COHEN and WOLF P.C.
ATTORNEYS AT LAW

JULIE D. KOHLER

PLEASE REPLY TO: Bridgeport
WRITER'S DIRECT DIAL: (203) 337-4157
E-Mail Address: jkohler@cohenandwolf.com

January 7, 2015

Attorney Melanie Bachman
Acting Executive Director
Connecticut Siting Council
Ten Franklin Square
New Britain, CT 06051

Re: Notice of Exempt Modification
Verizon Wireless/T-Mobile equipment upgrade
Site ID CTNH416A
5 Old Farms Road, Barkhamsted, CT

Dear Attorney Bachman:

This office represents T-Mobile Northeast LLC ("T-Mobile") and has been retained to file exempt modification filings with the Connecticut Siting Council on its behalf.

In this case, Cellco Partnership, d/b/a Verizon Wireless owns the existing monopole telecommunications tower and related facility located at 5 Old Farms Road, Barkhamsted, Connecticut (Latitude:41.914525/ Longitude: -73.022331). T-Mobile intends to add three (3) antennas, remove six (6) TMAs (tower mounted amplifiers), add six (6) TMAs and add three (3) Bias Tees and related equipment at this existing telecommunications facility in Barkhamsted ("Barkhamsted Facility"). Please accept this letter as notification, pursuant to R.C.S.A. § 16-50j-73, of construction which constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is also being sent to the First Selectman, Donald S. Stein, and the property owner, John and Ethel Lavieri.

The existing Barkhamsted Facility consists of a 145 foot tall monopole tower, approved by the Council in Docket No. 305.[1] T-Mobile plans to add three (3) antennas, remove six (6) TMAs (tower mounted amplifiers), add six (6) TMAs and add three (3) Bias Tees on proposed pipe masts that will be attached to existing T-Arms at a centerline of 125 feet. (See the plans revised to December 24, 2014 attached hereto as Exhibit A). T-Mobile will also replace an equipment cabinet on an existing concrete pad, install three (3) RRUs (remote radio units) on a proposed H-frame, install coax cable and reuse existing coax cable. The existing Barkhamsted Facility is structurally capable of supporting T-Mobile's proposed modifications,

[1] T-Mobile's proposed equipment on the Barkhamsted Facility is consistent with the Decision and Order in this docket (dated May 3, 2005). T-Mobile filed a notice of intent for this Facility captioned EM-T-MOBILE-005-141006 which was subsequently acknowledged by the Council.

as indicated in the structural analysis dated December 2, 2014 and attached hereto as Exhibit B.

The planned modifications to the Barkhamsted Facility fall squarely within those activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed modification will not increase the height of the tower. T-Mobile's replacement antennas will be installed at a centerline of 125 feet on a tower that is 145 feet in elevation. The enclosed tower drawing confirms that the proposed modification will not increase the height of the tower.

2. The proposed modifications will not require an extension of the site boundaries. T-Mobile's equipment will be located entirely within the existing compound and leased area as shown on Sheet 2 of Exhibit A.

3. The proposed modification to the Barkhamsted Facility will not increase the noise levels at the existing facility by six decibels or more.

4. The operation of the proposed antennas will not increase the total radio frequency (RF) power density, measured at the base of the tower, to a level at or above the applicable standard. According to an Emissions Analysis Report prepared by EBI dated December 22, 2014 T-Mobile's operations would add 10.62%% of the FCC Standard. Therefore, the calculated "worst case" power density for the planned combined operation at the site including all of the proposed antennas would be 49.05% of the FCC Standard as calculated for a mixed frequency site as evidenced by the engineering exhibit attached hereto as Exhibit C.

For the foregoing reasons, T-Mobile respectfully submits that the proposed antennas and equipment at the Barkhamsted Facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2). Upon acknowledgement by the Council of this proposed exempt modification, T-Mobile shall commence construction approximately sixty days from the date of the Council's notice of acknowledgement.

Sincerely,

Julie D. Kohler, Esq.

cc: Town of Barkhamsted, First Selectman Donald S. Stein
Cellco Partnership, d/b/a Verizon Wireless
John and Ethel Lavieri
Sheldon Freincle, NSS

EXHIBIT A

ALL EQUIPMENT LOCATIONS ARE APPROXIMATE AND ARE SUBJECT TO APPROVAL BY LESSEE/LICENSEE'S STRUCTURAL & RF ENGINEERS. LOCATIONS OF POWER & TELEPHONE FACILITIES ARE SUBJECT TO APPROVAL BY UTILITY COMPANIES.

KEY MAP
SCALE: N.T.S

1
LE–1

PROJECT : L700
CONFIGURATION
704BU

SUBMITTALS	
LE REV A	08.19.14
LE REV 0	08.22.14
LE REV 1	08.26.14
LE REV 2	12.17.14
LE REV 3	12.24.14

ATLANTIS GROUP
1340 Centre Street
Suite 203
Newton, MA 02459
Office: 617-965-0789
Fax: 617-213-5056

LEASE EXHIBIT

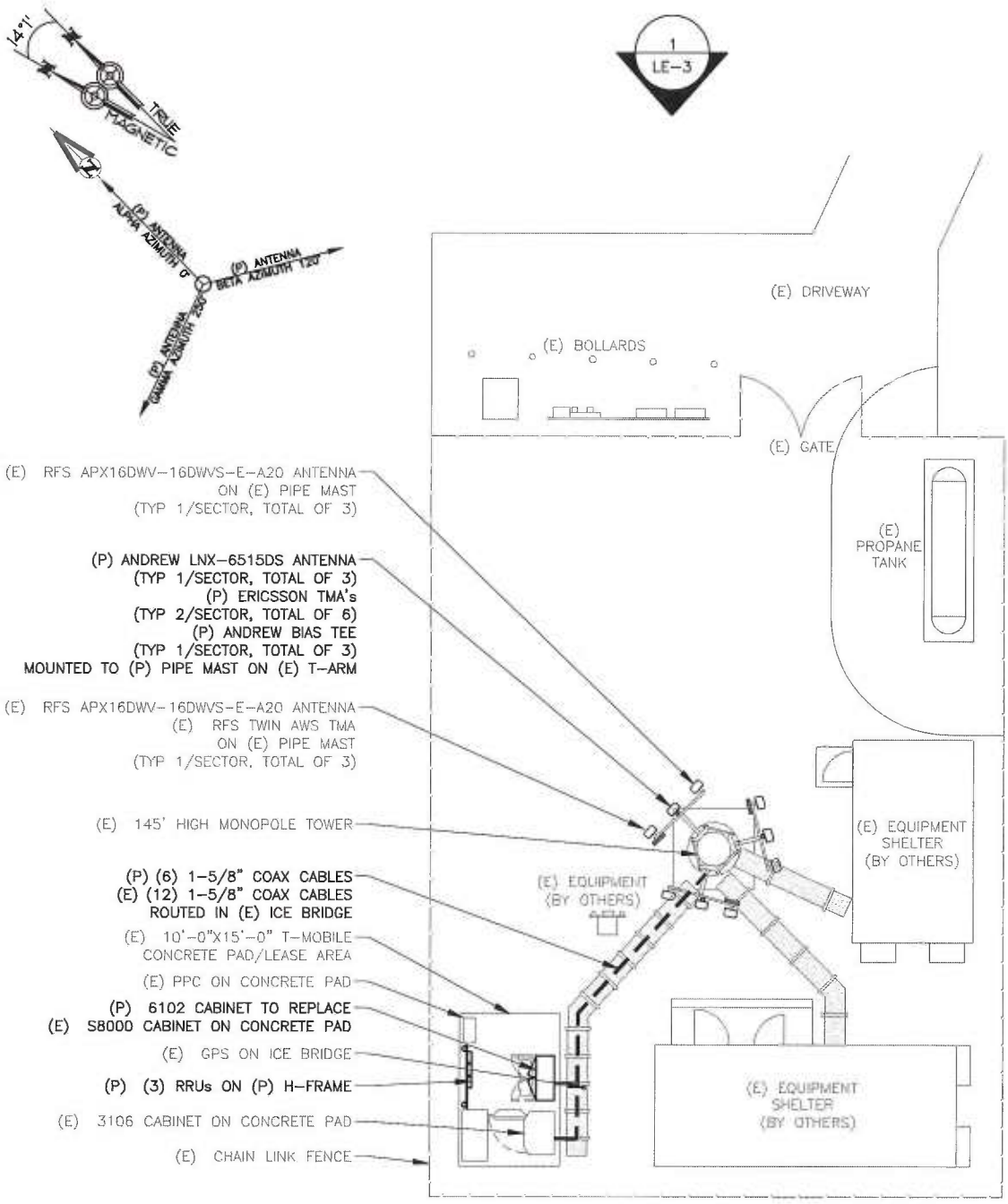
SITE NUMBER:
CTNH416A

SITE NAME:
OLD FARM - VERIZON

SITE ADDRESS:
5 OLD FARMS ROAD
BARKHAMSTED, CT, 06063

NORTHEAST SITE SOLUTIONS
54 MAIN STREET, UNIT 3
STURBRIDGE, MA 01566
(508) 434-5237
FOR
T-MOBILE NORTHEAST, LLC
35 GRIFFIN ROAD SOUTH
BLOOMFIELD, CT 06002
OFFICE: (860) 692-7100
FAX: (860) 692-7159

DRAWN BY: FG | CHECKED BY: SM



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SITE PLAN

SCALE: 1/16" = 1'-0"

1
LE-2

PROJECT : L700

CONFIGURATION

704BU

SUBMITTALS	
LE REV A	08.19.14
LE REV 0	08.22.14
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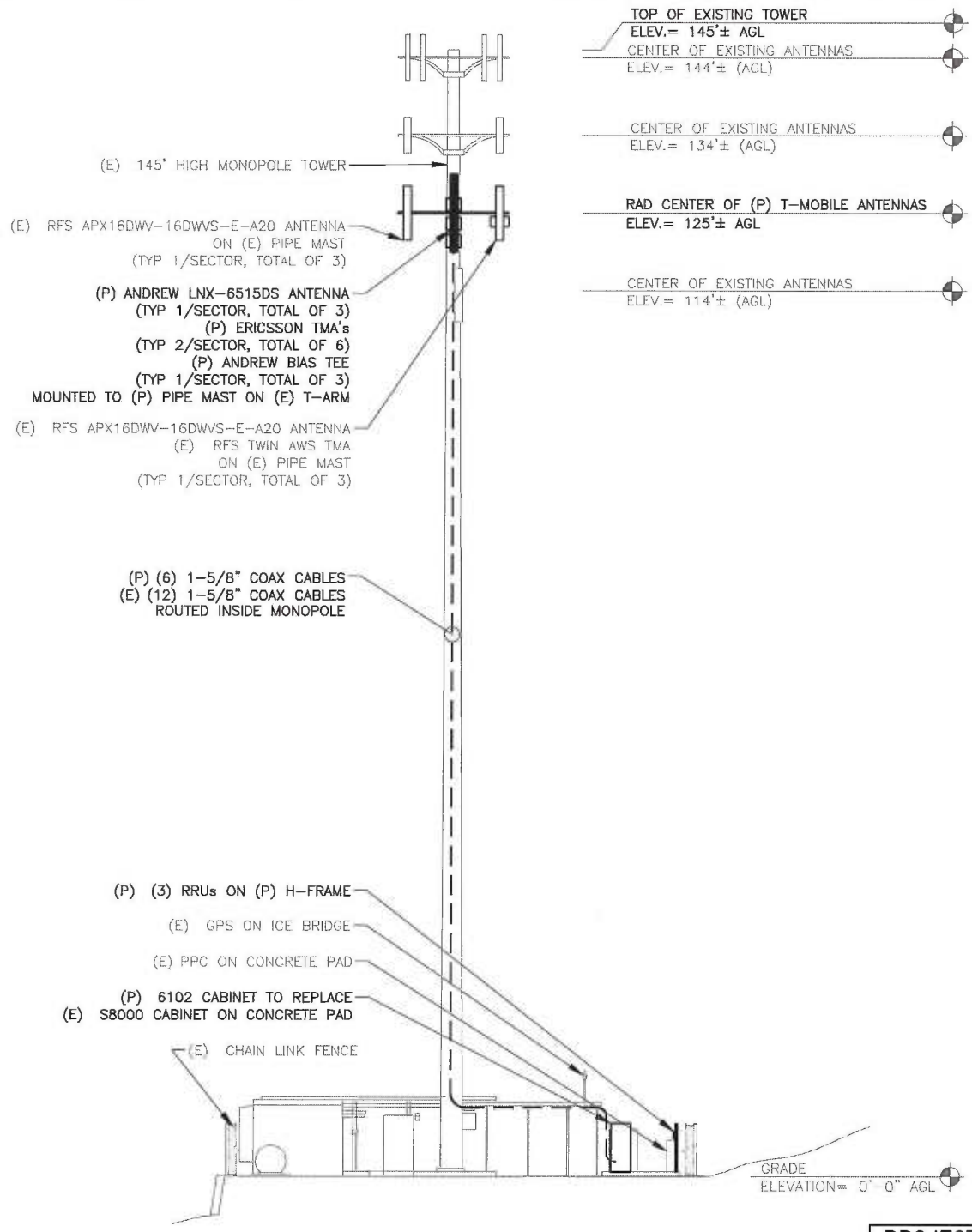

ELEVATION

SCALE: 1/16" = 1'-0"

1 / LE-3

ALL EQUIPMENT LOCATIONS ARE APPROXIMATE AND ARE SUBJECT TO APPROVAL BY LESSEE/LICENSEE'S STRUCTURAL & RF ENGINEERS. LOCATIONS OF POWER & TELEPHONE FACILITIES ARE SUBJECT TO APPROVAL BY UTILITY COMPANIES.

PROJECT : L700

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704BU

SUBMITTALS	
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DRAWN BY: FG | CHECKED BY: SM

EXHIBIT B

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

145-ft Existing EEI Monopole

Proposed T-Mobile
Antenna Upgrade

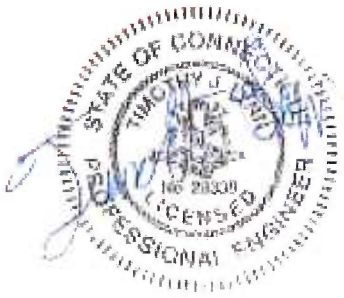
T-Mobile Site Ref: CTNH416A

Verizon Site Ref: Barkhamsted West

5 Old Farm Road
Barkhamsted, CT

Centek Project No. 14033.017

~~Date: September 23, 2014~~
~~Rev 1: November 10, 2014~~
Rev 2: December 2, 2014



Prepared for:
T-Mobile USA
35 Griffin Road
Bloomfield, CT 06002

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 summarize the results of the non-linear, P-Δ structural analysis of the antenna installation proposed by T-Mobile on the existing monopole (tower) owned and operated by Verizon Wireless, located in Barkhamsted, CT.

The host tower is a 145-ft tall, three-section, eighteen sided, tapered monopine, originally designed and manufactured by Engineered Endeavors Inc., job no; 13841-E01, dated December 6, 2005. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design documents. The tower was reinforced per a previous structural report prepared by Centek Engineering job no. 12063.032 dated November 29, 2012

Antenna and appurtenance information were obtained from the aforementioned Centek Engineering structural report, a tower mapping report prepared by Eastern Communications dated September 8, 2014 and a T-Mobile RF data sheet.

The tower consists of three (3) tapered vertical steel sections conforming to ASTM A572-65 (65ksi). The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 17.5-in at the top and 55.0-in at the base.

T-Mobile proposes the removal of six (6) TMA's and the installation of three (3) panel antennas, six (6) TMA's and three (3) Bias Tee's mounted to the existing three (3) T-Arms. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- VERIZON (RESERVED):
  Antennas: Six (6) Antel LPA-80063-6CF panel antennas, six (6) Antel BXA-70063-6CF panel antennas, six (6) LPA-171063-12CF panel antennas and three (3) RRH's mounted on an existing low profile platform with a RAD center elevation of 145-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing monopole, six (6) 1-5/8" ∅ coax cables banded to the exterior of the existing monopole and one (1) 1-1/4" ∅ fiber cable banded to the exterior of the existing monopole.
- METROPCS (EXISTING):
  Antennas: Three (3) RFS APXV18-206517S-C panel antennas flush mounted with a RAD center elevation of 115-ft above grade.
  Coax Cables: Six (6) 1-5/8" ∅ coax cables running on the inside of the existing tower.

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, twelve (12) Powerwave LGP21401 TMA's, two (2) KMW AM-X-CD-16-65-00T-RET panel antennas, one (1) KWM AM-X-CD-14-65-00T-RET panel antenna, six (6) Ericsson RRUS-11, one (1) Raycap DC6-48-60-18-8F surge arrestor and one (1) Andrew ABT-DFDM-ADBH Bias Tee mounted on an existing low profile platform with a RAD center elevation of 135-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables, one (1) fiber cable and two (2) dc control cables running on the inside of the existing tower.
- T-MOBILE (EXISTING TO REMAIN):
  Antennas: Three (3) RFS APX16DWV-16DWVS-E-A20 panel antennas mounted on an three (3) 12-ft T-arms with a RAD center elevation of 125-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- T-MOBILE (RESERVED):
  Antennas: Three (3) RFS APX16DWV-16DWVS-E-A20 panel antennas mounted on an three (3) 12-ft T-arms with a RAD center elevation of 125-ft above grade.
- T-MOBILE (EXISTING TO REMOVE):
  Antennas: Three (3) RFS Twin AWS TMA's and three (3) Andrew Twin PCS TMA's mounted on an three (3) 12-ft T-arms with a RAD center elevation of 125-ft above grade.
- **T-MOBILE (Proposed):**
  Antennas: Three (3) Andrew LNX-6515DS panel antennas, three (3) Ericsson KRY112-144-1 TMA's, three (3) Ericsson KRY112-71-2 TMAs's and three (3) Andrew ATSBT-TOP-FM-4G Bias Tee's mounted on an three (3) 12-ft T-arms with a RAD center elevation of 125-ft above grade.
  Coax Cable: Six (6) 1-5/8" ∅ coax cables running on the exterior of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

The existing tower was analyzed for the controlling basic wind speed (fastest mile) with no ice and a 75% reduction of wind force with ½ inch accumulative ice to determine stresses in members as per guidelines of TIA/EIA-222-F-96 entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix K of the CSBC[1] and the wind speed data available in the TIA/EIA-222-F-96 Standard. The higher of the two wind speeds is utilized in preparation on the tower analysis.

Tower Loading

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA/EIA-222-F, gravity loads of the tower structure and its components, and the application of ½" radial ice on the tower structure and its components.

Basic Wind Speed:	Litchfield; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Barkhamsted; v = 90 mph (3 second gust) equivalent to v = 75 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA-EIA-222-F wind speed controls.	
Load Cases:	Load Case 1; 80 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 2009 CT State Supplement. (CSBC)

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software tnxTower. Allowable stresses were determined based on Table 5 of the TIA/EIA code with a 1/3 increase per Section 3.1.1.1 of the same code.

