based on top of Mast/Antenna					1.6 Flat Surfaces 1.3 Round Surfaces
NESC Extreme Ice with Wind Conditon*		Tower/Pole Analysis with Antennas below top of Tower/Pole	Use NESC C2-2007, Section 25, Rule 250D: Extreme Ice with Wind Loading 4PSF Wind Load Height above ground level based on top of Tower/Pole					1.6 Flat Surfaces 1.3 Round Surfaces
NESC Extreme Ice with Wind Conditon*		Conductors:	Conductor loads provided by NU					

* Only for Structures Installed after 2007

Shape Factor Criteria shall be per TIA Shape Factors.

2) STEP 2 - The electric transmission structure analysis and evaluation shall be performed in accordance with NESC requirements and shall include the mast and antenna loads determined from NESC applied loading conditions (not TIA/EIA Loads) on the structure and mount as specified below, and shall include the wireless communication mast and antenna loads per NESC criteria)

The structure shall be analyzed using yield stress theory in accordance with Attachment A, "NU Design Criteria." This specifies uniform loadings (different from the TIA loadings) on each of the following components of the installed facility:

a) Wireless communication mast for its total height above ground level, including the initial and any planned future equipment (Support Platforms, Antennas, TMA's etc.) above the top of an electric transmission structure.

b) Conductors and related devices and hardware (wire loads will be provided by NU).

c) Electric Transmission Structure

i) The loads from the wireless communication equipment components based on NESC and NU Criteria in Attachment A, and from the electric conductors shall be applied to the structure at conductor and wireless communication mast attachment points, where those loads transfer to the tower.

ii) Shape Factor Multiplier:

NESC Structure Shape	Cd
Polyround (for polygonal steel poles)	1.3
Flat	1.6
Open Lattice	3.2

iii) When Coaxial Cables are mounted along side the pole structure, the shape multiplier shall be:

Mount Type	Cable Cd	Pole Cd
Coaxial Cables on outside periphery (One layer)	1.45	1.45
Coaxial Cables mounted on stand offs	1.6	1.3

d) The uniform loadings and factors specified for the above components in Attachment A, "NU Design Criteria" are based upon the National Electric Safety Code 2007 Edition Extreme Wind (Rule 250C) and Combined Ice and Wind (Rule 250B-Heavy) Loadings. These provide equivalent loadings compared to the TIA and its loads and factors with the exceptions noted above.

Note: The NESC does not require ice load be included in the supporting structure. (Ice on conductors and shield wire only, and NU will provide these loads).

e) Mast reaction loads shall be evaluated for local effects on the transmission structure members at the attachment points.

TITLE AT&T SITE CT-089, TRUMBULL, CT 12/1/99

STRUCT #844

CONDUCTOR

	AHEAD		BACK	
	LAPWING		LAPWING	
	1595.000		1595.000	
	45/7 ACSR		45/7 ACSR	
DIAM =	1.504		1.504	
WEIGHT =	1.790		1.790	
TENSION (LBS)	AHEAD	11,400	BACK	11,400

LOADCASE	NESC HEAVY
WIND (PSF)	4
ICE (IN)	0.50
OLF ANG	1.65
OLF WIND	2.50
OLF WT	1.50

STR	ANGLE	WIND SPAN	WGT SPAN	NESC HEAVY H	L	V
BACK	0	407	493	849	-18810	2245
AHEAD	0	407	493	849	18810	2245
TOTALS	**0.0**	**814**	**986**	**1699**	**0**	**4490**

TITLE AT&T SITE CT-089, TRUMBULL, CT 12/1/99

STRUCT # 844

CONDUCTOR

	AHEAD	BACK
	LAPWING	LAPWING
	1595.000	1595.000
	45/7 ACSR	45/7 ACSR
DIAM =	1.504	1.504
WEIGHT =	1.790	1.790
TENSION (LBS)	AHEAD 9,401	BACK 9,401

LOADCASE	HI WIND
WIND (PSF)	20
ICE (IN)	0.00
OLF ANG	1.15
OLF WIND	1.15
OLF WT	1.15

STR	ANGLE	WIND SPAN	WGT SPAN	HI WIND H	HI WIND L	HI WIND V
BACK	0	407	493	1173	-10811	1015
AHEAD	0	407	493	1173	10811	1015
TOTALS	0.0	814	986	2346	0	2030

TITLE AT&T SITE, CT-089, TRUMBULL, CT   12/1/99
STRUCT #844

CONDUCTOR - SHIELD WIRE

	AHEAD	BACK
	3/8 AW	3/8 AW
	0.000	0.000
	7 #8 Al Weld	7 #8 Al Weld
DIAM =	0.385	0.385
WEIGHT =	0.262	0.262
TENSION (LBS)	AHEAD 4,200	BACK 4,200

LOADCASE	NESC HEAVY
WIND (PSF)	4
ICE (IN)	0.50
OLF ANG	1.65
OLF WIND	2.50
OLF WT	1.50

STR	ANGLE	WIND SPAN	WGT SPAN	NESC HEAVY H	L	V
BACK	0	407	493	470	-6930	601
AHEAD	0	407	493	470	6930	601
TOTALS	**0.0**	**814**	**986**	**939**	**0**	**1201**

TITLE AT&T SITE CT-099, TRUMBULL, CT 12/1/99

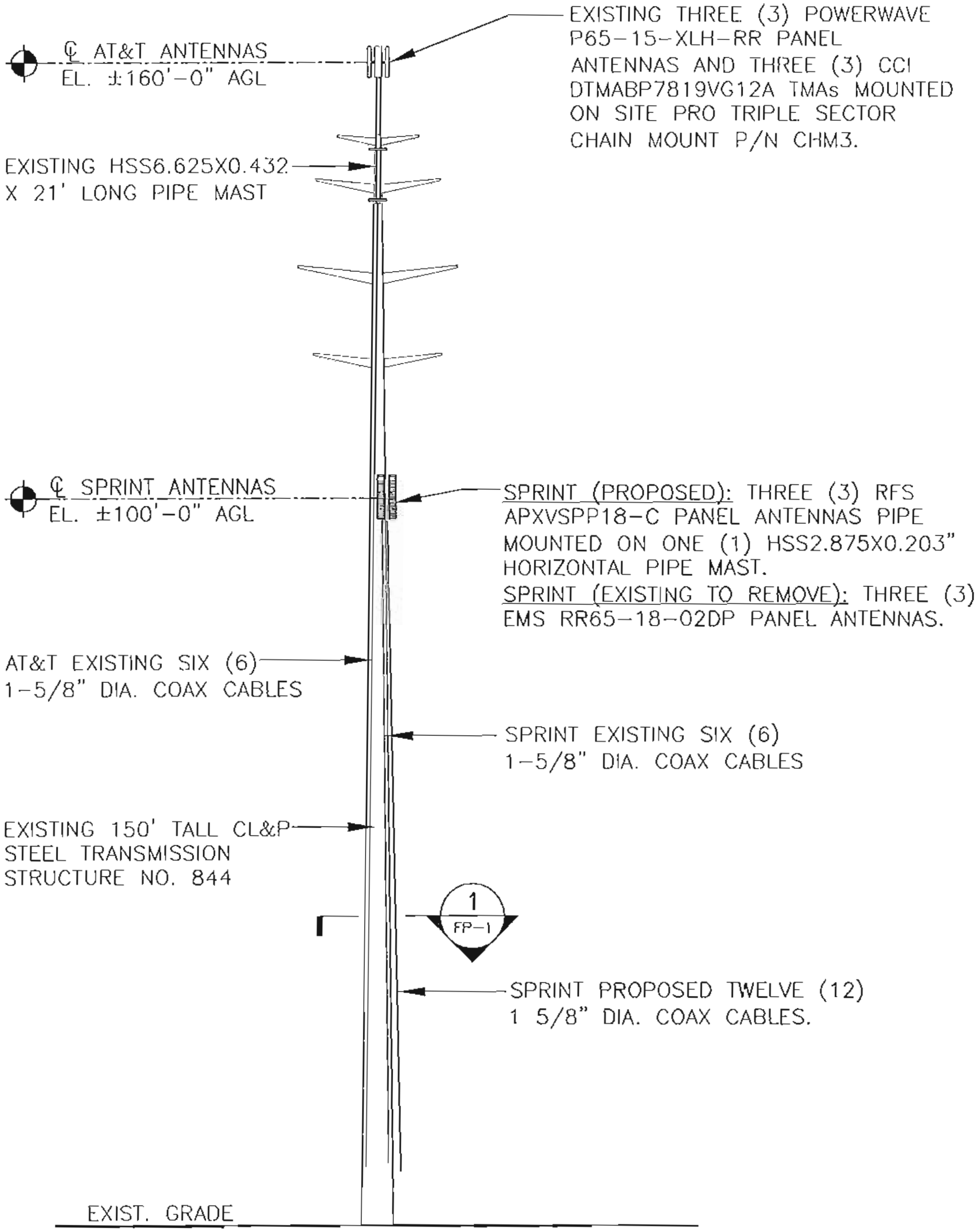
STRUCT # 944

CONDUCTOR

	AHEAD	BACK
	3/8 AW	3/8 AW
	0.000	0.000
	7 #8 Al Weld	7 #8 Al Weld
DIAM =	0.385	0.385
WEIGHT =	0.262	0.262
TENSION (LBS)	AHEAD 2,521	BACK 2,521

LOADCASE	HI WIND
WIND (PSF)	20
ICE (IN)	0.00
OLF ANG	1.15
OLF WIND	1.15
OLF WT	1.15

STR	ANGLE	WIND SPAN	WGT SPAN	HI WIND H	HI WIND L	HI WIND V
BACK	0	407	493	300	-2899	148
AHEAD	0	407	493	300	2899	148
TOTALS	0.0	814	986	601	0	297



1 / EL-1 **TOWER & MAST ELEVATION**

SCALE: NOT TO SCALE

REVISIONS		
00	4.9.13	ISSUED FOR HJ REVIEW

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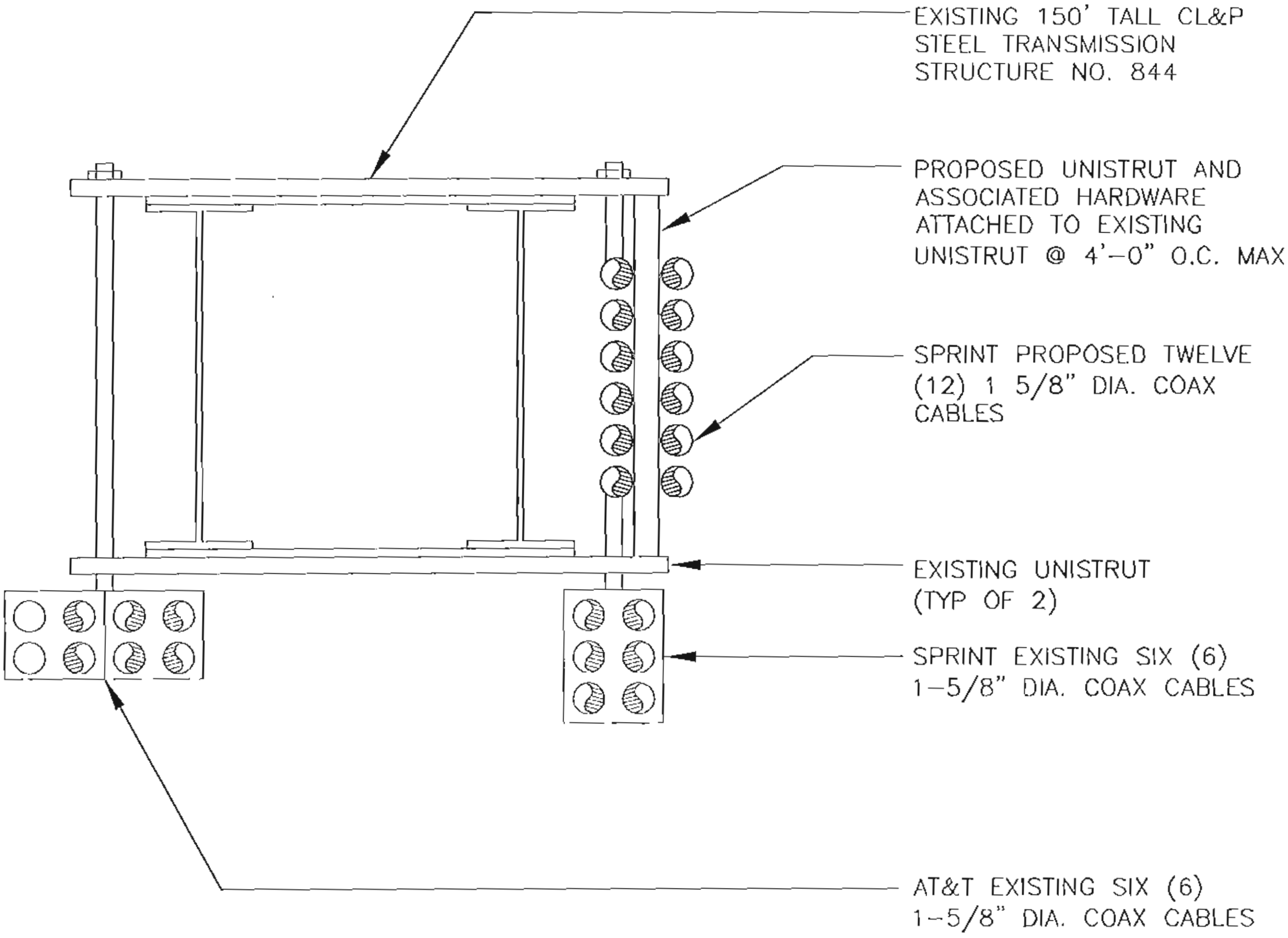
124 QUARRY ROAD
TRUMBULL, CT 06611

PROJECT NO:	12047 CO11
DRAWN BY:	TJL
CHECKED BY:	CFC
SCALE:	AS NOTED
DATE:	4/9/13

TOWER AND MAST ELEVATION

EL-1

DWG. 1 OF 2



1 FP-1 FEEDLINE PLAN - TOWER

SCALE: NOT TO SCALE

REVISIONS		
00	4/9/13	ISSUED FOR NU REVIEW

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FEEDLINE PLAN

FP-1

DWG. 2 OF 2

Development of Design Heights, Exposure Coefficients, and Velocity Pressures Per TIA/EIA

Wind Speeds

Basic Wind Speed $V := 85$ mph (User Input per NU Mast Design Criteria Exception 1)

Basic Wind Speed with Ice $V_i := 74$ mph (User Input per TIA/EIA-222-F Section 2.3.16)

Heights above ground level, z

Mast $z_{mast} := 100$ ft (User Input)

Sprint $z_{spt} := 100$ ft (User Input)

Exposure Coefficients, kz

(per TIA/EIA-222-F Section 2.3.3)

Mast $Kz_{mast} := \left(\frac{z_{mast}}{33}\right)^{\frac{2}{7}} = 1.373$

Sprint $Kz_{spt} := \left(\frac{z_{spt}}{33}\right)^{\frac{2}{7}} = 1.373$

Velocity Pressure without Ice, qz

(per TIA/EIA-222-F Section 2.3.3)

Mast $qz_{mast} := 0.00256 \cdot Kz_{mast} \cdot V^2 = 25.389$

Sprint $qz_{spt} := 0.00256 \cdot Kz_{spt} \cdot V^2 = 25.389$

Velocity Pressure with Ice, qzICE

(per TIA/EIA-222-F Section 2.3.3)

Mast $qzICE_{mast} := 0.00256 \cdot Kz_{mast} \cdot V_i^2 = 19.243$

Sprint $qzICE_{spt} := 0.00256 \cdot Kz_{spt} \cdot V_i^2 = 19.243$

TIA/EIA Common Factors:

Gust Response Factor = $G_H := 1.69$ (User Input per TIA/EIA-222-F Section 2.3.4)

Gust Response Factor Multiplier = $m := 1.25$ (User Input per TIA/EIA-222-F Section 2.3.4.4)

Radial Ice Thickness = $Ir := 0.50$ in (User Input per TIA/EIA-222-F Section 2.3.1)

Radial Ice Density = $Id := 56.00$ pcf (User Input)

Development of Wind & Ice Load on PCS Mast (per TIA/EIA-222-F-1996 Criteria)

Mast Data: (HSS2.875x0.203) (User Input)

Mast Shape = Round (User Input)

Mast Diameter = $D_{mast} := 2.875$ in (User Input)

Mast Length = $L_{mast} := 10$ ft (User Input)

Mast Thickness = $t_{mast} := 0.203$ in (User Input)

Mast Aspect Ratio = $Ar_{mast} := \frac{12L_{mast}}{D_{mast}} = 41.7$

Mast Force Coefficient = $Ca_{mast} = 1.2$ (per TIA/EIA-222-F Table 3)

Wind Load (without ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Mast Projected Surface Area = $A_{mast} := \frac{D_{mast}}{12} = 0.24$ sf/ft

Total Mast Wind Force = $qz_{mast} \cdot G_H \cdot Ca_{mast} \cdot A_{mast} = 12$ plf **BLC 5,7**

Wind Load (with ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Mast Projected Surface Area w/ Ice = $AICE_{mast} := \frac{(D_{mast} + 2 \cdot Ir)}{12} = 0.323$ sf/ft

Total Mast Wind Force w/ Ice = $qzICE_{mast} \cdot G_H \cdot Ca_{mast} \cdot AICE_{mast} = 13$ plf **BLC 4,6**

Gravity Loads (without ice)

Weight of the mast = Self Weight **(Computed internally by Risa-3D)** plf **BLC 1**

Gravity Loads (ice only)

Ice Area per Linear Foot = $Ai_{mast} := \frac{\pi}{4}\left[(D_{mast} + Ir \cdot 2)^2 - D_{mast}^2\right] = 5.3$ sq in

Weight of Ice on Mast = $W_{ICEmast} := Id \cdot \frac{Ai_{mast}}{144} = 2$ plf **BLC 3**

Development of Wind & Ice Load on Antennas

(per TIA/EIA-222-F-1996 Criteria)

Antenna Data: (Sprint)

Antenna Model = RFS APXVSPP18-C

Antenna Shape = Flat (User Input)

Antenna Height = $L_{ant} := 72$ in (User Input)

Antenna Width = $W_{ant} := 11.8$ in (User Input)

Antenna Thickness = $T_{ant} := 7$ in (User Input)

Antenna Weight = $WT_{ant} := 57$ lbs (User Input)

Number of Antennas = $N_{ant} := 1$ (User Input) (One per pipe mast / tot. of 3)

Antenna Aspect Ratio = $Ar_{ant} := \frac{L_{ant}}{W_{ant}} = 6.1$

Antenna Force Coefficient = $Ca_{ant} = 1.4$ (per TIA/EIA-222-F-1996 Table 3)

Wind Load (without ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna = $SA_{ant} := \frac{L_{ant} \cdot W_{ant}}{144} = 5.9$ sf

Antenna Projected Surface Area = $A_{ant} := SA_{ant} \cdot N_{ant} = 5.9$ sf

Total Antenna Wind Force = $F_{ant} := qz_{spt} \cdot G_H \cdot Ca_{ant} \cdot A_{ant} = 354$ lbs BLC 5,7

Wind Load (with ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna w/ Ice = $SA_{ICEant} := \frac{(L_{ant}+1) \cdot (W_{ant}+1)}{144} = 6.5$ sf

Antenna Projected Surface Area w/ Ice = $A_{ICEant} := SA_{ICEant} \cdot N_{ant} = 6.5$ sf

Total Antenna Wind Force w/ Ice = $Fi_{ant} := qzICE_{spt} \cdot G_H \cdot Ca_{ant} \cdot A_{ICEant} = 295$ lbs BLC 4,6

Gravity Load (without ice)

Weight of All Antennas = $WT_{ant} \cdot N_{ant} = 57$ lbs BLC 2

Gravity Loads (ice only)

Volume of Each Antenna = $V_{ant} := L_{ant} \cdot W_{ant} \cdot T_{ant} = 5947$ cu in

Volume of Ice on Each Antenna = $V_{ice} := (L_{ant}+1)(W_{ant}+1) \cdot (T_{ant}+1) - V_{ant} = 1528$ cu in

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

Weight of Ice on All Antennas = $W_{ICEant} \cdot N_{ant} = 50$ lbs BLC 3

Development of Wind & Ice Load on Pipe Mast (per TIA/EIA-222-F-1996 Criteria)

Mast Data:	(2" Std. Pipe)		(User Input)
Mast Shape =	Round		(User Input)
Mast Diameter =	$D_{mast} := 2.375$	in	(User Input)
Mast Length =	$L_{mast} := 6$	ft	(User Input)
Mast Thickness =	$t_{mast} := 0.154$	in	(User Input)
Mast Aspect Ratio =	$Ar_{mast} := \frac{12 L_{mast}}{D_{mast}} = 30.3$		
Mast Force Coefficient =	$Ca_{mast} = 1.2$		(per TIA/EIA-222-F Table 3)

Wind Load (without Ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Mast Projected Surface Area =	$A_{mast} := \frac{D_{mast}}{12} = 0.198$	sf/ft	
Total Mast Wind Force =	$qz_{mast} \cdot G_H \cdot Ca_{mast} \cdot A_{mast} = 10$	plf	BLC 5,7

Wind Load (with Ice) (per TIA/EIA-222-F-1996 Section 2.3.2)

Mast Projected Surface Area w/ Ice =	$AICE_{mast} := \frac{(D_{mast} + 2 \cdot Ir)}{12} = 0.281$	sf/ft	
Total Mast Wind Force w/ Ice =	$qzICE_{mast} \cdot G_H \cdot Ca_{mast} \cdot AICE_{mast} = 11$	plf	BLC 4,6

Gravity Loads (without ice)

Weight of the mast =	Self Weight	(Computed Internally by Risa-3D)	plf	BLC 1

Gravity Loads (ice only)

Ice Area per Linear Foot =	$Ai_{mast} := \frac{\pi}{4}\left[(D_{mast} + Ir \cdot 2)^2 - D_{mast}^2\right] = 4.5$	sq in	
Weight of Ice on Mast =	$W_{ICEmast} := Id \cdot \frac{Ai_{mast}}{144} = 2$	plf	BLC 3

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Consulting Engineers
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Branford, CT 06405
Ph. 203-488-0580 / Fax. 203-488-8587

Subject: **Analysis of TIA/EIA Wind and Ice Loads for Design of PCS Structure Only**
Tabulated Load Cases / Sprint

Location: **Trumbull, CT**

Date: 4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Case	Description
1	Self Weight (PCS Mast)
2	Weight of Appurtenances
3	Weight of Ice Only on PCS Structure
4	x-direction TIA/EIA Wind with Ice on PCS Structure
5	x-direction TIA/EIA Wind on PCS Structure
6	z-direction TIA/EIA Wind with Ice on PCS Structure
7	z-direction TIA/EIA Wind on PCS Structure

Footnotes:
(1) PCS Structure includes: Mast and Appurtenances

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Ph. 203-488-0580 / Fax. 203-488-8587

Subject: **Analysis of TIA/EIA Wind and Ice Loads for Design of PCS Structure Only**
Load Combinations Table / Sprint

Location: **Trumbull, CT**

Date: 4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Combination	Description	Envelope Soultion	Wind Factor	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	x-direction TIA/EIA Wind + Ice on PCS Structure		1		1	1	2	1	3	1	4	1		
2	x-direction TIA/EIA Wind on PCS Structure		1		1	1	2	1	5	1				
3	z-direction TIA/EIA Wind + Ice on PCS Structure		1		1	1	2	1	3	1	6	1		
4	z-direction TIA/EIA Wind on PCS Structure		1		1	1	2	1	7	1				

Footnotes:
(1) BLC = Basic Load Case
(2) PCS Structure includes: Mast and Appurtenances

Global

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y
Global Member Orientation Plane	XZ

Hot Rolled Steel Code	AISC 9th: ASD
Cold Formed Steel Code	AISI 1999: ASD
Wood Code	AF&PA NDS-97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-02
Masonry Code	ACI 530-05/08: ASD
Aluminum Code	AA ADM1-05: ASD

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
Bad Framing Warnings	No
Unused Force Warnings	Yes

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ct Exp. X	.75
Ct Exp. Z	.75
Ca	.36
Cv	.54
Nv	1
SD1	1
SDS	1
S1	1
Occupancy Code	4
Seismic Zone	3
Use Group	I
Use Gravity Self Wt in Diaphragm Mass	Yes
Use Deck Self Wt in Diaphragm Mass	Yes
Use Lateral Self Wt in Diaphragm Mass	Yes
Seismic Detailing Code	None
Om X	1
Om Z	1
Rho X	1
Rho Z	1

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A36 Gr.36	29000	11154	.3	.65	.49	36	1.5	58	1.2
2	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	58	1.2
3	A992	29000	11154	.3	.65	.49	50	1.1	58	1.2
4	A500 Gr.42	29000	11154	.3	.65	.49	42	1.3	58	1.1
5	A500 Gr.46	29000	11154	.3	.65	.49	46	1.2	58	1.1
6	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	58	1.2

Hot Rolled Steel Design Parameters

	Label	Shape	Lengt...	Lbyy[ft]	Lbzz[ft]	Lcomp top[ft]	Lcomp bot[ft]	Kyy	Kzz	Cm-...	Cm-...	Cb	y sw...	z sw...	Function
1	M1	Horz Mast	10												Lateral
2	M2	Pipe Mast	6												Lateral
3	M3	Pipe Mast	6												Lateral
4	M4	Pipe Mast	6												Lateral

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	Horz Mast	HSS2.875X0.203	Beam	Pipe	A500 Gr.42	Typical	1.59	1.45	1.45	2.89
2	Pipe Mast	PIPE_2.0	Beam	Tube	A53 Gr. B	Typical	1	.627	.627	1.25

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N3			Horz Mast	Beam	Pipe	A500 Gr.42	Typical
2	M2	N6	N5			Pipe Mast	Beam	Tube	A53 Gr. B	Typical
3	M3	N8	N7			Pipe Mast	Beam	Tube	A53 Gr. B	Typical
4	M4	N10	N9			Pipe Mast	Beam	Tube	A53 Gr. B	Typical

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N1	0	0	0	0	
2	N2	4	0	0	0	
3	N3	10	0	0	0	
4	N4	2	0	0	0	
5	N5	0	3	0	0	
6	N6	0	-3	0	0	
7	N7	2	3	0	0	
8	N8	2	-3	0	0	
9	N9	10	3	0	0	
10	N10	10	-3	0	0	
11	N11	6	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]	Footing
1	N2	Reaction	Reaction	Reaction				
2	N11	Reaction	Reaction	Reaction				

Joint Loads and Enforced Displacements

Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
No Data to Print ...			

Member Point Loads (BLC 2 : Weight of Appurtenances)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Y	-.057	%50
2	M3	Y	-.057	%50
3	M4	Y	-.057	%50

Member Point Loads (BLC 3 : Weight of Ice Only on PCS Struct)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Y	-.05	%50
2	M3	Y	-.05	%50
3	M4	Y	-.05	%50

Member Point Loads (BLC 4 : x-dir TIA/EIA Wind with Ice on P)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	X	.295	%50
2	M3	X	.295	%50
3	M4	X	.295	%50

Member Point Loads (BLC 5 : x-dir TIA/EIA Wind on PCS Struct)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	X	.354	%50
2	M3	X	.354	%50
3	M4	X	.354	%50

Member Point Loads (BLC 6 : z-dir TIA/EIA Wind with Ice on P)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Z	.295	%50
2	M3	Z	.295	%50
3	M4	Z	.295	%50

Member Point Loads (BLC 7 : z-dir TIA/EIA Wind on PCS Struct)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Z	.354	%50
2	M3	Z	.354	%50
3	M4	Z	.354	%50

Member Distributed Loads (BLC 3 : Weight of Ice Only on PCS Struct)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.002	-.002	0	0
2	M2	Y	-.002	-.002	0	0
3	M3	Y	-.002	-.002	0	0
4	M4	Y	-.002	-.002	0	0

Member Distributed Loads (BLC 4 : x-dir TIA/EIA Wind with Ice on P)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	X	.011	.011	0	0
2	M3	X	.011	.011	0	0
3	M4	X	.011	.011	0	0

Member Distributed Loads (BLC 5 : x-dir TIA/EIA Wind on PCS Struct)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	X	.01	.01	0	0
2	M3	X	.01	.01	0	0
3	M4	X	.01	.01	0	0

Member Distributed Loads (BLC 6 : z-dir TIA/EIA Wind with Ice on P)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.013	.013	0	0
2	M2	Z	.011	.011	0	0
3	M3	Z	.011	.011	0	0
4	M4	Z	.011	.011	0	0

Member Distributed Loads (BLC 7 : z-dir TIA/EIA Wind on PCS Struct)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.012	.012	0	0
2	M2	Z	.01	.01	0	0
3	M3	Z	.01	.01	0	0
4	M4	Z	.01	.01	0	0

Basic Load Cases

	BLC Description	Category	X Gr...	Y Gr...	Z Grav...	Joint	Point	Distri...	Area(...	Surfa...
1	Self Weight (PCS Mast)	None		-1						
2	Weight of Appurtenances	None					3			
3	Weight of Ice Only on PCS Struct	None					3	4		
4	x-dir TIA/EIA Wind with Ice on P	None					3	3		
5	x-dir TIA/EIA Wind on PCS Struct	None					3	3		
6	z-dir TIA/EIA Wind with Ice on P	None					3	4		
7	z-dir TIA/EIA Wind on PCS Struct	None					3	4		

Load Combinations

	Description	So...	PDelta	SRSS	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	x-dir TIA/EIA Wind + Ice on P..	Yes			1	1	2	1	3	1	4	1								
2	x-dir TIA/EIA Wind on PCS S..	Yes			1	1	2	1	5	1										
3	z-dir TIA/EIA Wind + Ice on P..	Yes			1	1	2	1	3	1	6	1								
4	z-dir TIA/EIA Wind on PCS S..	Yes			1	1	2	1	7	1										
5	Self Weight																			

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Momen...	LC	z-z Momen...	LC
1	M1	1	max	.414	2	-.077	4	.414	4	0	1	0	1	0	1
2			min	0	3	-.139	1	0	1	0	1	0	1	0	1
3		2	max	.828	2	-.168	2	.858	4	0	1	1.279	4	.441	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Momen...	LC	z-z Momen...	LC
4			min	0	3	-.297	1	0	1	0	1	0	1	.249	4
5		3	max	0	1	.139	1	0	1	0	1	2.16	4	.753	1
6			min	0	1	.077	4	-.414	4	0	1	0	1	.428	2
7		4	max	0	3	.158	3	0	1	0	1	1.072	4	.372	1
8			min	-.414	2	.091	2	-.444	4	0	1	0	1	.21	2
9		5	max	0	3	.139	3	0	1	0	1	0	1	0	1
10			min	-.414	2	.077	2	-.414	4	0	1	0	1	0	1
11	M2	1	max	0	1	0	1	0	1	0	1	0	1	0	1
12			min	0	1	0	1	0	1	0	1	0	1	0	1
13		2	max	-.005	2	0	3	.016	3	0	1	.012	3	.012	1
14			min	-.008	1	-.016	1	0	1	0	1	0	1	0	3
15		3	max	-.01	2	.033	1	.033	3	0	1	.049	3	.05	1
16			min	-.016	1	0	3	0	1	0	1	0	1	0	3
17		4	max	.008	1	.017	1	0	1	0	1	.012	3	.012	1
18			min	.005	2	0	3	-.016	3	0	1	0	1	0	3
19		5	max	0	1	0	1	0	1	0	1	0	1	0	1
20			min	0	1	0	1	0	1	0	1	0	1	0	1
21	M3	1	max	0	1	0	1	0	1	0	1	0	1	0	1
22			min	0	1	0	1	0	1	0	1	0	1	0	1
23		2	max	-.005	2	0	3	.016	3	0	1	.012	3	.012	1
24			min	-.008	1	-.016	1	0	1	0	1	0	1	0	3
25		3	max	-.01	2	.03	2	.033	3	0	1	.049	3	.049	1
26			min	-.016	1	-.033	1	0	1	0	1	0	1	0	3
27		4	max	.008	1	.016	1	0	1	0	1	.012	3	.012	1
28			min	.005	2	0	3	-.016	3	0	1	0	1	0	3
29		5	max	0	1	0	1	0	1	0	1	0	1	0	1
30			min	0	1	0	1	0	1	0	1	0	1	0	1
31	M4	1	max	0	1	0	1	0	1	0	1	0	1	0	1
32			min	0	1	0	1	0	1	0	1	0	1	0	1
33		2	max	-.005	2	0	3	.017	3	0	1	.012	3	.012	1
34			min	-.008	1	-.016	1	0	1	0	1	0	1	0	3
35		3	max	-.01	2	.03	2	.033	3	0	1	.05	3	.049	1
36			min	-.016	1	-.033	1	0	1	0	1	0	1	0	3
37		4	max	.008	1	.016	1	0	1	0	1	.012	3	.012	1
38			min	.005	2	0	3	-.016	3	0	1	0	1	0	3
39		5	max	0	1	0	1	0	1	0	1	0	1	0	1
40			min	0	1	0	1	0	1	0	1	0	1	0	1

Envelope Member Section Stresses

	Member	Sec		Axial[ksi]	LC	y Shear[...	LC	z Shear[...	LC	y-Top[ksi]	LC	y-Bot[ksi]	LC	z-Top[ksi]	LC	z-Bot[ksi]	LC
1	M1	1	max	.26	2	-.097	4	.521	4	0	1	0	1	0	1	0	1
2			min	0	3	-.175	1	0	1	0	1	0	1	0	1	0	1
3		2	max	.521	2	-.212	2	1.079	4	-2.964	4	5.251	1	15.222	4	0	1
4			min	0	3	-.374	1	0	1	-5.251	1	2.964	4	0	1	-15.222	4
5		3	max	0	1	.175	1	0	1	-5.088	2	8.954	1	25.697	4	0	1
6			min	0	1	.097	4	-.521	4	-8.954	1	5.088	2	0	1	-25.697	4
7		4	max	0	3	.199	3	0	1	-2.504	2	4.422	1	12.759	4	0	1
8			min	-.26	2	.114	2	-.558	4	-4.422	1	2.504	2	0	1	-12.759	4
9		5	max	0	3	.175	3	0	1	0	1	0	1	0	1	0	1
10			min	-.26	2	.097	2	-.521	4	0	1	0	1	0	1	0	1
11	M2	1	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Envelope Member Section Stresses (Continued)

	Member	Sec		Axial[ksi]	LC	y Shear[...	LC	z Shear[...	LC	y-Top[ksi]	LC	y-Bot[ksi]	LC	z-Top[ksi]	LC	z-Bot[ksi]	LC
12			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
13		2	max	-.005	2	0	3	.033	3	0	3	.281	1	.281	3	0	1
14			min	-.008	1	-.033	1	0	1	-.281	1	0	3	0	1	-.281	3
15		3	max	-.01	2	.066	1	.066	3	0	3	1.125	1	1.125	3	0	1
16			min	-.016	1	0	3	0	1	-1.125	1	0	3	0	1	-1.125	3
17		4	max	.008	1	.033	1	0	1	0	3	.281	1	.281	3	0	1
18			min	.005	2	0	3	-.033	3	-.281	1	0	3	0	1	-.281	3
19		5	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
20			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
21	M3	1	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
22			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
23		2	max	-.005	2	0	3	.033	3	0	3	.281	1	.281	3	0	1
24			min	-.008	1	-.033	1	0	1	-.281	1	0	3	0	1	-.281	3
25		3	max	-.01	2	.06	2	.066	3	0	3	1.125	1	1.125	3	0	1
26			min	-.016	1	-.066	1	0	1	-1.125	1	0	3	0	1	-1.125	3
27		4	max	.008	1	.033	1	0	1	0	3	.281	1	.281	3	0	1
28			min	.005	2	0	3	-.033	3	-.281	1	0	3	0	1	-.281	3
29		5	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
30			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
31	M4	1	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
32			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
33		2	max	-.005	2	0	3	.033	3	0	3	.281	1	.281	3	0	1
34			min	-.008	1	-.033	1	0	1	-.281	1	0	3	0	1	-.281	3
35		3	max	-.01	2	.06	2	.066	3	0	3	1.125	1	1.125	3	0	1
36			min	-.016	1	-.066	1	0	1	-1.125	1	0	3	0	1	-1.125	3
37		4	max	.008	1	.033	1	0	1	0	3	.281	1	.281	3	0	1
38			min	.005	2	0	3	-.033	3	-.281	1	0	3	0	1	-.281	3
39		5	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
40			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	0	3	.455	1	0	1	0	1	0	1	0	1
2		min	-.828	2	.259	2	-1.302	4	0	1	0	1	0	1
3	N11	max	0	3	.037	1	0	1	0	1	0	1	0	1
4		min	-.414	2	.027	2	-.065	3	0	1	0	1	0	1
5	N4	max	NC		NC		NC		LOCKED		NC		NC	
6		min	NC		NC		NC		LOCKED		NC		NC	
7	Totals:	max	0	3	.492	1	0	1						
8		min	-1.242	2	.286	2	-1.362	4						

Envelope Joint Displacements

	Joint		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation...	LC	Y Rotation...	LC	Z Rotation...	LC
1	N1	max	0	2	-.172	4	.876	4	0	1	2.254e-2	4	7.801e-3	1
2		min	0	3	-.304	1	0	1	0	4	0	1	4.413e-3	4
3	N2	max	0	2	0	2	0	4	0	4	7.92e-3	4	2.756e-3	1
4		min	0	3	0	1	0	1	0	1	0	1	1.564e-3	2
5	N3	max	0	2	-.141	2	.712	4	0	4	0	1	-3.69e-3	2
6		min	0	3	-.248	3	0	1	0	1	-1.867e-2	4	-6.498e-3	3
7	N4	max	0	2	-.07	4	.357	4	0	1	1.965e-2	4	6.812e-3	1

Envelope Joint Displacements (Continued)

	Joint		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation...	LC	Y Rotation...	LC	Z Rotation...	LC
8		min	0	3	-.124	1	0	1	0	4	0	1	3.858e-3	4
9	N5	max	-.149	2	-.172	4	.885	4	3.92e-4	3	2.254e-2	4	7.801e-3	3
10		min	-.281	3	-.304	1	0	1	0	1	0	1	4.057e-3	2
11	N6	max	.292	1	-.172	4	.885	4	0	1	2.254e-2	4	8.193e-3	1
12		min	.159	4	-.304	1	0	1	-3.92e-4	3	0	1	4.413e-3	4
13	N7	max	-.129	2	-.07	4	.366	4	3.92e-4	3	1.965e-2	4	6.812e-3	3
14		min	-.245	3	-.124	1	0	1	0	1	0	1	3.502e-3	2
15	N8	max	.256	1	-.07	4	.366	4	0	1	1.965e-2	4	7.204e-3	1
16		min	.139	4	-.124	1	0	1	-3.92e-4	3	0	1	3.858e-3	4
17	N9	max	.245	1	-.141	2	.721	4	3.92e-4	3	0	1	-3.69e-3	4
18		min	.133	4	-.248	3	0	1	0	1	-1.867e-2	4	-6.89e-3	1
19	N10	max	-.123	2	-.141	2	.721	4	0	1	0	1	-3.333e-3	2
20		min	-.234	3	-.248	3	0	1	-3.92e-4	3	-1.867e-2	4	-6.498e-3	3
21	N11	max	0	2	0	2	0	3	0	4	0	1	-1.371e-3	2
22		min	0	3	0	1	0	1	0	1	-6.888e-3	4	-2.408e-3	1

Envelope AISC ASD Steel Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Sh...	Loc[ft]	......		Fa...	Ft [ksi]	Fb y-y [ksi]	Fb.........		...		AS...
1	M1	HSS2.8...	.838	4.063	4	.050	3.958		4	12...	33.592	36.951	36..	1	....	....	H2...
2	M2	PIPE_2.0	.037	3	1	.004	3		1	18...	27.993	30.792	30...	1	.6	....	H2...
3	M3	PIPE_2.0	.037	3	1	.004	3		3	18...	27.993	30.792	30...	1	.6	....	H2...
4	M4	PIPE_2.0	.037	3	3	.004	3		3	18...	27.993	30.792	30...	....	....	.6	H2...

