EVERSOURCE ENERGY

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

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

March 11, 2020

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

RE: **Notice of Exempt Modification**
Eversource Site # 2390
1554 Highland Avenue, Torrington, CT 06790
Latitude: 41-48-5.69 N / Longitude: 73-10-25.9 W

Dear Ms. Bachman:

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource") currently maintains multiple antennas and microwave dishes at various mounting heights on an existing 196-foot self-support tower located at 1554 Highland Avenue in Torrington. See Attachment A, Parcel Map and Property Card. The tower and property are owned by Eversource. Eversource plans to install one 14-feet tall omni-directional antenna to be mounted at 187 feet above ground level ("AGL"), one 5.5-foot tall dipole antenna mounted at 165 feet 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 existing 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 9, 2020 and Attachment C, Structural Analysis, dated February 26, 2020.

The Connecticut Siting Council approved a guyed tower at this location in Docket No. 178 in September 1997. Pursuant to an exempt modification filing (EM-CL&P-143-080916), the guyed tower was replaced with the current existing self-support tower in 2016.

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 Elinor Carbone, Mayor for the City of Torrington and Martin J. Connor, AICP, City Planner for the City of Torrington 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 Radio Frequency Emissions Report, dated February 6, 2020 (Attachment D – 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). Two copies of this notice and a check in the amount of $625 are enclosed.

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 Elinor Carbone, Mayor, City of Torrington
Martin J. Connor, AICP, City Planner, City of Torrington

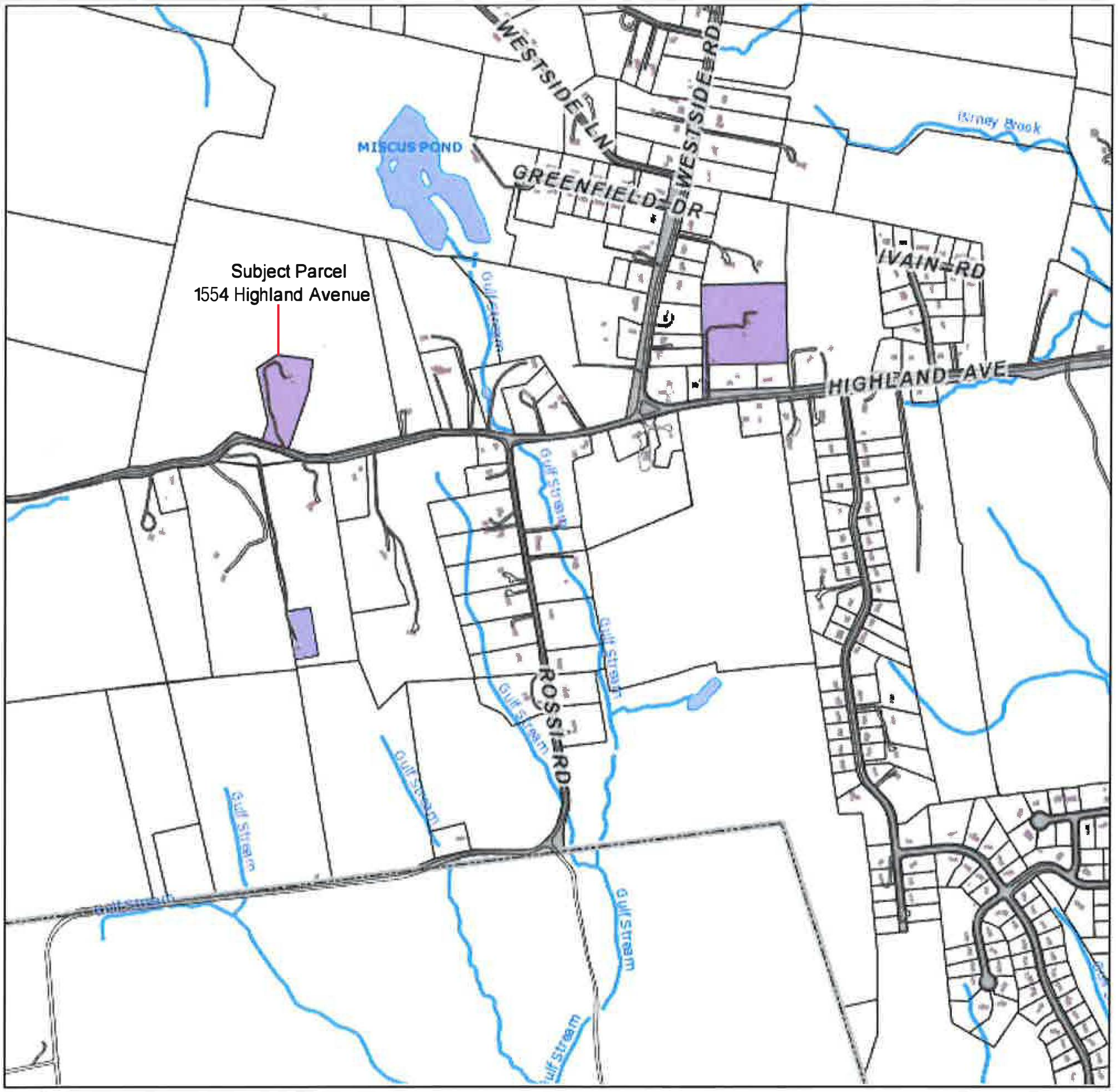
Attachments

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

Town of Torrington
Geographic Information System (GIS)

Date Printed: 3/4/2020



MAP DISCLAIMER - NOTICE OF LIABILITY
This map is for assessment purposes only. It is not for legal description or conveyances. All information is subject to verification by any user. The Town of Torrington and its mapping contractors assume no legal responsibility for the information contained herein.

Approximate Scale: 1 inch = 1000 feet

0 1,000 Feet

N W E S

The Assessor’s office is responsible for the maintenance of records on the ownership of properties. Assessments are computed at 70% of the estimated market value of real property at the time of the last revaluation which was 2014.

Information on the Property Records for the Municipality of Torrington was last updated on 3/3/2020.

Parcel Information

Location:	HIGHLAND AVE UNIT 2	Property Use:	Vacant Land	Primary Use:	Commercial Vacant Land
Unique ID:	2390	Map Block Lot:	217/002/002/002	Acres:	3.10
490 Acres:	0.00	Zone:	R60	Volume / Page:	0305/0685
Developers Map / Lot:	4482	Census:	3108-2N		

Value Information

	Appraised Value	Assessed Value
Land	68,931	48,250
Buildings	0	0
Detached Outbuildings	0	0
Total	68,931	48,250

Owner's Information

Owner's Data
CONNECTICUT LIGHT & POWER CO PO BOX 270 HARTFORD, CT 06141-0270

Owner History - Sales

Owner Name	Volume	Page	Sale Date	Deed Type	Valid Sale	Sale Price
CONNECTICUT LIGHT & POWER CO	0305	0685	06/08/1976		No	$0

Information Published With Permission From The Assessor

ATTACHMENT B – CONSTRUCTION DRAWINGS

EVERSOURCE ENERGY

SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

PROJECT SUMMARY

THE GENERAL SCOPE OF WORK CONSISTS OF THE FOLLOWING:

1. INSTALL TWO (2) NEW ANTENNAS, ONE (1) OMNI/WHIP ANTENNA AT ELEVATION 202'-0"± AGL AND ONE (1) DIPOLE ANTENNA AT ELEVATION 171'-0"± AGL.
2. INSTALL (1) NEW RACK WITH DMR EQUIPMENT IN EXISTING CONTROL BUILDING.

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:	SOAPSTONE RADIO
SITE ID NUMBER:	#2390
SITE ADDRESS:	1554 HIGHLAND AVE TORRINGTON, CT 06790
MAP:	217
BLOCK:	002
LOT:	002
ZONE:	R-60
LATITUDE:	41° 48' 5.69" N
LONGITUDE:	73° 10' 25.90" W
ELEVATION:	1353'± AMSL
FEMA/FIRM DESIGNATION:	C
ACREAGE:	3.1 ± AC (BOOK: 0305, PAGE: 0685)

CONTACT INFORMATION

APPLICANTS:
EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037

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

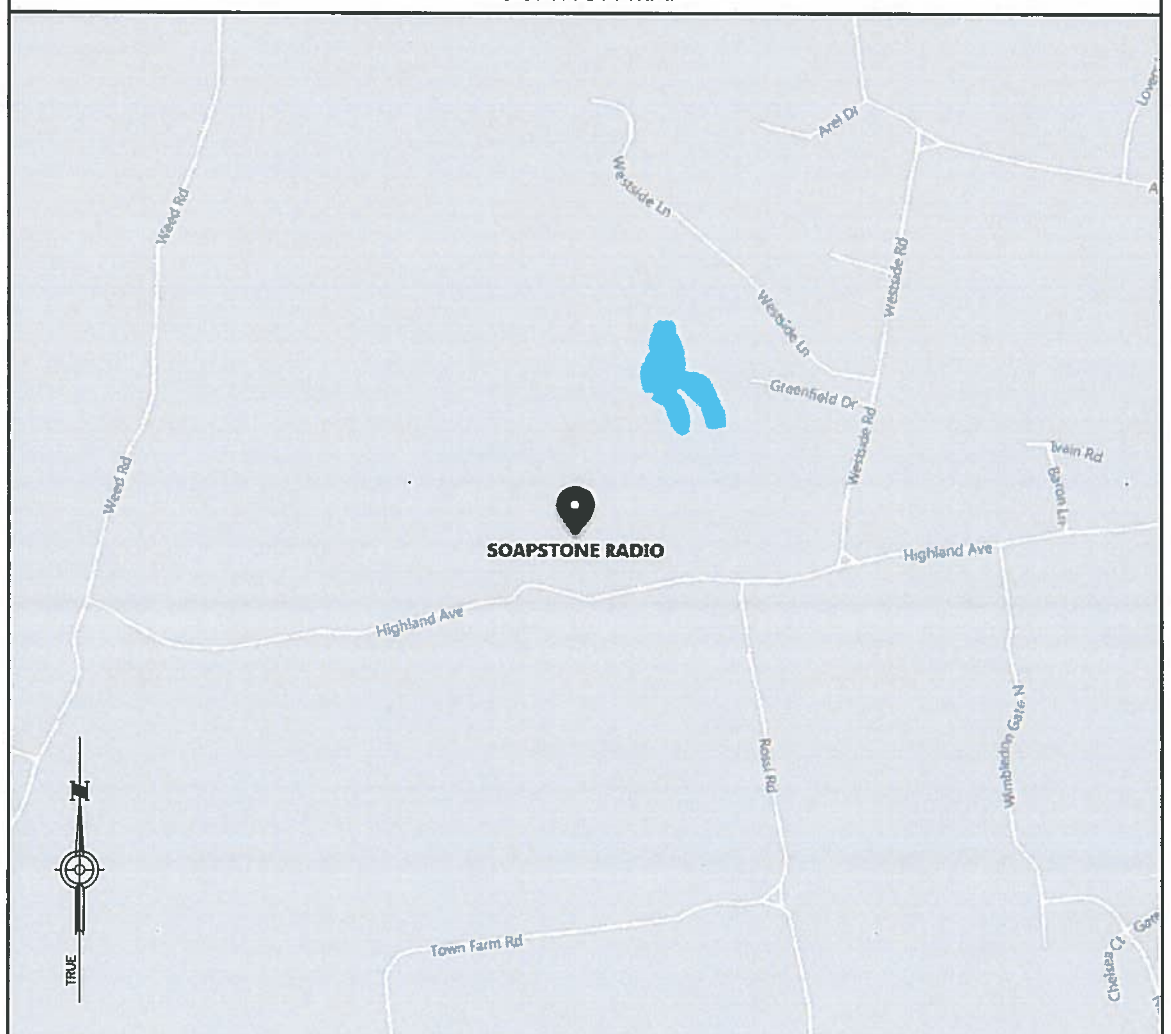
EVERSOURCE ENERGY PROJECT MANAGER:
NIKOLL PRECI
(860) 655-3079

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

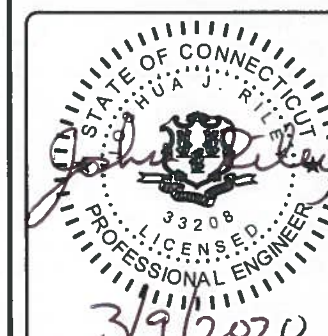
UNDERGROUND SERVICE ALERT
UTILITIES PROTECTION CENTER, INC.
811
48 HOURS BEFORE YOU DIG

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:	TYW
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

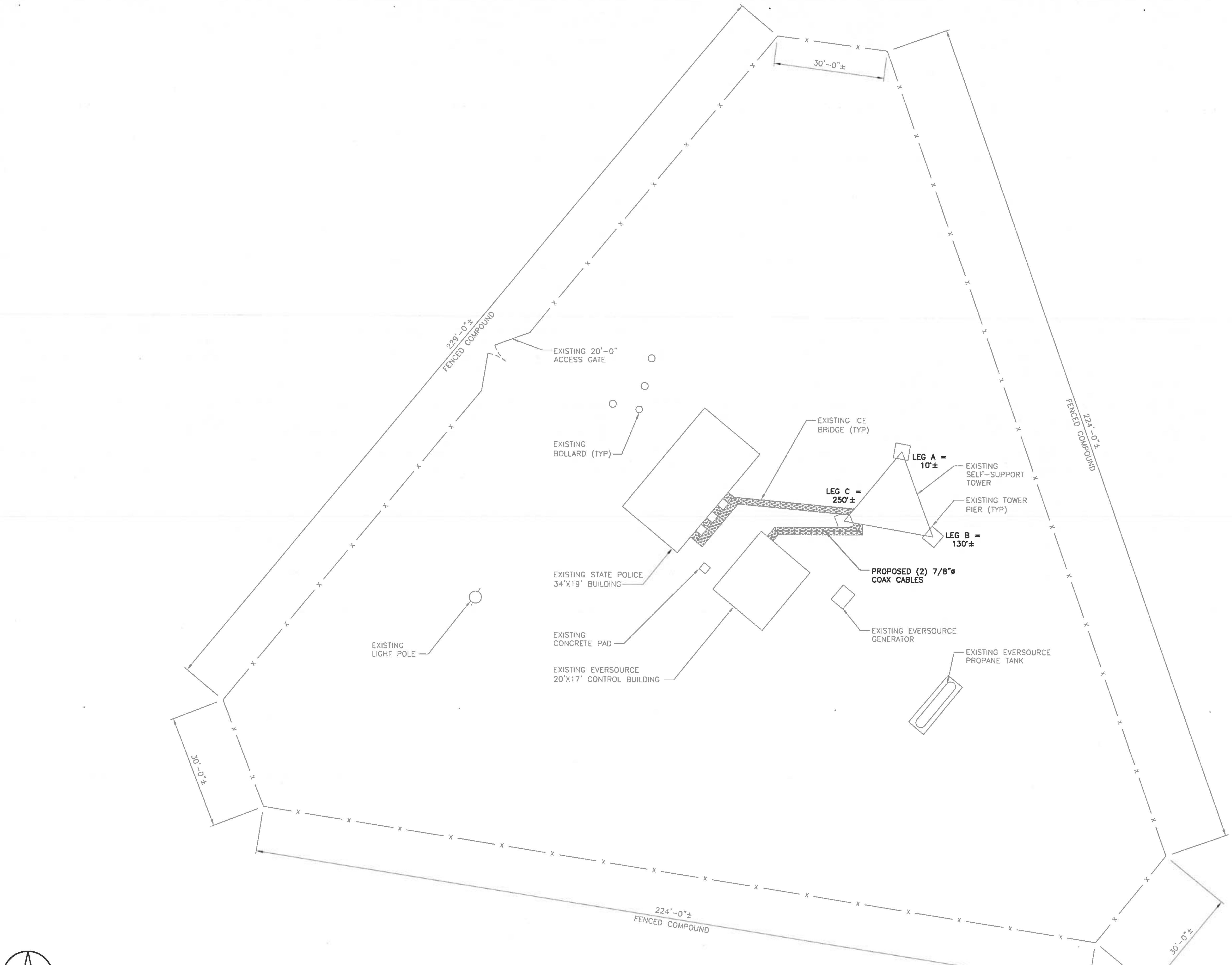


IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS THEY ARE ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

