

September 25, 2015

Melanie A. Bachman  
Acting Executive Director  
Connecticut Siting Council  
10 Franklin Square  
New Britain, CT 06051

Re: **Notice of Exempt Modification – Facility Modification  
74 Goodrich Lane, Portland, Connecticut**

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless (“Cellco”) currently maintains fifteen (15) antennas at the top of the existing 160-foot tower at 74 Goodrich Lane in Portland, Connecticut (the Property”). The tower is owned by Crown Castle. The Council approved Cellco’s use of this tower in 1986 (Docket No. 58). Cellco now intends to modify its facility by replacing six (6) of its existing antennas with three (3) model SBNHH-1D65B, 700 MHz antennas and three (3) model SBNHH-1D65B, 2100 MHz antennas, all at the same level on the tower. Cellco also intends to replace three (3) remote radio heads (“RRHs”) and install six (6) new RRHs. Included in Attachment 1 are specifications for Cellco’s new antennas and RRHs.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that 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 being sent to Susan Bransfield, First Selectwoman of the Town of Portland. A copy of this letter is also being sent to Joan Hale, the owner of the Property and Crown, the tower owner.

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

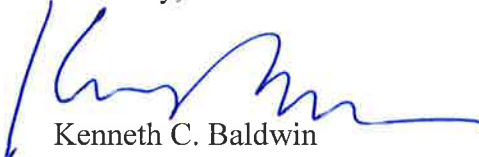
# Robinson+Cole

Melanie A. Bachman  
September 25, 2015  
Page 2

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas and RRHs will be installed on its existing platform at the top of the existing 160-foot tower.
2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.
3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.
4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table for Cellco's modified facility is included in Attachment 2.
5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.
6. The tower and its foundation can support Cellco's proposed modifications. (*See Structural Analysis Report included in Attachment 3*).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,



Kenneth C. Baldwin

Enclosures

Copy to:

Susan Bransfield, Portland First Selectwoman  
Joan Hale  
Holly Haas, Crown Castle  
Tim Parks

# **ATTACHMENT 1**



## SBNHH-1D65B

**Andrew® Tri-band Antenna, 698–896 and 2x 1695–2360 MHz, 65° horizontal beamwidth, internal RET. Both high bands share the same electrical tilt.**

- Interleaved dipole technology providing for attractive, low wind load mechanical package

### Electrical Specifications

Frequency Band, MHz	698–806	806–896	1695–1880	1850–1990	1920–2200	2300–2360
Gain, dBi	14.9	14.7	17.7	18.2	18.6	18.6
Beamwidth, Horizontal, degrees	68	66	69	66	63	58
Beamwidth, Vertical, degrees	12.1	10.7	5.6	5.2	5.0	4.5
Beam Tilt, degrees	0–14	0–14	0–7	0–7	0–7	0–7
USLS, dB	14	13	15	15	15	13
Front-to-Back Ratio at 180°, dB	27	29	28	28	28	27
CPR at Boresight, dB	20	23	20	20	17	21
CPR at Sector, dB	14	10	12	10	9	1
Isolation, dB	25	25	25	25	25	25
Isolation, Intersystem, dB	30	30	30	30	30	30
VSWR   Return Loss, dB	1.5   14.0	1.5   14.0	1.5   14.0	1.5   14.0	1.5   14.0	1.5   14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350	350	350	300
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

### Electrical Specifications, BASTA\*

Frequency Band, MHz	698–806	806–896	1695–1880	1850–1990	1920–2200	2300–2360
Gain by all Beam Tilts, average, dBi	14.5	14.3	17.4	17.9	18.2	18.3
Gain by all Beam Tilts Tolerance, dB	±0.5	±0.8	±0.4	±0.3	±0.5	±0.3
Gain by Beam Tilt, average, dBi	0°   14.6	0°   14.5	0°   17.4	0°   17.8	0°   18.1	0°   18.2
	7°   14.6	7°   14.4	3°   17.5	3°   17.9	3°   18.3	3°   18.4
	14°   14.2	14°   13.6	7°   17.4	7°   17.9	7°   18.2	7°   18.4
Beamwidth, Horizontal Tolerance, degrees	±2.2	±3.4	±2	±4.6	±5.7	±4.3
Beamwidth, Vertical Tolerance, degrees	±0.8	±1	±0.3	±0.2	±0.3	±0.2
USLS, dB	16	14	16	16	16	15
Front-to-Back Total Power at 180° ± 30°, dB	25	26	27	26	26	26
CPR at Boresight, dB	22	23	21	20	20	22
CPR at Sector, dB	13	11	16	12	11	4

\* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, [download the whitepaper Time to Raise the Bar on BSAs.](#)

### General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® multiband with internal RET
Band	Multiband
Brand	DualPol®   Teletilt®
Operating Frequency Band	1695 – 2360 MHz   698 – 896 MHz
Performance Note	Outdoor usage

SBNHH-1D65B



## Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum   Low loss circuit board
Radome Material	Fiberglass, UV resistant
Reflector Material	Aluminum
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	6
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.4 km/h   150.0 mph

## Dimensions

Depth	181.0 mm   7.1 in
Length	1851.0 mm   72.9 in
Width	301.0 mm   11.9 in
Net Weight	18.4 kg   40.6 lb

## Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	13.0 W
Protocol	3GPP/AISG 2.0 (Multi-RET)
RET Interface	8-pin DIN Female   8-pin DIN Male
RET Interface, quantity	1 female   1 male
RET System	Teletilt®

## Packed Dimensions

Depth	299.0 mm   11.8 in
Length	1970.0 mm   77.6 in
Width	409.0 mm   16.1 in
Shipping Weight	31.0 kg   68.3 lb

## Regulatory Compliance/Certifications

### Agency

RoHS 2011/65/EU  
China RoHS SJ/T 11364-2006  
ISO 9001:2008

### Classification

Compliant by Exemption  
Above Maximum Concentration Value (MCV)  
Designed, manufactured and/or distributed under this quality management system



## Included Products

# Product Specifications

COMMSCOPE®

SBNHH-1D65B

POWERED BY



**BSAMNT-1** — Wide Profile Antenna Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

## \* **Footnotes**

**Performance Note**      Severe environmental conditions may degrade optimum performance

# ALCATEL-LUCENT B13 RRH4X30-4R

Alcatel-Lucent B13 Remote Radio Head 4x30-4R is the newest addition of Remote Radio Head to the extended product line of Alcatel-Lucent's distributed Base Station solutions, aimed at facilitating smooth RF site acquisition and related civil engineering.

**Supporting 2Tx/4Tx MIMO and 4-way Rx diversity**, Alcatel-Lucent B13 RRH4x30-4R allows operators to have a compact radio solution to deploy LTE in the 700U band (700 MHz, 3GPP band 13), providing them with the means to achieve high capacity, high quality and high coverage with minimum site requirements.

The Alcatel-Lucent B13 RRH4x30-4R product has four transmit RF paths, offering the possibility to **select, via software only, 2Tx or 4Tx MIMO configurations** with either 2x60 W or 4x30 W RF output power. It supports also 4-way Rx diversity and up to 10MHz instantaneous bandwidth.

The Alcatel-Lucent B13 RRH4x30-4R is a near zero-footprint solution and operates noise free, simplifying negotiations with site property owners and minimizing environmental impacts.

Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the RF feeder needs and installation costs.

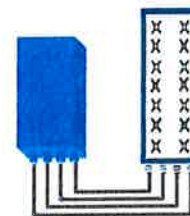


## FEATURES

- Supporting LTE in 700 MHz band (700U, 3GPP band 13)
- LTE 2Tx or 4Tx MIMO (SW switchable)
- Output power: Up to 2x60W or 4x30W
- 10MHz LTE carrier with 4Rx Diversity
- Convection-cooled (fan-less)
- Supports AISG 2.0 ALD devices (RET, TMA) through RS485 or RF ports

## BENEFITS

- Compact to reduce additional footprint when adding LTE in 700U band
- MIMO scheme operation selection (2Tx or 4Tx) by software only
- Improves downlink spectral efficiency through MIMO4
- Increases LTE coverage thanks to 4Rx diversity capability and best in class Rx sensitivity
- Flexible mounting options: Pole or Wall



4x30W with 4T4R  
or  
2x60W with 2T4R

Can be switched between modes via SW w/o site visit

## TECHNICAL SPECIFICATIONS

Features & performance	
Number of TX/RX paths	4 duplexed (either 4T4R or 2T4R by SW)
Frequency band	U700 (C) (3GPP bands 13): DL: 746 - 756 MHz / UL: 777 - 787 MHz
Instantaneous bandwidth - #carriers	10MHz - 1 LTE carrier (in 10MHz occupied bandwidth)
LTE carrier bandwidth	10 MHz
RF output power	2x60W or 4x30W (by SW)
Noise figure - RX Diversity scheme	2 dB typ. (<2.5 dB max) - 2 or 4 way Rx diversity
Sizes (HxWxD) in mm (in.)	550 x 305 x 230 (21.6" x 12.0" x 9") (with solar shield)
Volume in L	38 (with solar shield)
Weight in kg (lb) (w/o mounting HW)	26 (57.2) (with solar shield)
DC voltage range	-40.5 to -57V at full performance, -38 to -57V with relaxation on power consumption
DC power consumption	550W typical @100% RF load ( in 2Tx or 4TX mode)
Environmental conditions	-40°C (-40°F) / +55°C (+131°F)
Wind load (@150km/h or 93mph)	IP65 Frontal: <200N / Lateral : <150N
Antenna ports	4 ports 7/16 DIN female (50 ohms) VSWR < 1.5
CPRI ports	2 CPRI ports (HW ready for Rate7, 9.8 Gbps) SFP single mode dual fiber
AISG interfaces	1 AISG2.0 output (RS485) Integrated Smart Bias Tees (x2)
Misc. Interfaces	4 external alarms (1 connector) - 4 RF Tx & 4 RF Rx monitor ports - 1 DC connector (2 pins)
Installation conditions	Pole and wall mounting
Regulatory compliance	3GPP 36.141 / 3GPP 36.113 / GR-1089-CORE / GR-3108-CORE / UL 60950-1 / FCC Part 27

www.alcatel-lucent.com Alcatel-Lucent, Alcatel-Lucent and the Alcatel-Lucent logo are trademarks of Alcatel-Lucent. All other trademarks are the property of their respective owners. The information presented is subject to change without notice. Alcatel-Lucent assumes no responsibility for inaccuracies contained herein. Copyright © 2014 Alcatel-Lucent. All Rights Reserved

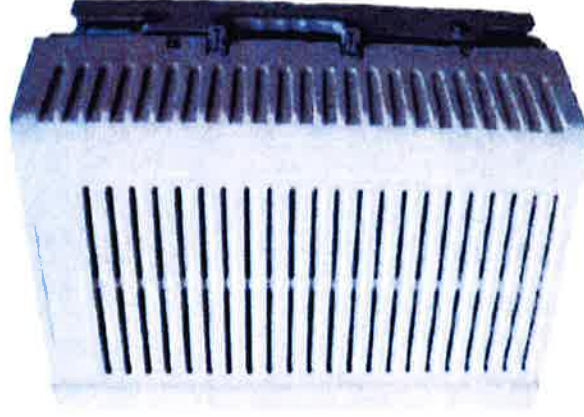


# PCS RF MODULES

## RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

RRH2x60	
RF Output Power	2x60W
Instantaneous Bandwidth	20MHz
Transmitter	2 TX
Receiver	2 Branch RX – LA6.0.1 4 Branch RX – LR13.3
Features	AISG 2.0 for RET/TMA Internal Smart Bias-T
Power	-48VDC
CPRI Ports	2 CPRI Rate 3 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (top mounted)



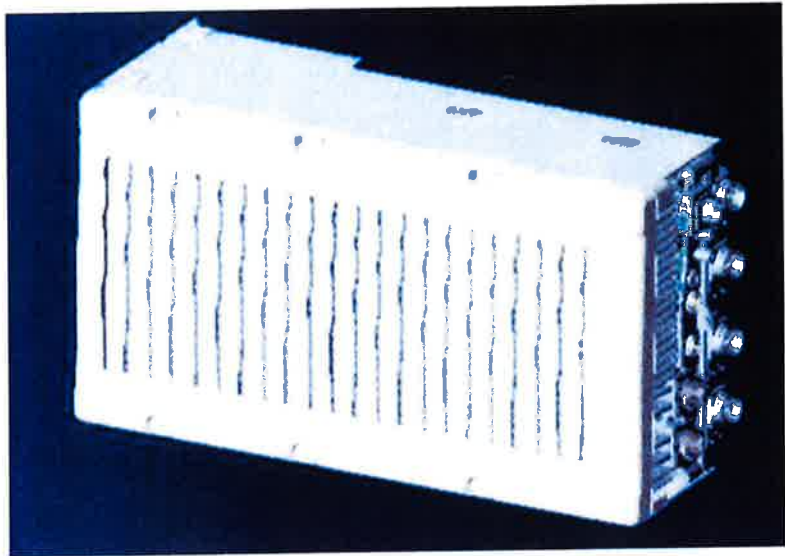
\*\* Not a Verizon Wireless deployed product

ALCATEL-LUCENT – CONFIDENTIAL – SOLELY FOR AUTHORIZED PERSONS HAVING A NEED TO KNOW – PROPRIETARY – USE PURSUANT TO COMPANY INSTRUCTION

# NEW PCS RF MODULES FOR VZW RRH2X60 - HW CHARACTERISTICS

LR14.3

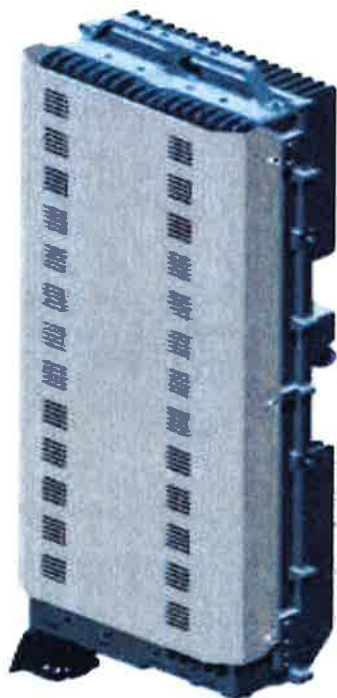
	<b>RRH2X60</b>
RF Output Power	2x60W (4x30W HW Ready)
Instantaneous Bandwidth	60MHz
Target Reliability (Annual Return Rate)	<2%
Receiver	4 Branch Rx
Features	AISG 2.0 for RET/TMA
Power	-48VDC Internal Smart Bias-T
CPRI Ports	2 CPRI Rate 5 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX, RX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (downward facing)
Dimensions	22"(h) x 12"(w) x 9.4" (d)**
Weight	55lb**



\*\* - Includes solar shield but not mounting brackets (8 lbs.)

# ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET RRH2X60-AWS FOR BAND 4 APPLICATIONS

The Alcatel-Lucent RRH2x60-AWS is a high power, small form factor Remote Radio Head operating in the AWS frequency band (3GPP Band 4) for LTE technology. It is designed with an eco-efficient approach, providing operators with the means to achieve high quality and high capacity coverage with minimum site requirements and efficient operation.



A distributed Node B expands the deployment options by using two components, a Base Band Unit (BBU) containing the digital assets and a separate RRH containing the radio-frequency (RF) elements. This modular design optimizes available space and allows the main components of a Node B to be installed separately, within the same site or several kilometers apart.

The Alcatel-Lucent RRH2x60-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals

along with operations, administration and maintenance (OA&M) information.

#### SUPERIOR RF PERFORMANCE

The Alcatel-Lucent RRH2x60-AWS integrates all the latest technologies. This allows to offer best-in-class characteristics.

