



Crown Castle  
3 Corporate Park Drive, Suite 101  
Clifton Park, NY 12065

June 26, 2019

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

RE: **Notice of Exempt Modification for T-Mobile:  
842856 - T-Mobile Site ID: CT11501E  
122 Jonathan Trumbull Highway (Route 6), Andover, CT 06232  
Latitude: 41° 45' 0.46" / Longitude: -72° 24' 9.63"**

Dear Ms. Bachman:

T-Mobile currently maintains six (6) total antennas at the 140-foot mount on the existing 149-foot Monopole Tower, located at 122 Jonathan Trumbull Highway (Route 6), in Andover, CT. The tower is owned by Crown Castle and the property is owned by ASC Real Estate Inc. T-Mobile now intends to replace three (3) existing antennas with three (3) new 600/700 MHz antennas. T-Mobile also intends to install three (3) new remote radios and (1) hybrid line.

**Planned Modifications:**

**Tower:**

Remove and Replace:

(3) Andrew LNX-6515DS-A1M Antenna (**REMOVE**) - (3) RFS-APXVAARR24\_43U-NA20 Antenna 600/700 MHz (**REPLACE**)

Install New:

(3) RRU 4449 B71/B12  
(1) 6x12 HCS Hybrid Fiber Trunk

Existing to Remain:

(3) RFS APX16DWV-S-E-A20 Antenna 1900/2100 MHz  
(3) 1A- PCS Twin Style TMA  
(12) Coax

**Ground:** Internal upgrade to existing Cabinet.

The facility was approved by the Connecticut Siting Council on October 14, 2003 in Docket No. 242. This approval included conditions that T-Mobile's proposed modifications are in compliance with.

Please accept this letter as notification pursuant to Regulations of Connecticut State Agencies §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 Robert Burbank, First Selectman for the Town of Andover, John Valente, Zoning Agent, Crown Castle, the tower owner, and ASC Real Estate Inc., the property owner.

1. The proposed modifications will not result in an increase in the height of the existing tower.
2. The proposed modifications will not require the extension of the site boundary.
3. The proposed modification 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 emissions at the facility to a level at or above the Federal Communication Commission safety standard.
5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.
6. The existing structure and its foundation can support the proposed loading.

For the foregoing reasons, T-Mobile respectfully submits that the proposed modifications to the above-reference telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2). Please send approval/rejection letter to Attn: Anne Marie Zsamba.

Sincerely,

Anne Marie Zsamba  
Real Estate Specialist  
3 Corporate Park Drive, Suite 101  
Clifton Park, NY 12065  
(201) 236-9224  
AnneMarie.Zsamba@crowncastle.com

Attachments

cc:

Melanie A. Bachman

Page 3

Robert Burbank, First Selectman  
Town of Andover  
17 School Road  
Andover, CT 06232  
860.742.7305

John Valente, Zoning Agent  
Town of Andover  
17 School Road  
Andover, CT 06232  
860.742.7305

ASC Real Estate Inc, Property Owner  
PO Box 122  
Andover, CT 06232

# Exhibit A

## **Original Facility Approval**

# Connecticut Siting Council

## Decisions

**DOCKET NO. 242** - AT&T Wireless PCS, LLC d/b/a } Connecticut  
AT&T Wireless application for a Certificate of }  
Environmental Compatibility and Public Need for the } Siting  
construction, maintenance and operation of a wireless } Council  
telecommunications facility at one of two sites at 122 Route }  
6 (Andover Sportsmen Club), Andover, Connecticut. }  
October 14, 2003

### Decision and Order

Pursuant to the foregoing Findings of Fact and Opinion, the Connecticut Siting Council (Council) finds that the effects associated with the construction, operation, and maintenance of a telecommunications facility including effects on the natural environment; ecological integrity and balance; public health and safety; scenic, historic, and recreational values; forests and parks; air and water purity; and fish and wildlife are not disproportionate either alone or cumulatively with other effects when compared to need, are not in conflict with the policies of the State concerning such effects, and are not sufficient reason to deny the application and therefore directs that a Certificate of Environmental Compatibility and Public Need, as provided by General Statutes § 16-50k, be issued to AT&T Wireless PCS d/b/a AT&T Wireless for the construction, maintenance and operation of a wireless telecommunications facility at Site A at the Andover Sportsmen Club, 122 Route 6, Andover, Connecticut. The Council denies certification of Site B, also located at 122 Route 6, Andover, Connecticut.

The facility shall be constructed, operated, and maintained substantially as specified in the Council's record in this matter, and subject to the following conditions:

1. The tower shall be constructed as a monopole, no taller than necessary to provide the proposed telecommunications services, sufficient to accommodate the antennas of AT&T Wireless PCS, LLC and Omnipoint Holdings, Inc. d/b/a T-Mobile and other entities, both public and private, but such tower shall not exceed a height of 150 feet above ground level.
2. Panel antennas shall be installed on the monopole using a flush mount design.
3. Site preparation and construction activities shall occur during the time period of November 1 through March 31 to reduce potential impacts to populations of the Wood Turtle (*Clemmys insculpta*), a State Species of Special Concern.
4. The Certificate Holder shall prepare a Development and Management (D&M) Plan for this site in compliance with Sections 16-50j-75 through 16-50j-77 of the Regulations of Connecticut State Agencies. The D&M Plan shall be submitted to and approved by the Council prior to the commencement of facility construction and shall include:
  - a. a detailed site development plan that depicts the location of the access road, compound, tower, utility line, erosion and sedimentation control features, and landscaping;
  - b. specifications for the tower, tower foundation, antennas, equipment building, and security fence; and
  - c. construction plans for site clearing, water drainage, and erosion and sedimentation control consistent with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, as amended.
5. The Certificate Holder shall, prior to the commencement of operation, provide the Council worst-case modeling of electromagnetic radio frequency power density of all proposed entities' antennas at the closest point of uncontrolled access to the tower base, consistent with Federal Communications Commission, Office of Engineering and Technology, Bulletin No. 65, August 1997. The Certificate Holder shall ensure a recalculated report of electromagnetic radio frequency power density is submitted to the

Council if and when circumstances in operation cause a change in power density above the levels calculated and provided pursuant to this Decision and Order.

6. Upon the establishment of any new State or federal radio frequency standards applicable to frequencies of this facility, the facility granted herein shall be brought into compliance with such standards.
7. The Certificate Holder shall permit public or private entities to share space on the proposed tower for fair consideration, or shall provide any requesting entity with specific legal, technical, environmental, or economic reasons precluding such tower sharing. The Certificate Holder shall provide space on the tower for no compensation for any municipal antennas, provided such antennas are compatible with the structural integrity of the tower.
8. If the facility does not initially provide wireless services within one year of completion of construction or ceases to provide wireless services for a period of one year, this Decision and Order shall be void, and the Certificate Holder shall dismantle the tower and remove all associated equipment or reapply for any continued or new use to the Council before any such use is made.
9. Any antenna that becomes obsolete and ceases to function shall be removed within 60 days after such antennas become obsolete and ceases to function.
10. Unless otherwise approved by the Council, this Decision and Order shall be void if the facility authorized herein is not operational within one year of the effective date of this Decision and Order or within one year after all appeals to this Decision and Order have been resolved.

Pursuant to General Statutes § 16-50p, we hereby direct that a copy of the Findings of Fact, Opinion, and Decision and Order be served on each person listed below, and notice of issuance shall be published in The Hartford Courant, Rivereast News Bulletin, and the Journal Inquirer.

By this Decision and Order, the Council disposes of the legal rights, duties, and privileges of each party named or admitted to the proceeding in accordance with Section 16-50j-17 of the Regulations of Connecticut State Agencies.

The parties and intervenors to this proceeding are:

**Applicant**

AT&T Wireless PCS, LLC  
d/b/a AT&T Wireless

**Its Representative**

Christopher B. Fisher, Esq.  
Cuddy & Feder LLP  
90 Maple Avenue  
White Plains, New York 10601  
(914) 761-1300

**Party**

Tower Ventures II, LLC

**Its Representative**

Julie Donaldson Kohler, Esq.  
Hurwitz & Sagarin, LLC  
147 N. Broad Street  
Milford, CT 06460  
(203) 877-8000

**Party**

Town of Andover

**Its Representative**

First Selectman  
Andover Town Office Building  
17 School Road, P.O. Box 328

Andover, CT 06232-0328  
(860) 742-7305

**Intervenor**

Omnipoint Holdings, Inc.  
d/b/a T-Mobile

**Its Representative**

Stephen J. Humes, Esq.  
Diane W. Whitney, Esq.  
LeBoeuf, Lamb, Greene & MacRae  
Goodwin Square  
225 Asylum Street  
Hartford, CT 06103

# Exhibit B

## Property Card



**122 ROUTE 6**

**Location** 122 ROUTE 6

**Mblu** 28/ 5/ 4/ /

**Acct#** 530

**Owner** ASC REAL ESTATE INC

**Assessment** \$361,340

**Appraisal** \$586,800

**PID** 530

**Building Count** 2

**Current Value**

Appraisal			
Valuation Year	Improvements	Land	Total
2016	\$239,100	\$347,700	\$586,800

Assessment			
Valuation Year	Improvements	Land	Total
2016	\$167,500	\$193,840	\$361,340

**Owner of Record**

<b>Owner</b>	ASC REAL ESTATE INC	<b>Sale Price</b>	\$0
<b>Co-Owner</b>	ANDOVER SPORTSMANS CLUB	<b>Certificate</b>	
<b>Address</b>	P O BOX 122 ANDOVER, CT 06232	<b>Book &amp; Page</b>	0020/0572
		<b>Sale Date</b>	

**Ownership History**

Ownership History				
Owner	Sale Price	Certificate	Book & Page	Sale Date
ASC REAL ESTATE INC	\$0		0020/0572	

**Building Information**

**Building 1 : Section 1**

**Year Built:** 1970  
**Living Area:** 1,040  
**Replacement Cost:** \$154,971  
**Building Percent** 79  
**Good:**  
**Replacement Cost**  
**Less Depreciation:** \$122,400

**Building Photo**

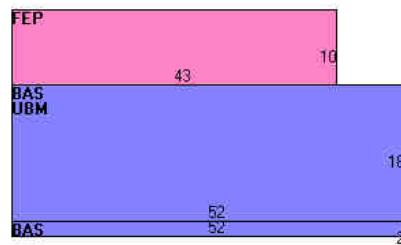
Building Attributes	
Field	Description
STYLE	Clubs/Lodges
MODEL	Commercial

Grade	C
Stories:	1
Occupancy	1
Exterior Wall 1	Vinyl Siding
Exterior Wall 2	
Roof Structure	Gable/Hip
Roof Cover	Asph/F Gls/Cmp
Interior Wall 1	Drywall/Sheet
Interior Wall 2	
Interior Floor 1	Vinyl/Asphalt
Interior Floor 2	
Heating Fuel	Oil
Heating Type	Hot Air-no Duc
AC Type	Central
Bldg Use	Fratnl Org
Total Rooms	
Total Bedrms	00
Total Baths	0
1st Floor Use:	3530
Heat/AC	NONE
Frame Type	WOOD FRAME
Baths/Plumbing	AVERAGE
Ceiling/Wall	CEIL & WALLS
Rooms/Prtns	AVERAGE
Wall Height	8
% Comn Wall	0



(http://images.vgsi.com/photos2/AndoverCTPhotos//default.jp

**Building Layout**



(http://images.vgsi.com/photos2/AndoverCTPhotos//Sketches.

Building Sub-Areas (sq ft)		Legend	
Code	Description	Gross Area	Living Area
BAS	First Floor	1,040	1,040
FEP	Porch, Enclosed, Finished	430	0
UBM	Basement, Unfinished	936	0
		2,406	1,040

**Building 2 : Section 1**

**Year Built:** 1970  
**Living Area:** 896  
**Replacement Cost:** \$132,799  
**Building Percent Good:** 71  
**Replacement Cost Less Depreciation:** \$94,300

Building Attributes : Bldg 2 of 2	
Field	Description
STYLE	Clubs/Lodges
MODEL	Commercial
Grade	C
Stories:	1
Occupancy	

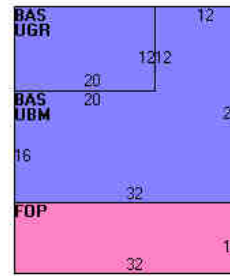
**Building Photo**



(http://images.vgsi.com/photos2/AndoverCTPhotos//default.jp

Exterior Wall 1	Vinyl Siding
Exterior Wall 2	
Roof Structure	Gable/Hip
Roof Cover	Asph/F GlS/Cmp
Interior Wall 1	Drywall/Sheet
Interior Wall 2	
Interior Floor 1	Carpet
Interior Floor 2	
Heating Fuel	Coal or Wood
Heating Type	None
AC Type	None
Bldg Use	Fratnl Org
Total Rooms	
Total Bedrms	00
Total Baths	0
1st Floor Use:	
Heat/AC	NONE
Frame Type	WOOD FRAME
Baths/Plumbing	AVERAGE
Ceiling/Wall	CEIL & WALLS
Rooms/Prtns	AVERAGE
Wall Height	8
% Comn Wall	

**Building Layout**



(<http://images.vgsi.com/photos2/AndoverCTPhotos//Sketches/53>)

Building Sub-Areas (sq ft)			Legend
Code	Description	Gross Area	Living Area
BAS	First Floor	896	896
FOP	Porch, Open, Finished	320	0
UBM	Basement, Unfinished	656	0
UGR	Garage, Unfinished	240	0
		2,112	896

**Extra Features**

Extra Features	Legend
No Data for Extra Features	

**Land**

**Land Use**

Use Code	3530
Description	Fratnl Org
Zone	R-40
Neighborhood	C1
Alt Land Appr Category	No

**Land Line Valuation**

Size (Acres)	67.13
Frontage	0
Depth	0
Assessed Value	\$193,840
Appraised Value	\$347,700

**Outbuildings**

Outbuildings						Legend
Code	Description	Sub Code	Sub Description	Size	Value	Bldg #
FN3	Fence-6' Chain			290 L.F.	\$2,000	1

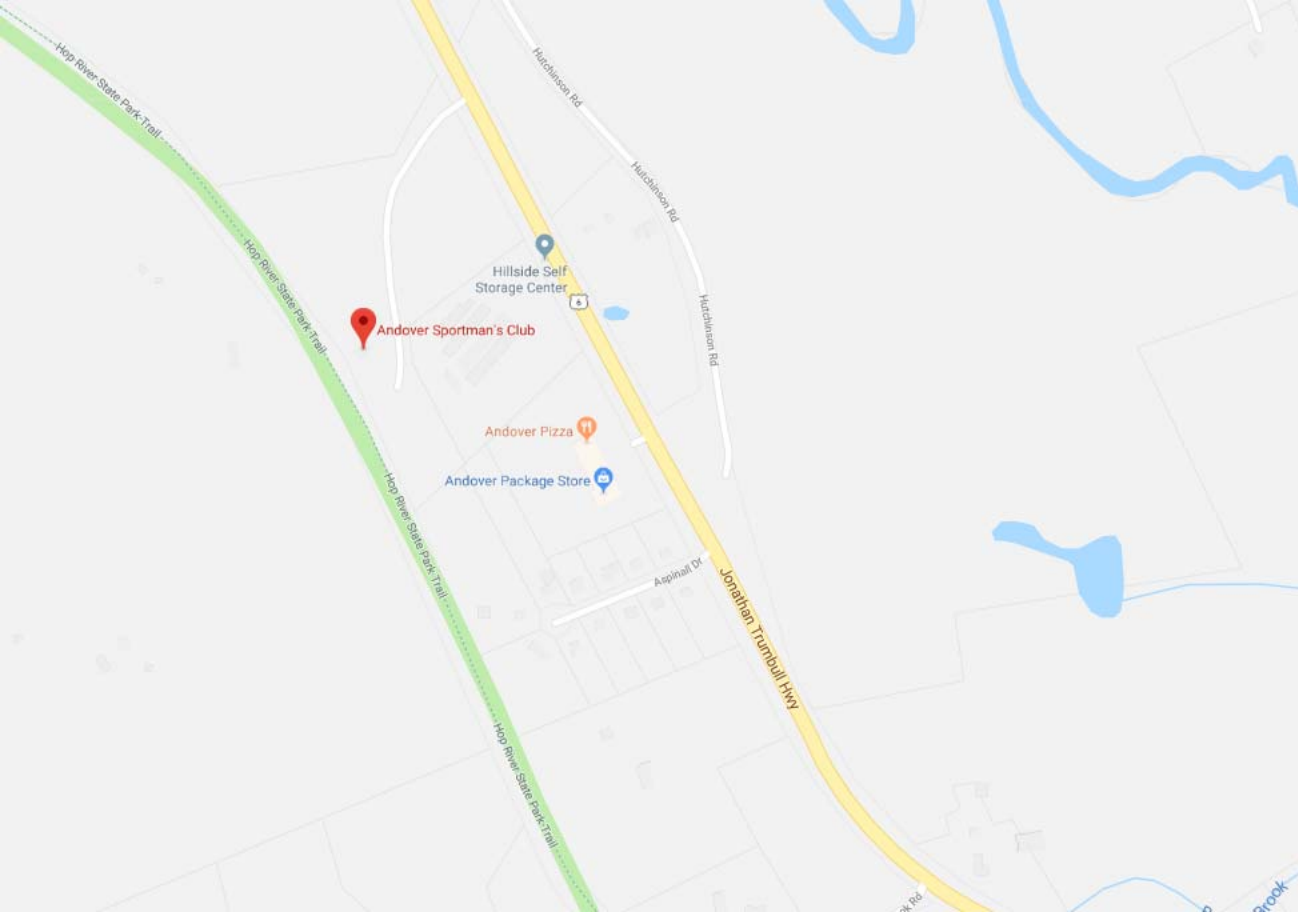
SHD5	Shed			384 S.F.	\$6,500	2
LT4	Lights (4)			2 UNITS	\$1,300	2
SHD5	Shed			91 S.F.	\$1,300	1
LT1	Lights (1)			10 UNITS	\$2,000	2
PAV1	Paving-Asphalt			1344 S.F.	\$600	1
SHD1	Shed Frame			180 S.F.	\$1,100	1
SHD1	Shed Frame			180 S.F.	\$1,100	2
PAT1	Patio Av			360 S.F.	\$500	2
SHD1	Shed Frame			180 S.F.	\$1,100	1
SHD1	Shed Frame			144 S.F.	\$900	1
PAV1	Paving-Asphalt			840 S.F.	\$400	1
SHD1	Shed Frame			120 S.F.	\$700	1
SHD1	Shed Frame			240 S.F.	\$2,900	1

**Valuation History**

Appraisal			
Valuation Year	Improvements	Land	Total
2015	\$107,800	\$334,000	\$441,800
2011	\$222,400	\$334,000	\$556,400
2010	\$124,700	\$239,200	\$363,900

Assessment			
Valuation Year	Improvements	Land	Total
2015	\$138,200	\$171,050	\$309,250
2011	\$155,700	\$171,050	\$326,750
2010	\$87,300	\$102,280	\$189,580

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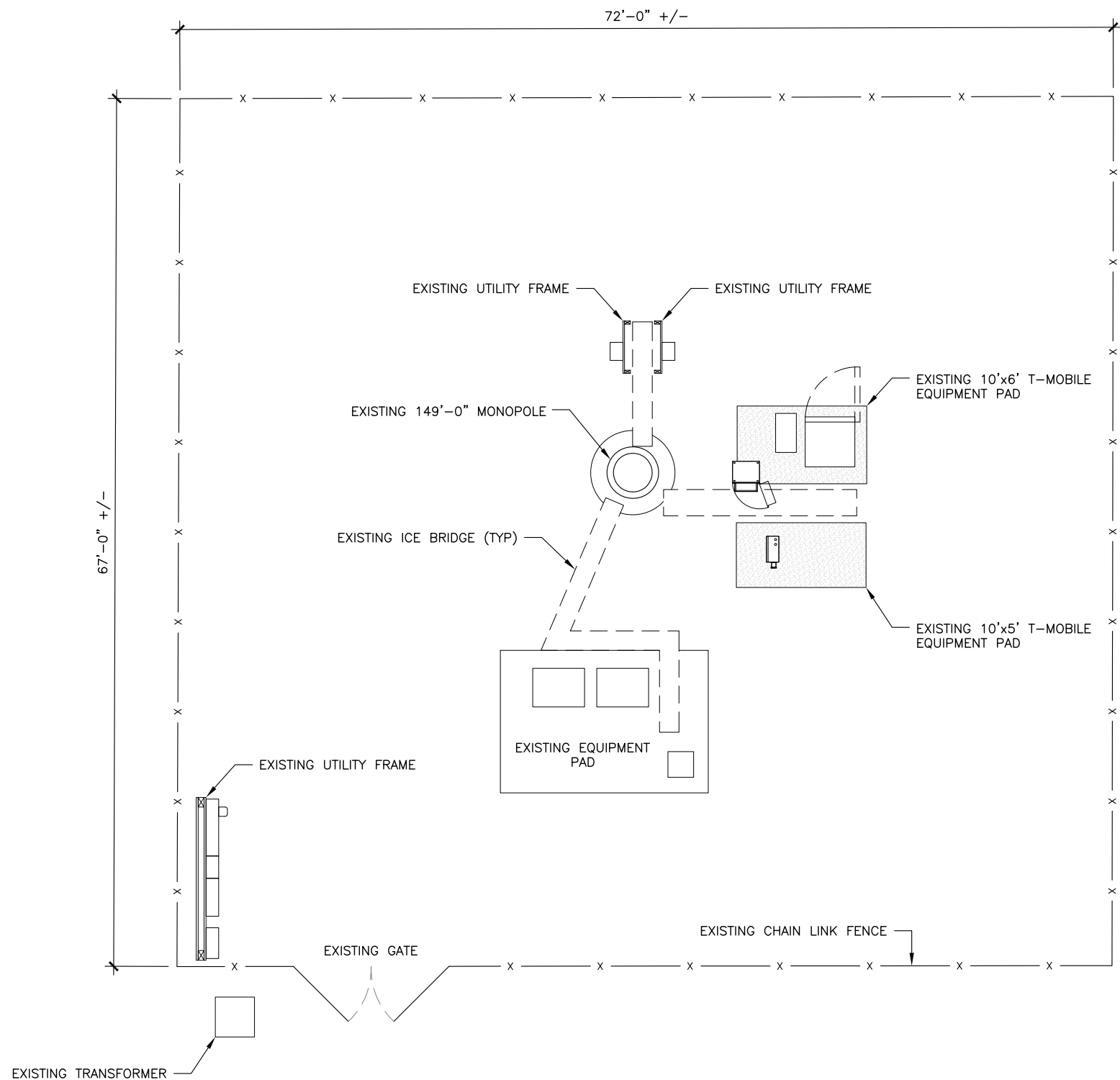


# Exhibit C

## **Construction Drawings**



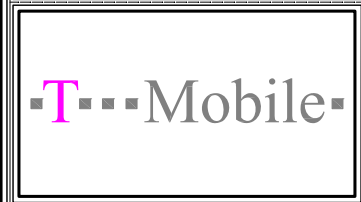
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**1 OVERALL SITE PLAN**  
 SCALE: 0' 4' 8' 16' 32'



- GENERAL NOTES:**
- SUBJECT PROPERTY IS KNOWN AS BLOCK TBD LOT TBD AS SHOWN ON THE ANDOVER TOWNSHIP TAX MAP AND IS SITUATED AT 122 JONATHAN TRUMBULL HWY (ROUTE 6), ANDOVER, CT 06232.
  - APPLICANT: T-MOBILE  
 A DELAWARE LIMITED LIABILITY COMPANY  
 4 SYLVAN WAY  
 PARSIPPANY, NEW JERSEY 07054  
 (973) 397-4800  
  
 TOWER OWNER: CROWN CASTLE INTERNATIONAL
  - THE APPLICANT IS TO UPDATE THEIR NETWORK BY INSTALLING SIX (6) NEW PANEL ANTENNAS, THREE (3) TMAS, THREE (3) RRUS, AND EIGHT (8) ADDITIONAL CABLES MOUNTED ON AN EXISTING MONOPOLE.
  - THIS FACILITY SHALL BE VISITED ON THE AVERAGE OF ONCE A MONTH FOR MAINTENANCE AND SHALL BE MONITORED FROM A REMOTE FACILITY.
  - THE EXISTING SITE IS LOCATED AT LATITUDE OF 41.750123° N± AND LONGITUDE OF 72.402707° W±. THE HORIZONTAL DATUM ARE IN TERMS OF NORTH AMERICAN DATUM OF 1983 (NAD 83).
  - THIS SET OF PLANS HAS BEEN PREPARED FOR THE PURPOSES OF MUNICIPAL AND AGENCY REVIEW AND APPROVAL. THIS SET OF PLANS SHALL NOT BE UTILIZED AS CONSTRUCTION DOCUMENTS UNTIL ALL CONDITIONS OF APPROVAL HAVE BEEN SATISFIED AND EACH OF THE DRAWINGS HAVE BEEN REVISED TO INDICATED "ISSUED FOR CONSTRUCTION"
  - ALL MATERIALS, WORKMANSHIP, AND CONSTRUCTION FOR THE SITE IMPROVEMENTS SHOWN HEREON SHALL BE IN ACCORDANCE WITH:
    - CURRENT PREVAILING MUNICIPAL AND/OR COUNTY SPECIFICATIONS, STANDARDS, AND REQUIREMENTS.
    - CURRENT PREVAILING UTILITY COMPANY AUTHORITY SPECIFICATIONS, STANDARDS AND REQUIREMENTS.
  - THE CONTRACTOR SHALL NOTIFY B+T GROUP, P.A. IMMEDIATELY IF ANY FIELD-CONDITIONS ENCOUNTERED DIFFER FROM THOSE REPRESENTED HEREON, AND/OR IF SUCH CONDITIONS WOULD OR COULD RENDER THE DESIGNS SHOWN HEREON INAPPROPRIATE AND/OR INEFFECTIVE.
  - THE CONTRACTOR IS RESPONSIBLE TO PROTECT, REPAIR AND/OR REPLACE ANY DAMAGED STRUCTURES, UTILITIES OR LANDSCAPED AREA WHICH MAY BE DISTURBED DURING THE CONSTRUCTION OF THIS FACILITY.
  - THE CONSTRUCTION CONTRACTOR IS SOLELY RESPONSIBLE FOR DETERMINING ALL CONSTRUCTION MEANS AND METHODS. THE CONSTRUCTION CONTRACTOR IS ALSO RESPONSIBLE FOR ALL JOB SITE SAFETY.
  - SITE INFORMATION SHOWN TAKEN FROM CROWN CASTLE SITE PLANS AND FROM CROWN CASTLE INSPECTION PHOTOS.
  - NO GUARANTEE IS MADE NOR SHOULD BE ASSUMED AS TO THE COMPLETENESS OR ACCURACY OF THE HORIZONTAL OR VERTICAL LOCATIONS. ALL PARTIES UTILIZING THIS INFORMATION SHALL FIELD VERIFY THE ACCURACY AND COMPLETENESS OF THE INFORMATION SHOWN PRIOR TO CONSTRUCTION ACTIVITIES.
  - ALL IMPROVEMENTS SHALL BE SUBJECT TO INSPECTION AND APPROVAL BY THE TOWNSHIP ENGINEER WHO WILL BE GIVEN PROPER NOTIFICATION PRIOR TO THE START OF ANY CONSTRUCTION.