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:	TYW
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REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED PROFESSIONAL ENGINEER
3/9/2020

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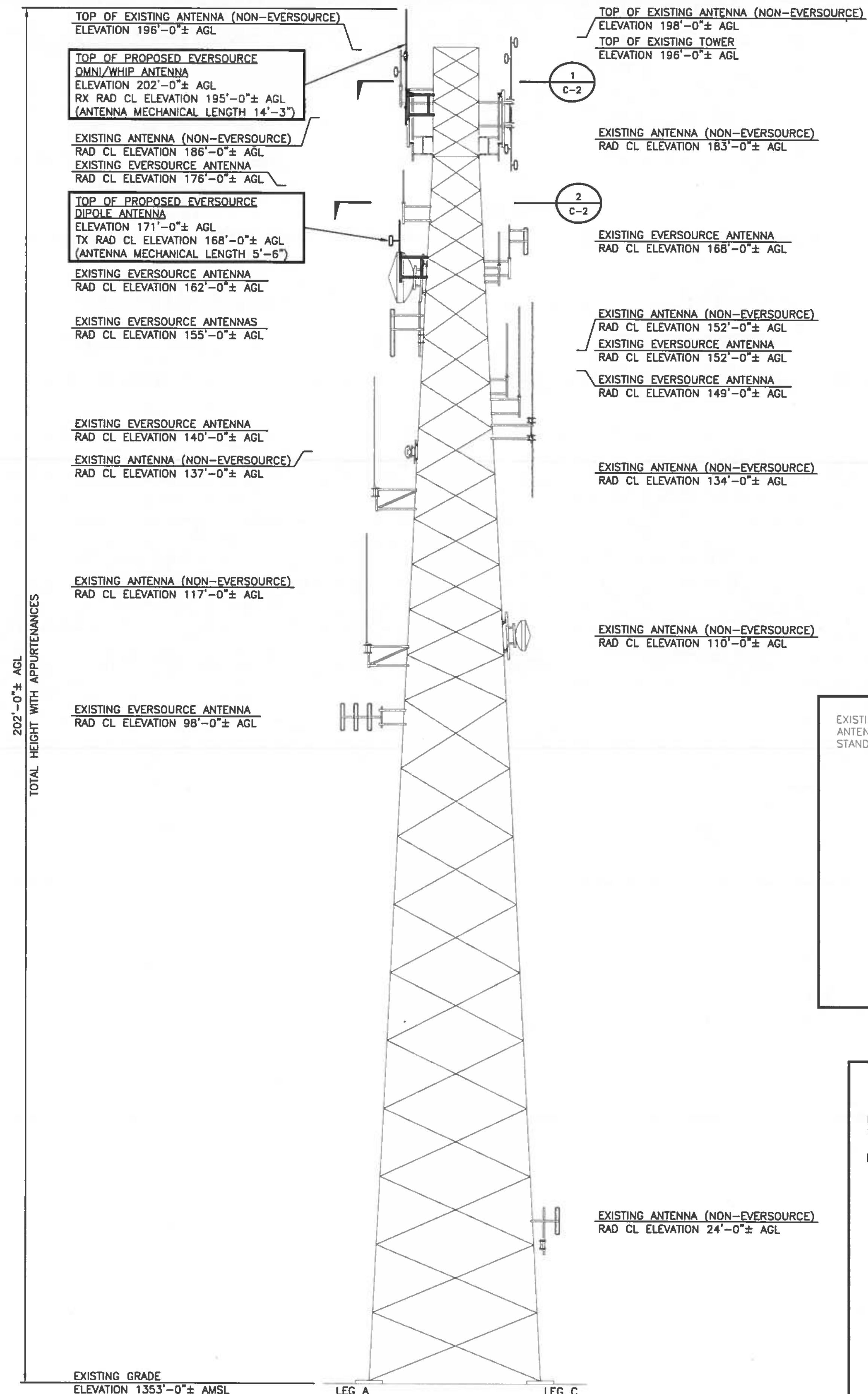
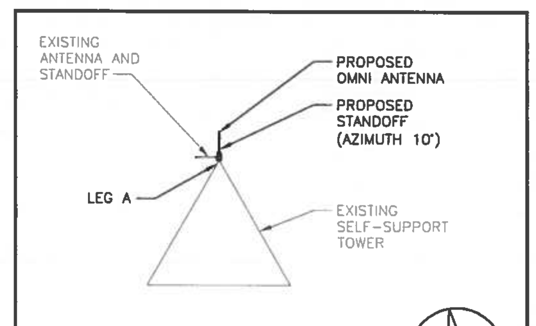
SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

SHEET TITLE
SITE PLAN

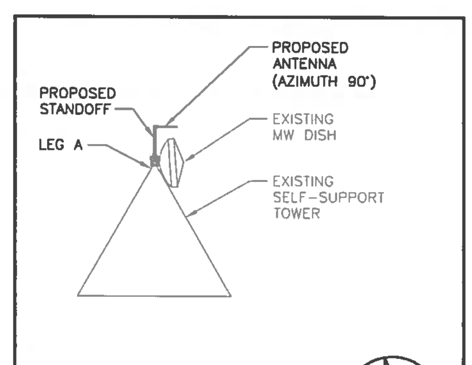
SHEET NUMBER
C-1



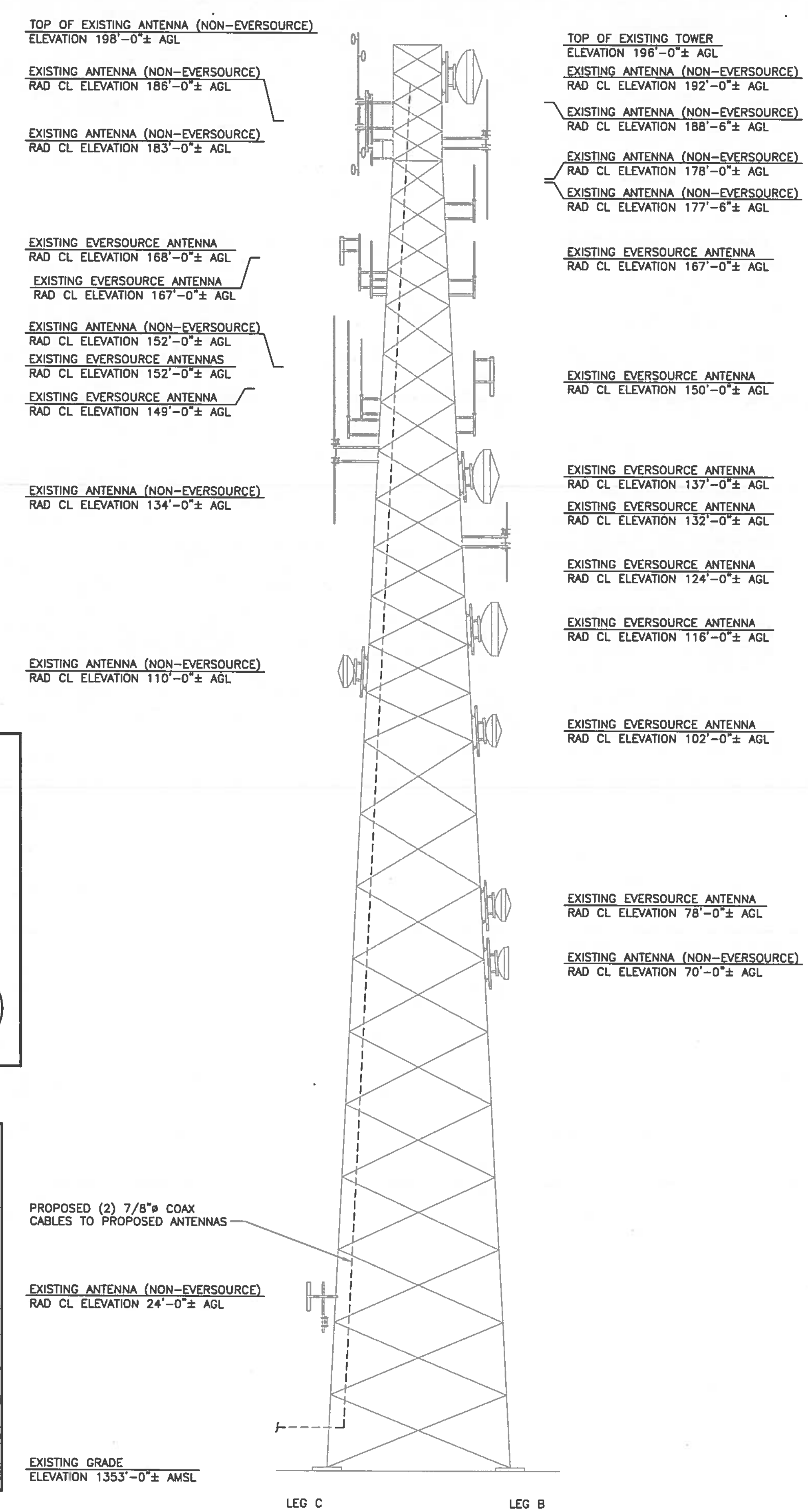
TOWER ELEVATION FACE AC
NO SCALE



SECTION 1
NO SCALE



SECTION 2
NO SCALE



TOWER ELEVATION FACE CB
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
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STATE OF CONNECTICUT
33208
LICENSED PROFESSIONAL ENGINEER
3/9/2020

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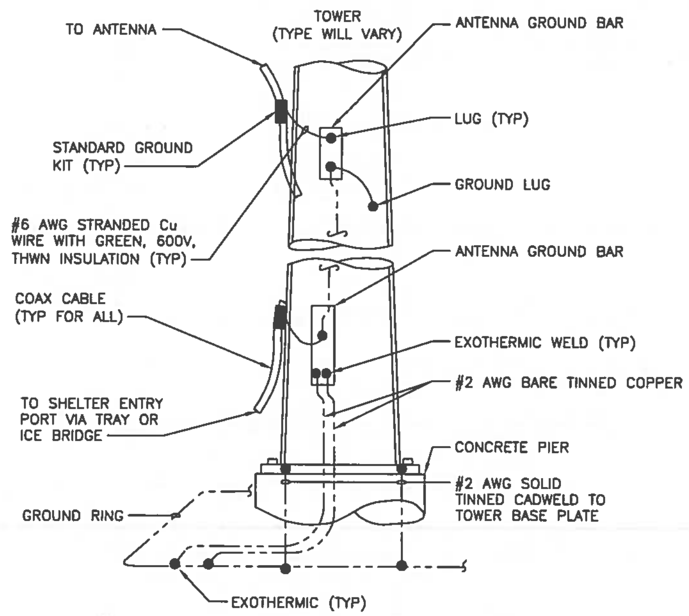
SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

SHEET TITLE
TOWER ELEVATION

SHEET NUMBER
C-2

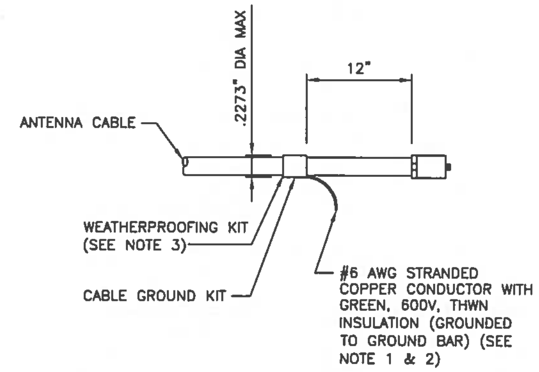


NOTE

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

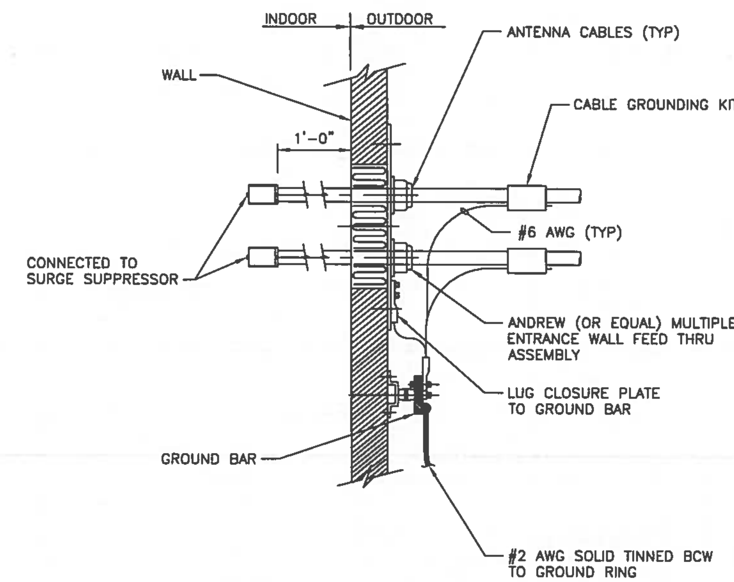


NOTES

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.