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N2	-.722	.455	0	0	0	0
2	1	N11	-.361	.037	0	0	0	0
3	1	N4	NC	NC	NC	LOCKED	NC	NC
4	1	Totals:	-1.083	.492	0			
5	1	COG (ft):	X: 4.151	Y: 0	Z: 0			

Joint Reactions

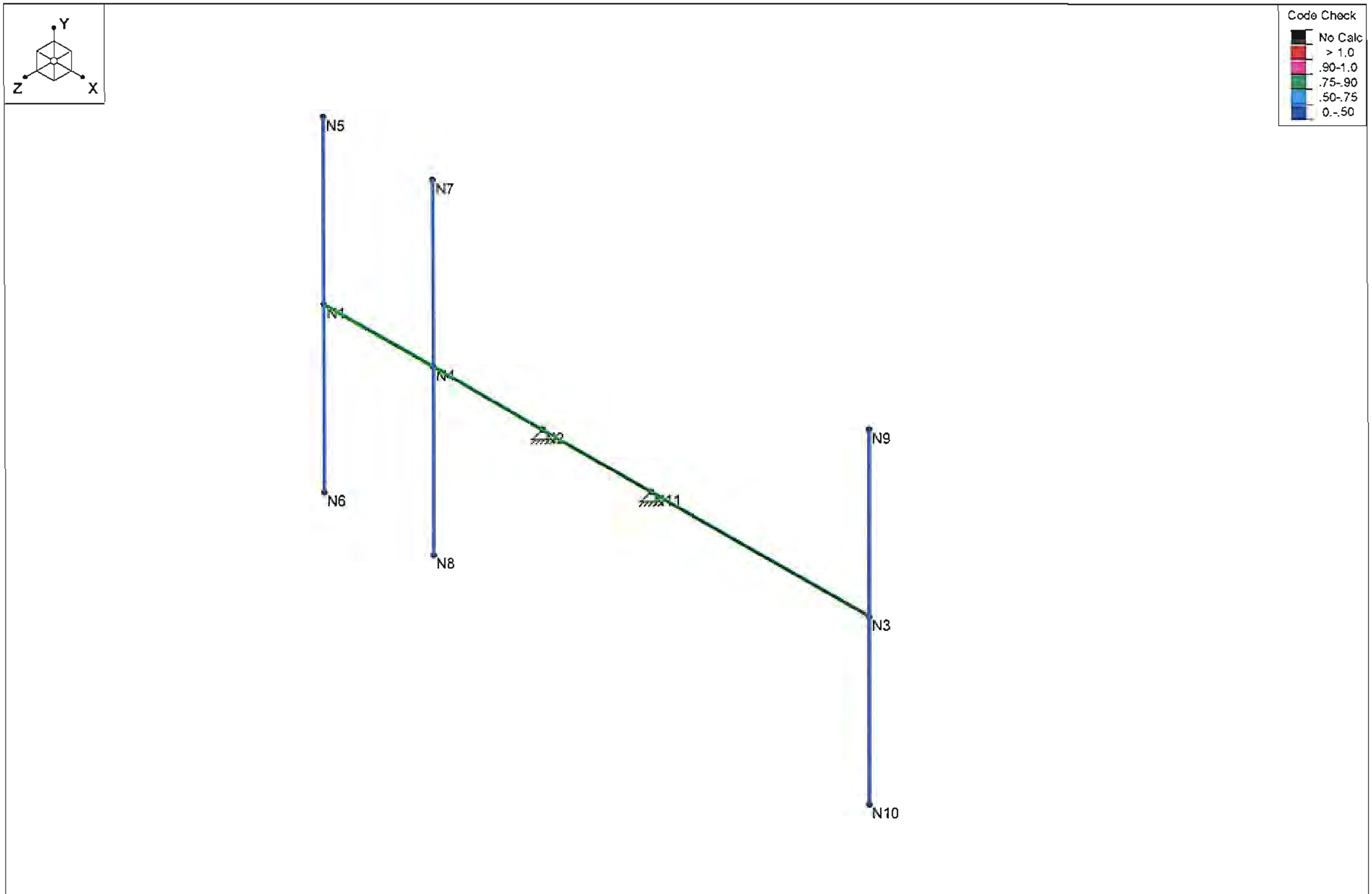
	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	N2	-.828	.259	0	0	0	0
2	2	N11	-.414	.027	0	0	0	0
3	2	N4	NC	NC	NC	LOCKED	NC	NC
4	2	Totals:	-1.242	.286	0			
5	2	COG (ft):	X: 4.189	Y: 0	Z: 0			

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	3	N2	0	.455	-1.148	0	0	0
2	3	N11	0	.037	-.065	0	0	0
3	3	N4	NC	NC	NC	LOCKED	NC	NC
4	3	Totals:	0	.492	-1.213			
5	3	COG (ft):	X: 4.151	Y: 0	Z: 0			

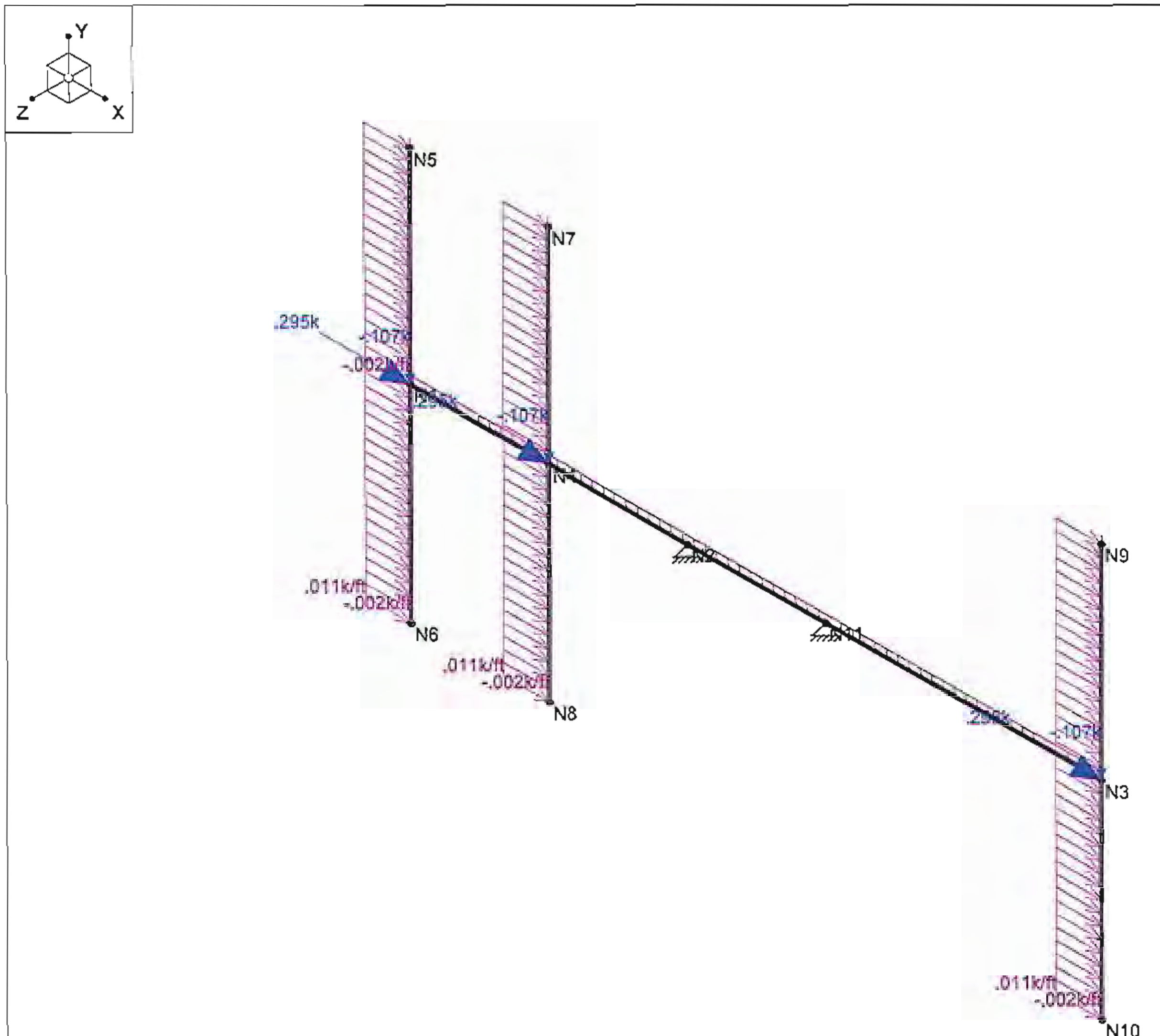
Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	N2	0	.259	-1.302	0	0	0
2	4	N11	0	.027	-.06	0	0	0
3	4	N4	NC	NC	NC	LOCKED	NC	NC
4	4	Totals:	0	.286	-1.362			
5	4	COG (ft):	X: 4.189	Y: 0	Z: 0			



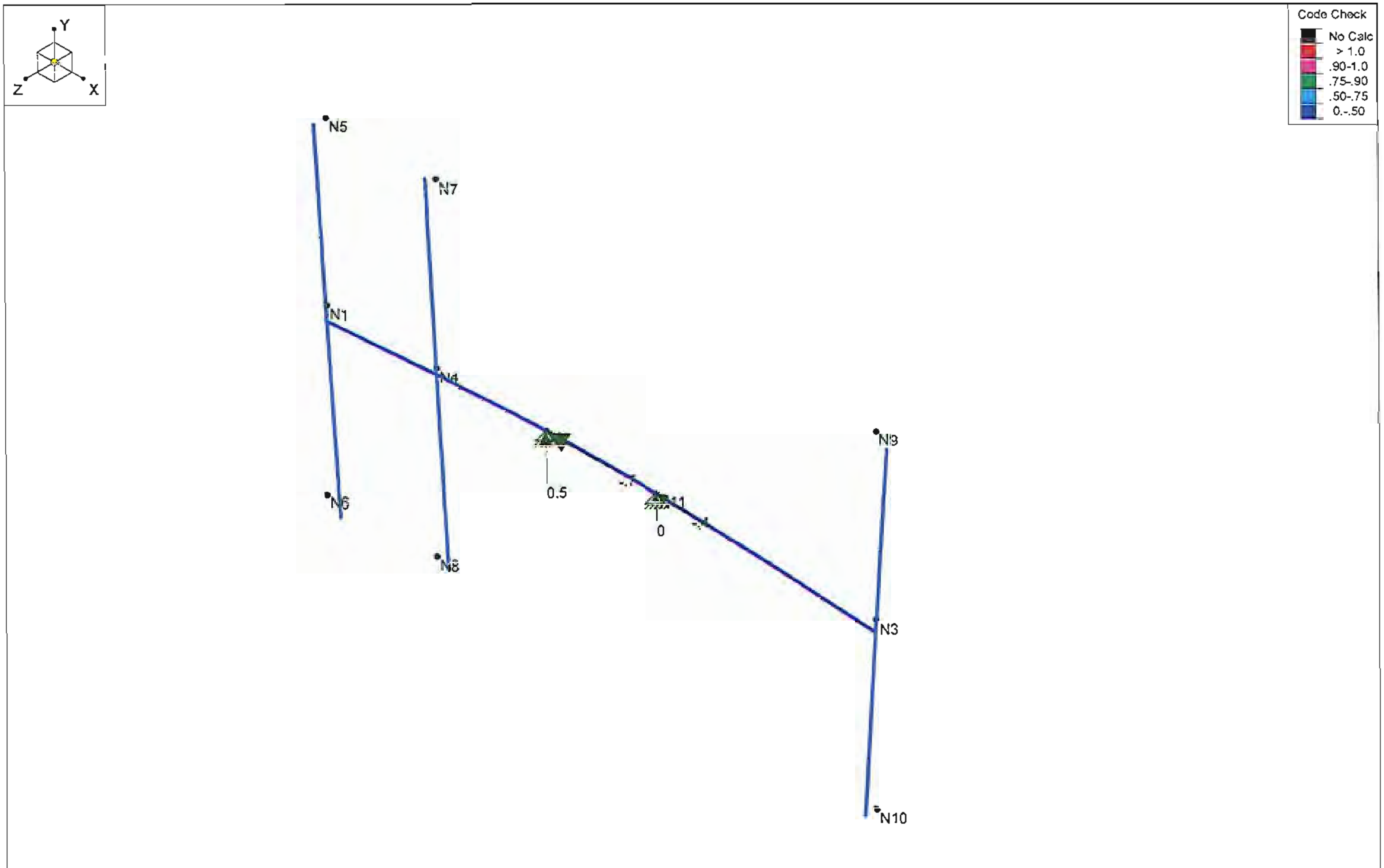
Solution: Envelope

CENTEK Engineering, INC.	CL&P Tower # 844 - Sprint Mast	
tjl, cfc	Unity Check	Apr 9, 2013 at 10:04 AM
12047.CO11 - CT43XC811		TIA-EIA - Sprint.r3d



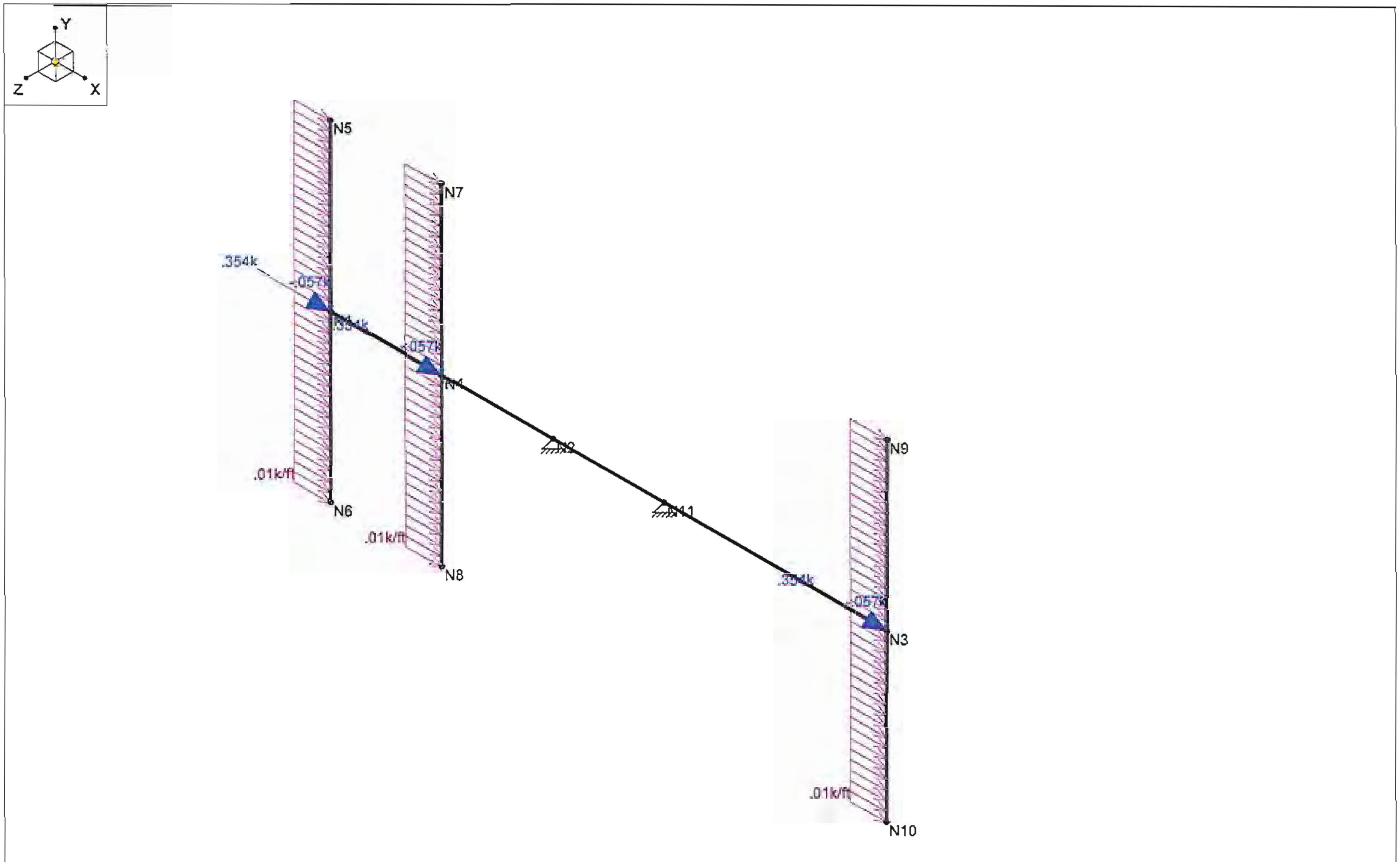
Loads: LC 1, x-dir TIA/EIA Wind + Ice on PCS Structure

CENTEK Engineering, INC.	CL&P Tower # 844 - Sprint Mast	
tjl, cfc		Apr 9, 2013 at 10:04 AM
12047.CO11 - CT43XC811	LC #1 Loads	TIA-EIA - Sprint.r3d



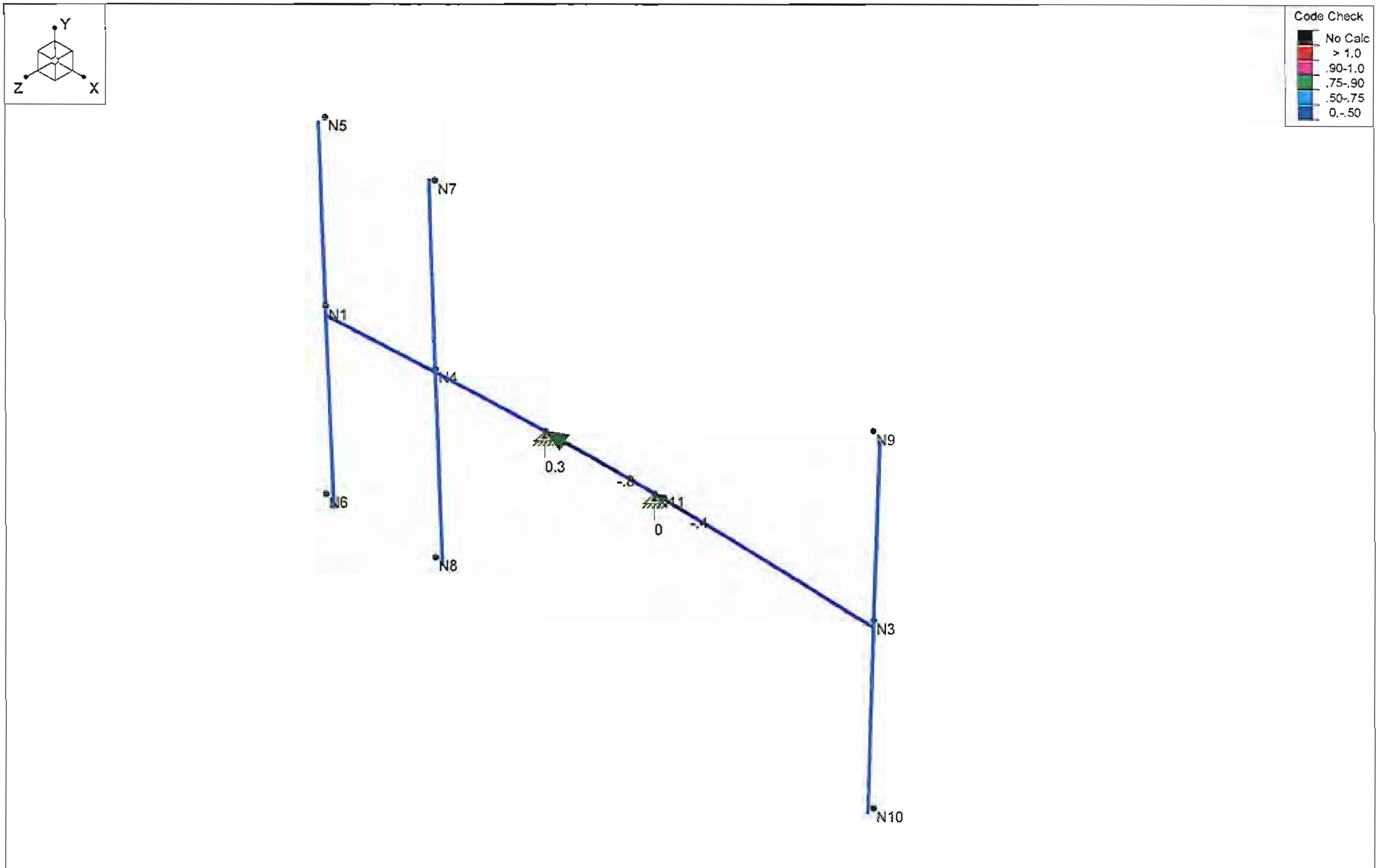
Results for LC 1, x-dir TIA/EIA Wind + Ice on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, INC.		
tjl, cfc	CL&P Tower # 844 - Sprint Mast	Apr 9, 2013 at 10:06 AM
12047.CO11 - CT43XC811	LC #1 Reactions and Deflected Shape	TIA-EIA - Sprint.r3d



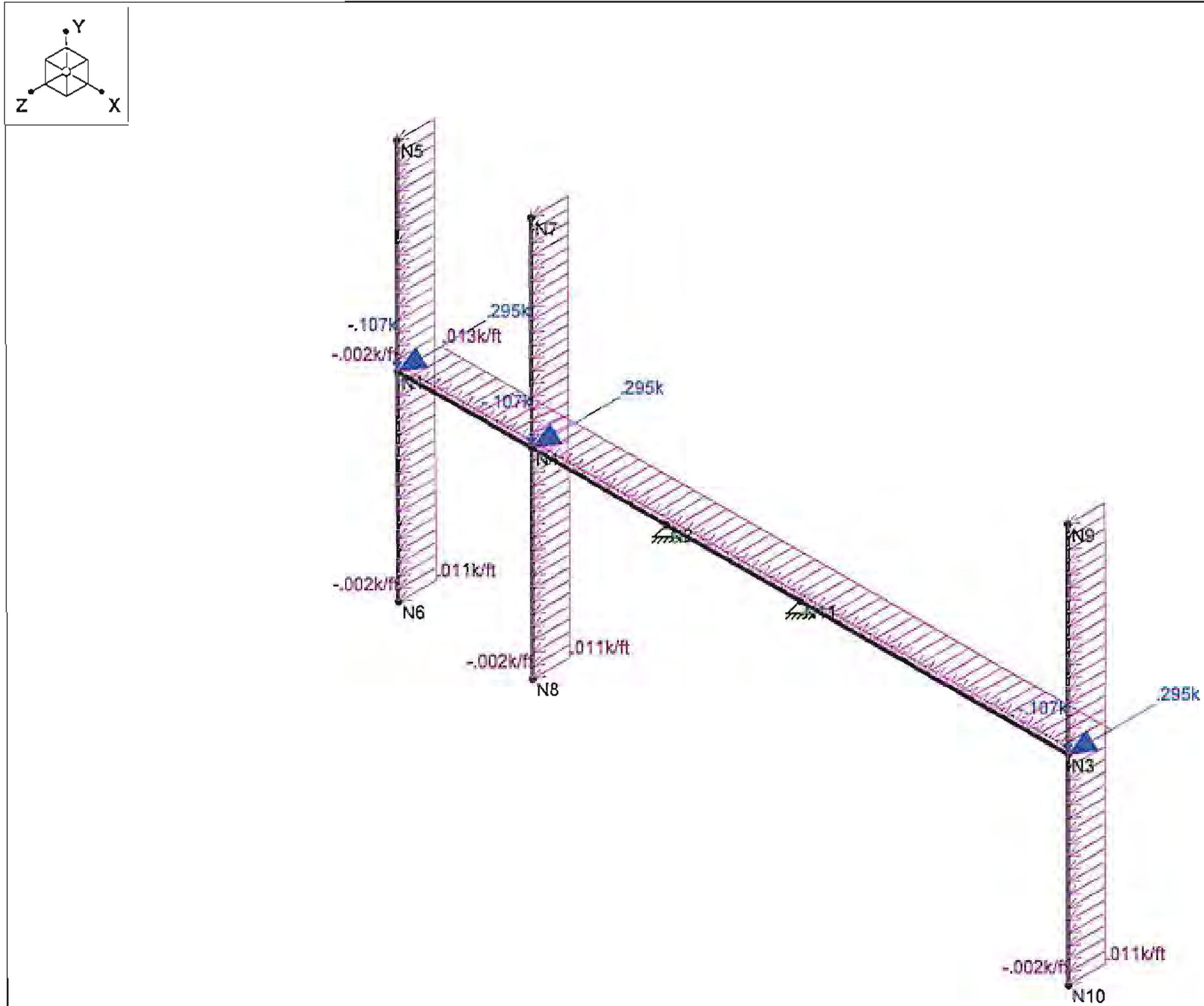
Loads: LC 2, x-dir TIA/EIA Wind on PCS Structure

CENTEK Engineering, INC.	CL&P Tower # 844 - Sprint Mast	
tjl, cfc		Apr 9, 2013 at 10:05 AM
12047.CO11 - CT43XC811	LC #2 Loads	TIA-EIA - Sprint.r3d



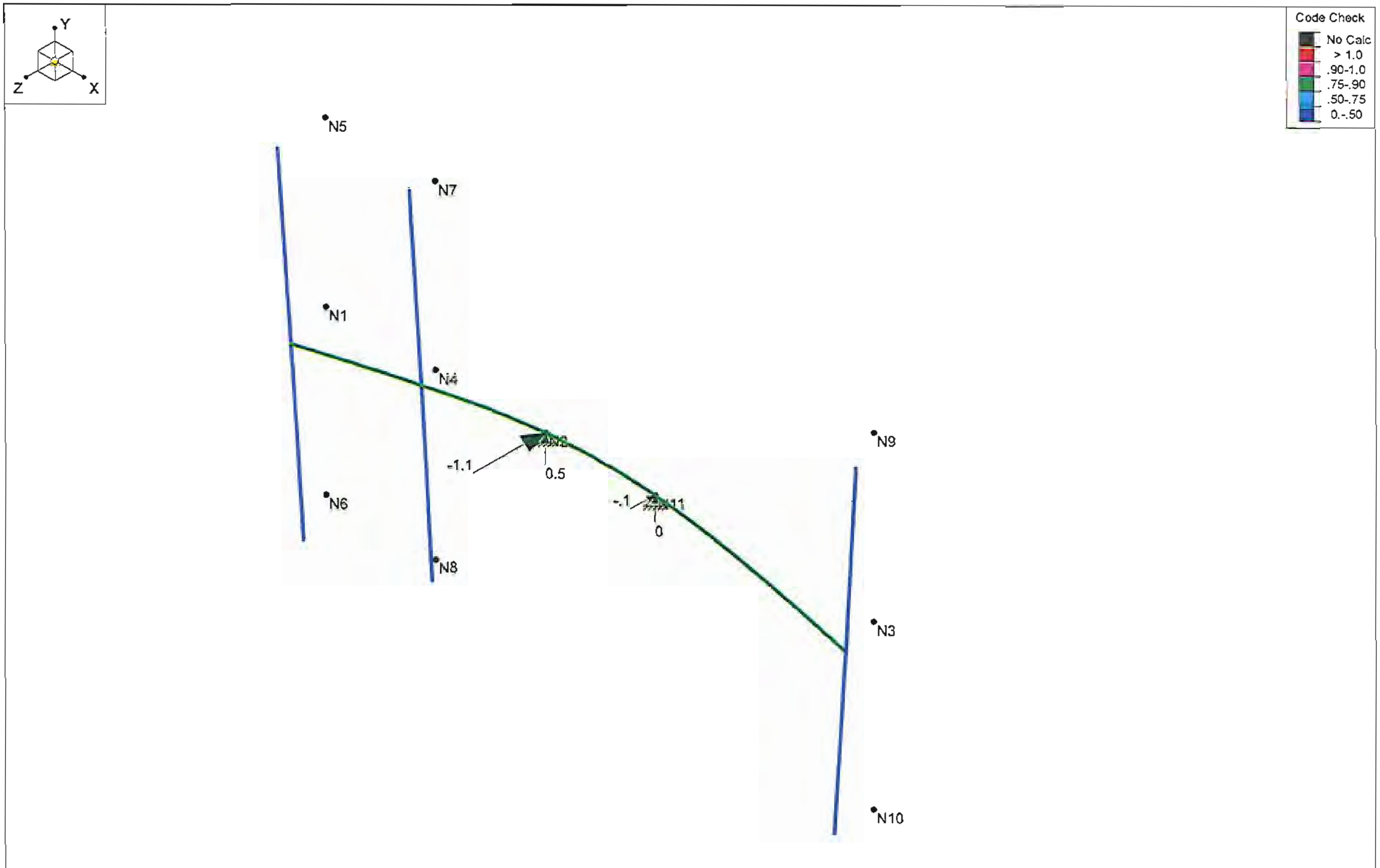
Results for LC 2, x-dir TIA/EIA Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, INC.		
tjl, cfc	CL&P Tower # 844 - Sprint Mast	Apr 9, 2013 at 10:07 AM
12047.CO11 - CT43XC811	LC #2 Reactions and Deflected Shape	TIA-EIA - Sprint.r3d



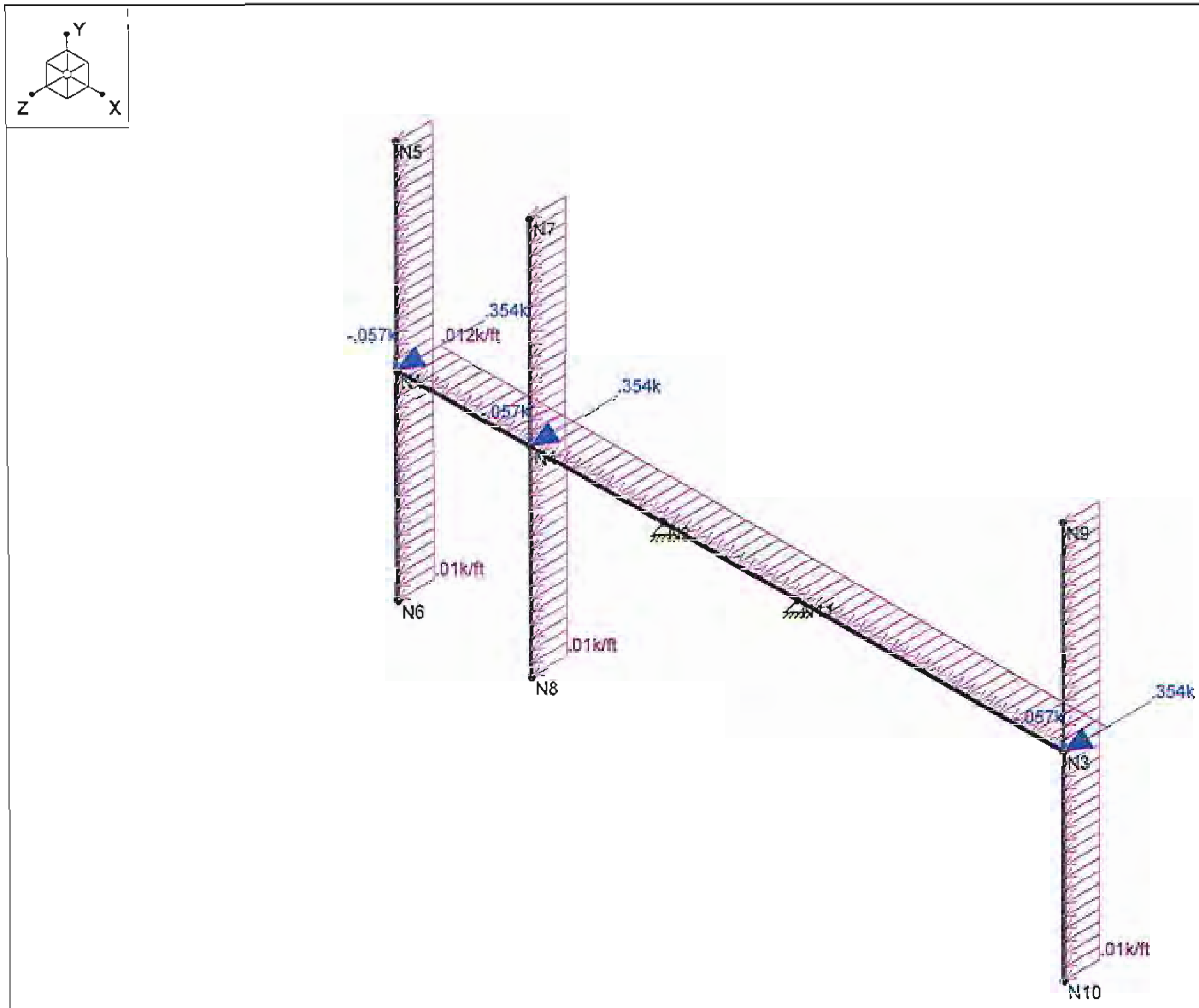
Loads: LC 3, z-dir TIA/EIA Wind + Ice on PCS Structure

CENTEK Engineering, INC.	CL&P Tower # 844 - Sprint Mast	
tjl, cfc		Apr 9, 2013 at 10:05 AM
12047.CO11 - CT43XC811	LC #3 Loads	TIA-EIA - Sprint.r3d