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", the maximum tower steel usage was found to be at **99.8%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	109.79'-145.00'	99.8%	**PASS**
Pole Shaft (L2)	94.79'-109.79'	87.9%	**PASS**
Pole Shaft (L3)	47.00'-94.79'	88.9%	**PASS**
Pole Shaft (L4)	1.0'-47.00'	99.0%	**PASS**

Foundation and Anchors

The existing foundation consists of a 7-ft square x 5.5-ft long reinforced concrete pier on a 21.5-ft square x 3.5-ft thick reinforced concrete pad. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned Centek structural report. The base of the tower is connected to the foundation by means of (14) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-ft into the concrete foundation structure.

- The tower base reactions developed from the governing Load Case 1 were used in the verification of the foundation and its anchors:

Location	Vector	Proposed Reactions
Base	Shear	27 kips
	Compression	32 kips
	Moment	2886 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	IBC 2003/2005 CT State Building Code Section 3108.4.2 (FS)[1]	Proposed Loading (FS)[1]	Result
Reinforced Concrete Pad and Pier	OTM[2]	2.0	2.21	**PASS**

Note 1: FS denotes Factor of Safety.
Note 2: OTM denotes Overturning Moment

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Axial and Bending	80.5%	**PASS**
Base Plate	Bending	95.1%	**PASS**

Conclusion

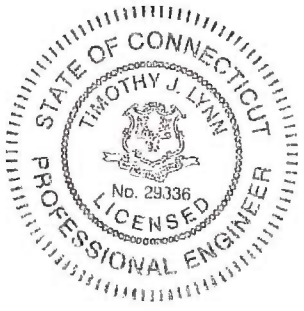
This analysis shows that the subject tower **is adequate** to support the proposed modified antenna configuration.

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer



Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

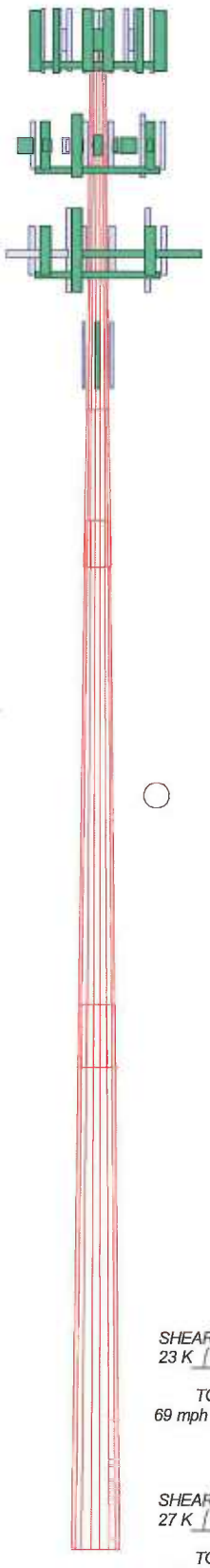
GENERAL DESCRIPTION OF STRUCTURAL ANALYSIS PROGRAM

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

tnxTower Features:

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

Section	1	2	3	4
Length (ft)	35.210	15.000	52.210	52.000
Number of Sides	18	18	18	18
Thickness (in)	0.188	0.250	0.313	0.313
Socket Length (ft)		4.420	6.000	
Top Dia (in)	17.600	26.970	29.320	41.130
Bot Dia (in)	26.970	31.010	43.370	55.000
Grade	A572-65			
Weight (K) 17.5	1.6	1.2	6.3	8.4



AXIAL
41 K

SHEAR
23 K

MOMENT
2500 kip-ft

TORQUE 6 kip-ft
69 mph WIND - 0.500 in ICE

AXIAL
32 K

SHEAR
27 K

MOMENT
2886 kip-ft

TORQUE 7 kip-ft
REACTIONS - 80 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80063/6CF (Verizon - Reserved)	145	(2) RRUS-11 (ATT - Existing)	135
LPA-171063-12CF (Verizon - Reserved)	145	DC6-48-60-18-8F Surge Arrestor (ATT - Existing)	135
BXA-70063/6CF (Verizon - Reserved)	145	ABT-DFDM-ADBH Bias Tee (ATT - Existing)	135
BXA-70063/6CF (Verizon - Reserved)	145	EEI Low Profile Platform (ATT - Existing)	133
LPA-171063-12CF (Verizon - Reserved)	145	LNX-6515DS (T-Mobile - Proposed)	125
LPA-80063/6CF (Verizon - Reserved)	145	KRY 112-144-1 TMA (T-Mobile - Proposed)	125
LPA-80063/6CF (Verizon - Reserved)	145	KRY 112-144-1 TMA (T-Mobile - Proposed)	125
LPA-171063-12CF (Verizon - Reserved)	145	KRY 112-144-1 TMA (T-Mobile - Proposed)	125
BXA-70063/6CF (Verizon - Reserved)	145	KRY112-71-2 (T-Mobile - Proposed)	125
BXA-70063/6CF (Verizon - Reserved)	145	KRY112-71-2 (T-Mobile - Proposed)	125
LPA-171063-12CF (Verizon - Reserved)	145	KRY112-71-2 (T-Mobile - Proposed)	125
LPA-80063/6CF (Verizon - Reserved)	145	ATSBT-TOP-FM-4G (T-Mobile - Proposed)	125
LPA-80063/6CF (Verizon - Reserved)	145	ATSBT-TOP-FM-4G (T-Mobile - Proposed)	125
LPA-171063-12CF (Verizon - Reserved)	145	ATSBT-TOP-FM-4G (T-Mobile - Proposed)	125
BXA-70063/6CF (Verizon - Reserved)	145	(2) APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125
BXA-70063/6CF (Verizon - Reserved)	145	(2) APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125
LPA-171063-12CF (Verizon - Reserved)	145	(2) APX16DWV-16DWVS-E-A20 (T-Mobile - Existing)	125
LPA-80063/6CF (Verizon - Reserved)	145	LNX-6515DS (T-Mobile - Proposed)	125
RRH (Verizon - Reserved)	145	LNX-6515DS (T-Mobile - Proposed)	125
RRH (Verizon - Reserved)	145	Valmont T-Arm (1) (T-Mobile - Existing)	123
RRH (Verizon - Reserved)	145	Valmont T-Arm (1) (T-Mobile - Existing)	123
EEI Low Profile Platform (Verizon - Existing)	143	Valmont T-Arm (1) (T-Mobile - Existing)	123
(2) 7770.00 (ATT - Existing)	135	APXV18-206517-C (MetroPCS - Existing)	115
(2) 7770.00 (ATT - Existing)	135	APXV18-206517-C (MetroPCS - Existing)	115
(2) 7770.00 (ATT - Existing)	135	Valmont Uni-Tri Bracket (MetroPCS - Existing)	115
(4) LGP21401 TMA (ATT - Existing)	135	APXV18-206517-C (MetroPCS - Existing)	115
(4) LGP21401 TMA (ATT - Existing)	135		
(4) LGP21401 TMA (ATT - Existing)	135		
AM-X-CD-14-65-00T-RET (ATT - Existing)	135		
AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	135		
AM-X-CD-16-65-00T-RET(72") (ATT - Existing)	135		
(2) RRUS-11 (ATT - Existing)	135		
(2) RRUS-11 (ATT - Existing)	135		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. Pole Section 2 - Equivalent Thickness of 0.25" Used to Account for Stiffened Section
9. TOWER RATING: 99.8%

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

Job: ***14033.017 - CTNH416A***		
Project: ***145-ft EEI Monopole - 5 Old Farm Rd., Barkhamsted, CT***		
Client: T-Mobile	Drawn by: TJL	App'd:
Code: TIA/EIA-222-F	Date: 12/02/14	Scale: NTS
Path:		Dwg No. E-1

tnxTower	Job	Page
	14033.017 - CTNH416A	1 of 30
Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	**Project** 145-ft EEI Monopole - 5 Old Farm Rd., Barkhamsted, CT	**Date** 08:30:13 12/02/14
	Client T-Mobile	**Designed by** TJL

Tower Input Data

There is a pole section.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

Basic wind speed of 80 mph.
Nominal ice thickness of 0.500 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
Weld together tower sections have flange connections..
Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Welds are fabricated with ER-70S-6 electrodes..
Pole Section 2 - Equivalent Thickness of 0.25" Used to Account for Stiffened Section.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.333.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Treat Feedline Bundles As Cylinder
	Consider Moments - Horizontals		Assume Legs Pinned		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Calculate Redundant Bracing Forces
	Use Moment Magnification		Use Clear Spans For Wind Area		Ignore Redundant Members in FEA
√	Use Code Stress Ratios		Use Clear Spans For KL/r		SR Leg Bolts Resist Compression
	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		All Leg Panels Have Same Allowable
	Escalate Ice	√	Bypass Mast Stability Checks		Offset Girt At Foundation
	Always Use Max Kz		Use Azimuth Dish Coefficients		Consider Feedline Torque
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Include Angle Block Shear Check
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Poles
	Leg Bolts Are At Top Of Section		SR Members Have Cut Ends	√	Include Shear-Torsion Interaction
	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Always Use Sub-Critical Flow
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Use Top Mounted Sockets
	Add IBC .6D+W Combination				

Tapered Pole Section Geometry

Section	*Elevation*	*Section Length*	*Splice Length*	*Number of Sides*	*Top Diameter*	*Bottom Diameter*	*Wall Thickness*	*Bend Radius*	*Pole Grade*
	ft	*ft*	*ft*		*in*	*in*	*in*	*in*	
L1	145.000-109.790	35.210	0.000	18	17.500	26.970	0.188	0.750	A572-65 (65 ksi)
L2	109.790-94.790	15.000	4.420	18	26.970	31.010	0.250	1.000	A572-65 (65 ksi)
L3	94.790-47.000	52.210	6.000	18	29.320	43.370	0.313	1.250	A572-65

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	47.000-1.000	52.000		18	41.130	55.000	0.313	1.250	(65 ksi) A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	17.770	10.303	390.144	6.146	8.890	43.886	780.801	5.153	2.750	14.667
	27.386	15.939	1444.438	9.508	13.701	105.428	2890.777	7.971	4.417	23.556
L2	27.386	21.202	1912.466	9.486	13.701	139.588	3827.449	10.603	4.307	17.227
	31.488	24.408	2917.718	10.920	15.753	185.216	5839.276	12.206	5.018	20.071
L3	30.980	28.771	3058.475	10.298	14.894	205.345	6120.975	14.388	4.610	14.753
	44.039	42.708	10003.243	15.285	22.032	454.033	20019.649	21.358	7.083	22.666
L4	43.390	40.486	8522.042	14.490	20.894	407.866	17055.297	20.247	6.689	21.405
	55.848	54.243	20495.504	19.414	27.940	733.554	41017.977	27.127	9.130	29.216

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 145.000-109.790				1	1	1		
L2 109.790-94.790				1	1	1		
L3 94.790-47.000				1	1	1		
L4 47.000-1.000				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8 (Verizon - Existing)	B	No	Inside Pole	145.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (AT&T - Existing)	B	No	Inside Pole	135.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (T-Mobile - Existing)	B	No	Inside Pole	125.000 - 4.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (MetroPCS - Existing)	B	No	Inside Pole	135.000 - 4.000	6	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001
1 5/8 (Verizon - Existing)	B	No	CaAa (Out Of Face)	145.000 - 4.000	1	No Ice	0.198	0.001
						1/2" Ice	0.298	0.003
1 5/8 (Verizon - Existing)	B	No	CaAa (Out Of Face)	145.000 - 4.000	5	No Ice	0.000	0.001
						1/2" Ice	0.000	0.003
#8 AWG Copper WIre (AT&T - Existing)	C	No	Inside Pole	135.000 - 4.000	2	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
RG6-Fiber	C	No	Inside Pole	135.000 - 4.000	1	No Ice	0.000	0.001
(AT&T - Existing)						1/2" Ice	0.000	0.001
HYBRIFLEX 1-1/4"	C	No	CaAa (Out Of	145.000 - 1.000	1	No Ice	0.154	0.001
(Verizon - Reserved)			Face)			1/2" Ice	0.254	0.003
1 5/8	B	No	CaAa (Out Of	125.000 - 4.000	1	No Ice	0.198	0.001
(T-Mobile - Proposed)			Face)			1/2" Ice	0.298	0.003
1 5/8	B	No	CaAa (Out Of	125.000 - 4.000	5	No Ice	0.000	0.001
(T-Mobile - Proposed)			Face)			1/2" Ice	0.000	0.003

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	145.000-109.790	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	9.983	1.416
		C	0.000	0.000	0.000	5.422	0.074
L2	109.790-94.790	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	5.940	0.842
		C	0.000	0.000	0.000	2.310	0.036
L3	94.790-47.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	18.925	2.684
		C	0.000	0.000	0.000	7.359	0.115
L4	47.000-1.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	17.028	2.415
		C	0.000	0.000	0.000	7.084	0.107

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	145.000-109.790	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	15.025	1.873
		C		0.000	0.000	0.000	8.943	0.117
L2	109.790-94.790	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	8.940	1.114
		C		0.000	0.000	0.000	3.810	0.055
L3	94.790-47.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	28.483	3.550
		C		0.000	0.000	0.000	12.139	0.174
L4	47.000-1.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	25.628	3.194
		C		0.000	0.000	0.000	11.684	0.164

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
EEI Low Profile Platform	C	From Face	2.000	0.000	143.000	No Ice	22.500	22.500	1.500
(Verizon - Existing)			0.000			1/2" Ice	28.200	28.200	2.250
			0.000						
(2) 7770.00	A	From Face	3.500	0.000	135.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			0.000			1/2" Ice	6.314	3.273	0.068
			0.000						
(2) 7770.00	B	From Face	3.500	0.000	135.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			0.000			1/2" Ice	6.314	3.273	0.068
			0.000						
(2) 7770.00	C	From Face	3.500	0.000	135.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			0.000			1/2" Ice	6.314	3.273	0.068
			0.000						
(4) LGP21401 TMA	A	From Face	3.500	0.000	135.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
(4) LGP21401 TMA	B	From Face	3.500	0.000	135.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
(4) LGP21401 TMA	C	From Face	3.500	0.000	135.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
AM-X-CD-14-65-00T-RET	B	From Face	3.000	0.000	135.000	No Ice	5.507	2.828	0.037
(AT&T - Existing)			2.000			1/2" Ice	5.899	3.137	0.069
			0.000						
AM-X-CD-16-65-00T-RET(72")	B	From Face	3.000	0.000	135.000	No Ice	8.260	4.642	0.050
			2.000			1/2" Ice	8.807	5.088	0.096
(AT&T - Existing)			0.000						
AM-X-CD-16-65-00T-RET(72")	C	From Face	3.000	0.000	135.000	No Ice	8.260	4.642	0.050
			2.000			1/2" Ice	8.807	5.088	0.096
(AT&T - Existing)			0.000						
(2) RRUS-11	A	From Face	1.000	0.000	135.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	B	From Face	1.000	0.000	135.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	C	From Face	1.000	0.000	135.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
DC6-48-60-18-8F Surge	C	From Face	0.500	0.000	135.000	No Ice	2.228	2.228	0.020
Arrestor			0.000			1/2" Ice	2.447	2.447	0.039
(AT&T - Existing)			0.000						
ABT-DFDM-ADBH Bias	A	From Face	1.000	0.000	135.000	No Ice	0.052	0.025	0.002
Tee			2.000			1/2" Ice	0.088	0.050	0.003
(AT&T - Existing)			0.000						
EEI Low Profile Platform	C	From Face	2.000	0.000	133.000	No Ice	22.500	22.500	1.500
(AT&T - Existing)			0.000			1/2" Ice	28.200	28.200	2.250
			0.000						
(2)	A	From Face	3.500	0,000	125.000	No Ice	7.065	2.150	0.041
APX16DWV-16DWVS-E-A			0.000			1/2" Ice	7.516	2.490	0.074
20			0.000						
(T-Mobile - Existing)									
(2)	B	From Face	3.500	0.000	125.000	No Ice	7.065	2.150	0.041
APX16DWV-16DWVS-E-A			0.000			1/2" Ice	7.516	2.490	0.074
20			0.000						
(T-Mobile - Existing)									
(2)	C	From Face	3.500	0.000	125.000	No Ice	7.065	2.150	0.041

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
APX16DWV-16DWVS-E-A			0.000			1/2" Ice	7.516	2.490	0.074
20			0.000						
(T-Mobile - Existing)									
LNX-6515DS	A	From Face	3.500	0.000	125.000	No Ice	11.445	7.696	0.055
(T-Mobile - Proposed)			2.000			1/2" Ice	12.064	8.289	0.121
			0.000						
LNX-6515DS	B	From Face	3.500	0.000	125.000	No Ice	11.445	7.696	0.055
(T-Mobile - Proposed)			2.000			1/2" Ice	12.064	8.289	0.121
			0.000						
LNX-6515DS	C	From Face	3.500	0.000	125.000	No Ice	11.445	7.696	0.055
(T-Mobile - Proposed)			2.000			1/2" Ice	12.064	8.289	0.121
			0.000						
KRY 112-144-1 TMA	A	From Face	3.500	0.000	125.000	No Ice	0.000	0.166	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.228	0.018
			0.000						
KRY 112-144-1 TMA	B	From Face	3.500	0.000	125.000	No Ice	0.000	0.166	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.228	0.018
			0.000						
KRY 112-144-1 TMA	C	From Face	3.500	0.000	125.000	No Ice	0.000	0.166	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.228	0.018
			0.000						
KRY112-71-2	A	From Face	3.500	0.000	125.000	No Ice	0.000	0.450	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.559	0.020
			0.000						
KRY112-71-2	B	From Face	3.500	0.000	125.000	No Ice	0.000	0.450	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.559	0.020
			0.000						
KRY112-71-2	C	From Face	3.500	0.000	125.000	No Ice	0.000	0.450	0.015
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.559	0.020
			0.000						
ATSBT-TOP-FM-4G	A	From Face	3.500	0.000	125.000	No Ice	0.000	0.109	0.050
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.163	0.052
			0.000						
ATSBT-TOP-FM-4G	B	From Face	3.500	0.000	125.000	No Ice	0.000	0.109	0.050
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.163	0.052
			0.000						
ATSBT-TOP-FM-4G	C	From Face	3.500	0.000	125.000	No Ice	0.000	0.109	0.050
(T-Mobile - Proposed)			-4.000			1/2" Ice	0.000	0.163	0.052
			0.000						
Valmont T-Arm (1)	A	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	B	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	C	From Face	2.000	0.000	123.000	No Ice	10.540	10.540	0.336
(T-Mobile - Existing)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
APXV18-206517-C	A	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						
APXV18-206517-C	B	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						
APXV18-206517-C	C	From Face	0.500	0.000	115.000	No Ice	5.513	3.929	0.022
(MetroPCS - Existing)			0.000			1/2" Ice	5.983	4.385	0.053
			0.000						