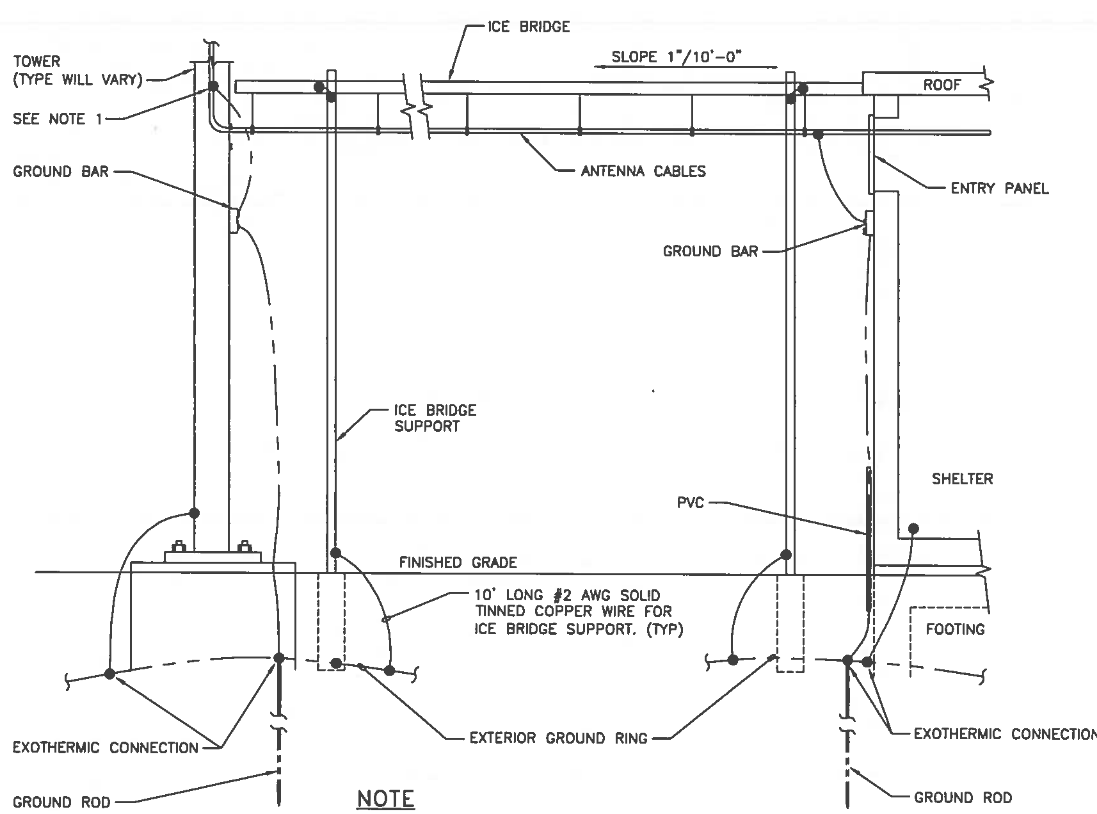
CONNECTION OF CABLE GROUND KIT TO ANTENNA CABLE

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
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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:	TYW
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

STATE OF CONNECTICUT
MARK P. S...
34358
LICENSED PROFESSIONAL ENGINEER
3-9-2020

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SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

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.

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:	TYW
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

STATE OF CONNECTICUT · JOSHUA J. RILEY · 33208 · LICENSED PROFESSIONAL ENGINEER

3/9/2020

SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

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. 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).
4. 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.
5. 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.
6. 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.
7. THE MINIMUM BEND RADIUS SHALL BE 8 INCHES FOR #6 WIRE AND SMALLER AND 12 INCHES FOR WIRE LARGER THAN #6.
8. BOND THE FENCE TO THE GROUND RING AT EACH CORNER, AND AT EACH GATE POST WITH #2 SOLID TINNED WIRE. EXOTHERMIC WELD BOTH ENDS.
9. GROUND KITS SHALL BE SOLID COPPER STRAP WITH #6 WIRE 2–HOLE COMPRESSION CRIMPED LUGS AND SHALL BE SEALED ACCORDING TO MANUFACTURER INSTRUCTIONS.
10. FERROUS METAL CLIPS WHICH COMPLETELY SURROUND THE GROUNDING CONDUCTOR SHALL BE USED.
11. 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.

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.

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:	TYW
CHECKED BY:	CAG

REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED
PROFESSIONAL ENGINEER
3/9/2020

SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

SHEET TITLE
NOTES & SPECIFICATIONS

SHEET NUMBER
N-2

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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3/9/2020

SOAPSTONE RADIO
1554 HIGHLAND AVE
TORRINGTON, CT 06790

SHEET TITLE
NOTES & SPECIFICATIONS

SHEET NUMBER
N-3

REFERENCE CUTSHEETS

216 - 225 MHz

ANT220F6

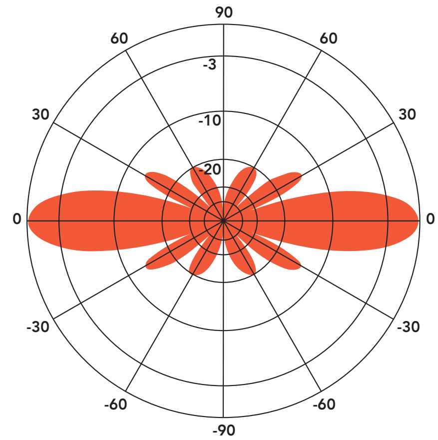
FIBERGLASS COLLINEAR ANTENNA 6 dBd

The Telewave ANT220F6 is an extremely rugged, medium-gain, fiberglass collinear antenna, designed for operation in all environmental conditions. The antenna is constructed with brass and copper elements, connected at DC ground potential for lightning impulse protection. The ANT220F6 is an excellent choice for wireless PTC systems in urban or rural areas.

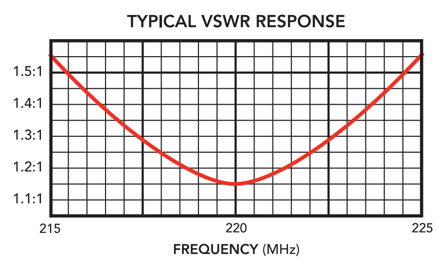
All junctions are fully soldered to prevent RF intermodulation, and each antenna is completely protected within a rugged, high-tech radome to ensure survivability in the worst environments. The "Cool Blue" radome provides maximum protection from corrosive gases, ultraviolet radiation, icing, salt spray, acid rain, and wind blown abrasives.

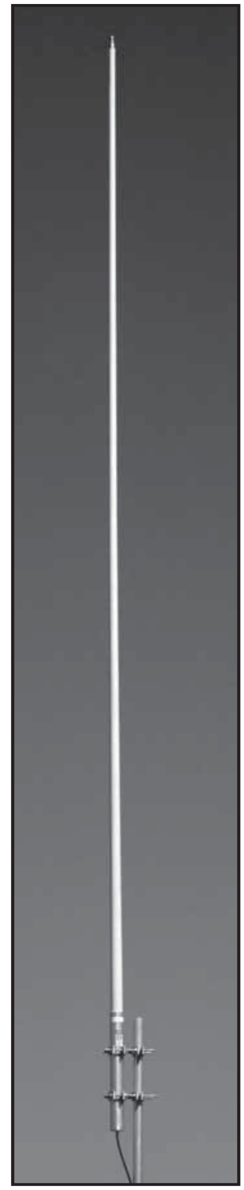
The ANT220F6 includes an ANTC482 dual clamp set for mounting to a 1.5" to 3.5" O.D. support pipe, and a 24" removable RG-213 N-Male jumper. Stand-off and top mounts are also available.

NOTE: THIS ANTENNA IS SHIPPED VIA TRUCK FREIGHT ONLY



ANT220F6 - 221 MHz
Vertical Plane
Gain = 6.11 dBd





SPECIFICATIONS			
Frequency (continuous)	216-225 MHz	**Dimensions (L x base diam.) in.**	171 x 2.75
Gain	6 dBd	**Tower weight (antenna + clamps)**	35 lb.
Power rating (typ.)	500 watts	**Shipping weight**	50 lb.
Impedance	50 ohms	**Wind rating / with 0.5" ice**	150 / 125 MPH
VSWR	1.5:1 or less	**Maximum exposed area**	3.1 ft.^{2}
Pattern	Omnidirectional	**Lateral thrust at 100 MPH**	122 lb.
Vertical beamwidth	20°	**Bending moment at top clamp**	494 ft. lb.
Termination	Recessed N Female 7-16 DIN-F opt.	**(100 MPH, 40 PSF flat plate equiv.)**	

220MHz EXPOSED DIPOLES 215-225 MHz

870 Series 220MHz Exposed Dipoles

The 870 Series 220MHz Exposed Dipoles are available in 1, 2, 4, 8 dipole configurations. All our antennas can be completely customized to your particular applications. Our antennas can be black anodized, adjustable, or fixed, side mount or top mount, and heavy-duty versions are available.

- Each antenna is offered in a 1/4, 3/8 or 1/2 wave spacing versions.
- The 87XA-70 has external cabling and a field-adjustable pattern.
- The 87XF-70 has internal cabling and fixed dipole-mast spacing.
- Heavy-duty versions are available. Please contact our Technical Support team for consultation.

Electrical Specifications	871F-70-2	872F-70-2	874F-70-2
Frequency Range, MHz	215-225	215-225	215-225
Nominal Gain, dBd	2.0-2.5	5.0-5.5	8.0-8.5
Number of Dipoles	1	2	4
Bandwidth 1.5:1 VSWR, MHz	10	10	10
Polarization	Vertical	Vertical	Vertical
Pattern	Offset / bi	Offset / bi	Offset / bi
Power Rating, Watts	200	300	500
Nominal Impedance, Ohms	50	50	50
Lightning Protection	DC Ground	DC Ground	DC Ground
Standard Termination	Type N Male	Type N Male	Type N Male
Mechanical Specifications	**871F-70-2**	**872F-70-2**	**874F-70-2**
Length, in (mm)	66 (1676)	112 (2845)	200 (5080)
Width (1/2 Wave Spacing), in (mm)	31 (787)	31 (787)	32 (813)
Weight, lbs. (kg)	12.5 (5.7)	21 (9.5)	51 (23)
Rated Wind Velocity, No Ice, mph (km/h)	165 (266)	150 (241)	145 (233)
Rated Wind Velocity, 0.5" (13mm) ice, mph (km/h)	140 (225)	130 (209)	105 (177)
Lateral Thrust @ 100 mph, wind, lbs. (kg)	40 (18)	66 (30)	143 (65)
Bending Moment @ top clamp: 100 mph, ft.*lb (kg*m)	58 (8)	150 (21)	610 (84)
Projected Area, ft² (m²)	1.5 (0.14)	2.6 (0.24)	5.5 (0.51)
Mounting Information Mast O.D. (mm)	1.9" (48)	1.9" (48)	2.4" (60)

* See next page for ordering information (page 3) *

872F-70-2

(1) ONE SITE PRO 1 P/N DCP12K CLAMP SET REQUIRED.

COMPROD Simplifying RF Solutions
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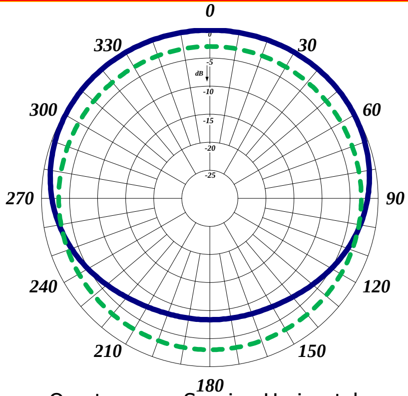
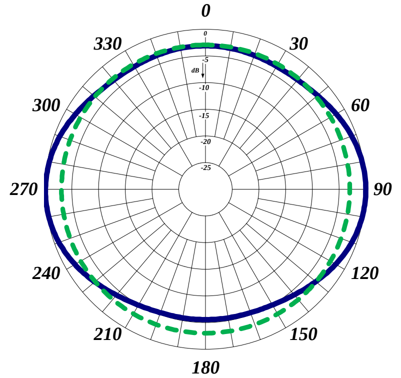
Tel: US 1.877.825.2007 / CAN 1.800.603.1454
Email: sales@comprodcom.com
Fax: 1.800.554.1033