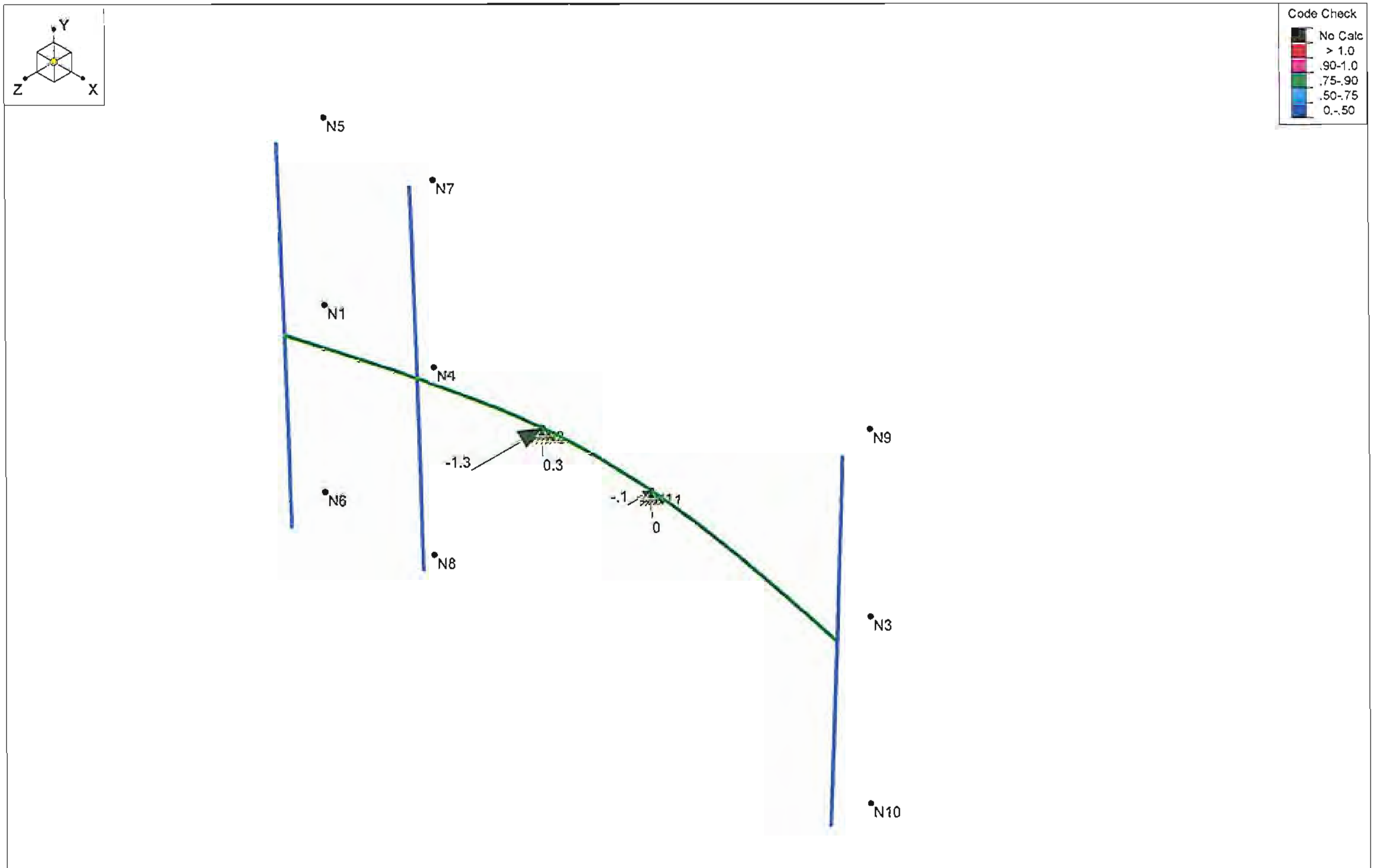
Results for LC 3, z-dir TIA/EIA Wind + Ice on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, INC.	CL&P Tower # 844 - Sprint Mast	
tjl, cfc		Apr 9, 2013 at 10:07 AM
12047.CO11 - CT43XC811	LC #3 Reactions and Deflected Shape	TIA-EIA - Sprint.r3d



Loads: LC 4, z-dir TIA/EIA Wind on PCS Structure

CENTEK Engineering, INC.		
tjl, cfc	CL&P Tower # 844 - Sprint Mast	Apr 9, 2013 at 10:05 AM
12047.CO11 - CT43XC811	LC #4 Loads	TIA-EIA - Sprint.r3d



Results for LC 4, z-dir TIA/EIA Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, INC.		
tjl, cfc	CL&P Tower # 844 - Sprint Mast	Apr 9, 2013 at 10:08 AM
12047.CO11 - CT43XC811	LC #4 Reactions and Deflected Shape	TIA-EIA - Sprint.r3d

Subject:	Connection of Mast to CL&P Tower # 844
Location:	Trumbull, CT
Rev. 0: 4/9/13	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Mast Connection to CL&P Tower:

Reactions:

Moment = $Moment := 0 \cdot kips$ (Input From Risa-3D)

Vertical = $Vertical := 0.26 \cdot kips$ (Input From Risa-3D)

Horizontal x-dir = $Horizontal_x := 0.83 \cdot kips$ (Input From Risa-3D)

Horizontal z-dir = $Horizontal_z := 1.3 \cdot kips$ (Input From Risa-3D)

Bolt Data:

Bolt Type = ASTMA325 (User Input)

Bolt Diameter = $D := 0.75 \cdot in$ (User Input)

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

Allowable Tensile Strength = $F_t := 9.94 \cdot kips$ (User Input)

Allowable Shear Strength = $F_v := 5.97 \cdot kips$ (User Input)

Shear Force = $f_v := \frac{\sqrt{Horizontal_x^2 + Vertical^2}}{N_b} = 0.4 \cdot kips$

Bolt Shear % of Capacity = $\frac{f_v}{F_v} = 7.28 \cdot \%$

Check Bolt Shear = $Bolt\_Shear := if\left(\frac{f_v}{F_v} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

$Bolt\_Shear = \text{"OK"}$

Tension Force = $f_t := \frac{Horizontal_z}{N_b} = 0.7 \cdot kips$

Bolt Tenison % of Capacity = $\frac{f_t}{F_t} = 6.54 \cdot \%$

Check Bolt Tension = $Bolt\_Tension := if\left(\frac{f_t}{F_t} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

$Bolt\_Tension = \text{"OK"}$

Basic Components

Heavy Wind Pressure =	$p := 4.00$	psf	(User Input NESC 2007 Figure 250-1 & Table 250-1)
Basic Windspeed =	$V := 110$	mph	(User Input NESC 2007 Figure 250-2(e))
Radial Ice Thickness =	$Ir := 0.50$	in	(User Input)
Radial Ice Density =	$Id := 56.0$	pcf	(User Input)

Factors for Extreme Wind Calculation

Elevation of Top of PCS Mast Above Grade =	$TME := 163$	ft	(User Input)
Multiplier Gust Response Factor =	$m := 1.25$		(User Input - Only for NESC Extreme wind case)
NESC Factor =	$kv := 1.43$		(User Input from NESC 2007 Table 250-3 equation)
Importance Factor =	$I := 1.0$		(User Input from NESC 2007 Section 250.C.2)

Velocity Pressure Coefficient = $Kz := 2.01 \cdot \left(\frac{TME}{900}\right)^{\frac{2}{9.5}} = 1.403$ (NESC 2007 Table 250-2)

Exposure Factor = $Es := 0.346 \left[\frac{33}{(0.67 \cdot TME)}\right]^{\frac{1}{7}} = 0.292$ (NESC 2007 Table 250-3)

Response Term = $Bs := \frac{1}{\left(1 + 0.375 \cdot \frac{TME}{220}\right)} = 0.783$ (NESC 2007 Table 250-3)

Gust Response Factor = $Grf := \frac{\left[1 + \left(2.7 \cdot Es \cdot Bs^{\frac{1}{2}}\right)\right]}{kv^2} = 0.83$ (NESC 2007 Table 250-3)

Wind Pressure = $qz := 0.00256 \cdot Kz \cdot V^2 \cdot Grf \cdot I = 36$ psf (NESC 2007 Section 250.C.2)

Shape Factors

NUS Design Criteria Issued April 12, 2007

Shape Factor for Round Members =	$Cd_R := 1.3$	(User Input)
Shape Factor for Flat Members =	$Cd_F := 1.6$	(User Input)
Shape Factor for Coax Cables Attached to Outside of Pole =	$Cd_{coax} := 1.45$	(User Input)

Overload Factors

NU Design Criteria Table

Overload Factors for Wind Loads:

NESC Heavy Loading =	2.5	(User Input)	Apply in Risa-3D Analysis
NESC Extreme Loading =	1.0	(User Input)	Apply in Risa-3D Analysis

Overload Factors for Vertical Loads:

NESC Heavy Loading =	1.5	(User Input)	Apply in Risa-3D Analysis
NESC Extreme Loading =	1.0	(User Input)	Apply in Risa-3D Analysis

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

Subject:	Load Analysis of Pipe Mast and Sprint Equipment on CL&P Structure #844
Location:	Trumbull, CT
Rev. 0: 4/9/13	Prepared by: T.J.L Checked by: C.F.C. Job No. 12047.CO11

Development of Wind & Ice Load on PCS Mast

PCS Mast Data: (HSS2.875x0.203)

Mast Shape = Round (User Input)

Mast Diameter = $D_{mast} := 2.875$ in (User Input)

Mast Length = $L_{mast} := 10$ ft (User Input)

Mast Thickness = $t_{mast} := 0.293$ in (User Input)

Wind Load (NESC Extreme)

Mast Projected Surface Area = $A_{mast} := \frac{D_{mast}}{12} = 0.24$ sf/ft

Total Mast Wind Force (Below NU Structure) = $qz \cdot Cd_R \cdot A_{mast} = 11$ plf **BLC 5,7**

Wind Load (NESE Heavy)

Mast Projected Surface Area w/ Ice = $AICE_{mast} := \frac{(D_{mast} + 2 \cdot Ir)}{12} = 0.323$ sf/ft

Total Mast Wind Force w/ Ice = $p \cdot Cd_R \cdot AICE_{mast} = 2$ plf **BLC 4,6**

Gravity Loads (without ice)

Weight of the Mast = Self Weight (Computed internally by Risa-3D) plf **BLC 1**

Gravity Loads (ice only)

Ice Area per Linear Foot = $Ai_{mast} := \frac{\pi}{4}\left[(D_{mast} + Ir \cdot 2)^2 - D_{mast}^2\right] = 5.3$ sq in

Weight of Ice on Mast = $W_{ICEmast} := Id \cdot \frac{Ai_{mast}}{144} = 2$ plf **BLC 3**

Development of Wind & Ice Load on Antennas

Antenna Data: (Sprint)

Antenna Model =	RFS APXVSPP18-C			
Antenna Shape =	Flat		(User Input)	
Antenna Height =	$L_{ant} := 72$	in	(User Input)	
Antenna Width =	$W_{ant} := 11.8$	in	(User Input)	
Antenna Thickness =	$T_{ant} := 7$	in	(User Input)	
Antenna Weight =	$WT_{ant} := 57$	lbs	(User Input)	
Number of Antennas =	$N_{ant} := 1$		(User Input)	(One per pipe mast / tot. of 3)

Wind Load (NESC Extreme)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna = $SA_{ant} := \frac{L_{ant} \cdot W_{ant}}{144} = 5.9$ sf

Antenna Projected Surface Area = $A_{ant} := SA_{ant} \cdot N_{ant} = 5.9$ sf

Total Antenna Wind Force = $F_{ant} := qz \cdot Cd_F \cdot A_{ant} \cdot m = 425$ lbs **BLC 5,7**

Wind Load (NESC Heavy)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna w/ Ice = $SA_{ICEant} := \frac{(L_{ant}+1) \cdot (W_{ant}+1)}{144} = 6.5$ sf

Antenna Projected Surface Area w/ Ice = $A_{ICEant} := SA_{ICEant} \cdot N_{ant} = 6.5$ sf

Total Antenna Wind Force w/ Ice = $Fi_{ant} := p \cdot Cd_F \cdot A_{ICEant} = 42$ lbs **BLC 4,6**

Gravity Load (without Ice)

Weight of All Antennas = $WT_{ant} \cdot N_{ant} = 57$ lbs **BLC 2**

Gravity Load (ice only)

Volume of Each Antenna = $V_{ant} := L_{ant} \cdot W_{ant} \cdot T_{ant} = 5947$ cu in

Volume of Ice on Each Antenna = $V_{ice} := (L_{ant}+1)(W_{ant}+1) \cdot (T_{ant}+1) - V_{ant} = 1528$ cu in

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

Weight of Ice on All Antennas = $W_{ICEant} \cdot N_{ant} = 50$ lbs **BLC 3**

Development of Wind & Ice Load on Pipe Mast

Mast Data: (2" Std. Pipe)

Mast Shape =	Round		(User Input)
Mast Diameter =	$D_{mast} := 2.375$	in	(User Input)
Mast Length =	$L_{mast} := 6$	ft	(User Input)
Mast Thickness =	$t_{mast} := 0.154$	in	(User Input)

Wind Load (NESC Extreme)

Mast Projected Surface Area = $A_{mast} := \frac{D_{mast}}{12} = 0.198$ sf/ft

Total Mast Wind Force (Below NU Structure) = $qz \cdot Cd_R \cdot A_{mast} = 9$ plf **BLC 5,7**

Wind Load (NESC Heavy)

Mast Projected Surface Area w/ Ice = $AICE_{mast} := \frac{(D_{mast} + 2 \cdot Ir)}{12} = 0.281$ sf/ft

Total Mast Wind Force w/ Ice = $p \cdot Cd_R \cdot AICE_{mast} = 1$ plf **BLC 4,6**

Gravity Loads (without ice)

Weight of the Mast = Self Weight (Computed internally by Risa-3D) plf **BLC 1**

Gravity Loads (ice only)

Ice Area per Linear Foot = $Ai_{mast} := \frac{\pi}{4}\left[(D_{mast} + Ir \cdot 2)^2 - D_{mast}^2\right] = 4.5$ sq in

Weight of Ice on Mast = $W_{ICEmast} := Id \cdot \frac{Ai_{mast}}{144} = 2$ plf **BLC 3**

Basic Components

Heavy Wind Pressure =	$p := 4.00$	psf	(User Input NESC 2007 Figure 250-1 & Table 250-1)
Basic Windspeed =	$V := 110$	mph	(User Input NESC 2007 Figure 250-2(e))
Radial Ice Thickness =	$Ir := 0.50$	in	(User Input)
Radial Ice Density =	$Id := 56.0$	pcf	(User Input)

Factors for Extreme Wind Calculation

Elevation of Top of PCS Mast Above Grade =	$TME := 163$	ft	(User Input)
Multiplier Gust Response Factor =	$m := 1.25$		(User Input - Only for NESC Extreme wind case)
NESC Factor =	$kv := 1.43$		(User Input from NESC 2007 Table 250-3 equation)
Importance Factor =	$I := 1.0$		(User Input from NESC 2007 Section 250.C.2)

Velocity Pressure Coefficient = $Kz := 2.01 \cdot \left(\frac{TME}{900}\right)^{\frac{2}{9.5}} = 1.403$ (NESC 2007 Table 250-2)

Exposure Factor = $Es := 0.346 \left[\frac{33}{(0.67 \cdot TME)}\right]^{\frac{1}{7}} = 0.292$ (NESC 2007 Table 250-3)

Response Term = $Bs := \frac{1}{\left(1 + 0.375 \cdot \frac{TME}{220}\right)} = 0.783$ (NESC 2007 Table 250-3)

Gust Response Factor = $Grf := \frac{\left[1 + \left(2.7 \cdot Es \cdot Bs^{\frac{1}{2}}\right)\right]}{kv^2} = 0.83$ (NESC 2007 Table 250-3)

Wind Pressure = $qz := 0.00256 \cdot Kz \cdot V^2 \cdot Grf \cdot I = 36$ psf (NESC 2007 Section 250.C.2)

Shape Factors NUS Design Criteria Issued April 12, 2007

Shape Factor for Round Members =	$Cd_R := 1.3$	(User Input)
Shape Factor for Flat Members =	$Cd_F := 1.6$	(User Input)
Shape Factor for Coax Cables Attached to Outside of Pole =	$Cd_{coax} := 1.45$	(User Input)

Overload Factors NU Design Criteria Table

Overload Factors for Wind Loads:

NESC Heavy Loading =	2.5	(User Input)	Apply in Risa-3D Analysis
NESC Extreme Loading =	1.0	(User Input)	Apply in Risa-3D Analysis

Overload Factors for Vertical Loads:

NESC Heavy Loading =	1.5	(User Input)	Apply in Risa-3D Analysis
NESC Extreme Loading =	1.0	(User Input)	Apply in Risa-3D Analysis

Development of Wind & Ice Load on PCS Mast

Existing PCS Mast Data: (HSS6.625x0.432)

Mast Shape = Round (User Input)

Mast Diameter = $D_{mast} := 6.625$ in (User Input)

Mast Length = $L_{mast} := 21.0$ ft (User Input)

Mast Thickness = $t_{mast} := 0.432$ in (User Input)

Wind Load (NESC Extreme)

Mast Projected Surface Area = $A_{mast} := \frac{D_{mast}}{12} = 0.552$

Total Mast Wind Force (Above NU Structure) = $qz \cdot Cd_R \cdot A_{mast} \cdot m = 32$ plf **BLC 5**

Total Mast Wind Force (Below NU Structure) = $qz \cdot Cd_R \cdot A_{mast} = 26$ plf **BLC 5**

Wind Load (NESE Heavy)

Mast Projected Surface Area w/ Ice = $AICE_{mast} := \frac{(D_{mast} + 2 \cdot Ir)}{12} = 0.635$

Total Mast Wind Force w/ Ice = $p \cdot Cd_R \cdot AICE_{mast} = 3$ plf **BLC 4**

Gravity Loads (without ice)

Weight of the mast = Self Weight (Computed Internally by Risa-3D) plf **BLC 1**

Gravity Loads (ice only)

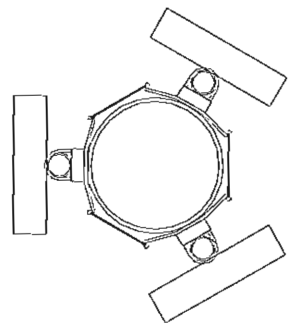
Ice Area per Linear Foot = $Ai_{mast} := \frac{\pi}{4}\left[(D_{mast} + Ir \cdot 2)^2 - D_{mast}^{\ 2}\right] = 11.2$ sq in

Weight of Ice on Mast = $W_{ICEmast} := Id \cdot \frac{Ai_{mast}}{144} = 4$ plf **BLC 3**

Development of Wind & Ice Load on Antennas

Proposed Antenna Data:

Antenna Model =	Powerwave P65-15-XLH-RR		
Antenna Shape =	Flat		(User Input)
Antenna Height =	$L_{ant} := 51.0$	in	(User Input)
Antenna Width =	$W_{ant} := 12.0$	in	(User Input)
Antenna Thickness =	$T_{ant} := 6.0$	in	(User Input)
Antenna Weight =	$WT_{ant} := 41$	lbs	(User Input)
Number of Antennas =	$N_{ant} := 3$		(User Input)



Wind Load (NESC Extreme)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna =	$SA_{ant} := \frac{L_{ant} \cdot W_{ant}}{144} = 4.3$	sf	
Antenna Projected Surface Area =	$A_{ant} := SA_{ant} \cdot N_{ant} = 12.8$	sf	
Total Antenna Wind Force =	$F_{ant} := qz \cdot Cd_F \cdot A_{ant} \cdot m = 919$	lbs	**BLC 5**

Wind Load (NESC Heavy)

Assumes Maximum Possible Wind Pressure Applied to all Antennas Simultaneously

Surface Area for One Antenna w/ Ice =	$SA_{ICEant} := \frac{(L_{ant} + 1) \cdot (W_{ant} + 1)}{144} = 4.7$	sf	
Antenna Projected Surface Area w/ Ice =	$A_{ICEant} := SA_{ICEant} \cdot N_{ant} = 14.1$	sf	
Total Antenna Wind Force w/ Ice =	$Fi_{ant} := p \cdot Cd_F \cdot A_{ICEant} = 90$	lbs	**BLC 4**

Gravity Load (without ice)

Weight of All Antennas =	$WT_{ant} \cdot N_{ant} = 123$	lbs	**BLC 2**

Gravity Load (ice only)

Volume of Each Antenna =	$V_{ant} := L_{ant} \cdot W_{ant} \cdot T_{ant} = 3672$	cu in	
Volume of Ice on Each Antenna =	$V_{ice} := (L_{ant} + 1)(W_{ant} + 1) \cdot (T_{ant} + 1) - V_{ant} = 1060$	cu in	
Weight of Ice on Each Antenna =	$W_{ICEant} := \frac{V_{ice}}{1728} \cdot Id = 34$	lbs	
Weight of Ice on All Antennas =	$W_{ICEant} \cdot N_{ant} = 103$	lbs	**BLC 3**

Development of Wind & Ice Load on TMAs

Proposed TMA Data:

TMA Model = CCI DTMABP7819VG12A

TMA Shape = Flat (User Input)

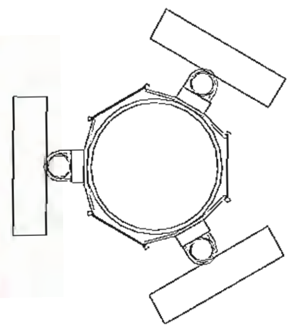
TMA Height = $L_{tma} := 10.63$ in (User Input)

TMA Width = $W_{tma} := 11.02$ in (User Input)

TMA Thickness = $T_{tma} := 3.78$ in (User Input)

TMA Weight = $WT_{tma} := 19.2$ lbs (User Input)

Number of TMAs = $N_{tma} := 3$ (User Input)



Wind Load (NESC Extreme)

Assumes Maximum Possible Wind Pressure Applied to ALL TMAs Simultaneously

Surface Area for One TMA = $SA_{tma} := \frac{L_{tma} \cdot W_{tma}}{144} = 0.8$ sf

TMA Projected Surface Area = $A_{tma} := SA_{tma} \cdot N_{tma} = 2.4$ sf

Total TMA Wind Force = $F_{tma} := qz \cdot Cd_F \cdot A_{tma} \cdot m = 176$ lbs **BLC 5**

Wind Load (NESC Heavy)

Assumes Maximum Possible Wind Pressure Applied to ALL TMAs Simultaneously

Surface Area for One TMA w/ Ice = $SA_{ICEtma} := \frac{(L_{tma} + 1) \cdot (W_{tma} + 1)}{144} = 1$ sf

TMA Projected Surface Area w/ Ice = $A_{ICEtma} := SA_{ICEtma} \cdot N_{tma} = 2.9$ sf

Total TMA Wind Force w/ Ice = $Fi_{tma} := p \cdot Cd_F \cdot A_{ICEtma} = 19$ lbs **BLC 4**

Gravity Load (without ice)

Weight of All TMAs = $WT_{tma} \cdot N_{tma} = 58$ lbs **BLC 2**

Gravity Loads (ice only)

Volume of Each TMA = $V_{tma} := L_{tma} \cdot W_{tma} \cdot T_{tma} = 443$ cu in

Volume of Ice on Each TMA = $V_{ice} := (L_{tma} + 1)(W_{tma} + 1) \cdot (T_{tma} + 1) - V_{tma} = 225$ cu in

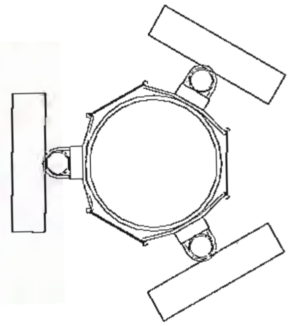
Weight of Ice on Each TMA = $W_{ICEtma} := \frac{V_{ice}}{1728} \cdot Id = 7$ lbs

Weight of Ice on All TMAs = $W_{ICEtma} \cdot N_{tma} = 22$ lbs **BLC 3**

Development of Wind & Ice Load on Antenna Mounts

Proposed Mount Data:

Mount Type: Site Pro Tri-Sector Chain Mount w/ 3 Pipes



Mount Shape = Round (User Input)

Pipe Mount Length = $L_{mnt} := 60$ in (User Input)

2 inch Pipe Mount Linear Weight = $W_{mnt} := 3.66$ plf (User Input)

Pipe Mount Outside Diameter = $D_{mnt} := 2.375$ in (User Input)

Number of Mounting Pipes = $N_{mnt} := 3$ (User Input)

Tri Sector Chain Mount Weight = $W_{tsc.mnt} := 101$ lbs (User Input)

Wind Load (NESC Extreme)

Assumes Mount Is Shielded by Antenna

Mount Projected Surface Area = $A_{mnt} := 0.0$ sf

Total Mount Wind Force = $F_{mnt} := qz \cdot Cd_F \cdot A_{mnt} \cdot m = 0$ lbs **BLC 5**

Wind Load (NESC Heavy)

Assumes Mount is Shielded by Antenna

Mount Projected Surface Area w/ Ice = $A_{ICEmnt} := 0.0$ sf

Total Mount Wind Force = $Fi_{mnt} := p \cdot Cd_F \cdot A_{ICEmnt} = 0$ lbs **BLC 4**

Gravity Loads (without ice)

(per TIA/EIA-222-F-1996)

Weight Each Pipe Mount = $WT_{mnt} := W_{mnt} \cdot \frac{L_{mnt}}{12} = 18$ lbs

Weight of All Mounts = $WT_{mnt} \cdot N_{mnt} + W_{tsc.mnt} = 156$ lbs **BLC 2**

Gravity Load (ice only)

(per TIA/EIA-222-F-1996)

Volume of Each Pipe = $V_{mnt} := \frac{\pi}{4} \cdot D_{mnt}^{2} \cdot L_{mnt} = 266$ cu in

Volume of Ice on Each Pipe = $V_{ice} := \left[\frac{\pi}{4} \cdot \left[\left(D_{mnt} + 1\right)^2\right] \cdot \left(L_{mnt} + 1\right)\right] - V_{mnt} = 280$ cu in

Weight of Ice each mount (incl, hardware) = $W_{ICEmnt} := \frac{V_{ice}}{1728} \cdot Id = 9$ lbs

Weight of Ice on All Mounts = $W_{ICEmnt} \cdot N_{mnt} + 5 = 32$ lbs **BLC 3**

Development of Wind & Ice Load on Coax Cables

Existing Coax Cable Data:

Coax Type = HELIAX 1-5/8"

Shape = Round (User Input)

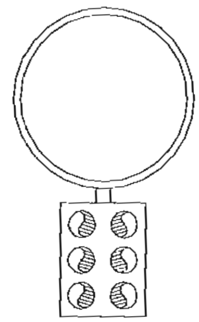
Coax Outside Diameter = $D_{coax} := 1.98$ in (User Input)

Coax Cable Length = $L_{coax} := 21$ ft (User Input)

Weight of Coax per foot = $Wt_{coax} := 1.04$ plf (User Input)

Total Number of Coax = $N_{coax} := 6$ (User Input)

No. of Coax Projecting Outside Face of PCS Mast = $NP_{coax} := 3$ (User Input)



Wind Load (NESC Extreme)

Coax projected surface area = $A_{coax} := \frac{(NP_{coax} D_{coax})}{12} = 0.5$ ft

Total Coax Wind Force (Above NU Structure) = $F_{coax} := qz \cdot Cd_{coax} \cdot A_{coax} \cdot m = 32$ plf **BLC 5**

Wind Load (NESC Heavy)

Coax projected surface area w/ Ice = $AICE_{coax} := \frac{(NP_{coax} \cdot D_{coax} + 2 \cdot Ir)}{12} = 0.6$ ft

Total Coax Wind Force w/ Ice = $Fi_{coax} := p \cdot Cd_{coax} \cdot AICE_{coax} = 3$ plf **BLC 4**

Gravity Loads (without ice)

Weight of all cables w/o ice $WT_{coax} := Wt_{coax} \cdot N_{coax} = 6$ plf **BLC 2**

Gravity Load (ice only)

Ice Area per Linear Foot = $Ai_{coax} := \frac{\pi}{4}\left[(D_{coax} + 2 \cdot Ir)^2 - D_{coax}^2\right] = 3.9$ sq in

Ice Weight All Coax per foot = $WTi_{coax} := N_{coax} \cdot Id \cdot \frac{Ai_{coax}}{144} = 9$ plf **BLC 3**

CENTEK engineering, INC.
Consulting Engineers
63-2 North Branford Road
Branford, CT 06405
Ph. 203-488-0580 / Fax. 203-488-8587

Subject: **Analysis of NESC Heavy Wind and NESC Extreme Wind for Obtaining PCS Structure Reactions Applied to CL&P Structure Tabulated Load Cases / Sprint**

Location: **Trumbull, CT**

Date:4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Case	Description
1	Self Weight (PCS Mast)
2	Weight of Appurtenances
3	Weight of Ice Only on PCS Structure (1)
4	x-direction NESC Heavy Wind on PCS Structure(1)
5	x-direction NESC Extreme Wind on PCS Structure(1)
6	z-direction NESC Heavy Wind on PCS Structure(1)
7	z-direction NESC Extreme Wind on PCS Structure(1)

Footnotes:
(1) PCS Structure includes: Mast and Appurtenances

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Subject: **Analysis of NESC Heavy Wind and NESC Extreme Wind for Obtaining PCS Structure Reactions Applied to CL&P Structure Load Combinations Table / Sprint**

Location: **Trumbull, CT**

Date: 4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Combination	Description	Envelope Soultion	Wind Factor	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	x-direction NESC Heavy Wind on PCS Structure		1		1	1.5	2	1.5	3	1.5	4	2.5		
2	x-direction NESC Extreme Wind on PCS Structure		1		1	1	2	1	5	1				
3	z-direction NESC Heavy Wind on PCS Structure		1		1	1.5	2	1.5	3	1.5	6	2.5		
4	z-direction NESC Extreme Wind on PCS Structure		1		1	1	2	1	7	1				

Footnotes:
(1) BLC = Basic Load Case
(2) PCS Structure includes: Mast and Appurtenances

Global

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y
Global Member Orientation Plane	XZ

Hot Rolled Steel Code	AISC 9th: ASD
Cold Formed Steel Code	AISI 1999: ASD
Wood Code	AF&PA NDS-97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-02
Masonry Code	ACI 530-05/08: ASD
Aluminum Code	AA ADM1-05: ASD

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
Bad Framing Warnings	No
Unused Force Warnings	Yes

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ct Exp. X	.75
Ct Exp. Z	.75
Ca	.36
Cv	.54
Nv	1
SD1	1
SDS	1
S1	1
Occupancy Code	4
Seismic Zone	3
Use Group	I
Use Gravity Self Wt in Diaphragm Mass	Yes
Use Deck Self Wt in Diaphragm Mass	Yes
Use Lateral Self Wt in Diaphragm Mass	Yes
Seismic Detailing Code	None
Om X	1
Om Z	1
Rho X	1
Rho Z	1

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A36 Gr.36	29000	11154	.3	.65	.49	36	1.5	58	1.2
2	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	58	1.2
3	A992	29000	11154	.3	.65	.49	50	1.1	58	1.2
4	A500 Gr.42	29000	11154	.3	.65	.49	42	1.3	58	1.1
5	A500 Gr.46	29000	11154	.3	.65	.49	46	1.2	58	1.1
6	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	58	1.2

Hot Rolled Steel Design Parameters

	Label	Shape	Lengt...	Lbyy[ft]	Lbzz[ft]	Lcomp top[ft]	Lcomp bot[ft]	Kyy	Kzz	Cm-...	Cm-...	Cb	y sw...	z sw...	Function
1	M1	Horz Mast	10												Lateral
2	M2	Pipe Mast	6												Lateral
3	M3	Pipe Mast	6												Lateral
4	M4	Pipe Mast	6												Lateral

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	Horz Mast	HSS2.875X0.203	Beam	Pipe	A500 Gr.42	Typical	1.59	1.45	1.45	2.89
2	Pipe Mast	PIPE_2.0	Beam	Pipe	A53 Gr. B	Typical	1	.627	.627	1.25

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N3			Horz Mast	Beam	Pipe	A500 Gr.42	Typical
2	M2	N6	N5			Pipe Mast	Beam	Pipe	A53 Gr. B	Typical
3	M3	N8	N7			Pipe Mast	Beam	Pipe	A53 Gr. B	Typical
4	M4	N10	N9			Pipe Mast	Beam	Pipe	A53 Gr. B	Typical

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N1	0	0	0	0	
2	N2	4	0	0	0	
3	N3	10	0	0	0	
4	N4	2	0	0	0	
5	N5	0	3	0	0	
6	N6	0	-3	0	0	
7	N7	2	3	0	0	
8	N8	2	-3	0	0	
9	N9	10	3	0	0	
10	N10	10	-3	0	0	
11	N11	6	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]	Footing
1	N2	Reaction	Reaction	Reaction				
2	N11	Reaction	Reaction	Reaction				

Joint Loads and Enforced Displacements

Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
No Data to Print ...			