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Valmont Uni-Tri Bracket	A	From Face	0.500	0.000	115.000	No Ice	1.750	1.750	0.290
(MetroPCS - Existing)			0.000			1/2" Ice	1.940	1.940	0.306
			0.000						
LPA-80063/6CF	A	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	A	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	A	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
BXA-70063/6CF	A	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
LPA-171063-12CF	A	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	A	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-80063/6CF	B	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	B	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	B	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
BXA-70063/6CF	B	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
LPA-171063-12CF	B	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	B	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-80063/6CF	C	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			6.000			1/2" Ice	10.868	9.554	0.101
			0.000						
LPA-171063-12CF	C	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
BXA-70063/6CF	C	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
BXA-70063/6CF	C	From Face	3.000	0.000	145.000	No Ice	7.731	4.158	0.012
(Verizon - Reserved)			-1.000			1/2" Ice	8.268	4.595	0.054
			0.000						
LPA-171063-12CF	C	From Face	3.000	0.000	145.000	No Ice	5.994	6.054	0.012
(Verizon - Reserved)			-4.000			1/2" Ice	6.462	6.523	0.055
			0.000						
LPA-80063/6CF	C	From Face	3.000	0.000	145.000	No Ice	10.308	9.005	0.027
(Verizon - Reserved)			-6.000			1/2" Ice	10.868	9.554	0.101
			0.000						

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
RRH	A	From Face	3.000	0.000	145.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						
RRH	B	From Face	3.000	0.000	145.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						
RRH	C	From Face	3.000	0.000	145.000	No Ice	2.917	2.188	0.050
(Verizon - Reserved)			0.000			1/2" Ice	3.161	2.412	0.072
			0.000						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	126.317	1.467	0.024	65.241	A	0.000	65.241	65.241	100.00	0.000	0.000
145.000-109.7					B	0.000	65.241		100.00	0.000	9.983
90					C	0.000	65.241		100.00	0.000	5.422
L2	102.116	1.381	0.023	36.237	A	0.000	36.237	36.237	100.00	0.000	0.000
109.790-94.79					B	0.000	36.237		100.00	0.000	5.940
0					C	0.000	36.237		100.00	0.000	2.310
L3	70.087	1.24	0.020	147.112	A	0.000	147.112	147.112	100.00	0.000	0.000
94.790-47.000					B	0.000	147.112		100.00	0.000	18.925
					C	0.000	147.112		100.00	0.000	7.359
L4	23.145	1	0.017	187.317	A	0.000	187.317	187.317	100.00	0.000	0.000
47.000-1.000					B	0.000	187.317		100.00	0.000	17.028
					C	0.000	187.317		100.00	0.000	7.084

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	126.317	1.467	0.018	0.500	68.175	A	0.000	68.175	68.175	100.00	0.000	0.000
145.000-109.790						B	0.000	68.175		100.00	0.000	15.025
						C	0.000	68.175		100.00	0.000	8.943
L2	102.116	1.381	0.017	0.500	37.487	A	0.000	37.487	37.487	100.00	0.000	0.000
109.790-94.790						B	0.000	37.487		100.00	0.000	8.940
						C	0.000	37.487		100.00	0.000	3.810
L3	70.087	1.24	0.015	0.500	151.094	A	0.000	151.094	151.094	100.00	0.000	0.000
94.790-47.000						B	0.000	151.094		100.00	0.000	28.483

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L4 47.000-1.000	23.145	1	0.012	0.500	191.150	C	0.000	151.094		100.00	0.000	12.139
						A	0.000	191.150	191.150	100.00	0.000	0.000
						B	0.000	191.150		100.00	0.000	25.628
						C	0.000	191.150		100.00	0.000	11.684

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	126.317	1.467	0.009	65.241	A	0.000	65.241	65.241	100.00	0.000	0.000
145.000-109.7					B	0.000	65.241		100.00	0.000	9.983
90					C	0.000	65.241		100.00	0.000	5.422
L2	102.116	1.381	0.009	36.237	A	0.000	36.237	36.237	100.00	0.000	0.000
109.790-94.79					B	0.000	36.237		100.00	0.000	5.940
0					C	0.000	36.237		100.00	0.000	2.310
L3	70.087	1.24	0.008	147.112	A	0.000	147.112	147.112	100.00	0.000	0.000
94.790-47.000					B	0.000	147.112		100.00	0.000	18.925
					C	0.000	147.112		100.00	0.000	7.359
L4	23.145	1	0.006	187.317	A	0.000	187.317	187.317	100.00	0.000	0.000
47.000-1.000					B	0.000	187.317		100.00	0.000	17.028
					C	0.000	187.317		100.00	0.000	7.084

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	2.347	0.067	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	1.216	0.081	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	4.164	0.087	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	4.075	0.089	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	794.972 kip-ft	11.802		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	2.347	0.067	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	1.216	0.081	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	4.164	0.087	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	4.075	0.089	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	794.972 kip-ft	11.802		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	2.347	0.067	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	1.216	0.081	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	4.164	0.087	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	4.075	0.089	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	794.972 kip-ft	11.802		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	2.347	0.067	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	1.216	0.081	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	4.164	0.087	C
94.790-47.000			B	1	0.65	1	1	1	147.112			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	4.075	0.089	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	794.972 kip-ft	11.802		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.990	2.066	A	1	0.65	1	1	1	68.175	2.079	0.059	C
145.000-109.7			B	1	0.65	1	1	1	68.175			
90			C	1	0.65	1	1	1	68.175			
L2	1.169	1.437	A	1	0.65	1	1	1	37.487	1.064	0.071	C
109.790-94.79			B	1	0.65	1	1	1	37.487			
0			C	1	0.65	1	1	1	37.487			
L3	3.724	7.454	A	1	0.65	1	1	1	151.094	3.556	0.074	C
94.790-47.000			B	1	0.65	1	1	1	151.094			
			C	1	0.65	1	1	1	151.094			
L4	3.358	9.782	A	1	0.65	1	1	1	191.150	3.385	0.074	C
47.000-1.000			B	1	0.65	1	1	1	191.150			
			C	1	0.65	1	1	1	191.150			
Sum Weight:	10.241	20.739						OTM	688.819 kip-ft	10.085		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.990	2.066	A	1	0.65	1	1	1	68.175	2.079	0.059	C
145.000-109.7			B	1	0.65	1	1	1	68.175			
90			C	1	0.65	1	1	1	68.175			
L2	1.169	1.437	A	1	0.65	1	1	1	37.487	1.064	0.071	C
109.790-94.79			B	1	0.65	1	1	1	37.487			
0			C	1	0.65	1	1	1	37.487			
L3	3.724	7.454	A	1	0.65	1	1	1	151.094	3.556	0.074	C
94.790-47.000			B	1	0.65	1	1	1	151.094			
			C	1	0.65	1	1	1	151.094			
L4	3.358	9.782	A	1	0.65	1	1	1	191.150	3.385	0.074	C
47.000-1.000			B	1	0.65	1	1	1	191.150			
			C	1	0.65	1	1	1	191.150			
Sum Weight:	10.241	20.739						OTM	688.819 kip-ft	10.085		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.990	2.066	A	1	0.65	1	1	1	68.175	2.079	0.059	C
145.000-109.7			B	1	0.65	1	1	1	68.175			
90			C	1	0.65	1	1	1	68.175			
L2	1.169	1.437	A	1	0.65	1	1	1	37.487	1.064	0.071	C
109.790-94.79			B	1	0.65	1	1	1	37.487			
0			C	1	0.65	1	1	1	37.487			
L3	3.724	7.454	A	1	0.65	1	1	1	151.094	3.556	0.074	C
94.790-47.000			B	1	0.65	1	1	1	151.094			
			C	1	0.65	1	1	1	151.094			
L4	3.358	9.782	A	1	0.65	1	1	1	191.150	3.385	0.074	C
47.000-1.000			B	1	0.65	1	1	1	191.150			
			C	1	0.65	1	1	1	191.150			
Sum Weight:	10.241	20.739						OTM	688.819 kip-ft	10.085		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.990	2.066	A	1	0.65	1	1	1	68.175	2.079	0.059	C
145.000-109.7			B	1	0.65	1	1	1	68.175			
90			C	1	0.65	1	1	1	68.175			
L2	1.169	1.437	A	1	0.65	1	1	1	37.487	1.064	0.071	C
109.790-94.79			B	1	0.65	1	1	1	37.487			
0			C	1	0.65	1	1	1	37.487			
L3	3.724	7.454	A	1	0.65	1	1	1	151.094	3.556	0.074	C
94.790-47.000			B	1	0.65	1	1	1	151.094			
			C	1	0.65	1	1	1	151.094			
L4	3.358	9.782	A	1	0.65	1	1	1	191.150	3.385	0.074	C
47.000-1.000			B	1	0.65	1	1	1	191.150			
			C	1	0.65	1	1	1	191.150			
Sum Weight:	10.241	20.739						OTM	688.819 kip-ft	10.085		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	0.917	0.026	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	0.475	0.032	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	1.626	0.034	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	1.592	0.035	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	310.536 kip-ft	4.610		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	0.917	0.026	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	0.475	0.032	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	1.626	0.034	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	1.592	0.035	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	310.536 kip-ft	4.610		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	0.917	0.026	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	0.475	0.032	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	1.626	0.034	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	1.592	0.035	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	310.536 kip-ft	4.610		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	1.489	1.572	A	1	0.65	1	1	1	65.241	0.917	0.026	C
145.000-109.7			B	1	0.65	1	1	1	65.241			
90			C	1	0.65	1	1	1	65.241			
L2	0.878	1.164	A	1	0.65	1	1	1	36.237	0.475	0.032	C
109.790-94.79			B	1	0.65	1	1	1	36.237			
0			C	1	0.65	1	1	1	36.237			
L3	2.799	6.349	A	1	0.65	1	1	1	147.112	1.626	0.034	C
94.790-47.000			B	1	0.65	1	1	1	147.112			
			C	1	0.65	1	1	1	147.112			
L4	2.522	8.381	A	1	0.65	1	1	1	187.317	1.592	0.035	C
47.000-1.000			B	1	0.65	1	1	1	187.317			
			C	1	0.65	1	1	1	187.317			
Sum Weight:	7.688	17.467						OTM	310.536 kip-ft	4.610		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	17.467					
Bracing Weight	0.000					
Total Member Self-Weight	17.467			8.393	0.118	
Total Weight	31.511			8.393	0.118	
Wind 0 deg - No Ice		0.112	-26.475	-2765.461	-14.949	0.822
Wind 30 deg - No Ice		13.325	-22.984	-2401.368	-1398.591	3.941
Wind 45 deg - No Ice		18.787	-18.800	-1963.672	-1970.156	5.149
Wind 60 deg - No Ice		22.968	-13.335	-1391.582	-2407.450	6.005
Wind 90 deg - No Ice		26.456	-0.112	-6.674	-2771.203	6.460
Wind 120 deg - No Ice		22.855	13.140	1382.271	-2392.383	5.183
Wind 135 deg - No Ice		18.628	18.641	1959.150	-1948.848	3.987
Wind 150 deg - No Ice		13.131	22.872	2403.087	-1372.494	2.518
Wind 180 deg - No Ice		-0.112	26.475	2782.247	15.185	-0.822
Wind 210 deg - No Ice		-13.325	22.984	2418.154	1398.827	-3.941
Wind 225 deg - No Ice		-18.787	18.800	1980.458	1970.392	-5.149
Wind 240 deg - No Ice		-22.968	13.335	1408.368	2407.686	-6.005
Wind 270 deg - No Ice		-26.456	0.112	23.460	2771.439	-6.460
Wind 300 deg - No Ice		-22.855	-13.140	-1365.485	2392.619	-5.183
Wind 315 deg - No Ice		-18.628	-18.641	-1942.364	1949.084	-3.987
Wind 330 deg - No Ice		-13.131	-22.872	-2386.301	1372.730	-2.518
Member Ice	3.273					
Total Weight Ice	41.145			12.780	-0.106	
Wind 0 deg - Ice		0.087	-22.501	-2346.906	-11.717	0.682
Wind 30 deg - Ice		11.318	-19.530	-2036.574	-1189.046	3.543
Wind 45 deg - Ice		15.962	-15.972	-1663.980	-1675.511	4.658
Wind 60 deg - Ice		19.517	-11.325	-1177.118	-2047.800	5.455
Wind 90 deg - Ice		22.487	-0.087	1.169	-2357.876	5.906
Wind 120 deg - Ice		19.431	11.175	1182.568	-2036.190	4.773
Wind 135 deg - Ice		15.839	15.849	1673.120	-1659.091	3.694

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 150 deg - Ice		11.168	19.443	2050.522	-1168.936	2.362
Wind 180 deg - Ice		-0.087	22.501	2372.466	11.505	-0.682
Wind 210 deg - Ice		-11.318	19.530	2062.133	1188.834	-3.543
Wind 225 deg - Ice		-15.962	15.972	1689.540	1675.299	-4.658
Wind 240 deg - Ice		-19.517	11.325	1202.678	2047.588	-5.455
Wind 270 deg - Ice		-22.487	0.087	24.390	2357.664	-5.906
Wind 300 deg - Ice		-19.431	-11.175	-1157.008	2035.978	-4.773
Wind 315 deg - Ice		-15.839	-15.849	-1647.560	1658.879	-3.694
Wind 330 deg - Ice		-11.168	-19.443	-2024.963	1168.724	-2.362
Total Weight	31.511			8.393	0.118	
Wind 0 deg - Service		0.044	-10.342	-1075.144	-5.768	0.321
Wind 30 deg - Service		5.205	-8.978	-932.920	-546.253	1.540
Wind 45 deg - Service		7.339	-7.344	-761.945	-769.520	2.011
Wind 60 deg - Service		8.972	-5.209	-538.472	-940.338	2.346
Wind 90 deg - Service		10.334	-0.044	2.507	-1082.429	2.523
Wind 120 deg - Service		8.928	5.133	545.064	-934.453	2.025
Wind 135 deg - Service		7.276	7.282	770.407	-761.197	1.557
Wind 150 deg - Service		5.129	8.934	943.820	-536.059	0.984
Wind 180 deg - Service		-0.044	10.342	1091.930	6.003	-0.321
Wind 210 deg - Service		-5.205	8.978	949.706	546.489	-1.540
Wind 225 deg - Service		-7.339	7.344	778.731	769.756	-2.011
Wind 240 deg - Service		-8.972	5.209	555.258	940.574	-2.346
Wind 270 deg - Service		-10.334	0.044	14.279	1082.665	-2.523
Wind 300 deg - Service		-8.928	-5.133	-528.278	934.689	-2.025
Wind 315 deg - Service		-7.276	-7.282	-753.621	761.433	-1.557
Wind 330 deg - Service		-5.129	-8.934	-927.034	536.295	-0.984

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp

Comb. No.	Description
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	145 - 109.79	Pole	Max Tension	11	0.171	5.160	-8.963
			Max. Compression	18	-14.220	-0.117	-13.407
			Max. Mx	14	-7.746	440.399	-11.210
			Max. My	10	-7.729	3.114	-449.286
			Max. Vy	6	17.825	-440.155	-5.302
			Max. Vx	10	17.851	3.114	-449.286
			Max. Torque	14			6.662
L2	109.79 - 94.79	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-16.037	-0.118	-13.563
			Max. Mx	14	-9.330	633.362	-12.597
			Max. My	10	-9.318	4.348	-642.511
			Max. Vy	14	-18.676	633.362	-12.597
			Max. Vx	10	18.701	4.348	-642.511
			Max. Torque	14			6.566
L3	94.79 - 47	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-26.521	-0.123	-14.039
			Max. Mx	14	-18.513	1586.561	-18.418
			Max. My	10	-18.507	9.758	-1596.806
			Max. Vy	14	-22.571	1586.561	-18.418
			Max. Vx	10	22.594	9.758	-1596.806
			Max. Torque	14			6.554
L4	47 - 1	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-41.145	-0.124	-14.190
			Max. Mx	14	-31.488	2862.876	-24.499
			Max. My	10	-31.488	15.741	-2874.211
			Max. Vy	14	-26.483	2862.876	-24.499
			Max. Vx	10	26.502	15.741	-2874.211
			Max. Torque	14			6.525

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	41.145	0.087	-22.501
	Max. H_x	14	31.511	26.456	-0.112
	Max. H_z	2	31.511	-0.112	26.475
	Max. M_x	2	2856.506	-0.112	26.475
	Max. M_z	6	2862.626	-26.456	0.112
	Max. Torsion	14	6.516	26.456	-0.112
	Min. Vert	1	31.511	0.000	-0.000
	Min. H_x	6	31.511	-26.456	0.112
	Min. H_z	10	31.511	0.112	-26.475
	Min. M_x	10	-2874.211	0.112	-26.475
	Min. M_z	14	-2862.876	26.456	-0.112
	Min. Torsion	6	-6.512	-26.456	0.112

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	31.511	0.000	0.000	8.975	0.123	0.000
Dead+Wind 0 deg - No Ice	31.511	0.112	-26.475	-2856.506	-15.475	0.768
Dead+Wind 30 deg - No Ice	31.511	13.325	-22.984	-2480.370	-1444.741	3.922
Dead+Wind 45 deg - No Ice	31.511	18.787	-18.800	-2028.240	-2035.142	5.148
Dead+Wind 60 deg - No Ice	31.511	22.968	-13.335	-1437.294	-2486.852	6.024
Dead+Wind 90 deg - No Ice	31.511	26.456	-0.112	-6.717	-2862.626	6.512
Dead+Wind 120 deg - No Ice	31.511	22.855	13.140	1428.085	-2471.319	5.258
Dead+Wind 135 deg - No Ice	31.511	18.628	18.641	2024.012	-2013.133	4.065
Dead+Wind 150 deg - No Ice	31.511	13.131	22.872	2482.595	-1417.738	2.595
Dead+Wind 180 deg - No Ice	31.511	-0.112	26.475	2874.211	15.741	-0.763
Dead+Wind 210 deg - No Ice	31.511	-13.325	22.984	2498.087	1444.973	-3.916
Dead+Wind 225 deg - No Ice	31.511	-18.787	18.800	2045.973	2035.365	-5.144
Dead+Wind 240 deg - No Ice	31.511	-22.968	13.335	1455.047	2487.076	-6.022
Dead+Wind 270 deg - No Ice	31.511	-26.456	0.112	24.498	2862.876	-6.516
Dead+Wind 300 deg - No Ice	31.511	-22.855	-13.140	-1410.312	2471.604	-5.261
Dead+Wind 315 deg - No Ice	31.511	-18.628	-18.641	-2006.255	2013.426	-4.067
Dead+Wind 330 deg - No Ice	31.511	-13.131	-22.872	-2464.858	1418.031	-2.594
Dead+Ice+Temp	41.145	0.000	0.000	14.190	-0.124	0.001
Dead+Wind 0 deg+Ice+Temp	41.145	0.087	-22.501	-2463.713	-12.358	0.631
Dead+Wind 30 deg+Ice+Temp	41.145	11.318	-19.530	-2137.846	-1248.589	3.575
Dead+Wind 45 deg+Ice+Temp	41.145	15.962	-15.972	-1746.615	-1759.380	4.729
Dead+Wind 60 deg+Ice+Temp	41.145	19.517	-11.325	-1235.402	-2150.284	5.561
Dead+Wind 90 deg+Ice+Temp	41.145	22.487	-0.087	1.834	-2475.866	6.057
Dead+Wind 120 deg+Ice+Temp	41.145	19.431	11.175	1242.369	-2138.069	4.931
Dead+Wind 135 deg+Ice+Temp	41.145	15.839	15.849	1757.478	-1742.083	3.839
Dead+Wind 150 deg+Ice+Temp	41.145	11.168	19.443	2153.767	-1227.382	2.485
Dead+Wind 180 deg+Ice+Temp	41.145	-0.087	22.501	2491.797	12.135	-0.625
Dead+Wind 210 deg+Ice+Temp	41.145	-11.318	19.530	2165.940	1248.329	-3.568
Dead+Wind 225 deg+Ice+Temp	41.145	-15.962	15.972	1774.726	1759.112	-4.723

