Filed by:
Kri Pelletier, Property Specialist - SBA Communications
134 Flanders Rd., Suite 125, Westborough, MA 01581
508.251.0720 x 3804 - kpelletier@sbasite.com

November 13, 2018

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

Notice of Exempt Modification
184 (aka 181) Garden Hill Circle, Waterbury, CT
41 34 12.9000 N
-73 0 59.4000 W
Sprint #: CT03XC045_Nokia

Dear Ms. Bachman:

Sprint currently maintains (6) antennas at the 130-foot level of the existing 185-foot Self Support Tower at 184 (aka 181) Garden Hill Circle, Waterbury, CT. The Tower and Property are owned by MCM Acquisition, 2017 (an SBA entity.) Sprint now intends to remove (3) existing cell antennas and replace with (3) newer technology cell antennas at the 130-foot level of the tower. The proposed full scope of work is as follows:

Remove: N/A

Remove and Replace:

- Remove: (3) RFS APXVTM14-C-I20 Panel Antennas
  - Replace with: (3) Nokia AAHC Antennas
- Remove: (1) 1-5/8" fiber
  - Replace with: (1) 1.66" Hybrid

Install: N/A

Existing Equipment to Remain (Including entitlements):

- (3) RFS APXVSPP18-C-A20 Panel Antennas
- (3) ALU 800MHz RRHs
- (6) ALU 1900MHz RRHs
- (3) TD-RRH8x20-25 RRU/RRHs
- (3) RFS IBC1900BB-1 Combiners
- (3) RFS IBC1900HG-2A Combiners
- (3) 19' Face Mounts with (3) Pipe Mounts
- (3) 1-1/4" Fiber
- (2) 1-5/8" Fiber

This facility was approved prior to the Council's jurisdiction on July 18, 1988. The City of Waterbury's Zoning Board of Appeals granted approval for a 185-foot tower under Special Exception. On January 16, 1990, the City's ZBA further approved variance to construct an addition onto the existing equipment building, construct an auxiliary building and erect a 500 gallon propane tank for the property located at Warner Tract Extension off Garden Hill Circle, an R.M. zone. The proposed modification complies with all known tower conditions.

Please accept this letter as notification pursuant to Regulations of Connecticut State Agencies §16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. §16.50j-72(b)(2). In accordance with R.C.S.A. § 16.50j-73, a copy of this letter is being sent to the City's Mayor, Neil M. O'Leary, and City Planner, James A. Sequin. (Separate notice is not being sent to the tower or property owner, as it is SBA.)

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 structure.
2. The proposed modification will not require the extension of the site boundary.
3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.
4. The operation of the replacement antennas will not increase radio frequency emissions at the facility to a level at or above the Federal Communications Commission safety standard.
5. The proposed modification will not cause a change or alteration in the physical or environmental characteristics of the site.
6. The existing structure and its foundation can support the proposed loading.

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

Sincerely,

Kri Pelletier
Property Specialist
SBA COMMUNICATIONS CORPORATION
134 Flanders Rd., Suite 125
Westborough, MA 01581
508.251.0720 x3804 + T - 508.366.2610 + F
kpelletier@sbasite.com

Attachments

cc: Neil M. O'Leary, Mayor / with attachments
City of Waterbury, City Hall Building, 235 Grand Street, Waterbury, CT 06702
James A. Sequin, AICP, City Planner / with attachments
City of Waterbury, City Hall Building, 235 Grand Street, Waterbury, CT 06702

POWER DENSITY

From RF Report, attached:

Using the far-field power density equations from FCC Bulletin OET 65, the power density at any given distance from the antennas is equal to 0.360(ERP)/R2 where R is the distance to the point at which the exposure is being calculated. The given equation is a conversion of the OET 65 power density equation for calculating power density given the distance in feet and the result in metric units (mW/cm2). This calculated power density assumes the location is in the main beam of the vertical pattern of the antenna. After making an adjustment for the reduction in power density due to the vertical pattern of the transmit antenna, the calculated ground level power density is well below 1 % of the FCC general population exposure limit at any distance from the antenna system of Sprint.

The exposure at ground level at any distance from the structure would be substantially below 1 % of the FCC general population exposure limits due to Sprint antennas alone. The extremely low ground exposure levels are due to the elevated positions of the antennas in the structure and the low power which these systems operate. See Figures 1 and 2 in back of this report which discuss the relationship between height, proximity or distance, and orientation to level of electromagnetic field exposure.

In summary, the existing communications facility complies with all applicable exposure limits and guidelines adopted by the FCC governing human exposure to radiofrequency electromagnetic fields (FCC Bulletin OET 65). The facility will remain in compliance with the proposed antenna and operating parameter modifications of Sprint.

FULL REPORT ATTACHED

ORIGIN ID:BBFA (508) 251-0720
KRI PELLETIER
SBA COMMUNICATIONS CORPORATION
134 FLANDERS RD
SUITE 125
WESTBOROUGH, MA 01581
UNITED STATES US

SHIP DATE: 13NOV18
ACTWGT: 1.00 LB
CAD: 105843304/INET4040

BILL SENDER

TO **NEIL M O'LEARY, MAYOR**
CITY OF WATERBURY
235 GRAND STREET

WATERBURY CT 06702
(508) 251-0720 X 3804 REF: 10-56-92009-6069
INV:
PO: DEPT:

552J3/C3B2/DCA5

FedEx Express

E

J182118081501uv

TRK# 0201 **7737 1460 0897**

WED - 14 NOV 10:30A
PRIORITY OVERNIGHT

EB BNHA

06702
CT-US **BDL**

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ORIGIN ID:BBFA (508) 251-0720
KRI PELLETIER
SBA COMMUNICATIONS CORPORATION
134 FLANDERS RD
SUITE 125
WESTBOROUGH, MA 01581
UNITED STATES US

SHIP DATE: 13NOV18
ACTWGT: 1.00 LB
CAD: 105843304/INET4040

BILL SENDER

TO JAMES A SEQUIN, CITY PLANNER
CITY OF WATERBURY, CITY HALL
235 GRAND ST

WATERBURY CT 06702
(508) 251-0720 X 3804 REF: 10-56-92009-6089
INV:
PO: DEPT:

552J3/C3B2/DCA5

FedEx Express

E

J182118081501uv

WED - 14 NOV 10:30A
PRIORITY OVERNIGHT

TRK# 0201 7737 1466 0550

06702
CT-US BDL

EB BNHA

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The Assessor's office is responsible for the maintenance of records on the ownership of properties. Assessments are computed at 70% of the estimated market value of real property at the time of the last revaluation which was 2017.

CITY OF WATERBURY

Information on the Property Records for the Municipality of Waterbury was last updated on 11/13/2018.

Property Summary Information

Parcel Data And Values | Building | Sales | Permits | Google Map

Parcel Information

Location:	FARMDALE DR	Property Use:	Storage	Primary Use:	Shed
Unique ID:	018505590032	Map Block Lot:	0185-0559-0032	Acres:	0.04
490 Acres:	0.00	Zone:	RL	Volume / Page:	4580/ 140
Developers Map / Lot:		Census:			

Value Information

	Appraised Value	Assessed Value
Land	11,550	8,080
Buildings	6,250	4,380
Detached Outbuildings	0	0
Total	17,800	12,460

Owner's Information

Owner's Data
WATER LLC C/O MCM ACQUISITION 2017 LLC ATTEN: TAX DEPT - CT22104-A 8051 CONGRESS AVE BOCA RATON, FL 33487

Back To Search (JavaScript:window.history.back(1);)

Print View (PrintPage.aspx?towncode=151&uniqueid=018505590032)

Water LLC / MCM Acquisition 2017 LLC merged 5/31/17

MILLENNIUM ENGINEERING, P.C.
132 Jaffrey Road
Malvern, Pennsylvania 19355
Cell: 610-220-3820 Fax: 610-644-4355
www.millenniumeng.com Email: pauldugan@comcast.net

November 11, 2018

Attn: Evan Hughes, Project Director, SDS
SBA Communications Corporation
470 Davidson Road
Pittsburgh, PA 15239

Re: RF Safety FCC Compliance of Proposed Communications Facility Modifications (MIMO)
SBA Site Name (ID): Waterbury 5, CT (CT22104-A-02)
Sprint Site Name (ID): Waterbury (CT03XC045)
Site Description: Collocation on Existing 180' Lattice Tower (186' Overall Height)
Site Address: 184 Garden Hill Circle, Waterbury, CT 06704 (City of Waterbury, New Haven County)
Latitude 40.57021388° N, Longitude 73.01649444° W, Ground Elevation: 830' +/- A.M.S.L.

Dear Mr. Hughes,

I have performed an analysis to provide an independent determination and certification that the proposed Sprint communications facility modifications at the above referenced property will comply with Federal Communications Commission (FCC) exposure limits and guidelines for human exposure to radiofrequency electromagnetic fields (Code of Federal Regulation 47 CFR 1.1307 and 1.1310). As a registered professional engineer, I am under the jurisdiction of the State Registration Boards in which I am licensed to hold paramount the safety, health, and welfare of the public and to issue all public statements in an objective and truthful manner.

The existing communications facility consists of collocation on an existing 180' lattice tower (186' overall height – top of lightning rod) owned by SBA Communications Corporation at the above referenced property. The existing Sprint antenna configuration from the information furnished to me consists of (1) 850/1900 MHz (LTE) dualband antenna (RFS APXVSPP18-C-A20 or equivalent) and (1) 2500 MHz (LTE) antenna (RFS APXVT14-C-I20 or equivalent) on each of three faces (total of 6 antennas) spaced with azimuths of 25/105/290 degrees on the horizontal plane at a centerline of 130' above ground level. Transmitting from these antennas currently is (1) 850 LTE wideband channel, up to (2) 1900 MHz LTE wideband channels and up to (2) 2500 MHz LTE wideband channels per face.

Sprint plans to remove the (3) existing 2500 MHz (LTE) antennas and replace them with (1) alternative 2500 MHz (LTE) antenna per face. The (3) existing 850/1900 MHz (LTE) dualband antennas will remain. The revised Sprint antenna configuration from the information furnished to me consists of (1) 850/1900 MHz (LTE) dualband antenna (RFS APXVSPP18-C-A20 or equivalent) and (1) 2500 MHz (LTE) antenna (Nokia AAHC or equivalent) on each of three faces (total of 6 antennas) spaced with azimuths of 25/105/290 degrees on the horizontal plane at a centerline of 130' above ground level. Transmitting from these antennas will be (1) 850 LTE wideband channel, up to (2) 1900 MHz LTE wideband channels and up to (2) 2500 MHz LTE wideband channels per face.

The following assumptions are made for reasonable upper limit radiofrequency operating parameters for the revised facility due to Sprint antennas alone to accommodate all licensed frequency bands:

- (1) 850/1900 MHz (LTE) dualband transmit antenna per face at 0-10 degrees mechanical downtilt
- (1) 2500 MHz (LTE) transmit antenna per face at 0-10 degrees mechanical downtilt
- (1) 850 MHz LTE wideband channel/face at 4x40W max power/face before cable loss/antenna gain
- (2) 1900 MHz LTE wideband channels/face at 2x4x40W max power/face before cable loss/antenna gain
- (2) 2500 MHz LTE wideband channels/face at 8x25W max power/face before cable loss/antenna gain
- The facility would be at or near full capacity during busy hour

Using the far-field power density equations from FCC Bulletin OET 65, the power density at any given distance from the antennas is equal to $0.360(ERP)/R^2$ where R is the distance to the point at which the exposure is being calculated. The given equation is a conversion of the OET 65 power density equation for calculating power density given the distance in feet and the result in metric units (mW/cm^2). This calculated power density assumes the location is in the main beam of the vertical pattern of the antenna. After making an adjustment for the reduction in power density due to the vertical pattern of the transmit antenna, the calculated ground level power density is well below 1 % of the FCC general population exposure limit at any distance from the antenna system of Sprint.

The 850 MHz (SMR) transmit frequencies (861-869 MHz), which Sprint is licensed by the FCC to operate, have an uncontrolled/general population maximum permissible exposure (MPE) FCC limit of 574 $\mu W/cm^2$ or 0.574 mW/cm^2. The 1900 MHz (PCS) “B Block” and “G Block” transmit frequencies (1950-1965, 1990-1995 MHz), which Sprint is also licensed by the FCC to operate, have an uncontrolled/general population MPE FCC limit of 1000 $\mu W/cm^2$ or 1 mW/cm^2. The 2500 MHz (BRS) transmit frequencies (2496-2673.5 MHz), which Sprint is also licensed by the FCC to operate, have an uncontrolled/general population MPE FCC limit of 1000 $\mu W/cm^2$ or 1 mW/cm^2. Therefore, the exposure at ground level at any distance from the structure would be substantially below 1 % of the FCC general population exposure limits due to Sprint antennas alone. The extremely low ground exposure levels are due to the elevated positions of the antennas in the structure and the low power which these systems operate. See Figures 1 and 2 in back of this report which discuss the relationship between height, proximity or distance, and orientation to level of electromagnetic field exposure.

From the information furnished to me, the existing structure currently contains one miscellaneous omni antenna and one other antenna array of Clearwire (owned by Sprint), as follows:

- Miscellaneous Omni Antenna: (1) omnidirectional antenna; elevated approximately 184’ above ground level; not included in our analysis since this antenna is currently disconnected/not in service

- Clearwire (owned by Sprint): (1) 2500 MHz (WiMAX) antenna (Argus LLPX310R-V1 or equivalent) on each of three faces and (4) 23 GHz (microwave) dish antennas (CommScope VHLP2-23-DW1 or equivalent) (total of 7 antennas); elevated approximately 136.8’ (2500 MHz) and 137.1’ (23 GHz) above ground level; licensed to transmit the 2500 MHz (BRS) frequencies (2496-2673.5 MHz) and in the 23 GHz microwave frequency range (21.2-23.6 GHz)

I have reviewed the antenna configurations and operating parameters of all licensees (existing & revised), performed a similar upper limit evaluation and find the composite ground level exposure will be well below 1 % of the FCC general population exposure limits anywhere in close proximity to the structure. Again, the extremely low ground exposure levels are due to the elevated positions of the antennas in the structure and the low power which these systems operate.

From the standpoint of RF exposure, the presence of Sprint does not preclude the future addition of other tenants or licensees including emergency or other municipal services which benefit the public from collocation on this structure. There is a substantial margin of safety to allow for the addition of transmit antennas of other communications services. Keep in mind that continuous exposure at 100 % of standard is considered by the scientific community as just as safe as 1 % of standard since the exposure limits themselves contain a large margin of safety.

In summary, the existing communications facility complies with all applicable exposure limits and guidelines adopted by the FCC governing human exposure to radiofrequency electromagnetic fields (FCC Bulletin OET 65). The facility will remain in compliance with the proposed antenna and operating parameter modifications of Sprint. Federal law (FCC Rule Title 47 CFR 1.1307 and 1.1310) sets the national standard for compliance with electromagnetic field safety. The FCC exposure limits are based on exposure limits recommended by the National Council on Radiation Protection and Measurements (NCRP) and, over a wide range of frequencies, the exposure limits developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI). **Thus, there is full compliance with the standards of the IRPA, FCC, IEEE, ANSI, and NCRP.**

General Information on Electromagnetic Field Safety

Sprint facilities transmit and receive low power electromagnetic fields (EMF) between base station antennas and handheld portable cell phones. The radiofrequency energy from these facilities and devices is non-ionizing electromagnetic energy. Non-ionizing, unlike X-Rays or other forms of potentially harmful energy in the microwave region, is not cumulative over time nor can the energy change the chemical makeup of atoms (e.g. strip electrons from ions). "Non-ionizing" simply means that the energy is not strong enough to break ionic bonds.

Safe levels of electromagnetic fields were determined by numerous worldwide organizations, such the International Committee for Non-Ionizing Radiation Protection, a worldwide multi-disciplinary team of researchers and scientists studying the effects of non-ionizing radiofrequency energy such as that emitted by base stations or cell phones. The FCC did not arbitrarily establish their own standards, but rather adopted the recommendations of all leading organizations that set standards and research the subject such as the Institute of Electrical and Electronics Engineers (IEEE), American National Standards Institute (ANSI), and National Council on Radiation Protection and Measurements (NCRP).

When Sprint is located on an antenna structure such as a self-supporting lattice type tower, lattice tower, guyed tower, watertank, etc. the antennas are typically 10 meters or more above ground level (10 meters = 32.81 feet). With the relatively low power and elevated positions of the antennas on the structure with respect to ground level, the maximum ground level exposure can rarely approach 1 % of the applicable FCC exposure limit regardless of how many sets of antennas are collocated on the structure. For this reason, the FCC considers the facilities "categorically excluded" from routine evaluation at antenna heights above 10 meters (or above 32.81 feet). Categorical exclusion exempts a site from routine on-site evaluation. However, the facility is not excluded from compliance with the federal exposure limits and guidelines. The types of facilities used by Sprint typically elevated on antenna structures (away from access to close proximity, i.e. greater than 10 meters or 32.81 feet) simply cannot generate ground level exposure levels that approach the limits under any circumstances.

From a regulatory perspective, the FCC has sole jurisdiction over the regulation of electromagnetic fields from all facilities and devices. The FCC has established guidelines and limits over emissions and exposure to protect the general public. The FCC also has certain criteria that trigger when an environmental evaluation must be performed. The criteria are based on distance from the antennas (accessibility) and transmit power levels.

CONCLUSIONS:

1) **The existing communications facility complies with electromagnetic field safety standards by a substantial margin (well below 1 %) in all publicly accessible areas. This includes the base of the existing structure and any areas in proximity to the existing structure.**

2) **Sprint takes appropriate measures to ensure that all telecommunications facilities (including this existing facility with proposed modifications) comply with applicable exposure limits and guidelines adopted by the FCC governing human exposure to radiofrequency electromagnetic fields (FCC Bulletin OET 65). With the proposed antenna and operating parameter modifications of Sprint, the composite electromagnetic field exposure from all existing and revised communications facilities together will remain well below 1 % of the applicable standards in all publicly accessible areas.**

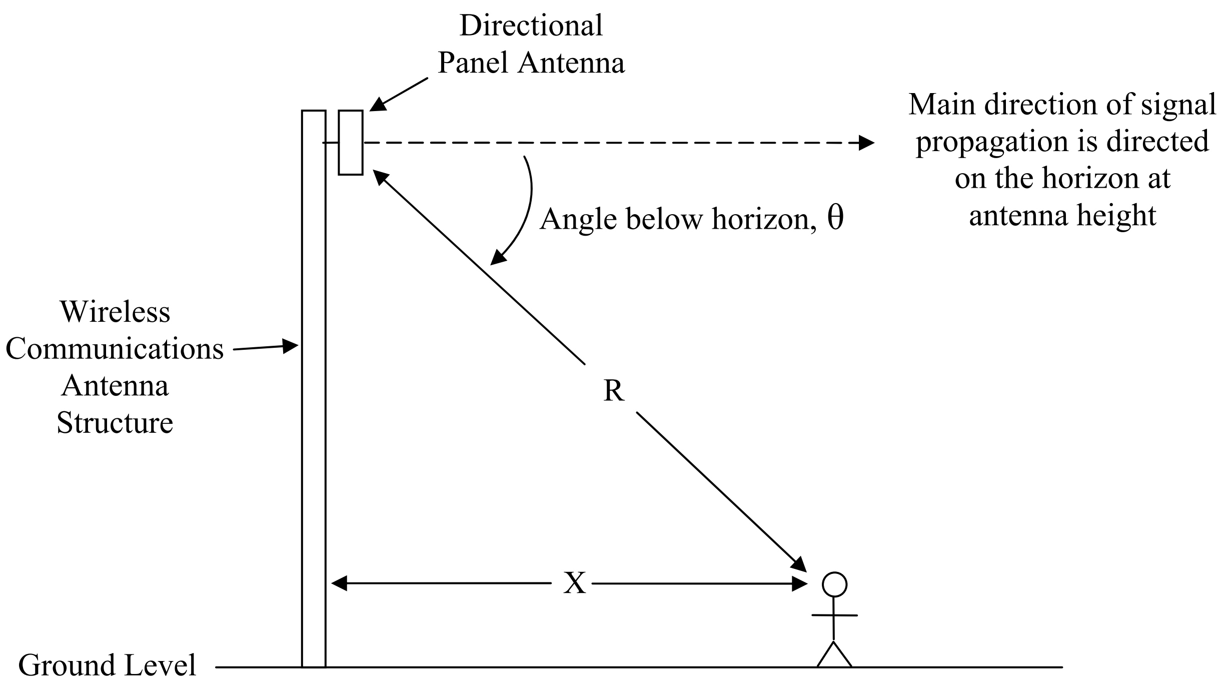
3) **In cases where such compliance exists, the subject of electromagnetic field safety is preempted**. The Telecommunications Act of 1996 states that: "No state or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the [FCC's] regulations concerning such emissions." Telecommunications Act of 1996, § 332[c][7][B][iv].

Respectfully,

Paul Dugan, P.E.
Registered Professional Engineer
Connecticut License Number 22566

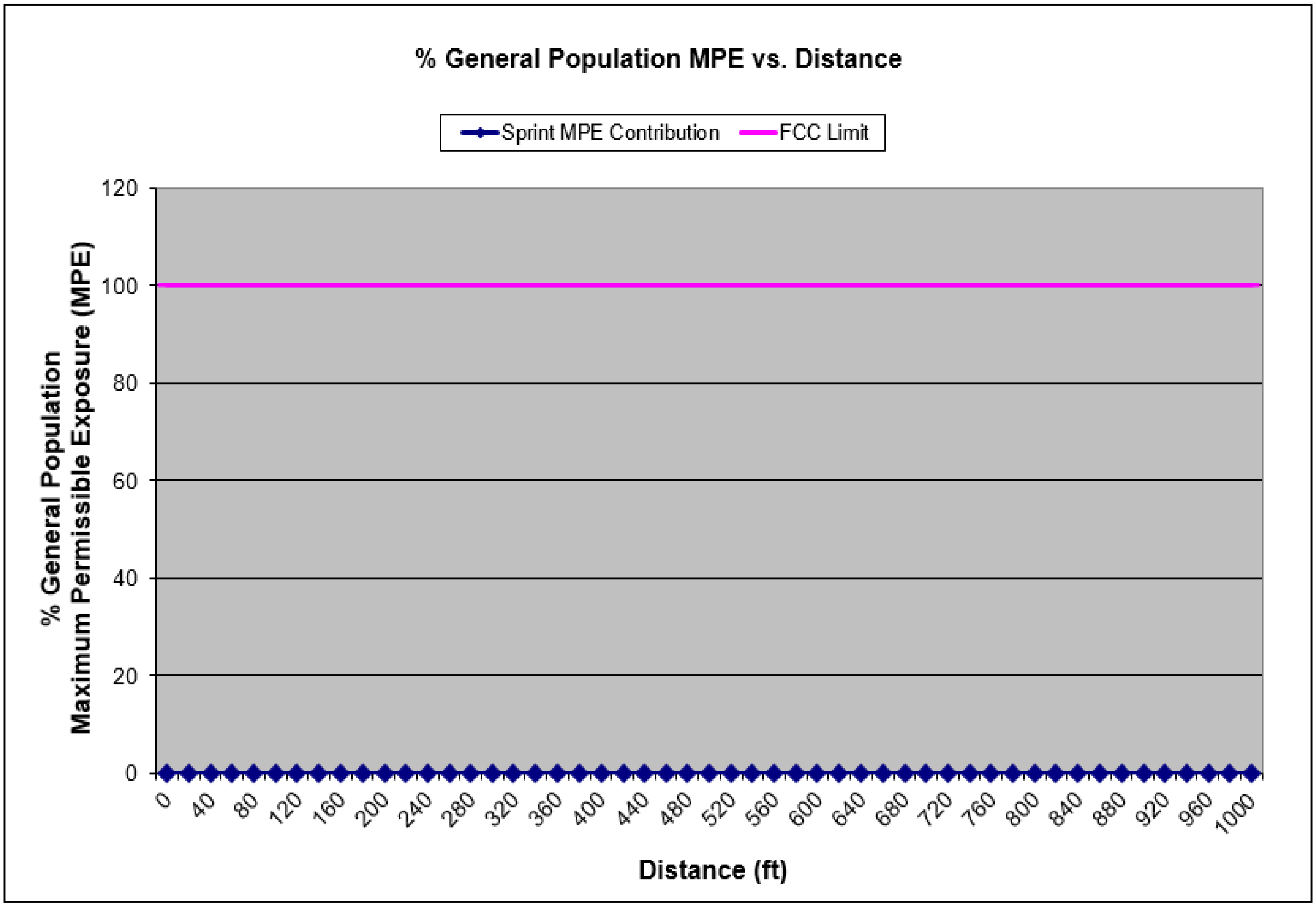
STATE OF CONNECTICUT
PAUL ALLEN DUGAN
No. 22566
LICENSED
PROFESSIONAL ENGINEER

FIGURE 1: Diagram of Electromagnetic Field Strength as a Function of Distance and Antenna Orientation



The above diagram illustrates the conceptual relationship of distance and orientation to directional panel antennas used in wireless communications. At the base of the structure ($x = 0$), the distance R is a minimum when the angle of the direction of propagation θ is a maximum. As one moves away from the antenna structure, the horizontal distance X increases as well as the distance R to the antennas while the angle below the horizon decreases. For this reason, electromagnetic fields from these facilities remain fairly uniform up to a few hundred feet and continue to taper off with distance. As noted in the report, the electromagnetic fields from these types of facilities are hundreds of times below safety standards at any distance from the antenna structure, making them essentially indistinguishable relative to other sources of electromagnetic fields in the environment due to the elevated heights of the antennas and the relatively low power at which these systems operate.