It delivers an outstanding 120 watts of total RF power thanks to its two transmit RF paths of 60 W each.

It is ideally suited to support multiple-input multiple-output (MIMO) 2x2 operation.

It includes four RF receivers to natively support 4-way uplink reception diversity. This improves the radio uplink coverage and this can be used to extend the cell radius commensurate with 2x2MIMO 2x60 W for the downlink.

It supports multiple discontinuous LTE carriers within an instantaneous bandwidth of 45 MHz corresponding to the entire AWS B4 spectrum.

The latest generation power amplifiers (PA) used in this product achieve high efficiency (>40%), resulting in improved power consumption figures.

#### OPTIMIZED TCO

The Alcatel-Lucent RRH2x60-AWS is designed to make available all the benefits of a distributed Node B, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX).

The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

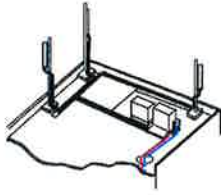
#### EASY INSTALLATION

The RRH2x60-AWS includes a reversible mounting bracket which allows for ease of installation behind an antenna, or on a rooftop knee wall while providing easy access to the mid body RF connectors.

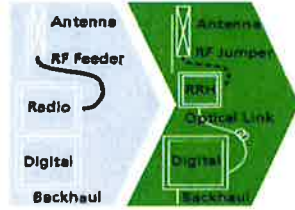
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

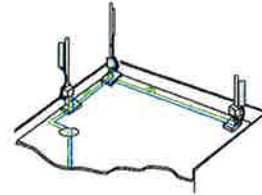
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

**FEATURES**

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control

**BENEFITS**

- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and

silent solutions, with minimum impact on the neighborhood, which ease the deployment

- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

**TECHNICAL SPECIFICATIONS**

Specifications listed are hardware capabilities. Some capabilities depend on support in a specific software release or future release.

**Dimensions and weights**

- HxWxD : 510x285x186mm (27 l with solar shield)
- Weight : 20 kg (44 lbs)

**Electrical Data**

- Power Supply : -48V DC (-40.5 to -57V)
- Power Consumption (ETSI average traffic load reference) : 250W @2x60W

**RF Characteristics**

- Frequency band: 1710-1755, UL / 2110-2155 MHz, DL (3GPP band 4)
- Output power: 2x60W at antenna connectors
- Technology supported: LTE
- Instantaneous bandwidth: 45 MHz
- Rx diversity: 2-way and 4-way uplink reception
- Typical sensitivity without Rx diversity: -105 dBm for LTE

**Connectivity**

- Two CPRI optical ports for daisy chaining and up to six RRHs per fiber
- Type of optical fiber: Single-Mode (SM) and Multi-Mode (MM) SFPs
- Optical fiber length: up to 500m using MM fiber, up to 20km using SM fiber
- TMA/RETA : AISG 2.0 (RS485 connector and internal Bias-Tee)
- Six external alarms
- Surge protection for all external ports (DC and RF)

**Safety and Regulatory Data**

- EMC : 3GPP 25113, EN 301 489-1, EN 301 489-23, GR 1089, GR 3108, OET-65
- Safety : IEC60950-1, EN 60825-1, UL, ANSI/NFPA 70, CAN/CSA-C22.2
- Regulatory : FCC Part 15 Class B, CE Mark – European Directive : 2002/95/EC (ROHS); 2002/96/EC (WEEE); 1999/5/EC (R&TTE)
- Health : EN 50385

**Environmental specifications**

- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection : IEC 60529 IP65
- Acoustic Noise : Noiseless (natural convection cooling)

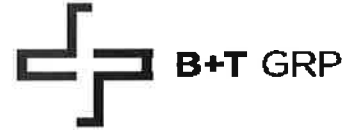
www.alcatel-lucent.com Alcatel, Lucent, Alcatel-Lucent and the Alcatel-Lucent logo are trademarks of Alcatel-Lucent. All other trademarks are the property of their respective owners. The information presented is subject to change without notice. Alcatel-Lucent assumes no responsibility for inaccuracies contained herein.

Copyright © 2012 Alcatel-Lucent. All rights reserved. M2012XXXXXX (March)

# **ATTACHMENT 2**

		General		Power		Density							
Site Name: Portland Tower Height: 160ft													
CARRIER	# OF CHAN.	WATTS ERP	HEIGHT	CALC. POWER DENS	FREQ.	MAX. PERMISS. EXP.	FRACTION MPE	Total					
*AT&T UMTS	2	565	120	0.0282	880	0.5867	4.81%						
*AT&T UMTS	2	875	120	0.0437	1900	1.0000	4.37%						
*AT&T GSM	1	283	120	0.0071	880	0.5867	1.21%						
*AT&T GSM	4	525	120	0.0525	1900	1.0000	5.25%						
*AT&T LTE	1	1313	120	0.0328	734	0.4893	6.70%						
*Clearwire	2	153	142	0.0055	2469	1.0000	0.55%						
*Clearwire	1	211	142	0.0038	11 GHz	1.0000	0.38%						
*Sprint	11	122	153	0.0206	1950	1.0000	2.06%						
*Nextel	9	100	132	0.0186	850	0.5667	3.28%						
*VoiceStream	8	245	135	0.0387	1935	1.0000	3.87%						
<b>Verizon PCS</b>	<b>1</b>	<b>2443</b>	<b>160</b>	<b>0.0343</b>	<b>1970</b>	<b>1.0000</b>	<b>3.43%</b>						
<b>Verizon Cellular</b>	<b>9</b>	<b>380</b>	<b>160</b>	<b>0.0480</b>	<b>869</b>	<b>0.5793</b>	<b>8.29%</b>						
<b>Verizon AWS</b>	<b>1</b>	<b>2306</b>	<b>160</b>	<b>0.0324</b>	<b>2145</b>	<b>1.0000</b>	<b>3.24%</b>						
<b>Verizon 700</b>	<b>1</b>	<b>1050</b>	<b>160</b>	<b>0.0147</b>	<b>746</b>	<b>0.4973</b>	<b>2.97%</b>						<b>50.40%</b>
* Source: Siting Council													

# **ATTACHMENT 3**



B+T Group  
 1717 S. Boulder, Suite 300  
 Tulsa, OK 74119  
 (918) 587-4630  
 btwo@btgrp.com

August 06, 2015

Holly Haas  
 Crown Castle  
 3530 Toringdon Way Suite 300  
 Charlotte, NC 28277  
 (704) 405-6535

**Subject:** **Structural Analysis Report**

**Carrier Designation:** **Verizon Wireless Co-Locate**  
**Carrier Site Number:** 119703  
**Carrier Site Name:** Portland CT

**Crown Castle Designation:** **Crown Castle BU Number:** 806382  
**Crown Castle Site Name:** HRT 082 943274  
**Crown Castle JDE Job Number:** 342635  
**Crown Castle Work Order Number:** 1100983  
**Crown Castle Application Number:** 305924 Rev. 1

**Engineering Firm Designation:** **B+T Group Project Number:** 81363.010.01

**Site Data:** **Old Marlborough Turnpike, Portland, Middlesex County, CT**  
**Latitude 41° 36' 29.9", Longitude -72° 35' 29.56"**  
**160 Foot - Monopole Tower**

Dear Holly Haas,

B+T Group is pleased to submit this "**Structural Analysis Report**" to determine the structural integrity of the above mentioned tower. This analysis has been performed in accordance with the Crown Castle Structural 'Statement of Work' and the terms of Crown Castle Purchase Order Number 813130, in accordance with application 305924, revision 1.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the tower stress level for the structure and foundation, under the following load case, to be:

LC5: Existing + Proposed Equipment **Sufficient Capacity**  
 Note: See Table 1 and Table 2 for the proposed and existing loading, respectively.

This analysis has been performed in accordance with the TIA/EIA-222-F standard and 2005 CT State Building Code with 2009 amendment based upon a wind speed of 85 mph fastest mile.

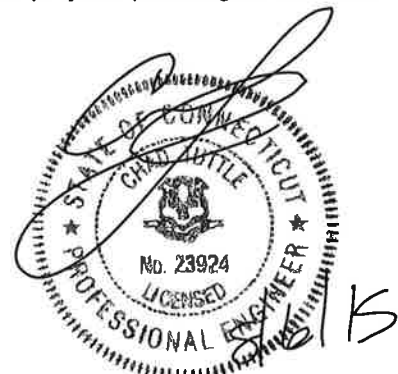
All equipment proposed in this report shall be installed in accordance with the attached drawings for the determined available structural capacity to be effective.

We at B+T Group appreciate the opportunity of providing our continuing professional services to you and Crown Castle. If you have any questions or need further assistance on this or any other projects please give us a call.

Respectfully submitted by:  
 B+T Engineering, Inc.

Jacob Johnson, E.I.T.  
 Project Engineer

Chad E. Tuttle, P.E.  
 President





## TABLE OF CONTENTS

### 1) INTRODUCTION

### 2) ANALYSIS CRITERIA

Table 1 - Proposed Antenna and Cable Information

Table 2 - Existing Antenna and Cable Information

Table 3 - Design Antenna and Cable Information

### 3) ANALYSIS PROCEDURE

Table 4 - Documents Provided

3.1) Analysis Method

3.2) Assumptions

### 4) ANALYSIS RESULTS

Table 5 - Section Capacity (Summary)

Table 6 – Tower Components vs. Capacity

4.1) Recommendations

### 5) APPENDIX A

tnxTower Output

### 6) APPENDIX B

Base Level Drawing

### 7) APPENDIX C

Additional Calculations

## 1) INTRODUCTION

This tower is a 160 ft. Monopole tower designed by Valmont in January of 1998. The tower was originally designed for a wind speed of 85 mph per TIA/EIA-222-F. This tower has been modified by B+T Group in May of 2013 and those modifications were incorporated in this analysis.

## 2) ANALYSIS CRITERIA

The structural analysis was performed for this tower in accordance with the requirements of TIA/EIA-222-F Structural Standards for Steel Antenna Towers and Antenna Supporting Structures using a fastest mile wind speed of 85 mph with no ice, 37.6 mph with 0.75 inch ice thickness and 50 mph under service loads.

**Table 1 - Proposed Antenna and Cable Information**

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
160.0	160.0	3	Alcatel Lucent	RRH2X60-AWS	--	--	--
		3	Alcatel Lucent	RRH2X60-PCS			
		3	Alcatel Lucent	RRH2x60-700			
		6	Andrew	SBNHH-1D65B			
		1	RFS Celwave	DB-B1-6C-8AB-0Z			

**Table 2 - Existing Antenna and Cable Information**

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
160.0	160.0	3	Alcatel Lucent	RRH2x40-AWS	1	1-5/8	2
		3	Andrew	HBXX-6517DS-A2M			
		3	Antel	BXA-70063/6CF			
		4	RFS Celwave	FD9R6004/2C-3L			
		3	Andrew	HBXX-6517DS-A2M	2	1-1/4	1
		2	Decibel	DB846F65ZAXY			
		4	Decibel	DB846H80E-SX			
		1	RFS Celwave	DB-T1-6Z-8AB-0Z			
		2	RFS Celwave	FD9R6004/2C-3L			
		1	--	Platform Mount [LP 602-1]			
150.0	152.0	6	Decibel	DB980H90E-M	6	1-5/8	1
	150.0	1	--	Platform Mount [LP 602-1]	1	1/2	
142.0	144.0	2	Radiowaves	HP3-11	2	1/2	1
	142.0	1	--	Side Arm Mount [SO 101-3]			
134.0	137.0	3	EMS Wireless	RR90-17-00DP	6	1-5/8	1
	134.0	6	Ericsson	KRY 112 71/1			
		1	--	Miscellaneous [NA 508-3]			
116.0	120.0	3	Ericsson	RRUS-11	12	1-1/4	1
		3	Kmw Comm.	AM-X-CD-16-65-00T-RET			
		6	Powerwave Tech.	7770.00			
		6	Powerwave Tech.	LGP21401			
		6	Powerwave Tech.	LGP21901			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
116.0	120.0	1	Raycap	DC6-48-60-18-8F	--	--	1
	116.0	1	--	Platform Mount [LP 303-1]			
50.0	50.0	2	--	Side Arm Mount [SO 701-1]	2	1/2	1
		2	Unknown	GPS			

- Notes:  
 1) Existing Equipment  
 2) Equipment To Be Removed; Not Considered in This Analysis

**Table 3 - Design Antenna and Cable Information**

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
157	157	12	Swedcom	ALP 9212-N	--	--
		1	Generic	Cellular Platform		
148	148	12	Decibel	DB980H90	--	--
		1	Generic	Cellular Platform		
138	138	12	Swedcom	ALP 9212-N	--	--
		1	Generic	Cellular Platform		
128	128	12	Swedcom	ALP 9212-N	--	--
		1	Generic	Cellular Platform		
60	60	2	Generic	GPS	--	--
		2	Generic	Antenna Mount		
50	50	2	Generic	GPS	--	--
		2	Generic	Antenna Mount		

### 3) ANALYSIS PROCEDURE

**Table 4 - Documents Provided**

Document	Remarks	Reference	Source
Online Application	Verizon Wireless Co-locate, Rev# 1	305924	CCI Sites
Tower Manufacturer Drawing	Valmont, Order No: 16750-98	255193	CCI Sites
Tower Modification Drawing	B+T Group, Project No: 81363.004.01 Date: 05/29/2013	3865159	CCI Sites
Post Modification Inspection	TEP, Project No: 47567.5988 Date: 09/17/2013	3996803	CCI Sites
Foundation Drawing	Valmont, Order No: 16750-98	301226	CCI Sites
Geotechnical Reports	TGG, Project No: GTX-1694	1041653	CCI Sites
Antenna Configuration	Crown CAD Package	Date: 08/05/2015	CCI Sites

#### 3.1) Analysis Method

tnxTower (version 6.1.4.1), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

### 3.2) Assumptions

- 1) Tower and structures were built in accordance with the manufacturer's specifications.
- 2) The tower and structures have been maintained in accordance with the manufacturer's specification.
- 3) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
- 4) When applicable, transmission cables are considered as structural components for calculating wind loads as allowed by TIA/EIA-222-F.
- 5) Mount areas and weights are assumed based on photographs provided.

This analysis may be affected if any assumptions are not valid or have been made in error. B+T Group should be notified to determine the effect on the structural integrity of the tower.

### 4) ANALYSIS RESULTS

**Table 5 - Section Capacity (Summary)**

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
L1	160 - 123.667	Pole	TP29.05x18.87x0.188	1	-6.235	772.705	99.2%	Pass
L2	123.667 - 76.25	Pole	TP41.95x27.461x0.313	2	-15.983	2028.373	93.2%	Pass
L3	76.25 - 51	Pole	TP48.398x39.715x0.344	3	-23.779	2547.816	99.6%	Pass
L4	51 - 37	Pole	TP52.32x48.398x0.433	4	-26.098	2742.501	97.9%	Pass
L5	37 - 0	Pole	TP62x49.672x0.406	5	-41.390	3659.311	94.8%	Pass
							Summary	
						Pole (L3)	99.6	Pass
						RATING =	99.6	Pass

**Table 6 - Tower Component Stresses vs. Capacity – LC5**

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	Base	92.8	Pass
1	Base Plate	Base	53.7	Pass
1	Base Foundation (Structural)	Base	61.9	Pass
1	Base Foundation (Soil Interaction)	Base	97.8	Pass

<b>Structure Rating (max from all components) =</b>	<b>99.6%</b>
---	--------------

Notes:

- 1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity consumed.
- 2) Capacities up to 100% are considered acceptable based on analysis methods used.

