Robinson+Cole

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Also admitted in Massachusetts

August 30, 2019

Melanie A. Bachman, Esq.
Executive Director/Staff Attorney
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Facility Modification**
250 Silas Deane Highway, Wethersfield, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the 90-foot level of the existing 120-foot tower at 250 Silas Deane Highway in Wethersfield, Connecticut (the "Property"). The tower and underlying property are owned by the Town of Wethersfield ("Town"). The Council approved Cellco's use of this tower in 2004. Cellco now intends to modify its facility by replacing six (6) remote radio heads ("RRHs") with six (6) newer model RRHs. Included in Attachment 1 are specifications for Cellco's replacement RRHs.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Wethersfield Town Manager, Gary Evans; and Peter Gillespie, Wethersfield Director of Planning and Economic Development. The Town is the owner of the Property and the tower.

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

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's new RRHs will be installed at a centerline height of 90 feet on the 120-foot tower.

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.

3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.

4. The installation of six (6) new RRHs will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. Far Field approximation tables for Cellco's modified facility are included in Attachment 2.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. The tower and its foundation can support Cellco's proposed modifications. (*See* Structural Assessment Report included in Attachment 3).

A copy of the parcel map and Property owner information is included in Attachment 4. A Certificate of Mailing verifying that this filing was sent to municipal officials is included in Attachment 5.

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Gary Evans, Town Manager
Peter Gillespie, Director of Planning and Economic Development
Tim Parks

ATTACHMENT 1

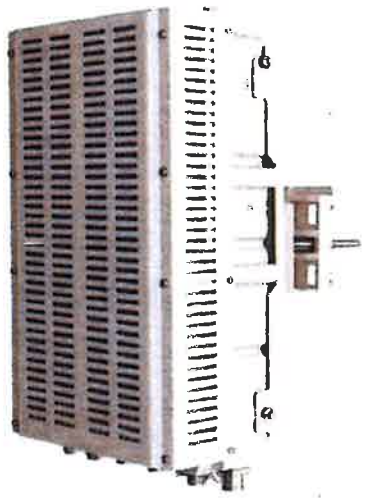
B66a RRH4x45W

Datasheet

Radio Technology FDD-LTE

Feature description:

- Remote Radio Head 4x45W or 2x90W Switchable via SW



Power Output	4 x 45 W or 2x90W (SW Switchable) w/o fans
IBW	70MHz
OBW	60 MHz
RF Sharing	LTE
Mass/Volume	25.8kg/56.9 lb Weight 655H x 299W x 182D mm 25.8"x11.8"x7.2" 29.7L / 35.5L
Antenna Conf.	4Tx/4Rx
Temperature	-40 to 55 °C
IP class	IP65
Input Power	DC 48 V
Cooling	Natural Convection
Mounting	Wall, Pole mount
BBU connection	2x 9.8Gbps SFP(Rate 7 HW ready)

B66a RRH 4x45 – Interfaces

Power:

- Max power: 816W (add 58W for AISG)
- Breaker size: 25A
- Max distance with 6ga power feed and 5.5V drop: 284 feet

RF Interfaces:

- 4.3/10 Connectors
- No monitoring ports(Spectrum analyzer SW takes place of monitoring ports)

AISG:

- Two Smart Bias-T
- One AISG port

B66 Details

- Max power for a single carrier is:
  - 2x60W for 10,15,20 MHz carrier
  - 2x40W for 5 MHz carrier
- Multi- Carrier Support with AWS-1 carriers: 15.1
- Multi- Carrier Support with AWS-3 carriers: 16.2

Carrier power: Multi-carrier

- Assuming 2 Tx power can be assigned per carrier subject to 40W max for 5Mhz, 60W for larger in 2T, cut that power in half for 4T
- Example:B4 (20Mhz) and AWS3 (10MHz)
  - Power can be varied between those two carriers, can go 60W for 20 MHz carrier, 30W for 10 MHz carrier to use the 90W in 2T.
  - It could be 45/45 for 20Mhz/10Mhz if desired.

ALCATEL-LUCENT B13 RRH4X30-4R

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

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

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

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

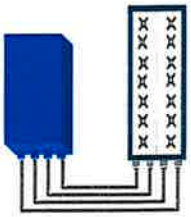
Its compactness and slim design makes the Alcatel-Lucent B13 RRH4x30-4R easy to install close to the antenna: operators can therefore locate this Remote Radio Head where RF design conditions are deemed ideal, minimizing trade-offs between available sites and RF optimum sites, together with reducing the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

FEATURES

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

BENEFITS

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



4x30W with 4T4R
or
2x60W with 2T4R

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

Alcatel·Lucent

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

ATTACHMENT 2

Far Field Approximation
with downtilt variation

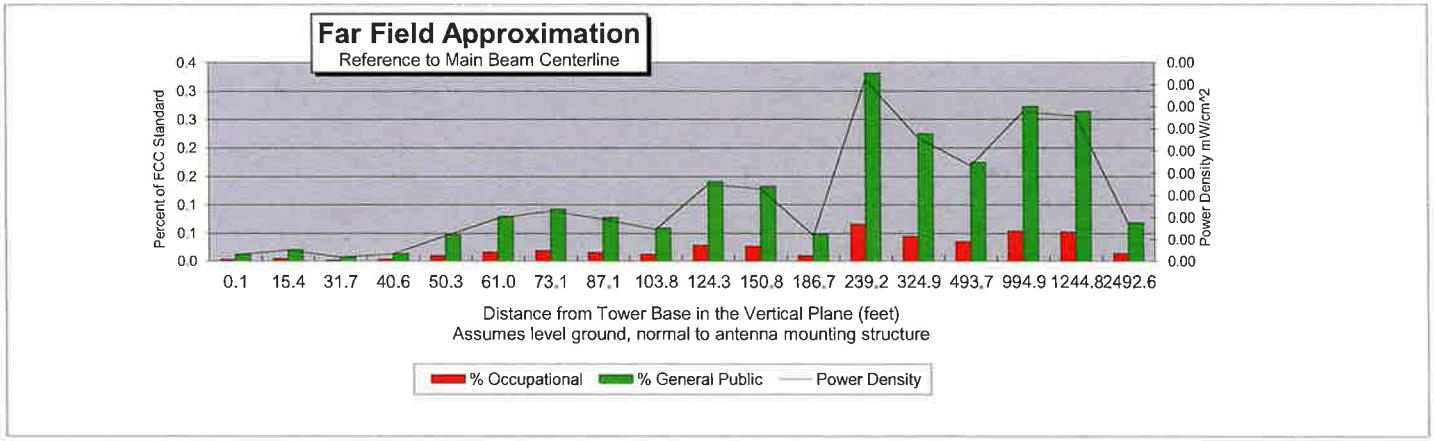
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Hartford 9, CT
Site #:	
Date:	08/29/19
Name:	Mark Brauer
File Name:	Hartford 9, CT - FF Power

Operating Freq. (MHz)	**746.0**
Antenna Height (ft):	**90.0**
Antenna Gain (dBi):	**14.9**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
Power @ J4 (w):	**160.0**
Number of Channels	**1**



Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	87.0	88.4	92.6	96.0	100.5	106.2	113.6	123.1	135.4	151.7	174.1	206.0	254.5	336.3	501.3	998.7	1247.8	2494.1	
Distance from Antenna Structure Base in Horizontal plane	0.1	15.4	31.7	40.6	50.3	61.0	73.1	87.1	103.8	124.3	150.8	186.7	239.2	324.9	493.7	994.9	1244.8	2492.6	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	
Percent of General Population Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.2	0.3	0.3	0.1	

Antenna Type SBNHH-1D65B
Max% 0.33%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Pow
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

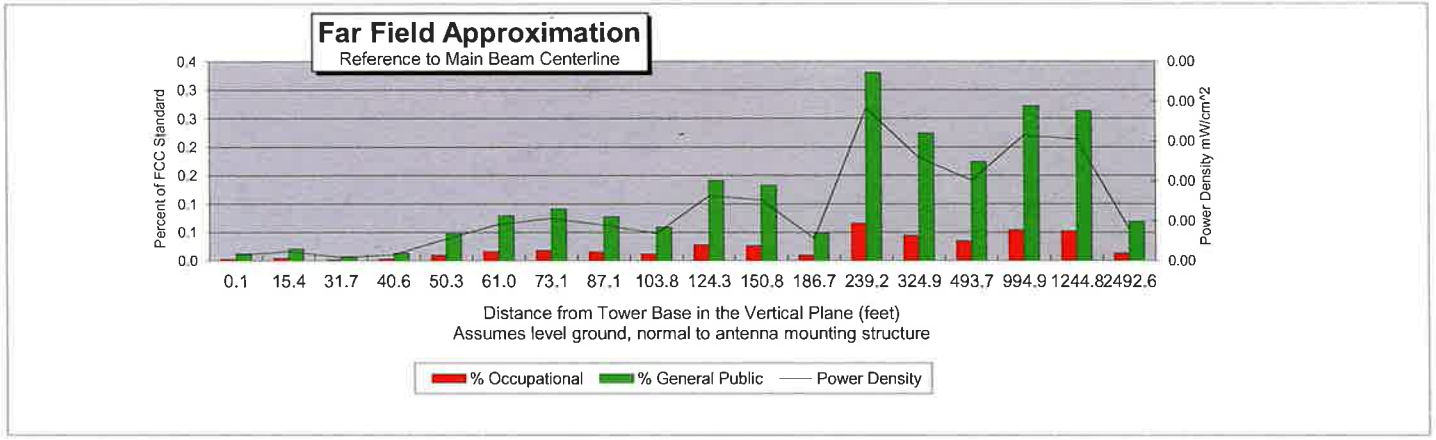
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Hartford 9, CT
Site #:	
Date:	08/29/19
Name:	Mark Brauer
File Name:	Hartford 9, CT - FF Power

Operating Freq. (MHz)	**869.0**
Antenna Height (ft):	**90.0**
Antenna Gain (dBi):	**15.5**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
Power @ J4 (w):	**160.0**
Number of Channels	**1**



Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	87.0	88.4	92.6	96.0	100.5	106.2	113.6	123.1	135.4	151.7	174.1	206.0	254.5	336.3	501.3	998.7	1247.8	2494.1	
Distance from Antenna Structure Base in Horizontal plane	0.1	15.4	31.7	40.6	50.3	61.0	73.1	87.1	103.8	124.3	150.8	186.7	239.2	324.9	493.7	994.9	1244.8	2492.6	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	
Percent of General Population Standard	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.2	0.3	0.3	0.1	

Antenna Type SBNHH-1D65B
Max% 0.33%

Instructions:

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Far Field Approximation
with downtilt variation

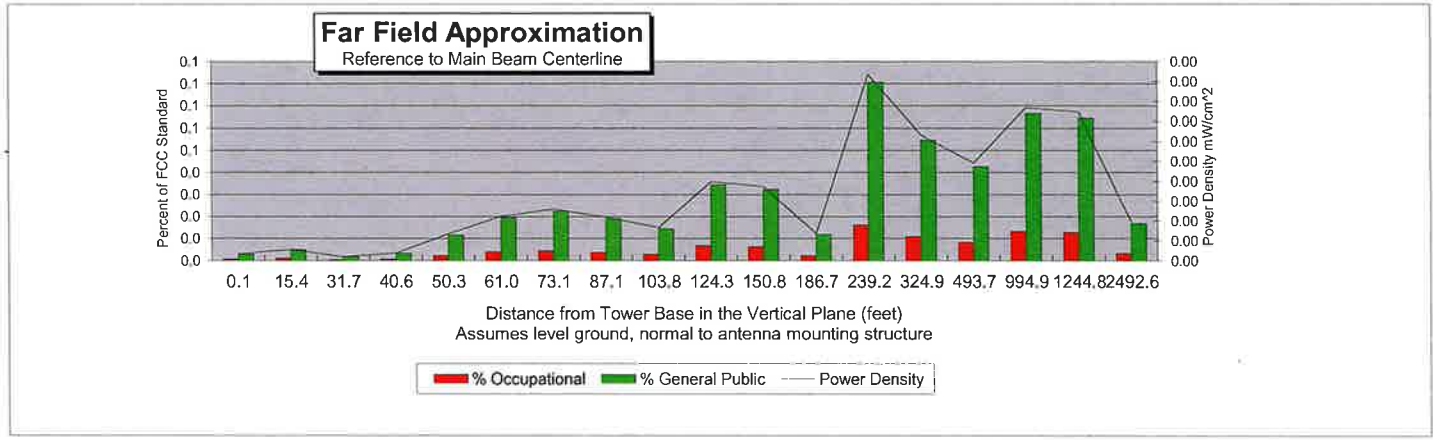
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	East Haven Cosey Beach, CT
Site #:	
Date:	08/29/19
Name:	Mark Brauer
File Name:	East Haven Cosey Beach, CT

Operating Freq. (MHz)	**869.0**
Antenna Height (ft):	**90.0**
Antenna Gain (dBi):	**16.7**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
Power @ J4 (w):	**60.0**
Number of Channels	**3**



Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	87.0	88.4	92.6	96.0	100.5	106.2	113.6	123.1	135.4	151.7	174.1	206.0	254.5	336.3	501.3	998.7	1247.8	2494.1	
Distance from Antenna Structure Base in Horizontal plane	0.1	15.4	31.7	40.6	50.3	61.0	73.1	87.1	103.8	124.3	150.8	186.7	239.2	324.9	493.7	994.9	1244.8	2492.6	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Percent of General Population Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	

Antenna Type BXA-80063-6CF
Max% 0.08%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Pow
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
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7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

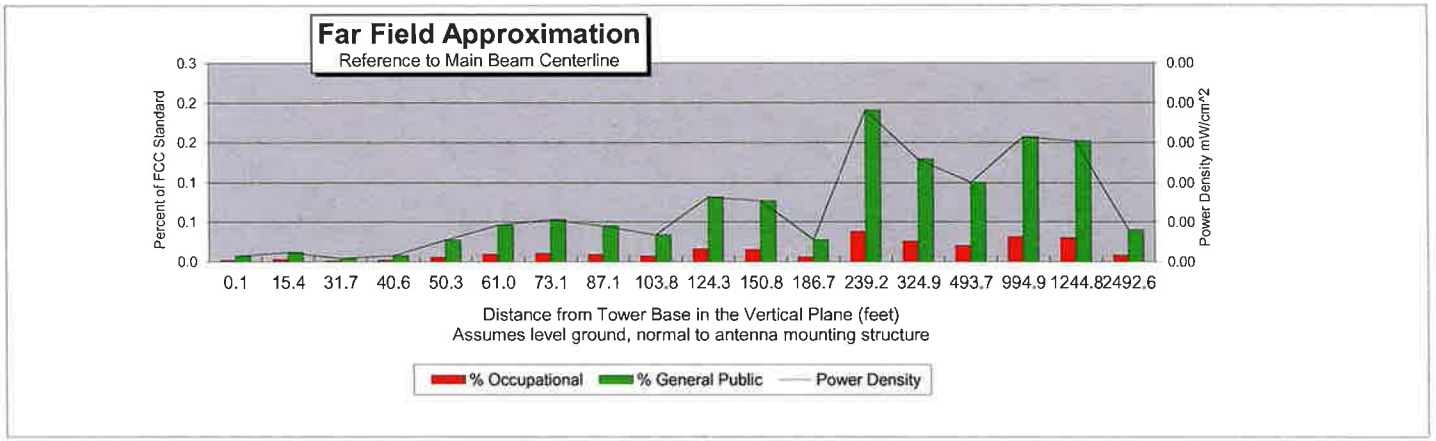
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Hartford 9, CT
Site #:	
Date:	08/29/19
Name:	Mark Brauer
File Name:	Hartford 9, CT - FF Power

Operating Freq. (MHz)	**1970.0**
Antenna Height (ft):	**90.0**
Antenna Gain (dBi):	**18.5**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
Power @ J4 (w):	**160.0**
Number of Channels	**1**



Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	87.0	88.4	92.6	96.0	100.5	106.2	113.6	123.1	135.4	151.7	174.1	206.0	254.5	336.3	501.3	998.7	1247.8	2494.1	
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Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Percent of General Population Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.1	0.2	0.2	0.0	

Antenna Type SBNHH-1D65B
Max% 0.19%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
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Far Field Approximation
with downtilt variation