FIGURE 2: Graph of MPE Contribution vs. Distance



The above graph represents the contribution of Sprint to the composite electromagnetic field exposure level at any distance from the base of the structure. The contribution of Sprint will remain well under 1% of the FCC general population maximum permissible exposure (MPE) at any distance as shown.

DECLARATION OF ENGINEER

Paul Dugan, P.E., declares and states that he is a graduate telecommunications consulting engineer (BSE/ME Widener University 1984/1988), whose qualifications are a matter of record with the Federal Communications Commission (FCC). His firm, Millennium Engineering, P.C., has been retained by SBA Communications Corporation, on behalf of Sprint, to perform power density measurements or calculations for an existing or proposed communications facility and analyze the data for compliance with FCC exposure limits and guidelines for human exposure to radiofrequency electromagnetic fields.

Mr. Dugan also states that the calculations or measurements made in the evaluation were made by himself or his technical associates under his direct supervision, and the summary letter certification of FCC compliance associated with the foregoing document was made or prepared by him personally. Mr. Dugan is a registered professional engineer in the Jurisdictions of Pennsylvania, New Jersey, Delaware, Maryland, Virginia, New York, Connecticut, District of Columbia, West Virginia and Puerto Rico with over 30 years of engineering experience. Mr. Dugan is also an active member of the Association of Federal Communications Consulting Engineers, the National Council of Examiners for Engineering, the National Society of Professionals Engineers, the Pennsylvania Society of Professional Engineers, and the Radio Club of America. Mr. Dugan further states that all facts and statements contained herein are true and accurate to the best of his own knowledge, except where stated to be in information or belief, and, as to those facts, he believes them to be true. He believes under penalty of perjury the foregoing is true and correct.

Paul Dugan, P.E.

Executed this the 11th day of November, 2018.

PAUL DUGAN, P.E.
132 Jaffrey Road
Malvern, Pennsylvania 19355

Cell: 610-220-3820
Fax: 610-644-4355
Email: pauldugan@comcast.net
Web Page: www.millenniumeng.com

EDUCATION:

Widener University, Chester, Pennsylvania
Master of Business Administration, July 1991
Master of Science, Electrical Engineering, December 1988
Bachelor of Science, Electrical Engineering, May 1984

PROFESSIONAL ASSOCIATIONS:

Registered Professional Engineer in the following jurisdictions:

Pennsylvania, License Number PE-045711-E
New Jersey, License Number GE41731
Maryland, License Number 24211
Delaware, License Number 11797
Virginia, License Number 36239
Connecticut, License Number 22566
New York, License Number 079144
District of Columbia, License Number PE-900355
West Virginia, License Number 20258
Puerto Rico, License Number 18946

Full member of **The Association of Federal Communications Consulting Engineers** (www.afcce.org) January 1999 to Present
Elected to serve on the Board of Directors for 2006-2007

Full member of **The National Society of Professional Engineers** (www.nspe.org) and the **Pennsylvania Society of Professional Engineers** (www.pspe.org) June 2003 to Present
Currently serving on the Board of Directors of the Valley Forge Chapter and as South East Region Vice-Chair for the "Professional Engineers in Private Practice" Executive Committee

Actively participate in **Chester County ARES/RACES** (CCAR www.w3eoc.org) which prepares and provides emergency backup communications for Chester County Department of Emergency Services, March 2005 to Present

Full member of **The National Council of Examiners for Engineering** (www.ncees.org) May 2001 to Present

Full Member of **The Radio Club of America** (www.radio-club-of-america.org) December 2003 to present

PROFESSIONAL EXPERIENCE:

Millennium Engineering, P.C., Malvern, Pennsylvania
Position: **President**, August 1999 to Present (www.millenniumeng.com)

Verizon Wireless, Plymouth Meeting, Pennsylvania
Position: **Cellular RF System Design/Performance Engineer**, April 1990 to August 1999

Communications Test Design, Inc., West Chester, Pennsylvania
Position: **Electrical Engineer,** May 1984 to April 1990

ALLPRO CONSULTING GROUP, INC.
9221 Lyndon B. Johnson Freeway, #204, Dallas, TX 75243 ★ PHONE 972-231-8893 ★ FAX 1-866-364-8375
www.allprocgi.com ★ e-mail: info@allprocgi.com

Tower Structural Analysis Report for
SBA Network Services, Inc.

Existing 185' Self Support Tower

SBA Site Name: Waterbury 5, CT
SBA Site ID: CT22104-A-02
Carrier Name: Sprint Nextel
Carrier Site Name: CT03XC045 / Waterbury
Application # 95085, v2

Site Location: 184 Garden Circle
Waterbury, CT 06704
New Haven County

Latitude: 41.570363°
Longitude: -73.016444°

ACGI Job # 18-6240

ANALYSIS RESULTS		
Tower Components	55.4 %	**Pass**
Tower Foundation	10.1 %	**Pass**
Net Change in Tower Member Stresses	-41.9 %	**Change from previous SA by SC Wireless, Project # AE212, dated 12/20/12.**

Prepared By:
Tao Xiang
Staff Engineer, E.I.T.

STATE OF CONNECTICUT JOJI M. GEORGE No. 24444 LICENSED PROFESSIONAL ENGINEER

09/26/2018
Approved By:
Joji George, P.E.
CT PE # 24444

Table of Contents

1. ANALYSIS SUMMARY

The existing 185' Self Support Tower located in Waterbury, CT was analyzed by Allpro Consulting Group, Inc. (ACGI) for the existing loads and the proposed Sprint Nextel antennas, radios and coaxes as authorized by SBA Communication Corp. Based on the results of the analysis, the existing tower with below mentioned proposed and existing loading is found **to be in code compliance** with *TIA 222-G-Addendum 2, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and 2012 International Building Code.*

2. SCOPE & SOURCE OF INFORMATION

The purpose of this structural analysis is to determine whether the existing structure is capable of supporting the proposed loads.

SOURCE OF INFORMATION		
Tower Data:	Rohn	Tower design by ROHN, project # 23910DB, dated 05/12/89.
	Tectonic	Tower anchor bolt modification drawing by Tectonic, project # 3997.06, dated 11/01/2006
	CHA	Previous Modification design by CHA, project #20621-1014-1101, dated 07/12/2010.
		Previous tower structural analysis with modification by CHA, project # 20621-1014-28000, dated 10/13/2010.
	SC Wireless	Previous tower structural analysis by SC Wireless, project # AE212, dated 12/20/2012.
	FDH Velocitel	TIA Inspection Report by FDH Velocity, FDH Job # 17QAHN1500, dated 04/06/2017.
	HDG	Previous Mount Analysis by HDG, project # CT03XC045, dated 08/03/2018.
Foundation Data:	Rohn	Foundation drawings by ROHN, project # 23910DB, dated 05/12/89.
Geotechnical Report:	Earth Engineering Inc.	Geotechnical Report Prepared by Clarence Welti Assoc. Inc., dated 10/10/1988
Loading Data:	SC Wireless	Existing loading as per TIA report by FDH Velocity, FDH Job # 17QAHN1500, dated 04/06/2017.
	SBA Portal (sbasite.com)	Proposed final loading for Sprint Nextel as per SBA Portal (sbasite.com), Application ID 95085,v2
Authorization:	SBA Communication Corp.	

3. ANALYSIS METHODS & DATA

The analysis was performed in accordance with Telecommunication Industry Association specification TIA-222-G-Addendum 2. The tower was modeled using TNX Tower, a 3-D finite element program. TNX Tower is a general-purpose modeling, analysis, and design program created specifically for communication towers using the EIA-222-C, EIA-222-D, TIA/EIA-222-F or TIA-222-G standards. The 3-D model included the tower, with existing appurtenances and all proposed loads.

SITE DATA	
SBA Site Name:	Waterbury 5, CT
SBA Site Number:	CT22104-A-02
Carrier Site Name:	CT03XC045 / Waterbury
City, State:	Waterbury, CT
County:	New Haven
Code Wind Load Requirement:	ANSI/TIA-222-G & IBC 2012 (125 mph ultimate wind speed, equivalent to 97 mph basic wind speed) per local criteria.
Wind Load Used:	ANSI/TIA-222-G Code: • Basic wind speed of 97 mph (3 second gust wind speed) • Structure Class II. • Exposure Category B. • Topographic Category 1. • A wind speed of 50 mph is used in combination with ice. • Nominal ice thickness of 0.75 in.
Seismic Check:	Ss = 0.188 g < 1.0g, thus seismic loading can be ignored as per 2.7.3 of the TIA-222-G codes.

This structural analysis is based upon the tower being classified as a class II; however, if a different classification is required subsequent to the date hereof, the tower classification will be changed to meet such requirement and a new structural analysis will be run.

TOWER DATA	
Tower Type:	3 Sided Self Support Tower
Height:	185'
Cross Section:	Triangular
Steel Strength:	Legs – 50 ksi, Braces – 50ksi/36 ksi
Type of Foundation:	Pier Foundation w/ Anchor Rod

TOWER HISTORY	
Tower Manufacturer / Model:	ROHN
Date of Original Design:	05/12/89
Previous Modifications:	Tower anchor bolt modification design by Tectonic, project # 3997.06, dated 11/01/2006 Previous Modification design by CHA, project #20621-1014-1101, dated 07/12/2010.
Original Design Code Req.:	EIA/TIA-222-F

4. ASSUMPTIONS

This analysis was completed based on the following assumptions:

- Tower has been properly maintained
- Tower erection was in accordance to manufacturer drawings
- Leg flanges have been properly designed by manufacturer to not be a limiting reaction
- Welds have been properly designed and installed by manufacturer to not be a limiting reaction
- Foundation was constructed in accordance to manufacturer drawings
- Foundation does not have structural damage
- Bolts have been properly tightened according to manufacturer specifications
- Appurtenance, mount and transmission line sizes and weights are best estimates using the tnxTower database and manufacturer information

5. DISCLAIMER

Installation procedures and related loading are not within the scope of this analysis. A contractor experienced in similar work should perform all installation work. The engineering services provided by Allpro Consulting Group, Inc. (ACGI) are limited to the computer analysis and calculations of the structure with the proposed and existing loads. This analysis is considered void if the loading mentioned in this report is changed or is different as installed. It is assumed that the existing structure is properly maintained and is in good condition free of any defects. Scope of this analysis does not include existing connections, except as noted in this report. It is assumed that the tower is in good condition and free from damage and defects.

ACGI does not make any warranties, expressed or implied in connection with this engineering analysis report and disclaims any liability arising from deficiencies or any existing conditions of the original structure. ACGI will not be responsible for consequential or incidental damages sustained by any parties as a result of any data or conclusions included in this Report. The maximum liability of ACGI pursuant to this report shall be limited to the consulting fee received for the preparation of the report.

6. CONCLUSIONS

RESULT SUMMARY			
MEMBER		*% Capacity*	*Pass/Fail*
Leg		**44.6 %**	**Pass**
Diagonal		**55.4 %**	**Pass**
Horizontal		**35.8 %**	**Pass**
Top Girt		**5.8 %**	**Pass**
Redundant Horizontal		**36.7 %**	**Pass**
Redundant Diagonal		**40.5 %**	**Pass**
Redundant Hip		**0.6 %**	**Pass**
Redundant Hip Diagonal		**0.8 %**	**Pass**
Inner Bracing		**0.4 %**	**Pass**
Bolt Checks		**45.8 %**	**Pass**
Anchor Bolt Check		**39.7 %**	**Pass**
TOWER FOUNDATION			
Pier Foundation w/ Anchor Rod	Download	**10.1 %**	**Pass**
	Uplift	**3.6 %**	**Pass**
Tower Overall Rating = 55.4 % (Pass)			

TWIST AND SWAY AT SERVICE WIND SPEED			
MW Dish	**Tilt (deg.)**	**Twist (deg.)**	**Pass/Fail**
Andrew VHLP2-223-DW1 Dishes @ 137.1'	0.045°	0.004°	**N/A**

*Note: It is the responsibility of the carrier to determine allowable deflection for microwave dishes and ensure they are greater than these values.

As per the results of the analysis, the existing tower **to be in code compliance** for the proposed and existing antenna loads.

Maximum tower member stress **is less than allowable, making it in code compliance** under the TIA-222-G code and IBC 2012 requirements.

The Stress ratio reduced by 41.7 % compare to the previous SA by SC Wireless, project # AE212, dated 12/20/2012, due to changing building code and equipment loading.

7. APPURTENANCE LISTING

EXISTING ANTENNA LOAD DESCRIPTION					
ELEV (ft.)	***Qty.***	***Antenna Description***	***Mount Type & Qty.***	***TX. LINE (in)***	***TENANT***
184.'±	1	2.5"∅x8.0' Omni	Direct	-	Unknown
178'±	-	-	(1)2.4"∅x5.5' Pipe mount	-	
168'±	-	-	(1)1.9"∅x5.5' Pipe mount	-	
145'±	-	-	(1)1.9"∅x5.5' Pipe mount	-	
137.1'±	4	Andrew VHLP2-223-DW1 Dishes	(3) 12.5'x4.0' Sector Frames w/ (9) 3.5"∅x7.0'Pipe Mount @ 132.8'	(4) 1/2" Coax	Clearwire
136.8'±	3	Argus LLPX310R-V1 Panel		(2) 2.4" ∅F.C.	
135.8'±	4	Samsung RRH2WB0 01 RRHs			
133.3'±	1	1.4'x1.2'x4.0" Junction Box	Direct @ 133.6'		
130'±	3	RFS APXVSPP18-C-A20 Antenna	(3) 19' Face Mounts w/ (3) pipe mount	(3) 1-1/4" Fiber (3) 1-5/8" Fiber	Sprint Nextel
	3	RFS APXVTM14-C-I20 Antena			
	3	ALU 800MHz RRH			
	6	ALU 1900MHz RRH			
	3	TD-RRH8x20-25 RRU/RRH			
	3	RFS IBC1900BB-1 Combiner			
	3	RFS IBC1900HG-2A Combiner			
125'±	-	-	(1)2.4"∅x3.0' Pipe mount	-	Unknown
20'±	-	-	(1)2.4"∅x24' Pipe mount	-	

FINAL SPRINT NEXTEL LOAD DESCRIPTION					
ELEV (ft.)	***Qty.***	***Antenna Description***	***Mount Type & Qty.***	***TX. LINE (in)***	***TENANT***
130'±	3	RFS APXVSPP18-C-A20 Antenna	(3) 19' Face Mounts w/ (3) pipe mount	(3) 1-1/4" Hybrid (2) 1-5/8" Hybrid (1) 1.66" Hybrid	Sprint Nextel
	3	Nokia AAHC Antenna			
	3	ALU 800MHz RRH			
	6	ALU 1900MHz RRH			
	3	TD-RRH8x20-25 RRU/RRH			
	3	RFS IBC1900BB-1 Combiner			
	3	RFS IBC1900HG-2A Combiner			

Notes:

1. ACGI should be notified of any discrepancies found in the data listed in this report.
2. Notify Allpro Consulting Group, Inc. of any potential physical and other interference with existing antennas for a redesign.

8. SUMMARY OF WORKING PERCENTAGE OF STRUCTURAL COMPONENTS

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	øP_allow K	% Capacity	Pass Fail
T1	180 - 160	Leg	ROHN 2.5 X-STR	1	-1.949	58.512	3.3	Pass
T2	160 - 140	Leg	ROHN 3 STD	27	-6.877	70.891	9.7	Pass
T3	140 - 120	Leg	ROHN 3.5 X-STR	48	-17.173	89.148	19.3	Pass
T4	120 - 100	Leg	ROHN 4 EH	62	-32.370	122.171	26.5	Pass
T5	100 - 80	Leg	ROHN 4 EH	77	-48.783	122.170	39.9	Pass
T6	80 - 60	Leg	ROHN 5 X-STR	92	-66.312	201.243	33.0	Pass
T7	60 - 40	Leg	ROHN 5 EH	107	-84.530	201.200	42.0	Pass
T8	40 - 20	Leg	ROHN 5 EH	122	-89.781	201.133	44.6	Pass
T9	20 - 0	Leg	ROHN 6 EHS	155	-106.215	243.965	43.5	Pass
T1	180 - 160	Diagonal	L2x2x1/8	8	-0.635	2.500	25.4	Pass
T2	160 - 140	Diagonal	L2 1/2x2 1/2x3/16	29	-1.148	5.674	20.2	Pass
T3	140 - 120	Diagonal	L3x3x3/16	51	-3.736	6.743	55.4	Pass
T4	120 - 100	Diagonal	L3 1/2x3 1/2x1/4	66	-4.381	11.957	36.6	Pass
T5	100 - 80	Diagonal	L3 1/2x3 1/2x1/4	81	-5.091	10.111	50.4	Pass
T6	80 - 60	Diagonal	L4x4x1/4	97	-5.853	13.115	44.6	Pass
T7	60 - 40	Diagonal	L4x4x5/16	112	-6.348	13.647	46.5	Pass
T8	40 - 20	Diagonal	ROHN 2.5 EH	135	-10.497	20.462	51.3	Pass
T9	20 - 0	Diagonal	ROHN 3 STD	168	-10.418	30.240	34.5	Pass
T8	40 - 20	Horizontal	ROHN 2.5 STD	131	-5.625	15.893	35.4	Pass
T9	20 - 0	Horizontal	ROHN 2.5 EH	164	-5.900	16.472	35.8	Pass
T1	180 - 160	Top Girt	L2x2x1/8	4	-0.068	1.175	5.8	Pass
T8	40 - 20	Redund Horz 1 Bracing	ROHN 1.5 TUBE	129	-1.652	6.034	27.4	Pass
T9	20 - 0	Redund Horz 1 Bracing	ROHN 1.5 TUBE	162	-1.843	5.020	36.7	Pass
T8	40 - 20	Redund Diag 1 Bracing	ROHN 1.5 STD	130	-1.515	3.739	40.5	Pass
T9	20 - 0	Redund Diag 1 Bracing	ROHN 2.25 TUBE	167	-1.580	7.343	21.5	Pass
T8	40 - 20	Redund Hip 1 Bracing	ROHN 1.5 TUBE	138	-0.023	5.596	0.4	Pass
T9	20 - 0	Redund Hip 1 Bracing	ROHN 1.5 TUBE	171	-0.025	4.626	0.6	Pass
T8	40 - 20	Redund Hip Diagonal 1 Bracing	ROHN 2.5 STD	139	-0.083	10.623	0.8	Pass
T9	20 - 0	Redund Hip Diagonal 1 Bracing	ROHN 2.5 STD	172	-0.079	9.548	0.8	Pass
T8	40 - 20	Inner Bracing	ROHN 2 STD	151	-0.014	6.664	0.4	Pass
T9	20 - 0	Inner Bracing	ROHN 3 STD	184	-0.018	24.965	0.3	Pass
							Summary	
						Leg (T8)	44.6	Pass
						Diagonal (T3)	55.4	Pass
						Horizontal (T9)	35.8	Pass
						Top Girt (T1)	5.8	Pass
						Redund Horz 1 Bracing (T9)	36.7	Pass
						Redund Diag 1 Bracing (T8)	40.5	Pass
						Redund Hip 1 Bracing (T9)	0.6	Pass
						Redund Hip Diagonal 1 Bracing (T9)	0.8	Pass
						Inner Bracing (T8)	0.4	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
						Bolt Checks	45.8	Pass
						RATING =	**55.4**	**Pass**

APPENDIX

TOWER DATA

CT22104-A-02 Waterbury 5, CT

Exposure B

USGS Design Maps Summary Report

User–Specified Input

Report Title CT22104-A-02 Waterbury
Mon September 24, 2018 21:40:18 UTC

Building Code Reference Document 2012/2015 International Building Code
(which utilizes USGS hazard data available in 2008)

Site Coordinates 41.57036°N, 73.01644°W

Site Soil Classification Site Class D – "Stiff Soil"

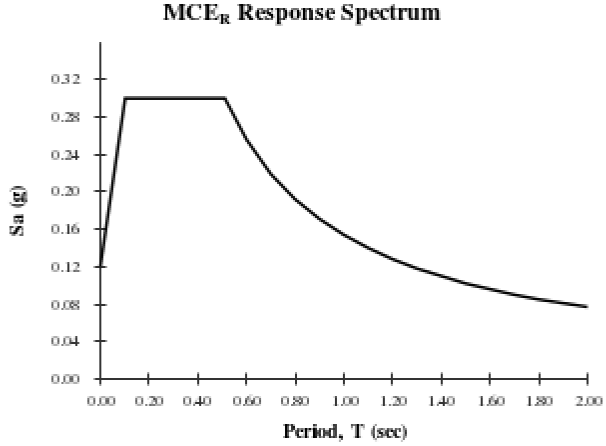
Risk Category I/II/III

USGS–Provided Output

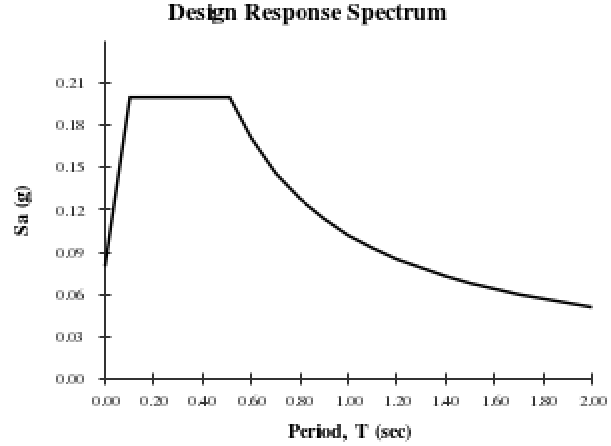
S_S =	0.188 g	**S_{MS} =**	0.300 g	**S_{DS} =**	0.200 g
S_1 =	0.064 g	**S_{M1} =**	0.154 g	**S_{D1} =**	0.102 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