### 4.1) Recommendations

The tower and its foundation have sufficient capacity to carry the existing and proposed loads. No modifications are required at this time.

**APPENDIX A**  
**TNXTOWER OUTPUT**

**DESIGNED APPURTENANCE LOADING**

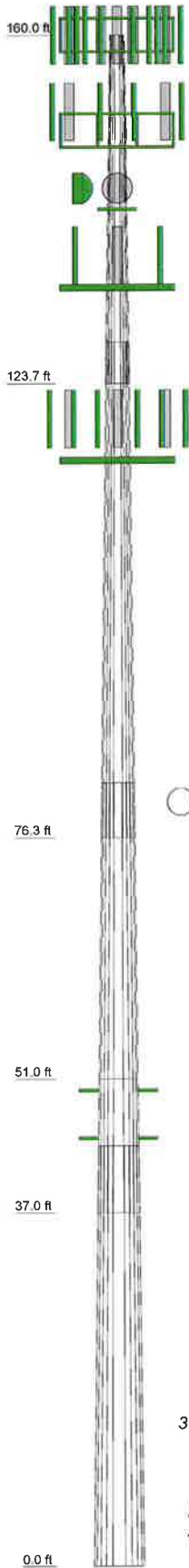
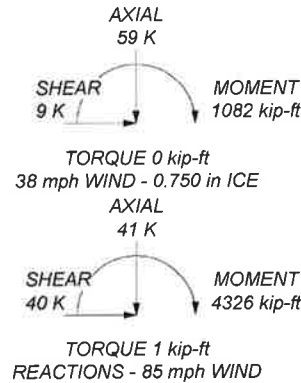
TYPE	ELEVATION	TYPE	ELEVATION
(2) DB846H80E-SX w/ Mount Pipe (E)	160	Radiowaves HP3-11 (E)	142
(2) DB846H80E-SX w/ Mount Pipe (E)	160	RR90-17-00DP w/ Mount Pipe (E)	134
(2) DB846F65ZAXY w/ Mount Pipe (E)	160	(2) KRY 112 71/1 (E-as per photo)	134
HBXX-6517DS-A2M w/ Mount Pipe (E)	160	(2) KRY 112 71/1 (E-as per photo)	134
HBXX-6517DS-A2M w/ Mount Pipe (E)	160	Miscellaneous [NA 508-3] (E)	134
HBXX-6517DS-A2M w/ Mount Pipe (E)	160	RR90-17-00DP w/ Mount Pipe (E)	134
HBXX-6517DS-A2M w/ Mount Pipe (E)	160	RR90-17-00DP w/ Mount Pipe (E)	134
(2) FD9R6004/2C-3L (E)	160	(2) 7770.00 w/ Mount Pipe (E)	116
DB-T1-6Z-8AB-OZ (E)	160	AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	116
(2) SBNHH-1D65B w/ Mount Pipe (P)	160	AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	116
(2) SBNHH-1D65B w/ Mount Pipe (P)	160	AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	116
(2) SBNHH-1D65B w/ Mount Pipe (P)	160	AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	116
RRH2X60-AWS (P)	160	(2) LGP21401 (E)	116
RRH2X60-AWS (P)	160	(2) LGP21401 (E)	116
RRH2X60-PCS (P)	160	(2) LGP21401 (E)	116
RRH2X60-PCS (P)	160	(2) LGP21901 (E)	116
RRH2X60-PCS (P)	160	(2) LGP21901 (E)	116
RRH2x60-700 (P)	160	(2) LGP21901 (E)	116
RRH2x60-700 (P)	160	RRUS-11 (E)	116
RRH2x60-700 (P)	160	RRUS-11 (E)	116
DB-B1-6C-8AB-OZ (P)	160	RRUS-11 (E)	116
Platform Mount [LP 602-1] (E)	160	DC6-48-60-18-8F (E)	116
(2) DB980H90E-M w/ Mount Pipe (E)	150	(2) 2' x 2" Pipe Mount (E-For TMA)	116
(2) DB980H90E-M w/ Mount Pipe (E)	150	2' x 2" Pipe Mount (E-For TMA)	116
(2) DB980H90E-M w/ Mount Pipe (E)	150	(2) 2' x 2" Pipe Mount (E-For TMA)	116
(2) 6' x 2" Mount Pipe (E)	150	Platform Mount [LP 303-1] (E)	116
(2) 6' x 2" Mount Pipe (E)	150	(2) 7770.00 w/ Mount Pipe (E)	116
(2) 6' x 2" Mount Pipe (E)	150	(2) 7770.00 w/ Mount Pipe (E)	116
Platform Mount [LP 602-1] (E)	150	2' x 2" Pipe Mount (E)	50
4' x 2" Horizontal Face Mount Pipe (E-Dish Tie Back)	145	2' x 2" Pipe Mount (E)	50
4' x 2" Horizontal Face Mount Pipe (E-Dish Tie Back)	145	Side Arm Mount [SO 701-1] (E)	50
(2) 6' x 3" Mount Pipe (E)	142	GPS (E)	50
(2) 6' x 3" Mount Pipe (E)	142	GPS (E)	50
(2) 6' x 3" Mount Pipe (E)	142	Side Arm Mount [SO 701-1] (E-Empty)	45
Side Arm Mount [SO 101-3] (E)	142	Side Arm Mount [SO 701-1] (E-Empty)	45
Radiowaves HP3-11 (E)	142	2' x 2" Pipe Mount (E)	45
		2' x 2" Pipe Mount (E)	45

**MATERIAL STRENGTH**

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi	49 2B4685ksi	49 ksi	64 ksi

**TOWER DESIGN NOTES**

1. Tower is located in Middlesex County, Connecticut.
2. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 38 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 99.6%



Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	36.333	12	0.188	4.333	18.870	29.050	A572-65	1.8
2	51.750	12	0.313	5.750	27.461	41.950	A572-65	6.1
3	31.000	12	0.344	7.000	39.715	48.398	A572-65	5.1
4	14.000	12	0.433	7.000	48.398	52.320	A572-65	3.3
5	44.000	12	0.406	49.672	62.000	49.284685ksi	A572-65	10.9
								27.1



**B+T Group**  
1717 S Boulder Ave, Suite 300  
Tulsa, OK 74119  
Phone: (918) 587-4630  
FAX: (918) 295-0265

Job: **81363.010.01 - HRT 082 943274, CT (BU# 806:**

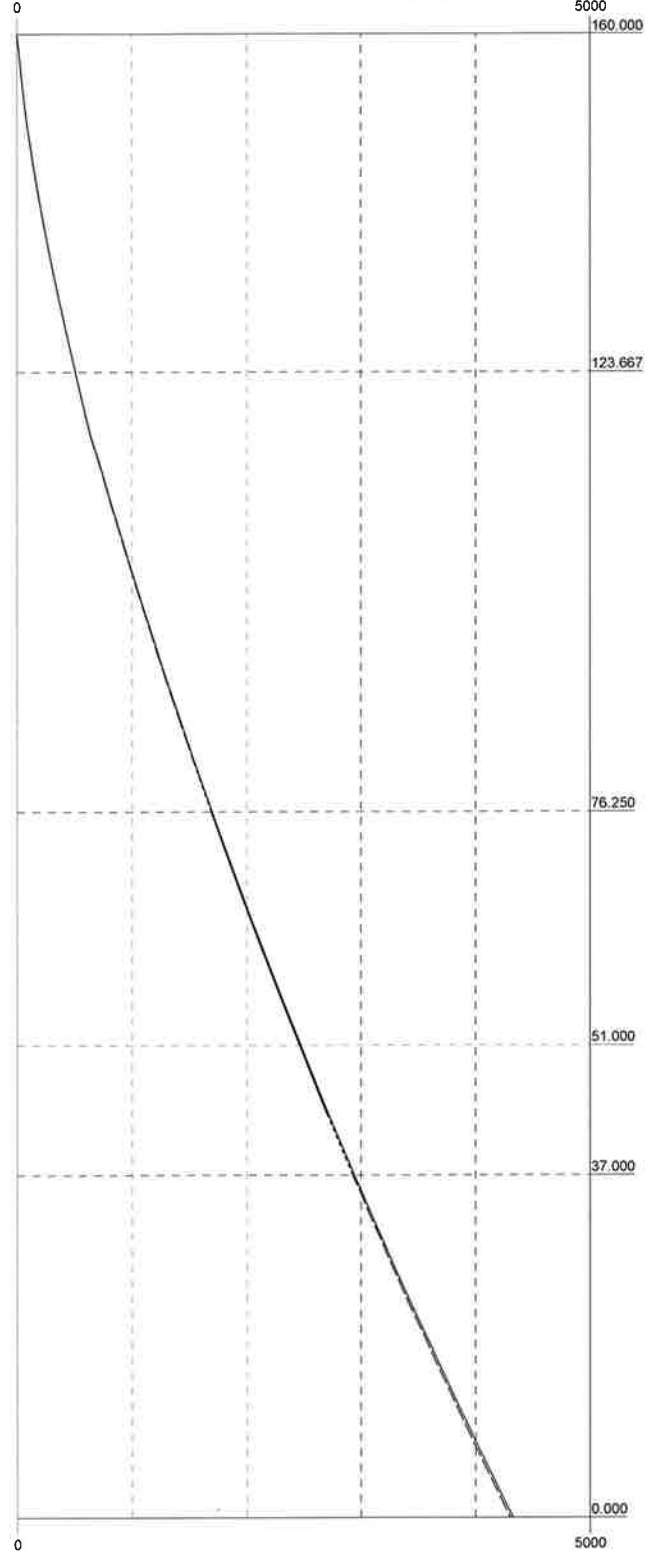
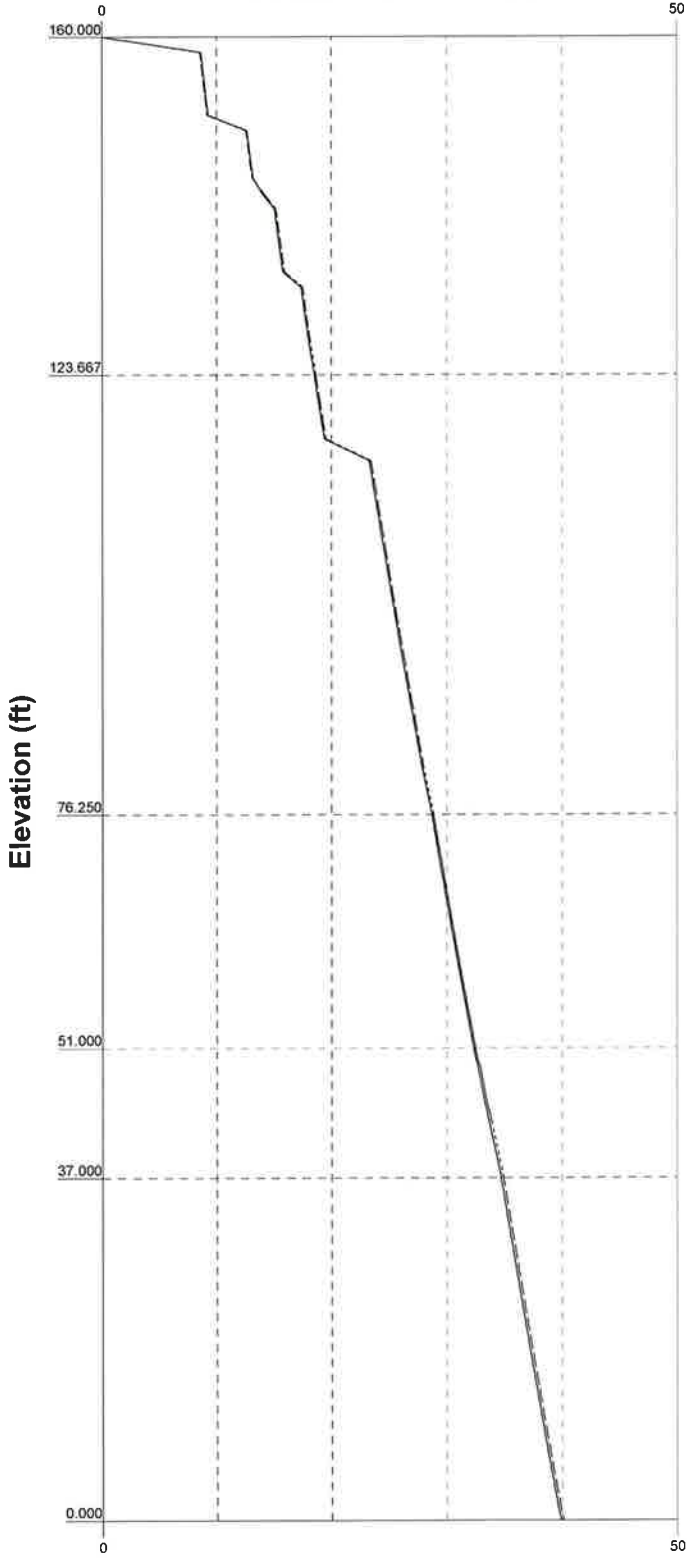
Project:	Client: Crown Castle	Drawn by: J. Johnson	App'd:
Code: TIA/EIA-222-F	Date: 08/06/15	Scale: NTS	Dwg No: E-1
Path:			