CT11501E  
 BU #: 842856  
 CT501/ATT ANDOVER-PRIME  
 122 JONATHAN TRUMBULL HWY (ROUTE 6)  
 ANDOVER, CT 06232  
 EXISTING 149'-0" MONOPOLE

PROJECT NO: 135726.001.01  
 CHECKED BY: RMC

**ISSUED FOR:**

REV	DATE	DRWN	DESCRIPTION
A	5/10/19	STH	PRELIMINARY REVIEW
0	6/17/19	JJD	FOR CONSTRUCTION
1	6/18/19	GEH	FOR CONSTRUCTION

B&T ENGINEERING, INC.  
 PEC.0001564  
 Expires 2/10/20



IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

SHEET NUMBER: **A-1** REVISION: **1**

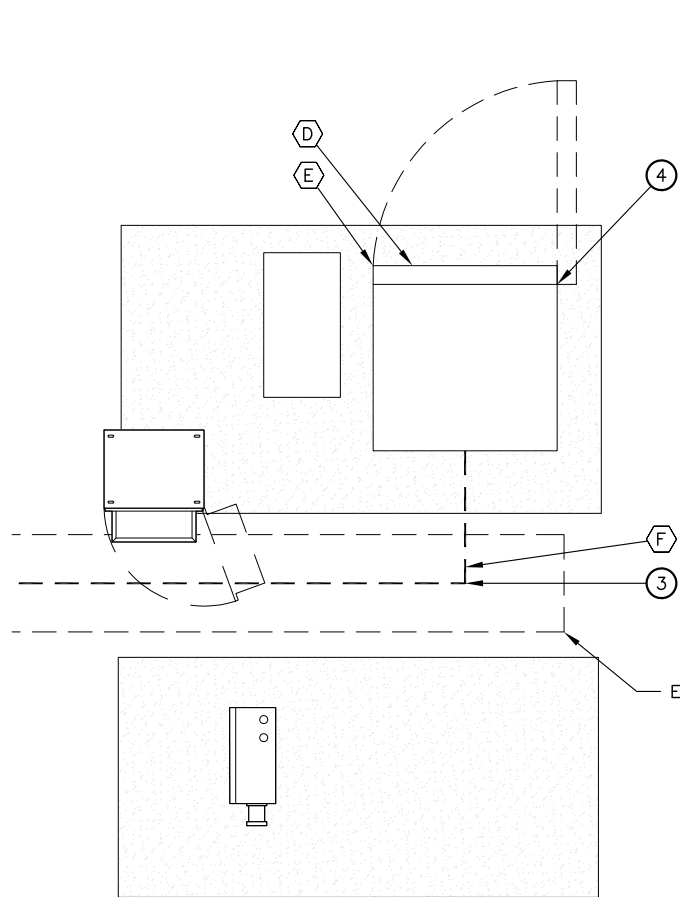


**LEGEND**

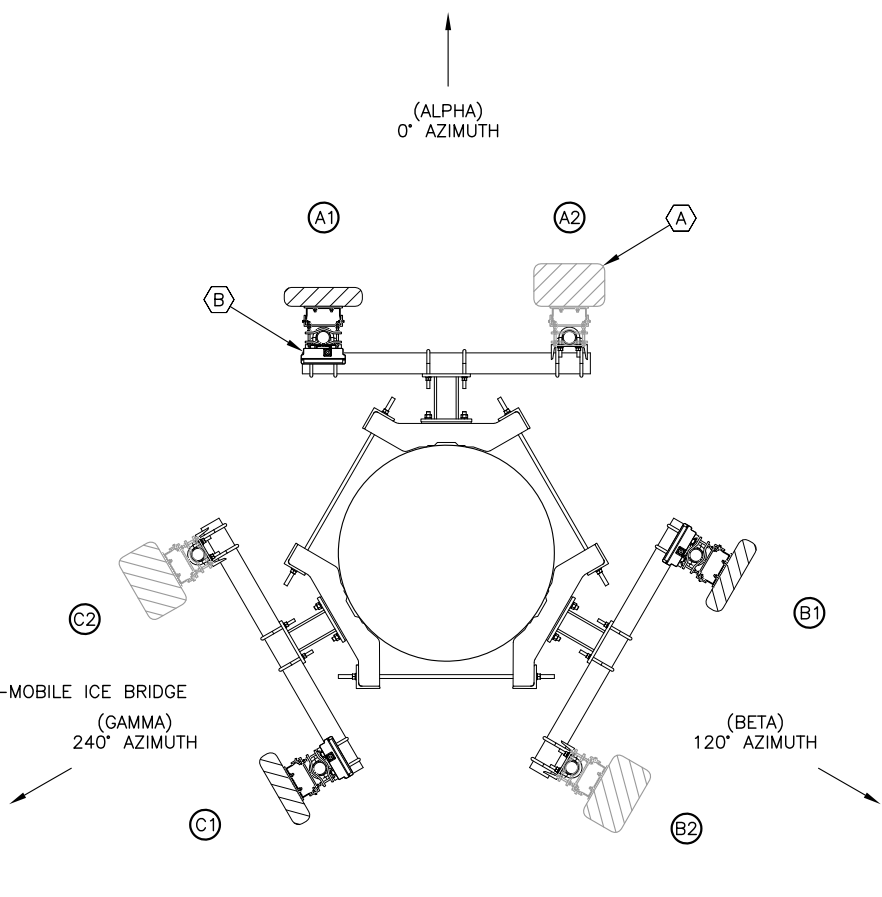
EXISTING/DEMOLITION NOTES		INSTALLATION NOTES	
(A)	EXISTING RFS APX16DWV-16DWV-S-E-A20 ANTENNA TO REMAIN (TOTAL OF 3)	(1)	INSTALL RFS APXVAARR24_43-U-NA20 (8 FT) ANTENNAS ON EXISTING MOUNT. PROVIDE NEW 2 7/8" OD SCH.40 PIPE MAST (LENGTH TO BE V.I.F) (TYP. OF 1 PER SECTOR, TOTAL OF 3)
(B)	EXISTING TMA TO REMAIN (SEE INSTALLATION NOTE 2)	(2)	INSTALL RADIO 4449 B12/B71 (TYP. OF 1 PER SECTOR, TOTAL OF 3)
(C)	EXISTING ANDREW LNX-6515DS-A1M ANTENNA TO BE REMOVED (TOTAL OF 3)	(3)	INSTALL (1) 6x12 HCS HYBRID FIBER TRUNK FROM EQUIPMENT TO ANTENNAS FOLLOWING EXISTING ROUTING.
(D)	EXISTING DUS41 TO BE REMOVED (TOTAL OF 1)	(4)	INSTALL (2) BB 6630
(E)	EXISTING RUS01 B12 TO BE REMOVED (TOTAL OF 6)		
(F)	EXISTING (12) COAX TO REMAIN		

**ANTENNA AND CABLE SCHEDULE**

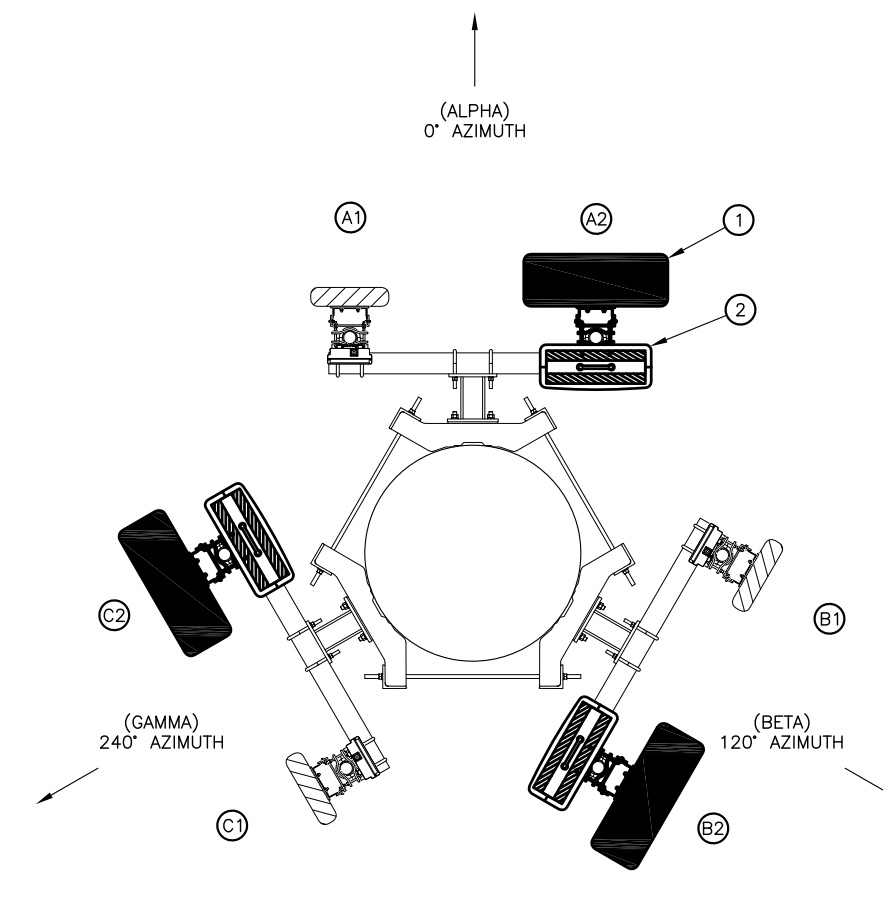
SECTOR	POSITION	EXISTING ANTENNAS	PROPOSED ANTENNA CONFIGURATION		E-TILT	M-TILT	ANTENNA CENTERLINE	TMA/RRH	CABLES	JUMPER TYPE	CABLE LENGTH
0° - ALPHA	A1	RFS APX16DWV-16DWV-S-E-A20	GSM	-	2'	0'	140'-0"	1/0	(2) 1 5/8" COAX	1/2" COAX	160'-0"
	A2	RFS APXVAARR24_43-U-NA20	LTE	B12	2'/2'	0'		0/1	(1) 1 1/4" HYBRID FIBER TRUNK	DC/FIBER & 1/2" COAX	190'-0"
120° - BETA	B1	RFS APX16DWV-16DWV-S-E-A20	GSM	-	2'	0'	140'-0"	1/0	(2) 1 5/8" COAX	1/2" COAX	160'-0"
	B2	RFS APXVAARR24_43-U-NA20	LTE	B12	2'/2'	0'		0/1	SHARED FIBER	DC/FIBER & 1/2" COAX	-
240° - GAMMA	C1	RFS APX16DWV-16DWV-S-E-A20	GSM	-	2'	0'	140'-0"	1/0	(2) 1 5/8" COAX	1/2" COAX	160'-0"
	C2	RFS APXVAARR24_43-U-NA20	LTE	B12	2'/2'	0'		0/1	SHARED FIBER	DC/FIBER & 1/2" COAX	-



**1 EQUIPMENT PLAN**  
SCALE: 0' 1' 2' 4' 10'



**2 EXISTING ANTENNA ORIENTATION**  
SCALE: 0' 1' 2' 4' 8'



**3 PROPOSED ANTENNA ORIENTATION**  
SCALE: 0' 1' 2' 4' 8'



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SHEET NUMBER: **A-2** REVISION: **1**

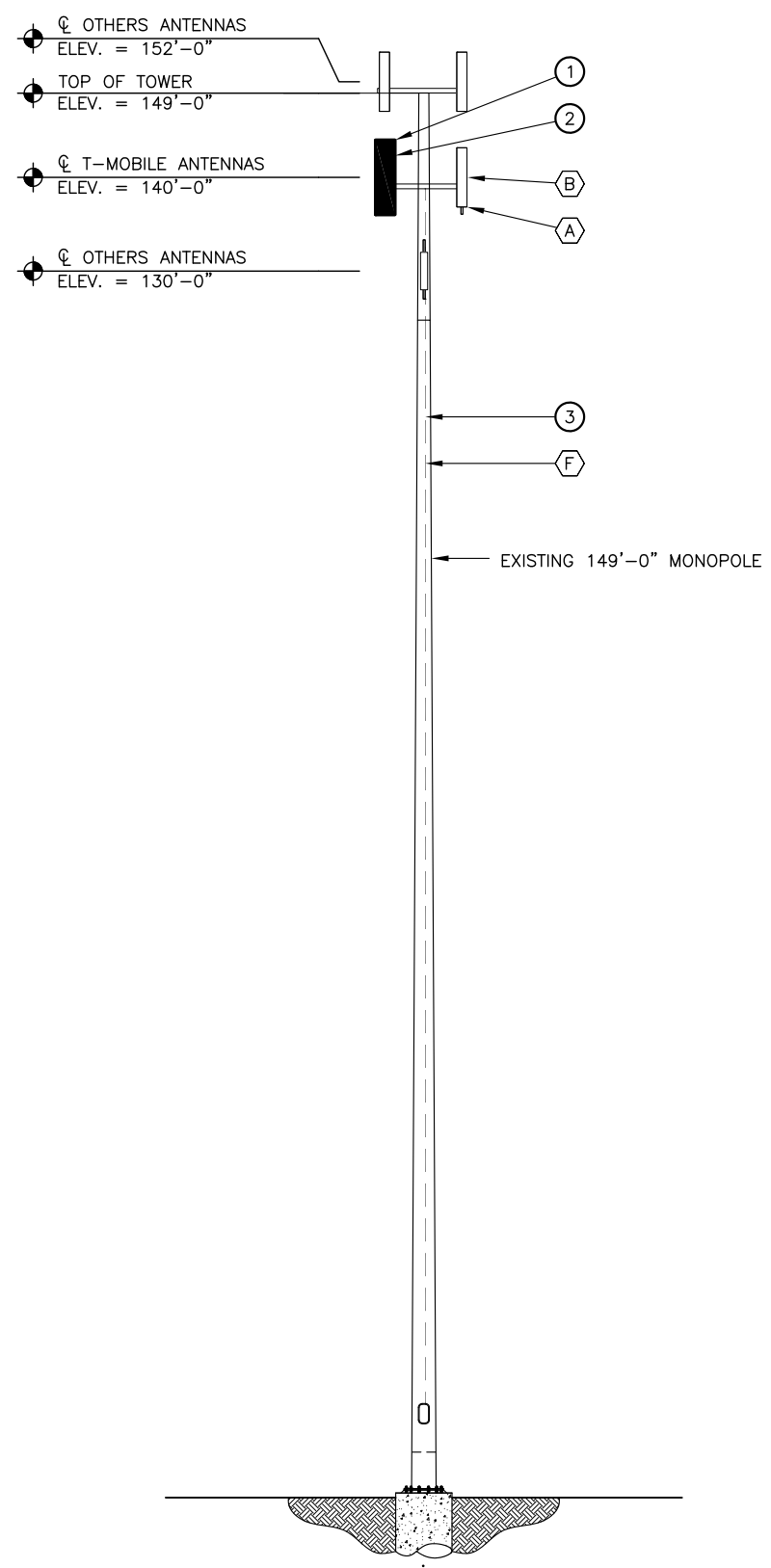
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1:35726\_842856\_Andover North.dwg -- Sheet:A-3 -- User: ghoyes -- Jun 18, 2019 -- 11:11am

LEGEND	
EXISTING/DEMOLITION NOTES	INSTALLATION NOTES
(A) EXISTING RFS APX16DWV-16DWV-S-E-A20 ANTENNA TO REMAIN (TOTAL OF 3)	(1) INSTALL RFS APXVAARR24_43-U-NA20 (8 FT) ANTENNAS ON EXISTING MOUNT. PROVIDE NEW 2 7/8" OD SCH.40 PIPE MAST (LENGTH TO BE V.I.F) (TYP. OF 1 PER SECTOR, TOTAL OF 3)
(B) EXISTING TMA TO REMAIN (SEE INSTALLATION NOTE 2)	(2) INSTALL RADIO 4449 B12/B71 (TYP. OF 1 PER SECTOR, TOTAL OF 3)
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(E) EXISTING RUS01 B12 TO BE REMOVED (TOTAL OF 6)	
(F) EXISTING (12) COAX TO REMAIN	

EXISTING MOUNT IS SUFFICIENT PER STRUCTURAL ANALYSIS BY GPD ENGINEERING AND ARCHITECTURE PROFESSIONAL CORPORATION DATED 5/13/19.

LEGEND:  
 NEW  
 EXISTING  
 FUTURE



1 TOWER ELEVATION  
 SCALE: NOT TO SCALE



CT11501E  
 BU #: 842856  
 CT501/ATT ANDOVER-PRIME  
 122 JONATHAN TRUMBULL HWY (ROUTE 6)  
 ANDOVER, CT 06232  
 EXISTING 149'-0" MONOPOLE

PROJECT NO: 135726.001.01  
 CHECKED BY: RMC

ISSUED FOR:			
REV	DATE	DRWN	DESCRIPTION
A	5/10/19	STH	PRELIMINARY REVIEW
0	6/17/19	JJD	FOR CONSTRUCTION
1	6/18/19	GEH	FOR CONSTRUCTION

B&T ENGINEERING, INC.  
 PEC.0001564  
 Expires 2/10/20



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SHEET NUMBER: A-3  
 REVISION: 1

1A  
A-4 PROPOSED ANTENNA TO PIPE CLAMP  
(INCLUDED WITH ANTENNA)

2  
A-4 PROPOSED L700 ANTENNA

3  
A-4 PROPOSED RRU

EXISTING PLATFORM  
MOUNTING RAIL

WORKING POINT

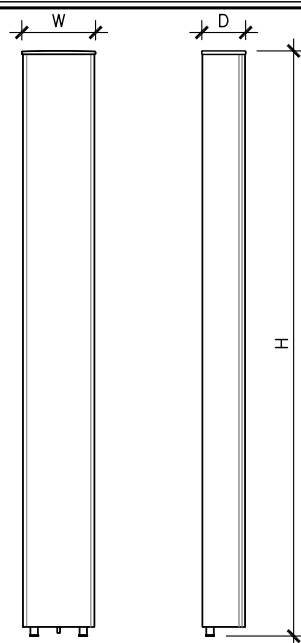
EXISTING MOUNTING PIPE

UPPER BRACKET ASSEMBLY

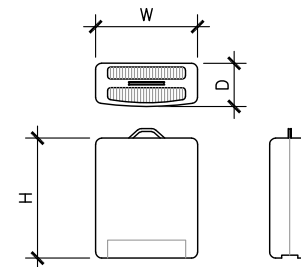
LOWER BRACKET ASSEMBLY

MOUNTING PIPE  
(2 1/2" - 4 1/2" O.D.)

ANTENNA MOUNTING KIT  
P/N: APM40



ANTENNA SPECS	
MANUFACTURER	RFS
MODEL #	APXVAARR24_43-U-NA20
WIDTH	24.0"
DEPTH	8.7"
HEIGHT	95.9"
WEIGHT	128.0 LBS



RRU SPECIFICATIONS	
MANUFACTURER	ERICSSON
MODEL #	4449
WIDTH	13.2"
DEPTH	10.4"
HEIGHT	14.9"
WEIGHT	74 LBS

1 PROPOSED L600 ANTENNA  
& RRU MOUNTING DETAIL  
SCALE: N.T.S.

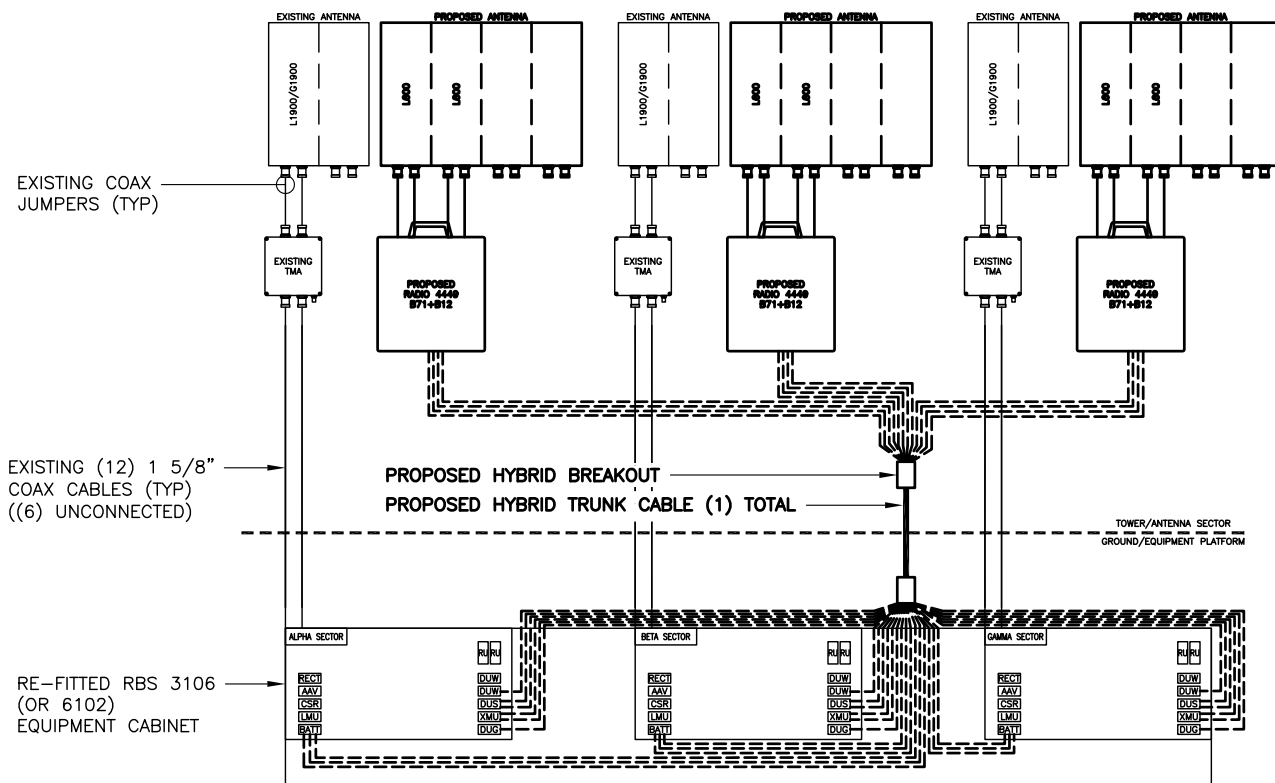
1A ANTENNA  
MOUNTING BRACKET  
SCALE: N.T.S.

2 L600 ANTENNA DETAIL  
SCALE: N.T.S.

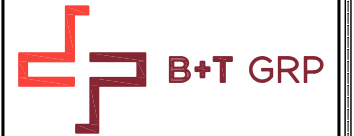
3 REMOTE RADIO UNIT (RRU)  
SCALE: N.T.S.

NOTES:

1. TAG ALL EXISTING AND PROPOSED CABLES/JUMPERS PER T-MOBILE SPECIFICATIONS.
2. SEE RF SCHEDULE FOR CABLE AND JUMPER LENGTHS.
3. REFER TO ANTENNA ORIENTATION ON SHEET C-3 FOR EXACT ANTENNA POSITIONING.



4 ANTENNA & CABLING SCHEMATIC  
SCALE: N.T.S.



CT11501E  
BU #: 842856  
CT501/ATT ANDOVER-PRIME  
122 JONATHAN TRUMBULL HWY (ROUTE 6)  
ANDOVER, CT 06232  
EXISTING 149'-0" MONOPOLE

PROJECT NO: 135726.001.01

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ISSUED FOR:			
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PEC.0001564  
Expires 2/10/20



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TO ALTER THIS DOCUMENT.

SHEET NUMBER: A-4  
REVISION: 1

# Exhibit D

## **Structural Analysis Report**



GPD Engineering and Architecture  
Professional Corporation

520 South Main Street, Suite 2531  
Akron, OH 44311  
(216) 927-8663

Date: **May 13, 2019**

Heather Simeone  
Crown Castle  
3530 Toringdon Way Suite 300  
Charlotte, NC 28277

**Subject: Structural Analysis Report**

**Carrier Designation: T-Mobile Co-Locate**  
**Carrier Site Number:** CT11501E  
**Carrier Site Name:** CT501/ATT Andover - Prime

**Crown Castle Designation:**  
**Crown Castle BU Number:** 842856  
**Crown Castle Site Name:** ANDOVER NORTH  
**Crown Castle JDE Job Number:** 559272  
**Crown Castle Work Order Number:** 1728309  
**Crown Castle Order Number:** 479836 Rev. 1

**Engineering Firm Designation:** GPD Group Project Number: 2019777.842856.03

**Site Data:** 122 Jonathan Trumbull Hwy (Rte 6), Andover, CT 06232, Tolland County  
Latitude 41° 45' 0.46", Longitude -72° 24' 9.63"  
149 Foot – Modified EEI Monopole Tower

Dear Heather Simeone,

We are pleased to submit this “**Structural Analysis Report**” to determine the structural integrity of the above mentioned tower.

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:

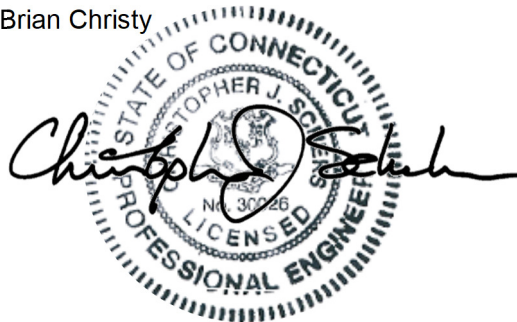
LC7: Proposed Equipment Configuration **Sufficient Capacity 93.3%**

This analysis utilizes an ultimate 3-second gust wind speed of 130 mph as required by the 2018 Connecticut State Building Code. Applicable Standard references and design criteria are listed in Section 2 - Analysis Criteria.

Structural analysis prepared by: Brian Christy

Respectfully submitted by:

Christopher J. Scheks, P.E.  
Connecticut #: 0030026



5/13/2019

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tnxTower Output

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Base Level Drawing

### **8) APPENDIX C**

Additional Calculations

## 1) INTRODUCTION

The existing tower consists of four major sections connected by slip joints. It has an 18-sided cross section and is evenly tapered from 47.5" (flat-flat) at the base to 21.5" (flat-flat) at the top. It is galvanized and doesn't have aviation lighting.

This tower is a 149 ft Monopole tower designed by EEI in November of 2003. The tower was originally designed for a wind speed of 85 mph per TIA/EIA-222-F.

The modifications designed by GPD (Project #: 2009260.48, dated 01/29/2009), consisting of adding base plate stiffeners, have been considered in this analysis.

The modifications designed by Crown Castle (WO #: 1070878, dated 6/30/15), consisting of replacing base plate stiffeners and adding flat plates from 44.75' - 59.75' and 80.5' - 100.5' have been considered in this analysis.

## 2) ANALYSIS CRITERIA

<b>TIA-222 Revision:</b>	TIA-222-H
<b>Risk Category:</b>	II
<b>Wind Speed:</b>	130 mph
<b>Exposure Category:</b>	C
<b>Topographic Factor:</b>	1
<b>Ice Thickness:</b>	2.0
<b>Wind Speed with Ice:</b>	50 mph
<b>Service Wind Speed:</b>	60 mph

**Table 1 - Proposed Equipment Configuration**

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
140.0	140.0	3	RFS/Celwave	APX16DWV-16DWV-S-E-A20	13	1-5/8
		3	RFS/Celwave	APXVAARR24_43-U-NA20		
		3	Ericsson	KRY 112 489/2		
		3	Ericsson	RADIO 4449 B12/B71		
		1	--	Side Arm Mount [SO 101-3]		

**Table 2 – Other Considered Equipment**

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)
149.0	151.0	3	Ericsson	RRUS-11	6 2 1	1-1/4 7/8 1/2
		3	KMW Communications	AM-X-CD-16-65-00T-RET		
		3	Powerwave Technologies	7770.00		
		6	Powerwave Technologies	LGP17201		
		6	Powerwave Technologies	LGP21901		
		1	Raycap	DC6-48-60-18-8F		
	149.0	1	--	T-Arm Mount [TA 702-3]		
130.0	130.0	6	Andrew	SBNHH-1D65B	2	1-5/8
		3	Alcatel Lucent	B13 RRH4X30-4R		
		3	Alcatel Lucent	B25 RRH4X30		
		3	Alcatel Lucent	B66A RRH4X45		
		3	Alcatel Lucent	B13 RRH4X30-4R		
		2	Raycap	RCMDC-3315-PF-48		
		1	--	Side Arm Mount [SO 101-3]		

**3) ANALYSIS PROCEDURE**

**Table 3 - Documents Provided**

Document	Remarks	Reference	Source
Tower Drawings	EEl Project #: 12026, dated 11/29/2003	4713188	CCISITES
Foundation Drawings	EEl Project #: 12026, dated 12/02/2003	4529267	CCISITES
Geotechnical Report	VN Engineers Project #: 23-120G, dated 10/17/2003	4713186	CCISITES
Modification Drawings	GPD Job #: 2009260.48, dated 01/29/2009	4713190	CCISITES
Modification Inspection	GPD Job #: 2009513.00, dated 03/18/2009	4713189	CCISITES
Modification Drawings	Crown WO #: 1070878, dated 6/30/2015	5760149	CCISITES
Modification Inspection	TEP Project #: 63435.37584, dated 12/7/2015	6003147	CCISITES

**3.1) Analysis Method**

tnxTower (version 8.0.5.0), 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) The tower and structures were built and maintained in accordance with the manufacturer's specification.
- 2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.

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

### 4) ANALYSIS RESULTS

**Table 4 - Section Capacity (Summary)**

Section No.	Elevation (ft)	Component Type	Size	Critical Element	% Capacity	Pass / Fail
L1	149 - 144	Pole	TP22.426x21.5x0.1875	Pole	5.7%	Pass
L2	144 - 139	Pole	TP23.352x22.426x0.1875	Pole	10.6%	Pass
L3	139 - 134	Pole	TP24.278x23.352x0.1875	Pole	18.2%	Pass
L4	134 - 129	Pole	TP25.204x24.278x0.1875	Pole	26.1%	Pass
L5	129 - 127.39	Pole	TP26.202x25.204x0.1875	Pole	29.3%	Pass
L6	127.39 - 122.39	Pole	TP26.043x25.128x0.1875	Pole	39.9%	Pass
L7	122.39 - 117.39	Pole	TP26.958x26.043x0.1875	Pole	49.1%	Pass
L8	117.39 - 112.39	Pole	TP27.873x26.958x0.1875	Pole	57.7%	Pass
L9	112.39 - 107.39	Pole	TP28.788x27.873x0.1875	Pole	65.8%	Pass
L10	107.39 - 102.39	Pole	TP29.703x28.788x0.1875	Pole	73.5%	Pass
L11	102.39 - 98.5	Pole	TP30.415x29.703x0.1875	Pole	79.2%	Pass
L12	98.5 - 98.25	Pole + Reinf.	TP30.46x30.415x0.3438	Reinf. 2 Tension Rupture	63.8%	Pass
L13	98.25 - 93.25	Pole + Reinf.	TP31.375x30.46x0.3375	Reinf. 2 Tension Rupture	69.5%	Pass
L14	93.25 - 88.25	Pole + Reinf.	TP32.29x31.375x0.3313	Reinf. 2 Tension Rupture	75.1%	Pass
L15	88.25 - 83.87	Pole + Reinf.	TP33.96x32.29x0.3313	Reinf. 2 Tension Rupture	80.0%	Pass
L16	83.87 - 78.13	Pole	TP33.763x32.716x0.25	Pole	72.7%	Pass
L17	78.13 - 73.13	Pole	TP34.675x33.763x0.25	Pole	77.0%	Pass
L18	73.13 - 68.13	Pole	TP35.586x34.675x0.25	Pole	81.0%	Pass
L19	68.13 - 63.13	Pole	TP36.497x35.586x0.25	Pole	85.0%	Pass
L20	63.13 - 58.13	Pole	TP37.408x36.497x0.25	Pole	88.7%	Pass
L21	58.13 - 57.25	Pole	TP37.568x37.408x0.25	Pole	89.4%	Pass
L22	57.25 - 57	Pole + Reinf.	TP37.614x37.568x0.4188	Reinf. 1 Tension Rupture	74.1%	Pass
L23	57 - 52	Pole + Reinf.	TP38.525x37.614x0.4125	Reinf. 1 Tension Rupture	77.1%	Pass
L24	52 - 48.76	Pole + Reinf.	TP40.121x38.525x0.4125	Reinf. 1 Tension Rupture	79.0%	Pass
L25	48.76 - 42.24	Pole	TP39.803x38.616x0.3125	Pole	75.2%	Pass
L26	42.24 - 37.24	Pole	TP40.714x39.803x0.3125	Pole	77.7%	Pass
L27	37.24 - 32.24	Pole	TP41.625x40.714x0.3125	Pole	80.1%	Pass
L28	32.24 - 27.24	Pole	TP42.536x41.625x0.3125	Pole	82.3%	Pass
L29	27.24 - 22.24	Pole	TP43.447x42.536x0.3125	Pole	84.5%	Pass
L30	22.24 - 17.24	Pole	TP44.358x43.447x0.3125	Pole	86.6%	Pass
L31	17.24 - 12.24	Pole	TP45.269x44.358x0.3125	Pole	88.6%	Pass
L32	12.24 - 7.24	Pole	TP46.18x45.269x0.3125	Pole	90.6%	Pass
L33	7.24 - 2.24	Pole	TP47.091x46.18x0.3125	Pole	92.5%	Pass

Section No.	Elevation (ft)	Component Type	Size	Critical Element	% Capacity	Pass / Fail
L34	2.24 - 0	Pole	TP47.5x47.091x0.3125	Pole	93.3%	Pass
					Summary	
				Pole	93.3%	Pass
				Reinforcement	80.0%	Pass
				Overall	93.3%	Pass

**Table 5 - Tower Component Stresses vs. Capacity – LC7**

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	79.5	Pass
1	Base Plate	0	86.9	Pass
1	Base Foundation	0	62.2	Pass
1	Base Foundation Soil Interaction	0	85.8	Pass

<b>Structure Rating (max from all components) =</b>	<b>93.3%</b>
---	--------------

Notes:

- 1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity consumed.
- 2) Rating per TIA-222-H Section 15.5.

**4.1) Recommendations**

The tower and its foundations have sufficient capacity to carry the proposed load configuration. No modifications are required at this time.

## 5) DISCLAIMER OF WARRANTIES

GPD GROUP has not performed a site visit to the tower to verify the member sizes or antenna/coax loading. If the existing conditions are not as represented on the tower elevation contained in this report, we should be contacted immediately to evaluate the significance of the discrepancy. This is not a condition assessment of the tower or foundation. This report does not replace a full tower inspection. The tower and foundations are assumed to have been properly fabricated, erected, maintained, in good condition, twist free, and plumb.

The engineering services rendered by GPD GROUP in connection with this Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. No allowance was made for any damaged, bent, missing, loose, or rusted members (above and below ground). No allowance was made for loose bolts or cracked welds.

This analysis is limited to the designated maximum wind and seismic conditions per the governing tower standards and code. Wind forces resulting in tower vibrations near the structure's resonant frequencies were not considered in this analysis and are outside the scope of this analysis. Lateral loading from any dynamic response was not evaluated under a time-domain based fatigue analysis.

GPD GROUP does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information needed to perform a thorough analysis of every structural sub-component and connection of an existing tower. GPD GROUP provides a limited scope of service in that we cannot verify the adequacy of every weld, plate connection detail, etc. The purpose of this report is to assess the capability of adding appurtenances usually accompanied by transmission lines to the structure.