Member Point Loads (BLC 2 : Weight of Appurtenances)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Y	-.057	%50
2	M3	Y	-.057	%50
3	M4	Y	-.057	%50

Member Point Loads (BLC 3 : Weight of Ice Only on PCS Struct)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Y	-.05	%50
2	M3	Y	-.05	%50
3	M4	Y	-.05	%50

Member Point Loads (BLC 4 : x-dir NESC Heavy Wind on PCS Str)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	X	.042	%50
2	M3	X	.042	%50
3	M4	X	.042	%50

Member Point Loads (BLC 5 : x-dir NESC Extreme Wind on PCS S)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	X	.425	%50
2	M3	X	.425	%50
3	M4	X	.425	%50

Member Point Loads (BLC 6 : z-dir NESC Heavy Wind on PCS Str)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Z	.042	%50
2	M3	Z	.042	%50
3	M4	Z	.042	%50

Member Point Loads (BLC 7 : z-dir NESC Extreme Wind on PCS S)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M2	Z	.425	%50
2	M3	Z	.425	%50
3	M4	Z	.425	%50

Member Distributed Loads (BLC 3 : Weight of Ice Only on PCS Struct)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.002	-.002	0	0
2	M2	Y	-.002	-.002	0	0
3	M3	Y	-.002	-.002	0	0
4	M4	Y	-.002	-.002	0	0

Member Distributed Loads (BLC 4 : x-dir NESC Heavy Wind on PCS Str)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	X	.001	.001	0	0
2	M3	X	.001	.001	0	0
3	M4	X	.001	.001	0	0

Member Distributed Loads (BLC 5 : x-dir NESC Extreme Wind on PCS S)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	X	.009	.009	0	0
2	M3	X	.009	.009	0	0
3	M4	X	.009	.009	0	0

Member Distributed Loads (BLC 6 : z-dir NESC Heavy Wind on PCS Str)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	Z	.001	.001	0	0
2	M3	Z	.001	.001	0	0
3	M4	Z	.001	.001	0	0
4	M1	Z	.002	.002	0	0

Member Distributed Loads (BLC 7 : z-dir NESC Extreme Wind on PCS S)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M2	Z	.009	.009	0	0
2	M3	Z	.009	.009	0	0
3	M4	Z	.009	.009	0	0
4	M1	Z	.011	.011	0	0

Basic Load Cases

	BLC Description	Category	X Gr...	Y Gr...	Z Grav...	Joint	Point	Distri...	Area(...	Surfa...
1	Self Weight (PCS Mast)	None		-1						
2	Weight of Appurtenances	None					3			
3	Weight of Ice Only on PCS Struct	None					3	4		
4	x-dir NESC Heavy Wind on PCS Str	None					3	3		
5	x-dir NESC Extreme Wind on PCS S	None					3	3		
6	z-dir NESC Heavy Wind on PCS Str	None					3	4		
7	z-dir NESC Extreme Wind on PCS S	None					3	4		

Load Combinations

	Description	So...	PDelta	SRSS	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	x-dir NESC Heavy Wind on P..	Yes			1	1.5	2	1.5	3	1.5	4	2.5								
2	x-dir NESC Extreme Wind on..	Yes			1	1	2	1	5	1										
3	z-dir NESC Heavy Wind on P..	Yes			1	1.5	2	1.5	3	1.5	6	2.5								
4	z-dir NESC Extreme Wind on..	Yes			1	1	2	1	7	1										
5	Self Weight				1	1														

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	0	3	.683	1	0	1	0	1	0	1	0	1
2		min	-.958	2	.259	2	-1.492	4	0	1	0	1	0	1
3	N11	max	0	3	.056	1	0	1	0	1	0	1	0	1

Envelope Joint Reactions (Continued)

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
4		min	-.479	2	.027	2	-.055	4	0	1	0	1	0	1
5	N4	max	NC		NC		NC		LOCKED		NC		NC	
6		min	NC		NC		NC		LOCKED		NC		NC	
7	Totals:	max	0	3	.739	1	0	1						
8		min	-1.437	2	.286	2	-1.547	4						

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N2	-.24	.683	0	0	0	0
2	1	N11	-.12	.056	0	0	0	0
3	1	N4	NC	NC	NC	LOCKED	NC	NC
4	1	Totals:	-.36	.739	0			
5	1	COG (ft):	X: 4.151	Y: 0	Z: 0			

Joint Reactions

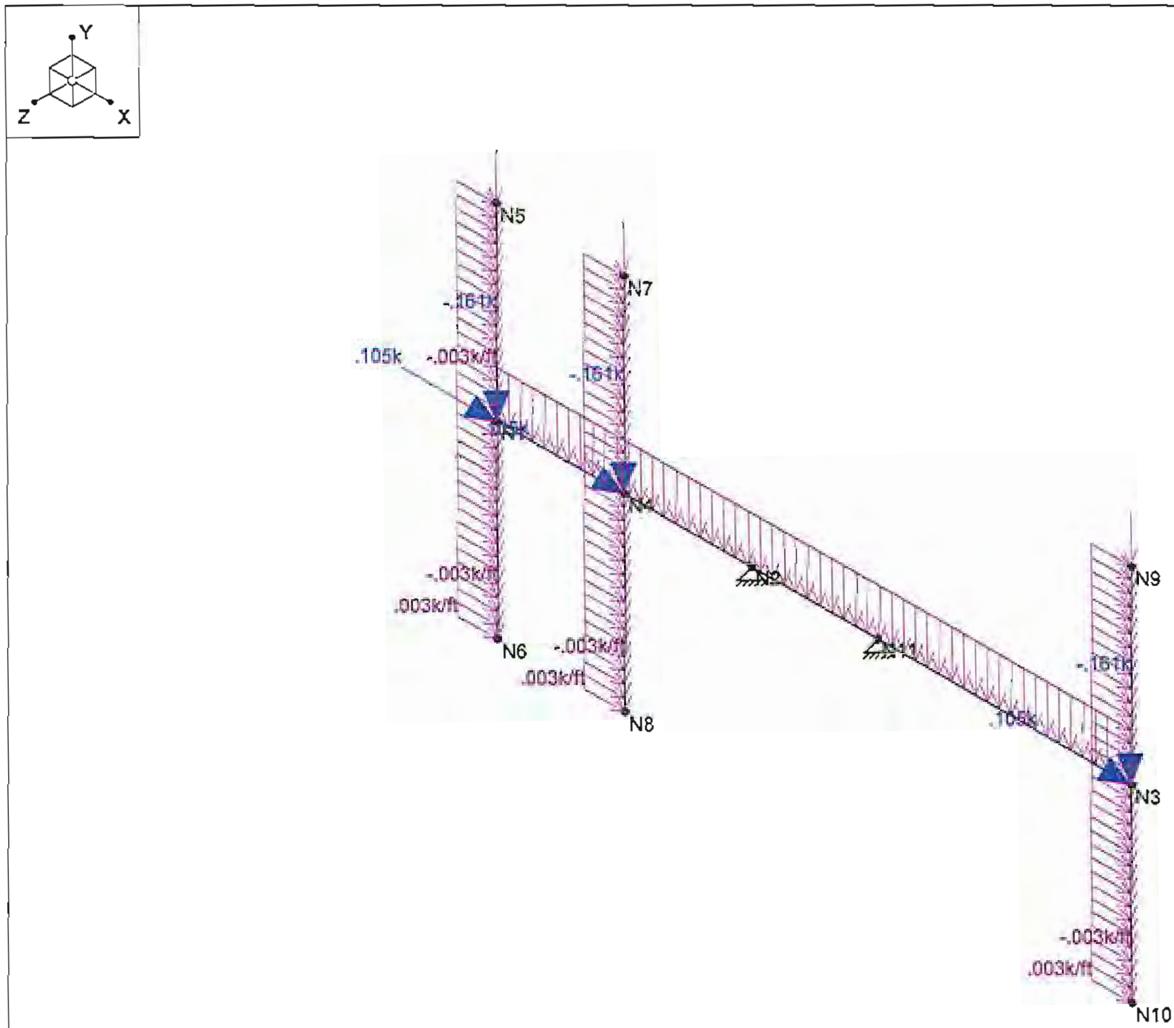
	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	N2	-.958	.259	0	0	0	0
2	2	N11	-.479	.027	0	0	0	0
3	2	N4	NC	NC	NC	LOCKED	NC	NC
4	2	Totals:	-1.437	.286	0			
5	2	COG (ft):	X: 4.189	Y: 0	Z: 0			

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	3	N2	0	.683	-.385	0	0	0
2	3	N11	0	.056	-.025	0	0	0
3	3	N4	NC	NC	NC	LOCKED	NC	NC
4	3	Totals:	0	.739	-.41			
5	3	COG (ft):	X: 4.151	Y: 0	Z: 0			

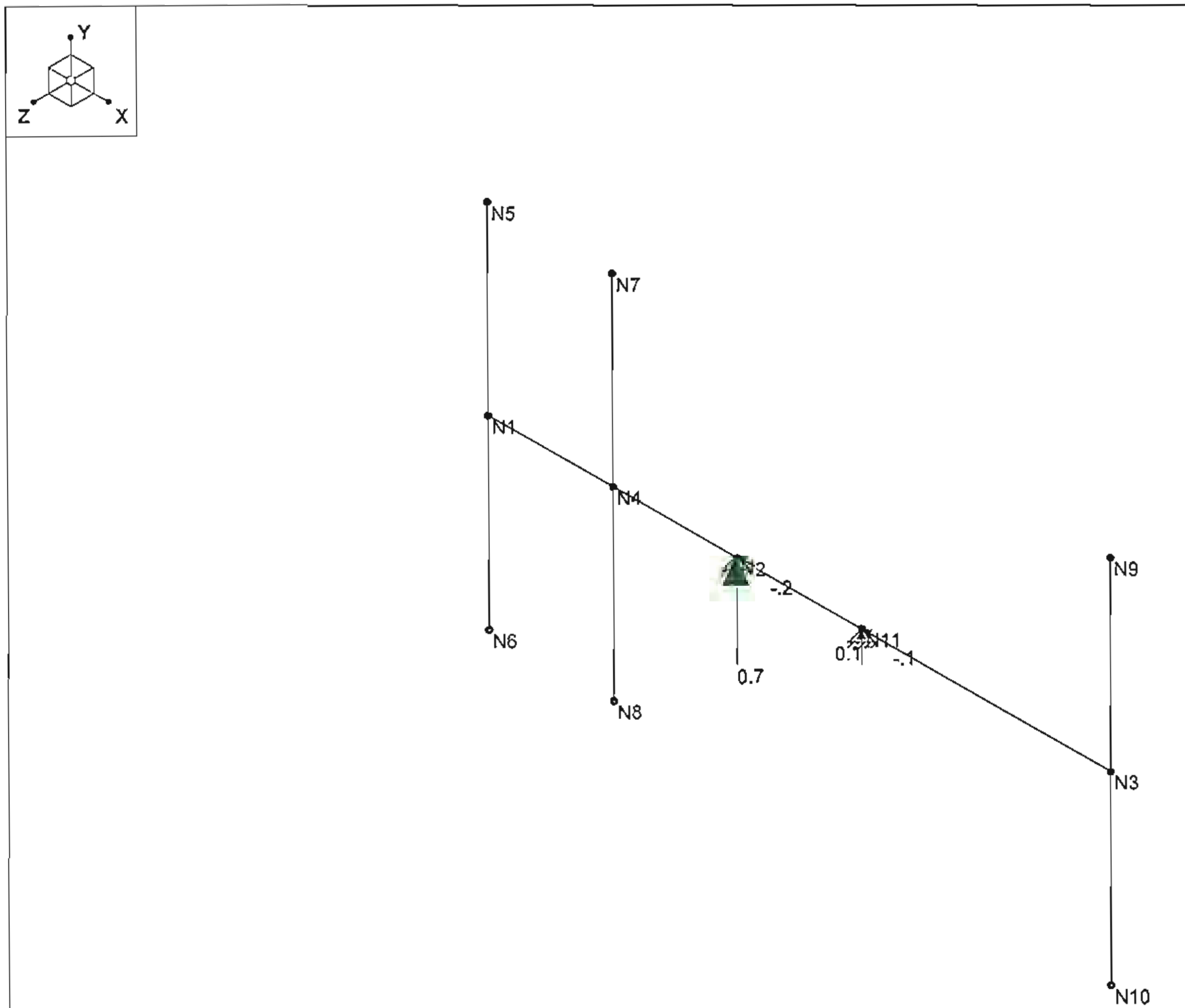
Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	N2	0	.259	-1.492	0	0	0
2	4	N11	0	.027	-.055	0	0	0
3	4	N4	NC	NC	NC	LOCKED	NC	NC
4	4	Totals:	0	.286	-1.547			
5	4	COG (ft):	X: 4.189	Y: 0	Z: 0			



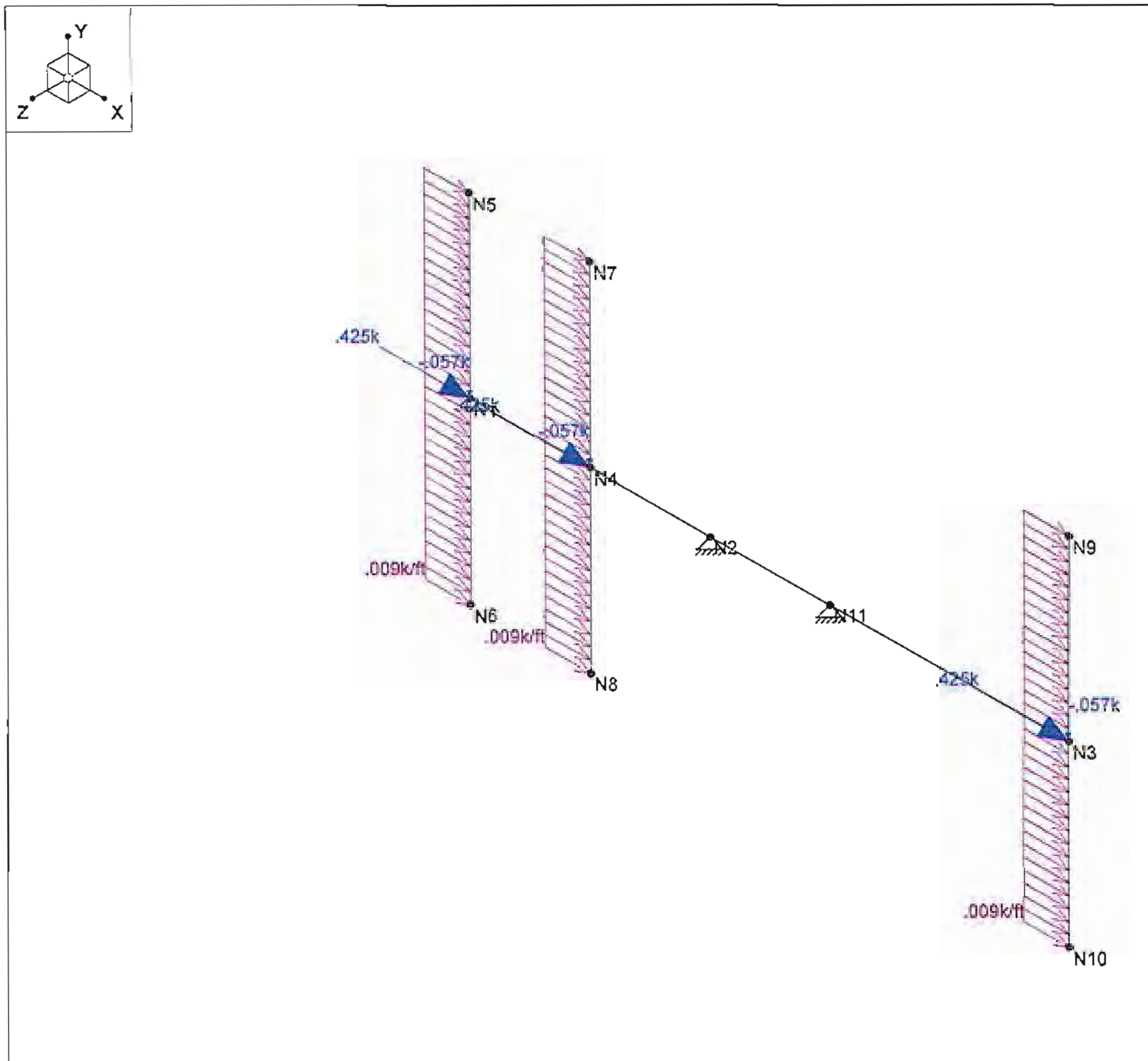
Loads: LC 1, x-dir NESC Heavy Wind on PCS Structure

CENTEK Engineering, Inc.		
tjl, cfc	CL&P Tower # 844 - Sprint	Apr 9, 2013 at 10:32 AM
12047.CO11 - CT43XC811	LC #1 Loads	NESC - Sprint.r3d



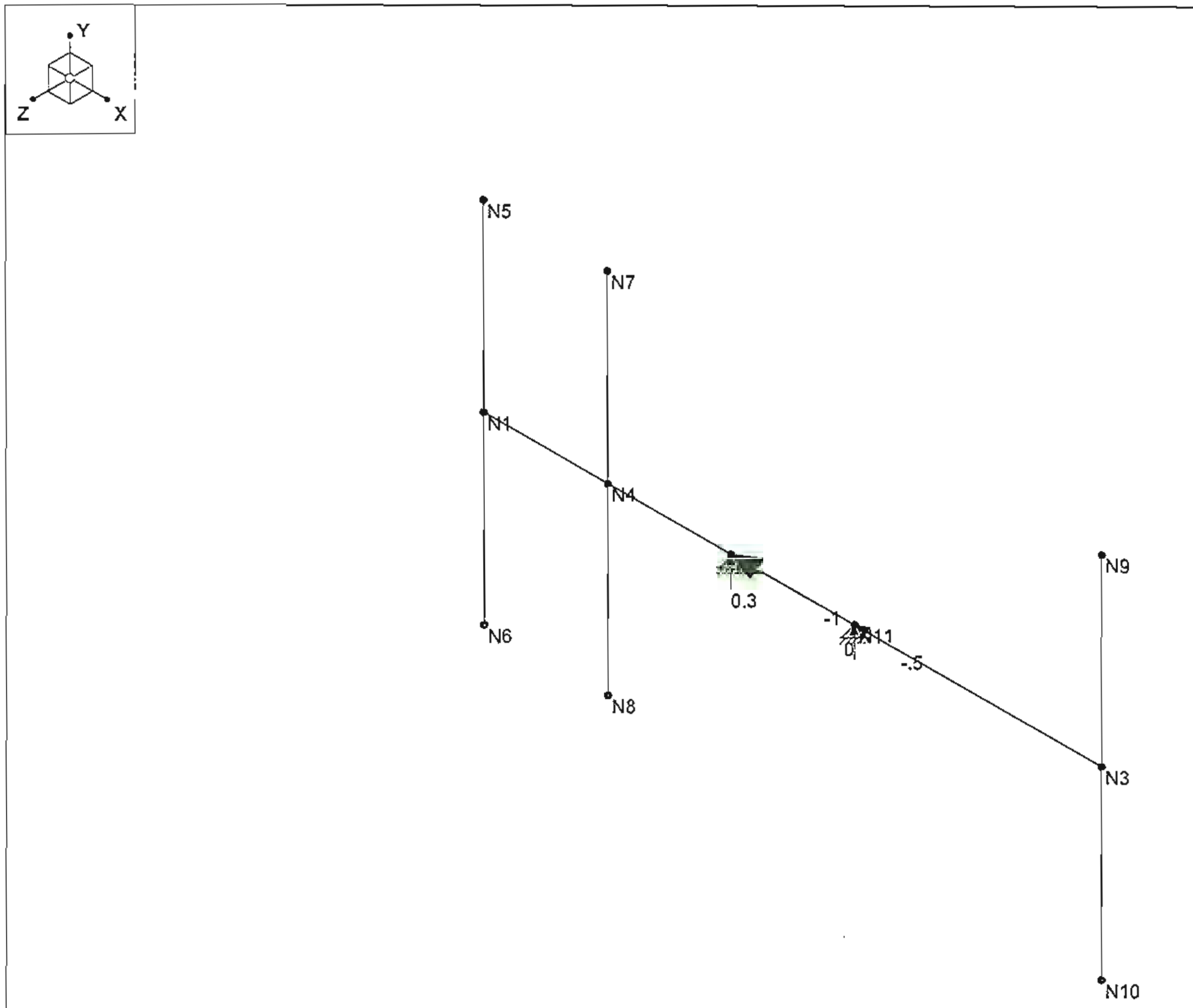
Results for LC 1, x-dir NESC Heavy Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, Inc.		
tjl, cfc	CL&P Tower # 844 - Sprint	Apr 9, 2013 at 10:33 AM
12047.CO11 - CT43XC811	LC #1 Reactions	NESC - Sprint.r3d



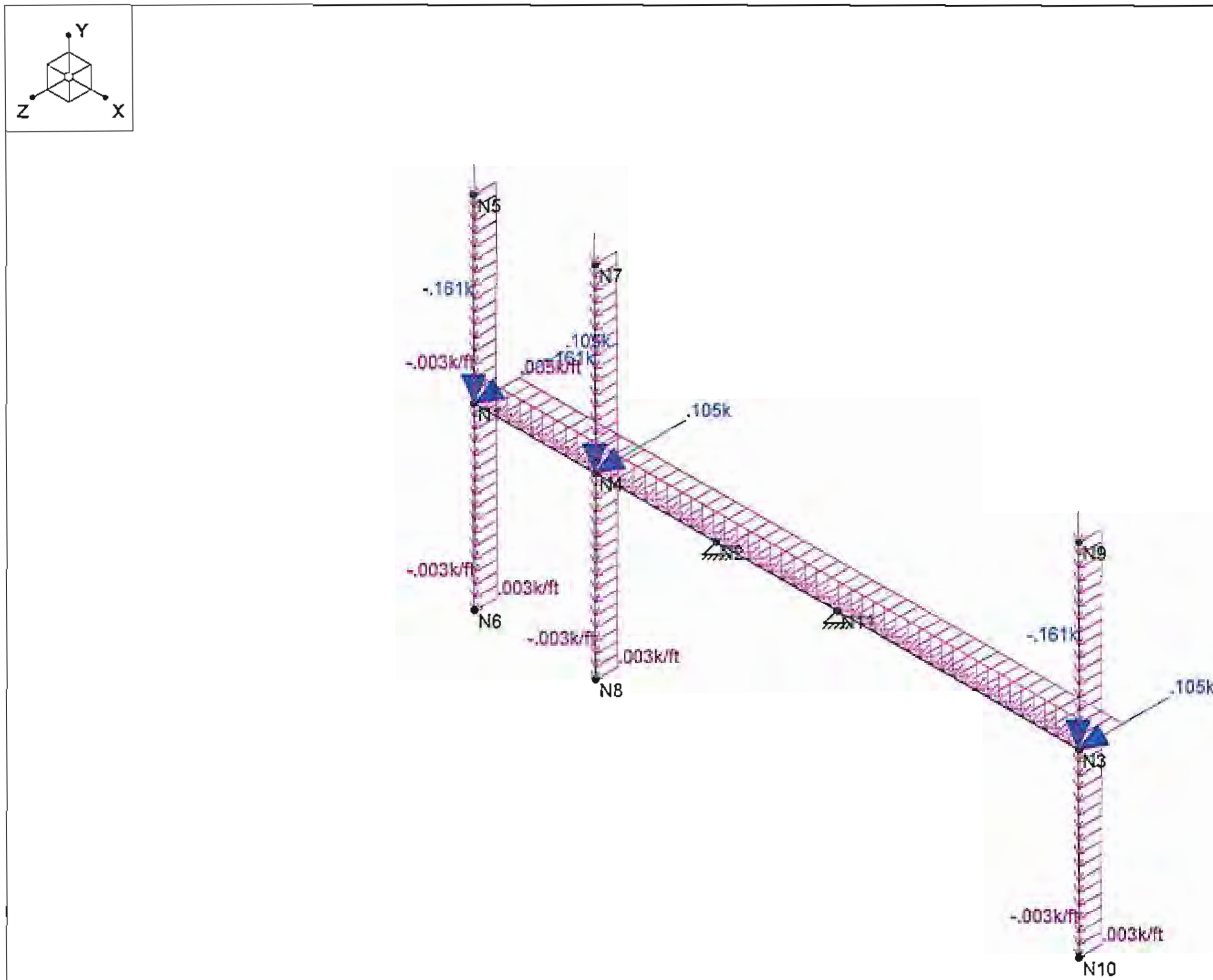
Loads: LC 2, x-dir NESC Extreme Wind on PCS Structure

CENTEK Engineering, Inc.	CL&P Tower # 844 - Sprint	
tjl, cfc	LC #2 Loads	Apr 9, 2013 at 10:32 AM
12047.CO11 - CT43XC811		NESC - Sprint.r3d



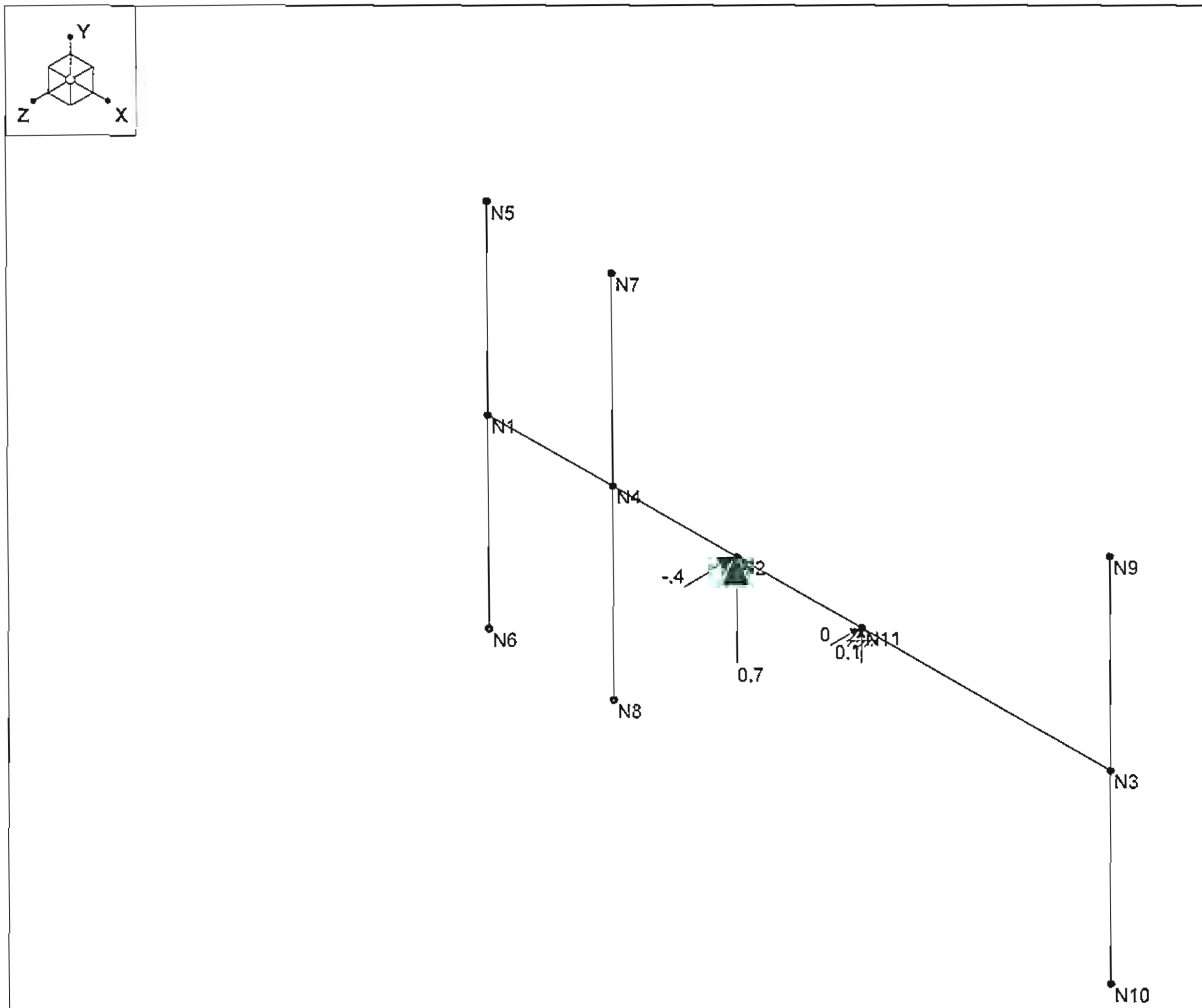
Results for LC 2, x-dir NESC Extreme Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, Inc.		
tjl, cfc	CL&P Tower # 844 - Sprint	Apr 9, 2013 at 10:34 AM
12047.CO11 - CT43XC811	LC #2 Reactions	NESC - Sprint.r3d



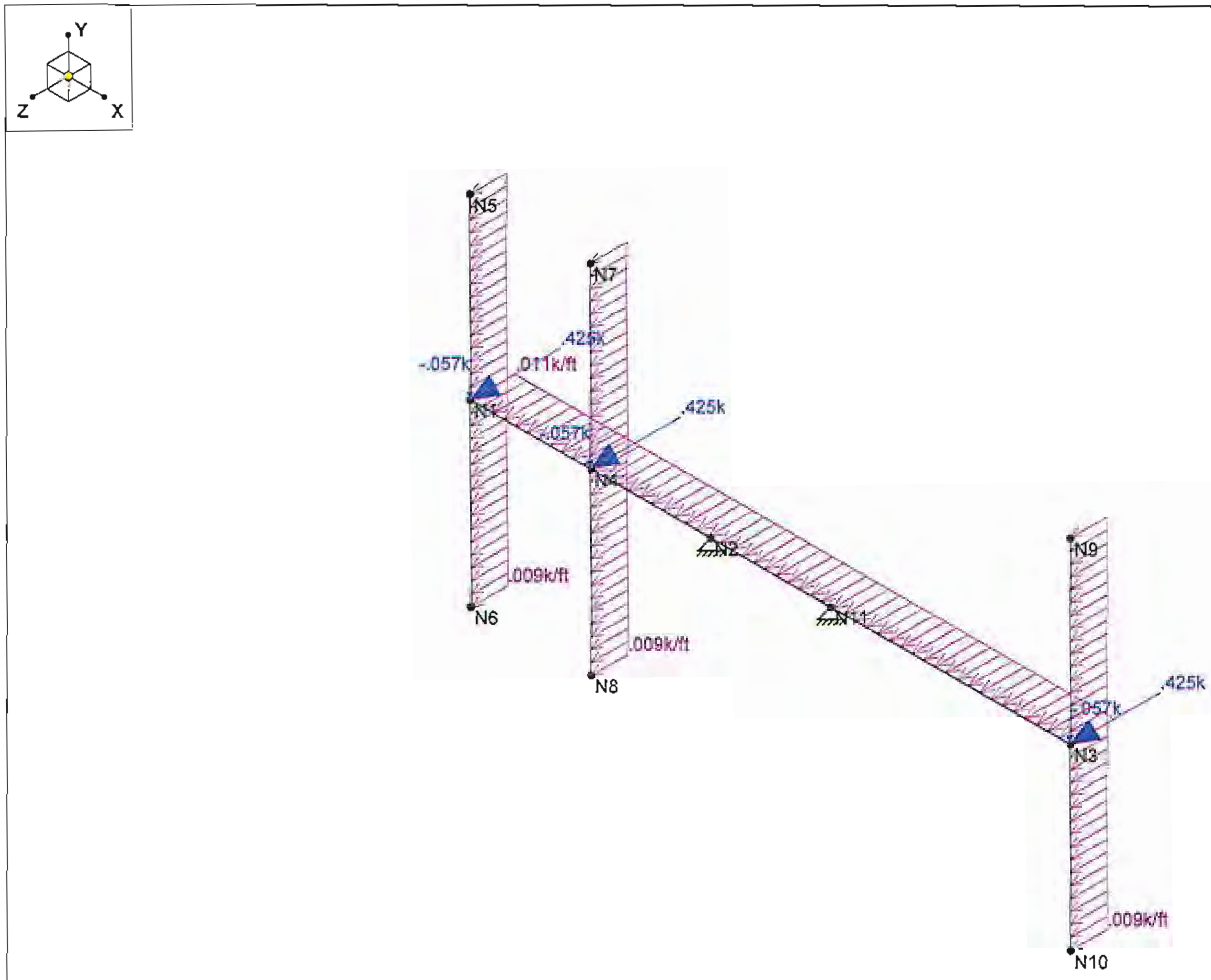
Loads: LC 3, z-dir NESC Heavy Wind on PCS Structure

CENTEK Engineering, Inc.	CL&P Tower # 844 - Sprint	
tjl, cfc	LC #3 Loads	Apr 9, 2013 at 10:32 AM
12047.CO11 - CT43XC811		NESC - Sprint.r3d



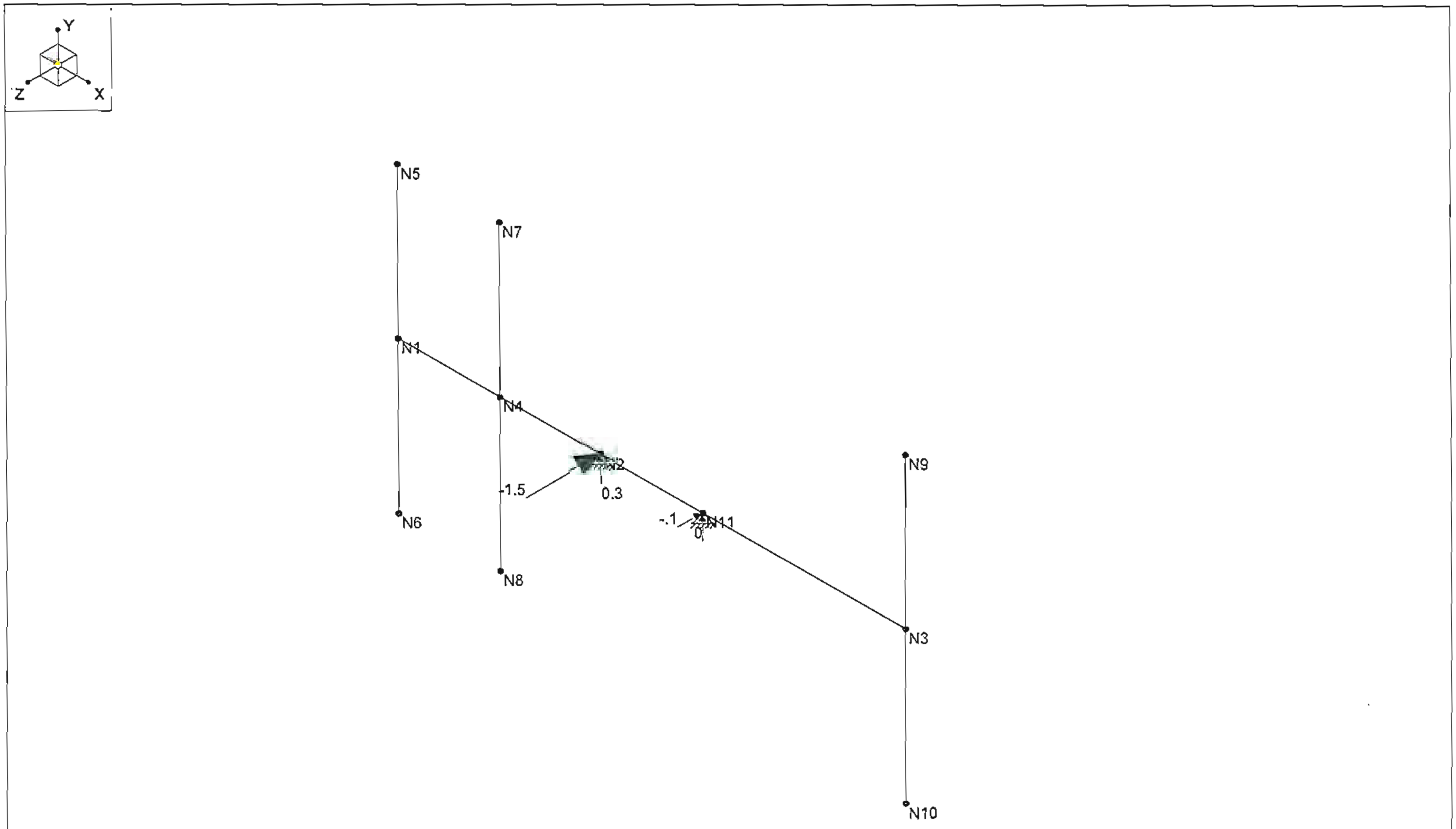
Results for LC 3, z-dir NESC Heavy Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, Inc.	CL&P Tower # 844 - Sprint	
tjl, cfc		Apr 9, 2013 at 10:34 AM
12047.CO11 - CT43XC811	LC #3 Reactions	NESC - Sprint.r3d



Loads: LC 4, z-dir NESC Extreme Wind on PCS Structure

CENTEK Engineering, Inc.		
tjl, cfc	CL&P Tower # 844 - Sprint	Apr 9, 2013 at 10:33 AM
12047.CO11 - CT43XC811	LC #4 Loads	NESC - Sprint.r3d



Results for LC 4, z-dir NESC Extreme Wind on PCS Structure
Z-moment Reaction units are k and k-ft

CENTEK Engineering, Inc.		
tjl, cfc	CL&P Tower # 844 - Sprint	Apr 9, 2013 at 10:35 AM
12047.CO11 - CT43XC811	LC #4 Reactions	NESC - Sprint.r3d

CENTEK engineering, INC.
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Ph. 203-488-0580 / Fax. 203-488-8587

Subject: **Analysis of NESC Heavy Wind and NESC Extreme Wind for Obtaining PCS Structure Reactions Applied to CL&P Structure Tabulated Load Cases / AT&T**

Location: **Trumbull, CT**

Date:4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Case	Description
1	Self Weight (PCS Mast)
2	Weight of Appurtenances
3	Weight of Ice Only on PCS Structure (1)
4	x-direction NESC Heavy Wind on PCS Structure(1)
5	x-direction NESC Extreme Wind on PCS Structure(1)

Footnotes:
(1) PCS Structure includes: Mast and Appurtenances

CENTEK engineering, INC.
Consulting Engineers
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Branford, CT 06405
Ph. 203-488-0580 / Fax. 203-488-8587

Subject: **Analysis of NESC Heavy Wind and NESC Extreme Wind for Obtaining PCS Structure Reactions Applied to CL&P Structure Load Combinations Table / AT&T**
Location: **Trumbull, CT**
Date: 4/9/13 Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Load Combination	Description	Envelope Soultion	Wind Factor	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	x-direction NESC Heavy Wind on PCS Structure		1		1	1.5	2	1.5	3	1.5	4	2.5		
2	x-direction NESC Extreme Wind on PCS Structure		1		1	1	2	1	5	1				

Footnotes:
(1) BLC = Basic Load Case
(2) PCS Structure includes: Mast and Appurtenances

Global

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y
Global Member Orientation Plane	XZ

Hot Rolled Steel Code	AISC 9th: ASD
Cold Formed Steel Code	AISI 1999: ASD
Wood Code	AF&PA NDS-97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-02
Masonry Code	ACI 530-05/08: ASD
Aluminum Code	AA ADM1-05: ASD

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
Bad Framing Warnings	No
Unused Force Warnings	Yes

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ct Exp. X	.75
Ct Exp. Z	.75
Ca	.36
Cv	.54
Nv	1
SD1	1
SDS	1
S1	1
Occupancy Code	4
Seismic Zone	3
Use Group	I
Use Gravity Self Wt in Diaphragm Mass	Yes
Use Deck Self Wt in Diaphragm Mass	Yes
Use Lateral Self Wt in Diaphragm Mass	Yes
Seismic Detailing Code	None
Om X	1
Om Z	1
Rho X	1
Rho Z	1

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A36 Gr.36	29000	11154	.3	.65	.49	36	1.5	58	1.2
2	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	58	1.2
3	A992	29000	11154	.3	.65	.49	50	1.1	58	1.2
4	A500 Gr.42	29000	11154	.3	.65	.49	42	1.3	58	1.1
5	A500 Gr.46	29000	11154	.3	.65	.49	46	1.2	58	1.1
6	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	58	1.2

Hot Rolled Steel Design Parameters

	Label	Shape	Lengt...	Lbyy[ft]	Lbzz[ft]	Lcomp top[ft]	Lcomp bot[ft]	Kyy	Kzz	Cm-...	Cm-...	Cb	y sw...	z sw...	Function
1	M1	Existing ..	21.5												Lateral

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	Existing Mast	HSS6.625X0.432	Column	Pipe	A500 Gr.42	Typical	7.86	38.2	38.2	76.4

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	BOTTOM-..	TOP-MAST			Existing Mast	Column	Pipe	A500 Gr.42	Typical

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	BOTTOM-MAST	0	140.5	0	0	
2	BOTTOM-BRACE	0	141	0	0	
3	TOP-BRACE	0	148	0	0	
4	ANTENNA-CL	0	160	0	0	
5	TOP-MAST	0	162	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]	Footing
1	BOTTOM-BRACE	Reaction	Reaction	Reaction		Reaction		
2	TOP-BRACE	Reaction	Reaction	Reaction		Reaction		

Joint Loads and Enforced Displacements (BLC 2 : Weight of Appurtenances)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ANTENNA-CL	L	Y	-.123
2	ANTENNA-CL	L	Y	-.058
3	ANTENNA-CL	L	Y	-.156

Joint Loads and Enforced Displacements (BLC 3 : Weight of Ice Only on PCS Struct)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ANTENNA-CL	L	Y	-.103
2	ANTENNA-CL	L	Y	-.022

Joint Loads and Enforced Displacements (BLC 3 : Weight of Ice Only on PCS Struct) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
3	ANTENNA-CL	L	Y	-.032

Joint Loads and Enforced Displacements (BLC 4 : NESC Heavy Wind on PCS Structure)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ANTENNA-CL	L	X	.09
2	ANTENNA-CL	L	X	.019

Joint Loads and Enforced Displacements (BLC 5 : NESC Extreme Wind on PCS Structu)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ANTENNA-CL	L	X	.919
2	ANTENNA-CL	L	X	.176

Member Point Loads

Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
	No Data to Print ...		