—— Vx    - - - - Vz

—— Mx    - - - - Mz

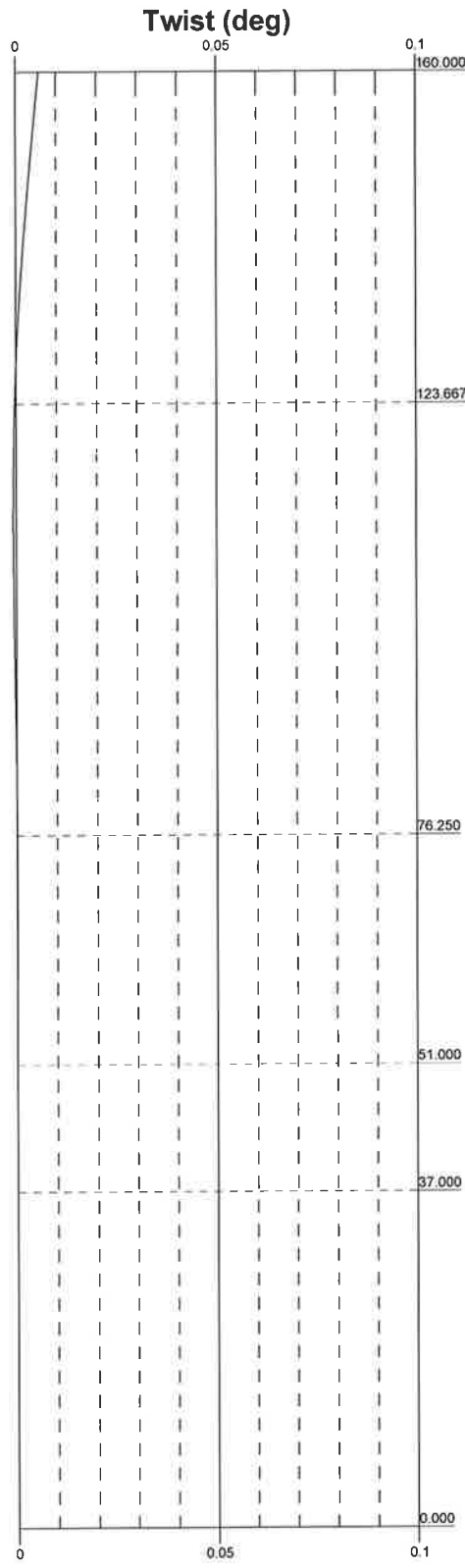
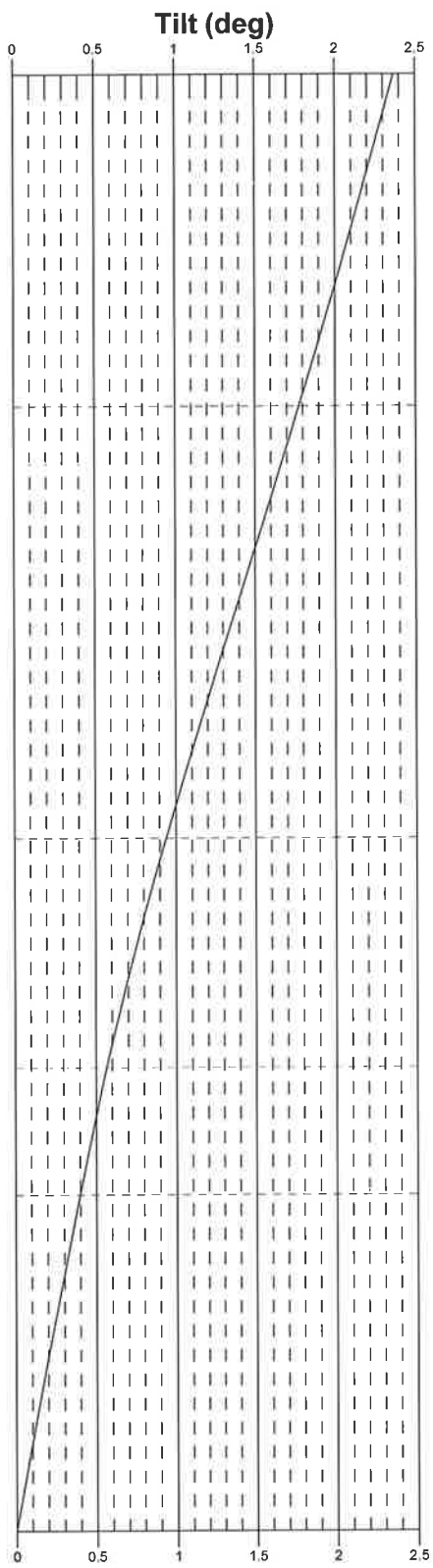
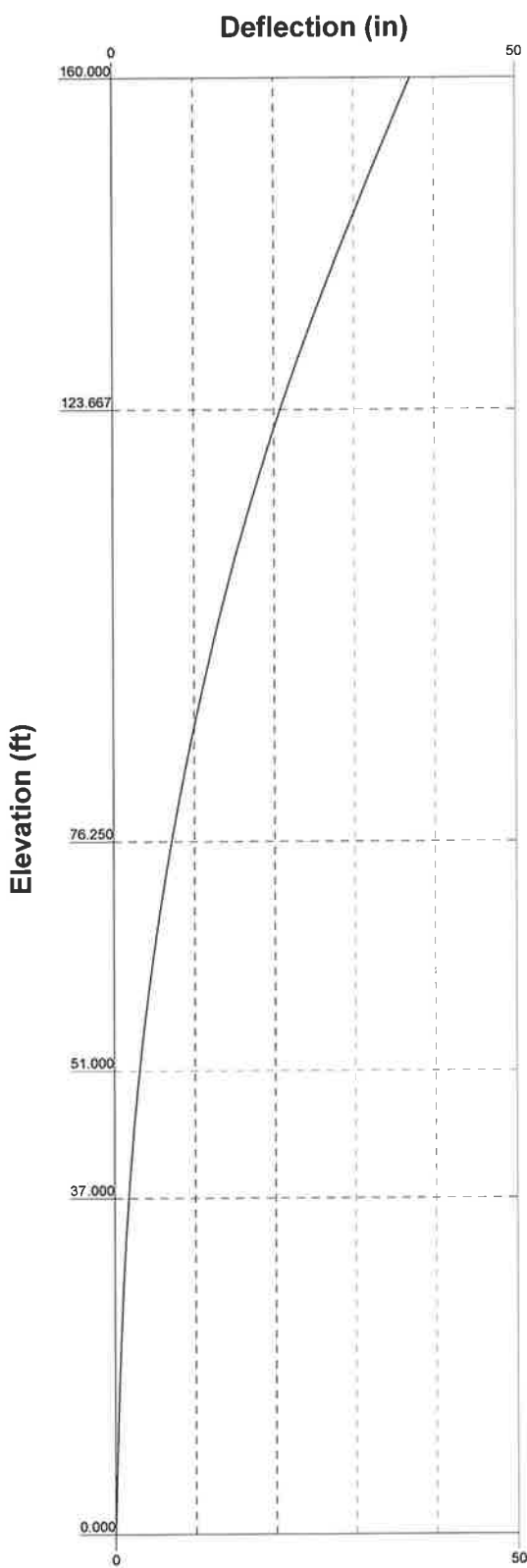
Global Mast Shear (K)

Global Mast Moment (kip-ft)



**B+T Group**  
 1717 S Boulder Ave, Suite 300  
 Tulsa, OK 74119  
 Phone: (918) 587-4630  
 FAX: (918) 295-0265

Job: <b>81363.010.01 - HRT 082 943274, CT (BU# 806:</b>		
Project:		
Client: Crown Castle	Drawn by: J. Johnson	App'd:
Code: TIA/EIA-222-F	Date: 08/06/15	Scale: NTS
Path:		Dwg No. E-4



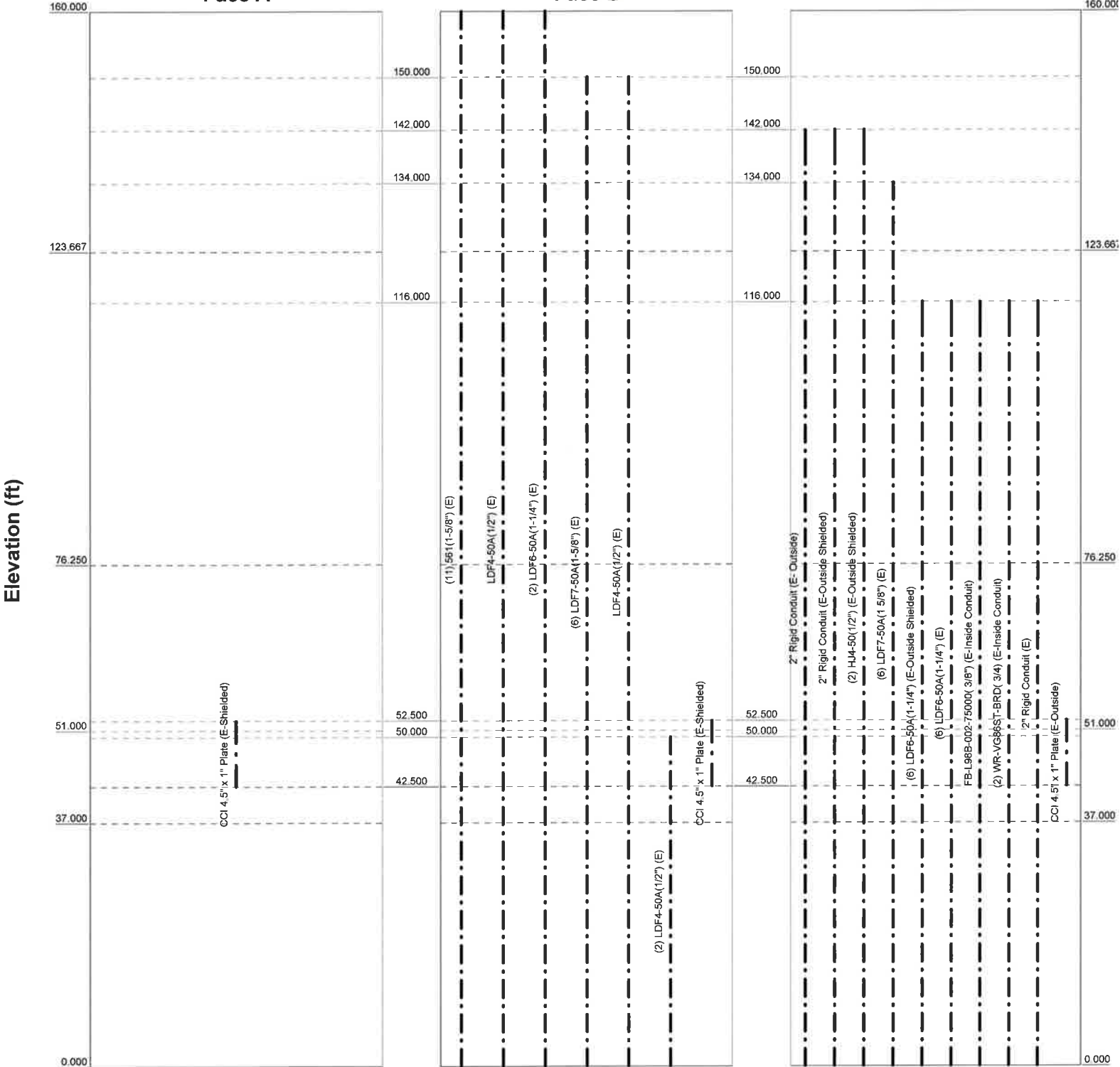
 <p><b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265</p>	<p>Job: <b>81363.010.01 - HRT 082 943274, CT (BU# 806)</b></p>		
	Project:	Drawn by: J. Johnson	App'd:
	Client: Crown Castle	Date: 08/06/15	Scale: NTS
	Code: TIA/EIA-222-F		Dwg No. E-5
	Path:		




Face A

Face B

Face C



 <p><b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265</p>	Job: <b>81363.010.01 - HRT 082 943274, CT (BU# 806:</b>		
	Project:		
	Client: Crown Castle	Drawn by: J. Johnson	App'd:
	Code: TIA/EIA-222-F	Date: 08/06/15	Scale: NTS
	Path:	Dwg No. E-7	

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 1 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

## Tower Input Data

There is a pole section.

This tower is designed using the TIA/EIA-222-F standard.

The following design criteria apply:

Tower is located in Middlesex County, Connecticut.

Basic wind speed of 85 mph.

Nominal ice thickness of 0.750 in.

Ice thickness is considered to increase with height.

Ice density of 56.000 pcf.

A wind speed of 38 mph is used in combination with ice.

Temperature drop of 50.000 °F.

Deflections calculated using a wind speed of 50 mph.

TOWER RATING: 99.6%.

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, feed line supports, and appurtenance mounts are not considered.

## Options

<ul style="list-style-type: none"> <li>Consider Moments - Legs</li> <li>Consider Moments - Horizontals</li> <li>Consider Moments - Diagonals</li> <li>Use Moment Magnification</li> <li>√ Use Code Stress Ratios</li> <li>√ Use Code Safety Factors - Guys</li> <li>√ Escalate Ice</li> <li>Always Use Max Kz</li> <li>Use Special Wind Profile</li> <li>Include Bolts In Member Capacity</li> <li>Leg Bolts Are At Top Of Section</li> <li>Secondary Horizontal Braces Leg</li> <li>Use Diamond Inner Bracing (4 Sided)</li> <li>Add IBC .6D+W Combination</li> </ul>	<ul style="list-style-type: none"> <li>Distribute Leg Loads As Uniform</li> <li>Assume Legs Pinned</li> <li>√ Assume Rigid Index Plate</li> <li>√ Use Clear Spans For Wind Area</li> <li>Use Clear Spans For KL/r</li> <li>Retension Guys To Initial Tension</li> <li>√ Bypass Mast Stability Checks</li> <li>√ Use Azimuth Dish Coefficients</li> <li>√ Project Wind Area of Appurt.</li> <li>Autocalc Torque Arm Areas</li> <li>SR Members Have Cut Ends</li> <li>Sort Capacity Reports By Component</li> <li>Triangulate Diamond Inner Bracing</li> <li>Use TIA-222-G Tension Splice Capacity Exemption</li> </ul>	<ul style="list-style-type: none"> <li>Treat Feedline Bundles As Cylinder</li> <li>Use ASCE 10 X-Brace Ly Rules</li> <li>Calculate Redundant Bracing Forces</li> <li>Ignore Redundant Members in FEA</li> <li>SR Leg Bolts Resist Compression</li> <li>All Leg Panels Have Same Allowable</li> <li>Offset Girt At Foundation</li> <li>√ Consider Feedline Torque</li> <li>Include Angle Block Shear Check</li> <li style="text-align: center;"><b>Poles</b></li> <li>√ Include Shear-Torsion Interaction</li> <li>Always Use Sub-Critical Flow</li> <li>Use Top Mounted Sockets</li> </ul>
--	---	--

## 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	160.000-123.667	36.333	4.333	12	18.870	29.050	0.188	0.750	A572-65 (65 ksi)
L2	123.667-76.250	51.750	5.750	12	27.461	41.950	0.313	1.250	A572-65 (65 ksi)
L3	76.250-51.000	31.000	0.000	12	39.715	48.398	0.344	1.375	A572-65 (65 ksi)
L4	51.000-37.000	14.000	7.000	12	48.398	52.320	0.433	1.731	49.284685ksi (49 ksi)
L5	37.000-0.000	44.000		12	49.672	62.000	0.406	1.625	A572-65 (65 ksi)

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 2 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

### Tapered Pole Properties

Section	Tip Dia. in	Area in <sup>2</sup>	I in <sup>4</sup>	r in	C in	I/C in <sup>3</sup>	J in <sup>4</sup>	I/Q in <sup>2</sup>	w in	w/t
L1	19.536	11.280	502.514	6.688	9.775	51.410	1018.229	5.551	4.555	24.292
	30.075	17.426	1852.870	10.333	15.048	123.131	3754.417	8.576	7.283	38.842
L2	29.686	27.318	2569.965	9.719	14.225	180.668	5207.445	13.445	6.522	20.871
	43.430	41.898	9271.410	14.906	21.730	426.662	18786.390	20.621	10.405	33.296
L3	42.784	43.579	8622.350	14.095	20.572	419.122	17471.219	21.448	9.722	28.283
	50.106	53.191	15678.080	17.204	25.070	625.362	31768.040	26.179	12.050	35.053
L4	50.106	66.843	19629.140	17.172	25.070	782.960	39773.960	32.898	11.811	27.291
	54.166	72.308	24847.930	18.576	27.102	916.838	50348.643	35.588	12.862	29.719
L5	53.454	64.445	19964.737	17.637	25.730	775.933	40453.969	31.718	12.223	30.088
	64.187	80.572	39016.215	22.051	32.116	1214.853	79057.429	39.655	15.527	38.221
<i>Tower Elevation</i>	<i>Gusset Area (per face)</i>	<i>Gusset Thickness</i>	<i>Gusset Grade</i>	<i>Adjust. Factor A<sub>f</sub></i>	<i>Adjust. Factor A<sub>r</sub></i>	<i>Weight Mult.</i>	<i>Double Angle Stitch Bolt Spacing Diagonals</i>	<i>Double Angle Stitch Bolt Spacing Horizontals</i>		
<i>ft</i>	<i>ft<sup>2</sup></i>	<i>in</i>					<i>in</i>	<i>in</i>		
L1				1	1	1				
160.000-123.6										
67										
L2				1	1	1				
123.667-76.25										
0										
L3				1	1	1				
76.250-51.000										
L4				1	1	0.987468				
51.000-37.000										
L5				1	1	1				
37.000-0.000										

### Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number	Number Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight klf
***√***										

### Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C <sub>A</sub> A <sub>A</sub> ft <sup>2</sup> /ft	Weight klf
561(1-5/8") (E)	B	No	Inside Pole	160.000 - 0.000	11	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001
LDF4-50A(1/2") (E)	B	No	Inside Pole	160.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000
LDF6-50A(1-1/4") (E)	B	No	Inside Pole	160.000 - 0.000	2	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 3 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C <sub>AA</sub> ft <sup>2</sup> /ft	Weight klf
*** LDF7-50A(1-5/8") (E)	B	No	Inside Pole	150.000 - 0.000	6	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001
LDF4-50A(1/2") (E)	B	No	Inside Pole	150.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000
*** 2" Rigid Conduit (E- Outside)	C	No	CaAa (Out Of Face)	142.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.200 0.300 0.400 0.600 1.000	0.003 0.004 0.006 0.013 0.032
2" Rigid Conduit (E-Outside Shielded)	C	No	CaAa (Out Of Face)	142.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.003 0.004 0.006 0.013 0.032
HJ4-50(1/2") (E-Outside Shielded)	C	No	CaAa (Out Of Face)	142.000 - 0.000	2	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.000 0.001 0.002 0.007 0.023
*** LDF7-50A(1 5/8") (E)	C	No	Inside Pole	134.000 - 0.000	6	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001
*** LDF6-50A(1-1/4") (E-Outside Shielded)	C	No	CaAa (Out Of Face)	116.000 - 0.000	6	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.002 0.004 0.009 0.028
LDF6-50A(1-1/4") (E)	C	No	Inside Pole	116.000 - 0.000	6	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001
FB-L98B-002-75000( 3/8") (E-Inside Conduit)	C	No	Inside Pole	116.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.000 0.000
WR-VG86ST-BRD( 3/4) (E-Inside Conduit)	C	No	Inside Pole	116.000 - 0.000	2	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.001 0.001 0.001 0.001 0.001
2" Rigid Conduit (E)	C	No	Inside Pole	116.000 - 0.000	1	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	0.000 0.000 0.000 0.000 0.000	0.003 0.003 0.003 0.003 0.003
*** LDF4-50A(1/2")	B	No	Inside Pole	50.000 - 0.000	2	No Ice	0.000	0.000

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 4 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C <sub>AA</sub> A <sub>A</sub> ft <sup>2</sup> /ft	Weight klf
(E)						1/2" Ice	0.000	0.000
						1" Ice	0.000	0.000
						2" Ice	0.000	0.000
						4" Ice	0.000	0.000
**√**								
**√**								
CCI 4.5" x 1" Plate (E-Shielded)	A	No	CaAa (Out Of Face)	52.500 - 42.500	1	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
						1" Ice	0.000	0.000
						2" Ice	0.000	0.000
						4" Ice	0.000	0.000
CCI 4.5" x 1" Plate (E-Shielded)	B	No	CaAa (Out Of Face)	52.500 - 42.500	1	No Ice	0.000	0.000
						1/2" Ice	0.000	0.000
						1" Ice	0.000	0.000
						2" Ice	0.000	0.000
						4" Ice	0.000	0.000
CCI 4.5" x 1" Plate (E-Outside)	C	No	CaAa (Out Of Face)	52.500 - 42.500	1	No Ice	0.167	0.000
						1/2" Ice	0.250	0.000
						1" Ice	0.333	0.000
						2" Ice	0.500	0.000
						4" Ice	0.833	0.000
**√**								

### Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A <sub>R</sub> ft <sup>2</sup>	A <sub>F</sub> ft <sup>2</sup>	C <sub>AA</sub> A <sub>A</sub> In Face ft <sup>2</sup>	C <sub>AA</sub> A <sub>A</sub> Out Face ft <sup>2</sup>	Weight K
L1	160.000-123.667	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.726
		C	0.000	0.000	0.000	3.667	0.163
L2	123.667-76.250	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	1.014
		C	0.000	0.000	0.000	9.483	0.998
L3	76.250-51.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.540
		C	0.000	0.000	0.000	5.300	0.580
L4	51.000-37.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.303
		C	0.000	0.000	0.000	4.217	0.322
L5	37.000-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.803
		C	0.000	0.000	0.000	7.400	0.850

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

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A <sub>R</sub> ft <sup>2</sup>	A <sub>F</sub> ft <sup>2</sup>	C <sub>AA</sub> A <sub>A</sub> In Face ft <sup>2</sup>	C <sub>AA</sub> A <sub>A</sub> Out Face ft <sup>2</sup>	Weight K
L1	160.000-123.667	A	0.893	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.726
		C		0.000	0.000	0.000	6.939	0.341
L2	123.667-76.250	A	0.856	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	1.014
		C		0.000	0.000	0.000	17.948	2.107
L3	76.250-51.000	A	0.811	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.540

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 5 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A <sub>R</sub> ft <sup>2</sup>	A <sub>F</sub> ft <sup>2</sup>	C <sub>AA</sub> In Face ft <sup>2</sup>	C <sub>AA</sub> Out Face ft <sup>2</sup>	Weight K
L4	51,000-37,000	C	0.776	0.000	0.000	0.000	9.834	1.203
		A		0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.303
L5	37,000-0.000	C	0.750	0.000	0.000	0.000	7.489	0.627
		A		0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.803
		C		0.000	0.000	0.000	13.144	1.658

### Feed Line Center of Pressure

Section	Elevation ft	CP <sub>X</sub> in	CP <sub>Z</sub> in	CP <sub>Y</sub> Ice in	CP <sub>Z</sub> Ice in
L1	160,000-123,667	-0.138	0.080	-0.234	0.135
L2	123,667-76,250	-0.243	0.140	-0.417	0.241
L3	76,250-51,000	-0.259	0.150	-0.444	0.257
L4	51,000-37,000	-0.363	0.210	-0.597	0.345
L5	37,000-0.000	-0.249	0.144	-0.419	0.242

### Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft	C <sub>AA</sub> Front ft <sup>2</sup>	C <sub>AA</sub> Side ft <sup>2</sup>	Weight K	
(2) DB846H80E-SX w/ Mount Pipe (E)	A	From Leg	4.000	0.000	160.000	No Ice	5.331	7.735	0.041
			0.000			1/2" Ice	5.888	8.930	0.099
			0.000			1" Ice	6.412	9.843	0.165
						2" Ice	7.481	11.711	0.323
						4" Ice	9.828	15.894	0.782
(2) DB846H80E-SX w/ Mount Pipe (E)	B	From Leg	4.000	0.000	160.000	No Ice	5.331	7.735	0.041
			0.000			1/2" Ice	5.888	8.930	0.099
			0.000			1" Ice	6.412	9.843	0.165
						2" Ice	7.481	11.711	0.323
						4" Ice	9.828	15.894	0.782
(2) DB846F65ZAXY w/ Mount Pipe (E)	C	From Leg	4.000	0.000	160.000	No Ice	7.271	7.821	0.047
			0.000			1/2" Ice	7.877	9.010	0.114
			0.000			1" Ice	8.484	9.912	0.189
						2" Ice	9.724	11.812	0.367
						4" Ice	12.325	15.978	0.867
HBXX-6517DS-A2M w/ Mount Pipe (E)	A	From Leg	4.000	0.000	160.000	No Ice	8.976	6.963	0.067
			0.000			1/2" Ice	9.647	8.182	0.137
			0.000			1" Ice	10.291	9.144	0.215
						2" Ice	11.595	11.022	0.398
						4" Ice	14.321	15.027	0.914
HBXX-6517DS-A2M w/ Mount Pipe (E)	B	From Leg	4.000	0.000	160.000	No Ice	8.976	6.963	0.067
			0.000			1/2" Ice	9.647	8.182	0.137
			0.000			1" Ice	10.291	9.144	0.215
						2" Ice	11.595	11.022	0.398
						4" Ice	14.321	15.027	0.914
HBXX-6517DS-A2M w/ Mount Pipe (E)	C	From Leg	4.000	0.000	160.000	No Ice	8.976	6.963	0.067
			0.000			1/2" Ice	9.647	8.182	0.137
			0.000			1" Ice	10.291	9.144	0.215
						2" Ice	11.595	11.022	0.398
						4" Ice	14.321	15.027	0.914

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b>	<b>Page</b>
	81363.010.01 - HRT 082 943274, CT (BU# 806382)	6 of 18
	<b>Project</b>	<b>Date</b>
		16:35:12 08/06/15
	<b>Client</b>	<b>Designed by</b>
	Crown Castle	J. Johnson

Description	Face or Leg	Offset Type	Offsets:			Azimuth Adjustment	Placement	C <sub>AA</sub> Front	C <sub>AA</sub> Side	Weight
			Horz	Vert	Lateral					
			ft	ft	ft	°	ft	ft <sup>2</sup>	ft <sup>2</sup>	K
(2) FD9R6004/2C-3L (E)	B	From Leg	4.000	0.000	0.000	160.000	4" Ice	14.321	15.027	0.914
							No Ice	0.300	0.085	0.003
							1/2" Ice	0.451	0.136	0.005
							1" Ice	0.543	0.196	0.009
							2" Ice	0.755	0.343	0.020
DB-T1-6Z-8AB-0Z (E)	B	From Leg	4.000	0.000	0.000	160.000	4" Ice	1.281	0.740	0.063
							No Ice	3.000	2.333	0.044
							1/2" Ice	5.915	2.558	0.080
							1" Ice	6.240	2.791	0.120
							2" Ice	6.914	3.284	0.213
(2) SBNHH-1D65B w/ Mount Pipe (P)	A	From Leg	4.000	0.000	0.000	160.000	4" Ice	8.365	4.373	0.455
							No Ice	8.637	7.071	0.066
							1/2" Ice	9.293	8.260	0.135
							1" Ice	9.917	9.170	0.212
							2" Ice	11.190	11.006	0.394
(2) SBNHH-1D65B w/ Mount Pipe (P)	B	From Leg	4.000	0.000	0.000	160.000	4" Ice	13.855	15.043	0.903
							No Ice	8.637	7.071	0.066
							1/2" Ice	9.293	8.260	0.135
							1" Ice	9.917	9.170	0.212
							2" Ice	11.190	11.006	0.394
(2) SBNHH-1D65B w/ Mount Pipe (P)	C	From Leg	4.000	0.000	0.000	160.000	4" Ice	13.855	15.043	0.903
							No Ice	8.637	7.071	0.066
							1/2" Ice	9.293	8.260	0.135
							1" Ice	9.917	9.170	0.212
							2" Ice	11.190	11.006	0.394
RRH2X60-AWS (P)	A	From Leg	4.000	0.000	0.000	160.000	4" Ice	13.855	15.043	0.903
							No Ice	2.000	1.816	0.060
							1/2" Ice	4.272	2.075	0.083
							1" Ice	4.596	2.360	0.109
							2" Ice	5.271	2.957	0.173
RRH2X60-AWS (P)	B	From Leg	4.000	0.000	0.000	160.000	4" Ice	6.722	4.253	0.354
							No Ice	2.000	1.816	0.060
							1/2" Ice	4.272	2.075	0.083
							1" Ice	4.596	2.360	0.109
							2" Ice	5.271	2.957	0.173
RRH2X60-AWS (P)	C	From Leg	4.000	0.000	0.000	160.000	4" Ice	6.722	4.253	0.354
							No Ice	2.000	1.816	0.060
							1/2" Ice	4.272	2.075	0.083
							1" Ice	4.596	2.360	0.109
							2" Ice	5.271	2.957	0.173
RRH2X60-PCS (P)	A	From Leg	4.000	0.000	0.000	160.000	4" Ice	6.722	4.253	0.354
							No Ice	1.250	2.011	0.055
							1/2" Ice	2.791	2.218	0.075
							1" Ice	3.025	2.435	0.099
							2" Ice	3.517	2.894	0.155
RRH2X60-PCS (P)	B	From Leg	4.000	0.000	0.000	160.000	4" Ice	4.606	3.915	0.313
							No Ice	1.250	2.011	0.055
							1/2" Ice	2.791	2.218	0.075
							1" Ice	3.025	2.435	0.099
							2" Ice	3.517	2.894	0.155
RRH2X60-PCS (P)	C	From Leg	4.000	0.000	0.000	160.000	4" Ice	4.606	3.915	0.313
							No Ice	1.250	2.011	0.055
							1/2" Ice	2.791	2.218	0.075
							1" Ice	3.025	2.435	0.099
							2" Ice	3.517	2.894	0.155
RRH2x60-700	A	From Leg	4.000	0.000	0.000	160.000	No Ice	2.000	1.816	0.060

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 7 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft	C <sub>AA</sub> Front ft <sup>2</sup>	C <sub>AA</sub> Side ft <sup>2</sup>	Weight K
(P)			0.000 0.000			1/2" Ice 4.272 1" Ice 4.596 2" Ice 5.271 4" Ice 6.722	2.075 2.360 2.957 4.253	0.083 0.109 0.173 0.354
RRH2x60-700 (P)	B	From Leg	4.000 0.000 0.000	0.000	160.000	No Ice 2.000 1/2" Ice 4.272 1" Ice 4.596 2" Ice 5.271 4" Ice 6.722	1.816 2.075 2.360 2.957 4.253	0.060 0.083 0.109 0.173 0.354
RRH2x60-700 (P)	C	From Leg	4.000 0.000 0.000	0.000	160.000	No Ice 2.000 1/2" Ice 4.272 1" Ice 4.596 2" Ice 5.271 4" Ice 6.722	1.816 2.075 2.360 2.957 4.253	0.060 0.083 0.109 0.173 0.354
DB-B1-6C-8AB-0Z (P)	A	From Leg	4.000 0.000 0.000	0.000	160.000	No Ice 3.000 1/2" Ice 5.915 1" Ice 6.240 2" Ice 6.914 4" Ice 8.365	2.333 2.558 2.791 3.284 4.373	0.044 0.080 0.120 0.213 0.455
Platform Mount [LP 602-1] (E)	C	None		0.000	160.000	No Ice 32.030 1/2" Ice 38.710 1" Ice 45.390 2" Ice 58.750 4" Ice 85.470	32.030 38.710 45.390 58.750 85.470	1.343 1.800 2.257 3.170 4.998
***								
(2) DB980H90E-M w/ Mount Pipe (E)	A	From Leg	4.000 0.000 2.000	0.000	150.000	No Ice 4.036 1/2" Ice 4.499 1" Ice 4.947 2" Ice 5.870 4" Ice 8.046	3.619 4.481 5.219 6.744 9.995	0.030 0.066 0.109 0.216 0.549
(2) DB980H90E-M w/ Mount Pipe (E)	B	From Leg	4.000 0.000 2.000	0.000	150.000	No Ice 4.036 1/2" Ice 4.499 1" Ice 4.947 2" Ice 5.870 4" Ice 8.046	3.619 4.481 5.219 6.744 9.995	0.030 0.066 0.109 0.216 0.549
(2) DB980H90E-M w/ Mount Pipe (E)	C	From Leg	4.000 0.000 2.000	0.000	150.000	No Ice 4.036 1/2" Ice 4.499 1" Ice 4.947 2" Ice 5.870 4" Ice 8.046	3.619 4.481 5.219 6.744 9.995	0.030 0.066 0.109 0.216 0.549
(2) 6' x 2" Mount Pipe (E)	A	From Leg	4.000 0.000 0.000	0.000	150.000	No Ice 1.425 1/2" Ice 1.925 1" Ice 2.294 2" Ice 3.060 4" Ice 4.702	1.425 1.925 2.294 3.060 4.702	0.022 0.033 0.048 0.090 0.231
(2) 6' x 2" Mount Pipe (E)	B	From Leg	4.000 0.000 0.000	0.000	150.000	No Ice 1.425 1/2" Ice 1.925 1" Ice 2.294 2" Ice 3.060 4" Ice 4.702	1.425 1.925 2.294 3.060 4.702	0.022 0.033 0.048 0.090 0.231
(2) 6' x 2" Mount Pipe (E)	C	From Leg	4.000 0.000 0.000	0.000	150.000	No Ice 1.425 1/2" Ice 1.925 1" Ice 2.294 2" Ice 3.060 4" Ice 4.702	1.425 1.925 2.294 3.060 4.702	0.022 0.033 0.048 0.090 0.231
Platform Mount [LP 602-1] (E)	C	None		0.000	150.000	No Ice 32.030 1/2" Ice 38.710	32.030 38.710	1.343 1.800