It is the owner's responsibility to determine the amount of ice accumulation in excess of the code specified amount, if any, that should be considered in the structural analysis.

The attached sketches are a schematic representation of the analyzed tower. If any material is fabricated from these sketches, the contractor shall be responsible for field verifying the existing conditions, proper fit, and clearance in the field. Any mentions of structural modifications are reasonable estimates and should not be used as a precise construction document. Precise modification drawings are obtainable from GPD GROUP, but are beyond the scope of this report.

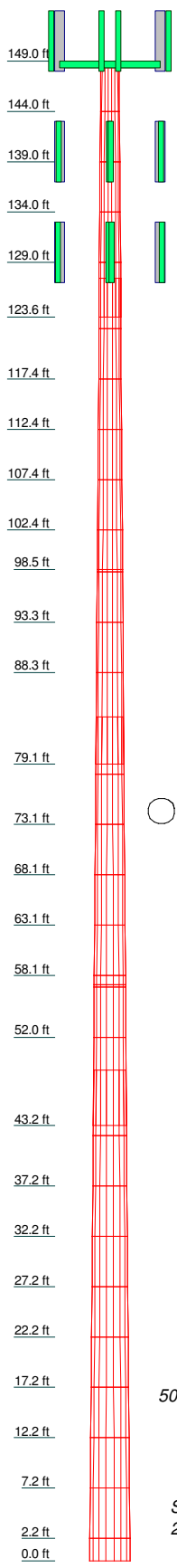
Miscellaneous items such as antenna mounts, etc., have not been designed or detailed as a part of our work. We recommend that material of adequate size and strength be purchased from a reputable tower manufacturer.

Towers are designed to carry gravity, wind, and ice loads. All members, legs, diagonals, struts, and redundant members provide structural stability to the tower with little redundancy. Absence or removal of a member can trigger catastrophic failure unless a substitute is provided before any removal. Legs carry axial loads and derive their strength from shorter unbraced lengths by the presence of redundant members and their connection to the diagonals with bolts or welds. If the bolts or welds are removed without providing any substitute to the frame, the leg is subjected to a higher unbraced length that immediately reduces its load carrying capacity. If a diagonal is also removed in addition to the connection, the unbraced length of the leg is greatly increased, jeopardizing its load carrying capacity. Failure of one leg can result in a tower collapse because there is no redundancy. Redundant members and diagonals are critical to the stability of the tower.

GPD GROUP makes no warranties, expressed and/or implied, in connection with this report and disclaims any liability arising from material, fabrication, and erection of this tower. GPD GROUP will not be responsible whatsoever for, or on account of, consequential or incidental damages sustained by any person, firm, or organization as a result of any data or conclusions contained in this report. The maximum liability of GPD GROUP pursuant to this report will be limited to the total fee received for preparation of this report.

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

Section	Length (ft)	Number of Sides	Thickness (in)	Socket Length (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
2	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
3	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
4	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
5	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
6	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
7	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
8	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
9	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
10	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
11	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
12	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
13	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
14	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
15	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
16	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
17	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
18	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
19	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
20	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
21	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
22	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
23	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
24	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
25	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
26	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
27	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
28	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
29	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
30	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
31	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
32	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
33	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2
34	5.00	18	0.1875	3.78	21.5000	22.4260	A572-65	0.2

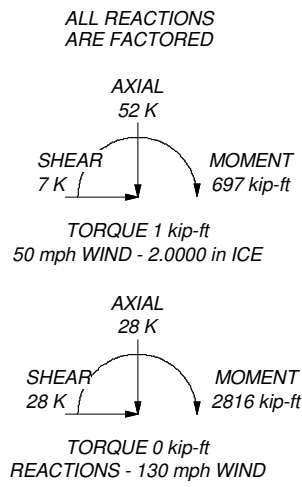


**MATERIAL STRENGTH**

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

**TOWER DESIGN NOTES**

1. Tower is located in Tolland County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-H Standard.
3. Tower designed for a 130 mph basic wind in accordance with the TIA-222-H Standard.
4. Tower is also designed for a 50 mph basic wind with 2.00 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Risk Category II.
7. Topographic Category 1 with Crest Height of 0.00 ft

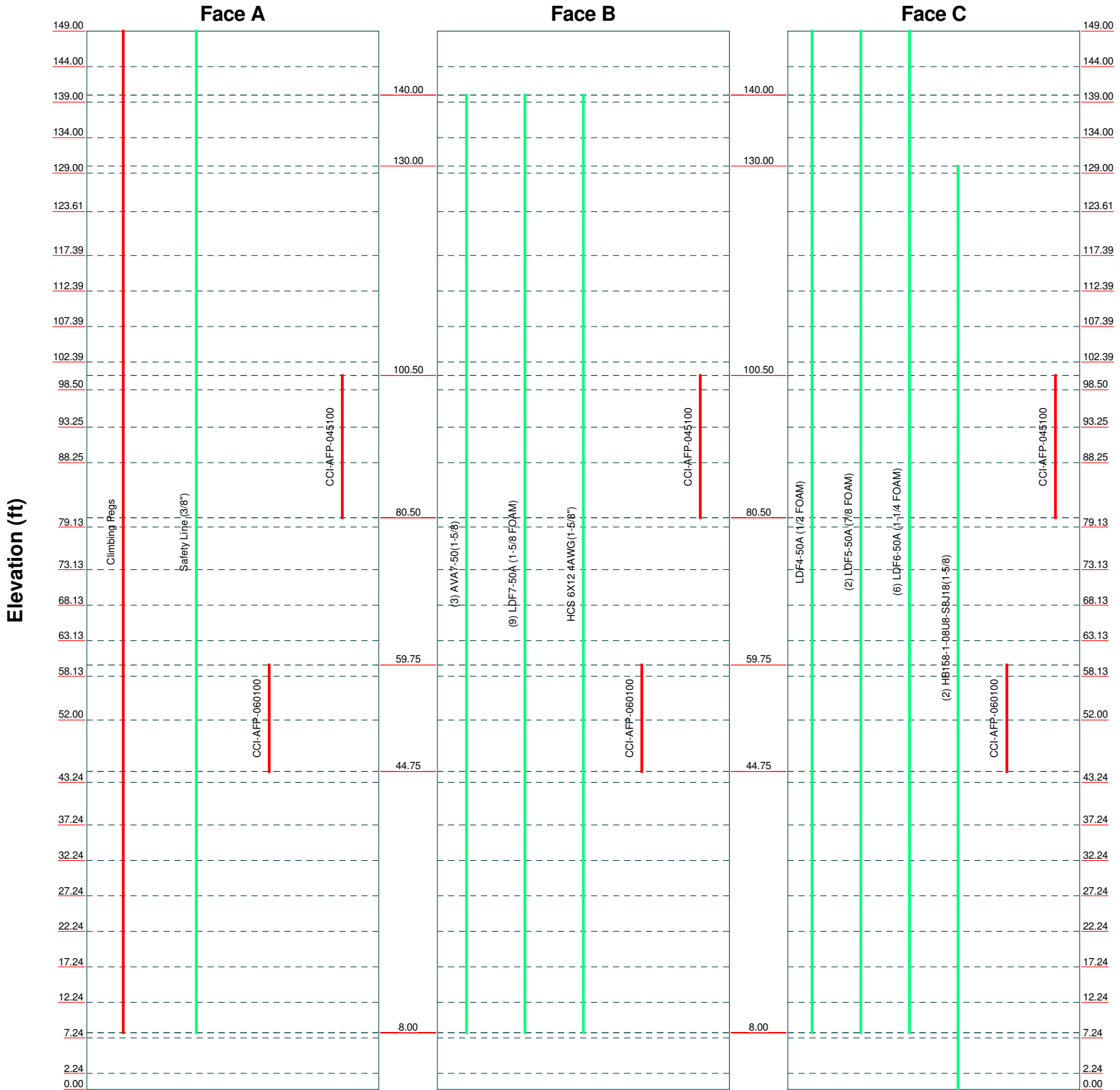


**GPD**  
520 South Main Street Suite 2531  
Akron, Ohio 44311  
Phone: (555) 555-1234  
FAX: (555) 555-1235

Job: <b>ANDOVER NORTH / BU#: 842856</b>			
Project: <b>2019777.842856.03</b>			
Client: Crown Castle USA, Inc.	Drawn by: bchristy	App'd:	
Code: TIA-222-H	Date: 04/30/19	Scale: NTS	
Path: \\AKRN05.gpdco.com\TELECOM\Crown\842856\03\Rev 01\m\842856 Modified.dwg		Dwg No. E-1	

# Feed Line Distribution Chart 0' - 149'

— Round   
 — Flat   
 — App In Face   
 — App Out Face   
 — Truss Leg



<p><b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235</p>	<b>Job: ANDOVER NORTH / BU#: 842856</b>		
	Project: <b>2019777.842856.03</b>		
	Client: Crown Castle USA, Inc.	Drawn by: bchristy	App'd:
	Code: TIA-222-H	Date: 04/30/19	Scale: NTS
	Path: \\AKRN05.apdco.com\TELECOM\Crown\842856\03\Rev 0\trw\842856 Modified.dwg		Dwg No. E-7

<p><b>tnxTower</b></p> <p><b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235</p>	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	1 of 24
	<b>Project</b>	2019777.842856.03	<b>Date</b>	11:32:13 04/30/19
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## Tower Input Data

The tower is a monopole.

This tower is designed using the TIA-222-H standard.

The following design criteria apply:

- Tower is located in Tolland County, Connecticut.
- Tower base elevation above sea level: 495.00 ft.
- Basic wind speed of 130 mph.
- Risk Category II.
- Exposure Category C.
- Simplified Topographic Factor Procedure for wind speed-up calculations is used.
- Topographic Category: 1.
- Crest Height: 0.00 ft.
- Nominal ice thickness of 2.0000 in.
- Ice thickness is considered to increase with height.
- Ice density of 56 pcf.
- A wind speed of 50 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 60 mph.
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.05.
- Tower analysis based on target reliabilities in accordance with Annex S.
- Load Modification Factors used:  $K_{es}(F_w) = 0.95$ ,  $K_{es}(t_i) = 0.85$ .
- 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>SR Members Have Cut Ends</li> <li>SR Members Are Concentric</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>Add IBC .6D+W Combination</li> <li>√ Sort Capacity Reports By Component</li> <li>Triangulate Diamond Inner Bracing</li> <li>Treat Feed Line Bundles As Cylinder</li> <li>Ignore KL/r For 60 Deg. Angle Legs</li> </ul> | <ul style="list-style-type: none"> <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 Feed Line Torque</li> <li>Include Angle Block Shear Check</li> <li>Use TIA-222-H Bracing Resist. Exemption</li> <li>Use TIA-222-H Tension Splice Exemption</li> <li style="text-align: center;">Poles</li> <li>√ Include Shear-Torsion Interaction</li> <li>Always Use Sub-Critical Flow</li> <li>Use Top Mounted Sockets</li> <li>Pole Without Linear Attachments</li> <li>Pole With Shroud Or No Appurtenances</li> <li>Outside and Inside Corner Radii Are Known</li> </ul> |
|--|--|---|

## Tapered Pole Section Geometry

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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
L1	149.00-144.00	5.00	0.00	18	21.5000	22.4260	0.1875	0.7500	A572-65 (65 ksi)
L2	144.00-139.00	5.00	0.00	18	22.4260	23.3521	0.1875	0.7500	A572-65 (65 ksi)
L3	139.00-134.00	5.00	0.00	18	23.3521	24.2781	0.1875	0.7500	A572-65 (65 ksi)
L4	134.00-129.00	5.00	0.00	18	24.2781	25.2042	0.1875	0.7500	A572-65 (65 ksi)
L5	129.00-123.61	5.39	3.78	18	25.2042	26.2021	0.1875	0.7500	A572-65 (65 ksi)
L6	123.61-122.39	5.00	0.00	18	25.1277	26.0428	0.1875	0.7500	A572-65 (65 ksi)
L7	122.39-117.39	5.00	0.00	18	26.0428	26.9578	0.1875	0.7500	A572-65 (65 ksi)
L8	117.39-112.39	5.00	0.00	18	26.9578	27.8729	0.1875	0.7500	A572-65 (65 ksi)
L9	112.39-107.39	5.00	0.00	18	27.8729	28.7879	0.1875	0.7500	A572-65 (65 ksi)
L10	107.39-102.39	5.00	0.00	18	28.7879	29.7030	0.1875	0.7500	A572-65 (65 ksi)
L11	102.39-98.50	3.89	0.00	18	29.7030	30.4145	0.1875	0.7500	A572-65 (65 ksi)
L12	98.50-98.25	0.25	0.00	18	30.4145	30.4603	0.3438	1.3750	A572-65 (65 ksi)
L13	98.25-93.25	5.00	0.00	18	30.4603	31.3753	0.3375	1.3500	A572-65 (65 ksi)
L14	93.25-88.25	5.00	0.00	18	31.3753	32.2904	0.3312	1.3250	A572-65 (65 ksi)
L15	88.25-79.13	9.12	4.75	18	32.2904	33.9598	0.3312	1.3250	A572-65 (65 ksi)
L16	79.13-78.13	5.75	0.00	18	32.7164	33.7634	0.2500	1.0000	A572-65 (65 ksi)
L17	78.13-73.13	5.00	0.00	18	33.7634	34.6747	0.2500	1.0000	A572-65 (65 ksi)
L18	73.13-68.13	5.00	0.00	18	34.6747	35.5859	0.2500	1.0000	A572-65 (65 ksi)
L19	68.13-63.13	5.00	0.00	18	35.5859	36.4971	0.2500	1.0000	A572-65 (65 ksi)
L20	63.13-58.13	5.00	0.00	18	36.4971	37.4084	0.2500	1.0000	A572-65 (65 ksi)
L21	58.13-57.25	0.88	0.00	18	37.4084	37.5684	0.2500	1.0000	A572-65 (65 ksi)
L22	57.25-57.00	0.25	0.00	18	37.5684	37.6139	0.4188	1.6750	A572-65 (65 ksi)
L23	57.00-52.00	5.00	0.00	18	37.6139	38.5252	0.4125	1.6500	A572-65 (65 ksi)
L24	52.00-43.24	8.76	5.52	18	38.5252	40.1211	0.4125	1.6500	A572-65 (65 ksi)
L25	43.24-42.24	6.52	0.00	18	38.6156	39.8031	0.3125	1.2500	A572-65 (65 ksi)
L26	42.24-37.24	5.00	0.00	18	39.8031	40.7141	0.3125	1.2500	A572-65 (65 ksi)
L27	37.24-32.24	5.00	0.00	18	40.7141	41.6251	0.3125	1.2500	A572-65 (65 ksi)
L28	32.24-27.24	5.00	0.00	18	41.6251	42.5362	0.3125	1.2500	A572-65 (65 ksi)
L29	27.24-22.24	5.00	0.00	18	42.5362	43.4472	0.3125	1.2500	A572-65 (65 ksi)
L30	22.24-17.24	5.00	0.00	18	43.4472	44.3582	0.3125	1.2500	A572-65 (65 ksi)



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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 (65 ksi)
L31	17.24-12.24	5.00	0.00	18	44.3582	45.2693	0.3125	1.2500	A572-65 (65 ksi)
L32	12.24-7.24	5.00	0.00	18	45.2693	46.1803	0.3125	1.2500	A572-65 (65 ksi)
L33	7.24-2.24	5.00	0.00	18	46.1803	47.0913	0.3125	1.2500	A572-65 (65 ksi)
L34	2.24-0.00	2.24		18	47.0913	47.5000	0.3125	1.2500	A572-65 (65 ksi)

**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>	It/Q in <sup>2</sup>	w in	w/t
L1	21.8027	12.6836	727.8616	7.5659	10.9220	66.6418	1456.6810	6.3430	3.4540	18.421
	22.7431	13.2347	826.9227	7.8947	11.3924	72.5853	1654.9335	6.6186	3.6170	19.291
L2	22.7431	13.2347	826.9227	7.8947	11.3924	72.5853	1654.9335	6.6186	3.6170	19.291
	23.6834	13.7858	934.5871	8.2234	11.8629	78.7826	1870.4039	6.8942	3.7800	20.16
L3	23.6834	13.7858	934.5871	8.2234	11.8629	78.7826	1870.4039	6.8942	3.7800	20.16
	24.6237	14.3369	1051.2132	8.5522	12.3333	85.2338	2103.8097	7.1698	3.9430	21.029
L4	24.6237	14.3369	1051.2132	8.5522	12.3333	85.2338	2103.8097	7.1698	3.9430	21.029
	25.5641	14.8881	1177.1593	8.8809	12.8037	91.9388	2355.8675	7.4454	4.1059	21.898
L5	25.5641	14.8881	1177.1593	8.8809	12.8037	91.9388	2355.8675	7.4454	4.1059	21.898
	26.5774	15.4819	1323.7230	9.2352	13.3107	99.4483	2649.1877	7.7424	4.2816	22.835
L6	26.5774	15.4819	1323.7230	9.2352	13.3107	99.4483	2649.1877	7.7424	4.2816	22.835
	26.4156	15.3871	1299.5539	9.1786	13.2297	98.2297	2600.8177	7.6950	4.2535	22.686
L7	26.4156	15.3871	1299.5539	9.1786	13.2297	98.2297	2600.8177	7.6950	4.2535	22.686
	27.3448	15.9317	1442.4727	9.5035	13.6946	105.3316	2886.8434	7.9674	4.4146	23.544
L8	27.3448	15.9317	1442.4727	9.5035	13.6946	105.3316	2886.8434	7.9674	4.4146	23.544
	28.2740	16.4763	1595.5037	9.8283	14.1594	112.6813	3193.1068	8.2397	4.5756	24.403
L9	28.2740	16.4763	1595.5037	9.8283	14.1594	112.6813	3193.1068	8.2397	4.5756	24.403
	29.2031	17.0208	1758.9924	10.1532	14.6243	120.2789	3520.2994	8.5120	4.7367	25.262
L10	29.2031	17.0208	1758.9924	10.1532	14.6243	120.2789	3520.2994	8.5120	4.7367	25.262
	30.1323	17.5654	1933.2845	10.4780	15.0891	128.1244	3869.1129	8.7844	4.8977	26.121
L11	30.1323	17.5654	1933.2845	10.4780	15.0891	128.1244	3869.1129	8.7844	4.8977	26.121
	30.8548	17.9889	2076.5017	10.7306	15.4506	134.3963	4155.7357	8.9961	5.0230	26.789
L12	30.8548	17.9889	2076.5017	10.7306	15.4506	134.3963	4155.7357	8.9961	5.0230	26.789
	30.8307	32.8091	3748.1881	10.6751	15.4506	242.5920	7501.3081	16.4077	4.7480	13.812
L13	30.8307	32.8091	3748.1881	10.6751	15.4506	242.5920	7501.3081	16.4077	4.7480	13.812
	30.8772	32.8590	3765.3225	10.6914	15.4738	243.3349	7535.5995	16.4326	4.7560	13.836
L14	30.8772	32.8590	3765.3225	10.6914	15.4738	243.3349	7535.5995	16.4326	4.7560	13.836
	30.8781	32.2683	3699.1641	10.6936	15.4738	239.0594	7403.1957	16.1372	4.7670	14.124
L15	30.8781	32.2683	3699.1641	10.6936	15.4738	239.0594	7403.1957	16.1372	4.7670	14.124
	31.8073	33.2485	4046.6203	11.0184	15.9387	253.8869	8098.5652	16.6274	4.9281	14.602
L16	31.8073	33.2485	4046.6203	11.0184	15.9387	253.8869	8098.5652	16.6274	4.9281	14.602
	31.8083	32.6394	3974.0826	11.0207	15.9387	249.3359	7953.3945	16.3228	4.9391	14.91
L17	31.8083	32.6394	3974.0826	11.0207	15.9387	249.3359	7953.3945	16.3228	4.9391	14.91
	32.7374	33.6014	4335.9604	11.3455	16.4035	264.3312	8677.6262	16.8039	5.1001	15.397
L18	32.7374	33.6014	4335.9604	11.3455	16.4035	264.3312	8677.6262	16.8039	5.1001	15.397
	34.4326	35.3566	5051.5503	11.9381	17.2516	292.8167	10109.7476	17.6817	5.3939	16.284
L19	34.4326	35.3566	5051.5503	11.9381	17.2516	292.8167	10109.7476	17.6817	5.3939	16.284
	34.0607	25.7621	3430.7380	11.5256	16.6199	206.4230	6865.9902	12.8835	5.3181	21.272
L20	34.0607	25.7621	3430.7380	11.5256	16.6199	206.4230	6865.9902	12.8835	5.3181	21.272
	34.2457	26.5929	3773.4697	11.8973	17.1518	220.0040	7551.9045	13.2990	5.5024	22.009
L21	34.2457	26.5929	3773.4697	11.8973	17.1518	220.0040	7551.9045	13.2990	5.5024	22.009
	35.1710	27.3160	4089.7176	12.2208	17.6147	232.1760	8184.8166	13.6606	5.6627	22.651
L22	35.1710	27.3160	4089.7176	12.2208	17.6147	232.1760	8184.8166	13.6606	5.6627	22.651
	36.0963	28.0390	4423.1591	12.5442	18.0776	244.6758	8852.1382	14.0222	5.8231	23.292
L23	36.0963	28.0390	4423.1591	12.5442	18.0776	244.6758	8852.1382	14.0222	5.8231	23.292
	37.0216	28.7621	4774.2491	12.8677	18.5405	257.5032	9554.7803	14.3838	5.9835	23.934
L24	37.0216	28.7621	4774.2491	12.8677	18.5405	257.5032	9554.7803	14.3838	5.9835	23.934
	37.9469	29.4852	5143.4433	13.1912	19.0034	270.6585	10293.6546	14.7454	6.1439	24.575
L25	37.9469	29.4852	5143.4433	13.1912	19.0034	270.6585	10293.6546	14.7454	6.1439	24.575
	38.1094	29.6121	5210.1763	13.2480	19.0847	273.0023	10427.2082	14.8089	6.1720	24.688
L26	38.1094	29.6121	5210.1763	13.2480	19.0847	273.0023	10427.2082	14.8089	6.1720	24.688
	38.0833	49.3760	8609.1912	13.1881	19.0847	451.1036	17229.7107	24.6927	5.8750	14.03



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Tower Elevation	Gusset Area (per face)	Gusset Thickness	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	Double Angle Stitch Bolt Spacing Redundants in
ft	ft <sup>2</sup>	in							
L16				1	1	1			
79.13-78.13									
L17				1	1	1			
78.13-73.13									
L18				1	1	1			
73.13-68.13									
L19				1	1	1			
68.13-63.13									
L20				1	1	1			
63.13-58.13									
L21				1	1	1			
58.13-57.25									
L22				1	1	0.963839			
57.25-57.00									
L23				1	1	0.969379			
57.00-52.00									
L24				1	1	0.963836			
52.00-43.24									
L25				1	1	1			
43.24-42.24									
L26				1	1	1			
42.24-37.24									
L27				1	1	1			
37.24-32.24									
L28				1	1	1			
32.24-27.24									
L29				1	1	1			
27.24-22.24									
L30				1	1	1			
22.24-17.24									
L31				1	1	1			
17.24-12.24									
L32 12.24-7.24				1	1	1			
L33 7.24-2.24				1	1	1			
L34 2.24-0.00				1	1	1			

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

Description	Sector	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight plf
Climbing Pegs	A	No	Surface Ar (CaAa)	149.00 - 8.00	1	1	0.000 0.000	0.1500		0.31
CCI-AFP-060100	A	No	Surface Af (CaAa)	59.75 - 44.75	1	1	0.000 0.000	6.0000	14.0000	0.00
CCI-AFP-060100	B	No	Surface Af (CaAa)	59.75 - 44.75	1	1	0.000 0.000	6.0000	14.0000	0.00
CCI-AFP-060100	C	No	Surface Af (CaAa)	59.75 - 44.75	1	1	0.000 0.000	6.0000	14.0000	0.00
CCI-AFP-045100	A	No	Surface Af (CaAa)	100.50 - 80.50	1	1	0.000 0.000	4.5000	11.0000	0.00
CCI-AFP-045100	B	No	Surface Af (CaAa)	100.50 - 80.50	1	1	0.000 0.000	4.5000	11.0000	0.00
CCI-AFP-045100	C	No	Surface Af	100.50 -	1	1	0.000	4.5000	11.0000	0.00

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Description	Sector	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Start/End Position	Width or Diameter in	Perimeter in	Weight plf
			(CaAa)	80.50			0.000			

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

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C <sub>A</sub> A <sub>A</sub> ft <sup>2</sup> /ft	Weight plf
Safety Line (3/8")	A	No	No	CaAa (Out Of Face)	149.00 - 8.00	1	No Ice	0.04	0.22
							1/2" Ice	0.14	0.75
							1" Ice	0.24	1.28
							2" Ice	0.44	2.34
LDF4-50A (1/2 FOAM)	C	No	No	Inside Pole	149.00 - 8.00	1	No Ice	0.00	0.15
							1/2" Ice	0.00	0.15
							1" Ice	0.00	0.15
							2" Ice	0.00	0.15
LDF5-50A (7/8 FOAM)	C	No	No	Inside Pole	149.00 - 8.00	2	No Ice	0.00	0.33
							1/2" Ice	0.00	0.33
							1" Ice	0.00	0.33
							2" Ice	0.00	0.33
LDF6-50A (1-1/4 FOAM)	C	No	No	Inside Pole	149.00 - 8.00	6	No Ice	0.00	0.66
							1/2" Ice	0.00	0.66
							1" Ice	0.00	0.66
							2" Ice	0.00	0.66
AVA7-50(1-5/8)	B	No	No	Inside Pole	140.00 - 8.00	3	No Ice	0.00	0.70
							1/2" Ice	0.00	0.70
							1" Ice	0.00	0.70
							2" Ice	0.00	0.70
LDF7-50A (1-5/8 FOAM)	B	No	No	Inside Pole	140.00 - 8.00	9	No Ice	0.00	0.82
							1/2" Ice	0.00	0.82
							1" Ice	0.00	0.82
							2" Ice	0.00	0.82
HCS 6X12 4AWG(1-5/8")	B	No	No	Inside Pole	140.00 - 8.00	1	No Ice	0.00	2.40
							1/2" Ice	0.00	2.40
							1" Ice	0.00	2.40
							2" Ice	0.00	2.40
HB158-1-08U8-S8J 18(1-5/8)	C	No	No	Inside Pole	130.00 - 0.00	2	No Ice	0.00	1.30
							1/2" Ice	0.00	1.30
							1" Ice	0.00	1.30
							2" Ice	0.00	1.30

### 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>A</sub> A <sub>A</sub> In Face ft <sup>2</sup>	C <sub>A</sub> A <sub>A</sub> Out Face ft <sup>2</sup>	Weight K
L1	149.00-144.00	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.02
L2	144.00-139.00	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.01

<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	7 of 24
<b>Project</b>	2019777.842856.03	<b>Date</b>	11:32:13 04/30/19
<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

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> In Face ft <sup>2</sup>	C <sub>AA</sub> Out Face ft <sup>2</sup>	Weight K
L3	139.00-134.00	C	0.000	0.000	0.000	0.000	0.02
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L4	134.00-129.00	C	0.000	0.000	0.000	0.000	0.02
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L5	129.00-123.61	C	0.000	0.000	0.000	0.000	0.03
		A	0.000	0.000	0.081	0.202	0.00
		B	0.000	0.000	0.000	0.000	0.06
L6	123.61-122.39	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.018	0.046	0.00
		B	0.000	0.000	0.000	0.000	0.01
L7	122.39-117.39	C	0.000	0.000	0.000	0.000	0.01
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L8	117.39-112.39	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L9	112.39-107.39	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L10	107.39-102.39	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L11	102.39-98.50	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	1.558	0.146	0.00
		B	0.000	0.000	1.500	0.000	0.05
L12	98.50-98.25	C	0.000	0.000	1.500	0.000	0.03
		A	0.000	0.000	0.191	0.009	0.00
		B	0.000	0.000	0.188	0.000	0.00
L13	98.25-93.25	C	0.000	0.000	0.188	0.000	0.00
		A	0.000	0.000	3.825	0.188	0.00
		B	0.000	0.000	3.750	0.000	0.06
L14	93.25-88.25	C	0.000	0.000	3.750	0.000	0.04
		A	0.000	0.000	3.825	0.188	0.00
		B	0.000	0.000	3.750	0.000	0.06
L15	88.25-79.13	C	0.000	0.000	3.750	0.000	0.04
		A	0.000	0.000	5.949	0.342	0.00
		B	0.000	0.000	5.813	0.000	0.11
L16	79.13-78.13	C	0.000	0.000	5.813	0.000	0.07
		A	0.000	0.000	0.015	0.037	0.00
		B	0.000	0.000	0.000	0.000	0.01
L17	78.13-73.13	C	0.000	0.000	0.000	0.000	0.01
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L18	73.13-68.13	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L19	68.13-63.13	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
L20	63.13-58.13	C	0.000	0.000	0.000	0.000	0.04
		A	0.000	0.000	1.697	0.188	0.00
		B	0.000	0.000	1.622	0.000	0.06
L21	58.13-57.25	C	0.000	0.000	1.622	0.000	0.04
		A	0.000	0.000	0.891	0.033	0.00
		B	0.000	0.000	0.878	0.000	0.01
L22	57.25-57.00	C	0.000	0.000	0.878	0.000	0.01
		A	0.000	0.000	0.254	0.009	0.00
		B	0.000	0.000	0.250	0.000	0.00
		C	0.000	0.000	0.250	0.000	0.00

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<b>Project</b>	2019777.842856.03	<b>Date</b>	11:32:13 04/30/19
<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

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> In Face ft <sup>2</sup>	C <sub>AA</sub> Out Face ft <sup>2</sup>	Weight K
L23	57.00-52.00	A	0.000	0.000	5.075	0.188	0.00
		B	0.000	0.000	5.000	0.000	0.06
		C	0.000	0.000	5.000	0.000	0.04
L24	52.00-43.24	A	0.000	0.000	7.381	0.328	0.00
		B	0.000	0.000	7.250	0.000	0.10
		C	0.000	0.000	7.250	0.000	0.06
L25	43.24-42.24	A	0.000	0.000	0.015	0.037	0.00
		B	0.000	0.000	0.000	0.000	0.01
		C	0.000	0.000	0.000	0.000	0.01
L26	42.24-37.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L27	37.24-32.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L28	32.24-27.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L29	27.24-22.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L30	22.24-17.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L31	17.24-12.24	A	0.000	0.000	0.075	0.188	0.00
		B	0.000	0.000	0.000	0.000	0.06
		C	0.000	0.000	0.000	0.000	0.04
L32	12.24-7.24	A	0.000	0.000	0.064	0.159	0.00
		B	0.000	0.000	0.000	0.000	0.05
		C	0.000	0.000	0.000	0.000	0.03
L33	7.24-2.24	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.01
L34	2.24-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.01

**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> In Face ft <sup>2</sup>	C <sub>AA</sub> Out Face ft <sup>2</sup>	Weight K
L1	149.00-144.00	A	1.973	0.000	0.000	2.048	2.161	0.04
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.02
L2	144.00-139.00	A	1.966	0.000	0.000	2.041	2.154	0.04
		B		0.000	0.000	0.000	0.000	0.01
		C		0.000	0.000	0.000	0.000	0.02
L3	139.00-134.00	A	1.959	0.000	0.000	2.034	2.147	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.02
L4	134.00-129.00	A	1.952	0.000	0.000	2.027	2.140	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.03
L5	129.00-123.61	A	1.944	0.000	0.000	2.176	2.297	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L6	123.61-122.39	A	1.939	0.000	0.000	0.494	0.522	0.01