Member Distributed Loads (BLC 2 : Weight of Appurtenances)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.006	-.006	0	0

Member Distributed Loads (BLC 3 : Weight of Ice Only on PCS Struct)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.004	-.004	0	0
2	M1	Y	-.009	-.009	0	0

Member Distributed Loads (BLC 4 : NESC Heavy Wind on PCS Structure)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.003	.003	0	0
2	M1	X	.003	.003	0	0

Member Distributed Loads (BLC 5 : NESC Extreme Wind on PCS Structu)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.026	.026	0	9
2	M1	X	.032	.032	9	21.5
3	M1	X	.032	.032	0	0

Basic Load Cases

	BLC Description	Category	X Gr...	Y Gr...	Z Grav...	Joint	Point	Distri...	Area(...	Surfa...
1	Self Weight (PCS Mast)	None		-1						
2	Weight of Appurtenances	None				3		1		
3	Weight of Ice Only on PCS Struct	None				3		2		
4	NESC Heavy Wind on PCS Structure	None				2		2		
5	NESC Extreme Wind on PCS Structu	None				2		3		

Load Combinations

	Description	So...	PDelta	SRSS	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	NESC Heavy Wind on PCS ...	Yes			1	1.5	2	1.5	3	1.5	4	2.5								
2	NESC Extreme Wind on PCS..	Yes			1	1	2	1	5	1										
3	Self Weight				1	1														

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Momen...	LC	z-z Momen...	LC
1	M1	1	max	0	1	0	1	0	1	0	1	0	1	0	1
2			min	0	1	0	1	0	1	0	1	0	1	0	1
3		2	max	-.045	2	-.697	1	0	1	0	1	0	1	13.216	2
4			min	-.094	1	-2.851	2	0	1	0	1	0	1	3.224	1
5		3	max	1.479	1	1.783	2	0	1	0	1	0	1	13.279	2
6			min	.689	2	.434	1	0	1	0	1	0	1	3.251	1
7		4	max	1.11	1	1.439	2	0	1	0	1	0	1	4.62	2
8			min	.513	2	.353	1	0	1	0	1	0	1	1.136	1
9		5	max	0	1	0	1	0	1	0	1	0	1	0	1
10			min	0	1	0	1	0	1	0	1	0	1	0	1

Envelope Member Section Stresses

	Member	Sec		Axial[ksi]	LC	y Shear[...	LC	z Shear[...	LC	y-Top[ksi]	LC	y-Bot[ksi]	LC	z-Top[ksi]	LC	z-Bot[ksi]	LC
1	M1	1	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
2			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1
3		2	max	-.006	2	-.177	1	0	1	-3.355	1	13.752	2	0	1	0	1
4			min	-.012	1	-.725	2	0	1	-13.752	2	3.355	1	0	1	0	1
5		3	max	.188	1	.454	2	0	1	-3.383	1	13.818	2	0	1	0	1
6			min	.088	2	.11	1	0	1	-13.818	2	3.383	1	0	1	0	1
7		4	max	.141	1	.366	2	0	1	-1.182	1	4.808	2	0	1	0	1
8			min	.065	2	.09	1	0	1	-4.808	2	1.182	1	0	1	0	1
9		5	max	0	1	0	1	0	1	0	1	0	1	0	1	0	1
10			min	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	BOTTOM-BR...	max	2.539	2	.274	1	0	1	0	1	0	1	0	1
2		min	.617	1	.131	2	0	1	0	1	0	1	0	1
3	TOP-BRACE	max	-1.212	1	1.942	1	0	1	0	1	0	1	0	1
4		min	-4.956	2	.91	2	0	1	0	1	0	1	0	1
5	Totals:	max	-.595	1	2.216	1	0	1						
6		min	-2.417	2	1.041	2	0	1						

Envelope Joint Displacements

	Joint		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation...	LC	Y Rotation...	LC	Z Rotation...	LC
1	BOTTOM-MA...	max	.017	2	0	2	0	1	0	1	0	1	2.778e-3	2
2		min	.004	1	0	1	0	1	0	1	0	1	6.771e-4	1
3	BOTTOM-BR...	max	0	1	0	2	0	1	0	1	0	1	2.778e-3	2
4		min	0	2	0	1	0	1	0	1	0	1	6.771e-4	1
5	TOP-BRACE	max	0	2	0	2	0	1	0	1	0	1	-1.425e-3	1

Envelope Joint Displacements (Continued)

	Joint		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation...	LC	Y Rotation...	LC	Z Rotation...	LC
6		min	0	1	0	1	0	1	0	1	0	1	-5.838e-3	2
7	ANTENNA-CL	max	2.218	2	0	2	0	1	0	1	0	1	-4.864e-3	1
8		min	.542	1	0	1	0	1	0	1	0	1	-1.988e-2	2
9	TOP-MAST	max	2.695	2	0	2	0	1	0	1	0	1	0	1
10		min	.659	1	0	1	0	1	0	1	0	1	0	1

Envelope AISC ASD Steel Code Checks

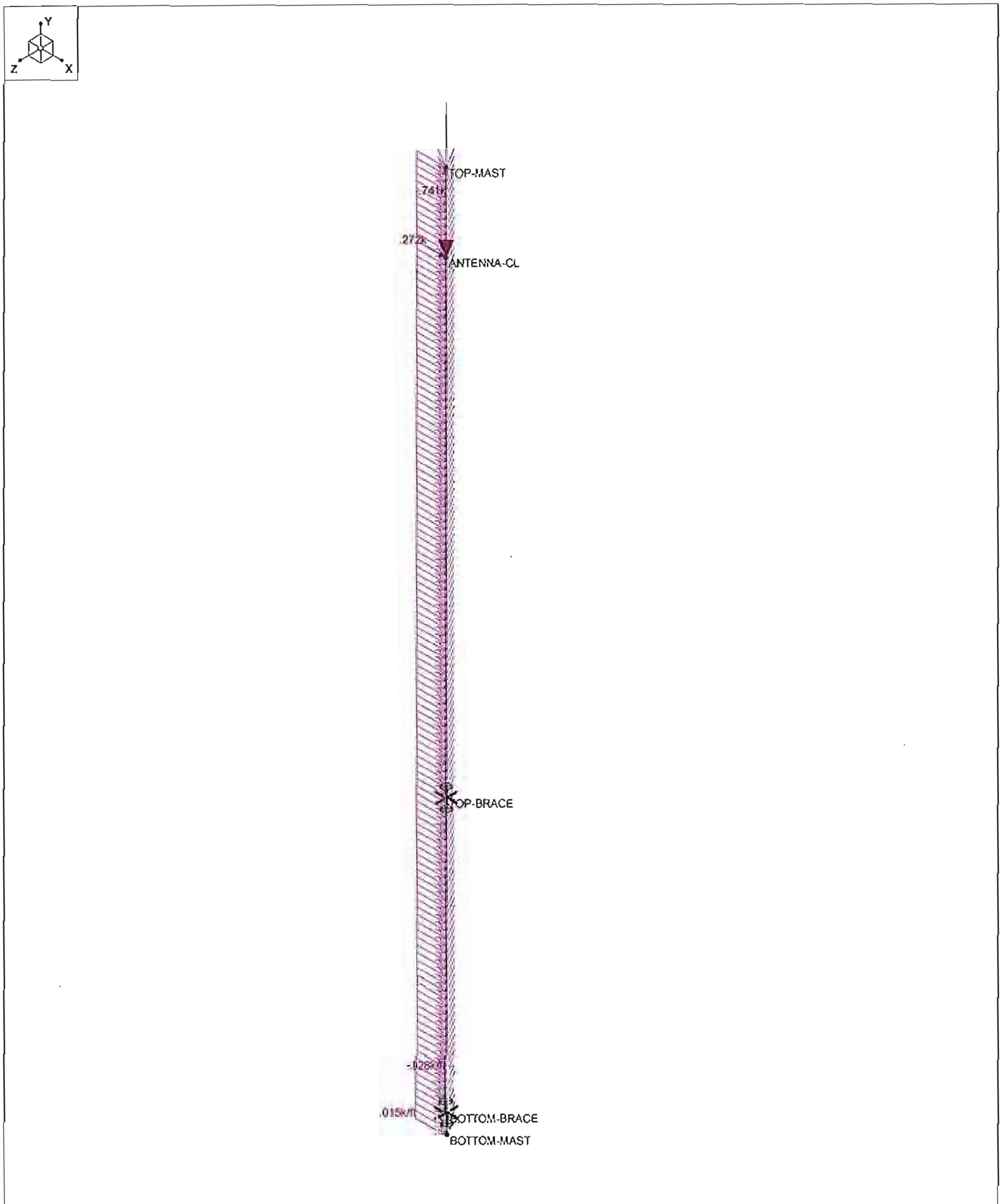
	Member	Shape	Code Check	Loc[ft]	LC	Sh...	Loc[ft]	...	...Fa...	Ft [ksi]	Fb y-y [ksi]	Fb...	...	...	...	AS...
1	M1	HSS6.6...	.729	7.615	2	.045	7.391	2	10...	25.2	27.72	27...	1	.6	1	H1...

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	BOTTOM-BRACE	.617	.274	0	0	0	0
2	1	TOP-BRACE	-1.212	1.942	0	0	0	0
3	1	Totals:	-.595	2.216	0			
4	1	COG (ft):	X: 0	Y: 154.175	Z: 0			

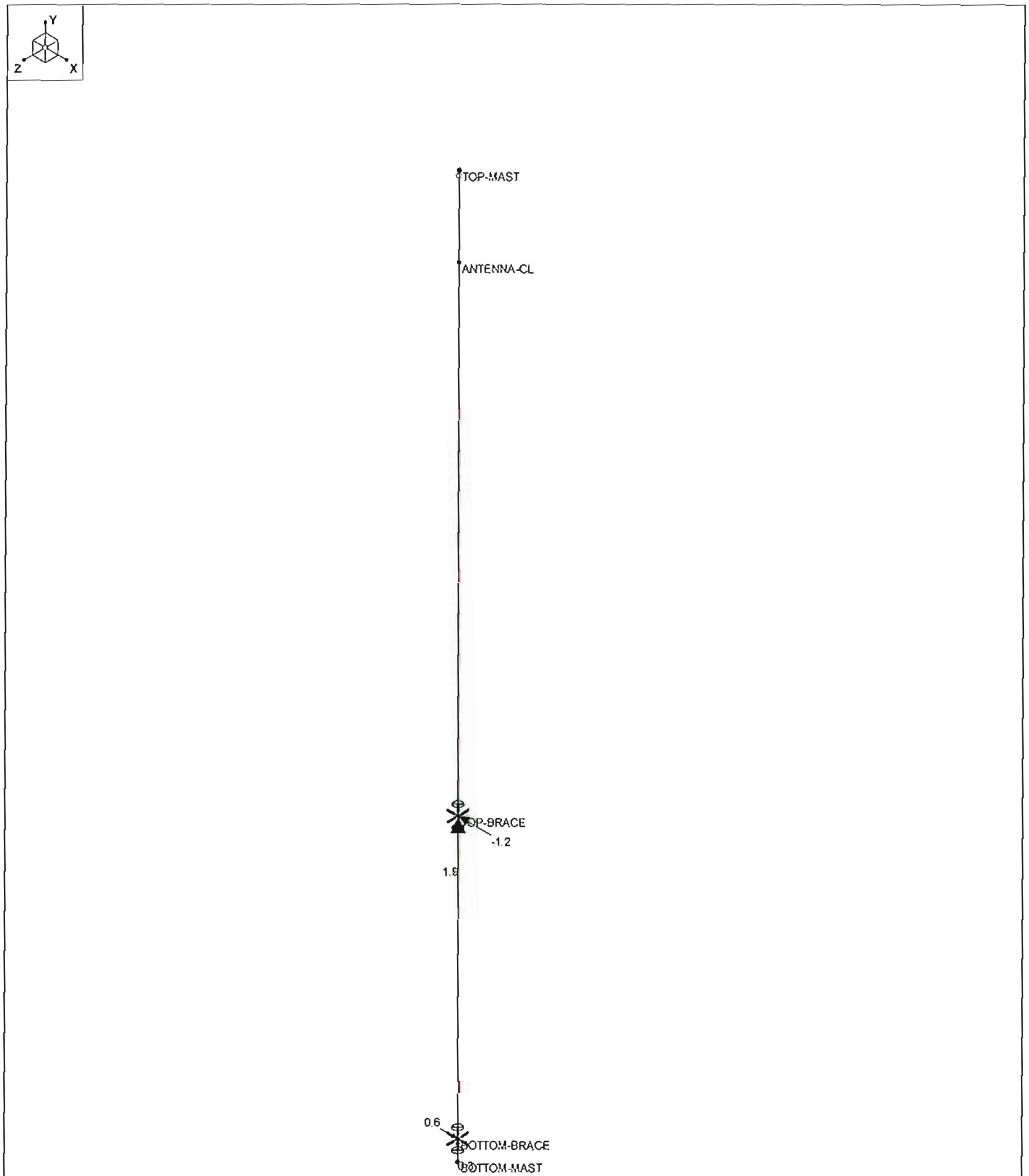
Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	BOTTOM-BRACE	2.539	.131	0	0	0	0
2	2	TOP-BRACE	-4.956	.91	0	0	0	0
3	2	Totals:	-2.417	1.041	0			
4	2	COG (ft):	X: 0	Y: 154.083	Z: 0			



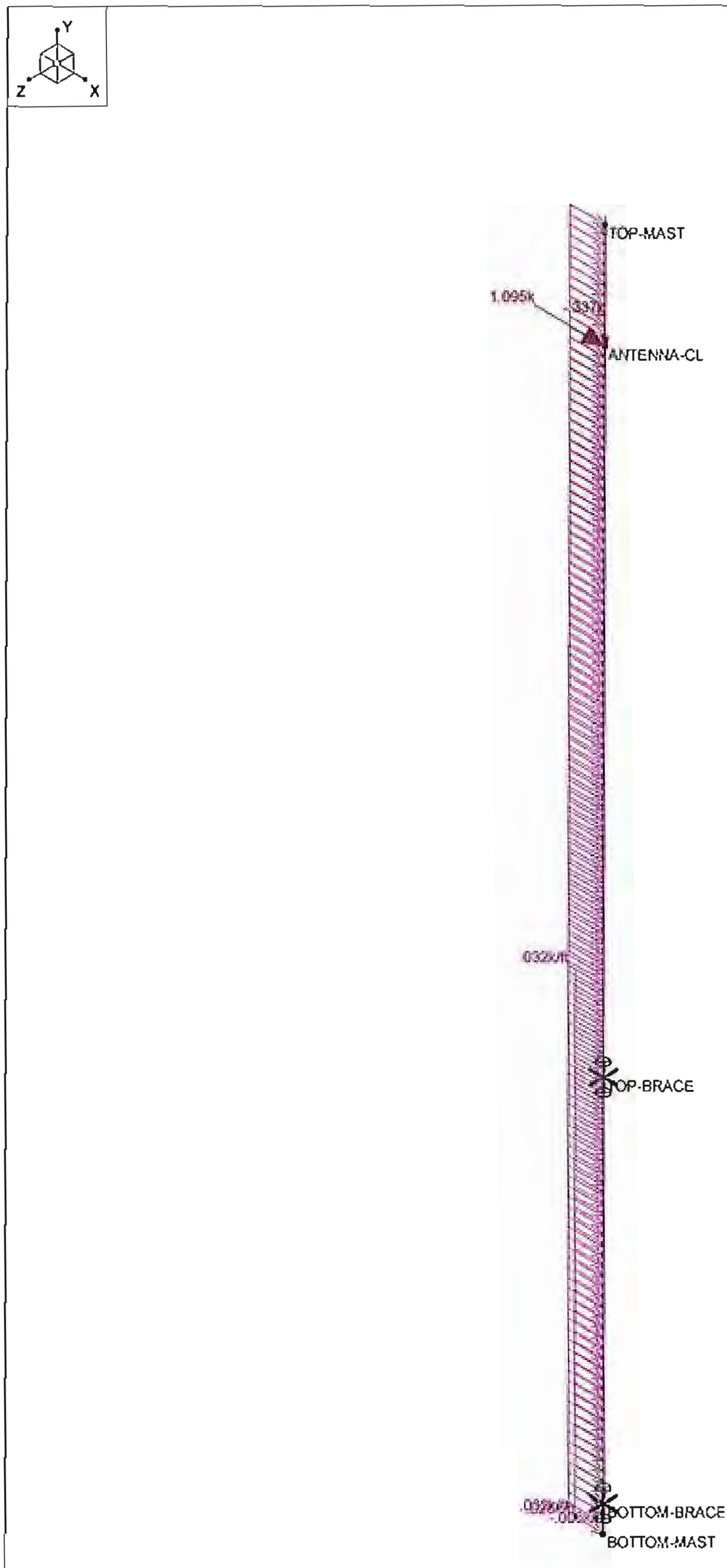
Loads: LC 1, NESC Heavy Wind on PCS Structure

Centek Engineering		
tjl, cfc	CL&P Tower # 844 - AT&T Mast	Apr 9, 2013 at 9:33 AM
12047.CO11 - CT43XC811	LC #1 Loads	NESC - AT&T.r3d



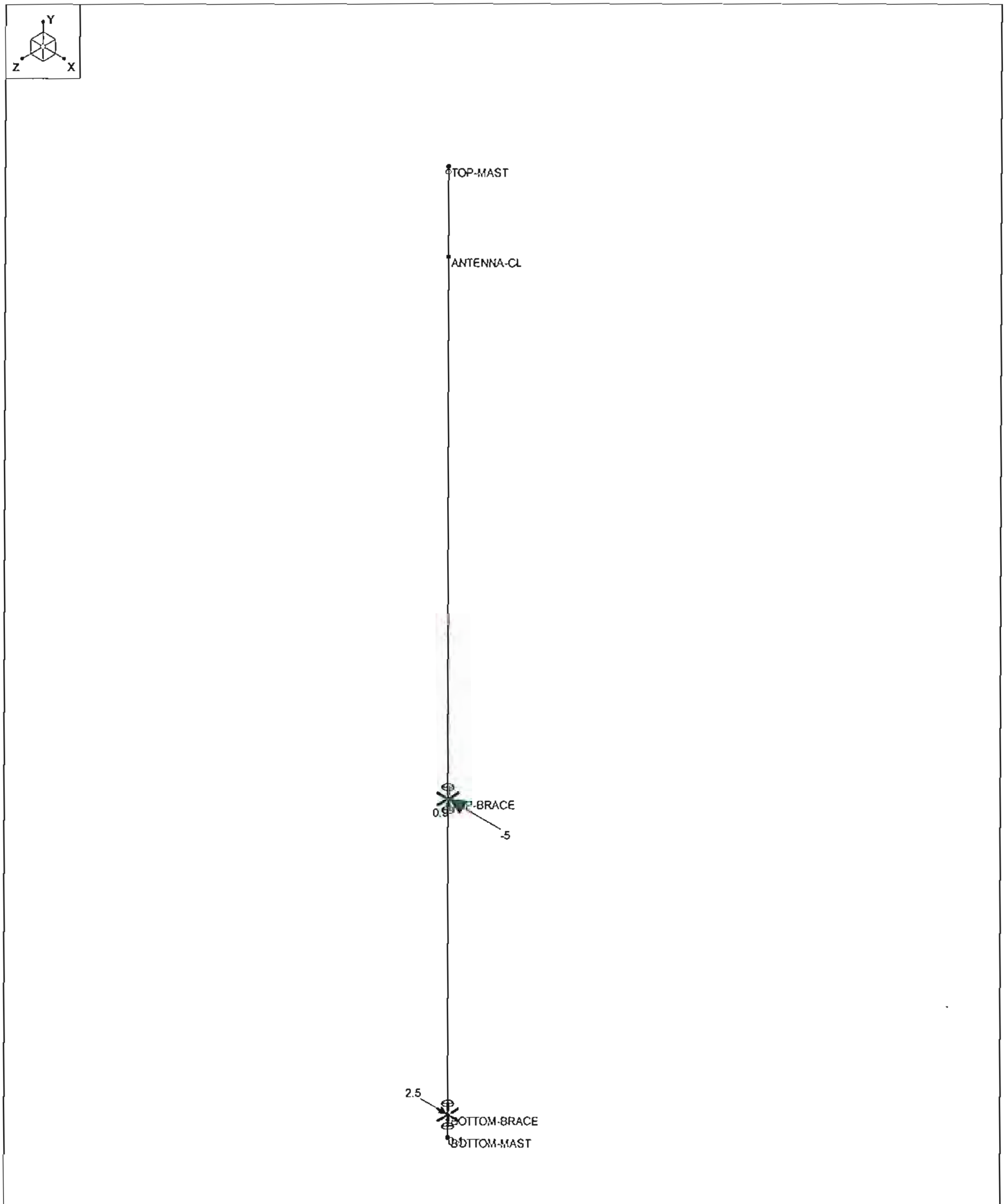
Results for LC 1, NESC Heavy Wind on PCS Structure
Z-moment Reaction units are k and k-ft

Centek Engineering		
tjl, cfc	CL&P Tower # 844 - AT&T Mast	Apr 9, 2013 at 9:34 AM
12047.CO11 - CT43XC811	LC #1 Reactions	NESC - AT&T.r3d



Loads: LC 2, NESC Extreme Wind on PCS Structure

Centek Engineering		
tjl, cfc	CL&P Tower # 844 - AT&T Mast	Apr 9, 2013 at 9:34 AM
12047.CO11 - CT43XC811	LC #2 Loads	NESC - AT&T.r3d



Results for LC 2, NESC Extreme Wind on PCS Structure
Z-moment Reaction units are k and k-ft

Centek Engineering		
tjl, cfc	CL&P Tower # 844 - AT&T Mast	Apr 9, 2013 at 9:35 AM
12047.CO11 - CT43XC811	LC #2 Reactions	NESC - AT&T.r3d

Basic Components

Heavy Wind Pressure = $p := 4.00$ psf (User Input NESC 2007 Figure 250-1 & Table 250-1)

Basic Windspeed = $V := 110$ mph (User Input NESC 2007 Figure 250-2(e))

Radial Ice Thickness = $Ir := 0.50$ in (User Input)

Radial Ice Density = $Id := 56.0$ pcf (User Input)

Factors for Extreme Wind Calculation

Elevation of Top of PCS Mast Above Grade = $TME := 163$ ft (User Input)

Multiplier Gust Response Factor = $m := 1.25$ (User Input - Only for NESC Extreme wind case)

NESC Factor = $kv := 1.43$ (User Input from NESC 2007 Table 250-3 equation)

Importance Factor = $I := 1.0$ (User Input from NESC 2007 Section 250.C.2)

Velocity Pressure Coefficient = $$Kz := 2.01 \cdot \left(\frac{TME}{900}\right)^{\frac{2}{9.5}} = 1.403$$ (NESC 2007 Table 250-2)

Exposure Factor = $$Es := 0.346\left[\frac{33}{(0.67 \cdot TME)}\right]^{\frac{1}{7}} = 0.292$$ (NESC 2007 Table 250-3)

Response Term = $$Bs := \frac{1}{\left(1 + 0.375 \cdot \frac{TME}{220}\right)} = 0.783$$ (NESC 2007 Table 250-3)

Gust Response Factor = $$Grf := \frac{\left[1 + \left(2.7 \cdot Es \cdot Bs^{\frac{1}{2}}\right)\right]}{kv^2} = 0.83$$ (NESC 2007 Table 250-3)

Wind Pressure = $$qz := 0.00256 \cdot Kz \cdot V^2 \cdot Grf \cdot I = 36$$ psf (NESC 2007 Section 250.C.2)

Shape Factors

NUS Design Criteria Issued April 12, 2007

Shape Factor for Round Members = $Cd_R := 1.3$ (User Input)

Shape Factor for Flat Members = $Cd_F := 1.6$ (User Input)

Shape Factor for Coax Cables Attached to Outside of Pole = $Cd_{coax} := 1.45$ (User Input)

Overload Factors

NU Design Criteria Table

Overload Factors for Wind Loads:

NESC Heavy Loading = 2.5 (User Input) Apply in Risa-3D Analysis

NESC Extreme Loading = 1.0 (User Input) Apply in Risa-3D Analysis

Overload Factors for Vertical Loads:

NESC Heavy Loading = 1.5 (User Input) Apply in Risa-3D Analysis

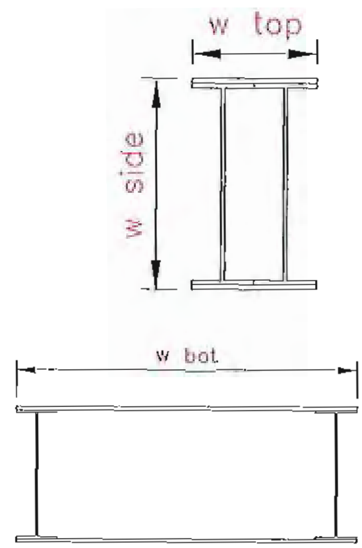
NESC Extreme Loading = 1.0 (User Input) Apply in Risa-3D Analysis

CENTEK engineering Centered on Solutions www.centekeng.com 63-2 North Branford Road P: (203) 488 0580 Branford, CT 06405 F: (203) 488 8587	Subject:	Load Analysis of CL&P Pole #844
	Location:	Trumbull, CT
	Rev. 0: 4/9/13	Prepared by: T.J.L Checked by: C.F.C. Job No. 12047.CO11

Development of Wind & Ice Load on CL&P Pole

Pole Data:

Shape =	Flat	
Width Side =	$W_{side} := 21.7$	in
Width Top =	$W_{top} := 12$	in
Width Bottom =	$W_{bot} := 54$	in
Length =	$L := 150$	ft
Area Top =	$A_{top} := 30.9$	sq in
Area Bottom =	$A_{bot} := 80.0$	sq in
Weight of Steel =	$W_{steel} := 490$	pcf
Area Top w/ Ice =	$Ai_{top} := 40$	sq in
Area Bottom w/ Ice =	$Ai_{bot} := 112$	sq in



Gravity Loads (without ice)

Weight Pole Top =	$Wt_{top} := \frac{A_{top}}{144} \cdot W_{steel} = 105$	plf	BLC 2
Weight Pole Bottom =	$Wt_{bot} := \frac{A_{bot}}{144} \cdot W_{steel} = 272$	plf	BLC 2

Gravity Loads (ice only)

Weight of Ice on Pole Top =	$W_{ICE.top} := Id \cdot \frac{Ai_{top}}{144} = 16$	plf	BLC 3
Weight of Ice on Pole Bottom =	$W_{ICE.bot} := Id \cdot \frac{Ai_{bot}}{144} = 44$	plf	BLC 3

Wind Load (NESC Extreme)

Pole Projected Surface Area Top =	$A_{top} := \frac{W_{top}}{12} = 1$	sq ft/ft	
Pole Projected Surface Area Bottom =	$A_{bot} := \frac{W_{bot}}{12} = 4.5$	sq ft/ft	
Pole Projected Surface Area Side =	$A_{side} := \frac{W_{side}}{12} = 1.808$	sq ft/ft	
Total Pole Wind Force Top =	$qz \cdot Cd_F \cdot A_{top} = 58$	plf	BLC 7
Total Pole Wind Force Bottom =	$qz \cdot Cd_F \cdot A_{bot} = 260$	plf	BLC 7
Total Pole Wind Force Side =	$qz \cdot Cd_F \cdot A_{side} = 104$	plf	BLC 5

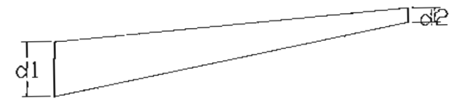
Wind Load (NESE Heavy)

Pole Projected Surface Area w/ Ice Top =	$AICE_{top} := \frac{(W_{top} + 2 \cdot Ir)}{12} = 1.083$	sq ft/ft	
Pole Projected Surface Area w/ Ice Bottom =	$AICE_{bot} := \frac{(W_{bot} + 2 \cdot Ir)}{12} = 4.583$	sq ft/ft	
Pole Projected Surface Area w/ Ice Side =	$AICE_{side} := \frac{(W_{side} + 2 \cdot Ir)}{12} = 1.892$	sq ft/ft	
Total Pole Wind Force w/ Ice Top =	$p \cdot Cd_F \cdot AICE_{top} = 7$	plf	BLC 6
Total Pole Wind Force w/ Ice Bottom =	$p \cdot Cd_F \cdot AICE_{bot} = 29$	plf	BLC 6
Total Pole Wind Force w/ Ice Side =	$p \cdot Cd_F \cdot AICE_{side} = 12$	plf	BLC 4

Development of Wind & Ice Load on CL&P Pole Arms

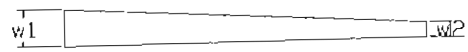
ARM Data:

Shape = Flat



Depth of Arm at Top = $ARM_{d1} := 12$

Depth of Arm at Bottom = $ARM_{d2} := 4$



Width of Arm at Top = $ARM_{W1} := 8$

Width of Arm at Bottom = $ARM_{W2} := 4$

Thickness of Arm Wall = $ARM_t := 0.25$

Gravity Loads (without ice)

Arm Area Top = $A_{armtop} := (ARM_{d1} \cdot ARM_{W1}) - [(ARM_{W1} - 2ARM_t) \cdot (ARM_{d1} - 2ARM_t)]$

Arm Area Bottom = $A_{armbot} := (ARM_{d2} \cdot ARM_{W2}) - [(ARM_{W2} - 2ARM_t) \cdot (ARM_{d2} - 2ARM_t)]$

Weight Arm Top = $Wt_{top} := \frac{A_{armtop}}{144} \cdot W_{steel} = 33$ plf **BLC 2**

Weight Arm Bottom = $Wt_{bot} := \frac{A_{armbot}}{144} \cdot W_{steel} = 13$ plf **BLC 2**

Gravity Loads (ice only)

Arm Area w/ Ice Top = $Ai_{armtop} := (ARM_{d1} + 2 \cdot Ir) \cdot (ARM_{W1} + 2 \cdot Ir) - ARM_{d1} \cdot ARM_{W1} = 21$

Arm Area w/ Ice Bottom = $Ai_{armbot} := (ARM_{d2} + 2 \cdot Ir) \cdot (ARM_{W2} + 2 \cdot Ir) - ARM_{d2} \cdot ARM_{W2} = 9$

Weight of Ice on Arm Top = $W_{ICE.top} := Id \cdot \frac{Ai_{armtop}}{144} = 8$ plf **BLC 3**

Weight of Ice on Arm Bottom = $W_{ICE.bot} := Id \cdot \frac{Ai_{armbot}}{144} = 4$ plf **BLC 3**

Wind Load (NESC Extreme)

Arm Projected Surface Area Top = $A_{top} := \frac{ARM_{d1}}{12} = 1$ sq ft/ft

Arm Projected Surface Area Bottom = $A_{bot} := \frac{ARM_{d2}}{12} = 0.333$ sq ft/ft

Total Arm Wind Force Top = $qz \cdot Cd_F \cdot A_{top} = 58$ plf **BLC 7**

Total Arm Wind Force Bottom = $qz \cdot Cd_F \cdot A_{bot} = 19$ plf **BLC 7**

Wind Load (NESE Heavy)

Arm Projected Surface Area w/ Ice Top = $AICE_{top} := \frac{(ARM_{d1} + 2 \cdot Ir)}{12} = 1.083$ sq ft/ft

Arm Projected Surface Area w/ Ice Bottom = $AICE_{bot} := \frac{(ARM_{d2} + 2 \cdot Ir)}{12} = 0.417$ sq ft/ft

Total Arm Wind Force w/ Ice Top = $p \cdot Cd_F \cdot AICE_{top} = 7$ plf **BLC 6**

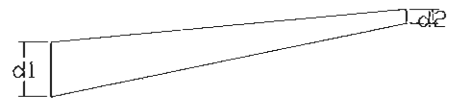
Total Arm Wind Force w/ Ice Bottom = $p \cdot Cd_F \cdot AICE_{bot} = 3$ plf **BLC 6**

Development of Wind & Ice Load on CL&P Pole Arms

ARM Data:

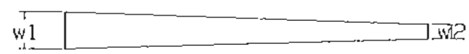
Shape = Flat

Depth of Arm at Top = $ARM_{d1} := 15$



Depth of Arm at Bottom = $ARM_{d2} := 4$

Width of Arm at Top = $ARM_{W1} := 10$



Width of Arm at Bottom = $ARM_{W2} := 4$

Thickness of Arm Wall = $ARM_t := 0.25$

Gravity Loads (without Ice)

Arm Area Top = $A_{armtop} := (ARM_{d1} \cdot ARM_{W1}) - [(ARM_{W1} - 2ARM_t) \cdot (ARM_{d1} - 2ARM_t)]$

Arm Area Bottom = $A_{armbot} := (ARM_{d2} \cdot ARM_{W2}) - [(ARM_{W2} - 2ARM_t) \cdot (ARM_{d2} - 2ARM_t)]$

Weight Arm Top = $Wt_{top} := \frac{A_{armtop}}{144} \cdot W_{steel} = 42$ plf **BLC 2**

Weight Arm Bottom = $Wt_{bot} := \frac{A_{armbot}}{144} \cdot W_{steel} = 13$ plf **BLC 2**

Gravity Loads (ice only)

Arm Area w/ Ice Top = $Ai_{armtop} := (ARM_{d1} + 2 \cdot Ir) \cdot (ARM_{W1} + 2 \cdot Ir) - ARM_{d1} \cdot ARM_{W1} = 26$

Arm Area w/ Ice Bottom = $Ai_{armbot} := (ARM_{d2} + 2 \cdot Ir) \cdot (ARM_{W2} + 2 \cdot Ir) - ARM_{d2} \cdot ARM_{W2} = 9$

Weight of Ice on Arm Top = $W_{ICE.top} := Id \cdot \frac{Ai_{armtop}}{144} = 10$ plf **BLC 3**

Weight of Ice on Arm Bottom = $W_{ICE.bot} := Id \cdot \frac{Ai_{armbot}}{144} = 4$ plf **BLC 3**

Wind Load (NESC Extreme)

Arm Projected Surface Area Top = $A_{top} := \frac{ARM_{d1}}{12} = 1.25$ sq ft/ft

Arm Projected Surface Area Bottom = $A_{bot} := \frac{ARM_{d2}}{12} = 0.333$ sq ft/ft

Total Arm Wind Force Top = $qz \cdot Cd_F \cdot A_{top} = 72$ plf **BLC 7**

Total Arm Wind Force Bottom = $qz \cdot Cd_F \cdot A_{bot} = 19$ plf **BLC 7**

Wind Load (NESE Heavy)

Arm Projected Surface Area w/ Ice Top = $AICE_{top} := \frac{(ARM_{d1} + 2 \cdot Ir)}{12} = 1.333$ sq ft/ft

Arm Projected Surface Area w/ Ice Bottom = $AICE_{bot} := \frac{(ARM_{d2} + 2 \cdot Ir)}{12} = 0.417$ sq ft/ft

Total Arm Wind Force w/ Ice Top = $p \cdot Cd_F \cdot AICE_{top} = 9$ plf **BLC 6**

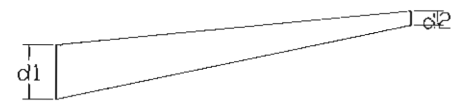
Total Arm Wind Force w/ Ice Bottom = $p \cdot Cd_F \cdot AICE_{bot} = 3$ plf **BLC 6**

Development of Wind & Ice Load on CL&P Pole Arms

ARM Data:

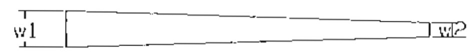
Shape = Flat

Depth of Arm at Top = $ARM_{d1} := 18$



Depth of Arm at Bottom = $ARM_{d2} := 4$

Width of Arm at Top = $ARM_{W1} := 12$



Width of Arm at Bottom = $ARM_{W2} := 4$

Thickness of Arm Wall = $ARM_t := 0.25$

Gravity Loads (without Ice)

Arm Area Top = $A_{armtop} := (ARM_{d1} \cdot ARM_{W1}) - [(ARM_{W1} - 2ARM_t) \cdot (ARM_{d1} - 2ARM_t)]$

Arm Area Bottom = $A_{armbot} := (ARM_{d2} \cdot ARM_{W2}) - [(ARM_{W2} - 2ARM_t) \cdot (ARM_{d2} - 2ARM_t)]$

Weight Arm Top = $Wt_{top} := \frac{A_{armtop}}{144} \cdot W_{steel} = 50$ plf **BLC 2**

Weight Arm Bottom = $Wt_{bot} := \frac{A_{armbot}}{144} \cdot W_{steel} = 13$ plf **BLC 2**

Gravity Loads (ice only)

Arm Area w/ Ice Top = $Ai_{armtop} := (ARM_{d1} + 2 \cdot Ir) \cdot (ARM_{W1} + 2 \cdot Ir) - ARM_{d1} \cdot ARM_{W1} = 31$

Arm Area w/ Ice Bottom = $Ai_{armbot} := (ARM_{d2} + 2 \cdot Ir) \cdot (ARM_{W2} + 2 \cdot Ir) - ARM_{d2} \cdot ARM_{W2} = 9$

Weight of Ice on Arm Top = $W_{ICE.top} := Id \cdot \frac{Ai_{armtop}}{144} = 12$ plf **BLC 3**

Weight of Ice on Arm Bottom = $W_{ICE.bot} := Id \cdot \frac{Ai_{armbot}}{144} = 4$ plf **BLC 3**

Wind Load (NESC Extreme)

Arm Projected Surface Area Top = $A_{top} := \frac{ARM_{d1}}{12} = 1.5$ sq ft/ft

Arm Projected Surface Area Bottom = $A_{bot} := \frac{ARM_{d2}}{12} = 0.333$ sq ft/ft

Total Arm Wind Force Top = $qz \cdot Cd_F \cdot A_{top} = 87$ plf **BLC 7**

Total Arm Wind Force Bottom = $qz \cdot Cd_F \cdot A_{bot} = 19$ plf **BLC 7**

Wind Load (NESE Heavy)