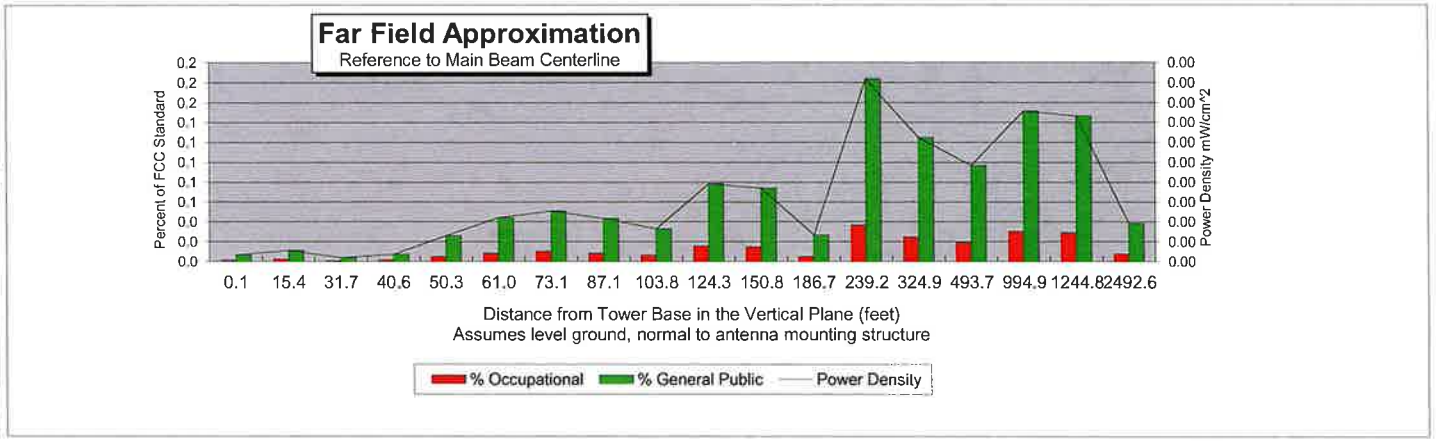
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Hartford 9, CT
Site #:	
Date:	08/29/19
Name:	Mark Brauer
File Name:	Hartford 9, CT - FF Power

Operating Freq. (MHz)	**2110.0**
Antenna Height (ft):	**90.0**
Antenna Gain (dBi):	**18.3**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
Power @ J4 (w):	**160.0**
Number of Channels	**1**



Distance in feet below:

Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	87.0	88.4	92.6	96.0	100.5	106.2	113.6	123.1	135.4	151.7	174.1	206.0	254.5	336.3	501.3	998.7	1247.8	2494.1	
Distance from Antenna Structure Base in Horizontal plane	0.1	15.4	31.7	40.6	50.3	61.0	73.1	87.1	103.8	124.3	150.8	186.7	239.2	324.9	493.7	994.9	1244.8	2492.6	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Percent of General Population Standard	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.1	0.2	0.1	0.0	

Antenna Type SBNHH-1D65B
Max% 0.18%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

ATTACHMENT 3

Dewberry

Dewberry Engineers Inc.
99 Summer Street, Suite 700
Boston, MA 02110-1200

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617.695.3310 fax
www.dewberry.com

Structural Analysis Report for a 120-ft Monopole Tower

Site Name: Hartford 9 CT
Site No.: 468180
Site Address: 250 Silas Deane Highway
Wethersfield, CT 06109
Hartford County

Prepared for:
Verizon Wireless
118 Flanders Road
Westborough, MA 01581-3956

August 09, 2019

Prepared by:
Dewberry Engineers Inc.
99 Summer Street, Suite 700
Boston, MA 02110-1200
Dewberry Project Number: 50110164

Tower Controlling Member	Capacity	Result
Tower Components	88.1%	*Sufficient*
Base Plate	-	*Sufficient*
Anchor Bolts	-	*Sufficient*
Foundation	-	*Sufficient*

Tower/Foundation Previously Reinforced?	YES ☒ / NO ☐
Previous Reinforcement Verified?	YES ☒ / NO ☐ Date: **07/26/19**
Additional Reinforcement Required?	YES ☐ / NO ☒

Prepared by:

James DeCelle Jr.
Project Engineer

Checked by:

Brandon Kelsey
Structural Project Engineer

Approved by:

STATE OF CONNECTICUT
28971
LICENSED
PROFESSIONAL ENGINEER

Benjamin Revette, P.E.
Senior Associate

Table of Contents

Client: Verizon
Site Name: Hartford 9 CT
Project No.: 50114613
Date: August 09, 2019

1.0 INTRODUCTION AND PROJECT SUMMARY

The objective of this report is to assess the proposed installation of new antennas and support equipment on an existing 120 ft. steel monopole tower located in Wethersfield, CT. This report is limited to the analysis of the tower only. The telecommunication upgrade is proposed by Verizon Wireless.

Please refer to the appendices for the structural analysis package regarding the structural analysis.

2.0 CODES, STANDARDS, AND REFRENCES

The structural analysis was completed according to the provisions of the following codes and standards:

- *International Building Code (IBC) 2015,* International Code Council
- *2018 Connecticut State Building Code*
- *TIA-222-G-4, Structural Standard for Antenna Supporting Structures and Antennas*
- *Steel Construction Manual 14th Ed,* American Institute of Steel Construction

The analysis was in compliance with the minimum requirements as specified by TIA-222-G for the County of Providence, RI under the following load parameters:

Risk Category:	II	
Exposure Category:	C	*IBC 2015*
Ultimate Design Wind Speed:	125 mph	*2018 CT Bld. Code*
Basic Design Wind Speed:	97 mph	*Except. #5, Sect. 1609.3.1, Eqn. 16-33, IBC 15*
Design Ice Wind Speed:	50 mph	*ASCE 7-10, Hazards Tool*
Design Ice Thickness:	1.00 in.	*ASCE 7-10, Hazards Tool*
Serviceability Wind Speed:	60 mph	*Sect. 2.8.3, TIA*

The tower geometry, member sizes, existing antenna loading, and foundation design loading were referenced from the following reports, all of which can be found in Appendix B:

- Structural Analysis Report by CENTEK Engineering dated November 14, 2016.
- Mount Analysis Report by Dewberry Engineers dated August 02, 2019.
- Radio Frequency Design Sheet (RFDS Name: Smithfield 5 RI) by Verizon Wireless dated June 04, 2019.
- Site Visit by Dewberry Engineers on July 26, 2019.

Client: Verizon
Site Name: Hartford 9 CT
Project No.: 50114613
Date: August 09, 2019

3.0 EXISTING AND PROPOSED TOWER LOADING

3.1 Existing (includes Reserved, if applicable) Antenna and Cable Information

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	COAX
117	123	Public Safety	2	DB809-XC Omni (Reserve)	(2) 7/8"
110	110	Public Safety	1	2' Dish	(2) 1/2"
			2	1' Dish	(6) 7/8"
			2	2' Dish	
105	106	T-Mobile	6	Air21	(1) 1-5/8"
	105		3	7' Face Width T-Arm	
90	92	VZW	3	B13 RRH 4x30	(12) 1-5/8" (1) Hybriflex
			3	B66A RRH 4x45	
			1	OVP Box	
	90		6	BXA 80063 6CF	
			6	SBNHH-1D65B	
			3	7' Face Width T-Arm	
54	63	Public Safety	1	PD1142	(5) 1/2"
	56.5		1	5'x1" Omni	
			1	DB404	
	52		2	DB583	
	54		3	4' Side Mount Standoff	

To be removed

3.2 Proposed Appurtenance Loading Configuration on Tower:

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	COAX
90	92	VZW	3	B2/B66A RRH	-
	90		3	BSAMNT-SBS-1-2	
	88		3	B5/B13 RRH	

3.3 Final Appurtenance Loading Configuration on Tower:

Mounting Elevation (ft)	Center Line Elevation (ft)	Carrier	QTY.	APPURTENANCES DESCRIPTION	COAX
90	92	VZW	3	B2/B66A RRH	(12) 1-5/8" (1) Hybriflex
			1	OVP Box	
	90		6	BXA 80063 6CF	
			6	SBNHH-1D65B	
			3	BSAMNT-SBS-1-2	
	88		3	B5/B13 RRH	
	90		3	4' T-Arm	

3.4 Method:

tnxTower, a commercially available engineering software program, was used to create a three dimensional model of the tower members and calculate primary member stresses under various loading conditions. Selected output from the analysis is included in Appendix A.

4.0 LOADING AND PERFORMANCE CRITERIA

4.1 Tower Structure Results

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	120 - 89.75	Pole	TP21.287x16x0.188	1	-3315.85	892475.00	28.6	Pass
L2	89.75 - 70	Pole	TP24.3628x20.4443x0.188	2	-7751.55	995069.00	79.8	Pass
L3	70 - 44.417	Pole	TP28.8342x24.3628x0.275	3	-10649.70	1804540.00	73.3	Pass
L4	44.417 - 35	Pole	TP29.93x27.6579x0.275	4	-12830.60	1885590.00	88.1	Pass
L5	35 - 0	Pole	TP36.0472x29.93x0.364	5	-19739.70	3062890.00	79.1	Pass
							Summary	
						Pole (L4)	88.1	Pass
						RATING =	**88.1**	**Pass**

Table above displays the summary of the ratio (as a percentage) of force in the member to their capacities. Values greater than 100% indicate the maximum force in the member exceed its capacity.

**Note: Capacities up to 105% are considered acceptable (where applicable)*

4.2 Foundation Results

The foundation reactions are summarized below:

Tower Component	Condition	Utilization	Pass/Fail
Base Plate	Bending (kip-ft)	21.7%	Fail
Anchor Bolts	Tensile (kip)	60.3%	Pass
Foundation	Overturning Moment (kip-ft)	1.27 F.S.	Pass

5.0 CONCLUSIONS AND COMMENTARY

After analysis, it was determined that the existing tower structure and foundation **is adequate** to support the proposed forces as a result of the telecommunication upgrade.

This engineering analysis is based upon the theoretical capacity of the structure. It is not a condition assessment of the tower and its foundation. Dewberry Engineers, Inc. reserves the right to add to or modify this report if more information becomes available. The conclusions reached by Dewberry Engineers, Inc. in this report are only applicable to the previous mentioned existing structural elements supporting the proposed wireless telecommunications installation. The results of this report are based on the assumption that existing structural elements have been installed per the original design documents, have been well maintained and are uncompromised. This report does not imply that a thorough inspection of the existing structure has been performed. Any deviation of the support condition, loading, location, placement, equipment configuration, etc. will require Dewberry Engineers, Inc. to generate an additional structural analysis.

6.0 ASSUMPTIONS

This feasibility structural analysis is based on the theoretical capacity of the members and is not a condition assessment of the tower. This analysis is from information supplied; and therefore, its results are based on and are as accurate as the supplied information. Dewberry Engineers, Inc. has made no independent determination, nor is it required to, of its accuracy. The following assumptions were made for this structural analysis:

1. The tower member sizes and shapes are considered accurate as supplied. The material grade is as per data supplied and/or as assumed and as stated in the materials section.
2. The antenna configuration is as supplied and/or as modeled in the analysis. It is assumed to be complete and accurate. All antennas, mounts, coax, and waveguides are assumed to be properly installed and supported per manufacturer requirements.
3. Some assumptions are made regarding antennas and mount sizes and their projected areas based on best interpretation of data supplied and of best knowledge of antenna type and industry practice.
4. All mounts, if applicable, are considered adequate to support the loading. No actual analysis of the mount(s) is performed. This analysis is limited to analyzing the tower only.
5. Foundations are properly designed and constructed to resist the original design loads indicated in the documents provided.
6. The tower and structures have been properly maintained in accordance with TIA Standards and/or with manufacturer's specifications.
7. All welds and connections are assumed to develop at least the member capacity unless determined otherwise and explicitly stated in this report.
8. All prior structural modifications are assumed to be as per data supplied / available and to have been properly installed.

If any of these assumptions are not valid or have been made in error, this analysis may be affected, and Dewberry Engineers, Inc. should be allowed to review any new information to determine its effect on the structural integrity of the tower.

7.0 DISCLAIMER OF WARRANTIES

The engineering services rendered by Dewberry Engineers, Inc. in connection with this Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. All tower components have been assumed to only resist dead loads when no other loads are applied. 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. Dewberry Engineers, Inc. does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information need to perform a thorough analysis of every structural sub-component and connection of an existing tower. Dewberry Engineers, Inc. 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 calculate the structural integrity for the existing tower under existing and proposed loadings.

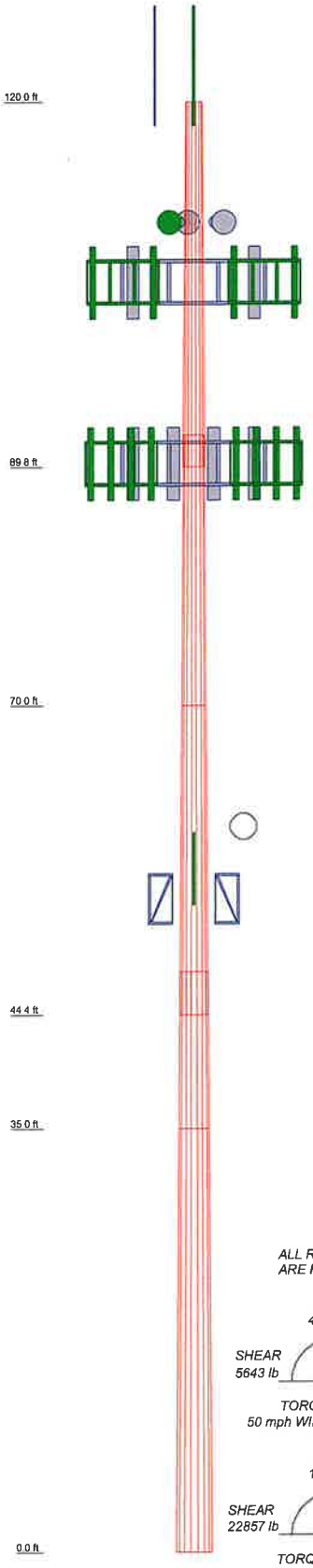
If the amount of ice accumulation is in excess of the specified code recommended amount, that should be considered in the structural analysis.

Dewberry Engineers, Inc. makes no warranties, expresses, and/or implied in connection with this report and disclaims any liability arising from material, fabrication, and erection of this tower. Dewberry 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 Dewberry pursuant to this report will be limited to the total fee received for preparation of this report.

APPENDIX A

Section	1	2	3	4	5
Length (ft)	30.25	22.42	25.58	13.00	35.00
Number of Sides	18	18	18	18	18
Thickness (in)	0.1880	0.1880	0.2750	0.2750	0.3640
Socket Length (ft)	2.67		3.58		
Top Dia (in)	16.0000	20.4443	24.3628	27.6579	29.9300
Bot Dia (in)	21.2870	24.3628	28.8342	29.9300	36.0472
Grade	A572-65				
Weight (lb)	1133.6	1011.3	2000.2	1101.2	4489.1

Total: 9735.3



ALL REACTIONS ARE FACTORED

AXIAL 43892 lb
SHEAR 5643 lb
MOMENT 474975 lb-ft
TORQUE 871 lb-ft
50 mph WIND - 1.0000 in ICE

AXIAL 19766 lb
SHEAR 22857 lb
MOMENT 1759651 lb-ft
TORQUE 4230 lb-ft
REACTIONS - 97 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
DB809K-XC	117	(2) SBNHH-1D65B SBS-1-2	90
DB809K-XC	117	B2/B66A RRH	90
6' Long 2-3/8" Mast Pipe	110	B5/B13 RRH	90
6' Long 2-3/8" Mast Pipe	110	BXA-80063-6CF w/ mast pipe	90
6' Long 2-3/8" Mast Pipe	110	4' T-Arm (7' Face)	90
2' Diameter Dish w/o Radome	110	BXA-80063-6CF w/ mast pipe	90
2' Diameter Dish w/o Radome	110	(2) SBNHH-1D65B SBS-1-2	90
2' Diameter Dish w/o Radome	110	B2/B66A RRH	90
1' Dish w/o Radome	110	B5/B13 RRH	90
1' Dish w/o Radome	110	BXA-80063-6CF w/ mast pipe	90
Ericsson Air 21 B2A w/ mast pipe	105	4' T-Arm (7' Face)	90
4' T-Arm (7' Face)	105	BXA-80063-6CF w/ mast pipe	90
Ericsson Air 21 B2A w/ mast pipe	105	(2) SBNHH-1D65B SBS-1-2	90
Ericsson Air 21 B2A w/ mast pipe	105	B2/B66A RRH	90
4' T-Arm (7' Face)	105	B5/B13 RRH	90
Ericsson Air 21 B2A w/ mast pipe	105	DB404 4-bay Dipole	54
Ericsson Air 21 B2A w/ mast pipe	105	Pirod 4' Side Mount Standoff	54
4' T-Arm (7' Face)	105	5' Omni	54
Ericsson Air 21 B2A w/ mast pipe	105	Pirod 4' Side Mount Standoff	54
BXA-80063-6CF w/ mast pipe	90	PD1142-1	54
12' OVP	90	DB583	54
4' T-Arm (7' Face)	90	Pirod 4' Side Mount Standoff	54
BXA-80063-6CF w/ mast pipe	90	DB583	54

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-G Standard.
2. Tower designed for a 97 mph basic wind in accordance with the TIA-222-G Standard.
3. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 88.1%

