EVERSOURCE ENERGY

56 Prospect Street,
P.O. Box 270
Hartford, CT 06103

Kathleen M. Shanley
Manager – Transmission Siting
Tel: (860) 728-4527

June 25, 2020

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

RE: **Notice of Exempt Modification**
Eversource Site # 3712
2 Tindall Avenue, Norwalk, CT 06851
Latitude: 41-07-31.26 N / Longitude: 73-25-17.36 W

Dear Ms. Bachman:

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource") currently maintains multiple antennas and equipment at various mounting heights on an existing 150-foot self-support tower located at 2 Tindall Avenue in Norwalk. See Attachment A, Parcel Map and Property Card. The tower and property are owned by Eversource. Eversource plans to install one 24-foot tall omni-directional antenna to be mounted at approximately 147 feet above ground level ("AGL") and two 7/8-inch diameter coaxial cables. There will be no changes to the area of the fenced compound, the tower or the antennas and equipment currently mounted on the tower. The tower and existing and proposed equipment on the tower are depicted on Attachment B, Construction Drawings, dated March 30, 2020 and Attachment C, Structural Analysis, dated March 5, 2020. The Connecticut Siting Council approved the self-support tower at this location in Petition No. 1156 in June 2015.

The proposed installation is part of Eversource's program to update the current obsolete analog voice radio communications system to a modern digital voice communications system. The new system will enable the highest level of voice communications under all operating conditions, including during critical emergency and storm restoration activities. The new radio system will also provide for remote control of distribution safety equipment.

Please accept this letter as notification pursuant to Regulations of Connecticut State Agencies ("R.C.S.A.") §16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this notice is being delivered to Harry W. Rilling, Mayor for the City of Norwalk and Steven Kleppin, Director of Planning & Zoning for the City of Norwalk via the United States Postal Service or private carrier. Proof of delivery is attached. See Attachment D, Proof of Delivery of Notice.

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. There will be no change to the height of the existing tower.
2. The proposed modifications will not require the extension of the site boundary.
3. The proposed modification will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.
4. The operation of the new antennas will not increase radio frequency emissions at the facility to a level at or above the Federal Communications Commission safety standard as shown in the attached Calculated Radio Frequency Emissions Report, dated February 5, 2020 (Attachment E – Power Density Report).
5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.
6. The existing structure and its foundation can support the proposed loading.

For the foregoing reasons, Eversource respectfully submits that the proposed modifications to the above referenced telecommunications facility constitute an exempt modification under R.C.S.A. § 16-50j-72(b)(2). One original copy of this notice has been provided via courier to the Council.

Communications regarding this Notice of Exempt Modification should be directed to Kathleen Shanley at (860) 728-4527.

By: ______________________________

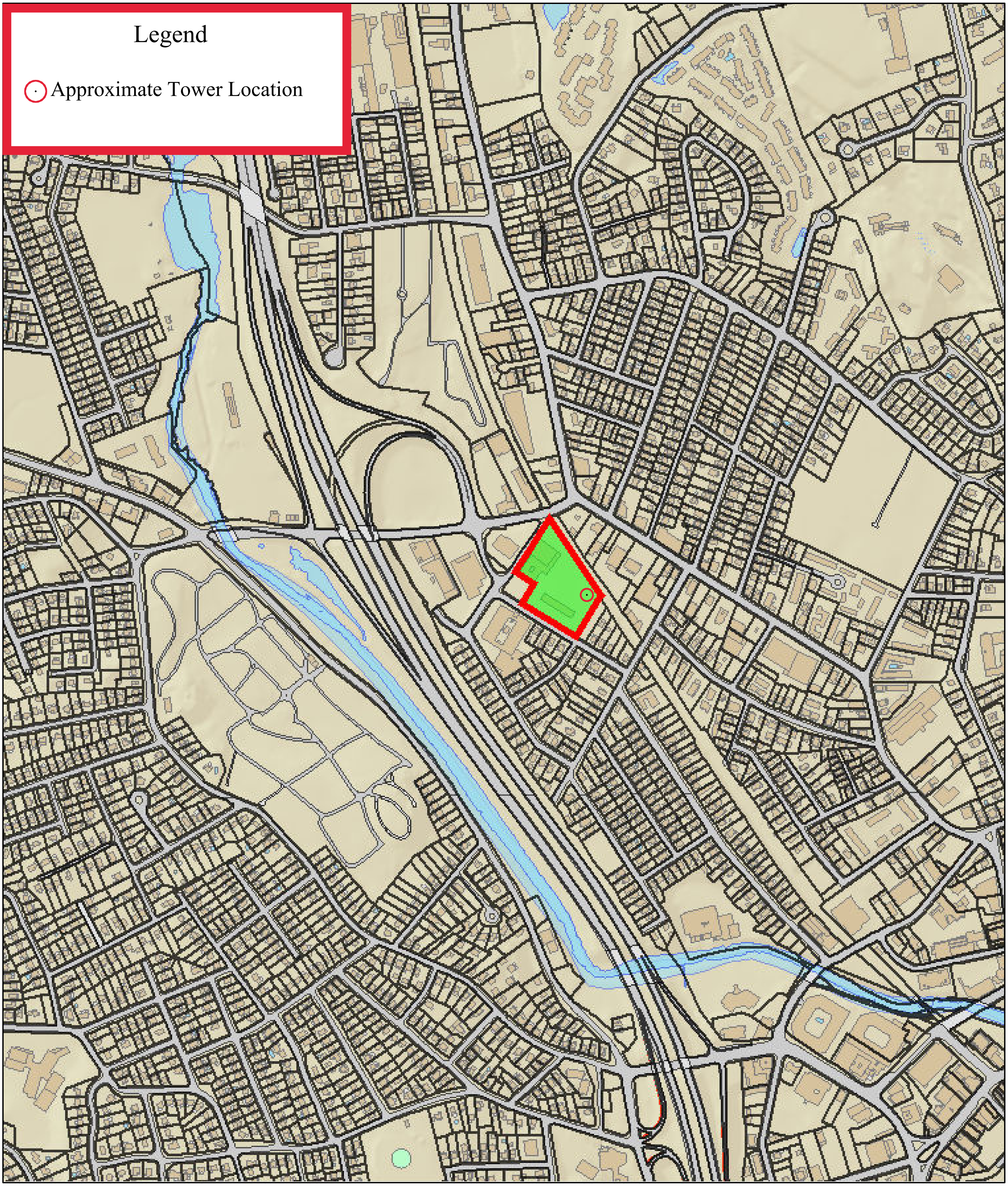
Kathleen M. Shanley
Manager – Transmission Siting

cc: Honorable Harry W. Rilling, Mayor, City of Norwalk
Steven Kleppin, Director of Planning & Zoning, City of Norwalk

Attachments

A. Parcel Map and Property Card
B. Construction Drawings
C. Structural Analysis
D. Proof of Delivery of Notice
E. Power Density Report

ATTACHMENT A – PARCEL MAP AND PROPERTY CARD



2 Tindall Ave Parcel Map

N
W E
S

Feet
0 650 1,300 2,600
1 inch = 952 feet

SEAL OF THE CITY OF NORWALK
E PLURIBUS UNUM
INCORPORATED 1913

2 TINDALL AVE

Location	2 TINDALL AVE	**Mblu**	1/ 92/ 13/ 0/
Acct#	3712	**Owner**	CONN LIGHT & POWER CO
Assessment	$5,009,670	**Appraisal**	$7,156,670
PID	3712	**Building Count**	1

Current Value

Appraisal			
Valuation Year	**Improvements**	**Land**	**Total**
2018	$4,043,250	$3,113,420	$7,156,670
Assessment			
Valuation Year	**Improvements**	**Land**	**Total**
2018	$2,830,280	$2,179,390	$5,009,670

Owner of Record

Owner CONN LIGHT & POWER CO
Co-Owner ATTN TAX DIVISION
Address 107 SELDEN ST
BERLIN, CT 06037-0000

Sale Price $0
Certificate
Book & Page 1189/110
Sale Date 12/26/1978

Ownership History

Ownership History				
Owner	**Sale Price**	**Certificate**	**Book & Page**	**Sale Date**
CONN LIGHT & POWER CO	$0		1189/110	12/26/1978

Building Information

Building 1 : Section 1

Year Built: 1929
Living Area: 37,776
Replacement Cost: $4,340,633
Building Percent Good: 72
Replacement Cost Less Depreciation: $3,125,260

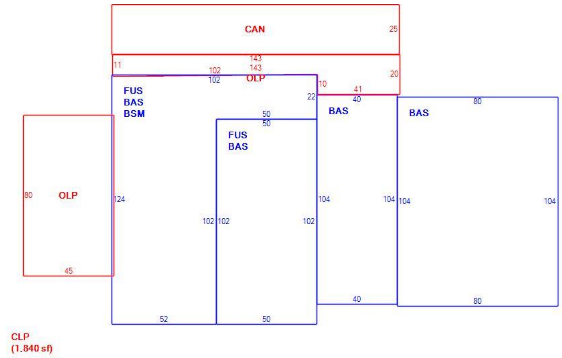
Building Attributes	
Field	**Description**

Building Photo

Building Photo
(http://images.vgsi.com/photos/NorwalkCTPhotos//24)

STYLE	Office/Warehs
MODEL	Industrial
Grade	B
Stories:	2.00
Occupancy	1.00
Exterior Wall 1	Brick/Masonry
Exterior Wall 2	Concrete
Roof Structure	Flat
Roof Cover	Tar and Gravel
Interior Wall 1	Plastered
Interior Wall 2	
Interior Floor 1	Carpet
Interior Floor 2	Concrete
Heating Fuel	Gas
Heating Type	Forced Air
AC Percent	48
Heat Percent	100
Bldg Use	Utility
Total Rooms	0
Bedrooms	0
Full Baths	0
Half Baths	9
Extra Fixtures	0
FBM Area	
Heat/AC	Heat/AC Pkg
Frame	Masonry
Plumbing	Average
Foundation	Poured Conc
Partitions	Average
Wall Height	12.00
% Sprinkler	0.00

Building Layout



(ParcelSketch.ashx?pid=3712&bid=3712)

Building Sub-Areas (sq ft)			Legend
Code	**Description**	**Gross Area**	**Living Area**
BAS	First Floor	25,128	25,128
FUS	Finished Upper Story	12,648	12,648
BSM	Basement	7,548	0
CAN	Canopy	3,575	0
CLP	Covered Loading Platform	1,840	0
OLP	Loading Platform	5,491	0
		56,230	37,776

Extra Features

Extra Features				Legend
Code	**Description**	**Size**	**Value**	**Bldg #**
A/C	Air Conditioning	37776.00 S.F.	$75,550	1

Land

Land Use

Use Code 401

Land Line Valuation

Size (Acres) 4

Description	Utility	**Frontage**	
Zone	B2	**Depth**	
Neighborhood	C120	**Assessed Value**	$2,179,390
		Appraised Value	$3,113,420

Outbuildings

Outbuildings						Legend
Code	**Description**	**Sub Code**	**Sub Description**	**Size**	**Value**	**Bldg #**
PAV1	Paving Asph.	FR		125000.00 S.F.	$243,750	1
PAV1	Paving Asph.			10000.00 S.F.	$19,500	1
SHD1	Shed	FR	Frame	96.00 S.F.	$890	1
FN6	Fence 6'			5000.00 L.F.	$68,180	1
GAR8	Industrial	BR	Masonry	8080.00 S.F.	$466,620	1
CNP	Canopy		Loading Dock	3480.00 S.F.	$43,500	1

Valuation History

Appraisal			
Valuation Year	**Improvements**	**Land**	**Total**
2018	$4,043,250	$3,113,420	$7,156,670
2017	$2,291,190	$2,506,970	$4,798,160
2016	$2,291,190	$2,506,970	$4,798,160

Assessment			
Valuation Year	**Improvements**	**Land**	**Total**
2018	$2,830,280	$2,179,390	$5,009,670
2017	$1,603,840	$1,754,880	$3,358,720
2016	$1,603,840	$1,754,880	$3,358,720

ATTACHMENT B – CONSTRUCTION DRAWINGS

EVERSOURCE ENERGY

NORWALK
2 TINDALL AVE
NORWALK, CT

PROJECT SUMMARY

THE GENERAL SCOPE OF WORK CONSISTS OF THE FOLLOWING:

1. INSTALL ONE (1) NEW OMNI/WHIP ANTENNA AT ELEVATION 172'-0"± AGL
2. INSTALL (1) NEW RACK WITH DMR EQUIPMENT IN EXISTING CONTROL HOUSE

GOVERNING CODES

2018 CONNECTICUT STATE BUILDING CODE (2015 IBC BASIS)
2017 NATIONAL ELECTRIC CODE
TIA-222-H

GENERAL NOTES

THE FACILITY IS UNMANNED AND NOT FOR HUMAN HABITATION. A TECHNICIAN WILL VISIT THE SITE AS REQUIRED FOR ROUTINE MAINTENANCE. THE PROJECT WILL NOT RESULT IN ANY SIGNIFICANT DISTURBANCE OR EFFECT ON DRAINAGE; NO SANITARY SEWER SERVICE, POTABLE WATER, OR TRASH DISPOSAL IS REQUIRED AND NO COMMERCIAL SIGNAGE IS PROPOSED.

SITE INFORMATION

SITE NAME:	NORWALK
SITE ID NUMBER:	#3712
SITE ADDRESS:	2 TINDALL AVE NORWALK, CT
MAP:	1
BLOCK:	92
LOT:	13
ZONE:	B-2
LATITUDE:	41° 7' 31.26" N
LONGITUDE:	73° 25' 17.36" W
ELEVATION:	57'± AMSL
FEMA/FIRM DESIGNATION:	X
ACREAGE:	4 ± AC (BOOK: 1189, PAGE: 110)

CONTACT INFORMATION

APPLICANTS:
EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037

PROPERTY OWNER:
EVERSOURCE ENERGY
107 SELDEN ST
BERLIN, CT 06037

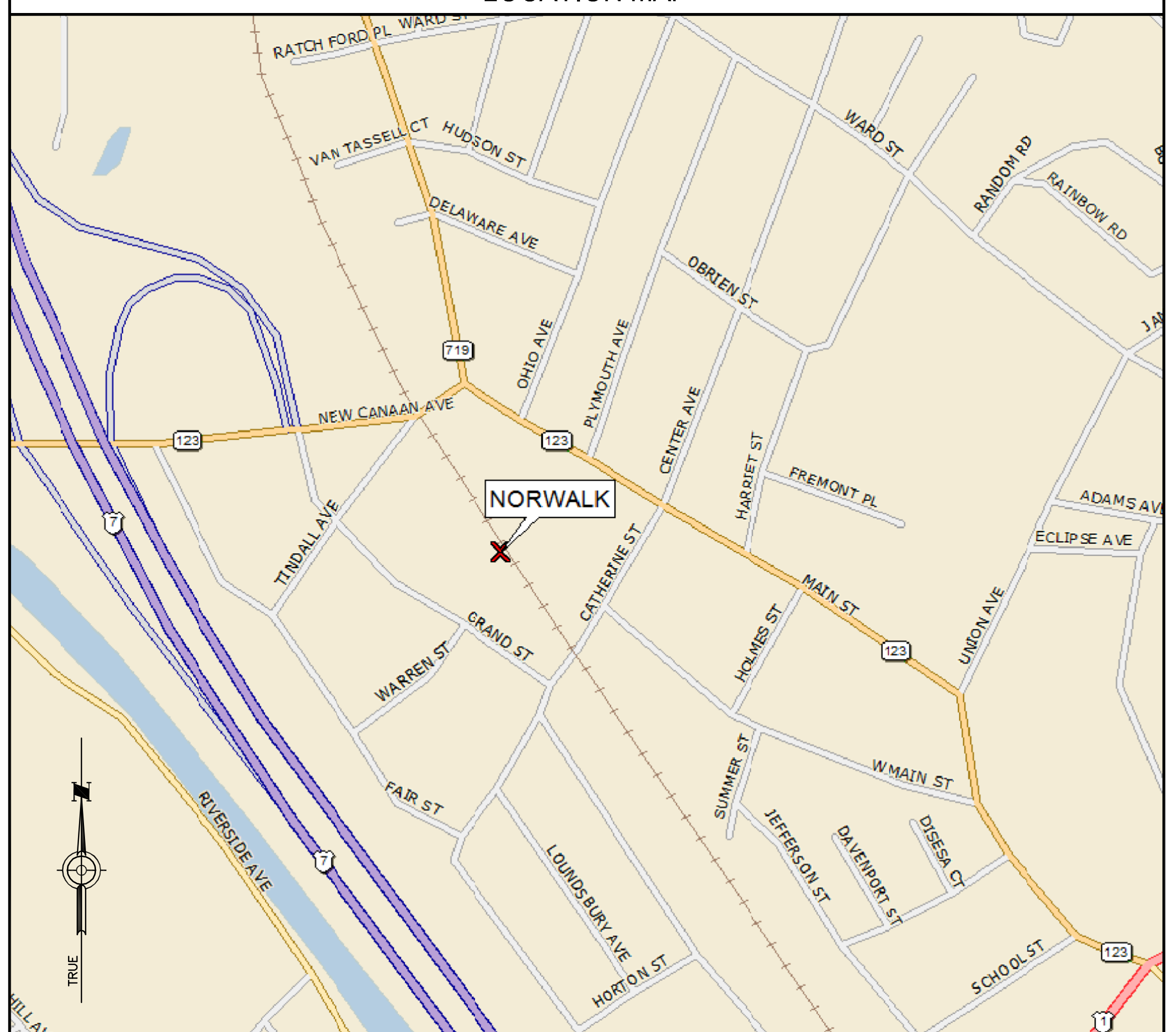
EVERSOURCE ENERGY PROJECT MANAGER:
NIKOLL PRECI
(860) 655-3079

POWER PROVIDER:
EVERSOURCE ENERGY
(800) 286-2000

TELCO PROVIDER:
FRONTIER
(800) 921-8102

CALL BEFORE YOU DIG:
(800) 922-4455

LOCATION MAP



NO SCALE

DESIGN TYPE

SITE UPGRADE
SELF-SUPPORT TOWER

DRAWING INDEX

SHEET NO:	SHEET TITLE
T-1	TITLE SHEET
C-1	SITE PLAN
C-2	TOWER ELEVATION
G-1	GROUNDING DETAILS
N-1	NOTES & SPECIFICATIONS
N-2	NOTES & SPECIFICATIONS
N-3	NOTES & SPECIFICATIONS

DO NOT SCALE DRAWINGS

SUBCONTRACTOR SHALL VERIFY ALL PLANS & EXISTING DIMENSIONS & CONDITIONS ON THE JOB SITE & SHALL IMMEDIATELY NOTIFY THE ENGINEER IN WRITING OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK OR BE RESPONSIBLE FOR SAME

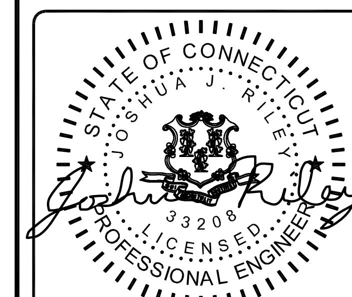
UNDERGROUND SERVICE ALERT
UTILITIES PROTECTION CENTER, INC.
811
48 HOURS BEFORE YOU DIG

EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037
PHONE: (800) 286-2000

BLACK & VEATCH
6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
PHONE: (913) 458-3595

PROJECT NO:	403093
DRAWN BY:	PKH
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/11/20	ISSUED FOR FILING

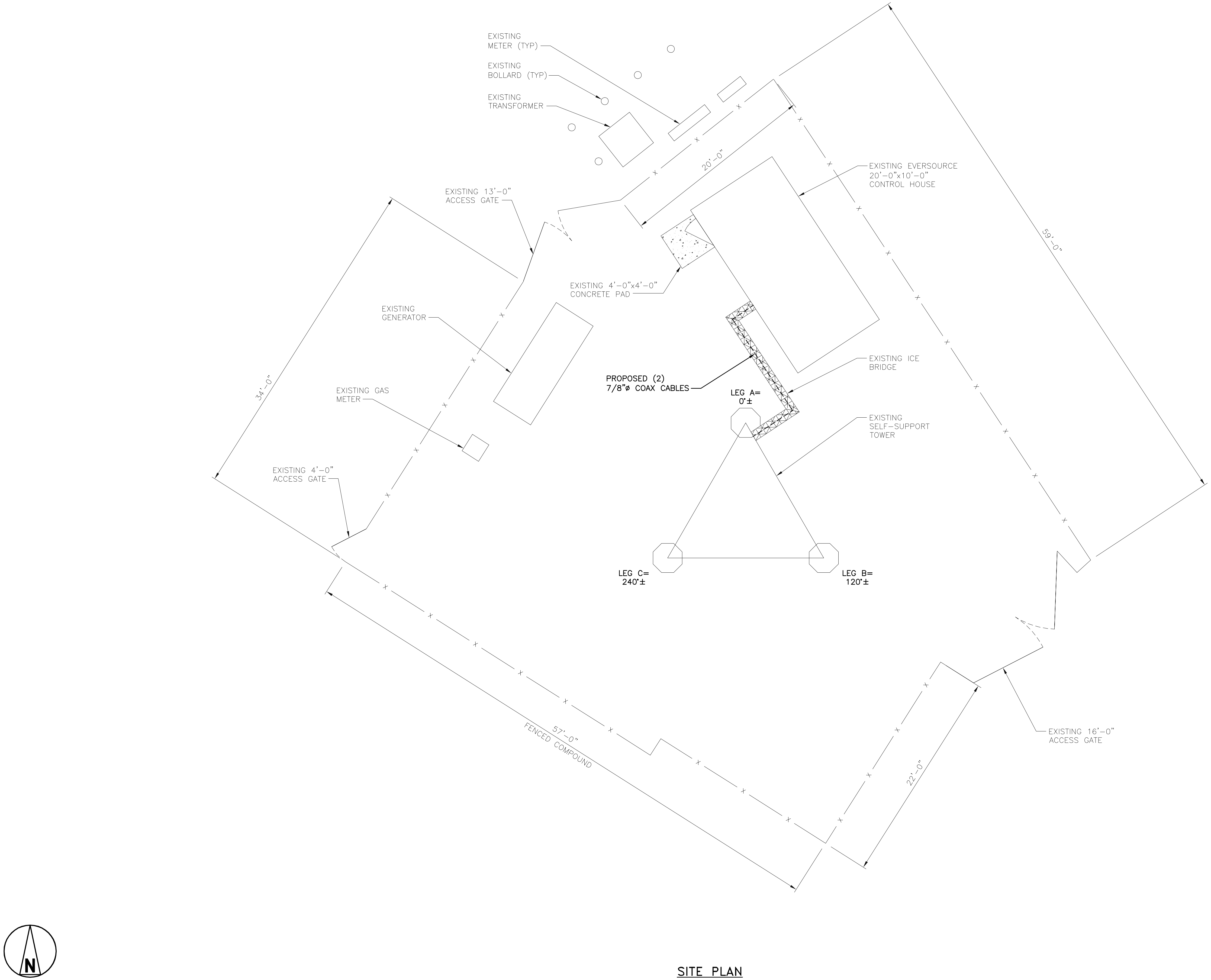


IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

NORWALK
2 TINDALL AVE
NORWALK, CT

SHEET TITLE
TITLE SHEET

SHEET NUMBER
T-1



SITE PLAN

NO SCALE

EVERSOURCE ENERGY

107 SELDEN STREET
BERLIN, CT 06037
PHONE: (800) 286-2000

BLACK & VEATCH

6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
PHONE: (913) 458-3595

PROJECT NO:	403093
DRAWN BY:	PKH
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/11/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED
PROFESSIONAL ENGINEER

03/30/2020

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NORWALK
2 TINDALL AVE
NORWALK, CT

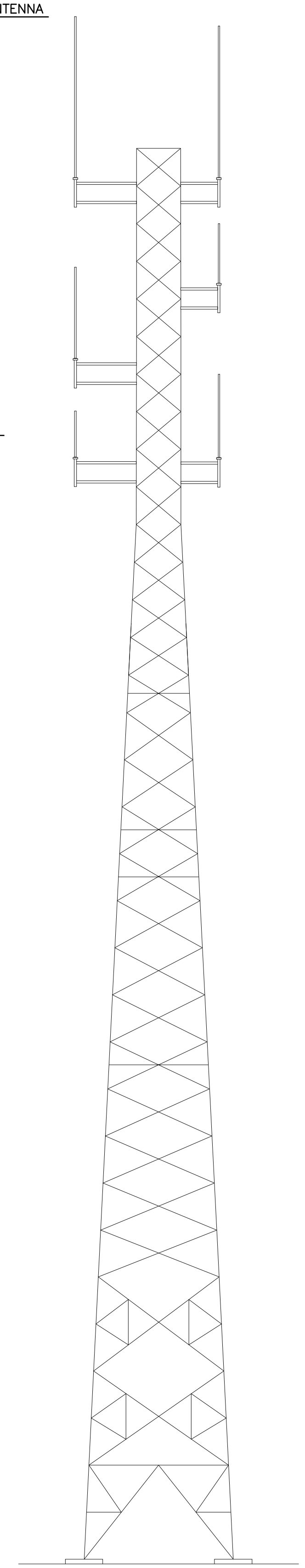
SHEET TITLE

SITE PLAN

SHEET NUMBER

C-1

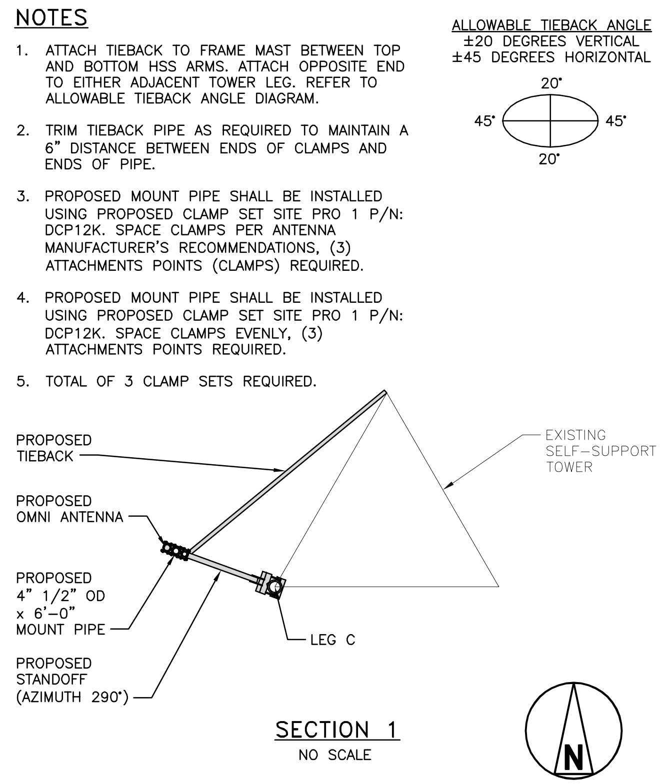
NOTE
RESERVED TOWER LOADING NOT SHOWN PER CLIENT REQUEST BUT WAS CONSIDERED IN THE TOWER ANALYSIS REPORT.



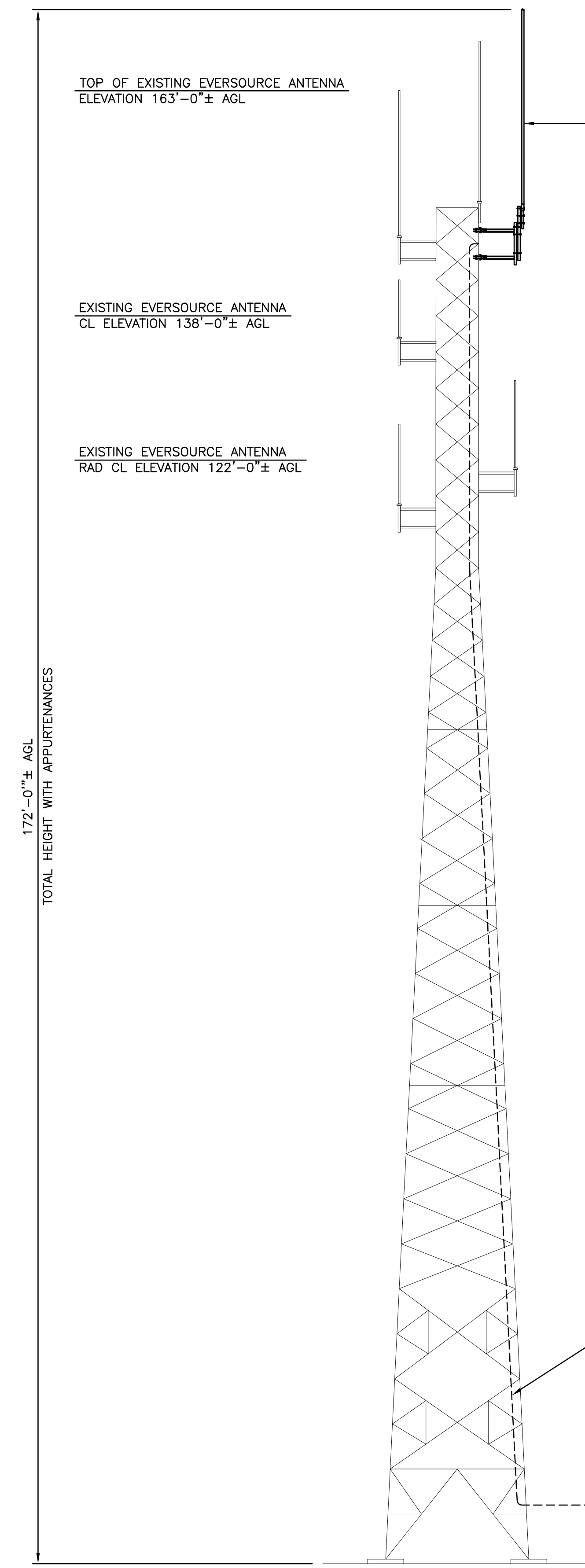
TOWER ELEVATION FACE BA
NO SCALE

NOTES

1. ATTACH TIEBACK TO FRAME MAST BETWEEN TOP AND BOTTOM HSS ARMS. ATTACH OPPOSITE END TO EITHER ADJACENT TOWER LEG. REFER TO ALLOWABLE TIEBACK ANGLE DIAGRAM.
2. TRIM TIEBACK PIPE AS REQUIRED TO MAINTAIN A 6" DISTANCE BETWEEN ENDS OF CLAMPS AND ENDS OF PIPE.
3. PROPOSED MOUNT PIPE SHALL BE INSTALLED USING PROPOSED CLAMP SET SITE PRO 1 P/N: DCP12K. SPACE CLAMPS PER ANTENNA MANUFACTURER'S RECOMMENDATIONS, (3) ATTACHMENTS POINTS (CLAMPS) REQUIRED.
4. PROPOSED MOUNT PIPE SHALL BE INSTALLED USING PROPOSED CLAMP SET SITE PRO 1 P/N: DCP12K. SPACE CLAMPS EVENLY, (3) ATTACHMENTS POINTS REQUIRED.
5. TOTAL OF 3 CLAMP SETS REQUIRED.



SECTION 1
NO SCALE



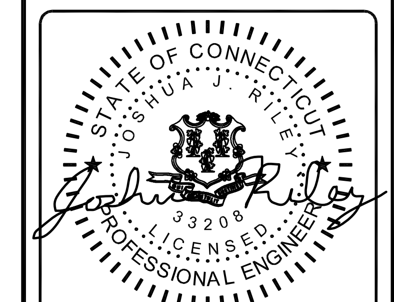
TOWER ELEVATION FACE AC
NO SCALE

EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037
PHONE: (800) 286–2000

BLACK & VEATCH
6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
PHONE: (913) 458–3595

PROJECT NO:	403093
DRAWN BY:	PKH
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/11/20	ISSUED FOR FILING



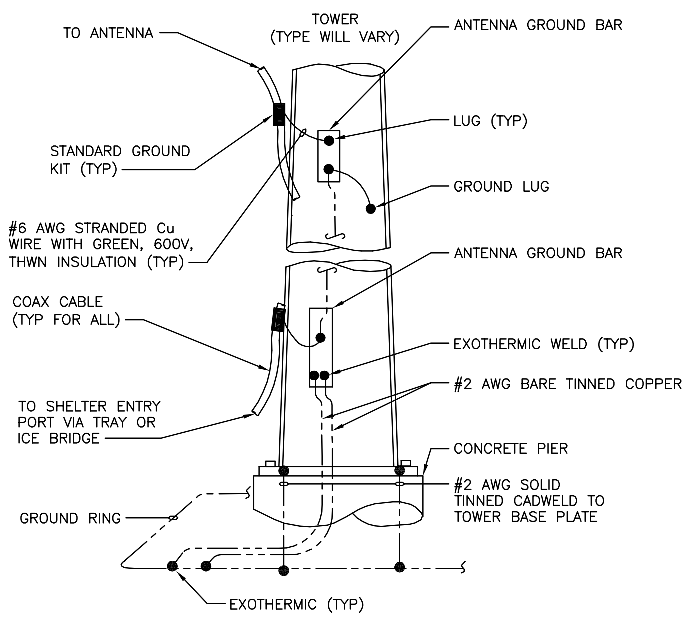
03/30/2020

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

NORWALK
2 TINDALL AVE
NORWALK, CT

SHEET TITLE
TOWER ELEVATION

SHEET NUMBER
C-2

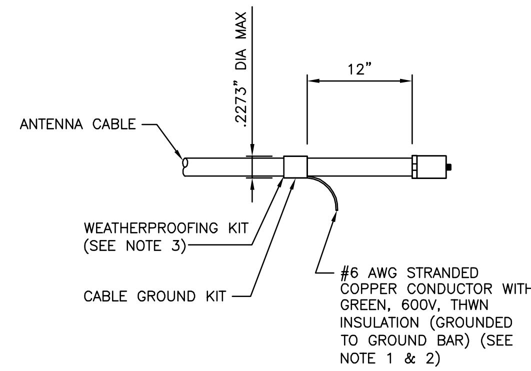


NOTE

1. NUMBER OF GROUND BARS MAY VARY DEPENDING ON THE TYPE OF TOWER, ANTENNA LOCATION AND CONNECTION ORIENTATION. PROVIDE AS REQUIRED.