220MHz EXPOSED DIPOLES 215-225 MHz

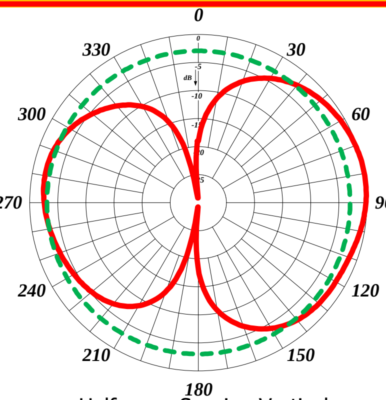
871F-70-2



Quarter-wave Spacing Horizontal

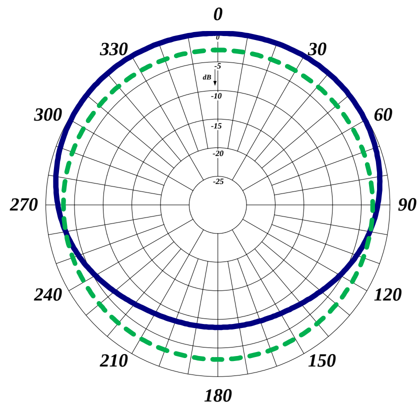


Half-wave Spacing Horizontal

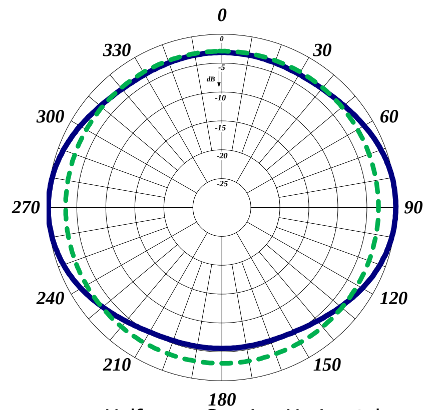


Half-wave Spacing Vertical

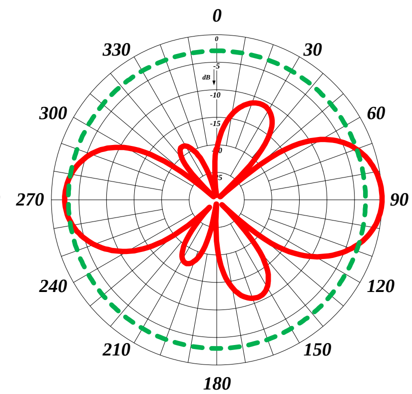
872F-70-2



Quarter-wave Spacing Horizontal

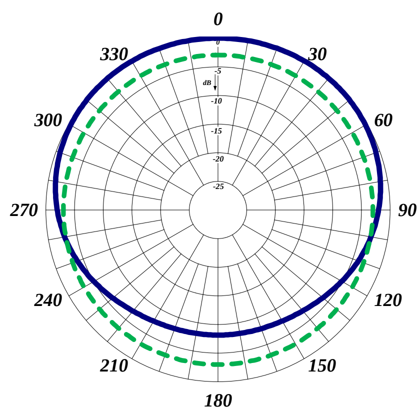


Half-wave Spacing Horizontal

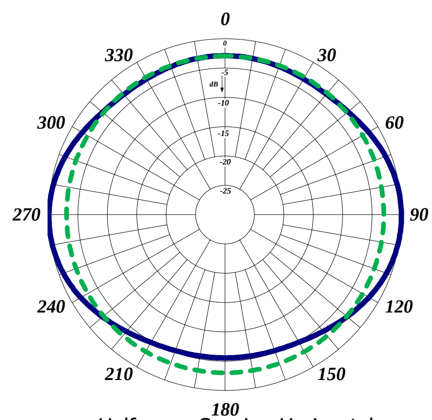


Half-wave Spacing Vertical

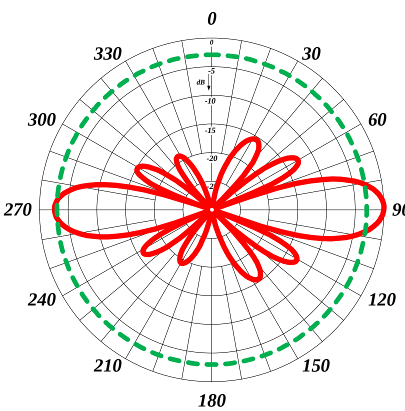
874F-70-2



Quarter-wave Spacing Horizontal



Half-wave Spacing Horizontal



Half-wave Spacing Vertical

COMPROD Simplifying RF Solutions
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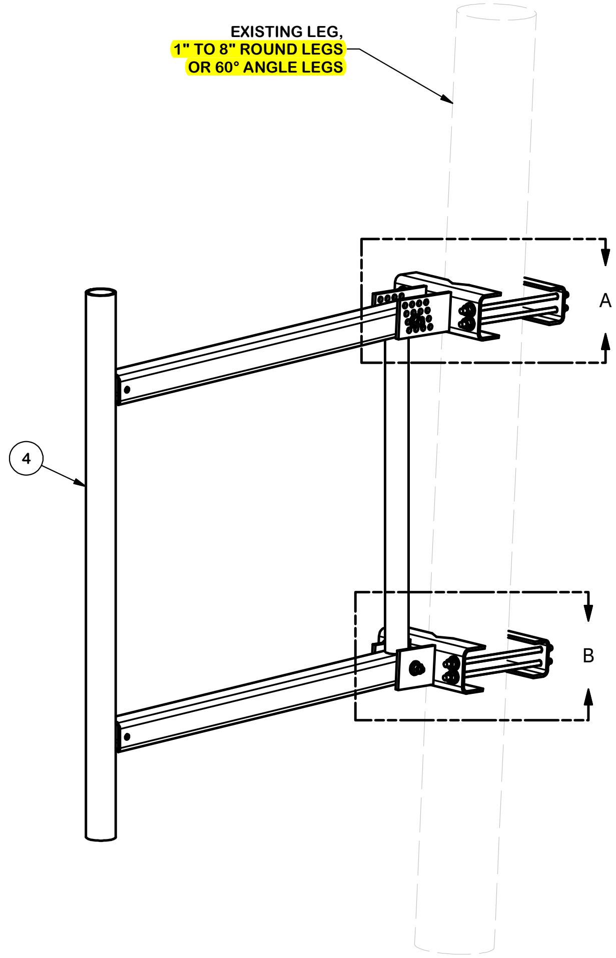
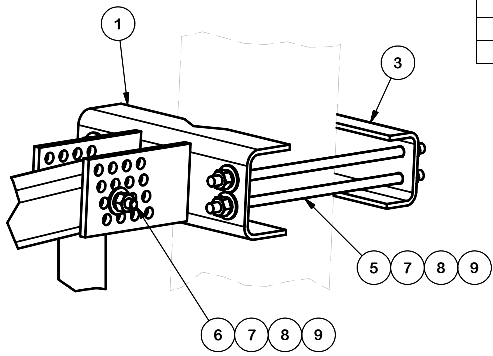
Tel: US 1.877.825.2007 / CAN 1.800.603.1454
Email: sales@comprodcom.com
Fax: 1.800.554.1033

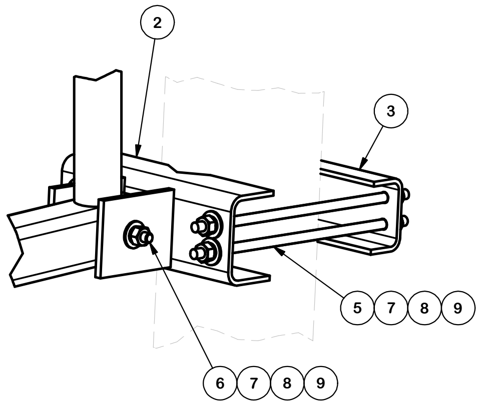
TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 3.5"±/4.5"± DIAMETER.

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

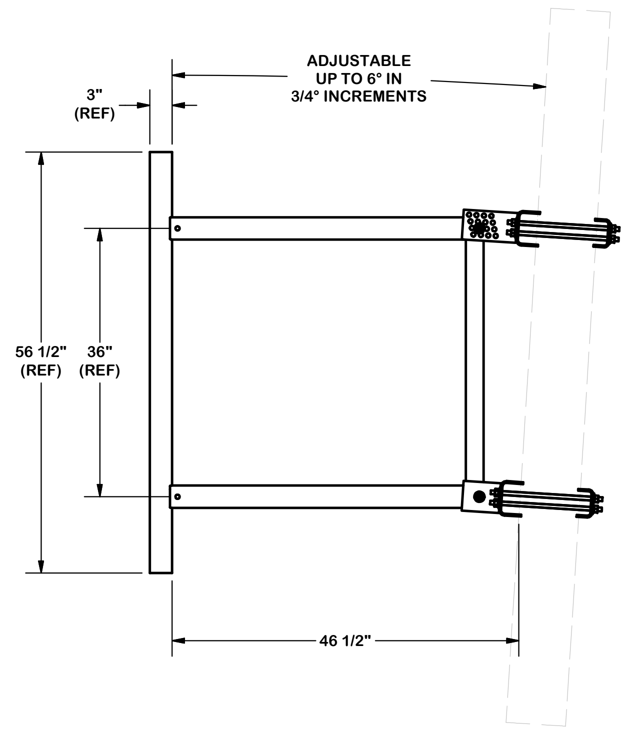




DETAIL A



DETAIL B



TOLERANCE NOTES

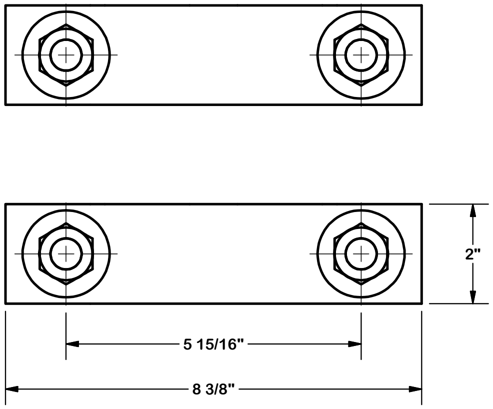
TOLERANCES ON DIMENSIONS, UNLESS OTHERWISE NOTED ARE:
SAWED, SHEARED AND GAS CUT EDGES *(± 0.030")*
DRILLED AND GAS CUT HOLES *(± 0.030")* - NO CONING OF HOLES
LASER CUT EDGES AND HOLES *(± 0.010")* - NO CONING OF HOLES
BENDS ARE ± 1/2 DEGREE
ALL OTHER MACHINING *(± 0.030")*
ALL OTHER ASSEMBLY *(± 0.060")*

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

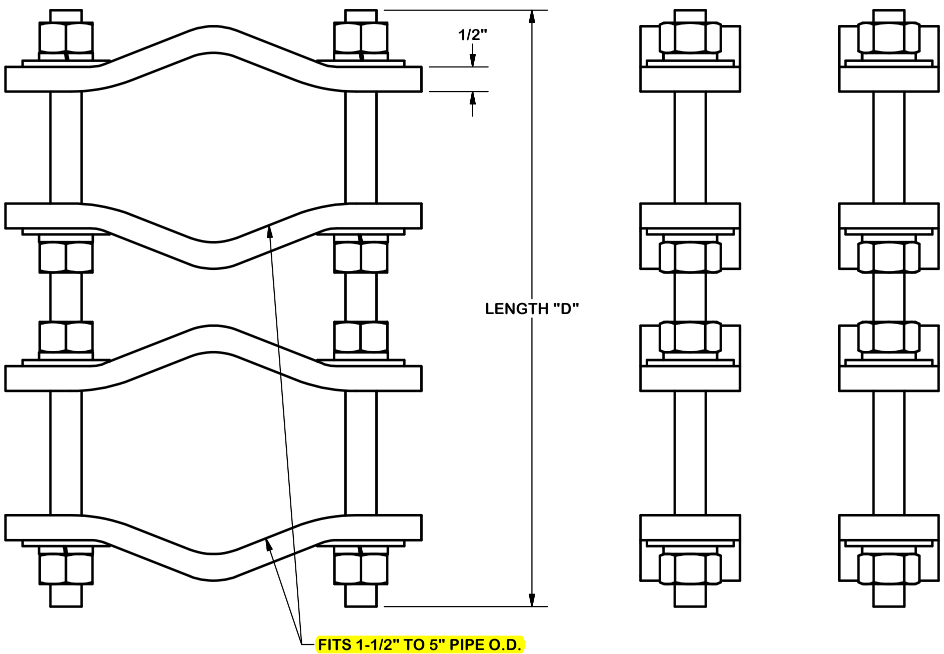
CPD NO.	DRAWN BY	ENG. APPROVAL	PART NO.
	RCH 2/4/2011		USF-4U

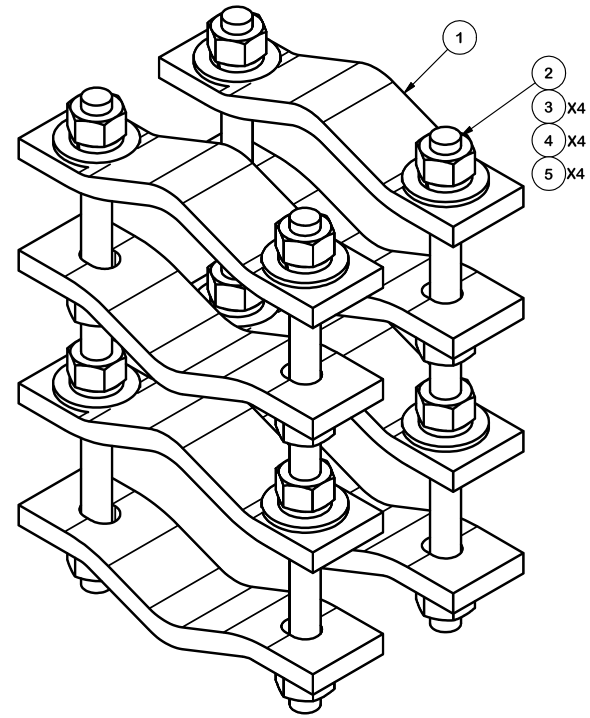
CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	01	CUSTOMER	BMC 2/16/2011	USF-4U



PARTS LIST						
ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	8	DCP	CLAMP HALF, 1/2" THICK, 8-3/8"		2.40	19.20
2	B	C	5/8" THREADED ROD	D	E	F
3	16	G58NUT	5/8" HDG HEAVY 2H HEX NUT		0.13	2.08
4	16	G58LW	5/8" HDG LOCKWASHER		0.03	0.42
5	16	G58FW	5/8" HDG USS FLATWASHER		0.07	1.13

VARIABLE PARTS TABLE						
ASSEMBLY "A"	QTY "B"	PART "C"	LENGTH "D"	UNIT WT. "E"	NET WT. "F"	TOTAL WEIGHT
DCP12K	4	G58R-12	12"	1.05	4.18	27.01
DCP18K	4	G58R-18	18"	1.57	6.27	29.10





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
PIPE TO PIPE CLAMP SET
1-1/2" TO 5" PIPE
1/2" THICK CLAMP

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.
		KC8 8/21/2012		SEE ASSEMBLY "A"
CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	01	CUSTOMER	CEK 1/22/2013	DCPxxK

ATTACHMENT C – STRUCTURAL ANALYSIS REPORT

Date: **February 26, 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:**	ES-086
	Site Name:	SoapstoneRS
Engineering Firm Designation:	**Black & Veatch Corp. Project Number:**	403093
Site Data:	**1554 Highland Avenue, Torrington, Litchfield County, CT** **Latitude *41° 48' 5.69"*, Longitude *-73° 10' 25.90"*** **196 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 – 60.6%**

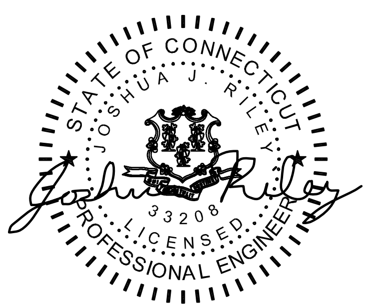
This analysis utilizes an ultimate 3-second gust wind speed of 125 mph as required by the 2018 Connecticut State Building Code. Applicable Standard references and design criteria are listed in Section 2 - Analysis Criteria.

Structural analysis prepared by: Aditya Kulkarni

Respectfully submitted by:

Joshua J. Riley, P.E.