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead+Wind 240 deg+Ice+Temp	41.145	-19.517	11.325	1263.534	2150.018	-5.556
Dead+Wind 270 deg+Ice+Temp	41.145	-22.487	0.087	26.326	2475.628	-6.057
Dead+Wind 300 deg+Ice+Temp	41.145	-19.431	-11.175	-1214.219	2137.867	-4.934
Dead+Wind 315 deg+Ice+Temp	41.145	-15.839	-15.849	-1729.345	1741.890	-3.840
Dead+Wind 330 deg+Ice+Temp	41.145	-11.168	-19.443	-2125.655	1227.187	-2.485
Dead+Wind 0 deg - Service	31.511	0.044	-10.342	-1112.220	-5.984	0.305
Dead+Wind 30 deg - Service	31.511	5.205	-8.978	-965.059	-565.260	1.557
Dead+Wind 45 deg - Service	31.511	7.339	-7.344	-788.142	-796.287	2.044
Dead+Wind 60 deg - Service	31.511	8.972	-5.209	-556.902	-973.041	2.392
Dead+Wind 90 deg - Service	31.511	10.334	-0.044	2.887	-1120.064	2.586
Dead+Wind 120 deg - Service	31.511	8.928	5.133	564.313	-966.933	2.088
Dead+Wind 135 deg - Service	31.511	7.276	7.282	797.495	-787.649	1.614
Dead+Wind 150 deg - Service	31.511	5.129	8.934	976.940	-554.678	1.030
Dead+Wind 180 deg - Service	31.511	-0.044	10.342	1130.200	6.233	-0.303
Dead+Wind 210 deg - Service	31.511	-5.205	8.978	983.041	565.504	-1.556
Dead+Wind 225 deg - Service	31.511	-7.339	7.344	806.126	796.530	-2.043
Dead+Wind 240 deg - Service	31.511	-8.972	5.209	574.888	973.283	-2.391
Dead+Wind 270 deg - Service	31.511	-10.334	0.044	15.104	1120.311	-2.586
Dead+Wind 300 deg - Service	31.511	-8.928	-5.133	-546.323	967.186	-2.087
Dead+Wind 315 deg - Service	31.511	-7.276	-7.282	-779.507	787.902	-1.613
Dead+Wind 330 deg - Service	31.511	-5.129	-8.934	-958.956	554.932	-1.029

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.000	-31.511	0.000	0.000	31.511	-0.000	0.000%
2	0.112	-31.511	-26.475	-0.112	31.511	26.475	0.000%
3	13.325	-31.511	-22.984	-13.325	31.511	22.984	0.000%
4	18.787	-31.511	-18.800	-18.787	31.511	18.800	0.000%
5	22.968	-31.511	-13.335	-22.968	31.511	13.335	0.000%
6	26.456	-31.511	-0.112	-26.456	31.511	0.112	0.000%
7	22.855	-31.511	13.140	-22.855	31.511	-13.140	0.000%
8	18.628	-31.511	18.641	-18.628	31.511	-18.641	0.000%
9	13.131	-31.511	22.872	-13.131	31.511	-22.872	0.000%
10	-0.112	-31.511	26.475	0.112	31.511	-26.475	0.000%
11	-13.325	-31.511	22.984	13.325	31.511	-22.984	0.000%
12	-18.787	-31.511	18.800	18.787	31.511	-18.800	0.000%
13	-22.968	-31.511	13.335	22.968	31.511	-13.335	0.000%
14	-26.456	-31.511	0.112	26.456	31.511	-0.112	0.000%
15	-22.855	-31.511	-13.140	22.855	31.511	13.140	0.000%
16	-18.628	-31.511	-18.641	18.628	31.511	18.641	0.000%
17	-13.131	-31.511	-22.872	13.131	31.511	22.872	0.000%
18	0.000	-41.145	0.000	-0.000	41.145	-0.000	0.000%
19	0.087	-41.145	-22.501	-0.087	41.145	22.501	0.000%
20	11.318	-41.145	-19.530	-11.318	41.145	19.530	0.000%
21	15.962	-41.145	-15.972	-15.962	41.145	15.972	0.000%
22	19.517	-41.145	-11.325	-19.517	41.145	11.325	0.000%
23	22.487	-41.145	-0.087	-22.487	41.145	0.087	0.000%
24	19.431	-41.145	11.175	-19.431	41.145	-11.175	0.000%
25	15.839	-41.145	15.849	-15.839	41.145	-15.849	0.000%
26	11.168	-41.145	19.443	-11.168	41.145	-19.443	0.000%
27	-0.087	-41.145	22.501	0.087	41.145	-22.501	0.000%
28	-11.318	-41.145	19.530	11.318	41.145	-19.530	0.000%
29	-15.962	-41.145	15.972	15.962	41.145	-15.972	0.000%
30	-19.517	-41.145	11.325	19.517	41.145	-11.325	0.000%
31	-22.487	-41.145	0.087	22.487	41.145	-0.087	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
32	-19.431	-41.145	-11.175	19.431	41.145	11.175	0.000%
33	-15.839	-41.145	-15.849	15.839	41.145	15.849	0.000%
34	-11.168	-41.145	-19.443	11.168	41.145	19.443	0.000%
35	0.044	-31.511	-10.342	-0.044	31.511	10.342	0.000%
36	5.205	-31.511	-8.978	-5.205	31.511	8.978	0.000%
37	7.339	-31.511	-7.344	-7.339	31.511	7.344	0.000%
38	8.972	-31.511	-5.209	-8.972	31.511	5.209	0.000%
39	10.334	-31.511	-0.044	-10.334	31.511	0.044	0.000%
40	8.928	-31.511	5.133	-8.928	31.511	-5.133	0.000%
41	7.276	-31.511	7.282	-7.276	31.511	-7.282	0.000%
42	5.129	-31.511	8.934	-5.129	31.511	-8.934	0.000%
43	-0.044	-31.511	10.342	0.044	31.511	-10.342	0.000%
44	-5.205	-31.511	8.978	5.205	31.511	-8.978	0.000%
45	-7.339	-31.511	7.344	7.339	31.511	-7.344	0.000%
46	-8.972	-31.511	5.209	8.972	31.511	-5.209	0.000%
47	-10.334	-31.511	0.044	10.334	31.511	-0.044	0.000%
48	-8.928	-31.511	-5.133	8.928	31.511	5.133	0.000%
49	-7.276	-31.511	-7.282	7.276	31.511	7.282	0.000%
50	-5.129	-31.511	-8.934	5.129	31.511	8.934	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	5	0.00000001	0.00004689
3	Yes	6	0.00000001	0.00004321
4	Yes	6	0.00000001	0.00004170
5	Yes	6	0.00000001	0.00003492
6	Yes	5	0.00000001	0.00024228
7	Yes	6	0.00000001	0.00004450
8	Yes	6	0.00000001	0.00004120
9	Yes	6	0.00000001	0.00003701
10	Yes	4	0.00000001	0.00034504
11	Yes	6	0.00000001	0.00003652
12	Yes	6	0.00000001	0.00004181
13	Yes	6	0.00000001	0.00004575
14	Yes	5	0.00000001	0.00027825
15	Yes	6	0.00000001	0.00003485
16	Yes	6	0.00000001	0.00004112
17	Yes	6	0.00000001	0.00004142
18	Yes	4	0.00000001	0.00013917
19	Yes	5	0.00000001	0.00043799
20	Yes	6	0.00000001	0.00019671
21	Yes	6	0.00000001	0.00020670
22	Yes	6	0.00000001	0.00016803
23	Yes	5	0.00000001	0.00084383
24	Yes	6	0.00000001	0.00020501
25	Yes	6	0.00000001	0.00020816
26	Yes	6	0.00000001	0.00017750
27	Yes	5	0.00000001	0.00043174
28	Yes	6	0.00000001	0.00017855
29	Yes	6	0.00000001	0.00021280
30	Yes	6	0.00000001	0.00021149
31	Yes	5	0.00000001	0.00090952
32	Yes	6	0.00000001	0.00016522

33	Yes	6	0.00000001	0.00020204
34	Yes	6	0.00000001	0.00018853
35	Yes	4	0.00000001	0.00025648
36	Yes	5	0.00000001	0.00017135
37	Yes	5	0.00000001	0.00017616
38	Yes	5	0.00000001	0.00012607
39	Yes	5	0.00000001	0.00007482
40	Yes	5	0.00000001	0.00018822
41	Yes	5	0.00000001	0.00018011
42	Yes	5	0.00000001	0.00014037
43	Yes	4	0.00000001	0.00017986
44	Yes	5	0.00000001	0.00014157
45	Yes	5	0.00000001	0.00018912
46	Yes	5	0.00000001	0.00019944
47	Yes	5	0.00000001	0.00007893
48	Yes	5	0.00000001	0.00012162
49	Yes	5	0.00000001	0.00016757
50	Yes	5	0.00000001	0.00015722

Maximum Tower Deflections - Service Wind

Section No.	*Elevation*	*Horz. Deflection*	*Gov. Load Comb.*	*Tilt*	*Twist*
	ft	*in*		°	°
L1	145 - 109.79	42.504	44	2.968	0.044
L2	109.79 - 94.79	22.824	44	2.173	0.016
L3	99.21 - 47	18.333	44	1.879	0.011
L4	53 - 1	4.887	44	0.888	0.003

Critical Deflections and Radius of Curvature - Service Wind

Elevation	*Appurtenance*	*Gov. Load Comb.*	*Deflection*	*Tilt*	*Twist*	*Radius of Curvature*
ft			*in*	°	°	*ft*
145.000	LPA-80063/6CF	44	42.504	2.968	0.044	10120
143.000	EEI Low Profile Platform	44	41.289	2.927	0.042	10120
135.000	(2) 7770.00	44	36.466	2.761	0.035	5059
133.000	EEI Low Profile Platform	44	35.279	2.719	0.033	4216
125.000	(2) APX16DWV-16DWVS-E-A20	44	30.663	2.546	0.026	2529
123.000	Valmont T-Arm (1)	44	29.552	2.501	0.024	2298
115.000	APXV18-206517-C	44	25.334	2.309	0.019	1685

Maximum Tower Deflections - Design Wind

Section No.	*Elevation*	*Horz. Deflection*	*Gov. Load Comb.*	*Tilt*	*Twist*
	ft	*in*		°	°
L1	145 - 109.79	106.982	11	7.391	0.111
L2	109.79 - 94.79	57.794	11	5.487	0.039
L3	99.21 - 47	46.466	11	4.754	0.028
L4	53 - 1	12.418	11	2.254	0.009

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
145.000	LPA-80063/6CF	11	106.982	7.391	0.112	4275
143.000	EEI Low Profile Platform	11	103.952	7.296	0.107	4275
135.000	(2) 7770.00	11	91.925	6.910	0.087	2136
133.000	EEI Low Profile Platform	11	88.964	6.811	0.083	1779
125.000	(2) APX16DWV-16DWVS-E-A20	11	77.440	6.397	0.065	1065
123.000	Valmont T-Arm (1)	11	74.662	6.288	0.061	968
115.000	APXV18-206517-C	11	64.100	5.822	0.047	707

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	145 - 143.239	TP26.97x17.5x0.188	35.210	0.000	3.3	39.000	10.585	0.000	412.811	0.000
	143.239 - 141.479					39.000	10.867	-1.323	423.801	0.003
	141.479 - 139.719					39.000	11.149	-1.453	434.791	0.003
	139.719 - 137.958					39.000	11.430	-1.586	445.780	0.004
	137.958 - 136.197					39.000	11.712	-1.722	456.770	0.004
	136.197 - 134.437					39.000	11.994	-2.393	467.760	0.005
	134.437 - 132.677					39.000	12.276	-3.912	478.750	0.008
	132.677 - 130.916					39.000	12.557	-4.061	489.740	0.008
	130.916 - 129.155					39.000	12.839	-4.215	500.730	0.008
	129.155 - 127.395					39.000	13.121	-4.373	511.720	0.009
	127.395 - 125.634					39.000	13.403	-4.534	522.710	0.009
	125.634 - 123.874					39.000	13.685	-5.059	533.700	0.009
	123.874 - 122.114					39.000	13.966	-6.087	544.689	0.011
	122.114 - 120.353					39.000	14.248	-6.266	555.679	0.011
	120.353 - 118.593					39.000	14.530	-6.450	566.669	0.011

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
	118.593 - 116.832					39.000	14.812	-6.637	577.659	0.011
	116.832 - 115.072					39.000	15.094	-6.827	588.649	0.012
	115.072 - 113.311					39.000	15.375	-7.311	599.639	0.012
	113.311 - 111.551					39.000	15.657	-7.511	610.629	0.012
	111.551 - 109.79					39.000	15.939	-7.713	621.619	0.012
L2	109.79 - 108.732	TP31.01x26.97x0.25	15.000	0.000	0.0	39.000	21.428	-7.879	835.709	0.009
	108.732 - 107.674					39.000	21.654	-8.033	844.527	0.010
	107.674 - 106.616					39.000	21.881	-8.188	853.346	0.010
	106.616 - 105.558					39.000	22.107	-8.344	862.164	0.010
	105.558 - 104.5					39.000	22.333	-8.501	870.982	0.010
	104.5 - 103.442					39.000	22.559	-8.660	879.801	0.010
	103.442 - 102.384					39.000	22.785	-8.819	888.619	0.010
	102.384 - 101.326					39.000	23.011	-8.979	897.437	0.010
	101.326 - 100.268					39.000	23.237	-9.141	906.256	0.010
	100.268 - 99.21					39.000	23.463	-9.303	915.074	0.010
	99.21 - 94.79					39.000	24.408	-4.718	951.914	0.005
L3	99.21 - 94.79	TP43.37x29.32x0.313	52.210	0.000	0.0	39.000	29.951	-5.648	1168.100	0.005
	94.79 - 92.4683					39.000	30.571	-10.772	1192.270	0.009
	92.4683 - 90.1467					39.000	31.191	-11.184	1216.430	0.009
	90.1467 - 87.825					39.000	31.810	-11.601	1240.600	0.009
	87.825 - 85.5033					39.000	32.430	-12.024	1264.770	0.010
	85.5033 - 83.1817					39.000	33.050	-12.453	1288.940	0.010
	83.1817 - 80.86					39.000	33.669	-12.886	1313.110	0.010
	80.86 - 78.5383					39.000	34.289	-13.325	1337.280	0.010
	78.5383 - 76.2167					39.000	34.909	-13.770	1361.450	0.010
	76.2167 - 73.895					39.000	35.529	-14.219	1385.620	0.010
	73.895 - 71.5733					39.000	36.148	-14.674	1409.790	0.010
	71.5733 - 69.2517					39.000	36.768	-15.134	1433.950	0.011
	69.2517 - 66.93					39.000	37.388	-15.599	1458.120	0.011
	66.93 - 64.6083					39.000	38.007	-16.070	1482.290	0.011
	64.6083 - 62.2867					39.000	38.627	-16.546	1506.460	0.011
	62.2867 - 59.965					39.000	39.247	-17.026	1530.630	0.011
	59.965 - 57.6433					39.000	39.867	-17.512	1554.800	0.011
	57.6433 - 55.3217					39.000	40.486	-18.003	1578.970	0.011
	55.3217 - 53					39.000	41.106	-18.500	1603.140	0.012
	53 - 47					39.000	42.708	-10.449	1665.600	0.006

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L4	53 - 47	TP55x41.13x0.313	52.000	0.000	0.0	39.000	42.074	-10.131	1640.870	0.006
	47 - 44.5789					39.000	42.714	-21.112	1665.850	0.013
	44.5789 - 42.1579					39.000	43.354	-21.643	1690.830	0.013
	42.1579 - 39.7368					39.000	43.995	-22.180	1715.810	0.013
	39.7368 - 37.3158					39.000	44.636	-22.721	1740.790	0.013
	37.3158 - 34.8947					39.000	45.276	-23.268	1765.770	0.013
	34.8947 - 32.4737					39.000	45.917	-23.821	1790.750	0.013
	32.4737 - 30.0526					38.986	46.557	-24.378	1815.050	0.013
	30.0526 - 27.6316					38.754	47.198	-24.941	1829.100	0.014
	27.6316 - 25.2105					38.523	47.838	-25.510	1842.860	0.014
	25.2105 - 22.7895					38.291	48.479	-26.084	1856.320	0.014
	22.7895 - 20.3684					38.060	49.119	-26.663	1869.480	0.014
	20.3684 - 17.9474					37.829	49.760	-27.247	1882.340	0.014
	17.9474 - 15.5263					37.597	50.400	-27.837	1894.910	0.015
	15.5263 - 13.1053					37.366	51.041	-28.432	1907.190	0.015
	13.1053 - 10.6842					37.135	51.681	-29.032	1919.160	0.015
	10.6842 - 8.26316					36.903	52.322	-29.638	1930.840	0.015
	8.26316 - 5.84211					36.672	52.962	-30.249	1942.220	0.016
	5.84211 - 3.42105					36.441	53.603	-30.866	1953.310	0.016
	3.42105 - 1					36.209	54.243	-31.488	1964.100	0.016