Dewberry Engineers, Inc.
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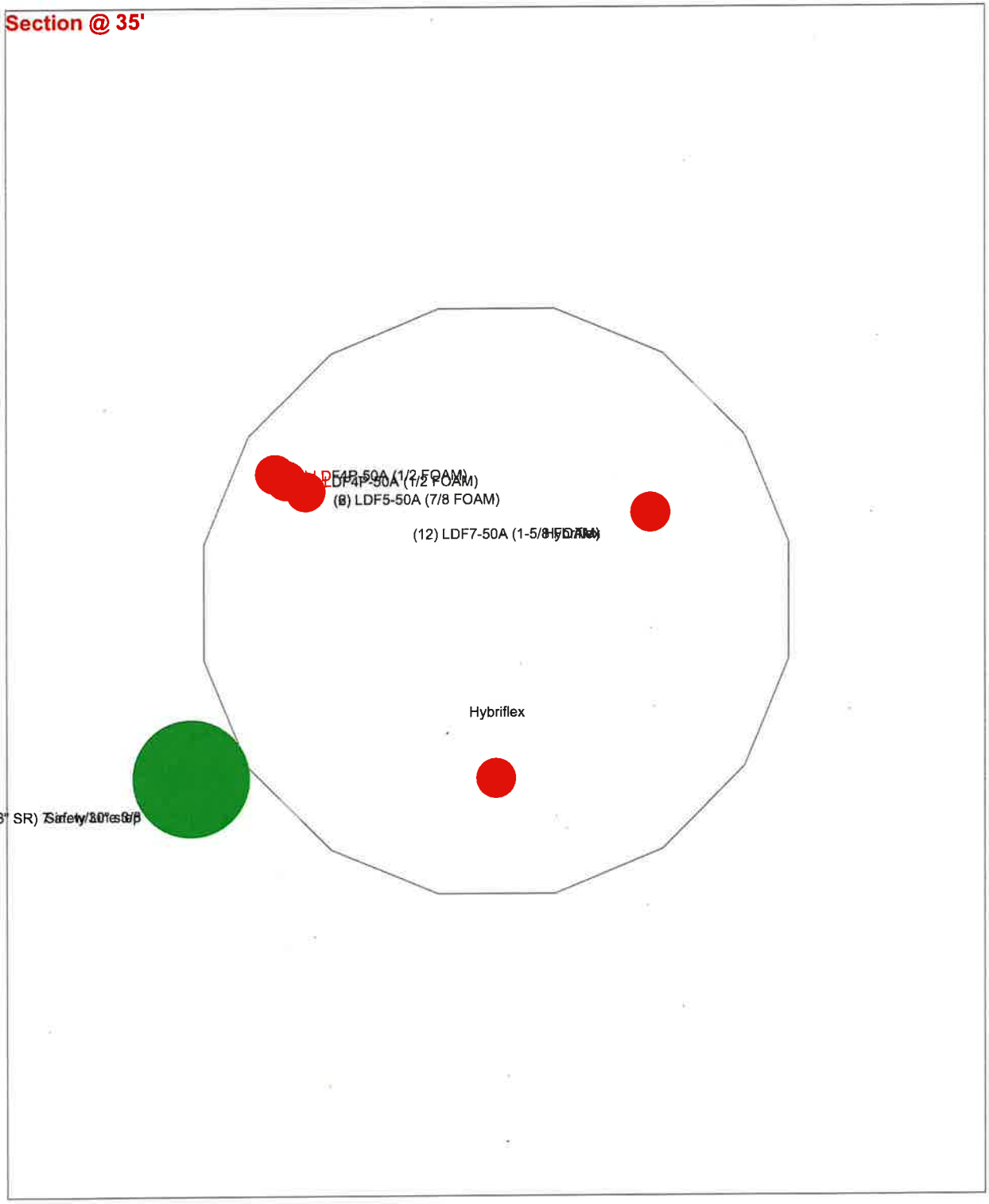
FAX: (617) 695.3310

Job: Hartford 9 CT			
Project: 50002925 / 50114613			
Client: VZW	Drawn by: jdecelle	App'd:	
Code: TIA-222-G	Date: 08/08/19	Scale: NTS	
Path:		Dwg No E-1	

Feed Line Plan
35'

Round Flat App In Face App Out Face



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Job: *Hartford 9 CT*			
Project: *50002925 / 50114613*			
Client: VZW	Drawn by: jdecelle	App'd:	
Code: TIA-222-G	Date: 08/08/19	Scale: NTS	
Path:		Dwg No. E-7	

Tower Input Data

The tower is a monopole.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

ASCE 7-10 Wind Data is used (wind speeds converted to nominal values).
Basic wind speed of 97 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 1.0000 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.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Tapered Pole Section Geometry

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	120.00-89.75	30.25	2.67	18	16.0000	21.2870	0.1880	0.7520	A572-65 (65 ksi)
L2	89.75-70.00	22.42	0.00	18	20.4443	24.3628	0.1880	0.7520	A572-65 (65 ksi)
L3	70.00-44.42	25.58	3.58	18	24.3628	28.8342	0.2750	1.1000	A572-65 (65 ksi)
L4	44.42-35.00	13.00	0.00	18	27.6579	29.9300	0.2750	1.1000	A572-65 (65 ksi)
L5	35.00-0.00	35.00		18	29.9300	36.0472	0.3640	1.4560	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	16.2178	9.4352	298.0318	5.6133	8.1280	36.6673	596.4558	4.7185	2.4851	13.219
	21.5864	12.5900	708.0890	7.4901	10.8138	65.4802	1417.1097	6.2962	3.4156	18.168
L2	21.2046	12.0872	626.5930	7.1910	10.3857	60.3321	1254.0105	6.0448	3.2673	17.379
	24.7097	14.4254	1065.1069	8.5821	12.3763	86.0600	2131.6153	7.2141	3.9570	21.048
L3	24.6963	21.0251	1541.2419	8.5512	12.3763	124.5315	3084.5118	10.5145	3.8039	13.832
	29.2365	24.9279	2568.6995	10.1385	14.6478	175.3648	5140.7791	12.4663	4.5908	16.694
L4	28.6781	23.9012	2264.2116	9.7209	14.0502	161.1512	4531.4024	11.9529	4.3838	15.941

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
	30.3493	25.8844	2875.8902	10.5275	15.2045	189.1478	5755.5646	12.9447	4.7837	17.395
L5	30.3356	34.1587	3772.4625	10.4959	15.2045	248.1156	7549.8888	17.0826	4.6270	12.712
	36.5472	41.2261	6631.9001	12.6675	18.3120	362.1616	13272.5267	20.6170	5.7037	15.669

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
L1 120.00-89.75				1	1	1			
L2 89.75-70.00				1	1	1			
L3 70.00-44.42				1	1	1			
L4 44.42-35.00				1	1	1			
L5 35.00-0.00				1	1	1			

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#		C_AA_A ft^2/ft	Weight plf
LDF4P-50A (1/2 FOAM)	A	No	No	Inside Pole	110.00 - 4.00	0.0000	0	2	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.15 0.15 0.15
LDF4P-50A (1/2 FOAM)	A	No	No	Inside Pole	55.00 - 4.00	0.0000	0	5	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.15 0.15 0.15
**********											
Hybriflex	C	No	No	Inside Pole	105.00 - 7.00	0.0000	0	1	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
**********											
Hybriflex	B	No	No	Inside Pole	90.00 - 4.00	0.0000	0	1	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
LDF7-50A (1-5/8 FOAM)	B	No	No	Inside Pole	90.00 - 4.00	0.0000	0	12	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.82 0.82 0.82
**********											
Safety Line 3/8	C	No	No	CaAa (Out Of Face)	120.00 - 4.00	4.0000	0	1	No Ice 1/2" Ice 1" Ice	0.04 0.14 0.24	0.22 0.75 1.28
Step Pegs (5/8" SR) 7-in.	C	No	No	CaAa (Out Of Face)	120.00 - 12.00	4.0000	0	2	No Ice	0.30 0.14	0.49 1.01

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#		C_AA_A ft^2/ft	Weight plf
w/30" step									1/2" Ice 1" Ice	0.23	1.53
**********											
LDF5-50A (7/8 FOAM)	A	No	No	Inside Pole	117.00 - 4.00	0.0000	0	2	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.33 0.33 0.33
LDF5-50A (7/8 FOAM)	A	No	No	Inside Pole	110.00 - 4.00	0.0000	0	6	No Ice 1/2" Ice 1" Ice	0.00 0.00 0.00	0.33 0.33 0.33

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	120.00-89.75	A	0.000	0.000	0.000	0.000	64.16
		B	0.000	0.000	0.000	0.000	2.67
		C	0.000	0.000	0.000	19.284	48.81
L2	89.75-70.00	A	0.000	0.000	0.000	0.000	58.06
		B	0.000	0.000	0.000	0.000	210.54
		C	0.000	0.000	0.000	12.591	39.90
L3	70.00-44.42	A	0.000	0.000	0.000	0.000	83.15
		B	0.000	0.000	0.000	0.000	272.71
		C	0.000	0.000	0.000	16.309	51.68
L4	44.42-35.00	A	0.000	0.000	0.000	0.000	34.75
		B	0.000	0.000	0.000	0.000	100.39
		C	0.000	0.000	0.000	6.003	19.02
L5	35.00-0.00	A	0.000	0.000	0.000	0.000	114.39
		B	0.000	0.000	0.000	0.000	330.46
		C	0.000	0.000	0.000	14.963	52.32

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	120.00-89.75	A	2.244	0.000	0.000	0.000	0.000	64.16
		B		0.000	0.000	0.000	0.000	2.67
		C		0.000	0.000	0.000	14.710	261.94
L2	89.75-70.00	A	2.184	0.000	0.000	0.000	0.000	58.06
		B		0.000	0.000	0.000	0.000	210.54
		C		0.000	0.000	0.000	9.604	179.05
L3	70.00-44.42	A	2.112	0.000	0.000	0.000	0.000	83.15
		B		0.000	0.000	0.000	0.000	272.71
		C		0.000	0.000	0.000	11.764	221.32
L4	44.42-35.00	A	2.037	0.000	0.000	0.000	0.000	34.75
		B		0.000	0.000	0.000	0.000	100.39
		C		0.000	0.000	0.000	4.330	81.47
L5	35.00-0.00	A	1.877	0.000	0.000	0.000	0.000	114.39

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
		B		0.000	0.000	0.000	0.000	330.46
		C		0.000	0.000	0.000	14.103	203.77

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	120.00-89.75	-2.0360	1.1755	-1.3895	0.8022
L2	89.75-70.00	-2.1304	1.2300	-1.4753	0.8518
L3	70.00-44.42	-2.2022	1.2714	-1.4799	0.8544
L4	44.42-35.00	-2.2388	1.2926	-1.5119	0.8729
L5	35.00-0.00	-2.4779	1.4306	-1.3787	0.7960

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_a No Ice	K_a Ice

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight lb
DB809K-XC	A	From Face	3.00 0.00 6.00	0.0000	117.00	No Ice 1/2" Ice 1" Ice	3.66 4.91 6.18	3.66 4.91 6.18	30.00 56.00 91.00
DB809K-XC	C	From Face	3.00 0.00 6.00	0.0000	117.00	No Ice 1/2" Ice 1" Ice	3.66 4.91 6.18	3.66 4.91 6.18	30.00 56.00 91.00
6' Long 2-3/8" Mast Pipe	A	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67
6' Long 2-3/8" Mast Pipe	B	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67
6' Long 2-3/8" Mast Pipe	C	None		0.0000	110.00	No Ice 1/2" Ice 1" Ice	1.43 1.92 2.29	1.43 1.92 2.29	21.96 32.79 47.67
**********									
4' T-Arm (7' Face)	A	From Face	2.00 0.00	0.0000	105.00	No Ice 1/2" Ice	5.00 8.00	5.00 8.00	500.00 750.00

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
			0.00			1" Ice	11.00	11.00	1000.00
Ericsson Air 21 B2A w/ mast pipe	A	From Face	4.00 -3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
Ericsson Air 21 B2A w/ mast pipe	A	From Face	4.00 3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
4' T-Arm (7' Face)	B	From Face	2.00 0.00 0.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	5.00 8.00 11.00	5.00 8.00 11.00	500.00 750.00 1000.00
Ericsson Air 21 B2A w/ mast pipe	B	From Face	4.00 -3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
Ericsson Air 21 B2A w/ mast pipe	B	From Face	4.00 3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
4' T-Arm (7' Face)	C	From Face	2.00 0.00 0.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	5.00 8.00 11.00	5.00 8.00 11.00	500.00 750.00 1000.00
Ericsson Air 21 B2A w/ mast pipe	C	From Face	4.00 -3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
Ericsson Air 21 B2A w/ mast pipe	C	From Face	4.00 3.50 1.00	0.0000	105.00	No Ice 1/2" Ice 1" Ice	6.26 6.74 7.20	5.64 6.49 7.21	104.90 161.79 225.40
**********									
4' T-Arm (7' Face)	A	From Face	2.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	5.00 8.00 11.00	5.00 8.00 11.00	500.00 750.00 1000.00
BXA-80063-6CF w/ mast pipe	A	From Face	4.00 -3.50 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	7.60 8.05 8.51	5.19 6.12 6.93	36.80 93.34 157.38
(2) SBNHH-1D65B SBS-1-2	A	From Face	4.00 -1.25 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	14.76 15.28 15.81	6.85 7.81 8.64	128.50 226.26 332.62
B2/B66A RRH	A	From Face	4.00 1.25 2.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	1.88 2.05 2.22	1.25 1.39 1.54	97.50 115.84 136.97
B5/B13 RRH	A	From Face	4.00 1.25 -2.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	1.88 2.05 2.22	1.01 1.14 1.28	82.00 98.43 117.53
BXA-80063-6CF w/ mast pipe	A	From Face	4.00 3.50 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	7.60 8.05 8.51	5.19 6.12 6.93	36.80 93.34 157.38
12 OVP	A	From Face	0.50 0.00 2.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	4.06 4.32 4.58	3.10 3.34 3.58	32.00 68.49 108.97
4' T-Arm (7' Face)	B	From Face	2.00 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	5.00 8.00 11.00	5.00 8.00 11.00	500.00 750.00 1000.00
BXA-80063-6CF w/ mast pipe	B	From Face	4.00 -3.50 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	7.60 8.05 8.51	5.19 6.12 6.93	36.80 93.34 157.38
(2) SBNHH-1D65B SBS-1-2	B	From Face	4.00 -1.25 0.00	0.0000	90.00	No Ice 1/2" Ice 1" Ice	14.76 15.28 15.81	6.85 7.81 8.64	128.50 226.26 332.62
B2/B66A RRH	B	From Face	4.00	0.0000	90.00	No Ice	1.88	1.25	97.50

tnxTower	Job: Hartford 9 CT	Page: 6 of 22
Dewberry Engineers, Inc. 99 Summer Street, Suite 700 Boston, MA 02110-1200 Phone: (617) 695.3400 FAX: (617) 695.3310	Project: 50002925 / 50114613	Date: 12:46:23 08/08/19
	Client: VZW	Designed by: jdecelle