Arm Projected Surface Area w/ Ice Top = $AICE_{top} := \frac{(ARM_{d1} + 2 \cdot Ir)}{12} = 1.583$ sq ft/ft

Arm Projected Surface Area w/ Ice Bottom = $AICE_{bot} := \frac{(ARM_{d2} + 2 \cdot Ir)}{12} = 0.417$ sq ft/ft

Total Arm Wind Force w/ Ice Top = $p \cdot Cd_F \cdot AICE_{top} = 10$ plf **BLC 6**

Total Arm Wind Force w/ Ice Bottom = $p \cdot Cd_F \cdot AICE_{bot} = 3$ plf **BLC 6**

Development of Wind & Ice Load on Coax Cables

Coax Cable Data:	(0-ft to 100-ft)			
Coax Type =	HELIAX 1-5/8"			
Shape =	Round		(User Input)	
Coax Outside Diameter =	$D_{coax} := 1.98$	in	(User Input)	
Coax Cable Length =	$L_{coax} := 100$	ft	(User Input)	
Weight of Coax per foot =	$Wt_{coax} := 1.04$	plf	(User Input)	
Total Number of Coax =	$N_{coax} := 24$		(User Input)	(6 AT&T and 18 Sprint)
No. of Coax Projecting Outside Face of PCS Mast =	$NP_{coax} := 6$		(User Input)	

Wind Load (NESC Extreme)

Coax projected surface area = $A_{coax} := \frac{(NP_{coax} D_{coax})}{12} = 1$ ft

Total Coax Wind Force (Below NU Structure) = $F_{coax} := qz \cdot Cd_{coax} \cdot A_{coax} = 52$ plf **BLC 19 & 21**

Wind Load (NESC Heavy)

Coax projected surface area w/ Ice = $AICE_{coax} := \frac{(NP_{coax} \cdot D_{coax} + 2 \cdot Ir)}{12} = 1.1$ ft

Total Coax Wind Force w/ Ice = $Fi_{coax} := p \cdot Cd_{coax} \cdot AICE_{coax} = 6$ plf **BLC 18 & 20**

Gravity Loads (without ice)

Weight of all cables w/o ice $WT_{coax} := Wt_{coax} \cdot N_{coax} = 25$ plf **BLC 16**

Gravity Load (ice only)

Ice Area per Linear Foot = $Ai_{coax} := \frac{\pi}{4}\left[\left(D_{coax} + 2 \cdot Ir\right)^2 - D_{coax}^{\ 2}\right] = 3.9$ sq in

Ice Weight All Coax per foot = $WTi_{coax} := N_{coax} \cdot Id \cdot \frac{Ai_{coax}}{144} = 36$ plf **BLC 17**

Development of Wind & Ice Load on Coax Cables

Coax Cable Data: (1000-ft to 140-ft)

Coax Type =	HELIAX 1-5/8"			
Shape =	Round		(User Input)	
Coax Outside Diameter =	$D_{coax} := 1.98$	in	(User Input)	
Coax Cable Length =	$L_{coax} := 40$	ft	(User Input)	
Weight of Coax per foot =	$Wl_{coax} := 1.04$	plf	(User Input)	
Total Number of Coax =	$N_{coax} := 6$		(User Input)	(6 AT&T)
No. of Coax Projecting Outside Face of PCS Mast =	$NP_{coax} := 2$		(User Input)	

Wind Load (NESC Extreme)

Coax projected surface area = $A_{coax} := \frac{(NP_{coax} D_{coax})}{12} = 0.3$ ft

Total Coax Wind Force (Below NU Structure) = $F_{coax} := qz \cdot Cd_{coax} \cdot A_{coax} = 17$ plf **BLC 19 & 21**

Wind Load (NESC Heavy)

Coax projected surface area w/ Ice = $AICE_{coax} := \frac{(NP_{coax} \cdot D_{coax} + 2 \cdot Ir)}{12} = 0.4$ ft

Total Coax Wind Force w/ Ice = $Fi_{coax} := p \cdot Cd_{coax} \cdot AICE_{coax} = 2$ plf **BLC 18 & 20**

Gravity Loads (without ice)

Weight of all cables w/o ice $WT_{coax} := Wl_{coax} \cdot N_{coax} = 6$ plf **BLC 16**

Gravity Load (ice only)

Ice Area per Linear Foot = $Ai_{coax} := \frac{\pi}{4}\left[(D_{coax} + 2 \cdot Ir)^2 - D_{coax}^{\;2}\right] = 3.9$ sq in

Ice Weight All Coax per foot = $WTi_{coax} := N_{coax} \cdot Id \cdot \frac{Ai_{coax}}{144} = 9$ plf **BLC 17**

Global

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y
Global Member Orientation Plane	XZ

Hot Rolled Steel Code	AISC 9th: ASD
Cold Formed Steel Code	AISI 1999: ASD
Wood Code	AF&PA NDS-97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-02
Masonry Code	ACI 530-05/08: ASD
Aluminum Code	AA ADM1-05: ASD

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
Bad Framing Warnings	No
Unused Force Warnings	Yes

Seismic Code	UBC 1997
Seismic Base Elevation (ft)	Not Entered
Ct X	.035
Ct Z	.035
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	8.5
R Z	8.5
Ct Exp. X	.75
Ct Exp. Z	.75
Ca	.36
Cv	.54
Nv	1
SD1	1
SDS	1
S1	1
Occupancy Code	4
Seismic Zone	3
Use Group	I
Use Gravity Self Wt in Diaphragm Mass	Yes
Use Deck Self Wt in Diaphragm Mass	Yes
Use Lateral Self Wt in Diaphragm Mass	Yes
Seismic Detailing Code	None
Om X	1
Om Z	1
Rho X	1
Rho Z	1

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E...	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A36 Gr.36	29000	11154	.3	.65	.49	36	1.5	58	1.2
2	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	58	1.2
3	A992	29000	11154	.3	.65	.49	50	1.1	58	1.2
4	A500 Gr.42	29000	11154	.3	.65	.49	42	1.3	58	1.1
5	A500 Gr.46	29000	11154	.3	.65	.49	46	1.2	58	1.1
6	A53 Gr. B	29000	11154	.3	.65	.49	35	1.5	58	1.2

Hot Rolled Steel Design Parameters

	Label	Shape	Lengt...	Lbyy[ft]	Lbzz[ft]	Lcomp top[ft]	Lcomp bot[ft]	Kyy	Kzz	Cm-...	Cm-...	Cb	y sw...	z sw...	Function
1	M1	CL&P P...	150												Lateral
2	M2	arm	9.006												Lateral
3	M3	arm	9.006												Lateral
4	M4	arm	10.854												Lateral
5	M5	arm	10.854												Lateral
6	M6	arm	8.74												Lateral
7	M7	arm	8.74												Lateral
8	M8	arm	5.63												Lateral
9	M9	arm	5.63												Lateral

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	CL&P Pole # 844	W21X44	Column	Wide Flange	A992	Typical	13	20.7	843	.77
2	arm	W8X28	Beam	Wide Flange	A992	Typical	8.25	21.7	98	.54

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	BOTTOM-...	TOP-POLE			CL&P Pole # ...	Column	Wide Flange	A992	Typical
2	M2	ARM1-LE...	ARM1			arm	Beam	Wide Flange	A992	Typical
3	M3	ARM1-RI...	ARM1			arm	Beam	Wide Flange	A992	Typical
4	M4	ARM2-LE...	ARM2			arm	Beam	Wide Flange	A992	Typical
5	M5	ARM2-RI...	ARM2			arm	Beam	Wide Flange	A992	Typical
6	M6	ARM3-LE...	ARM3			arm	Beam	Wide Flange	A992	Typical
7	M7	ARM3-RI...	ARM3			arm	Beam	Wide Flange	A992	Typical
8	M8	ARM4-RI...	ARM4			arm	Beam	Wide Flange	A992	Typical
9	M9	ARM4-LE...	ARM4			arm	Beam	Wide Flange	A992	Typical

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	BOTTOM-POLE	0	0	0	0	
2	POLE-CONNECTION	0	90	0	0	
3	ARM1-LEFT	-8.88	120	0	0	
4	ARM2-LEFT	-10.75	132	0	0	
5	ARM3-LEFT	-8.61	144	0	0	
6	ARM4-LEFT	-5.54	150	0	0	
7	TOP-POLE	0	150	0	0	
8	ARM1-RIGHT	8.88	120	0	0	

Joint Coordinates and Temperatures (Continued)

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	ARM2-RIGHT	10.75	132	0	0	
10	ARM3-RIGHT	8.61	144	0	0	
11	ARM4-RIGHT	5.54	150	0	0	
12	ARM1	0	118.5	0	0	
13	ARM2	0	130.5	0	0	
14	ARM3	0	142.5	0	0	
15	ARM4	0	149	0	0	
16	BOTTOM-BRACE	0	141	0	0	
17	TOP-BRACE	0	148	0	0	
18	SPRINT-ANTENNAS	0	101	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]	Footing
1	BOTTOM-POLE	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	
2	POLE-CONNECTI...							
3	ARM2-LEFT							
4	ARM1-LEFT							

Joint Loads and Enforced Displacements (BLC 8 : x-direction NESC Heavy Wire Load)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ARM4-LEFT	L	Y	-1.201
2	ARM4-RIGHT	L	Y	-1.201
3	ARM3-LEFT	L	Y	-4.49
4	ARM3-RIGHT	L	Y	-4.49
5	ARM2-RIGHT	L	Y	-4.49
6	ARM2-LEFT	L	Y	-4.49
7	ARM1-LEFT	L	Y	-4.49
8	ARM1-RIGHT	L	Y	-4.49
9	ARM4-LEFT	L	X	.939
10	ARM4-RIGHT	L	X	.939
11	ARM3-LEFT	L	X	1.699
12	ARM3-RIGHT	L	X	1.699
13	ARM2-LEFT	L	X	1.699
14	ARM2-RIGHT	L	X	1.699
15	ARM1-LEFT	L	X	1.699
16	ARM1-RIGHT	L	X	1.699

Joint Loads and Enforced Displacements (BLC 9 : x-driection NESC Extreme Wire Lo)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ARM4-LEFT	L	Y	-.297
2	ARM4-RIGHT	L	Y	-.297
3	ARM3-LEFT	L	Y	-2.03
4	ARM3-RIGHT	L	Y	-2.03
5	ARM2-LEFT	L	Y	-2.03
6	ARM2-RIGHT	L	Y	-2.03
7	ARM1-RIGHT	L	Y	-2.03
8	ARM1-LEFT	L	Y	-2.03
9	ARM4-LEFT	L	X	.601
10	ARM4-RIGHT	L	X	.601

Joint Loads and Enforced Displacements (BLC 9 : x-driection NESC Extreme Wire Lo) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
11	ARM3-LEFT	L	X	2.346
12	ARM3-RIGHT	L	X	2.346
13	ARM2-RIGHT	L	X	2.346
14	ARM2-LEFT	L	X	2.346
15	ARM1-LEFT	L	X	2.346
16	ARM1-RIGHT	L	X	2.346

Joint Loads and Enforced Displacements (BLC 10 : z-direction NESC Heavy Wire Lo)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ARM4-LEFT	L	Y	-1.201
2	ARM4-RIGHT	L	Y	-1.201
3	ARM3-LEFT	L	Y	-4.49
4	ARM3-RIGHT	L	Y	-4.49
5	ARM2-LEFT	L	Y	-4.49
6	ARM2-RIGHT	L	Y	-4.49
7	ARM1-LEFT	L	Y	-4.49
8	ARM1-RIGHT	L	Y	-4.49

Joint Loads and Enforced Displacements (BLC 11 : z-direction NESC Extreme Wire Lo)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	ARM4-LEFT	L	Y	-.297
2	ARM4-RIGHT	L	Y	-.297
3	ARM3-LEFT	L	Y	-2.03
4	ARM3-RIGHT	L	Y	-2.03
5	ARM2-LEFT	L	Y	-2.03
6	ARM2-RIGHT	L	Y	-2.03
7	ARM1-LEFT	L	Y	-2.03
8	ARM1-RIGHT	L	Y	-2.03

Joint Loads and Enforced Displacements (BLC 12 : x-direction NESC Heavy Mast Reac)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	TOP-BRACE	L	X	1.212
2	BOTTOM-BRACE	L	X	-.617
3	TOP-BRACE	L	Y	-1.942
4	BOTTOM-BRACE	L	Y	-.274
5	SPRINT-ANTENNAS	L	Y	-.739
6	SPRINT-ANTENNAS	L	X	.41

Joint Loads and Enforced Displacements (BLC 13 : x-direction NESC Extreme Mast Re)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	TOP-BRACE	L	X	4.956
2	BOTTOM-BRACE	L	X	-2.539
3	TOP-BRACE	L	Y	-.91
4	BOTTOM-BRACE	L	Y	-.131
5	SPRINT-ANTENNAS	L	Y	-.286
6	SPRINT-ANTENNAS	L	X	1.547

Joint Loads and Enforced Displacements (BLC 14 : z-direction NESC Heavy Mast Reac)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	TOP-BRACE	L	Z	1.212

Joint Loads and Enforced Displacements (BLC 14 : z-direction NESC Heavy Mast Reac) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
2	BOTTOM-BRACE	L	Z	-.617
3	TOP-BRACE	L	Y	-1.942
4	BOTTOM-BRACE	L	Y	-.274
5	SPRINT-ANTENNAS	L	Y	-.739
6	SPRINT-ANTENNAS	L	Z	.36

Joint Loads and Enforced Displacements (BLC 15 : z-direction NESC Extreme Mast Re)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/f...
1	TOP-BRACE	L	Z	4.956
2	BOTTOM-BRACE	L	Z	-2.539
3	TOP-BRACE	L	Y	-.91
4	BOTTOM-BRACE	L	Y	-.131
5	SPRINT-ANTENNAS	L	Y	-.286
6	SPRINT-ANTENNAS	L	Z	1.437

Member Point Loads

Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
No Data to Print ...			

Member Distributed Loads (BLC 2 : Weight Pole and Arms)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.272	-.105	0	0
2	M9	Y	-.013	-.033	0	0
3	M8	Y	-.013	-.033	0	0
4	M6	Y	-.013	-.042	0	0
5	M7	Y	-.013	-.042	0	0
6	M3	Y	-.013	-.042	0	0
7	M2	Y	-.013	-.042	0	0
8	M4	Y	-.013	-.05	0	0
9	M5	Y	-.013	-.05	0	0

Member Distributed Loads (BLC 3 : Weight of Ice Only on Pole and A)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.044	-.016	0	0
2	M9	Y	-.004	-.008	0	0
3	M8	Y	-.004	-.008	0	0
4	M6	Y	-.004	-.01	0	0
5	M7	Y	-.004	-.01	0	0
6	M3	Y	-.004	-.01	0	0
7	M2	Y	-.004	-.01	0	0
8	M4	Y	-.004	-.012	0	0
9	M5	Y	-.004	-.012	0	0

Member Distributed Loads (BLC 4 : x-direction NESC Heavy Wind on P)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.012	.012	0	0

Member Distributed Loads (BLC 5 : x-direction NESC Extreme Wind on)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.104	.104	0	0

Member Distributed Loads (BLC 6 : z-direction NESC Heavy Wind)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.029	.007	0	0
2	M8	Z	.003	.007	0	0
3	M9	Z	.003	.007	0	0
4	M7	Z	.003	.009	0	0
5	M6	Z	.003	.009	0	0
6	M3	Z	.003	.009	0	0
7	M2	Z	.003	.009	0	0
8	M5	Z	.003	.01	0	0
9	M4	Z	.003	.01	0	0

Member Distributed Loads (BLC 7 : z-direction NESC Extreme Wind)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.26	.058	0	0
2	M8	Z	.019	.058	0	0
3	M9	Z	.019	.058	0	0
4	M7	Z	.019	.072	0	0
5	M6	Z	.019	.072	0	0
6	M2	Z	.019	.072	0	0
7	M3	Z	.019	.072	0	0
8	M5	Z	.019	.087	0	0
9	M4	Z	.019	.087	0	0

Member Distributed Loads (BLC 16 : Weight of Coax Cables)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.025	-.025	0	100
2	M1	Y	-.006	-.006	100	140

Member Distributed Loads (BLC 17 : Weight of Ice on Coax Cables)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.036	-.036	0	100
2	M1	Y	-.009	-.009	100	140

Member Distributed Loads (BLC 18 : x-direction NESC Heavy Coax)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.006	.006	0	100
2	M1	X	.002	.002	100	140

Member Distributed Loads (BLC 19 : x-direction NESC Extreme Coax)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	X	.052	.052	0	100
2	M1	X	.017	.017	100	140

Member Distributed Loads (BLC 20 : z-direction NESC Heavy Coax)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.006	.006	0	100

Member Distributed Loads (BLC 20 : z-direction NESC Heavy Coax) (Continued)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
2	M1	Z	.002	.002	100	140

Member Distributed Loads (BLC 21 : z-direction NESC Extreme Coax)

	Member Label	Direction	Start Magnitude[k/ft,deg]	End Magnitude[k/f...	Start Location[ft,%]	End Location[ft,%]
1	M1	Z	.052	.052	0	100
2	M1	Z	.017	.017	100	140

Basic Load Cases

	BLC Description	Category	X Gr...	Y Gr...	Z Grav...	Joint	Point	Distri...	Area(...	Surfa...
1	Self Weight (Not Used)	None								
2	Weight Pole and Arms	None						9		
3	Weight of Ice Only on Pole and A	None						9		
4	x-direction NESC Heavy Wind on P	None						1		
5	x-direction NESC Extreme Wind on	None						1		
6	z-direction NESC Heavy Wind	None						9		
7	z-direction NESC Extreme Wind	None						9		
8	x-direction NESC Heavy Wire Load	None				16				
9	x-driection NESC Extreme Wire Lo	None				16				
10	z-direction NESC Heavy Wire Lo	None				8				
11	z-direction NESC Extreme Wire Lo	None				8				
12	x-direction NESC Heavy Mast Reac	None				6				
13	x-direction NESC Extreme Mast Re	None				6				
14	z-direction NESC Heavy Mast Reac	None				6				
15	z-direction NESC Extreme Mast Re	None				6				
16	Weight of Coax Cables	None						2		
17	Weight of Ice on Coax Cables	None						2		
18	x-direction NESC Heavy Coax	None						2		
19	x-direction NESC Extreme Coax	None						2		
20	z-direction NESC Heavy Coax	None						2		
21	z-direction NESC Extreme Coax	None						2		

Load Combinations

	Description	So...	PDelta	SRSS	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...
1	x-direction NESC Heavy Wind	Yes			2	1.5	3	1.5	4	2.5	8	1	12	1	16	1.5	17	1.5	18	2.5
2	x-direction NESC Extreme Wi...	Yes			2	1	5	1	9	1	13	1	16	1	19	1				
3	z-direction NESC Heavy Wind	Yes			2	1.5	3	1.5	6	2.5	10	1	14	1	16	1.5	17	1.5	20	2.5
4	z-direction NESC Extreme W...	Yes			2	1	7	1	11	1	15	1	16	1	21	1				

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	BOTTOM-PO...	max	0	3	95.122	1	0	1	0	1	0	1	4081.668	2
2		min	-40.722	2	47.035	2	-36.783	4	-2699.239	4	0	1	0	3
3	Totals:	max	0	3	95.122	1	0	1						
4		min	-40.722	2	47.035	2	-36.783	4						

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	BOTTOM-POLE	-19.277	95.122	0	0	0	2197.597
2	1	Totals:	-19.277	95.122	0			
3	1	COG (ft):	X: 0	Y: 89.397	Z: 0			

Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	BOTTOM-POLE	-40.722	47.035	0	0	0	4081.668
2	2	Totals:	-40.722	47.035	0			
3	2	COG (ft):	X: 0	Y: 87.092	Z: 0			

Joint Reactions

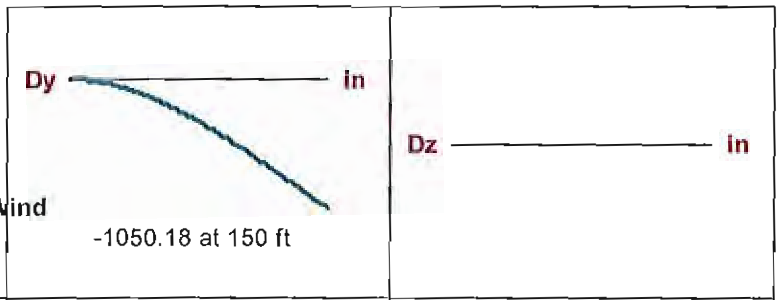
	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	3	BOTTOM-POLE	0	95.122	-10.431	-767.858	0	0
2	3	**Totals:**	**0**	**95.122**	**-10.431**			
3	3	COG (ft):	X: 0	Y: 89.397	Z: 0			

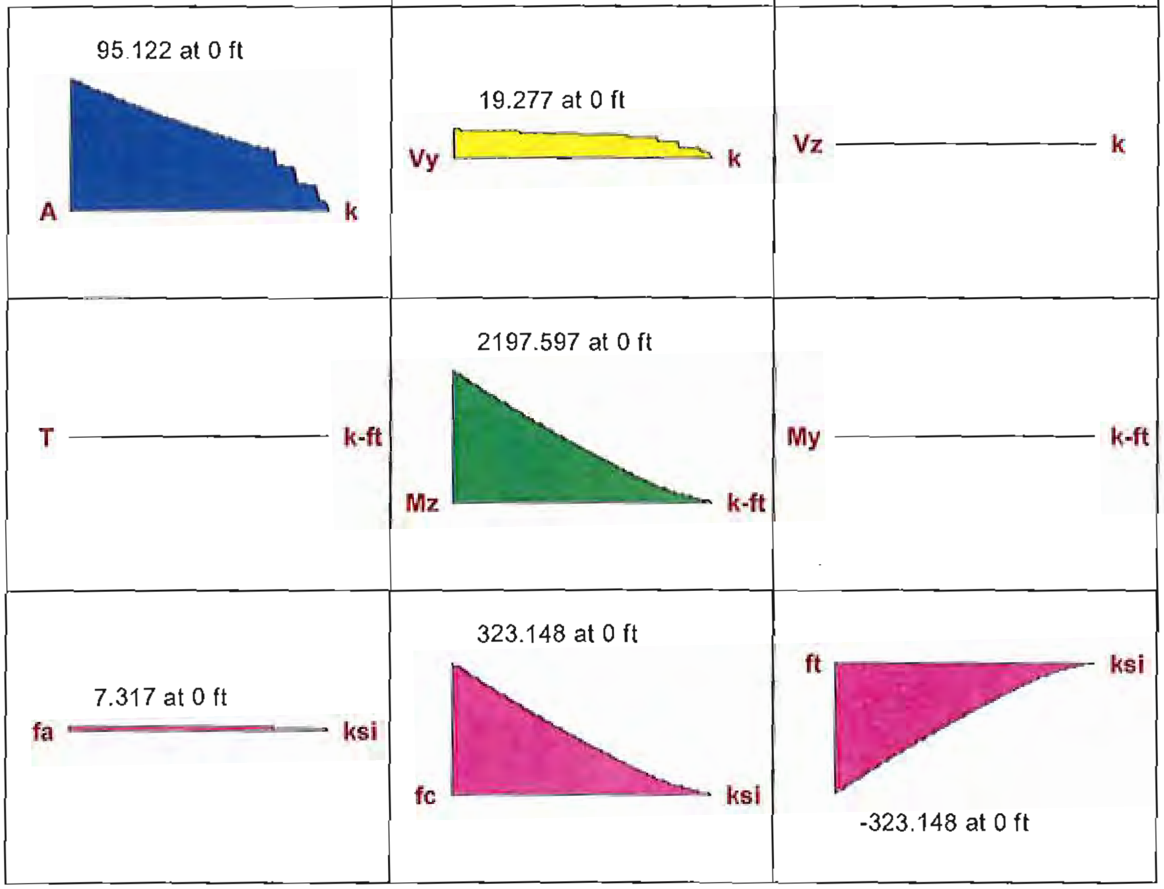
Joint Reactions

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	BOTTOM-POLE	0	47.035	-36.783	-2699.239	0	0
2	4	Totals:	0	47.035	-36.783			
3	4	COG (ft):	X: 0	Y: 87.092	Z: 0			

Column: ***M1***

Shape: **W21X44**
Material: **A992**
Length: **150 ft**
I Joint: **BOTTOM-POLE**
J Joint: **TOP-POLE**
LC 1: x-direction NESC Heavy Wind
Code Check: **No Calc**
Report Based On 97 Sections





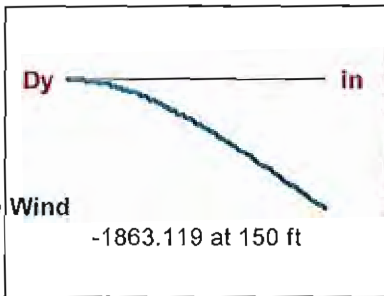
AISC 9th: ASD Code Check

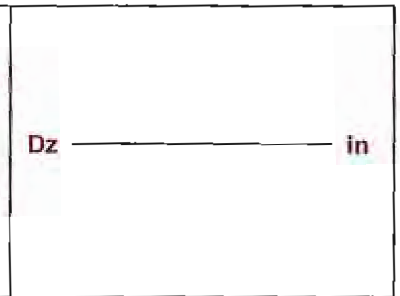
- Compressive stress fa exceeds F'e (Euler buckling) -

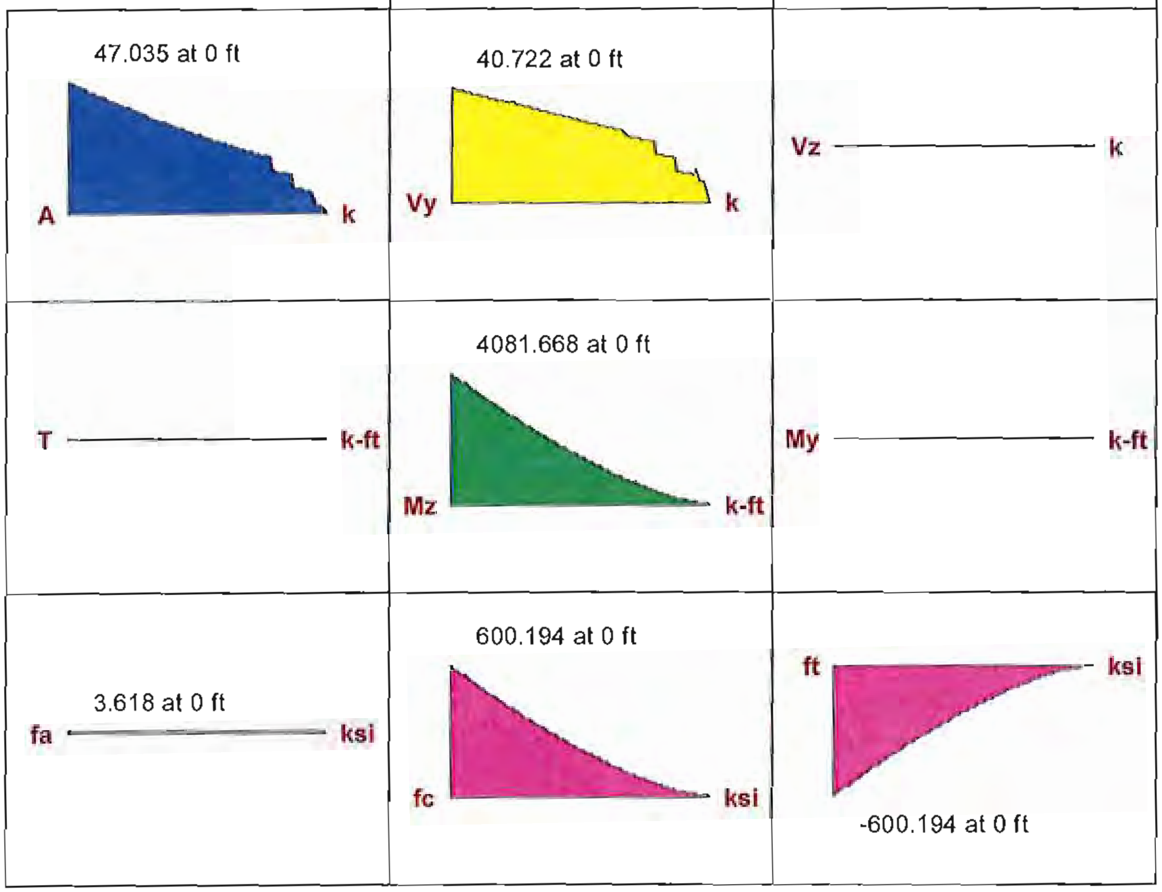
Max Defl Ratio **L/2**

Column: *M1*

Shape: **W21X44**
Material: **A992**
Length: **150 ft**
I Joint: **BOTTOM-POLE**
J Joint: **TOP-POLE**
LC 2: x-direction NESC Extreme Wind
Code Check: **No Calc**
Report Based On 97 Sections







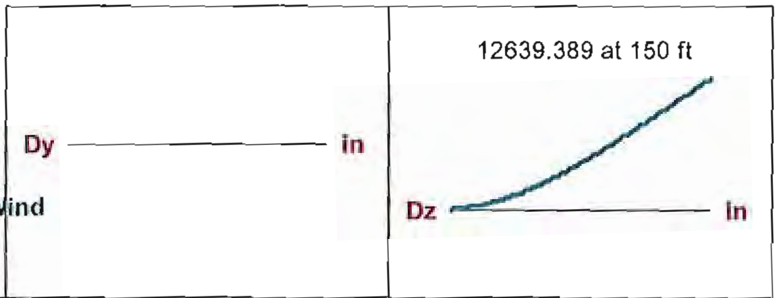
AISC 9th: ASD Code Check

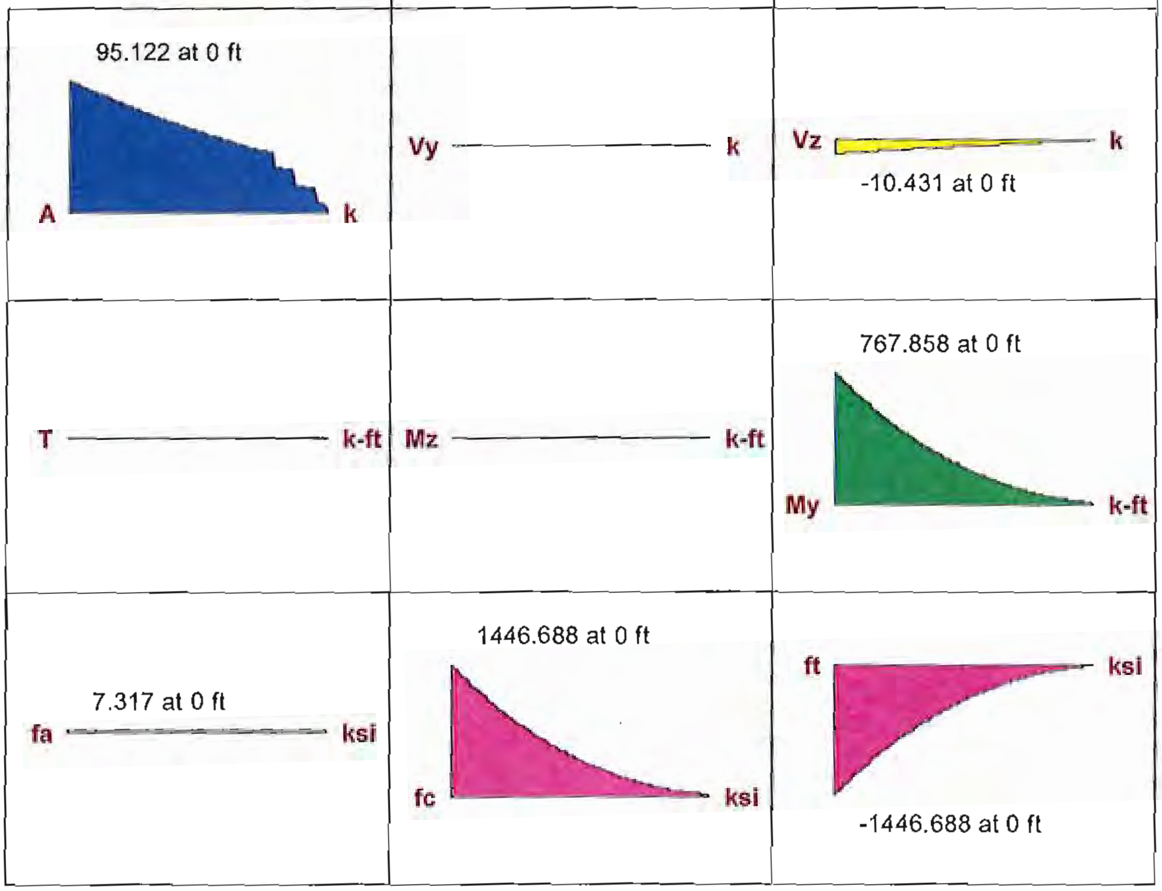
- Compressive stress fa exceeds F'e (Euler buckling) -

Max Defl Ratio **L/1**

Column: ***M1***

Shape: **W21X44**
Material: **A992**
Length: **150 ft**
I Joint: **BOTTOM-POLE**
J Joint: **TOP-POLE**
LC 3: z-direction NESC Heavy Wind
Code Check: **No Calc**
Report Based On 97 Sections





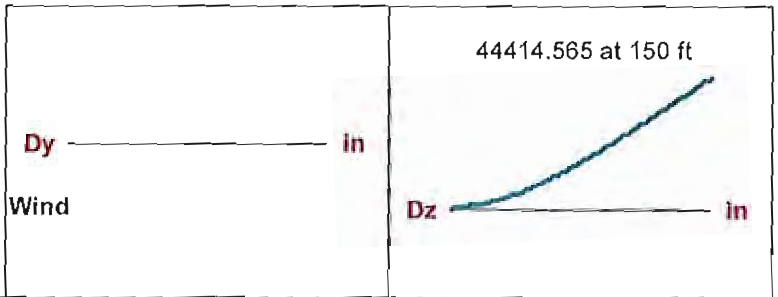
AISC 9th: ASD Code Check

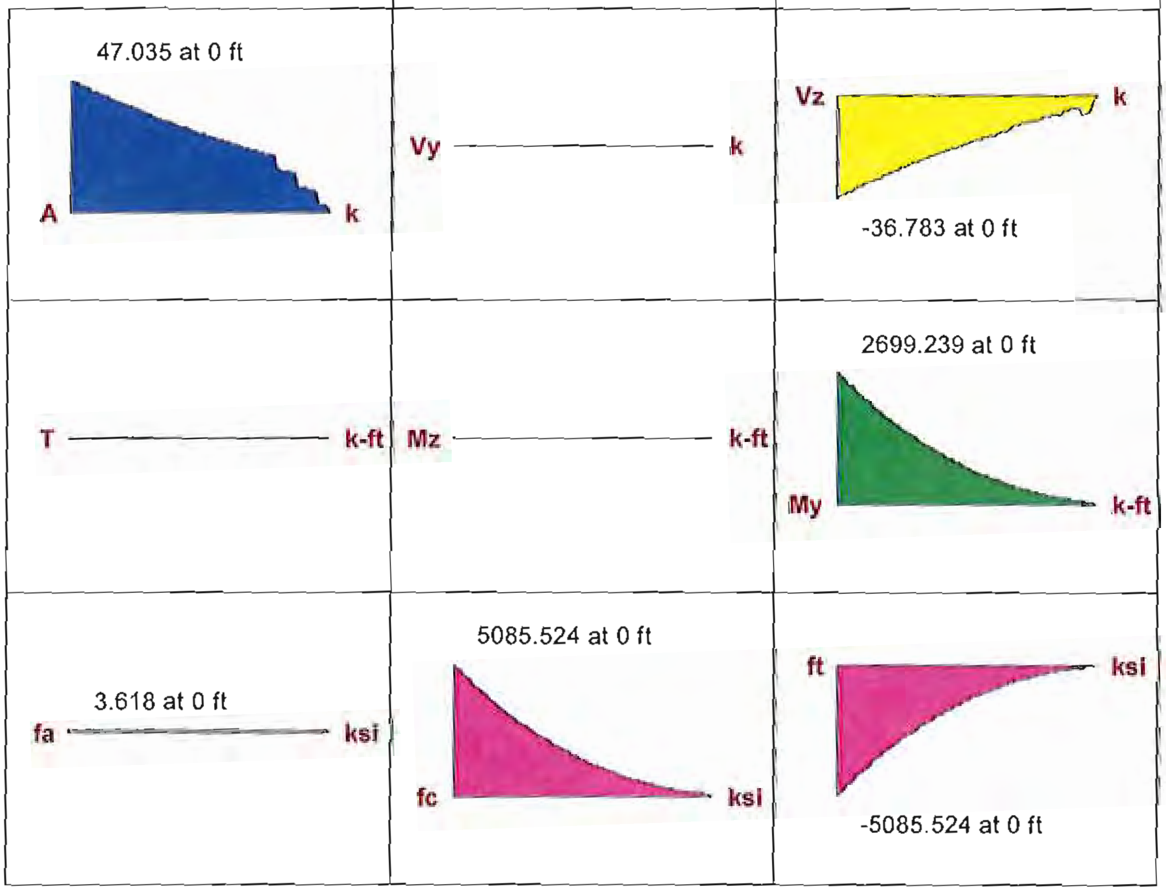
- Compressive stress fa exceeds F'e (Euler buckling) -