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	145 - 143.239	TP26.97x17.5x0.188	10.344	-2.679	39.000	0.069	0.000	0.000	39.000	0.000
	143.239 - 141.479		26.710	6.562	39.000	0.168	0.000	0.000	39.000	0.000
	141.479 - 139.719		39.451	9.206	39.000	0.236	0.000	0.000	39.000	0.000
	139.719 - 137.958		52.401	11.630	39.000	0.298	0.000	0.000	39.000	0.000
	137.958 - 136.197		65.563	13.856	39.000	0.355	0.000	0.000	39.000	0.000
	136.197 - 134.437		80.740	16.267	39.000	0.417	0.000	0.000	39.000	0.000
	134.437 - 132.677		103.973	19.993	39.000	0.513	0.000	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	132.677 - 130.916		124.747	22.918	39.000	0.588	0.000	0.000	39.000	0.000
	130.916 - 129.155		145.738	25.608	39.000	0.657	0.000	0.000	39.000	0.000
	129.155 - 127.395		166.951	28.083	39.000	0.720	0.000	0.000	39.000	0.000
	127.395 - 125.634		188.387	30.365	39.000	0.779	0.000	0.000	39.000	0.000
	125.634 - 123.874		212.523	32.854	39.000	0.842	0.000	0.000	39.000	0.000
	123.874 - 122.114		239.998	35.613	39.000	0.913	0.000	0.000	39.000	0.000
	122.114 - 120.353		268.906	38.334	39.000	0.983	0.000	0.000	39.000	0.000
	120.353 - 118.593		298.041	40.849	39.000	1.047	0.000	0.000	39.000	0.000
	118.593 - 116.832		327.404	43.176	39.000	1.107	0.000	0.000	39.000	0.000
	116.832 - 115.072		356.998	45.331	39.000	1.162	0.000	0.000	39.000	0.000
	115.072 - 113.311		387.938	47.464	39.000	1.217	0.000	0.000	39.000	0.000
	113.311 - 111.551		419.162	49.449	39.000	1.268	0.000	0.000	39.000	0.000
	111.551 - 109.79		450.618	51.290	39.000	1.315	0.000	0.000	39.000	0.000
L2	109.79 - 108.732	TP31.01x26.97x0.25	469.637	39.522	39.000	1.013	0.000	0.000	39.000	0.000
	108.732 - 107.674		488.745	40.272	39.000	1.033	0.000	0.000	39.000	0.000
	107.674 - 106.616		507.942	40.989	39.000	1.051	0.000	0.000	39.000	0.000
	106.616 - 105.558		527.227	41.676	39.000	1.069	0.000	0.000	39.000	0.000
	105.558 - 104.5		546.602	42.333	39.000	1.085	0.000	0.000	39.000	0.000
	104.5 - 103.442		566.069	42.962	39.000	1.102	0.000	0.000	39.000	0.000
	103.442 - 102.384		585.626	43.565	39.000	1.117	0.000	0.000	39.000	0.000
	102.384 - 101.326		605.275	44.142	39.000	1.132	0.000	0.000	39.000	0.000
	101.326 - 100.268		625.015	44.696	39.000	1.146	0.000	0.000	39.000	0.000
	100.268 - 99.21		644.848	45.226	39.000	1.160	0.000	0.000	39.000	0.000
	99.21 - 94.79		334.207	21.653	39.000	0.555	0.000	0.000	39.000	0.000
L3	99.21 - 94.79	TP43.37x29.32x0.313	394.654	21.273	39.000	0.545	0.000	0.000	39.000	0.000
	94.79 - 92.4683		773.714	40.023	39.000	1.026	0.000	0.000	39.000	0.000
	92.4683 - 90.1467		819.000	40.691	39.000	1.043	0.000	0.000	39.000	0.000
	90.1467 - 87.825		864.717	41.297	39.000	1.059	0.000	0.000	39.000	0.000
	87.825 - 85.5033		910.875	41.846	39.000	1.073	0.000	0.000	39.000	0.000
	85.5033 - 83.1817		957.467	42.345	39.000	1.086	0.000	0.000	39.000	0.000
	83.1817 - 80.86		1004.500	42.798	39.000	1.097	0.000	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	80.86 - 78.5383		1051.96 7	43.208	39.000	1.108	0.000	0.000	39.000	0.000
	78.5383 - 76.2167		1099.88 3	43.579	39.000	1.117	0.000	0.000	39.000	0.000
	76.2167 - 73.895		1148.23 3	43.915	39.000	1.126	0.000	0.000	39.000	0.000
	73.895 - 71.5733		1197.03 3	44.218	39.000	1.134	0.000	0.000	39.000	0.000
	71.5733 - 69.2517		1246.27 5	44.492	39.000	1.141	0.000	0.000	39.000	0.000
	69.2517 - 66.93		1295.96 7	44.739	39.000	1.147	0.000	0.000	39.000	0.000
	66.93 - 64.6083		1346.10 0	44.961	39.000	1.153	0.000	0.000	39.000	0.000
	64.6083 - 62.2867		1396.69 2	45.159	39.000	1.158	0.000	0.000	39.000	0.000
	62.2867 - 59.965		1447.72 5	45.337	39.000	1.163	0.000	0.000	39.000	0.000
	59.965 - 57.6433		1499.22 5	45.496	39.000	1.167	0.000	0.000	39.000	0.000
	57.6433 - 55.3217		1551.16 7	45.637	39.000	1.170	0.000	0.000	39.000	0.000
	55.3217 - 53		1603.57 5	45.762	39.000	1.173	0.000	0.000	39.000	0.000
	53 - 47		890.508	23.536	39.000	0.603	0.000	0.000	39.000	0.000
L4	53 - 47	TP55x41.13x0.313	850.867	23.174	39.000	0.594	0.000	0.000	39.000	0.000
	47 - 44.5789		1797.90 0	47.504	39.000	1.218	0.000	0.000	39.000	0.000
	44.5789 - 42.1579		1854.81 7	47.565	39.000	1.220	0.000	0.000	39.000	0.000
	42.1579 - 39.7368		1912.13 3	47.613	39.000	1.221	0.000	0.000	39.000	0.000
	39.7368 - 37.3158		1969.85 0	47.648	39.000	1.222	0.000	0.000	39.000	0.000
	37.3158 - 34.8947		2027.98 3	47.671	39.000	1.222	0.000	0.000	39.000	0.000
	34.8947 - 32.4737		2086.51 7	47.684	39.000	1.223	0.000	0.000	39.000	0.000
	32.4737 - 30.0526		2145.45 8	47.687	38.986	1.223	0.000	0.000	38.986	0.000
	30.0526 - 27.6316		2204.81 7	47.681	38.754	1.230	0.000	0.000	38.754	0.000
	27.6316 - 25.2105		2264.59 2	47.666	38.523	1.237	0.000	0.000	38.523	0.000
	25.2105 - 22.7895		2324.79 2	47.645	38.291	1.244	0.000	0.000	38.291	0.000
	22.7895 - 20.3684		2385.40 8	47.617	38.060	1.251	0.000	0.000	38.060	0.000
	20.3684 - 17.9474		2446.45 0	47.582	37.829	1.258	0.000	0.000	37.829	0.000
	17.9474 - 15.5263		2507.92 5	47.542	37.597	1.265	0.000	0.000	37.597	0.000
	15.5263 - 13.1053		2569.82 5	47.497	37.366	1.271	0.000	0.000	37.366	0.000
	13.1053 - 10.6842		2632.15 8	47.447	37.135	1.278	0.000	0.000	37.135	0.000
	10.6842 - 8.26316		2694.91 7	47.393	36.903	1.284	0.000	0.000	36.903	0.000
	8.26316 - 5.84211		2758.15 0	47.335	36.672	1.291	0.000	0.000	36.672	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	5.84211 - 3.42105		2821.825	47.274	36.441	1.297	0.000	0.000	36.441	0.000
	3.42105 - 1		2885.950	47.210	36.209	1.304	0.000	0.000	36.209	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	145 - 143.239	TP26.97x17.5x0.188	0.001	0.000	26.000	0.000	0.000	0.000	26.000	0.000
	143.239 - 141.479		7.179	0.661	26.000	0.052	0.001	0.000	26.000	0.000
	141.479 - 139.719		7.297	0.655	26.000	0.052	0.001	0.000	26.000	0.000
	139.719 - 137.958		7.416	0.649	26.000	0.051	0.001	0.000	26.000	0.000
	137.958 - 136.197		7.538	0.644	26.000	0.051	0.001	0.000	26.000	0.000
	136.197 - 134.437		10.510	0.876	26.000	0.067	0.897	0.088	26.000	0.003
	134.437 - 132.677		11.741	0.956	26.000	0.074	0.897	0.084	26.000	0.003
	132.677 - 130.916		11.865	0.945	26.000	0.073	0.897	0.080	26.000	0.003
	130.916 - 129.155		11.990	0.934	26.000	0.072	0.897	0.077	26.000	0.003
	129.155 - 127.395		12.117	0.923	26.000	0.071	0.897	0.074	26.000	0.003
	127.395 - 125.634		12.244	0.914	26.000	0.070	0.897	0.070	26.000	0.003
	125.634 - 123.874		14.854	1.085	26.000	0.083	4.102	0.309	26.000	0.012
	123.874 - 122.114		16.365	1.172	26.000	0.090	4.101	0.297	26.000	0.011
	122.114 - 120.353		16.494	1.158	26.000	0.089	4.100	0.285	26.000	0.011
	120.353 - 118.593		16.623	1.144	26.000	0.088	4.099	0.274	26.000	0.011
	118.593 - 116.832		16.754	1.131	26.000	0.087	4.098	0.264	26.000	0.010
	116.832 - 115.072		16.885	1.119	26.000	0.086	4.097	0.254	26.000	0.010
	115.072 - 113.311		17.680	1.150	26.000	0.088	4.095	0.245	26.000	0.009
	113.311 - 111.551		17.812	1.138	26.000	0.087	3.950	0.228	26.000	0.009
	111.551 - 109.79		17.946	1.126	26.000	0.087	3.949	0.220	26.000	0.008
L2	109.79 - 108.732	TP31.01x26.97x0.25	18.024	0.841	26.000	0.065	3.948	0.162	26.000	0.006
	108.732 - 107.674		18.108	0.836	26.000	0.064	3.947	0.159	26.000	0.006
	107.674 - 106.616		18.192	0.831	26.000	0.064	3.946	0.155	26.000	0.006
	106.616 -		18.277	0.827	26.000	0.064	3.946	0.152	26.000	0.006

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	105.558									
	105.558 - 104.5		18.362	0.822	26.000	0.063	3.945	0.149	26.000	0.006
	104.5 - 103.442		18.448	0.818	26.000	0.063	3.945	0.146	26.000	0.006
	103.442 - 102.384		18.534	0.813	26.000	0.063	3.944	0.143	26.000	0.006
	102.384 - 101.326		18.621	0.809	26.000	0.062	3.943	0.140	26.000	0.005
	101.326 - 100.268		18.708	0.805	26.000	0.062	3.943	0.137	26.000	0.005
	100.268 - 99.21		18.796	0.801	26.000	0.062	3.942	0.135	26.000	0.005
	99.21 - 94.79		8.928	0.366	26.000	0.028	1.807	0.057	26.000	0.002
L3	99.21 - 94.79	TP43.37x29.32x0.313	10.312	0.344	26.000	0.026	2.134	0.056	26.000	0.002
	94.79 - 92.4683		19.426	0.635	26.000	0.049	3.940	0.099	26.000	0.004
	92.4683 - 90.1467		19.613	0.629	26.000	0.048	3.939	0.095	26.000	0.004
	90.1467 - 87.825		19.801	0.622	26.000	0.048	3.937	0.092	26.000	0.004
	87.825 - 85.5033		19.989	0.616	26.000	0.047	3.936	0.088	26.000	0.003
	85.5033 - 83.1817		20.178	0.611	26.000	0.047	3.935	0.085	26.000	0.003
	83.1817 - 80.86		20.367	0.605	26.000	0.047	3.934	0.082	26.000	0.003
	80.86 - 78.5383		20.557	0.600	26.000	0.046	3.933	0.079	26.000	0.003
	78.5383 - 76.2167		20.748	0.594	26.000	0.046	3.932	0.076	26.000	0.003
	76.2167 - 73.895		20.939	0.589	26.000	0.045	3.931	0.073	26.000	0.003
	73.895 - 71.5733		21.131	0.585	26.000	0.045	3.930	0.071	26.000	0.003
	71.5733 - 69.2517		21.323	0.580	26.000	0.045	3.929	0.068	26.000	0.003
	69.2517 - 66.93		21.517	0.575	26.000	0.044	3.928	0.066	26.000	0.003
	66.93 - 64.6083		21.710	0.571	26.000	0.044	3.927	0.064	26.000	0.002
	64.6083 - 62.2867		21.905	0.567	26.000	0.044	3.926	0.062	26.000	0.002
	62.2867 - 59.965		22.100	0.563	26.000	0.043	3.925	0.060	26.000	0.002
	59.965 - 57.6433		22.296	0.559	26.000	0.043	3.925	0.058	26.000	0.002
	57.6433 - 55.3217		22.492	0.556	26.000	0.043	3.924	0.056	26.000	0.002
	55.3217 - 53		22.689	0.552	26.000	0.042	3.923	0.055	26.000	0.002
	53 - 47		12.052	0.282	26.000	0.022	2.006	0.026	26.000	0.001
L4	53 - 47	TP55x41.13x0.313	11.240	0.267	26.000	0.021	1.917	0.025	26.000	0.001
	47 - 44.5789		23.450	0.549	26.000	0.042	3.922	0.051	26.000	0.002
	44.5789 - 42.1579		23.615	0.545	26.000	0.042	3.921	0.049	26.000	0.002
	42.1579 - 39.7368		23.781	0.541	26.000	0.042	3.921	0.048	26.000	0.002
	39.7368 - 37.3158		23.948	0.537	26.000	0.041	3.920	0.046	26.000	0.002
	37.3158 -		24.117	0.533	26.000	0.041	3.919	0.045	26.000	0.002

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
	34.8947									
	34.8947 - 32.4737		24.286	0.529	26.000	0.041	3.919	0.044	26.000	0.002
	32.4737 - 30.0526		24.457	0.525	26.000	0.040	3.919	0.043	26.000	0.002
	30.0526 - 27.6316		24.628	0.522	26.000	0.040	3.918	0.041	26.000	0.002
	27.6316 - 25.2105		24.801	0.518	26.000	0.040	3.918	0.040	26.000	0.002
	25.2105 - 22.7895		24.975	0.515	26.000	0.040	3.917	0.039	26.000	0.002
	22.7895 - 20.3684		25.151	0.512	26.000	0.039	3.917	0.038	26.000	0.001
	20.3684 - 17.9474		25.327	0.509	26.000	0.039	3.917	0.037	26.000	0.001
	17.9474 - 15.5263		25.505	0.506	26.000	0.039	3.917	0.036	26.000	0.001
	15.5263 - 13.1053		25.683	0.503	26.000	0.039	3.917	0.035	26.000	0.001
	13.1053 - 10.6842		25.863	0.500	26.000	0.038	3.916	0.035	26.000	0.001
	10.6842 - 8.26316		26.055	0.498	26.000	0.038	5.144	0.044	26.000	0.002
	8.26316 - 5.84211		26.237	0.495	26.000	0.038	5.144	0.043	26.000	0.002
	5.84211 - 3.42105		26.420	0.493	26.000	0.038	5.144	0.042	26.000	0.002
	3.42105 - 1		26.605	0.490	26.000	0.038	5.144	0.041	26.000	0.002

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	145 - 143.239	0.000	0.069	0.000	0.000	0.000	0.069 ✔	1.333	H1-3 ✔
	143.239 - 141.479	0.003	0.168	0.000	0.052	0.000	0.172 ✔	1.333	H1-3+VT ✔
	141.479 - 139.719	0.003	0.236	0.000	0.052	0.000	0.240 ✔	1.333	H1-3+VT ✔
	139.719 - 137.958	0.004	0.298	0.000	0.051	0.000	0.302 ✔	1.333	H1-3+VT ✔
	137.958 - 136.197	0.004	0.355	0.000	0.051	0.000	0.360 ✔	1.333	H1-3+VT ✔
	136.197 - 134.437	0.005	0.417	0.000	0.067	0.003	0.424 ✔	1.333	H1-3+VT ✔
	134.437 - 132.677	0.008	0.513	0.000	0.074	0.003	0.522 ✔	1.333	H1-3+VT ✔
	132.677 - 130.916	0.008	0.588	0.000	0.073	0.003	0.598 ✔	1.333	H1-3+VT ✔
	130.916 - 129.155	0.008	0.657	0.000	0.072	0.003	0.667 ✔	1.333	H1-3+VT ✔

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	129.155 - 127.395	0.009	0.720	0.000	0.071	0.003	0.730 ✔	1.333	H1-3+VT ✔
	127.395 - 125.634	0.009	0.779	0.000	0.070	0.003	0.789 ✔	1.333	H1-3+VT ✔
	125.634 - 123.874	0.009	0.842	0.000	0.083	0.012	0.855 ✔	1.333	H1-3+VT ✔
	123.874 - 122.114	0.011	0.913	0.000	0.090	0.011	0.928 ✔	1.333	H1-3+VT ✔
	122.114 - 120.353	0.011	0.983	0.000	0.089	0.011	0.997 ✔	1.333	H1-3+VT ✔
	120.353 - 118.593	0.011	1.047	0.000	0.088	0.011	1.062 ✔	1.333	H1-3+VT ✔
	118.593 - 116.832	0.011	1.107	0.000	0.087	0.010	1.121 ✔	1.333	H1-3+VT ✔
	116.832 - 115.072	0.012	1.162	0.000	0.086	0.010	1.177 ✔	1.333	H1-3+VT ✔
	115.072 - 113.311	0.012	1.217	0.000	0.088	0.009	1.232 ✔	1.333	H1-3+VT ✔
	113.311 - 111.551	0.012	1.268	0.000	0.087	0.009	1.283 ✔	1.333	H1-3+VT ✔
	111.551 - 109.79	0.012	1.315	0.000	0.087	0.008	1.330 ✔	1.333	H1-3+VT ✔
L2	109.79 - 108.732	0.009	1.013	0.000	0.065	0.006	1.024 ✔	1.333	H1-3+VT ✔
	108.732 - 107.674	0.010	1.033	0.000	0.064	0.006	1.044 ✔	1.333	H1-3+VT ✔
	107.674 - 106.616	0.010	1.051	0.000	0.064	0.006	1.062 ✔	1.333	H1-3+VT ✔
	106.616 - 105.558	0.010	1.069	0.000	0.064	0.006	1.080 ✔	1.333	H1-3+VT ✔
	105.558 - 104.5	0.010	1.085	0.000	0.063	0.006	1.097 ✔	1.333	H1-3+VT ✔
	104.5 - 103.442	0.010	1.102	0.000	0.063	0.006	1.113 ✔	1.333	H1-3+VT ✔
	103.442 - 102.384	0.010	1.117	0.000	0.063	0.006	1.128 ✔	1.333	H1-3+VT ✔
	102.384 - 101.326	0.010	1.132	0.000	0.062	0.005	1.143 ✔	1.333	H1-3+VT ✔
	101.326 - 100.268	0.010	1.146	0.000	0.062	0.005	1.157 ✔	1.333	H1-3+VT ✔
	100.268 - 99.21	0.010	1.160	0.000	0.062	0.005	1.171 ✔	1.333	H1-3+VT ✔
	99.21 - 94.79	0.005	0.555	0.000	0.028	0.002	0.560 ✔	1.333	H1-3+VT ✔
L3	99.21 - 94.79	0.005	0.545	0.000	0.026	0.002	0.551 ✔	1.333	H1-3+VT ✔
	94.79 - 92.4683	0.009	1.026	0.000	0.049	0.004	1.036 ✔	1.333	H1-3+VT ✔
	92.4683 - 90.1467	0.009	1.043	0.000	0.048	0.004	1.053 ✔	1.333	H1-3+VT ✔
	90.1467 - 87.825	0.009	1.059	0.000	0.048	0.004	1.069 ✔	1.333	H1-3+VT ✔