ANTENNA CABLE GROUNDING

NO SCALE

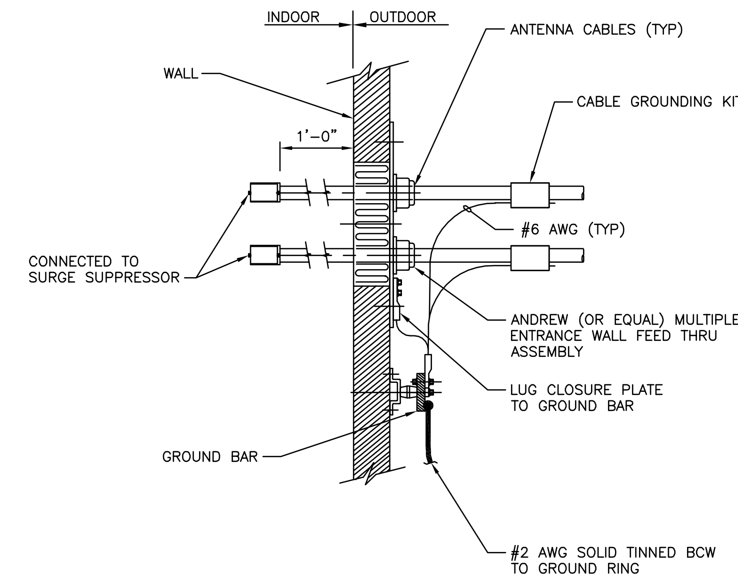


NOTES

1. DO NOT INSTALL CABLE GROUND KIT AT A BEND AND ALWAYS DIRECT GROUND WIRE DOWN TO GROUND BAR.
2. GROUNDING KIT SHALL BE TYPE AND PART NUMBER AS SUPPLIED OR RECOMMENDED BY CABLE MANUFACTURER.
3. WEATHER PROOFING SHALL BE TYPE AND PART NUMBER AS SUPPLIED OR RECOMMENDED BY CABLE MANUFACTURER.

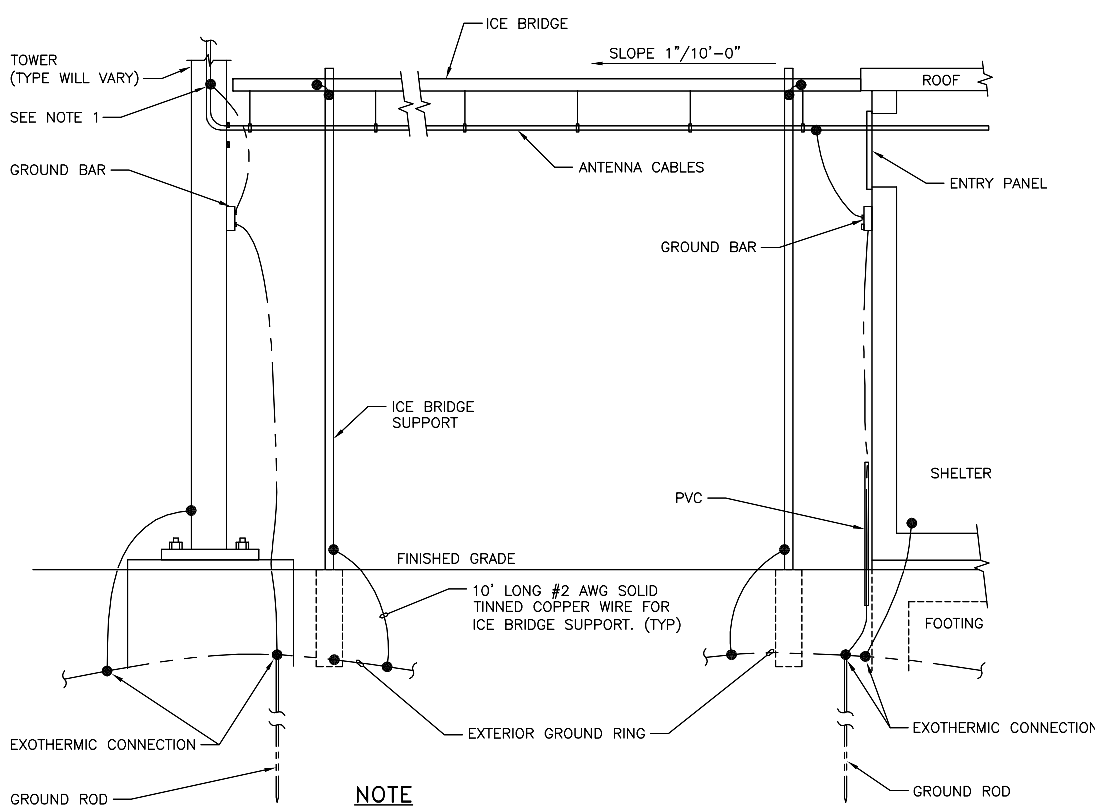
CONNECTION OF CABLE GROUND KIT TO ANTENNA CABLE

NO SCALE



CABLE INSTALLATION WITH WALL FEED THRU ASSEMBLY

NO SCALE



NOTE

1. PROVIDE GROUND KIT 6" BEFORE TURN

ICE BRIDGE AND ANTENNA CABLE DETAIL

NO SCALE

EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037
PHONE: (800) 286-2000

BLACK & VEATCH
6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
PHONE: (913) 458-3595

PROJECT NO:	403093
DRAWN BY:	PKH
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/11/20	ISSUED FOR FILING

STATE OF CONNECTICUT
MARK P. STILES
24358
LICENSED PROFESSIONAL ENGINEER
03/30/2020

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NORWALK
2 TINDALL AVE
NORWALK, CT

SHEET TITLE
GROUNDING DETAILS

SHEET NUMBER
G-1

DESIGN BASIS

1. GOVERNING CODE: 2018 CONNECTICUT STATE BUILDING CODE (2015 IBC BASIS).

GENERAL CONDITIONS

1. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO COMPLY WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL BUILDING CODES, PERMIT CONDITIONS AND SAFETY CODES DURING CONSTRUCTION.
2. THE ENGINEER IS NOT: A GUARANTOR OF THE INSTALLING CONTRACTOR'S WORK; RESPONSIBLE FOR SAFETY IN, ON OR ABOUT THE WORK SITE; IN CONTROL OF THE SAFETY OR ADEQUACY OF ANY BUILDING COMPONENT, SCAFFOLDING OR SUPERINTENDING THE WORK.
3. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL PERMITS, INSPECTIONS, TESTING AND CERTIFICATES NEEDED FOR LEGAL OCCUPANCY OF THE FINISHED PROJECT.
4. THE CONTRACTOR IS RESPONSIBLE TO REVIEW THIS COMPLETE PLAN SET AND VERIFY THE EXISTING CONDITIONS SHOWN IN THESE PLANS AS THEY RELATE TO THE WORK PRIOR TO SUBMITTING PRICE. SIGNIFICANT DEVIATIONS FROM WHAT IS SHOWN AFFECTING THE WORK SHALL BE REPORTED IMMEDIATELY TO THE CONSTRUCTION MANAGER.
5. DETAILS INCLUDED IN THIS PLAN SET ARE TYPICAL AND APPLY TO SIMILAR CONDITIONS.
6. EXISTING ELECTRICAL AND MECHANICAL FIXTURES, PIPING, WIRING, AND EQUIPMENT OBSTRUCTING THE WORK SHALL BE REMOVED AND/OR RELOCATED AS DIRECTED BY THE CONSTRUCTION MANAGER. TEMPORARY SERVICE INTERRUPTIONS MUST BE COORDINATED WITH OWNER.
7. THE CONTRACTOR SHALL DILIGENTLY PROTECT THE EXISTING BUILDING/SITE CONDITIONS AND THOSE OF ANY ADJOINING BUILDING/SITES AND RESTORE ANY DAMAGE CAUSED BY HIS ACTIVITIES TO THE PRE–CONSTRUCTION CONDITION.
8. THE CONTRACTOR SHALL SAFEGUARD AGAINST: CREATING A FIRE HAZARD, AFFECTING TENANT EGRESS OR COMPROMISING BUILDING SITE SECURITY MEASURES.
9. THE CONTRACTOR SHALL REMOVE ALL DEBRIS AND CONSTRUCTION WASTE FROM THE SITE EACH DAY. WORK AREAS SHALL BE SWEPT AND MADE CLEAN AT THE END OF EACH WORK DAY.
10. THE CONTRACTOR'S HOURS OF WORK SHALL BE IN ACCORDANCE WITH LOCAL CODES AND ORDINANCES AND BE APPROVED BY OWNER.
11. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CONSTRUCTION MANAGER IF ASBESTOS IS ENCOUNTERED DURING THE EXECUTION OF HIS WORK. THE CONTRACTOR SHALL CEASE ALL ACTIVITIES WHERE THE ASBESTOS MATERIAL IS FOUND UNTIL NOTIFIED BY THE CONSTRUCTION MANAGER TO RESUME OPERATIONS.

THERMAL & MOISTURE PROTECTION

1. FIRE–STOP ALL PENETRATIONS FOR ELECTRICAL CONDUITS OR WAVEGUIDE CABLING THROUGH BUILDING WALLS, FLOORS, AND CEILINGS SHALL BE FIRESTOPPED WITH ACCEPTED MATERIALS TO MAINTAIN THE FIRE RATING OF THE EXISTING ASSEMBLY. ALL FILL MATERIAL SHALL BE SHAPED, FITTED, AND PERMANENTLY SECURED IN PLACE. FIRESTOPPING SHALL BE INSTALLED IN ACCORDANCE WITH ASTM E814.
2. HILTI CP620 FIRE FOAM OR 3M FIRE BARRIER FILL, VOID OR CAVITY MATERIAL OR ACCEPTED EQUAL SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND ASSOCIATED UNDERWRITERS LABORATORIES (UL) SYSTEM NUMBER.
3. FIRESTOPPING SHALL BE APPLIED AS SOON AS PRACTICABLE AFTER PENETRATIONS ARE MADE AND EQUIPMENT INSTALLED.
4. FIRESTOPPED PENETRATIONS SHALL BE LEFT EXPOSED AND MADE AVAILABLE FOR INSPECTION BEFORE CONCEALING SUCH PENETRATIONS. FIRESTOPPING MATERIAL CERTIFICATES SHALL BE MADE AVAILABLE AT THE TIME OF INSPECTION.
5. ANY BUILDING ROOF PENETRATION AND/OR RESTORATION SHALL BE PERFORMED SO THAT THE ROOF WARRANTY IN PLACE IS NOT COMPROMISED. CONTRACTOR SHALL ARRANGE FOR OWNER'S ROOFING CONTRACTOR TO PERFORM ANY AND ALL ROOFING WORK IF SO REQUIRED BY EXISTING ROOF WARRANTY. OTHERWISE, ROOF SHALL BE MADE WATERTIGHT WITH LIKE CONSTRUCTION AS SOON AS PRACTICABLE AND AT COMPLETION OF CONSTRUCTION.
6. ALL PENETRATIONS INTO AND/OR THROUGH BUILDING EXTERIOR WALLS SHALL BE SEALED WITH SILICONE SEALER.
7. WHERE CONDUIT AND CABLES PENETRATES FIRE RATED WALLS AND FLOORS, FIRE GROUT ALL PENETRATIONS IN ORDER TO MAINTAIN THE FIRE RATING USING A LISTED FIRE SEALING DEVICE OR GROUT.
8. CONTRACTOR TO REMOVE AND RE–INSTALL ALL FIRE PROOFING AS REQUIRED DURING CONSTRUCTION.

SUBMITTALS

1. CONTRACTOR TO SUBMIT SHOP DRAWINGS TO ENGINEER FOR REVIEW PRIOR TO FABRICATION.
2. CONTRACTOR TO NOTIFY ENGINEER FOR INSPECTION PRIOR TO CLOSING PENETRATIONS.
3. CONTRACTORS SHALL VERIFY ALL DIMENSIONS AND CONDITIONS IN THE FIELD PRIOR TO FABRICATION AND ERECTION OF ANY MATERIAL. THE ENGINEER SHALL BE NOTIFIED OF ANY CONDITIONS WHICH PRECLUDE COMPLETION OF THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
4. ALL STEEL MATERIAL EXPOSED TO WEATHER SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A123 " ZINC (HOT–DIPPED GALVANIZED) COATINGS" ON IRON AND STEEL PRODUCTS.
5. THE ENGINEER SHALL BE NOTIFIED OF ANY INCORRECTLY FABRICATED, DAMAGED OR OTHERWISE MISFITTING OR NONCONFORMING MATERIALS OR CONDITIONS FOR REMEDIAL OR CORRECTIVE ACTION. ANY SUCH ACTION SHALL REQUIRE ENGINEER REVIEW.

STEEL

1. MATERIAL:

WIDE FLANGE:	ASTM A572, GR 50
TUBING:	ASTM A500, GR C
PIPE:	ASTM A53, GR B
BOLTS:	ASTM A325
GRATING:	TYPE GW–2 (1"x3/16" BARS)
MISC. MATERIAL:	ASTM A36

ALL STEEL SHAPES SHALL BE HOT–DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A123 WITH A COATING WEIGHT OF 2 OZ/SF.

2. DAMAGED GALVANIZED SURFACES SHALL BE CLEANED WITH A WIRE BRUSH AND PAINTED WITH TWO COATS OF COLD ZINC, "GALVANOX", "DRY GALV", "ZINC IT", OR APPROVED EQUIVALENT, IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES. TOUCH UP DAMAGED NON GALVANIZED STEEL WITH SAME PAINT IN SHOP OR FIELD.
3. DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE AISC "MANUAL OF STEEL CONSTRUCTION" 13TH EDITION.
4. THE STEEL STRUCTURE IS DESIGNED TO BE SELF–SUPPORTING AND STABLE AFTER COMPLETION. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE AND TO INSURE THE SAFETY OF THE BUILDING AND ITS COMPONENT PARTS DURING ERECTION.
5. ALL STEEL ELEMENTS SHALL BE INSTALLED PLUMB AND LEVEL.
6. TOWER MANUFACTURER'S DESIGNS SHALL PREVAIL FOR TOWER.

SITE GENERAL

1. CONTRACTOR SHALL FOLLOW CONDITIONS OF ALL APPLICABLE PERMITS AND WORK IN ACCORDANCE WITH OSHA REGULATIONS.
2. THESE PLANS DEPICT KNOWN UNDERGROUND STRUCTURES, CONDUITS, AND/OR PIPELINES. THE LOCATIONS FOR THESE ELEMENTS ARE BASED UPON THE VARIOUS RECORD DRAWINGS AVAILABLE. THE CONTRACTOR IS HEREBY ADVISED THAT THESE DRAWINGS MAY NOT ACCURATELY DEPICT AS–BUILT LOCATIONS AND OTHER UNKNOWN STRUCTURES. THE CONTRACTOR SHALL THEREFORE DETERMINE THE EXACT LOCATION OF EXISTING UNDERGROUND ELEMENTS AND EXCAVATE WITH CARE AFTER CALLING MARKOUT SERVICE AT 1–800–272–4480 48 HOURS BEFORE DIGGING, DRILLING OR BLASTING.
3. ALL EXISTING ACTIVE SEWER, WATER, GAS, ELECTRIC, FIBER OPTIC, AND OTHER UTILITIES WHERE ENCOUNTERED, SHALL BE PROTECTED AT ALL TIMES, AND WHERE REQUIRED FOR THE PROPER EXECUTION, SHALL BE RELOCATED AS DIRECTED BY ENGINEER. EXTREME CAUTION SHOULD BE USED BY THE CONTRACTOR WHEN EXCAVATING OR PIER DRILLING AROUND OR NEAR UTILITIES. CONTRACTOR SHALL HAND DIG UTILITIES AS NEEDED. CONTRACTOR SHALL PROVIDE, BUT IS NOT LIMITED TO, APPROPRIATE A) FALL PROTECTION, B) CONFINED SPACE ENTRY, C) ELECTRICAL SAFETY, AND D) TRENCHING AND EXCAVATION.
4. IF NECESSARY, RUBBISH, STUMPS, DEBRIS, STICKS, STONES, AND OTHER REFUSE SHALL BE REMOVED FROM THE SITE AND DISPOSED OF LEGALLY.
5. ALL EXISTING INACTIVE SEWER, WATER, GAS, ELECTRIC, FIBER OPTIC, OR OTHER UTILITIES, WHICH INTERFERE WITH THE EXECUTION OF THE WORK, SHALL BE REMOVED, AND/OR CAPPED, PLUGGED OR OTHERWISE DISCONTINUED AT THE POINTS WHICH WILL NOT INTERFERE WITH THE EXECUTION OF THE WORK, SUBJECT TO THE APPROVAL OF THE CONSTRUCTION MANAGER.
6. CONTRACTOR IS RESPONSIBLE FOR REPAIRING OR REPLACING STRUCTURES OR UTILITIES DAMAGED DURING CONSTRUCTION.
7. CONTRACTOR SHALL PROTECT EXISTING PAVED AND GRAVEL SURFACES, CURBS, LANDSCAPE AND STRUCTURES AND RESTORE SITE OR PRE–CONSTRUCTION CONDITION WITH AS GOOD, OR BETTER, MATERIALS. NEW MATERIALS SHALL MATCH EXISTING THICKNESS AND TYPE.
8. THE CONTRACTOR SHALL SHORE ALL TRENCH EXCAVATIONS GREATER THAN 5 FEET IN DEPTH OR LESS WHERE SOIL CONDITIONS ARE DEEMED UNSTABLE. ALL SHEETING AND/OR SHORING METHODS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER.
9. THE CONTRACTOR IS RESPONSIBLE FOR MANAGING GROUNDWATER LEVELS IN THE VICINITY OF EXCAVATIONS TO PROTECT ADJACENT PROPERTIES AND NEW WORK. GROUNDWATER SHALL BE DRAINED IN ACCORDANCE WITH LOCAL SEDIMENTATION AND EROSION CONTROL GUIDELINES.

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PROJECT NO:	403093
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CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/11/20	ISSUED FOR FILING

03/30/2020

NORWALK
2 TINDALL AVE
NORWALK, CT

SHEET TITLE
NOTES
& SPECIFICATIONS

SHEET NUMBER
N-1

ELECTRICAL

1. CONTRACTOR SHALL VERIFY EXISTING ELECTRIC SERVICE TYPE AND CAPACITY AND ORDER NEW ELECTRIC SERVICE FROM LOCAL ELECTRIC UTILITY, WHERE APPLICABLE.

2. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH ALL APPLICABLE CODES, AND SHALL BE ACCEPTABLE TO ALL AUTHORITIES HAVING JURISDICTION. WHERE A CONFLICT EXISTS BETWEEN CODES, PLAN AND SPECIFICATIONS, OR AUTHORITIES HAVING JURISDICTION, THE MORE STRINGENT AUTHORITIES SHALL APPLY.

3. CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, INSURANCE, EQUIPMENT, INSTALLATION, CONSTRUCTION TOOLS, TRANSPORTATION, ETC, FOR A COMPLETE AND PROPERLY OPERATIVE SYSTEM ENERGIZED THROUGHOUT AND AS INDICATED ON THE DRAWINGS AND AS SPECIFIED HEREIN AND/OR OTHERWISE REQUIRED.

4. ALL ELECTRICAL CONDUCTORS SHALL BE 100% COPPER AND SHALL HAVE TYPE THHN INSULATION UNLESS INDICATED OTHERWISE.

5. CONDUIT SHALL BE THREADED RIGID GALVANIZED STEEL OR EMT WITH ONLY COMPRESSION TYPE COUPLINGS AND CONNECTORS, ALL MADE UP WRENCH TIGHT.

6. ALL BURIED CONDUIT SHALL BE MINIMUM SCH 40 PVC UNLESS NOTED OTHERWISE, OR AS PER LOCAL CODE REQUIREMENTS.

7. PROVIDE FLEXIBLE STEEL CONDUIT OR LIQUID TIGHT FLEXIBLE STEEL CONDUIT TO ALL VIBRATING EQUIPMENT, INCLUDING HVAC UNITS, TRANSFORMERS, MOTORS, ETC, OR WHERE EQUIPMENT IS PLACED UPON A SLAB ON GRADE.

8. ALL BRANCH CIRCUITS AND FEEDERS SHALL HAVE A SEPARATE GREEN INSULATED EQUIPMENT GROUNDING CONDUCTOR BONDED TO ALL ENCLOSURES, PULLBOXES, ETC.

9. CONDUIT AND CABLE WITHIN CORRIDORS SHALL BE CONCEALED AND EXPOSED ELSEWHERE, UNLESS NOTED OTHERWISE.

10. ELECTRICAL MATERIALS INSTALLED ON ROOFTOP SHALL BE LISTED FOR NEMA 3R USE. –AND ALL WIRING WITHIN A VENTILATION DUCT SHALL BE LISTED FOR SUCH USE. IN GENERAL WIRING METHODS WITHIN A DUCT SHALL BE AN MC CABLE WITH SMOOTH OR CORRUGATED METAL JACKET AND HAVE NO OUTER COVERING OVER THE METAL JACKET. INTERLOCKED ARMOR TYPE OF MC CABLE IS NOT ACCEPTABLE FOR THIS APPLICATION. CONTRACTOR CAN ALSO USE TYPE MI CABLE IN THE VENTILATION DUCT PROVIDED IT DOES NOT HAVE ANY OUTER COVERINGS OVER THE METAL EXTERIOR.

11. WIRING DEVICES SHALL BE SPECIFICATION GRADE, AND WIRING DEVICE COVER PLATES SHALL BE PLASTIC WITH ENGRAVING AS SPECIFIED.

12. GROUNDING SYSTEM RESISTANCE SHALL BE MEASURED, RECORDED, AND DATED USING MEGGER DET14 OR SIMILAR INSTRUMENT. GROUND RESISTANCE SHALL NOT EXCEED 5 OHMS. IF THE RESISTANCE VALUE IS EXCEEDED, NOTIFY CONSTRUCTION MANAGER FOR FURTHER INSTRUCTION.

13. COORDINATE WITH BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK INVOLVING EXISTING SYSTEMS OR EQUIPMENT IN ORDER TO DETERMINE THE EFFECT, IF ANY, ON OTHER TENANTS WITHIN THE BUILDING, AND TO DETERMINE THE APPROPRIATE TIME FOR PERFORMING THIS WORK.

14. THE CONTRACTOR SHALL BE REQUIRED TO VISIT THE SITE PRIOR TO SUBMITTING BID IN ORDER TO DETERMINE THE EXTENT OF THE EXISTING CONDITIONS.

15. ALL CONDUCTOR ENDS SHALL BE TAGGED AND ELECTRICAL EQUIPMENT LABELED WITH ENGRAVED IDENTIFICATION PLATES.

16. CONTRACTOR IS RESPONSIBLE FOR ALL CONTROL WIRING AND ALARM TIE–INS.

GROUNDING

1. #6 THWN SHALL BE STRANDED #6 COPPER WITH GREEN THWN INSULATION SUITABLE FOR WET INSTALLATIONS.

2. #2 THWN SHALL BE STRANDED #2 COPPER WITH THWN INSULATION SUITABLE FOR WET INSTALLATIONS.

3. #2 BARE TINNED SHALL BE SOLID COPPER TINNED. ALL BURIED WIRE SHALL MEET THIS CRITERIA.

4. ALL LUGS SHALL BE 2–HOLE, LONG BARREL, TINNED SOLID COPPER UNLESS OTHERWISE SPECIFIED, LUGS SHALL BE THOMAS AND BETTS SERIES 548##BE OR EQUIVALENT (IE #2 THWN – 54856BE, #2 SOLID – 54856BE, AND #6 THWN – 54852BE).

5. ALL HARDWARE, BOLTS, NUTS, AND WASHERS SHALL BE 18–8 STAINLESS STEEL. EVERY CONNECTION SHALL BE BOLT–FLAT WASHER–BUSS–LUG–FLAT WASHER–BELLEVILLE WASHER–NUT IN THAT EXACT ORDER. BACK–TO–BACK LUGGING, BOLT–FLAT WASHER–LUG–BUSS–LUG–FLAT WASHER–BELLEVILLE WASHER–NUT, IN THAT EXACT ORDER, IS ACCEPTED WHERE NECESSARY TO CONNECT MANY LUGS TO A BUSS BAR. STACKING OF LUGS, BUSS–LUG–LUG, IS NOT ACCEPTABLE.

6. WHERE CONNECTIONS ARE MADE TO STEEL OR DISSIMILAR METALS, A THOMAS AND BETTS DRAGON TOOTH WASHER MODEL DTWXXX SHALL BE USED BETWEEN THE LUG AND THE STEEL, BOLT–FLAT WASHER–STEEL–DRAGON TOOTH WASHER–LUG–FLAT WASHER–BELEVILE WASHER–NUT.

7. ALL CONNECTIONS, INTERIOR AND EXTERIOR, SHALL BE MADE WITH THOMAS AND BETTS KPOR–SHIELD. COAT ALL WIRES BEFORE LUGGING AND COAT ALL SURFACES BEFORE CONNECTING.

8. THE MINIMUM BEND RADIUS SHALL BE 8 INCHES FOR #6 WIRE AND SMALLER AND 12 INCHES FOR WIRE LARGER THAN #6.

9. ALL CONNECTIONS TO THE GROUND RING SHALL BE EXOTHERMIC WELD.

10. BOND THE FENCE TO THE GROUND RING AT EACH CORNER, AND AT EACH GATE POST WITH #2 SOLID TINNED WIRE. EXOTHERMIC WELD BOTH ENDS.

11. GROUND KITS SHALL BE SOLID COPPER STRAP WITH #6 WIRE 2–HOLE COMPRESSION CRIMPED LUGS AND SHALL BE SEALED ACCORDING TO MANUFACTURER INSTRUCTIONS.

12. FERROUS METAL CLIPS WHICH COMPLETELY SURROUND THE GROUNDING CONDUCTOR SHALL BE USED.

13. GROUND BARS SHALL BE FURNISHED AND INSTALLED WITH PRE–DRILLED HOLE DIAMETERS AND SPACINGS. GROUND BARS SHALL NEITHER BE FIELD FABRICATED NOR NEW HOLES DRILLED. GROUND LUGS SHALL MATCH THE SPACING ON THE BAR. HARDWARE DIAMETER SHALL BE MINIMUM 3.8 INCH.

14. MGB GROUND CONNECTION SHALL BE EXOTHERMIC WELDED TO THE GROUND SYSTEM.

15. ALL CABLE TRAY AND/OR PLATFORM STEEL SHALL BE BONDED TOGETHER WITH JUMPERS (#6 IN EQUIPMENT ROOM, #2 ELSEWHERE AND HOMERUN).

ANTENNA & CABLE NOTES

1. THE CONTRACTOR SHALL FURNISH AND INSTALL ALL TRANSMISSION CABLES, JUMPERS, CONNECTORS, GROUNDING STRAPS, ANTENNAS, MOUNTS AND HARDWARE. ALL MATERIALS SHALL BE INSPECTED BY THE CONTRACTOR FOR DAMAGE UPON DELIVERY. JUMPERS SHALL BE SUPPLIED AT ANTENNAS AND EQUIPMENT INSIDE SHELTER COORDINATE LENGTH OF JUMP CABLES WITH EVERSOURCE. COORDINATE AND VERIFY ALL OF THE MATERIALS TO BE PROVIDED WITH EVERSOURCE PRIOR TO SUBMITTING BID AND ORDERING MATERIALS.

2. AFTER INSTALLATION, THE TRANSMISSION LINE SYSTEM SHALL BE PIM/SWEEP TESTED FOR PROPER INSTALLATION AND DAMAGE WITH ANTENNAS CONNECTED. CONTRACTOR TO OBTAIN LATEST TESTING PROCEDURES FROM EVERSOURCE PRIOR TO BIDDING.

3. ANTENNA CABLES SHALL BE COLOR CODED AT THE FOLLOWING LOCATIONS:
   - AT THE ANTENNAS.
   - AT THE WAVEGUIDE ENTRY PLATE ON BOTH SIDES OF THE EQUIPMENT SHELTER WALL.
   - JUMPER CABLES AT THE EQUIPMENT ENTER.

4. SYSTEM INSTALLATION:
   THE CONTRACTOR SHALL INSTALL ALL CABLES AND ANTENNAS TO THE MANUFACTURER'S SPECIFICATIONS. THE CONTRACTOR IS RESPONSIBLE FOR THE PROCUREMENT AND INSTALLATION OF THE FOLLOWING:
   - ALL CONNECTORS, ASSOCIATED CABLE MOUNTING, AND GROUNDING HARDWARE.
   - WALL MOUNTS, STANDOFFS, AND ASSOCIATED HARDWARE.
   - 1/2 INCH HELIAX ANTENNA JUMPERS OF APPROPRIATE LENGTHS.

5. MINIMUM BENDING RADIUS FOR COAXIAL CABLES:
   - 7/8 INCH, RMIN = 15 INCHES
   - 1 5/8 INCH, RMIN = 25 INCHES

6. CABLE SHALL BE INSTALLED WITH A MINIMUM NUMBER OF BENDS WHERE POSSIBLE. CABLE SHALL NOT BE LEFT UNTERMINATED AND SHALL BE SEALED IMMEDIATELY AFTER BEING INSTALLED.