MCE_R Response Spectrum



Design Response Spectrum



CONNECTICUT DESIGN CRITERIA - STATE

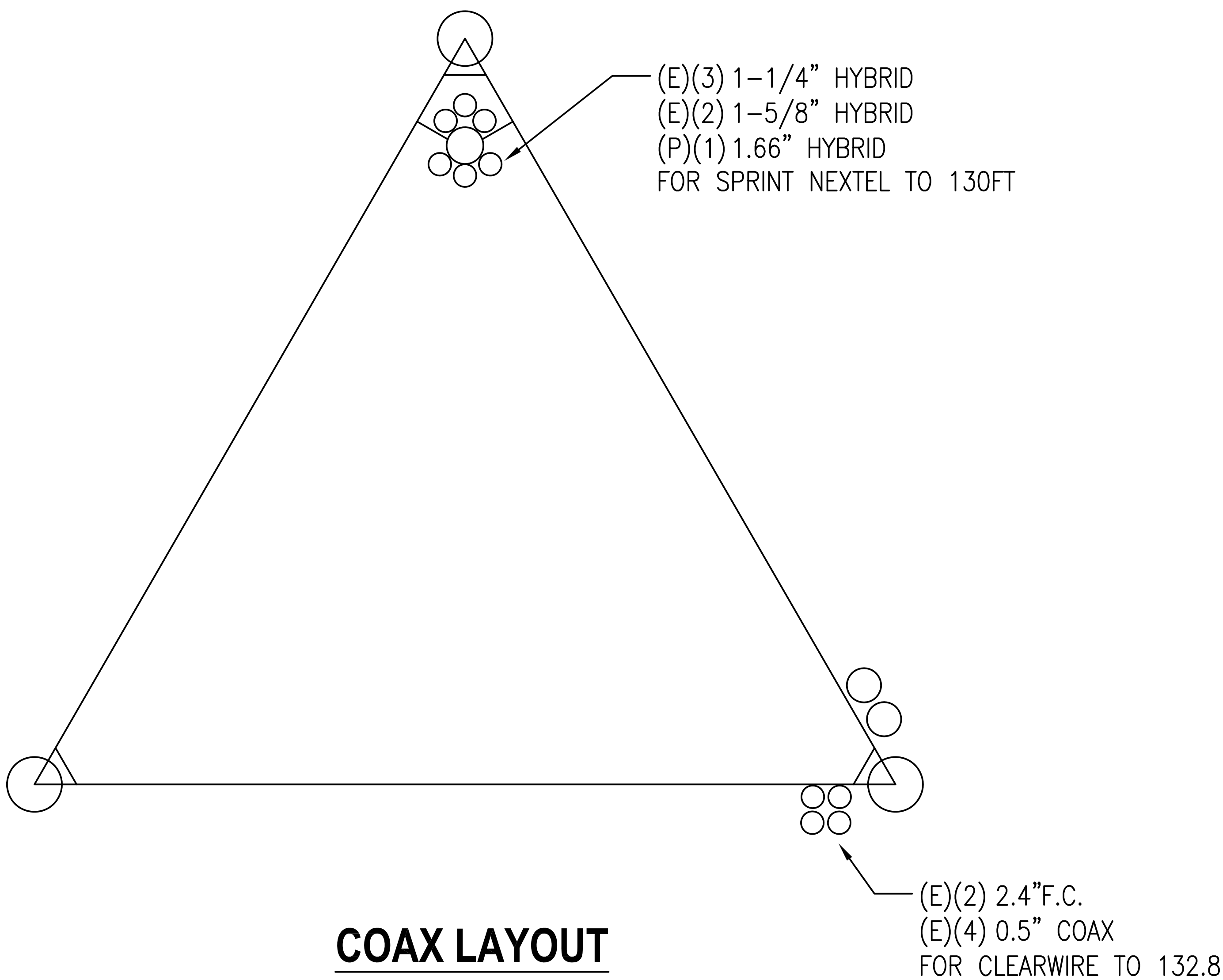
Revison: R-263 8/23/2018

CT is NOT a Home Rule State; Tab added only for Design Criteria

(APPENDIX N) MUNICIPALITY - SPECIFIC STRUCTURAL DESIGN PARAMETERS

Municipality	Ground Snow Load	MCE Spectral Accelerations (%g)		*Wind Design Parameters* Ultimate Design Wind Speeds, V_{ult} (mph)			Nominal Design Wind Speeds, V_{asd} (mph)			Wind-Borne Debris Regions[1]		Hurricane-Prone Regions
		S_s	S_1	Risk Cat.I	Risk Cat.II	Risk Cat III-IV	Risk Cat. I	Risk Cat. II	Risk Cat. III-IV	Risk Cat. II & III except Occup I-2	Risk Cat III Occup I-2 & Risk Cat. IV	
Warren	40	0.186	0.065	105	115	125	81	89	97			
Washington	35	0.192	0.065	105	120	125	81	93	97			Yes
Waterbury	35	0.189	0.064	110	125	130	85	97	101			Yes
Waterford	30	0.161	0.058	125	135	145	97	105	112	Type B	Type A	Yes
Watertown	35	0.189	0.064	110	120	130	85	93	101			Yes
Westbrook	30	0.167	0.059	120	135	145	93	105	112	Type B	Type A	Yes
West Hartford	30	0.181	0.064	115	125	135	89	97	105			Yes
West Haven	30	0.188	0.062	115	125	135	89	97	105		Type B	Yes
Weston	30	0.224	0.067	110	120	130	85	93	101			Yes
Westport	30	0.226	0.067	110	120	130	85	93	101		Type B	Yes
Wethersfield	30	0.181	0.064	115	125	135	89	97	105			Yes
Willington	35	0.174	0.063	115	125	135	89	97	105			Yes
Wilton	30	0.231	0.068	110	120	130	85	93	101			Yes
Winchester	40	0.177	0.065	105	120	125	81	93	97			Yes
Windham	30	0.173	0.062	120	130	140	93	101	108			Yes
Windsor	35	0.179	0.064	115	125	135	89	97	105			Yes
Windsor Locks	35	0.177	0.064	110	125	130	85	97	101			Yes
Wolcott	35	0.187	0.064	110	125	130	85	97	101			Yes
Woodbridge	30	0.191	0.063	115	125	135	89	97	105			Yes
Woodbury	35	0.194	0.065	110	120	130	85	93	101			Yes
Woodstock	40	0.172	0.063	120	130	140	93	101	108			Yes

COAX LAYOUT

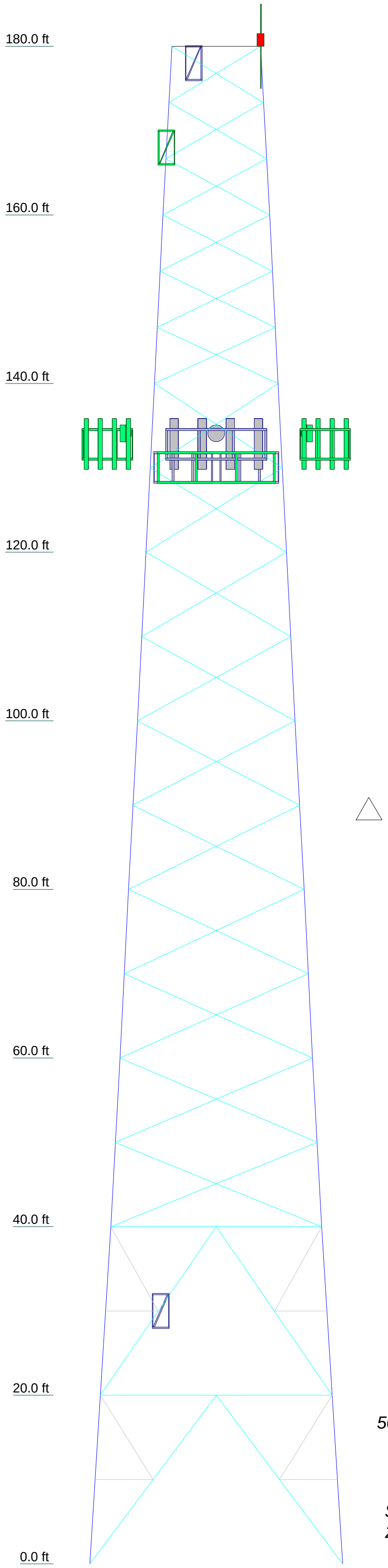


COAX LAYOUT

N.T.S

TOWER ELEVATION DRAWINGS

Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Horizontals	Red. Horizontals	Red. Diagonals	Red. Hips	Inner Bracing	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	ROHN 2.5 X-STR	A572-50	L2x2x1/8	A36	L2x2x1/8	N.A.	N.A.	N.A.	N.A.	N.A.	10.5599	6 @ 6.66667	1.0
T2	ROHN 3 STD		L2 1/2x2 1/2x3/16		N.A.						12.599		1.4
T3	ROHN 3.5 X-STR		L3x3x3/16								14.651		1.7
T4	ROHN 4 EH		L3 1/2x3 1/2x1/4	A572-50							16.6901	10 @ 10	2.4
T5											18.7292		2.6
T6	ROHN 5 X-STR		L4x4x1/4								20.7708		3.3
T7	ROHN 5 EH		L4x4x5/16								22.8099		4.0
T8			ROHN 2.5 EH			ROHN 2.5 STD	ROHN 1.5 TUBE	ROHN 1.5 STD	ROHN 1.5 TUBE	ROHN 2 STD	25.0391	2 @ 20	3.7
T9	ROHN 6 EHS		ROHN 3 STD			ROHN 2.5 EH		ROHN 2.25 TUBE		ROHN 3 STD	27.5391		4.3
											30.0391		24.2



MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

TOWER DESIGN NOTES

1. Tower is located in New Haven County, Connecticut.
2. Tower designed for Exposure B to the TIA-222-G Standard.
3. Tower designed for a 97 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 50 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0'
8. TOWER RATING: 55.4%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 121 K
SHEAR: 18 K

UPLIFT: -87 K
SHEAR: 14 K

AXIAL 95 K
SHEAR 8 K
MOMENT 810 kip-ft
TORQUE 8 kip-ft
50 mph WIND - 0.750 in ICE

AXIAL 40 K
SHEAR 29 K
MOMENT 2797 kip-ft
TORQUE 23 kip-ft
REACTIONS - 97 mph WIND

Allpro Consulting Group, Inc.
9221 Lyndon B Johnson Fwy, Suite 204
Dallas, TX
Phone: 972 231-8993
FAX: 866 364-8375

Job:	***18-6240***
Project:	***CT22104-A-02 Waterbury 5, CT SA***
Client:	SBA Communications Corporation
Drawn by:	TX
App'd:	
Code:	TIA-222-G
Date:	09/26/18
Scale:	NTS
Path:	P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri
Dwg No.	E-1

Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Horizontals	Red. Horizontals	Red. Diagonals	Red. Hips	Inner Bracing	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	ROHN 2.5 X-STR	A572-50	L2x2x1/8	A36	L2x2x1/8	N.A.	N.A.	N.A.	N.A.	N.A.	10.5599	6 @ 6.66667	1.0
T2	ROHN 3 STD		L2 1/2x2 1/2x3/16		N.A.						12.599		1.4
T3	ROHN 3.5 X-STR		L3x3x3/16								14.651	10 @ 10	1.7
T4	ROHN 4 EH		L3 1/2x3 1/2x1/4	A572-50							16.6901		2.4
T5											18.7292		2.6
T6	ROHN 5 X-STR		L4x4x1/4								20.7708		3.3
T7	ROHN 5 EH		L4x4x5/16								22.8099		4.0
T8			ROHN 2.5 EH			ROHN 2.5 STD	ROHN 1.5 TUBE	ROHN 1.5 STD	ROHN 1.5 TUBE	ROHN 2 STD	25.0391	2 @ 20	3.7
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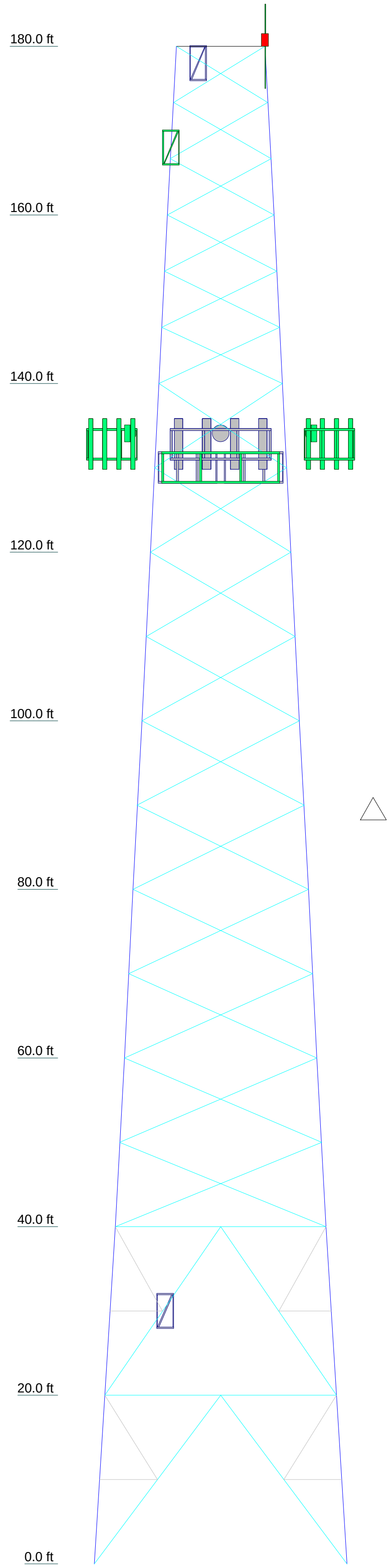
											30.0391		24.2



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 1/2"x6'	180	800 MHz RRH (Sprint)	130
Beacon	180	800 MHz RRH (Sprint)	130
2.5"x8.0' Omni (Unknown)	180	(2) 1900 MHz RRH (Sprint)	130
2.4"x5.5' Pipe Mount	178	(2) 1900 MHz RRH (Sprint)	130
1.9"x5.5' pipe Mount	168	(2) 1900 MHz RRH (Sprint)	130
1.9"x5.5' pipe Mount	145	TD-RRH8x20-25 (Sprint)	130
(2) VHLP2-23	137.099	TD-RRH8x20-25 (Sprint)	130
VHLP2-23	137.099	TD-RRH8x20-25 (Sprint)	130
VHLP2-23	137.099	IBC1900BB-1 Combiner (Sprint)	130
LLPX310R-V1 (Clearwire)	136.799	IBC1900BB-1 Combiner (Sprint)	130
LLPX310R-V1 (Clearwire)	136.799	IBC1900BB-1 Combiner (Sprint)	130
LLPX310R-V1 (Clearwire)	136.799	IBC1900HG-2A Combiner (Sprint)	130
(2) RRH2WB0 01 RRH (Clearwire)	135.799	IBC1900HG-2A Combiner (Sprint)	130
RRH2WB0 01 RRH (Clearwire)	135.799	IBC1900HG-2A Combiner (Sprint)	130
RRH2WB0 01 RRH (Clearwire)	135.799	AAHC (Sprint)	130
Junction Box (Clearwire)	133.299	AAHC (Sprint)	130
12.5' Sector Frame (Clearwire)	132.799	AAHC (Sprint)	130
12.5' Sector Frame (Clearwire)	132.799	APXVSPP18-C-A20 (Sprint)	130
12.5' Sector Frame (Clearwire)	132.799	APXVSPP18-C-A20 (Sprint)	130
(1) 19' Face Mount (Sprint)	130	APXVSPP18-C-A20 (Sprint)	130
(1) 19' Face Mount (Sprint)	130	2.4"x3.0' Pipe Mount	125
(1) 19' Face Mount (Sprint)	130	2.4"x24' Pipe Mount	30
800 MHz RRH (Sprint)	130		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

TOWER DESIGN NOTES

1. Tower is located in New Haven County, Connecticut.
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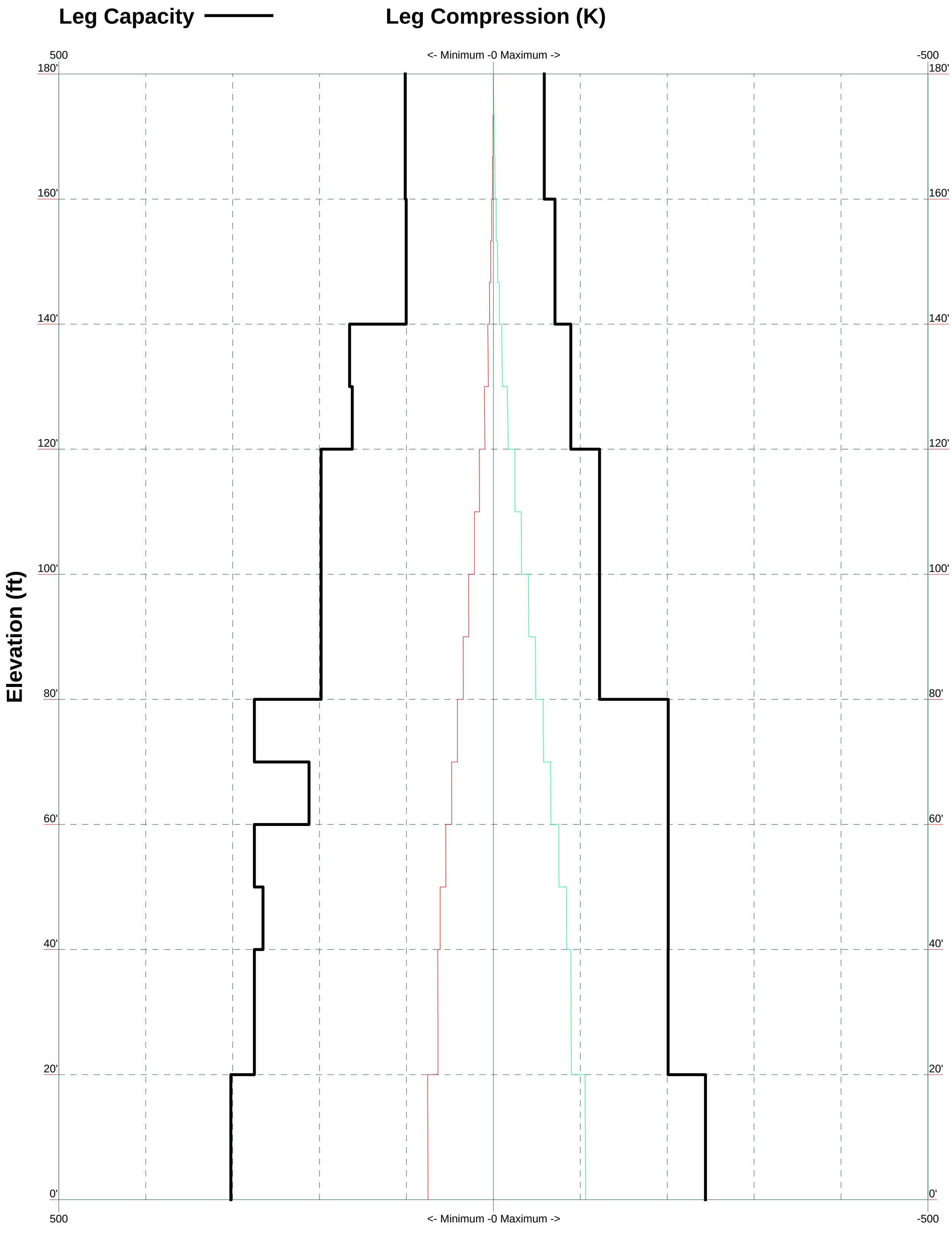
Code: TIA-222-G		Date: 09/26/18	Scale: NTS
Path: P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri			Dwg No. E-1

MISCELLANEOUS PLOTS

TIA-222-G - 97 mph/50 mph 0.750 in Ice Exposure B



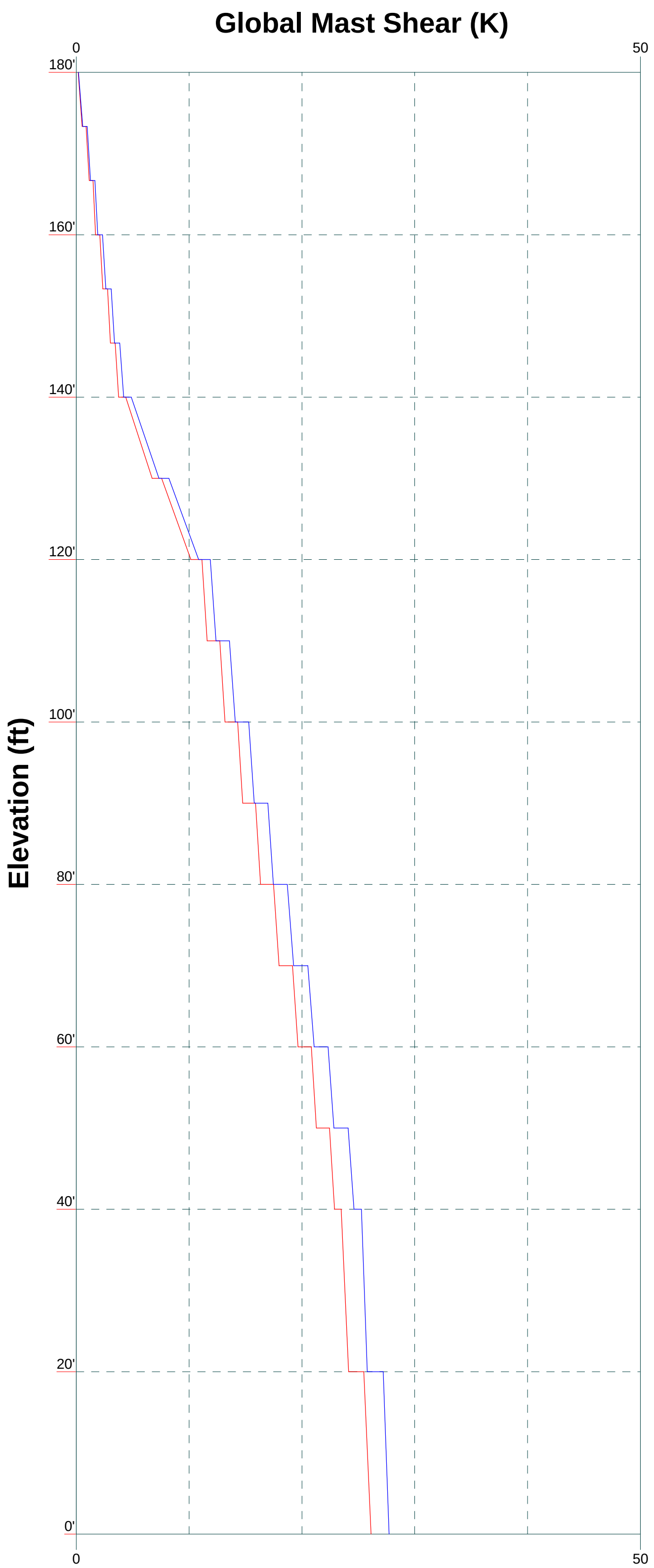
Allpro Consulting Group, Inc.
9221 Lyndon B Johnson Fwy, Suite 204
Dallas, TX
Phone: 972 231-8993
FAX: 866 364-8375