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	87.825 - 85.5033	0.010	1.073	0.000	0.047	0.003	1.083 ✔	1.333	H1-3+VT ✔
	85.5033 - 83.1817	0.010	1.086	0.000	0.047	0.003	1.096 ✔	1.333	H1-3+VT ✔
	83.1817 - 80.86	0.010	1.097	0.000	0.047	0.003	1.108 ✔	1.333	H1-3+VT ✔
	80.86 - 78.5383	0.010	1.108	0.000	0.046	0.003	1.119 ✔	1.333	H1-3+VT ✔
	78.5383 - 76.2167	0.010	1.117	0.000	0.046	0.003	1.128 ✔	1.333	H1-3+VT ✔
	76.2167 - 73.895	0.010	1.126	0.000	0.045	0.003	1.137 ✔	1.333	H1-3+VT ✔
	73.895 - 71.5733	0.010	1.134	0.000	0.045	0.003	1.145 ✔	1.333	H1-3+VT ✔
	71.5733 - 69.2517	0.011	1.141	0.000	0.045	0.003	1.152 ✔	1.333	H1-3+VT ✔
	69.2517 - 66.93	0.011	1.147	0.000	0.044	0.003	1.158 ✔	1.333	H1-3+VT ✔
	66.93 - 64.6083	0.011	1.153	0.000	0.044	0.002	1.164 ✔	1.333	H1-3+VT ✔
	64.6083 - 62.2867	0.011	1.158	0.000	0.044	0.002	1.169 ✔	1.333	H1-3+VT ✔
	62.2867 - 59.965	0.011	1.163	0.000	0.043	0.002	1.174 ✔	1.333	H1-3+VT ✔
	59.965 - 57.6433	0.011	1.167	0.000	0.043	0.002	1.178 ✔	1.333	H1-3+VT ✔
	57.6433 - 55.3217	0.011	1.170	0.000	0.043	0.002	1.182 ✔	1.333	H1-3+VT ✔
	55.3217 - 53	0.012	1.173	0.000	0.042	0.002	1.185 ✔	1.333	H1-3+VT ✔
	53 - 47	0.006	0.603	0.000	0.022	0.001	0.610 ✔	1.333	H1-3+VT ✔
L4	53 - 47	0.006	0.594	0.000	0.021	0.001	0.601 ✔	1.333	H1-3+VT ✔
	47 - 44.5789	0.013	1.218	0.000	0.042	0.002	1.231 ✔	1.333	H1-3+VT ✔
	44.5789 - 42.1579	0.013	1.220	0.000	0.042	0.002	1.233 ✔	1.333	H1-3+VT ✔
	42.1579 - 39.7368	0.013	1.221	0.000	0.042	0.002	1.234 ✔	1.333	H1-3+VT ✔
	39.7368 - 37.3158	0.013	1.222	0.000	0.041	0.002	1.235 ✔	1.333	H1-3+VT ✔
	37.3158 - 34.8947	0.013	1.222	0.000	0.041	0.002	1.236 ✔	1.333	H1-3+VT ✔
	34.8947 - 32.4737	0.013	1.223	0.000	0.041	0.002	1.236 ✔	1.333	H1-3+VT ✔
	32.4737 - 30.0526	0.013	1.223	0.000	0.040	0.002	1.237 ✔	1.333	H1-3+VT ✔
	30.0526 - 27.6316	0.014	1.230	0.000	0.040	0.002	1.244 ✔	1.333	H1-3+VT ✔
	27.6316 - 25.2105	0.014	1.237	0.000	0.040	0.002	1.252 ✔	1.333	H1-3+VT ✔

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	25.2105 - 22.7895	0.014	1.244	0.000	0.040	0.002	1.259 ✔	1.333	H1-3+VT ✔
	22.7895 - 20.3684	0.014	1.251	0.000	0.039	0.001	1.266 ✔	1.333	H1-3+VT ✔
	20.3684 - 17.9474	0.014	1.258	0.000	0.039	0.001	1.273 ✔	1.333	H1-3+VT ✔
	17.9474 - 15.5263	0.015	1.265	0.000	0.039	0.001	1.280 ✔	1.333	H1-3+VT ✔
	15.5263 - 13.1053	0.015	1.271	0.000	0.039	0.001	1.286 ✔	1.333	H1-3+VT ✔
	13.1053 - 10.6842	0.015	1.278	0.000	0.038	0.001	1.293 ✔	1.333	H1-3+VT ✔
	10.6842 - 8.26316	0.015	1.284	0.000	0.038	0.002	1.300 ✔	1.333	H1-3+VT ✔
	8.26316 - 5.84211	0.016	1.291	0.000	0.038	0.002	1.307 ✔	1.333	H1-3+VT ✔
	5.84211 - 3.42105	0.016	1.297	0.000	0.038	0.002	1.314 ✔	1.333	H1-3+VT ✔
	3.42105 - 1	0.016	1.304	0.000	0.038	0.002	1.320 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	145 - 109.79	Pole	TP26.97x17.5x0.188	1	-7.713	828.618	99.8	Pass
L2	109.79 - 94.79	Pole	TP31.01x26.97x0.25	2	-9.303	1219.794	87.9	Pass
L3	94.79 - 47	Pole	TP43.37x29.32x0.313	3	-18.500	2136.986	88.9	Pass
L4	47 - 1	Pole	TP55x41.13x0.313	4	-31.488	2618.145	99.0	Pass
							Summary	
						Pole (L1)	99.8	Pass
						RATING =	**99.8**	**Pass**

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Subject:		Anchor Bolt and Base Plate Anlaysis
Location:		145-ft EEI Monopole Barkhamsted, CT
Rev. 2: 12/2/14		Prepared by: T.J.L. Checked by: C.F.C. Job No. 14033.017

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 2886·ft·kips	(Input From tnxTower)
Shear Force =	Shear := 27·kips	(Input From tnxTower)
Axial Force =	Axial := 32·kips	(Input From tnxTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 14	(User Input)
Diameter of Bolt Circle =	D_{bc} := 64·in	(User Input)
Bolt "Column" Distance =	l := 3.0·in	(User Input)
Bolt Ultimate Strength =	F_u := 100·ksi	(User Input)
Bolt Yield Strength =	F_y := 75·ksi	(User Input)
Bolt Modulus =	E := 29000·ksi	(User Input)
Diameter of Anchor Bolts =	D := 2.25·in	(User Input)
Threads per Inch =	n := 4.5	(User Input)

Base Plate Data:

Use ASTM A572 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 1.75·in	(User Input)
Base Plate Diameter =	D_{bp} := 70·in	(User Input)
Outer Pole Diameter =	D_{pole} := 55·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =:

$$R_{bc} := \frac{D_{bc}}{2} = 32 \cdot in$$

Distance to Bolts =

$$i := 1 .. N$$

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

$d_1 = 13.88 \cdot in$ $d_7 = 0.00 \cdot in$

$d_2 = 25.02 \cdot in$ $d_8 = -13.88 \cdot in$

$d_3 = 31.20 \cdot in$ $d_9 = -25.02 \cdot in$

$d_4 = 31.20 \cdot in$ $d_{10} = -31.20 \cdot in$

$d_5 = 25.02 \cdot in$ $d_{11} = -31.20 \cdot in$

$d_6 = 13.88 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius =

$$R_{pole} := \frac{D_{pole}}{2} = 27.5 \cdot in$$

Moment Arms of Bolts about Neutral Axis =

$$MA_i := if\left(d_i \geq R_{pole}, d_i - R_{pole}, 0in\right)$$

$MA_1 = 0.00 \cdot in$ $MA_7 = 0.00 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 3.70 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 3.70 \cdot in$ $MA_{10} = 0.00 \cdot in$

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

$MA_6 = 0.00 \cdot in$ etc

Effective Width of Baseplate for Bending =

$$B_{eff} := .9 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 39 \cdot in$$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 7.168 \times 10^3 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 152.3 \cdot kips$

Allowable Tensile Force = $T_{ALL.Gross} := 1.333 \cdot \left(0.33 \cdot A_g \cdot F_u\right) = 174.9 \cdot kips$ (1.333 increase allowed per TIA/EIA)

$T_{ALL.Net} := 1.333 \cdot \left(0.60 \cdot A_n \cdot F_y\right) = 194.812 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} \cdot 100 = 78$ Bolts are "upset bolts". Use net area per AISC

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

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.482 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 7 \cdot ksi$

Allowable Bending Stress = $F_{bx} := 1.333 \cdot 0.6 \cdot F_y = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Check Combined Stress Requirement:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required.

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot in$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot ksi$$

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 156.9 \cdot kips$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 48.3 \cdot ksi$$

$$K := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_y}} = 87.364$$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^2}\right] \cdot F_y}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^3}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} = 45 \cdot ksi$$

Allowable Compressive Stress =

$$F_a := 1.333 \cdot F_a = 60 \cdot ksi$$

(1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) \cdot 100 = 80.5$$

Condition 2 =

$$Condition2 := if\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \le 1.00, "OK", "Overstressed"\right)$$

Condition2 = "OK"

Base Plate Analysis:

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

$C_1 = 69.4 \cdot kips$ $C_7 = 2.3 \cdot kips$

$C_2 = 123.2 \cdot kips$ $C_8 = -64.8 \cdot kips$

$C_3 = 153.0 \cdot kips$ $C_9 = -118.6 \cdot kips$

$C_4 = 153.0 \cdot kips$ $C_{10} = -148.4 \cdot kips$

$C_5 = 123.2 \cdot kips$ $C_{11} = -148.4 \cdot kips$

$C_6 = 69.4 \cdot kips$ etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} t_{bp}^2\right)} = 56.9 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} \cdot 100 = 95.1$

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

Condition3 = "Ok"

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Subject:		Foundation Analysis
Location:		145-ft EEI Monopole Barkhamsted, CT
Rev. 2: 12/2/14		Prepared by: T.J.L. Checked by: C.F.C. Job No. 14033.017

Standard Monopole Foundation:

Input Data:

Tower Data

Overturning Moment =	$OM := 2886 \cdot ft \cdot kips$	(User Input from tnxTower)	
Shear Force =	$Shear := 27 \cdot kip$	(User Input from tnxTower)	
Axial Force =	$Axial := 32 \cdot kip$	(User Input from tnxTower)	
Tower Height =	$H_t := 145 \cdot ft$	(User Input)	

Footing Data:

Overall Depth of Footing =	$D_f := 8 \cdot ft$	(User Input)	
Length of Pier =	$L_p := 5.5 \cdot ft$	(User Input)	
Extension of Pier Above Grade =	$L_{pag} := 1 \cdot ft$	(User Input)	
Diameter of Pier =	$d_p := 7 \cdot ft$	(User Input)	
Thickness of Footing =	$T_f := 3.5 \cdot ft$	(User Input)	
Width of Footing =	$W_f := 21.5 \cdot ft$	(User Input)	

Anchor Bolt Data:

Length of Anchor Bolts =	$L_{st} := 96 \cdot in$	(User Input)	
Projection of Anchor Bolts Above Pier =	$A_{BP} := 12 \cdot in$	(User Input)	
Anchor Bolt Diameter =	$d_{anchor} := 2.25 \cdot in$	(User Input)	
Base Plate Bolt Circle =	$MP := 64.0 \cdot in$	(User Input)	

Material Properties:

Concrete Compressive Strength =	$f_c := 4000 \cdot psi$	(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 =	$q_s := 8000 \cdot psf$	(User Input)	
Unit Weight of Soil =	$\gamma_{soil} := 100 \cdot pcf$	(User Input)	
Unit Weight of Concrete =	$\gamma_{conc} := 150 \cdot pcf$	(User Input)	
Foundation Bouyancy =	$Bouyancy := 0$	(User Input)	(Yes=1 / No=0)
Depth to Neglect =	$n := 0 \cdot ft$	(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)	

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Pier Reinforcement:

Bar Size =	$BS_{pier} := 8$	(User Input)	
Bar Diameter =	$d_{bpier} := 1.00 \cdot in$	(User Input)	
Number of Bars =	$NB_{pier} := 46$	(User Input)	
Clear Cover of Reinforcement =	$Cvr_{pier} := 3 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pier} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Diameter of Tie =	$d_{Tie} := 3 \cdot in$	(User Input)	

Pad Reinforcement:

Bar Size =	$BS_{top} := 8$	(User Input)	(Top of Pad)
Bar Diameter =	$d_{btop} := 1.00 \cdot in$	(User Input)	(Top of Pad)
Number of Bars =	$NB_{top} := 22$	(User Input)	(Top of Pad)
Bar Size =	$BS_{bot} := 8$	(User Input)	(Bottom of Pad)
Bar Diameter =	$d_{bbot} := 1.00 \cdot in$	(User Input)	(Bottom of Pad)
Number of Bars =	$NB_{bot} := 22$	(User Input)	(Bottom of Pad)
Clear Cover of Reinforcement =	$Cvr_{pad} := 3.0 \cdot in$	(User Input)	
Reinforcement Location Factor =	$\alpha_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Coating Factor =	$\beta_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Concrete Strength Factor =	$\lambda_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)
Reinforcement Size Factor =	$\gamma_{pad} := 1.0$	(User Input)	(ACI-2008 12.2.4)

Calculated Factors:

Pier Reinforcement Bar Area =

$$A_{bpier} := \frac{\pi \cdot d_{bpier}^2}{4} = 0.785 \cdot in^2$$

Pad Top Reinforcement Bar Area =

$$A_{btop} := \frac{\pi \cdot d_{btop}^2}{4} = 0.785 \cdot in^2$$

Pad Bottom Reinforcement Bar Area =

$$A_{bbot} := \frac{\pi \cdot d_{bbot}^2}{4} = 0.785 \cdot in^2$$

Coefficient of Lateral Soil Pressure =

$$K_p := \frac{1 + \sin(\Phi_s)}{1 - \sin(\Phi_s)} = 3$$

Load Factor =

$$LF := \begin{cases} 1.333 & \text{if } H_t \le 700 \cdot ft \\ 1.7 & \text{if } H_t \ge 1200 \cdot ft \\ 1.333 + \left(\frac{H_t - 700ft}{1200ft - 700ft}\right) \cdot 0.4 & \text{otherwise} \end{cases} = 1.333$$

Adjusted Concrete Unit Weight =

$$\gamma_c := if(Bouyancy = 1, \gamma_{conc} - 62.4pcf, \gamma_{conc}) = 150 \cdot pcf$$

Adjusted Soil Unit Weight =

$$\gamma_s := if(Bouyancy = 1, \gamma_{soil} - 62.4pcf, \gamma_{soil}) = 100 \cdot pcf$$

Stability of Footing:

Adjusted Concrete Unit Weight =

$$\gamma_c := \text{if}\left(\text{Bouyancy} = 1, \gamma_{conc} - 62.4\text{pcf}, \gamma_{conc}\right) = 150\cdot\text{pcf}$$

Adjusted Soil Unit Weight =

$$\gamma_s := \text{if}\left(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}\right) = 100\cdot\text{pcf}$$

Passive Pressure =

$$P_{pn} := K_p\cdot\gamma_s\cdot n + c\cdot 2\cdot\sqrt{K_p} = 0\cdot\text{ksf}$$

$$P_{pt} := K_p\cdot\gamma_s\cdot\left(D_f - T_f\right) + c\cdot 2\cdot\sqrt{K_p} = 1.35\cdot\text{ksf}$$

$$P_{top} := \text{if}\left[n < \left(D_f - T_f\right), P_{pt}, P_{pn}\right] = 1.35\cdot\text{ksf}$$

$$P_{bot} := K_p\cdot\gamma_s\cdot D_f + c\cdot 2\cdot\sqrt{K_p} = 2.4\cdot\text{ksf}$$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} = 1.875\cdot\text{ksf}$$

$$T_p := \text{if}\left[n < \left(D_f - T_f\right), T_f, \left(D_f - n\right)\right] = 3.5$$

$$A_p := W_f\cdot T_p = 75.25$$

Ultimate Shear =

$$S_u := P_{ave}\cdot A_p = 141.094\cdot\text{kip}$$

Weight of Concrete Pad =

$$WT_c := \left[\left(W_f^2\cdot T_f\right) + d_p^2\cdot L_p\right]\cdot\gamma_c = 283.106\cdot\text{kip}$$

Weight of Soil Above Footing =

$$WT_{s1} := \left[\left(W_f^2 - d_p^2\right)\cdot\begin{cases}\left(L_p - L_{pag} - n\right) & \text{if } \left(L_p - L_{pag} - n\right) \geq 0 \\ 0 & \text{if } \left(L_p - L_{pag} - n\right) \leq 0\end{cases}\right]\cdot\gamma_s = 185.96\cdot\text{kip}$$

Weight of Soil Wedge at Back Face =

$$WT_{s2} := \left(\frac{D_f^2\cdot\tan\left(\Phi_s\right)}{2}\cdot W_f\right)\cdot\gamma_s = 39.722\cdot\text{kip}$$

Weight of Soil Wedge at back face Corners =

$$WT_{s3} := 2\cdot\left[\left(D_f\right)^3\cdot\frac{\tan\left(\Phi_s\right)}{3}\right]\cdot\gamma_s = 19.707\cdot\text{kips}$$

Total Weight =

$$WT_{tot} := WT_c + WT_{s1} + \text{Axial} = 501.069\cdot\text{kip}$$

Resisting Moment =

$$M_r := \left(WT_{tot}\right)\cdot\frac{W_f}{2} + S_u\cdot\frac{T_f}{3} + \left[\left(WT_{s2} + WT_{s3}\right)\cdot\left(W_f + \frac{D_f\cdot\tan\left(\Phi_s\right)}{3}\right)\right] = 6920\cdot\text{kip}\cdot\text{ft}$$

Overturning Moment =

$$M_{ot} := OM + \text{Shear}\cdot\left(L_p + T_f\right) = 3129\cdot\text{kip}\cdot\text{ft}$$

Factor of Safety Actual =

$$FS := \frac{M_r}{M_{ot}} = 2.21$$

Factor of Safety Required =

$$FS_{req} := 2$$

$$\text{OverTurning\_Moment\_Check} := \text{if}\left(FS \geq FS_{req}, \text{"Okay"}, \text{"No Good"}\right)$$

OverTurning_Moment_Check = "Okay"

Shear Capacity in Pier:

Shear Resistance of Pier = $S_p := \frac{\mu \cdot WT_{tot}}{FS_{req}} = 112.74 \cdot kips$

$Shear\_Check := if(S_p > Shear, "Okay", "No Good")$

Shear_Check = "Okay"

Bearing Pressure Caused by Footing:

Area of the Mat = $A_{mat} := W_f^{\,2} = 462.25$

Section Modulus of Mat = $S := \frac{W_f^{\,3}}{6} = 1656.4 \cdot ft^3$

Maximum Pressure in Mat = $P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S} = 2.973 \cdot ksf$

$Max\_Pressure\_Check := if(P_{max} < q_s, "Okay", "No Good")$

Max_Pressure_Check = "Okay"

Minimum Pressure in Mat = $P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S} = -0.805 \cdot ksf$

$Min\_Pressure\_Check := if[(P_{min} \geq 0) \cdot (P_{min} < q_s), "Okay", "No Good"]$

Min_Pressure_Check = "No Good"

Distance to Resultant of Pressure Distribution = $X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} = 5.64$

Distance to Kern = $X_k := \frac{W_f}{6} = 3.583$

Since Resultant Force is Not in Kern, Area to which Pressure is Applied Must be Reduced.