Professional Engineer



02/26/2020

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 196 ft Self Support tower designed by Rohn in September of 2008.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	III
Wind Speed:	125 mph ultimate
Exposure Category:	C
Topographic Factor:	1
Ice Thickness:	1.5 in
Wind Speed with Ice:	50 mph
Seismic Ss:	0.182
Seismic S_1:	0.065
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
187.0	195.0	1	dbspectra	ANT220F6	1	7/8	-
	187.0	1	site pro1	USF-4U [4' SO 203-1 + Vert. Pipe Support]			
165.0	168.0	1	comprod	871F-70-2	1	7/8	-
	165.0	1	site pro1	USF-4U [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
192.0	192.0	1	tower mounts	6' x 3" Mount Pipe	1	WE65	1
		1	unknown	8' Dish			
188.0	193.0	1	decibel	DB222-C	2	7/8	1
	188.0	1	tower mounts	Side Arm Mount [SO 308-1]			
	183.0	1	decibel	DB222-C			
186.0	191.0	1	decibel	DB220-A	1	7/8	1
	186.0	1	tower mounts	Side Arm Mount [SO 308-1]			
183.0	188.5	1	scala	OGT9-840	2	1 5/8	1
	183.0	1	tower mounts	Side Arm Mount [SO 308-1]			
	177.5	1	scala	OGT9-840			
182.0	187.5	2	antennae	OGT9-806	8 2	1 5/8 1/2	1
	186.0	2	sinclair	SE419-SWBP4LDF			
		4	sinclair	SE419-SWBPALDF			
	182.0	2	bird technologies group	TX/RX 432E-83I-01T			
		2	tower mounts	Sector Mount [SM 403-1]			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
173.0	178.0	1	decibel	DB220-A	1	7/8	1
	173.0	1	tower mounts	Side Arm Mount [SO 308-1]			
170.0	176.0	1	telewave	ANT150F2	1	7/8	1
	170.0	1	tower mounts	Side Arm Mount [SO 308-1]			
168.0	168.0	1	sinclair	SD110	1	7/8	1
		1	tower mounts	10' x 2.5" pipe mount			
163.0	167.0	1	unknown	DB630	1	7/8	1
	163.0	1	tower mounts	Side Arm Mount [SO 308-1]			
162.0	162.0	1	unknown	4' Dish	1	WE65	1
155.0	155.0	1	sinclair	SD110	1	7/8	1
		1	tower mounts	10' x 2.5" pipe mount			
152.0	152.0	1	sinclair	SD110	1	7/8	1
		1	tower mounts	10' x 2.5" pipe mount			
150.0	150.0	1	sinclair	SD110	1	7/8	1
		1	tower mounts	10' x 2.5" pipe mount			
145.0	152.0	1	celwave	PD458-1	1	1 5/8	1
	145.0	1	tower mounts	Side Arm Mount [SO 308-1]			
143.0	152.0	1	celwave	PD1142-1	1	1 1/4	1
	143.0	1	tower mounts	Side Arm Mount [SO 308-1]			
139.0	149.0	1	celwave	PD220	1	7/8	1
	139.0	1	tower mounts	Side Arm Mount [SO 308-1]	-	-	-
	134.0	1	unknown	BCD-80609-NE	1	1 5/8	1
137.0	137.0	1	tower mounts	6' x 3" Mount Pipe	2	7/8	1
		1	unknown	4' Dish			
137.0	137.0	1	tower mounts	6' x 3" Mount Pipe	1	WE65	1
		1	unknown	8' Dish			
130.0	140.0	1	celwave	PD220	1	7/8	1
	130.0	1	tower mounts	Side Arm Mount [SO 308-1]			
128.0	132.0	1	decibel	DB586-Y	2	7/8	1
	128.0	1	tower mounts	Side Arm Mount [SO 308-1]			
	124.0	1	decibel	DB586-Y			
116.0	116.0	1	tower mounts	6' x 3" Mount Pipe	1	WE65	1
		1	unknown	8' Dish			
108.0	110.0	1	unknown	6' Dish	1	WE65	1
	108.0	1	tower mounts	6' x 3" Mount Pipe			
107.0	117.0	1	celwave	PD220	1	7/8	1
	107.0	1	tower mounts	Side Arm Mount [SO 308-1]			
102.0	102.0	1	tower mounts	6' x 3" Mount Pipe	1	WE65	1
		1	unknown	6' Dish			
98.0	98.0	1	antennae	3' Yagi	1	7/8	1
		1	tower mounts	Side Arm Mount [SO 301-1]			
78.0	78.0	1	tower mounts	6' x 3" Mount Pipe	1	WE65	1
		1	unknown	6' Dish			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
70.0	70.0	1	tower mounts	6' x 3" Mount Pipe	2	3/8	1
		1	unknown	4' Dish			
24.0	24.0	1	sinclair	SD210	1	1/2	1
		1	tower mounts	Side Arm Mount [SO 701-1]			

Notes:
1) Existing Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
GEOTECHNICAL REPORTS	Dr. Clarence Welti, P.E., P.C., dated 05/08/2008	-	Eversource
TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	Rohn, dated 09/16/2008	-	Eversource
TOWER MANUFACTURER DRAWINGS	Rohn, dated 09/16/2008	-	Eversource
TOWER STRUCTURAL ANALYSIS REPORTS	CENTEK Engineering, Inc. dated 12/04/2017	-	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) The existing base plate grout was considered in this analysis. Grout must be maintained and inspected periodically and must be replaced if damaged or cracked.
4) 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.
5) Tower loading is based on 2018 drone mapping photos and previous Centek SA.

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	196 - 180	Leg	ROHN 3 EH	3	-10.292	125.242	8.2	Pass
T2	180 - 160	Leg	ROHN 4 EH	31	-38.442	184.677	20.8	Pass
T3	160 - 140	Leg	ROHN 5 EH	61	-67.065	251.347	26.7	Pass
T4	140 - 120	Leg	ROHN 6 EHS	82	-100.775	288.510	34.9	Pass
T5	120 - 100	Leg	ROHN 6 EH	103	-138.102	360.247	38.3	Pass
T6	100 - 80	Leg	ROHN 8 EH	124	-173.953	530.812	32.8	Pass
T7	80 - 60	Leg	ROHN 8 EH	140	-213.789	530.833	40.3	Pass
T8	60 - 40	Leg	ROHN 8 EH	155	-253.877	530.827	47.8	Pass
T9	40 - 20	Leg	ROHN 8 EH	170	-292.483	530.802	55.1	Pass
T10	20 - 0	Leg	ROHN 10 EH	185	-330.824	702.088	47.1	Pass
T1	196 - 180	Diagonal	L1 3/4x1 3/4x3/16	10	-2.887	11.576	24.9 39.8 (b)	Pass
T2	180 - 160	Diagonal	L2x2x1/4	42	-4.408	13.155	33.5 40.2 (b)	Pass
T3	160 - 140	Diagonal	L2 1/2x2 1/2x1/4	68	-5.490	16.293	33.7 49.6 (b)	Pass
T4	140 - 120	Diagonal	L3x3x1/4	89	-6.948	22.361	31.1 46.4 (b)	Pass
T5	120 - 100	Diagonal	L3 1/2x3 1/2x1/4	107	-9.027	27.943	32.3 60.6 (b)	Pass
T6	100 - 80	Diagonal	L4x4x5/16	128	-10.908	35.297	30.9 58.5 (b)	Pass
T7	80 - 60	Diagonal	L4x4x3/8	143	-12.780	35.100	36.4 48.6 (b)	Pass
T8	60 - 40	Diagonal	L4x4x3/8	158	-13.440	29.661	45.3 50.5 (b)	Pass
T9	40 - 20	Diagonal	L5x5x3/8	173	-14.112	50.024	28.2 52.2 (b)	Pass
T10	20 - 0	Diagonal	L5x5x3/8	188	-16.197	43.804	37.0 57.0 (b)	Pass
T1	196 - 180	Top Girt	L1 3/4x1 3/4x3/16	5	-0.201	4.031	5.0	Pass
T2	180 - 160	Top Girt	L2x2x1/4	34	-0.270	7.929	3.4	Pass
							Summary	
						Leg (T9)	55.1	Pass
						Diagonal (T5)	60.6	Pass
						Top Girt (T1)	5.0	Pass
						Bolt Checks	60.6	Pass
						Rating =	**60.6**	**Pass**

Table 4 - Tower Component Stresses vs. Capacity - LC1

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	45.6	Pass
1	Base Foundation	0	28.5	Pass
1	Base Foundation Soil Interaction		43.0	Pass

Structure Rating (max from all components) =	**60.6%**

Notes:
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	196 - 180	2.861	47	0.122	0.019	OK
T2	180 - 160	2.447	47	0.12	0.022	OK
T3	160 - 140	1.945	47	0.11	0.023	OK
T4	140 - 120	1.496	47	0.096	0.02	OK
T5	120 - 100	1.106	47	0.08	0.017	OK
T6	100 - 80	0.779	47	0.065	0.014	OK

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

1) Maximum Rotation = 4 Degrees

2) Maximum Deflection = 0.03 * Tower Height = 71 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?*
192	8' Dish	0.122	0.02	8	10	10 dB	0.664	Not Exceeded
162	4' Dish	0.111	0.023	4	10	10 dB	1.328	Not Exceeded
137	8' Dish	0.094	0.02	8	10	10 dB	0.664	Not Exceeded
116	8' Dish	0.077	0.017	8	10	10 dB	0.664	Not Exceeded
110	6' Dish	0.072	0.016	6	10	10 dB	0.885	Not Exceeded
102	6' Dish	0.066	0.014	6	10	10 dB	0.885	Not Exceeded
78	6' Dish	0.052	0.011	6	10	10 dB	0.885	Not Exceeded
70	4' Dish	0.047	0.01	4	10	10 dB	1.328	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	196 - 180	7.383	47	0.314	0.049	0.318	OK
T2	180 - 160	6.314	47	0.31	0.057	0.315	OK
T3	160 - 140	5.021	47	0.282	0.06	0.288	OK
T4	140 - 120	3.863	47	0.248	0.053	0.254	OK
T5	120 - 100	2.861	43	0.207	0.046	0.212	OK
T6	100 - 80	2.019	43	0.167	0.036	0.171	OK

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

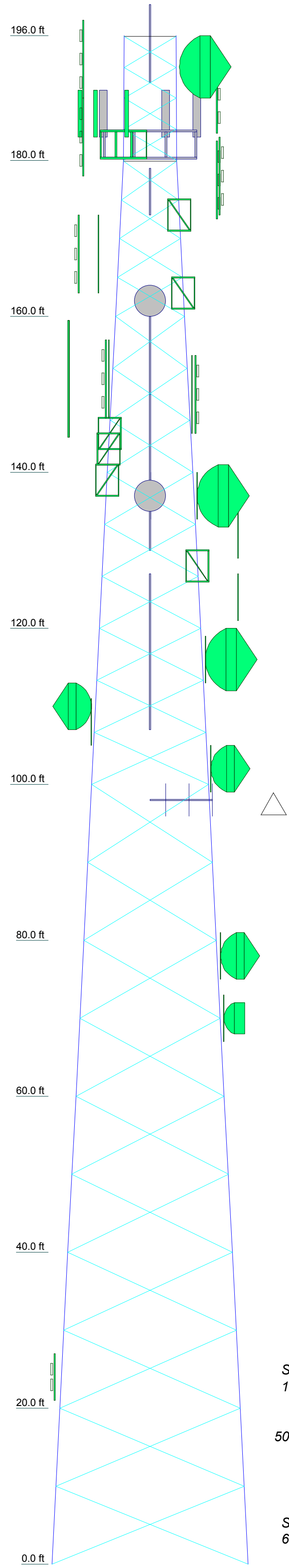
Critical Deflections of Tower at the MW Dish Elevations - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
192	8' Dish	47	7.115	0.314	0.051	530651.000
162	4' Dish	47	5.145	0.286	0.06	32764.000
137	8' Dish	47	3.703	0.242	0.052	32507.000
116	8' Dish	43	2.68	0.198	0.044	28775.000
110	6' Dish	43	2.42	0.186	0.041	28758.000
102	6' Dish	43	2.096	0.171	0.037	28807.000
78	6' Dish	43	1.274	0.134	0.028	38708
70	4' Dish	43	1.042	0.121	0.025	37093

APPENDIX A

TNXTOWER OUTPUT

Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	ROHN 3 EH	A572-50	L1 3/4x1 3/4x3/16	A36	L1 3/4x1 3/4x3/16	6.69	4 @ 3.97917	1.0
T2	ROHN 4 EH	A572-50	L2x2x1/4	A36	L2x2x1/4	6.76	4 @ 4.97917	1.8
T3	ROHN 5 EH	A572-50	L2 1/2x2 1/2x1/4	A36	N.A.	8.83	9 @ 6.66667	2.2
T4	ROHN 6 EHS	A572-50	L3x3x1/4	A572-50	N.A.	10.92	9 @ 6.66667	2.7
T5	ROHN 6 EH	A572-50	L3 1/2x3 1/2x1/4	A572-50	N.A.	12.92	9 @ 6.66667	3.5
T6	ROHN 8 EH	A572-50	L4x4x5/16	A572-50	N.A.	14.99	10 @ 10	4.7
T7	ROHN 8 EH	A572-50	L4x4x3/8	A572-50	N.A.	17.08	10 @ 10	5.3
T8	ROHN 8 EH	A572-50	L4x4x3/8	A572-50	N.A.	19.08	10 @ 10	5.5
T9	ROHN 8 EH	A572-50	L5x5x3/8	A572-50	N.A.	21.1	10 @ 10	6.5
T10	ROHN 10 EH	A572-50	L5x5x3/8	A572-50	N.A.	23.23	10 @ 10	7.5
						25.25		40.6