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft	Offsets: Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
			1.25				1/2" Ice	2.05	1.39	115.84
			2.00				1" Ice	2.22	1.54	136.97
B5/B13 RRH	B	From Face	4.00	0.0000		90.00	No Ice	1.88	1.01	82.00
			1.25				1/2" Ice	2.05	1.14	98.43
			-2.00				1" Ice	2.22	1.28	117.53
BXA-80063-6CF w/ mast pipe	B	From Face	4.00	0.0000		90.00	No Ice	7.60	5.19	36.80
			3.50				1/2" Ice	8.05	6.12	93.34
			0.00				1" Ice	8.51	6.93	157.38
4' T-Arm (7' Face)	C	From Face	2.00	0.0000		90.00	No Ice	5.00	5.00	500.00
			0.00				1/2" Ice	8.00	8.00	750.00
			0.00				1" Ice	11.00	11.00	1000.00
BXA-80063-6CF w/ mast pipe	C	From Face	4.00	0.0000		90.00	No Ice	7.60	5.19	36.80
			-3.50				1/2" Ice	8.05	6.12	93.34
			0.00				1" Ice	8.51	6.93	157.38
(2) SBNHH-1D65B SBS-1-2	C	From Face	4.00	0.0000		90.00	No Ice	14.76	6.85	128.50
			-1.25				1/2" Ice	15.28	7.81	226.26
			0.00				1" Ice	15.81	8.64	332.62
B2/B66A RRH	C	From Face	4.00	0.0000		90.00	No Ice	1.88	1.25	97.50
			1.25				1/2" Ice	2.05	1.39	115.84
			2.00				1" Ice	2.22	1.54	136.97
B5/B13 RRH	C	From Face	4.00	0.0000		90.00	No Ice	1.88	1.01	82.00
			1.25				1/2" Ice	2.05	1.14	98.43
			-2.00				1" Ice	2.22	1.28	117.53
BXA-80063-6CF w/ mast pipe	C	From Face	4.00	0.0000		90.00	No Ice	7.60	5.19	36.80
			3.50				1/2" Ice	8.05	6.12	93.34
			0.00				1" Ice	8.51	6.93	157.38
**********										
Pirod 4' Side Mount Standoff	A	From Face	2.00	0.0000		54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
PD1142-1	A	From Face	4.00	0.0000		54.00	No Ice	1.32	1.32	10.00
			0.00				1/2" Ice	3.21	3.21	24.00
			9.00				1" Ice	5.12	5.12	49.00
DB583	A	From Face	4.00	0.0000		54.00	No Ice	0.54	0.54	6.20
			0.00				1/2" Ice	0.71	0.71	12.00
			-2.00				1" Ice	0.89	0.89	19.00
Pirod 4' Side Mount Standoff	B	From Face	2.00	0.0000		54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
DB583	B	From Face	4.00	0.0000		54.00	No Ice	0.54	0.54	6.20
			0.00				1/2" Ice	0.71	0.71	12.00
			-2.00				1" Ice	0.89	0.89	19.00
DB404 4-bay Dipole	B	From Face	4.00	0.0000		54.00	No Ice	1.14	1.14	14.00
			0.00				1/2" Ice	2.05	2.05	18.20
			2.50				1" Ice	2.96	2.96	22.40
Pirod 4' Side Mount Standoff	C	From Face	2.00	0.0000		54.00	No Ice	2.72	2.72	50.00
			0.00				1/2" Ice	4.91	4.91	89.00
			0.00				1" Ice	7.10	7.10	128.00
5' Omni	C	From Face	4.00	0.0000		54.00	No Ice	1.58	1.58	10.00
			0.00				1/2" Ice	2.40	2.40	20.00
			2.50				1" Ice	3.22	3.22	30.00

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft²	Weight lb
2' Diameter Dish w/o Radome	C	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
2' Diameter Dish w/o Radome	A	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
2' Diameter Dish w/o Radome	B	Paraboloid w/o Radome	From Face	1.00 2.00 0.00	0.0000		110.00	2.00	No Ice 1/2" Ice 1" Ice	3.14 3.41 3.68	35.00 52.50 70.01
1' Dish w/o Radome	A	Paraboloid w/o Radome	From Face	1.00 0.50 0.00	0.0000		110.00	1.00	No Ice 1/2" Ice 1" Ice	0.79 0.92 1.06	10.00 20.00 30.00
1' Dish w/o Radome	B	Paraboloid w/o Radome	From Face	1.00 0.50 0.00	0.0000		110.00	1.00	No Ice 1/2" Ice 1" Ice	0.79 0.92 1.06	10.00 20.00 30.00

Tower Pressures - No Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg % %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-89.75	104.27	1.277	29	47.649	A	0.000	47.649	47.649	100.00	0.000	0.000
					B	0.000	47.649		100.00	0.000	0.000
					C	0.000	47.649		100.00	0.000	19.284
L2 89.75-70.00	79.62	1.206	28	37.784	A	0.000	37.784	37.784	100.00	0.000	0.000
					B	0.000	37.784		100.00	0.000	0.000
					C	0.000	37.784		100.00	0.000	12.591
L3 70.00-44.42	56.85	1.124	26	57.490	A	0.000	57.490	57.490	100.00	0.000	0.000
					B	0.000	57.490		100.00	0.000	0.000
					C	0.000	57.490		100.00	0.000	16.309
L4 44.42-35.00	39.66	1.042	25	23.161	A	0.000	23.161	23.161	100.00	0.000	0.000
					B	0.000	23.161		100.00	0.000	0.000
					C	0.000	23.161		100.00	0.000	6.003
L5 35.00-0.00	17.46	0.876	22	97.537	A	0.000	97.537	97.537	100.00	0.000	0.000
					B	0.000	97.537		100.00	0.000	0.000
					C	0.000	97.537		100.00	0.000	14.963

Tower Pressure - With Ice

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg % %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-89.75	104.27	1.277	8	2.2439	58.962	A	0.000	58.962	58.962	100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
						B	0.000	58.962		100.00	0.000	0.000
						C	0.000	58.962		100.00	0.000	14.710
L2 89.75-70.00	79.62	1.206	7	2.1842	45.170	A	0.000	45.170	45.170	100.00	0.000	0.000
						B	0.000	45.170		100.00	0.000	0.000
						C	0.000	45.170		100.00	0.000	9.604
L3 70.00-44.42	56.85	1.124	7	2.1118	66.494	A	0.000	66.494	66.494	100.00	0.000	0.000
						B	0.000	66.494		100.00	0.000	0.000
						C	0.000	66.494		100.00	0.000	11.764
L4 44.42-35.00	39.66	1.042	7	2.0371	26.475	A	0.000	26.475	26.475	100.00	0.000	0.000
						B	0.000	26.475		100.00	0.000	0.000
						C	0.000	26.475		100.00	0.000	4.330
L5 35.00-0.00	17.46	0.876	6	1.8767	108.485	A	0.000	108.485	108.485	100.00	0.000	0.000
						B	0.000	108.485		100.00	0.000	0.000
						C	0.000	108.485		100.00	0.000	14.103

Tower Pressure - Service

$G_H = 1.100$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	104.27	1.277	10	47.649	A	0.000	47.649	47.649	100.00	0.000	0.000
120.00-89.75					B	0.000	47.649		100.00	0.000	0.000
					C	0.000	47.649		100.00	0.000	19.284
L2 89.75-70.00	79.62	1.206	9	37.784	A	0.000	37.784	37.784	100.00	0.000	0.000
					B	0.000	37.784		100.00	0.000	0.000
					C	0.000	37.784		100.00	0.000	12.591
L3 70.00-44.42	56.85	1.124	9	57.490	A	0.000	57.490	57.490	100.00	0.000	0.000
					B	0.000	57.490		100.00	0.000	0.000
					C	0.000	57.490		100.00	0.000	16.309
L4 44.42-35.00	39.66	1.042	9	23.161	A	0.000	23.161	23.161	100.00	0.000	0.000
					B	0.000	23.161		100.00	0.000	0.000
					C	0.000	23.161		100.00	0.000	6.003
L5 35.00-0.00	17.46	0.876	7	97.537	A	0.000	97.537	97.537	100.00	0.000	0.000
					B	0.000	97.537		100.00	0.000	0.000
					C	0.000	97.537		100.00	0.000	14.963

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	26	1	1	57.490	2412.70	94.31	C

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	25	1	1	23.161	930.50	98.81	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	22	1	1	97.537	1988.90	56.83	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	604938.10 lb-ft	9546.95		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	26	1	1	57.490	2412.70	94.31	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	25	1	1	23.161	930.50	98.81	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	22	1	1	97.537	1988.90	56.83	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	604938.10 lb-ft	9546.95		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	29	1	1	47.649	2455.80	81.18	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	28	1	1	37.784	1759.06	89.07	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	26	1	1	57.490	2412.70	94.31	C
70.00-44.42			B	1	1.2		1	1	57.490			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	25	1	1	23.161	930.50	98.81	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	22	1	1	97.537	1988.90	56.83	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	604938.10 lb-ft	9546.95		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.76	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	447.65	2332.94	A	1	1.2	7	1	1	45.170	514.80	26.07	C
89.75-70.00			B	1	1.2		1	1	45.170			
			C	1	1.2		1	1	45.170			
L3	577.19	3914.76	A	1	1.2	7	1	1	66.494	688.11	26.90	C
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			
L4	216.60	1838.63	A	1	1.2	7	1	1	26.475	264.09	28.04	C
44.42-35.00			B	1	1.2		1	1	26.475			
			C	1	1.2		1	1	26.475			
L5 35.00-0.00	648.62	7315.80	A	1	1.2	6	1	1	108.485	911.45	26.04	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2218.81	18285.71						OTM	182549.48 lb-ft	3107.77		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.76	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	447.65	2332.94	A	1	1.2	7	1	1	45.170	514.80	26.07	C
89.75-70.00			B	1	1.2		1	1	45.170			
			C	1	1.2		1	1	45.170			
L3	577.19	3914.76	A	1	1.2	7	1	1	66.494	688.11	26.90	C
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L4	216.60	1838.63	A	1	1.2	7	1	1	26.475	264.09	28.04	C
44.42-35.00			B	1	1.2		1	1	26.475			
			C	1	1.2		1	1	26.475			
L5 35.00-0.00	648.62	7315.80	A	1	1.2	6	1	1	108.485	911.45	26.04	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2218.81	18285.71						OTM	182549.48 lb-ft	3107.77		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	328.76	2883.58	A	1	1.2	8	1	1	58.962	729.32	24.11	C
120.00-89.75			B	1	1.2		1	1	58.962			
			C	1	1.2		1	1	58.962			
L2	447.65	2332.94	A	1	1.2	7	1	1	45.170	514.80	26.07	C
89.75-70.00			B	1	1.2		1	1	45.170			
			C	1	1.2		1	1	45.170			
L3	577.19	3914.76	A	1	1.2	7	1	1	66.494	688.11	26.90	C
70.00-44.42			B	1	1.2		1	1	66.494			
			C	1	1.2		1	1	66.494			
L4	216.60	1838.63	A	1	1.2	7	1	1	26.475	264.09	28.04	C
44.42-35.00			B	1	1.2		1	1	26.475			
			C	1	1.2		1	1	26.475			
L5 35.00-0.00	648.62	7315.80	A	1	1.2	6	1	1	108.485	911.45	26.04	C
			B	1	1.2		1	1	108.485			
			C	1	1.2		1	1	108.485			
Sum Weight:	2218.81	18285.71						OTM	182549.48 lb-ft	3107.77		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	9	1	1	57.490	825.96	32.29	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	9	1	1	23.161	318.54	33.83	C

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	7	1	1	97.537	680.88	19.45	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	207092.94 lb-ft	3268.28		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	9	1	1	57.490	825.96	32.29	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	9	1	1	23.161	318.54	33.83	C
44.42-35.00			B	1	1.2		1	1	23.161			
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	7	1	1	97.537	680.88	19.45	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	207092.94 lb-ft	3268.28		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	115.63	1133.58	A	1	1.2	10	1	1	47.649	840.71	27.79	C
120.00-89.75			B	1	1.2		1	1	47.649			
			C	1	1.2		1	1	47.649			
L2	308.50	1011.33	A	1	1.2	9	1	1	37.784	602.19	30.49	C
89.75-70.00			B	1	1.2		1	1	37.784			
			C	1	1.2		1	1	37.784			
L3	407.54	2000.18	A	1	1.2	9	1	1	57.490	825.96	32.29	C
70.00-44.42			B	1	1.2		1	1	57.490			
			C	1	1.2		1	1	57.490			
L4	154.16	1101.17	A	1	1.2	9	1	1	23.161	318.54	33.83	C
44.42-35.00			B	1	1.2		1	1	23.161			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
			C	1	1.2		1	1	23.161			
L5 35.00-0.00	497.17	4489.08	A	1	0.704	7	1	1	97.537	680.88	19.45	C
			B	1	0.704		1	1	97.537			
			C	1	0.704		1	1	97.537			
Sum Weight:	1482.99	9735.34						OTM	207092.94 lb-ft	3268.28		

Force Totals

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Leg Weight	9735.34					
Bracing Weight	0.00					
Total Member Self-Weight	9735.34			42.47	230.56	
Total Weight	16471.81			42.47	230.56	
Wind 0 deg - No Ice		-10.40	-14213.07	-1051871.83	1187.02	-2377.07
Wind 30 deg - No Ice		7022.73	-12318.54	-912098.49	-516562.24	-1530.87
Wind 60 deg - No Ice		12378.09	-7095.75	-524891.04	-918274.15	-596.47
Wind 90 deg - No Ice		14222.88	108.16	11752.62	-1052547.52	988.18
Wind 120 deg - No Ice		12347.22	7123.71	527727.13	-914691.06	1968.16
Wind 150 deg - No Ice		7199.75	12250.93	904559.69	-535710.58	2328.96
Wind 180 deg - No Ice		10.40	14267.09	1057899.09	-725.89	1758.85
Wind 210 deg - No Ice		-7181.74	12240.54	903603.24	534515.08	1229.71
Wind 240 deg - No Ice		-12336.82	7105.70	526070.50	914195.73	2.67
Wind 270 deg - No Ice		-14222.88	87.36	9839.72	1053008.64	-1322.39
Wind 300 deg - No Ice		-12388.49	-7113.76	-526547.66	919691.73	-2592.95
Wind 330 deg - No Ice		-7040.74	-12328.93	-913054.94	518679.99	-2675.55
Member Ice	8550.37					
Total Weight Ice	40138.08			321.50	1671.54	
Wind 0 deg - Ice		-3.04	-5615.04	-416939.76	1951.13	-835.00
Wind 30 deg - Ice		2776.95	-4866.58	-361483.46	-203612.49	-622.90
Wind 60 deg - Ice		4891.49	-2802.35	-207787.85	-362819.65	-364.86
Wind 90 deg - Ice		5620.26	41.00	4776.89	-416100.05	172.56
Wind 120 deg - Ice		4878.04	2814.00	209617.77	-361285.31	538.08
Wind 150 deg - Ice		2843.11	4840.96	359253.94	-210795.23	725.36
Wind 180 deg - Ice		3.04	5637.08	420007.24	1391.96	604.44
Wind 210 deg - Ice		-2837.85	4837.92	358974.36	213654.06	513.46
Wind 240 deg - Ice		-4875.00	2808.74	209133.51	364348.81	145.81
Wind 270 deg - Ice		-5620.26	34.92	4217.72	419443.13	-297.56
Wind 300 deg - Ice		-4894.53	-2807.62	-208272.11	366442.32	-771.73
Wind 330 deg - Ice		-2782.22	-4869.62	-361763.04	207439.83	-856.20
Total Weight	16471.81			42.47	230.56	
Wind 0 deg - Service		-3.56	-4865.66	-360135.92	438.87	-813.76
Wind 30 deg - Service		2404.14	-4217.10	-312286.27	-176806.07	-524.07
Wind 60 deg - Service		4237.48	-2429.14	-179730.68	-314327.08	-204.19
Wind 90 deg - Service		4869.02	37.03	3982.51	-360293.87	338.29
Wind 120 deg - Service		4226.91	2438.71	180619.89	-313100.45	673.77
Wind 150 deg - Service		2464.74	4193.95	309623.77	-183361.26	797.29
Wind 180 deg - Service		3.56	4884.16	362117.58	-215.99	602.12
Wind 210 deg - Service		-2458.58	4190.39	309296.34	183017.02	420.97
Wind 240 deg - Service		-4223.36	2432.55	180052.76	312995.90	0.92
Wind 270 deg - Service		-4869.02	29.91	3327.66	360516.75	-452.70

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Wind 300 deg - Service		-4241.04	-2435.31	-180297.81	314877.39	-887.67
Wind 330 deg - Service		-2410.31	-4220.66	-312613.70	177596.07	-915.94

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 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

Comb. No.	Description
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial lb	Major Axis Moment lb-ft	Minor Axis Moment lb-ft
L1	120 - 89.75	Pole	Max Tension	33	0.00	-0.16	0.30
			Max. Compression	26	-16738.29	598.47	-18.19
			Max. Mx	20	-3335.10	104858.99	-2814.99
			Max. My	14	-3317.77	117.62	-106391.08
			Max. Vy	8	8150.88	-65019.19	-1723.06
			Max. Vx	14	8183.13	48.17	-66057.19
			Max. Torque	22			1944.20
L2	89.75 - 70	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-26474.11	1248.03	-234.99
			Max. Mx	20	-7772.46	386287.68	-6220.32
			Max. My	14	-7757.26	-191.81	-389426.69
			Max. Vy	20	-14588.94	386287.68	-6220.32
			Max. Vx	14	14663.89	-191.81	-389426.69
			Max. Torque	22			2493.85
L3	70 - 44.417	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-31622.04	1672.93	-189.84
			Max. Mx	20	-10665.13	745046.68	-9480.34
			Max. My	14	-10654.02	-553.96	-749786.29
			Max. Vy	20	-18249.95	745046.68	-9480.34
			Max. Vx	14	18324.35	-553.96	-749786.29
			Max. Torque	22			3065.78
L4	44.417 - 35	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-34930.00	1791.86	-253.69
			Max. Mx	20	-12842.02	995226.88	-11410.26
			Max. My	14	-12833.80	-757.47	-1000922.54
			Max. Vy	20	-20203.93	995226.88	-11410.26
			Max. Vx	14	20277.73	-757.47	-1000922.54
			Max. Torque	24			3480.95
L5	35 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-43891.70	2008.02	-378.80
			Max. Mx	20	-19739.95	1748414.51	-16444.92
			Max. My	14	-19739.75	-1319.49	-1756628.04
			Max. Vy	20	-22779.36	1748414.51	-16444.92
			Max. Vx	14	22850.19	-1319.49	-1756628.04
			Max. Torque	24			4229.63