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<b>Project</b>	2019777.842856.03	<b>Date</b>	11:32:13 04/30/19
<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

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
		B		0.000	0.000	0.000	0.000	0.01
		C		0.000	0.000	0.000	0.000	0.01
L7	122.39-117.39	A	1.934	0.000	0.000	2.009	2.122	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L8	117.39-112.39	A	1.926	0.000	0.000	2.001	2.113	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L9	112.39-107.39	A	1.917	0.000	0.000	1.992	2.105	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L10	107.39-102.39	A	1.908	0.000	0.000	1.983	2.096	0.04
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L11	102.39-98.50	A	1.900	0.000	0.000	3.796	1.623	0.06
		B		0.000	0.000	2.260	0.000	0.07
		C		0.000	0.000	2.260	0.000	0.06
L12	98.50-98.25	A	1.896	0.000	0.000	0.381	0.104	0.01
		B		0.000	0.000	0.282	0.000	0.01
		C		0.000	0.000	0.282	0.000	0.01
L13	98.25-93.25	A	1.891	0.000	0.000	7.607	2.079	0.10
		B		0.000	0.000	5.641	0.000	0.13
		C		0.000	0.000	5.641	0.000	0.10
L14	93.25-88.25	A	1.881	0.000	0.000	7.587	2.068	0.10
		B		0.000	0.000	5.631	0.000	0.13
		C		0.000	0.000	5.631	0.000	0.10
L15	88.25-79.13	A	1.866	0.000	0.000	12.245	3.746	0.17
		B		0.000	0.000	8.704	0.000	0.21
		C		0.000	0.000	8.704	0.000	0.17
L16	79.13-78.13	A	1.854	0.000	0.000	0.388	0.411	0.01
		B		0.000	0.000	0.000	0.000	0.01
		C		0.000	0.000	0.000	0.000	0.01
L17	78.13-73.13	A	1.847	0.000	0.000	1.922	2.034	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L18	73.13-68.13	A	1.834	0.000	0.000	1.909	2.022	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L19	68.13-63.13	A	1.821	0.000	0.000	1.896	2.008	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L20	63.13-58.13	A	1.807	0.000	0.000	3.929	1.994	0.06
		B		0.000	0.000	2.047	0.000	0.08
		C		0.000	0.000	2.047	0.000	0.06
L21	58.13-57.25	A	1.798	0.000	0.000	1.436	0.349	0.02
		B		0.000	0.000	1.107	0.000	0.02
		C		0.000	0.000	1.107	0.000	0.02
L22	57.25-57.00	A	1.796	0.000	0.000	0.409	0.099	0.01
		B		0.000	0.000	0.315	0.000	0.01
		C		0.000	0.000	0.315	0.000	0.01
L23	57.00-52.00	A	1.787	0.000	0.000	8.163	1.975	0.11
		B		0.000	0.000	6.301	0.000	0.13
		C		0.000	0.000	6.301	0.000	0.11
L24	52.00-43.24	A	1.763	0.000	0.000	12.339	3.417	0.16
		B		0.000	0.000	9.119	0.000	0.21
		C		0.000	0.000	9.119	0.000	0.17
L25	43.24-42.24	A	1.745	0.000	0.000	0.368	0.390	0.01
		B		0.000	0.000	0.000	0.000	0.01
		C		0.000	0.000	0.000	0.000	0.01
L26	42.24-37.24	A	1.732	0.000	0.000	1.807	1.919	0.03
		B		0.000	0.000	0.000	0.000	0.06

<b>tnxTower</b>  <b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	10 of 24
	<b>Project</b>	2019777.842856.03	<b>Date</b>	11:32:13 04/30/19
	<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

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
L27	37.24-32.24	C		0.000	0.000	0.000	0.000	0.04
		A	1.709	0.000	0.000	1.784	1.896	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L28	32.24-27.24	A	1.682	0.000	0.000	1.757	1.870	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L29	27.24-22.24	A	1.652	0.000	0.000	1.727	1.839	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L30	22.24-17.24	A	1.615	0.000	0.000	1.690	1.802	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L31	17.24-12.24	A	1.568	0.000	0.000	1.643	1.756	0.03
		B		0.000	0.000	0.000	0.000	0.06
		C		0.000	0.000	0.000	0.000	0.04
L32	12.24-7.24	A	1.505	0.000	0.000	1.340	1.436	0.02
		B		0.000	0.000	0.000	0.000	0.05
		C		0.000	0.000	0.000	0.000	0.03
L33	7.24-2.24	A	1.400	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.01
L34	2.24-0.00	A	1.212	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.01

### Feed Line Center of Pressure

Section	Elevation ft	CP <sub>x</sub> in	CP <sub>z</sub> in	CP <sub>x</sub> Ice in	CP <sub>z</sub> Ice in
L1	149.00-144.00	-0.1020	-0.3515	-1.1324	-2.0239
L2	144.00-139.00	-0.1022	-0.3520	-1.1462	-2.0490
L3	139.00-134.00	-0.1023	-0.3525	-1.1588	-2.0723
L4	134.00-129.00	-0.1024	-0.3529	-1.1705	-2.0937
L5	129.00-123.61	-0.1025	-0.3533	-1.1816	-2.1142
L6	123.61-122.39	-0.1025	-0.3534	-1.1848	-2.1201
L7	122.39-117.39	-0.1026	-0.3536	-1.1887	-2.1275
L8	117.39-112.39	-0.1026	-0.3540	-1.1974	-2.1438
L9	112.39-107.39	-0.1027	-0.3543	-1.2054	-2.1586
L10	107.39-102.39	-0.1028	-0.3546	-1.2125	-2.1719
L11	102.39-98.50	-0.0640	-0.2208	-0.8633	-1.5467
L12	98.50-98.25	-0.0475	-0.1640	-0.6814	-1.2210
L13	98.25-93.25	-0.0479	-0.1654	-0.6864	-1.2303
L14	93.25-88.25	-0.0487	-0.1680	-0.6957	-1.2473
L15	88.25-79.13	-0.0539	-0.1861	-0.7565	-1.3567
L16	79.13-78.13	-0.1031	-0.3559	-1.2392	-2.2226
L17	78.13-73.13	-0.1032	-0.3561	-1.2352	-2.2162
L18	73.13-68.13	-0.1032	-0.3563	-1.2369	-2.2201
L19	68.13-63.13	-0.1033	-0.3565	-1.2378	-2.2224
L20	63.13-58.13	-0.0729	-0.2517	-0.9890	-1.7764
L21	58.13-57.25	-0.0456	-0.1573	-0.7002	-1.2579
L22	57.25-57.00	-0.0456	-0.1576	-0.7010	-1.2593
L23	57.00-52.00	-0.0460	-0.1587	-0.7033	-1.2638
L24	52.00-43.24	-0.0517	-0.1784	-0.7644	-1.3745
L25	43.24-42.24	-0.1035	-0.3573	-1.2352	-2.2209
L26	42.24-37.24	-0.1035	-0.3573	-1.2219	-2.1987



<b>tnxTower</b>  <b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	11 of 24
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Section	Elevation	CP <sub>x</sub>	CP <sub>z</sub>	CP <sub>x</sub>	CP <sub>z</sub>
	ft	in	in	Ice in	Ice in
L27	37.24-32.24	-0.1035	-0.3575	-1.2150	-2.1875
L28	32.24-27.24	-0.1035	-0.3576	-1.2058	-2.1724
L29	27.24-22.24	-0.1036	-0.3578	-1.1937	-2.1523
L30	22.24-17.24	-0.1036	-0.3579	-1.1776	-2.1252
L31	17.24-12.24	-0.1036	-0.3580	-1.1552	-2.0875
L32	12.24-7.24	-0.0881	-0.3043	-0.9678	-1.7520
L33	7.24-2.24	0.0000	0.0000	0.0000	0.0000
L34	2.24-0.00	0.0000	0.0000	0.0000	0.0000

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

### Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K <sub>a</sub> No Ice	K <sub>a</sub> Ice
L1	1	Climbing Pegs	144.00 - 149.00	1.0000	1.0000
L2	1	Climbing Pegs	139.00 - 144.00	1.0000	1.0000
L3	1	Climbing Pegs	134.00 - 139.00	1.0000	1.0000
L4	1	Climbing Pegs	129.00 - 134.00	1.0000	1.0000
L5	1	Climbing Pegs	123.61 - 129.00	1.0000	1.0000
L7	1	Climbing Pegs	117.39 - 122.39	1.0000	1.0000
L8	1	Climbing Pegs	112.39 - 117.39	1.0000	1.0000
L9	1	Climbing Pegs	107.39 - 112.39	1.0000	1.0000
L10	1	Climbing Pegs	102.39 - 107.39	1.0000	1.0000
L11	1	Climbing Pegs	98.50 - 102.39	1.0000	1.0000
L11	18	CCI-AFP-045100	98.50 - 100.50	1.0000	1.0000
L11	19	CCI-AFP-045100	98.50 - 100.50	1.0000	1.0000
L11	20	CCI-AFP-045100	98.50 - 100.50	1.0000	1.0000
L12	1	Climbing Pegs	98.25 - 98.50	1.0000	1.0000
L12	18	CCI-AFP-045100	98.25 - 98.50	1.0000	1.0000
L12	19	CCI-AFP-045100	98.25 - 98.50	1.0000	1.0000
L12	20	CCI-AFP-045100	98.25 - 98.50	1.0000	1.0000
L13	1	Climbing Pegs	93.25 - 98.25	1.0000	1.0000
L13	18	CCI-AFP-045100	93.25 - 98.25	1.0000	1.0000
L13	19	CCI-AFP-045100	93.25 - 98.25	1.0000	1.0000
L13	20	CCI-AFP-045100	93.25 - 98.25	1.0000	1.0000
L14	1	Climbing Pegs	88.25 - 93.25	1.0000	1.0000
L14	18	CCI-AFP-045100	88.25 - 93.25	1.0000	1.0000
L14	19	CCI-AFP-045100	88.25 - 93.25	1.0000	1.0000
L14	20	CCI-AFP-045100	88.25 - 93.25	1.0000	1.0000
L15	1	Climbing Pegs	79.13 - 88.25	1.0000	1.0000
L15	18	CCI-AFP-045100	80.50 - 88.25	1.0000	1.0000
L15	19	CCI-AFP-045100	80.50 - 88.25	1.0000	1.0000
L15	20	CCI-AFP-045100	80.50 - 88.25	1.0000	1.0000
L17	1	Climbing Pegs	73.13 - 78.13	1.0000	1.0000

<p><b>tnxTower</b></p> <p><b>GPD</b></p> <p>520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235</p>	<p><b>Job</b></p> <p>ANDOVER NORTH / BU#: 842856</p>	<p><b>Page</b></p> <p>12 of 24</p>
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	<p><b>Client</b></p> <p>Crown Castle USA, Inc.</p>	<p><b>Designed by</b></p> <p>bchristy</p>

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	$K_a$ No Ice	$K_a$ Ice
L18	1	Climbing Pegs	68.13 - 73.13	1.0000	1.0000
L19	1	Climbing Pegs	63.13 - 68.13	1.0000	1.0000
L20	1	Climbing Pegs	58.13 - 63.13	1.0000	1.0000
L20	15	CCI-AFP-060100	58.13 - 59.75	1.0000	1.0000
L20	16	CCI-AFP-060100	58.13 - 59.75	1.0000	1.0000
L20	17	CCI-AFP-060100	58.13 - 59.75	1.0000	1.0000
L21	1	Climbing Pegs	57.25 - 58.13	1.0000	1.0000
L21	15	CCI-AFP-060100	57.25 - 58.13	1.0000	1.0000
L21	16	CCI-AFP-060100	57.25 - 58.13	1.0000	1.0000
L21	17	CCI-AFP-060100	57.25 - 58.13	1.0000	1.0000
L22	1	Climbing Pegs	57.00 - 57.25	1.0000	1.0000
L22	15	CCI-AFP-060100	57.00 - 57.25	1.0000	1.0000
L22	16	CCI-AFP-060100	57.00 - 57.25	1.0000	1.0000
L22	17	CCI-AFP-060100	57.00 - 57.25	1.0000	1.0000
L23	1	Climbing Pegs	52.00 - 57.00	1.0000	1.0000
L23	15	CCI-AFP-060100	52.00 - 57.00	1.0000	1.0000
L23	16	CCI-AFP-060100	52.00 - 57.00	1.0000	1.0000
L23	17	CCI-AFP-060100	52.00 - 57.00	1.0000	1.0000
L24	1	Climbing Pegs	43.24 - 52.00	1.0000	1.0000
L24	15	CCI-AFP-060100	44.75 - 52.00	1.0000	1.0000
L24	16	CCI-AFP-060100	44.75 - 52.00	1.0000	1.0000
L24	17	CCI-AFP-060100	44.75 - 52.00	1.0000	1.0000
L26	1	Climbing Pegs	37.24 - 42.24	1.0000	1.0000
L27	1	Climbing Pegs	32.24 - 37.24	1.0000	1.0000
L28	1	Climbing Pegs	27.24 - 32.24	1.0000	1.0000
L29	1	Climbing Pegs	22.24 - 27.24	1.0000	1.0000
L30	1	Climbing Pegs	17.24 - 22.24	1.0000	1.0000
L31	1	Climbing Pegs	12.24 - 17.24	1.0000	1.0000
L32	1	Climbing Pegs	8.00 - 12.24	1.0000	1.0000

### Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement	$C_A A_A$ Front	$C_A A_A$ Side	Weight	
			Horz Lateral	Vert						
			ft	ft	°	ft	ft <sup>2</sup>	ft <sup>2</sup>	K	
T-Arm Mount [TA 702-3]	C	None			0.0000	149.00	No Ice 1/2" Ice 1" Ice 2" Ice	5.64 6.55 7.46 9.28	5.64 6.55 7.46 9.28	0.34 0.43 0.52 0.70
7770.00 w/ Mount Pipe	A	From Leg	3.00 0.00 2.00		0.0000	149.00	No Ice 1/2" Ice 1" Ice 2" Ice	5.84 6.32 6.77 7.71	4.35 5.20 5.92 7.41	0.06 0.11 0.16 0.29
7770.00 w/ Mount Pipe	B	From Leg	3.00 0.00 2.00		0.0000	149.00	No Ice 1/2" Ice 1" Ice 2" Ice	5.84 6.32 6.77 7.71	4.35 5.20 5.92 7.41	0.06 0.11 0.16 0.29
7770.00 w/ Mount Pipe	C	From Leg	3.00 0.00 2.00		0.0000	149.00	No Ice 1/2" Ice 1" Ice 2" Ice	5.84 6.32 6.77 7.71	4.35 5.20 5.92 7.41	0.06 0.11 0.16 0.29

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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
AM-X-CD-16-65-00T-RET w/ Mount Pipe	A	From Leg	3.00	0.0000	149.00	No Ice	8.26	6.30	0.07
			0.00			1/2" Ice	8.82	7.48	0.14
			2.00			1" Ice	9.35	8.37	0.21
						2" Ice	10.42	10.18	0.38
AM-X-CD-16-65-00T-RET w/ Mount Pipe	B	From Leg	3.00	0.0000	149.00	No Ice	8.26	6.30	0.07
			0.00			1/2" Ice	8.82	7.48	0.14
			2.00			1" Ice	9.35	8.37	0.21
						2" Ice	10.42	10.18	0.38
AM-X-CD-16-65-00T-RET w/ Mount Pipe	C	From Leg	3.00	0.0000	149.00	No Ice	8.26	6.30	0.07
			0.00			1/2" Ice	8.82	7.48	0.14
			2.00			1" Ice	9.35	8.37	0.21
						2" Ice	10.42	10.18	0.38
(2) LGP17201	A	From Leg	3.00	0.0000	149.00	No Ice	1.67	0.47	0.03
			0.00			1/2" Ice	1.83	0.57	0.04
			2.00			1" Ice	2.00	0.68	0.06
						2" Ice	2.36	0.91	0.09
(2) LGP17201	B	From Leg	3.00	0.0000	149.00	No Ice	1.67	0.47	0.03
			0.00			1/2" Ice	1.83	0.57	0.04
			2.00			1" Ice	2.00	0.68	0.06
						2" Ice	2.36	0.91	0.09
(2) LGP17201	C	From Leg	3.00	0.0000	149.00	No Ice	1.67	0.47	0.03
			0.00			1/2" Ice	1.83	0.57	0.04
			2.00			1" Ice	2.00	0.68	0.06
						2" Ice	2.36	0.91	0.09
(2) LGP21901	A	From Leg	3.00	0.0000	149.00	No Ice	0.23	0.16	0.01
			0.00			1/2" Ice	0.29	0.21	0.01
			2.00			1" Ice	0.36	0.28	0.01
						2" Ice	0.53	0.42	0.02
(2) LGP21901	B	From Leg	3.00	0.0000	149.00	No Ice	0.23	0.16	0.01
			0.00			1/2" Ice	0.29	0.21	0.01
			2.00			1" Ice	0.36	0.28	0.01
						2" Ice	0.53	0.42	0.02
(2) LGP21901	C	From Leg	3.00	0.0000	149.00	No Ice	0.23	0.16	0.01
			0.00			1/2" Ice	0.29	0.21	0.01
			2.00			1" Ice	0.36	0.28	0.01
						2" Ice	0.53	0.42	0.02
RRUS-11	A	From Leg	3.00	0.0000	149.00	No Ice	2.78	1.19	0.05
			0.00			1/2" Ice	2.99	1.33	0.07
			2.00			1" Ice	3.21	1.49	0.09
						2" Ice	3.66	1.83	0.15
RRUS-11	B	From Leg	3.00	0.0000	149.00	No Ice	2.78	1.19	0.05
			0.00			1/2" Ice	2.99	1.33	0.07
			2.00			1" Ice	3.21	1.49	0.09
						2" Ice	3.66	1.83	0.15
RRUS-11	C	From Leg	3.00	0.0000	149.00	No Ice	2.78	1.19	0.05
			0.00			1/2" Ice	2.99	1.33	0.07
			2.00			1" Ice	3.21	1.49	0.09
						2" Ice	3.66	1.83	0.15
DC6-48-60-18-8F Surge Suppression Unit	B	From Leg	3.00	0.0000	149.00	No Ice	0.92	0.92	0.02
			0.00			1/2" Ice	1.46	1.46	0.04
			2.00			1" Ice	1.64	1.64	0.06
						2" Ice	2.04	2.04	0.11
Side Arm Mount [SO 101-3]	C	None		0.0000	140.00	No Ice	7.50	7.50	0.25
						1/2" Ice	8.90	8.90	0.33
						1" Ice	10.30	10.30	0.41
						2" Ice	13.10	13.10	0.58
APXVAARR24_43-U-NA20	A	From Leg	1.00	0.0000	140.00	No Ice	20.24	10.79	0.16

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Description	Face or Leg	Offset Type	Offsets:		Azimuth Adjustment	Placement	C <sub>AA</sub> Front	C <sub>AA</sub> Side	Weight	
			Horz Lateral	Vert						°
w/ Mount Pipe			0.00			1/2" Ice	20.89	12.21	0.29	
			0.00			1" Ice	21.55	13.49	0.44	
			0.00			2" Ice	22.88	15.72	0.76	
APXVAARR24_43-U-NA20 w/ Mount Pipe	B	From Leg	1.00		0.0000	140.00	No Ice	20.24	10.79	0.16
			0.00				1/2" Ice	20.89	12.21	0.29
			0.00				1" Ice	21.55	13.49	0.44
			0.00				2" Ice	22.88	15.72	0.76
APXVAARR24_43-U-NA20 w/ Mount Pipe	C	From Leg	1.00		0.0000	140.00	No Ice	20.24	10.79	0.16
			0.00				1/2" Ice	20.89	12.21	0.29
			0.00				1" Ice	21.55	13.49	0.44
			0.00				2" Ice	22.88	15.72	0.76
RADIO 4449 B12/B71	A	From Leg	1.00		0.0000	140.00	No Ice	1.65	1.16	0.07
			0.00				1/2" Ice	1.81	1.30	0.09
			0.00				1" Ice	1.98	1.45	0.11
			0.00				2" Ice	2.34	1.76	0.16
RADIO 4449 B12/B71	B	From Leg	1.00		0.0000	140.00	No Ice	1.65	1.16	0.07
			0.00				1/2" Ice	1.81	1.30	0.09
			0.00				1" Ice	1.98	1.45	0.11
			0.00				2" Ice	2.34	1.76	0.16
RADIO 4449 B12/B71	C	From Leg	2.00		0.0000	140.00	No Ice	1.65	1.16	0.07
			0.00				1/2" Ice	1.81	1.30	0.09
			0.00				1" Ice	1.98	1.45	0.11
			0.00				2" Ice	2.34	1.76	0.16
APX16DWV-16DWV-S-E-A 20 w/ Mount Pipe	A	From Leg	2.00		0.0000	140.00	No Ice	7.14	3.81	0.07
			0.00				1/2" Ice	7.76	4.88	0.12
			0.00				1" Ice	8.29	5.66	0.18
			0.00				2" Ice	9.37	7.26	0.32
APX16DWV-16DWV-S-E-A 20 w/ Mount Pipe	B	From Leg	2.00		0.0000	140.00	No Ice	7.14	3.81	0.07
			0.00				1/2" Ice	7.76	4.88	0.12
			0.00				1" Ice	8.29	5.66	0.18
			0.00				2" Ice	9.37	7.26	0.32
APX16DWV-16DWV-S-E-A 20 w/ Mount Pipe	C	From Leg	2.00		0.0000	140.00	No Ice	7.14	3.81	0.07
			0.00				1/2" Ice	7.76	4.88	0.12
			0.00				1" Ice	8.29	5.66	0.18
			0.00				2" Ice	9.37	7.26	0.32
KRY 112 489/2	A	From Leg	2.00		0.0000	140.00	No Ice	0.56	0.37	0.02
			0.00				1/2" Ice	0.66	0.45	0.02
			0.00				1" Ice	0.76	0.54	0.03
			0.00				2" Ice	1.00	0.75	0.05
KRY 112 489/2	B	From Leg	2.00		0.0000	140.00	No Ice	0.56	0.37	0.02
			0.00				1/2" Ice	0.66	0.45	0.02
			0.00				1" Ice	0.76	0.54	0.03
			0.00				2" Ice	1.00	0.75	0.05
KRY 112 489/2	C	From Leg	2.00		0.0000	140.00	No Ice	0.56	0.37	0.02
			0.00				1/2" Ice	0.66	0.45	0.02
			0.00				1" Ice	0.76	0.54	0.03
			0.00				2" Ice	1.00	0.75	0.05
Side Arm Mount [SO 101-3]	C	None			0.0000	130.00	No Ice	7.50	7.50	0.25
							1/2" Ice	8.90	8.90	0.33
							1" Ice	10.30	10.30	0.41
							2" Ice	13.10	13.10	0.58
(2) SBNHH-1D65B w/ Mount Pipe	A	From Leg	2.00		0.0000	130.00	No Ice	8.16	6.16	0.06
			0.00				1/2" Ice	8.62	6.82	0.12
			0.00				1" Ice	9.09	7.51	0.19
							2" Ice	10.04	8.92	0.35
(2) SBNHH-1D65B w/ Mount Pipe	B	From Leg	2.00		0.0000	130.00	No Ice	8.16	6.16	0.06
			0.00				1/2" Ice	8.62	6.82	0.12

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Description	Face or Leg	Offset Type	Offsets:			Azimuth Adjustment	Placement	C <sub>AA</sub> Front	C <sub>AA</sub> Side	Weight	
			Horz	Lateral	Vert						°
			0.00								
(2) SBNHH-1D65B w/ Mount Pipe	C	From Leg	2.00			0.0000	130.00	1" Ice	9.09	7.51	0.19
			0.00					2" Ice	10.04	8.92	0.35
			0.00					No Ice	8.16	6.16	0.06
			0.00					1/2" Ice	8.62	6.82	0.12
B13 RRH4X30-4R	A	From Leg	2.00			0.0000	130.00	1" Ice	9.09	7.51	0.19
			0.00					2" Ice	10.04	8.92	0.35
			0.00					No Ice	2.16	1.62	0.06
			0.00					1/2" Ice	2.35	1.79	0.08
B13 RRH4X30-4R	B	From Leg	2.00			0.0000	130.00	1" Ice	2.55	1.97	0.10
			0.00					2" Ice	2.97	2.36	0.15
			0.00					No Ice	2.16	1.62	0.06
			0.00					1/2" Ice	2.35	1.79	0.08
B13 RRH4X30-4R	C	From Leg	2.00			0.0000	130.00	1" Ice	2.55	1.97	0.10
			0.00					2" Ice	2.97	2.36	0.15
			0.00					No Ice	2.16	1.62	0.06
			0.00					1/2" Ice	2.35	1.79	0.08
B25 RRH4X30	A	From Leg	2.00			0.0000	130.00	1" Ice	2.55	1.97	0.10
			0.00					2" Ice	2.97	2.36	0.15
			0.00					No Ice	2.20	1.74	0.06
			0.00					1/2" Ice	2.39	1.92	0.08
B25 RRH4X30	B	From Leg	2.00			0.0000	130.00	1" Ice	2.59	2.11	0.10
			0.00					2" Ice	3.01	2.50	0.16
			0.00					No Ice	2.20	1.74	0.06
			0.00					1/2" Ice	2.39	1.92	0.08
B25 RRH4X30	C	From Leg	2.00			0.0000	130.00	1" Ice	2.59	2.11	0.10
			0.00					2" Ice	3.01	2.50	0.16
			0.00					No Ice	2.20	1.74	0.06
			0.00					1/2" Ice	2.39	1.92	0.08
B66A RRH4X45	A	From Leg	2.00			0.0000	130.00	1" Ice	2.59	2.11	0.10
			0.00					2" Ice	3.01	2.50	0.16
			0.00					No Ice	2.54	1.61	0.06
			0.00					1/2" Ice	2.75	1.79	0.08
B66A RRH4X45	B	From Leg	2.00			0.0000	130.00	1" Ice	2.97	1.98	0.10
			0.00					2" Ice	3.43	2.37	0.16
			0.00					No Ice	2.54	1.61	0.06
			0.00					1/2" Ice	2.75	1.79	0.08
B66A RRH4X45	C	From Leg	2.00			0.0000	130.00	1" Ice	2.97	1.98	0.10
			0.00					2" Ice	3.43	2.37	0.16
			0.00					No Ice	2.54	1.61	0.06
			0.00					1/2" Ice	2.75	1.79	0.08
RCMDC-3315-PF-48	A	From Leg	2.00			0.0000	130.00	1" Ice	2.97	1.98	0.10
			0.00					2" Ice	3.43	2.37	0.16
			0.00					No Ice	3.71	2.19	0.03
			0.00					1/2" Ice	3.95	2.39	0.06
RCMDC-3315-PF-48	C	From Leg	2.00			0.0000	130.00	1" Ice	4.20	2.61	0.10
			0.00					2" Ice	4.72	3.05	0.18
			0.00					No Ice	3.71	2.19	0.03
			0.00					1/2" Ice	3.95	2.39	0.06
							1" Ice	4.20	2.61	0.10	
							2" Ice	4.72	3.05	0.18	

<p><b>tnxTower</b></p> <p><b>GPD</b></p> <p>520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235</p>	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	16 of 24
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	<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

## Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.0 Wind 0 deg - No Ice
3	0.9 Dead+1.0 Wind 0 deg - No Ice
4	1.2 Dead+1.0 Wind 30 deg - No Ice
5	0.9 Dead+1.0 Wind 30 deg - No Ice
6	1.2 Dead+1.0 Wind 60 deg - No Ice
7	0.9 Dead+1.0 Wind 60 deg - No Ice
8	1.2 Dead+1.0 Wind 90 deg - No Ice
9	0.9 Dead+1.0 Wind 90 deg - No Ice
10	1.2 Dead+1.0 Wind 120 deg - No Ice
11	0.9 Dead+1.0 Wind 120 deg - No Ice
12	1.2 Dead+1.0 Wind 150 deg - No Ice
13	0.9 Dead+1.0 Wind 150 deg - No Ice
14	1.2 Dead+1.0 Wind 180 deg - No Ice
15	0.9 Dead+1.0 Wind 180 deg - No Ice
16	1.2 Dead+1.0 Wind 210 deg - No Ice
17	0.9 Dead+1.0 Wind 210 deg - No Ice
18	1.2 Dead+1.0 Wind 240 deg - No Ice
19	0.9 Dead+1.0 Wind 240 deg - No Ice
20	1.2 Dead+1.0 Wind 270 deg - No Ice
21	0.9 Dead+1.0 Wind 270 deg - No Ice
22	1.2 Dead+1.0 Wind 300 deg - No Ice
23	0.9 Dead+1.0 Wind 300 deg - No Ice
24	1.2 Dead+1.0 Wind 330 deg - No Ice
25	0.9 Dead+1.0 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

## Maximum Tower Deflections - Service Wind

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

<b>tnxTower</b>  <b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	17 of 24
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	<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	149 - 144	26.947	45	1.5480	0.0002
L2	144 - 139	25.329	45	1.5425	0.0003
L3	139 - 134	23.719	45	1.5311	0.0004
L4	134 - 129	22.125	45	1.5111	0.0005
L5	129 - 123.612	20.558	45	1.4822	0.0005
L6	127.388 - 122.388	20.059	45	1.4708	0.0005
L7	122.388 - 117.388	18.531	45	1.4431	0.0005
L8	117.388 - 112.388	17.047	45	1.3895	0.0004
L9	112.388 - 107.388	15.623	45	1.3281	0.0004
L10	107.388 - 102.388	14.268	45	1.2604	0.0004
L11	102.388 - 98.5	12.986	45	1.1874	0.0003
L12	98.5 - 98.25	12.043	45	1.1276	0.0003
L13	98.25 - 93.25	11.984	45	1.1254	0.0003
L14	93.25 - 88.25	10.829	45	1.0802	0.0003
L15	88.25 - 79.128	9.723	45	1.0323	0.0003
L16	83.873 - 78.128	8.796	45	0.9890	0.0002
L17	78.128 - 73.128	7.627	45	0.9474	0.0002
L18	73.128 - 68.128	6.672	45	0.8765	0.0002
L19	68.128 - 63.128	5.792	45	0.8045	0.0002
L20	63.128 - 58.128	4.988	45	0.7315	0.0002
L21	58.128 - 57.25	4.260	45	0.6578	0.0001
L22	57.25 - 57	4.140	45	0.6449	0.0001
L23	57 - 52	4.107	45	0.6426	0.0001
L24	52 - 43.243	3.458	45	0.5970	0.0001
L25	48.76 - 42.243	3.063	45	0.5673	0.0001
L26	42.243 - 37.243	2.312	45	0.5255	0.0001
L27	37.243 - 32.243	1.795	45	0.4628	0.0001
L28	32.243 - 27.243	1.343	45	0.3999	0.0001
L29	27.243 - 22.243	0.957	45	0.3372	0.0001
L30	22.243 - 17.243	0.637	45	0.2746	0.0001
L31	17.243 - 12.243	0.382	45	0.2123	0.0000
L32	12.243 - 7.243	0.192	45	0.1502	0.0000
L33	7.243 - 2.243	0.067	45	0.0886	0.0000
L34	2.243 - 0	0.006	45	0.0273	0.0000