<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 8 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C <sub>AA</sub> Front ft <sup>2</sup>	C <sub>AA</sub> Side ft <sup>2</sup>	Weight K
						1" Ice	45.390	45.390	2.257
						2" Ice	58.750	58.750	3.170
						4" Ice	85.470	85.470	4.998
**v**									
(2) 6' x 3" Mount Pipe (E)	A	From Leg	2.000 0.000 0.000	0.000	142.000	No Ice	1.767	1.767	0.030
						1/2" Ice	2.129	2.129	0.044
						1" Ice	2.501	2.501	0.061
						2" Ice	3.272	3.272	0.109
						4" Ice	4.926	4.926	0.260
(2) 6' x 3" Mount Pipe (E)	B	From Leg	2.000 0.000 0.000	0.000	142.000	No Ice	1.767	1.767	0.030
						1/2" Ice	2.129	2.129	0.044
						1" Ice	2.501	2.501	0.061
						2" Ice	3.272	3.272	0.109
						4" Ice	4.926	4.926	0.260
(2) 6' x 3" Mount Pipe (E)	C	From Leg	2.000 0.000 0.000	0.000	142.000	No Ice	1.767	1.767	0.030
						1/2" Ice	2.129	2.129	0.044
						1" Ice	2.501	2.501	0.061
						2" Ice	3.272	3.272	0.109
						4" Ice	4.926	4.926	0.260
4' x 2" Horizontal Face Mount Pipe (E-Dish Tie Back)	B	From Face	0.500 0.000 0.000	0.000	145.000	No Ice	0.866	0.043	0.010
						1/2" Ice	1.111	0.087	0.017
						1" Ice	1.365	0.131	0.027
						2" Ice	1.901	0.219	0.057
						4" Ice	3.228	0.394	0.157
4' x 2" Horizontal Face Mount Pipe (E-Dish Tie Back)	C	From Face	0.500 0.000 0.000	0.000	145.000	No Ice	0.866	0.043	0.010
						1/2" Ice	1.111	0.087	0.017
						1" Ice	1.365	0.131	0.027
						2" Ice	1.901	0.219	0.057
						4" Ice	3.228	0.394	0.157
Side Arm Mount [SO 101-3] (E)	C	None		0.000	142.000	No Ice	7.500	7.500	0.252
						1/2" Ice	8.900	8.900	0.333
						1" Ice	10.300	10.300	0.414
						2" Ice	13.100	13.100	0.576
						4" Ice	18.700	18.700	0.900
**v**									
RR90-17-00DP w/ Mount Pipe (E)	A	From Leg	4.000 0.000 3.000	0.000	134.000	No Ice	4.593	3.319	0.034
						1/2" Ice	5.088	4.089	0.072
						1" Ice	5.578	4.784	0.115
						2" Ice	6.588	6.225	0.224
						4" Ice	8.731	9.308	0.557
RR90-17-00DP w/ Mount Pipe (E)	B	From Leg	4.000 0.000 3.000	0.000	134.000	No Ice	4.593	3.319	0.034
						1/2" Ice	5.088	4.089	0.072
						1" Ice	5.578	4.784	0.115
						2" Ice	6.588	6.225	0.224
						4" Ice	8.731	9.308	0.557
RR90-17-00DP w/ Mount Pipe (E)	C	From Leg	4.000 0.000 3.000	0.000	134.000	No Ice	4.593	3.319	0.034
						1/2" Ice	5.088	4.089	0.072
						1" Ice	5.578	4.784	0.115
						2" Ice	6.588	6.225	0.224
						4" Ice	8.731	9.308	0.557
(2) KRY 112 71/1 (E-as per photo)	A	From Leg	1.000 0.000 0.000	0.000	134.000	No Ice	0.681	0.450	0.013
						1/2" Ice	0.802	0.559	0.018
						1" Ice	0.932	0.677	0.025
						2" Ice	1.219	0.939	0.044
						4" Ice	1.896	1.566	0.111
(2) KRY 112 71/1 (E-as per photo)	B	From Leg	1.000 0.000	0.000	134.000	No Ice	0.681	0.450	0.013
						1/2" Ice	0.802	0.559	0.018

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 9 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Offset Type	Offsets:			Placement	C <sub>AA</sub> Front	C <sub>AA</sub> Side	Weight
			Horz	Lateral	Vert				
			0.000			1" Ice	0.932	0.677	0.025
						2" Ice	1.219	0.939	0.044
						4" Ice	1.896	1.566	0.111
(2) KRY 112 71/1 (E-as per photo)	B	From Leg	1.000	0.000	134.000	No Ice	0.681	0.450	0.013
			0.000			1/2" Ice	0.802	0.559	0.018
			0.000			1" Ice	0.932	0.677	0.025
						2" Ice	1.219	0.939	0.044
						4" Ice	1.896	1.566	0.111
Miscellaneous [NA 508-3] (E)	C	None		0.000	134.000	No Ice	13.710	13.710	0.398
						1/2" Ice	19.500	19.500	0.538
						1" Ice	25.290	25.290	0.678
						2" Ice	36.870	36.870	0.958
						4" Ice	60.030	60.030	1.518
**v**									
(2) 7770.00 w/ Mount Pipe (E)	A	From Leg	4.000	0.000	116.000	No Ice	6.119	4.254	0.055
			0.000			1/2" Ice	6.626	5.014	0.103
			4.000			1" Ice	7.128	5.711	0.157
						2" Ice	8.164	7.155	0.287
						4" Ice	10.360	10.412	0.665
(2) 7770.00 w/ Mount Pipe (E)	B	From Leg	4.000	0.000	116.000	No Ice	6.119	4.254	0.055
			0.000			1/2" Ice	6.626	5.014	0.103
			4.000			1" Ice	7.128	5.711	0.157
						2" Ice	8.164	7.155	0.287
						4" Ice	10.360	10.412	0.665
(2) 7770.00 w/ Mount Pipe (E)	C	From Leg	4.000	0.000	116.000	No Ice	6.119	4.254	0.055
			0.000			1/2" Ice	6.626	5.014	0.103
			4.000			1" Ice	7.128	5.711	0.157
						2" Ice	8.164	7.155	0.287
						4" Ice	10.360	10.412	0.665
AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	A	From Leg	4.000	0.000	116.000	No Ice	8.498	6.304	0.074
			0.000			1/2" Ice	9.149	7.479	0.139
			4.000			1" Ice	9.767	8.368	0.212
						2" Ice	11.031	10.179	0.385
						4" Ice	13.679	14.024	0.874
AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	B	From Leg	4.000	0.000	116.000	No Ice	8.498	6.304	0.074
			0.000			1/2" Ice	9.149	7.479	0.139
			4.000			1" Ice	9.767	8.368	0.212
						2" Ice	11.031	10.179	0.385
						4" Ice	13.679	14.024	0.874
AM-X-CD-16-65-00T-RET w/ Mount Pipe (E)	C	From Leg	4.000	0.000	116.000	No Ice	8.498	6.304	0.074
			0.000			1/2" Ice	9.149	7.479	0.139
			4.000			1" Ice	9.767	8.368	0.212
						2" Ice	11.031	10.179	0.385
						4" Ice	13.679	14.024	0.874
(2) LGP21401 (E)	A	From Leg	4.000	0.000	116.000	No Ice	0.500	0.233	0.014
			0.000			1/2" Ice	1.445	0.313	0.021
			4.000			1" Ice	1.611	0.403	0.030
						2" Ice	1.969	0.608	0.055
						4" Ice	2.788	1.121	0.135
(2) LGP21401 (E)	B	From Leg	4.000	0.000	116.000	No Ice	0.500	0.233	0.014
			0.000			1/2" Ice	1.445	0.313	0.021
			4.000			1" Ice	1.611	0.403	0.030
						2" Ice	1.969	0.608	0.055
						4" Ice	2.788	1.121	0.135
(2) LGP21401 (E)	C	From Leg	4.000	0.000	116.000	No Ice	0.500	0.233	0.014
			0.000			1/2" Ice	1.445	0.313	0.021
			4.000			1" Ice	1.611	0.403	0.030

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 10 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment °	Placement ft	C <sub>AA</sub> Front ft <sup>2</sup>	C <sub>AA</sub> Side ft <sup>2</sup>	Weight K
			Horz ft	Lateral Vert ft ft					
						2" Ice	1.969	0.608	0.055
						4" Ice	2.788	1.121	0.135
(2) LGP21901 (E)	A	From Leg	4.000	0.000	116.000	No Ice	0.200	0.184	0.006
			0.000			1/2" Ice	0.343	0.248	0.008
			4.000			1" Ice	0.425	0.322	0.011
						2" Ice	0.616	0.494	0.022
						4" Ice	1.101	0.943	0.066
(2) LGP21901 (E)	B	From Leg	4.000	0.000	116.000	No Ice	0.200	0.184	0.006
			0.000			1/2" Ice	0.343	0.248	0.008
			4.000			1" Ice	0.425	0.322	0.011
						2" Ice	0.616	0.494	0.022
						4" Ice	1.101	0.943	0.066
(2) LGP21901 (E)	C	From Leg	4.000	0.000	116.000	No Ice	0.200	0.184	0.006
			0.000			1/2" Ice	0.343	0.248	0.008
			4.000			1" Ice	0.425	0.322	0.011
						2" Ice	0.616	0.494	0.022
						4" Ice	1.101	0.943	0.066
RRUS-11 (E)	A	From Leg	4.000	0.000	116.000	No Ice	1.000	1.373	0.048
			0.000			1/2" Ice	3.491	1.551	0.068
			4.000			1" Ice	3.741	1.738	0.092
						2" Ice	4.268	2.138	0.150
						4" Ice	5.426	3.042	0.310
RRUS-11 (E)	B	From Leg	4.000	0.000	116.000	No Ice	1.000	1.373	0.048
			0.000			1/2" Ice	3.491	1.551	0.068
			4.000			1" Ice	3.741	1.738	0.092
						2" Ice	4.268	2.138	0.150
						4" Ice	5.426	3.042	0.310
RRUS-11 (E)	C	From Leg	4.000	0.000	116.000	No Ice	1.000	1.373	0.048
			0.000			1/2" Ice	3.491	1.551	0.068
			4.000			1" Ice	3.741	1.738	0.092
						2" Ice	4.268	2.138	0.150
						4" Ice	5.426	3.042	0.310
DC6-48-60-18-8F (E)	C	From Leg	4.000	0.000	116.000	No Ice	1.000	1.467	0.019
			0.000			1/2" Ice	1.667	1.667	0.037
			4.000			1" Ice	1.878	1.878	0.057
						2" Ice	2.333	2.333	0.105
						4" Ice	3.378	3.378	0.239
(2) 2' x 2" Pipe Mount (E-For TMA)	A	From Leg	4.000	0.000	116.000	No Ice	0.026	0.026	0.007
			0.000			1/2" Ice	0.056	0.056	0.008
			4.000			1" Ice	0.097	0.097	0.009
						2" Ice	0.212	0.212	0.013
						4" Ice	0.576	0.576	0.034
2' x 2" Pipe Mount (E-For TMA)	B	From Leg	4.000	0.000	116.000	No Ice	0.026	0.026	0.007
			0.000			1/2" Ice	0.056	0.056	0.008
			4.000			1" Ice	0.097	0.097	0.009
						2" Ice	0.212	0.212	0.013
						4" Ice	0.576	0.576	0.034
(2) 2' x 2" Pipe Mount (E-For TMA)	C	From Leg	4.000	0.000	116.000	No Ice	0.026	0.026	0.007
			0.000			1/2" Ice	0.056	0.056	0.008
			4.000			1" Ice	0.097	0.097	0.009
						2" Ice	0.212	0.212	0.013
						4" Ice	0.576	0.576	0.034
Platform Mount [LP 303-1] (E)	C	None		0.000	116.000	No Ice	14.660	14.660	1.250
						1/2" Ice	18.870	18.870	1.481
						1" Ice	23.080	23.080	1.713
						2" Ice	31.500	31.500	2.175
						4" Ice	48.340	48.340	3.101

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 11 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement	C <sub>AA</sub> Front	C <sub>AA</sub> Side	Weight	
			Horz	Lateral						Vert
<b>**v**</b>										
GPS (E)	B	From Leg	3.000	0.000	0.000	50.000	No Ice	0.175	0.175	0.000
							1/2" Ice	0.238	0.238	0.002
							1" Ice	0.309	0.309	0.005
							2" Ice	0.477	0.477	0.014
GPS (E)	C	From Leg	3.000	0.000	0.000	50.000	No Ice	0.175	0.175	0.000
							1/2" Ice	0.238	0.238	0.002
							1" Ice	0.309	0.309	0.005
							2" Ice	0.477	0.477	0.014
2' x 2" Pipe Mount (E)	B	From Leg	3.000	0.000	0.000	50.000	No Ice	0.026	0.026	0.007
							1/2" Ice	0.056	0.056	0.008
							1" Ice	0.097	0.097	0.009
							2" Ice	0.212	0.212	0.013
2' x 2" Pipe Mount (E)	C	From Leg	3.000	0.000	0.000	50.000	No Ice	0.026	0.026	0.007
							1/2" Ice	0.056	0.056	0.008
							1" Ice	0.097	0.097	0.009
							2" Ice	0.212	0.212	0.013
Side Arm Mount [SO 701-1] (E)	B	From Leg	1.500	0.000	0.000	50.000	No Ice	0.850	1.670	0.065
							1/2" Ice	1.140	2.340	0.079
							1" Ice	1.430	3.010	0.093
							2" Ice	2.010	4.350	0.121
Side Arm Mount [SO 701-1] (E)	C	From Leg	1.500	0.000	0.000	50.000	No Ice	0.850	1.670	0.065
							1/2" Ice	1.140	2.340	0.079
							1" Ice	1.430	3.010	0.093
							2" Ice	2.010	4.350	0.121
<b>**v**</b>										
2' x 2" Pipe Mount (E)	B	From Leg	3.000	0.000	0.000	45.000	No Ice	0.026	0.026	0.007
							1/2" Ice	0.056	0.056	0.008
							1" Ice	0.097	0.097	0.009
							2" Ice	0.212	0.212	0.013
2' x 2" Pipe Mount (E)	C	From Leg	3.000	0.000	0.000	45.000	No Ice	0.026	0.026	0.007
							1/2" Ice	0.056	0.056	0.008
							1" Ice	0.097	0.097	0.009
							2" Ice	0.212	0.212	0.013
Side Arm Mount [SO 701-1] (E-Empty)	B	From Leg	1.500	0.000	0.000	45.000	No Ice	0.850	1.670	0.065
							1/2" Ice	1.140	2.340	0.079
							1" Ice	1.430	3.010	0.093
							2" Ice	2.010	4.350	0.121
Side Arm Mount [SO 701-1] (E-Empty)	C	From Leg	1.500	0.000	0.000	45.000	No Ice	0.850	1.670	0.065
							1/2" Ice	1.140	2.340	0.079
							1" Ice	1.430	3.010	0.093
							2" Ice	2.010	4.350	0.121
<b>**v**</b>										