7. ALL CABLE CONNECTIONS OUTSIDE SHALL BE COVERED WITH WATERPROOF SPLICING KIT.

8. CONTRACTOR SHALL VERIFY EXACT LENGTH AND DIRECTION OF TRAVEL IN FIELD PRIOR TO CONSTRUCTION.

9. CABLE SHALL BE FURNISHED WITHOUT SPLICES AND WITH CONNECTORS AT EACH END.

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PROJECT NO:	403093
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STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED PROFESSIONAL ENGINEER
03/30/2020

NORWALK
2 TINDALL AVE
NORWALK, CT

SHEET TITLE
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SYMBOLS

- EXOTHERMIC CONNECTION
- COMPRESSION CONNECTION
- 5/8"ø×10'-0" COPPER CLAD STEEL GROUND ROD.
- TEST GROUND ROD WITH INSPECTION SLEEVE
- GROUNDING CONDUCTOR
- (A) KEY NOTES

CHAINLINK FENCE	—— x —— x —— x —— x —— x ——
WOOD FENCE	—□——□——□——□——□——□——□—
LEASE AREA	— — — — — — — — — — — — — — —
ICE BRIDGE	
CABLE TRAY	
GAS LINE	—— G —— G —— G —— G —— G ——
UNDERGROUND ELECTRICAL/TELCO	—— E/T —— E/T —— E/T —— E/T ——
UNDERGROUND ELECTRICAL/CONTROL	—— E/C —— E/C —— E/C —— E/C ——
UNDERGROUND ELECTRICAL	—— E —— E —— E —— E —— E ——
UNDERGROUND TELCO	—— T —— T —— T —— T —— T ——
PROPERTY LINE (PL)	—— — — —— — — —— — — —— — — ——

ABBREVIATIONS

AC	ALTERNATING CURRENT	MGB	MASTER GROUNDING BAR
AIC	AMPERAGE INTERRUPTION CAPACITY	MIN	MINIMUM
ANI	AUXILIARY NETWORK INTERFACE	MW	MICROWAVE
ATM	ASYNCHRONOUS TRANSFER MODE	MTS	MANUAL TRANSFER SWITCH
ATS	AUTOMATIC TRANSFER SWITCH	NEC	NATIONAL ELECTRICAL CODE
AWG	AMERICAN WIRE GAUGE	OC	ON CENTER
AWS	ADVANCED WIRELESS SERVICES	PP	POLARIZING PRESERVING
BATT	BATTERY	PCU	PRIMARY CONTROL UNIT
BBU	BASEBAND UNIT	PDU	PROTOCOL DATA UNIT
BTC	BARE TINNED COPPER CONDUCTOR	PWR	POWER
BTS	BASE TRANSCEIVER STATION	RECT	RECTIFIER
CCU	CLIMATE CONTROL UNIT	RET	REMOTE ELECTRICAL TILT
CDMA	CODE DIVISION MULTIPLE ACCESS	RMC	RIGID METALLIC CONDUIT
CHG	CHARGING	RF	RADIO FREQUENCY
CLU	CLIMATE UNIT	RUC	RACK USER COMMISSIONING
COMM	COMMON	RRH	REMOTE RADIO HEAD
DC	DIRECT CURRENT	RRU	REMOTE RADIO UNIT
DIA	DIAMETER	RWY	RACEWAY
DWG	DRAWING	SFP	SMALL FORM-FACTOR PLUGGABLE
EC	ELECTRICAL CONDUCTOR	SIAD	SMART INTEGRATED ACCESS DEVICE
EMT	ELECTRICAL METALLIC TUBING	SSC	SITE SOLUTIONS CABINET
FIF	FACILITY INTERFACE FRAME	T1	1544KBPS DIGITAL LINE
GEN	GENERATOR	TDMA	TIME-DIVISION MULTIPLE ACCESS
GPS	GLOBAL POSITIONING SYSTEM	TMA	TOWER MOUNT AMPLIFIER
GSM	GLOBAL SYSTEM FOR MOBILE	TVSS	TRANSIENT VOLTAGE SUPPRESSION SYSTEM
HVAC	HEAT/VENTILATION/AIR CONDITIONING	TYP	TYPICAL
ICF	INTERCONNECTION FRAME	UMTS	UNIVERSAL MOBILE TELECOMMUNICATION SYSTEM
IGR	INTERIOR GROUNDING RING (HALO)	UPS	UNINTERRUPTIBLE POWER SUPPLY (DC POWER PLANT)
LTE	LONG TERM EVOLUTION		

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SHEET NUMBER

N-3

REFERENCE CUTSHEETS

VHF Omni Antennas (160-222 MHz)

dbSpectra

160-174 MHz

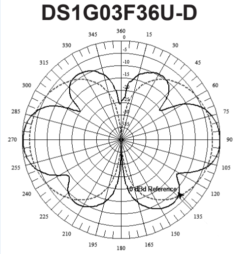
Model Number	DS1G03F36U-N	DS1G03F36U-D	DS1G06F36U-N	DS1G06F36U-D	DS1G03F36D-N	DS1G03F36D-D
Input Connector	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN
Type	Single		Single		Dual	
ELECTRICAL						
Bandwidth, MHz	14		14		14	
Power, Watts	500		500		350	
Gain, dBd	3		6		3	
Horizontal Beamwidth, degrees	360		360		360	
Vertical Beamwidth, degrees	30		16		30	
Beam Tilt, degrees	0		0		0	
Isolation (minimum), dB	N/A		N/A		30	
MECHANICAL						
Number of Connectors	1		1		2	
Flat Plate Area, ft²(m²)	2.53 (0.24)		4.38 (0.41)		4.5 (0.42)	
Lateral Windload Thrust, lbf(N)	95 (423)		164 (730)		169 (752)	
Survival Wind Speed without ice, mph(kph)	110 (177)		75 (121)		75 (121)	
Survival Wind Speed with 0.5" radial ice, mph(kph)	93 (150)		60 (97)		65 (105)	
Mounting Hardware included	DSH3V3R		DSH3V3N		DSH3V3N	
DIMENSIONS						
Length, ft(m)	12.7 (3.9)		21.9 (6.7)		22.3 (6.8)	
Radome O.D., in(cm)	3 (7.6)		3 (7.6)		3 (7.6)	
Mast O.D., in(cm)	2.5 (6.4)		2.5 (6.4)		2.5 (6.4)	
Net Weight w/o bracket, lb(kg)	37 (16.8)		60 (27.2)		63 (28.6)	
Shipping Weight, lb(kg)	67 (30.4)		90 (40.8)		93 (42.2)	

217-222 MHz

Model Number	DS2C00F36U-N	DS2C00F36U-D	DS2C03F36U-N	DS2C03F36U-D	DS2C06F36U-N	DS2C06F36U-D	DS2C00F36D-N	DS2C00F36D-D	DS2C03F36D-N	DS2C03F36D-D
Input Connector	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN
Type	Single		Single		Single		Dual		Dual	
ELECTRICAL										
Bandwidth, MHz	5		5		5		5		5	
Power, Watts	500		500		500		350		350	
Gain, dBd	0		3		6		0		3	
Horizontal Beamwidth, degrees	360		360		360		360		360	
Vertical Beamwidth, degrees	60		30		16		60		30	
Beam Tilt, degrees	0		0		0		0		0	
Isolation (minimum), dB	N/A		N/A		N/A		30		30	
MECHANICAL										
Number of Connectors	1		1		1		2		2	
Flat Plate Area, ft²(m²)	1.9 (0.18)		1.9 (0.18)		2.58 (0.24)		2.4 (0.22)		4.1 (0.38)	
Lateral Windload Thrust, lbf(N)	53 (236)		69 (307)		108 (480)		90 (400)		169 (752)	
Survival Wind Speed without ice, mph(kph)	222 (357)		172 (277)		110 (177)		130 (209)		75 (121)	
Survival Wind Speed with 0.5" radial ice, mph(kph)	193 (311)		150 (241)		96 (154)		115 (185)		65 (105)	
Mounting Hardware included	DSH2V3R		DSH2V3R		DSH3V3N		DSH3V3R		DSH3V3N	
DIMENSIONS										
Length, ft(m)	7.7 (2.3)		9.9 (3)		18.1 (5.5)		13.6 (4.1)		24.3 (7.4)	
Radome O.D., in(cm)	3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)	
Mast O.D., in(cm)	2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)	
Net Weight w/o bracket, lb(kg)	19 (8.6)		26 (11.8)		47 (21.3)		40 (18.1)		70 (31.8)	
Shipping Weight, lb(kg)	39 (17.7)		56 (25.4)		77 (34.9)		70 (31.8)		100 (45.4)	

VERTICAL PATTERNS

DS1G03F36U-N
DS1G03F36U-D



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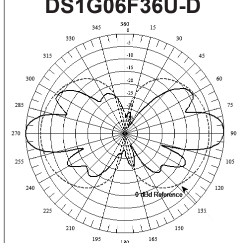

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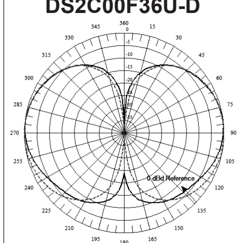

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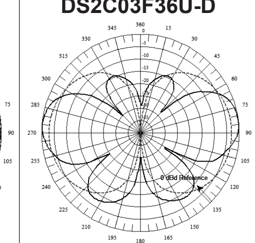

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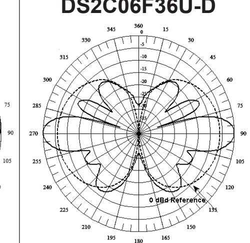

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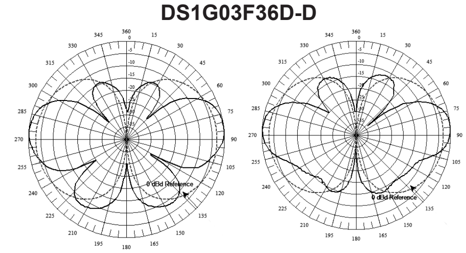
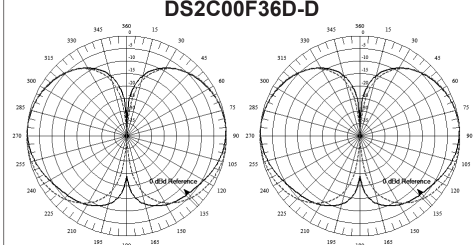


Top Bottom

DS2C00F36D-N
DS2C00F36D-D



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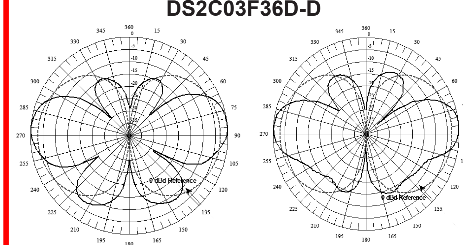
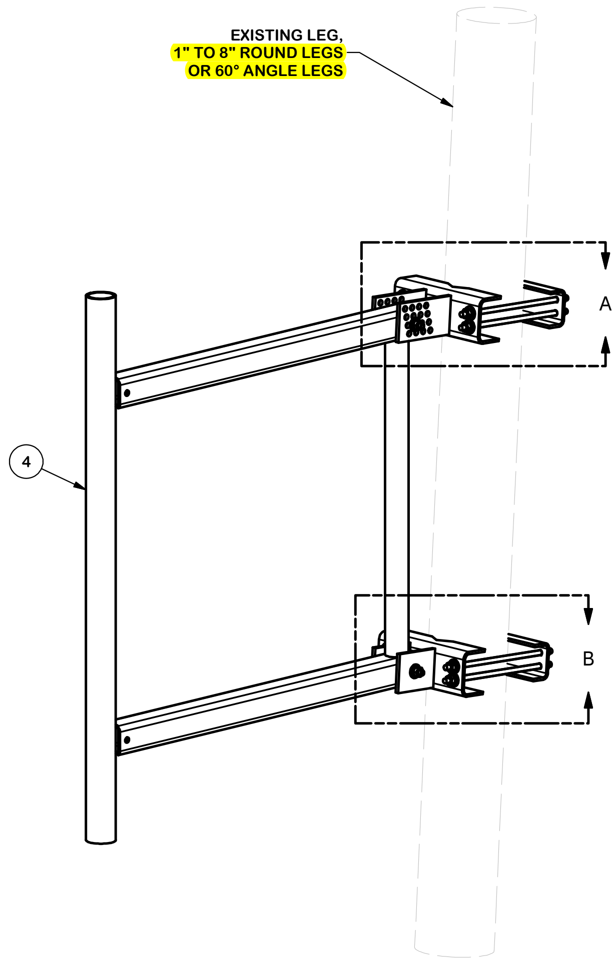
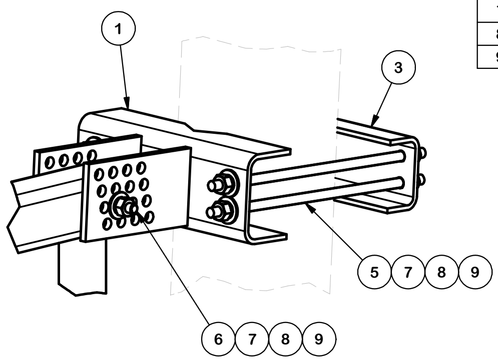


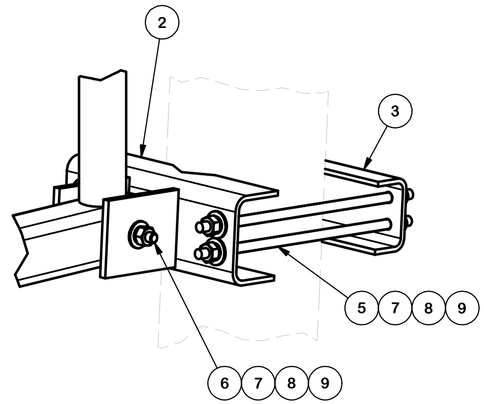
Top Bottom

TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 2 1/4"± DIAMETER.

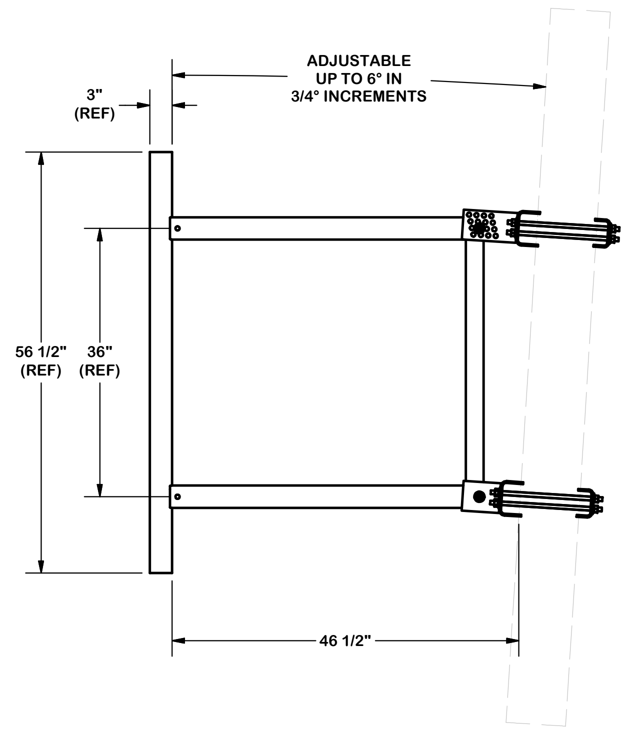




DETAIL A



DETAIL B



PARTS LIST						
ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	1	CFM	UPPER GATE FOOT WELDMENT		13.90	13.90
2	1	CFS	LOWER GATE FOOT WELDMENT		12.72	12.72
3	2	GBB	GATE BACKING BAR		4.53	9.06
4	1	4PBG	48" PIPE MOUNT STANDOFF ARM		113.96	113.96
5	8	G12R-12	1/2" x 12" GALV. THREADED ROD		0.67	5.35
5	8	G12R-15	1/2" x 15" GALV. THREADED ROD		0.84	6.69
6	2	A1205	1/2" x 5" A325 HDG BOLT		0.34	0.69
7	18	G12FW	1/2" HDG USS FLATWASHER		0.03	0.61
8	18	G12LW	1/2" HDG LOCKWASHER		0.01	0.25
9	18	G12NUT	1/2" HDG HEAVY 2H HEX NUT		0.07	1.29
					TOTAL WT. #	164.53

TOLERANCE NOTES

TOLERANCES ON DIMENSIONS, UNLESS OTHERWISE NOTED ARE:
SAWED, SHEARED AND GAS CUT EDGES *(± 0.030")*
DRILLED AND GAS CUT HOLES *(± 0.030")* - NO CONING OF HOLES
LASER CUT EDGES AND HOLES *(± 0.010")* - NO CONING OF HOLES
BENDS ARE ± 1/2 DEGREE
ALL OTHER MACHINING *(± 0.030")*
ALL OTHER ASSEMBLY *(± 0.060")*

DESCRIPTION
48" ULTIMATE UNIVERSAL
STANDOFF FRAME

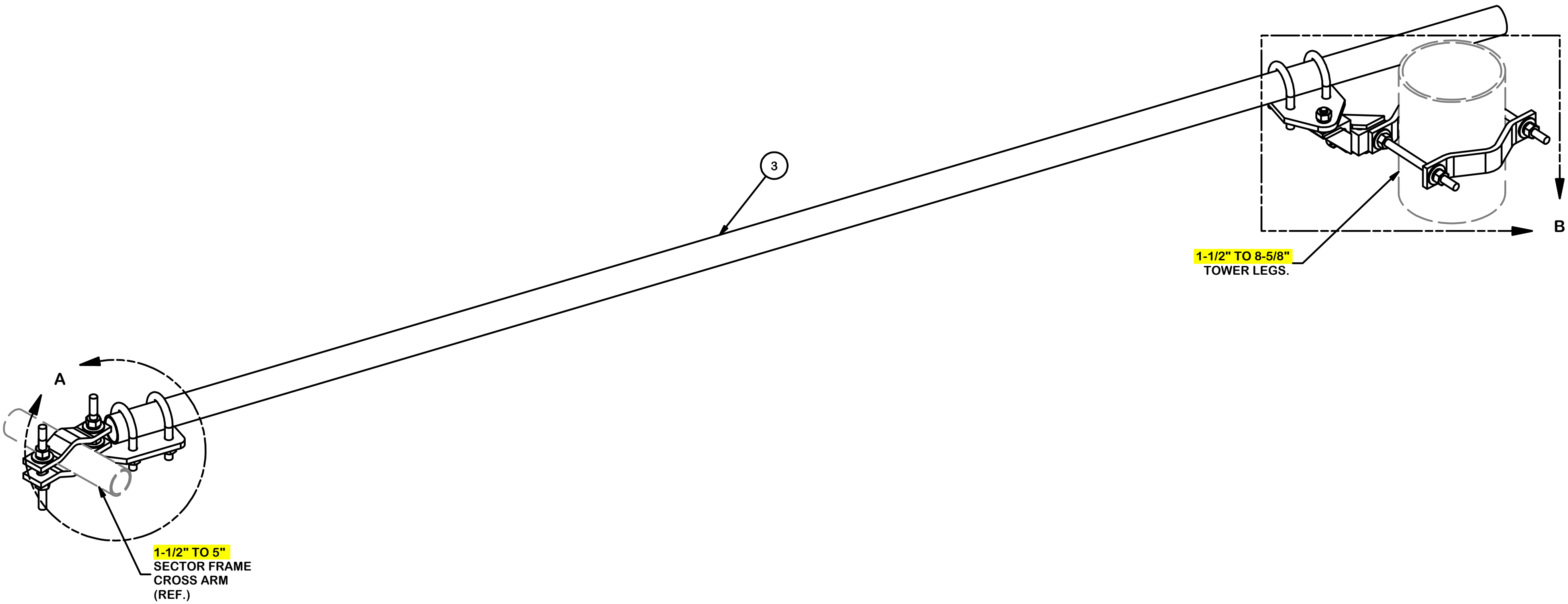
SITE PRO 1
A valmont COMPANY
Engineering Support Team: 1-888-753-7446
Locations:
New York, NY
Atlanta, GA
Los Angeles, CA
Plymouth, IN
Salem, OR
Dallas, TX

CPD NO. | DRAWN BY: RCH 2/4/2011 | ENG. APPROVAL | PART NO.: USF-4U
CLASS: 81 | SUB: 01 | DRAWING USAGE: CUSTOMER | CHECKED BY: BMC 2/16/2011 | DWG. NO.: USF-4U

TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 2.875" ± DIAMETER.
FRAME MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 3.000" ± DIAMETER.

PARTS LIST

ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	2	X-SPTB	SLIDING PIPE TIE BACK PLATE	5 1/2 in	5.87	11.74
2	2	X-TBCA	TIE BACK CLIP ANGLE		2.08	4.16
3	1	P2126	2-3/8" OD X 126" SCH 40 GALVANIZED PIPE	126 in	40.75	40.75
4	2	MCP	CLAMP HALF 1/2" THICK, 11-5/8" LONG	12 1/16 in	3.59	7.19
5	4	DCP	1/2" THICK, 5-3/4" CNTER TO CENTER CLAMP HALF	8 1/8 in	2.42	9.68
6	2	G58R-12	5/8" x 12" THREADED ROD (HDG.)		1.05	2.09
7	4	G58R-8	5/8" x 8" THREADED ROD (HDG.)		0.70	2.79
8	4	X-UB5258	5/8" X 2-5/8" X 4-1/2" X 2" U-BOLT (HDG.)		1.00	4.00
9	4	G5804	5/8" x 4" HDG HEX BOLT GR5		0.44	1.78
10	2	G5802	5/8" x 2" HDG HEX BOLT GR5		0.27	0.54
11	10	G58FW	5/8" HDG USS FLATWASHER	1/8 in	0.07	0.70
12	18	G58LW	5/8" HDG LOCKWASHER		0.03	0.47
13	20	G58NUT	5/8" HDG HEAVY 2H HEX NUT		0.13	2.60
					TOTAL WT. #	88.49



TOLERANCE NOTES

TOLERANCES ON DIMENSIONS, UNLESS OTHERWISE NOTED ARE:
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DRILLED AND GAS CUT HOLES *(± 0.030")* - NO CONING OF HOLES
LASER CUT EDGES AND HOLES *(± 0.010")* - NO CONING OF HOLES
BENDS ARE ± 1/2 DEGREE
ALL OTHER MACHINING *(± 0.030")*
ALL OTHER ASSEMBLY *(± 0.060")*

DESCRIPTION
SLIDING PIPE
TIE BACK ASSEMBLY

SITE PRO 1
A valmont COMPANY
Engineering Support Team:
1-888-753-7446
Locations:
New York, NY
Atlanta, GA
Los Angeles, CA
Plymouth, IN
Salem, OR
Dallas, TX

CPD NO.	DRAWN BY	ENG. APPROVAL	PART NO.
	CEK 10/19/2016		SPTB

CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	02	CUSTOMER	BMC 11/17/2016	SPTB

ATTACHMENT C – STRUCTURAL ANALYSIS REPORT

Date: **March 5, 2020**

Black & Veatch Corp.
6800 W. 115th St., Suite 2292
Overland Park, KS 66211
(913) 458-2522

Subject:	**Structural Analysis Report**	
Eversource Designation:	**Site Number:** **Site Name:**	ES-060 NorwalkAWC
Engineering Firm Designation:	**Black & Veatch Corp. Project Number:**	403093
Site Data:	**2 Tindall Ave, Norwalk, Fairfield County, CT** **Latitude *41° 7' 31.26"*, Longitude *-73° 25' 17.36"*** **150 Foot - Self Support Tower**	

Black & Veatch Corp. is pleased to submit this **"Structural Analysis Report"** to determine the structural integrity of the above-mentioned tower.

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

LC1: Proposed Equipment Configuration **Sufficient Capacity – 67.7%**

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

Structural analysis prepared by: Khushal Patel

Respectfully submitted by:

Joshua J Riley, P.E.

Professional Engineer

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED
PROFESSIONAL ENGINEER
03/05/2020

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 150 ft Self Support tower designed by Rohn in July of 2015.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	III
Wind Speed:	130 mph ultimate
Exposure Category:	C
Topographic Factor:	1
Ice Thickness:	1.5 in
Wind Speed with Ice:	50 mph
Seismic Ss:	0.233
Seismic S1:	0.067
Service Wind Speed:	60 mph

Table 1 - Proposed Equipment Configuration

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
147.0	160.0	1	dbspectra	DS2C03F36D-D	2	7/8	-
	147.0	1	site pro 1	USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]			

Table 2 - Other Considered Equipment

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
148.0	158.0	1	dbspectra	DS9A09F36D-N	2	1-5/8	1
146.0	146.0	1	miscl	TMA	1	1/2	1
144.0	154.0	1	telewave	ANT150F6	1 1	1-5/8 7/8	1
	151.5	1	rfs celwave	1151-3N			
	144.0	2	tower mounts	Side Arm Mount [SO 308-1]			
135.0	135.0	1	celwave	PAL6-59	1	E65	2
		1	mount pipes	6'x2" Mount Pipe			
134.0	138.0	1	telewave	ANT150F2	1	7/8	1
	134.0	1	tower mounts	Side Arm Mount [SO 308-1]			
126.0	132.0	1	kreco	CO-36A	1	7/8	1
	126.0	1	tower mounts	Side Arm Mount [SO 308-1]			
120.0	126.0	1	kreco	CO-36A	1	7/8	1
	120.0	1	tower mounts	Side Arm Mount [SO 308-1]			
		1	celwave	PAL6-59	1	E65	2
		1	mount pipes	6'x2" Mount Pipe			
116.0	122.0	1	kreco	CO-36A	2	7/8	1

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
	120.0	1	telewave	ANT150F2			
	116.0	2	tower mounts	Side Arm Mount [SO 308-1]			
110.0	110.0	9	quintel technology	QS6656-5_TIA w/ Mount Pipe	1	1 5/8	2
		3	rfs celwave	B2/B66A RRH-BR049			
		3	rfs celwave	B5/B13 RRH-BR04C			
		1	rfs celwave	DB-C1-12C-24AB-0Z			
		1	cci tower mounts	Sector Mount [SM 802-3]			
100.0	100.0	9	alcatel lucent	RRH2X40-AWS	5	1-5/8	2
		6	amphenol	BXA-70063-6CF-EDIN-X w/ Mount Pipe			
		6	antel	BXA-171063-12CF-EDIN-X w/ Mount Pipe			
		3	tower mounts	Pirod 12' T-Frame Sector Mount (1)			
		1	rfs celwave	DB-T1-6Z-8AB-0Z			
90.0	90.0	3	alcatel lucent	FD-RRH-2x50-800	6	1-5/8	2
		3	tower mounts	Pirod 12' T-Frame Sector Mount (1)			
		3	rfs celwave	APXVSPP18-C_TIA w/ Mount Pipe			
80.0	80.0	3	tower mounts	Pirod 12' T-Frame Sector Mount (1)	8	1-5/8	2
		6	ericsson	AIR 21 w/ Mount Pipe			
		3	ericsson	KRY 112 144/1			

Notes:
1) Existing Equipment
2) Reserved Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
4-GEOTECHNICAL REPORTS	Dr. Clarence Welti, P.E., P.C., dated 04/21/2014	-	Eversource
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	Rohn, dated 07/30/2015	-	Eversource
4-TOWER MANUFACTURER DRAWINGS	Rohn, dated 07/30/2015	-	Eversource
4-TOWER STRUCTURAL ANALYSIS REPORTS	Paul J. Ford & Company, dated 05/02/2017	-	Eversource

3.1) Analysis Method

tnxTower (version 8.0.5.0), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

1) Tower and structures were built and maintained in accordance with the manufacturer's specifications.
2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
3) Existing tower loading is based on 2018 drone mapping photos.
4) Reserved tower loading is based on 2019 Paul J. Ford Structural Analysis Report.
5) This analysis was performed under the assumption that all information provided to Black & Veatch is current and correct. This is to include site data, appurtenance loading, tower/foundation details, and geotechnical data.

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

4) ANALYSIS RESULTS

Table 4 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
T1	150 - 130	Leg	2 1/4	3	-13.770	110.313	12.5	Pass
T2	130 - 110	Leg	2 1/2	39	-48.033	150.688	31.9	Pass
T3	110 - 94	Leg	2 3/4	70	-85.061	196.260	43.3	Pass
T4	94 - 90	Leg	2 3/4	97	-94.346	255.206	37.0	Pass
T5	90 - 80	Leg	3 1/4	109	-118.566	262.722	45.1	Pass
T6	80 - 70	Leg	3 1/4	124	-144.617	352.529	41.0	Pass
T7	70 - 55	Leg	3 3/4	145	-180.374	386.401	46.7	Pass
T8	55 - 50	Leg	3 3/4	166	-191.371	482.329	39.7	Pass
T9	50 - 30	Leg	4 1/4	178	-234.234	530.474	44.2	Pass
T10	30 - 10	Leg	4 1/2	205	-269.411	609.947	44.2	Pass
T11	10 - 0	Leg	4 1/2	220	-279.570	609.947	45.8	Pass
T1	150 - 130	Diagonal	L1 1/2x1 1/2x3/16	10	-2.982	11.381	26.2 44.4 (b)	Pass
T2	130 - 110	Diagonal	L1 3/4x1 3/4x3/16	42	-5.353	17.039	31.4 56.1 (b)	Pass
T3	110 - 94	Diagonal	L2x2x3/16	76	-6.205	17.480	35.5 67.7 (b)	Pass
T4	94 - 90	Diagonal	L2x2x3/16	103	-5.974	15.772	37.9 63.8 (b)	Pass
T5	90 - 80	Diagonal	L2 1/2x2 1/2x3/16	115	-6.787	22.560	30.1 61.8 (b)	Pass
T6	80 - 70	Diagonal	L2 1/2x2 1/2x3/16	130	-7.389	18.848	39.2 67.1 (b)	Pass
T7	70 - 55	Diagonal	L2 1/2x2 1/2x1/4	151	-7.159	20.071	35.7 48.7 (b)	Pass
T8	55 - 50	Diagonal	L2 1/2x2 1/2x1/4	172	-7.311	17.641	41.4 48.1 (b)	Pass
T9	50 - 30	Diagonal	L3x3x3/16	185	-7.388	18.586	39.8 66.1 (b)	Pass
T10	30 - 10	Diagonal	L3 1/2x3 1/2x1/4	212	-9.217	51.419	17.9	Pass

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
							31.8 (b)	
T11	10 - 0	Diagonal	L3 1/2x3 1/2x1/4	238	-12.636	26.967	46.9	Pass
T11	10 - 0	Horizontal	L3 1/2x3 1/2x1/4	237	-7.643	32.365	23.6 26.5 (b)	Pass
T4	94 - 90	Secondary Horizontal	L2x2x1/4	106	1.636	28.812	5.7 13.3 (b)	Pass
T6	80 - 70	Secondary Horizontal	L2 1/2x2 1/2x3/16	133	-2.508	26.519	9.5 22.5 (b)	Pass
T8	55 - 50	Secondary Horizontal	L2 1/2x2 1/2x1/4	175	-3.319	22.678	14.6 22.4 (b)	Pass
T1	150 - 130	Top Girt	L2x2x3/16	4	-0.071	12.486	0.6 0.8 (b)	Pass
T11	10 - 0	Redund Horz 1 Bracing	L2 1/2x2 1/2x1/4	225	-4.849	42.183	11.5	Pass
T11	10 - 0	Redund Diag 1 Bracing	L2 1/2x2 1/2x1/4	243	-3.970	18.067	22.0	Pass
T11	10 - 0	Inner Bracing	L3x3x1/4	246	-0.012	19.067	0.3	Pass
							Summary	
						Leg (T7)	46.7	Pass
						Diagonal (T3)	67.7	Pass
						Horizontal (T11)	26.5	Pass
						Secondary Horizontal (T6)	22.5	Pass
						Top Girt (T1)	0.8	Pass
						Redund Horz 1 Bracing (T11)	11.5	Pass
						Redund Diag 1 Bracing (T11)	22.0	Pass
						Inner Bracing (T11)	0.3	Pass
						Bolt Checks	67.7	Pass
						Rating =	67.7	Pass

Table 5 - Tower Component Stresses vs. Capacity - LC1

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	28.2	Pass
1	Base Foundation	0	20.3	Pass
	Base Foundation Soil Interaction		45.0	Pass

Structure Rating (max from all components) =	67.7%

Note:
1) See additional documentation in “Appendix C – Additional Calculations” for calculations supporting the % capacity consumed. Rating per TIA-222-H section 15.5.

4.1) Recommendations

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

Maximum Tower Deflections - Service Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*	*Check**
T1	150 - 130	2.433	46	0.14	0.079	OK
T2	130 - 110	1.849	46	0.135	0.07	OK
T3	110 - 94	1.299	46	0.116	0.044	OK
T4	94 - 90	0.927	46	0.093	0.025	OK
T5	90 - 80	0.847	46	0.087	0.022	OK
T6	80 - 70	0.664	46	0.075	0.016	OK

*Limit State Deformation (TIA-222-H Section 2.8.2)

1) Maximum Rotation = 4 Degrees

2) Maximum Deflection = 0.03 * Tower Height = 54 in.

Critical Deflections of Tower at the MW Dish Elevations - Service Wind

Elevation (ft)	*MW Dish*	*Tilt (°)*	*Twist (°)*	*Diameter, D (ft)*	*Frequency, α (GHz)*	*Decibel Points*	*Deformation Limit (θ)**	*Deformation Limit Exceeded?*
135	PAL6-59	0.138	0.073	6	10	10 dB	0.885	Not Exceeded
120	PAL6-59	0.127	0.058	6	10	10 dB	0.885	Not Exceeded

*Limit per TIA-222-H Annex D

Maximum Tower Deflections - Design Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*	*Combined Max*	*Check**
T1	150 - 130	6.964	46	0.401	0.224	0.459	OK
T2	130 - 110	5.277	46	0.388	0.198	0.436	OK
T3	110 - 94	3.695	46	0.332	0.126	0.355	OK
T4	94 - 90	2.633	46	0.266	0.072	0.276	OK
T5	90 - 80	2.403	46	0.248	0.062	0.256	OK
T6	80 - 70	1.884	46	0.213	0.045	0.218	OK

*Up to 0.5 degree is considered acceptable per SUB090 Section 7

Critical Deflections of Tower at the MW Dish Elevations - Design Wind

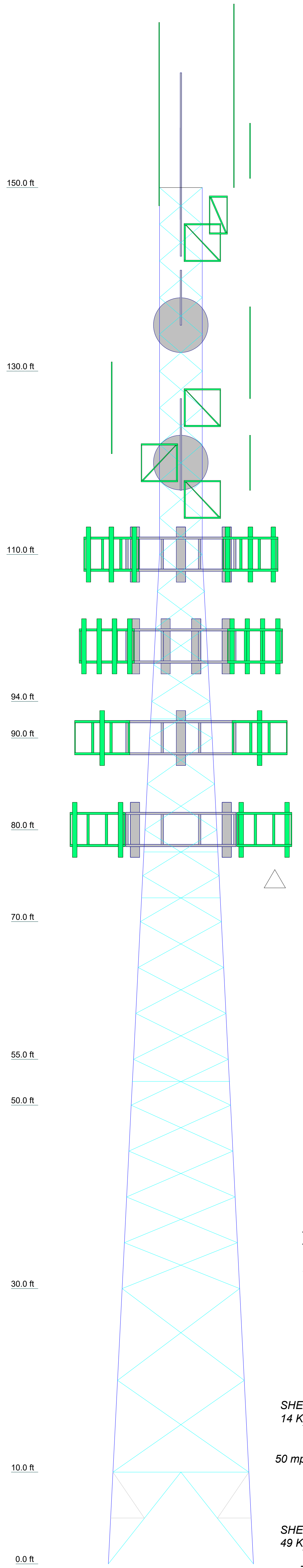
Elevation ft	*Appurtenance*	*Gov. Load Comb.*	*Deflection in*	*Tilt °*	*Twist °*	*Radius of Curvature ft*
135	PAL6-59	46	5.695	0.395	0.208	67053.000
120	PAL6-59	46	4.462	0.365	0.165	24272.000

APPENDIX A

TNXTOWER OUTPUT

Section	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11
Legs	SR 2 1/4	SR 2 1/2	SR 2 3/4		SR 3 1/4		SR 3 3/4		SR 4 1/4	SR 4 1/2	
Leg Grade	A572-50										
Diagonals	L1 1/2x1 1/2x3/16	L1 3/4x1 3/4x3/16	L2x2x3/16			L2 1/2x2 1/2x3/16	L2 1/2x2 1/2x1/4		L3x3x3/16	L3 1/2x3 1/2x1/4	
Diagonal Grade	A572-50										
Top Girts	L2x2x3/16	N.A.									
Horizontals	N.A.										L3 1/2x3 1/2x1/4
Sec. Horizontals	N.A.			L2x2x1/4	N.A.	L2 1/2x2 1/2x3/16	N.A.	A	N.A.		
Red. Horizontals	N.A.										L2 1/2x2 1/2x1/4
Red. Diagonals	N.A.										L2 1/2x2 1/2x1/4
Inner Bracing	N.A.										L3x3x1/4
Face Width (ft)	4.70313 / 4.72396	4.72396 / 4.73958	4.73958 / 6.36979	6.36979 / 6.77604	6.77604 / 7.79427	7.79427 / 8.8125	8.8125 / 10.3411	10.3411 / 10.849	10.849 / 12.8646	12.8646 / 14.8646	14.8646 / 15.8646
# Panels @ (ft)	15 @ 4				12 @ 5					3 @ 10	
Weight (K)	1.2	1.5	1.4	0.4	1.2	1.4	2.6	1.0	4.2	4.7	2.8

Weight (K): 22.6



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 5/8"x5'	150	B5/B13 RRH-BR04C	110
DS9A09F36D-N	148	DB-C1-12C-24AB-0Z	110
DS2C03F36D-D	147	Pirod 12' T-Frame Sector Mount (1)	100
USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]	147	Pirod 12' T-Frame Sector Mount (1)	100
		Pirod 12' T-Frame Sector Mount (1)	100
TMA	146	(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	100
1151-3N	144	(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	100
Side Arm Mount [SO 308-1]	144	(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	100
12' horizontal x 2" Pipe Mount	144	(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	100
ANT150F6	144	(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	100
12' horizontal x 2" Pipe Mount	144	(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	100
Side Arm Mount [SO 308-1]	144	(3) RRH2X40-AWS	100
6'x2" Mount Pipe	135	(3) RRH2X40-AWS	100
PAL6-59	135	(3) RRH2X40-AWS	100
ANT150F2	134	DB-T1-6Z-8AB-0Z	100
Side Arm Mount [SO 308-1]	134	APXVSPP18-C_TIA w/ Mount Pipe	90
12' horizontal x 2" Pipe Mount	134	APXVSPP18-C_TIA w/ Mount Pipe	90
12' horizontal x 2" Pipe Mount	126	APXVSPP18-C_TIA w/ Mount Pipe	90
CO-36A	126	FD-RRH-2x50-800	90
Side Arm Mount [SO 308-1]	126	FD-RRH-2x50-800	90
12' horizontal x 2" Pipe Mount	120	FD-RRH-2x50-800	90
6'x2" Mount Pipe	120	Pirod 12' T-Frame Sector Mount (1)	90
CO-36A	120	Pirod 12' T-Frame Sector Mount (1)	90
Side Arm Mount [SO 308-1]	120	Pirod 12' T-Frame Sector Mount (1)	90
PAL6-59	120	(2) AIR 21 w/ Mount Pipe	80
12' horizontal x 2" Pipe Mount	116	(2) AIR 21 w/ Mount Pipe	80
CO-36A	116	(2) AIR 21 w/ Mount Pipe	80
Side Arm Mount [SO 308-1]	116	KRY 112 144/1	80
12' horizontal x 2" Pipe Mount	116	KRY 112 144/1	80
Side Arm Mount [SO 308-1]	116	KRY 112 144/1	80
ANT150F2	116	Pirod 12' T-Frame Sector Mount (1)	80
Sector Mount [SM 802-3]	110	Pirod 12' T-Frame Sector Mount (1)	80
(3) QS6656-5_TIA w/ Mount Pipe	110	Pirod 12' T-Frame Sector Mount (1)	80
(3) QS6656-5_TIA w/ Mount Pipe	110	(6) Secondary Members 30'-20'	25
(3) QS6656-5_TIA w/ Mount Pipe	110	(6) Secondary Members 30'-20'	25
B2/B66A RRH-BR049	110	(6) Secondary Members 30'-20'	25
B2/B66A RRH-BR049	110	(6) Secondary Members 20'-10'	15
B2/B66A RRH-BR049	110	(6) Secondary Members 20'-10'	15
B5/B13 RRH-BR04C	110	(6) Secondary Members 20'-10'	15
B5/B13 RRH-BR04C	110		