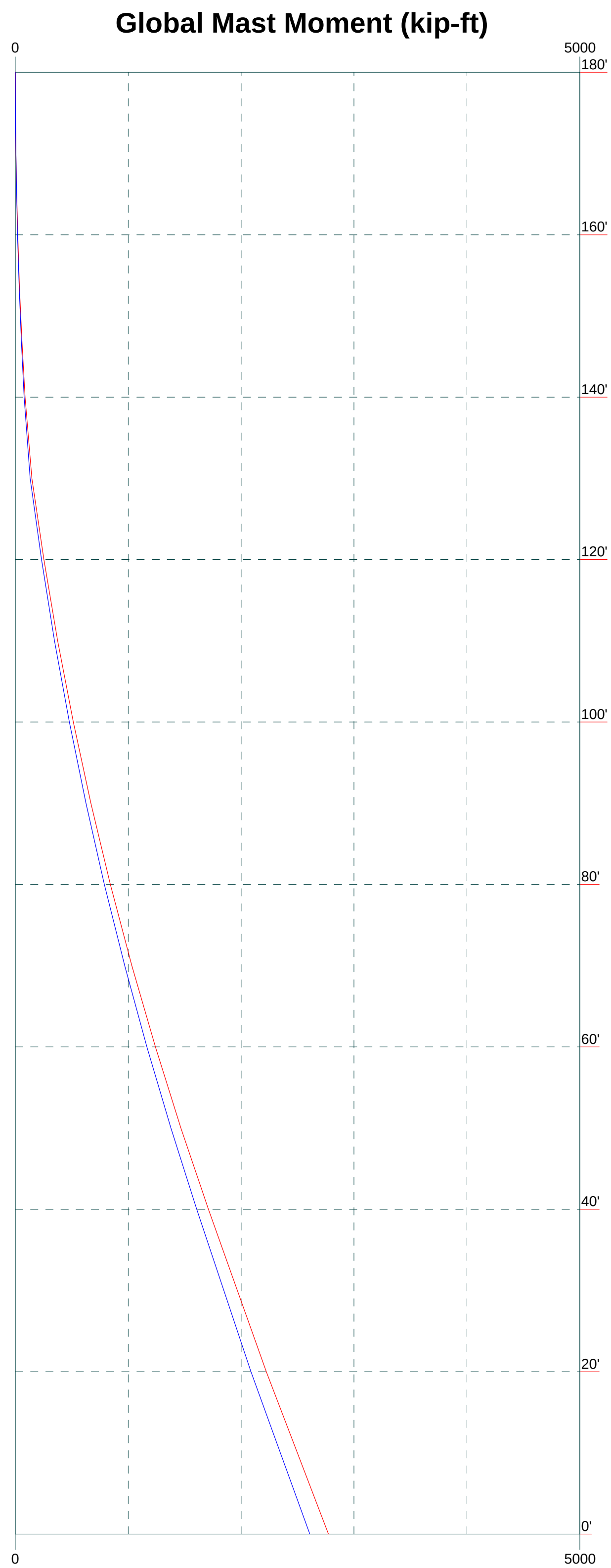
Job: ***18-6240***		
Project: ***CT22104-A-02 Waterbury 5, CT SA***		
Client: SBA Communications Corporation	Drawn by: TX	App'd:
Code: TIA-222-G	Date: 09/26/18	Scale: NTS
Path: P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri		Dwg No. E-3

TIA-222-G - 97 mph/50 mph 0.750 in Ice Exposure B

Maximum Values

Vx Vz Mx Mz

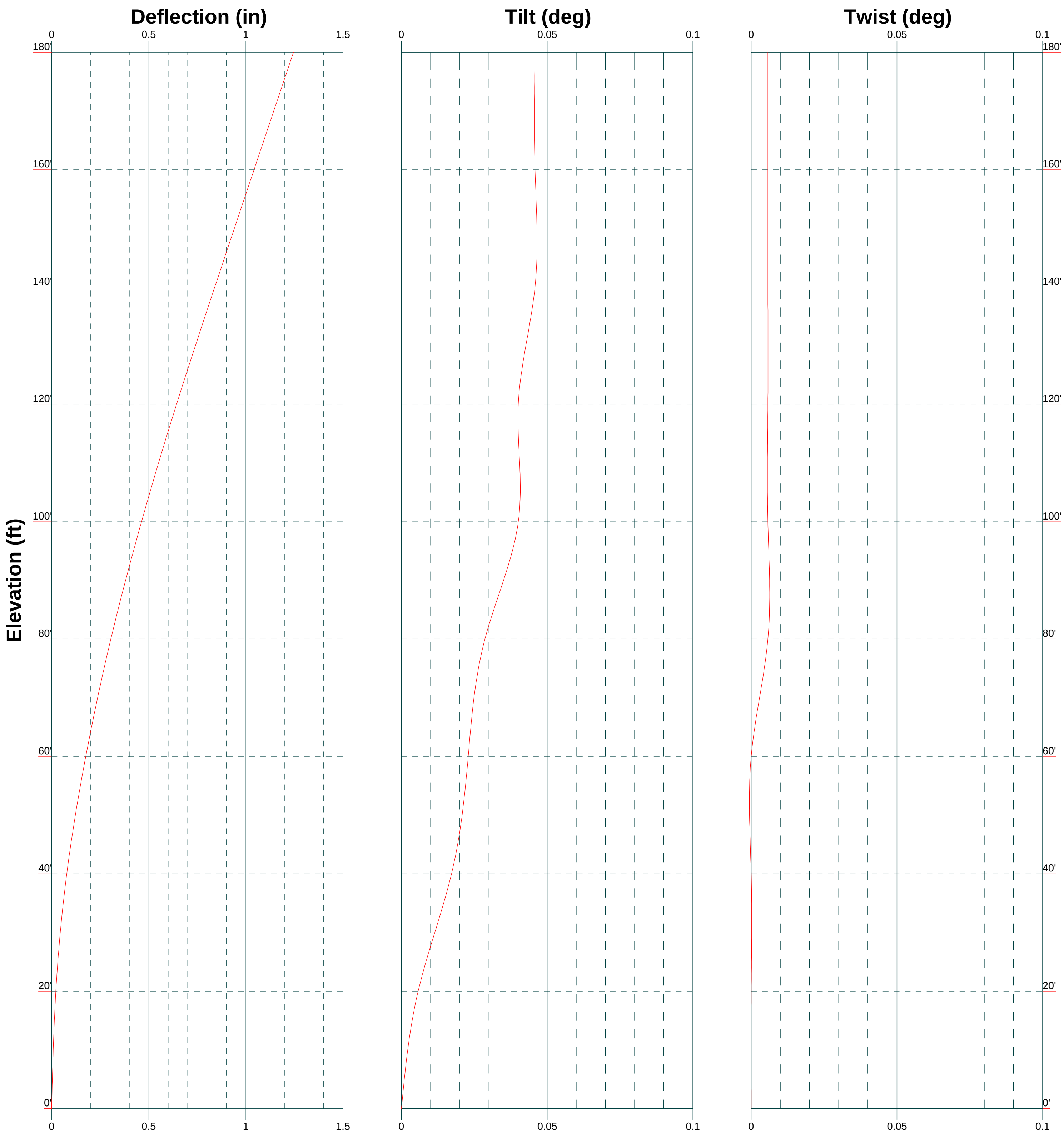




Allpro Consulting Group, Inc.	Job: ***18-6240***		
9221 Lyndon B Johnson Fwy, Suite 204	Project: ***CT22104-A-02 Waterbury 5, CT SA***		
Dallas, TX	Client: SBA Communications Corporation	Drawn by: TX	App'd:
Phone: 972 231-8993	Code: TIA-222-G	Date: 09/26/18	Scale: NTS
FAX: 866 364-8375	Path: P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri		Dwg No. E-4

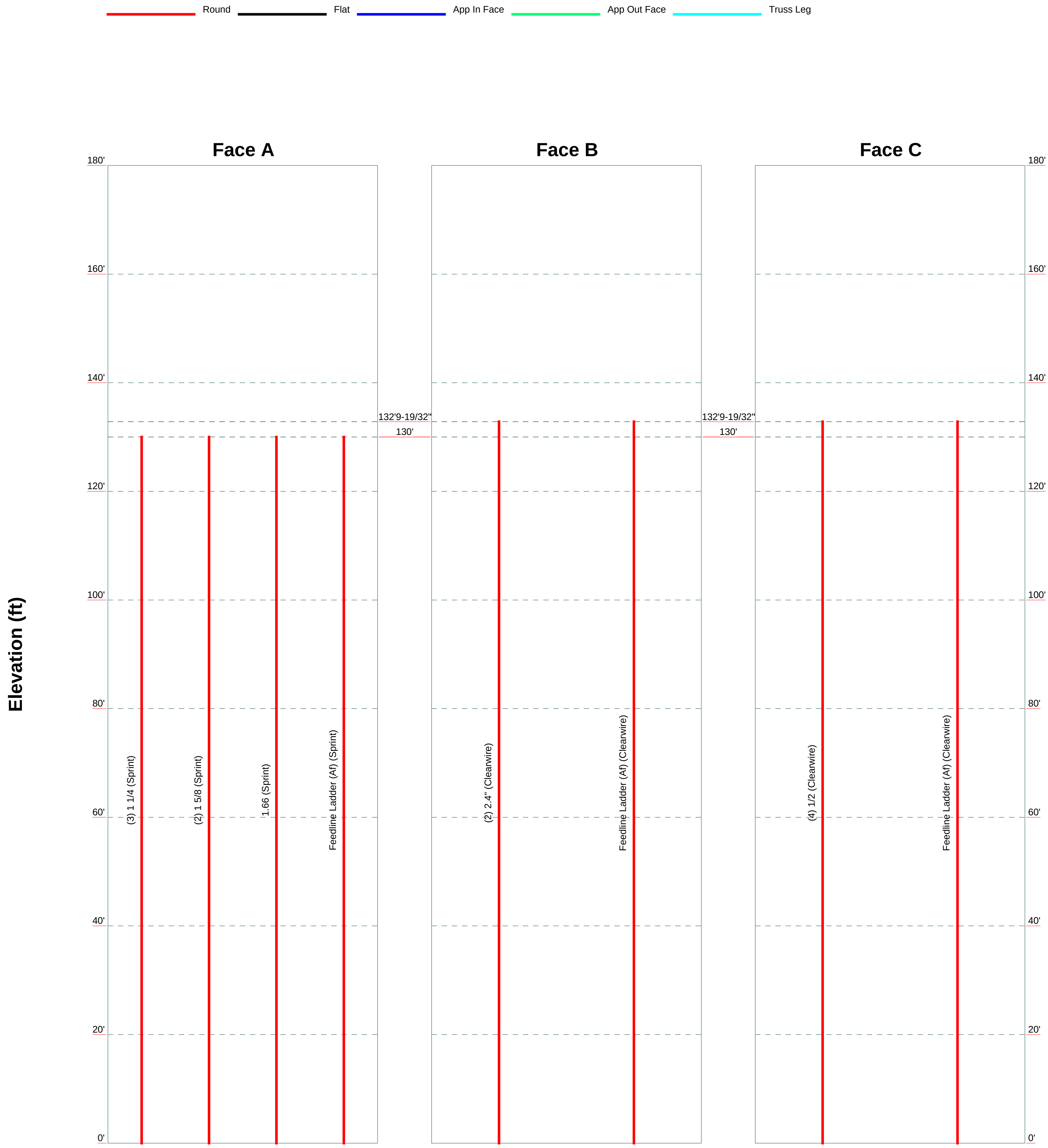
TIA-222-G - Service - 60 mph

Maximum Values



Allpro Consulting Group, Inc. 9221 Lyndon B Johnson Fwy, Suite 204 Dallas, TX Phone: 972 231-8993 FAX: 866 364-8375	Job: ***18-6240***		
	Project: ***CT22104-A-02 Waterbury 5, CT SA***		
	Client: SBA Communications Corporation	Drawn by: TX	App'd:
	Code: TIA-222-G	Date: 09/26/18	Scale: NTS
	Path: P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri		Dwg No. E-5

Feed Line Distribution Chart
0' - 180'



Allpro Consulting Group, Inc. 9221 Lyndon B Johnson Fwy, Suite 204 Dallas, TX Phone: 972 231-8993 FAX: 866 364-8375	Job: ***18-6240***		
	Project: ***CT22104-A-02 Waterbury 5, CT SA***		
	Client: SBA Communications Corporation	Drawn by: TX	App'd:
	Code: TIA-222-G	Date: 09/26/18	Scale: NTS
	Path: P:\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\Tnx\18-6240 CT22104-A-02 Waterbury 5, CT SA.eri		Dwg No. E-7

CALCULATION PRINTOUT

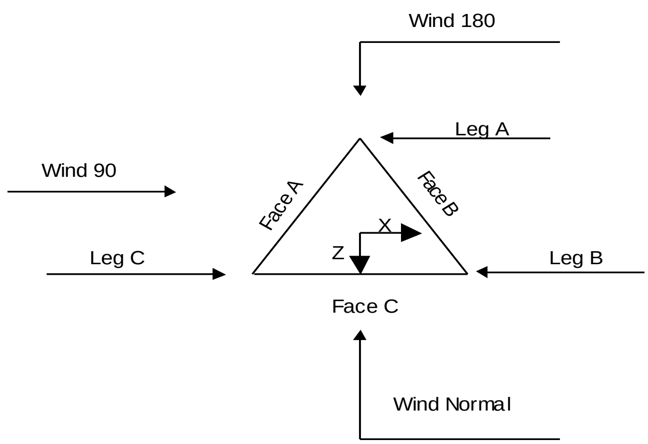
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 180' above the ground line.
The base of the tower is set at an elevation of 0' above the ground line.
The face width of the tower is 10'6-23/32" at the top and 30'15/32" at the base.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

- Tower is located in New Haven County, Connecticut.
- ASCE 7-10 Wind Data is used (wind speeds converted to nominal values).
- Basic wind speed of 97 mph.
- Structure Class II.
- Exposure Category B.
- Topographic Category 1.
- Crest Height 0'.
- Nominal ice thickness of 0.750 in.
- Ice thickness is considered to increase with height.
- Ice density of 56.000 pcf.
- A wind speed of 50 mph is used in combination with ice.
- Temperature drop of 50.000 °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 tower member 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				Pole Without Linear Attachments
					Pole With Shroud Or No Appurtenances
					Outside and Inside Corner Radii Are Known



Triangular Tower

Tower Section Geometry

Tower Section	*Tower Elevation* *ft*	*Assembly Database*	*Description*	*Section Width* *ft*	*Number of Sections*	*Section Length* *ft*
T1	180'-160'			10'6-23/32"	1	20'
T2	160'-140'			12'7-3/16"	1	20'
T3	140'-120'			14'7-13/16"	1	20'
T4	120'-100'			16'8-9/32"	1	20'
T5	100'-80'			18'8-3/4"	1	20'
T6	80'-60'			20'9-1/4"	1	20'
T7	60'-40'			22'9-23/32"	1	20'
T8	40'-20'			25'15/32"	1	20'
T9	20'-0'			27'6-15/32"	1	20'

Tower Section Geometry *(cont'd)*

Tower Section	*Tower Elevation* *ft*	*Diagonal Spacing* *ft*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset* *in*	*Bottom Girt Offset* *in*
T1	180'-160'	6'8"	X Brace	No	No	0.000	0.000
T2	160'-140'	6'8"	X Brace	No	No	0.000	0.000
T3	140'-120'	10'	X Brace	No	No	0.000	0.000
T4	120'-100'	10'	X Brace	No	No	0.000	0.000
T5	100'-80'	10'	X Brace	No	No	0.000	0.000
T6	80'-60'	10'	X Brace	No	No	0.000	0.000

Tower Section	*Tower Elevation ft*	*Diagonal Spacing ft*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset in*	*Bottom Girt Offset in*
T7	60'-40'	10'	X Brace	No	No	0.000	0.000
T8	40'-20'	20'	K1 Down	No	Yes	0.000	0.000
T9	20'-0'	20'	K1 Down	No	Yes	0.000	0.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Type*	*Leg Size*	*Leg Grade*	*Diagonal Type*	*Diagonal Size*	*Diagonal Grade*
T1 180'-160'	Pipe	ROHN 2.5 X-STR	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)
T2 160'-140'	Pipe	ROHN 3 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T3 140'-120'	Pipe	ROHN 3.5 X-STR	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)
T4 120'-100'	Pipe	ROHN 4 EH	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T5 100'-80'	Pipe	ROHN 4 EH	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T6 80'-60'	Pipe	ROHN 5 X-STR	A572-50 (50 ksi)	Equal Angle	L4x4x1/4	A572-50 (50 ksi)
T7 60'-40'	Pipe	ROHN 5 EH	A572-50 (50 ksi)	Equal Angle	L4x4x5/16	A572-50 (50 ksi)
T8 40'-20'	Pipe	ROHN 5 EH	A572-50 (50 ksi)	Pipe	ROHN 2.5 EH	A572-50 (50 ksi)
T9 20'-0'	Pipe	ROHN 6 EHS	A572-50 (50 ksi)	Pipe	ROHN 3 STD	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Top Girt Type*	*Top Girt Size*	*Top Girt Grade*	*Bottom Girt Type*	*Bottom Girt Size*	*Bottom Girt Grade*
T1 180'-160'	Equal Angle	L2x2x1/8	A36 (36 ksi)	Equal Angle		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*No. of Mid Girts*	*Mid Girt Type*	*Mid Girt Size*	*Mid Girt Grade*	*Horizontal Type*	*Horizontal Size*	*Horizontal Grade*
T8 40'-20'	None	Solid Round		A36 (36 ksi)	Pipe	ROHN 2.5 STD	A36 (36 ksi)
T9 20'-0'	None	Solid Round		A36 (36 ksi)	Pipe	ROHN 2.5 EH	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Secondary Horizontal Type*	*Secondary Horizontal Size*	*Secondary Horizontal Grade*	*Inner Bracing Type*	*Inner Bracing Size*	*Inner Bracing Grade*
T8 40'-20'	Equal Angle		A36 (36 ksi)	Pipe	ROHN 2 STD	A36 (36 ksi)
T9 20'-0'	Equal Angle		A36 (36 ksi)	Pipe	ROHN 3 STD	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Redundant Bracing Grade*		*Redundant Type*	*Redundant Size*	*K Factor*
T8 40'-20'	A36 (36 ksi)	Horizontal (1)	Pipe	ROHN 1.5 TUBE	1
		Diagonal (1)	Pipe	ROHN 1.5 STD	1
		Hip (1)	Pipe	ROHN 1.5 TUBE	1
		Hip Diagonal (1)	Pipe	ROHN 2.5 STD	1
T9 20'-0'	A36 (36 ksi)	Horizontal (1)	Pipe	ROHN 1.5 TUBE	1
		Diagonal (1)	Pipe	ROHN 2.25 TUBE	1
		Hip (1)	Pipe	ROHN 1.5 TUBE	1
		Hip Diagonal (1)	Pipe	ROHN 2.5 STD	1

Tower Section Geometry *(cont'd)*

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*
T1 180'-160'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T2 160'-140'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T3 140'-120'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T4 120'-100'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T5 100'-80'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T6 80'-60'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T7 60'-40'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T8 40'-20'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000
T9 20'-0'	0.000	0.000	A36 (36 ksi)	1	1	1.05	0.000	0.000	36.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1 180'-160'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T2 160'-140'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T3 140'-120'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T4 120'-100'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T5 100'-80'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T6 80'-60'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T7 60'-40'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T8 40'-20'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T9 20'-0'	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1

[1]Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Net Width Deduct in	Leg U	Diagonal Net Width Deduct in	Diagonal U	Top Girt Net Width Deduct in	Top Girt U	Bottom Girt Net Width Deduct in	Bottom Girt U	Mid Girt Net Width Deduct in	Mid Girt U	Long Horizontal Net Width Deduct in	Long Horizontal U	Short Horizontal Net Width Deduct in	Short Horizontal U
T1 180'-160'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T2 160'-140'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T3 140'-120'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T4 120'-100'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T5 100'-80'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T6 80'-60'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T7 60'-40'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T8 40'-20'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
T9 20'-0'	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Connection Type*	*Leg*		*Diagonal*		*Top Girt*		*Bottom Girt*		*Mid Girt*		*Long Horizontal*		*Short Horizontal*	
		Bolt Size in	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*
T1 180'-160'	Flange	0.750 A325N	4	0.500 A325X	1	0.500 A325X	1	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T2 160'-140'	Flange	0.875 A325N	4	0.500 A325X	1	0.625 A325X	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T3 140'-120'	Flange	0.875 A325N	4	0.625 A325X	1	0.625 A325X	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T4 120'-100'	Flange	1.000 A325N	4	0.750 A325X	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T5 100'-80'	Flange	1.000 A325N	4	0.750 A325X	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T6 80'-60'	Flange	1.000 A325N	4	0.750 A325X	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T7 60'-40'	Flange	1.000 A325N	5	0.750 A325X	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.500 A325N	0
T8 40'-20'	Flange	1.000 A325N	6	0.750 A325X	3	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	2	0.500 A325N	0
T9 20'-0'	Flange	0.000 A325N	0	0.750 A325X	3	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	2	0.500 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement ft*	*Face Offset in*	*Lateral Offset (Frac FW)*	*#*	*# Per Row*	*Clear Spacing in*	*Width or Diameter in*	*Perimeter in*	*Weight klf*
1 1/4 (Sprint)	A	No	Ar (CaAa)	130' - 0'	-1.000	0.4	3	3	0.500	1.550		0.001
1 5/8 (Sprint)	A	No	Ar (CaAa)	130' - 0'	-1.000	0.4	2	2	0.500	1.980		0.001
1.66 (Sprint)	A	No	Ar (CaAa)	130' - 0'	-1.000	0.4	1	1	0.500	1.980		0.001
Feedline Ladder (Af) (Sprint)	A	No	Af (CaAa)	130' - 0'	-1.000	0.4	1	1	1.500	3.000		0.008
***												
2.4" (Clearwire)	B	No	Ar (CaAa)	132'9-19/32" - 0'	0.000	0.4	2	2	0.500	2.380		0.001
Feedline Ladder (Af) (Clearwire)	B	No	Af (CaAa)	132'9-19/32" - 0'	0.000	0.4	1	1	1.500	3.000		0.008
1/2 (Clearwire)	C	No	Ar (CaAa)	132'9-19/32" - 0'	0.000	-0.4	4	2	0.500	0.580		0.000
Feedline Ladder (Af) (Clearwire)	C	No	Af (CaAa)	132'9-19/32" - 0'	0.000	-0.4	1	1	1.500	3.000		0.008

Feed Line/Linear Appurtenances Section Areas

Tower Section	*Tower Elevation ft*	*Face*	*A_R ft^2*	*A_F ft^2*	*C_AA_A In Face ft^2*	*C_AA_A Out Face ft^2*	*Weight K*

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	180'-160'	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
T2	160'-140'	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
T3	140'-120'	A	0.000	0.000	15.590	0.000	0.135
		B	0.000	0.000	12.492	0.000	0.137
		C	0.000	0.000	9.369	0.000	0.120
T4	120'-100'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188
T5	100'-80'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188
T6	80'-60'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188
T7	60'-40'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188
T8	40'-20'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188
T9	20'-0'	A	0.000	0.000	31.180	0.000	0.270
		B	0.000	0.000	19.520	0.000	0.214
		C	0.000	0.000	14.640	0.000	0.188