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

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
149.00	T-Arm Mount [TA 702-3]	45	26.947	1.5480	0.0002	33676
140.00	Side Arm Mount [SO 101-3]	45	24.040	1.5341	0.0004	20585
130.00	Side Arm Mount [SO 101-3]	45	20.868	1.4890	0.0005	9865

### Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	149 - 144	134.639	14	7.7436	0.0026
L2	144 - 139	126.566	14	7.7162	0.0027
L3	139 - 134	118.537	14	7.6598	0.0027

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Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L4	134 - 129	110.587	14	7.5603	0.0027
L5	129 - 123.612	102.764	14	7.4163	0.0026
L6	127.388 - 122.388	100.276	14	7.3594	0.0026
L7	122.388 - 117.388	92.648	14	7.2214	0.0025
L8	117.388 - 112.388	85.241	14	6.9536	0.0024
L9	112.388 - 107.388	78.134	14	6.6469	0.0023
L10	107.388 - 102.388	71.362	14	6.3083	0.0021
L11	102.388 - 98.5	64.957	14	5.9434	0.0020
L12	98.5 - 98.25	60.246	14	5.6446	0.0019
L13	98.25 - 93.25	59.952	14	5.6338	0.0019
L14	93.25 - 88.25	54.178	14	5.4075	0.0018
L15	88.25 - 79.128	48.648	14	5.1679	0.0017
L16	83.873 - 78.128	44.015	14	4.9517	0.0016
L17	78.128 - 73.128	38.168	14	4.7431	0.0015
L18	73.128 - 68.128	33.391	14	4.3887	0.0014
L19	68.128 - 63.128	28.988	14	4.0281	0.0012
L20	63.128 - 58.128	24.964	14	3.6626	0.0011
L21	58.128 - 57.25	21.323	14	3.2936	0.0010
L22	57.25 - 57	20.724	14	3.2290	0.0010
L23	57 - 52	20.555	14	3.2178	0.0010
L24	52 - 43.243	17.307	14	2.9893	0.0009
L25	48.76 - 42.243	15.329	14	2.8407	0.0008
L26	42.243 - 37.243	11.574	14	2.6314	0.0008
L27	37.243 - 32.243	8.984	14	2.3170	0.0007
L28	32.243 - 27.243	6.723	14	2.0024	0.0006
L29	27.243 - 22.243	4.791	14	1.6882	0.0005
L30	22.243 - 17.243	3.187	14	1.3748	0.0004
L31	17.243 - 12.243	1.911	14	1.0626	0.0003
L32	12.243 - 7.243	0.961	14	0.7520	0.0002
L33	7.243 - 2.243	0.336	14	0.4433	0.0001
L34	2.243 - 0	0.032	14	0.1367	0.0000

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

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
149.00	T-Arm Mount [TA 702-3]	14	134.639	7.7436	0.0026	7057
140.00	Side Arm Mount [SO 101-3]	14	120.138	7.6744	0.0027	4287
130.00	Side Arm Mount [SO 101-3]	14	104.316	7.4502	0.0027	2043

### Compression Checks

### Pole Design Data

Section No.	Elevation ft	Size	L ft	L <sub>u</sub> ft	Kl/r	A in <sup>2</sup>	P <sub>u</sub> K	φP <sub>n</sub> K	Ratio $\frac{P_u}{\phi P_n}$
L1	149 - 144 (1)	TP22.426x21.5x0.1875	5.00	0.00	0.0	13.2347	-1.13	774.23	0.001
L2	144 - 139 (2)	TP23.3521x22.426x0.1875	5.00	0.00	0.0	13.7858	-2.35	806.47	0.003



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	<p><b>Client</b></p> <p>Crown Castle USA, Inc.</p>	<p><b>Designed by</b></p> <p>bchristy</p>

Section No.	Elevation ft	Size	L ft	L <sub>u</sub> ft	Kl/r	A in <sup>2</sup>	P <sub>u</sub> K	φP <sub>n</sub> K	Ratio P <sub>u</sub> φP <sub>n</sub>
L3	139 - 134 (3)	TP24.2781x23.3521x0.1875	5.00	0.00	0.0	14.3369	-2.69	838.71	0.003
L4	134 - 129 (4)	TP25.2042x24.2781x0.1875	5.00	0.00	0.0	14.8881	-4.05	870.95	0.005
L5	129 - 123.612 (5)	TP26.2021x25.2042x0.1875	5.39	0.00	0.0	15.0657	-4.18	881.35	0.005
L6	123.612 - 122.388 (6)	TP26.0428x25.1277x0.1875	5.00	0.00	0.0	15.3871	-4.81	900.15	0.005
L7	122.388 - 117.388 (7)	TP26.9578x26.0428x0.1875	5.00	0.00	0.0	15.9317	-5.25	932.01	0.006
L8	117.388 - 112.388 (8)	TP27.8729x26.9578x0.1875	5.00	0.00	0.0	16.4763	-5.71	963.86	0.006
L9	112.388 - 107.388 (9)	TP28.7879x27.8729x0.1875	5.00	0.00	0.0	17.0208	-6.20	995.72	0.006
L10	107.388 - 102.388 (10)	TP29.703x28.7879x0.1875	5.00	0.00	0.0	17.5654	-6.71	1027.58	0.007
L11	102.388 - 98.5 (11)	TP30.4145x29.703x0.1875	3.89	0.00	0.0	17.9889	-7.12	1052.35	0.007
L12	98.5 - 98.25 (12)	TP30.4603x30.4145x0.3438	0.25	0.00	0.0	32.8590	-7.17	1922.25	0.004
L13	98.25 - 93.25 (13)	TP31.3753x30.4603x0.3375	5.00	0.00	0.0	33.2485	-7.91	1945.04	0.004
L14	93.25 - 88.25 (14)	TP32.2904x31.3753x0.3313	5.00	0.00	0.0	33.6014	-8.67	1965.68	0.004
L15	88.25 - 79.128 (15)	TP33.9598x32.2904x0.3313	9.12	0.00	0.0	34.4436	-9.35	2014.95	0.005
L16	79.128 - 78.128 (16)	TP33.7634x32.7164x0.25	5.75	0.00	0.0	26.5929	-10.73	1555.68	0.007
L17	78.128 - 73.128 (17)	TP34.6747x33.7634x0.25	5.00	0.00	0.0	27.3160	-11.48	1597.98	0.007
L18	73.128 - 68.128 (18)	TP35.5859x34.6747x0.25	5.00	0.00	0.0	28.0390	-12.25	1640.28	0.007
L19	68.128 - 63.128 (19)	TP36.4971x35.5859x0.25	5.00	0.00	0.0	28.7621	-13.04	1682.58	0.008
L20	63.128 - 58.128 (20)	TP37.4084x36.4971x0.25	5.00	0.00	0.0	29.4852	-13.85	1724.88	0.008
L21	58.128 - 57.25 (21)	TP37.5684x37.4084x0.25	0.88	0.00	0.0	29.6121	-14.00	1732.31	0.008
L22	57.25 - 57 (22)	TP37.6139x37.5684x0.4188	0.25	0.00	0.0	49.4366	-14.06	2892.04	0.005
L23	57 - 52 (23)	TP38.5252x37.6139x0.4125	5.00	0.00	0.0	49.9000	-15.19	2919.15	0.005
L24	52 - 43.243 (24)	TP40.1211x38.5252x0.4125	8.76	0.00	0.0	50.6731	-15.93	2964.37	0.005
L25	43.243 - 42.243 (25)	TP39.8031x38.6156x0.3125	6.52	0.00	0.0	39.1697	-18.25	2291.43	0.008
L26	42.243 - 37.243 (26)	TP40.7141x39.8031x0.3125	5.00	0.00	0.0	40.0733	-19.29	2344.29	0.008
L27	37.243 - 32.243 (27)	TP41.6251x40.7141x0.3125	5.00	0.00	0.0	40.9770	-20.35	2397.15	0.008
L28	32.243 - 27.243 (28)	TP42.5362x41.6251x0.3125	5.00	0.00	0.0	41.8806	-21.44	2450.02	0.009
L29	27.243 - 22.243 (29)	TP43.4472x42.5362x0.3125	5.00	0.00	0.0	42.7842	-22.55	2502.88	0.009
L30	22.243 - 17.243 (30)	TP44.3582x43.4472x0.3125	5.00	0.00	0.0	43.6879	-23.69	2555.74	0.009
L31	17.243 - 12.243 (31)	TP45.2693x44.3582x0.3125	5.00	0.00	0.0	44.5915	-24.84	2608.60	0.010
L32	12.243 - 7.243 (32)	TP46.1803x45.2693x0.3125	5.00	0.00	0.0	45.4951	-26.01	2661.46	0.010
L33	7.243 - 2.243 (33)	TP47.0913x46.1803x0.3125	5.00	0.00	0.0	46.3987	-27.11	2714.33	0.010
L34	2.243 - 0 (34)	TP47.5x47.0913x0.3125	2.24	0.00	0.0	46.8041	-27.61	2738.04	0.010

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### Pole Bending Design Data

Section No.	Elevation ft	Size	$M_{ux}$	$\phi M_{rx}$	Ratio	$M_{uy}$	$\phi M_{ry}$	Ratio
			kip-ft	kip-ft	$\frac{M_{ux}}{\phi M_{rx}}$	kip-ft	kip-ft	$\frac{M_{uy}}{\phi M_{ry}}$
L1	149 - 144 (1)	TP22.426x21.5x0.1875	24.57	422.86	0.058	0.00	422.86	0.000
L2	144 - 139 (2)	TP23.3521x22.426x0.1875	49.05	452.93	0.108	0.00	452.93	0.000
L3	139 - 134 (3)	TP24.2781x23.3521x0.1875	90.78	483.48	0.188	0.00	483.48	0.000
L4	134 - 129 (4)	TP25.2042x24.2781x0.1875	138.46	514.46	0.269	0.00	514.46	0.000
L5	129 - 123.612 (5)	TP26.2021x25.2042x0.1875	159.01	524.53	0.303	0.00	524.53	0.000
L6	123.612 - 122.388 (6)	TP26.0428x25.1277x0.1875	224.52	542.84	0.414	0.00	542.84	0.000
L7	122.388 - 117.388 (7)	TP26.9578x26.0428x0.1875	292.54	574.11	0.510	0.00	574.11	0.000
L8	117.388 - 112.388 (8)	TP27.8729x26.9578x0.1875	363.03	605.63	0.599	0.00	605.63	0.000
L9	112.388 - 107.388 (9)	TP28.7879x27.8729x0.1875	436.00	637.35	0.684	0.00	637.35	0.000
L10	107.388 - 102.388 (10)	TP29.703x28.7879x0.1875	511.49	669.22	0.764	0.00	669.22	0.000
L11	102.388 - 98.5 (11)	TP30.4145x29.703x0.1875	571.93	694.06	0.824	0.00	694.06	0.000
L12	98.5 - 98.25 (12)	TP30.4603x30.4145x0.3438	575.87	1506.55	0.382	0.00	1506.55	0.000
L13	98.25 - 93.25 (13)	TP31.3753x30.4603x0.3375	657.05	1571.88	0.418	0.00	1571.88	0.000
L14	93.25 - 88.25 (14)	TP32.2904x31.3753x0.3313	742.75	1630.72	0.455	0.00	1630.72	0.000
L15	88.25 - 79.128 (15)	TP33.9598x32.2904x0.3313	821.48	1703.49	0.482	0.00	1703.49	0.000
L16	79.128 - 78.128 (16)	TP33.7634x32.7164x0.25	930.25	1228.92	0.757	0.00	1228.92	0.000
L17	78.128 - 73.128 (17)	TP34.6747x33.7634x0.25	1028.62	1283.78	0.801	0.00	1283.78	0.000
L18	73.128 - 68.128 (18)	TP35.5859x34.6747x0.25	1129.60	1339.04	0.844	0.00	1339.04	0.000
L19	68.128 - 63.128 (19)	TP36.4971x35.5859x0.25	1233.18	1394.68	0.884	0.00	1394.68	0.000
L20	63.128 - 58.128 (20)	TP37.4084x36.4971x0.25	1339.33	1450.61	0.923	0.00	1450.61	0.000
L21	58.128 - 57.25 (21)	TP37.5684x37.4084x0.25	1358.26	1460.46	0.930	0.00	1460.46	0.000
L22	57.25 - 57 (22)	TP37.6139x37.5684x0.4188	1363.68	2799.79	0.487	0.00	2799.79	0.000
L23	57 - 52 (23)	TP38.5252x37.6139x0.4125	1474.49	2896.98	0.509	0.00	2896.98	0.000
L24	52 - 43.243 (24)	TP40.1211x38.5252x0.4125	1548.79	2987.93	0.518	0.00	2987.93	0.000
L25	43.243 - 42.243 (25)	TP39.8031x38.6156x0.3125	1704.34	2177.53	0.783	0.00	2177.53	0.000
L26	42.243 - 37.243 (26)	TP40.7141x39.8031x0.3125	1827.68	2261.48	0.808	0.00	2261.48	0.000
L27	37.243 - 32.243 (27)	TP41.6251x40.7141x0.3125	1953.45	2346.11	0.833	0.00	2346.11	0.000
L28	32.243 - 27.243 (28)	TP42.5362x41.6251x0.3125	2081.56	2431.36	0.856	0.00	2431.36	0.000
L29	27.243 - 22.243 (29)	TP43.4472x42.5362x0.3125	2211.93	2517.18	0.879	0.00	2517.18	0.000
L30	22.243 - 17.243 (30)	TP44.3582x43.4472x0.3125	2344.43	2603.52	0.900	0.00	2603.52	0.000
L31	17.243 -	TP45.2693x44.3582x0.3125	2478.95	2690.31	0.921	0.00	2690.31	0.000

<b>tnxTower</b>  <b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	21 of 24
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	<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

Section No.	Elevation ft	Size	$M_{ux}$ kip-ft	$\phi M_{rx}$ kip-ft	Ratio $\frac{M_{ux}}{\phi M_{rx}}$	$M_{uy}$ kip-ft	$\phi M_{ry}$ kip-ft	Ratio $\frac{M_{uy}}{\phi M_{ry}}$
L32	12.243 (31) 12.243 - 7.243 (32)	TP46.1803x45.2693x0.3125	2615.39	2777.50	0.942	0.00	2777.50	0.000
L33	7.243 - 2.243 (33)	TP47.0913x46.1803x0.3125	2753.75	2865.04	0.961	0.00	2865.04	0.000
L34	2.243 - 0 (34)	TP47.5x47.0913x0.3125	2816.43	2904.42	0.970	0.00	2904.42	0.000

### Pole Shear Design Data

Section No.	Elevation ft	Size	Actual $V_u$ K	$\phi V_n$ K	Ratio $\frac{V_u}{\phi V_n}$	Actual $T_u$ kip-ft	$\phi T_n$ kip-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	149 - 144 (1)	TP22.426x21.5x0.1875	3.92	232.27	0.017	0.01	452.35	0.000
L2	144 - 139 (2)	TP23.3521x22.426x0.1875	8.11	241.94	0.034	0.14	490.81	0.000
L3	139 - 134 (3)	TP24.2781x23.3521x0.1875	8.58	251.61	0.034	0.14	530.84	0.000
L4	134 - 129 (4)	TP25.2042x24.2781x0.1875	12.68	261.29	0.049	0.14	572.43	0.000
L5	129 - 123.612 (5)	TP26.2021x25.2042x0.1875	12.84	264.40	0.049	0.14	586.18	0.000
L6	123.612 - 122.388 (6)	TP26.0428x25.1277x0.1875	13.36	270.04	0.049	0.14	611.46	0.000
L7	122.388 - 117.388 (7)	TP26.9578x26.0428x0.1875	13.85	279.60	0.050	0.14	655.50	0.000
L8	117.388 - 112.388 (8)	TP27.8729x26.9578x0.1875	14.35	289.16	0.050	0.14	701.08	0.000
L9	112.388 - 107.388 (9)	TP28.7879x27.8729x0.1875	14.85	298.72	0.050	0.14	748.19	0.000
L10	107.388 - 102.388 (10)	TP29.703x28.7879x0.1875	15.35	308.27	0.050	0.14	796.83	0.000
L11	102.388 - 98.5 (11)	TP30.4145x29.703x0.1875	15.75	315.70	0.050	0.14	835.71	0.000
L12	98.5 - 98.25 (12)	TP30.4603x30.4145x0.3438	15.79	576.68	0.027	0.14	1520.96	0.000
L13	98.25 - 93.25 (13)	TP31.3753x30.4603x0.3375	16.69	583.51	0.029	0.13	1586.07	0.000
L14	93.25 - 88.25 (14)	TP32.2904x31.3753x0.3313	17.60	589.71	0.030	0.13	1650.47	0.000
L15	88.25 - 79.128 (15)	TP33.9598x32.2904x0.3313	18.39	604.49	0.030	0.13	1734.25	0.000
L16	79.128 - 78.128 (16)	TP33.7634x32.7164x0.25	19.42	466.70	0.042	0.13	1369.75	0.000
L17	78.128 - 73.128 (17)	TP34.6747x33.7634x0.25	19.94	479.39	0.042	0.13	1445.25	0.000
L18	73.128 - 68.128 (18)	TP35.5859x34.6747x0.25	20.47	492.08	0.042	0.13	1522.78	0.000
L19	68.128 - 63.128 (19)	TP36.4971x35.5859x0.25	20.98	504.77	0.042	0.13	1602.33	0.000
L20	63.128 - 58.128 (20)	TP37.4084x36.4971x0.25	21.50	517.47	0.042	0.13	1683.90	0.000
L21	58.128 - 57.25 (21)	TP37.5684x37.4084x0.25	21.65	519.69	0.042	0.13	1698.43	0.000
L22	57.25 - 57 (22)	TP37.6139x37.5684x0.4188	21.69	867.61	0.025	0.13	2826.13	0.000
L23	57 - 52 (23)	TP38.5252x37.6139x0.4125	22.64	875.74	0.026	0.13	2922.98	0.000
L24	52 - 43.243 (24)	TP40.1211x38.5252x0.4125	23.24	889.31	0.026	0.13	3014.26	0.000
L25	43.243 - 42.243 (25)	TP39.8031x38.6156x0.3125	24.43	687.43	0.036	0.13	2377.39	0.000

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<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

Section No.	Elevation ft	Size	Actual $V_u$ K	$\phi V_n$ K	Ratio $\frac{V_u}{\phi V_n}$	Actual $T_u$ kip-ft	$\phi T_n$ kip-ft	Ratio $\frac{T_u}{\phi T_n}$
L26	42.243 - 37.243 (26)	TP40.7141x39.8031x0.3125	24.93	703.29	0.035	0.13	2488.35	0.000
L27	37.243 - 32.243 (27)	TP41.6251x40.7141x0.3125	25.40	719.15	0.035	0.13	2601.83	0.000
L28	32.243 - 27.243 (28)	TP42.5362x41.6251x0.3125	25.86	735.01	0.035	0.13	2717.85	0.000
L29	27.243 - 22.243 (29)	TP43.4472x42.5362x0.3125	26.31	750.86	0.035	0.13	2836.40	0.000
L30	22.243 - 17.243 (30)	TP44.3582x43.4472x0.3125	26.72	766.72	0.035	0.13	2957.47	0.000
L31	17.243 - 12.243 (31)	TP45.2693x44.3582x0.3125	27.11	782.58	0.035	0.13	3081.08	0.000
L32	12.243 - 7.243 (32)	TP46.1803x45.2693x0.3125	27.50	798.44	0.034	0.13	3207.22	0.000
L33	7.243 - 2.243 (33)	TP47.0913x46.1803x0.3125	27.88	814.30	0.034	0.13	3335.89	0.000
L34	2.243 - 0 (34)	TP47.5x47.0913x0.3125	28.05	821.41	0.034	0.13	3394.44	0.000

**Pole Interaction Design Data**

Section No.	Elevation ft	Ratio $P_u$ $\phi P_n$	Ratio $M_{ux}$ $\phi M_{nx}$	Ratio $M_{uy}$ $\phi M_{ny}$	Ratio $V_u$ $\phi V_n$	Ratio $T_u$ $\phi T_n$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	149 - 144 (1)	0.001	0.058	0.000	0.017	0.000	0.060	1.050	4.8.2
L2	144 - 139 (2)	0.003	0.108	0.000	0.034	0.000	0.112	1.050	4.8.2
L3	139 - 134 (3)	0.003	0.188	0.000	0.034	0.000	0.192	1.050	4.8.2
L4	134 - 129 (4)	0.005	0.269	0.000	0.049	0.000	0.276	1.050	4.8.2
L5	129 - 123.612 (5)	0.005	0.303	0.000	0.049	0.000	0.310	1.050	4.8.2
L6	123.612 - 122.388 (6)	0.005	0.414	0.000	0.049	0.000	0.421	1.050	4.8.2
L7	122.388 - 117.388 (7)	0.006	0.510	0.000	0.050	0.000	0.518	1.050	4.8.2
L8	117.388 - 112.388 (8)	0.006	0.599	0.000	0.050	0.000	0.608	1.050	4.8.2
L9	112.388 - 107.388 (9)	0.006	0.684	0.000	0.050	0.000	0.693	1.050	4.8.2
L10	107.388 - 102.388 (10)	0.007	0.764	0.000	0.050	0.000	0.773	1.050	4.8.2
L11	102.388 - 98.5 (11)	0.007	0.824	0.000	0.050	0.000	0.833	1.050	4.8.2
L12	98.5 - 98.25 (12)	0.004	0.382	0.000	0.027	0.000	0.387	1.050	4.8.2
L13	98.25 - 93.25 (13)	0.004	0.418	0.000	0.029	0.000	0.423	1.050	4.8.2
L14	93.25 - 88.25 (14)	0.004	0.455	0.000	0.030	0.000	0.461	1.050	4.8.2
L15	88.25 - 79.128 (15)	0.005	0.482	0.000	0.030	0.000	0.488	1.050	4.8.2
L16	79.128 - 78.128 (16)	0.007	0.757	0.000	0.042	0.000	0.766	1.050	4.8.2
L17	78.128 - 73.128 (17)	0.007	0.801	0.000	0.042	0.000	0.810	1.050	4.8.2
L18	73.128 - 68.128 (18)	0.007	0.844	0.000	0.042	0.000	0.853	1.050	4.8.2

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<b>Client</b>	Crown Castle USA, Inc.	<b>Designed by</b>	bchristy

Section No.	Elevation ft	Ratio $P_u$	Ratio $M_{ux}$	Ratio $M_{uy}$	Ratio $V_u$	Ratio $T_u$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
		$\phi P_n$	$\phi M_{nx}$	$\phi M_{ny}$	$\phi V_n$	$\phi T_n$			
L19	68.128 - 63.128 (19)	0.008	0.884	0.000	0.042	0.000	0.894	1.050	4.8.2
L20	63.128 - 58.128 (20)	0.008	0.923	0.000	0.042	0.000	0.933	1.050	4.8.2
L21	58.128 - 57.25 (21)	0.008	0.930	0.000	0.042	0.000	0.940	1.050	4.8.2
L22	57.25 - 57 (22)	0.005	0.487	0.000	0.025	0.000	0.493	1.050	4.8.2
L23	57 - 52 (23)	0.005	0.509	0.000	0.026	0.000	0.515	1.050	4.8.2
L24	52 - 43.243 (24)	0.005	0.518	0.000	0.026	0.000	0.524	1.050	4.8.2
L25	43.243 - 42.243 (25)	0.008	0.783	0.000	0.036	0.000	0.792	1.050	4.8.2
L26	42.243 - 37.243 (26)	0.008	0.808	0.000	0.035	0.000	0.818	1.050	4.8.2
L27	37.243 - 32.243 (27)	0.008	0.833	0.000	0.035	0.000	0.842	1.050	4.8.2
L28	32.243 - 27.243 (28)	0.009	0.856	0.000	0.035	0.000	0.866	1.050	4.8.2
L29	27.243 - 22.243 (29)	0.009	0.879	0.000	0.035	0.000	0.889	1.050	4.8.2
L30	22.243 - 17.243 (30)	0.009	0.900	0.000	0.035	0.000	0.911	1.050	4.8.2
L31	17.243 - 12.243 (31)	0.010	0.921	0.000	0.035	0.000	0.932	1.050	4.8.2
L32	12.243 - 7.243 (32)	0.010	0.942	0.000	0.034	0.000	0.953	1.050	4.8.2
L33	7.243 - 2.243 (33)	0.010	0.961	0.000	0.034	0.000	0.972	1.050	4.8.2
L34	2.243 - 0 (34)	0.010	0.970	0.000	0.034	0.000	0.981	1.050	4.8.2

### Section Capacity Table

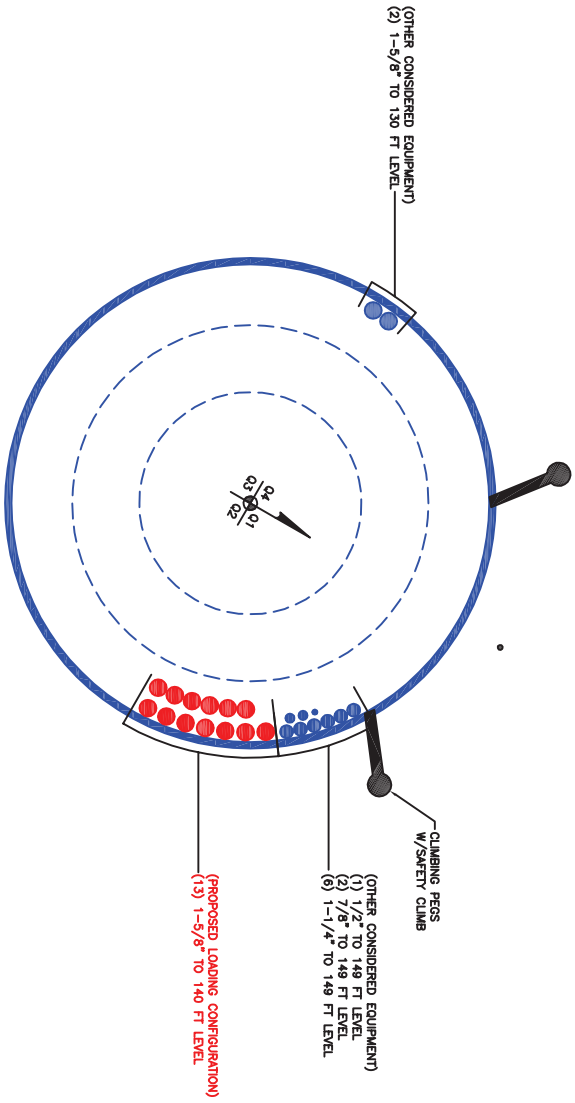
Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$\phi P_{allow}$ K	% Capacity	Pass Fail
L1	149 - 144	Pole	TP22.426x21.5x0.1875	1	-1.13	812.94	5.7	Pass
L2	144 - 139	Pole	TP23.3521x22.426x0.1875	2	-2.35	846.79	10.7	Pass
L3	139 - 134	Pole	TP24.2781x23.3521x0.1875	3	-2.69	880.65	18.3	Pass
L4	134 - 129	Pole	TP25.2042x24.2781x0.1875	4	-4.05	914.50	26.3	Pass
L5	129 - 123.612	Pole	TP26.2021x25.2042x0.1875	5	-4.18	925.41	29.5	Pass
L6	123.612 - 122.388	Pole	TP26.0428x25.1277x0.1875	6	-4.81	945.15	40.1	Pass
L7	122.388 - 117.388	Pole	TP26.9578x26.0428x0.1875	7	-5.25	978.61	49.3	Pass
L8	117.388 - 112.388	Pole	TP27.8729x26.9578x0.1875	8	-5.71	1012.06	57.9	Pass
L9	112.388 - 107.388	Pole	TP28.7879x27.8729x0.1875	9	-6.20	1045.50	66.0	Pass
L10	107.388 - 102.388	Pole	TP29.703x28.7879x0.1875	10	-6.71	1078.96	73.7	Pass
L11	102.388 - 98.5	Pole	TP30.4145x29.703x0.1875	11	-7.12	1104.97	79.4	Pass
L12	98.5 - 98.25	Pole	TP30.4603x30.4145x0.3438	12	-7.17	2018.36	36.8	Pass
L13	98.25 - 93.25	Pole	TP31.3753x30.4603x0.3375	13	-7.91	2042.29	40.3	Pass
L14	93.25 - 88.25	Pole	TP32.2904x31.3753x0.3313	14	-8.67	2063.96	43.9	Pass

<b>tnxTower</b>  <b>GPD</b> 520 South Main Street Suite 2531 Akron, Ohio 44311 Phone: (555) 555-1234 FAX: (555) 555-1235	<b>Job</b>	ANDOVER NORTH / BU#: 842856	<b>Page</b>	24 of 24
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Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$\phi P_{allow}$ K	% Capacity	Pass Fail
L15	88.25 - 79.128	Pole	TP33.9598x32.2904x0.3313	15	-9.35	2115.70	46.5	Pass
L16	79.128 - 78.128	Pole	TP33.7634x32.7164x0.25	16	-10.73	1633.46	72.9	Pass
L17	78.128 - 73.128	Pole	TP34.6747x33.7634x0.25	17	-11.48	1677.88	77.2	Pass
L18	73.128 - 68.128	Pole	TP35.5859x34.6747x0.25	18	-12.25	1722.29	81.2	Pass
L19	68.128 - 63.128	Pole	TP36.4971x35.5859x0.25	19	-13.04	1766.71	85.1	Pass
L20	63.128 - 58.128	Pole	TP37.4084x36.4971x0.25	20	-13.85	1811.12	88.9	Pass
L21	58.128 - 57.25	Pole	TP37.5684x37.4084x0.25	21	-14.00	1818.93	89.5	Pass
L22	57.25 - 57	Pole	TP37.6139x37.5684x0.4188	22	-14.06	3036.64	46.9	Pass
L23	57 - 52	Pole	TP38.5252x37.6139x0.4125	23	-15.19	3065.11	49.0	Pass
L24	52 - 43.243	Pole	TP40.1211x38.5252x0.4125	24	-15.93	3112.59	49.9	Pass
L25	43.243 - 42.243	Pole	TP39.8031x38.6156x0.3125	25	-18.25	2406.00	75.4	Pass
L26	42.243 - 37.243	Pole	TP40.7141x39.8031x0.3125	26	-19.29	2461.50	77.9	Pass
L27	37.243 - 32.243	Pole	TP41.6251x40.7141x0.3125	27	-20.35	2517.01	80.2	Pass
L28	32.243 - 27.243	Pole	TP42.5362x41.6251x0.3125	28	-21.44	2572.52	82.5	Pass
L29	27.243 - 22.243	Pole	TP43.4472x42.5362x0.3125	29	-22.55	2628.02	84.7	Pass
L30	22.243 - 17.243	Pole	TP44.3582x43.4472x0.3125	30	-23.69	2683.53	86.8	Pass
L31	17.243 - 12.243	Pole	TP45.2693x44.3582x0.3125	31	-24.84	2739.03	88.8	Pass
L32	12.243 - 7.243	Pole	TP46.1803x45.2693x0.3125	32	-26.01	2794.53	90.7	Pass
L33	7.243 - 2.243	Pole	TP47.0913x46.1803x0.3125	33	-27.11	2850.05	92.6	Pass
L34	2.243 - 0	Pole	TP47.5x47.0913x0.3125	34	-27.61	2874.94	93.4	Pass

Summary ELC: Load Case 7  
Pole (L34) 93.4 Pass  
Rating = 93.4 Pass

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



BUSINESS UNIT: 842856 TOWER ID: C\_BASELEVEL

PLOT DATE: 9/7/2016

FILE NAME: 842856\_BASELEVEL.dwg

CROWN REGION ADDRESS  
USA

SC  
NH  
SLS  
BWT  
SLW  
AST  
BRT

11/8/2014	UPDATED PER WORK ORDER 909072
9/5/2015	UPDATED PER WORK ORDER 1022375
28/9/2015	UPDATED PER WORK ORDER 1057809
18/11/2015	UPDATED PER WORK ORDER 1185384
05/07/16	UPDATED PER WORK ORDER 1231863
02/09/16	UPDATED PER WORK ORDER 1284429
17/04/16	UPDATED PER WORK ORDER 1728307

DRAWN BY: VLL  
CHECKED BY:  
DRAWING DATE: 11/08/14

SITE NUMBER: \_\_\_\_\_  
 SITE NAME: \_\_\_\_\_  
 ANDOVER NORTH  
 BUSINESS UNIT NUMBER: \_\_\_\_\_  
 842856  
 SITE ADDRESS: \_\_\_\_\_  
 122 JONATHAN TRUMBULL HIGHWAY #R  
 ANDOVER, CT 06022  
 TOLLAND COUNTY  
 USA  
 SHEET TITLE: \_\_\_\_\_  
**BASE LEVEL DRAWING**  
 SHEET NUMBER: \_\_\_\_\_

A1-0

N.T.S.