SYMBOL LIST

MARK	SIZE	MARK	SIZE
A	L2 1/2x2 1/2x1/4		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi			

TOWER DESIGN NOTES

1. Tower is located in Fairfield County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-H Standard.
3. Tower designed for a 130 mph basic wind in accordance with the TIA-222-H Standard.
4. Tower is also designed for a 50 mph basic wind with 1.50 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Risk Category III.
7. Topographic Category 1 with Crest Height of 0.000 ft
8. TOWER RATING: 67.7%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 297 K
SHEAR: 29 K

UPLIFT: -266 K
SHEAR: 26 K

AXIAL 123 K
SHEAR 14 K
MOMENT 1102 kip-ft
TORQUE 4 kip-ft
50 mph WIND - 1.500 in ICE

AXIAL 47 K
SHEAR 49 K
MOMENT 3890 kip-ft
TORQUE 12 kip-ft
REACTIONS - 130 mph WIND

BLACK & VEATCH Building a world of difference.	*Black & Veatch Corp.* 6800 W. 115th St., Suite 2292 Overland Park, KS 66211 Phone: (913) 458-2984 FAX: (913) 458-8136	Job: *ES-060 NorwalkAWC*
		Project: *403093*
		Client: Eversource · Drawn by: Josh Riley · App'd:
		Code: TIA-222-H · Date: 03/03/20 · Scale: NTS
		Path: C:\Users\rl68982\Documentum\Checkout\ES-060 NorwalkAWC Structural Analysis.eri · Dwg No. E-1

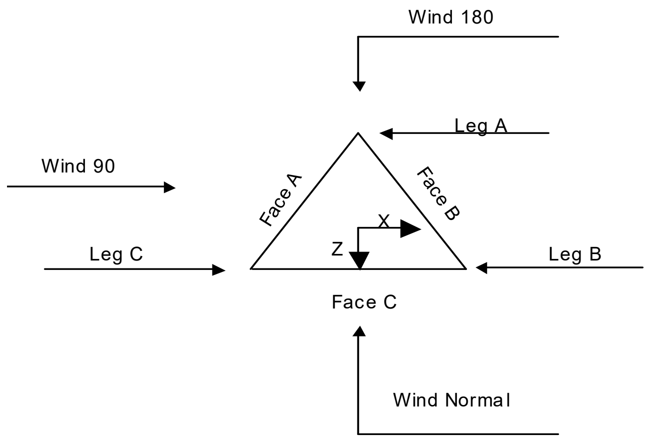
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 150.000 ft above the ground line.
The base of the tower is set at an elevation of 0.000 ft above the ground line.
The face width of the tower is 4.703 ft at the top and 15.865 ft at the base.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

1) Tower is located in Fairfield County, Connecticut.
2) Tower base elevation above sea level: 57.000 ft.
3) Basic wind speed of 130 mph.
4) Risk Category III.
5) Exposure Category C.
6) Simplified Topographic Factor Procedure for wind speed-up calculations is used.
7) Topographic Category: 1.
8) Crest Height: 0.000 ft.
9) Nominal ice thickness of 1.500 in.
10) Ice thickness is considered to increase with height.
11) Ice density of 56.000 pcf.
12) A wind speed of 50 mph is used in combination with ice.
13) Temperature drop of 50.000 °F.
14) Deflections calculated using a wind speed of 60 mph.
15) Pressures are calculated at each section.
16) Stress ratio used in tower member design is 1.05.
17) 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-H Bracing Resist. Exemption
√	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Use TIA-222-H 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		Ignore KL/ry For 60 Deg. Angle Legs		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	150.000-130.000			4.703	1	20.000
T2	130.000-110.000			4.724	1	20.000
T3	110.000-94.000			4.740	1	16.000
T4	94.000-90.000			6.370	1	4.000
T5	90.000-80.000			6.776	1	10.000
T6	80.000-70.000			7.794	1	10.000
T7	70.000-55.000			8.813	1	15.000
T8	55.000-50.000			10.341	1	5.000
T9	50.000-30.000			10.849	1	20.000
T10	30.000-10.000			12.865	1	20.000
T11	10.000-0.000			14.865	1	10.000

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	150.000-130.000	4.000	X Brace	No	No	0.000	0.000
T2	130.000-110.000	4.000	X Brace	No	No	0.000	0.000
T3	110.000-94.000	4.000	X Brace	No	No	0.000	0.000
T4	94.000-90.000	4.000	X Brace	No	Yes	0.000	0.000
T5	90.000-80.000	5.000	X Brace	No	No	0.000	0.000
T6	80.000-70.000	5.000	X Brace	No	Yes	0.000	0.000
T7	70.000-55.000	5.000	X Brace	No	No	0.000	0.000
T8	55.000-50.000	5.000	X Brace	No	Yes	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
T9	50.000-30.000	5.000	X Brace	No	No	0.000	0.000
T10	30.000-10.000	10.000	X Brace	No	No	0.000	0.000
T11	10.000-0.000	10.000	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 150.000-130.000	Solid Round	2 1/4	A572-50 (50 ksi)	Equal Angle	L1 1/2x1 1/2x3/16	A572-50 (50 ksi)
T2 130.000-110.000	Solid Round	2 1/2	A572-50 (50 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A572-50 (50 ksi)
T3 110.000-94.000	Solid Round	2 3/4	A572-50 (50 ksi)	Equal Angle	L2x2x3/16	A572-50 (50 ksi)
T4 94.000-90.000	Solid Round	2 3/4	A572-50 (50 ksi)	Equal Angle	L2x2x3/16	A572-50 (50 ksi)
T5 90.000-80.000	Solid Round	3 1/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)
T6 80.000-70.000	Solid Round	3 1/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)
T7 70.000-55.000	Solid Round	3 3/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/4	A572-50 (50 ksi)
T8 55.000-50.000	Solid Round	3 3/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/4	A572-50 (50 ksi)
T9 50.000-30.000	Solid Round	4 1/4	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A572-50 (50 ksi)
T10 30.000-10.000	Solid Round	4 1/2	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T11 10.000-0.000	Solid Round	4 1/2	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	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 150.000-130.000	Equal Angle	L2x2x3/16	A572-50 (50 ksi)	Solid Round		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
T11 10.000-0.000	None	Flat Bar		A36 (36 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 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*
T4 94.000-90.000	Equal Angle	L2x2x1/4	A572-50 (50 ksi)	Solid Round		A572-50 (50 ksi)
T6 80.000-70.000	Equal Angle	L2 1/2x2 1/2x3/16	A572-50 (50 ksi)	Solid Round		A572-50 (50 ksi)
T8 55.000-50.000	Equal Angle	L2 1/2x2 1/2x1/4	A572-50 (50 ksi)	Solid Round		A572-50 (50 ksi)
T11 10.000-0.000	Solid Round		A572-50 (50 ksi)	Equal Angle	L3x3x1/4	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Redundant Bracing Grade*		*Redundant Type*	*Redundant Size*	*K Factor*
T11 10.000-0.000	A572-50 (50 ksi)	Horizontal (1)	Equal Angle	L2 1/2x2 1/2x1/4	1
		Diagonal (1)	Equal Angle	L2 1/2x2 1/2x1/4	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 150.000-130.000	0.000	0.250	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T2 130.000-110.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T3 110.000-94.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T4 94.000-90.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T5 90.000-80.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T6 80.000-70.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T7 70.000-55.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T8 55.000-50.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T9 50.000-30.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T10 30.000-10.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt
T11 10.000-0.000	0.000	0.375	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	Mid-Pt

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 150.000-130.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2 130.000-110.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T3 110.000-94.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 94.000-90.000	No	No	1	1 1	1 1	1 1	1 1	1 1	1 0.5	1 1
T5 90.000-80.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T6 80.000-70.000	No	No	1	1 1	1 1	1 1	1 1	1 1	1 0.5	1 1
T7 70.000-55.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T8 55.000-50.000	No	No	1	1 1	1 1	1 1	1 1	1 1	1 0.5	1 1
T9 50.000-30.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T10 30.000-10.000	No	No	0.5	0.5 1	1 1	1 1	1 1	1 1	1 1	1 1
T11 10.000-0.000	No	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 150.000-130.000	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 130.000-110.000	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 110.000-94.000	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 94.000-90.000	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 90.000-80.000	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 80.000-70.000	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 70.000-55.000	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 55.000-50.000	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 50.000-30.000	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
T10 30.000-10.000	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
T11 10.000-0.000	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 150.000-130.000	Flange	0.875 A325N	4	0.500 A325N	1	0.500 A325N	1	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T2 130.000-110.000	Flange	1.000 A325N	5	0.625 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T3 110.000-94.000	Flange	1.000 A325N	0	0.625 A325N	1	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T4 94.000-90.000	Flange	1.000 A325N	5	0.625 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	1
T5 90.000-80.000	Flange	1.000 A325N	0	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T6 80.000-70.000	Flange	1.000 A325N	7	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.750 A325N	1
T7 70.000-55.000	Flange	1.500 A325N	0	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T8 55.000-50.000	Flange	1.500 A325N	5	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.750 A325N	1
T9 50.000-30.000	Flange	1.500 A325N	7	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T10 30.000-10.000	Flange	1.500 A325N	0	0.625 A325N	2	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T11 10.000-0.000	Flange	1.500 F1554-105	0	0.625 A325N	2	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.625 A325N	2	0.625 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Safety Line 3/8	C	No	No	Ar (CaAa)	150.000 - 0.000	0.000	0.5	1	1	0.375	0.375		0.220
***													
Feedline Ladder (Af)	B	No	No	Af (CaAa)	150.000 - 0.000	0.000	-0.415	1	1	3.000	3.000		8.400
LDF7-50A(1-5/8)	B	No	No	Ar (CaAa)	148.000 - 144.000	0.000	-0.36	2	2	0.500	1.980		0.820
LDF7-50A(1-5/8)	B	No	No	Ar (CaAa)	144.000 - 8.000	0.000	-0.38	3	3	0.500	1.980		0.820
LDF4-50A(1/2)	B	No	No	Ar (CaAa)	146.000 - 8.000	0.000	-0.393	1	1	0.500	0.625		0.150
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	144.000 - 132.000	0.000	-0.4	1	1	0.500	1.030		0.330
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	132.000 - 126.000	0.000	-0.42	2	2	0.500	1.030		0.330
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	126.000 - 120.000	0.000	-0.41	3	3	0.500	1.030		0.330
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	120.000 - 116.000	0.000	-0.44	4	4	0.500	1.030		0.330
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	116.000 - 8.000	0.000	-0.45	6	6	0.500	1.030		0.330
***													
Reserved Loading													
EP65 (ELLIPTICAL AIR)	B	No	No	Ar (CaAa)	135.000 - 120.000	0.000	-0.34	1	1	2.000	2.000		0.670

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
EP65 (ELLIPTICAL AIR)	B	No	No	Ar (CaAa)	120.000 - 0.000	0.000	-0.33	2	2	2.000	2.000		0.670
***													
Feedline Ladder (Af)	B	No	No	Af (CaAa)	110.000 - 0.000	0.000	0.4	1	1	3.000	3.000		8.400
LDF7-50A(1-5/8)	B	No	No	Ar (CaAa)	110.000 - 0.000	0.000	0.4	1	1	0.500	1.980		0.820
***													
Feedline Ladder (Af)	C	No	No	Af (CaAa)	100.000 - 0.000	0.000	-0.4	1	1	3.000	3.000		8.400
LDF7-50A(1-5/8)	C	No	No	Ar (CaAa)	100.000 - 0.000	0.000	-0.4	5	3	0.500	1.980		0.820
***													
Feedline Ladder (Af)	C	No	No	Af (CaAa)	90.000 - 0.000	0.000	0.4	1	1	3.000	3.000		8.400
LDF7-50A(1-5/8)	C	No	No	Ar (CaAa)	90.000 - 0.000	0.000	0.4	6	3	0.500	1.980		0.820
***													
Feedline Ladder (Af)	A	No	No	Af (CaAa)	80.000 - 0.000	0.000	-0.4	1	1	3.000	3.000		8.400
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	80.000 - 0.000	0.000	-0.4	8	4	0.500	1.980		0.820
***													
Proposed													
LCF78-50JA(7/8)	B	No	No	Ar (CaAa)	147.000 - 0.000	0.000	-0.32	2	2	0.500	1.090		0.320
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Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	C_AA_A ft²/ft	Weight plf
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Feed Line/Linear Appurtenances Section Areas

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	150.000-130.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	27.254	0.000	0.231
		C	0.000	0.000	0.750	0.000	0.004
T2	130.000-110.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	41.524	0.000	0.279
		C	0.000	0.000	0.750	0.000	0.004
T3	110.000-94.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	49.448	0.000	0.387
		C	0.000	0.000	9.540	0.000	0.079
T4	94.000-90.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	12.362	0.000	0.097

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
		C	0.000	0.000	6.110	0.000	0.051
T5	90.000-80.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	30.905	0.000	0.242
		C	0.000	0.000	32.155	0.000	0.260
T6	80.000-70.000	A	0.000	0.000	20.840	0.000	0.150
		B	0.000	0.000	30.905	0.000	0.242
		C	0.000	0.000	32.155	0.000	0.260
T7	70.000-55.000	A	0.000	0.000	31.260	0.000	0.224
		B	0.000	0.000	46.358	0.000	0.363
		C	0.000	0.000	48.233	0.000	0.391
T8	55.000-50.000	A	0.000	0.000	10.420	0.000	0.075
		B	0.000	0.000	15.452	0.000	0.121
		C	0.000	0.000	16.078	0.000	0.130
T9	50.000-30.000	A	0.000	0.000	41.680	0.000	0.299
		B	0.000	0.000	61.810	0.000	0.484
		C	0.000	0.000	64.310	0.000	0.521
T10	30.000-10.000	A	0.000	0.000	41.680	0.000	0.299
		B	0.000	0.000	61.810	0.000	0.484
		C	0.000	0.000	64.310	0.000	0.521
T11	10.000-0.000	A	0.000	0.000	20.840	0.000	0.150
		B	0.000	0.000	20.709	0.000	0.205
		C	0.000	0.000	32.155	0.000	0.260

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	150.000-130.000	A	1.993	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	81.188	0.000	1.288
		C		0.000	0.000	8.723	0.000	0.120
T2	130.000-110.000	A	1.963	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	125.662	0.000	1.835
		C		0.000	0.000	8.601	0.000	0.117
T3	110.000-94.000	A	1.931	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	135.728	0.000	2.136
		C		0.000	0.000	22.324	0.000	0.391
T4	94.000-90.000	A	1.911	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	33.761	0.000	0.528
		C		0.000	0.000	11.998	0.000	0.221
T5	90.000-80.000	A	1.896	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	84.078	0.000	1.309
		C		0.000	0.000	55.598	0.000	1.067
T6	80.000-70.000	A	1.873	0.000	0.000	28.136	0.000	0.586
		B		0.000	0.000	83.570	0.000	1.292
		C		0.000	0.000	55.291	0.000	1.055
T7	70.000-55.000	A	1.839	0.000	0.000	41.928	0.000	0.866
		B		0.000	0.000	124.262	0.000	1.901
		C		0.000	0.000	82.276	0.000	1.556
T8	55.000-50.000	A	1.807	0.000	0.000	13.890	0.000	0.285
		B		0.000	0.000	41.079	0.000	0.622
		C		0.000	0.000	27.219	0.000	0.511
T9	50.000-30.000	A	1.759	0.000	0.000	55.031	0.000	1.115
		B		0.000	0.000	162.229	0.000	2.421
		C		0.000	0.000	107.613	0.000	1.996
T10	30.000-10.000	A	1.641	0.000	0.000	53.750	0.000	1.059
		B		0.000	0.000	157.168	0.000	2.258
		C		0.000	0.000	104.550	0.000	1.882
T11	10.000-0.000	A	1.428	0.000	0.000	25.721	0.000	0.480
		B		0.000	0.000	48.147	0.000	0.707
		C		0.000	0.000	49.514	0.000	0.843

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	150.000-130.000	0.849	-8.526	0.077	-8.270
T2	130.000-110.000	1.173	-11.149	0.519	-11.168
T3	110.000-94.000	5.836	-8.810	5.281	-9.321
T4	94.000-90.000	7.785	-6.555	6.545	-6.874
T5	90.000-80.000	3.314	-3.930	3.606	-5.509
T6	80.000-70.000	-1.183	-1.172	-0.847	-2.983
T7	70.000-55.000	-1.442	-1.424	-1.075	-3.727
T8	55.000-50.000	-1.355	-1.369	-1.042	-3.632
T9	50.000-30.000	-1.541	-1.556	-1.229	-4.251
T10	30.000-10.000	-1.928	-1.937	-1.545	-5.259
T11	10.000-0.000	-2.265	5.195	-2.199	3.519

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	Safety Line 3/8	130.00 - 150.00	0.6000	0.5167
T1	3	Feedline Ladder (Af)	130.00 - 150.00	0.6000	0.5167
T1	4	LDF7-50A(1-5/8)	144.00 - 148.00	0.6000	0.5167
T1	5	LDF7-50A(1-5/8)	130.00 - 144.00	0.6000	0.5167
T1	6	LDF4-50A(1/2)	130.00 - 146.00	0.6000	0.5167
T1	7	LDF5-50A(7/8)	132.00 - 144.00	0.6000	0.5167
T1	8	LDF5-50A(7/8)	130.00 - 132.00	0.6000	0.5167
T1	14	EP65 (ELLIPTICAL AIR)	130.00 - 135.00	0.6000	0.5167
T1	30	LCF78-50JA(7/8)	130.00 - 147.00	0.6000	0.5167
T2	1	Safety Line 3/8	110.00 - 130.00	0.6000	0.5265
T2	3	Feedline Ladder (Af)	110.00 - 130.00	0.6000	0.5265
T2	5	LDF7-50A(1-5/8)	110.00 - 130.00	0.6000	0.5265
T2	6	LDF4-50A(1/2)	110.00 - 130.00	0.6000	0.5265
T2	8	LDF5-50A(7/8)	126.00 - 130.00	0.6000	0.5265
T2	9	LDF5-50A(7/8)	120.00 - 126.00	0.6000	0.5265
T2	10	LDF5-50A(7/8)	116.00 - 120.00	0.6000	0.5265
T2	11	LDF5-50A(7/8)	110.00 - 116.00	0.6000	0.5265
T2	14	EP65 (ELLIPTICAL AIR)	120.00 - 130.00	0.6000	0.5265
T2	15	EP65 (ELLIPTICAL AIR)	110.00 - 120.00	0.6000	0.5265
T2	30	LCF78-50JA(7/8)	110.00 - 130.00	0.6000	0.5265
T3	1	Safety Line 3/8	94.00 - 110.00	0.6000	0.5519

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T3	3	Feedline Ladder (Af)	94.00 - 110.00	0.6000	0.5519
T3	5	LDF7-50A(1-5/8)	94.00 - 110.00	0.6000	0.5519
T3	6	LDF4-50A(1/2)	94.00 - 110.00	0.6000	0.5519
T3	11	LDF5-50A(7/8)	94.00 - 110.00	0.6000	0.5519
T3	15	EP65 (ELLIPTICAL AIR)	94.00 - 110.00	0.6000	0.5519
T3	17	Feedline Ladder (Af)	94.00 - 110.00	0.6000	0.5519
T3	18	LDF7-50A(1-5/8)	94.00 - 110.00	0.6000	0.5519
T3	20	Feedline Ladder (Af)	94.00 - 100.00	0.6000	0.5519
T3	21	LDF7-50A(1-5/8)	94.00 - 100.00	0.6000	0.5519
T3	30	LCF78-50JA(7/8)	94.00 - 110.00	0.6000	0.5519
T4	1	Safety Line 3/8	90.00 - 94.00	0.6000	0.4787
T4	3	Feedline Ladder (Af)	90.00 - 94.00	0.6000	0.4787
T4	5	LDF7-50A(1-5/8)	90.00 - 94.00	0.6000	0.4787
T4	6	LDF4-50A(1/2)	90.00 - 94.00	0.6000	0.4787
T4	11	LDF5-50A(7/8)	90.00 - 94.00	0.6000	0.4787
T4	15	EP65 (ELLIPTICAL AIR)	90.00 - 94.00	0.6000	0.4787
T4	17	Feedline Ladder (Af)	90.00 - 94.00	0.6000	0.4787
T4	18	LDF7-50A(1-5/8)	90.00 - 94.00	0.6000	0.4787
T4	20	Feedline Ladder (Af)	90.00 - 94.00	0.6000	0.4787
T4	21	LDF7-50A(1-5/8)	90.00 - 94.00	0.6000	0.4787
T4	30	LCF78-50JA(7/8)	90.00 - 94.00	0.6000	0.4787
T5	1	Safety Line 3/8	80.00 - 90.00	0.6000	0.6000
T5	3	Feedline Ladder (Af)	80.00 - 90.00	0.6000	0.6000
T5	5	LDF7-50A(1-5/8)	80.00 - 90.00	0.6000	0.6000
T5	6	LDF4-50A(1/2)	80.00 - 90.00	0.6000	0.6000
T5	11	LDF5-50A(7/8)	80.00 - 90.00	0.6000	0.6000
T5	15	EP65 (ELLIPTICAL AIR)	80.00 - 90.00	0.6000	0.6000
T5	17	Feedline Ladder (Af)	80.00 - 90.00	0.6000	0.6000
T5	18	LDF7-50A(1-5/8)	80.00 - 90.00	0.6000	0.6000
T5	20	Feedline Ladder (Af)	80.00 - 90.00	0.6000	0.6000
T5	21	LDF7-50A(1-5/8)	80.00 - 90.00	0.6000	0.6000
T5	23	Feedline Ladder (Af)	80.00 - 90.00	0.6000	0.6000
T5	24	LDF7-50A(1-5/8)	80.00 - 90.00	0.6000	0.6000
T5	30	LCF78-50JA(7/8)	80.00 - 90.00	0.6000	0.6000

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
T6	1	Safety Line 3/8	70.00 - 80.00	0.6000	0.5486
T6	3	Feedline Ladder (Af)	70.00 - 80.00	0.6000	0.5486
T6	5	LDF7-50A(1-5/8)	70.00 - 80.00	0.6000	0.5486
T6	6	LDF4-50A(1/2)	70.00 - 80.00	0.6000	0.5486
T6	11	LDF5-50A(7/8)	70.00 - 80.00	0.6000	0.5486
T6	15	EP65 (ELLIPTICAL AIR)	70.00 - 80.00	0.6000	0.5486
T6	17	Feedline Ladder (Af)	70.00 - 80.00	0.6000	0.5486
T6	18	LDF7-50A(1-5/8)	70.00 - 80.00	0.6000	0.5486
T6	20	Feedline Ladder (Af)	70.00 - 80.00	0.6000	0.5486
T6	21	LDF7-50A(1-5/8)	70.00 - 80.00	0.6000	0.5486
T6	23	Feedline Ladder (Af)	70.00 - 80.00	0.6000	0.5486
T6	24	LDF7-50A(1-5/8)	70.00 - 80.00	0.6000	0.5486
T6	26	Feedline Ladder (Af)	70.00 - 80.00	0.6000	0.5486
T6	27	LDF7-50A(1-5/8)	70.00 - 80.00	0.6000	0.5486
T6	30	LCF78-50JA(7/8)	70.00 - 80.00	0.6000	0.5486
T7	1	Safety Line 3/8	55.00 - 70.00	0.6000	0.6000
T7	3	Feedline Ladder (Af)	55.00 - 70.00	0.6000	0.6000
T7	5	LDF7-50A(1-5/8)	55.00 - 70.00	0.6000	0.6000
T7	6	LDF4-50A(1/2)	55.00 - 70.00	0.6000	0.6000
T7	11	LDF5-50A(7/8)	55.00 - 70.00	0.6000	0.6000
T7	15	EP65 (ELLIPTICAL AIR)	55.00 - 70.00	0.6000	0.6000
T7	17	Feedline Ladder (Af)	55.00 - 70.00	0.6000	0.6000
T7	18	LDF7-50A(1-5/8)	55.00 - 70.00	0.6000	0.6000
T7	20	Feedline Ladder (Af)	55.00 - 70.00	0.6000	0.6000
T7	21	LDF7-50A(1-5/8)	55.00 - 70.00	0.6000	0.6000
T7	23	Feedline Ladder (Af)	55.00 - 70.00	0.6000	0.6000
T7	24	LDF7-50A(1-5/8)	55.00 - 70.00	0.6000	0.6000
T7	26	Feedline Ladder (Af)	55.00 - 70.00	0.6000	0.6000
T7	27	LDF7-50A(1-5/8)	55.00 - 70.00	0.6000	0.6000
T7	30	LCF78-50JA(7/8)	55.00 - 70.00	0.6000	0.6000
T8	1	Safety Line 3/8	50.00 - 55.00	0.6000	0.5840
T8	3	Feedline Ladder (Af)	50.00 - 55.00	0.6000	0.5840
T8	5	LDF7-50A(1-5/8)	50.00 - 55.00	0.6000	0.5840
T8	6	LDF4-50A(1/2)	50.00 - 55.00	0.6000	0.5840

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T8	11	LDF5-50A(7/8)	50.00 - 55.00	0.6000	0.5840
T8	15	EP65 (ELLIPTICAL AIR)	50.00 - 55.00	0.6000	0.5840
T8	17	Feedline Ladder (Af)	50.00 - 55.00	0.6000	0.5840
T8	18	LDF7-50A(1-5/8)	50.00 - 55.00	0.6000	0.5840
T8	20	Feedline Ladder (Af)	50.00 - 55.00	0.6000	0.5840
T8	21	LDF7-50A(1-5/8)	50.00 - 55.00	0.6000	0.5840
T8	23	Feedline Ladder (Af)	50.00 - 55.00	0.6000	0.5840
T8	24	LDF7-50A(1-5/8)	50.00 - 55.00	0.6000	0.5840
T8	26	Feedline Ladder (Af)	50.00 - 55.00	0.6000	0.5840
T8	27	LDF7-50A(1-5/8)	50.00 - 55.00	0.6000	0.5840
T8	30	LCF78-50JA(7/8)	50.00 - 55.00	0.6000	0.5840
T9	1	Safety Line 3/8	30.00 - 50.00	0.6000	0.6000
T9	3	Feedline Ladder (Af)	30.00 - 50.00	0.6000	0.6000
T9	5	LDF7-50A(1-5/8)	30.00 - 50.00	0.6000	0.6000
T9	6	LDF4-50A(1/2)	30.00 - 50.00	0.6000	0.6000
T9	11	LDF5-50A(7/8)	30.00 - 50.00	0.6000	0.6000
T9	15	EP65 (ELLIPTICAL AIR)	30.00 - 50.00	0.6000	0.6000
T9	17	Feedline Ladder (Af)	30.00 - 50.00	0.6000	0.6000
T9	18	LDF7-50A(1-5/8)	30.00 - 50.00	0.6000	0.6000
T9	20	Feedline Ladder (Af)	30.00 - 50.00	0.6000	0.6000
T9	21	LDF7-50A(1-5/8)	30.00 - 50.00	0.6000	0.6000
T9	23	Feedline Ladder (Af)	30.00 - 50.00	0.6000	0.6000
T9	24	LDF7-50A(1-5/8)	30.00 - 50.00	0.6000	0.6000
T9	26	Feedline Ladder (Af)	30.00 - 50.00	0.6000	0.6000
T9	27	LDF7-50A(1-5/8)	30.00 - 50.00	0.6000	0.6000
T9	30	LCF78-50JA(7/8)	30.00 - 50.00	0.6000	0.6000
T10	1	Safety Line 3/8	10.00 - 30.00	0.6000	0.6000
T10	3	Feedline Ladder (Af)	10.00 - 30.00	0.6000	0.6000
T10	5	LDF7-50A(1-5/8)	10.00 - 30.00	0.6000	0.6000
T10	6	LDF4-50A(1/2)	10.00 - 30.00	0.6000	0.6000
T10	11	LDF5-50A(7/8)	10.00 - 30.00	0.6000	0.6000
T10	15	EP65 (ELLIPTICAL AIR)	10.00 - 30.00	0.6000	0.6000
T10	17	Feedline Ladder (Af)	10.00 - 30.00	0.6000	0.6000
T10	18	LDF7-50A(1-5/8)	10.00 - 30.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T10	20	Feedline Ladder (Af)	10.00 - 30.00	0.6000	0.6000
T10	21	LDF7-50A(1-5/8)	10.00 - 30.00	0.6000	0.6000
T10	23	Feedline Ladder (Af)	10.00 - 30.00	0.6000	0.6000
T10	24	LDF7-50A(1-5/8)	10.00 - 30.00	0.6000	0.6000
T10	26	Feedline Ladder (Af)	10.00 - 30.00	0.6000	0.6000
T10	27	LDF7-50A(1-5/8)	10.00 - 30.00	0.6000	0.6000
T10	30	LCF78-50JA(7/8)	10.00 - 30.00	0.6000	0.6000
T11	1	Safety Line 3/8	0.00 - 10.00	0.6000	0.6000
T11	3	Feedline Ladder (Af)	0.00 - 10.00	0.6000	0.6000
T11	5	LDF7-50A(1-5/8)	8.00 - 10.00	0.6000	0.6000
T11	6	LDF4-50A(1/2)	8.00 - 10.00	0.6000	0.6000
T11	11	LDF5-50A(7/8)	8.00 - 10.00	0.6000	0.6000
T11	15	EP65 (ELLIPTICAL AIR)	0.00 - 10.00	0.6000	0.6000
T11	17	Feedline Ladder (Af)	0.00 - 10.00	0.6000	0.6000
T11	18	LDF7-50A(1-5/8)	0.00 - 10.00	0.6000	0.6000
T11	20	Feedline Ladder (Af)	0.00 - 10.00	0.6000	0.6000
T11	21	LDF7-50A(1-5/8)	0.00 - 10.00	0.6000	0.6000
T11	23	Feedline Ladder (Af)	0.00 - 10.00	0.6000	0.6000
T11	24	LDF7-50A(1-5/8)	0.00 - 10.00	0.6000	0.6000
T11	26	Feedline Ladder (Af)	0.00 - 10.00	0.6000	0.6000
T11	27	LDF7-50A(1-5/8)	0.00 - 10.00	0.6000	0.6000
T11	30	LCF78-50JA(7/8)	0.00 - 10.00	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 (ft^2)	C_AA_A Side (ft^2)	Weight (K)
Lightning Rod 5/8"x5'	A	From Leg	0.000	0.000	150.000	No Ice	0.313	0.313	0.005
			0.000			1/2"	0.826	0.826	0.009
			2.500			Ice	1.322	1.322	0.015
						1" Ice	1.957	1.957	0.039
						2" Ice			
****									
DS9A09F36D-N	C	From Leg	0.000	0.000	148.000	No Ice	6.325	6.325	0.076
			0.000			1/2"	8.467	8.467	0.121
			10.000			Ice	10.625	10.625	0.180
						1" Ice	14.992	14.992	0.339
						2" Ice			
***									
TMA	C	From Face	0.500	0.000	146.000	No Ice	0.600	0.407	0.010
			0.000			1/2"	0.704	0.497	0.015
			0.000			Ice	0.815	0.593	0.022
						1" Ice	1.059	0.815	0.042
						2" Ice			
***									
Side Arm Mount [SO 308-1]	A	From Leg	0.000	0.000	144.000	No Ice	0.410	3.060	0.053
			0.000			1/2"	0.810	5.100	0.080
			0.000			Ice	1.230	7.200	0.122
						1" Ice	2.090	11.960	0.246
						2" Ice			

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*Placement*		*C_AA_A Front*	*C_AA_A Side*	*Weight*
			ft ft ft	*°*	*ft*		*ft^2*	*ft^2*	*K*
12' horizontal x 2" Pipe Mount	A	From Leg	0.000 0.000 0.000	0.000	144.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
1151-3N	A	From Leg	6.000 0.000 7.500	0.000	144.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.180 5.731 7.299 10.485	4.180 5.731 7.299 10.485	0.016 0.047 0.087 0.197
***									
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	144.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246
12' horizontal x 2" Pipe Mount	B	From Leg	0.000 0.000 0.000	0.000	144.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
ANT150F6	B	From Leg	6.000 0.000 10.000	0.000	144.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.800 6.828 8.873 13.013	4.800 6.828 8.873 13.013	0.030 0.066 0.114 0.249
***									
Side Arm Mount [SO 308-1]	A	From Leg	0.000 0.000 0.000	0.000	134.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246
12' horizontal x 2" Pipe Mount	A	From Leg	0.000 0.000 0.000	0.000	134.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
ANT150F2	A	From Leg	6.000 0.000 4.000	0.000	134.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.227 1.530 1.842 2.494	1.227 1.530 1.842 2.494	0.013 0.022 0.035 0.072
***									
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	126.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246
12' horizontal x 2" Pipe Mount	B	From Leg	0.000 0.000 0.000	0.000	126.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
CO-36A	B	From Leg	6.000 0.000 6.000	0.000	126.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.700 3.927 5.171 7.520	2.700 3.927 5.171 7.520	0.012 0.032 0.061 0.141
***									
Side Arm Mount [SO 308-1]	C	From Leg	0.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246