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
7' Hori. 5"x5" Tube	192	10' x 2.5" pipe mount	150
7'-0" x 2" horizontal mount pipe	192	PD458-1	145
6' x 3" Mount Pipe	192	Side Arm Mount [SO 308-1]	145
8' Dish	192	PD1142-1	143
DB222-C	188	Side Arm Mount [SO 308-1]	143
Side Arm Mount [SO 308-1]	188	BCD-80609-NE	139
DB222-C	188	PD220	139
ANT220F6	187	Side Arm Mount [SO 308-1]	139
USF-4U [4' SO 203-1 + Vert. Pipe Support]	187	11' Hori. 5"x5" Tube	137
Side Arm Mount [SO 308-1]	186	7'-0" x 2" horizontal mount pipe	137
DB220-A	186	6' x 3" Mount Pipe	137
OGT9-840	183	6' x 3" Mount Pipe	137
Side Arm Mount [SO 308-1]	183	8' Dish	137
OGT9-840	183	4' Dish	137
(2) 6' x 2" Mount Pipe	182	PD220	130
SE419-SWBP4LDF	182	Side Arm Mount [SO 308-1]	130
SE419-SWBPALDF	182	DB586-Y	128
SE419-SWBPALDF	182	Side Arm Mount [SO 308-1]	128
TX/RX 432E-83I-01T	182	12"x10"x4" Box	128
Sector Mount [SM 403-1]	182	DB586-Y	128
(2) 6' x 2" Mount Pipe	182	6' x 3" Mount Pipe	116
SE419-SWBP4LDF	182	15' Hori. 5"x5" Tube	116
SE419-SWBPALDF	182	7'-0" x 2" horizontal mount pipe	116
SE419-SWBPALDF	182	8' Dish	116
TX/RX 432E-83I-01T	182	7'-0" x 2" horizontal mount pipe	108
OGT9-806	182	6' x 3" Mount Pipe	108
OGT9-806	182	15' Hori. 5"x5" Tube	108
Sector Mount [SM 403-1]	182	6' Dish	108
DB220-A	173	PD220	107
Side Arm Mount [SO 308-1]	173	Side Arm Mount [SO 308-1]	107
ANT150F2	173	15' Hori. 5"x5" Tube	102
Side Arm Mount [SO 308-1]	170	7'-0" x 2" horizontal mount pipe	102
SD110	168	6' x 3" Mount Pipe	102
10' x 2.5" pipe mount	168	6' Dish	102
871F-70-2	165	Side Arm Mount [SO 301-1]	98
USF-4U [4' SO 203-1 + Vert. Pipe Support]	165	3' Yagi	98
DB630	163	7'-0" x 2" horizontal mount pipe	78
Side Arm Mount [SO 308-1]	163	18' Hori. 5"x5" Tube	78
6' x 3" Mount Pipe	162	6' x 3" Mount Pipe	78
4' Dish	162	6' Dish	78
SD110	155	6' x 3" Mount Pipe	70
10' x 2.5" pipe mount	155	4' Dish	70
SD110	152	Side Arm Mount [SO 701-1]	24
10' x 2.5" pipe mount	152	SD210	24
SD110	150		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-H Standard.
3. Tower designed for a 125 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: 60.6%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 341 K
SHEAR: 41 K

UPLIFT: -284 K
SHEAR: 35 K

AXIAL 178 K
SHEAR 19 K
MOMENT 2326 kip-ft
TORQUE 45 kip-ft
50 mph WIND - 1.500 in ICE

AXIAL 67 K
SHEAR 66 K
MOMENT 6958 kip-ft
TORQUE 109 kip-ft
REACTIONS - 125 mph WIND

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FAX: (913) 458-8136

Job: *ES-086 SoapstoneRS*			
Project: *403093*			
Client: Eversource	Drawn by: Aditya Kulkarni	App'd:	
Code: TIA-222-H	Date: 02/19/20	Scale: NTS	
Path: Y:\TELECOM\2020\Engineering\Projects\Ever Source SA\SoapstoneRS\Structural\Rev_H\ES-086 SoapstoneRS Structural Analysis.eri		Dwg No. E-1	

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 196.000 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 6.690 ft at the top and 25.250 ft at the base.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

1. Tower is located in Litchfield County, Connecticut.
2. Tower base elevation above sea level: 1353.000 ft.
3. Basic wind speed of 125 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

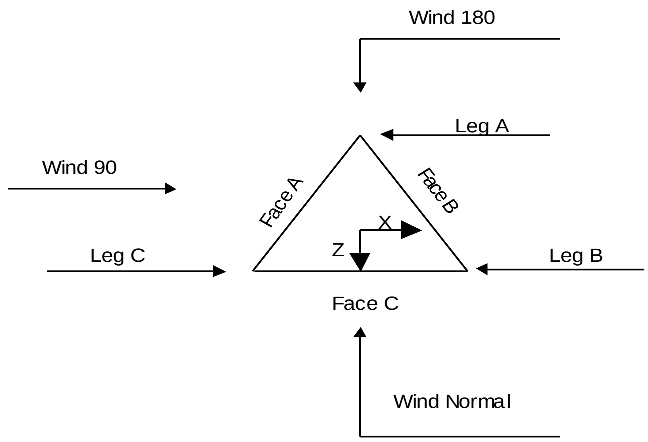
Consider Moments - Legs
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
Use Code Stress Ratios
√ Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
√ Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
√ Secondary Horizontal Braces Leg
Use Diamond Inner Bracing (4 Sided)
SR Members Have Cut Ends
SR Members Are Concentric

Distribute Leg Loads As Uniform
Assume Legs Pinned
√ Assume Rigid Index Plate
√ Use Clear Spans For Wind Area
√ Use Clear Spans For KL/r
Retension Guys To Initial Tension
√ Bypass Mast Stability Checks
Use Azimuth Dish Coefficients
√ Project Wind Area of Appurt.
Autocalc Torque Arm Areas
Add IBC .6D+W Combination
√ Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing
Treat Feed Line Bundles As Cylinder
Ignore KL/ry For 60 Deg. Angle Legs

Use ASCE 10 X-Brace Ly Rules
√ Calculate Redundant Bracing Forces
Ignore Redundant Members in FEA
√ SR Leg Bolts Resist Compression
All Leg Panels Have Same Allowable
Offset Girt At Foundation
√ Consider Feed Line Torque
√ Include Angle Block Shear Check
Use TIA-222-H Bracing Resist. Exemption
Use TIA-222-H Tension Splice Exemption

Poles

Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets
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	196.000-180.000			6.690	1	16.000
T2	180.000-160.000			6.760	1	20.000
T3	160.000-140.000			8.830	1	20.000
T4	140.000-120.000			10.920	1	20.000
T5	120.000-100.000			12.920	1	20.000
T6	100.000-80.000			14.990	1	20.000
T7	80.000-60.000			17.080	1	20.000
T8	60.000-40.000			19.080	1	20.000
T9	40.000-20.000			21.100	1	20.000
T10	20.000-0.000			23.230	1	20.000

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	196.000-180.000	3.979	X Brace	No	No	1.000	0.000
T2	180.000-160.000	4.979	X Brace	No	No	1.000	0.000
T3	160.000-140.000	6.667	X Brace	No	No	0.000	0.000
T4	140.000-120.000	6.667	X Brace	No	No	0.000	0.000
T5	120.000-100.000	6.667	X Brace	No	No	0.000	0.000
T6	100.000-80.000	10.000	X Brace	No	No	0.000	0.000

Tower Section	*Tower Elevation* *ft*	*Diagonal Spacing* *ft*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset* *in*	*Bottom Girt Offset* *in*
T7	80.000-60.000	10.000	X Brace	No	No	0.000	0.000
T8	60.000-40.000	10.000	X Brace	No	No	0.000	0.000
T9	40.000-20.000	10.000	X Brace	No	No	0.000	0.000
T10	20.000-0.000	10.000	X Brace	No	No	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 196.000-180.000	Pipe	ROHN 3 EH	A572-50 (50 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T2 180.000-160.000	Pipe	ROHN 4 EH	A572-50 (50 ksi)	Equal Angle	L2x2x1/4	A36 (36 ksi)
T3 160.000-140.000	Pipe	ROHN 5 EH	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)
T4 140.000-120.000	Pipe	ROHN 6 EHS	A572-50 (50 ksi)	Equal Angle	L3x3x1/4	A572-50 (50 ksi)
T5 120.000-100.000	Pipe	ROHN 6 EH	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x1/4	A572-50 (50 ksi)
T6 100.000-80.000	Pipe	ROHN 8 EH	A572-50 (50 ksi)	Equal Angle	L4x4x5/16	A572-50 (50 ksi)
T7 80.000-60.000	Pipe	ROHN 8 EH	A572-50 (50 ksi)	Equal Angle	L4x4x3/8	A572-50 (50 ksi)
T8 60.000-40.000	Pipe	ROHN 8 EH	A572-50 (50 ksi)	Equal Angle	L4x4x3/8	A572-50 (50 ksi)
T9 40.000-20.000	Pipe	ROHN 8 EH	A572-50 (50 ksi)	Equal Angle	L5x5x3/8	A572-50 (50 ksi)
T10 20.000-0.000	Pipe	ROHN 10 EH	A572-50 (50 ksi)	Equal Angle	L5x5x3/8	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 196.000-180.000	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)	Single Angle		A36 (36 ksi)
T2 180.000-160.000	Single Angle	L2x2x1/4	A36 (36 ksi)	Single Angle		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Gusset Area (per face)* *ft²*	*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 196.000-180.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T2 180.000-160.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T3 160.000-140.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T4 140.000-120.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T5 120.000-100.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T6 100.000-80.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000

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
T7 80.000-60.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T8 60.000-40.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T9 40.000-20.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000
T10 20.000-0.000	0.000	0.000	A36 (36 ksi)	1.05	1	1.05	0.000	0.000	36.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1 196.000-180.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2 180.000-160.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T3 160.000-140.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 140.000-120.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T5 120.000-100.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T6 100.000-80.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T7 80.000-60.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T8 60.000-40.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T9 40.000-20.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T10 20.000-0.000	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1

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

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Net Width Deduct in	Leg U	Diagonal Net Width Deduct in	Diagonal U	Top Girt Net Width Deduct in	Top Girt U	Bottom Girt Net Width Deduct in	Bottom Girt U	Mid Girt Net Width Deduct in	Mid Girt U	Long Horizontal Net Width Deduct in	Long Horizontal U	Short Horizontal Net Width Deduct in	Short Horizontal U
T1 196.000-180.000	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 180.000-160.000	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 160.000-140.000	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 140.000-120.000	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 120.000-100.000	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 100.000-80.000	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

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T7 80.000-60.000	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 60.000-40.000	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 40.000-20.000	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 20.000-0.000	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 196.000-180.000	Flange	0.875 A325N	4	0.625 A325N	1	0.625 A325N	1	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T2 180.000-160.000	Flange	1.000 A325N	4	0.625 A325N	1	0.625 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T3 160.000-140.000	Flange	1.000 A325N	6	0.625 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T4 140.000-120.000	Flange	1.000 A325N	6	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T5 120.000-100.000	Flange	1.000 A325N	8	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T6 100.000-80.000	Flange	1.000 A325N	8	0.750 A325N	1	0.000 A325N	0	0.000 A325N	0	0.625 A325N	0	0.000 A325N	0	0.625 A325N	0
T7 80.000-60.000	Flange	1.000 A325N	8	0.875 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T8 60.000-40.000	Flange	1.000 A325N	8	0.875 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T9 40.000-20.000	Flange	1.000 A325N	12	0.875 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0
T10 20.000-0.000	Flange	1.000 A354-BC	0	0.875 A325N	1	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 A325N	0	0.000 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
Feedline Ladder (Af)	A	No	No	Af (CaAa)	196.000 - 0.000	0.000	-0.4	1	1	3.000	3.000		8.400
Feedline Ladder (Af)	C	No	No	Af (CaAa)	196.000 - 0.000	0.000	0.4	1	1	3.000	3.000		8.400
Climbing Ladder (Af)	C	No	No	Af (CaAa)	196.000 - 0.000	-10.000	-0.4	1	1	3.000	3.000		8.400
Safety Line 3/8	C	No	No	Ar (CaAa)	196.000 - 0.000	-10.000	-0.4	1	1	0.375	0.375		0.220
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	173.000 - 168.000	0.000	0.39	1	1	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	168.000 - 163.000	0.000	0.39	2	2	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	163.000 - 152.000	0.000	0.39	3	3	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	152.000 - 150.000	0.000	0.39	4	4	0.500	1.030		0.330

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*
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	150.000 - 139.000	0.000	0.39	5	5	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	139.000 - 130.000	0.000	0.39	6	6	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	130.000 - 128.000	0.000	0.39	7	7	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	128.000 - 98.000	0.000	0.39	9	9	0.500	1.030		0.330
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	98.000 - 6.000	0.000	0.39	10	10	0.500	1.030		0.330
LDF7-50A(1-5/8)	C	No	No	Ar (CaAa)	90.000 - 6.000	0.000	0.44	1	1	0.500	1.980		0.820
WE65	C	No	No	Ar (CaAa)	162.000 - 6.000	2.000	0.44	1	1	0.500	1.584		0.530
WE65	C	No	No	Ar (CaAa)	137.000 - 6.000	0.000	0.45	1	1	0.500	1.584		0.530
WE65	C	No	No	Ar (CaAa)	116.000 - 6.000	0.000	0.47	1	1	0.500	1.584		0.530
WE65	C	No	No	Ar (CaAa)	102.000 - 6.000	0.000	0.48	1	1	0.500	1.584		0.530
WE65	C	No	No	Ar (CaAa)	78.000 - 6.000	0.000	0.46	1	1	0.500	1.584		0.530
LDF2-50(3/8)	C	No	No	Ar (CaAa)	128.000 - 6.000	1.500	0.37	1	1	0.440	0.440		0.080
******													
WE65	A	No	No	Ar (CaAa)	192.000 - 6.000	0.000	-0.35	1	1	0.500	1.584		0.530
WE65	A	No	No	Ar (CaAa)	108.000 - 6.000	0.000	-0.36	1	1	0.500	1.584		0.530
LDF2-50(3/8)	A	No	No	Ar (CaAa)	70.000 - 6.000	0.000	-0.37	2	1	0.440	0.440		0.080
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	183.000 - 182.000	0.000	-0.41	2	2	0.500	1.980		0.820
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	182.000 - 145.000	0.000	-0.41	10	6	0.500	1.980		0.820
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	145.000 - 134.000	0.000	-0.41	11	6	0.500	1.980		0.820
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	134.000 - 6.000	0.000	-0.41	12	6	0.500	1.980		0.820
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	188.000 - 186.000	0.000	-0.46	2	2	0.500	1.030		0.330
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	186.000 - 170.000	0.000	-0.46	3	2	0.500	1.030		0.330
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	170.000 - 155.000	0.000	-0.46	4	2	0.500	1.030		0.330
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	155.000 - 137.000	0.000	-0.46	5	2	0.500	1.030		0.330
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	137.000 - 107.000	0.000	-0.46	7	2	0.500	1.030		0.330
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	107.000 - 6.000	0.000	-0.46	8	2	0.500	1.030		0.330
LDF4P-50A(1/2)	A	No	No	Ar (CaAa)	182.000 - 6.000	0.000	-0.44	2	2	0.500	0.630		0.150
LDF6-50A(1-1/4)	A	No	No	Ar (CaAa)	143.000 - 6.000	0.000	-0.34	1	1	0.500	1.550		0.600
LDF4P-50A(1/2)	A	No	No	Ar (CaAa)	24.000 - 6.000	0.000	-0.35	1	1	0.500	0.630		0.150
******													
** Proposed for Discrete Loads													
LCF78-50J(7/8)	C	No	No	Ar (CaAa)	187.000 - 165.000	1.500	0.41	1	1	0.500	1.100		0.530
LCF78-50J(7/8)	C	No	No	Ar (CaAa)	165.000 - 0.000	1.500	0.41	2	1	0.500	1.100		0.530
** Proposed for Dish													
******													