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Pole	Max. Vert	37	43891.70	4894.56	2807.63
	Max. H_x	20	19766.17	22756.61	-139.78
	Max. H_z	2	19766.17	16.63	22740.90

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
	Max. M_x	2	1746641.15	16.63	22740.90
	Max. M_z	8	1747829.81	-22756.61	-173.05
	Max. Torsion	24	4229.58	11265.18	19726.29
	Min. Vert	23	14824.63	19821.58	11382.02
	Min. H_x	8	19766.17	-22756.61	-173.05
	Min. H_z	14	19766.17	-16.63	-22827.34
	Min. M_x	14	-1756628.03	-16.63	-22827.34
	Min. M_z	20	-1748414.51	22756.61	-139.78
	Min. Torsion	12	-3682.85	-11519.60	-19601.49

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
Dead Only	16471.81	0.00	0.00	42.47	230.56	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	19766.17	-16.63	-22740.90	-1746641.15	1849.36	-3759.25
0.9 Dead+1.6 Wind 0 deg - No Ice	14824.63	-16.63	-22740.90	-1729113.11	1765.11	-3757.90
1.2 Dead+1.6 Wind 30 deg - No Ice	19766.17	11236.37	-19709.66	-1514592.08	-857754.36	-2420.34
0.9 Dead+1.6 Wind 30 deg - No Ice	14824.63	11236.37	-19709.66	-1499390.03	-849242.23	-2419.10
1.2 Dead+1.6 Wind 60 deg - No Ice	19766.17	19804.95	-11353.21	-871542.85	-1524921.30	-934.71
0.9 Dead+1.6 Wind 60 deg - No Ice	14824.63	19804.95	-11353.21	-862809.25	-1509653.29	-934.42
1.2 Dead+1.6 Wind 90 deg - No Ice	19766.17	22756.61	173.05	19636.13	-1747829.81	1565.61
0.9 Dead+1.6 Wind 90 deg - No Ice	14824.63	22756.61	173.05	19386.23	-1730350.18	1565.47
1.2 Dead+1.6 Wind 120 deg - No Ice	19766.17	19755.55	11397.94	876239.21	-1518941.65	3112.56
0.9 Dead+1.6 Wind 120 deg - No Ice	14824.63	19755.55	11397.94	867428.18	-1503747.41	3111.81
1.2 Dead+1.6 Wind 150 deg - No Ice	19766.17	11519.60	19601.49	1501895.13	-889788.15	3682.85
0.9 Dead+1.6 Wind 150 deg - No Ice	14824.63	11519.60	19601.49	1486828.06	-880883.73	3681.57
1.2 Dead+1.6 Wind 180 deg - No Ice	19766.17	16.63	22827.34	1756628.03	-1320.44	2787.64
0.9 Dead+1.6 Wind 180 deg - No Ice	14824.63	16.63	22827.34	1738952.59	-1374.61	2785.66
1.2 Dead+1.6 Wind 210 deg - No Ice	19766.17	-11490.79	19584.86	1500340.59	887582.26	1949.03
0.9 Dead+1.6 Wind 210 deg - No Ice	14824.63	-11490.79	19584.86	1485283.25	878564.43	1947.51
1.2 Dead+1.6 Wind 240 deg - No Ice	19766.17	-19738.92	11369.13	873511.62	1517934.60	11.00
0.9 Dead+1.6 Wind 240 deg - No Ice	14824.63	-19738.92	11369.13	864723.62	1502606.67	9.95
1.2 Dead+1.6 Wind 270 deg - No Ice	19766.17	-22756.61	139.78	16444.21	1748414.51	-2083.53
0.9 Dead+1.6 Wind 270 deg - No Ice	14824.63	-22756.61	139.78	16230.42	1730781.35	-2083.91
1.2 Dead+1.6 Wind 300 deg -	19766.17	-19821.58	-11382.02	-874339.63	1527057.12	-4088.84

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	lb	lb	lb	lb-ft	lb-ft	lb-ft
No Ice 0.9 Dead+1.6 Wind 300 deg -	14824.63	-19821.58	-11382.02	-865564.14	1511626.66	-4088.82
No Ice 1.2 Dead+1.6 Wind 330 deg -	19766.17	-11265.18	-19726.29	-1516201.57	861034.68	-4229.58
No Ice 0.9 Dead+1.6 Wind 330 deg -	14824.63	-11265.18	-19726.29	-1500974.84	852354.74	-4228.58
No Ice 1.2 Dead+1.0 Ice+1.0 Temp	43891.70	-0.02	0.00	378.80	2008.02	-0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	43891.70	-3.04	-5615.08	-469585.89	2389.31	-850.54
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	43891.70	2776.97	-4866.60	-407138.38	-229046.36	-635.26
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	43891.70	4891.52	-2802.37	-233996.80	-408550.47	-370.71
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	43891.70	5620.29	41.00	5533.56	-468479.24	174.56
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	43891.70	4878.07	2814.02	236138.54	-406771.06	547.51
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	43891.70	2843.13	4840.99	404591.20	-237339.28	739.82
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	43891.70	3.04	5637.12	473168.44	1759.10	620.34
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	43891.70	-2837.87	4837.95	404279.26	240942.08	525.74
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	43891.70	-4875.03	2808.76	235594.18	410611.00	152.26
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	43891.70	-5620.29	34.92	4898.35	472638.02	-298.61
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	43891.70	-4894.56	-2807.63	-234554.85	413020.12	-780.54
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	43891.70	-2782.23	-4869.64	-407460.83	233742.99	-870.67
Dead+Wind 0 deg - Service	16471.81	-3.56	-4865.66	-372076.14	581.69	-815.39
Dead+Wind 30 deg - Service	16471.81	2404.14	-4217.10	-322635.39	-182551.69	-525.28
Dead+Wind 60 deg - Service	16471.81	4237.48	-2429.14	-185652.17	-324702.64	-204.57
Dead+Wind 90 deg - Service	16471.81	4869.03	37.03	4216.81	-372182.67	338.61
Dead+Wind 120 deg - Service	16471.81	4226.92	2438.71	186718.91	-323423.95	674.76
Dead+Wind 150 deg - Service	16471.81	2464.74	4193.95	320005.05	-189374.43	798.74
Dead+Wind 180 deg - Service	16471.81	3.56	4884.16	374283.42	-95.88	603.78
Dead+Wind 210 deg - Service	16471.81	-2458.58	4190.39	319667.05	189273.61	422.24
Dead+Wind 240 deg - Service	16471.81	-4223.36	2432.55	186132.57	323572.44	1.70
Dead+Wind 270 deg - Service	16471.81	-4869.03	29.91	3538.39	372670.59	-452.64
Dead+Wind 300 deg - Service	16471.81	-4241.04	-2435.31	-186241.16	325528.45	-888.41
Dead+Wind 330 deg - Service	16471.81	-2410.31	-4220.66	-322975.48	183624.73	-917.47

Solution Summary

Load Comb.	Sum of Applied Forces PX lb	PY lb	PZ lb	Sum of Reactions PX lb	PY lb	PZ lb	% Error
1	0.00	-16471.81	0.00	0.00	16471.81	0.00	0.000%
2	-16.63	-19766.17	-22740.90	16.63	19766.17	22740.90	0.000%
3	-16.63	-14824.63	-22740.90	16.63	14824.63	22740.90	0.000%
4	11236.37	-19766.17	-19709.66	-11236.37	19766.17	19709.66	0.000%
5	11236.37	-14824.63	-19709.66	-11236.37	14824.63	19709.66	0.000%
6	19804.95	-19766.17	-11353.21	-19804.95	19766.17	11353.21	0.000%
7	19804.95	-14824.63	-11353.21	-19804.95	14824.63	11353.21	0.000%
8	22756.61	-19766.17	173.05	-22756.61	19766.17	-173.05	0.000%

Load Comb.	Sum of Applied Forces PX lb	PY lb	PZ lb	Sum of Reactions PX lb	PY lb	PZ lb	% Error
9	22756.61	-14824.63	173.05	-22756.61	14824.63	-173.05	0.000%
10	19755.55	-19766.17	11397.94	-19755.55	19766.17	-11397.94	0.000%
11	19755.55	-14824.63	11397.94	-19755.55	14824.63	-11397.94	0.000%
12	11519.60	-19766.17	19601.49	-11519.60	19766.17	-19601.49	0.000%
13	11519.60	-14824.63	19601.49	-11519.60	14824.63	-19601.49	0.000%
14	16.63	-19766.17	22827.34	-16.63	19766.17	-22827.34	0.000%
15	16.63	-14824.63	22827.34	-16.63	14824.63	-22827.34	0.000%
16	-11490.79	-19766.17	19584.86	11490.79	19766.17	-19584.86	0.000%
17	-11490.79	-14824.63	19584.86	11490.79	14824.63	-19584.86	0.000%
18	-19738.92	-19766.17	11369.13	19738.92	19766.17	-11369.13	0.000%
19	-19738.92	-14824.63	11369.13	19738.92	14824.63	-11369.13	0.000%
20	-22756.61	-19766.17	139.78	22756.61	19766.17	-139.78	0.000%
21	-22756.61	-14824.63	139.78	22756.61	14824.63	-139.78	0.000%
22	-19821.58	-19766.17	-11382.02	19821.58	19766.17	11382.02	0.000%
23	-19821.58	-14824.63	-11382.02	19821.58	14824.63	11382.02	0.000%
24	-11265.18	-19766.17	-19726.29	11265.18	19766.17	19726.29	0.000%
25	-11265.18	-14824.63	-19726.29	11265.18	14824.63	19726.29	0.000%
26	0.00	-43891.70	0.00	0.02	43891.70	-0.00	0.000%
27	-3.04	-43891.70	-5615.04	3.04	43891.70	5615.08	0.000%
28	2776.95	-43891.70	-4866.58	-2776.97	43891.70	4866.60	0.000%
29	4891.49	-43891.70	-2802.35	-4891.52	43891.70	2802.37	0.000%
30	5620.26	-43891.70	41.00	-5620.29	43891.70	-41.00	0.000%
31	4878.04	-43891.70	2814.00	-4878.07	43891.70	-2814.02	0.000%
32	2843.11	-43891.70	4840.96	-2843.13	43891.70	-4840.99	0.000%
33	3.04	-43891.70	5637.08	-3.04	43891.70	-5637.12	0.000%
34	-2837.85	-43891.70	4837.92	2837.87	43891.70	-4837.95	0.000%
35	-4875.00	-43891.70	2808.74	4875.03	43891.70	-2808.76	0.000%
36	-5620.26	-43891.70	34.92	5620.29	43891.70	-34.92	0.000%
37	-4894.53	-43891.70	-2807.62	4894.56	43891.70	2807.63	0.000%
38	-2782.22	-43891.70	-4869.62	2782.23	43891.70	4869.64	0.000%
39	-3.56	-16471.81	-4865.66	3.56	16471.81	4865.66	0.000%
40	2404.14	-16471.81	-4217.10	-2404.14	16471.81	4217.10	0.000%
41	4237.48	-16471.81	-2429.14	-4237.48	16471.81	2429.14	0.000%
42	4869.02	-16471.81	37.03	-4869.03	16471.81	-37.03	0.000%
43	4226.91	-16471.81	2438.71	-4226.92	16471.81	-2438.71	0.000%
44	2464.74	-16471.81	4193.95	-2464.74	16471.81	-4193.95	0.000%
45	3.56	-16471.81	4884.16	-3.56	16471.81	-4884.16	0.000%
46	-2458.58	-16471.81	4190.39	2458.58	16471.81	-4190.39	0.000%
47	-4223.36	-16471.81	2432.55	4223.36	16471.81	-2432.55	0.000%
48	-4869.02	-16471.81	29.91	4869.03	16471.81	-29.91	0.000%
49	-4241.04	-16471.81	-2435.31	4241.04	16471.81	2435.31	0.000%
50	-2410.31	-16471.81	-4220.66	2410.31	16471.81	4220.66	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	5	0.00000001	0.00045359
3	Yes	5	0.00000001	0.00018529
4	Yes	6	0.00000001	0.00014294
5	Yes	6	0.00000001	0.00003692
6	Yes	6	0.00000001	0.00015855
7	Yes	6	0.00000001	0.00004153
8	Yes	5	0.00000001	0.00028257
9	Yes	5	0.00000001	0.00011405

10	Yes	6	0.00000001	0.00016461
11	Yes	6	0.00000001	0.00004350
12	Yes	6	0.00000001	0.00014239
13	Yes	6	0.00000001	0.00003612
14	Yes	5	0.00000001	0.00026646
15	Yes	5	0.00000001	0.00010853
16	Yes	6	0.00000001	0.00015972
17	Yes	6	0.00000001	0.00004191
18	Yes	6	0.00000001	0.00015325
19	Yes	6	0.00000001	0.00003985
20	Yes	5	0.00000001	0.00035413
21	Yes	5	0.00000001	0.00014354
22	Yes	6	0.00000001	0.00013946
23	Yes	6	0.00000001	0.00003517
24	Yes	6	0.00000001	0.00016988
25	Yes	6	0.00000001	0.00004559
26	Yes	4	0.00000001	0.00007801
27	Yes	6	0.00000001	0.00031579
28	Yes	6	0.00000001	0.00050502
29	Yes	6	0.00000001	0.00054183
30	Yes	6	0.00000001	0.00030311
31	Yes	6	0.00000001	0.00054818
32	Yes	6	0.00000001	0.00051901
33	Yes	6	0.00000001	0.00031129
34	Yes	6	0.00000001	0.00055495
35	Yes	6	0.00000001	0.00053914
36	Yes	6	0.00000001	0.00030948
37	Yes	6	0.00000001	0.00052704
38	Yes	6	0.00000001	0.00055970
39	Yes	4	0.00000001	0.00071944
40	Yes	5	0.00000001	0.00005725
41	Yes	5	0.00000001	0.00007371
42	Yes	4	0.00000001	0.00030902
43	Yes	5	0.00000001	0.00008202
44	Yes	5	0.00000001	0.00006008
45	Yes	4	0.00000001	0.00045192
46	Yes	5	0.00000001	0.00007552
47	Yes	5	0.00000001	0.00006735
48	Yes	4	0.00000001	0.00044430
49	Yes	5	0.00000001	0.00005988
50	Yes	5	0.00000001	0.00008932

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 89.75	24.510	49	1.6513	0.0113
L2	92.42 - 70	15.142	49	1.5451	0.0077
L3	70 - 44.417	8.597	49	1.1835	0.0047
L4	48 - 35	3.995	49	0.8013	0.0028
L5	35 - 0	2.088	49	0.5700	0.0018

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	DB809K-XC	49	23.465	1.6502	0.0153	35080
110.00	2' Diameter Dish w/o Radome	49	21.037	1.6434	0.0139	17540
105.00	4' T-Arm (7' Face)	49	19.323	1.6308	0.0128	11693
90.00	4' T-Arm (7' Face)	49	14.367	1.5166	0.0096	5561
54.00	Pirod 4' Side Mount Standoff	49	5.077	0.9055	0.0038	3520

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 89.75	114.676	22	7.7472	0.0540
L2	92.42 - 70	70.928	22	7.2534	0.0370
L3	70 - 44.417	40.312	22	5.5575	0.0222
L4	48 - 35	18.743	22	3.7623	0.0129
L5	35 - 0	9.799	22	2.6760	0.0085

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	DB809K-XC	22	109.799	7.7426	0.0700	7780
110.00	2' Diameter Dish w/o Radome	22	98.467	7.7120	0.0633	3888
105.00	4' T-Arm (7' Face)	22	90.460	7.6536	0.0585	2591
90.00	4' T-Arm (7' Face)	22	67.309	7.1198	0.0441	1226
54.00	Pirod 4' Side Mount Standoff	22	23.817	4.2519	0.0178	759

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	30.25	0.00	0.0	12.3116	-3315.85	892475.00	0.004
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	22.42	0.00	0.0	14.4254	-7751.55	995069.00	0.008
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	25.58	0.00	0.0	24.3813	-10649.70	1804540.00	0.006
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	13.00	0.00	0.0	25.8844	-12830.60	1885590.00	0.007
L5	35 - 0 (5)	TP36.0472x29.93x0.364	35.00	0.00	0.0	41.2261	-19739.70	3062890.00	0.006