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 12 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

## Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft	Aperture Area ft <sup>2</sup>	Weight K	
Radiowaves HP3-11 (E)	A	Paraboloid w/Shroud (HP)	From Leg	2.000	-42.000		142.000	3.167	No Ice	7.876	0.050
				0.000					1/2" Ice	8.296	0.093
				2.000					1" Ice	8.716	0.135
									2" Ice	9.556	0.220
Radiowaves HP3-11 (E)	C	Paraboloid w/Shroud (HP)	From Leg	2.000	-50.000		142.000	3.167	No Ice	7.876	0.050
				0.000					1/2" Ice	8.296	0.093
				2.000					1" Ice	8.716	0.135
									2" Ice	9.556	0.220
								4" Ice	11.236	0.391	

\*\*\*v\*\*\*

## 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 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	Dead+Wind 330 deg - Service

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 13 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

### 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	160 - 123.667	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	14	-14.600	0.063	0.130
			Max. Mx	5	-6.255	-428.447	-0.789
			Max. My	2	-6.234	-0.110	429.307
			Max. Vy	5	17.966	-428.447	-0.789
			Max. Vx	2	-18.101	-0.110	429.307
			Max. Torque	4			1.489
L2	123.667 - 76.25	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	14	-28.590	2.247	-1.082
			Max. Mx	5	-15.998	-1526.646	-6.862
			Max. My	2	-15.983	3.809	1534.470
			Max. Vy	5	27.783	-1526.646	-6.862
			Max. Vx	2	-27.930	3.809	1534.470
			Max. Torque	4			1.418
L3	76.25 - 51	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	14	-38.280	3.911	-2.043
			Max. Mx	5	-23.788	-2458.262	-11.081
			Max. My	2	-23.779	6.562	2470.845
			Max. Vy	5	32.351	-2458.262	-11.081
			Max. Vx	2	-32.498	6.562	2470.845
			Max. Torque	4			1.413
L4	51 - 37	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	14	-41.087	4.317	-2.999
			Max. Mx	5	-26.107	-2688.689	-12.562
			Max. My	2	-26.098	7.199	2702.017
			Max. Vy	5	33.536	-2688.689	-12.562
			Max. Vx	2	-33.739	7.199	2702.017
			Max. Torque	4			1.412
L5	37 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	14	-59.264	7.141	-4.630
			Max. Mx	5	-41.390	-4303.317	-18.590
			Max. My	2	-41.390	11.258	4325.905
			Max. Vy	5	39.898	-4303.317	-18.590
			Max. Vx	2	-40.098	11.258	4325.905
			Max. Torque	4			1.008

### Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	21	59.264	-0.038	-9.421
	Max. H <sub>x</sub>	11	41.412	39.830	0.037
	Max. H <sub>z</sub>	2	41.412	0.071	40.076
	Max. M <sub>x</sub>	2	4325.905	0.071	40.076
	Max. M <sub>z</sub>	5	4303.317	-39.876	-0.124
	Max. Torsion	4	1.007	-34.471	20.105
	Min. Vert	1	41.412	0.000	0.000
	Min. H <sub>x</sub>	5	41.412	-39.876	-0.124
	Min. H <sub>z</sub>	8	41.412	-0.133	-40.050
	Min. M <sub>x</sub>	8	-4325.434	-0.133	-40.050
	Min. M <sub>z</sub>	11	-4300.811	39.830	0.037
	Min. Torsion	10	-0.767	34.474	-20.019

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 14 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

## Tower Mast Reaction Summary

Load Combination	Vertical	Shear <sub>x</sub>	Shear <sub>z</sub>	Overturning Moment, M <sub>x</sub>	Overturning Moment, M <sub>z</sub>	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead Only	41.412	0.000	0.000	1.655	2.096	0.000
Dead+Wind 0 deg - No Ice	41.412	-0.071	-40.076	-4325.905	11.258	-0.824
Dead+Wind 30 deg - No Ice	41.412	19.853	-34.771	-3756.317	-2139.230	-0.953
Dead+Wind 60 deg - No Ice	41.412	34.471	-20.105	-2173.248	-3717.931	-1.007
Dead+Wind 90 deg - No Ice	41.412	39.876	0.124	18.590	-4303.317	-0.090
Dead+Wind 120 deg - No Ice	41.412	34.518	20.147	2180.384	-3723.508	0.585
Dead+Wind 150 deg - No Ice	41.412	19.912	34.739	3753.613	-2145.506	0.593
Dead+Wind 180 deg - No Ice	41.412	0.133	40.050	4325.434	-16.227	0.382
Dead+Wind 210 deg - No Ice	41.412	-19.789	34.684	3746.872	2133.968	0.433
Dead+Wind 240 deg - No Ice	41.412	-34.474	20.019	2163.946	3722.651	0.767
Dead+Wind 270 deg - No Ice	41.412	-39.830	-0.037	-2.385	4300.811	0.060
Dead+Wind 300 deg - No Ice	41.412	-34.414	-20.121	-2173.236	3712.446	-0.675
Dead+Wind 330 deg - No Ice	41.412	-19.851	-34.749	-3751.655	2140.695	-0.926
Dead+Ice+Temp	59.264	-0.000	0.000	4.630	7.141	-0.000
Dead+Wind 0 deg+Ice+Temp	59.264	-0.025	-9.426	-1073.723	10.953	-0.216
Dead+Wind 30 deg+Ice+Temp	59.264	4.656	-8.172	-930.637	-524.405	-0.195
Dead+Wind 60 deg+Ice+Temp	59.264	8.092	-4.719	-535.488	-917.729	-0.160
Dead+Wind 90 deg+Ice+Temp	59.264	9.365	0.036	10.098	-1063.962	0.069
Dead+Wind 120 deg+Ice+Temp	59.264	8.112	4.744	548.651	-920.632	0.222
Dead+Wind 150 deg+Ice+Temp	59.264	4.685	8.175	940.409	-528.688	0.205
Dead+Wind 180 deg+Ice+Temp	59.264	0.038	9.421	1082.308	1.570	0.119
Dead+Wind 210 deg+Ice+Temp	59.264	-4.642	8.154	937.247	536.859	0.081
Dead+Wind 240 deg+Ice+Temp	59.264	-8.093	4.701	542.136	932.372	0.108
Dead+Wind 270 deg+Ice+Temp	59.264	-9.355	-0.017	2.143	1077.020	-0.076
Dead+Wind 300 deg+Ice+Temp	59.264	-8.089	-4.739	-538.388	931.810	-0.242
Dead+Wind 330 deg+Ice+Temp	59.264	-4.672	-8.177	-931.287	541.244	-0.278
Dead+Wind 0 deg - Service	41.412	-0.025	-13.867	-1497.775	5.302	-0.287
Dead+Wind 30 deg - Service	41.412	6.870	-12.032	-1300.421	-739.818	-0.334
Dead+Wind 60 deg - Service	41.412	11.928	-6.957	-751.900	-1286.808	-0.355
Dead+Wind 90 deg - Service	41.412	13.798	0.043	7.542	-1489.634	-0.034
Dead+Wind 120 deg - Service	41.412	11.944	6.971	756.576	-1288.743	0.202
Dead+Wind 150 deg - Service	41.412	6.890	12.020	1301.683	-741.989	0.204
Dead+Wind 180 deg - Service	41.412	0.046	13.858	1499.815	-4.220	0.132
Dead+Wind 210 deg - Service	41.412	-6.847	12.001	1299.340	740.793	0.152
Dead+Wind 240 deg - Service	41.412	-11.929	6.927	750.877	1291.246	0.271
Dead+Wind 270 deg - Service	41.412	-13.782	-0.013	0.277	1491.564	0.025
Dead+Wind 300 deg - Service	41.412	-11.908	-6.962	-751.885	1287.701	-0.233
Dead+Wind 330 deg - Service	41.412	-6.869	-12.024	-1298.795	743.123	-0.322

## Solution Summary

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
1	0.000	-41.412	0.000	0.000	41.412	0.000	0.000%
2	-0.071	-41.412	-40.076	0.071	41.412	40.076	0.000%
3	19.853	-41.412	-34.771	-19.853	41.412	34.771	0.000%
4	34.471	-41.412	-20.105	-34.471	41.412	20.105	0.000%
5	39.876	-41.412	0.124	-39.876	41.412	-0.124	0.000%
6	34.518	-41.412	20.147	-34.518	41.412	-20.147	0.000%
7	19.912	-41.412	34.739	-19.912	41.412	-34.739	0.000%
8	0.133	-41.412	40.050	-0.133	41.412	-40.050	0.000%
9	-19.789	-41.412	34.684	19.789	41.412	-34.684	0.000%
10	-34.474	-41.412	20.019	34.474	41.412	-20.019	0.000%
11	-39.830	-41.412	-0.037	39.830	41.412	0.037	0.000%
12	-34.414	-41.412	-20.121	34.414	41.412	20.121	0.000%

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b>	81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b>	15 of 18
	<b>Project</b>		<b>Date</b>	16:35:12 08/06/15
	<b>Client</b>	Crown Castle	<b>Designed by</b>	J. Johnson

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
13	-19.851	-41.412	-34.749	19.851	41.412	34.749	0.000%
14	0.000	-59.264	0.000	0.000	59.264	-0.000	0.000%
15	-0.025	-59.264	-9.426	0.025	59.264	9.426	0.000%
16	4.656	-59.264	-8.172	-4.656	59.264	8.172	0.000%
17	8.092	-59.264	-4.719	-8.092	59.264	4.719	0.000%
18	9.365	-59.264	0.036	-9.365	59.264	-0.036	0.000%
19	8.112	-59.264	4.744	-8.112	59.264	-4.744	0.000%
20	4.685	-59.264	8.175	-4.685	59.264	-8.175	0.000%
21	0.038	-59.264	9.421	-0.038	59.264	-9.421	0.000%
22	-4.642	-59.264	8.154	4.642	59.264	-8.154	0.000%
23	-8.093	-59.264	4.701	8.093	59.264	-4.701	0.000%
24	-9.355	-59.264	-0.017	9.355	59.264	0.017	0.000%
25	-8.089	-59.264	-4.739	8.089	59.264	4.739	0.000%
26	-4.672	-59.264	-8.177	4.672	59.264	8.177	0.000%
27	-0.025	-41.412	-13.867	0.025	41.412	13.867	0.000%
28	6.870	-41.412	-12.032	-6.870	41.412	12.032	0.000%
29	11.928	-41.412	-6.957	-11.928	41.412	6.957	0.000%
30	13.798	-41.412	0.043	-13.798	41.412	-0.043	0.000%
31	11.944	-41.412	6.971	-11.944	41.412	-6.971	0.000%
32	6.890	-41.412	12.020	-6.890	41.412	-12.020	0.000%
33	0.046	-41.412	13.858	-0.046	41.412	-13.858	0.000%
34	-6.847	-41.412	12.001	6.847	41.412	-12.001	0.000%
35	-11.929	-41.412	6.927	11.929	41.412	-6.927	0.000%
36	-13.782	-41.412	-0.013	13.782	41.412	0.013	0.000%
37	-11.908	-41.412	-6.962	11.908	41.412	6.962	0.000%
38	-6.869	-41.412	-12.024	6.869	41.412	12.024	0.000%

### Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00024863
3	Yes	5	0.00000001	0.00025154
4	Yes	5	0.00000001	0.00026296
5	Yes	4	0.00000001	0.00018112
6	Yes	5	0.00000001	0.00025750
7	Yes	5	0.00000001	0.00025590
8	Yes	4	0.00000001	0.00018270
9	Yes	5	0.00000001	0.00025682
10	Yes	5	0.00000001	0.00025158
11	Yes	4	0.00000001	0.00023321
12	Yes	5	0.00000001	0.00025613
13	Yes	5	0.00000001	0.00025743
14	Yes	4	0.00000001	0.00002229
15	Yes	5	0.00000001	0.00022914
16	Yes	5	0.00000001	0.00024981
17	Yes	5	0.00000001	0.00024955
18	Yes	5	0.00000001	0.00022716
19	Yes	5	0.00000001	0.00025183
20	Yes	5	0.00000001	0.00025226
21	Yes	5	0.00000001	0.00023027
22	Yes	5	0.00000001	0.00025262
23	Yes	5	0.00000001	0.00025233
24	Yes	5	0.00000001	0.00022931
25	Yes	5	0.00000001	0.00025222
26	Yes	5	0.00000001	0.00025283
27	Yes	4	0.00000001	0.00009921
28	Yes	4	0.00000001	0.00073964



<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 16 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

29	Yes	4	0.00000001	0.00080010
30	Yes	4	0.00000001	0.00009744
31	Yes	4	0.00000001	0.00076864
32	Yes	4	0.00000001	0.00076209
33	Yes	4	0.00000001	0.00009404
34	Yes	4	0.00000001	0.00077041
35	Yes	4	0.00000001	0.00074083
36	Yes	4	0.00000001	0.00009929
37	Yes	4	0.00000001	0.00076171
38	Yes	4	0.00000001	0.00077158

### Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 123.667	37.063	33	2.364	0.004
L2	128 - 76.25	22.500	33	1.850	0.002
L3	82 - 51	8.413	33	1.035	0.001
L4	51 - 37	3.109	33	0.570	0.000
L5	44 - 0	2.337	33	0.484	0.000

### Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
160.000	(2) DB846H80E-SX w/ Mount Pipe	33	37.063	2.364	0.005	16011
150.000	(2) DB980H90E-M w/ Mount Pipe	33	32.282	2.208	0.004	8005
145.000	4' x 2" Horizontal Face Mount Pipe	33	29.938	2.129	0.004	5336
144.000	Radiowaves HP3-11	33	29.476	2.113	0.003	5003
142.000	(2) 6' x 3" Mount Pipe	33	28.558	2.081	0.003	4446
134.000	RR90-17-00DP w/ Mount Pipe	33	25.006	1.950	0.003	3078
116.000	(2) 7770.00 w/ Mount Pipe	33	17.986	1.640	0.002	2741
50.000	GPS	33	2.989	0.557	0.000	3754
45.000	2' x 2" Pipe Mount	33	2.437	0.496	0.000	3839

### Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	160 - 123.667	106.717	2	6.811	0.011
L2	128 - 76.25	64.826	2	5.332	0.006
L3	82 - 51	24.253	2	2.984	0.002
L4	51 - 37	8.963	2	1.642	0.001
L5	44 - 0	6.738	2	1.395	0.000

### Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
160.000	(2) DB846H80E-SX w/ Mount Pipe	2	106.717	6.811	0.014	5709
150.000	(2) DB980H90E-M w/ Mount Pipe	2	92.966	6.362	0.011	2853

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 17 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
145.000	4' x 2" Horizontal Face Mount Pipe	2	86.224	6.135	0.010	1901
144.000	Radiowaves HP3-11	2	84.893	6.089	0.010	1782
142.000	(2) 6' x 3" Mount Pipe	2	82.253	5.997	0.010	1583
134.000	RR90-17-00DP w/ Mount Pipe	2	72.034	5.622	0.008	1094
116.000	(2) 7770.00 w/ Mount Pipe	2	51.831	4.728	0.005	967
50.000	GPS	2	8.618	1.606	0.001	1304
45.000	2' x 2" Pipe Mount	2	7.028	1.430	0.001	1333