Eccentricity = $e := \frac{M_{ot}}{WT_{tot}} = 6.245$

Adjusted Soil Pressure = $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} = 3.449 \cdot ksf$

$q_{adj} := if(P_{min} < 0, P_a, P_{max}) = 3.449 \cdot ksf$

$Pressure\_Check := if(q_{adj} < q_s, "Okay", "No Good")$

Pressure_Check = "Okay"

Concrete Bearing Capacity:

Strength Reduction Factor = $\Phi_c := 0.65$ (ACI-2008 9.3.2.2)

Bearing Strength Between Pier and Pad = $P_b := \Phi_c \cdot 0.85 \cdot f_c \cdot \frac{\pi \cdot d_p^2}{4} = 1.225 \times 10^4 \cdot kips$ (ACI-2008 10.14)

$Bearing\_Check := if\left(P_b > LF \cdot Axial, "Okay", "No Good"\right)$

Bearing_Check = "Okay"

Shear Strength of Concrete:

Beam Shear: (Critical section located at a distance d from the face of Pier) (ACI 11.3.1.1)

$\phi_c := 0.85$ (ACI 9.3.2.5)

$d := T_f - Cvr_{pad} - d_{bbot} = 38 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$

$d_2 := d_1 - d$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$

$V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f_c \cdot psi} \cdot W_f \cdot d$ (ACI-2008 11.2.1.1)

$Beam\_Shear\_Check := if\left(V_{req} < V_{Avail}, "Okay", "No Good"\right)$

Beam_Shear_Check = "Okay"

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.11.1.2)

Critical Perimeter of Punching Shear = $b_o := \left(d_p + d\right) \cdot \pi = 31.9$

Area Included Inside Perimeter = $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4} = 81.2$

Area Outside of Perimeter = $A_{out} := A_{mat} - A_{bo} = 381.1$

Guess Value = $v_u := 1ksf$

(From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

Given $d^2 + d_p \cdot d = \frac{WT_{tot}}{\pi \cdot v_u}$

$v_u := Find(v_u) = 5 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f = 337.3 \cdot kips$

Required Shear Strength = $V_{req} := LF \cdot V_u = 449.6 \cdot kips$

Available Shear Strength = $V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f_c \cdot psi} \cdot b_o \cdot d = 3131.9 \cdot kip$ (ACI-2008 11.11.2.1)

$Punching\_Shear\_Check := if(V_{req} < V_{Avail}, "Okay", "No Good")$

$Punching\_Shear\_Check = "Okay"$

Steel Reinforcement in Pad:

Required Reinforcement for Bending:

Strength Reduction Factor = $\phi_m := .90$ (ACI-2008 9.3.2.1)

$q_b := q_{adj} - d_1 \cdot Slope = 1.599 \cdot ksf$

Maximum Bending at Face of Pier = $M_u := LF \cdot \left[\left(q_{adj} - q_b \right) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f = 2133.1 \cdot kip \cdot ft$

$$\beta := \begin{cases} 0.85 & \text{if } 2500 \cdot psi \le f_c \le 4000 \cdot psi \\ 0.65 & \text{if } f_c > 8000 \cdot psi \\ \left[0.85 - \left[\frac{\left(\frac{f_c}{psi} - 4000 \right)}{1000} \right] \cdot 0.5 \right] & \text{otherwise} \end{cases} = 0.85$$

(ACI-200810.2.7.3)

$R_n := \frac{M_u}{\phi_m \cdot W_f \cdot d^2} = 76.3 \cdot psi$

$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_n}{0.85 \cdot f_c}} \right) = 0.0013$

$\rho_{min} := \rho = 0.00129$

Required Reinforcement for Temperature and Shrinkage:

$$\rho_{sh} := \begin{cases} .0018 & \text{if } f_y \geq 60000 \cdot psi \\ .0020 & \text{otherwise} \end{cases}$$ (ACI -2008 7.12.2.1)

Check Bottom Bars:

$$As := \begin{cases} \rho_{min} \cdot W_f \cdot d & \text{if } \rho_{min} > \frac{\rho_{sh}}{2} \\ \rho_{sh} \cdot W_f \cdot \frac{d}{2} & \text{otherwise} \end{cases} = 12.617 \cdot in^2$$

$$As_{prov} := A_{bbot} \cdot NB_{bot} = 17.3 \cdot in^2$$

$$Pad\_Reinforcement\_Bot := if\left(As_{prov} > As, "Okay", "No Good"\right)$$

$Pad\_Reinforcement\_Bot = "Okay"$

Check top Bars:

$$As := \rho_{sh} \cdot \left(W_f \cdot \frac{d}{2}\right) = 8.8 \cdot in^2$$

$$As_{prov} := A_{btop} \cdot NB_{top} = 17.3 \cdot in^2$$

$$Pad\_Reinforcement\_Top := if\left(As_{prov} > As, "Okay", "No Good"\right)$$

$Pad\_Reinforcement\_Top = "Okay"$

Developement Length Pad Reinforcement:

Bar Spacing =

$$B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1} = 10.95 \cdot in$$

Spacing or Cover Dimension =

$$c := if\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2}\right) = 3 \cdot in$$

Transverse Reinforcement Index =

$$k_{tr} := 0$$ (ACI-2008 12.2.3)

$$L_{dbt} := \frac{3 \cdot f_y \alpha_{pad} \cdot \beta_{pad} \cdot \gamma_{pad} \cdot \lambda_{pad}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot} = 23.7 \cdot in$$

Minimum Development Length =

$$L_{dbmin} := 12 \cdot in$$ (ACI-2008 12.2.1)

$$L_{dbtCheck} := if\left(L_{dbt} \geq L_{dbmin}, "Use\ L.dbt", "Use\ L.dbmin"\right)$$

Available Length in Pad =

$$L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad} = 84 \cdot in$$

$$Lpad\_Check := if\left(L_{Pad} > L_{dbt}, "Okay", "No Good"\right)$$

$Lpad\_Check = "Okay"$

Steel Reinforcement in Pier:

Area of Pier =

$$A_p := \frac{\pi \cdot d_p^2}{4} = 5541.77 \cdot in^2$$

$$A_{smin} := 0.01 \cdot 0.5 \cdot A_p = 27.71 \cdot in^2$$ (ACI-2008 10.8.4 & 10.9.1)

$$A_{sprov} := NB_{pier} \cdot A_{bpier} = 36.13 \cdot in^2$$

Steel_Area_Check := if($A_{sprov} > A_{smin}$, "Okay", "No Good")

Steel_Area_Check = "Okay"

Bar Spacing In Pier =

$$B_{sPier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier} = 4.737 \cdot in$$

Diameter of Reinforcement Cage =

$$Diam_{cage} := d_p - 2 \cdot Cvr_{pier} = 78 \cdot in$$

Maximum Moment in Pier =

$$M_p := \left[OM + Shear \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF = 48755.8 \cdot in \cdot kips$$

Pier Check evaluated from outside program and results are listed below;

$$(D \ N \ n \ P_u \ M_{xu}) := \left(d_p \cdot 12 \ \ NB_{pier} \ \ BS_{pier} \ \ \frac{Axial \cdot 1.333}{kips} \ \ \frac{M_p}{in \cdot kips} \right)$$

$$(D \ N \ n \ P_u \ M_{xu}) = (84 \ \ 46 \ \ 8 \ \ 42.656 \ \ 4.876 \times 10^4)$$

$$(\phi P_n \ \ \phi M_{xn} \ \ f_{sp} \ \ \rho) := (0 \ \ 0 \ \ 0 \ \ 0)$$

$$(\phi P_n \ \ \phi M_{xn} \ \ f_{sp} \ \ \rho) := \phi P'_n(D, N, n, P_u, M_{xu})^T$$

$$(\phi P_n \ \ \phi M_{xn} \ \ f_{sp} \ \ \rho) = (60.895 \ \ 6.96 \times 10^4 \ \ -60 \ \ 6.557 \times 10^{-3})$$

Axial_Load_Check := if($\phi P_n \geq P_u$, "Okay", "No Good")

Axial_Load_Check = "Okay"

Bending_Check := if($\phi M_{xn} \geq M_{xu}$, "Okay", "No Good")

Bending_Check = "Okay"

Development Length Pier Reinforcement:

Available Length in Foundation:

$L_{pier} := L_p - Cvr_{pier} = 63 \cdot in$

$L_{pad} := T_f - Cvr_{pad} = 39 \cdot in$

Tension: (ACI-2008 12.2.3)

Spacing or Cover Dimension =

$c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right) = 2.368 \cdot in$

Transverse Reinforcement =

$k_{tr} := 0$ (ACI-2008 12.2.3)

$L_{dbt} := \frac{3 \cdot f_y \alpha_{pier} \cdot \beta_{pier} \cdot \gamma_{pier} \cdot \lambda_{pier}}{40 \cdot \sqrt{f_c \cdot psi} \cdot \left(\frac{c + k_{tr}}{d_{bpier}}\right)} \cdot d_{bpier} = 30.04 \cdot in$

Minimum Development Length =

$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{psi}}} \cdot .7 = 13.282 \cdot in$ (ACI 12.2.1)

Pier reinforcement bars are standard 90 degree hooks and therefore developement in the pad is computed as follows:

$L_{db} := \max\left(L_{dbt}, L_{dbmin}\right)$

$L_{tension\_Check} := if\left(L_{pier} + L_{pad} > L_{dbt}, "Okay", "No Good"\right)$

$L_{tension\_Check} = "Okay"$

Compression: (ACI-2008 12.3.2)

$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot psi}} = 18.974 \cdot in$

$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot f_y\right) = 18 \cdot in$

$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) = 18.974 \cdot in$

$L_{compression\_Check} := if\left(L_{pier} + L_{pad} > L_{dbc}, "Okay", "No Good"\right)$

$L_{compression\_Check} = "Okay"$

Tie Size and Spacing in Column:

Minimum Tie Size =

$Tie_{min} := if(BS_{pier} \le 10, 3, 4) = 3$

Used #4 Ties

Seismic Factor =

$z := if(Z \le 2, 1, 0.5) = 1$ (ACI-2008 21.10.5)

$s_{lim1} := 16 \cdot d_{bpier} \cdot z = 16 \cdot in$

$s_{lim2} := 48 \cdot d_{Tie} \cdot z = 144 \cdot in$

$s_{lim3} := D_f \cdot z = 96 \cdot in$

$s_{lim4} := 18in$

Maximum Spacing =

$$s_{tie} := \min\left(\begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix}\right) = 16 \cdot in$$

Number of Ties Required =

$$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 = 4.75$$

Check Anchor Steel Embedment:

Depth Available =

$D_{ab} := L_{st} - A_{BP} = 7 \cdot ft$

Length of Anchor Bolt =

$$L_{anchor} := \frac{(0.11 \cdot f_{ya}) \cdot in}{\sqrt{f_c \cdot psi}} = 10.87 \cdot ft$$

$Depth\_Check := if(D_{ab} \ge L_{anchor}, "Okay", "No Good")$

$Depth\_Check = "No Good"$

Note: Anchor plate is provided

Network Modernization RFDS v3.0

Site ID	CTNH416A	Latitude	41.91490
		Longitude	-73.02194
Site Name	Old fArms- Verizon	Site Type	Structure (Non-Build
Address	5 Old Farms Rd Barkhamsted	Site Class	Monopole
Market	Connecticut	Landlord	Verizon

Configuration
704BU

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date 07/16/2014

Site Information

Existing Configuration					Proposed Configuration			
1	2	3	4	Cabinet #	1	2	3	4
GSM	UMTS			Technology	GSM/UMTS/LTE			
S8000	3106			Cabinet type	6102			
				CBU				
	1			DUW30	1			
				DUL20				
				DUG20	1			
				DUS41	1			
				RBS6601				
3				dTRU/TRX				
				RU22 B4				
				RUS01 B2	6			
	6			RUS01 B4	6			

[ ]	Relocate cabinet
[ ]	Add cabinet
[x]	Swap cabinet
[ ]	Remove cabinet
[ ]	Make cabinet dark

Comments

Swap cabinet for Ericsson 6102

ALPHA - Scope of Work

[ ]	Add new mount	[x]	Add RRU	Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T
[ ]	Relocate antenna	[ ]	Swap existing RRU	
[x]	Add antenna	[ ]	Remove RRU	
[ ]	Swap antenna	[ ]	Consolidate coax cables	
[ ]	Remove antenna	[x]	Add coax cables	
[ ]	Add TMA	[ ]	Add fiber cables	
[ ]	Swap TMA	[ ]	Add hybrid combiner	
[ ]	Remove TMA	[ ]	Add filter combiner	

BETA - Scope of Work

[ ]	Add new mount	[x]	Add RRU	Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T
[ ]	Relocate antenna	[ ]	Swap existing RRU	
[x]	Add antenna	[ ]	Remove RRU	
[ ]	Swap antenna	[ ]	Consolidate coax cables	
[ ]	Remove antenna	[x]	Add coax cables	
[ ]	Add TMA	[ ]	Add fiber cables	
[ ]	Swap TMA	[ ]	Add hybrid combiner	
[ ]	Remove TMA	[ ]	Add filter combiner	

GAMMA - Scope of Work

[ ]	Add new mount	[x]	Add RRU	Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T
[ ]	Relocate antenna	[ ]	Swap existing RRU	
[x]	Add antenna	[ ]	Remove RRU	
[ ]	Swap antenna	[ ]	Consolidate coax cables	
[ ]	Remove antenna	[x]	Add coax cables	
[ ]	Add TMA	[ ]	Add fiber cables	
[ ]	Swap TMA	[ ]	Add hybrid combiner	
[ ]	Remove TMA	[ ]	Add filter combiner	

DELTA - Scope of Work

[ ]	Add new mount	[ ]	Add RRU	
[ ]	Relocate antenna	[ ]	Swap existing RRU	
[ ]	Add antenna	[ ]	Remove RRU	
[ ]	Swap antenna	[ ]	Consolidate coax cables	
[ ]	Remove antenna	[ ]	Add coax cables	
[ ]	Add TMA	[ ]	Add fiber cables	
[ ]	Swap TMA	[ ]	Add hybrid combiner	
[ ]	Remove TMA	[ ]	Add filter combiner	

Network Modernization RFDS v3.0

Site ID	**CTNH416A**	**Latitude**	41.91490
		Longitude	-73.02194
Site Name	Old fArms- Verizon	**Site Type**	Structure (Non-Build
Address	5 Old Farms Rd Barkhamsted	**Site Class**	Monopole
Market	Connecticut	**Landlord**	Verizon

Configuration

704BU

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date 07/16/2014

ALPHA (view from behind)

Existing Configuration					Proposed Configuration				
X	X			Mount	X				x
GSM / UMTS				Technology	GSM / UMTS				LTE
B2 / B4				Band	B2 / B4				B12
P / P				Active/Passive	P / P				P
Quad pole				Ant. Type	Quad pole				Dual pole
PX16DWV-16DWVS-E-A				Ant. Model	PX16DWV-16DWVS-E-A2				LNX-6515DS-VTM
RFS				Ant. Vendor	RFS				Commscope
125				Ant. Height	125				125
0				Azimuth	0				0
Yes / Yes				RET deployed	Yes / Yes				Yes
2 / 2				E-Tilt	2 / 2				2
0 / 0				M-Tilt	0 / 0				0
1 / 1				TMA #	1 / 1				
dd B2 / dd B4				TMA Type	dd B2 / dd B4				
				RRU #					1
				RRU Type					RUS11_B
2 / 2				Used Coax #	2 / 2				2
1-5/8" / 1-5/8"				Coax Type	1-5/8" / 1-5/8"				1-5/8"
160				Coax Length (ft)	160				160
				Fiber (CPRI) #					
				Splitter #					
				Combiner #					
				Combiner Type					

	Add new mount	x	Add RRU
	Relocate antenna		Swap existing RRU
x	Add antenna		Remove RRU
	Swap antenna		Consolidate coax cables
	Remove antenna	x	Add coax cables
	Add TMA		Add fiber cables
	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T

BETA (view from behind)

Existing Configuration					Proposed Configuration				
X	X				X				x
GSM / UMTS				Technology	GSM / UMTS				LTE
B2 / B4				Band	B2 / B4				B12
P / P				Active/Passive	P / P				P
Quad pole				Ant. Type	Quad pole				Dual pole
PX16DWV-16DWVS-E-A				Ant. Model	PX16DWV-16DWVS-E-A2				LNX-6515DS-VTM
RFS				Ant. Vendor	RFS				Commscope
125				Ant. Height	125				125
120					120				120
Yes / Yes				RET deployed	Yes / Yes				Yes
2 / 2				E-Tilt	2 / 2				2
0 / 0				M-Tilt	0 / 0				0
1 / 1				TMA #	1 / 1				
dd B2 / dd B4				TMA Type	dd B2 / dd B4				
				RRU #					1
				RRU Type					RUS11_B
2 / 2				Used Coax #	2 / 2				2
1-5/8" / 1-5/8"				Coax Type	1-5/8" / 1-5/8"				1-5/8"
160				Coax Length (ft)	160				160
				Fiber (CPRI) #					
				Splitter #					
				Combiner #					
				Combiner Type					

	Add new mount	x	Add RRU
	Relocate antenna		Swap existing RRU
x	Add antenna		Remove RRU
	Swap antenna		Consolidate coax cables
	Remove antenna	x	Add coax cables
	Add TMA		Add fiber cables
	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T

Network Modernization RFDS v3.0

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Configuration
704BU

Approvals	
Market RF	
Market Development	

RFDS Revision	
RFDS Final	

Date 07/16/2014

GAMMA (view from behind)

Existing Configuration					Proposed Configuration				
X	X				X				x
GSM / UMTS				Technology	GSM / UMTS				LTE
B2 / B4				Band	B2 / B4				B12
P / P				Active/Passive	P / P				P
Quad pole				Ant. Type	Quad pole				Dual pole
X16DWV-16DWVS-E-A				Ant. Model	PX16DWV-16DWVS-E-A2				LNX-6515DS-VTM
RFS				Ant. Vendor	RFS				Commscope
125				Ant. Height	125				125
250					250				250
Yes / Yes				RET deployed	Yes / Yes				Yes
2 / 2				E-Tilt	2 / 2				2
0 / 0				M-Tilt	0 / 0				0
1 / 1				TMA #	1 / 1				
dd B2 / dd B4				TMA Type	dd B2 / dd B4				
				RRU #					1
				RRU Type					RUS11_B
2 / 2				Used Coax #	2 / 2				2
1-5/8" / 1-5/8"				Coax Type	1-5/8" / 1-5/8"				1-5/8"
160				Coax Length (ft)	160				160
				Fiber (CPRI) #					
				Splitter #					
				Combiner #					
				Combiner Type					

	Add new mount	x	Add RRU
	Relocate antenna		Swap existing RRU
x	Add antenna		Remove RRU
	Swap antenna		Consolidate coax cables
	Remove antenna	x	Add coax cables
	Add TMA		Add fiber cables
	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

Add a LTE 700 passive antenna. Add 2 coax. Add RRUS on ground.Add smart Bias-T

DELTA (view from behind)

Existing Configuration					Proposed Configuration				
				Technology					
				Band					
				Active/Passive					
				Ant. Type					
				Ant. Model					
				Ant. Vendor					
				Ant. Height					
				Azimuth					
				RET deployed					
				E-Tilt					
				M-Tilt					
				TMA #					
				TMA Type					
				RRU #					
				RRU Type					
				Used Coax #					
				Coax Type					
				Coax Length (ft)					
				Splitter #					
				Fiber (CPRI) #					
				Combiner #					
				Combiner Type					

	Add new mount		Add RRU
	Relocate antenna		Swap existing RRU
	Add antenna		Remove RRU
	Swap antenna		Consolidate coax cables
	Remove antenna		Add coax cables
	Add TMA		Add fiber cables
	Swap TMA		Add hybrid combiner
	Remove TMA		Add filter combiner

Scope of work

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

LNX-6515DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Excellent choice to maximize both coverage and capacity in suburban and rural applications
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- Exceptional horizontal pattern roll-off and strong front-to-back ratio
- Extended bandwidth allows one antenna to serve multiple frequency allocations
- Great solution to maximize network coverage and capacity
- The RF connectors are designed for IP67 rating and the radome for IP56 rating
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain by all Beam Tilts, average, dBi	16.6	16.9
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3
Gain by Beam Tilt, average, dBi	0 ° | 16.6 4 ° | 16.6 8 ° | 16.4	0 ° | 17.0 4 ° | 17.0 8 ° | 16.8
Beamwidth, Horizontal, degrees	65	64
Beamwidth, Horizontal Tolerance, degrees	±1	±0.9
Beamwidth, Vertical, degrees	9.7	8.6
Beamwidth, Vertical Tolerance, degrees	±0.6	±0.4
Beam Tilt, degrees	0–8	0–8
USLS, dB	18	18
Front-to-Back Total Power at 180° ± 30°, dB	25	23
CPR at Boresight, dB	24	27
CPR at Sector, dB	15	13
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz
Number of Ports, all types	2

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum

Product Specifications

LNX-6515DS-VTM

Radome Material	Fiberglass, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	2
Wind Loading, maximum	878.0 N @ 150 km/h 197.4 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	2449.0 mm | 96.4 in
Width	301.0 mm | 11.9 in
Net Weight	22.8 kg | 50.3 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6515DS-R2M
Model with Factory Installed AISG 2.0 Actuator	LNX-6515DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

DB380-3 — Pipe Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Used for wide panel antennas. Includes three clamp sets.