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	106446.67	378179.17	0.281	0.00	378179.17	0.000
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	390245.83	494703.33	0.789	0.00	494703.33	0.000
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	751345.83	1034475.00	0.726	0.00	1034475.00	0.000
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	1002883.33	1148233.33	0.873	0.00	1148233.33	0.000
L5	35 - 0 (5)	TP36.0472x29.93x0.364	1759650.00	2242233.33	0.785	0.00	2242233.33	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	120 - 89.75 (1)	TP21.287x16x0.188	7240.98	446237.00	0.016	1944.20	758324.17	0.003
L2	89.75 - 70 (2)	TP24.3628x20.4443x0.188	14695.10	497535.00	0.030	2493.85	991783.33	0.003
L3	70 - 44.417 (3)	TP28.8342x24.3628x0.275	18355.40	902268.00	0.020	3065.78	2074550.00	0.001
L4	44.417 - 35 (4)	TP29.93x27.6579x0.275	20308.60	942795.00	0.022	3441.70	2302483.33	0.001
L5	35 - 0 (5)	TP36.0472x29.93x0.364	22880.00	1531450.00	0.015	4088.82	4496850.00	0.001

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	120 - 89.75 (1)	0.004	0.281	0.000	0.016	0.003	0.286 ✔	1.000	4.8.2 ✔
L2	89.75 - 70 (2)	0.008	0.789	0.000	0.030	0.003	0.798 ✔	1.000	4.8.2 ✔
L3	70 - 44.417 (3)	0.006	0.726	0.000	0.020	0.001	0.733 ✔	1.000	4.8.2 ✔
L4	44.417 - 35 (4)	0.007	0.873	0.000	0.022	0.001	0.881 ✔	1.000	4.8.2 ✔
L5	35 - 0 (5)	0.006	0.785	0.000	0.015	0.001	0.791 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	120 - 89.75	Pole	TP21.287x16x0.188	1	-3315.85	892475.00	28.6	Pass
L2	89.75 - 70	Pole	TP24.3628x20.4443x0.188	2	-7751.55	995069.00	79.8	Pass
L3	70 - 44.417	Pole	TP28.8342x24.3628x0.275	3	-10649.70	1804540.00	73.3	Pass
L4	44.417 - 35	Pole	TP29.93x27.6579x0.275	4	-12830.60	1885590.00	88.1	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L5	35 - 0	Pole	TP36.0472x29.93x0.364	5	-19739.70	3062890.00	79.1	Pass
							Summary	
						Pole (L4)	88.1	Pass
						RATING =	**88.1**	**Pass**

Dewberry

Job Number	50114613
Made by:	JSD
Date:	08/05/19
Checked by:	BGK
Date:	08/06/19

(Hartford 9 CT) - Anchor Bolt & Base Plate

\\CAPECOD\Projects\50002925\50114613 - Hartford 9 CT\Tech\Tower Analysis\Rev.0\50110171 - Monopole Anchor Bolts, Base Plate and Foundation Check.xlsx

-TIA 222 Rev G

Site Name: Hartford 9 CT

Monopole Anchor Bolt & Base Plate Check

	LRFD Loads	
Global Axial Force (1.2DL), P_L =	19.8 kips	*(TNX Tower MTO)*
Global Shear Force (1.6WL), S_L =	22.9 kips	*(TNX Tower MTO)*
Global Moment (1.6WL), M_L =	1759.7 kip-ft	*(TNX Tower MTO)*

Existing Anchor Bolt Data:

Number of Anchor Bolts, N =	6
Diameter of Bolt Circle, d_{bc} =	41.50 in
Bolt "Column" Distance, l =	3.50 in
Bolt Ultimate Strength, F_u =	100 ksi
Bolt Yield Strength, F_y =	75 ksi
Bolt Modulus of Elasticity, E =	29000 ksi
Diameter of Bolt Circle, d_{ab} =	2.25 in
Threads per Inch, n =	4.5
Top of Concrete to Bolt Leveling Nut, l_{ar} =	2.00 in

Reinforcement Anchor Bolt Data:

Number of Anchor Bolts, N_o =	6
Diameter of Bolt Circle, d_{bco} =	50.38 in
Bolt "Column" Distance, l_o =	3.00 in
Bolt Ultimate Strength, F_{uo} =	100 ksi
Bolt Yield Strength, F_{yo} =	75 ksi
Bolt Modulus of Elasticity, E_o =	29000 ksi
Diameter of Bolt Circle, d_{abo} =	2.75 in
Threads per Inch, n_o =	4

Base Plate Data:

Plate Yield Strength, F_{ybp} =	50 ksi	
Base Plate Thickness, t_{bp} =	2.25 in	
γ_j =	0.5	*per TIA-222-G Section 4.9.9 (detail type d)*
Base Plate Diameter, d_{bp} =	47.50 in	
Monopole Outside Diameter, d_{mp} =	36.00 in	

Geometry:

Distance from Bolts to Centroid of Monopole:

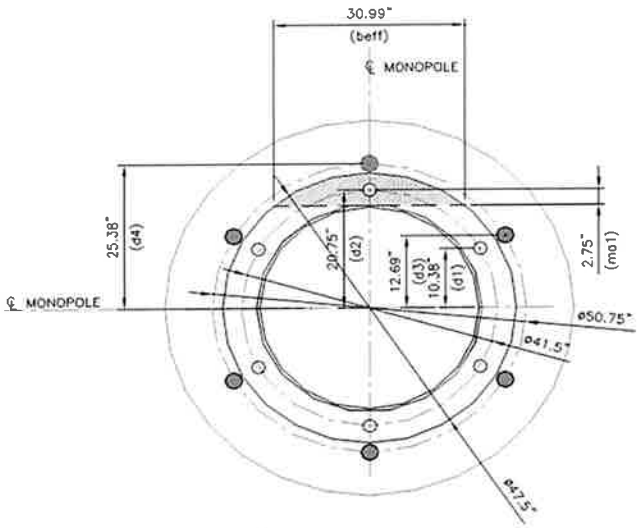
d_1 =	10.38 in
d_2 =	20.75 in
d_3 =	12.69 in
d_4 =	25.38 in

Critical Distances for Bending in Plate:

m_{a1} =	2.75 in

Effective Width of Base Plate (Bending):

b_{eff} =	30.99 in



Analysis of Inner Anchor Bolts:

Total Polar Moment of Inertia, $I_p = d_1^2 * 4 + d_2^2 * 2 + d_3^2 * 4 + d_4^2 * 2$
$= 3224.54 \text{ in}^2$

Gross Area of Inner Bolts, $A_{gi} = \pi / 4 * d_{ab}^2$
$= 3.98 \text{ in}^2$

Net Area of Inner Bolts, $A_{ni} = \pi / 4 * (d_{ab} - 0.9743 / n)^2$ *per TIA-222-G Section 4.9.9 (detail type d)*
$\approx 3.25 \text{ in}^2$

Net Diameter of Inner Bolts, $d_{ni} = 2 * \sqrt{A_{ni}} / \sqrt{\pi}$
$= 2.03 \text{ in}$

Radius of Gyration of Inner Bolts, $r_i = d_{ni} / 4$
$= 0.51 \text{ in}$

Section Modulus of Inner Bolts, $S_{xi} = \pi * d_{ni}^3 / 32$
$= 0.83 \text{ in}^3$

Plastic Modulus of Inner Bolts, $Z_{xi} = d_{ni}^3 / 6$
$= 1.40 \text{ in}^3$

Anchor Bolt Tension Force Check:

Maximum Tensile Force, $T_{MAX} = M_L * d_2 / I_p - P_L / N$
$= 132.6 \text{ kips}$

Maximum Compressive Force, $P_u = M_L * d_2 / I_p + P_L / N$
$= 139.2 \text{ kips}$

Maximum Shear Force, $V_u = S_L / N$
$= 3.8 \text{ kips}$

Tensile Check:

Design Tensile Strength, $\Phi R_{nt} = 0.75 * F_u * A_{ni}$
$= 243.6 \text{ kips}$

Tensile Capacity of Bolt = $(P_u + V_u / \eta) / \Phi R_{nt}$
$= 60.3\% \leq 100\%$ **OK!**

Shear Check:

Design Shear Strength, $\Phi R_{nv} = 0.75 * 0.45 * F_u * A_{gi}$
$= 134.2 \text{ kips}$

Shear Capacity of Bolt = $V_u / \Phi R_{nv}$
$= 2.8\% \leq 100\%$ **OK!**

Flexure Check:

Design Flexure Strength, $\Phi R_{nm} = 0.9 * F_y * Z_{xi}$
$= 94.6 \text{ kip-ft}$

M_u = if $l_{ar} < d_{ab}$, 0; otherwise, $0.65 * l_{ar} * V_u$
$= 0.0 \text{ kip-ft}$

Flexure Capacity of Bolt = $M_u / \Phi R_{nm}$
$= 0.0\% \leq 100\%$ **OK!**

Combined Check:

Capacity of Bolt = $(V_u / \Phi R_{nv})^2 + (P_u / \Phi R_{nt} + M_u / \Phi R_{nm})^2$
$= 32.7\% \leq 100\%$ **OK!**

Analysis of Outer Anchor Bolts:

Total Polar Moment of Inertia, $I_p = d_1^2 * 4 + d_2^2 * 2 + d_3^2 * 4 + d_4^2 * 2$
$= 3224.54 \text{ in}^2$

Gross Area of Outer Bolts, $A_{go} = \pi / 4 * d_{abo}^2$
$= 5.94 \text{ in}^2$

Net Area of Outer Bolts, $A_{no} = \pi / 4 * (d_{abo} - 0.9743 / n_o)^2$ *per TIA-222-G Section 4.9.9 (detail type d)*
$= 4.93 \text{ in}^2$

Net Diameter of Outer Bolts, $d_{no} = 2 * \sqrt{A_{no}} / \sqrt{\pi}$
$= 2.51 \text{ in}$

Radius of Gyration of Outer Bolts, $r_o = d_{no} / 4$
$= 0.63 \text{ in}$

Section Modulus of Outer Bolts, $S_{xo} = \pi * d_{no}^3 / 32$
$= 1.55 \text{ in}^3$

Plastic Modulus of Outer Bolts, $Z_{xo} = d_{no}^3 / 6$
$= 2.62 \text{ in}^3$

Anchor Bolt Tension Force Check:

Maximum Tensile Force, $T_{MAX} = M_L * d_4 / I_p - P_L / N_o$
$= 162.9 \text{ kips}$

Maximum Compressive Force, $P_u = M_L * d_4 / I_p + P_L / N_o$
$= 169.5 \text{ kips}$

Maximum Shear Force, $V_u = S_L / N_o$
$= 3.8 \text{ kips}$

Tensile Check:

Design Tensile Strength, $\Phi R_{nt} = 0.8 * F_{uo} * A_{no}$
$= 394.7 \text{ kips}$

Tensile Capacity of Bolt = $(P_u + V_u / \eta) / \Phi R_{nt}$
$= 44.9\% \quad \leq 100\%$ **OK!**

Shear Check:

Design Shear Strength, $\Phi R_{nv} = 0.75 * 0.45 * F_{uo} * A_{go}$
$= 200.5 \text{ kips}$

Shear Capacity of Bolt = $V_u / \Phi R_{nv}$
$= 1.9\% \quad \leq 100\%$ **OK!**

Flexure Check:

Design Flexure Strength, $\Phi R_{nm} = 0.9 * F_{yo} * Z_{xo}$
$= 177.1 \text{ kip-ft}$

M_u = if $l_{ar} < d_{abo}$, 0; otherwise, $0.65 * l_{ar} * V_u$
$= 0.0 \text{ kip-ft}$

Flexure Capacity of Bolt = $M_u / \Phi R_{nm}$
$= 0.0\% \quad \leq 100\%$ **OK!**

Combined Check:

Capacity of Bolt = $(V_u / \Phi R_{nv})^2 + (P_u / \Phi R_{nt} + M_u / \Phi R_{nm})^2$
$= 18.5\%$

Base Plate Analysis:

Force from Bolts, $C_1 = M_L * d_2 / I_p + P_L / N_o$
$= 139.2 \text{ kips}$

Applied Bending Stress in Plate, $f_{bp} = 4 * C_1 * m_{a1} / (b_{eff} + t_{bp}^2)$
$= 9.8 \text{ ksi}$

Allowable Bending Stress in Plate, $F_{bp} = 0.9 * F_{ybp}$
$= 45.0 \text{ ksi}$

Capacity of Base Plate = f_{bp} / F_{bp}
$= 21.7\% \quad \leq 100\%$ **OK!**

Dewberry

Job Number	50114613
Made by:	JSD
Date:	08/05/19
Checked by:	BGK
Date:	08/06/19

(Hartford 9 CT) - Foundation

\\CAPECOD\Projects\50002925\50114613 - Hartford 9 CT\Tech\Tower Analysis\Rev.0\50110171 - Monopole Anchor Bolts, Base Plate and Foundation Check.xlsx

-TIA 222 Rev G

Site Name: Hartford 9 CT

Monopole Foundation Check

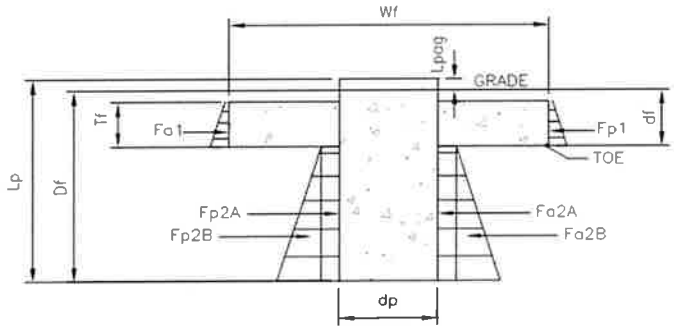
	LRFD Loads	
Global Axial Force (1.2DL), P_L =	19.8 kips	*(TNX Tower MTO)*
Global Shear Force (1.6WL), S_L =	22.9 kips	*(TNX Tower MTO)*
Global Moment (1.6WL), M_L =	1759.7 kip-ft	*(TNX Tower MTO)*

Tower & Monopole Data:

Monopole Height, H_t =	120.00 ft	Footing Thickness, T_f =	2.00 ft
Depth of Footing, D_f =	19.00 ft	Footing Width, W_f =	14.50 ft
Pier Length, L_p =	19.50 ft	Water Depth, d_{water} =	0.00 ft
Pier Extension Above Grade, L_{peg} =	0.50 ft	Distance from Grade to Bottom of Pad, d_f =	4.00 ft
Cassion Diameter, d_p =	5.50 ft		

Material Properties:

Unit Weight of Concrete, γ_c =	150 psf	Internal Friction Angle of Soil, Φ_{s1} =	33 °	*(mat)*
Unit Weight of Soil, γ_{s1} =	120 psf	Internal Friction Angle of Soil, Φ_{s2} =	33 °	*(below mat)*
Unit Weight of Soil, γ_{s2} =	58 psf	Ultimate Soil Bearing Capacity, q_s =	8000 psf	
Concrete Compressive Strength, f'_c =	3000 psi	Depth to Neglect Foundation Bouyancy, n =	0.00 ft	*(if applicable)*
Steel Reinforcement Yield Strength, f_y =	60000 psi	Cohesion of Clay Type Soil, c =	0 ksf	*(0 for Sandy Soil)*
Anchor Bolt Yield Strength, f_{ya} =	75000 psi	Seismic Zone Factor, z =	2	*(UBC-1997, Fig. 23-2)*



Coefficient of Lateral Soil Factors:

$k_{p1} = (1 + \sin(\Phi_{s1}) / (1 - \sin(\Phi_{s1}))$ = 3.39

$k_{p2} = (1 + \sin(\Phi_{s2}) / (1 - \sin(\Phi_{s2}))$ = 3.39

$k_{a1} = (1 - \sin(\Phi_{s1}) / (1 + \sin(\Phi_{s1}))$ = 0.29

$k_{a2} = (1 - \sin(\Phi_{s2}) / (1 + \sin(\Phi_{s2}))$ = 0.29

Footing Stability Check:

Passive Pressure 1, $P_{p1top} = k_{p1} * \gamma_{s1} * (d_f - T_f)$
$= 0.814$ ksf

Passive Pressure 1, $P_{p1bot} = k_{p1} * \gamma_{s1} * d_f$
$= 1.628$ ksf

Passive Pressure 1, $P_{p1ave} = (P_{p1top} + P_{p1bot}) / 2$
$= 1.221$ ksf

Active Pressure 1, $P_{a1top} = k_{a1} * \gamma_{s1} * (d_f - T_f)$
$= 0.071$ ksf