### Compression Checks

### Pole Design Data

Section No.	Elevation	Size	L	L <sub>u</sub>	Kl/r	F <sub>a</sub>	A	Actual P	Allow. P <sub>a</sub>	Ratio P
	ft		ft	ft		ksi	in <sup>2</sup>	K	K	P/P <sub>a</sub>
L1	160 - 123.667 (1)	TP29.05x18.87x0.188	36.333	0.000	0.0	34.726	16.693	-6.235	579.674	0.011
L2	123.667 - 76.25 (2)	TP41.95x27.461x0.313	51.750	0.000	0.0	37.779	40.278	-15.983	1521.660	0.011
L3	76.25 - 51 (3)	TP48.398x39.715x0.344	31.000	0.000	0.0	35.934	53.191	-23.779	1911.340	0.012
L4	51 - 37 (4)	TP52.32x48.398x0.433	14.000	0.000	0.0	29.571	69.575	-26.098	2057.390	0.013
L5	37 - 0 (5)	TP62x49.672x0.406	44.000	0.000	0.0	34.071	80.572	-41.390	2745.170	0.015

### Pole Bending Design Data

Section No.	Elevation	Size	Actual M <sub>x</sub>	Actual f <sub>bx</sub>	Allow. F <sub>bx</sub>	Ratio f <sub>bx</sub> /F <sub>bx</sub>	Actual M <sub>y</sub>	Actual f <sub>by</sub>	Allow. F <sub>by</sub>	Ratio f <sub>by</sub> /F <sub>by</sub>
	ft		kip-ft	ksi	ksi		kip-ft	ksi	ksi	
L1	160 - 123.667 (1)	TP29.05x18.87x0.188	430.413	45.724	34.726	1.317	0.000	0.000	34.726	0.000
L2	123.667 - 76.25 (2)	TP41.95x27.461x0.313	1534.47	46.713	37.779	1.236	0.000	0.000	37.779	0.000
L3	76.25 - 51 (3)	TP48.398x39.715x0.344	2470.85	47.413	35.934	1.319	0.000	0.000	35.934	0.000
L4	51 - 37 (4)	TP52.32x48.398x0.433	2702.02	38.210	29.571	1.292	0.000	0.000	29.571	0.000
L5	37 - 0 (5)	TP62x49.672x0.406	4325.91	42.730	34.071	1.254	0.000	0.000	34.071	0.000

### Pole Shear Design Data

Section No.	Elevation	Size	Actual V	Actual f <sub>v</sub>	Allow. F <sub>v</sub>	Ratio f <sub>v</sub> /F <sub>v</sub>	Actual T	Actual f <sub>vt</sub>	Allow. F <sub>vt</sub>	Ratio f <sub>vt</sub> /F <sub>vt</sub>
	ft		K	ksi	ksi		kip-ft	ksi	ksi	
L1	160 - 123.667 (1)	TP29.05x18.87x0.188	18.090	1.084	26.000	0.085	0.777	0.039	26.000	0.002
L2	123.667 - 76.25 (2)	TP41.95x27.461x0.313	27.930	0.693	26.000	0.054	0.536	0.008	26.000	0.000
L3	76.25 - 51 (3)	TP48.398x39.715x0.344	32.498	0.611	26.000	0.048	0.636	0.006	26.000	0.000
L4	51 - 37 (4)	TP52.32x48.398x0.433	33.740	0.485	19.714	0.050	0.669	0.004	19.714	0.000
L5	37 - 0 (5)	TP62x49.672x0.406	40.098	0.498	26.000	0.039	0.824	0.004	26.000	0.000

<b>tnxTower</b>  <b>B+T Group</b> 1717 S Boulder Ave, Suite 300 Tulsa, OK 74119 Phone: (918) 587-4630 FAX: (918) 295-0265	<b>Job</b> 81363.010.01 - HRT 082 943274, CT (BU# 806382)	<b>Page</b> 18 of 18
	<b>Project</b>	<b>Date</b> 16:35:12 08/06/15
	<b>Client</b> Crown Castle	<b>Designed by</b> J. Johnson

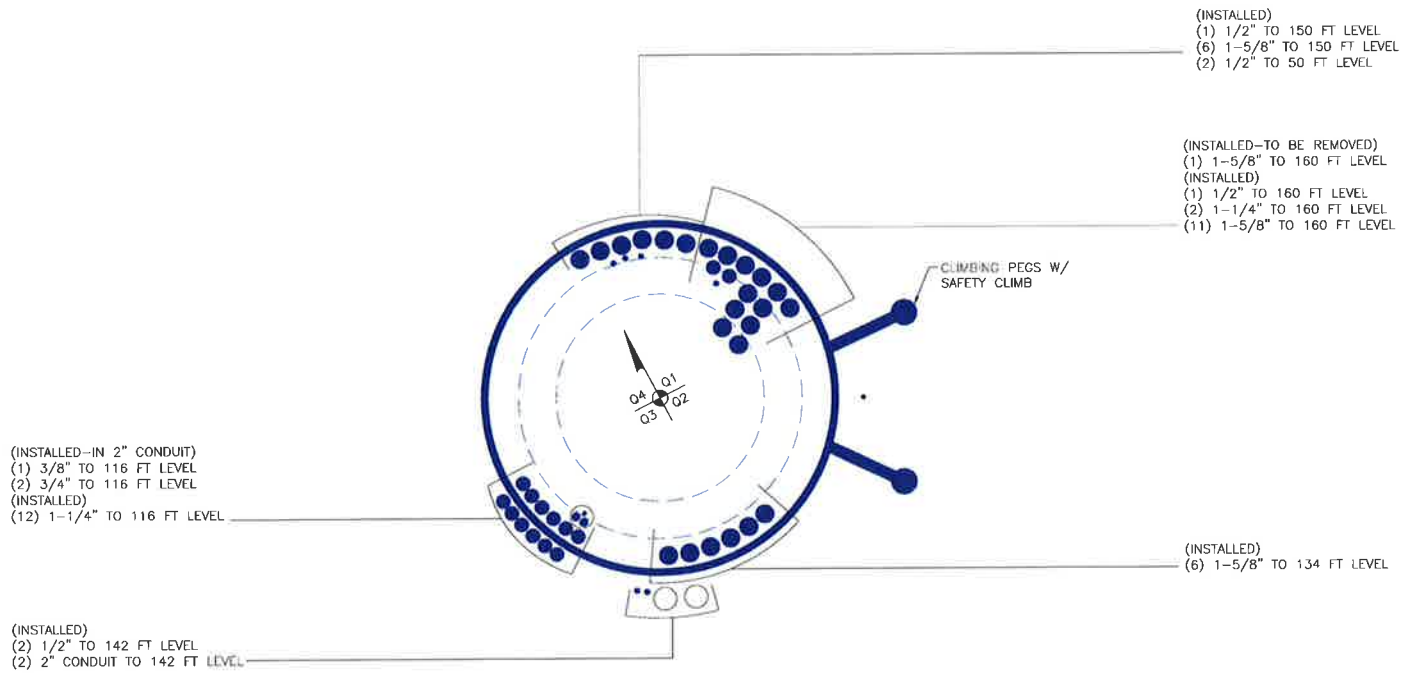
**Pole Interaction Design Data**

Section No.	Elevation ft	Ratio P	Ratio $f_{bc}$	Ratio $f_{bp}$	Ratio $f_v$	Ratio $f_{vt}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
		$P_a$	$F_{bc}$	$F_{bp}$	$F_v$	$F_{vt}$			
L1	160 - 123.667 (1)	0.011	1.317	0.000	0.085	0.002	1.329	1.333	H1-3+VT ✓
L2	123.667 - 76.25 (2)	0.011	1.236	0.000	0.054	0.000	1.248	1.333	H1-3+VT ✓
L3	76.25 - 51 (3)	0.012	1.319	0.000	0.048	0.000	1.332	1.333	H1-3+VT ✓
L4	51 - 37 (4)	0.013	1.292	0.000	0.050	0.000	1.305	1.333	H1-3+VT ✓
L5	37 - 0 (5)	0.015	1.254	0.000	0.039	0.000	1.270	1.333	H1-3+VT ✓

**Section Capacity Table**

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF*P <sub>allow</sub> K	% Capacity	Pass Fail	
L1	160 - 123.667	Pole	TP29.05x18.87x0.188	1	-6.235	772.705	99.2%	Pass	
L2	123.667 - 76.25	Pole	TP41.95x27.461x0.313	2	-15.983	2028.373	93.2%	Pass	
L3	76.25 - 51	Pole	TP48.398x39.715x0.344	3	-23.779	2547.816	99.6%	Pass	
L4	51 - 37	Pole	TP52.32x48.398x0.433	4	-26.098	2742.501	97.9%	Pass	
L5	37 - 0	Pole	TP62x49.672x0.406	5	-41.390	3659.311	94.8%	Pass	
							Summary		
							Pole (L3)	99.6	Pass
							<b>RATING =</b>	<b>99.6</b>	<b>Pass</b>

**APPENDIX B**  
**BASE LEVEL DRAWING**



BUSINESS UNIT: 806382

**APPENDIX C**  
**ADDITIONAL CALCULATIONS**









# Reinforcement Capacity

Dimensions and Properties										Compression				Actual		ASD-9		LRFD				
Model	Weight (lb/ft)	Area (in <sup>2</sup> )	Moment of Inertia (in <sup>4</sup> )	Moment of Inertia (in <sup>4</sup> )	Centroid from Mating Edge (in)	Centroid from Bolt Hole Center (in)	Web Thickness (in)	Width (in)	Flange Width (in)	Flange Thickness (in)	Hole Diameter (in)	Yield Stress (ksi)	Ultimate Stress (ksi)	Slender. Ratio Coefficient	Unbraced Length (in)	Slender. Ratio Coefficient	Unbraced Length (in)	Allowable Axial (kip)	Allowable Axial w/ Increase (kip)	Governing Axial Compress.	Design Axial Strength (kip)	Governing Axial Rupture
CD-MFP-0451009	15.3	4.50	0.38	7.59	0.5	0	1	4.5	0	0	1.1875	65	80	0.80	20	1.00	20	175.7	172.9	195.0	195.0	

# Stiffened or Unstiffened, UngROUTed, Circular Base Plate - Any Rod Material

## TIA Rev F

Site Data	
BU#:	806382
Site Name:	HRT 082 943274
App #:	305924 Rev. 1
Pole Manufacturer:	Other

Reactions	
Moment:	4325.9194 ft-kips
Axial:	41.3902 kips
Shear:	40.098363 kips

Anchor Rod Data		
Qty:	16	
Diam:	2.25	in
Rod Material:	A615-J	
Strength (Fu):	100	ksi
Yield (Fy):	75	ksi
Bolt Circle:	70.69	in

If No stiffeners, Criteria: **AISC ASD** <-Only Applicable to Unstiffened Cases

**Anchor Rod Results**  
 Maximum Rod Tension: 181.0 Kips  
 Allowable Tension: 195.0 Kips  
 Anchor Rod Stress Ratio: 92.8% **Pass**

Rigid
Service ASD
Fty*ASIF

Plate Data		
Diam:	76.69	in
Thick:	2.75	in
Grade:	60	ksi
Single-Rod B-eff:	12.46	in

**Base Plate Results**  
 Base Plate Stress: 32.2 ksi  
 Allowable Plate Stress: 60.0 ksi  
 Base Plate Stress Ratio: 53.7% **Pass**

Flexural Check

Rigid
Service ASD
0.75*Fy*ASIF
Y.L. Length: 33.96

Stiffener Data (Welding at both sides)		
Config:	0	*
Weld Type:		
Groove Depth:		in **
Groove Angle:		degrees
Fillet H. Weld:		<-- Disregard
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

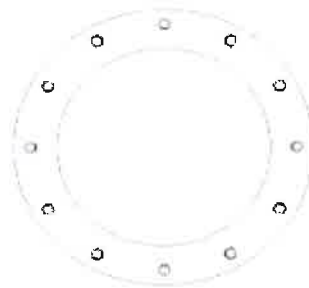
n/a

**Stiffener Results**  
 Horizontal Weld : n/a  
 Vertical Weld: n/a  
 Plate Flex+Shear, fb/Fb+(fv/Fv)^2: n/a  
 Plate Tension+Shear, ft/Ft+(fv/Fv)^2: n/a  
 Plate Comp. (AISC Bracket): n/a

**Pole Results**  
 Pole Punching Shear Check: n/a

Pole Data		
Diam:	62	in
Thick:	0.40625	in
Grade:	65	ksi
# of Sides:	12	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Stress Increase Factor	
ASIF:	1.333



\* 0 = none, 1 = every bolt, 2 = every 2 bolts, 3 = 2 per bolt

\*\* Note: for complete joint penetration groove welds the groove depth must be exactly 1/2 the stiffener thickness for calculation purposes

BU: 806382  
 Site Name: HRT 082 943274, CT  
 App Number: 305924 Rev. 1  
 Work Order: 1100983



Monopole Drilled Pier

Input

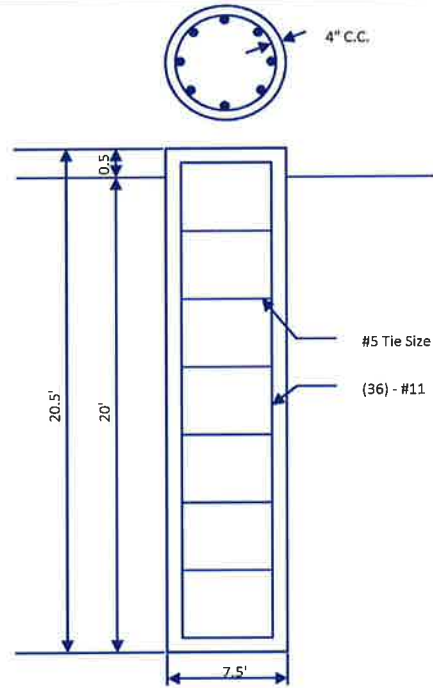
**Criteria**  
 TIA Revision: F  
 ACI 318 Revision: 2002  
 Seismic Category: B

**Forces**  
 Compression: 41 kips  
 Shear: 40 kips  
 Moment: 4326 k-ft  
 Swelling Force: 0 kips

**Foundation Dimensions**  
 Pier Diameter: 7.5 ft  
 Ext. above grade: 0.5 ft  
 Depth below grade: 20 ft

**Material Properties**  
 Number of Rebar: 36  
 Rebar Size: 11  
 Tie Size: 5  
 Rebar tensile strength: 60 ksi  
 Concrete Strength: 4000 psi  
 Ultimate Concrete Strain: 0.003 in/in  
 Clear Cover to Ties: 4 in

Soil Profile: Soil



Layer	Thickness (ft)	From (ft)	To (ft)	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)	Ultimate Uplift Friction (ksf)	Ultimate Comp. Skin Friction (ksf)	Ultimate Bearing Capacity (ksf)	SPT 'N' Counts
1	1	0	1	100	0	0	0	0	0	
2	5	1	6	110		34			0	
3	3.5	6	9.5	115		38			0	
4	10.5	9.5	20	145		45			30	

Analysis Results

Soil Lateral Capacity  
 Depth to Zero Shear: 4.51 ft  
 Max Moment, Mu: 4446.69 k-ft  
 Soil Safety Factor: 2.05  
 Safety Factor Req'd: 2  
**RATING: 97.8%**

Soil Axial Capacity  
 Skin Friction (k): 186.68 kips  
 End Bearing (k): 662.68 kips  
 Comp. Capacity (k), φCn: 849.36 kips  
 Comp. (k), Cu: 53.30 kips  
**RATING: 6.3%**

Concrete/Steel Check  
 Mu (from soil analysis) 5780.69 k-ft  
 φMn 9341.24 k-ft  
**RATING: 61.9%**

rho provided 0.88  
 rho required 0.33 OK

Rebar Spacing 5.51  
 Spacing required 22.56 OK

Dev. Length required 15.16  
 Dev. Length provided 53.51 OK

**Overall Foundation Rating: 97.8%**