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' horizontal x 2" Pipe Mount	C	From Leg	0.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
CO-36A	C	From Leg	6.000 0.000 6.000	0.000	120.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.700 3.927 5.171 7.520	2.700 3.927 5.171 7.520	0.012 0.032 0.061 0.141
***									
Side Arm Mount [SO 308-1]	A	From Leg	0.000 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246
12' horizontal x 2" Pipe Mount	A	From Leg	0.000 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
CO-36A	A	From Leg	6.000 0.000 6.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.700 3.927 5.171 7.520	2.700 3.927 5.171 7.520	0.012 0.032 0.061 0.141
***									
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.410 0.810 1.230 2.090	3.060 5.100 7.200 11.960	0.053 0.080 0.122 0.246
12' horizontal x 2" Pipe Mount	B	From Leg	0.000 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.280 3.500 4.750 7.280	0.010 0.040 0.090 0.210	0.033 0.050 0.076 0.150
ANT150F2	B	From Leg	6.000 0.000 4.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.227 1.530 1.842 2.494	1.227 1.530 1.842 2.494	0.013 0.022 0.035 0.072
***									
(6) Secondary Members 30'-20'	A	From Face	0.000 0.000 0.000	0.000	25.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083
(6) Secondary Members 30'-20'	B	From Face	0.000 0.000 0.000	0.000	25.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083
(6) Secondary Members 30'-20'	C	From Face	0.000 0.000 0.000	0.000	25.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083
***									
(6) Secondary Members 20'-10'	A	From Face	0.000 0.000 0.000	0.000	15.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft* *ft* *ft*	*Azimuth Adjustmen t* *°*	*Placement* *ft*		*C_AA_A Front* *ft^2*	*C_AA_A Side* *ft^2*	*Weight* *K*
(6) Secondary Members 20'-10'	B	From Face	0.000 0.000 0.000	0.000	15.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083
(6) Secondary Members 20'-10'	C	From Face	0.000 0.000 0.000	0.000	15.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.200 1.615 2.037 2.904	0.033 0.059 0.093 0.181	0.003 0.015 0.032 0.083
Reserved Loading									
6'x2" Mount Pipe	B	From Leg	1.000 0.000 0.000	0.000	135.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.425 1.925 2.294 3.060	1.425 1.925 2.294 3.060	0.022 0.033 0.048 0.090
***									
6'x2" Mount Pipe	B	From Leg	1.000 0.000 0.000	0.000	120.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.425 1.925 2.294 3.060	1.425 1.925 2.294 3.060	0.022 0.033 0.048 0.090
***									
Sector Mount [SM 802-3]	C	None		0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	25.340 33.440 41.560 58.130	25.340 33.440 41.560 58.130	0.930 1.388 1.977 3.540
(3) QS6656-5_TIA w/ Mount Pipe	A	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.371 8.931 9.457 10.531	8.463 9.657 10.548 12.352	0.091 0.166 0.250 0.446
(3) QS6656-5_TIA w/ Mount Pipe	B	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.371 8.931 9.457 10.531	8.463 9.657 10.548 12.352	0.091 0.166 0.250 0.446
(3) QS6656-5_TIA w/ Mount Pipe	C	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.371 8.931 9.457 10.531	8.463 9.657 10.548 12.352	0.091 0.166 0.250 0.446
B2/B66A RRH-BR049	A	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.875 2.133 2.392 2.908	1.250 1.467 1.683 2.117	0.084 0.103 0.121 0.158
B2/B66A RRH-BR049	B	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.875 2.133 2.392 2.908	1.250 1.467 1.683 2.117	0.084 0.103 0.121 0.158
B2/B66A RRH-BR049	C	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.875 2.133 2.392 2.908	1.250 1.467 1.683 2.117	0.084 0.103 0.121 0.158
B5/B13 RRH-BR04C	A	From Leg	4.000 0.000 0.000	0.000	110.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.875 2.133 2.392 2.908	1.013 1.213 1.414 1.816	0.070 0.087 0.103 0.136
B5/B13 RRH-BR04C	B	From Leg	4.000 0.000	0.000	110.000	No Ice	1.875 2.133	1.013 1.213	0.070 0.087

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
			0.000			1" Ice	2.392	1.414	0.103
						2" Ice	2.908	1.816	0.136
B5/B13 RRH-BR04C	C	From Leg	4.000	0.000	110.000	No Ice	1.875	1.013	0.070
			0.000			1/2" Ice	2.133	1.213	0.087
			0.000			1" Ice	2.392	1.414	0.103
						2" Ice	2.908	1.816	0.136
DB-C1-12C-24AB-0Z	A	From Leg	0.500	0.000	110.000	No Ice	4.056	3.098	0.032
			0.000			1/2" Ice	4.316	3.335	0.068
			0.000			1" Ice	4.582	3.580	0.109
						2" Ice	5.138	4.092	0.203
***									
Pirod 12' T-Frame Sector Mount (1)	A	From Leg	0.000	0.000	100.000	No Ice	13.600	13.600	0.465
			0.000			1/2" Ice	18.400	18.400	0.600
			0.000			1" Ice	23.200	23.200	0.735
						2" Ice	32.800	32.800	1.005
Pirod 12' T-Frame Sector Mount (1)	B	From Leg	0.000	0.000	100.000	No Ice	13.600	13.600	0.465
			0.000			1/2" Ice	18.400	18.400	0.600
			0.000			1" Ice	23.200	23.200	0.735
						2" Ice	32.800	32.800	1.005
Pirod 12' T-Frame Sector Mount (1)	C	From Leg	0.000	0.000	100.000	No Ice	13.600	13.600	0.465
			0.000			1/2" Ice	18.400	18.400	0.600
			0.000			1" Ice	23.200	23.200	0.735
						2" Ice	32.800	32.800	1.005
(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	A	From Leg	4.000	0.000	100.000	No Ice	5.029	5.289	0.041
			0.000			1/2" Ice	5.583	6.459	0.087
			0.000			1" Ice	6.103	7.348	0.140
						2" Ice	7.166	9.148	0.273
(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	B	From Leg	4.000	0.000	100.000	No Ice	5.029	5.289	0.041
			0.000			1/2" Ice	5.583	6.459	0.087
			0.000			1" Ice	6.103	7.348	0.140
						2" Ice	7.166	9.148	0.273
(2) BXA-171063-12CF-EDIN-X w/ Mount Pipe	C	From Leg	4.000	0.000	100.000	No Ice	5.029	5.289	0.041
			0.000			1/2" Ice	5.583	6.459	0.087
			0.000			1" Ice	6.103	7.348	0.140
						2" Ice	7.166	9.148	0.273
(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	A	From Leg	4.000	0.000	100.000	No Ice	7.806	5.801	0.058
			0.000			1/2" Ice	8.357	6.953	0.119
			0.000			1" Ice	8.872	7.819	0.187
						2" Ice	9.927	9.601	0.351
(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	B	From Leg	4.000	0.000	100.000	No Ice	7.806	5.801	0.058
			0.000			1/2" Ice	8.357	6.953	0.119
			0.000			1" Ice	8.872	7.819	0.187
						2" Ice	9.927	9.601	0.351
(2) BXA-70063-6CF-EDIN-X_TIA w/ Mount Pipe	C	From Leg	4.000	0.000	100.000	No Ice	7.806	5.801	0.058
			0.000			1/2" Ice	8.357	6.953	0.119
			0.000			1" Ice	8.872	7.819	0.187
						2" Ice	9.927	9.601	0.351
(3) RRH2X40-AWS	A	From Leg	4.000	0.000	100.000	No Ice	2.161	1.420	0.044
			0.000			1/2" Ice	2.360	1.590	0.061
			0.000			1" Ice	2.565	1.768	0.082
						2" Ice	2.999	2.143	0.132

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) RRH2X40-AWS	B	From Leg	4.000 0.000 0.000	0.000	100.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.161 2.360 2.565 2.999	1.420 1.590 1.768 2.143	0.044 0.061 0.082 0.132
(3) RRH2X40-AWS	C	From Leg	4.000 0.000 0.000	0.000	100.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.161 2.360 2.565 2.999	1.420 1.590 1.768 2.143	0.044 0.061 0.082 0.132
DB-T1-6Z-8AB-0Z	A	From Leg	4.000 0.000 0.000	0.000	100.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.800 5.070 5.348 5.926	2.000 2.193 2.393 2.815	0.044 0.080 0.120 0.213
***									
APXVSPP18-C_TIA w/ Mount Pipe	A	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.262 8.822 9.346 10.418	7.471 8.656 9.556 11.388	0.090 0.161 0.239 0.424
APXVSPP18-C_TIA w/ Mount Pipe	B	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.262 8.822 9.346 10.418	7.471 8.656 9.556 11.388	0.090 0.161 0.239 0.424
APXVSPP18-C_TIA w/ Mount Pipe	C	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	8.262 8.822 9.346 10.418	7.471 8.656 9.556 11.388	0.090 0.161 0.239 0.424
FD-RRH-2x50-800	A	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.058 2.240 2.429 2.829	1.362 1.519 1.683 2.034	0.053 0.071 0.092 0.144
FD-RRH-2x50-800	B	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.058 2.240 2.429 2.829	1.362 1.519 1.683 2.034	0.053 0.071 0.092 0.144
FD-RRH-2x50-800	C	From Leg	4.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.058 2.240 2.429 2.829	1.362 1.519 1.683 2.034	0.053 0.071 0.092 0.144
Pirod 12' T-Frame Sector Mount (1)	A	From Leg	0.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	13.600 18.400 23.200 32.800	13.600 18.400 23.200 32.800	0.465 0.600 0.735 1.005
Pirod 12' T-Frame Sector Mount (1)	B	From Leg	0.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	13.600 18.400 23.200 32.800	13.600 18.400 23.200 32.800	0.465 0.600 0.735 1.005
Pirod 12' T-Frame Sector Mount (1)	C	From Leg	0.000 0.000 0.000	0.000	90.000	No Ice 1/2" Ice 1" Ice 2" Ice	13.600 18.400 23.200 32.800	13.600 18.400 23.200 32.800	0.465 0.600 0.735 1.005
***									
(2) AIR 21 w/ Mount Pipe	A	From Leg	4.000 0.000 0.000	0.000	80.000	No Ice 1/2" Ice	6.287 6.732 7.170	5.701 6.482 7.188	0.112 0.169 0.232

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
						1" Ice	8.072	8.648	0.383
						2" Ice			
(2) AIR 21 w/ Mount Pipe	B	From Leg	4.000	0.000	80.000	No Ice	6.287	5.701	0.112
			0.000			1/2"	6.732	6.482	0.169
			0.000			Ice	7.170	7.188	0.232
						1" Ice	8.072	8.648	0.383
						2" Ice			
(2) AIR 21 w/ Mount Pipe	C	From Leg	4.000	0.000	80.000	No Ice	6.287	5.701	0.112
			0.000			1/2"	6.732	6.482	0.169
			0.000			Ice	7.170	7.188	0.232
						1" Ice	8.072	8.648	0.383
						2" Ice			
KRY 112 144/1	A	From Leg	4.000	0.000	80.000	No Ice	0.350	0.175	0.011
			0.000			1/2"	0.426	0.234	0.014
			0.000			Ice	0.509	0.301	0.019
						1" Ice	0.698	0.456	0.032
						2" Ice			
KRY 112 144/1	B	From Leg	4.000	0.000	80.000	No Ice	0.350	0.175	0.011
			0.000			1/2"	0.426	0.234	0.014
			0.000			Ice	0.509	0.301	0.019
						1" Ice	0.698	0.456	0.032
						2" Ice			
KRY 112 144/1	C	From Leg	4.000	0.000	80.000	No Ice	0.350	0.175	0.011
			0.000			1/2"	0.426	0.234	0.014
			0.000			Ice	0.509	0.301	0.019
						1" Ice	0.698	0.456	0.032
						2" Ice			
Pirod 12' T-Frame Sector Mount (1)	A	From Leg	0.000	0.000	80.000	No Ice	13.600	13.600	0.465
			0.000			1/2"	18.400	18.400	0.600
			0.000			Ice	23.200	23.200	0.735
						1" Ice	32.800	32.800	1.005
						2" Ice			
Pirod 12' T-Frame Sector Mount (1)	B	From Leg	0.000	0.000	80.000	No Ice	13.600	13.600	0.465
			0.000			1/2"	18.400	18.400	0.600
			0.000			Ice	23.200	23.200	0.735
						1" Ice	32.800	32.800	1.005
						2" Ice			
Pirod 12' T-Frame Sector Mount (1)	C	From Leg	0.000	0.000	80.000	No Ice	13.600	13.600	0.465
			0.000			1/2"	18.400	18.400	0.600
			0.000			Ice	23.200	23.200	0.735
						1" Ice	32.800	32.800	1.005
						2" Ice			
*****Proposed****									
DS2C03F36D-D	B	From Leg	4.000	0.000	147.000	No Ice	7.290	7.290	0.070
			0.000			1/2"	9.753	9.753	0.122
			13.000			Ice	12.233	12.233	0.190
						1" Ice	17.243	17.243	0.372
						2" Ice			
USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]	B	From Leg	2.000	0.000	147.000	No Ice	2.956	5.636	0.177
			0.000			1/2"	3.757	6.730	0.220
			0.000			Ice	4.634	7.914	0.277
						1" Ice	6.575	10.428	0.435
						2" Ice			

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 ft^2	Weight K
PAL6-59	A	Paraboloid w/o Radome	From Leg	1.000 0.000 0.000	0.000		135.000	6.000	No Ice 1/2" Ice 1" Ice 2" Ice	28.270 29.050 29.831 31.392	0.185 0.334 0.483 0.782
PAL6-59	A	Paraboloid w/o Radome	From Leg	1.000 0.000 0.000	0.000		120.000	6.000	No Ice 1/2" Ice 1" Ice 2" Ice	28.270 29.050 29.831 31.392	0.185 0.334 0.483 0.782

Load Combinations

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

Comb. No.	Description
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
T1	150 - 130	Leg	Max Tension	15	11.831	-0.220	0.010
			Max. Compression	2	-13.770	-0.022	-0.001
			Max. Mx	10	3.230	0.316	0.057
			Max. My	16	-1.052	0.100	-0.334
			Max. Vy	11	0.537	-0.218	0.057
			Max. Vx	16	-0.558	0.002	0.320
		Diagonal	Max Tension	24	2.986	0.000	0.000
			Max. Compression	24	-2.982	0.000	0.000
			Max. Mx	31	0.227	0.012	0.000
			Max. My	24	-2.968	0.001	-0.004
			Max. Vy	31	-0.019	0.012	0.000
			Max. Vx	24	0.001	0.000	0.000
		Top Girt	Max Tension	7	0.059	0.000	0.000
			Max. Compression	2	-0.071	0.000	0.000
			Max. Mx	26	-0.032	-0.041	0.000
			Max. My	26	-0.032	0.000	0.000
			Max. Vy	26	-0.035	0.000	0.000
			Max. Vx	26	-0.000	0.000	0.000
T2	130 - 110	Leg	Max Tension	15	46.638	0.064	0.027
			Max. Compression	2	-48.033	0.254	-0.023
			Max. Mx	10	17.356	0.450	0.021
			Max. My	12	-4.552	0.082	0.579
			Max. Vy	15	0.411	-0.364	-0.007
			Max. Vx	13	-0.490	0.084	-0.389
		Diagonal	Max Tension	25	5.167	0.000	0.000
			Max. Compression	10	-5.353	0.000	0.000
			Max. Mx	28	0.355	0.022	0.001
			Max. My	23	1.592	0.001	-0.013
			Max. Vy	28	-0.023	0.022	0.001
			Max. Vx	23	0.004	0.000	0.000
T3	110 - 94	Leg	Max Tension	15	80.322	-0.555	0.009
			Max. Compression	18	-85.061	-0.170	-0.016
			Max. Mx	14	70.266	0.924	0.010
			Max. My	20	-4.448	-0.029	1.027
			Max. Vy	14	-1.463	-0.229	0.021
			Max. Vx	20	-1.268	0.019	0.158
		Diagonal	Max Tension	24	6.238	0.000	0.000
			Max. Compression	25	-6.205	0.000	0.000
			Max. Mx	28	0.795	0.028	0.003
			Max. My	24	-5.156	-0.009	-0.020
			Max. Vy	29	0.029	0.025	-0.002
			Max. Vx	24	0.007	0.000	0.000
T4	94 - 90	Leg	Max Tension	15	89.374	0.175	0.009
			Max. Compression	18	-94.346	0.062	-0.043
			Max. Mx	2	-94.133	0.300	0.006
			Max. My	25	-1.558	-0.002	-0.073
			Max. Vy	2	-0.254	0.300	0.006
			Max. Vx	25	0.054	0.003	0.035
		Diagonal	Max Tension	25	5.876	0.010	-0.004
			Max. Compression	24	-5.974	0.000	0.000
			Max. Mx	27	1.238	0.028	0.002
			Max. My	22	2.607	0.009	-0.009
			Max. Vy	28	0.030	0.025	-0.003
			Max. Vx	22	0.003	0.000	0.000
		Secondary Horizontal	Max Tension	18	1.636	0.000	0.000
			Max. Compression	18	-1.636	0.004	-0.002
			Max. Mx	36	0.302	0.023	0.004
			Max. My	29	0.013	0.020	0.005

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vy	36	0.032	0.023	0.004
			Max. Vx	29	0.002	0.000	0.000
T5	90 - 80	Leg	Max Tension	15	110.969	-0.154	0.006
			Max. Compression	18	-118.566	0.012	-0.035
			Max. Mx	14	97.571	-0.156	0.006
			Max. My	17	-17.726	0.012	0.358
			Max. Vy	22	-0.784	-0.068	-0.038
			Max. Vx	8	0.690	-0.004	-0.022
		Diagonal	Max Tension	24	6.878	0.000	0.000
			Max. Compression	24	-6.902	0.000	0.000
			Max. Mx	28	0.821	0.046	0.005
			Max. My	24	-6.892	-0.011	-0.014
			Max. Vy	28	0.041	0.041	-0.006
			Max. Vx	24	0.004	0.000	0.000
T6	80 - 70	Leg	Max Tension	15	133.729	0.309	0.001
			Max. Compression	18	-144.617	0.037	-0.055
			Max. Mx	18	-144.529	0.544	0.013
			Max. My	17	-19.298	-0.073	0.426
			Max. Vy	22	-0.694	-0.021	-0.012
			Max. Vx	13	-0.767	-0.006	0.072
		Diagonal	Max Tension	25	7.475	0.017	-0.009
			Max. Compression	24	-7.629	0.000	0.000
			Max. Mx	27	1.783	0.052	0.005
			Max. My	24	-7.619	-0.004	-0.011
			Max. Vy	29	0.045	0.047	0.005
			Max. Vx	38	-0.003	0.000	0.000
		Secondary Horizontal	Max Tension	18	2.508	0.000	0.000
			Max. Compression	18	-2.508	0.004	-0.002
			Max. Mx	31	-0.046	0.040	0.006
			Max. My	28	0.054	0.037	0.007
			Max. Vy	31	-0.044	0.040	0.006
			Max. Vx	28	0.003	0.000	0.000
T7	70 - 55	Leg	Max Tension	15	166.072	-0.255	-0.004
			Max. Compression	18	-180.374	-0.043	-0.043
			Max. Mx	14	153.444	-0.257	-0.003
			Max. My	17	-22.369	-0.013	0.293
			Max. Vy	14	-0.097	-0.257	-0.003
			Max. Vx	12	0.079	-0.017	-0.290
		Diagonal	Max Tension	24	7.224	0.000	0.000
			Max. Compression	24	-7.271	0.000	0.000
			Max. Mx	29	1.309	0.067	0.009
			Max. My	37	-1.928	0.059	-0.009
			Max. Vy	29	0.056	0.067	0.009
			Max. Vx	37	0.003	0.000	0.000
T8	55 - 50	Leg	Max Tension	15	175.845	0.022	-0.003
			Max. Compression	18	-191.371	-0.159	-0.039
			Max. Mx	18	-191.231	0.672	0.005
			Max. My	17	-22.865	-0.013	0.293
			Max. Vy	18	0.341	0.672	0.005
			Max. Vx	13	-0.150	-0.013	-0.290
		Diagonal	Max Tension	25	7.147	0.026	-0.002
			Max. Compression	24	-7.311	0.000	0.000
			Max. Mx	27	1.787	0.070	0.007
			Max. My	30	-1.561	0.061	0.009
			Max. Vy	29	0.057	0.069	0.007
			Max. Vx	38	0.003	0.000	0.000
		Secondary Horizontal	Max Tension	18	3.319	0.000	0.000
			Max. Compression	18	-3.319	0.013	0.000
			Max. Mx	35	0.204	0.059	0.009
			Max. My	28	0.093	0.057	0.010
			Max. Vy	35	0.056	0.059	0.009
			Max. Vx	28	0.003	0.000	0.000
T9	50 - 30	Leg	Max Tension	15	213.055	-0.120	-0.007
			Max. Compression	18	-234.234	0.757	-0.036
			Max. Mx	19	-231.306	0.759	-0.036
			Max. My	20	-11.504	-0.003	-0.416
			Max. Vy	6	0.169	-0.717	0.044

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vx	13	0.091	0.025	-0.389
		Diagonal	Max Tension	4	7.360	0.000	0.000
			Max. Compression	4	-7.388	0.000	0.000
			Max. Mx	29	1.418	0.098	0.012
			Max. My	30	-1.278	0.093	0.013
			Max. Vy	29	0.071	0.098	0.012
			Max. Vx	30	-0.004	0.000	0.000
T10	30 - 10	Leg	Max Tension	15	242.879	-0.490	-0.021
			Max. Compression	18	-269.411	-0.022	-0.053
			Max. Mx	19	-245.787	0.759	-0.036
			Max. My	12	-30.528	-0.044	-0.853
			Max. Vy	6	-0.180	-0.495	0.018
			Max. Vx	25	-0.200	-0.048	0.834
		Diagonal	Max Tension	4	9.113	0.000	0.000
			Max. Compression	4	-9.217	0.000	0.000
			Max. Mx	28	2.171	0.183	-0.026
			Max. My	30	1.944	0.182	0.027
			Max. Vy	28	0.096	0.183	-0.026
			Max. Vx	30	-0.006	0.000	0.000
T11	10 - 0	Leg	Max Tension	15	250.568	-0.067	-0.002
			Max. Compression	18	-279.570	0.000	-0.000
			Max. Mx	18	-279.185	1.565	0.059
			Max. My	20	-14.376	0.113	0.739
			Max. Vy	18	-0.345	1.565	0.059
			Max. Vx	13	-0.305	-0.062	-0.625
		Diagonal	Max Tension	5	12.345	0.058	-0.005
			Max. Compression	4	-12.636	0.000	0.000
			Max. Mx	16	6.868	0.104	-0.007
			Max. My	29	-0.560	0.020	0.017
			Max. Vy	28	-0.046	0.063	0.017
			Max. Vx	35	-0.004	0.000	0.000
		Horizontal	Max Tension	4	7.690	0.056	-0.002
			Max. Compression	5	-7.643	0.042	-0.001
			Max. Mx	29	0.031	0.118	0.004
			Max. My	18	-0.019	-0.005	-0.026
			Max. Vy	29	-0.084	0.118	0.004
			Max. Vx	18	-0.004	-0.005	-0.026
		Redund Horz 1 Bracing	Max Tension	18	4.849	0.000	0.000
			Max. Compression	18	-4.849	0.000	0.000
			Max. Mx	26	0.687	-0.024	0.000
			Max. My	26	0.677	0.000	0.001
			Max. Vy	26	0.026	0.000	0.000
			Max. Vx	26	-0.001	0.000	0.000
		Redund Diag 1 Bracing	Max Tension	18	3.970	0.000	0.000
			Max. Compression	18	-3.970	0.000	0.000
			Max. Mx	26	0.613	-0.036	0.000
			Max. My	26	0.597	0.000	0.002
			Max. Vy	26	0.024	0.000	0.000
			Max. Vx	26	-0.001	0.000	0.000
		Inner Bracing	Max Tension	19	0.005	0.000	0.000
			Max. Compression	29	-0.012	0.000	0.000
			Max. Mx	26	-0.010	-0.111	0.000
			Max. Vy	26	0.060	0.000	0.000

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	18	297.385	24.993	-14.740
	Max. H_x	18	297.385	24.993	-14.740
	Max. H_z	5	-222.473	-18.430	13.113
	Min. Vert	7	-249.241	-21.662	12.941

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Min. H_x	7	-249.241	-21.662	12.941
	Min. H_z	18	297.385	24.993	-14.740
Leg B	Max. Vert	10	291.289	-24.646	-14.417
	Max. H_x	23	-242.867	21.313	12.614
	Max. H_z	23	-242.867	21.313	12.614
	Min. Vert	23	-242.867	21.313	12.614
	Min. H_x	10	291.289	-24.646	-14.417
	Min. H_z	10	291.289	-24.646	-14.417
Leg A	Max. Vert	2	294.035	0.188	28.789
	Max. H_x	20	15.199	4.516	1.001
	Max. H_z	2	294.035	0.188	28.789
	Min. Vert	15	-266.072	-0.185	-26.362
	Min. H_x	9	12.627	-4.514	0.828
	Min. H_z	15	-266.072	-0.185	-26.362

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	39.558	0.000	-0.000	2.463	-1.048	0.000
1.2 Dead+1.0 Wind 0 deg - No Ice	47.470	0.063	-48.085	-3822.391	-10.398	5.154
0.9 Dead+1.0 Wind 0 deg - No Ice	35.603	0.063	-48.085	-3823.130	-10.084	5.154
1.2 Dead+1.0 Wind 30 deg - No Ice	47.470	23.165	-40.433	-3235.398	-1849.640	-2.036
0.9 Dead+1.0 Wind 30 deg - No Ice	35.603	23.165	-40.433	-3236.137	-1849.326	-2.036
1.2 Dead+1.0 Wind 60 deg - No Ice	47.470	38.708	-22.923	-1845.614	-3076.696	-9.850
0.9 Dead+1.0 Wind 60 deg - No Ice	35.603	38.708	-22.923	-1846.353	-3076.381	-9.850
1.2 Dead+1.0 Wind 90 deg - No Ice	47.470	45.031	-0.091	-9.697	-3536.662	-12.425
0.9 Dead+1.0 Wind 90 deg - No Ice	35.603	45.031	-0.091	-10.436	-3536.348	-12.425
1.2 Dead+1.0 Wind 120 deg - No Ice	47.470	39.749	26.540	2236.457	-3078.929	-1.780
0.9 Dead+1.0 Wind 120 deg - No Ice	35.603	39.749	26.540	2235.718	-3078.614	-1.780
1.2 Dead+1.0 Wind 150 deg - No Ice	47.470	21.000	40.361	3309.503	-1616.868	3.084
0.9 Dead+1.0 Wind 150 deg - No Ice	35.603	21.000	40.361	3308.764	-1616.553	3.084
1.2 Dead+1.0 Wind 180 deg - No Ice	47.470	-0.063	46.774	3819.388	7.883	-5.154
0.9 Dead+1.0 Wind 180 deg - No Ice	35.603	-0.063	46.774	3818.649	8.197	-5.154
1.2 Dead+1.0 Wind 210 deg - No Ice	47.470	-22.174	42.268	3475.425	1720.702	-3.783
0.9 Dead+1.0 Wind 210 deg - No Ice	35.603	-22.174	42.268	3474.686	1721.017	-3.783
1.2 Dead+1.0 Wind 240 deg - No Ice	47.470	-40.349	26.960	2287.341	3146.265	4.727
0.9 Dead+1.0 Wind 240 deg - No Ice	35.603	-40.349	26.960	2286.602	3146.579	4.727
1.2 Dead+1.0 Wind 270 deg - No Ice	47.470	-45.031	0.036	8.584	3534.147	12.425
0.9 Dead+1.0 Wind 270 deg - No Ice	35.603	-45.031	0.036	7.845	3534.461	12.425
1.2 Dead+1.0 Wind 300 deg - No Ice	47.470	-38.109	-22.504	-1794.731	3004.329	6.903
0.9 Dead+1.0 Wind 300 deg - No Ice	35.603	-38.109	-22.504	-1795.470	3004.644	6.903

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
1.2 Dead+1.0 Wind 330 deg - No Ice	47.470	-21.991	-38.526	-3069.476	1740.775	2.735
0.9 Dead+1.0 Wind 330 deg - No Ice	35.603	-21.991	-38.526	-3070.215	1741.089	2.735
1.2 Dead+1.0 Ice+1.0 Temp	123.463	0.000	-0.000	-11.991	-4.100	-0.000
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	123.463	0.025	-13.027	-1081.569	-7.639	2.038
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	123.463	6.540	-11.352	-944.955	-541.305	-0.375
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	123.463	11.296	-6.618	-557.168	-927.260	-3.695
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	123.463	12.846	-0.030	-16.100	-1049.111	-4.361
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	123.463	10.980	6.906	573.126	-892.937	-2.194
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	123.463	6.070	11.164	919.653	-494.089	-1.399
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	123.463	-0.025	12.925	1063.950	-0.560	-2.038
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	123.463	-6.379	11.650	958.889	512.630	-0.567
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	123.463	-11.466	7.216	599.866	923.974	2.865
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	123.463	-12.846	0.021	-9.021	1040.912	4.361
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	123.463	-10.810	-6.308	-530.429	879.825	3.024
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	123.463	-6.230	-10.867	-905.719	506.365	2.341
Dead+Wind 0 deg - Service	39.558	0.014	-10.243	-812.404	-2.995	1.098
Dead+Wind 30 deg - Service	39.558	4.935	-8.613	-687.364	-394.786	-0.434
Dead+Wind 60 deg - Service	39.558	8.246	-4.883	-391.315	-656.171	-2.098
Dead+Wind 90 deg - Service	39.558	9.592	-0.019	-0.233	-754.152	-2.647
Dead+Wind 120 deg - Service	39.558	8.467	5.654	478.238	-656.647	-0.379
Dead+Wind 150 deg - Service	39.558	4.473	8.598	706.816	-345.202	0.657
Dead+Wind 180 deg - Service	39.558	-0.014	9.964	815.430	0.899	-1.098
Dead+Wind 210 deg - Service	39.558	-4.723	9.004	742.160	365.760	-0.806
Dead+Wind 240 deg - Service	39.558	-8.595	5.743	489.077	669.430	1.007
Dead+Wind 270 deg - Service	39.558	-9.592	0.008	3.662	752.056	2.647
Dead+Wind 300 deg - Service	39.558	-8.118	-4.794	-380.476	639.195	1.470
Dead+Wind 330 deg - Service	39.558	-4.684	-8.207	-652.020	370.036	0.583

Solution Summary

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
1	0.000	-39.558	0.000	-0.000	39.558	0.000	0.000%
2	0.063	-47.470	-48.085	-0.063	47.470	48.085	0.000%
3	0.063	-35.603	-48.085	-0.063	35.603	48.085	0.000%
4	23.165	-47.470	-40.433	-23.165	47.470	40.433	0.000%
5	23.165	-35.603	-40.433	-23.165	35.603	40.433	0.000%
6	38.708	-47.470	-22.923	-38.708	47.470	22.923	0.000%
7	38.708	-35.603	-22.923	-38.708	35.603	22.923	0.000%
8	45.031	-47.470	-0.091	-45.031	47.470	0.091	0.000%
9	45.031	-35.603	-0.091	-45.031	35.603	0.091	0.000%
10	39.749	-47.470	26.540	-39.749	47.470	-26.540	0.000%
11	39.749	-35.603	26.540	-39.749	35.603	-26.540	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
12	21.000	-47.470	40.361	-21.000	47.470	-40.361	0.000%
13	21.000	-35.603	40.361	-21.000	35.603	-40.361	0.000%
14	-0.063	-47.470	46.774	0.063	47.470	-46.774	0.000%
15	-0.063	-35.603	46.774	0.063	35.603	-46.774	0.000%
16	-22.174	-47.470	42.268	22.174	47.470	-42.268	0.000%
17	-22.174	-35.603	42.268	22.174	35.603	-42.268	0.000%
18	-40.349	-47.470	26.960	40.349	47.470	-26.960	0.000%
19	-40.349	-35.603	26.960	40.349	35.603	-26.960	0.000%
20	-45.031	-47.470	0.036	45.031	47.470	-0.036	0.000%
21	-45.031	-35.603	0.036	45.031	35.603	-0.036	0.000%
22	-38.109	-47.470	-22.504	38.109	47.470	22.504	0.000%
23	-38.109	-35.603	-22.504	38.109	35.603	22.504	0.000%
24	-21.991	-47.470	-38.526	21.991	47.470	38.526	0.000%
25	-21.991	-35.603	-38.526	21.991	35.603	38.526	0.000%
26	0.000	-123.463	0.000	-0.000	123.463	0.000	0.000%
27	0.025	-123.463	-13.027	-0.025	123.463	13.027	0.000%
28	6.540	-123.463	-11.352	-6.540	123.463	11.352	0.000%
29	11.296	-123.463	-6.618	-11.296	123.463	6.618	0.000%
30	12.846	-123.463	-0.030	-12.846	123.463	0.030	0.000%
31	10.980	-123.463	6.906	-10.980	123.463	-6.906	0.000%
32	6.070	-123.463	11.164	-6.070	123.463	-11.164	0.000%
33	-0.025	-123.463	12.925	0.025	123.463	-12.925	0.000%
34	-6.379	-123.463	11.650	6.379	123.463	-11.650	0.000%
35	-11.466	-123.463	7.216	11.466	123.463	-7.216	0.000%
36	-12.846	-123.463	0.021	12.846	123.463	-0.021	0.000%
37	-10.810	-123.463	-6.308	10.810	123.463	6.308	0.000%
38	-6.230	-123.463	-10.867	6.230	123.463	10.867	0.000%
39	0.014	-39.558	-10.243	-0.014	39.558	10.243	0.000%
40	4.935	-39.558	-8.613	-4.935	39.558	8.613	0.000%
41	8.246	-39.558	-4.883	-8.246	39.558	4.883	0.000%
42	9.592	-39.558	-0.019	-9.592	39.558	0.019	0.000%
43	8.467	-39.558	5.654	-8.467	39.558	-5.654	0.000%
44	4.473	-39.558	8.598	-4.473	39.558	-8.598	0.000%
45	-0.014	-39.558	9.964	0.014	39.558	-9.964	0.000%
46	-4.723	-39.558	9.004	4.723	39.558	-9.004	0.000%
47	-8.595	-39.558	5.743	8.595	39.558	-5.743	0.000%
48	-9.592	-39.558	0.008	9.592	39.558	-0.008	0.000%
49	-8.118	-39.558	-4.794	8.118	39.558	4.794	0.000%
50	-4.684	-39.558	-8.207	4.684	39.558	8.207	0.000%