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

Site BU: 842856

Work Order: 728309



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**Pole Geometry**

	Pole Height Above Base (ft)	Section Length (ft)	Lap Splice Length (ft)	Number of Sides	Top Diameter (in)	Bottom Diameter (in)	Wall Thickness (in)	Bend Radius (in)	Pole Material
1	149	25.388	3.776	18	21.5	26.2021	0.1875	Auto	A572-65
2	127.388	48.26	4.745	18	25.13	33.9598	0.1875	Auto	A572-65
3	83.873	40.63	5.517	18	32.72	40.1211	0.25	Auto	A572-65
4	48.76	48.76	0	18	38.62	47.5	0.3125	Auto	A572-65

**Reinforcement Configuration**

	Bottom Effective Elevation (ft)	Top Effective Elevation (ft)	Type	Model	Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	47.25	57.25	plate	CCI-AFP-060100	3			x																
2	82.5	98.5	plate	CCI-AFP-045100	3		x																	
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								

**Reinforcement Details**

	B (in)	H (in)	Gross Area (in <sup>2</sup> )	Pole Face to Centroid (in)	Bottom Termination Length (in)	Top Termination Length (in)	L <sub>u</sub> (in)	Net Area (in <sup>2</sup> )	Bolt Hole Size (in)	Reinforcement Material
1	6	1	6	0.5	30,000	30,000	16,000	4.750	1.1875	A572-65
2	4.5	1	4.5	0.5	24,000	24,000	20,000	3.250	1.1875	A572-65

# TNX Geometry Input

Increment (ft): 5

	Section Height (ft)	Section Length (ft)	Lap Splice Length (ft)	Number of Sides	Top Diameter (in)	Bottom Diameter (in)	Wall Thickness (in)	Tapered Pole Grade	Weight Multiplier
1	149 - 144	5		18	21.500	22.426	0.1875	A572-65	1.000
2	144 - 139	5		18	22.426	23.352	0.1875	A572-65	1.000
3	139 - 134	5		18	23.352	24.278	0.1875	A572-65	1.000
4	134 - 129	5		18	24.278	25.204	0.1875	A572-65	1.000
5	129 - 127.388	5.388	3.776	18	25.204	26.202	0.1875	A572-65	1.000
6	127.388 - 122.388	5		18	25.128	26.043	0.1875	A572-65	1.000
7	122.388 - 117.388	5		18	26.043	26.958	0.1875	A572-65	1.000
8	117.388 - 112.388	5		18	26.958	27.873	0.1875	A572-65	1.000
9	112.388 - 107.388	5		18	27.873	28.788	0.1875	A572-65	1.000
10	107.388 - 102.388	5		18	28.788	29.703	0.1875	A572-65	1.000
11	102.388 - 98.5	3.888		18	29.703	30.415	0.1875	A572-65	1.000
12	98.5 - 98.25	0.25		18	30.415	30.460	0.34375	A572-65	0.959
13	98.25 - 93.25	5		18	30.460	31.375	0.3375	A572-65	0.964
14	93.25 - 88.25	5		18	31.375	32.290	0.33125	A572-65	0.970
15	88.25 - 83.873	9.122	4.745	18	32.290	33.960	0.33125	A572-65	0.960
16	83.873 - 78.128	5.745		18	32.716	33.763	0.25	A572-65	1.000
17	78.128 - 73.128	5		18	33.763	34.675	0.25	A572-65	1.000
18	73.128 - 68.128	5		18	34.675	35.586	0.25	A572-65	1.000
19	68.128 - 63.128	5		18	35.586	36.497	0.25	A572-65	1.000
20	63.128 - 58.128	5		18	36.497	37.408	0.25	A572-65	1.000
21	58.128 - 57.25	0.878		18	37.408	37.568	0.25	A572-65	1.000
22	57.25 - 57	0.25		18	37.568	37.614	0.41875	A572-65	0.964
23	57 - 52	5		18	37.614	38.525	0.4125	A572-65	0.969
24	52 - 48.76	8.757	5.517	18	38.525	40.121	0.4125	A572-65	0.964
25	48.76 - 42.243	6.517		18	38.616	39.803	0.3125	A572-65	1.000
26	42.243 - 37.243	5		18	39.803	40.714	0.3125	A572-65	1.000
27	37.243 - 32.243	5		18	40.714	41.625	0.3125	A572-65	1.000
28	32.243 - 27.243	5		18	41.625	42.536	0.3125	A572-65	1.000
29	27.243 - 22.243	5		18	42.536	43.447	0.3125	A572-65	1.000
30	22.243 - 17.243	5		18	43.447	44.358	0.3125	A572-65	1.000
31	17.243 - 12.243	5		18	44.358	45.269	0.3125	A572-65	1.000
32	12.243 - 7.243	5		18	45.269	46.180	0.3125	A572-65	1.000
33	7.243 - 2.243	5		18	46.180	47.091	0.3125	A572-65	1.000
34	2.243 - 0	2.243		18	47.091	47.500	0.3125	A572-65	1.000

## TNX Section Forces

Increment (ft):		TNX Output				
	5	Section Height (ft)		$P_u$ (K)	$M_{ux}$ (kip-ft)	$V_u$ (K)
1		149 - 144		1.13	24.57	3.92
2		144 - 139		2.35	49.05	8.11
3		139 - 134		2.69	90.78	8.58
4		134 - 129		4.05	138.45	12.68
5		129 - 127.388		4.18	159.01	12.84
6		127.388 - 122.388		4.81	224.52	13.36
7		122.388 - 117.388		5.25	292.54	13.85
8		117.388 - 112.388		5.71	363.03	14.35
9		112.388 - 107.388		6.20	436.00	14.85
10		107.388 - 102.388		6.71	511.49	15.35
11		102.388 - 98.5		7.12	571.93	15.75
12		98.5 - 98.25		7.17	575.87	15.79
13		98.25 - 93.25		7.91	657.05	16.69
14		93.25 - 88.25		8.67	742.75	17.60
15		88.25 - 83.873		9.35	821.48	18.39
16		83.873 - 78.128		10.73	930.25	19.42
17		78.128 - 73.128		11.48	1028.62	19.94
18		73.128 - 68.128		12.25	1129.60	20.47
19		68.128 - 63.128		13.04	1233.17	20.98
20		63.128 - 58.128		13.85	1339.32	21.50
21		58.128 - 57.25		14.00	1358.26	21.65
22		57.25 - 57		14.06	1363.67	21.69
23		57 - 52		15.19	1474.49	22.64
24		52 - 48.76		15.93	1548.79	23.24
25		48.76 - 42.243		18.25	1704.34	24.43
26		42.243 - 37.243		19.29	1827.69	24.93
27		37.243 - 32.243		20.35	1953.45	25.40
28		32.243 - 27.243		21.44	2081.56	25.86
29		27.243 - 22.243		22.55	2211.92	26.31
30		22.243 - 17.243		23.69	2344.43	26.72
31		17.243 - 12.243		24.84	2478.95	27.11
32		12.243 - 7.243		26.01	2615.39	27.50
33		7.243 - 2.243		27.11	2753.75	27.88
34		2.243 - 0		27.61	2816.43	28.05

# Analysis Results

Elevation (ft)	Component Type	Size	Critical Element	% Capacity	Pass / Fail
149 - 144	Pole	TP22.426x21.5x0.1875	Pole	5.7%	Pass
144 - 139	Pole	TP23.352x22.426x0.1875	Pole	10.6%	Pass
139 - 134	Pole	TP24.278x23.352x0.1875	Pole	18.2%	Pass
134 - 129	Pole	TP25.204x24.278x0.1875	Pole	26.1%	Pass
129 - 127.39	Pole	TP26.202x25.204x0.1875	Pole	29.3%	Pass
127.39 - 122.39	Pole	TP26.043x25.128x0.1875	Pole	39.9%	Pass
122.39 - 117.39	Pole	TP26.958x26.043x0.1875	Pole	49.1%	Pass
117.39 - 112.39	Pole	TP27.873x26.958x0.1875	Pole	57.7%	Pass
112.39 - 107.39	Pole	TP28.788x27.873x0.1875	Pole	65.8%	Pass
107.39 - 102.39	Pole	TP29.703x28.788x0.1875	Pole	73.5%	Pass
102.39 - 98.5	Pole	TP30.415x29.703x0.1875	Pole	79.2%	Pass
98.5 - 98.25	Pole + Reinf.	TP30.46x30.415x0.3438	Reinf. 2 Tension Rupture	63.8%	Pass
98.25 - 93.25	Pole + Reinf.	TP31.375x30.46x0.3375	Reinf. 2 Tension Rupture	69.5%	Pass
93.25 - 88.25	Pole + Reinf.	TP32.29x31.375x0.3313	Reinf. 2 Tension Rupture	75.1%	Pass
88.25 - 83.87	Pole + Reinf.	TP33.96x32.29x0.3313	Reinf. 2 Tension Rupture	80.0%	Pass
83.87 - 78.13	Pole	TP33.763x32.716x0.25	Pole	72.7%	Pass
78.13 - 73.13	Pole	TP34.675x33.763x0.25	Pole	77.0%	Pass
73.13 - 68.13	Pole	TP35.586x34.675x0.25	Pole	81.0%	Pass
68.13 - 63.13	Pole	TP36.497x35.586x0.25	Pole	85.0%	Pass
63.13 - 58.13	Pole	TP37.408x36.497x0.25	Pole	88.7%	Pass
58.13 - 57.25	Pole	TP37.568x37.408x0.25	Pole	89.4%	Pass
57.25 - 57	Pole + Reinf.	TP37.614x37.568x0.4188	Reinf. 1 Tension Rupture	74.1%	Pass
57 - 52	Pole + Reinf.	TP38.525x37.614x0.4125	Reinf. 1 Tension Rupture	77.1%	Pass
52 - 48.76	Pole + Reinf.	TP40.121x38.525x0.4125	Reinf. 1 Tension Rupture	79.0%	Pass
48.76 - 42.24	Pole	TP39.803x38.616x0.3125	Pole	75.2%	Pass
42.24 - 37.24	Pole	TP40.714x39.803x0.3125	Pole	77.7%	Pass
37.24 - 32.24	Pole	TP41.625x40.714x0.3125	Pole	80.1%	Pass
32.24 - 27.24	Pole	TP42.536x41.625x0.3125	Pole	82.3%	Pass
27.24 - 22.24	Pole	TP43.447x42.536x0.3125	Pole	84.5%	Pass
22.24 - 17.24	Pole	TP44.358x43.447x0.3125	Pole	86.6%	Pass
17.24 - 12.24	Pole	TP45.269x44.358x0.3125	Pole	88.6%	Pass
12.24 - 7.24	Pole	TP46.18x45.269x0.3125	Pole	90.6%	Pass
7.24 - 2.24	Pole	TP47.091x46.18x0.3125	Pole	92.5%	Pass
2.24 - 0	Pole	TP47.5x47.091x0.3125	Pole	93.3%	Pass
				Summary	
			Pole	93.3%	Pass
			Reinforcement	80.0%	Pass
			Overall	93.3%	Pass

## Additional Calculations

Section Elevation (ft)	Moment of Inertia (in <sup>4</sup> )			Area (in <sup>2</sup> )			% Capacity*		
	Pole	Reinf.	Total	Pole	Reinf.	Total	Pole	R1	R2
149 - 144	827	n/a	827	13.23	n/a	13.23	5.7%		
144 - 139	934	n/a	934	13.79	n/a	13.79	10.6%		
139 - 134	1051	n/a	1051	14.34	n/a	14.34	18.2%		
134 - 129	1177	n/a	1177	14.89	n/a	14.89	26.1%		
129 - 127.39	1219	n/a	1219	15.07	n/a	15.07	29.3%		
127.39 - 122.39	1299	n/a	1299	15.39	n/a	15.39	39.9%		
122.39 - 117.39	1442	n/a	1442	15.93	n/a	15.93	49.1%		
117.39 - 112.39	1595	n/a	1595	16.48	n/a	16.48	57.7%		
112.39 - 107.39	1758	n/a	1758	17.02	n/a	17.02	65.8%		
107.39 - 102.39	1933	n/a	1933	17.56	n/a	17.56	73.5%		
102.39 - 98.5	2076	n/a	2076	17.99	n/a	17.99	79.2%		
98.5 - 98.25	2085	1682	3767	18.02	13.50	31.52	43.4%		63.8%
98.25 - 93.25	2280	1781	4061	18.56	13.50	32.06	48.1%		69.5%
93.25 - 88.25	2487	1882	4369	19.10	13.50	32.60	52.7%		75.1%
88.25 - 83.87	2677	1973	4651	19.58	13.50	33.08	56.9%		80.0%
83.87 - 78.13	3772	n/a	3772	26.59	n/a	26.59	72.7%		
78.13 - 73.13	4088	n/a	4088	27.31	n/a	27.31	77.0%		
73.13 - 68.13	4422	n/a	4422	28.04	n/a	28.04	81.0%		
68.13 - 63.13	4773	n/a	4773	28.76	n/a	28.76	85.0%		
63.13 - 58.13	5142	n/a	5142	29.48	n/a	29.48	88.7%		
58.13 - 57.25	5208	n/a	5208	29.61	n/a	29.61	89.4%		
57.25 - 57	5227	3383	8610	29.65	18.00	47.65	53.6%	74.1%	
57 - 52	5619	3543	9162	30.37	18.00	48.37	56.4%	77.1%	
52 - 48.76	5883	3649	9532	30.84	18.00	48.84	58.2%	79.0%	
48.76 - 42.24	7715	n/a	7715	39.17	n/a	39.17	75.2%		
42.24 - 37.24	8261	n/a	8261	40.07	n/a	40.07	77.7%		
37.24 - 32.24	8833	n/a	8833	40.98	n/a	40.98	80.1%		
32.24 - 27.24	9430	n/a	9430	41.88	n/a	41.88	82.3%		
27.24 - 22.24	10053	n/a	10053	42.78	n/a	42.78	84.5%		
22.24 - 17.24	10704	n/a	10704	43.69	n/a	43.69	86.6%		
17.24 - 12.24	11382	n/a	11382	44.59	n/a	44.59	88.6%		
12.24 - 7.24	12088	n/a	12088	45.49	n/a	45.49	90.6%		
7.24 - 2.24	12823	n/a	12823	46.40	n/a	46.40	92.5%		
2.24 - 0	13162	n/a	13162	46.80	n/a	46.80	93.3%		

Note: Section capacity checked in 5 degree increments.

Rating per TIA-222-H Section 15.5.

# Monopole Base Plate Connection

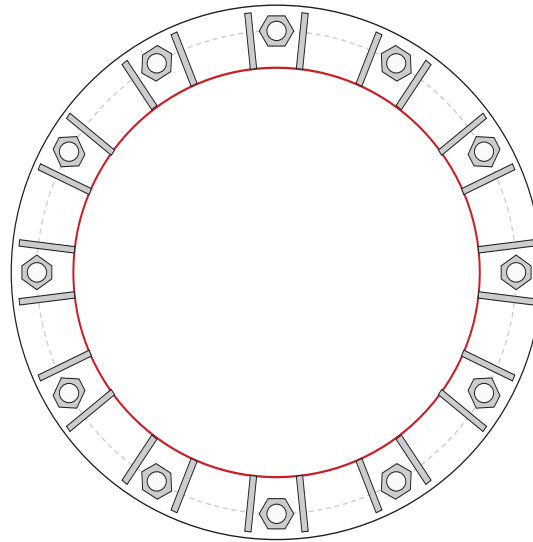


Site Info	
BU #	842856
Site Name	ANDOVER NORTH
Order #	479836 Rev. 1

Analysis Considerations	
TIA-222 Revision	H
Grout Considered:	No
$l_{ar}$ (in)	2.25

Applied Loads	
Moment (kip-ft)	2816.43
Axial Force (kips)	27.61
Shear Force (kips)	28.05

\*TIA-222-H Section 15.5 Applied



Connection Properties	Analysis Results
-----------------------	------------------

**Anchor Rod Data**  
 (12) 2-1/4"  $\phi$  bolts (A615-75 N;  $F_y=75$  ksi,  $F_u=100$  ksi) on 56" BC

**Base Plate Data**  
 62" OD x 1.5" Plate (A572-60;  $F_y=60$  ksi,  $F_u=75$  ksi)

**Stiffener Data**  
 (24) 13"H x 6.5"W x 0.75"T, Notch: 0.75"  
 plate:  $F_y=50$  ksi ; weld:  $F_y=80$  ksi  
 horiz. weld: 0.375" groove, 45° dbl bevel, 0.25" fillet  
 vert. weld: 0.3125" fillet

**Pole Data**  
 47.5" x 0.3125" 18-sided pole (A572-65;  $F_y=65$  ksi,  $F_u=80$  ksi)

**Anchor Rod Summary** *(units of kips, kip-in)*

$Pu_c = 203.34$	$\phi Pn_c = 243.75$	<b>Stress Rating</b>
$Vu = 2.34$	$\phi Vn = 73.13$	<b>79.5%</b>
$Mu = n/a$	$\phi Mn = n/a$	<b>Pass</b>

**Base Plate Summary**

Max Stress (ksi):	49.25	(Roark's Flexural)
Allowable Stress (ksi):	54	
Stress Rating:	<b>86.9%</b>	<b>Pass</b>

**Stiffener Summary**

Horizontal Weld:	<b>42.1%</b>	<b>Pass</b>
Vertical Weld:	<b>48.2%</b>	<b>Pass</b>
Plate Flexure+Shear:	<b>21.6%</b>	<b>Pass</b>
Plate Tension+Shear:	<b>43.9%</b>	<b>Pass</b>
Plate Compression:	<b>58.3%</b>	<b>Pass</b>

**Pole Summary**

Punching Shear:	<b>19.5%</b>	<b>Pass</b>
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# Pier and Pad Foundation



BU #: 842856  
 Site Name: ANDOVER NORTH  
 App. Number: 479836 Rev. 1

TIA-222 Revision: H  
 Tower Type: Monopole

Top & Bot. Pad Rein. Different?:   
 Block Foundation?:

Superstructure Analysis Reactions		
Compression, $P_{comp}$ :	28	kips
Base Shear, $V_{u\_comp}$ :	28	kips
Moment, $M_u$ :	2816	ft-kips
Tower Height, $H$ :	149	ft
BP Dist. Above Fdn, $bp_{dist}$ :	4.25	in

Foundation Analysis Checks				
	Capacity	Demand	Rating*	Check
<i>Lateral (Sliding) (kips)</i>	176.51	28.00	15.1%	Pass
<i>Bearing Pressure (ksf)</i>	9.00	4.26	47.3%	Pass
<i>Overtuning (kip*ft)</i>	3539.62	3035.92	85.8%	Pass
<i>Pier Flexure (Comp.) (kip*ft)</i>	4706.12	2942.00	59.5%	Pass
<i>Pier Compression (kip)</i>	21120.36	54.88	0.2%	Pass
<i>Pad Flexure (kip*ft)</i>	2307.21	1507.95	62.2%	Pass
<i>Pad Shear - 1-way (kips)</i>	735.13	279.46	36.2%	Pass
<i>Pad Shear - 2-way (Comp) (ksi)</i>	0.190	0.000	0.0%	Pass
<i>Flexural 2-way (Comp) (kip*ft)</i>	3421.43	1765.20	49.1%	Pass

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, $dpier$ :	6.5	ft
Ext. Above Grade, $E$ :	1	ft
Pier Rebar Size, $Sc$ :	8	
Pier Rebar Quantity, $mc$ :	40	
Pier Tie/Spiral Size, $St$ :	4	
Pier Tie/Spiral Quantity, $mt$ :	5	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, $cc_{pier}$ :	3	in

\*Rating per TIA-222-H Section 15.5

Soil Rating*:	85.8%
Structural Rating*:	62.2%

Pad Properties		
Depth, $D$ :	6.5	ft
Pad Width, $W$ :	20.5	ft
Pad Thickness, $T$ :	3	ft
Pad Rebar Size (Bottom), $Sp$ :	8	
Pad Rebar Quantity (Bottom), $mp$ :	21	
Pad Clear Cover, $cc_{pad}$ :	3	in

Material Properties		
Rebar Grade, $Fy$ :	60	ksi
Concrete Compressive Strength, $F'c$ :	4	ksi
Dry Concrete Density, $\delta c$ :	150	pcf

Soil Properties		
Total Soil Unit Weight, $\gamma$ :	115	pcf
Ultimate Gross Bearing, $Q_{ult}$ :	12.000	ksf
Cohesion, $Cu$ :		ksf
Friction Angle, $\phi$ :	30	degrees
SPT Blow Count, $N_{blows}$ :	47	
Base Friction, $\mu$ :		
Neglected Depth, $N$ :	3.33	ft
Foundation Bearing on Rock?	No	
Groundwater Depth, $gw$ :	10	ft

<--Toggle between Gross and Net

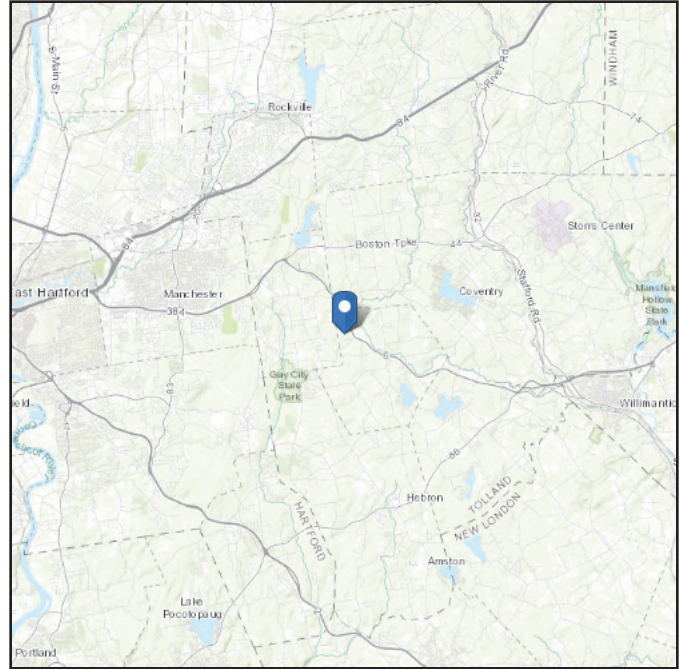
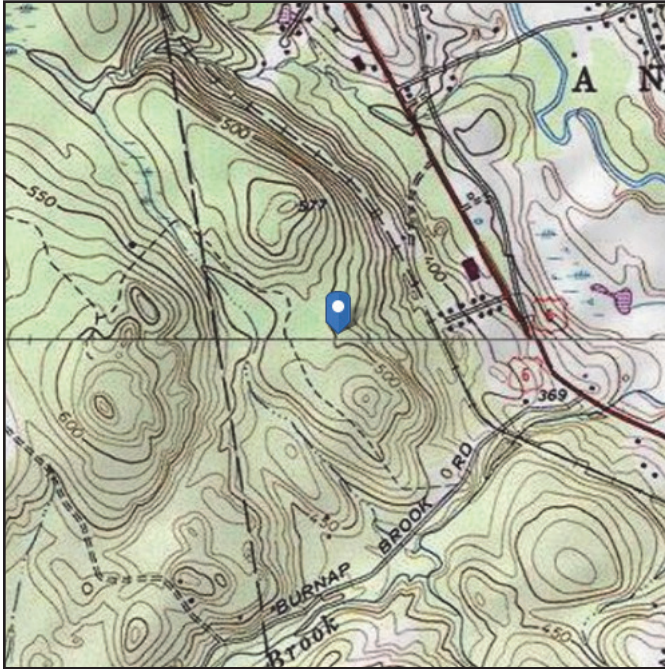


# ASCE 7 Hazards Report

**Address:**  
No Address at This  
Location

**Standard:** ASCE/SEI 7-10  
**Risk Category:** II  
**Soil Class:** D - Stiff Soil

**Elevation:** 495.67 ft (NAVD 88)  
**Latitude:** 41.750128  
**Longitude:** -72.402675



## Wind

**Data Source:** ASCE/SEI 7-10, Fig. 26.5-1A and Figs. CC-1–CC-4, incorporating errata of March 12, 2014

**Date Accessed:** Fri Apr 26 2019

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-10 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is in a hurricane-prone region as defined in ASCE/SEI 7-10 Section 26.2. Glazed openings need not be protected against wind-borne debris.

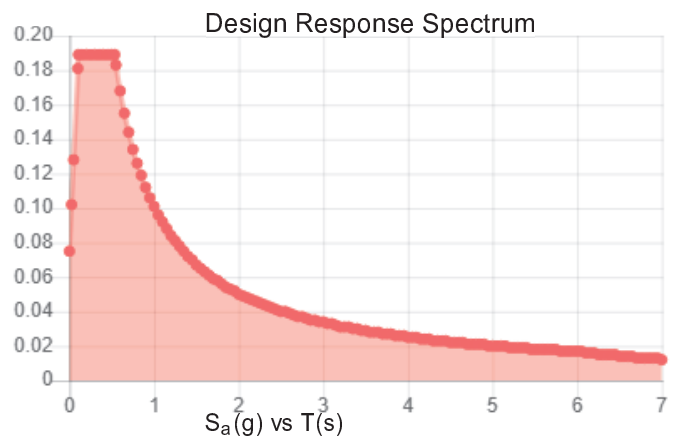
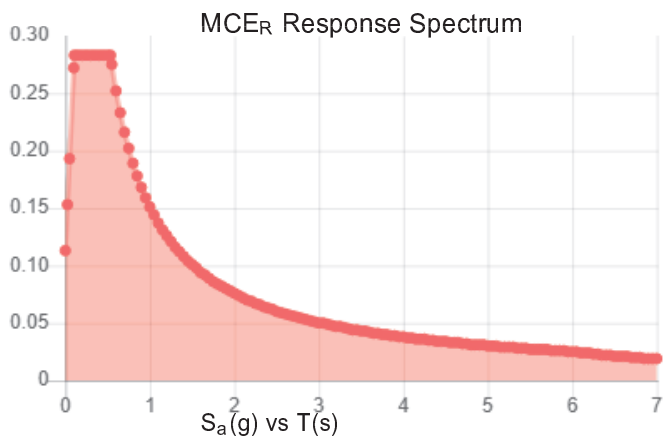
Mountainous terrain, gorges, ocean promontories, and special wind regions should be examined for unusual wind conditions.

**Site Soil Class:** D - Stiff Soil

**Results:**

$S_s$ :	0.177	$S_{DS}$ :	0.189
$S_1$ :	0.063	$S_{D1}$ :	0.101
$F_a$ :	1.6	$T_L$ :	6
$F_v$ :	2.4	PGA :	0.089
$S_{MS}$ :	0.283	PGA <sub>M</sub> :	0.142
$S_{M1}$ :	0.151	F <sub>PGA</sub> :	1.6
		$I_e$ :	1

**Seismic Design Category** B



**Data Accessed:**

Fri Apr 26 2019

**Date Source:**

USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

## Ice

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**Results:**

Ice Thickness: 1.00 in.  
Concurrent Temperature: 5 F  
Gust Speed: 50 mph

**Data Source:** Standard ASCE/SEI 7-10, Figs. 10-2 through 10-8

**Date Accessed:** Fri Apr 26 2019

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 50-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

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# Exhibit E

## **Mount Analysis**

# **PJF** PAUL J. FORD & COMPANY

Date: April 26, 2019

Kevin Morrow  
Crown Castle  
3530 Toringdon Way  
Charlotte, NC 28277

Paul J Ford and Company  
250 E. Broad Street, Suite 600  
Columbus, OH 43215  
614.221.6679

**Subject:** Mount Analysis Report

**Carrier Designation:** T-Mobile Equipment Change-out  
Carrier Site Number: CT11501E  
Carrier Site Name: CT501/ATT Andover - Prime

**Crown Castle Designation:** Crown Castle BU Number: 842856  
Crown Castle Site Name: Andover North  
Crown Castle JDE Job Number: 559272  
Crown Castle Purchase Order Number: 1370356  
Crown Castle Order Number: 479836 Rev. 1

**Engineering Firm Designation:** Paul J Ford and Company Project Number: A37519-1582.002.7190

**Site Data:** 122 Jonathan Trumbull, Andover, Tolland County, CT  
Latitude 41.750128°, Longitude -72.402675°

**Structure Information:** Tower Height & Type: 149 Foot Monopole  
Mount Elevation: 140 Foot  
Mount Type: (3) 5.5 Foot T-Arm

Dear Kevin Morrow,

Paul J Ford and Company is pleased to submit this "Mount Analysis Report" to determine the structural integrity of the T-Mobile antenna mounting system with the proposed appurtenance and equipment addition on the abovementioned supporting tower structure. Analysis of the existing supporting tower structure is to be completed by others and therefore is not part of this analysis. Analysis of the antenna mounting system as a tie-off point is not part of this document.

The purpose of the analysis is to determine acceptability of the mount stress level. Based on our analysis we have determined the mount stress level to be:

**5.5' T-Arm (typical)**

**SUFFICIENT\***

\*The mount has sufficient capacity once the changes, as described in Section 4.1 Recommendations of this report, are completed.

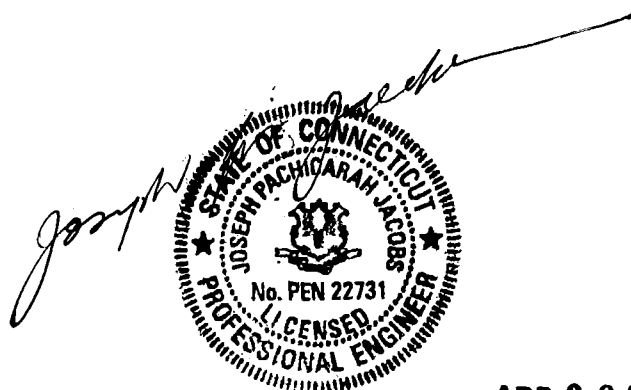
This analysis utilizes an ultimate 3-second gust wind speed of 130 mph as required by the 2018 Connecticut State Building Code and Appendix N. Applicable Standard references and design criteria are listed in Section 2 - Analysis Criteria.