DB5083D — Downtilt Mounting Kit for 2.4"-4.5" (60-115 mm) OD round members. Consists of two DB5083 heavy-duty, galvanized steel downtilt mounting brackets. This kit is compatible with the DB380-3 pipe mount for panel antennas with three mounting points.

Dual Duplex Tower Mounted Amplifier Fullband

for 1900 MHz

*When installed close to the antenna, this **Tower Mounted Amplifier (TMA)** enhances the overall network performance and coverage. This is due to reduced system noise figure and improved uplink sensitivity.*

Improved operator business – futureproof

Operators are now facing a familiar syndrome, where they are forced to merge or share network frequencies. This Ericsson dual duplex TMA eliminates any problems this could cause, by covering the entire GSM 1900 band.

When building new networks

Fast deployment is crucial in a new network rollout. This is where the Ericsson dual duplex TMAs can provide a cost-effective solution that gives a faster rollout with a reduction of the initial investments.

When improving existing network

Continuous improvement to the quality of the network and sufficient coverage is vital for operators. With the installation of TMAs the extra traffic generated provides a typical payback time of 2–12 months and increases the net revenue.

Key features

- The only approved dual duplex fullband TMA for Ericsson GSM 1900 MHz RBSs.
- Full 60 MHz bandwidth – futureproof and logistically simple
- Optimized for Ericsson's RBS 2102 / 2202 and RBS 2106 / 2206
- Compact casing

ERICSSON

Convincing results from the field

Actual test from the field in existing networks have shown significant improvements:
20–50% reduction of dropped calls and up to 5% increase in total talk time.

Excellent reliability

The durable Ericsson dual duplex TMAs have lightning protection, dual amplifiers and alarm functionality, providing continuous, dependable performance, even when mounted in hazardous weather environments.

Technical Specifications for Dual Duplex TMA Fullband for GSM 1900

Dual Duplex Tower Mounted Amplifier	**KRY 112 71**
Electrical specifications	
Bandwidth:	60 MHz
Receiver pass band:	1850 – 1910 MHz
Transmitting pass band:	1930 – 1990 MHz
Gain:	12 dB
Input IP3, better than:	12 dBm
Tx loss, typical:	0.5 dB
Tx/Rx Return Loss, typical:	20 dB
ANT Return Loss, typical:	20 dB
Noise figure, typical:	1.7 dB
Maximum power handling, continuous:	54 dBm (250 W)
All IM*/ in receiving band (2 x 43 dBm CW):	< –121 dBm
DC powering / Alarm handling:	Superimposed on the RF feeder. Dual alarm levels.
Impedance:	50 Ohm
Type approval:	Ericsson TMA + BTS fulfils ETSI requirements
Mechanical specifications	
Dimensions (H x W x D)	12.5 x 5.6 x 3.7 in (316 x 141 x 95 mm)
Weight:	13.2 lb (6.0 kg)
RF connectors:	7-16 female
Ground connector:	M8 bolt & nut
Mounting:	Pole or wall mounting
Environmental specifications	
Temperature range, full performance:	-27 °F to +130 °F (-33 °C to +55 °C)
MTBF:	1 000 000 hours
Sealing:	IP 65
Lightning protection:	IEC 1024
Safety:	UL1950, ETL marking, EN 60950
Ordering numbers	
ddTMA 1900 FB with LNA by-pass:	KRY 112 71/2
Available ordering guides:	EN/LZT 123 7019 and EN/LZT 123 7020

*/ Referring to IM5 and IM7 measured at the Antenna port.
IM3 considered subject to frequency planning.

Ericsson AB
www.ericsson.com

AE/LZT 123 6836 R4

DOUBLE TMA 17/21, PREMIUM

3GPP/AISG compatible with RET interface

Improving a radio uplink by using tower mounted amplifiers is perceived as a key method of optimizing radio networks. By ensuring maximum coverage including in-door penetration, a TMA supports the design of cost-efficient networks and extended talk-time handsets, low dropped call rates and high traffic billing.

TMA design
This Double Premium TMA for 17/2100 MHz has 12dB gain and is 3GPP/AISG 2.0 compatible, with a RET interface. It has superior RF performance, small size and low weight. There is a corresponding TMA version called ASC that has a higher gain and a VSWR measuring coupler.

System integration
The Double TMA 17/2100 is a part of Ericsson's TMA family. Power, control and supervision are provided by the RBS 3000. If sold to other RBS brand installations, it can be controlled and supervised from the "Antenna System & TMA Control Module", AST-CM, via the RF feeder.

3GPP/AISG
TMA communication is based on the 3GPP/AISG protocol standard and has a RET port for controlling antenna RET units. The communication port allows multiple RETs or Antenna Line Devices to be supervised and controlled via the TMA.

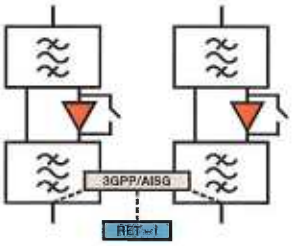
Future-proof
The Double TMA 17/21 Premium is designed for co-existence with future complementary, mast-mounted devices.

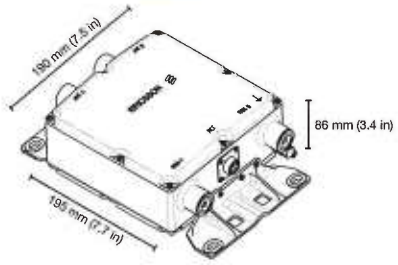
Excellent reliability
As the world's largest supplier of TMAs, Ericsson has a well-proven track record of reliable TMA designs. Reliability enhancing features include dual LNAs, weatherproof design, integrated alarm and lightning protection.

ERICSSON

Features

- Specified and verified as an integrated system solution for Ericsson RBSs
- Possible to power both TMAs from one feeder, or from both feeders
- High power capacity
- Automatic LNA by-pass function
- Built in lightning protection
- Excellent RF performance
- Connectors "in line"
- Distance between connectors simplifies sealing work
- A range of accessories for flexible site configurations





Technical Specifications for Double TMA 1700/2100, MHz Premium

Product name Double TMA 17/21, Premium 3GPP/ASIG compatible with RET interface	**Product number** KRY 112 144/1
Radio performance	
Bandwidth:	45 MHz
Receiving pass band:	1710 - 1755 MHz
Transmitting pass band:	2110 - 2155 MHz
RX Gain:	12± 1 dB
Input IP3:	16 dBm*
IM3 at antenna port (2x43dBM):	-128 dBm
Noise figure midband:	1.0 dB*
TX max input power (Max Peak):	57 dBm
TX insertion loss:	0.25 dB*
RX return loss:	22 dB*
TX return loss:	22 dB*
Electrical specifications	
Input power:	+12 - 32 VDC
Power consumption:	< 4.5 W
Mechanical specifications	
Dimensions (W x H x D):	155 x 176 x 71 mm
Weight:	5 kg
RF connectors:	7-16 DIN female
Ground connectors:	M8
DC/Alarm:	Superimposed on the RF signal
Mounting:	Pole or wall mounting
RET connectors:	Din con. IEC 60130-9 - Ed. 3.0 female
Environmental specifications	
Temperature range, full performance:	-40°C - +55°C
MTBF:	80 years
Sealing:	IP67
Lightning protection:	IEC 62305-1, IEC 61000-6
Safety approval:	International: CB certified, IEC 60 529 Europe: EN 60 529 North America: NRTL, NEMA 3R
Safety standard:	UL 60950-1, IEC 60950-1

* Typical values

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

ATSBT-TOP-FM-4G

Teletilt® Top Smart Bias Tee

- Injects AISG power and control signals onto a coaxial cable line
- Reduces cable and site lease costs by eliminating the need for AISG home run cables
- AISG 1.1 and 2.0 compliant
- Operates at 10-30 Vdc
- Weatherproof AISG connectors
- Intuitive schematics simplify and ensure proper installation
- Enhanced lightning protection plus grounding stud for additional surge protection
- 7-16 DIN female connector (BTS)
- 7-16 DIN male connector (ANT)

General Specifications

Smart Bias Tee Type	10–30 V Top
Brand	Teletilt®
Operating Frequency Band	694 – 2690 MHz

Electrical Specifications

EU Certification	CE
Protocol	AISG 1.1 | AISG 2.0
Antenna Interface Signal	dc Blocked | RF
BTS Interface Signal	AISG data | dc | RF
Interface Protocol Signal	Data | dc
Voltage Range	10–30 Vdc
VSWR | Return Loss	1.17:1 | 22 dB, typical
Power Consumption, maximum	0.6 W
RF Power, maximum	250 W @ 1850 MHz 500 W @ 850 MHz
Impedance	50 ohm
Insertion Loss, typical	0.1 dB
3rd Order IMD	-158.0 dBc (relative to carrier)
3rd Order IMD Test Method	Two +43 dBm carriers
Electromagnetic Compatibility (EMC)	CFR 47 Part 15, Subpart B, Class B | EN 55022, Class B | ICES-003 Issue 4 CAN/CSA-CEI/IEC CISPR 22:02

Mechanical Specifications

Antenna Interface	7-16 DIN Male
BTS Interface	7-16 DIN Female
AISG Input Connector	8-pin DIN Female
Color	Silver
Grounding Lug Thread Size	M8
Material Type	Aluminum
Lightning Surge Capability	5 times @ -3 kA 5 times @ 3 kA

Product Specifications

ATSBT-TOP-FM-4G

Lightning Surge Capability Test Method	IEC 61000-4-5, Level X
Lightning Surge Capability Waveform	1.2/50 voltage and 8/20 current combination waveform

Environmental Specifications

Ingress Protection Test Method	IEC 60529:2001, IP66
Operating Temperature	-40 °C to +70 °C (-40 °F to +158 °F)

Interface Port Drawing

Dimensions

Width	94.0 mm | 3.7 in
Depth	50.0 mm | 2.0 in
Height	143.00 mm | 5.63 in
Net Weight	0.8 kg | 1.8 lb

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption

EXHIBIT C

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RADIO FREQUENCY EMISSIONS ANALYSIS REPORT
EVALUATION OF HUMAN EXPOSURE POTENTIAL TO NON-IONIZING EMISSIONS

T-Mobile Existing Facility

Site ID: CTNH416A

Old Farms Verizon Colo
5 Old Farms Road
Barkhamstead, CT 06063

December 22, 2014

EBI Project Number: 62145248

Site Compliance Summary	
Compliance Status:	COMPLIANT
Site total MPE% of FCC general public allowable limit:	49.05 %

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December 22, 2014

T-Mobile USA
Attn: Jason Overbey, RF Manager
35 Griffin Road South
Bloomfield, CT 06002

Emissions Analysis for Site: **CTNH416A – Old Farms Verizon Colo**

EBI Consulting was directed to analyze the proposed T-Mobile facility located at **5 Old Farms Road, Barkhamstead, CT**, for the purpose of determining whether the emissions from the Proposed T-Mobile Antenna Installation located 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 $\mu W/cm^2$ 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 700 MHz Band is 467 $\mu W/cm^2$, and the general population exposure limit for the PCS and AWS bands 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 T-Mobile Wireless antenna facility located at **5 Old Farms Road, Barkhamstead, CT**, using the equipment information listed below. All calculations were performed per the specifications under FCC OET 65. Since T-Mobile is proposing highly focused directional panel antennas, which project most of the emitted energy out toward the horizon, all calculations were performed assuming a lobe representing the maximum gain of the antenna per the antenna manufactures supplied specifications, minus 10 dB, was focused at the base of the tower. 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 equipment was calculated using the following assumptions:

1) 2 GSM channels (PCS Band - 1900 MHz) were considered for each sector of the proposed installation. These Channels have a transmit power of 30 Watts per Channel

2) 2 UMTS channels (AWS Band – 2100 MHz) were considered for each sector of the proposed installation. These Channels have a transmit power of 30 Watts per Channel.

3) 2 LTE channels (AWS Band – 2100 MHz) were considered for each sector of the proposed installation. These Channels have a transmit power of 60 Watts per Channel.

4) 1 LTE channel (700 MHz Band) was considered for each sector of the proposed installation. This channel has a transmit power of 60 Watts.

5) 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.

6) For the following calculations the sample point was the top of a six foot person standing at the base of the tower. The maximum gain of the antenna per the antenna manufactures supplied specifications minus 10 dB was used in this direction. This value is a very conservative estimate as gain reductions for these particular antennas are typically much higher in this direction.

7) The antennas used in this modeling are the **RFS APX16DWV-16DWVS-E-A20** for 1900 MHz (PCS) and 2100 MHz (AWS) channels and the **Commscope LNX-6515DS-VTM** for 700 MHz channels. This is based on feedback from the carrier with regards to anticipated antenna selection. The **RFS APX16DWV-16DWVS-E-A20** has a maximum gain of **16.3 dBd** at its main lobe. The **Commscope LNX-6515DS-VTM** has a maximum gain of **14.6 dBd** at its main lobe. The maximum gain of the antenna per the antenna manufactures supplied specifications, minus 10 dB, was used for all calculations. This value is a very conservative estimate as gain reductions for these particular antennas are typically much higher in this direction.

8) The antenna mounting height centerline of the proposed antennas is **125 feet** above ground level (AGL).

9) 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 calculations were done with respect to uncontrolled / general public threshold limits.

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T-Mobile Site Inventory and Power Data

Sector:	A	Sector:	B	Sector:	C
Antenna #:	1	Antenna #:	1	Antenna #:	1
Make / Model:	RFS APX16DWV-16DWVS-E-A20	Make / Model:	RFS APX16DWV-16DWVS-E-A20	Make / Model:	RFS APX16DWV-16DWVS-E-A20
Gain:	16.3 dBd	Gain:	16.3 dBd	Gain:	16.3 dBd
Height (AGL):	125	Height (AGL):	125	Height (AGL):	125
Frequency Bands	1900 MHz(PCS) / 2100 MHz (AWS)	Frequency Bands	1900 MHz(PCS) / 2100 MHz (AWS)	Frequency Bands	1900 MHz(PCS) / 2100 MHz (AWS)
Channel Count	6	Channel Count	6	# PCS Channels:	6
Total TX Power:	240	Total TX Power:	240	# AWS Channels:	240
ERP (W):	10,237.91	ERP (W):	10,237.91	ERP (W):	10,237.91
Antenna A1 MPE%	2.60	Antenna B1 MPE%	2.60	Antenna C1 MPE%	2.60
Antenna #:	2	Antenna #:	2	Antenna #:	2
Make / Model:	Commscope LNX-6515DS-VTM	Make / Model:	Commscope LNX-6515DS-VTM	Make / Model:	Commscope LNX-6515DS-VTM
Gain:	14.6 dBd	Gain:	14.6 dBd	Gain:	14.6 dBd
Height (AGL):	125	Height (AGL):	125	Height (AGL):	125
Frequency Bands	700 Mhz	Frequency Bands	700 Mhz	Frequency Bands	700 Mhz
Channel Count	1	Channel Count	1	Channel Count	1
Total TX Power:	60	Total TX Power:	60	Total TX Power:	60
ERP (W):	1,730.42	ERP (W):	1,730.42	ERP (W):	1,730.42
Antenna A2 MPE%	0.94	Antenna B2 MPE%	0.94	Antenna C2 MPE%	0.94

Site Composite MPE%	
Carrier	**MPE%**
T-Mobile	**10.62**
Verizon Wireless	15.64 %
MetroPCS	5.15 %
AT&T	17.64 %
Site Total MPE %:	**49.05 %**

T-Mobile Sector 1 Total:	3.54 %
T-Mobile Sector 2 Total:	3.54 %
T-Mobile Sector 3 Total:	3.54 %
Site Total:	49.05 %

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Summary

All calculations performed for this analysis yielded results that were **within** the allowable limits for general public exposure to RF Emissions.

The anticipated maximum composite contributions from the T-Mobile facility as well as the site composite emissions value with regards to compliance with FCC's allowable limits for general public exposure to RF Emissions are shown here:

T-Mobile Sector	Power Density Value (%)
Sector 1:	3.54 %
Sector 2:	3.54 %
Sector 3 :	3.54 %
T-Mobile Total:	10.62 %
Site Total:	49.05 %
Site Compliance Status:	**COMPLIANT**

The anticipated composite MPE value for this site assuming all carriers present is **49.05%** 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.

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RF Engineering Director

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