Feed Line/Linear Appurtenances Section Areas - With Ice

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 K
T1	180'-160'	A	1.767	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
T2	160'-140'	A	1.745	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
T3	140'-120'	A	1.720	0.000	0.000	38.802	0.000	0.588
		B		0.000	0.000	27.553	0.000	0.467
		C		0.000	0.000	22.345	0.000	0.386
T4	120'-100'	A	1.692	0.000	0.000	76.985	0.000	1.157
		B		0.000	0.000	42.741	0.000	0.719
		C		0.000	0.000	34.600	0.000	0.594
T5	100'-80'	A	1.658	0.000	0.000	76.254	0.000	1.135
		B		0.000	0.000	42.373	0.000	0.707
		C		0.000	0.000	34.228	0.000	0.583
T6	80'-60'	A	1.617	0.000	0.000	75.360	0.000	1.107
		B		0.000	0.000	41.924	0.000	0.691
		C		0.000	0.000	33.773	0.000	0.570
T7	60'-40'	A	1.564	0.000	0.000	74.199	0.000	1.072
		B		0.000	0.000	41.339	0.000	0.672
		C		0.000	0.000	33.180	0.000	0.553
T8	40'-20'	A	1.486	0.000	0.000	72.509	0.000	1.022
		B		0.000	0.000	40.489	0.000	0.644
		C		0.000	0.000	32.318	0.000	0.529
T9	20'-0'	A	1.331	0.000	0.000	69.161	0.000	0.926

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
		B		0.000	0.000	38.802	0.000	0.590
		C		0.000	0.000	30.607	0.000	0.484

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	180'-160'	0.000	0.000	0.000	0.000
T2	160'-140'	0.000	0.000	0.000	0.000
T3	140'-120'	8.824	-1.026	12.049	-1.436
T4	120'-100'	11.521	-3.819	15.734	-5.198
T5	100'-80'	12.098	-4.053	16.590	-5.543
T6	80'-60'	11.535	-3.914	16.363	-5.547
T7	60'-40'	11.924	-4.079	16.949	-5.805
T8	40'-20'	21.101	-6.505	23.482	-7.601
T9	20'-0'	20.890	-6.476	23.512	-7.695

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T3	1	1 1/4	120.00 - 130.00	0.1000	0.1000
T3	2	1 5/8	120.00 - 130.00	0.6000	0.6000
T3	3	1.66	120.00 - 130.00	0.6000	0.6000
T3	4	Feedline Ladder (Af)	120.00 - 130.00	0.6000	0.6000
T3	6	2.4"	120.00 - 132.80	0.6000	0.6000
T3	7	Feedline Ladder (Af)	120.00 - 132.80	0.6000	0.6000
T3	8	1/2	120.00 - 132.80	0.6000	0.6000
T3	9	Feedline Ladder (Af)	120.00 - 132.80	0.6000	0.6000
T4	1	1 1/4	100.00 - 120.00	0.1000	0.1000
T4	2	1 5/8	100.00 - 120.00	0.6000	0.6000
T4	3	1.66	100.00 - 120.00	0.6000	0.6000
T4	4	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T4	6	2.4"	100.00 - 120.00	0.6000	0.6000
T4	7	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T4	8	1/2	100.00 -	0.6000	0.6000

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	K_a *No Ice*	K_a *Ice*
T4	9	Feedline Ladder (Af)	120.00 100.00 - 120.00	0.6000	0.6000
T5	1	1 1/4	80.00 - 100.00	0.1000	0.1000
T5	2	1 5/8	80.00 - 100.00	0.6000	0.6000
T5	3	1.66	80.00 - 100.00	0.6000	0.6000
T5	4	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T5	6	2.4"	80.00 - 100.00	0.6000	0.6000
T5	7	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T5	8	1/2	80.00 - 100.00	0.6000	0.6000
T5	9	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T6	1	1 1/4	60.00 - 80.00	0.1000	0.1000
T6	2	1 5/8	60.00 - 80.00	0.6000	0.6000
T6	3	1.66	60.00 - 80.00	0.6000	0.6000
T6	4	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T6	6	2.4"	60.00 - 80.00	0.6000	0.6000
T6	7	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T6	8	1/2	60.00 - 80.00	0.6000	0.6000
T6	9	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T7	1	1 1/4	40.00 - 60.00	0.1000	0.1000
T7	2	1 5/8	40.00 - 60.00	0.6000	0.6000
T7	3	1.66	40.00 - 60.00	0.6000	0.6000
T7	4	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T7	6	2.4"	40.00 - 60.00	0.6000	0.6000
T7	7	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T7	8	1/2	40.00 - 60.00	0.6000	0.6000
T7	9	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T8	1	1 1/4	20.00 - 40.00	0.1000	0.1000
T8	2	1 5/8	20.00 - 40.00	0.6000	0.6000
T8	3	1.66	20.00 - 40.00	0.6000	0.6000
T8	4	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T8	6	2.4"	20.00 - 40.00	0.6000	0.6000
T8	7	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T8	8	1/2	20.00 - 40.00	0.6000	0.6000
T8	9	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T9	1	1 1/4	0.00 - 20.00	0.1000	0.1000
T9	2	1 5/8	0.00 - 20.00	0.6000	0.6000
T9	3	1.66	0.00 - 20.00	0.6000	0.6000
T9	4	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T9	6	2.4"	0.00 - 20.00	0.6000	0.6000
T9	7	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T9	8	1/2	0.00 - 20.00	0.6000	0.6000
T9	9	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* ft ft ft	*Azimuth Adjustment* °	*Placement* ft		C_AA_A *Front* ft²	C_AA_A *Side* ft²	*Weight* K
Lightning Rod 1/2"x6'	B	From Leg	0.000 0'	0.000	180'	No Ice 1/2" Ice	0.300 0.913	0.300 0.913	0.023 0.026

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* ft ft ft	*Azimuth Adjustment* °	*Placement* ft		C_AA_A *Front* ft^2	C_AA_A *Side* ft^2	*Weight* K
			3'			1" Ice	1.542	1.542	0.034
Beacon	B	From Leg	0.000 0' 0'	0.000	180'	No Ice 1/2" Ice 1" Ice	2.000 2.500 3.000	2.000 2.500 3.000	0.020 0.030 0.040
***									
2.5"x8.0' Omni (Unknown)	B	From Leg	0.000 0' 0'	0.000	180'	No Ice 1/2" Ice 1" Ice	0.003 0.019 0.035	0.003 0.019 0.035	0.008 0.009 0.009
***									
2.4"x5.5' Pipe Mount	A	From Face	0.000 0' 0'	0.000	178'	No Ice 1/2" Ice 1" Ice	1.635 2.207 2.543	1.635 2.207 2.543	0.057 0.074 0.094
1.9"x5.5' pipe Mount	C	From Leg	0.000 0' 0'	0.000	168'	No Ice 1/2" Ice 1" Ice	1.635 2.207 2.543	1.635 2.207 2.543	0.057 0.074 0.094
1.9"x5.5' pipe Mount	A	From Leg	0.000 0' 0'	0.000	145'	No Ice 1/2" Ice 1" Ice	1.635 2.207 2.543	1.635 2.207 2.543	0.057 0.074 0.094
***									
LLPX310R-V1 (Clearwire)	A	From Leg	3.000 0' 0'	0.000	136'9-19/32"	No Ice 1/2" Ice 1" Ice	4.338 4.632 4.933	1.962 2.232 2.510	0.028 0.054 0.084
LLPX310R-V1 (Clearwire)	B	From Leg	3.000 0' 0'	0.000	136'9-19/32"	No Ice 1/2" Ice 1" Ice	4.338 4.632 4.933	1.962 2.232 2.510	0.028 0.054 0.084
LLPX310R-V1 (Clearwire)	C	From Leg	3.000 0' 0'	0.000	136'9-19/32"	No Ice 1/2" Ice 1" Ice	4.338 4.632 4.933	1.962 2.232 2.510	0.028 0.054 0.084
(2) RRH2WB0 01 RRH (Clearwire)	A	From Leg	3.000 0' 0'	0.000	135'9-19/32"	No Ice 1/2" Ice 1" Ice	2.356 2.561 2.773	1.334 1.503 1.680	0.052 0.070 0.090
RRH2WB0 01 RRH (Clearwire)	B	From Leg	3.000 0' 0'	0.000	135'9-19/32"	No Ice 1/2" Ice 1" Ice	2.356 2.561 2.773	1.334 1.503 1.680	0.052 0.070 0.090
RRH2WB0 01 RRH (Clearwire)	C	From Leg	3.000 0' 0'	0.000	135'9-19/32"	No Ice 1/2" Ice 1" Ice	2.356 2.561 2.773	1.334 1.503 1.680	0.052 0.070 0.090
Junction Box (Clearwire)	B	From Leg	3.000 0' 0'	0.000	133'3-19/32"	No Ice 1/2" Ice 1" Ice	1.200 1.337 1.481	0.600 0.704 0.815	0.010 0.020 0.033
***									
APXVSPP18-C-A20 (Sprint)	A	From Face	1.500 0' 0'	0.000	130'	No Ice 1/2" Ice 1" Ice	8.024 8.480 8.943	5.283 5.736 6.196	0.057 0.107 0.162
APXVSPP18-C-A20 (Sprint)	B	From Face	1.500 0' 0'	0.000	130'	No Ice 1/2" Ice 1" Ice	8.024 8.480 8.943	5.283 5.736 6.196	0.057 0.107 0.162
APXVSPP18-C-A20 (Sprint)	C	From Face	1.500 0' 0'	0.000	130'	No Ice 1/2" Ice 1" Ice	8.024 8.480 8.943	5.283 5.736 6.196	0.057 0.107 0.162
AAHC (Sprint)	A	From Face	1.500 0' 0'	0.000	130'	No Ice 1/2" Ice 1" Ice	4.203 4.458 4.721	2.068 2.260 2.463	0.104 0.136 0.172
AAHC (Sprint)	B	From Face	1.500 0' 0'	0.000	130'	No Ice 1/2" Ice 1" Ice	4.203 4.458 4.721	2.068 2.260 2.463	0.104 0.136 0.172
AAHC	C	From Face	1.500	0.000	130'	No Ice	4.203	2.068	0.104

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft ft ft*	*Azimuth Adjustment* *°*	*Placement* *ft*		*C_AA_A Front* *ft^2*	*C_AA_A Side* *ft^2*	*Weight* *K*
(Sprint)			0'			1/2" Ice	4.458	2.260	0.136
			0'			1" Ice	4.721	2.463	0.172
(1) 19' Face Mount	A	From Face	0.000	0.000	130'	No Ice	9.925	4.650	0.300
(Sprint)			0'			1/2" Ice	12.798	6.512	0.467
			0'			1" Ice	15.671	8.374	0.634
(1) 19' Face Mount	B	From Face	0.000	0.000	130'	No Ice	9.925	4.650	0.300
(Sprint)			0'			1/2" Ice	12.798	6.512	0.467
			0'			1" Ice	15.671	8.374	0.634
(1) 19' Face Mount	C	From Face	0.000	0.000	130'	No Ice	9.925	4.650	0.300
(Sprint)			0'			1/2" Ice	12.798	6.512	0.467
			0'			1" Ice	15.671	8.374	0.634
800 MHz RRH	A	From Face	1.500	0.000	130'	No Ice	2.134	1.773	0.053
(Sprint)			0'			1/2" Ice	2.320	1.946	0.074
			0'			1" Ice	2.512	2.127	0.098
800 MHz RRH	B	From Face	1.500	0.000	130'	No Ice	2.134	1.773	0.053
(Sprint)			0'			1/2" Ice	2.320	1.946	0.074
			0'			1" Ice	2.512	2.127	0.098
800 MHz RRH	C	From Face	1.500	0.000	130'	No Ice	2.134	1.773	0.053
(Sprint)			0'			1/2" Ice	2.320	1.946	0.074
			0'			1" Ice	2.512	2.127	0.098
(2) 1900 MHz RRH	A	From Face	1.500	0.000	130'	No Ice	2.313	2.375	0.060
(Sprint)			0'			1/2" Ice	2.517	2.581	0.084
			0'			1" Ice	2.728	2.794	0.111
(2) 1900 MHz RRH	B	From Face	1.500	0.000	130'	No Ice	2.313	2.375	0.060
(Sprint)			0'			1/2" Ice	2.517	2.581	0.084
			0'			1" Ice	2.728	2.794	0.111
(2) 1900 MHz RRH	C	From Face	1.500	0.000	130'	No Ice	2.313	2.375	0.060
(Sprint)			0'			1/2" Ice	2.517	2.581	0.084
			0'			1" Ice	2.728	2.794	0.111
TD-RRH8x20-25	A	From Face	1.500	0.000	130'	No Ice	3.704	1.294	0.066
(Sprint)			0'			1/2" Ice	3.946	1.465	0.090
			0'			1" Ice	4.196	1.642	0.117
TD-RRH8x20-25	B	From Face	1.500	0.000	130'	No Ice	3.704	1.294	0.066
(Sprint)			0'			1/2" Ice	3.946	1.465	0.090
			0'			1" Ice	4.196	1.642	0.117
TD-RRH8x20-25	C	From Face	1.500	0.000	130'	No Ice	3.704	1.294	0.066
(Sprint)			0'			1/2" Ice	3.946	1.465	0.090
			0'			1" Ice	4.196	1.642	0.117
IBC1900BB-1 Combiner	A	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.033
(Sprint)			0'			1/2" Ice	1.091	0.558	0.041
			0'			1" Ice	1.223	0.660	0.050
IBC1900BB-1 Combiner	B	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.033
(Sprint)			0'			1/2" Ice	1.091	0.558	0.041
			0'			1" Ice	1.223	0.660	0.050
IBC1900BB-1 Combiner	C	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.033
(Sprint)			0'			1/2" Ice	1.091	0.558	0.041
			0'			1" Ice	1.223	0.660	0.050
IBC1900HG-2A Combiner	A	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.022
(Sprint)			0'			1/2" Ice	1.091	0.558	0.030
			0'			1" Ice	1.223	0.660	0.039
IBC1900HG-2A Combiner	B	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.022
(Sprint)			0'			1/2" Ice	1.091	0.558	0.030
			0'			1" Ice	1.223	0.660	0.039
IBC1900HG-2A Combiner	C	From Face	1.500	0.000	130'	No Ice	0.966	0.463	0.022
(Sprint)			0'			1/2" Ice	1.091	0.558	0.030
			0'			1" Ice	1.223	0.660	0.039
***									

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
12.5' Sector Frame (Clearwire)	A	From Leg	3.000 0' 0'	0.000	132'9-19/32"	No Ice 1/2" Ice 1" Ice	14.425 19.017 23.609	11.800 15.458 19.116	0.500 0.667 0.834
12.5' Sector Frame (Clearwire)	B	From Leg	3.000 0' 0'	0.000	132'9-19/32"	No Ice 1/2" Ice 1" Ice	14.425 19.017 23.609	11.800 15.458 19.116	0.500 0.667 0.834
12.5' Sector Frame (Clearwire)	C	From Leg	3.000 0' 0'	0.000	132'9-19/32"	No Ice 1/2" Ice 1" Ice	14.425 19.017 23.609	11.800 15.458 19.116	0.500 0.667 0.834
***									
2.4"x3.0' Pipe Mount	A	From Leg	0.000 0' 0'	0.000	125'	No Ice 1/2" Ice 1" Ice	1.635 2.207 2.543	1.635 2.207 2.543	0.057 0.074 0.094
2.4"x24' Pipe Mount	A	From Face	0.000 0' 0'	0.000	30'	No Ice 1/2" Ice 1" Ice	5.700 7.633 9.566	1.635 2.207 2.543	0.100 0.140 0.180

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 K
(2) VHLP2-23	A	Paraboloid w/Shroud (HP)	From Leg	3.000 0' -3'	0.000		137'1-3/16"	2.000	No Ice 1/2" Ice 1" Ice	3.140 3.410 3.680	0.020 0.040 0.060
VHLP2-23	B	Paraboloid w/Shroud (HP)	From Leg	3.000 0' -3'	0.000		137'1-3/16"	2.000	No Ice 1/2" Ice 1" Ice	3.140 3.410 3.680	0.020 0.040 0.060
VHLP2-23	C	Paraboloid w/Shroud (HP)	From Leg	3.000 0' -3'	0.000		137'1-3/16"	2.000	No Ice 1/2" Ice 1" Ice	3.140 3.410 3.680	0.020 0.040 0.060
***											

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

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

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
T1	180 - 160	1.245	43	0.048	0.005
T2	160 - 140	1.042	43	0.048	0.004
T3	140 - 120	0.840	43	0.045	0.004
T4	120 - 100	0.643	43	0.043	0.004
T5	100 - 80	0.463	43	0.038	0.004
T6	80 - 60	0.305	43	0.031	0.003
T7	60 - 40	0.176	43	0.024	0.003
T8	40 - 20	0.078	43	0.016	0.002
T9	20 - 0	0.022	47	0.008	0.001

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180'	Lightning Rod 1/2"x6'	43	1.245	0.048	0.005	Inf
178'	2.4"x5.5' Pipe Mount	43	1.225	0.048	0.005	Inf
168'	1.9"x5.5' pipe Mount	43	1.123	0.048	0.004	Inf
145'	1.9"x5.5' pipe Mount	43	0.890	0.046	0.004	Inf
136'9-19/32"	LLPX310R-V1	43	0.808	0.045	0.004	925043
135'9-19/32"	(2) RRH2WB0 01 RRH	43	0.798	0.045	0.004	796095
134'1-3/16"	(2) VHLP2-23	43	0.781	0.045	0.004	639547
133'3-19/32"	Junction Box	43	0.773	0.045	0.004	585326
132'9-19/32"	12.5' Sector Frame	43	0.768	0.045	0.004	555860
130'	APXVSPP18-C-A20	43	0.740	0.044	0.004	433620
125'	2.4"x3.0' Pipe Mount	43	0.691	0.043	0.004	311338
30'	2.4"x24' Pipe Mount	47	0.045	0.012	0.002	111486

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	180 - 160	5.122	10	0.196	0.019
T2	160 - 140	4.286	10	0.195	0.018
T3	140 - 120	3.455	10	0.187	0.019
T4	120 - 100	2.646	10	0.175	0.018
T5	100 - 80	1.907	10	0.155	0.016
T6	80 - 60	1.260	10	0.125	0.014
T7	60 - 40	0.729	10	0.099	0.011
T8	40 - 20	0.326	10	0.066	0.009
T9	20 - 0	0.092	18	0.033	0.004

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180'	Lightning Rod 1/2"x6'	10	5.122	0.196	0.019	Inf
178'	2.4"x5.5' Pipe Mount	10	5.038	0.197	0.019	Inf
168'	1.9"x5.5' pipe Mount	10	4.620	0.196	0.018	Inf
145'	1.9"x5.5' pipe Mount	10	3.662	0.189	0.019	540748
136'9-19/32"	LLPX310R-V1	10	3.323	0.185	0.018	230428
135'9-19/32"	(2) RRH2WB0 01 RRH	10	3.282	0.184	0.018	197458
134'1-3/16"	(2) VHLP2-23	10	3.212	0.184	0.018	157776
133'3-19/32"	Junction Box	10	3.180	0.183	0.018	144131
132'9-19/32"	12.5' Sector Frame	10	3.159	0.183	0.018	136736
130'	APXVSPP18-C-A20	10	3.045	0.181	0.018	106221
125'	2.4"x3.0' Pipe Mount	10	2.844	0.178	0.018	75949
30'	2.4"x24' Pipe Mount	11	0.187	0.050	0.007	27344

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt K	Allowable Load per Bolt K	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	180	Leg	A325N	0.750	4	0.258	29.821	0.009 ✔	1	Bolt Tension
		Diagonal	A325X	0.500	1	0.597	4.133	0.144 ✔	1	Member Bearing
		Top Girt	A325X	0.500	1	0.068	6.960	0.010 ✔	1	Member Bearing
T2	160	Leg	A325N	0.875	4	1.125	40.589	0.028 ✔	1	Bolt Tension
		Diagonal	A325X	0.500	1	1.133	6.199	0.183 ✔	1	Member Bearing
T3	140	Leg	A325N	0.875	4	2.451	40.589	0.060 ✔	1	Bolt Tension
		Diagonal	A325X	0.625	1	3.589	7.830	0.458 ✔	1	Member Bearing
T4	120	Leg	A325N	1.000	4	5.468	53.014	0.103 ✔	1	Bolt Tension
		Diagonal	A325X	0.750	1	4.281	14.137	0.303 ✔	1	Member Bearing
T5	100	Leg	A325N	1.000	4	8.669	53.014	0.164 ✔	1	Bolt Tension
		Diagonal	A325X	0.750	1	4.973	14.137	0.352 ✔	1	Member Bearing
T6	80	Leg	A325N	1.000	4	11.994	53.014	0.226 ✔	1	Bolt Tension
		Diagonal	A325X	0.750	1	5.724	14.137	0.405 ✔	1	Member Bearing
T7	60	Leg	A325N	1.000	5	12.257	53.014	0.231 ✔	1	Bolt Tension
		Diagonal	A325X	0.750	1	6.306	17.672	0.357 ✔	1	Member Bearing
T8	40	Leg	A325N	1.000	6	10.633	53.014	0.201 ✔	1	Bolt Tension
		Diagonal	A325X	0.750	3	3.499	21.868	0.160 ✔	1	Bolt Shear
T9	20	Diagonal	A325X	0.750	3	3.473	21.868	0.159 ✔	1	Bolt Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	ROHN 2.5 X-STR	20'13/32"	6'8-1/8"	86.7 K=1.00	2.254	-1.949	58.512	0.033 [1] ✔
T2	160 - 140	ROHN 3 STD	20'13/32"	6'8-1/8"	68.9 K=1.00	2.228	-6.877	70.891	0.097 [1] ✔
T3	140 - 120	ROHN 3.5 X-STR	20'13/32"	10'7/32"	92.0 K=1.00	3.678	-17.173	89.148	0.193 [1] ✔
T4	120 - 100	ROHN 4 EH	20'13/32"	10'7/32"	81.4 K=1.00	4.407	-32.370	122.171	0.265 [1] ✔
T5	100 - 80	ROHN 4 EH	20'13/32"	10'7/32"	81.4 K=1.00	4.407	-48.783	122.170	0.399 [1] ✔
T6	80 - 60	ROHN 5 X-STR	20'13/32	10'7/32"	65.4	6.112	-66.312	201.243	0.330 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
			"		K=1.00				
T7	60 - 40	ROHN 5 EH	20'1/2"	10'1/4"	65.4 K=1.00	6.112	-84.530	201.200	0.420 [1] ✓
T8	40 - 20	ROHN 5 EH	20'5/8"	10'5/16"	65.4 K=1.00	6.112	-89.781	201.133	0.446 [1] ✓
T9	20 - 0	ROHN 6 EHS	20'5/8"	10'5/16"	54.1 K=1.00	6.713	-106.215	243.965	0.435 [1] ✓