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	150 - 130	2.433	46	0.140	0.079
T2	130 - 110	1.849	46	0.135	0.070
T3	110 - 94	1.299	46	0.116	0.044
T4	94 - 90	0.927	46	0.093	0.025
T5	90 - 80	0.847	46	0.087	0.022
T6	80 - 70	0.664	46	0.075	0.016
T7	70 - 55	0.506	47	0.062	0.012
T8	55 - 50	0.319	47	0.046	0.008
T9	50 - 30	0.268	47	0.040	0.007
T10	30 - 10	0.101	47	0.023	0.003
T11	10 - 0	0.017	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
150.000	Lightning Rod 5/8"x5'	46	2.433	0.140	0.079	507278
148.000	DS9A09F36D-N	46	2.374	0.140	0.078	507278
147.000	DS2C03F36D-D	46	2.345	0.140	0.078	507278
146.000	TMA	46	2.316	0.140	0.077	507278
144.000	Side Arm Mount [SO 308-1]	46	2.257	0.140	0.077	422728
135.000	PAL6-59	46	1.994	0.138	0.073	169092
134.000	Side Arm Mount [SO 308-1]	46	1.965	0.137	0.073	158497
126.000	Side Arm Mount [SO 308-1]	46	1.734	0.133	0.066	95981
120.000	PAL6-59	46	1.565	0.127	0.058	66269
116.000	Side Arm Mount [SO 308-1]	46	1.456	0.123	0.053	54106
110.000	Sector Mount [SM 802-3]	46	1.299	0.116	0.044	43289
100.000	Pirod 12' T-Frame Sector Mount (1)	46	1.057	0.102	0.032	38305
90.000	APXVSPP18-C_TIA w/ Mount Pipe	46	0.847	0.087	0.022	42074
80.000	(2) AIR 21 w/ Mount Pipe	46	0.664	0.075	0.016	52235
25.000	(6) Secondary Members 30'-20'	47	0.072	0.020	0.002	54973
15.000	(6) Secondary Members 20'-10'	47	0.030	0.012	0.002	61878

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	150 - 130	11.566	17	0.668	0.370
T2	130 - 110	8.759	17	0.646	0.327
T3	110 - 94	6.128	17	0.552	0.208
T4	94 - 90	4.364	17	0.442	0.119
T5	90 - 80	3.984	17	0.412	0.102
T6	80 - 70	3.122	17	0.353	0.075
T7	70 - 55	2.379	19	0.290	0.056
T8	55 - 50	1.500	19	0.215	0.038
T9	50 - 30	1.257	19	0.190	0.033
T10	30 - 10	0.475	19	0.110	0.014
T11	10 - 0	0.078	19	0.036	0.005

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.000	Lightning Rod 5/8"x5'	17	11.566	0.668	0.370	123721
148.000	DS9A09F36D-N	17	11.284	0.667	0.367	123721
147.000	DS2C03F36D-D	17	11.142	0.667	0.365	123721
146.000	TMA	17	11.001	0.667	0.363	123721
144.000	Side Arm Mount [SO 308-1]	17	10.718	0.666	0.359	103101
135.000	PAL6-59	17	9.454	0.657	0.344	41240
134.000	Side Arm Mount [SO 308-1]	17	9.314	0.655	0.341	38653
126.000	Side Arm Mount [SO 308-1]	17	8.210	0.633	0.309	22207
120.000	PAL6-59	17	7.402	0.607	0.274	14451
116.000	Side Arm Mount [SO 308-1]	17	6.880	0.587	0.248	11627
110.000	Sector Mount [SM 802-3]	17	6.128	0.552	0.208	9190
100.000	Pirod 12' T-Frame Sector Mount (1)	17	4.982	0.487	0.150	8029
90.000	APXVSPP18-C_TIA w/ Mount Pipe	17	3.984	0.412	0.102	8773
80.000	(2) AIR 21 w/ Mount Pipe	17	3.122	0.353	0.075	10930
25.000	(6) Secondary Members 30'-20'	19	0.339	0.092	0.011	11706

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
15.000	(6) Secondary Members 20'-10'	19	0.142	0.055	0.007	13203

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	150	Leg	A325N	0.875	4	2.950	41.556	0.071	1.05	Bolt Tension
		Diagonal	A325N	0.500	1	2.986	6.398	0.467	1.05	Member Block Shear
		Top Girt	A325N	0.500	1	0.059	6.947	0.009	1.05	Member Bearing
T2	130	Leg	A325N	1.000	5	9.328	54.517	0.171	1.05	Bolt Tension
		Diagonal	A325N	0.625	1	5.167	8.775	0.589	1.05	Member Bearing
T3	110	Diagonal	A325N	0.625	1	6.238	8.775	0.711	1.05	Member Bearing
T4	94	Leg	A325N	1.000	5	17.861	54.517	0.328	1.05	Bolt Tension
		Diagonal	A325N	0.625	1	5.876	8.775	0.670	1.05	Member Bearing
		Secondary Horizontal	A325N	0.625	1	1.636	11.700	0.140	1.05	Member Bearing
T5	90	Diagonal	A325N	0.750	1	6.878	10.603	0.649	1.05	Member Bearing
T6	80	Leg	A325N	1.000	7	19.092	54.517	0.350	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	7.475	10.603	0.705	1.05	Member Bearing
		Secondary Horizontal	A325N	0.750	1	2.508	10.603	0.237	1.05	Member Bearing
T7	70	Diagonal	A325N	0.750	1	7.224	14.137	0.511	1.05	Member Bearing
T8	55	Leg	A325N	1.500	5	35.145	126.472	0.278	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	7.147	14.137	0.506	1.05	Member Bearing
		Secondary Horizontal	A325N	0.750	1	3.319	14.137	0.235	1.05	Member Bearing
T9	50	Leg	A325N	1.500	7	30.436	126.472	0.241	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	7.360	10.603	0.694	1.05	Member Bearing
T10	30	Diagonal	A325N	0.625	2	4.609	13.806	0.334	1.05	Bolt Shear
T11	10	Diagonal	A325N	0.625	2	6.318	13.806	0.458	1.05	Bolt Shear
		Horizontal	A325N	0.625	2	3.845	13.806	0.279	1.05	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	150 - 130	2 1/4	20.000	4.000	85.3 K=1.00	3.976	-13.770	105.060	0.131 [1]
T2	130 - 110	2 1/2	20.000	4.000	76.8 K=1.00	4.909	-48.033	143.512	0.335 [1]
T3	110 - 94	2 3/4	16.028	4.007	69.9 K=1.00	5.940	-85.061	186.914	0.455 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T4	94 - 90	2 3/4	4.007	2.065	36.0 K=1.00	5.940	-94.346	243.053	0.388 [1]
T5	90 - 80	3 1/4	10.017	5.009	74.0 K=1.00	8.296	-118.566	250.211	0.474 [1]
T6	80 - 70	3 1/4	10.017	2.579	38.1 K=1.00	8.296	-144.617	335.742	0.431 [1]
T7	70 - 55	3 3/4	15.026	5.009	64.1 K=1.00	11.045	-180.374	368.001	0.490 [1]
T8	55 - 50	3 3/4	5.009	2.564	32.8 K=1.00	11.045	-191.371	459.361	0.417 [1]
T9	50 - 30	4 1/4	20.034	5.008	56.6 K=1.00	14.186	-234.234	505.213	0.464 [1]
T10	30 - 10	4 1/2	20.033	10.017	53.4 K=0.50	15.904	-269.411	580.902	0.464 [1]
T11	10 - 0	4 1/2	10.017	5.008	53.4 K=1.00	15.904	-279.570	580.902	0.481 [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	150 - 130	L1 1/2x1 1/2x3/16	6.188	2.869	118.0 K=1.01	0.527	-2.982	10.839	0.275 [1]
T2	130 - 110	L1 3/4x1 3/4x3/16	6.201	2.845	104.6 K=1.05	0.621	-5.353	16.227	0.330 [1]
T3	110 - 94	L2x2x3/16	7.351	3.540	110.9 K=1.03	0.715	-6.205	16.647	0.373 [1]
T4	94 - 90	L2x2x3/16	7.695	3.832	116.7 K=1.00	0.715	-5.974	15.021	0.398 [1]
T5	90 - 80	L2 1/2x2 1/2x3/16	9.048	4.379	109.6 K=1.03	0.902	-6.787	21.486	0.316 [1]
T6	80 - 70	L2 1/2x2 1/2x3/16	9.913	4.947	119.9 K=1.00	0.902	-7.389	17.951	0.412 [1]
T7	70 - 55	L2 1/2x2 1/2x1/4	11.259	5.462	133.5 K=1.00	1.190	-7.159	19.116	0.375 [1]
T8	55 - 50	L2 1/2x2 1/2x1/4	11.717	5.826	142.4 K=1.00	1.190	-7.311	16.801	0.435 [1]
T9	50 - 30	L3x3x3/16	13.568	6.594	132.8 K=1.00	1.090	-7.388	17.701	0.417 [1]
T10	30 - 10	L3 1/2x3 1/2x1/4	17.505	8.829	97.2 K=1.00	1.690	-9.217	48.971	0.188 [1]
T11	10 - 0	L3 1/2x3 1/2x1/4	12.767	12.466	137.2 K=1.00	1.690	-12.636	25.683	0.492 [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 $\frac{P_u}{\phi P_n}$
T11	10 - 0	L3 1/2x3 1/2x1/4	14.865	7.245	125.3 K=1.00	1.690	-7.643	30.824	0.248 [1]

[1] P_u / ϕP_n controls

Secondary 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 $\frac{P_u}{\phi P_n}$
T4	94 - 90	L2x2x1/4	6.567	3.169	97.3 K=1.00	0.938	-1.636	27.528	0.059 [1]
T6	80 - 70	L2 1/2x2 1/2x3/16	8.550	4.140	100.4 K=1.00	0.902	-2.508	25.256	0.099 [1]
T8	55 - 50	L2 1/2x2 1/2x1/4	10.589	5.138	125.6 K=1.00	1.190	-3.319	21.598	0.154 [1]

[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	150 - 130	L2x2x3/16	4.703	4.307	131.2 K=1.00	0.715	-0.071	11.891	0.006 [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 $\frac{P_u}{\phi P_n}$
T11	10 - 0	L2 1/2x2 1/2x1/4	3.716	3.529	86.2 K=1.00	1.190	-4.849	40.174	0.121 [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 $\frac{P_u}{\phi P_n}$
T11	10 - 0	L2 1/2x2 1/2x1/4	6.086	5.757	140.7 K=1.00	1.190	-3.970	17.207	0.231 [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 $\frac{P_u}{\phi P_n}$
T11	10 - 0	L3x3x1/4	7.432	7.432	150.7	1.440	-0.012	18.159	0.001 [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				

[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	150 - 130	2 1/4	20.000	4.000	85.3	3.976	11.799	178.924	0.066 [1]
T2	130 - 110	2 1/2	20.000	4.000	76.8	4.909	46.638	220.893	0.211 [1]
T3	110 - 94	2 3/4	16.028	4.007	69.9	5.940	80.322	267.281	0.301 [1]
T4	94 - 90	2 3/4	4.007	1.942	33.9	5.940	89.374	267.281	0.334 [1]
T5	90 - 80	3 1/4	10.017	5.009	74.0	8.296	110.969	373.310	0.297 [1]
T6	80 - 70	3 1/4	10.017	2.430	35.9	8.296	133.729	373.310	0.358 [1]
T7	70 - 55	3 3/4	15.026	5.009	64.1	11.045	166.072	497.010	0.334 [1]
T8	55 - 50	3 3/4	5.009	2.444	31.3	11.045	175.845	497.010	0.354 [1]
T9	50 - 30	4 1/4	20.034	5.008	56.6	14.186	213.055	638.381	0.334 [1]
T10	30 - 10	4 1/2	20.033	10.017	106.8	15.904	242.879	715.694	0.339 [1]
T11	10 - 0	4 1/2	10.017	5.008	53.4	15.904	250.568	715.694	0.350 [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	150 - 130	L1 1/2x1 1/2x3/16	6.188	2.869	78.1	0.308	2.986	14.996	0.199 [1]
T2	130 - 110	L1 3/4x1 3/4x3/16	6.201	2.845	66.3	0.360	5.167	17.567	0.294 [1]
T3	110 - 94	L2x2x3/16	7.351	3.540	71.2	0.431	6.238	21.001	0.297 [1]
T4	94 - 90	L2x2x3/16	7.695	3.832	74.5	0.431	5.876	21.001	0.280 [1]
T5	90 - 80	L2 1/2x2 1/2x3/16	8.628	4.173	66.4	0.553	6.878	26.981	0.255 [1]
T6	80 - 70	L2 1/2x2 1/2x3/16	9.477	4.731	73.0	0.553	7.475	26.981	0.277 [1]
T7	70 - 55	L2 1/2x2 1/2x1/4	10.355	5.013	80.3	0.728	7.224	35.511	0.203 [1]
T8	55 - 50	L2 1/2x2 1/2x1/4	11.717	5.826	90.9	0.728	7.147	35.511	0.201 [1]
T9	50 - 30	L3x3x3/16	13.568	6.594	86.0	0.694	7.360	33.855	0.217 [1]
T10	30 - 10	L3 1/2x3 1/2x1/4	17.505	8.829	97.2	1.127	9.113	54.935	0.166 [1]
T11	10 - 0	L3 1/2x3 1/2x1/4	12.767	12.466	137.2	1.127	12.345	54.935	0.225 [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 $\frac{P_u}{\phi P_n}$
T11	10 - 0	L3 1/2x3 1/2x1/4	14.865	7.245	79.8	1.127	7.690	54.935	0.140 [1]

[1] P_u / ϕP_n controls

Secondary 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 $P_u / \phi P_n$
T4	94 - 90	L2x2x1/4	6.567	3.169	124.9	0.563	1.636	27.440	0.060 [1]
T6	80 - 70	L2 1/2x2 1/2x3/16	8.550	4.140	127.7	0.553	2.508	26.981	0.093 [1]
T8	55 - 50	L2 1/2x2 1/2x1/4	10.589	5.138	160.4	0.728	3.319	35.511	0.093 [1]

[1] P_u / ϕP_n controls

Top Girt 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 $P_u / \phi P_n$
T1	150 - 130	L2x2x3/16	4.703	4.307	87.8	0.448	0.059	21.858	0.003 [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 $P_u / \phi P_n$
T11	10 - 0	L2 1/2x2 1/2x1/4	3.716	3.529	55.1	1.190	4.849	53.550	0.091 [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 $P_u / \phi P_n$
T11	10 - 0	L2 1/2x2 1/2x1/4	6.086	5.757	89.8	1.190	3.970	53.550	0.074 [1]

[1] P_u / ϕP_n controls

Inner Bracing 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 $P_u / \phi P_n$
T11	10 - 0	L3x3x1/4	7.432	7.432	95.9	1.440	0.005	64.800	0.000 [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	150 - 130	Leg	2 1/4	3	-13.770	110.313	12.5	Pass
T2	130 - 110	Leg	2 1/2	39	-48.033	150.688	31.9	Pass
T3	110 - 94	Leg	2 3/4	70	-85.061	196.260	43.3	Pass
T4	94 - 90	Leg	2 3/4	97	-94.346	255.206	37.0	Pass
T5	90 - 80	Leg	3 1/4	109	-118.566	262.722	45.1	Pass
T6	80 - 70	Leg	3 1/4	124	-144.617	352.529	41.0	Pass
T7	70 - 55	Leg	3 3/4	145	-180.374	386.401	46.7	Pass
T8	55 - 50	Leg	3 3/4	166	-191.371	482.329	39.7	Pass
T9	50 - 30	Leg	4 1/4	178	-234.234	530.474	44.2	Pass
T10	30 - 10	Leg	4 1/2	205	-269.411	609.947	44.2	Pass
T11	10 - 0	Leg	4 1/2	220	-279.570	609.947	45.8	Pass
T1	150 - 130	Diagonal	L1 1/2x1 1/2x3/16	10	-2.982	11.381	26.2 44.4 (b)	Pass
T2	130 - 110	Diagonal	L1 3/4x1 3/4x3/16	42	-5.353	17.039	31.4 56.1 (b)	Pass
T3	110 - 94	Diagonal	L2x2x3/16	76	-6.205	17.480	35.5 67.7 (b)	Pass
T4	94 - 90	Diagonal	L2x2x3/16	103	-5.974	15.772	37.9 63.8 (b)	Pass
T5	90 - 80	Diagonal	L2 1/2x2 1/2x3/16	115	-6.787	22.560	30.1 61.8 (b)	Pass
T6	80 - 70	Diagonal	L2 1/2x2 1/2x3/16	130	-7.389	18.848	39.2 67.1 (b)	Pass
T7	70 - 55	Diagonal	L2 1/2x2 1/2x1/4	151	-7.159	20.071	35.7 48.7 (b)	Pass
T8	55 - 50	Diagonal	L2 1/2x2 1/2x1/4	172	-7.311	17.641	41.4 48.1 (b)	Pass
T9	50 - 30	Diagonal	L3x3x3/16	185	-7.388	18.586	39.8 66.1 (b)	Pass
T10	30 - 10	Diagonal	L3 1/2x3 1/2x1/4	212	-9.217	51.419	17.9 31.8 (b)	Pass
T11	10 - 0	Diagonal	L3 1/2x3 1/2x1/4	238	-12.636	26.967	46.9	Pass
T11	10 - 0	Horizontal	L3 1/2x3 1/2x1/4	237	-7.643	32.365	23.6 26.5 (b)	Pass
T4	94 - 90	Secondary Horizontal	L2x2x1/4	106	1.636	28.812	5.7 13.3 (b)	Pass
T6	80 - 70	Secondary Horizontal	L2 1/2x2 1/2x3/16	133	-2.508	26.519	9.5 22.5 (b)	Pass
T8	55 - 50	Secondary Horizontal	L2 1/2x2 1/2x1/4	175	-3.319	22.678	14.6 22.4 (b)	Pass
T1	150 - 130	Top Girt	L2x2x3/16	4	-0.071	12.486	0.6 0.8 (b)	Pass
T11	10 - 0	Redund Horz 1 Bracing	L2 1/2x2 1/2x1/4	225	-4.849	42.183	11.5	Pass
T11	10 - 0	Redund Diag 1 Bracing	L2 1/2x2 1/2x1/4	243	-3.970	18.067	22.0	Pass
T11	10 - 0	Inner Bracing	L3x3x1/4	246	-0.012	19.067	0.3	Pass
							Summary	
						Leg (T7)	46.7	Pass
						Diagonal (T3)	67.7	Pass
						Horizontal (T11)	26.5	Pass
						Secondary Horizontal (T6)	22.5	Pass
						Top Girt (T1)	0.8	Pass
						Redund Horz 1 Bracing (T11)	11.5	Pass
						Redund Diag 1 Bracing (T11)	22.0	Pass

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*øP$_{allow}$ K*	*% Capacity*	*Pass Fail*
						Inner Bracing (T11)	0.3	Pass
						Bolt Checks	67.7	Pass
						RATING =	**67.7**	**Pass**

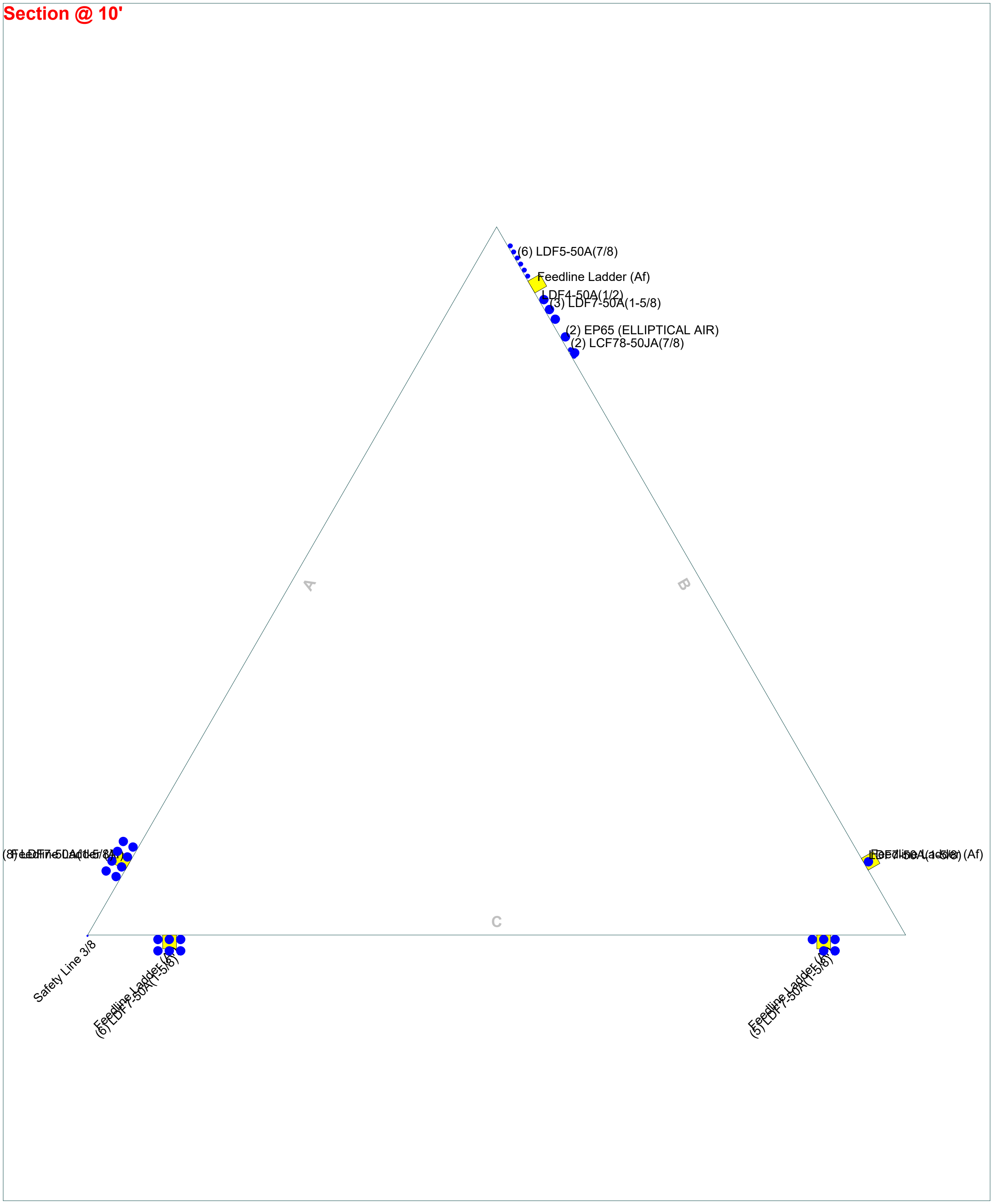
APPENDIX B

BASE LEVEL DRAWING

Feed Line Plan

10'

Round Flat App In Face App Out Face



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Job: ES-060 NorwalkAWC		
Project: 403093		
Client: Eversource	Drawn by: Khushal Patel	App'd:
Code: TIA-222-H	Date: 02/19/20	Scale: NTS
Path: Y:\TELECOM\2020\Engineering\Projects\Ever Source SA\NorwalkAWC\Structural\Rev. H\ES-060 NorwalkAWC Structural Analysis.eri		Dwg No. E-7

APPENDIX C

ADDITIONAL CALCULATIONS

References

ANCHOR ROD ANALYSIS

Project Information

Site Name:ES-060 NorwalkAWC

TIA Revision: Rev-G / Rev-H (selected: Rev-H)

TIA-222-G 105% Allowable? No / Yes (selected: No)

Apply TIA-222-H Section 15.5? No / Yes (selected: Yes)

Max Leg Reactions

Compression

$Axial\_C := 297 \cdot kip$

$Shear\_C := 29 \cdot kip$

Uplift

$Axial\_U := 266 \cdot kip$

$Shear\_U := 26 \cdot kip$

Anchor Rod Data

Diameter of Anchor Rod: $D := 1.5 \cdot in$

Number of Anchor Rods: $N := 7$

Length from top of concrete to bottom of anchor rod leveling nut: $lar := 1.375 \cdot in$

Anchor Rod Grade: F1554-105 (selected); options: F1554-105, A687, A354-BC, A354-BD, A449, A572-42, A572-50, A572-55, A572-60, A572-65, A588-42, A588-46, A588-50, A36M-42, A36M-45, A36M-50, A36M-55, A500-50, A514-GR100, A53-B-35, A53-B-42, A607-60, A607-65, S-128, S-22

Threads in Shear Plane?: Yes / No (selected: Yes)

Thread Series: Coarse / Fine / 8-Thread (selected: Coarse)

Consider Base Plate Grout? Yes / No (selected: No)

Grout Factor η: 0.90 / 0.70 / 0.55 / 0.50 (selected: 0.50)

Threads per Inch: $n = 6$ (Thread selection invalid if n = 0)

Rod Ultimate Strength: $Fu = 125 \cdot ksi$

Rod Yield Strength: $Fy = 105 \cdot ksi$

Anchor Rod Plastic Section Modulus: (based on tension root diameter)

$$Z := \frac{1}{6} \cdot \left(D - \frac{0.9743in}{n}\right)^3 = 0.399 \cdot in^3$$

Radius of Gyration:

$$r := \left(\frac{1}{4}\right) \cdot \left(D - \frac{0.9743in}{n}\right) = 0.334 \cdot in$$

Net Area of Anchor Rod:

$$An := \frac{\pi}{4} \cdot \left(D - \frac{0.9743in}{n}\right)^2 = 1.405 \cdot in^2$$

TIA-222-G/H Section 4.9.6.1

Nominal Unthreaded Area of Anchor Rod:

$$Ab := \frac{\pi}{4} \cdot (D)^2 = 1.767 \cdot in^2$$

Anchor Rod Design Capacities

Design Tension Strength: TIA-222-G/H Section 4.9.6.1

$Rnt := Fu \cdot An = 175.656 \cdot kip$

$\phi t = 0.75$

$\phi Rnt := \phi t \cdot Rnt = 131.742 \cdot kip$

Design Compression Strength:

$Rnc := Fy \cdot An = 147.551 \cdot kip$

$\phi c = 1$

$\phi Rnc := \phi c \cdot Rnc = 147.551 \cdot kip$

Design Buckling Strength: TIA-222-H Section 4.5.4.2

$K_0 := 1.2$

$Fcr = 104.608 \cdot ksi$

$Fe = 1.176 \times 10^4 \cdot ksi$

$Rnb := Fcr \cdot An = 147.001 \cdot kip$

$\phi c = 1$

$\phi Rnb := \phi c \cdot Rnb = 147.001 \cdot kip$

Design Shear Strength: TIA-222-G/H Section 4.9.6.3

$$Rnv := \begin{array}{|l} 0.55 \cdot Fu \cdot Ab \;\text{ if }\; Thread\_Type = \text{"No"} \wedge TIA = \text{"Rev-G"} \\ 0.45 \cdot Fu \cdot Ab \;\text{ if }\; Thread\_Type = \text{"Yes"} \wedge TIA = \text{"Rev-G"} \\ 0.625 \cdot Fu \cdot Ab \;\text{ if }\; Thread\_Type = \text{"No"} \wedge TIA = \text{"Rev-H"} \\ 0.5 \cdot Fu \cdot Ab \;\text{ if }\; Thread\_Type = \text{"Yes"} \wedge TIA = \text{"Rev-H"} \end{array}$$

$Rnv = 110.447 \cdot kip$

$Rnvc := 0.6 \cdot Fy \cdot 0.5 \cdot An = 44.265 \cdot kip$ TIA-222-H Section 4.9.9

$\phi v = 0.75$ $\phi c = 1$

$\phi Rnv := \phi v \cdot Rnv = 82.835 \cdot kip$ $\phi Rnvc := \phi c \cdot Rnvc = 44.265 \cdot kip$

Design Flexural Strength: TIA-222-G/H Section 4.7.1

$Rmn := Fy \cdot Z = 41.883 \cdot kip \cdot in$

$\phi f = 0.9$

$\phi Rmn := \phi f \cdot Rmn = 37.694 \cdot kip \cdot in$

Anchor Rod Loading Demands

Tension Demand:

$$Put := \frac{Axial\_U}{N} = 38 \cdot kip$$

Compression Demand:

$$Puc := \frac{Axial\_C}{N} = 42.429 \cdot kip$$

Shear Demand:

$$Vut := \frac{Shear\_U}{N} = 3.714 \cdot kip$$

$$Vuc := \frac{Shear\_C}{N} = 4.143 \cdot kip$$

Moment Demand:

$$Mut := 0.65 \cdot lar \cdot Vut = 3.32 \cdot kip \cdot in$$

$$Muc := 0.65 \cdot lar \cdot Vuc = 3.703 \cdot kip \cdot in$$

Anchor Rod Interaction Check TIA-222-G Section 4.9.9

$$SR\_g := \begin{cases} \dfrac{Put + \dfrac{Vut}{\eta}}{\phi Rnt} & \text{if } \eta > 0.50 \\ \dfrac{Put + \dfrac{Vut}{\eta}}{\phi Rnt} & \text{if } \eta = 0.50 \wedge lar \le D \wedge Put > Puc \\ \dfrac{Puc + \dfrac{Vuc}{\eta}}{\phi Rnt} & \text{if } \eta = 0.50 \wedge lar \le D \wedge Put < Puc \\ \left(\dfrac{Vut}{\phi Rnv}\right)^2 + \left(\dfrac{Put}{\phi Rnt} + \dfrac{Mut}{\phi Rmn}\right)^2 & \text{if } \eta = 0.5 \wedge lar > D \wedge Put > Puc \\ \left(\dfrac{Vuc}{\phi Rnv}\right)^2 + \left(\dfrac{Puc}{\phi Rnt} + \dfrac{Muc}{\phi Rmn}\right)^2 & \text{if } \eta = 0.5 \wedge lar > D \wedge Put < Puc \end{cases}$$

$$SR\_g = 0.385$$

Anchor Rod Interaction Check

TIA-222-H Section 4.9.9

$$SR\_Pt := \begin{cases} \left(\frac{Put}{\phi Rnt}\right)^2 + \left(\frac{Vut}{\phi Rnv}\right)^2 & \text{if } lar \le D \\ \left(\frac{Put}{\phi Rnt}\right)^2 + \left(\frac{Vut}{\phi Rnv}\right)^2 & \text{if } D < lar \le 3\cdot in \wedge Grout = \text{"Yes"} \\ \left(\frac{Put}{\phi Rnt} + \frac{Mut}{\phi Rmn}\right)^2 + \left(\frac{Vut}{\phi Rnv}\right)^2 & \text{if } 3\cdot in < lar \wedge Grout = \text{"Yes"} \\ \left(\frac{Put}{\phi Rnt} + \frac{Mut}{\phi Rmn}\right)^2 + \left(\frac{Vut}{\phi Rnv}\right)^2 & \text{if } D < lar \wedge Grout = \text{"No"} \end{cases}$$

$SR\_Pt = 0.085$

$$SR\_Pc := \begin{cases} \left(\frac{Puc}{\phi Rnc}\right) + \left(\frac{Vuc}{\phi Rnvc}\right)^2 & \text{if } lar \le D \\ \left(\frac{Puc}{\phi Rnc}\right) + \left(\frac{Vuc}{\phi Rnvc}\right)^2 & \text{if } D < lar \le 3\cdot in \wedge Grout = \text{"Yes"} \\ \left(\frac{Puc}{\phi Rnc} + \frac{Muc}{\phi Rmn}\right) + \left(\frac{Vuc}{\phi Rnvc}\right)^2 & \text{if } 3\cdot in < lar \wedge Grout = \text{"Yes"} \\ \left(\frac{Puc}{\phi Rnc} + \frac{Muc}{\phi Rmn}\right) + \left(\frac{Vuc}{\phi Rnvc}\right)^2 & \text{if } D < lar \le 4\cdot D \wedge Grout = \text{"No"} \\ \left(\frac{Puc}{\phi Rnb} + \frac{Muc}{\phi Rmn}\right) + \left(\frac{Vuc}{\phi Rnvc}\right)^2 & \text{if } lar > 4\cdot D \wedge Grout = \text{"No"} \end{cases}$$

$SR\_Pc = 0.296$

$$SR := \begin{cases} SR\_g & \text{if } TIA = \text{"Rev-G"} \\ \max(SR\_Pt, SR\_Pc) & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"No"} \\ \frac{\max(SR\_Pt, SR\_Pc)}{1.05} & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"Yes"} \end{cases} = 0.282$$

$$Check_{SR} := \begin{cases} \text{"Passing"} & \text{if } SR \le 1.00 \wedge TIA = \text{"Rev-G"} \wedge S105 = \text{"Yes"} \\ \text{"Acceptable"} & \text{if } 1.00 < SR \le 1.05 \wedge TIA = \text{"Rev-G"} \wedge S105 = \text{"Yes"} \\ \text{"Failing"} & \text{if } SR > 1.05 \wedge TIA = \text{"Rev-G"} \wedge S105 = \text{"Yes"} \\ \text{"Passing"} & \text{if } SR \le 1.00 \wedge TIA = \text{"Rev-G"} \wedge S105 = \text{"No"} \\ \text{"Failing"} & \text{if } SR > 1.00 \wedge TIA = \text{"Rev-G"} \wedge S105 = \text{"No"} \\ \text{"Passing"} & \text{if } SR \le 1.0 \wedge TIA = \text{"Rev-H"} \\ \text{"Failing"} & \text{if } SR > 1.0 \wedge TIA = \text{"Rev-H"} \end{cases} = \text{"Passing"}$$