Active Pressure 1, $P_{a1bot} = k_{a1} * \gamma_{s1} * d_f$
$= 0.142$ ksf

Active Pressure 1, $P_{a1ave} = (P_{a1top} + P_{a1bot}) / 2$
$= 0.106$ ksf

Area of Pressure 1, $A_{p1} = T_f * W_f$
$= 29.0$ ft²

Passive Force 1, $F_{p1} = P_{p1ave} * A_{p1}$
$= 35.4$ kips

Active Force 1, $F_{a1} = P_{a1ave} * A_{p1}$
$= 3.1$ kips

Ultimate Shear 1, $S_{u1} = F_{p1} - F_{a1}$
$= 32.3$ kips

Passive Pressure 2, $P_{p2top} = k_{p2} * \gamma_{s2} * d_f$
$= 0.787$ ksf

Passive Pressure 2, $P_{p2bot} = k_{p2} * \gamma_{s2} * D_f$
$= 3.738$ ksf

Active Pressure 2, $P_{a2top} = k_{a2} * \gamma_{s2} * d_f$
$= 0.068$ ksf

Active Pressure 2, $P_{a2bot} = k_{a2} * \gamma_{s2} * D_f$
$= 0.325$ ksf

Area of Pressure 2, $A_{p2} = (D_f - d_f) * d_p$
$= 82.5$ ft²

Passive Force 2, $F_{p2T} = P_{p2top} * A_{p2}$
$= 64.9$ kips

Passive Force 2, $F_{p2B} = 0.5 * (P_{p2bot} - P_{p2top}) * A_{p2}$
$= 121.7$ kips

Active Force 2, $F_{a2T} = P_{a2top} * A_{p2}$
$= 5.6$ kips

Active Force 2, $F_{a2B} = 0.5 * (P_{a2bot} - P_{a2top}) * A_{p2}$
$= 10.6$ kips

Ultimate Shear 2, $S_{u2T} = F_{p2T} - F_{a2T}$
$= 59.3$ kips

Ultimate Shear 2, $S_{u2B} = F_{p2B} - F_{a2B}$
$= 111.2$ kips

Concrete Mat Weight, $W_{mat} = (W_f^2 - d_p^2 * \pi / 4) * T_f * \gamma_c$
$= 55.9$ kips

Concrete Cassion Weight, $W_{cas} = (d_p^2 * \pi / 4) * L_p * \gamma_c$
$= 69.5$ kips

Soil Above Mat Weight, $W_{s1} = (W_f^2 - d_p^2 * \pi / 4) * (d_f - T_f) * \gamma_{s1}$
$= 44.8$ kips

Total Weight, $W_{tot} = 0.9 * (W_{mat} + W_{cas} + P_L) + 0.75W_{s1}$
$= 164.3$ kips

Overturning Moment, $M_{ot} = M_L + S_L * (d_f + L_{pag})$
$= 1862.8$ kip-ft

Resisting Moment, $M_r = W_{tot} * W_f / 2 + 0.75 * (S_{u1} * T_f / 3 + S_{u2T} * (D_f - d_f) / 2 + S_{u2B} * 2 * (D_f - d_f) / 3)$
$= 2374.4$ kip-ft

Factor of Safety, $FS = M_r / M_{ot}$
$= 1.27 \quad \leq 1.00$ **OK!**

Footing Stability Check:

Area of Mat, $A_{mat} = W_f^2 - d_p^2 * \pi / 4$
$= 186.5$ ft²

Section Modulus of Mat, $S_{mat} = W_f^3 / 6 - d_p^3 * \pi / 32$
$= 491.8$ ft³

Axial Force, $P_{mat} = W_{mat} + W_{s1}$
$= 100.7$ kips

Cassion Resisting Moment Capacity, $M_{cap} = S_{u2T} * (D_f - d_f) / 2 + S_{u2B} * 2 * (D_f - d_f) / 3$
$= 1556.2$ kip-ft

Matt Residual Moment Capacity, $M_{mat} = (M_L - M_{cap}) + S_L * (d_f + L_{pag}) \geq 0$
$= 306.6$ kip-ft

Maximum Matt Pressure, $p_{MAX} = P_{mat} / A_{mat} + M_{mat} / S_{mat} \leq 0.75q_s$
$= 1.163$ ksf ≤ 6.000 ksf **OK!**

Minimum Matt Pressure, $p_{MAX} = P_{mat} / A_{mat} - M_{mat} / S_{mat} \leq 0.75q_s$
$= -0.083$ ksf ≤ 6.000 ksf **OK!**

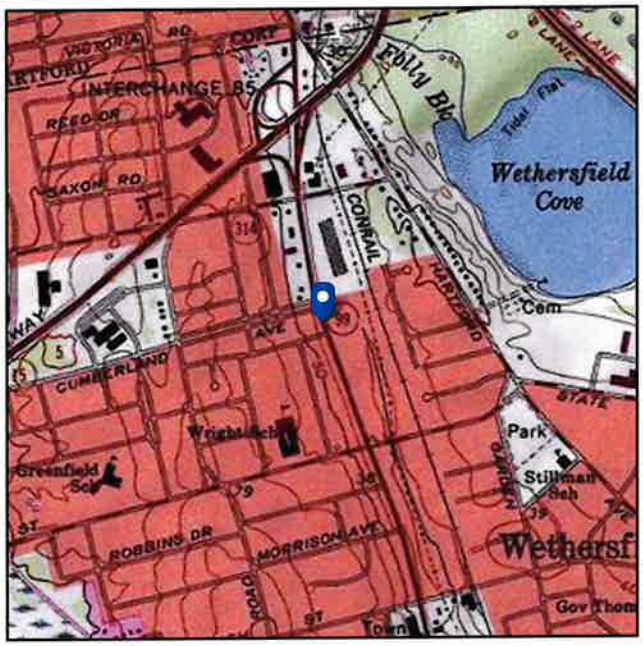
APPENDIX B

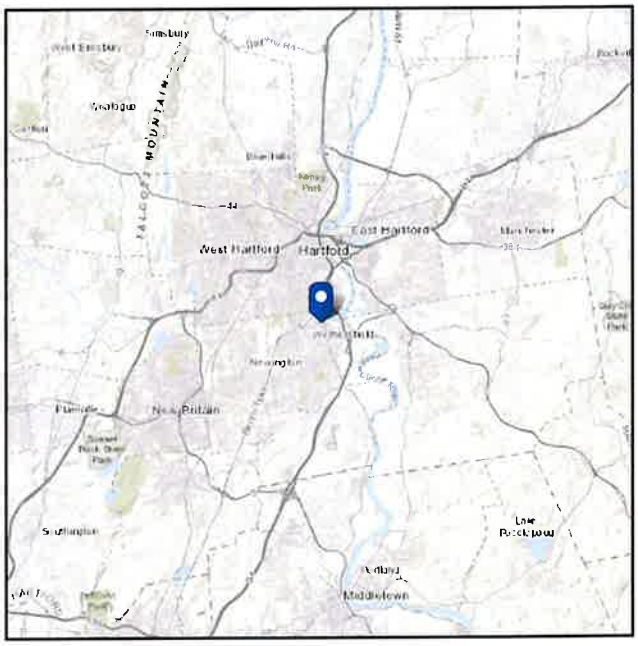
ASCE 7 Hazards Report

Address:
250 Silas Deane Hwy
Wethersfield, Connecticut
06109

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

Elevation: 36.77 ft (NAVD 88)
Latitude: 41.720291
Longitude: -72.667228





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: Mon Jul 29 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.

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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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CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

120-ft Existing Rohn Monopole

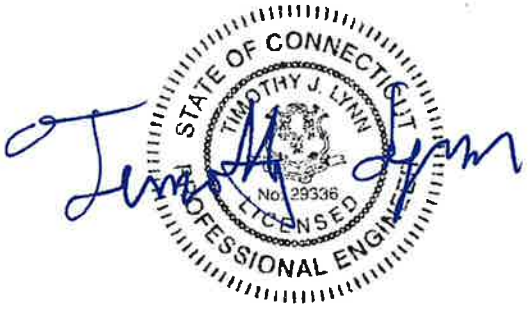
Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Hartford 9

250 Silas Deane Highway
Wethersfield, CT

Centek Project No. 15001.060

~~Date: July 21, 2015~~
~~Rev 1: November 8, 2016~~
Rev 2: November 14, 2016



Prepared for:
Verizon Wireless
99 East River Road, 9th Floor
East Hartford, CT 06108

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

Table of Contents

Introduction

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna upgrade proposed by Verizon on the existing monopole (tower) located in Wethersfield, CT.

The host tower is a 120-ft tall, three-section, eighteen sided, tapered monopole originally designed and manufactured by ROHN Eng. File No: 50576RA, dated July 11, 2002. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned tower design documents. This analysis takes into account monopole reinforcements designed and installed by Structural Components for Verizon Wireless, SC no. 110361, dated March 25, 2011.

Antenna and appurtenance information were obtained from a previous structural report prepared by Centek engineering job no; 12124.038 dated February 15, 2013, visual verification from grade by Centek personnel on July 21, 2015 and a Verizon RF data sheet.

The tower consists of three (3) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 16.00-in at the top and 36.00-in at the base.

Verizon proposes the removal of nine (9) panel antennas, six (6) diplexers and three (3) RRHs and the installation of nine (9) panel antennas, nine (9) RRHs and one (1) main distribution box mounted to the existing T-Arms. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

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

- TOWN (Reserved):
  Antennas: Two (2) Andrew DB809-XC Omni-directional whip antennas pipe mounted with an elevation of 117-ft above grade.
  Coax Cables: Two (2) 7/8" ∅ coax cables running on the inside of the existing monopole.
- TOWN (Existing):
  Antennas: One (1) 2-ft ∅ Microwave dish antenna pipe mounted to the monopole with an elevation of 110-ft above grade.
  Coax Cables: Two (2) 1/2" ∅ coax cables running on the inside of the existing monopole.
- TOWN (Reserved):
  Antennas: Two (2) 1-ft ∅ and two (2) 2-ft ∅ Microwave dish antennas pipe mounted to the monopole with an elevation of 110-ft above grade.
  Coax Cables: Six (6) 7/8" ∅ coax cables running on the inside of the existing monopole.

- METRO PCS (Existing):
  Antennas: Six (6) Ericsson AIR21 panel antennas mounted on three (3) 6-ft T-arms with a RAD center elevation of 105-ft above existing grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the inside of the existing monopole.
- TOWN (EXISTING):
  Antennas: One (1) Decibel DB404 4-Bay Dipole, two (2) Andrew Decibel DB583, one (1) RFS Celwave PD1142 and one (1) 5-ft x 1" ∅ Omni-directional whip antennas mounted on three (3) side arms with an elevation of 54-ft above existing grade.
  Coax Cables: Five (5) 1/2" ∅ coax cables running on the inside of the existing monopole.
- VERIZON WIRELESS (Existing to Remain):
  Antennas: Three (3) Antel BXA-80063-6CF panel antennas and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on T-Arms with a RAD center elevation of 90-ft above grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.
- VERIZON WIRELESS (Existing to Remove):
  Antennas: Three (3) Antel BXA-70063-6CF panel antennas, three (3) Antel BXA-185063-8CF panel antennas, three (3) BXA-171063-8CF panel antennas, six (6) RFS FD9R6004/2C-3L Diplexers and three (3) Alcatel-Lucent RRH2x40-AWS Remote Radio Heads mounted on T-Arms with a RAD center elevation of 90-ft above grade.
- **VERIZON (Proposed):**
  Antennas: Nine (9) Andrew SBNHH-1D65B panel antennas, three (3) Alcatel-Lucent RRH2x60-700 remote radio heads, three (3) Alcatel-Lucent RRH2x60-PCS remote radio heads, three (3) Alcatel-Lucent RRH4x45/2x90-AWS remote radio heads and one (1) RFS DB-T1-6Z-8AB-0Z main distribution box mounted on T-Arms with a RAD center elevation of 90-ft above grade.
  Coax Cables: One (1) 1-5/8" ∅ fiber cable running on the exterior of the existing tower.

Primary Assumptions Used in the Analysis

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

Analysis

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

The existing tower was analyzed for the controlling basic wind speed (3-second gust) with no ice and the applicable wind and ice combination to determine stresses in members as per guidelines of TIA-222-G-2005 entitled "Structural Standard for Antenna Support Structures and Antennas", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Load and Resistance Factor Design (LRFD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix N of the CSBC[1] and the wind speed data available in the TIA-222-G-2005 Standard.

Tower Loading

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA-222-G-2005, gravity loads of the tower structure and its components, and the application of 1.00" radial ice on the tower structure and its components.

Basic Wind Speed:	Hartford; v = 90-105 mph (3-second gust)	*[Annex B of TIA-222-G-2005]*
	Wethersfield; v = 97 mph (3 second gust)	*[Appendix N of the 2016 CT Building Code]*
Load Cases:	Load Case 1; 97 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Appendix N of the 2016 CT Building Code]*
	Load Case 2; 50 mph wind speed w/ 1.00" radial ice plus gravity load – used in calculation of tower stresses.	*[Annex B of TIA-222-G-2005]*

[1] The 2012 International Building Code as amended by the 2016 Connecticut State Building Code (CSBC).

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software tnxTower. Allowable stresses were determined based on Table 4-8 of the TIA code.

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **72.8%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L4)	35.00'-44.42'	72.8%	**PASS**

Foundation and Anchors

The existing foundation consists of a 5-ft 6in ∅ x 19ft-6in long modified reinforced concrete caisson with a 2.0-ft thick x 14-ft-6in square reinforced concrete pad. The base of the monopole tower is connected to the caisson foundation by means of (6) original 2.25"∅, ASTM A615-75 anchor bolts and six (6) additional 2.75"∅, ASTM A615-75 anchor bolts embedded approximately 7-ft into the concrete foundation. The base plate thickness was field measured and noted in a Pre-construction and TIA Inspection report prepared by Structural Components, dated August 25, 2010 as 2.25in thick in lieu of the original ROHN design thickness of 2.00in.

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

Location	Vector	Proposed Reactions
Base	Shear	20 kips
	Compression	20 kips
	Moment	1470 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	TIA-222-G Section 9.4 FS[1]	Proposed Loading (FS)[1]	Result
Reinforced Concrete Pad w/ Caisson	OTM[2]	1.0	1.52	**PASS**

Note 1: FS denotes Factor of Safety.

Note 2: OTM denotes Overturning Moment

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Combined Compression and Shear	47.5%	**PASS**
Base Plate	Bending	18.2%	**PASS**

Conclusion

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

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

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

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

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

General Description of Structural Analysis Program

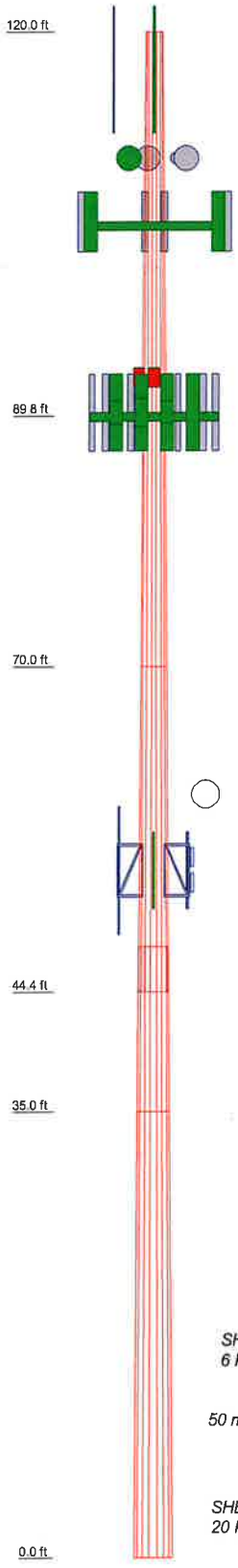
tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

tnxTower Features:

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

Section	1	2	3	4	5
Length (ft)	30.250	22.420	25.583	13.000	35.000
Number of Sides	18	18	18	18	18
Thickness (in)	0.188	0.188	0.275	0.275	0.364
Socket Length (ft)	2.670		3.583		
Top Dia (in)	16.000	20.445	24.252	27.549	29.880
Bot Dia (in)	21.287	24.252	28.725	29.880	36.000
Grade			A572-65		
Weight (K)	1.1	1.0	2.0	1.1	4.5

9.7



ALL REACTIONS ARE FACTORED

AXIAL 45 K
SHEAR 6 K
MOMENT 499 kip-ft
TORQUE 1 kip-ft
50 mph WIND - 1.000 in ICE