[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	L2x2x1/8	13'11-15/32"	6'11-3/16"	209.2 K=1.00	0.484	-0.635	2.500	0.254 [1] ✓
		KL/R > 200 (C) - 8							
T2	160 - 140	L2 1/2x2 1/2x3/16	15'9-7/16"	7'9-13/16"	189.6 K=1.00	0.902	-1.148	5.674	0.202 [1] ✓
T3	140 - 120	L3x3x3/16	19'9/32"	9'5-15/16"	191.1 K=1.00	1.090	-3.736	6.743	0.554 [1] ✓
T4	120 - 100	L3 1/2x3 1/2x1/4	20'9-13/32"	10'4"	178.7 K=1.00	1.690	-4.381	11.957	0.366 [1] ✓
T5	100 - 80	L3 1/2x3 1/2x1/4	22'7-5/32"	11'2-27/32"	194.3 K=1.00	1.690	-5.091	10.111	0.504 [1] ✓
T6	80 - 60	L4x4x1/4	24'5-9/32"	12'1-11/32"	182.8 K=1.00	1.940	-5.853	13.115	0.446 [1] ✓
T7	60 - 40	L4x4x5/16	26'5-3/8''	13'1-21/32"	199.3 K=1.00	2.400	-6.348	13.647	0.465 [1] ✓
T8	40 - 20	ROHN 2.5 EH	24'3-1/2''	12'1-3/4''	157.7 K=1.00	2.254	-10.497	20.462	0.513 [1] ✓
T9	20 - 0	ROHN 3 STD	25'1/4"	12'6-1/8''	129.0 K=1.00	2.228	-10.418	30.240	0.345 [1] ✓

[1] P_u / ϕP_n controls

Horizontal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 2.5 STD	25'15/32"	12'3-15/32"	155.6 K=1.00	1.704	-5.625	15.893	0.354 [1] ✓
T9	20 - 0	ROHN 2.5 EH	27'6-15/32"	13'6-15/32"	175.8 K=1.00	2.254	-5.900	16.472	0.358 [1] ✓

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	L2x2x1/8 KL/R > 200 (C) - 4	10'6-23/32"	10'1-11/32"	305.2 K=1.00	0.484	-0.068	1.175	0.058 [1] ✔

[1] P_u / ϕP_n controls

Redundant Horizontal (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 1.5 TUBE	6'3-1/8"	6'11/32"	149.6 K=1.00	0.598	-1.652	6.034	0.274 [1] ✔
T9	20 - 0	ROHN 1.5 TUBE	6'10-5/8''	6'7-5/16''	164.1 K=1.00	0.598	-1.843	5.020	0.367 [1] ✔

[1] P_u / ϕP_n controls

Redundant Diagonal (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 1.5 STD	11'5-13/16"	11'5/32"	214.7 K=1.00	0.763	-1.515	3.739	0.405 [1] ✔
T9	20 - 0	ROHN 2.25 TUBE	11'9-5/8''	11'4-13/32"	184.9 K=1.00	1.111	-1.580	7.343	0.215 [1] ✔

[1] P_u / ϕP_n controls

Redundant Hip (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 1.5 TUBE	6'3-1/8"	6'3-1/8"	155.4 K=1.00	0.598	-0.023	5.596	0.004 [1] ✔
T9	20 - 0	ROHN 1.5 TUBE	6'10-5/8''	6'10-5/8''	170.9 K=1.00	0.598	-0.025	4.626	0.006 [1] ✔

[1] P_u / ϕP_n controls

Redundant Hip Diagonal (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 2.5 STD	15'3/8"	15'3/8"	190.4 K=1.00	1.704	-0.083	10.623	0.008 [1] ✔
T9	20 - 0	ROHN 2.5 STD	15'10-1/4"	15'10-1/4"	200.8 K=1.00	1.704	-0.079	9.548	0.008 [1] ✔

[1] P_u / ϕP_n controls

Inner Bracing Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 2 STD	12'6-7/32"	12'6-7/32"	190.9 K=1.00	1.075	-0.014	6.664	0.002 [1] ✔
T9	20 - 0	ROHN 3 STD	13'9-7/32"	13'9-7/32"	142.0 K=1.00	2.228	-0.018	24.965	0.001 [1] ✔

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	ROHN 2.5 X-STR	20'13/32"	6'8-1/8"	86.7	2.254	1.030	101.409	0.010 [1] ✔
T2	160 - 140	ROHN 3 STD	20'13/32"	6'8-1/8"	68.9	2.228	4.499	100.281	0.045 [1] ✔

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T3	140 - 120	ROHN 3.5 X-STR	20'13/32"	10'7/32"	92.0	3.678	9.806	165.529	0.059 [1] ✔
T4	120 - 100	ROHN 4 EH	20'13/32"	10'7/32"	81.4	4.407	21.872	198.335	0.110 [1] ✔
T5	100 - 80	ROHN 4 EH	20'13/32"	10'7/32"	81.4	4.407	34.677	198.335	0.175 [1] ✔
T6	80 - 60	ROHN 5 X-STR	20'13/32"	10'7/32"	65.4	6.112	47.975	275.039	0.174 [1] ✔
T7	60 - 40	ROHN 5 EH	20'1/2"	10'1/4"	65.4	6.112	61.284	275.039	0.223 [1] ✔
T8	40 - 20	ROHN 5 EH	20'5/8"	10'5/16"	65.4	6.112	63.994	275.039	0.233 [1] ✔
T9	20 - 0	ROHN 6 EHS	20'5/8"	10'5/16"	54.1	6.713	75.565	302.097	0.250 [1] ✔

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	L2x2x1/8	13'11-15/32"	6'11-3/16"	134.8	0.305	0.597	13.254	0.045 [1] ✔
T2	160 - 140	L2 1/2x2 1/2x3/16	15'9-7/16"	7'9-13/16"	122.1	0.589	1.133	25.616	0.044 [1] ✔
T3	140 - 120	L3x3x3/16	19'9/32"	9'5-15/16"	122.8	0.712	3.589	30.968	0.116 [1] ✔
T4	120 - 100	L3 1/2x3 1/2x1/4	20'9-13/32"	10'4"	115.3	1.103	4.281	53.793	0.080 [1] ✔
T5	100 - 80	L3 1/2x3 1/2x1/4	22'7-5/32"	11'2-27/32"	125.2	1.103	4.973	53.793	0.092 [1] ✔
T6	80 - 60	L4x4x1/4	24'5-9/32"	12'1-11/32"	117.6	1.291	5.724	62.933	0.091 [1] ✔
T7	60 - 40	L4x4x5/16	26'5-3/8''	13'1-21/32"	128.5	1.595	6.306	77.752	0.081 [1] ✔
T8	40 - 20	ROHN 2.5 EH	24'3-1/2''	12'1-3/4''	157.7	2.254	9.950	101.409	0.098 [1] ✔
T9	20 - 0	ROHN 3 STD	25'1/4"	12'6-1/8''	129.0	2.228	9.709	100.281	0.097 [1] ✔

[1] P_u / ϕP_n controls

Horizontal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 2.5 STD	25'15/32"	12'3-15/32"	155.6	1.704	5.681	55.211	0.103 [1] ✔
T9	20 - 0	ROHN 2.5 EH	27'6-15/32"	13'6-15/32"	175.8	2.254	5.820	73.015	0.080 [1] ✔

[1] P_u / ϕP_n controls

Redundant Horizontal (1) Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 1.5 TUBE	6'3-1/8"	6'11/32"	149.6	0.598	1.652	19.380	0.085 [1] ✔
T9	20 - 0	ROHN 1.5 TUBE	6'10-5/8''	6'7-5/16''	164.1	0.598	1.843	19.380	0.095 [1] ✔

[1] P_u / ϕP_n controls

Redundant Diagonal (1) Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 1.5 STD	11'5-13/16"	11'5/32"	214.7	0.763	1.515	24.724	0.061 [1] ✔
T9	20 - 0	ROHN 2.25 TUBE	11'9-5/8''	11'4-13/32"	184.9	1.111	1.580	35.992	0.044 [1] ✔

[1] P_u / ϕP_n controls

Redundant Hip Diagonal (1) Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T8	40 - 20	ROHN 2.5 STD	15'3/8"	15'3/8"	190.4	1.704	0.073	55.211	0.001 [1] ✔
T9	20 - 0	ROHN 2.5 STD	15'10-1/4"	15'10-1/4"	200.8	1.704	0.069	55.211	0.001 [1] ✔

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T1	180 - 160	Leg	ROHN 2.5 X-STR	1	-1.949	58.512	3.3	Pass
T2	160 - 140	Leg	ROHN 3 STD	27	-6.877	70.891	9.7	Pass
T3	140 - 120	Leg	ROHN 3.5 X-STR	48	-17.173	89.148	19.3	Pass
T4	120 - 100	Leg	ROHN 4 EH	62	-32.370	122.171	26.5	Pass
T5	100 - 80	Leg	ROHN 4 EH	77	-48.783	122.170	39.9	Pass
T6	80 - 60	Leg	ROHN 5 X-STR	92	-66.312	201.243	33.0	Pass
T7	60 - 40	Leg	ROHN 5 EH	107	-84.530	201.200	42.0	Pass
T8	40 - 20	Leg	ROHN 5 EH	122	-89.781	201.133	44.6	Pass
T9	20 - 0	Leg	ROHN 6 EHS	155	-106.215	243.965	43.5	Pass
T1	180 - 160	Diagonal	L2x2x1/8	8	-0.635	2.500	25.4	Pass
T2	160 - 140	Diagonal	L2 1/2x2 1/2x3/16	29	-1.148	5.674	20.2	Pass
T3	140 - 120	Diagonal	L3x3x3/16	51	-3.736	6.743	55.4	Pass
T4	120 - 100	Diagonal	L3 1/2x3 1/2x1/4	66	-4.381	11.957	36.6	Pass
T5	100 - 80	Diagonal	L3 1/2x3 1/2x1/4	81	-5.091	10.111	50.4	Pass
T6	80 - 60	Diagonal	L4x4x1/4	97	-5.853	13.115	44.6	Pass
T7	60 - 40	Diagonal	L4x4x5/16	112	-6.348	13.647	46.5	Pass
T8	40 - 20	Diagonal	ROHN 2.5 EH	135	-10.497	20.462	51.3	Pass
T9	20 - 0	Diagonal	ROHN 3 STD	168	-10.418	30.240	34.5	Pass
T8	40 - 20	Horizontal	ROHN 2.5 STD	131	-5.625	15.893	35.4	Pass
T9	20 - 0	Horizontal	ROHN 2.5 EH	164	-5.900	16.472	35.8	Pass
T1	180 - 160	Top Girt	L2x2x1/8	4	-0.068	1.175	5.8	Pass
T8	40 - 20	Redund Horz 1 Bracing	ROHN 1.5 TUBE	129	-1.652	6.034	27.4	Pass
T9	20 - 0	Redund Horz 1 Bracing	ROHN 1.5 TUBE	162	-1.843	5.020	36.7	Pass
T8	40 - 20	Redund Diag 1 Bracing	ROHN 1.5 STD	130	-1.515	3.739	40.5	Pass
T9	20 - 0	Redund Diag 1 Bracing	ROHN 2.25 TUBE	167	-1.580	7.343	21.5	Pass
T8	40 - 20	Redund Hip 1 Bracing	ROHN 1.5 TUBE	138	-0.023	5.596	0.4	Pass
T9	20 - 0	Redund Hip 1 Bracing	ROHN 1.5 TUBE	171	-0.025	4.626	0.6	Pass
T8	40 - 20	Redund Hip Diagonal 1 Bracing	ROHN 2.5 STD	139	-0.083	10.623	0.8	Pass
T9	20 - 0	Redund Hip Diagonal 1 Bracing	ROHN 2.5 STD	172	-0.079	9.548	0.8	Pass
T8	40 - 20	Inner Bracing	ROHN 2 STD	151	-0.014	6.664	0.4	Pass
T9	20 - 0	Inner Bracing	ROHN 3 STD	184	-0.018	24.965	0.3	Pass
							Summary	
						Leg (T8)	44.6	Pass
						Diagonal (T3)	55.4	Pass
						Horizontal (T9)	35.8	Pass
						Top Girt (T1)	5.8	Pass
						Redund Horz 1 Bracing (T9)	36.7	Pass
						Redund Diag 1 Bracing (T8)	40.5	Pass
						Redund Hip 1 Bracing (T9)	0.6	Pass

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*øP_{allow} K*	*% Capacity*	*Pass Fail*
						Redund Hip Diagonal 1 Bracing (T9)	0.8	Pass
						Inner Bracing (T8)	0.4	Pass
						Bolt Checks	45.8	Pass
						RATING =	**55.4**	**Pass**

MATHCAD CALCULATION PRINTOUT

Existing 185' SST Pier Foundation Check

Customer Name: SBA
Customer Site Number: CT22104-A-02
Customer Site Name: Waterbury 5, CT

Carrier Name: Sprint Nextel

ACGI # 18-6240

Allpro Consulting Group, Inc.
9221 Lyndon B. Johnson Freeway, Suite 204
Dallas, TX 75243
Tel: 972-231-8893, Fax: 866-364-8375

INPUT DATA

-Foundation Reactions-(factored)

(From TNX output)

Down Load: $P_{dwn} := 121 \cdot kips$

Uplift Load: $P_{up} := 87 \cdot kips$

Shear Load: $S := 18 \cdot kips$

Moment: $M := 0 \cdot ft \cdot kips$

-Pier Dimensions-

Diameter: $D_{pier} := 4.5ft$

Extension above grade: $E_{pier} := 3 \cdot ft$

Concrete density See below

Concrete strength $F_c := 4000 \cdot psi$

Rebar Fy $F_y := 60 \cdot ksi$

Foundation design Building code - IBC2012, ACI318-08, TIA-222-G

-Reinforcement Data-

Typical concrete cover $cc := 3 \cdot in$

Vertical rebar size $d_{bar} := 10$

Tiebar size $d_{tie} := 4$

ACI Strength reduction factors

$\phi_{comp} := 0.75$ (ACI 9.3.2.2)

$\phi_{tens} := 0.9$ (ACI 9.3.2.2a)

$\phi_{shear} := 0.85$ (ACI 9.3.2.3)

-Factor of Safety for soil strength-

$\phi_{s\_Bear} := 0.75$ as per TIA-222-G code for bearing, 9.4.1 - for SST/MP

$\phi_{s\_friction} := 0.75$ as per TIA-222-G code for skin friction resistance, 9.4.1

$\phi_{s\_lateral} := 0.75$ as per TIA-222-G code for lateral resistance, 9.4.1

As per Report of Geotechnical Report, by clarence Welti Assoc., Inc., Dated 10/07/88. Foundation design by Rohn, project # 23910DB, dated 05/09/89.

-Soil Properties-

Number of soil layers $NSL := 1$ $j := 1 .. NSL$

Neglected soil height $L_{ngl} := 3.5 \cdot ft$ $k := 1 .. NSL$

$i_{neg} := 1$ (neglected soil layer number) $i := 1 .. NSL$

$\alpha := 0.4$ Estimated

Height	PHI	Cu	Soil Dens	Conc Dens	Bond Strength	
$H_j :=$	$\phi_j :=$	$Cu_j :=$	$\gamma_{s_j} :=$	$\gamma_{c_j} :=$	$SKU_{dn_j} :=$	$SKU_{up_j} :=$
3.5ft	0·deg	0·ksf	120·pcf	150·pcf	0·psi	0·psi
0ft	0deg	0ksf	0pcf	0pcf	0psi	0psi

$$L_{pier} := \sum_{j=1}^{NSL} H_j \qquad L_{pier} = 3.5\,ft$$

-Anchor Rod Section

Bearing Safety factor: $SF := 2$

End Ultimate bearing capacity: $BC_{ult} := 50ksf \cdot SF = 100 \cdot ksf$

Allowwable Bond Strength: $BOND := 200psi$

Anchor Rod Depth: $L_{anchor} := 17ft$

Diameter of hole: $D_{anchor} := 2.5in$

CALCULATIONS

-Pier calculation-

Pier area $A_{pier} := \pi \cdot \frac{D_{pier}^{2}}{4}$ $A_{pier} = 15.9\,ft^{2}$

Pier perimeter $PM_{pier} := \pi \cdot D_{pier}$ $PM_{pier} = 14.14\,ft$

Pier volume $V_{pier} := A_{pier} \cdot (L_{pier} + E_{pier})$ $V_{pier} = 3.83 \cdot cy$

Weighted average unit weight of concrete

$$\gamma_{cave} := \frac{\sum_{n=1}^{NSL} \left(\gamma_{c_n} \cdot H_n\right)}{\sum_{n=1}^{NSL} H_n} \qquad \gamma_{cave} = 150 \cdot pcf$$

Pier concrete weight $W_{pier} := V_{pier} \cdot \gamma_{cave}$ $W_{pier} = 15.51 \cdot kips$

Anchor Hole area $A_{anchor} := \pi \cdot \frac{D_{anchor}^{2}}{4}$ $A_{anchor} = 0.03\,ft^{2}$

Hole perimeter $PM_{anchor} := \pi \cdot D_{anchor}$ $PM_{anchor} = 0.65\,ft$

Number of Anchor Rod: $n_{rod} := 10$

Friction Area $A_{friction} := L_{anchor} \cdot PM_{anchor} \cdot n_{rod} = 111.26\,ft^{2}$

-Download capacity-

Consider download capacity is taken by rock upper layer bearing capacity.

$$P_{dcap} := \left(\sum_{k} P_k\right) \cdot \phi_{s\_Bear} = 1192.82 \cdot kip$$

$P_{dcap} = 1192.82 \cdot kips$ > $P_{dwn} = 121 \cdot kips$ **OK!** $\frac{P_{dwn}}{P_{dcap}} = 10.14 \cdot \%$

-Uplift capacity-

Consider uplift capacity is only taken by anchor rod bonding.

$SKFUN := A_{friction} \cdot BOND$ $SKFUN = 3204.42 \cdot kip$

Negative skin friction: $N_{sf} := 0psf$

$P_{uptot} := P_{up} + N_{sf} \cdot \pi \cdot D_{pier} \cdot (H_1)$ Total uplift load

$P_{ucap} := SKFUN \cdot \phi_{s\_friction} = 2403.32 \cdot kip$

$P_{ucap} = 2403.32 \cdot kips$ > $P_{uptot} = 87 \cdot kips$ **OK!** $\frac{P_{uptot}}{P_{ucap}} = 3.62 \cdot \%$

REINFORCEMENT CALCULATIONS

Effective pier diameter $D_{eff} := D_{pier} - cc \cdot 2$ $D_{eff} = 4 ft$

-Minimum required area of steel per ACI-

$Area_{stlmin} := 0.005 \cdot \frac{\pi}{4} \cdot D_{pier}^{\ 2}$ -(ACI 10.8.4) & (ACI 10.9.1)

$Area_{stlmin} = 11.45 \cdot in^2$

-Rebar details-

Selected rebar size $d_{bar} = 10$

-Rebar details-

$No := (0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5\ \ 6\ \ 7\ \ 8\ \ 9\ \ 10\ \ 11\ \ 12\ \ 13\ \ 14\ \ 15\ \ 16\ \ 17\ \ 18)^T$

$d_b := (0\ \ 0\ \ 0\ \ 0.375\ \ 0.5\ \ 0.625\ \ 0.75\ \ 0.875\ \ 1.00\ \ 1.125\ \ 1.25\ \ 1.41\ \ 0\ \ 0\ \ 1.693\ \ 0\ \ 0$

$A_b := (0\ \ 0\ \ 0\ \ 0.11\ \ 0.20\ \ 0.31\ \ 0.44\ \ 0.60\ \ 0.79\ \ 1.00\ \ 1.27\ \ 1.56\ \ 0\ \ 0\ \ 2.25\ \ 0\ \ 0\ \ 0\ \ 4$

$B := d_{bar}$ $\quad d_{b_B} = 1.25 \cdot in$ $\quad$ Bar area= $\quad Area_{abar} := A_{b_B}$ $\quad Area_{abar} = 1.27 \cdot in^2$

-Number of vertical rebars required-

$NRB := ceil\left(\frac{Area_{stlmin}}{Area_{abar}}\right)$ $\quad NRB = 10$ $\quad Area_{stluse} := Area_{abar} \cdot NRB$

As per Lpile calculations, need $NRB := 10$

Use ($NRB = 10$) $d_{bar} = 10$ vertical bars $Area_{stluse} = 12.7 \cdot in^2$

Vertical bar spacing $\quad S_{bar} := D_{eff} \cdot \frac{\pi}{NRB} - d_{b_B}$ $\quad S_{bar} = 13.83 \cdot in$

$Area_{use} := Area_{abar} \cdot NRB$ $\quad Area_{use} = 12.7 \cdot in^2$

-Check pier in compression-

$P_{comp} := 0.80 \cdot \phi_{comp} \cdot \left[0.85 \cdot F_c \cdot \left(A_{pier} - Area_{use}\right) + F_y \cdot Area_{use}\right]$ $\quad$ (ACI 10.3.6.2 - (10-2)

$P_{comp} = 5103.34 \cdot kips$ $\quad > \quad$ $P_{dwn} = 121 \cdot kips$ $\quad$ **OK!**

SUMMARY

-Pier Dimensions-

Depth of pier	$L_{pier} = 3.5\,ft$	Concrete strength	$F_c = 4000 \cdot psi$
Extension above grade	$E_{pier} = 3\,ft$	Rebar Fy	$F_y = 60 \cdot ksi$
Total length of pier	$L_{tot} := L_{pier} + E_{pier}$	$L_{tot} = 6.5\,ft$	
Diameter	$D_{pier} = 4.5\,ft$		
Volume of pier concrete	$V_{pier} = 3.83 \cdot cy$		
Weight of pier concrete	$W_{pier} = 15.51 \cdot kips$		

Calculations summary

-Download capacity-

$P_{dcap} = 1192.82 \cdot kips$ > $P_{dwn} = 121 \cdot kips$ **OK!** $\frac{P_{dwn}}{P_{dcap}} = 10.14 \cdot \%$

-Uplift capacity-

$P_{ucap} = 2403.32 \cdot kips$ > $P_{uptot} = 87 \cdot kips$ **OK!** $\frac{P_{uptot}}{P_{ucap}} = 3.62 \cdot \%$

==

LPile for Windows, Version 2018-10.006

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==

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Files Used for Analysis

Path to file locations:
\2018\Structural\18-6240 CT22104-A-02 Waterbury 5, CT SA\L-Pile\

Name of input data file:
18-6240 CT22104-A-02 Waterbury 5, CT.lp10

Name of output report file:
18-6240 CT22104-A-02 Waterbury 5, CT.lp10

Name of plot output file:
18-6240 CT22104-A-02 Waterbury 5, CT.lp10

Name of runtime message file:
18-6240 CT22104-A-02 Waterbury 5, CT.lp10

Date and Time of Analysis

Date: September 26, 2018 Time: 11:19:35

Problem Title

Project Name: CT22104-A-02 Waterbury 5, CT
Job Number: 18-46240
Client: SBA
Engineer: Tao Xiang
Description: Pier

Program Options and Settings

Computational Options:
- Compute nonlinear bending properties of pile only

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Output Options:
- Output files use decimal points to denote decimal symbols.
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 6.500 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	54.0000
2	6.500	54.0000

```
Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a round drilled shaft, bored pile, or CIDH pile
   Length of section                                =     6.500000 ft
   Shaft Diameter                                   =    54.000000 in
   Shear capacity of section                        =       0.0000 lbs




--------------------------------------------------------------------------------
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Axial thrust force values were determined from input values

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Drilled Shaft (Bored Pile):
--------------------------------------------------------

Length of Section                                   =     6.500000 ft
Shaft Diameter                                      =    54.000000 in
Concrete Cover Thickness (to edge of long. rebar)   =     3.000000 in
Number of Reinforcing Bars                          =           10 bars
Yield Stress of Reinforcing Bars                    =       60000. psi
Modulus of Elasticity of Reinforcing Bars           =    29000000. psi
Gross Area of Shaft                                 =        2290. sq. in.
Total Area of Reinforcing Steel                     =    12.700000 sq. in.
Area Ratio of Steel Reinforcement                   =         0.55 percent
Edge-to-Edge Bar Spacing                            =    13.170364 in
Maximum Concrete Aggregate Size                     =     0.750000 in
Ratio of Bar Spacing to Aggregate Size              =        17.56
Offset of Center of Rebar Cage from Center of Pile  =       0.0000 in

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As =     8505.572 kips
Tensile Load for Cracking of Concrete               =     -989.734 kips
Nominal Axial Tensile Capacity                      =     -762.000 kips


Reinforcing Bar Dimensions and Positions Used in Computations:

     Bar         Bar Diam.      Bar Area         X              Y
    Number        inches         sq. in.       inches         inches
  ----------    ----------     ----------    ----------     ----------
      1          1.270000       1.270000      23.365000       0.00000
      2          1.270000       1.270000      18.902682      13.733602
```