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 ft^2/ft	Weight plf
******									
******									

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	196.000-180.000	A	0.000	0.000	16.774	0.000	0.167
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	17.370	0.000	0.276
T2	180.000-160.000	A	0.000	0.000	62.497	0.000	0.372
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	26.289	0.000	0.363
T3	160.000-140.000	A	0.000	0.000	66.527	0.000	0.386
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	36.763	0.000	0.399
T4	140.000-120.000	A	0.000	0.000	78.921	0.000	0.433
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	46.296	0.000	0.430
T5	120.000-100.000	A	0.000	0.000	82.715	0.000	0.446
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	53.755	0.000	0.453
T6	100.000-80.000	A	0.000	0.000	85.954	0.000	0.457
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	61.073	0.000	0.479
T7	80.000-60.000	A	0.000	0.000	86.834	0.000	0.458
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	66.109	0.000	0.498
T8	60.000-40.000	A	0.000	0.000	87.714	0.000	0.460
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	66.426	0.000	0.499
T9	40.000-20.000	A	0.000	0.000	87.966	0.000	0.461
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	66.426	0.000	0.499
T10	20.000-0.000	A	0.000	0.000	65.282	0.000	0.374
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	54.043	0.000	0.458

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	196.000-180.000	A	2.053	0.000	0.000	38.861	0.000	0.740
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	39.951	0.000	0.934
T2	180.000-160.000	A	2.032	0.000	0.000	122.347	0.000	2.106
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	70.123	0.000	1.446
T3	160.000-140.000	A	2.007	0.000	0.000	125.424	0.000	2.170
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	104.706	0.000	1.924
T4	140.000-120.000	A	1.978	0.000	0.000	137.273	0.000	2.443
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	127.904	0.000	2.282
T5	120.000-100.000	A	1.946	0.000	0.000	141.046	0.000	2.513
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	149.819	0.000	2.598

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
T6	100.000-80.000	A	1.907	0.000	0.000	146.201	0.000	2.587
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	169.234	0.000	2.879
T7	80.000-60.000	A	1.860	0.000	0.000	152.637	0.000	2.632
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	182.619	0.000	3.046
T8	60.000-40.000	A	1.798	0.000	0.000	158.122	0.000	2.646
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	180.414	0.000	2.944
T9	40.000-20.000	A	1.709	0.000	0.000	155.837	0.000	2.536
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	175.663	0.000	2.774
T10	20.000-0.000	A	1.531	0.000	0.000	112.539	0.000	1.761
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	133.435	0.000	2.034

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	196.000-180.000	-5.027	5.258	-5.267	6.077
T2	180.000-160.000	-11.744	9.112	-13.438	10.656
T3	160.000-140.000	-16.150	11.836	-19.048	14.558
T4	140.000-120.000	-19.922	13.318	-24.214	17.133
T5	120.000-100.000	-22.181	14.563	-28.691	19.895
T6	100.000-80.000	-26.983	17.370	-35.336	23.938
T7	80.000-60.000	-30.374	19.667	-40.553	27.220
T8	60.000-40.000	-32.536	21.116	-44.035	29.320
T9	40.000-20.000	-31.090	20.373	-44.607	29.775
T10	20.000-0.000	-24.694	17.375	-36.651	26.065

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	Feedline Ladder (Af)	180.00 - 196.00	0.6000	0.5493
T1	2	Feedline Ladder (Af)	180.00 - 196.00	0.6000	0.5493
T1	3	Climbing Ladder (Af)	180.00 - 196.00	0.6000	0.5493
T1	4	Safety Line 3/8	180.00 - 196.00	0.6000	0.5493
T1	22	WE65	180.00 - 192.00	0.6000	0.5493
T1	25	LDF7-50A(1-5/8)	182.00 - 183.00	0.6000	0.5493
T1	26	LDF7-50A(1-5/8)	180.00 - 182.00	0.6000	0.5493
T1	29	LDF5-50A(7/8)	186.00 - 188.00	0.6000	0.5493
T1	30	LDF5-50A(7/8)	180.00 - 186.00	0.6000	0.5493
T1	35	LDF4P-50A(1/2)	180.00 - 182.00	0.6000	0.5493
T1	40	LCF78-50J(7/8)	180.00 - 187.00	0.6000	0.5493
T2	1	Feedline Ladder (Af)	160.00 - 180.00	0.6000	0.5998
T2	2	Feedline Ladder (Af)	160.00 - 180.00	0.6000	0.5998

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	K_a *No Ice*	K_a *Ice*
T2	3	Climbing Ladder (Af)	160.00 - 180.00	0.6000	0.5998
T2	4	Safety Line 3/8	160.00 - 180.00	0.6000	0.5998
T2	5	LDF5-50A(7/8)	168.00 - 173.00	0.6000	0.5998
T2	6	LDF5-50A(7/8)	163.00 - 168.00	0.6000	0.5998
T2	7	LDF5-50A(7/8)	160.00 - 163.00	0.6000	0.5998
T2	15	WE65	160.00 - 162.00	0.6000	0.5998
T2	22	WE65	160.00 - 180.00	0.6000	0.5998
T2	26	LDF7-50A(1-5/8)	160.00 - 180.00	0.6000	0.5998
T2	30	LDF5-50A(7/8)	170.00 - 180.00	0.6000	0.5998
T2	31	LDF5-50A(7/8)	160.00 - 170.00	0.6000	0.5998
T2	35	LDF4P-50A(1/2)	160.00 - 180.00	0.6000	0.5998
T2	40	LCF78-50J(7/8)	165.00 - 180.00	0.6000	0.5998
T2	41	LCF78-50J(7/8)	160.00 - 165.00	0.6000	0.5998
T3	1	Feedline Ladder (Af)	140.00 - 160.00	0.6000	0.6000
T3	2	Feedline Ladder (Af)	140.00 - 160.00	0.6000	0.6000
T3	3	Climbing Ladder (Af)	140.00 - 160.00	0.6000	0.6000
T3	4	Safety Line 3/8	140.00 - 160.00	0.6000	0.6000
T3	7	LDF5-50A(7/8)	152.00 - 160.00	0.6000	0.6000
T3	8	LDF5-50A(7/8)	150.00 - 152.00	0.6000	0.6000
T3	9	LDF5-50A(7/8)	140.00 - 150.00	0.6000	0.6000
T3	15	WE65	140.00 - 160.00	0.6000	0.6000
T3	22	WE65	140.00 - 160.00	0.6000	0.6000
T3	26	LDF7-50A(1-5/8)	145.00 - 160.00	0.6000	0.6000
T3	27	LDF7-50A(1-5/8)	140.00 - 145.00	0.6000	0.6000
T3	31	LDF5-50A(7/8)	155.00 - 160.00	0.6000	0.6000
T3	32	LDF5-50A(7/8)	140.00 - 155.00	0.6000	0.6000
T3	35	LDF4P-50A(1/2)	140.00 - 160.00	0.6000	0.6000
T3	36	LDF6-50A(1-1/4)	140.00 - 143.00	0.6000	0.6000
T3	41	LCF78-50J(7/8)	140.00 - 160.00	0.6000	0.6000
T4	1	Feedline Ladder (Af)	120.00 - 140.00	0.6000	0.6000
T4	2	Feedline Ladder (Af)	120.00 - 140.00	0.6000	0.6000
T4	3	Climbing Ladder (Af)	120.00 - 140.00	0.6000	0.6000
T4	4	Safety Line 3/8	120.00 - 140.00	0.6000	0.6000
T4	9	LDF5-50A(7/8)	139.00 - 140.00	0.6000	0.6000
T4	10	LDF5-50A(7/8)	130.00 -	0.6000	0.6000

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
			139.00		
T4	11	LDF5-50A(7/8)	128.00 - 130.00	0.6000	0.6000
T4	12	LDF5-50A(7/8)	120.00 - 128.00	0.6000	0.6000
T4	15	WE65	120.00 - 140.00	0.6000	0.6000
T4	16	WE65	120.00 - 137.00	0.6000	0.6000
T4	20	LDF2-50(3/8)	120.00 - 128.00	0.6000	0.6000
T4	22	WE65	120.00 - 140.00	0.6000	0.6000
T4	27	LDF7-50A(1-5/8)	134.00 - 140.00	0.6000	0.6000
T4	28	LDF7-50A(1-5/8)	120.00 - 134.00	0.6000	0.6000
T4	32	LDF5-50A(7/8)	137.00 - 140.00	0.6000	0.6000
T4	33	LDF5-50A(7/8)	120.00 - 137.00	0.6000	0.6000
T4	35	LDF4P-50A(1/2)	120.00 - 140.00	0.6000	0.6000
T4	36	LDF6-50A(1-1/4)	120.00 - 140.00	0.6000	0.6000
T4	41	LCF78-50J(7/8)	120.00 - 140.00	0.6000	0.6000
T5	1	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T5	2	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T5	3	Climbing Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T5	4	Safety Line 3/8	100.00 - 120.00	0.6000	0.6000
T5	12	LDF5-50A(7/8)	100.00 - 120.00	0.6000	0.6000
T5	15	WE65	100.00 - 120.00	0.6000	0.6000
T5	16	WE65	100.00 - 120.00	0.6000	0.6000
T5	17	WE65	100.00 - 116.00	0.6000	0.6000
T5	18	WE65	100.00 - 102.00	0.6000	0.6000
T5	20	LDF2-50(3/8)	100.00 - 120.00	0.6000	0.6000
T5	22	WE65	100.00 - 120.00	0.6000	0.6000
T5	23	WE65	100.00 - 108.00	0.6000	0.6000
T5	28	LDF7-50A(1-5/8)	100.00 - 120.00	0.6000	0.6000
T5	33	LDF5-50A(7/8)	107.00 - 120.00	0.6000	0.6000
T5	34	LDF5-50A(7/8)	100.00 - 107.00	0.6000	0.6000
T5	35	LDF4P-50A(1/2)	100.00 - 120.00	0.6000	0.6000
T5	36	LDF6-50A(1-1/4)	100.00 - 120.00	0.6000	0.6000
T5	41	LCF78-50J(7/8)	100.00 - 120.00	0.6000	0.6000
T6	1	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T6	2	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T6	3	Climbing Ladder (Af)	80.00 - 100.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T6	4	Safety Line 3/8	80.00 - 100.00	0.6000	0.6000
T6	12	LDF5-50A(7/8)	98.00 - 100.00	0.6000	0.6000
T6	13	LDF5-50A(7/8)	80.00 - 98.00	0.6000	0.6000
T6	14	LDF7-50A(1-5/8)	80.00 - 90.00	0.6000	0.6000
T6	15	WE65	80.00 - 100.00	0.6000	0.6000
T6	16	WE65	80.00 - 100.00	0.6000	0.6000
T6	17	WE65	80.00 - 100.00	0.6000	0.6000
T6	18	WE65	80.00 - 100.00	0.6000	0.6000
T6	20	LDF2-50(3/8)	80.00 - 100.00	0.6000	0.6000
T6	22	WE65	80.00 - 100.00	0.6000	0.6000
T6	23	WE65	80.00 - 100.00	0.6000	0.6000
T6	28	LDF7-50A(1-5/8)	80.00 - 100.00	0.6000	0.6000
T6	34	LDF5-50A(7/8)	80.00 - 100.00	0.6000	0.6000
T6	35	LDF4P-50A(1/2)	80.00 - 100.00	0.6000	0.6000
T6	36	LDF6-50A(1-1/4)	80.00 - 100.00	0.6000	0.6000
T6	41	LCF78-50J(7/8)	80.00 - 100.00	0.6000	0.6000
T7	1	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T7	2	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T7	3	Climbing Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T7	4	Safety Line 3/8	60.00 - 80.00	0.6000	0.6000
T7	13	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T7	14	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T7	15	WE65	60.00 - 80.00	0.6000	0.6000
T7	16	WE65	60.00 - 80.00	0.6000	0.6000
T7	17	WE65	60.00 - 80.00	0.6000	0.6000
T7	18	WE65	60.00 - 80.00	0.6000	0.6000
T7	19	WE65	60.00 - 78.00	0.6000	0.6000
T7	20	LDF2-50(3/8)	60.00 - 80.00	0.6000	0.6000
T7	22	WE65	60.00 - 80.00	0.6000	0.6000
T7	23	WE65	60.00 - 80.00	0.6000	0.6000
T7	24	LDF2-50(3/8)	60.00 - 70.00	0.6000	0.6000
T7	28	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T7	34	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T7	35	LDF4P-50A(1/2)	60.00 - 80.00	0.6000	0.6000
T7	36	LDF6-50A(1-1/4)	60.00 -	0.6000	0.6000

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
			80.00		
T7	41	LCF78-50J(7/8)	60.00 - 80.00	0.6000	0.6000
T8	1	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T8	2	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T8	3	Climbing Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T8	4	Safety Line 3/8	40.00 - 60.00	0.6000	0.6000
T8	13	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T8	14	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T8	15	WE65	40.00 - 60.00	0.6000	0.6000
T8	16	WE65	40.00 - 60.00	0.6000	0.6000
T8	17	WE65	40.00 - 60.00	0.6000	0.6000
T8	18	WE65	40.00 - 60.00	0.6000	0.6000
T8	19	WE65	40.00 - 60.00	0.6000	0.6000
T8	20	LDF2-50(3/8)	40.00 - 60.00	0.6000	0.6000
T8	22	WE65	40.00 - 60.00	0.6000	0.6000
T8	23	WE65	40.00 - 60.00	0.6000	0.6000
T8	24	LDF2-50(3/8)	40.00 - 60.00	0.6000	0.6000
T8	28	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T8	34	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T8	35	LDF4P-50A(1/2)	40.00 - 60.00	0.6000	0.6000
T8	36	LDF6-50A(1-1/4)	40.00 - 60.00	0.6000	0.6000
T8	41	LCF78-50J(7/8)	40.00 - 60.00	0.6000	0.6000
T9	1	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T9	2	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T9	3	Climbing Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T9	4	Safety Line 3/8	20.00 - 40.00	0.6000	0.6000
T9	13	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T9	14	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T9	15	WE65	20.00 - 40.00	0.6000	0.6000
T9	16	WE65	20.00 - 40.00	0.6000	0.6000
T9	17	WE65	20.00 - 40.00	0.6000	0.6000
T9	18	WE65	20.00 - 40.00	0.6000	0.6000
T9	19	WE65	20.00 - 40.00	0.6000	0.6000
T9	20	LDF2-50(3/8)	20.00 - 40.00	0.6000	0.6000
T9	22	WE65	20.00 - 40.00	0.6000	0.6000