Max Defl Ratio **L/1**

Column: ***M1***

Shape: **W21X44**
Material: **A992**
Length: **150 ft**
I Joint: **BOTTOM-POLE**
J Joint: **TOP-POLE**
LC 4: z-direction NESC Extreme Wind
Code Check: **No Calc**
Report Based On 97 Sections

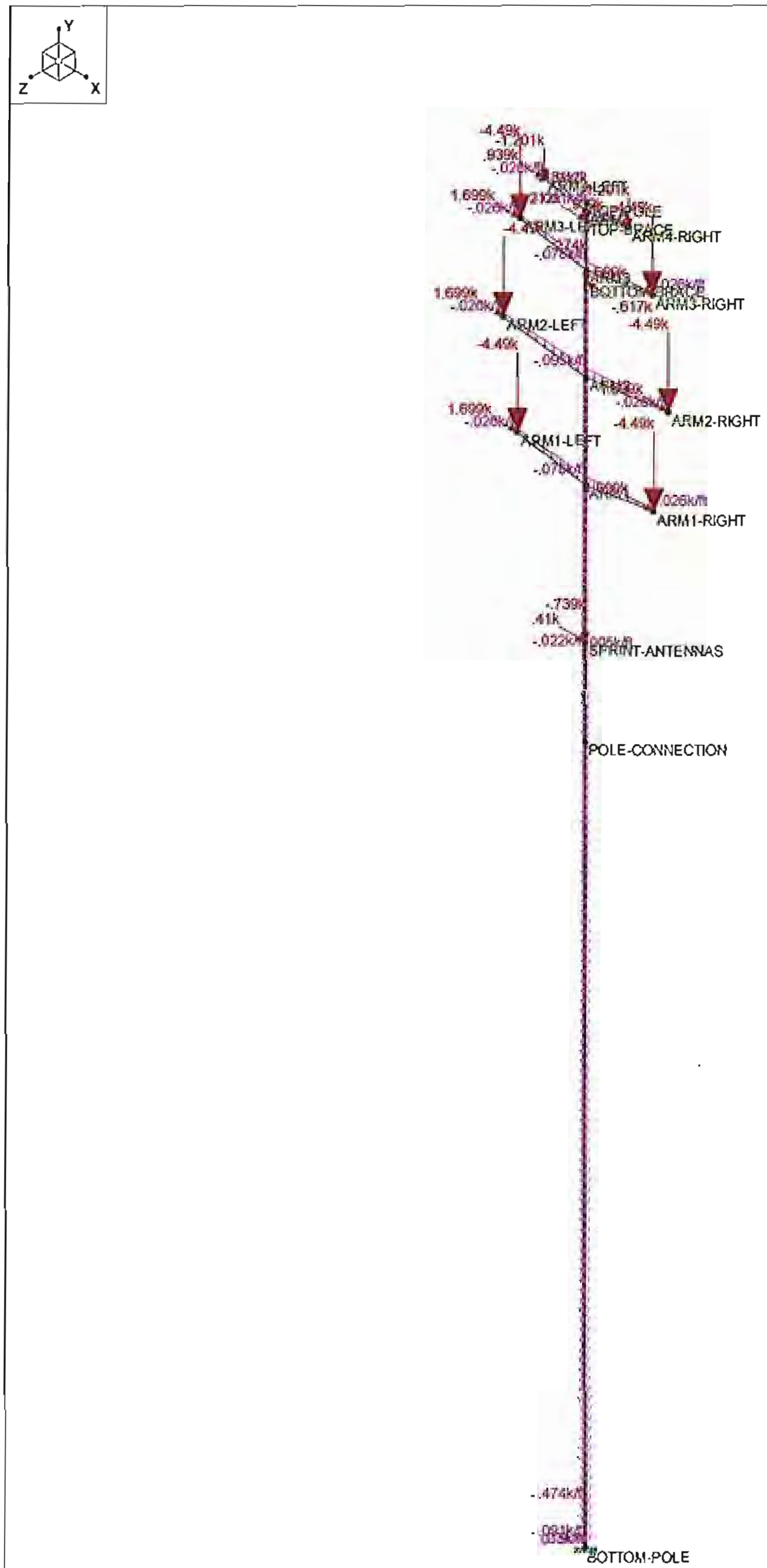




AISC 9th: ASD Code Check

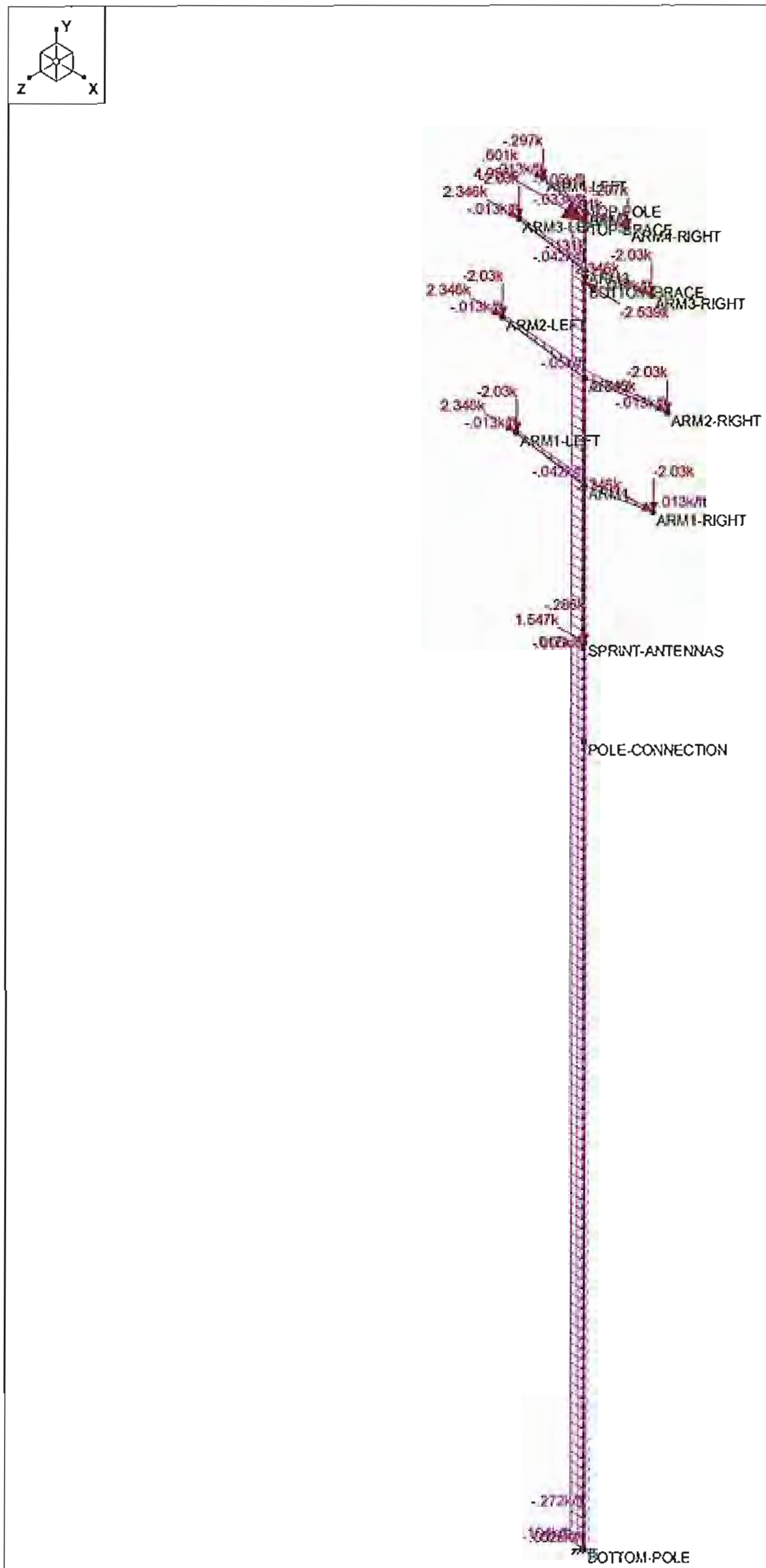
- Compressive stress fa exceeds F'e (Euler buckling) -

Max Defl Ratio L/1



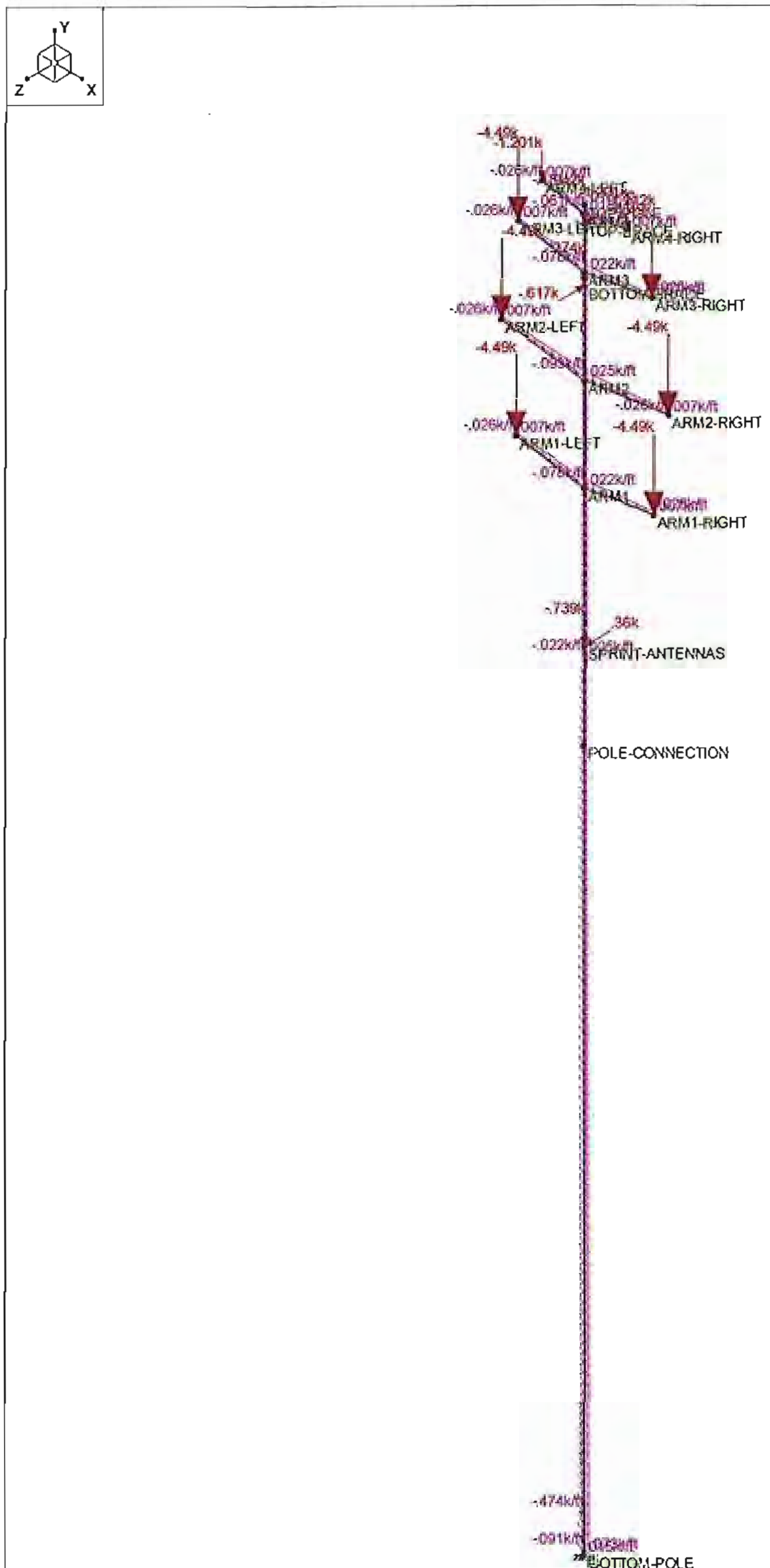
Loads: LC 1, x-direction NESC Heavy Wind

Centek Engineering		
tjl, cfc	CL&P Pole # 844	Apr 9, 2013 at 11:51 AM
12047.CO11 - CT43XC811	LC #1 Loads	5089 Pole Analysis Using NESC Loa...



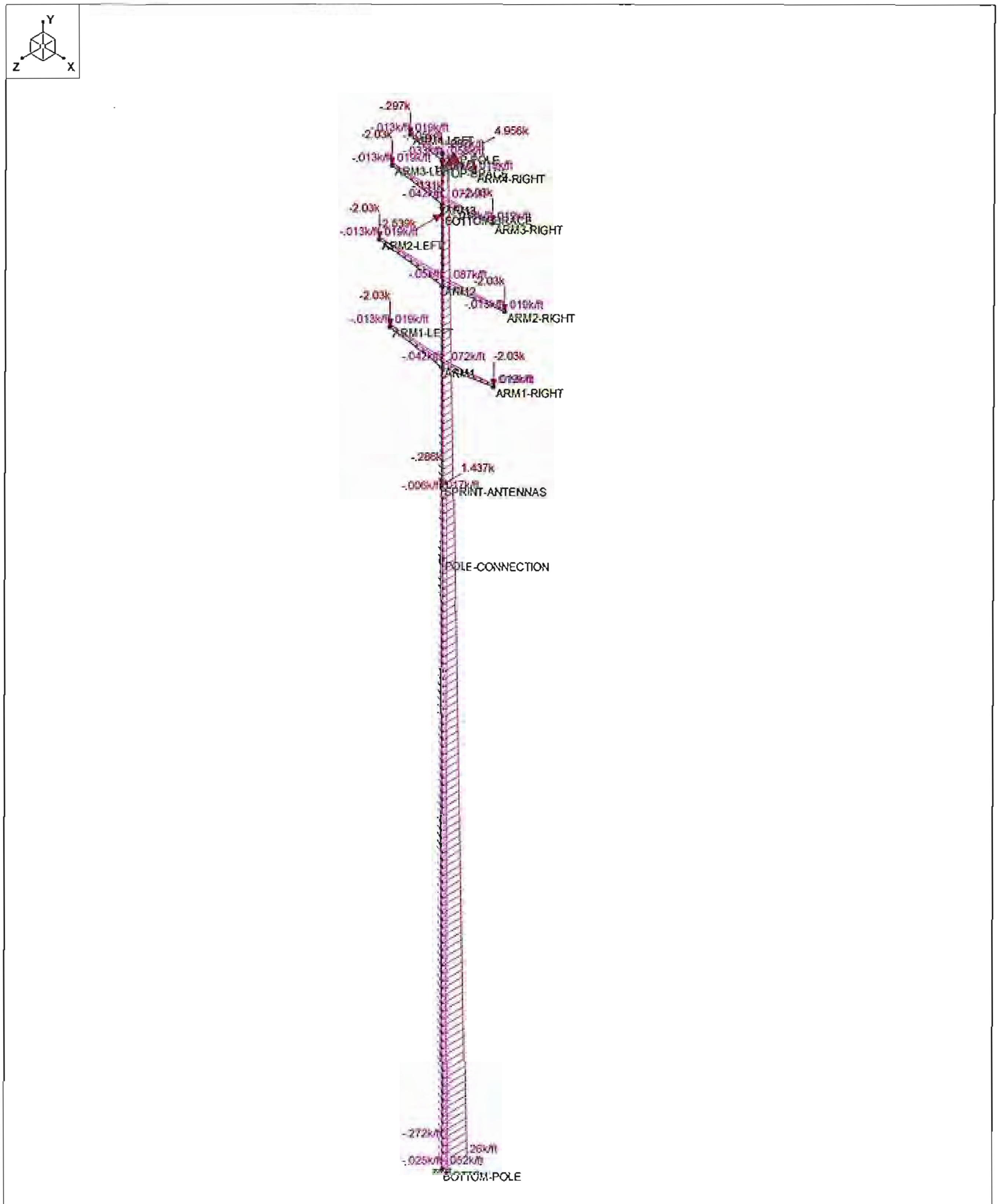
Loads: LC 2, x-direction NESC Extreme Wind

Centek Engineering		
tjl, cfc	CL&P Pole # 844	Apr 9, 2013 at 11:51 AM
12047.CO11 - CT43XC811	LC #2 Loads	5089 Pole Analysis Using NESC Loa...



Loads: LC 3, z-direction NESC Heavy Wind

Centek Engineering		
tjl, cfc	CL&P Pole # 844	Apr 9, 2013 at 11:52 AM
12047.CO11 - CT43XC811	LC #3 Loads	5089 Pole Analysis Using NESC Loa...



Loads: LC 4, z-direction NESC Extreme Wind

Centek Engineering		
tjl, cfc	CL&P Pole # 844	Apr 9, 2013 at 11:52 AM
12047.CO11 - CT43XC811	LC #4 Loads	5089 Pole Analysis Using NESC Loa...

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

Subject:	CL&P Pole #844
Location:	Trumbull, CT
Rev. 0: 4/9/13	Prepared by: T.J.L Checked by: C.F.C. Job No. 12047.CO11

WMECO Pole Analysis:

Pole Properties:

Wide Flange Moment of Inertia Iy =	$I_{yy} := 20.7 \cdot in^4$	(User Input)
Wide Flange Moment of Inertia Ix =	$I_{xx} := 843 \cdot in^4$	(User Input)
Wide Flange Area =	$A_{wf} := 13.0 \cdot in^2$	(User Input)
Flange Width =	$b_f := 6.5 \cdot in$	(User Input)
Wide Flange Depth =	$d_{wf} := 20.7 \cdot in$	(User Input)
Tower Width Top =	$W_{TTop} := 13 \cdot in$	(User Input)
Tower Width Base =	$W_{TBase} := 54 \cdot in$	(User Input)
Plate Thickness Top =	$Plt_{tTop} := 0.1875 \cdot in$	(User Input)
Plate Thickness Base =	$Plt_{tBase} := 0.5 \cdot in$	(User Input)
Length of Pole =	$L_{pole} := 150 \cdot ft$	(User Input)
Nominal Bending Stress =	$F_b := 60 \cdot ksi$	(User Input)
Modulus of Elasticity =	$E := 29000 \cdot ksi$	(User Input)

Member Forces:

Bending Moment x-direction Top =	$M_{xtop} := 0 \cdot kip \cdot ft$	(User Input from RISA-3D)
Bending Moment x-direction Midspan =	$M_{xmid} := 1467 \cdot kip \cdot ft$	(User Input from RISA-3D)
Bending Moment x-direction Bottom =	$M_{xbot} := 4082 \cdot kip \cdot ft$	(User Input from RISA-3D)
Bending Moment y-direction Top =	$M_{ytop} := 0 \cdot kip \cdot ft$	(User Input from RISA-3D)
Bending Moment y-direction Midspan =	$M_{ymid} := 724 \cdot kip \cdot ft$	(User Input from RISA-3D)
Bending Moment y-direction Bottom =	$M_{ybot} := 2700 kip \cdot ft$	(User Input from RISA-3D)
Axial Force Top =	$P_{top} := 0 \cdot kip$	(User Input from RISA-3D)
Axial Force Bottom =	$P_{bot} := 47 \cdot kip$	(User Input from RISA-3D)

Increment Length =	$lc := 5 \cdot ft$	(User Input)
Number of Increments =	$N := \frac{L_{pole}}{lc}$	(User Input)

$$d_i := \left| \begin{array}{l} x \leftarrow (lc \cdot i) \\ d \leftarrow (L_{pole} - x) \end{array} \right.$$

Distance Above Ground Level =

$$d_i = \begin{pmatrix} 150 \\ 145 \\ 140 \\ 135 \\ 130 \\ 125 \\ 120 \\ 115 \\ 110 \\ 105 \\ 100 \\ 95 \\ 90 \\ 85 \\ 80 \\ 75 \\ 70 \\ 65 \\ 60 \\ 55 \\ 50 \\ 45 \\ 40 \\ 35 \\ 30 \\ 25 \\ 20 \\ 15 \\ 10 \\ 5 \\ 0 \end{pmatrix} ft$$

Bending Moment x-direction @ 5' Increments =

$$M_{x_i} := \begin{array}{|l} \Delta M_x \leftarrow \frac{(M_{xmid} - M_{xtop})}{0.5 \cdot L_{pole}} \cdot \left(d_i - \frac{L_{pole}}{2}\right) \text{ if } d_i > \frac{L_{pole}}{2} \\ \Delta M_x \leftarrow \frac{(M_{xbot} - M_{xmid})}{0.5 \cdot L_{pole}} \cdot d_i \text{ if } d_i \le \frac{L_{pole}}{2} \\ M_x \leftarrow M_{xmid} - \Delta M_x \text{ if } d_i > \frac{L_{pole}}{2} \\ M_x \leftarrow M_{xbot} - \Delta M_x \text{ if } d_i \le \frac{L_{pole}}{2} \end{array}$$

$$M_{x_i} = \begin{pmatrix} -2\times 10^{-13} \\ 98 \\ 196 \\ 293 \\ 391 \\ 489 \\ 587 \\ 685 \\ 782 \\ 880 \\ 978 \\ 1076 \\ 1174 \\ 1271 \\ 1369 \\ 1467 \\ 1641 \\ 1816 \\ 1990 \\ 2164 \\ 2339 \\ 2513 \\ 2667 \\ 2862 \\ 3036 \\ 3210 \\ 3385 \\ 3559 \\ 3733 \\ 3908 \\ 4082 \end{pmatrix} \cdot kip \cdot ft$$

Bending Moment y-direction @ 5' Increments =

$$M_{y_i} := \begin{array}{|l} \Delta M_y \leftarrow \frac{(M_{ymid} - M_{ytop})}{0.5 \cdot L_{pole}} \cdot \left(d_i - \frac{L_{pole}}{2}\right) \text{ if } d_i > \frac{L_{pole}}{2} \\ \Delta M_y \leftarrow \frac{(M_{ybot} - M_{ymid})}{0.5 \cdot L_{pole}} \cdot d_i \text{ if } d_i \le \frac{L_{pole}}{2} \\ M_y \leftarrow M_{ymid} - \Delta M_y \text{ if } d_i > \frac{L_{pole}}{2} \\ M_y \leftarrow M_{ybot} - \Delta M_y \text{ if } d_i \le \frac{L_{pole}}{2} \end{array}$$

$$M_{y_i} = \begin{pmatrix} 0 \\ 48 \\ 97 \\ 145 \\ 193 \\ 241 \\ 290 \\ 338 \\ 386 \\ 434 \\ 483 \\ 531 \\ 579 \\ 627 \\ 676 \\ 724 \\ 856 \\ 987 \\ 1119 \\ 1251 \\ 1383 \\ 1514 \\ 1646 \\ 1778 \\ 1910 \\ 2041 \\ 2173 \\ 2305 \\ 2437 \\ 2568 \\ 2700 \end{pmatrix} \cdot kip \cdot ft$$

Tower Width =

$$W_{Tx_i} := \left| \begin{array}{l} \Delta W_{T.x} \leftarrow \frac{(W_{TBase} - W_{TTop})}{L_{pole}} \cdot d_i \\ W_{Tx} \leftarrow W_{TBase} - \Delta W_{T.x} \end{array} \right.$$

Plate Thickness =

$$Plt_{t_i} := \left| \begin{array}{l} \Delta Plt_t \leftarrow \frac{(Plt_{tBase} - Plt_{tTop})}{L_{pole}} \cdot d_i \\ Plt_t \leftarrow Plt_{tBase} - \Delta Plt_t \end{array} \right.$$

Plate Area =

$$Plt_{A_i} := W_{Tx_i} \cdot Plt_{t_i}$$

W_{Tx_i} = (ft)	Plt_{t_i} = (in)	Plt_{A_i} = (in²)
1.083	0.187	2.4
1.197	0.198	2.8
1.311	0.208	3.3
1.425	0.219	3.7
1.539	0.229	4.2
1.653	0.24	4.8
1.767	0.25	5.3
1.881	0.26	5.9
1.994	0.271	6.5
2.108	0.281	7.1
2.222	0.292	7.8
2.336	0.302	8.5
2.45	0.313	9.2
2.564	0.323	9.9
2.678	0.333	10.7
2.792	0.344	11.5
2.906	0.354	12.3
3.019	0.365	13.2
3.133	0.375	14.1
3.247	0.385	15
3.361	0.396	16
3.475	0.406	16.9
3.589	0.417	17.9
3.703	0.427	19
3.817	0.438	20
3.931	0.448	21.1
4.044	0.458	22.2
4.158	0.469	23.4
4.272	0.479	24.6
4.386	0.49	25.8
4.5	0.5	27

Distance from Wide Flange Centroid to Built-up Section Centroid =

$$d_{x_i} := \frac{W_{Tx_i}}{2} - \frac{b_f}{2}$$

$$d_{x_i} = \begin{pmatrix} 3.25 \\ 3.93 \\ 4.62 \\ 5.3 \\ 5.98 \\ 6.67 \\ 7.35 \\ 8.03 \\ 8.72 \\ 9.4 \\ 10.08 \\ 10.77 \\ 11.45 \\ 12.13 \\ 12.82 \\ 13.5 \\ 14.18 \\ 14.87 \\ 15.55 \\ 16.23 \\ 16.92 \\ 17.6 \\ 18.28 \\ 18.97 \\ 19.65 \\ 20.33 \\ 21.02 \\ 21.7 \\ 22.38 \\ 23.07 \\ 23.75 \end{pmatrix} \cdot in$$

Distance from Plate Centroid to Built-up Section Centroid =

$$d_{y_i} := \frac{Plt_{t_i}}{2} + \frac{d_{wf}}{2}$$

$$d_{y_i} = \begin{pmatrix} 10.44 \\ 10.45 \\ 10.45 \\ 10.46 \\ 10.46 \\ 10.47 \\ 10.47 \\ 10.48 \\ 10.49 \\ 10.49 \\ 10.5 \\ 10.5 \\ 10.51 \\ 10.51 \\ 10.52 \\ 10.52 \\ 10.53 \\ 10.53 \\ 10.54 \\ 10.54 \\ 10.55 \\ 10.55 \\ 10.56 \\ 10.56 \\ 10.57 \\ 10.57 \\ 10.58 \\ 10.58 \\ 10.59 \\ 10.59 \\ 10.6 \end{pmatrix} \cdot in$$

Total Bult-up Section Area =

$$A_{Tot_i} := 2 \cdot \left(Plt_{A_i} + A_{wf}\right)$$

$$A_{Tot_i} = \begin{pmatrix} 30.9 \\ 31.7 \\ 32.6 \\ 33.5 \\ 34.5 \\ 35.5 \\ 36.6 \\ 37.8 \\ 39 \\ 40.2 \\ 41.6 \\ 42.9 \\ 44.4 \\ 45.9 \\ 47.4 \\ 49 \\ 50.7 \\ 52.4 \\ 54.2 \\ 56 \\ 57.9 \\ 59.9 \\ 61.9 \\ 64 \\ 66.1 \\ 68.3 \\ 70.5 \\ 72.8 \\ 75.1 \\ 77.5 \\ 80 \end{pmatrix} \cdot in^2$$

Built of Section Moment of Inertia Ix =

$$I_{x_i} := 2\cdot\left[I_{yy} + A_{wf}\cdot\left(d_{x_i}\right)^2 + \frac{1}{12}\cdot Plt_{t_i}\cdot\left(W_{Tx_i}\right)^3\right]$$

Built of Section Moment of Inertia Iy =

$$I_{y_i} := 2\cdot\left[I_{xx} + \frac{1}{12}\cdot W_{Tx_i}\cdot\left(Plt_{t_i}\right)^3 + Plt_{A_i}\cdot\left(d_{y_i}\right)^2\right]$$

I_{x_i} (in^4)	I_{y_i} (in^4)
385	2218
541	2307
731	2402
954	2504
1213	2613
1508	2728
1843	2849
2218	2977
2636	3111
3098	3252
3607	3400
4165	3554
4774	3714
5436	3882
6158	4056
6934	4236
7774	4423
8678	4617
9651	4818
10694	5025
11611	5239
13005	5460
14280	5687
15639	5922
17086	6163
18624	6411
20258	6666
21992	6928
23628	7196
25773	7472
27829	7755

Built of Section Modulus Sx = $S_{x_i} := \frac{I_{x_i}}{\frac{W_{Tx_i}}{2}}$

Built of Section Modulus Sy = $S_{y_i} := \frac{I_{y_i}}{Plt_{l_i} + \frac{d_{wf}}{2}}$

$$S_{x_i} = \begin{pmatrix} 59 \\ 75 \\ 93 \\ 112 \\ 131 \\ 152 \\ 174 \\ 197 \\ 220 \\ 245 \\ 271 \\ 297 \\ 325 \\ 353 \\ 383 \\ 414 \\ 446 \\ 479 \\ 513 \\ 549 \\ 586 \\ 624 \\ 663 \\ 704 \\ 746 \\ 790 \\ 835 \\ 881 \\ 930 \\ 979 \\ 1031 \end{pmatrix} \cdot in^3$$

$$S_{y_i} = \begin{pmatrix} 210 \\ 219 \\ 228 \\ 237 \\ 247 \\ 258 \\ 269 \\ 281 \\ 293 \\ 306 \\ 319 \\ 334 \\ 348 \\ 364 \\ 380 \\ 396 \\ 413 \\ 431 \\ 449 \\ 468 \\ 488 \\ 508 \\ 528 \\ 549 \\ 571 \\ 594 \\ 617 \\ 640 \\ 665 \\ 669 \\ 715 \end{pmatrix} \cdot in^3$$

Bending Stress x-direction @ 5' Increments = $fb_{x_i} := \frac{M_{x_i}}{S_{x_i}}$

Bending Stress y-direction @ 5' Increments = $fb_{y_i} := \frac{M_{y_i}}{S_{y_i}}$

$$fb_{x_i} = \begin{pmatrix} -3.5\times10^{-14} \\ 15.6 \\ 25.3 \\ 31.6 \\ 35.7 \\ 38.6 \\ 40.5 \\ 41.8 \\ 42.6 \\ 43.1 \\ 43.4 \\ 43.5 \\ 43.4 \\ 43.2 \\ 42.9 \\ 42.5 \\ 44.2 \\ 45.5 \\ 46.5 \\ 47.3 \\ 47.9 \\ 48.3 \\ 48.6 \\ 48.8 \\ 48.8 \\ 48.8 \\ 48.7 \\ 48.5 \\ 48.2 \\ 47.9 \\ 47.5 \end{pmatrix} \cdot ksi \qquad fb_{y_i} = \begin{pmatrix} 0 \\ 2.6 \\ 5.1 \\ 7.3 \\ 9.4 \\ 11.2 \\ 12.9 \\ 14.5 \\ 15.8 \\ 17 \\ 18.1 \\ 19.1 \\ 20 \\ 20.7 \\ 21.4 \\ 21.9 \\ 24.9 \\ 27.5 \\ 29.9 \\ 32.1 \\ 34 \\ 35.8 \\ 37.4 \\ 38.8 \\ 40.1 \\ 41.3 \\ 42.3 \\ 43.2 \\ 44 \\ 44.7 \\ 45.3 \end{pmatrix} \cdot ksi$$

Maximum Bending Stress x-direction = $f_{bxmax} := 48.8 \cdot ksi$

Percent Stressed = $\frac{f_{bxmax}}{F_b} = 81.3 \cdot \%$

Bending_Check_x := if($f_{bxmax} < F_b$,"OK" ,"NG")

Bending_Check_x = "OK"

Maximum Bending Stress y-direction = $f_{bymax} := 45.3 \cdot ksi$

Percent Stressed = $\frac{f_{bymax}}{F_b} = 75.5 \cdot \%$

Bending_Check_y := if($f_{bymax} < F_b$,"OK" ,"NG")

Bending_Check_y = "OK"

Flange Bolts and Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 1065 \cdot ft \cdot kips$	(Input From Risa-3D)
Shear Force =	$Shear := 26.7 \cdot kips$	(Input From Risa-3D)
Axial Force =	$Axial := 24.8 \cdot kips$	(Input From Risa-3D)

Flange Bolt Data:

Use ASTM A490

Number of Flange Bolts =	$N := 24$	(User Input)
Bolt Ultimate Strength =	$F_u := 150 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 125 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Flange Bolts =	$D := 0.875 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Flange Plate Data:

Use ASTM A36

Plate Yield Strength =	$Fy_{bp} := 36 \cdot ksi$	(User Input)
Flange Plate Thickness =	$t_{bp} := 2.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 2.0in$ (User Input)

$d_2 := 7.0in$ (User Input)

$d_3 := 12.0in$ (User Input)

$d_4 := 15.5in$ (User Input)

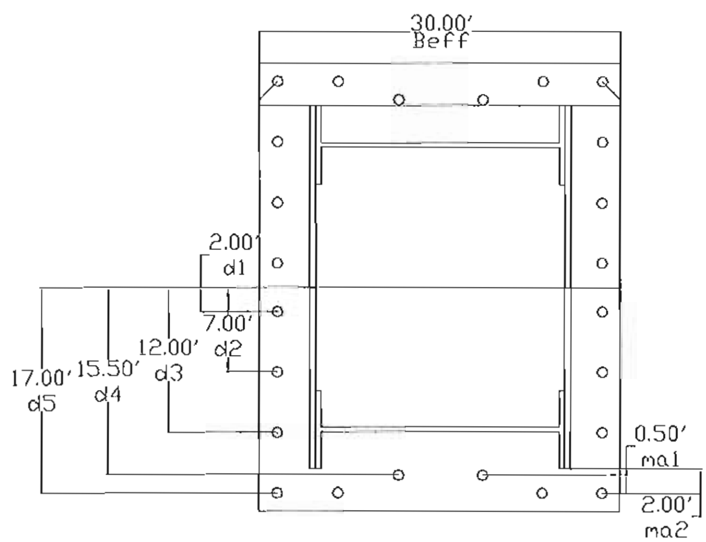
$d_5 := 17.0in$ (User Input)

Critical Distances For Bending in Plate:

$ma_1 := 0.5in$ (User Input)

$ma_2 := 2.0in$ (User Input)

Effective Width of Flange Plate for Bending = $B_{eff} := 30.0in$ (User Input)



FLANGE BOLT AND PLATE GEOMETRY

Flange Bolt Analysis:

Calculated Flange Bolt Properties:

Polar Moment of Inertia = $I_p := \left[(d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4 + (d_5)^2 \cdot 8\right] = 4.061 \times 10^3 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 0.601 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 0.341 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 0.658 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.165 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^3}{32} = 0.028 \cdot in^3$

Check Flange Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{d_5}{I_p} - \frac{Axial}{N} = 52.5 \cdot kips$

Allowable Tensile Force (Gross Area) = $T_{ALL.Gross} := 0.75 \cdot A_g \cdot F_u = 67.6 \cdot kips$

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Gross}} \cdot 100 = 77.6$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Gross}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Note Shear stress is negligible

Flange Plate Analysis:

Force from Bolts =

$$C_1 := \frac{OM \cdot d_4}{I_p} + \frac{Axial}{N} = 49.8 \cdot kips$$

$$C_2 := \frac{OM \cdot d_5}{I_p} + \frac{Axial}{N} = 54.5 \cdot kips$$

Applied Bending Stress in Plate =

$$f_{bp} := \frac{6 \cdot \left(2C_1 \cdot ma_1 + 4 \cdot C_2 \cdot ma_2\right)}{B_{eff} \cdot t_{bp}^{\,2}} = 24.3 \cdot ksi$$

Allowable Bending Stress in Plate =

$$F_{bp} := 0.9 \cdot Fy_{bp} = 32.4 \cdot ksi$$

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} \cdot 100 = 75$$

Condition3 =

$$Condition2 := if\left(\frac{f_{bp}}{F_{bp}} < 1.00, "Ok", "Overstressed"\right)$$

$$Condition2 = "Ok"$$

Flange Bolts and Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 491 \cdot ft \cdot kips$	(Input From Risa-3D)
Shear Force =	$Shear := 14.2 \cdot kips$	(Input From Risa-3D)
Axial Force =	$Axial := 24.8 \cdot kips$	(Input From Risa-3D)

Flange Bolt Data:

Use ASTM A490

Number of Flange Bolts =	$N := 24$	(User Input)
Bolt Ultimate Strength =	$F_u := 150 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 125 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Flange Bolts =	$D := 0.875 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Flange Plate Data:

Use ASTM A36

Plate Yield Strength =	$Fy_{bp} := 36 \cdot ksi$	(User Input)
Flange Plate Thickness =	$t_{bp} := 2.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 3.5in$ (User Input)

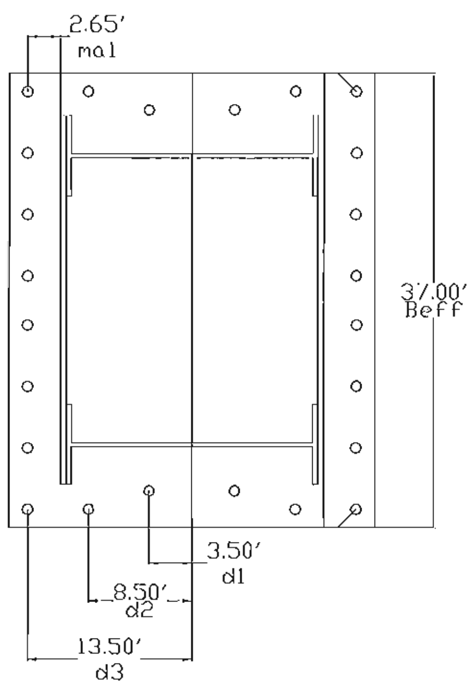
$d_2 := 8.5in$ (User Input)