3	1.270000	1.270000	7.220182	22.221436
4	1.270000	1.270000	-7.220182	22.221436
5	1.270000	1.270000	-18.902682	13.733602
6	1.270000	1.270000	-23.365000	0.00000
7	1.270000	1.270000	-18.902682	-13.733602
8	1.270000	1.270000	-7.220182	-22.221436
9	1.270000	1.270000	7.220182	-22.221436
10	1.270000	1.270000	18.902682	-13.733602

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 13.170 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 17.56

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Input Axial Thrust Forces:

Number of Axial Thrust Force Values Determined from Input Data = 2

Number	Axial Thrust Force kips
1	-87.000
2	121.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = -87.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
6.25000E-07	1155.	1847704291.	13.0608058	0.00000816	-0.00002559	0.0338332	-0.7371291	
0.00000125	2305.	1843937351.	20.0064348	0.00002501	-0.00004249	0.1039478	-1.2224792	
0.00000188	3448.	1839174439.	22.3207912	0.00004185	-0.00005940	0.1734305	-1.7078757	
0.00000250	4585.	1834133255.	23.4777344	0.00005869	-0.00007631	0.2422856	-2.1932892	
0.00000313	5716.	1828977789.	24.1717781	0.00007554	-0.00009321	0.3105140	-2.6787138	
0.00000375	6839.	1823764561.	24.6343901	0.00009238	-0.0001101	0.3781161	-3.1641476	
0.00000438	6839.	1563226767.	-26.9924229	-0.0001181	-0.0003543	0.00000	-10.2416575	C
0.00000500	6839.	1367823421.	-20.2432665	-0.0001012	-0.0003712	0.00000	-10.7261236	C
0.00000563	6839.	1215843041.	-14.9939227	-0.00008434	-0.0003881	0.00000	-11.2105899	C
0.00000625	6839.	1094258737.	-10.7944476	-0.00006747	-0.0004050	0.00000	-11.6950561	C
0.00000688	6839.	994780670.	-7.3585135	-0.00005059	-0.0004218	0.00000	-12.1795223	C
0.00000750	6839.	911882280.	-4.4952350	-0.00003371	-0.0004387	0.00000	-12.6639886	C
0.00000813	6839.	841737490.	-2.0724609	-0.00001684	-0.0004556	0.00000	-13.1484548	C
0.00000875	6839.	781613383.	0.0042026	3.67724E-08	-0.0004725	0.00000	-13.6329211	C
0.00000938	6839.	729505824.	1.6444030	0.00001542	-0.0004908	0.0544610	-14.1607717	C
0.00001000	6839.	683911710.	2.7941215	0.00002794	-0.0005121	0.1063361	-14.7714047	C
0.00001063	6839.	643681610.	3.6437276	0.00003871	-0.0005350	0.1505839	-15.4328327	C
0.00001125	6839.	607921520.	4.3043322	0.00004842	-0.0005591	0.1901750	-16.1251244	C
0.00001188	6839.	575925651.	4.8425770	0.00005751	-0.0005837	0.2269782	-16.8356065	C
0.00001250	6839.	547129368.	5.2933689	0.00006617	-0.0006088	0.2618795	-17.5582789	C
0.00001313	6839.	521075589.	5.6806247	0.00007456	-0.0006342	0.2955150	-18.2887934	C
0.00001375	6839.	497390335.	6.0056219	0.00008258	-0.0006599	0.3274869	-19.0300957	C

0.00001438	6839.	475764668.	6.2958442	0.00009050	-0.0006857	0.3589414	-19.7741137 C
0.00001500	6839.	455941140.	6.5478679	0.00009822	-0.0007118	0.3894136	-20.5242274 C
0.00001563	6839.	437703495.	6.7780840	0.0001059	-0.0007378	0.4196546	-21.2750869 C
0.00001625	6839.	420868745.	6.9770723	0.0001134	-0.0007641	0.4488907	-22.0323171 C
0.00001688	6839.	405281014.	7.1618532	0.0001209	-0.0007904	0.4780426	-22.7892868 C
0.00001750	6839.	390806692.	7.3307570	0.0001283	-0.0008167	0.5068886	-23.5476158 C
0.00001813	6839.	377330599.	7.4797909	0.0001356	-0.0008432	0.5350278	-24.3102661 C
0.00001875	6839.	364752912.	7.6193194	0.0001429	-0.0008696	0.5630849	-25.0726825 C
0.00001938	6839.	352986689.	7.7502644	0.0001502	-0.0008961	0.5910597	-25.8348639 C
0.00002000	6839.	341955855.	7.8703876	0.0001574	-0.0009226	0.6187144	-26.5985752 C
0.00002063	6839.	331593557.	7.9783374	0.0001646	-0.0009492	0.6458646	-27.3652132 C
0.00002125	6839.	321840805.	8.0802813	0.0001717	-0.0009758	0.6729337	-28.1316391 C
0.00002188	6839.	312645353.	8.1767359	0.0001789	-0.0010024	0.6999213	-28.8978518 C
0.00002250	6839.	303960760.	8.2681601	0.0001860	-0.0010290	0.7268274	-29.6638505 C
0.00002313	6839.	295745604.	8.3549634	0.0001932	-0.0010555	0.7536518	-30.4296339 C
0.00002375	6839.	287962825.	8.4329338	0.0002003	-0.0010822	0.7799804	-31.1983543 C
0.00002438	6839.	280579163.	8.5062146	0.0002073	-0.0011089	0.8061379	-31.9675632 C
0.00002563	6839.	266892375.	8.6428424	0.0002215	-0.0011623	0.8582091	-33.5053939 C
0.00002688	6839.	254478776.	8.7677730	0.0002356	-0.0012156	0.9099537	-35.0424356 C
0.00002813	6839.	243168608.	8.8825752	0.0002498	-0.0012689	0.9613702	-36.5786808 C
0.00002938	6839.	232821008.	8.9833763	0.0002639	-0.0013224	1.0118998	-38.1185301 C
0.00003063	6839.	223318110.	9.0751177	0.0002779	-0.0013758	1.0619132	-39.6591173 C
0.00003188	6839.	214560537.	9.1604627	0.0002920	-0.0014293	1.1115963	-41.1989660 C
0.00003313	6839.	206463913.	9.2401425	0.0003061	-0.0014827	1.1609476	-42.7380693 C
0.00003438	6839.	198956134.	9.3147819	0.0003202	-0.0015361	1.2099655	-44.2764204 C
0.00003563	6899.	193654591.	9.3849182	0.0003343	-0.0015894	1.2586485	-45.8140125 C
0.00003688	7186.	194887555.	9.4509506	0.0003485	-0.0016427	1.3069865	-47.3509084 C
0.00003813	7474.	196042656.	9.5093878	0.0003625	-0.0016962	1.3544652	-48.8914142 C

0.00003938	7762.	197117546.	9.5647359	0.0003766	-0.0017496	1.4016053	-50.4312109 C
0.00004063	8049.	198119576.	9.6172852	0.0003907	-0.0018030	1.4484052	-51.9702920 C
0.00004188	8335.	199055220.	9.6672916	0.0004048	-0.0018564	1.4948633	-53.5086513 C
0.00004313	8622.	199930201.	9.7149816	0.0004190	-0.0019098	1.5409781	-55.0462823 C
0.00004438	8908.	200749595.	9.7605559	0.0004331	-0.0019631	1.5867479	-56.5831783 C
0.00004563	9194.	201517922.	9.8041935	0.0004473	-0.0020164	1.6321713	-58.1193327 C
0.00004688	9480.	202239218.	9.8460543	0.0004615	-0.0020697	1.6772465	-59.6547386 C
0.00004813	9765.	202917102.	9.8862817	0.0004758	-0.0021230	1.7219719	-60.0000000 CY
0.00004938	10051.	203554822.	9.9250047	0.0004900	-0.0021762	1.7663458	-60.0000000 CY
0.00005063	10335.	204155307.	9.9623395	0.0005043	-0.0022294	1.8103665	-60.0000000 CY
0.00005188	10619.	204705688.	9.9975699	0.0005186	-0.0022826	1.8539000	-60.0000000 CY
0.00005313	10859.	204396169.	10.0154002	0.0005321	-0.0023367	1.8944237	-60.0000000 CY
0.00005438	11010.	202487194.	10.0042852	0.0005440	-0.0023923	1.9298977	-60.0000000 CY
0.00005563	11156.	200553967.	9.9920023	0.0005558	-0.0024479	1.9647898	-60.0000000 CY
0.00005688	11301.	198703005.	9.9798140	0.0005676	-0.0025036	1.9993094	-60.0000000 CY
0.00005813	11447.	196929418.	9.9682652	0.0005794	-0.0025593	2.0335536	-60.0000000 CY
0.00005938	11592.	195228408.	9.9574528	0.0005912	-0.0026150	2.0675460	-60.0000000 CY
0.00006063	11737.	193595475.	9.9473330	0.0006031	-0.0026707	2.1012857	-60.0000000 CY
0.00006188	11882.	192026482.	9.9378654	0.0006149	-0.0027263	2.1347719	-60.0000000 CY
0.00006313	12026.	190517617.	9.9290127	0.0006268	-0.0027820	2.1680037	-60.0000000 CY
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3.9839319    60.0000000 CYT
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3.9742235    60.0000000 CYT


Axial Thrust Force =    121.000 kips

    Bending       Bending       Bending      Depth to      Max Comp      Max Tens
Max Conc      Max Steel  Run
   Curvature      Moment       Stiffness      N Axis        Strain        Strain
Stress        Stress    Msg
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rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi
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0.00000188	3446.	1838071661.	33.5089369	0.00006283	-0.00003842	0.2599560	1.8073672
0.00000250	4583.	1833292140.	31.8994220	0.00007975	-0.00005525	0.3283352	2.2931331
0.00000313	5713.	1828296935.	30.9339408	0.00009667	-0.00007208	0.3960865	2.7789196
0.00000375	6837.	1823191595.	30.2904276	0.0001136	-0.00008891	0.4632090	3.2647215
0.00000438	7954.	1818022648.	29.8308786	0.0001305	-0.0001057	0.5297023	3.7505365
0.00000500	7954.	1590769817.	20.0540576	0.0001003	-0.0001697	0.4085372	-4.8830116 C
0.00000563	7954.	1414017615.	19.2946395	0.0001085	-0.0001952	0.4409886	-5.6172682 C
0.00000625	7954.	1272615854.	18.6607830	0.0001166	-0.0002209	0.4726376	-6.3562956 C
0.00000688	7954.	1156923504.	18.1211439	0.0001246	-0.0002467	0.5035719	-7.0995158 C
0.00000750	7954.	1060513212.	17.6552040	0.0001324	-0.0002726	0.5338891	-7.8462682 C
0.00000813	7954.	978935272.	17.2491586	0.0001401	-0.0002986	0.5636978	-8.5957983 C
0.00000875	7954.	909011324.	16.8935749	0.0001478	-0.0003247	0.5931194	-9.3472428 C
0.00000938	7954.	848410569.	16.5774857	0.0001554	-0.0003508	0.6221252	-10.1008398 C
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0.00001125	7954.	707008808.	15.8109997	0.0001779	-0.0004296	0.7071458	-12.3710738 C
0.00001188	7954.	669797818.	15.6014152	0.0001853	-0.0004560	0.7348867	-13.1305313 C
0.00001250	7954.	636307927.	15.4131431	0.0001927	-0.0004823	0.7625272	-13.8898606 C
0.00001313	7954.	606007549.	15.2365130	0.0002000	-0.0005088	0.7897365	-14.6515835 C
0.00001375	7954.	578461752.	15.0753091	0.0002073	-0.0005352	0.8167982	-15.4135580 C
0.00001438	7954.	553311241.	14.9284269	0.0002146	-0.0005617	0.8437619	-16.1754058 C
0.00001500	7954.	530256606.	14.7914583	0.0002219	-0.0005881	0.8704799	-16.9382656 C
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0.00001750	7954.	454505662.	14.3318539	0.0002508	-0.0006942	0.9755991	-19.9945591	C
0.00001813	7954.	438833053.	14.2338246	0.0002580	-0.0007208	1.0014027	-20.7601772	C
0.00001875	7954.	424205285.	14.1415708	0.0002652	-0.0007473	1.0270437	-21.5262083	C
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  0.0001994       19183.     96213873.     9.1389856     0.0018221    -0.0089442
3.9843419   -60.0000000 CY
  0.0002044       19213.     94008799.     9.0853589     0.0018568    -0.0091794
3.9919477   -60.0000000 CY
  0.0002094       19243.     91906664.     9.0349884     0.0018917    -0.0094145
3.9970643   -60.0000000 CY
  0.0002144       19272.     89900219.     8.9876574     0.0019267    -0.0096495
3.9996587   -60.0000000 CY
  0.0002194       19301.     87982290.     8.9432779     0.0019619    -0.0098843
3.9948490   -60.0000000 CY
  0.0002244       19329.     86145504.     8.9005233     0.0019971    -0.0101192
3.9943392   -60.0000000 CY
  0.0002294       19355.     84380925.     8.8560713     0.0020314    -0.0103549
3.9981374   -60.0000000 CY
```