Anchor Rod Results

Axial Tension Demand:	$Put = 38 \cdot kip$
Axial Tension Capacity:	$\phi Rnt = 131.742 \cdot kip$
Axial Compression Demand:	$Puc = 42.429 \cdot kip$
Axial Compression Capacity:	$\phi Rnc = 147.551 \cdot kip$
Shear Tension Demand:	$Vut = 3.714 \cdot kip$
Tension Shear Capacity:	$\phi Rnv = 82.835 \cdot kip$
Shear Compression Demand:	$Vuc = 4.143 \cdot kip$
Compresison Shear Capacity:	$\phi R_{nvc} = 44.265 \cdot kip$
Moment Tension Demand:	M_{ut} = "Moment Not Considered" $\cdot kip \cdot in$
Moment Compression Demand:	M_{uc} = "Moment Not Considered" $\cdot kip \cdot in$
Moment Capacity:	ϕR_{mn} = "Moment Not Considered" $\cdot kip \cdot in$

Governing Stress Ratio

$SR = 28.22 \cdot \%$

$Check_{SR}$ = "Passing"

SST Unit Base Foundation

ES-060
NorwalkAWC

TIA-222 Revision: H

Top & Bot. Pad Rein. Different?:	☐
Tower Centroid Offset?:	☑
Block Foundation?:	☐

Superstructure Analysis Reactions		
Global Moment, **M**:	3890	ft-kips
Global Axial, **P**:	47	kips
Global Shear, **V**:	49	kips
Leg Compression, $\mathbf{P}_{comp}$:	297	kips
Leg Comp. Shear, $\mathbf{V}_{u\_comp}$:	29	kips
Leg Uplift, $\mathbf{P}_{uplift}$:	266	kips
Leg Uplift. Shear, $\mathbf{V}_{u\_uplift}$:	26	kips
Tower Height, **H**:	150	ft
Base Face Width, **BW**:	15.86	ft
BP Dist. Above Fdn, $\mathbf{bp}_{dist}$:	2	in

Foundation Analysis Checks				
	Capacity	**Demand**	**Rating***	**Check**
Lateral (Sliding) (kips)	435.45	49.00	**10.7%**	**Pass**
Bearing Pressure (ksf)	6.00	1.72	**27.3%**	**Pass**
*Overturning (kip*ft)*	9677.04	4352.66	**45.0%**	**Pass**
*Pier Flexure (Comp.) (kip*ft)*	2192.27	108.75	**4.7%**	**Pass**
*Pier Flexure (Tension) (kip*ft)*	1382.70	97.50	**6.7%**	**Pass**
Pier Compression (kip)	11388.12	307.74	**2.6%**	**Pass**
*Pad Flexure (kip*ft)*	6358.97	486.27	**7.3%**	**Pass**
Pad Shear - 1-way (kips)	1025.44	100.14	**9.3%**	**Pass**
Pad Shear - Comp 2-way (ksi)	0.201	0.043	**20.3%**	**Pass**
*Flexural 2-way (Comp) (kip*ft)*	5408.14	65.25	**1.1%**	**Pass**
Pad Shear - Tension 2-way (ksi)	0.201	0.040	**19.1%**	**Pass**
*Flexural 2-way (Tension) (kip*ft)*	5408.14	58.50	**1.0%**	**Pass**

**Rating per TIA-222-H Section 15.5*

Soil Rating*:	**45.0%**
Structural Rating*:	**20.3%**

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, **dpier**:	4.5	ft
Ext. Above Grade, **E**:	0.50	ft
Pier Rebar Size, **Sc**:	9	
Pier Rebar Quantity, **mc**:	18	
Pier Tie/Spiral Size, **St**:	4	
Pier Tie/Spiral Quantity, **mt**:	23	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, $\mathbf{cc}_{pier}$:	3	in

Pad Properties		
Depth, **D**:	6.00	ft
Pad Width, **W**:	30.00	ft
Pad Thickness, **T**:	2.75	ft
Pad Rebar Size (Bottom), **Sp**:	9	
Pad Rebar Quantity (Bottom), **mp**:	52	
Pad Clear Cover, $\mathbf{cc}_{pad}$:	3	in

Material Properties		
Rebar Grade, **Fy**:	60	ksi
Concrete Compressive Strength, **F'c**:	5	ksi
Dry Concrete Density, δ**c**:	150	pcf

Soil Properties		
Total Soil Unit Weight, γ:	125	pcf
Ultimate Gross Bearing, Qult:	8.000	ksf
Cohesion, **Cu**:	0.000	ksf
Friction Angle, φ:	34	degrees
SPT Blow Count, $\mathbf{N}_{blows}$:		
Base Friction, μ:	0.6	
Neglected Depth, **N**:	3.5	ft
Foundation Bearing on Rock?	No	
Groundwater Depth, **gw**:	25	ft

<-- Toggle between Gross and Net

Version 3.2.0

TIA-222- H | ACI : 2014

PHYSICAL PARAMETERS

Pier Height Above Water Table:	h_{pier_above} = (MIN(gw,D-T) + E)	h_{pier_above} =	3.75	ft
Pier Height Below Water Table:	h_{pier_below} = ((D-T) - MIN(gw,D-T))	h_{pier_below} =	0	ft
Buoyant Weight of Pier:	W_{pier} = (π/4) * (dpier^2) * hpier_above * δc / 1000 + (π/4) * (dpier^2) * hpier_below * (δc-62.4) / 1000	W_{pier} =	8.95	kips
Pad Height Above Water Table:	h_{pad_above} = IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw)))	h_{pad_above} =	2.75	ft
Pad Height Below Water Table:	h_{pad_below} = (T-IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw))))	h_{pad_below} =	0	ft
Buoyant Weight of Pad:	W_{pad} = (W^2) * hpad_above * δc / 1000 + (W^2) * hpad_below * (δc-62.4) / 1000	W_{pad} =	371.25	kips
Concrete weight:	W_c = V * δc	W_c =	398.1	kips
Soil weight:	W_s = (D - T) * (W² - 3*(dpier² / 4 * π)) * γ	W_s =	346.2	kips
EIA/TIA-222 Load Factor:	LF = 1	LF =	1.00	

LATERAL RESISTANCE

Total Nominal Pp Resistance:	P_{p_total} = Pp_pier *Ap_piers + Pp_pad * Ap_pad	P_{p_total} =	157.51	kips
Factored Total Weight for Compression:	$P_{factored\_comp}$ = φD * (Wc + Ws + P / 1.2)	$P_{factored\_comp}$ =	705.15	kips
Nominal Base Friction Resistance (Comp):	R_{s_comp} = P * μ	R_{s_comp} =	423.09	kips
Lateral Resistance (Comp):	ΦVn = Φs * (Pp_total + Rs_comp)	ΦVn =	435.45	kips

Check **ΦVn = 435.45 kips >= Vu = 49.00 kips** **RATING: 11.25% OK**

PIER REINFORCEMENT

Pier / Column Compression

Pier Cross-Sectional Area:	A_1 = dpier^2 * π/4	A_1 =	2290.22	in²
Support Area (2H:1V Slope):	A_2 = (MIN((2*(W/2-(2/3)*BW*cos(30°)+Offset)),(W-BW),dpier+4*T))²*(π/4)	A_2 =	22612.64	in²
Compressive Resistance (H/D < 3):	$ΦP_{n1}$ = 0.65*0.85 * F'c * A1 * MIN(√(A2/A1),2)	$ΦP_{n1}$ =	11388.12	kips
Rebar:	s_pier = 9; m_pier = 18	d_{b_pier} = 1.128 in; A_{b_pier} = 1 in²		
Provided area of steel:	A_{s_pier} = Ab_pier * m_pier	A_{s_pier} =	18.00	in²
Compressive Resistance (H/D >= 3):	$ΦP_{n2}$ = 0.65 * 0.8 * (0.85 * (F\c) * (A_1 - As_pier) + ((Fy) * As_pier))	$ΦP_{n2}$ =	5081.05	kips
	H/D = (D - T + E) / dpier	H/D =	0.83	
Utilized Compressive Resistance:	$ΦP_n$ = Pn1	$ΦP_n$ =	11388.12	kips
Applied Compressive Force:	P_u = Pcomp + 1.2 * Wpier	P_u =	307.74	kips

Check **$ΦP_n$ = 11388.12 kips >= P_u = 307.74 kips** **RATING: 2.70% OK**

Pier Flexure

Cross-sectional area:	A_g = dpier² * π / 4	A_g =	2290.22	in²
Min. area of steel (pier):	A_{smin_pier} = Ag * 0.005	A_{smin_pier} =	11.45	in²
Cage Diameter:	d_o = dpier - 2 * cc - 2 * tie - d_b	d_o =	45.87	in

Check **A_{s_pier} = 18.00 in² >= A_{smin_pier} = 11.45 in²** **OK**

Applied Moment to DSMC (Compression):	M_{u_comp} = IF(T>D,E,(D - T + E)) * Vu_comp	M_{u_comp} =	108.75	ft-kips
Pier Moment Capacity (Compression):	$ΦM_{n\_comp}$ = *from DSMC*	$ΦM_{n\_comp}$ =	2192.27	ft-kips

Check **M_{u_comp} = 108.75 ft-kips >= $ΦM_{n\_comp}$ = 2192.27 ft-kips** **RATING: 4.96% OK**

Applied Moment to DSMC (Tension):	$M_{u\_tension}$ = IF(T>D,E,(D - T + E)) * Vu_uplift	$M_{u\_tension}$ =	97.50	ft-kips
Pier Moment Capacity (Tension):	$ΦM_{n\_tension}$ = *from DSMC*	$ΦM_{n\_tension}$ =	1382.70	ft-kips

Check **M_{u_comp} = 97.50 ft-kips >= $ΦM_{n\_comp}$ = 1382.70 ft-kips** **RATING: 7.05% OK**

PAD REINFORCEMENT

Elastic Bearing Pressure for Soil Checks

Tower Cetroid offset from Fdn Centroid:	Offset = (1/2-1/3)*BW*sin(60°)	Offset = 2.29	ft	
Distance from Leg to Edge of Pad:	L_{edge} = (1/2)*W - Offset - (1/3)*BW*sin(60°)	L_{edge} = 8.13	ft	
*Overturning Moment (0.9*D LC):*	$M_{o\_0.9}$ = M + V * (D + E + bpdist/12) + (0.9/1.2)*(P+3*Wpier*1.2)*Offset	$M_{o\_0.9}$ = 4352.66	ft-kips	
*Overturning Moment (1.2*D LC):*	$M_{o\_1.2}$ = M + V * (D + E + bpdist/12) + (1.2/1.2)*(P+3*Wpier*1.2)*Offset	$M_{o\_1.2}$ = 4397.99	ft-kips	
Compressive Load for Bearing:	$P_{bearing}$ = Wc + Ws + P / 1.2	$P_{bearing}$ = 783.50	kips	
*Load Eccentricity (0.9*D LC):*	$e_{c\_0.9}$ = Mo / 0.9*Pbearing	$e_{c\_0.9}$ = 6.17	ft	L/6 < e <= L
*Load Eccentricity (1.2*D LC):*	$e_{c\_1.2}$ = Mo / 1.2*Pbearing	$e_{c\_1.2}$ = 4.68	ft	e <= L/6
Elastic Section Modulus:	S = W³ / 6	S = 4500.00	ft³	
*Positive Pressure (0.9*D LC):*	$P_{pos\_st\_0.9}$ = 0.9*Pbearing / Area + Mo / S	$P_{pos\_st\_0.9}$ = 1.75	ksf	
*Positive Pressure (1.2*D LC):*	$P_{pos\_st\_1.2}$ = 1.2*Pbearing / Area + Mo / S	$P_{pos\_st\_1.2}$ = 2.02	ksf	
*Negative Pressure (0.9*D LC):*	$P_{neg\_st\_0.9}$ = 0.9*Pbearing / Area - Mo / S **Note: The stress resultant is NOT within the kern. Bearing area has been adjusted below.**	$P_{neg\_st\_0.9}$ = -0.18	ksf	
*Negative Pressure (1.2*D LC):*	$P_{neg\_st\_1.2}$ = 1.2*Pbearing / Area - Mo / S **Note: The resultant stress is within the kern. No adjustment is required.**	$P_{neg\_st\_1.2}$ = 0.07	ksf	
*Adjusted Pressure (0.9*D LC):*	$P_{adj\_0.9}$ = (2 * 0.9*Pbearing) / (3 * W * (W / 2 - ec_0.9))	$P_{adj\_0.9}$ = 1.78	ksf	
*Adjusted Pressure (1.2*D LC):*	$P_{adj\_1.2}$ = (2 * 1.2*Pbearing) / (3 * W * (W / 2 - ec_1.2))	$P_{adj\_1.2}$ = 2.02	ksf	
*Maximum Pressure (0.9*D LC):*	$q_{u\_st\_0.9}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_0.9}$ = 1.78	ksf	
*Maximum Pressure (1.2*D LC):*	$q_{u\_st\_1.2}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_1.2}$ = 2.02	ksf	

One-Way Shear

Rebar: $s_{\_pad}$ = 9, $m_{\_pad}$ = 52 — *Equally spaced, top and bottom, both directions.* — d_{b_pad} = 1.128 in, A_{b_pad} = 1 in^2

Effective depth:	d_c = T - cc - 1.5 * db	d_c = 28.3	in
Distance from Edge of Pad to Column Face:	d' = Ledge - dpier/2	d' = 5.9	ft
Distance from Edge of Pad to dc from Column Face:	d'' = d' - d_c / 12	d'' = 3.52	ft
Distance to qs (0.9D LC):	$L'_{\_0.9}$ = (W / 2 - ec_0.9) * 3	$L'_{\_0.9}$ = 26.48	ft
Distance to qs (1.2D LC):	$L'_{\_1.2}$ = (W / 2 - ec_1.2) * 3	$L'_{\_1.2}$ = 30.97	ft
*Slope of qs (0.9*D LC):*	$sq_{s\_0.9}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_0.9}$ = 0.07	kcf
*Slope of qs (1.2*D LC):*	$sq_{s\_1.2}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_1.2}$ = 0.07	kcf
Nominal Shear Strength:	V_{n1} = 2 * W * √(F'c*1000) * dc	V_{n1} = 1367.25	kips
Shear Reduction Factor:	φ_{shear} = 0.75	φ_{shear} = 0.75	
Design Shear Strength:	φV_{n1} = φshear * V_{n1}	φV_{n1} = 1025.44	kips

Resisting Weight above Critical Section:

	Thickness (ft)	Unit Weight (kcf)	Weight (kip) (0.9*D LC)	Weight (kip) (1.2*D LC)
Soil Above Water Table:	3.25	0.125	38.65	51.53
Soil Below Water Table:	0	0.063	0.00	0.00
Pad Above Water Table:	2.75	0.150	39.24	52.32
Pad Below Water Table:	0	0.088	0.00	0.00
Total:			77.89	103.85

*Applied Shear (0.9*D LC):*	$V_{u1\_0.9}$ = 'Pad Shear and Moment Diagrams'!$AY$21	$V_{u1\_0.9}$ = 98.99	kips
*Applied Shear (1.2*D LC):*	$V_{u1\_1.2}$ = 'Pad Shear and Moment Diagrams'!$CG$21	$V_{u1\_1.2}$ = 100.14	kips

Check **φV_{n1} = 1025.44 kips >= V_{u1} = 100.14 kips** **RATING: 9.77% OK**

Two-Way Shear (Compression)

Avg. Effective Depth for Punching Shear:	d_{c_2} = T - cc - AVERAGE(0.5 * db , 1.5 * db)	d_{c_2} =	28.87	in
Radius of Two-Way Shear Plane:	r_{2way} = 0.5*(dpier + dc_2/12)	r_{2way} =	3.45	ft
Length to Edge of Pad from Pier Centroid:	L_{edge2} = W/2 - 2/3*SIN(60°)*BW + Offset	L_{edge2} =	8.13	ft
Length of Shear Perimeter to Deduct:	s = r_{2way} * (2 * ACOS(((r_{2way}-MAX(r_{2way}-L_{edge},0))/r_{2way}))	s =	0.00	ft
Pier Shape:	Pier Shape: Circular	Pier Shape:	Circular	
Pier Diameter:	d_{pier1} = d_{pier} * 12 in / ft	d_{pier1} =	54.00	in
Equivalent Square Pier Diameter:	d_{pier_sq} = √π / 2 * dpier	d_{pier_sq} =	47.86	in
Factor of transfer of Moment:	Y_f = 1/(1+(2/3)*√(dpier1/dpier1))	Y_f =	0.60	
Factor of transfer of eccentricity of Shear:	Y_v = 1 - Y_f	Y_v =	0.40	
Moment applied at base of Pier:	M_v = M_{u_comp} * 12 in / ft	M_v =	1305.00	kip*in
Circular Critical Perimeter:	P_{crit_cir} = (dpier+dc_2/12)*PI() - $L$171)*12	P_{crit_cir} =	260.35	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_sq\_1}$ = 4*(dpier_sq+dc_2)	$P_{crit\_sq\_1}$ =	306.91	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_sq\_2}$ = 2*(dpier_sq + dc_2) + (W*12-BW*12)	$P_{crit\_sq\_2}$ =	323.14	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_sq\_3}$ = 2 * (dpier_sq + dc_2 + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_sq\_3}$ =	348.63	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_sq\_4}$ = 2 * (dpier_sq + dc_2 + Ledge2 * 12)	$P_{crit\_sq\_4}$ =	348.63	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_sq\_5}$ = dpier_sq + dc_2 + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30)) - Led	$P_{crit\_sq\_5}$ =	259.16	in
Area of Concrete in Shear:	A_c = ((dpier1 + dc_2)*PI()) * dc_2	A_c =	7516.83	in^2
Eq. Square Area of Concrete in Shear (1):	$A_{c\_sq\_1}$ = $P_{crit\_sq\_1}$ * d_{c_2}	$A_{c\_sq\_1}$ =	8861.19	in^2
Eq. Square Area of Concrete in Shear (2):	$A_{c\_sq\_2}$ = $P_{crit\_sq\_2}$ * d_{c_2}	$A_{c\_sq\_2}$ =	9329.60	in^2
Eq. Square Area of Concrete in Shear (3):	$A_{c\_sq\_3}$ = $P_{crit\_sq\_3}$ * d_{c_2}	$A_{c\_sq\_3}$ =	10065.78	in^2
Eq. Square Area of Concrete in Shear (4):	$A_{c\_sq\_4}$ = $P_{crit\_sq\_4}$ * d_{c_2}	$A_{c\_sq\_4}$ =	10065.78	in^2
Eq. Square Area of Concrete in Shear (5):	$A_{c\_sq\_5}$ = $P_{crit\_sq\_5}$ * d_{c_2}	$A_{c\_sq\_5}$ =	7482.39	in^2
Polar Moment of Inertia at assumed Critical Section:	J_{c_cir} = dc_2*(dpier1+dc_2)^3/6 + ((dpier1+dc_2)*(dc_2^3))/6 + (dc_2*(dpier1+dc_2))*(dpier1+dc_2)^2/(IF($L$169=0,2,4))	J_{c_cir} =	11287336.49	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section 1:	$J_{c\_sq\_1}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/2	$J_{c\_sq\_1}$ =	9002414.98	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_2}$ = (dc_2*(dpier_sq+dc_2)^3)/12 + ((dpier_sq+dc_2)*(dc_2^3))/12 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/2	$J_{c\_sq\_2}$ =	7761697.13	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_3}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_3}$ =	5741925.34	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_4}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_4}$ =	5741925.34	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_5}$ = (dc_2*(dpier_sq+dc_2)^3)/12 + ((dpier_sq+dc_2)*(dc_2^3))/12 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_5}$ =	4501207.49	in^4
*Applied Shear Force (1.2*D LC):*	$V_{u\_1.2}$ = 1.2*W_{pier} + 1.2 * IF(OR($B$1="G",$B$1="H"), P_{comp} / 1.2, P_{comp})	$V_{u\_1.2}$ =	307.74	kip
*Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling}$ = $V_{u\_1.2}$ / A_c + (Y_v * M_v * (d_{pier1} + dc_2)/2) / J_{c_1}	$v_{u\_1.2\_controlling}$ =	0.043	ksi
*Eq. Sq. Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling\_sq}$ = $V_{u\_1.2}$ / A_c + (Y_v * M_v * (d_{pier_sq} + dc_2)/2) / J_c	$v_{u\_1.2\_controlling\_sq}$ =	0.046	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.201	ksi

Check	**Φv_n =**	**0.201**	**ksi**	**>=**	**v_{u_demand} =**	**0.043**	**ksi**	**RATING:** **21.30%**	**OK**

Two-Way Shear (Compression, Flexural Component) [BOTTOM REINFORCEMENT]

Distance To Outside Edge:	$dist_{outside}$ = MIN((W-BW)/2,BW/2)*2	$dist_{outside}$ =	14.14	ft
Effective Pad Width:	$b_{\_pad}$ = MIN(dpier+3*T,W,dist_outside)	$b_{\_pad}$ =	12.75	ft
Bar Spacing:	B_{s_pad} = Bs_pad (see design checks below)	B_{s_pad} =	6.92	in
Fraction of Bars in Effective Width:	$m_{\_effective}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad)	$m_{\_effective}$ =	22.11	
Area of Steel in Effective Width:	$A_{s\_effective}$ = VLOOKUP(Sp,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective}$ =	22.11	in²
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective}$ = $A_{s\_effective}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective}$ =	2.27	in
	β_{pad} = β_{pad} (see design checks below)	β_{pad} =	0.825	
Distance from Top to Nuetral Axis:	$c_{\_effective}$ = $a_{\_effective}$ / β_{pad}	$c_{\_effective}$ =	2.75	
Effective depth:	dc = dc (see One-Way Shear check above)	dc =	28.308	in
Modulus of Elasticity of Steel:	E_s = 29000 ksi	E_s =	29000	ksi
Strain in Steel:	$\varepsilon_{s\_effective}$ = 0.003 * (dc-c) / c	$\varepsilon_{s\_effective}$ =	0.02790	in/in
Compression-Controlled Strain Limit::	ε_c = F_y / E_s	ε_c =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_t = 0.005	ε_t =	0.00500	in/in
Flexure Strength Reduction Factor:	$\varphi flex_{\_effective}$ = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	$\varphi flex_{\_effective}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective}$ = $A_{s\_effective}$ * (F_y) * (dc - $a_{\_effective}$ / 2) * (1/12)	$M_{n\_effective}$ =	3004.52	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective}$ =	2704.07	ft-kips

Two-Way Shear (Compression, Flexural Component) [TOP REINFORCEMENT]

Bar Spacing:	$B_{s\_pad\_top}$ = IF(Input!$S$6=TRUE,(W*12 - 2 * ccpad - VLOOKUP(sptop,Ref!$A$2:C	$B_{s\_pad\_top}$ =	12.75	in
Fraction of Bars in Effective Width:	$m_{\_effective\_top}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad_top)	$m_{\_effective\_top}$ =	22.11	
Area of Steel in Effective Width:	$A_{s\_effective\_top}$ = VLOOKUP(Sptop,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective\_top}$ =	22.11	in²
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective\_top}$ = $A_{s\_effective\_top}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective\_top}$ =	2.27	in
Distance from Top to Nuetral Axis:	$c_{\_effective\_top}$ = $a_{\_effective\_top}$ / β_{pad}	$c_{\_effective\_top}$ =	2.75	
Effective depth:	dc_top = T *12 - ccpad - 1.5 * VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)	d_{c_top} =	28.308	in
Strain in Steel:	$\varepsilon_{s\_effective\_top}$ = 0.003 * (dc_top-c_effective_top) / c_effective_top	$\varepsilon_{s\_effective\_top}$ =	0.02790	in/in
Flexure Strength Reduction Factor:	$\varphi flex_{\_effective\_top}$ = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	$\varphi flex_{\_effective\_top}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective\_top}$ = $A_{s\_effective\_top}$ * (F_y) * (dc_top - $a_{\_effective\_top}$ / 2) * (1/12)	$M_{n\_effective\_top}$ =	3004.52	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective\_top}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective\_top}$ =	2704.07	ft-kips
Applied Moment:	$Yf*M_{u\_comp}$ = $Yf*M_{u\_comp}$	$Yf*M_{u\_comp}$ =	65.25	ft-kips

Check **$\varphi M_{n\_effective}$ = 5408.14 ksi >= $Yf*M_{u\_comp}$ = 65.25 ksi** **RATING: 1.21% OK**

Two-Way Shear (Uplift)

Moment applied at base of Pier:	M_{v_tens} =	$M_{u\_tension}$ * 12 in / ft	M_{v_tens} =	1170.00	kip*in
Diameter of Longitudinal Rebar Cage:	$d_{\_cage}$ =	dpier*12-2*(ccpier+VLOOKUP(St,Ref!$A$2:$C$12,2,0))-VLOOKUP(Sc,Ref!$A$2:$C$12,2,0)	$d_{\_cage}$ =	45.87	in
Eq. Sq. Diameter of Longitudinal Rebar Cage:	$d_{\_cage\_sq}$ =	SQRT(PI())/2*d_cage	$d_{\_cage\_sq}$ =	40.65	in
Steel Embedment Length:	L_{embed} =	dc_2 (see One-Way Shear check above)	L_{embed} =	28.87	in
Radius of Two-Way Shear Plane:	r_{2way_tens} =	0.5*(d_cage/12 + Lembed/12)	r_{2way_tens} =	3.11	ft
	$r_{2way\_tens\_sq}$ =	0.5*(SQRT(PI())/2*d_cage/12 + Lembed/12)	$r_{2way\_tens\_sq}$ =	2.90	ft
Length of Shear Perimeter to Deduct:	s_{tens} =	r_tens*RADIANS(2*ACOS(((r_tens-MAX(r_tens-Ledge,0))/r_tens))*180/PI())	s_{tens} =	0.00	ft
Eq. Sq. Length of Shear Perimeter to Deduct:	s_{tens_sq} =	0	s_{tens_sq} =	0.00	ft
Circular Critical Perimeter:	P_{crit_tens} =	((d_cage/12+Lembed/12)*PI() - stens)*12	P_{crit_tens} =	234.82	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_tens\_sq\_1}$ =	4*(d_cage_sq+Lembed)	$P_{crit\_tens\_sq\_1}$ =	278.10	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_tens\_sq\_2}$ =	2*(d_cage_sq + Lembed) + (W*12-BW*12)	$P_{crit\_tens\_sq\_2}$ =	308.73	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_tens\_sq\_3}$ =	2 * (d_cage_sq + Lembed) + (W - BW * COS(RADIANS(30)) - Ledge2)*12	$P_{crit\_tens\_sq\_3}$ =	334.23	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_tens\_sq\_4}$ =	2 * (d_cage_sq + Lembed + Ledge2 * 12)	$P_{crit\_tens\_sq\_4}$ =	334.23	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_tens\_sq\_5}$ =	d_cage_sq + Lembed + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30))	$P_{crit\_tens\_sq\_5}$ =	251.95	in
Area of Concrete in Shear:	A_{c_tens} =	Pcrit_tens*Lembed	A_{c_tens} =	6779.58	in^2
Equivalent Square Area of Concrete in Shear:	$A_{c\_tens\_sq1}$ =	Pcrit_tens_sq1*Lembed	$A_{c\_tens\_sq1}$ =	8029.30	in^2
	$A_{c\_tens\_sq2}$ =	'Pcrit_tens_sq2*Lembed	$A_{c\_tens\_sq2}$ =	8913.65	in^2
	$A_{c\_tens\_sq3}$ =	Pcrit_tens_sq3*Lembed	$A_{c\_tens\_sq3}$ =	9649.83	in^2
	$A_{c\_tens\_sq4}$ =	Pcrit_tens_sq4*Lembed	$A_{c\_tens\_sq4}$ =	9649.83	in^2
	$A_{c\_tens\_sq5}$ =	Pcrit_tens_sq5*Lembed	$A_{c\_tens\_sq5}$ =	7274.42	in^2
Polar Moment of Inertia at assumed Critical Section:	J_{c_tens} =	Lembed*(d_cage+Lembed)^3/6 + ((d_cage+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage+Lembed))*(d_cage+Lembed)^2/(IF(Ledge2=0,2,4))	J_{c_tens} =	5323180.45	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section 1:	$J_{c\_tens\_sq\_1}$ =	(Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/2	$J_{c\_tens\_sq\_1}$ =	6747457.12	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_2}$ =	(Lembed*(d_cage_sq+Lembed)^3)/12 + ((d_cage_sq+Lembed)*(Lembed^3))/12 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/2	$J_{c\_tens\_sq\_2}$ =	5799444.26	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_3}$ =	(Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_3}$ =	4321741.42	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_4}$ =	(Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_4}$ =	4321741.42	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_5}$ =	(Lembed*(d_cage_sq+Lembed)^3)/12 + ((d_cage_sq+Lembed)*(Lembed^3))/12 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_5}$ =	3373728.56	in^4
*Applied Shear Force (0.9*D LC):*	$V_{u\_0.9\_tens}$ =	MAX(-0.9*Wpier + 0.9 * IF(OR($B$1="G",$B$1="H"), Puplift / 0.9, Puplift),	$V_{u\_0.9\_tens}$ =	257.95	kip
*Controlling Shear Stress (0.9*D LC):*	$v_{u\_0.9\_controlling\_tens}$ =	$V_{u\_0.9}$ / A_{c_tens} + (Υ_v * M_v * (d_{cage} + Lembed)/2) / J_{c_tens}	$v_{u\_0.9\_controlling\_tens}$ =	0.041	ksi
*Equivalent Square Shear Stress (0.9*D LC):*	$v_{u\_0.9\_tens\_sq}$ =	Vu_0.9_tens/Ac_tens_sq5 + (Υv * Mv_tens * (d_cage_sq + Lembed)/2) /	$v_{u\_0.9\_tens\_sq}$ =	0.040	ksi
Shear Stress Capacity:	Φv_n =	φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.201	ksi

Check	**Φv_n =**	**0.201**	**ksi**	**>=**	**v_{u_demand} =**	**0.040**	**ksi**	**RATING:** **20.02%**	**OK**

Two-Way Shear (Uplift, Flexural Component)

Applied Moment: $Yf*M_{u\_tension}$ = $Yf*M_{u\_tension}$ | $Yf*M_{u\_tension}$ = 58.5

Check $\varphi M_{n\_effective}$ = **5408.14 ksi** >= $f*M_{u\_tension}$ = **58.50 ksi** **RATING: 1.08% OK**

Pad Flexure (Net Bearing Pressure)

	β_{pad} = IF(F'c <= 4, 0.85, IF(F'c >= 8, 0.65, 0.85 - (F'c - 4) * 0.05))	β_{pad} = 0.825	
Provided Steel:	A_{s_pad} = A_{b_pad} * m_pad	A_{s_pad} = 52.00	in^2
Depth of Equivalent Rectangular Stress Block:	a = A_{s_pad} * Fy / (0.85 * F'c * W)	a = 2.27	in
Distance from Top to Nuetral Axis:	c = a / β_{pad}	c = 2.75	in
Modulus of Elasticity of Steel:	E_s = 29000 ksi	E_s = 29000	ksi
Strain in Steel:	ε_s = 0.003 * (dc-c) / c	ε_s = 0.02792	in/in
Compression-Controlled Strain Limit::	ε_c = F_y / E_s	ε_c = 0.00207	in/in
Tension-Controlled Strain Limit::	ε_t = 0.005	ε_t = 0.00500	in/in
Flexure Strength Reduction Factor:	φflex = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	φflex = 0.9	
Nominal Flexural Strength:	M_n = $As_{\_pad}$ * (F_y) * (dc - a / 2) * (1/12)	M_n = 7065.53	ft-kips
Design Flexural Strength:	φM_n = φflex * Mn	φM_n = 6358.97	ft-kips
*Bearing Press. at Crit. Section (0.9*D LC):*	qmid_0.9 = qu_st_0.9 - sqs_0.9 * d'	qmid_0.9 = 1.38	ksf
*Bearing Press. at Crit. Section (1.2*D LC):*	qmid_1.2 = qu_st_1.2 - sqs_1.2 * d'	qmid_1.2 = 1.64	ksf

Resisting Weight above Critical Section:

	Thickness (ft)	Unit Weight (kcf)	Weight (kip) (0.9*D LC)	Weight (kip) (1.2*D LC)	Moment Arm (ft)	Resisting Moment (ft-kips) (0.9*D LC)	Resisting Moment (ft-kips) (1.2*D LC)
Soil Above Water Table:	3.25	0.125	64.52	86.03	2.941209274	189.77	253.03
Soil Below Water Table:	0	0.063	0.00	0.00	2.941209274	0.00	0.00
Pad Above Water Table:	2.75	0.150	65.52	87.35	2.941209274	192.69	256.93
Pad Below Water Table:	0	0.088	0.00	0.00	2.941209274	0.00	0.00
Total:			130.04	173.38		382.47	509.96

*Factored Bending Moment (0.9*D LC):* Mu_pad_0.9 = 'Pad Shear and Moment Diagrams'!$AZ$21 | Mu_pad_0.9 = 480.25 ft-kips

*Factored Bending Moment (1.2*D LC):* Mu_pad_1.2 = 'Pad Shear and Moment Diagrams'!$CH$21 | Mu_pad_1.2 = 486.27 ft-kips

Check φM_n = **6358.97 ft-kips** >= M_{u_pad} = **486.27 ft-kips** **RATING: 7.65% OK**

PIER DESIGN CHECKS

Minimum Steel

Min. area of steel (pier): A_{st_c} = Ag * 0.005 | A_{st_c} = 11.45 in^2

Check A_{s_pier} = **18.00 in²** >= A_{st_c} = **11.45 in²** **RATING: 63.62% OK**