AXIAL 20 K
SHEAR 20 K
MOMENT 1470 kip-ft
TORQUE 1 kip-ft
REACTIONS - 97 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
DB809K-XC (Town)	117	RRH2x60-PCS (Verizon - Proposed)	90
DB809K-XC (Town)	117	RRH2x60-07-U (Verizon - Proposed)	90
6'x2" Pipe Mount (Town)	110	RRH4x45/2x90-AWS (Verizon - Proposed)	90
6'x2" Pipe Mount (Town)	110		
6'x2" Pipe Mount (Town)	110	EEI 6-ft T-Arm (Verizon - Existing)	90
2-ft dish (Town)	110	EEI 6-ft T-Arm (Verizon - Existing)	90
2-ft dish (Town)	110	EEI 6-ft T-Arm (Verizon - Existing)	90
2-ft dish (Town)	110	BXA-80063/6CF (Verizon - Existing)	90
1-ft Dish (Town)	110	SBNHH-1D65B (Verizon - Proposed)	90
1-ft Dish (Town)	110	SBNHH-1D65B (Verizon - Proposed)	90
(2) AIR21 B2A/B4P (MetroPCS - Existing)	105	BXA-80063/6CF (Verizon - Existing)	90
		SBNHH-1D65B (Verizon - Proposed)	90
(2) AIR21 B2A/B4P (MetroPCS - Existing)	105	SBNHH-1D65B (Verizon - Proposed)	90
		SBNHH-1D65B (Verizon - Proposed)	90
(2) AIR21 B2A/B4P (MetroPCS - Existing)	105	RRH2x60-07-U (Verizon - Proposed)	90
		RRH2x60-07-U (Verizon - Proposed)	90
EEI 6-ft T-Arm (MetroPCS - Existing)	105	SBNHH-1D65B (Verizon - Proposed)	90
EEI 6-ft T-Arm (MetroPCS - Existing)	105	SBNHH-1D65B (Verizon - Proposed)	90
EEI 6-ft T-Arm (MetroPCS - Existing)	105	BXA-80063/6CF (Verizon - Existing)	90
Valmont Uni-Tri Bracket (MetroPCS - Existing)	105	SBNHH-1D65B (Verizon - Proposed)	90
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	92	SBNHH-1D65B (Verizon - Proposed)	90
		Pirod 4' Side Mount Standoff (1) (Town)	54
DB-T1-6Z-8AB-0Z (Verizon - Existing)	92	Pirod 4' Side Mount Standoff (1) (Town)	54
RRH4x45/2x90-AWS (Verizon - Proposed)	90	5' x 1" dia. Omni (Town)	54
		PD1142-1 (Town)	54
RRH4x45/2x90-AWS (Verizon - Proposed)	90	DB404 (Town)	54
		DB583 (Town)	54
RRH2x60-PCS (Verizon - Proposed)	90	DB583 (Town)	54
RRH2x60-PCS (Verizon - Proposed)	90	Pirod 4' Side Mount Standoff (1) (Town)	54

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for Exposure C to the TIA-222-G Standard.
2. Tower designed for a 97 mph basic wind in accordance with the TIA-222-G Standard.
3. Tower is also designed for a 50 mph basic wind with 1.00 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.000 ft
7. Weld together tower sections have flange connections.
8. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
9. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
10. Welds are fabricated with ER-70S-6 electrodes.
11. Pole Sections 3 and 4 - Equivalent Thickness of 0.275" Used to Account for Stiffened Section
12. Pole Section 5 - Equivalent Thickness of 0.3640" Used to Account for Stiffened Section.
13. Includes monpole reinforcement design prepared by Structural Components, LLC., dated 03/25/11.
14. TOWER RATING: 72.8%

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

Job: 15001.060 - Hartford 9			
Project: 120-ft ROHN Monopole - 250 Silas Deane Hwy., Wethersfield, CT			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA-222-G	Date: 11/14/16	Scale: NTS	
Path:		Dwg No. E-1	

tnxTower	Job	Page
	15001.060 - Hartford 9	1 of 36
Centek Engineering Inc. 63-2 North Branford Rd.	**Project** 120-ft ROHN Monopole - 250 Silas Deane Hwy., Wethersfield, CT	**Date** 13:08:00 11/14/16
Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	**Client** Verizon Wireless	**Designed by** TJL

Tower Input Data

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

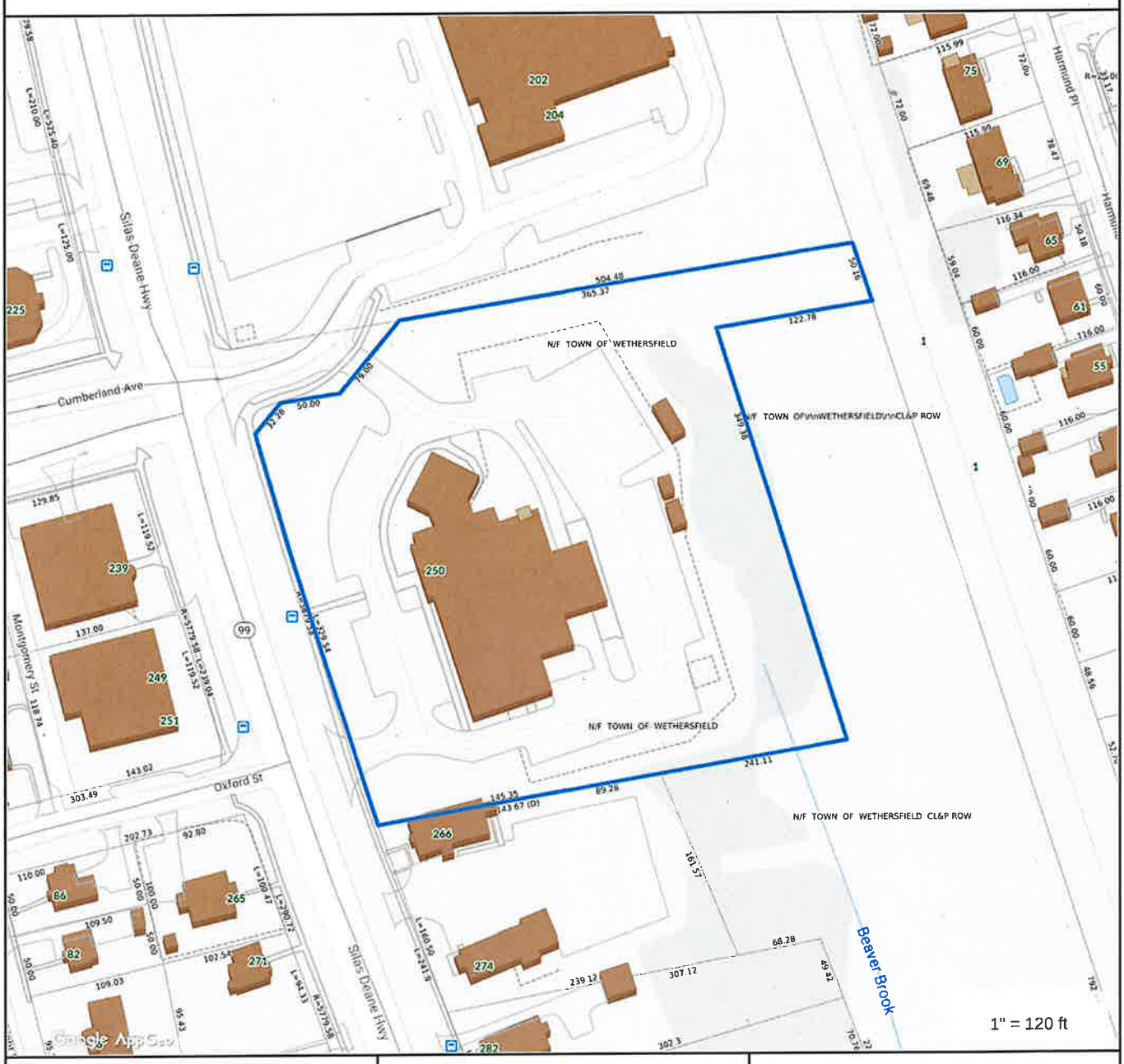
Basic wind speed of 97 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.000 ft.
Nominal ice thickness of 1.000 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 50 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 60 mph.
Weld together tower sections have flange connections..
Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Welds are fabricated with ER-70S-6 electrodes..
Pole Sections 3 and 4 - Equivalent Thickness of 0.275" Used to Account for Stiffened Section.
Pole Section 5 - Equivalent Thickness of 0.3640" Used to Account for Stiffened Section..
Includes monpole reinforcement design prepared by Structural Components, LLC., dated 03/25/11..
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Horizontals	Assume Legs Pinned	Calculate Redundant Bracing Forces
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Ignore Redundant Members in FEA
Use Moment Magnification	Use Clear Spans For Wind Area	SR Leg Bolts Resist Compression
√ Use Code Stress Ratios	Use Clear Spans For KL/r	All Leg Panels Have Same Allowable
√ Use Code Safety Factors - Guys	Retension Guys To Initial Tension	Offset Girt At Foundation
Escalate Ice	√ Bypass Mast Stability Checks	√ Consider Feed Line Torque
Always Use Max Kz	Use Azimuth Dish Coefficients	Include Angle Block Shear Check
Use Special Wind Profile	√ Project Wind Area of Appurt.	Use TIA-222-G Bracing Resist. Exemption
Include Bolts In Member Capacity	Autocalc Torque Arm Areas	Use TIA-222-G Tension Splice Exemption
Leg Bolts Are At Top Of Section	Add IBC .6D+W Combination	Poles
Secondary Horizontal Braces Leg	√ Sort Capacity Reports By Component	√ Include Shear-Torsion Interaction
Use Diamond Inner Bracing (4 Sided)	Triangulate Diamond Inner Bracing	Always Use Sub-Critical Flow
SR Members Have Cut Ends	Treat Feed Line Bundles As Cylinder	Use Top Mounted Sockets
SR Members Are Concentric		

Tapered Pole Section Geometry

ATTACHMENT 4



Property Information

Property ID	210010
Location	250 SILAS DEANE HWY
Owner	WETHERSFIELD TOWN OF

MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

Town of Wethersfield, CT makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Geometry updated 11/14/17
Data updated daily

Unique ID: 210010 **Wethersfield** **Card No:** 1of 1

Location:	250 SILAS DEANE HWY	Map/Lot:	210 010	Zone:	GB	Date Printed:	08-06-19
911 Address:		Exempt	X	Nbhd:	C35	Last Update:	07-02-19

Owner Of Record	Volume/Page	Date	Sales Type	Valid	Sale Price
WETHERSFIELD TOWN OF POLICE FACILITY	0784 /0051	01-12-00		NO	1,300,000
505 SILAS DEANE HWY WETHERSFIELD , CT 06109					
Additional Owners:					
Prior Owner History					
ROBERT JOSEPH L A & SCOVILLE HOMER	0333 /0023	02-28-83		NO	725,000
	/				
	/				
	/				
	/				

Permit Number	Date	Cost	New Hous	Status	% Comp	Est Completion	Building Permit
M-18-0122	12-21-19	4,000	No	Closed	100	06-21-19	EMERGENCY BURNER REPLACEMENT BOILER #2
E-19-0100	04-26-19	326,280	No	Closed	100	06-26-19	INSTALL & WIRE WPD HQ IP VIDEO SECURITY SYSTEM
P-19-0090	04-15-19	1,500	No	Closed	100	06-26-19	CHANGE PENDANT SPRINKLER HEADS TO UPRIGHT HEADS IN 2ND COMPUTER ROOM
M-19-0062	04-12-19	1,500	No	Closed	100	06-26-19	INSTALL PAN UNDER HVAC UNIT
E-19-0175	04-08-19	10,000	Yes	Closed	100	01-01-01	Install 2 new UPS's , new feeds from MDP-E to mech room to power new UP
M-19-0047	04-03-19	12,575	No	Closed	100	06-26-19	REPL DISPATCH COOLING ONLY ROOFTOP UNIT

		State Item Codes						Appraised Value	
Census/Tract	4923	Code	Quantity	Value	Code	Quantity	Value	Total Land Value	1,274,948
Dev Map	Dev Lot 3	21- Comm Land	3.52	892,460				Total Building Value	5,450,266
Date	05/14/2018	22-Comm Bldg	1.00	3,815,190				Total Outbuilding Value	946,380
Inspector	EQ	25-Comm Outbldg	4.00	662,470				Total Market Value	7,671,594
Action	Measure & List								

Acres

Land Type	Acres	490	Rate	Adj	Influence	Total Value
Primary Site	1.00	0.00	500,000	1.00	150	1,250,000
Comm Excess	2.52	0.00	10,000	0.99	0	24,948
Total	3.52					1,274,948

Influence Factors

Land Type	Influence	Reason	Comment
Primary Site	150	Intensive Use	

Assessment History (Prior Years as of Oct 1)

	Current	2018	2017	2016	2015
Land	892,460	892,460	512,300	512,300	512,300
Building	3,815,190	3,815,190	3,483,700	3,483,700	4,303,900
Outbuilding	662,470	662,470	820,200	820,200	0
Total	**5,370,120**	**5,370,120**	**4,816,200**	**4,816,200**	**4,816,200**

490 Appraised Totals

Type	Acres	Value	Type	Acres	Value
			Totals		

Comments

CELL POLE 4500 MONTH, 8 CAP RATE
4 X 3000 X 12= 144,000 LESS 25% EXP=
GENERATOR BACKUP/6 HOLDING CELLS
2003 CELL TOWER-180'
108,000/.11 CAP= 981,800
POLICE STATION

Unique ID: 210010 **Wethersfield**

Location:	250 SILAS DEANE HWY	**Unit**	

Use	Class	Quality	Stry	WH	Area	BG	Units
Police Station	Fireproof Steel	C+	2	12	26,000	NO	

Commercial Building Description	
Building Use	Jail - Police S
Class	Steel & Conc
Overall Condition	Good
Construction Quality	C+
Stories	2.00
Year Built	2002
Remodel	
Percent Complete	100
GLA	26,000
Basement	
Basement Area	
Basement Unfinished Area	
HVAC	
Heating Type	Forced Hot Air
Fuel Type	Natural Gas
Cooling Type	Central 100 %
Interior	
Floors	Vinyl Tile
Walls	Drywall
Wall Height	12
Exterior	
Exterior Walls	Brick Veneer
Roof Cover	Asphalt
Special Features	
Comm Pass Elev	2
Wet Sprinkler	26,080

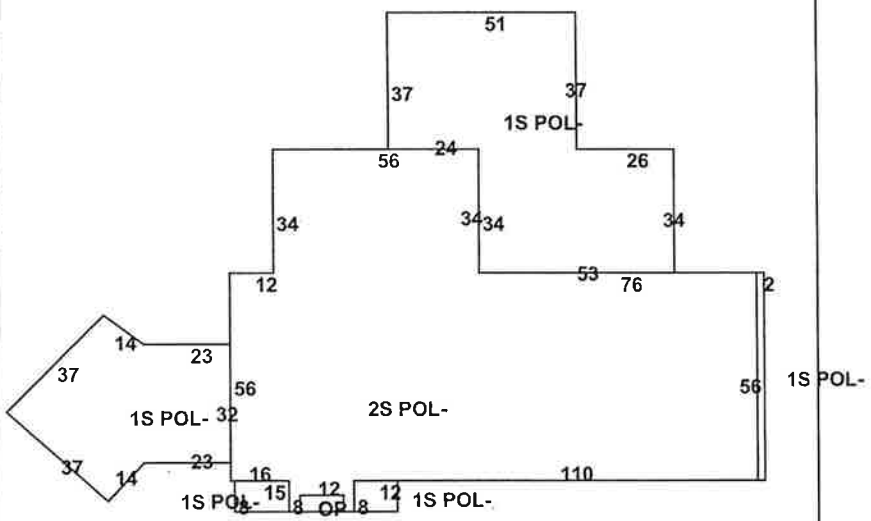
Total Building Value			
Building	1	**Value**	5,450,266
Valuation Method	C		

Description	Area/Qty	Value
Base Value	26,000	5,362,500
Central Air	5,362,500	120,656
Commercial Passenger Elev	2	135,000
Wet Sprinklers	26,080	58,680
Value Before Depr.	0	5,676,836
Depr/Adjust Amount	0	227,073
Final Value (After Depr)	0	5,449,763

Grade Factor	0	**Physical Depreciation %**	4
Functional Depreciation %	0	**Economical Depreciation %**	0

Attached Component Computations

Type	Yr Blt	Condition	Area/Qty	Value
Open Porch	2002	Average	48	503



Detached Component Computations

Type	Year	Condition	Area/Qty	Value
Lights in W/PL	2007	Average/Good	17	186,048
PreCastConCel	2007	Good	348	16,704
Paving	2002	Excellent	43,000	68,628
Cell Tower	2002	Average	1	675,000

Type	Year	Condition	Area/Qty	Value

ATTACHMENT 5

UNITED STATES POSTAL SERVICE®

Certificate of Mailing — Firm

Name and Address of Sender	TOTAL NO. of Pieces Listed by Sender	TOTAL NO. of Pieces Received at Post Office™	Affix Stamp Here ***Postmark with Date of Receipt.***
Kenneth C. Baldwin, Esq. Robinson & Cole LLP 280 Trumbull Street Hartford, CT 06103		2	neopost 08/30/2019 US POSTAGE $002.79 ZIP 06103 041L12203937
	Postmaster, per *(name of receiving employee)*		OLD SAYBROOK CT 06475 AUG 30 2019

USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Gary Evans, Town Manager Town of Wethersfield 505 Silas Deane Highway Wethersfield, CT 06109				
2.	Peter Gillespie, Director of Planning and Economic Development Town of Wethersfield 505 Silas Deane Highway Wethersfield, CT 06109				
3.					
4.					
5.					
6.					

Hartford 9

See Reverse for Instructions