```
    0.0002344       19380.     82689862.     8.8141276     0.0020658    -0.0105904
  3.9998807   -60.0000000 CY
    0.0002394       19405.     81066607.     8.7748021     0.0021005    -0.0108258
  3.9936343   -60.0000000 CY
    0.0002444       19430.     79507768.     8.7377533     0.0021353    -0.0110610
3.9926442    60.0000000 CY
    0.0002494       19454.     78010023.     8.7027147     0.0021702    -0.0112960
3.9968792    60.0000000 CY
    0.0002544       19477.     76569742.     8.6695775     0.0022053    -0.0115309
3.9993332    60.0000000 CY
    0.0002594       19501.     75183317.     8.6383088     0.0022406    -0.0117657
3.9987038    60.0000000 CY
    0.0002644       19523.     73846625.     8.6090884     0.0022760    -0.0120002
3.9897005    60.0000000 CY
    0.0002694       19545.     72558476.     8.5813874     0.0023116    -0.0122346
3.9921093    60.0000000 CY
    0.0002744       19567.     71316196.     8.5551304     0.0023473    -0.0124689
3.9962797    60.0000000 CY
    0.0003044       19691.     64694216.     8.4254930     0.0025645    -0.0138717
3.9957627    60.0000000 CY
    0.0003344       19803.     59223355.     8.3265245     0.0027842    -0.0152721
3.9898148    60.0000000 CY
    0.0003644       19905.     54626728.     8.2479149     0.0030053    -0.0166709
3.9884406    60.0000000 CYT
    0.0003944       19983.     50669045.     8.1766006     0.0032246    -0.0180716
3.9976335    60.0000000 CYT
    0.0004244       20024.     47183830.     8.0943293     0.0034350    -0.0194812
3.9814382    60.0000000 CYT
    0.0004544       20039.     44101478.     8.0065423     0.0036380    -0.0208983
3.9911914    60.0000000 CYT
    0.0004844       20042.     41376622.     7.9227951     0.0038376    -0.0223186
3.9998787    60.0000000 CYT
```

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	-87.000	15672.350	0.00300000
2	121.000	19902.158	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	15672.	-56.550000	10187.	203842599.
2	0.65	19902.	78.650000	12936.	270523449.
1	0.70	15672.	-60.900000	10971.	202985481.
2	0.70	19902.	84.700000	13932.	266678816.
1	0.75	15672.	-65.250000	11754.	193405599.
2	0.75	19902.	90.750000	14927.	261061984.

The analysis ended normally.

EXISTING 185' SELF SUPPORT TOWER ANCHOR BOLT CHECK

REACTIONS ON THE FOUNDATION

As per Tnx output (see attached)

Down load; $Pv := 121 \cdot kips$ Shear; $V_u := 14 \cdot kips$

Uplift load; $P_{up} := 87 \cdot kips$ Moment; $M := 0 \cdot kips \cdot ft$

Anchor Rod Data is as per tower modification design by Tectonic, project # 3997.06, dated 06/29/96.

Number of Anchor Bolt: $N_{anchors} := 6$

Diameter of Anchors: $D_{anchors} := 1in$ $n := 8in^{-1}$

Number of Added Anchor Bolt: $N_{anchors.add} := 3$

Diameter of Added Anchors: $D_{anchors.add} := 1.75in$ $n_{add} := 6in^{-1}$

Area of anchor bolts

$$A_b := \frac{\pi \cdot \left(D_{anchors}^{2}\right)}{4} = 0.785 \cdot in^2$$

$$A_{b.add} := \frac{\pi \cdot \left(D_{anchors.add}^{2}\right)}{4} = 2.405 \cdot in^2$$

Net Tensile Area of Anchors:

$$A_{net} := \frac{\pi}{4} \cdot \left(D_{anchors} - \frac{0.9743}{n}\right)^2 = 0.606 \cdot in^2$$

$$A_{net.add} := \frac{\pi}{4} \cdot \left(D_{anchors.add} - \frac{0.9743}{n_{add}}\right)^2 = 1.98 \cdot in^2$$

Minimum Yield Stress $F_{Yanchors} := 50ksi$ (Assumed) $F_{Yanchors.add.bolt} := 65ksi$ (Grade F593)

Ultimate Tensile Stress: $F_{Uanchors} := 65ksi$ $F_{Uanchors.add.bolt} := 125ksi$

Saftey Factor for Anchor: $\phi_t := 0.8$ (Section 4.9.9, TIA-222-G Addendum 2)

Allowable Axial Load per Anchor:

$T_{cap} := \phi_t \cdot F_{Uanchors} \cdot A_{net}$ $T_{cap.add} := \phi_t \cdot F_{Uanchors.add.bolt} \cdot A_{net.add}$

$T_{cap} = 31.499 \cdot kips$ $T_{cap.add} = 197.962 \cdot kips$

Interaction Equation for Anchor Rods as per Section 4.9.9, TIA-222-G Addendum 1 and Figure 4.4

For detail type (C) as per Figure 4.4 $\eta := 0.55$

$P_u := \text{if}\left(\eta > 0.5, P_{up}, Pv\right) = 87 \cdot kips$

Maximum Load on Anchor: $T_{max} := \dfrac{P_u + \dfrac{V_u}{\eta}}{N_{anchors} + N_{anchors.add}}$

$T_{max} = 12.495 \cdot kips$

Anchor Rod Capacity: $\dfrac{T_{max}}{T_{cap}} = 39.668 \cdot \%$ OK!

$Anchor\_Rod\_Check := \text{if}\left(T_{max} < T_{cap}, \text{"OK"}, \text{"Not OK"}\right)$

$Anchor\_Rod\_Check = \text{"OK"}$

Summary

-Foundation Reactions from Tower Base-

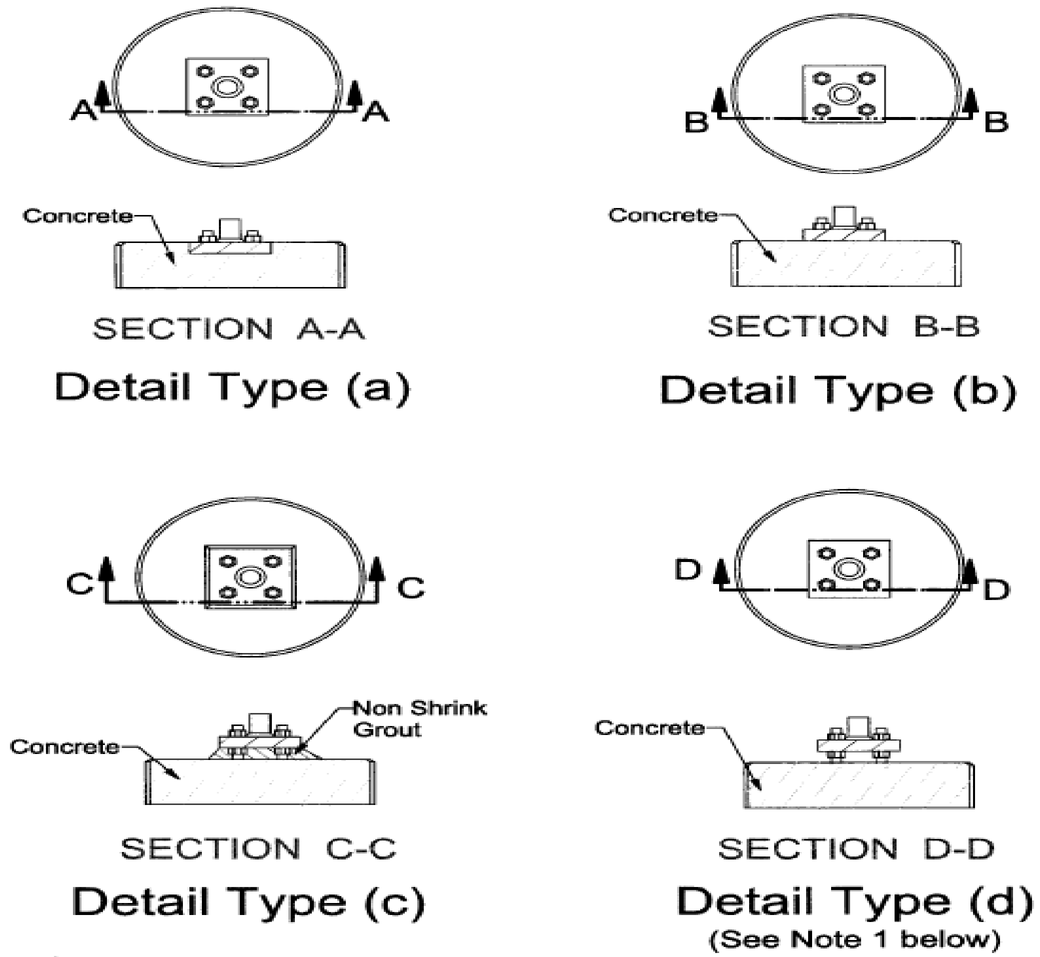
Shear	$V_u = 14 \cdot kips$
Down load	$Pv = 121 \cdot kips$
Uplift load	$P_{up} = 87 \cdot kips$
Moment	$M = 0 \cdot ft \cdot kip$

Anchor Rod Check $T_{max} = 12.495 \cdot kips$ < $T_{cap} = 31.499 \cdot kips$

$Anchor\_Rod\_Check := \text{if}\left(T_{max} < T_{cap}, \text{"OK"}, \text{"Not OK"}\right)$

$Anchor\_Rod\_Check = \text{"OK"}$

ANSI/TIA-222-G



Note:

1. When clear distance from top of concrete to the bottom face of the leveling nut exceeds 1.5 times the diameter of the anchor rod, bending of the anchor rod shall be considered (refer to 4.9.9).

Figure 4-4: Anchor Rod Detail Types

4.9.9 Anchor Rods

For anchor rods, the following interaction equation shall be satisfied:

$$\left(\frac{P_u + \frac{V_u}{\eta}}{\phi R_{nt}}\right) \leq 1$$

where:

ϕ= 0.80

P_u = tension force for detail types (a), (b) & (c) and larger of compression or tension force for type (d) as depicted in Figure 4-4.

V_u = shear force (direct shear and torsion components) corresponding to P_u

R_{nt} = nominal tensile strength of anchor rod as per 4.9.6.1

η = 0.90 for detail type (a)
= 0.70 for detail type (b)
= 0.55 for detail type (c)
= 0.50 for detail type (d)

For detail type (d), when the clear distance from the top of concrete to the bottom leveling nut exceeds 1.0 times the diameter of the anchor rod, the following interaction equation shall also be satisfied:

$$\left(\frac{V_u}{\phi R_{nv}}\right)^2 + \left(\left|\frac{P_u}{\phi R_{nt}}\right| + \left|\frac{M_u}{\phi R_{nm}}\right|\right)^2 \leq 1$$

where:

M_u = bending moment corresponding to V_u
= 0.65 $l_{ar}V_u$

l_{ar} = length from top of concrete to bottom of anchor rod leveling nut

Addendum 1

ϕR_{nv} = design shear strength of anchor rod as per 4.9.6.3

ϕR_{nm} = design flexural strength of anchor rod in accordance with 4.7.1 using the tensile root diameter for the determination of z

d_{rt} = tensile root diameter of rod, in [mm]
= d – 0.9743/n inches
= d – 0.9382(p) mm

d = nominal rod diameter, in [mm]

n = number of threads per inch

p = pitch of threads, mm

4.9.6.3 Design Shear Strength

The design shear strength of a bolt, ϕR_{nv}, shall be taken as:

$\phi = 0.75$

(a) When threads are excluded from the shear plane:
$R_{nv} = 0.55\ F_{ub}\ A_b$

(b) When threads are included in the shear plane:
$R_{nv} = 0.45\ F_{ub}\ A_b$

where:

F_{ub} = Specified minimum tensile strength of bolt

A_b = nominal unthreaded area of bolt

4.7.1 Solid Round Members

For solid round members, M_n shall be determined as follows:

$M_n = F_y'Z$

where:

F_y' = effective yield stress as determined from 4.5.4.1

Z = plastic section modulus

4.5.4.1 Effective Yield Stress

For 60^O and 90^O angle members, the effective yield stress for axial compression, F'_y, shall be determined as follows:

$w/t \le 0.47\sqrt{\frac{E}{F_y}}$ $\quad$ $F'_y = F_y$

$0.47\sqrt{\frac{E}{F_y}} < w/t \le 0.85\sqrt{\frac{E}{F_y}}$ $\quad$ $F'_y = [1.677\text{-}0.677\left(\frac{w/t}{0.47\sqrt{E/F_y}}\right)]\ F_y$

$0.85\sqrt{\frac{E}{F_y}} < w/t \le 25$ $\quad$ $F'_y = [0.0332\ \pi^2\ E/(w/t)^2]$

The width to thickness ratio (w/t) shall not exceed 25 for angle members (refer to Figure 4-3).

For solid round members, the effective yield stress, F'_y, shall be equal to F_y.

For tubular round members, the diameter to thickness ratio (D/t) shall not exceed 400. The effective yield stress, F'_y, shall be determined as follows:

$D/t \le 0.114\ E/F_y$ $\quad$ $F'_y = F_y$

$0.114\ E/F_y < D/t \le 0.448\ E/F_y$ $\quad$ $F'_y = \left(\frac{0.0379E}{(D/t)F_y} + \frac{2}{3}\right)F_y$

$0.448\ E/F_y < D/t \le 400$ $\quad$ $F'_y = \frac{0.337E}{(D/t)}$

PROJECT INFORMATION

SITE INFORMATION:

LATITUDE:	41.57021388° N
LONGITUDE:	73.01649444° W
GROUND ELEVATION	830'± AMSL (PER GOOGLE EARTH)
STRUCTURE HEIGHT	185'± AGL (TYPE: SELF SUPPORT)
ZONING JURISDICTION	WATERBURY

APPLICANT:

SPRINT
1 INTERNATIONAL BLVD. SUITE 800
MAHWAH, NJ 07495

PROPERTY OWNER:

UNAVAILABLE

TOWER OWNER:

MCM ACQUISITION 2017, LLC
8051 CONGRESS AVENUE
BOCA RATON, FL 33487
(561)995–7670

SBA SITE ID: CT22104–A, SBA SITE NAME: WATERBURY 5, CT

SBA CONTACT:

STEPHEN ROTH
sroth@sbasite.com
(860)539–4920

VICINITY MAP N.T.S.

CODE COMPLIANCE

1. IBC 2012 WITH 2016 CT STATE BUILDING CODE AMENDMENTS
2. TIA–EIA–222–G
3. NFPA 70 2014 – NATIONAL ELECTRIC CODE

BASED ON INFORMATION PROVIDED BY SPRINT, THIS TELECOMMUNICATIONS EQUIPMENT DEPLOYMENT IS AN ELIGIBLE FACILITY UNDER THE TAX RELIEF ACT OF 2012, 47 USC 1455(A), AND IS SUBJECT TO AN EXPEDITED ELIGIBLE FACILITIES REQUEST/REVIEW AND ZONING PRE–EMPTION FOR LOCAL DISCRETIONARY PERMITS (VARIANCE, SPECIAL PERMIT, SITE PLAN REVIEW).

SOURCE: HDG 07–17–2018

FEEDLINES

FEEDLINE SCHEDULE	FEEDLINE DESCRIPTION	LOCATION
A	EXISTING TO REMAIN: (3) 1–1/4" AND (1) 7/8" HYBRID FIBER TRUNKS	ROUTED ON EXISTING WAVEGUIDE CABLE LADDER
B	PROPOSED: NONE	

NOTE:
EXISTING SPRINT EQUIPMENT FEEDLINE INVENTORY BASED ON OBSERVED FIELD CONDITIONS, RFDS AND FEEDLINE LEASING ENTITLEMENTS MAY DIFFER.

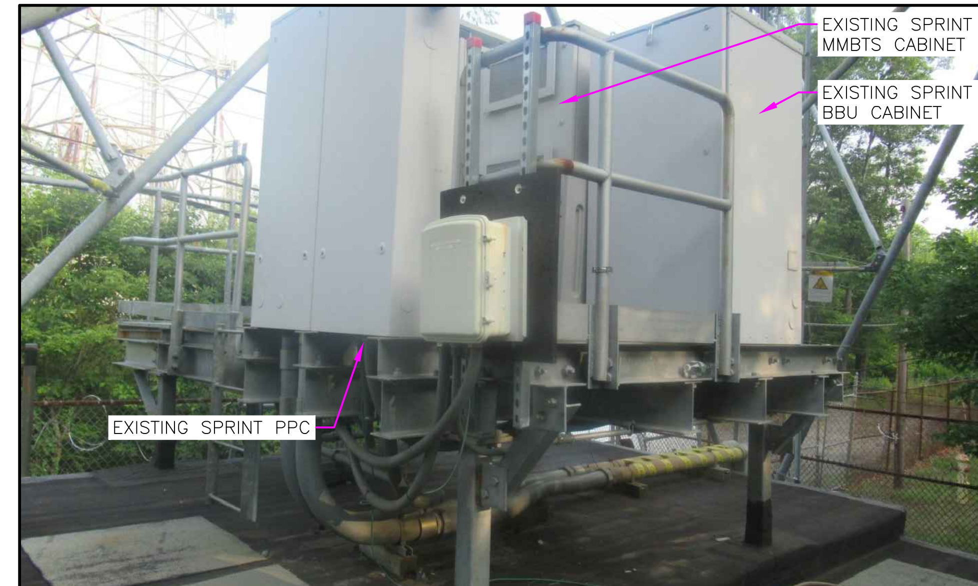
TOWER ELEVATION PHOTO DETAIL 1 / A–1
SCALE: N.T.S

DO MACRO UPGRADE EQUIPMENT DEPLOYMENT

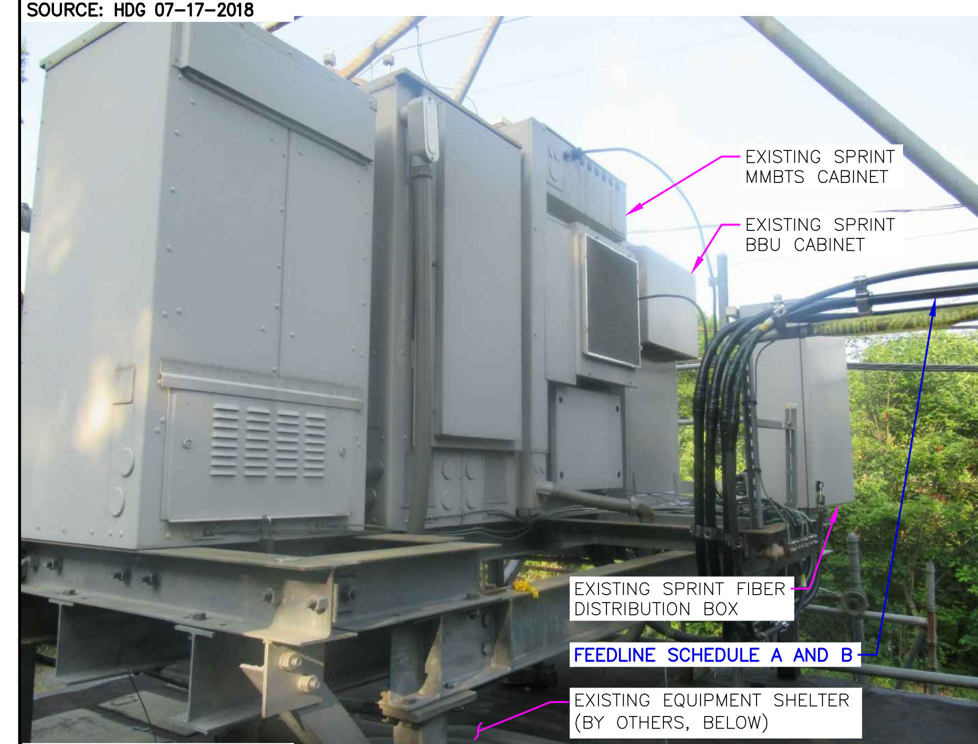
SITE NAME: WATERBURY

184 GARDEN HILL CIRCLE
WATERBURY, CT 06704

SITE CASCADE: CT03XC045



SOURCE: HDG 07–17–2018



SOURCE: HDG 07–17–2018

EQUIPMENT PLAN PHOTO DETAIL 2 / A–1
SCALE: N.T.S

Sprint
1 INTERNATIONAL BLVD, SUITE 800
MAHWAH, NJ 07495
TEL: (800) 357-7641

SBA
SBA COMMUNICATIONS CORP.
134 FLANDERS ROAD, SUITE 125
WESTBOROUGH, MA 01581
TEL: (508) 251-0720
FAX: (508) 251-1755

HDG
HUDSON Design Group LLC
45 BEECHWOOD DRIVE
N. ANDOVER, MA 01845
TEL: (978) 557-5553
FAX: (978) 336-5586

STATE OF CONNECTICUT
DEREK J. CREASER
No.28551
LICENSED PROFESSIONAL ENGINEER

CONSTRUCTION DRAWINGS ARE VALID FOR SIX MONTHS AFTER ENGINEER OF RECORD'S STAMPED AND SIGNED SUBMITTAL DATE LISTED HEREIN

CHECKED BY: BB

APPROVED BY: DJC

SUBMITTALS

REV.	DATE	DESCRIPTION	BY
0	08/14/18	ISSUED FOR CONSTRUCTION	DJM

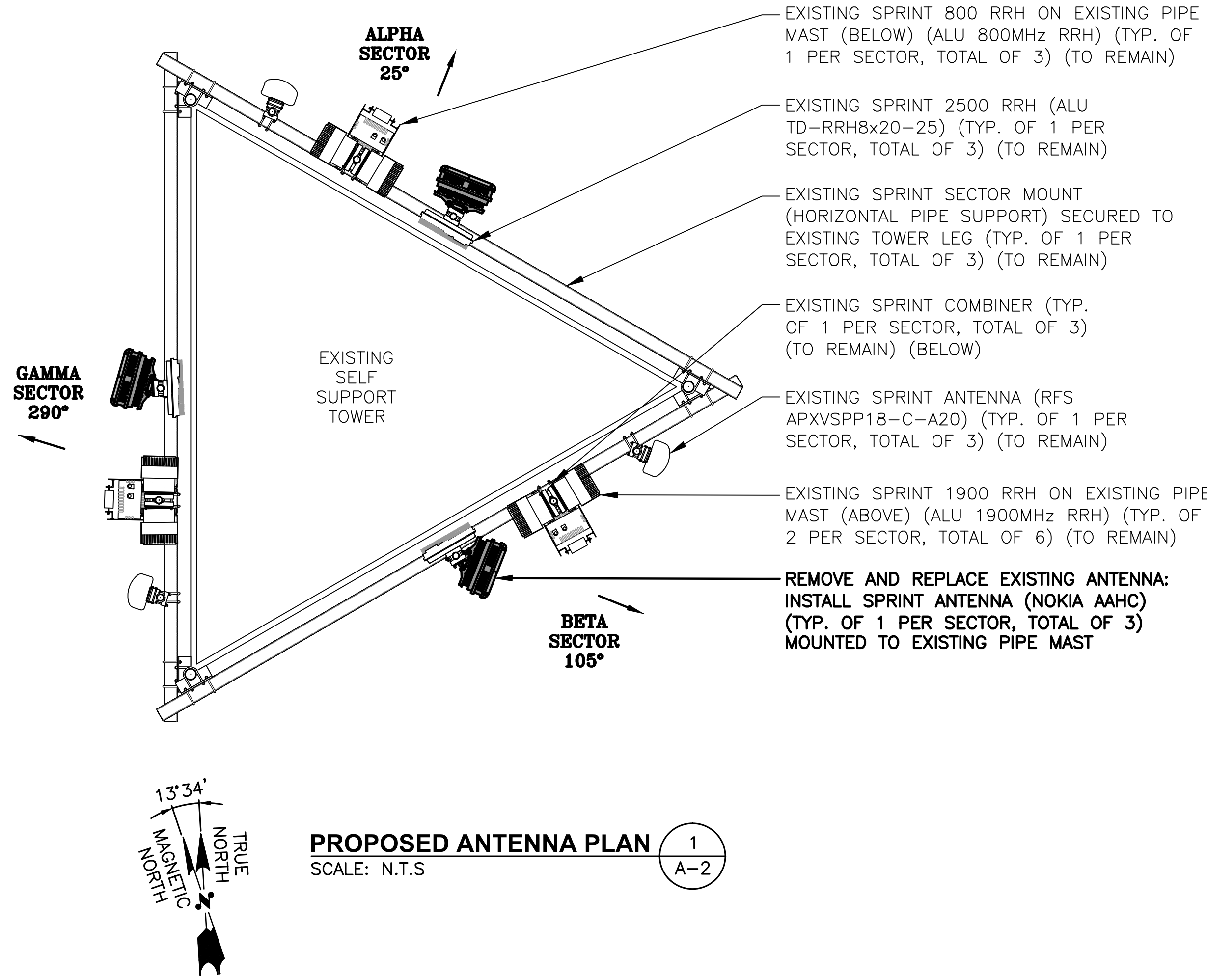
SITE NUMBER:
CT03XC045

SITE NAME:
WATERBURY

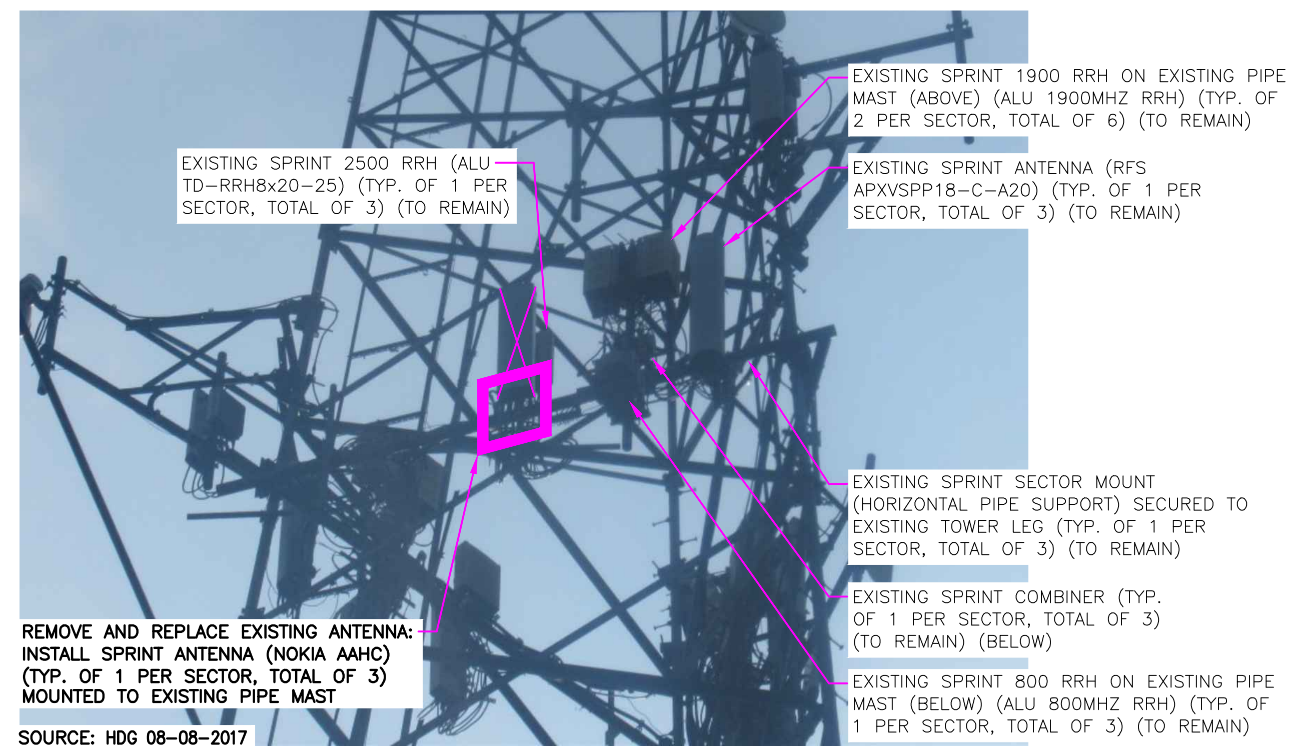
SITE ADDRESS:
184 GARDEN HILL CIRCLE
WATERBURY, CT 06704

SHEET TITLE
TITLE SHEET ELEVATION & EQUIPMENT PLAN PHOTO DETAIL
(DO MACRO)

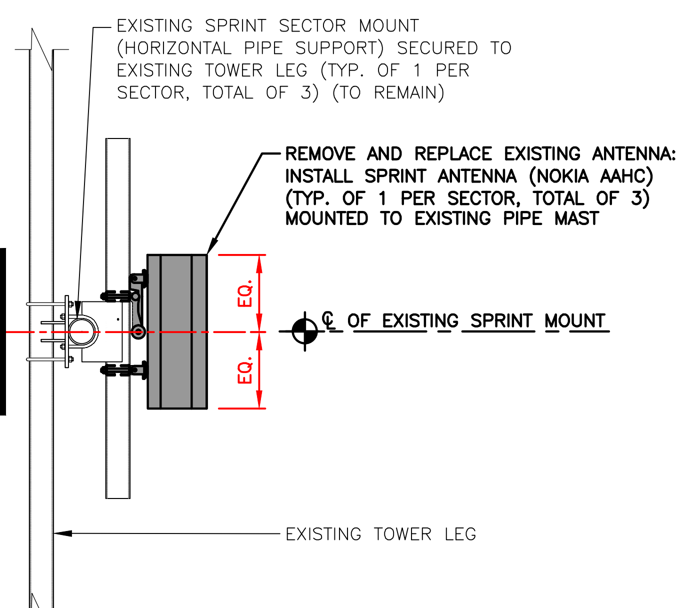
SHEET NUMBER
A-1



PROPOSED ANTENNA PLAN (1 / A–2)
SCALE: N.T.S



ANTENNA & RRH MOUNT PHOTO DETAIL (3 / A–2)
SCALE: N.T.S



ANTENNA INSTALLATION SPECIAL WORK NOTE: ANTENNA INSTALLATION WORKING POINT IS THE VERTICAL CENTERLINE OF THE EXISTING HORIZONTAL PIPE SUPPORT. UNLESS NOTED OTHERWISE, VERTICALLY CENTER **ALL** PIPE MASTS AND **ALL** ANTENNAS ON THIS WORKING POINT.

ANTENNA & RRH MOUNTING ELEVATION (2 / A–2)
22x34 SCALE: 3/4"=1'–0"
11x17 SCALE: 3/8"=1'–0"

0 8" 1'–4" 2'–8" 4'–0"

MAJOR RF EQUIPMENT LIST

(GC SHALL FURNISH AND INSTALL ALL OTHER MATERIALS AND EQUIPMENT NOT SUPPLIED BY SPRINT)

DESCRIPTION	QUANTITY	UNITS	MAKE/MODEL/MATERIAL	PROVIDED BY
ANTENNA	3	EA	RFS APXVSPP18–C–A20	EXISTING TO REMAIN
ANTENNA	3	EA	NOKIA AAHC	SPRINT
2500 RRU	3	EA	ALCATEL LUCENT TD–RRH8x20–25	EXISTING TO REMAIN
1900 RRU	6	EA	ALCATEL LUCENT 1900MHz RRH	EXISTING TO REMAIN
800 RRU	3	EA	ALCATEL LUCENT 800MHz RRH	EXISTING TO REMAIN
HYBRID TRUNK	3 @ 180'±	LINEAR FEET LISTED	1–1/4" HYBRID	EXISTING TO REMAIN
HYBRID TRUNK	1 @ 180'±	LINEAR FEET LISTED	7/8" HYBRID	EXISTING TO REMAIN

SPRINT-PROVIDED EQUIPMENT SCHEDULE (4 / A–2)
SCALE: N.T.S

Sprint
1 INTERNATIONAL BLVD, SUITE 800
MAHWAH, NJ 07495
TEL: (800) 357-7641

SBA
SBA COMMUNICATIONS CORP.
134 FLANDERS ROAD, SUITE 125
WESTBOROUGH, MA 01581
TEL: (508) 251-0720
FAX: (508) 251-1755

HDG HUDSON Design Group LLC
45 BEECHWOOD DRIVE
N. ANDOVER, MA 01845
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FAX: (978) 336-5586

STATE OF CONNECTICUT DEREK J. CREASER LICENSED PROFESSIONAL ENGINEER

CONSTRUCTION DRAWINGS ARE VALID FOR SIX MONTHS AFTER ENGINEER OF RECORD'S STAMPED AND SIGNED SUBMITTAL DATE LISTED HEREIN

CHECKED BY: BB

APPROVED BY: DJC

SUBMITTALS

REV.	DATE	DESCRIPTION	BY
0	08/14/18	ISSUED FOR CONSTRUCTION	DJM

SITE NUMBER: CT03XC045

SITE NAME: WATERBURY

SITE ADDRESS: 184 GARDEN HILL CIRCLE WATERBURY, CT 06704

SHEET TITLE: ANTENNA PLAN AND DETAILS (DO MACRO)

SHEET NUMBER: A-2