Respectfully submitted by:



Angela Sage, E.I.  
Structural Designer  
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RMD



**APR 29 2019**

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STANDARD ANTENNA CENTERING CONDITIONS

**1) INTRODUCTION**

The existing mounts under consideration are (3) 5.5' T-Arm mounts mapped by RKS on 04/09/2019.

**2) ANALYSIS CRITERIA**

TIA-222 Revision: TIA-222-H  
 Risk Category: II  
 Ultimate Wind Speed: 130 mph  
 Exposure Category: C  
 Topographic Factor at Base: 1  
 Topographic Factor at Mount: 1  
 Ice Thickness: 2 in  
 Wind Speed with Ice: 50 mph

**Table 1 - Proposed Equipment Configuration**

Mount Centerline (ft)	Antenna Centerline (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Mount / Modification Details
140	140	3	RFS CELWAVE	APX16DWV-16DWV-S-E-A20	(3) 5.5' T-Arm
		3	RFS CELWAVE	APXVAARR24_43-U-NA20	
		3	ERICSSON	KRY 112 489/2	
		3	ERICSSON	RADIO 4449 B12/B71	

### 3) ANALYSIS PROCEDURE

**Table 2 - Documents Provided**

Document	Remarks	Reference	Source
Mount Mapping	842856 Dated: 04/09/2019	8352827	CCISites
Order	ID: 479836 Rev. 1 Dated: 04/15/2019	-	CCISites

#### 3.1) Analysis Method

RISA-3D (version 15.0.4), 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.

This analysis was performed in accordance with Crown Castle's ENG-SOW-10208 *Tower Mount Analysis* (Revision C).

#### 3.2) Assumptions

- 1) *The analysis of the existing tower or the effect of the mount attachment to the tower is not within the current scope of work.*
- 2) *The antenna mounting system was properly fabricated, installed and maintained in good condition, twist free and plumb in accordance with its original design and manufacturer's specifications and all bolts are tightened as specified by the manufacturer and AISC requirements.*
- 3) *The configuration of antennas, mounts, and other appurtenances are as specified in Table 1.*
- 4) *All member connections have been designed to meet or exceed the load carrying capacity of the connected member unless otherwise specified in this report. All U-Bolt connections have been properly tightened. This analysis will be required to be revised if the existing conditions in the field differ from those shown in the above referenced documents or assumed in this analysis. No allowance was made for any damaged, missing, or rusted members.*
- 5) *Steel grades are as follows, unless noted otherwise:*

a) Channel, Solid Round, Angle, Plate, Unistrut	ASTM A36 (GR 36)
b) Pipe	ASTM A53 (GR 35)
c) HSS (Rectangular)	ASTM 500 (GR B-46)
d) HSS (Round)	ASTM 500 (GR B-42)
e) Threaded Rods	ASTM F1554 (GR 36)
f) Connection Bolts	ASTM A325
g) U-Bolts	SAE J429 (GR 2)
- 6) *Proposed equipment is to be installed in the locations specified in Appendix A. Any changes to the proposed equipment locations will render this report invalid.*
- 7) *All proposed equipment shall be installed symmetrically along and centered vertically about the face horizontal member, unless noted otherwise.*

This analysis may be affected if any assumptions are not valid or have been made in error. Paul J Ford and Company should be notified to determine the effect on the structural integrity of the mount.



#### 4) ANALYSIS RESULTS

**Table 3 - Mount Component Capacity**

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1, 2	Face Horizontals	140	19.4	Pass
1, 2	Standoff Members		20.4	Pass
1, 2	Mount Pipes		94.6	Pass
1, 2	Mount to Tower Connection		31.2	Pass

<b>Mount Rating (max from all components) =</b>	<b>94.6%</b>
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Notes:

- 1) See additional documentation in "Appendix C – Software Analysis Output" for calculations supporting the % capacity consumed.
- 2) All sectors are typical.

#### 4.1) Recommendations

The mount will have sufficient capacity to carry the proposed loading configuration. In order for the results of the analysis to be considered valid, modification listed below must be completed.

- All proposed antennas and their respective mount pipes shall be centered vertically with respect to the mount. See "Appendix D: Standard Antenna Centering Conditions" in this report for reference. Pipe relocation may require unbolting existing connections and installing new U-bolt connections.

No structural modifications are required at this time, provided that the above-listed changes are implemented.

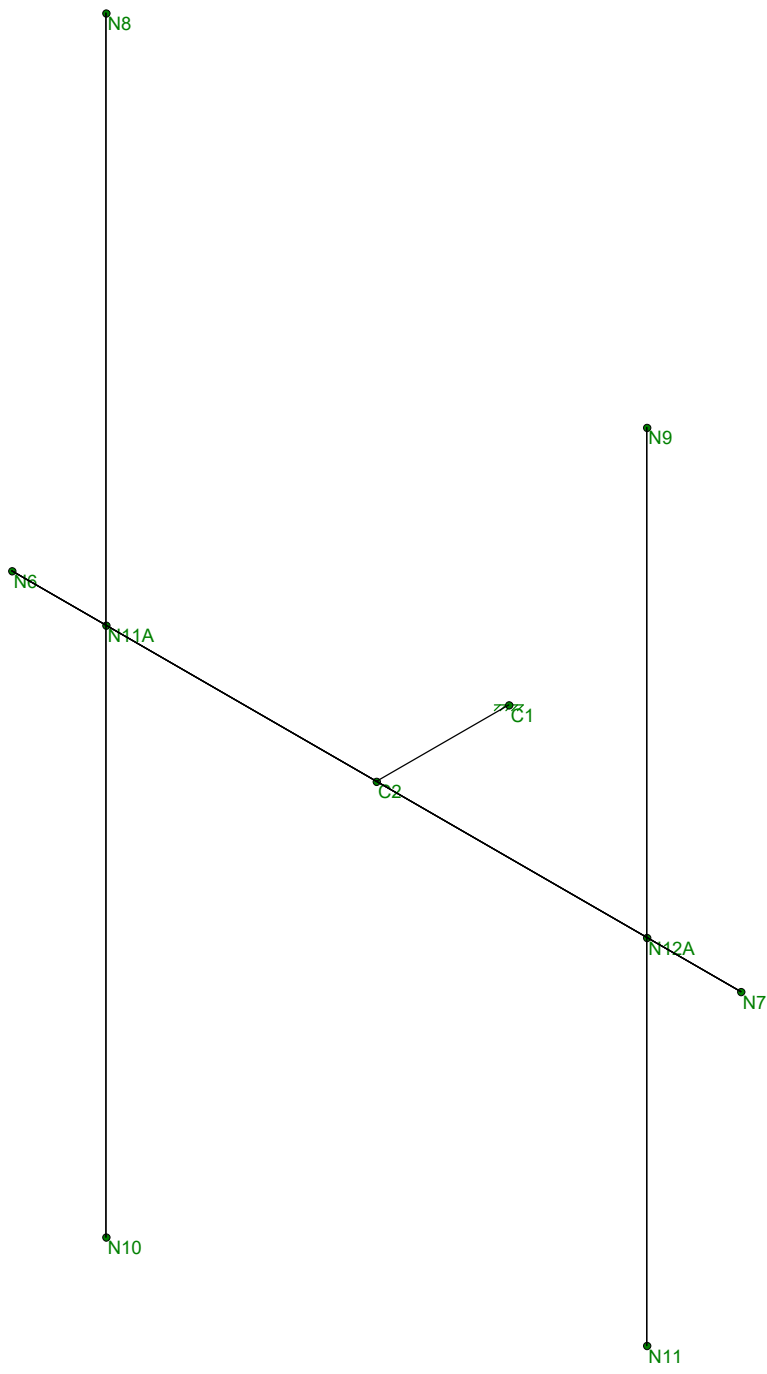
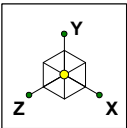
**STANDARD CONDITIONS FOR FURNISHING OF PROFESSIONAL ENGINEERING  
SERVICES ON EXISTING MOUNTS BY PAUL J. FORD AND COMPANY**

- 1) It is the responsibility of the client to ensure that the information provided to Paul J. Ford and Company is accurate and complete. Paul J. Ford and Company will rely on the accuracy and completeness of such information in performing or furnishing services under this project.
- 2) If the existing conditions are not as represented on the referenced drawings and/or documents, Paul J. Ford and Company should be contacted immediately to evaluate the significance of the deviation.
- 3) The mount has been analyzed according to the minimum design loads recommended by the Reference Standard. If additional design loads are required, Paul J. Ford and Company should be made aware of this prior to the start of the project.
- 4) The standard of care for all Professional Engineering Services performed or furnished by Paul J. Ford and Company under this project will be the skill and care used by members of the Consultant's profession practicing under similar circumstances at the same time and in the same locality.
- 5) All Services are performed, results obtained, and recommendations made in accordance with generally accepted engineering principles and practices. Paul J. Ford and Company is not responsible for the conclusions, opinions and/or recommendations made by others based on the information supplied herein.

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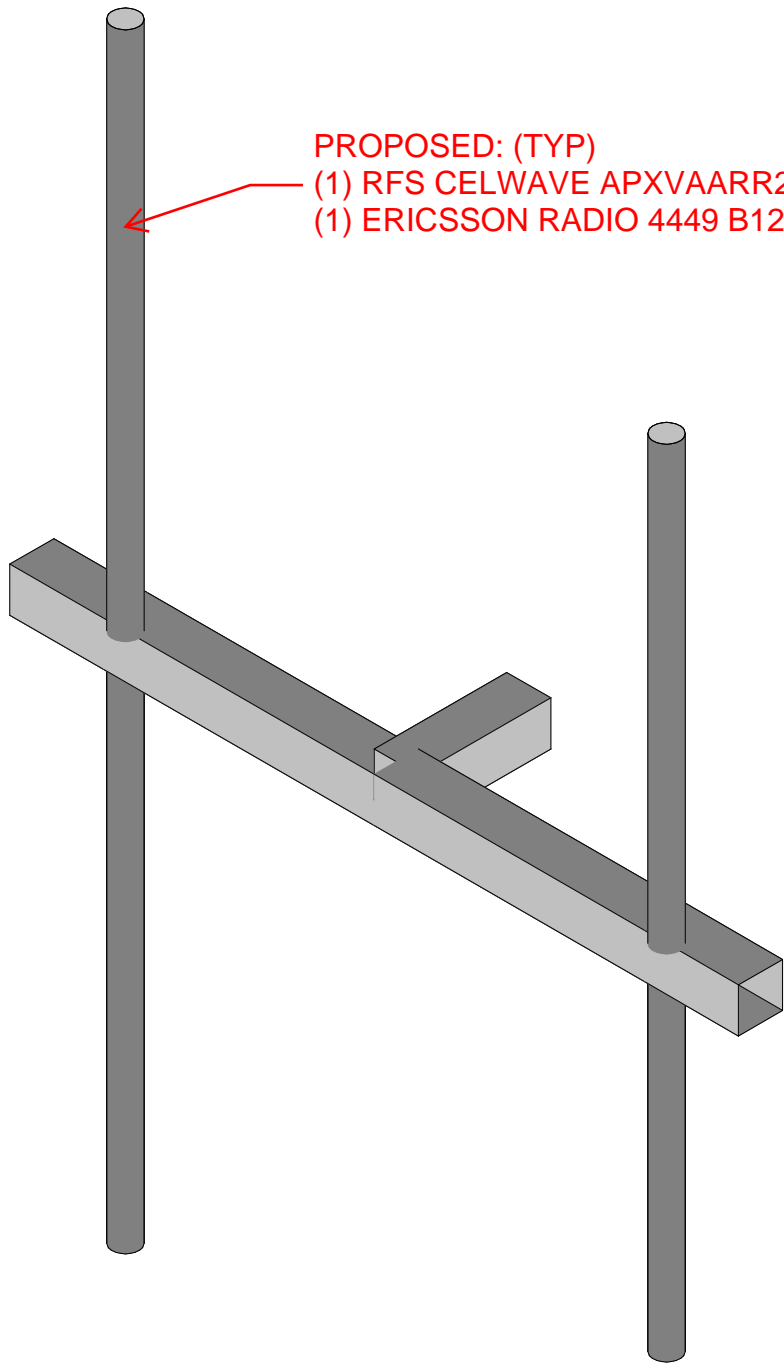
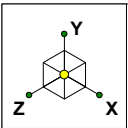
# **APPENDIX A**

## **WIRE FRAME AND RENDERED MODELS**



Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 1
AMS		Apr 26, 2019 at 10:24 AM
37519-1582.002.7190		CP_37519-1582_Wind Load.r3d



PROPOSED: (TYP)  
(1) RFS CELWAVE APXVAARR24\_43-U-NA20  
(1) ERICSSON RADIO 4449 B12/B71

Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 2
AMS		Apr 26, 2019 at 10:24 AM
37519-1582.002.7190		CP_37519-1582_Wind Load.r3d

# **APPENDIX B**

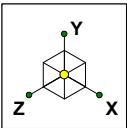
## **SOFTWARE INPUT CALCULATION**



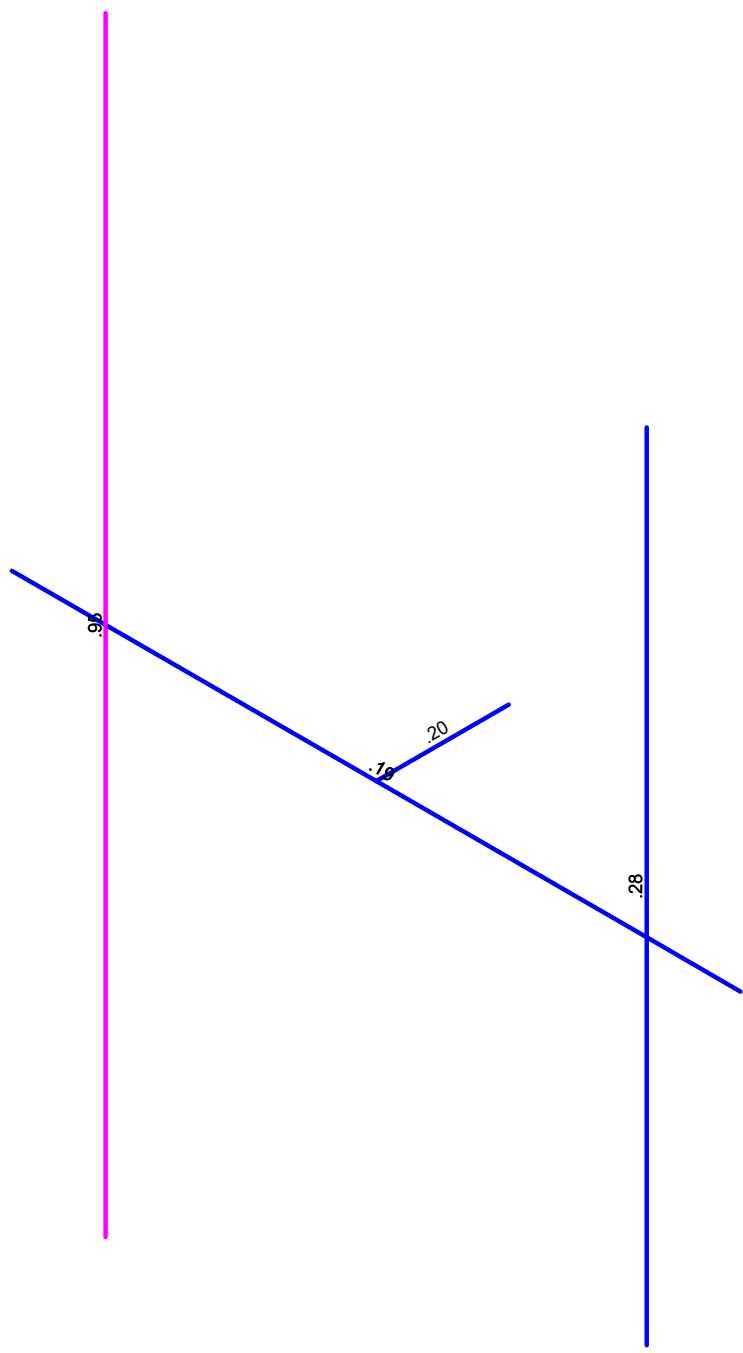
# **APPENDIX C**

## **SOFTWARE ANALYSIS OUTPUT**



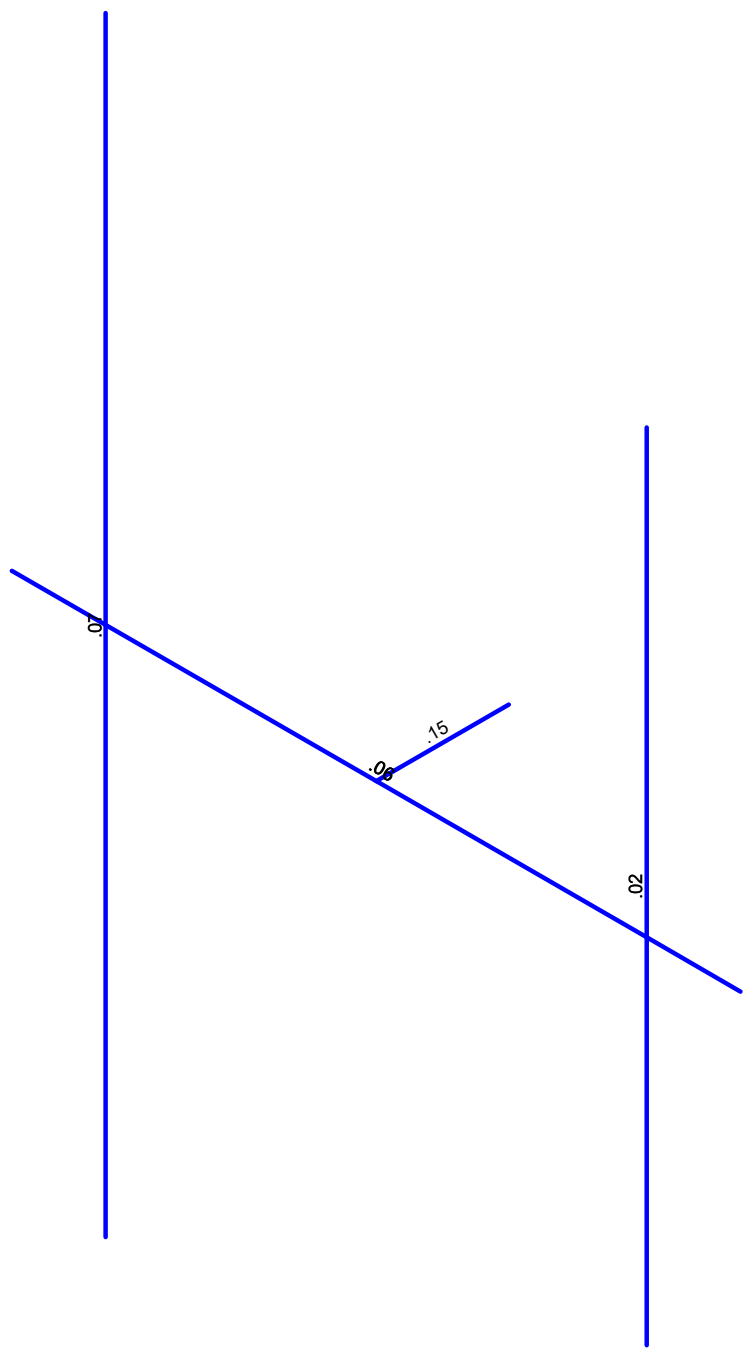
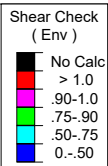
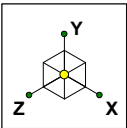


Code Check ( Env )	
Black	No Calc
Red	> 1.0
Magenta	.90-1.0
Green	.75-.90
Cyan	.50-.75
Blue	0.-.50



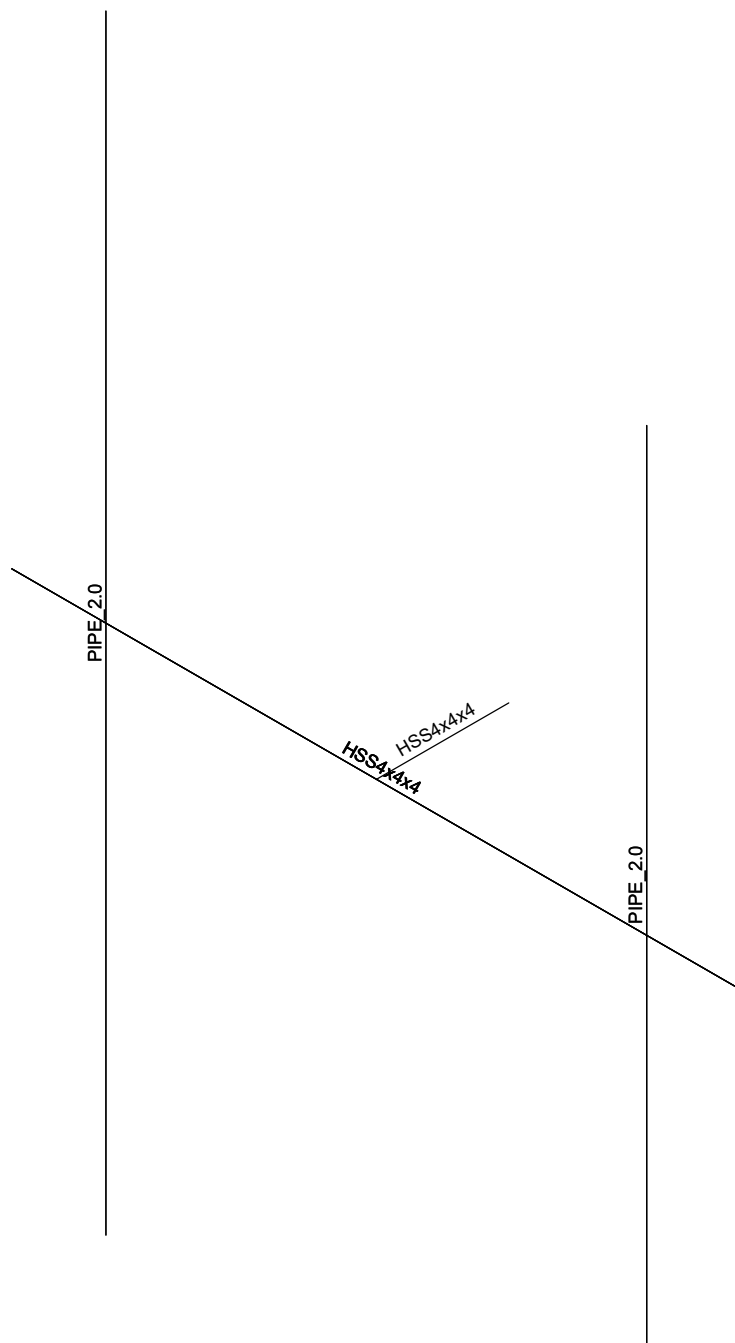
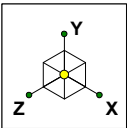
Member Code Checks Displayed (Enveloped)  
Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 3
AMS		Apr 26, 2019 at 10:24 AM
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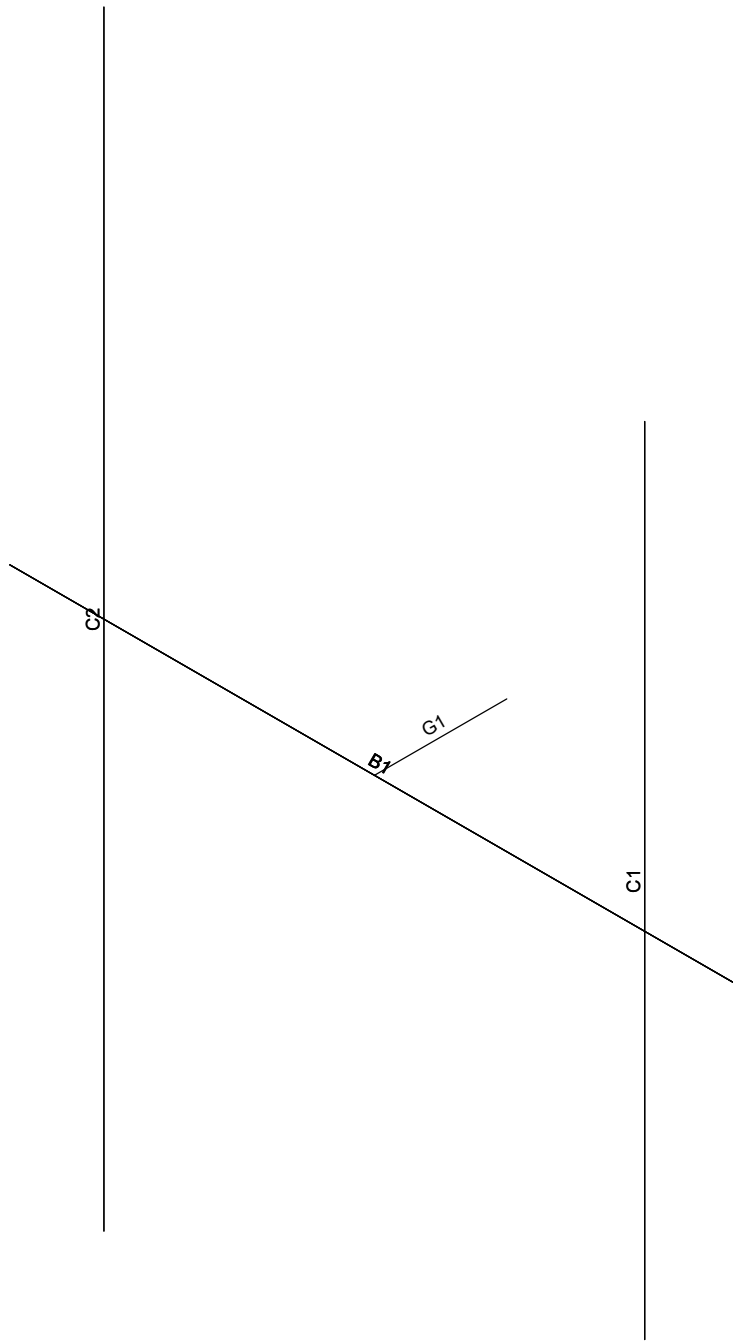
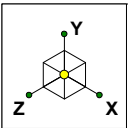
Member Shear Checks Displayed (Enveloped)  
Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 4
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37519-1582.002.7190		CP_37519-1582_Wind Load.r3d



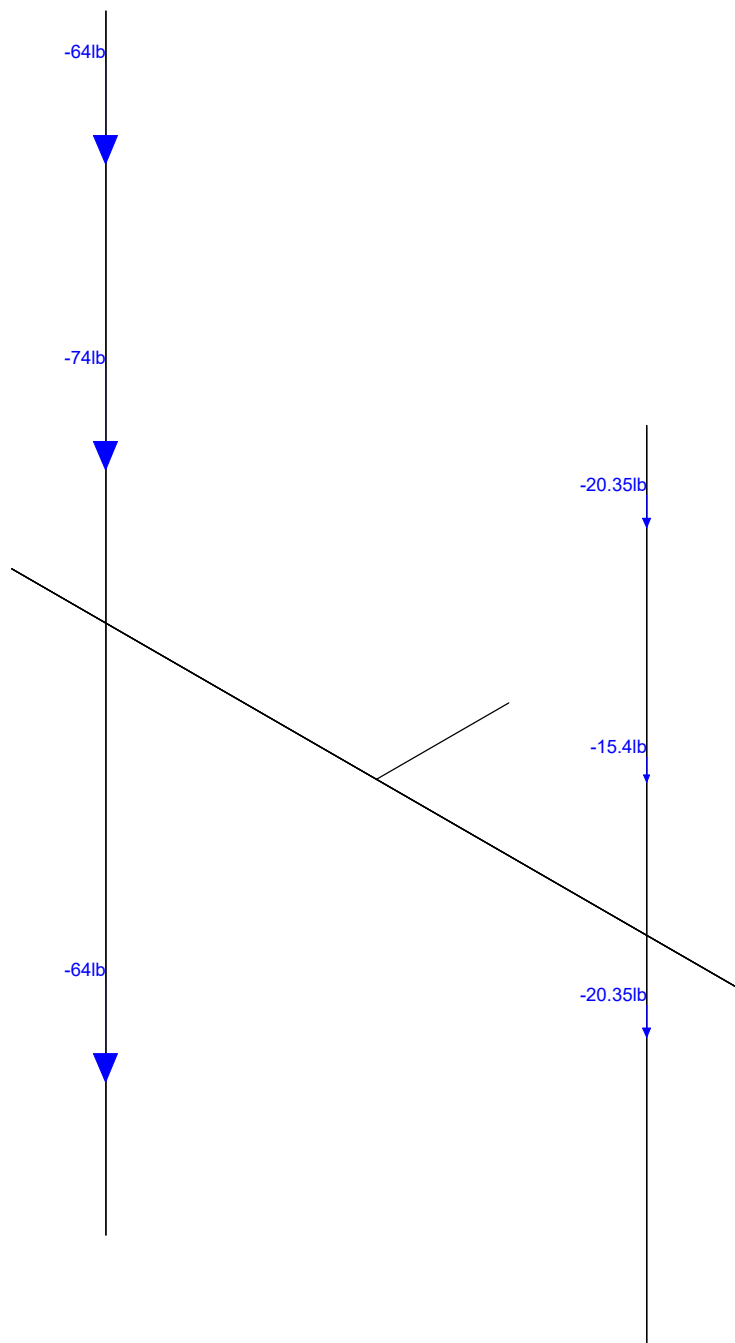
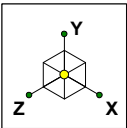
Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 5
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37519-1582.002.7190		CP_37519-1582_Wind Load.r3d



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Paul J. Ford and Company	842856 - Andover North	SK - 6
AMS		Apr 26, 2019 at 10:24 AM
37519-1582.002.7190		CP_37519-1582_Wind Load.r3d



Loads: BLC 1, Dead  
Envelope Only Solution

Paul J. Ford and Company	842856 - Andover North	SK - 7
AMS		Apr 26, 2019 at 10:24 AM
37519-1582.002.7190		CP_37519-1582_Wind Load.r3d



**(Global) Model Settings**

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation?	Yes
Increase Nailing Capacity for Wind?	Yes
Include Warping?	Yes
Trans Load Btwn Intersecting Wood Wall?	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Include P-Delta for Walls?	Yes
Automatically Iterate Stiffness for Walls?	No
Max Iterations for Wall Stiffness	3
Gravity Acceleration (in/sec^2)	386.4
Wall Mesh Size (in)	12
Eigensolution Convergence Tol. (1.E-)	4
Vertical Axis	Y
Global Member Orientation Plane	XZ
Static Solver	Sparse Accelerated
Dynamic Solver	Accelerated Solver

Hot Rolled Steel Code	AISC 14th(360-10): LRFD
Adjust Stiffness?	Yes(Iterative)
RISAConnection Code	None
Cold Formed Steel Code	None
Wood Code	None
Wood Temperature	< 100F
Concrete Code	None
Masonry Code	None
Aluminum Code	None - Building

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections?	No
Use Cracked Sections Slab?	Yes
Bad Framing Warnings?	No
Unused Force Warnings?	No
Min 1 Bar Diam. Spacing?	No
Concrete Rebar Set	REBAR SET ASTMA615
Min % Steel for Column	1
Max % Steel for Column	0