Bar Spacing

Bar separation: B_{s_pier} = (do * π) / m_pier - db_pier | B_{s_pier} = 6.88 in

Check **18.00 in** >= B_{s_pier} = **6.88 in** **RATING: 38.21% OK**

Vertical Rebar Development Length

Reinforcement location:	α_c =	if space under bar > 12", 1.3, else use 1.0	α_c =	1.3	
Epoxy coating:	β_c =	for non- epoxy coated, use 1.0	β_c =	1.0	
Max term:	$\alpha\beta_c$ =	product of α x β not to exceed 1.7	$\alpha\beta_c$ =	1.3	
Reinforcement size:	γ_c =	if bar size is 6 or less, 0.8, else use 1.0	γ_c =	1	
Light weight concrete:	λ_c =	1.0	λ_c =	1.0	
Spacing/cover:	c_c =	use smaller of half of bar spacing or concrete cover	c_c =	3.6	in
Transverse bars:	k_{tr_c} =	0 in (per simplification)	k_{tr_c} =	0	in
Max term:	c_c' =	MIN(2.5, (c_c + ktr_c) / db_c)	c_c' =	2.500	
Excess reinforcement:	R_c =	Ast_c / As_c	R_c =	0.64	
Development (tensile):	$L_{dt}'\_c$ =	(3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ_c * γ_c * λ_c * R_c * db_c / c_c'	$L_{dt}'\_c$ =	25.03	in
Minimum length:	L_{d_min} =	12 inches	L_{d_min} =	12.0	in
Development length:	L_{dt_c} =	MAX(Ld_min, Ldt'_c)	L_{dt_c} =	25.03	in
Development (comp.):	$L_{dc}'\_c$ =	0.02 * db_c * Fy*1000 / √(F'c*1000)	$L_{dc}'\_c$ =	20.18	in
	$L_{dc}''\_c$ =	0.0003 * db_c * Fy*1000	$L_{dc}''\_c$ =	20.30	in
Development length:	L_{dc_c} =	MAX(8, Ldc'_c, Ldc''_c)	L_{dc_c} =	20.30	in
Length available in pier:	L_{vc} =	D - T + E - cc	L_{vc} =	42.0	in
Check	L_{vc} = **42.00 in**	**>=**	L_{dt_c} = **25.03 in**		**OK**
Check	L_{vc} = **42.00 in**	**>=**	L_{dc_c} = **20.30 in**		**OK**
Length available in pad:	L_{vp} =	T - ccpad	L_{vp} =	30.0	in
Check	L_{vp} = **30.00 in**	**>=**	L_{dt_c} = **25.03 in**		**OK**
Check	L_{vp} = **30.00 in**	**>=**	L_{dc_c} = **20.30 in**		**OK**

Vertical Rebar Hook Ending

Bar size & clear cover:	α_h =	=if bar <= 11, and cc >= 2.5", use 0.7, else use 1.0	α_h =	0.7	
Epoxy coating:	β_h =	for non- epoxy coated, use 1.0	β_h =	1.0	
Light weight concrete:	λ_h =	1.0	λ_h =	1.0	
Development (hook):	L_{dh}' =	0.02 * αh * βh * λh * Fy*1000 / √(F'c*1000) * db_c	L_{dh}' =	14.1	in
Minimum length:	L_{dh_min} =	the larger of: 8 * d_b or 6 in	L_{dh_min} =	9.0	in
Development length:	L_{dh} =	MAX(Ldh_min, Ldh')	L_{dh} =	14.1	in
Check	L_{vp} = **30.00 in**	**>=**	L_{dh} = **14.12 in**		**OK**
Hook tail length:	L_{h_tail} =	12 * db beyond the bend radius	L_{h_tail} =	19.2	in
Length available in pad:	L_{h_pad} =	12*MIN((W/2-(2/3)*BW*cos(30°)+Offset-dpier/2),(W-BW-dpier)/2) + ccpier - ccpad	L_{h_pad} =	57.8	in
Check	L_{h_pad} = **57.84 in**	**>=**	L_{dh_tail} = **19.18 in**		**OK**

Pier Ties

Minimum size: [ACI 7.10.5.1]	s_{t_min} =IF(s_c <= 10, 3, 4)	s_{t_min} =	3
z factor:	z_seismic = 0.5 if the SDC is A, B, or C, else 1.0	z_seismic =	0.5
Tie parameters:	s_{t} = 4; m_{t} = 23	d_{b_t} = 0.5 in; A_{b_t} = 0.2 in^2	
Allowable tie spacing per vertical rebar:	$B_{s\_t\_max1}$ = 8 / z * db_c	$B_{s\_t\_max1}$ =	18.048 in
per tie size:	$B_{s\_t\_max2}$ = 24 / z * db_t	$B_{s\_t\_max2}$ =	24 in
per pier diameter:	$B_{s\_t\_max3}$ = di / (4 * z²)	$B_{s\_t\_max3}$ =	54 in
per seismic zone:	$B_{s\_t\_max4}$ = 12" in active seismic zones, else 18"	$B_{s\_t\_max4}$ =	18 in
Maximum tie spacing:	$B_{s\_t\_max}$ = MIN(Bs_t_max1, Bs_t_max2, Bs_t_max3, Bs_t_max4)	$B_{s\_t\_max}$ =	18 in
Minimum required ties:	m_{t_min} = (D - T + E) / Bs_t_max + 2	m_{t_min} =	5.00

Check **m_{t} = 23.00 >= m_{t_min} = 5.00** **OK**

PAD DESIGN CHECKS

Minimum Steel Required for Shrinkage

Shrinkage:	ρ_{sh} = IF(Fy >= 60, 0.0018, 0.002)	ρ_{sh} =	0.0018
Min. Required Shrinkage Steel:	$A_{st\_p\_sh}$ = ρsh * W * T	$A_{st\_p\_sh}$ =	21.384 in^2

Check **A_{s_p} = 52.00 in^2 >= A_{st_p} = 21.38 in^2** **OK**

Bar Separation

Bar separation:	B_{s_pad} = (W - 2 * cc - db) / (m - 1)	B_{s_pad} =	6.92 in

Check **18" >= B_{s_p} = 6.92 in >= 2"** **OK**

Pad Development Length

Reinforcement location:	α_{p} = if space under bar > 12", 1.3, else use 1.0	α_{p} =	1.3
Epoxy coating:	β_{p} = for non- epoxy coated, use 1.0	β_{p} =	1.0
Max term:	$\alpha\beta_{p}$ = product of α x β not to exceed 1.7	$\alpha\beta_{p}$ =	1.3
Reinforcement size:	γ_{p} = if bar size is 6 or less, 0.8, else use 1.0	γ_{p} =	1
Light weight concrete:	λ_{p} = 1.0	λ_{p} =	1.0
Spacing/cover:	c_{p} = use smaller of half of bar spacing or concrete cover	c_{p} =	3.56 in
Transverse bars:	k_{tr_p} = 0 in (per simplification)	k_{tr_p} =	0 in
Max term:	c_{p}' = MIN(2.5, (c + ktr) / db)	c_{p}' =	2.500
Required moment (φt = 0.9):	M_{nr} = Mu_pad / φflex	M_{nr} =	540.3 ft-kips
Steel estimate:	A_{st_p}' = Mn / (φt * Fy * dc)	A_{st_p}' =	4.241 in^2
	a_{p} = Ast' * Fy / (β * F'c * W)	a_{p} =	0.19 in
Required steel:	$A_{st\_p\_st}$ = M_{nr} / (Fy * (dc - ap / 2))	$A_{st\_p\_st}$ =	3.830 in^2
Excess reinforcement:	R_{p} = Ast_p / As_p	R_{p} =	0.41
Development (tensile):	L_{d} = (3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ * γ * λ * R * db / c'	L_{d} =	16.18 in
Minimum length:	L_{d_min} = 12 inches	L_{d_min} =	12.0 in
Development length:	L_{dp} = MAX(Ld_min, Ldp')	L_{dp} =	16.18 in
Length available in pad:	L_{pad} = 12*MIN((W/2-(2/3)*BW*cos(30°)+Offset-dpier/2),(W-BW-dpier)/2)- ccpad	L_{pad} =	67.59 in

Check **L_{pad} = 67.59 in >= L_{dp} = 16.18 in** **OK**

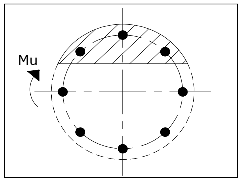
Maximum Allowable Moment of a Circular Pier

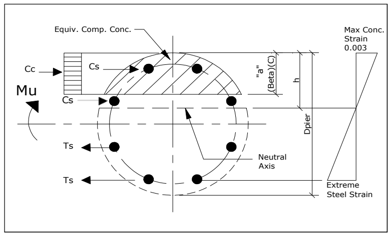
Pu: 266 kips (from Results Tab)
Axial Force type: Tension (from Results Tab)

For Internal Calculations:
Axial Load (Negative for Compression) = 266.00 kips

	Case 1	Case 2	
Reduction factor, ϕ2002 =	0.90	0.90	<-- ϕ based on ACI 318 2002, Section 9.3.2.2 and corresponding comentaries. Transition zone equation for ties: φ=0.48+83(et). Transition zone equation for spirals: φ=0.57+67(et).
Reduction factor, ϕ2005 =	0.90	0.90	<-- ϕ based on ACI 318 2005, Section 9.3.2.2 and corresponding comentaries. Transition zone equation for ties: φ=0.65+((et)-0.002)(250/3). Transition zone equation for spirals: φ=0.70+((et)-0.002)(200/3).
Reduction factor, ϕ2014 =	0.90	0.90	<-- ϕ based on ACI 318 2014, Section 21.2 and corresponding comentaries. Transition zone equation for ties: φ=0.65+0.25((et-εty)/(0.005-εty). Transition zone equation for spirals: φ=0.75+0.15((et-εty)/(0.005-εty).
ACI code:	0.90	0.90	

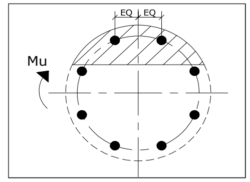
Case 1: Single Bar Near the Extreme Fiber





General Sketch (Variables) for both cases

Case 2: (2) Equidistant Bars Near the Extreme Fiber



Case 3: = Case 1, but Pu set at Max Axial Compression per ACI 318 (10-2) and phi=0.65.

Case 1

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.05 in
Equivalent compression zone factor = 0.825
Distance from extreme edge to equivalent compression zone factor, a = 5.81 in
Distance from centroid to neutral axis = 19.95 in

Compression Zone

Area of steel in compression zone, Asc = 3.00 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 38.31 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 132.81 in^2
Force in concrete = 0.85 * f'c * Acc, Fc = 508.01 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -774.01 kips <-- ϕ Not Involved = Total Steel Pn
Case 1, φ= 0.900
Axial (comp=negative), Pu = 266.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -508.01 kips
Shaft Comp. Capacity, ϕPn= **-239.40** kips <--φ Pn=Pu

Sum of the axial forces in the shaft = 0.00 kips **OK**

Maximum Moment

First moment of the concrete area in compression about the centoid = 3125.72 in^3
Distance between centroid of concrete in compression and centroid of pier = 23.53 in
Moment of concrete in compression = 11955.88 in-kips 996.3236 ft-kips
Total reinforcement moment = 6480.07 in-kips 540.0057 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 18435.95 in-kips
Moment Capacity of Drilled Shaft, ϕMn = 16592.36 in-kips 1382.696 ft-kips

Case 1, φMn = 1382.70 ft-kips

Case 2

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.12 in
Equivalent compression zone factor = 0.825
Distance from extreme edge to equivalent compression zone factor, a = 5.87 in
Distance from centroid to neutral axis = 19.88 in

Compression Zone

Area of steel in compression zone, Asc = 2.00 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 38.52 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 134.87 in^2
Force in concrete = 0.85 * f'c * Acc, Fc = 515.86 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -781.86 kips <-- ϕ Not Involved = Total Steel Pn
Case 2, φ= 0.900
Axial (comp=negative), Pu = 266.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -515.86 kips
Shaft Comp. Capacity, ϕPn= **-239.40** kips <--φ Pn=Pu

Sum of the axial forces in concrete in the shaft= 0.00 kips **OK**

Maximum Moment

First moment of the concrete area in compression about the centoid = 3169.16 in^3
Distance between centroid of concrete in compression and centroid of pier = 23.50 in
Moment of concrete in compression = 12122.03 in-kips 1010.169 ft-kips
Total reinforcement moment = 6408.35 in-kips 534.029 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 18530.38 in-kips
Moment Capacity of Drilled Shaft, ϕMn = 16677.34 in-kips 1389.778 ft-kips

Case 2, φMn = 1389.78 ft-kips

Case 3

Neutral Axis

Distance from extreme edge to neutral axis, h = 50.26 in
Equivalent compression zone factor = 0.825
Distance from extreme edge to equivalent compression zone factor, a = 41.47 in
Distance from centroid to neutral axis = -23.26 in

Compression Zone

Area of steel in compression zone, Asc = 13.00 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 122.40 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 1887.22 in^2
Force in concrete = 0.85 * f'c * Acc, Fc = 7218.60 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = 598.39 kips <-- ϕ Not Involved = Total Steel Pn
φ= 0.65
Magnified, Max Axial Comp, Pn, per ACI 318 (10-2)/(ϕ=0.65)= -7817.00 kips <-- (Pn per ACI 10-2)/ϕ
Balance Force in concrete, Fs+Fu = -7218.60 kips
Shaft Comp. Capacity, (ϕ=0.65)Pn= **5081.05** kips <--φ Pn=Pu

Sum of the axial forces in the shaft = 0.00 kips **OK**

Maximum Moment

First moment of the concrete area in compression about the centoid = 7897.48 in^3
Distance between centroid of concrete in compression and centroid of pier = 4.18 in
Moment of concrete in compression = 30207.84 in-kips 2517.32 ft-kips
Total reinforcement moment = 6214.37 in-kips 517.8639 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 36422.21 in-kips
Moment Capacity of Drilled Shaft, (ϕ=0.65)Mn = 23674.44 in-kips 1972.87 ft-kips

Case 3, at Pmax, (φ=0.65)Mn = 1972.87 ft-kips

Final Results		
Governing Orientation Case=	**1**	
phi, φ=	0.900	
Shaft ϕ*Mn=	**1382.70**	ft-kips
Distance from Edge of Shaft to N.A.=	7.05	in
Shaft Beta=	0.83	
Maximum Tensile Strain=	-0.01826	<------------- εt > 0.0050, Tension Controlled
Shaft Tension Cap., φTn= (φ=0.9)*(Total As)(Fy)=	972.00	kips
Shaft Max Comp, (φ=0.65)(0.80)[0.85*f'c*(Ag-Ast)+Ast*Fy]=	5081.05	kips

TC

Individual Bars (Case 1)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	22.94	2.98	1.75	0.00127	1.00	36.82	33.00	756.88
2	20.00	21.55	1.60	0.37	0.00068	1.00	19.75	15.92	343.16
3	40.00	17.57	-2.38	-3.62	-0.00101	0.00	-29.43	-29.43	-517.01
4	60.00	11.47	-8.49	-9.72	-0.00361	0.00	-60.00	-60.00	-688.08
5	80.00	3.98	-15.97	-17.20	-0.00680	0.00	-60.00	-60.00	-238.97
6	100.00	-3.98	-23.94	-25.17	-0.01019	0.00	-60.00	-60.00	238.97
7	120.00	-11.47	-31.42	-32.65	-0.01338	0.00	-60.00	-60.00	688.08
8	140.00	-17.57	-37.52	-38.76	-0.01598	0.00	-60.00	-60.00	1054.20
9	160.00	-21.55	-41.51	-42.74	-0.01767	0.00	-60.00	-60.00	1293.17
10	180.00	-22.94	-42.89	-44.12	-0.01826	0.00	-60.00	-60.00	1376.16
11	200.00	-21.55	-41.51	-42.74	-0.01767	0.00	-60.00	-60.00	1293.17
12	220.00	-17.57	-37.52	-38.76	-0.01598	0.00	-60.00	-60.00	1054.20
13	240.00	-11.47	-31.42	-32.65	-0.01338	0.00	-60.00	-60.00	688.08
14	260.00	-3.98	-23.94	-25.17	-0.01019	0.00	-60.00	-60.00	238.97
15	280.00	3.98	-15.97	-17.20	-0.00680	0.00	-60.00	-60.00	-238.97
16	300.00	11.47	-8.49	-9.72	-0.00361	0.00	-60.00	-60.00	-688.08
17	320.00	17.57	-2.38	-3.62	-0.00101	0.00	-29.43	-29.43	-517.01
18	340.00	21.55	1.60	0.37	0.00068	1.00	19.75	15.92	343.16

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	10.00	22.59	2.71	1.46	0.00114	1.00	33.09	29.26	661.02
2	30.00	19.86	-0.02	-1.26	-0.00001	0.00	-0.20	-0.20	-3.89
3	50.00	14.74	-5.14	-6.38	-0.00216	0.00	-60.00	-60.00	-884.58
4	70.00	7.84	-12.03	-13.28	-0.00507	0.00	-60.00	-60.00	-470.67
5	90.00	0.00	-19.88	-21.13	-0.00838	0.00	-60.00	-60.00	0.00
6	110.00	-7.84	-27.72	-28.97	-0.01168	0.00	-60.00	-60.00	470.67
7	130.00	-14.74	-34.62	-35.87	-0.01459	0.00	-60.00	-60.00	884.58
8	150.00	-19.86	-39.74	-40.99	-0.01674	0.00	-60.00	-60.00	1191.79
9	170.00	-22.59	-42.47	-43.71	-0.01789	0.00	-60.00	-60.00	1355.25
10	190.00	-22.59	-42.47	-43.71	-0.01789	0.00	-60.00	-60.00	1355.25
11	210.00	-19.86	-39.74	-40.99	-0.01674	0.00	-60.00	-60.00	1191.79
12	230.00	-14.74	-34.62	-35.87	-0.01459	0.00	-60.00	-60.00	884.58
13	250.00	-7.84	-27.72	-28.97	-0.01168	0.00	-60.00	-60.00	470.67
14	270.00	0.00	-19.88	-21.13	-0.00838	0.00	-60.00	-60.00	0.00
15	290.00	7.84	-12.03	-13.28	-0.00507	0.00	-60.00	-60.00	-470.67
16	310.00	14.74	-5.14	-6.38	-0.00216	0.00	-60.00	-60.00	-884.58
17	330.00	19.86	-0.02	-1.26	-0.00001	0.00	-0.20	-0.20	-3.89
18	350.00	22.59	2.71	1.46	0.00114	1.00	33.09	29.26	661.02

Individual Bars (Case 3)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	22.94	46.20	37.40	0.00276	1.00	60.00	56.18	1288.43
2	20.00	21.55	44.82	36.02	0.00267	1.00	60.00	56.18	1210.73
3	40.00	17.57	40.83	32.04	0.00244	1.00	60.00	56.18	986.99
4	60.00	11.47	34.73	25.94	0.00207	1.00	60.00	56.18	644.21
5	80.00	3.98	27.25	18.45	0.00163	1.00	47.16	43.34	172.60
6	100.00	-3.98	19.28	10.49	0.00115	1.00	33.37	29.55	-117.69
7	120.00	-11.47	11.80	3.00	0.00070	1.00	20.42	16.59	-190.29
8	140.00	-17.57	5.69	-3.10	0.00034	0.00	9.86	9.86	-173.19
9	160.00	-21.55	1.71	-7.08	0.00010	0.00	2.96	2.96	-63.87
10	180.00	-22.94	0.33	-8.47	0.00002	0.00	0.57	0.57	-13.06
11	200.00	-21.55	1.71	-7.08	0.00010	0.00	2.96	2.96	-63.87
12	220.00	-17.57	5.69	-3.10	0.00034	0.00	9.86	9.86	-173.19
13	240.00	-11.47	11.80	3.00	0.00070	1.00	20.42	16.59	-190.29
14	260.00	-3.98	19.28	10.49	0.00115	1.00	33.37	29.55	-117.69
15	280.00	3.98	27.25	18.45	0.00163	1.00	47.16	43.34	172.60
16	300.00	11.47	34.73	25.94	0.00207	1.00	60.00	56.18	644.21
17	320.00	17.57	40.83	32.04	0.00244	1.00	60.00	56.18	986.99
18	340.00	21.55	44.82	36.02	0.00267	1.00	60.00	56.18	1210.73

Moment Capacity of Drilled Concrete Shaft (Caisson) for TIA Rev F, G, or H

Note: **Shaft assumed to have ties, not spiral, transverse reinforcing**

Site Data

ES-060
NorwalkAWC

Loads Already Factored		
For M (WL):	1.00	
For P (DL):	1.00	

Pier Properties		
Concrete:		
Pier Diameter =	4.5	ft
Concrete Area =	2290.2	in^2
Reinforcement:		
Clear Cover to **Tie**=	3.00	in
Horiz. **Tie** Bar Size=	4	
Vert. Cage Diameter =	3.82	ft
Vert. Cage Diameter =	45.87	in
Vertical Bar Size =	9	
Bar Diameter =	1.13	in
Bar Area =	1	in^2
Number of Bars =	18	
As Total=	18	in^2
A s/ Aconc, Rho:	0.0079	0.79%

ACI 10.5 , ACI 21.10.4, and IBC 1810.
Min As for Flexural, Tension Controlled, Shafts:

(3)*(Sqrt(f'c)/Fy:	0.0034	
200 / Fy:	0.0033	

Minimum Rho Check:

Assumed Min. Rho:	0.50%	
Provided Rho:	0.79%	**OK**

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn. Pn		
per ACI 318 (10-2)	5081.05	kips
at Mu=(ϕ=0.65)Mn=	1972.87	ft-kips
Max Tu, (φ=0.9) Tn =	972	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces		
TIA Revision:	H	
Max. Factored Shaft Mu:	97.5	ft-kips **(* Note)**
Max. Factored Shaft Pu:	266	kips
Max Axial Force Type:	Tension	

(*) Note: Max Shaft Superimposed Moment does not necessarily equal to the shaft top reaction moment

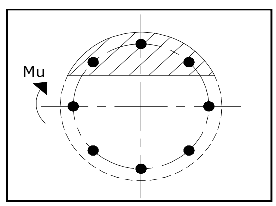
Load Factor	Shaft Factored Loads		
1.00	Mu:	97.5	ft-kips
1.00	Pu:	266	kips

Material Properties		
Concrete Comp. strength, f'c =	4500	psi
Reinforcement yield strength, Fy =	60	ksi
Reinforcing Modulus of Elasticity, E =	29000	ksi
Reinforcement yield strain =	0.00207	
Limiting compressive strain =	0.003	
ACI 318 Code		
Select Analysis ACI Code=	2014	

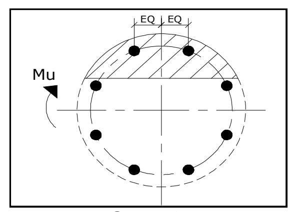
SOLVE <-- Press Upon Completing All Input

Results:

Governing Orientation Case: **1**



Case 1



Case 2

Dist. From Edge to Neutral Axis:	**7.05**	in
Extreme Steel Strain, εt:	**0.0183**	

εt > 0.0050, Tension Controlled

Reduction Factor,φ:	**0.900**	

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	-239.40	kips
Drilled Shaft Moment Capacity, φMn:	**1382.70**	ft-kips
Drilled Shaft Superimposed Mu:	**97.50**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**7.1%**

NorwalkAWC Exp. C
Legend
NorwalkAWC (41.125392 -73.421578)
Kellogg Pond
Google Earth
© 2018 Google
2000 ft

ATTACHMENT D – PROOF OF DELIVERY OF NOTICE

Ref: CT578100 ES-060 Date: 25Jun20
Dep: BL GRAPHICS Wgt: 1.05 LBS
DV: 0.00

SHIPPING:	0.00
SPECIAL:	0.00
HANDLING:	0.00
TOTAL:	0.00

Svcs: PRIORITY OVERNIGHT
TRCK: 1714 2090 5347

ORIGIN ID:RSPA (800) 301-3077
BL GRAPHICS
BL GRAPHICS
355 RESEARCH PARKWAY

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 25JUN20
ACTWGT: 1.05 LB
CAD: 0765627/CAFE3311

BILL THIRD PARTY

TO **HONORABLE HARRY W. RILLING, MAYOR**
CITY OF NORWALK
125 EAST AVENUE

NORWALK CT 06856

REF: CT578100 ES-060

DEPT: BL GRAPHICS

565C1/C7DD/05A2

FedEx Express

E

J191219082001uv

FRI - 26 JUN 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **1714 2090 5347**

E4 YAKA

06856
CT-US **JFK**

Ref: CT578100 ES-060 Date: 25Jun20 SHIPPING: 0.00
Dep: BL GRAPHICS Wgt: 1.05 LBS SPECIAL: 0.00
HANDLING: 0.00
DV: 0.00 TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT
TRCK: 1714 2090 5358

ORIGIN ID:RSPA (800) 301-3077
BL GRAPHICS
BL GRAPHICS
355 RESEARCH PARKWAY

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 25JUN20
ACTWGT: 1.05 LB MAN
CAD: 0765627/CAFE3311

BILL THIRD PARTY

TO **STEVEN KLEPPIN– DIRECTOR OF PLANNIN**
CITY OF NORWALK
125 EAST AVENUE

NORWALK CT 06856
REF: CT578100 ES-060
DEPT: BL GRAPHICS

565C1/C7DD/05A2

FedEx Express

E

J191219082001uv

FRI – 26 JUN 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **1714 2090 5358**

E4 YAKA

06856
CT-US **JFK**

ATTACHMENT E - POWER DENSITY REPORT

C Squared Systems, LLC
65 Dartmouth Drive
Auburn, NH 03032
603-644-2800
support@csquaredsystems.com

Calculated Radio Frequency Emissions Report

ES-060

2 Tindall Avenue

Norwalk, CT 06851

February 5, 2020

Table of Contents

List of Tables

List of Figures

1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed Eversource installation to be located at 2 Tindall Avenue in Norwalk, CT.

Eversource is proposing to install one omnidirectional antenna as part of its 220 MHz communications system.

This report considers the planned antenna configuration as provided by Eversource along with power density information of the existing Eversource antennas to calculate the % MPE (Maximum Permissible Exposure) of the proposed facility at ground level.

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. Power Density Calculation Methods

The power density calculation results were generated using the following formula as outlined in FCC bulletin OET 65, and Connecticut Siting Council recommendations:

$$\text{Power Density} = \left(\frac{1.6^2 \times 1.64 \times \text{ERP}}{4\pi \times R^2}\right) \text{X Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power = 1.64 x ERP

R = Radial Distance = $\sqrt{(H^2 + V^2)}$

H = Horizontal Distance from antenna

V = Vertical Distance from radiation center of antenna

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and full power, and that all antenna channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not consider actual terrain elevations which could attenuate the signal. As a result, the calculated power density and corresponding % MPE levels reported below are much higher than the actual levels will be from the final installation.

4. Calculated % MPE Results

Table 1 below outlines the power density information for the site. The Eversource omnidirectional antenna has a narrow vertical beamwidth of 30°; therefore, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the facility. Please refer to Attachment C for the vertical pattern of the proposed Eversource antenna. The calculated result in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	% MPE
Eversource Energy	*121*	*220*	*1*	*150*	*0.0004*	*0.2000*	*0.20%*
Eversource Energy	*144*	*220*	*1*	*150*	*0.0003*	*0.2000*	*0.14%*
Eversource Energy	158	935.4	2	255	0.0008	0.6236	0.13%
Eversource Energy	154	154.5	1	990	0.0016	0.2000	0.81%
Eversource Energy	151.5	451.4	1	120	0.0002	0.3009	0.07%
Eversource Energy	138	158	1	40	0.0001	0.2000	0.04%
Eversource Energy	132	37.7	1	250	0.0006	0.2000	0.28%
Eversource Energy	126	48.3	1	250	0.0006	0.2000	0.31%
Eversource Energy	122	47.8	1	100	0.0003	0.2000	0.13%
Eversource Energy	120	173	1	100	0.0003	0.2000	0.14%
Eversource Energy	153	217	4	124	0.0008	0.2000	0.41%
						Total	**2.33%**

Table 1: Proposed Facility % MPE [1] [2] [3] [4]

[1] The power density information for Eversource was taken directly from the CSC database dated 12/13/2019. Please note that % MPE values listed are rounded to two decimal points and the total % MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not identically match the total value reflected in the table.

[2] The existing Eversource antenna heights listed are in reference to the structural analysis report dated 01/10/2020.

[3] The proposed antenna height listed for Eversource is in reference to Black & Veatch Construction Drawing dated 12/30/2019.

[4] The two existing Eversource 220 MHz entries in the CSC database should be removed and replaced with the updated (blue) Eversource values provided in Table 1.

5. Conclusion

The above analysis concludes that RF exposure at ground level with the proposed antenna installation will be below the maximum power density limits as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Using the conservative calculation methods discussed herein, the highest expected percent of Maximum Permissible Exposure at ground level with the proposed installation is **2.33% of the FCC General Population/Uncontrolled limit**.

As noted previously, the calculated % MPE levels are more conservative (higher) than the actual levels will be from the finished installation.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in FCC OET Bulletin 65 Edition 97-01, IEEE Std. C95.1, and IEEE Std. C95.3.

Cory Goulet [signature]

February 5, 2020

Report Prepared By: Cory Goulet
Associate RF Engineer
C Squared Systems, LLC

Date

Keith Vellante [signature]

February 5, 2020

Reviewed/Approved By: Keith Vellante
Director of RF Services
C Squared Systems, LLC

Date

C2 Systems

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

IEEE C95.1-2005, IEEE Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz IEEE-SA Standards Board

IEEE C95.3-2002 (R2008), IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz-300 GHz IEEE-SA Standards Board

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[6]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

[5] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure

[6] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure

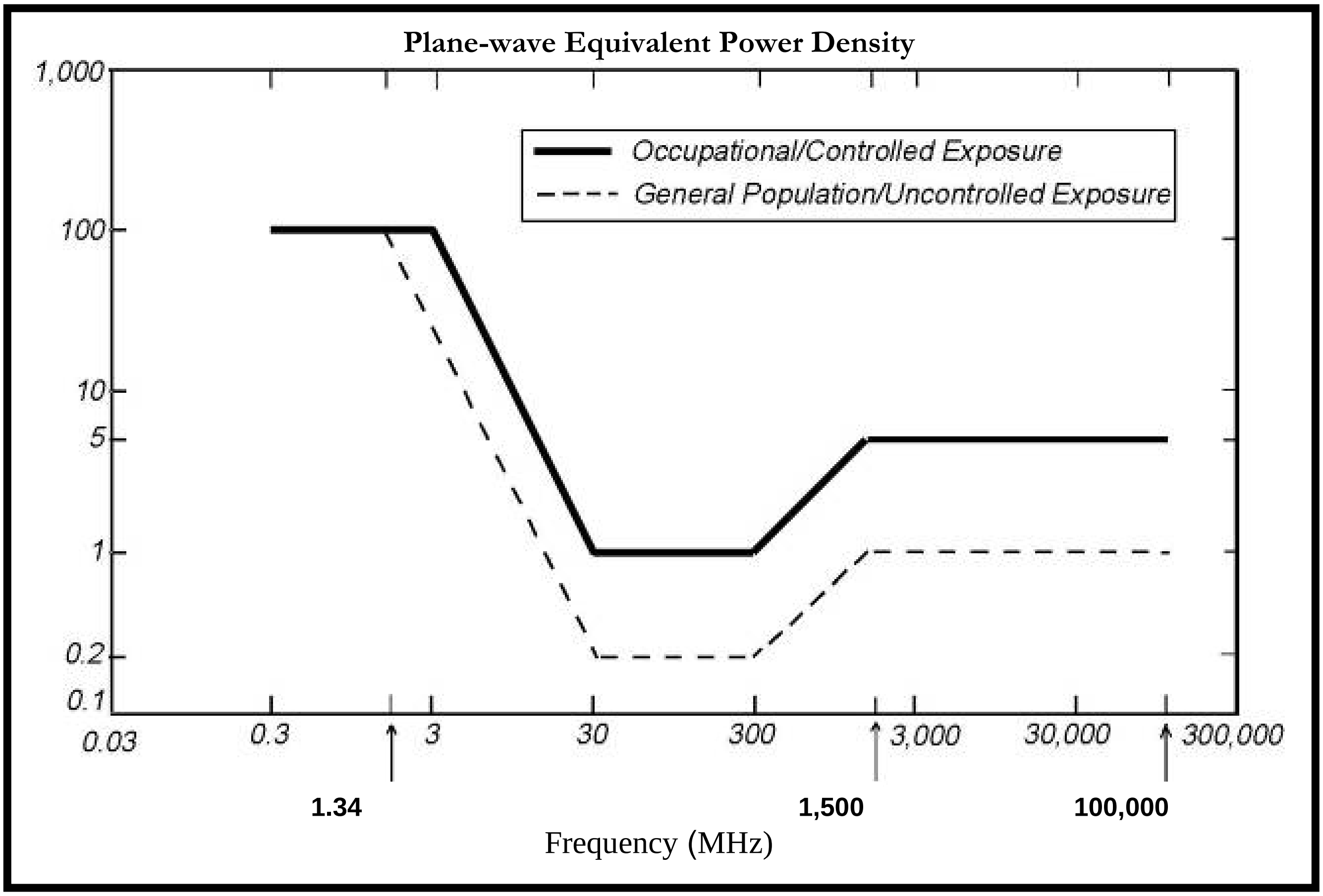


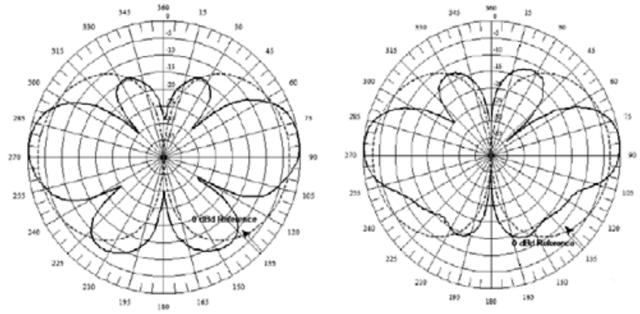
Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: Eversource Antenna Data Sheets and Electrical Patterns

217 MHz

Manufacturer:	dbSpectra
Model #:	DS2C03F36D
Frequency Band:	217-222 MHz
Gain:	3.0 dBd
Vertical Beamwidth:	30°
Horizontal Beamwidth:	360°
Polarization:	Vertical
Length:	24.3'

DS2C03F36D-N
DS2C03F36D-D



Top Bottom