$d_3 := 13.5in$ (User Input)

Critical Distances For Bending in Plate:

$ma_1 := 2.65in$ (User Input)

Effective Width of Flange Plate for Bending = $B_{eff} := 37.0in$ (User Input)



FLANGE BOLT AND PLATE GEOMETRY

Flange Bolt Analysis:

Calculated Flange Bolt Properties:

Polar Moment of Inertia = $I_p := \left[\left(d_1\right)^2\cdot 4 + \left(d_2\right)^2\cdot 4 + \left(d_3\right)^2\cdot 16\right] = 3.254\times 10^3\cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4}\cdot D^2 = 0.601\cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4}\cdot\left(D - \frac{0.9743\cdot in}{n}\right)^2 = 0.341\cdot in^2$

Net Diameter = $D_n := \frac{2\cdot\sqrt{A_n}}{\sqrt{\pi}} = 0.658\cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.165\cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi\cdot D_n^{\,3}}{32} = 0.028\cdot in^3$

Check Flange Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM\cdot\frac{d_3}{I_p} - \frac{Axial}{N} = 23.4\cdot kips$

Allowable Tensile Force (Gross Area) = $T_{ALL.Gross} := \left(.75A_g\cdot F_u\right) = 67.6\cdot kips$

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Gross}}\cdot 100 = 34.6$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Gross}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Note Shear stress is negligible

Flange Plate Analysis:

Force from Bolts = $C_1 := \frac{OM \cdot d_3}{I_p} + \frac{Axial}{N} = 25.5 \cdot kips$

Applied Bending Stress in Plate = $f_{bp} := \frac{6 \cdot (8C_1 \cdot ma_1)}{B_{eff} \cdot t_{bp}^2} = 21.9 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 0.9 \cdot Fy_{bp} = 32.4 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 67.6$

Condition3 = Condition2 := if$\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition2 = "Ok"

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 4082 \cdot ft \cdot kips$	(Input From RisaTower)
Shear Force =	$Shear := 40.7 \cdot kips$	(Input From RisaTower)
Axial Force =	$Axial := 47.1 \cdot kips$	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 60

Number of Anchor Bolts =	$N := 26$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 90 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 60 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 Grade 42

Plate Yield Strength =	$Fy_{bp} := 42 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 7.5in$ (User Input)

$d_2 := 15.0in$ (User Input)

$d_3 := 22.5in$ (User Input)

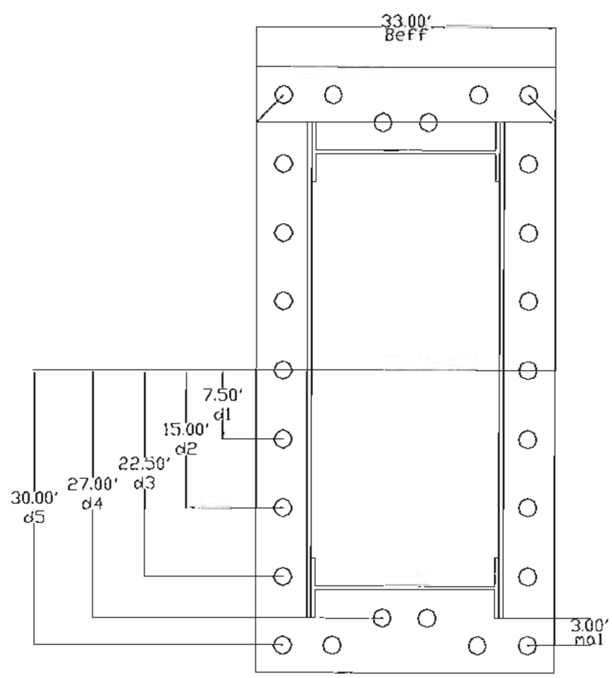
$d_4 := 27.0in$ (User Input)

$d_5 := 30in$ (User Input)

Critical Distances For Bending in Plate:

$ma_1 := 3.0in$ (User Input)

Effective Width of Baseplate for Bending = $B_{eff} := 33.0in$ (User Input)



ANCHOR BOLT AND PLATE GEOMETRY

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \left[(d_1)^2 \cdot 4 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4 + (d_4)^2 \cdot 4 + (d_5)^2 \cdot 8\right] = 1.327 \times 10^4 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 3.248 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 2.033 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^{\ 3}}{32} = 0.826 \cdot in^3$

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{d_5}{I_p} - \frac{Axial}{N} = 109 \cdot kips$

Allowable Tensile Force (Gross Area) = $T_{ALL} := (A_n \cdot F_y) = 194.9 \cdot kips$

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL}} \cdot 100 = 55.9$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Note Shear stress is negligible

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Base Plate Analysis:

Force from Bolts = $C_1 := \frac{OM \cdot d_5}{I_p} + \frac{Axial}{N} = 112.6 \cdot kips$

Applied Bending Stress in Plate = $f_{bp} := \frac{6 \cdot (4C_1 \cdot ma_1)}{B_{eff} \cdot t_{bp}^2} = 27.29 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := Fy_{bp} = 42 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 65$

Condition3 = $Condition2 := if\left(\frac{f_{bp}}{F_{bp}} < 1.00, \text{"Ok"}, \text{"Overstressed"}\right)$

Condition2 = "Ok"

CENTEK engineering Centered on Solutions™ www.centekeng.com 63-2 North Branford Road P: (203) 488-0580 Branford, CT 06405 F: (203) 488-8587	Subject:	Anchor Bolts and Base Plate Analysis y-direction CL&P Pole #844
	Location:	Trumbull, CT
	Rev. 0: 4/9/13	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	$OM := 2700 \cdot ft \cdot kips$	(Input From RISA-3D)
Shear Force =	$Shear := 36.8 \cdot kips$	(Input From Risa-3D)
Axial Force =	$Axial := 47.4 \cdot kips$	(Input From Risa-3D)

Anchor Bolt Data:

Use ASTM A615 Grade 60

Number of Anchor Bolts =	$N := 26$	(User Input)
Bolt "Column" Distance =	$l := 3.0 \cdot in$	(User Input)
Bolt Ultimate Strength =	$F_u := 90 \cdot ksi$	(User Input)
Bolt Yield Strength =	$F_y := 60 \cdot ksi$	(User Input)
Bolt Modulus =	$E := 29000 \cdot ksi$	(User Input)
Diameter of Anchor Bolts =	$D := 2.25 \cdot in$	(User Input)
Threads per Inch =	$n := 4.5$	(User Input)

Base Plate Data:

Use ASTM A572 Grade 42

Plate Yield Strength =	$Fy_{bp} := 42 \cdot ksi$	(User Input)
Base Plate Thickness =	$t_{bp} := 3.0 \cdot in$	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

$d_1 := 2.5in$ (User Input)

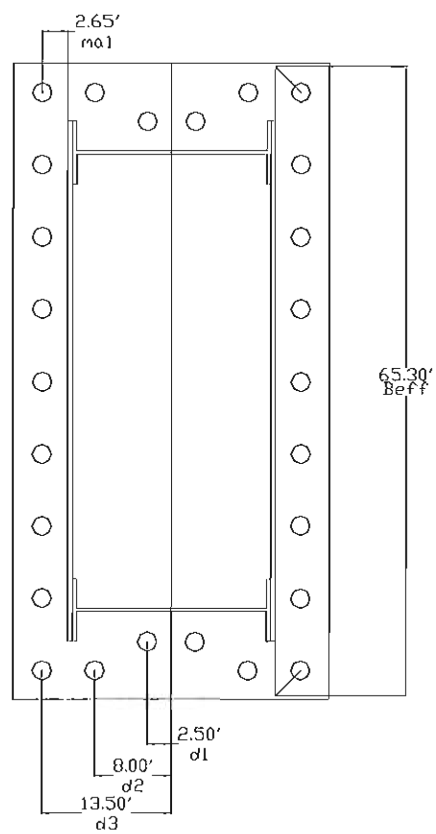
$d_2 := 8.0in$ (User Input)

$d_3 := 13.5in$ (User Input)

Critical Distances For Bending in Plate:

$ma_1 := 2.65in$ (User Input)

Effective Width of Baseplate for Bending = $B_{eff} := 65.3in$ (User Input)



ANCHOR BOLT AND PLATE GEOMETRY

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \left[(d_1)^2\cdot 4 + (d_2)^2\cdot 4 + (d_3)^2\cdot 18\right] = 3.562\times 10^3\cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4}\cdot D^2 = 3.976\cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4}\cdot\left(D - \frac{0.9743\cdot in}{n}\right)^2 = 3.248\cdot in^2$

Net Diameter = $D_n := \frac{2\cdot\sqrt{A_n}}{\sqrt{\pi}} = 2.033\cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508\cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi\cdot D_n^{\ 3}}{32} = 0.826\cdot in^3$

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM\cdot\frac{d_3}{I_p} - \frac{Axial}{N} = 121\cdot kips$

Allowable Tensile Force (Gross Area) = $T_{ALL} := (A_n\cdot F_y) = 194.9\cdot kips$

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL}}\cdot 100 = 62.1$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

Condition1 = "OK"

Note Shear stress is negligible

Base Plate Analysis:

Force from Bolts = $C_1 := \frac{OM \cdot d_3}{I_p} + \frac{Axial}{N} = 124.636 \cdot kips$

Applied Bending Stress in Plate = $f_{bp} := \frac{6 \cdot (9C_1 \cdot ma_1)}{B_{eff} t_{bp}^2} = 30.35 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := Fy_{bp} = 42 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 72.3$

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

Condition3 = "Ok"

CENTEK engineering Centered on Solutions · www.centekeng.com 63-2 North Branford Road P: (203) 488-0580 Branford, CT 06405 F: (203) 488-8587	Subject:	FOUNDATION ANALYSIS
	Location:	Trumbull, CT
	Rev. 0: 4/9/13	Prepared by: T.J.L. Checked by: C.F.C. Job No. 12047.CO11

Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 4082 \cdot 1.1 \cdot ft \cdot kips = 4490 \cdot ft \cdot kips$	(User Input from PLS-Pole)
Shear Force =	$Shear := 40.7 \cdot kip \cdot 1.1 = 44.77 \cdot kips$	(User Input from PLS-Pole)
Axial Force =	$Axial := 47.1 \cdot kip \cdot 1.1 = 51.81 \cdot kips$	(User Input from PLS-Pole)
Tower Height =	$H_t := 150 \cdot ft$	(User Input)

Footing Data:

Depth to Bottom of Footing =	$D_f := 20.5 \cdot ft$	(User Input)
Length of Pier =	$L_p := 8 \cdot ft$	(User Input)
Extension of Pier Above Grade =	$L_{pag} := 0.5 \cdot ft$	(User Input)
Width of Pier =	$W_p := 8 \cdot ft$	(User Input)
Depth of Soil =	$D_{soil} := 8 \cdot ft$	(User Input)
Depth of Rock =	$D_{rock} := 13 \cdot ft$	(User Input)

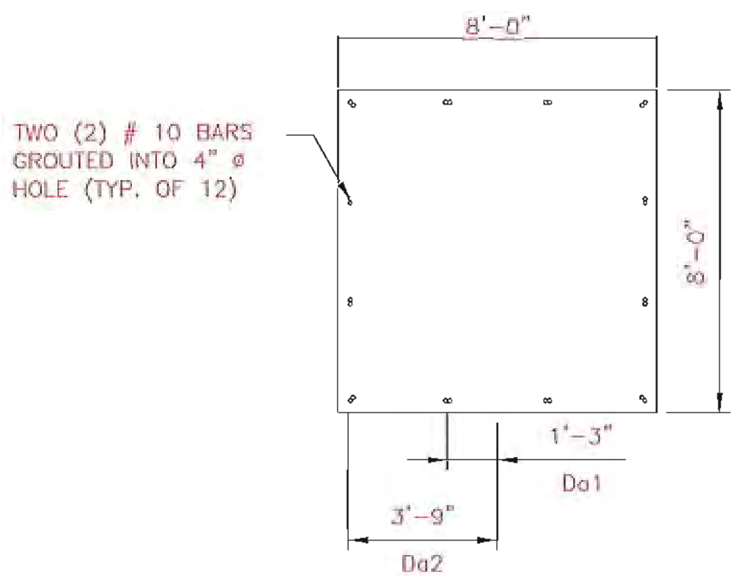
Material Properties:

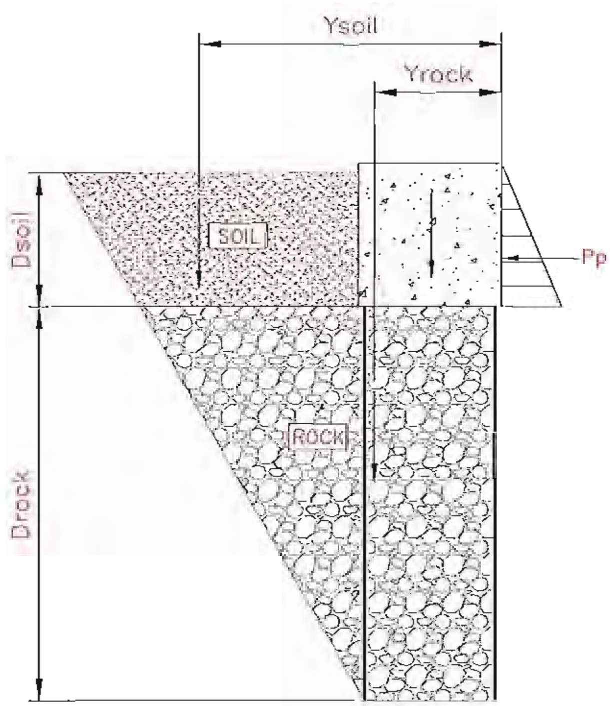
Concrete Compressive Strength =	$f_c := 3500 \cdot psi$	(User Input)	
Steel Reinforcment Yield Strength =	$f_y := 60000 \cdot psi$	(User Input)	
Anchor Bolt Yield Strength =	$f_{ya} := 75000 \cdot psi$	(User Input)	
Internal Friction Angle of Soil =	$\Phi_s := 30 \cdot deg$	(User Input)	
Allowable Soil Bearing Capacity =	$q_s := 4000 \cdot psf$	(User Input)	
Allowable Rock Bearing Capacity =	$q_{rock} := 50000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 120 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Unit Weight of Rock =	$\gamma_{rock} := 160 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 1.0 \cdot ft$	(User Input)	
Cohesion of Clay Type Soil =	$c := 0 \cdot ksf$	(User Input)	(Use 0 for Sandy Soil)
Seismic Zone Factor =	$Z := 2$	(User Input)	(UBC-1997 Fig 23-2)
Coefficient of Friction Between Concrete =	$\mu := 0.45$	(User Input)	

Rock Anchor Properties:

ASTM A615 Grade 60

Bolt Ultimate Strength =	$F_u := 90 \cdot ksi$	(User Input)	
Bolt Yield Strength =	$F_y := 60 \cdot ksi$	(User Input)	
Anchor Diameter =	$d_{ra} := 2.54 \cdot in$	(User Input)	(2 # 10 Bars)
Hole Diameter =	$d_{Hole} := 4 \cdot in$	(User Input)	
Grout Strength =	$\tau := 120 \cdot psi$	(User Input)	(Assumed Conservative Value)
Distance to Rock Anchor Group 1 =	$D_{a1} := 15 \cdot in$	(User Input)	
Distance to Rock Anchor Group 2 =	$D_{a2} := 45 \cdot in$	(User Input)	
Number of Rock Anchors in Group 1 =	$N_{a1} := 4$	(User Input)	
Number of Rock Anchors in Group 2 =	$N_{a2} := 8$	(User Input)	
Total Number of Rock Anchors =	$N_{atot} := 12$	(User Input)	





Area 1 = $A1 := \frac{1}{2} \cdot \tan(\Phi_s) \cdot D_{soil}^2 = 18.475 ft^2$ sf

Area 2 = $A2 := \tan(\Phi_s) \cdot D_{rock} \cdot D_{soil} = 60.044 ft^2$ sf

Distance to Centroid 1 = $Y1 := \tan(\Phi_s) \cdot D_{rock} + \frac{1}{3} \cdot \tan(\Phi_s) \cdot D_{soil} = 9.045 ft$ ft

Distance to Centroid 2 = $Y2 := \frac{1}{2} \cdot \tan(\Phi_s) \cdot D_{rock} = 3.753 ft$ ft

Distance from Toe to Centroid of Soil = $Y_{soil} := \frac{(A1 \cdot Y1 + A2 \cdot Y2)}{(A1 + A2)} + W_p = 13 ft$ ft

Area 1 = $A1 := \frac{1}{2} \cdot \tan(\Phi_s) \cdot D_{rock}^2 = 48.786 ft^2$ sf

Area 2 = $A2 := W_p \cdot D_{rock} = 104 ft^2$ sf

Distance to Centroid 1 = $Y1 := W_p + \frac{1}{3} \cdot \tan(\Phi_s) \cdot D_{rock} = 10.502 ft$ ft

Distance to Centroid 2 = $Y2 := \frac{W_p}{2} = 4 ft$ ft

Distance from Toe to Centroid of Rock = $Y_{rock} := \frac{(A1 \cdot Y1 + A2 \cdot Y2)}{(A1 + A2)} = 6.08 ft$ ft

Stability of Footing:

Adjusted Concrete Unit Weight = $\gamma_c := if(Bouyancy = 1, \gamma_{conc} - 62.4pcf, \gamma_{conc}) = 150 \cdot pcf$

Adjusted Soil Unit Weight = $\gamma_s := if(Bouyancy = 1, \gamma_{soil} - 62.4pcf, \gamma_{soil}) = 120 \cdot pcf$

Coefficient of Lateral Soil Pressure = $K_p := \dfrac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$

Passive Pressure = $P_{top} := 0 = 0 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_{soil} + c \cdot 2 \cdot \sqrt{K_p} = 2.88 \cdot ksf$

$P_{ave} := \dfrac{P_{top} + P_{bot}}{2} = 1.44 \cdot ksf$

$A_p := W_p \cdot (L_p - L_{pag}) = 60 ft^2$

Ultimate Shear = $S_u := P_{ave} \cdot A_p = 86.4 \cdot kip$

Weight of Concrete Pad = $WT_c := (W_p^{\,2} \cdot L_p) \cdot \gamma_c = 76.8 \cdot kip$

Weight of Soil Wedge at Back Face = $WT_{s1} := \left[W_p \cdot D_{soil} \cdot \tan(\Phi_s) \cdot \left(\dfrac{D_{soil}}{2} + D_{rock}\right)\right] \cdot \gamma_s = 75.379 \cdot kip$

Weight of Soil Wedge at Back Face Corners = $WT_{s2} := 2 \cdot \left[\dfrac{(D_f^{\,3} - D_{rock}^{\,3})}{3} \cdot (\tan(\Phi_s))^2\right] \cdot \gamma_s = 171.15 \cdot kips$

Total Weight of Soil = $WT_{Stot} := WT_{s1} + WT_{s2} = 246.5 \cdot kips$

Weight of Rock Between Rock Anchors = $WT_{R1} := (W_p^{\,2} \cdot D_{rock}) \cdot \gamma_{rock} = 133.12 \cdot kip$

Weight of Rock Wedge at Back Face = $WT_{R2} := \left(\dfrac{D_{rock}^{\,2} \cdot \tan(\Phi_s)}{2} \cdot W_p\right) \cdot \gamma_{rock} = 62.446 \cdot kip$

Weight of Rock at Back Face Corners = $WT_{R3} := 2 \cdot \left[\dfrac{D_{rock}}{3} \cdot (\tan(\Phi_s) \cdot D_{rock})^2\right] \cdot \gamma_{rock} = 78.116 \cdot kips$

Total Weight of Rock = $WT_{Rtot} := WT_{R1} + WT_{R2} + WT_{R3} = 273.7 \cdot kips$

Resisting Moment = $M_r := (WT_c + Axial) \cdot \dfrac{W_p}{2} + S_u \cdot \dfrac{(L_p - L_{pag})}{3} + WT_{Stot} \cdot Y_{soil} + WT_{Rtot} \cdot Y_{rock} = 5598 \cdot kip \cdot ft$

Overturning Moment = $M_{ot} := OM + Shear \cdot L_p = 4848 \cdot kip \cdot ft$

Factor of Safety Actual = $FS := \dfrac{M_r}{M_{ot}} = 1.15$

Factor of Safety Required = $FS_{req} := 1.0$

$OverTurning\_Moment\_Check := if(FS \geq FS_{req}, \text{"Okay"}, \text{"No Good"})$

$OverTurning\_Moment\_Check = \text{"Okay"}$

Rock Anchor Check:

Polar Moment of Inertia = $I_p := \left(D_{a1}{}^2 \cdot N_{a1} + D_{a2}{}^2 \cdot N_{a2}\right) = 17100 \cdot in^2$

Maximum Tension Force = $T_{Max} := \frac{OM \cdot D_{a2}}{I_p} - \frac{Axial + WT_c}{N_{atot}} = 131.1 \cdot kips$

Gross Area of Bolt Group = $A_g := \frac{\pi}{4} \cdot d_{ra}{}^2 = 5.067 \cdot in^2$

Allowable Tension = $T_{all} := A_g \cdot F_y = 304 \cdot kips$

$\frac{T_{Max}}{T_{all}} = 43.1 \cdot \%$

Condition1 := if$\left(T_{Max} < T_{all}, \text{"OK"}, \text{"NG"}\right)$

Condition1 = "OK"

Check Bond Strength:

Bond Strength = Bond_Strength := $d_{Hole} \cdot \pi \cdot D_{rock} \cdot \tau = 235 \cdot kips$

$\frac{T_{Max}}{Bond\_Strength} = 55.7 \cdot \%$

Condition2 := if$\left(T_{Max} < Bond_Strength, \text{"OK"}, \text{"NG"}\right)$

Condition2 = "OK"

	Market	Southern Connecticut		
	Cascade ID	CT43XC811		
		SECTOR 1	SECTOR 2	SECTOR 3
	Split sector present	No	No	No
1900	1900MHz_Azimuth	0	100	270
1900	1900MHz_No_of_Antennas	1	1	1
1900	1900MHz_RADCenter(ft)	100.3	100.3	100.3
1900	1900MHz_Antenna Make	RFS	RFS	RFS
1900	1900MHz_Antenna Model	APXVSPP18-C-A20	APXVSPP18-C-A20	APXVSPP18-C-A20
1900	1900MHz_Horizontal_Beamwidth	65	65	65
1900	1900MHz_Vertical_Beamwidth	5.5	5.5	5.5
1900	1900MHz_AntennaHeight (ft)	6	6	6
1900	1900MHz_AntennaGain(dBd)	15.9	15.9	15.9
1900	1900MHz_E_Tilt	0	0	0
1900	1900MHz _M_Tilt	0	0	0
1900	1900MHz_Carrier_Forecast_Year_2013	2	2	2
1900	1900MHz_RRH Manufacturer	ALU	ALU	ALU
1900	1900MHz_RRH Model	RRH 1900 4X45 65MHz	RRH 1900 4X45 65MHz	RRH 1900 4X45 65MHz
1900	1900MHz_RRH Count	1	1	1
1900	1900MHz_RRH Location	Top of the Pole/Tower	Top of the Pole/Tower	Top of the Pole/Tower
1900	1900MHz Combiner Model	No Combiner Required	No Combiner Required	No Combiner Required
1900	1900MHz_Top_Jumper #1_Length (RRH or Combiner-to-Antenna for TT or Main Coax to	10	10	10
1900	1900MHz_Top_Jumper #1_Cable_Model (RRH or Combiner-to-Antenna for TT or Main	LCF12-50J	LCF12-50J	LCF12-50J
1900	1900MHz_Top_Jumper #2_Length (RRH to Combiner for TT if applicable, ft)	N/A	N/A	N/A
1900	1900MHz_Top_Jumper #2_Cable_Model (RRH to Combiner for TT if applicable)	N/A	N/A	N/A
1900	1900MHz_Main_Coax_Cable_Length (ft)	N/A	N/A	N/A
1900	1900MHz_Main_Coax_Cable_Model	N/A	N/A	N/A
1900	1900MHz_Bottom_Jumper #1_Length (Ground based RRH to Combiner-OR-Main Coax, ft)	N/A	N/A	N/A
1900	1900MHz_Bottom_Jumper #1_Cable_Model (Ground based RRH to Combiner-OR-Main	N/A	N/A	N/A
1900	1900MHz_Bottom_Jumper #2_Length (Ground based-Combiner to Main Coax, ft)	N/A	N/A	N/A
1900	1900MHz_Bottom_Jumper #2_Cable_Model (Ground based-Combiner to Main Coax)	N/A	N/A	N/A
800	800MHz_Azimuth	0	100	270
800	800MHz_No_of_Antennas	0	0	0
800	800MHz_RADCenter(ft)	100.3	100.3	100.3
800	800MHz_AntennaMake	RFS	RFS	RFS
800	800MHz_AntennaModel	APXVSPP18-C-A20 (Shared w/1900)	APXVSPP18-C-A20 (Shared w/1900)	APXVSPP18-C-A20 (Shared w/1900)
800	800MHz_Horizontal_Beamwidth	65	65	65
800	800MHz_Vertical_Beamwidth	11.5	11.5	11.5
800	800MHz_AntennaHeight (ft)	6	6	6
800	800MHz_AntennaGain (dBd)	13.4	13.4	13.4
800	800MHz_E_Tilt	0	-8	-8
800	800MHz_M_Tilt	0	0	0
800	800MHz_RRH Manufacturer	ALU	ALU	ALU
800	800MHz_RRH Model	RRH 800 MHz 2x50W	RRH 800 MHz 2x50W	RRH 800 MHz 2x50W
800	800MHz_RRH Count	1	1	1
800	800MHz_RRH Location	Top of the Pole/Tower	Top of the Pole/Tower	Top of the Pole/Tower
800	800_Top_Jumper #1_Length (RRH to Antenna for TT or Main Coax to Antenna for GM)	10	10	10
800	800_Top_Jumper_Cable_Model (RRH to Antenna for TT or Main Coax to Antenna for GM)	LCF12-50J	LCF12-50J	LCF12-50J
800	800MHz_Main_Coax_Cable_Length (ft)	N/A	N/A	N/A
800	800MHz_Main_Coax_Cable_Model	N/A	N/A	N/A
800	800_Bottom_Jumper #1_Length (Ground based RRH to Main Coax)	N/A	N/A	N/A
800	800_Bottom_Jumper #1_Cable_Model (Ground based RRH to Main Coax)	N/A	N/A	N/A
	Plumbing Scenario *	124	124	124
Comments	* If plumbing scenario does not match the material received, please contact your Construction Manager			
Comments	11/9/2012			

Product Data Sheet **APXVSPP18-C**

Triple Band Dual Polarized Antenna, 806-1995, 65deg, 16-18dBi, 1.8m, VET, 0-10deg, 0.5m AISG Cable

RFS

Product Description

This antenna is an ideal choice for dual band site upgrade for high traffic areas. It features 4 ports in 1900 MHz and 2 ports in 800 MHz.

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 < 18 dB)**
- **Independent control of electrical downtilt for 800 and PCS bands**
- **Remote tilt – AISG compatible**
- **Low profile for low visual impact**
- **Quick and easy to adjust**
- **High front-to-back ratio**

Technical Specifications

Electrical Specifications

Frequency Range, MHz	806-869	1850-1995	1850-1995
Horizontal Beamwidth, deg	65	65	65
Vertical Beamwidth, deg	11.5	5.5	5.5
Electrical Downtilt, deg		0-10	
Gain, dBi (dBd)	15.5 (13.4)	18.0 (15.9)	18.0 (15.9)
1st Upper Sidelobe Suppression, dB, typ. @ T0° & T8°		>18	
Front-To-Back Ratio, dB, @ 180° ± 15°	>30	>27	>27
Polarization		Dual pol +/-45°	
Return Loss, dB		> 14	
Isolation between Ports, dB		>28	
3rd Order IMP @ 2 x 43 dBm, @ 2 min. duration		>110	
Cross Polar Discrimination (XPD) 0°, dB	>15	>20	>20
Cross Polar Discrimination (XPD) ± 60°, dB	>9.5	>11	>11
HBW Squint accross same band ports, °		±5	
Impedance, Ohms		50	
Maximum Power Input, W		250	
Lightning Protection		Direct Ground	
Connector Type		(6) 7-16 DIN Female	

Mechanical Specifications

Dimensions - HxWxD, mm (in)	1829 x 302 x 178 (72.0 x 11.8 x 7)
Weight w/o Mtg Hardware, kg (lb)	25.8 (57)
Radome Material	ASA
Radome Color	Light Grey RAL7035
Mounting Hardware Material	Diecasted Aluminum and Galvanized Steel

Ordering Information

Mounting Hardware	APM40-2 Downtilt Kit
AISG System Cable	0.5 m, included
Mounting Pipe Diameter, mm (in)	60-120 (2.4-4.7)
Mounting Hardware Weight, kg (lb)	3.4 (7.5)

Northeast Utilities System

107 Selden Street, Berlin, CT 06037

Northeast Utilities Service Company
P.O. Box 270
Hartford, CT 06141-0270
(203) 665-5000

January 3, 2014

Ms. Jennifer Gaudet
HPC Development

Sprint,
1 International Blvd.
Suite 300
Mahwah NJ
07495

RE: Sprint Antenna Site, CT-43XC811, 124Quarry Rd, Trumbull CT, structure 844.

Dear Ms. Gaudet:

Based on our reviews of the site drawings, the structural analysis and foundation review provided by Centek Engineering, we have reviewed for acceptance this modification.

Since there are no outstanding structural issues to resolve at this time please contact Mr. O'Brien (860-665-6987) to resolve any lease issues; once the lease amendment is secured you may then contact Mr. John Landry directly (860-665-5425) to begin the construction arrangements.

Sincerely,

Robert Gray
Transmission Line Engineering

REF: 12047.CO11_CT43XC811-Trumbull.pdf
NV_CT43XC811_12.31.13_Final CD_S&S 1-2-14.pdf

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RADIO FREQUENCY EMISSIONS ANALYSIS REPORT
EVALUATION OF HUMAN EXPOSURE POTENTIAL
TO NON-IONIZING EMISSIONS

Sprint Existing Facility

Site ID: CT43XC811

NU Pole# 844 - Trumbull
124 Quarry Road
Trumbull, CT 06611

June 6, 2013

EBI Project Number: 62136523

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June 6, 2013

Sprint
Attn: RF Engineering Manager
1 International Boulevard, Suite 800
Mahwah, NJ 07495

Re: Emissions Values for Site: **CT43XC811 – NU Pole# 844 - Trumbull**

EBI Consulting was directed to analyze the proposed upgrades to the existing Sprint facility located at 124 Quarry Road, Trumbull, CT, for the purpose of determining whether the emissions from the proposed Sprint equipment upgrades on this property are within specified federal limits.

All information used in this report was analyzed as a percentage of current Maximum Permissible Exposure (% MPE) as listed in the FCC OET Bulletin 65 Edition 97-01and ANSI/IEEE Std C95.1. The FCC regulates Maximum Permissible Exposure in units of microwatts per square centimeter (μW/cm2). The number of μW/cm2 calculated at each sample point is called the power density. The exposure limit for power density varies depending upon the frequencies being utilized. Wireless Carriers and Paging Services use different frequency bands each with different exposure limits, therefore it is necessary to report results and limits in terms of percent MPE rather than power density.

All results were compared to the FCC (Federal Communications Commission) radio frequency exposure rules, 47 CFR 1.1307(b)(1) – (b)(3), to determine compliance with the Maximum Permissible Exposure (MPE) limits for General Population/Uncontrolled environments as defined below.

General population/uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

Public exposure to radio frequencies is regulated and enforced in units of microwatts per square centimeter ($\mu W/cm^2$). The general population exposure limit for the cellular band is approximately 567 $\mu W/cm^2$, and the general population exposure limit for the PCS band is 1000 $\mu W/cm^2$. Because each carrier will be using different frequency bands, and each frequency band has different exposure limits, it is necessary to report percent of MPE rather than power density.

Occupational/controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Additional details can be found in FCC OET 65.

CALCULATIONS

Calculations were done for the proposed upgrades to the existing Sprint Wireless antenna facility located at 124 Quarry Road, Trumbull, CT, using the equipment information listed below. All calculations were performed per the specifications under FCC OET 65. All calculations were performed assuming the main lobe of the antenna was focused at the base of the tower to present a worst case scenario. Actual values seen from this site will be dramatically less than those shown in this report. For this report the sample point is the top of a 6 foot person standing at the base of the tower.

For all calculations, all emissions were calculated using the following assumptions:

1) 2 CDMA Carriers (1900 MHz) were considered for each sector of the proposed installation.
2) 1 CDMA Carrier (850 MHz) was considered for each sector of the proposed installation
3) All radios at the proposed installation were considered to be running at full power and were uncombined in their RF transmissions paths per carrier prescribed configuration. Per FCC OET Bulletin No. 65 - Edition 97-01 recommendations to achieve the maximum anticipated value at each sample point, all power levels emitting from the proposed antenna installation are increased by a factor of 2.56 to account for possible in-phase reflections from the surrounding environment. This is rarely the case, and if so, is never continuous.
4) For the following calculations the sample point was the top of a six foot person standing at the base of the tower. The actual gain in this direction was used per the manufactures supplied specifications.
5) The antenna used in this modeling is the APXVSPP18-C-A20. This is based on feedback from the carrier with regards to anticipated antenna selection. This antenna has a 15.9 dBd gain value at its main lobe at 1900 MHz and 13.4 dBd at its main lobe for 850 MHz. All calculations were performed assuming the main lobe of the antenna was focused at the base of the tower to present a worst case scenario.

6) The antenna mounting height centerline of the proposed antennas is **100.3 feet** above ground level (AGL)
7) Emissions values for additional carriers were taken from the Connecticut Siting Council active database. Values in this database are provided by the individual carriers themselves.

All calculation were done with respect to uncontrolled / general public threshold limits

Site ID	CT43XC811 - NU Pole# 844 - Trumbull
Site Addresss	124 Quarry Road, Trumbull, CT, 06611
Site Type	Utility Transmission Tower

Sector 1

Antenna Number	Antenna Make	Antenna Model	Radio Type	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
1a	RFS	APXVSPP18-C-A20	RRH	1900 MHz	CDMA / LTE	20	2	40	15.9	100.3	94.3	1/2 "	0.5	0	1386.9474	56.07155	5.60716%
1a	RFS	APXVSPP18-C-A20	RRH	850 MHz	CDMA / LTE	20	1	20	13.4	100.3	94.3	1/2 "	0.5	0	389.96892	15.76568	2.78054%
												Sector total Power Density Value:			8.388%		

Sector 2

Antenna Number	Antenna Make	Antenna Model	Radio Type	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
2a	RFS	APXVSPP18-C-A20	RRH	1900 MHz	CDMA / LTE	20	2	40	15.9	100.3	94.3	1/2 "	0.5	0	1386.9474	56.07155	5.60716%
2a	RFS	APXVSPP18-C-A20	RRH	850 MHz	CDMA / LTE	20	1	20	13.4	100.3	94.3	1/2 "	0.5	0	389.96892	15.76568	2.78054%
												Sector total Power Density Value:			8.388%		

Sector 3

Antenna Number	Antenna Make	Antenna Model	Radio Type	Frequency Band	Technology	Power Out Per Channel (Watts)	Number of Channels	Composite Power	Antenna Gain in direction of sample point (dBd)	Antenna Height (ft)	analysis height	Cable Size	Cable Loss (dB)	Additional Loss	ERP	Power Density Value	Power Density Percentage
3a	RFS	APXVSPP18-C-A20	RRH	1900 MHz	CDMA / LTE	20	2	40	15.9	100.3	94.3	1/2 "	0.5	0	1386.9474	56.07155	5.60716%
3a	RFS	APXVSPP18-C-A20	RRH	850 MHz	CDMA / LTE	20	1	20	13.4	100.3	94.3	1/2 "	0.5	0	389.96892	15.76568	2.78054%
												Sector total Power Density Value:			8.388%		

Site Composite MPE %	
Carrier	MPE %
Sprint	25.163%
AT&T	5.120%
Total Site MPE %	30.283%

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Summary

All calculations performed for this analysis yielded results that were well within the allowable limits for general public exposure to RF Emissions.

The anticipated Maximum Composite contributions from the Sprint facility are **25.163% (8.388% from each sector)** of the allowable FCC established general public limit considering all three sectors simultaneously sampled at the ground level.

The anticipated composite MPE value for this site assuming all carriers present is **30.283%** of the allowable FCC established general public limit sampled at the ground level. This is based upon values listed in the Connecticut Siting Council database for existing carrier emissions

FCC guidelines state that if a site is found to be out of compliance (over allowable thresholds), that carriers over a 5% contribution to the composite value will require measures to bring the site into compliance. For this facility, the composite values calculated were well within the allowable 100% threshold standard per the federal government.

Scott Heffernan
RF Engineering Director

EBI Consulting
21 B Street
Burlington, MA 01803