**(Global) Model Settings, Continued**

Seismic Code	None
Seismic Base Elevation (in)	Not Entered
Add Base Weight?	No
Ct X	0
Ct Z	0
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	1
R Z	1

**Hot Rolled Steel Properties**

	Label	E [ksi]	G [ksi]	Nu	Therm (\1...	Density[k/f...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A53 Gr. B (35 ksi)	29000	11154	.3	.65	.49	35	1.5	60	1.2
2	A500 Gr. B (46ksi)	29000	11154	.3	.65	.49	46	1.5	58	1.2
3	A36	29000	11154	.3	.65	.49	36	1.5	58	1.2

**Member Primary Data**

	Label	I Joint	J Joint	K Joint	Rotate(de...	Section/Shape	Type	Design List	Material	Design Rules
1	C2	N10	N8			PIPE 2.0	None	None	A53 Gr. ...	Typical
2	C1	N11	N9			PIPE 2.0	None	None	A53 Gr. ...	Typical
3	B1	N6	N7			HSS4x4x4	None	None	A500 Gr. ...	Typical
4	G1	C2	C1			HSS4x4x4	None	None	A500 Gr. ...	Typical

**Member Advanced Data**

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	Analysis ...	Inactive	Seismic Design ...
1	C2						Yes			None
2	C1						Yes			None
3	B1						Yes			None
4	G1						Yes			None

**Hot Rolled Steel Design Parameters**

	Label	Shape	Length[in]	Lbyy[in]	Lbzz[in]	Lcomp top[in]	Lcomp bot[in]	L-torqu...	Kyy	Kzz	Cb	Function
1	C2	PIPE 2.0	96									Lateral
2	C1	PIPE 2.0	72									Lateral
3	B1	HSS4x4x4	66									Lateral
4	G1	HSS4x4x4	12									Lateral

**Basic Load Cases**

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area(Me...	Surface(P...
1	Dead	None		-1.1			8		
2	Live	None							
3	Wind 0	None					16	8	
4	Wind 30	None					16	8	
5	Wind 60	None					16	8	
6	Wind 90	None					16	8	
7	Wind 120	None					16	8	
8	Wind 150	None					16	8	
9	Ice Load	None					8	4	
10	Ice 0	None					16	8	
11	Ice 30	None					16	8	



**Basic Load Cases (Continued)**

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area(Me...	Surface(P...
12	Ice 60	None					16	8	
13	Ice 90	None					16	8	
14	Ice 120	None					16	8	
15	Ice 150	None					16	8	

**Load Combinations**

	Description	S...	P...	S...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	
1	1.4 D	Yes	Y			1	1.4																
2	1.2 D + 1.6 L	Yes	Y			1	1.2	2	1.6														
3	1.2 D + 1.0 Wo @ 0	Yes	Y			1	1.2	3	1														
4	1.2 D + 1.0 Wo @ 30	Yes	Y			1	1.2	4	1														
5	1.2 D + 1.0 Wo @ 60	Yes	Y			1	1.2	5	1														
6	1.2 D + 1.0 Wo @ 90	Yes	Y			1	1.2	6	1														
7	1.2 D + 1.0 Wo @ 120	Yes	Y			1	1.2	7	1														
8	1.2 D + 1.0 Wo @ 150	Yes	Y			1	1.2	8	1														
9	1.2 D + 1.0 Wo @ 180	Yes	Y			1	1.2	3	-1														
10	1.2 D + 1.0 Wo @ 210	Yes	Y			1	1.2	4	-1														
11	1.2 D + 1.0 Wo @ 240	Yes	Y			1	1.2	5	-1														
12	1.2 D + 1.0 Wo @ 270	Yes	Y			1	1.2	6	-1														
13	1.2 D + 1.0 Wo @ 300	Yes	Y			1	1.2	7	-1														
14	1.2 D + 1.0 Wo @ 330	Yes	Y			1	1.2	8	-1														
15	1.2 D + 1.0 Di + 1.0 Wi @ 0	Yes	Y			1	1.2	9	1	10	1												
16	1.2 D + 1.0 Di + 1.0 Wi @ 30	Yes	Y			1	1.2	9	1	11	1												
17	1.2 D + 1.0 Di + 1.0 Wi @ 60	Yes	Y			1	1.2	9	1	12	1												
18	1.2 D + 1.0 Di + 1.0 Wi @ 90	Yes	Y			1	1.2	9	1	13	1												
19	1.2 D + 1.0 Di + 1.0 Wi @ 1...	Yes	Y			1	1.2	9	1	14	1												
20	1.2 D + 1.0 Di + 1.0 Wi @ 1...	Yes	Y			1	1.2	9	1	15	1												
21	1.2 D + 1.0 Di + 1.0 Wi @ 1...	Yes	Y			1	1.2	9	1	10	-1												
22	1.2 D + 1.0 Di + 1.0 Wi @ 2...	Yes	Y			1	1.2	9	1	11	-1												
23	1.2 D + 1.0 Di + 1.0 Wi @ 2...	Yes	Y			1	1.2	9	1	12	-1												
24	1.2 D + 1.0 Di + 1.0 Wi @ 2...	Yes	Y			1	1.2	9	1	13	-1												
25	1.2 D + 1.0 Di + 1.0 Wi @ 3...	Yes	Y			1	1.2	9	1	14	-1												
26	1.2 D + 1.0 Di + 1.0 Wi @ 3...	Yes	Y			1	1.2	9	1	15	-1												
27	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	3	.053	16	1.5												
28	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	4	.053	16	1.5												
29	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	5	.053	16	1.5												
30	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	6	.053	16	1.5												
31	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	7	.053	16	1.5												
32	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	8	.053	16	1.5												
33	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	3	-.053	16	1.5												
34	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	4	-.053	16	1.5												
35	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	5	-.053	16	1.5												
36	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	6	-.053	16	1.5												
37	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	7	-.053	16	1.5												
38	1.2 D + 1.5 Lm + 1.0 Wm @...	Yes	Y			1	1.2	8	-.053	16	1.5												
39	1.2 D + 1.5 Lv	Yes	Y			1	1.2	17	1.5														

**Envelope Joint Reactions**

	Joint		X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	C1	max	1265.3	13	1732.115	22	1759.663	3	.002	3	2.328	14	-.036	5
2		min	-1265.3	7	472.251	14	-1759.663	9	-1.842	21	-2.331	8	-1.476	25
3	Totals:	max	1265.3	13	1732.115	22	1759.663	3						
4		min	-1265.3	7	472.251	14	-1759.663	9						





Company : Paul J. Ford and Company  
 Designer : AMS  
 Job Number : 37519-1582.002.7190  
 Model Name : 842856 - Andover North

Apr 26, 2019  
 10:25 AM  
 Checked By: \_\_\_\_\_

**Envelope AISC 14th(360-10): LRFD Steel Code Checks**

Member	Shape	Code Check	Loc[in]	LC	Shear Check	Loc[in]	Dir	LC	phi*Pnc	phi*Pnt	phi*Mn y	phi*Mn z	Cb	Eqn
1	C2	PIPE 2.0	.946	48	10	.069	48	10	14916.0...	32130	1.872	1.872	1...	H1-1b
2	C1	PIPE 2.0	.280	32.25	9	.024	32.25	10	20866.7...	32130	1.872	1.872	1.5	H1-1b
3	G1	HSS4x4x4	.204	12	8	.153	12	y	25138935...	139518	16.181	16.181	1...	H1-1b
4	B1	HSS4x4x4	.194	33	9	.060	33	z	9122927...	139518	16.181	16.181	1...	H1-1b

# PJF PAUL J. FORD & COMPANY

250 E Broad St, Ste 600 • Columbus, OH 43215  
 Phone 614.221.6679 www.pauljford.com

Project # **37519-1582**

By **AMS**

Date: 04/26/19

v0.1, Effective 07/10/18

## MOUNT TO TOWER CONNECTION CHECKS

### REACTIONS

Px= **1.265** Kip  
 Py= **1.732** Kip  
 (Axial)Pz= **1.76** Kip  
 Mx= **22.109** Kip-in  
 My= **27.976** Kip-in  
 (Torque)Mz= **17.709** Kip-in

Number of Bolts	=	<b>4</b>	
Plate Size	b=	<b>8</b>	in
	d=	<b>8</b>	in
Edge distance for Bolts	=	<b>1</b>	in
Bolt group centroid y-coordinate, Yc		4	in
Bolt group centroid x-coordinate, Xc		4	in
Load eccentricity in x-direction, ex		0	in
Load eccentricity in y-direction, ey		0	in
Total Moment including load eccentricity $\Sigma M_x$ =		22.109	Kips-in
Total Moment including load eccentricity $\Sigma M_y$ =		27.976	Kips-in
Total Moment including load eccentricity $\Sigma M_z$ =		17.709	Kips-in

### BOLT CHECKS

Tension Reaction	4.61	kip
Shear Reaction	1.58	kip
Bolt Type	A325N	
Bolt Diameter	0.625	in
Tensile Strength	20.7	kips
Shear Strength	12.4	kips
Reduced Tensile Strength	-	kips

Tensile Capacity Used	<b>22.3%</b>
Shear Capacity Used	<b>12.7%</b>

**Note: Tension reduction not required if tension or shear capacity < 30%**

### WELD CHECKS

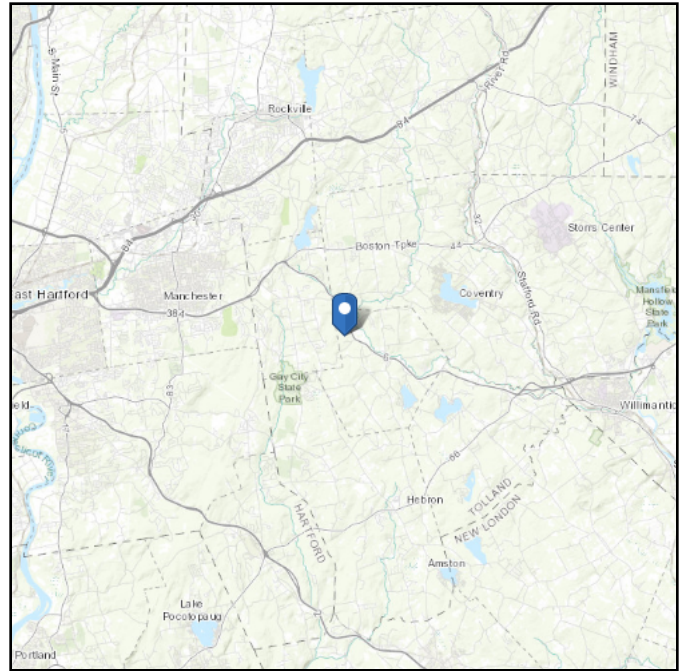
Standoff Member Type		<b>Square</b>	
Width	=	<b>4</b>	in
Depth (only for square members) =		<b>4</b>	in
Assumed Weld Size	=	<b>0.3750</b>	
Total Forces in X direction =		0.573	kips
Total Forces in Y direction =		0.632	kips
Total Forces in Z direction =		2.46	kips
Resultant =		2.60	kips
$\Phi * F_w$ (Kip/in)/16" weld =		1.392	
Capacity used		<b>31.15%</b>	

# ASCE 7 Hazards Report

**Address:**  
No Address at This Location

**Standard:** ASCE/SEI 7-10  
**Risk Category:** II  
**Soil Class:** D - Stiff Soil

**Elevation:** 495.67 ft (NAVD 88)  
**Latitude:** 41.750128  
**Longitude:** -72.402675



## Wind

### Results:

Wind Speed:	125 Vmph ← City requires a 130 mph ultimate wind speed
10-year MRI	77 Vmph
25-year MRI	87 Vmph
50-year MRI	94 Vmph
100-year MRI	102 Vmph

**Data Source:** ASCE/SEI 7-10, Fig. 26.5-1A and Figs. CC-1–CC-4, incorporating errata of March 12, 2014

**Date Accessed:** Thu Apr 25 2019

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-10 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is in a hurricane-prone region as defined in ASCE/SEI 7-10 Section 26.2. Glazed openings need not be protected against wind-borne debris.

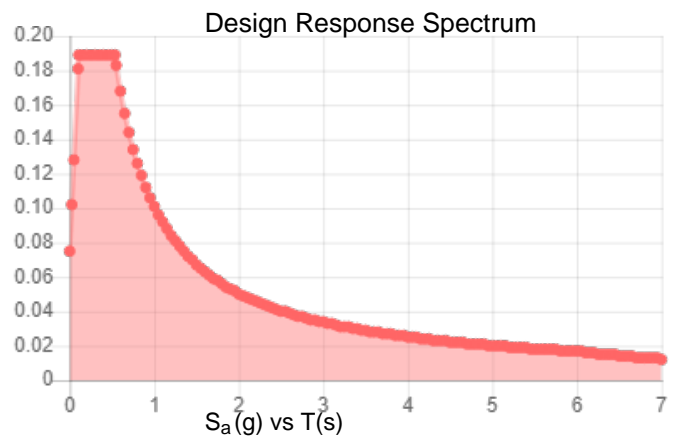
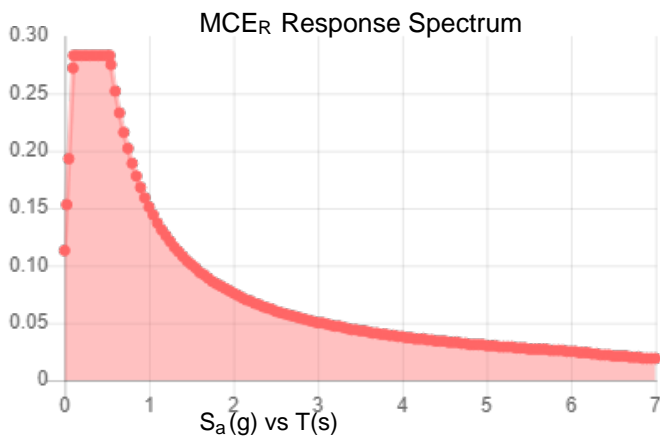
Mountainous terrain, gorges, ocean promontories, and special wind regions should be examined for unusual wind conditions.

**Site Soil Class:** D - Stiff Soil

**Results:**

$S_S$ :	0.177	$S_{DS}$ :	0.189
$S_1$ :	0.063	$S_{D1}$ :	0.101
$F_a$ :	1.6	$T_L$ :	6
$F_v$ :	2.4	PGA :	0.089
$S_{MS}$ :	0.283	PGA <sub>M</sub> :	0.142
$S_{M1}$ :	0.151	F <sub>PGA</sub> :	1.6
		$I_e$ :	1

**Seismic Design Category** B



**Data Accessed:**

Thu Apr 25 2019

**Date Source:**

USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

## Ice

---

**Results:**

Ice Thickness: 1.00 in.

Concurrent Temperature: 5 F

Gust Speed: 50 mph

**Data Source:** Standard ASCE/SEI 7-10, Figs. 10-2 through 10-8

**Date Accessed:** Thu Apr 25 2019

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 50-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

---

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

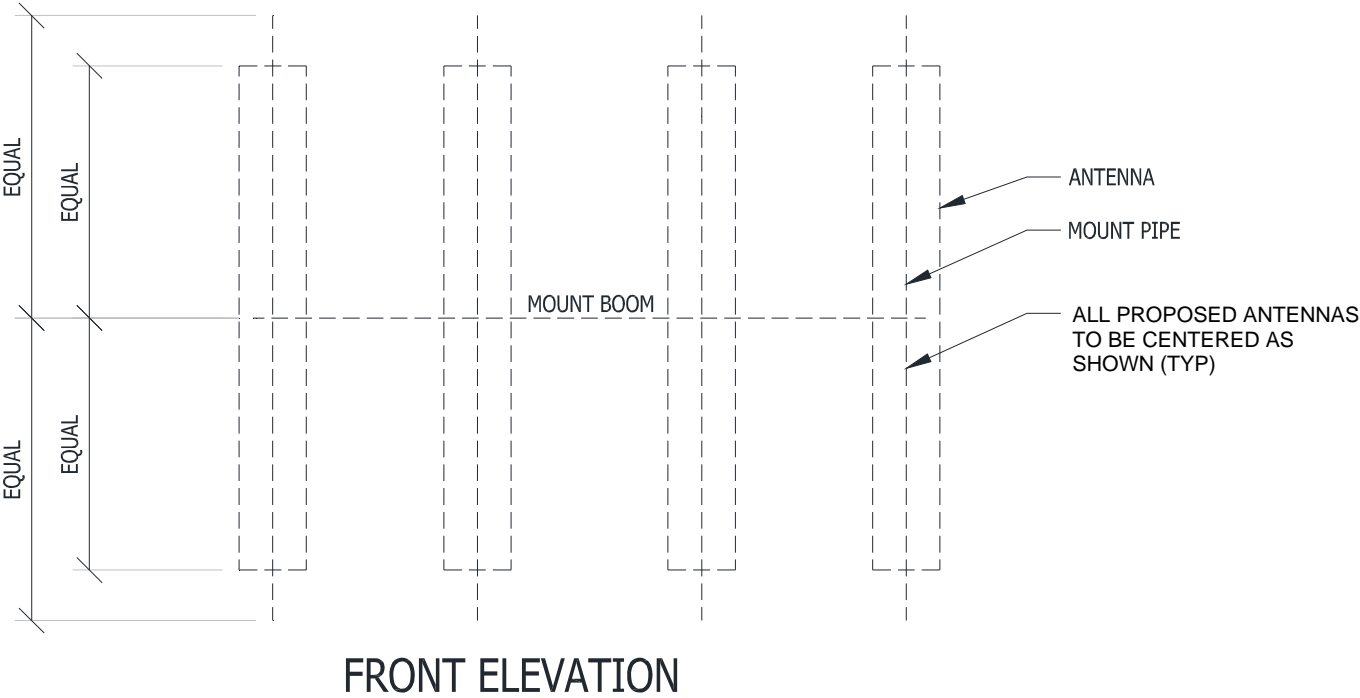
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# **APPENDIX D**

## **STANDARD ANTENNA CENTERING CONDITIONS**

# T-ARM



Note: Quantity of antennas shown above is representative only and may or may not represent the actual quantity of antennas considered in the analysis.

# Exhibit F

## **Power Density/RF Emissions Report**



# Transcom Engineering, Inc.

Wireless Network Design and Deployment

## Radio Frequency Emissions Analysis Report

**T-MOBILE** Existing Facility

**Site ID: CT11501E**

CT501/ATT Andover - Prime  
122 - Rt. 6  
Andover, CT 06232

**June 14, 2019**

**Transcom Engineering Project Number: 737001-0036**

Site Compliance Summary	
Compliance Status:	<b>COMPLIANT</b>
Site total MPE% of FCC general population allowable limit:	<b>7.05 %</b>

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

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June 14, 2019

T-MOBILE

Attn: Jason Overbey, RF Manager  
35 Griffin Road South  
Bloomfield, CT 6009

## Emissions Analysis for Site: **CT11501E – CT501/ATT Andover - Prime**

Transcom Engineering, Inc (“Transcom”) was directed to analyze the proposed upgrades to the T-MOBILE facility located at **122 - Rt. 6, Andover, 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 97-01 and ANSI/IEEE Std C95.1. The FCC regulates Maximum Permissible Exposure in units of microwatts per square centimeter ( $\mu\text{W}/\text{cm}^2$ ). The number of  $\mu\text{W}/\text{cm}^2$  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 population 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 population 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.

Population exposure to radio frequencies is regulated and enforced in units of microwatts per square centimeter ( $\mu\text{W}/\text{cm}^2$ ). The general population exposure limits for the 600 & 700 MHz bands are approximately  $400 \mu\text{W}/\text{cm}^2$  and  $467 \mu\text{W}/\text{cm}^2$  respectively. The general population exposure limit for the 1900 MHz (PCS) and 2100 MHz (AWS) bands is  $1000 \mu\text{W}/\text{cm}^2$ . 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.

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

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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.

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

## CALCULATIONS

Calculations were performed for the proposed upgrades to the T-MOBILE antenna facility located at **122 - Rt. 6, Andover, 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 for directional panel antennas, 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.

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. All power values expressed and analyzed are maximum power levels expected to be used on all radios.

All emissions values for additional carriers were taken from the Connecticut Siting Council (CSC) active MPE database. Values in this database are provided by the individual carriers themselves

For each sector the following channel counts, frequency bands and power levels were utilized as shown in *Table 1*:

Technology	Frequency Band	Channel Count	Transmit Power per Channel (W)
LTE	1900 MHz (PCS)	4	40
GSM	1900 MHz (PCS)	1	15
LTE / 5G NR	600 MHz	2	40
LTE	700 MHz	2	20

*Table 1: Channel Data Table*

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

The following antennas listed in *Table 2* were used in the modeling for transmission in the 600, 700 MHz, 1900 MHz (PCS) and 2100 MHz (AWS) frequency bands. This is based on feedback from the carrier with regards to anticipated antenna selection. Maximum gain values for all antennas are listed in the Inventory and Power Data table below. The maximum gain of the antenna per the antenna manufactures supplied specifications, minus 10 dB for directional panel antennas, 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.

Sector	Antenna Number	Antenna Make / Model	Antenna Centerline (ft)
A	1	RFS APX16DWV-16DWV-S-E-ACU	140
A	2	RFS APXVAARR24_43-U-NA20	140
B	1	RFS APX16DWV-16DWV-S-E-ACU	140
B	2	RFS APXVAARR24_43-U-NA20	140
C	1	RFS APX16DWV-16DWV-S-E-ACU	140
C	2	RFS APXVAARR24_43-U-NA20	140

*Table 2: Antenna Data*

All calculations were done with respect to uncontrolled / general population threshold limits.

Cable losses were factored in the calculations for this site. Since all **1900 MHz (PCS)** radios are ground mounted the following cable loss values were used. For each ground mounted **1900 MHz (PCS)** radio there was **1.65 dB** of cable loss calculated into the system gains / losses for this site. These values were calculated based upon the manufacturers specifications for **160 feet** of **1-5/8"** coax.

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

## RESULTS

Per the calculations completed for the proposed T-MOBILE configurations *Table 3* shows resulting emissions power levels and percentages of the FCC's allowable general population limit.

Antenna ID	Antenna Make / Model	Frequency Bands	Antenna Gain (dBd)	Channel Count	Total TX Power (W)	ERP (W)	MPE %
Antenna A1	RFS APX16DWV-16DWV-S-E-ACU	1900 MHz (PCS)	15.9	5	175	4,656.27	0.93
Antenna A2	RFS APXVAARR24_43-U-NA20	600 MHz / 700 MHz	12.95 / 13.35	4	120	2,443.03	1.16
Sector A Composite MPE%							<b>2.09</b>
Antenna B1	RFS APX16DWV-16DWV-S-E-ACU	1900 MHz (PCS)	15.9	5	175	4,656.27	0.93
Antenna B2	RFS APXVAARR24_43-U-NA20	600 MHz / 700 MHz	12.95 / 13.35	4	120	2,443.03	1.16
Sector B Composite MPE%							<b>2.09</b>
Antenna C1	RFS APX16DWV-16DWV-S-E-ACU	1900 MHz (PCS)	15.9	5	175	4,656.27	0.93
Antenna C2	RFS APXVAARR24_43-U-NA20	600 MHz / 700 MHz	12.95 / 13.35	4	120	2,443.03	1.16
Sector C Composite MPE%							<b>2.09</b>

*Table 3: T-MOBILE Emissions Levels*

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

The Following table (*table 4*) shows all additional carriers on site and their MPE% as recorded in the CSC active MPE database for this facility along with the newly calculated maximum T-MOBILE MPE contributions per this report. FCC OET 65 specifies that for carriers utilizing directional antennas that the highest recorded sector value be used for composite site MPE values due to their greatly reduced emissions contributions in the directions of the adjacent sectors. *Table 5* below shows a summary for each T-MOBILE Sector as well as the composite MPE value for the site.

Site Composite MPE%	
Carrier	MPE%
T-MOBILE – Max Per Sector Value	<b>2.09 %</b>
Verizon Wireless	2.95 %
AT&T	1.57 %
MetroPCS	0.44 %
<b>Site Total MPE %:</b>	<b>7.05 %</b>

*Table 4: All Carrier MPE Contributions*

T-MOBILE Sector A Total:	2.09 %
T-MOBILE Sector B Total:	2.09 %
T-MOBILE Sector C Total:	2.09 %
Site Total:	7.05 %

*Table 5: Site MPE Summary*

# Transcom Engineering, Inc.

Wireless Network Design and Deployment

FCC OET 65 specifies that for carriers utilizing directional antennas that the highest recorded sector value be used for composite site MPE values due to their greatly reduced emissions contributions in the directions of the adjacent sectors. *Table 6* below details a breakdown by frequency band and technology for the MPE power values for the maximum calculated T-MOBILE sector(s). For this site, all three sectors have the same configuration yielding the same results on all three sectors.

T-MOBILE _ Frequency Band / Technology Max Power Values (Per Sector)	# Channels	Watts ERP (Per Channel)	Height (feet)	Total Power Density ( $\mu\text{W}/\text{cm}^2$ )	Frequency (MHz)	Allowable MPE ( $\mu\text{W}/\text{cm}^2$ )	Calculated % MPE
T-Mobile 1900 MHz (PCS) LTE	4	1,064.29	140	8.52	1900 MHz (PCS)	1000	0.85%
T-Mobile 1900 MHz (PCS) GSM	1	399.11	140	0.80	1900 MHz (PCS)	1000	0.08%
T-Mobile 600 MHz LTE / 5G NR	2	788.97	140	3.16	600 MHz	400	0.79%
T-Mobile 700 MHz LTE	2	432.54	140	1.73	700 MHz	467	0.37%
						<b>Total:</b>	<b>2.09%</b>

*Table 6: T-MOBILE Maximum Sector MPE Power Values*



# Transcom Engineering, Inc.

Wireless Network Design and Deployment

## Summary

All calculations performed for this analysis yielded results that were **within** the allowable limits for general population 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 population exposure to RF Emissions are shown here:

T-MOBILE Sector	Power Density Value (%)
Sector A:	2.09 %
Sector B:	2.09 %
Sector C:	2.09 %
T-MOBILE Maximum Total (per sector):	2.09 %
Site Total:	7.05 %
Site Compliance Status:	<b>COMPLIANT</b>

The anticipated composite MPE value for this site assuming all carriers present is **7.05 %** of the allowable FCC established general population limit sampled at the ground level. This is based upon values listed in the Connecticut Siting Council database for existing carrier emissions.

FCC guidelines state that if a site is found to be out of compliance (over allowable thresholds), that carriers over a 5% contribution to the composite value will require measures to bring the site into compliance. For this facility, the composite values calculated were well within the allowable 100% threshold standard per the federal government.



Scott Heffernan  
RF Engineering Director  
**Transcom Engineering, Inc**  
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Sterling, MA 01564

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ANNE MARIE ZSAMBRA  
CROWN CASTLE  
3 CORPORATE PARK DRIVE  
SUITE 101  
CLIFTON PARK, NY 12065  
UNITED STATES US

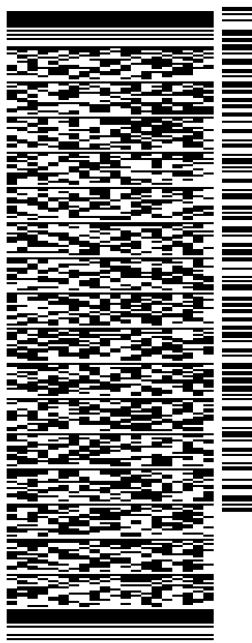
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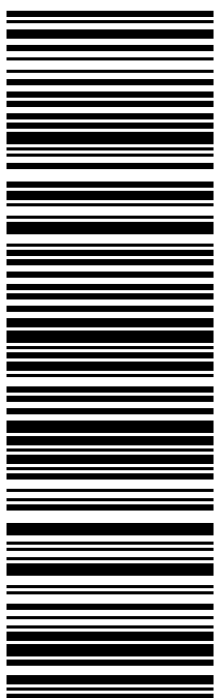
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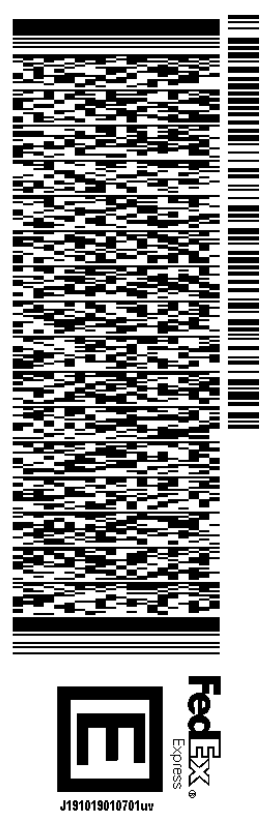
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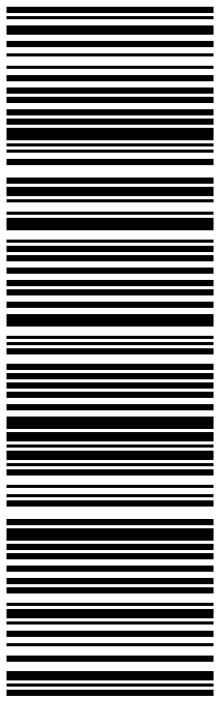
TO **ROBERT BURBANK, FIRST SELECTMAN**  
**TOWN OF ANDOVER**  
**17 SCHOOL ROAD**

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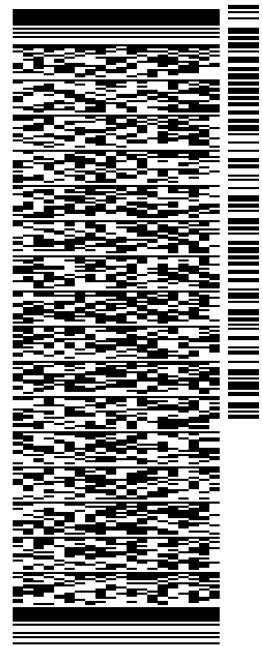
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17 SCHOOL ROAD

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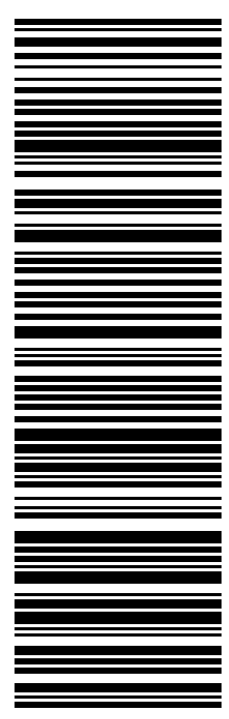
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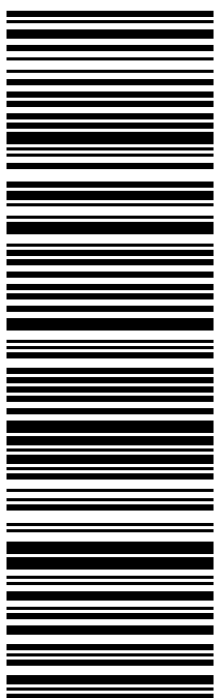
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565J1/D210/23AD

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1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

**Warning:** Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.

Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com. FedEx will not be responsible for any claim in excess of \$100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim. Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of \$100 or the authorized declared value. Recovery cannot exceed actual documented loss. Maximum for items of extraordinary value is \$1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our Service Guide. Written claims must be filed within strict time limits, see current FedEx Service Guide.