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
T9	23	WE65	20.00 - 40.00	0.6000	0.6000
T9	24	LDF2-50(3/8)	20.00 - 40.00	0.6000	0.6000
T9	28	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T9	34	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T9	35	LDF4P-50A(1/2)	20.00 - 40.00	0.6000	0.6000
T9	36	LDF6-50A(1-1/4)	20.00 - 40.00	0.6000	0.6000
T9	37	LDF4P-50A(1/2)	20.00 - 24.00	0.6000	0.6000
T9	41	LCF78-50J(7/8)	20.00 - 40.00	0.6000	0.6000
T10	1	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T10	2	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T10	3	Climbing Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T10	4	Safety Line 3/8	0.00 - 20.00	0.6000	0.6000
T10	13	LDF5-50A(7/8)	6.00 - 20.00	0.6000	0.6000
T10	14	LDF7-50A(1-5/8)	6.00 - 20.00	0.6000	0.6000
T10	15	WE65	6.00 - 20.00	0.6000	0.6000
T10	16	WE65	6.00 - 20.00	0.6000	0.6000
T10	17	WE65	6.00 - 20.00	0.6000	0.6000
T10	18	WE65	6.00 - 20.00	0.6000	0.6000
T10	19	WE65	6.00 - 20.00	0.6000	0.6000
T10	20	LDF2-50(3/8)	6.00 - 20.00	0.6000	0.6000
T10	22	WE65	6.00 - 20.00	0.6000	0.6000
T10	23	WE65	6.00 - 20.00	0.6000	0.6000
T10	24	LDF2-50(3/8)	6.00 - 20.00	0.6000	0.6000
T10	28	LDF7-50A(1-5/8)	6.00 - 20.00	0.6000	0.6000
T10	34	LDF5-50A(7/8)	6.00 - 20.00	0.6000	0.6000
T10	35	LDF4P-50A(1/2)	6.00 - 20.00	0.6000	0.6000
T10	36	LDF6-50A(1-1/4)	6.00 - 20.00	0.6000	0.6000
T10	37	LDF4P-50A(1/2)	6.00 - 20.00	0.6000	0.6000
T10	41	LCF78-50J(7/8)	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft ft ft*	*Azimuth Adjustment* *°*	*Placement* *ft*		*C_AA_A Front* *ft²*	*C_AA_A Side* *ft²*	*Weight* *K*
7' Hori. 5"x5" Tube	B	From Face	0.000 0.000 0.000	0.000	192.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.083 4.665 5.254 6.460	0.243 0.312 0.390 0.571	0.110 0.141 0.179 0.273
7'-0" x 2" horizontal mount pipe	B	From Face	0.500 0.000 0.000	0.000	192.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	192.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
DB220-A	A	From Leg	6.000 0.000 5.000	0.000	186.000	No Ice 1/2" Ice 1" Ice	1.852 2.933 4.031 6.019	1.852 2.933 4.031 6.019	0.016 0.031 0.052 0.116

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*
						2" Ice			
Side Arm Mount [SO 308-1]	A	From Leg	0.000 0.000 0.000	0.000	186.000	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
DB222-C	C	From Leg	6.000 0.000 5.000	0.000	188.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.600 2.880 4.160 6.720	1.600 2.880 4.160 6.720	0.016 0.021 0.026 0.035
Side Arm Mount [SO 308-1]	C	From Leg	0.000 0.000 0.000	0.000	188.000	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
DB222-C	C	From Leg	6.000 0.000 -5.000	0.000	188.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.600 2.880 4.160 6.720	1.600 2.880 4.160 6.720	0.016 0.021 0.026 0.035
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	183.000	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
OGT9-840	B	From Leg	6.000 0.000 5.500	0.000	183.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.273 3.435 4.613 6.812	2.273 3.435 4.613 6.812	0.019 0.036 0.061 0.133
OGT9-840	B	From Leg	6.000 0.000 -5.500	0.000	183.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.273 3.435 4.613 6.812	2.273 3.435 4.613 6.812	0.019 0.036 0.061 0.133
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OGT9-806	A	From Leg	3.000 0.000 5.500	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.273 3.435 4.613 6.812	2.273 3.435 4.613 6.812	0.019 0.036 0.061 0.133
OGT9-806	C	From Leg	3.000 0.000 5.500	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.273 3.435 4.613 6.812	2.273 3.435 4.613 6.812	0.019 0.036 0.061 0.133
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Sector Mount [SM 403-1]	A	From Leg	0.000 0.000 0.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	10.190 14.310 18.390 26.470	7.050 9.870 12.660 18.130	0.291 0.414 0.581 1.044
(2) 6' x 2" Mount Pipe	A	From Leg	3.000 0.000 0.000	0.000	182.000	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
SE419-SWBP4LDF	A	From Leg	3.000 -6.000 4.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.149 5.135 6.098 7.350	9.549 10.187 10.832 12.144	0.024 0.067 0.117 0.241
SE419-SWBPALDF	A	From Leg	3.000 2.000	0.000	182.000	No Ice 1/2"	22.746 23.437	9.549 10.187	0.036 0.159

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*
			4.000			Ice 1" Ice 2" Ice	24.135 25.552	10.832 12.144	0.291 0.584
SE419-SWBPALDF	A	From Leg	3.000 6.000 4.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	22.746 23.437 24.135 25.552	9.549 10.187 10.832 12.144	0.036 0.159 0.291 0.584
TX/RX 432E-83I-01T	A	From Leg	3.000 0.000 0.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.422 1.571 1.728 2.063	0.870 0.993 1.123 1.407	0.025 0.038 0.053 0.092
Sector Mount [SM 403-1]	C	From Leg	0.000 0.000 0.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	10.190 14.310 18.390 26.470	7.050 9.870 12.660 18.130	0.291 0.414 0.581 1.044
(2) 6' x 2" Mount Pipe	C	From Leg	3.000 0.000 0.000	0.000	182.000	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
SE419-SWBP4LDF	C	From Leg	3.000 -6.000 4.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	4.149 5.135 6.098 7.350	9.549 10.187 10.832 12.144	0.024 0.067 0.117 0.241
SE419-SWBPALDF	C	From Leg	3.000 2.000 4.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	22.746 23.437 24.135 25.552	9.549 10.187 10.832 12.144	0.036 0.159 0.291 0.584
SE419-SWBPALDF	C	From Leg	3.000 6.000 4.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	22.746 23.437 24.135 25.552	9.549 10.187 10.832 12.144	0.036 0.159 0.291 0.584
TX/RX 432E-83I-01T	C	From Leg	3.000 0.000 0.000	0.000	182.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.422 1.571 1.728 2.063	0.870 0.993 1.123 1.407	0.025 0.038 0.053 0.092
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DB220-A	B	From Leg	6.000 0.000 5.000	0.000	173.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.852 2.933 4.031 6.019	1.852 2.933 4.031 6.019	0.016 0.031 0.052 0.116
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	173.000	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
ANT150F2	A	From Leg	6.000 0.000 3.000	0.000	173.000	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]	A	From Leg	0.000 0.000 0.000	0.000	170.000	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
SD110	C	From Leg	6.000	0.000	168.000	No Ice	9.000	9.000	0.030

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 0.000			1/2" Ice 1" Ice 2" Ice	10.580 12.160 15.320	10.580 12.160 15.320	0.090 0.140 0.270
10' x 2.5" pipe mount	C	From Leg	3.000 0.000 0.000	0.000	168.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.875 3.907 4.956 6.188	2.875 3.907 4.956 6.188	0.041 0.061 0.089 0.164
DB630	B	From Leg	6.000 0.000 4.000	0.000	163.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.648 0.863 1.086 1.562	0.648 0.863 1.086 1.562	0.008 0.014 0.022 0.046
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	163.000	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
6' x 3" Mount Pipe	A	From Leg	0.500 0.000 0.000	0.000	162.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
SD110	A	From Leg	1.000 0.000 0.000	0.000	155.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.880 4.345 5.827 8.840	2.880 4.345 5.827 8.840	0.024 0.046 0.078 0.168
10' x 2.5" pipe mount	A	From Leg	0.500 0.000 0.000	0.000	155.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.875 3.907 4.956 6.188	2.875 3.907 4.956 6.188	0.041 0.061 0.089 0.164
SD110	C	From Leg	1.000 0.000 0.000	0.000	152.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.880 4.345 5.827 8.840	2.880 4.345 5.827 8.840	0.024 0.046 0.078 0.168
10' x 2.5" pipe mount	C	From Leg	0.500 0.000 0.000	0.000	152.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.875 3.907 4.956 6.188	2.875 3.907 4.956 6.188	0.041 0.061 0.089 0.164
SD110	B	From Leg	1.000 0.000 0.000	0.000	150.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.880 4.345 5.827 8.840	2.880 4.345 5.827 8.840	0.024 0.046 0.078 0.168
10' x 2.5" pipe mount	B	From Leg	0.500 0.000 0.000	0.000	150.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.875 3.907 4.956 6.188	2.875 3.907 4.956 6.188	0.041 0.061 0.089 0.164
PD458-1	C	From Leg	6.000 0.000 7.000	0.000	145.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.880 4.345 5.827 8.840	2.880 4.345 5.827 8.840	0.024 0.046 0.078 0.168
Side Arm Mount [SO 308-1]	C	From Leg	0.000 0.000 0.000	0.000	145.000	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
PD1142-1	C	From Leg	6.000	0.000	143.000	No Ice	1.316	1.316	0.010

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 9.000			1/2" Ice 1" Ice 2" Ice	3.210 5.121 8.993	3.210 5.121 8.993	0.024 0.049 0.136
Side Arm Mount [SO 308-1]	C	From Leg	0.000 0.000 0.000	0.000	143.000	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
PD220	C	From Leg	6.000 0.000 10.000	0.000	139.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.560 7.130 10.700 17.840	3.560 7.130 10.700 17.840	0.023 0.046 0.069 0.115
Side Arm Mount [SO 308-1]	C	From Leg	0.000 0.000 0.000	0.000	139.000	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
BCD-80609-NE	C	From Leg	6.000 0.000 -5.000	0.000	139.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.947 4.110 5.290 7.160	2.947 4.110 5.290 7.160	0.027 0.048 0.077 0.158
6' x 3" Mount Pipe	A	From Leg	0.500 0.000 0.000	0.000	137.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
11' Hori. 5"x5" Tube	B	From Face	0.000 0.000 0.000	0.000	137.000	No Ice 1/2" Ice 1" Ice 2" Ice	5.500 6.280 7.060 8.620	0.208 0.268 0.334 0.490	0.171 0.220 0.268 0.365
7'-0" x 2" horizontal mount pipe	B	From Face	0.500 0.000 0.000	0.000	137.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	137.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
PD220	A	From Leg	6.000 0.000 10.000	0.000	130.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.560 7.130 10.700 17.840	3.560 7.130 10.700 17.840	0.023 0.046 0.069 0.115
Side Arm Mount [SO 308-1]	A	From Leg	0.000 0.000 0.000	0.000	130.000	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
DB586-Y	B	From Leg	6.000 0.000 4.000	0.000	128.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.014 1.282 1.558 2.139	1.014 1.282 1.558 2.139	0.008 0.017 0.028 0.061
Side Arm Mount [SO 308-1]	B	From Leg	0.000 0.000 0.000	0.000	128.000	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"x10"x4" Box	B	From Leg	3.000	0.000	128.000	No Ice	1.000	0.407	0.010

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*		*ft²*	*ft²*	*K*
			0.000 0.000			1/2" Ice 1" Ice 2" Ice	1.126 1.259 1.548	0.497 0.593 0.815	0.018 0.027 0.053
DB586-Y	B	From Leg	6.000 0.000 -4.000	0.000	128.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.014 1.282 1.558 2.139	1.014 1.282 1.558 2.139	0.008 0.017 0.028 0.061
15' Hori. 5"x5" Tube	B	From Face	0.000 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.500 3.998 4.504 5.537	0.208 0.268 0.334 0.490	0.234 0.300 0.366 0.499
7'-0" x 2" horizontal mount pipe	B	From Face	0.500 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	116.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
15' Hori. 5"x5" Tube	C	From Face	0.000 0.000 0.000	0.000	108.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.500 3.998 4.504 5.537	0.208 0.268 0.334 0.490	0.234 0.300 0.366 0.499
7'-0" x 2" horizontal mount pipe	C	From Face	0.500 0.000 0.000	0.000	108.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	C	From Leg	0.500 0.000 0.000	0.000	108.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
PD220	A	From Leg	6.000 0.000 10.000	0.000	107.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.560 7.130 10.700 17.840	3.560 7.130 10.700 17.840	0.023 0.046 0.069 0.115
Side Arm Mount [SO 308-1]	A	From Leg	0.000 0.000 0.000	0.000	107.000	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
15' Hori. 5"x5" Tube	B	From Face	0.000 0.000 0.000	0.000	102.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.500 3.998 4.504 5.537	0.208 0.268 0.334 0.490	0.234 0.300 0.366 0.499
7'-0" x 2" horizontal mount pipe	B	From Face	0.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	102.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
3' Yagi	A	From Leg	2.000	0.000	98.000	No Ice	2.083	2.083	0.031

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 0.000			1/2" Ice 1" Ice 2" Ice	3.787 5.517 9.055	3.787 5.517 9.055	0.053 0.085 0.184
Side Arm Mount [SO 301-1]	A	From Leg	0.000 0.000 0.000	0.000	98.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.460 0.650 0.870 1.410	0.910 1.300 1.710 2.620	0.023 0.033 0.047 0.091
18' Hori. 5"x5" Tube	B	From Face	0.000 0.000 0.000	0.000	78.000	No Ice 1/2" Ice 1" Ice 2" Ice	9.000 10.280 11.560 14.120	0.208 0.268 0.334 0.490	0.280 0.359 0.438 0.596
7'-0" x 2" horizontal mount pipe	B	From Face	0.500 0.000 0.000	0.000	78.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.660 2.375 3.095 4.567	0.009 0.047 0.084 0.159	0.025 0.035 0.050 0.100
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	78.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
6' x 3" Mount Pipe	B	From Leg	0.500 0.000 0.000	0.000	70.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.767 2.129 2.501 3.272	1.767 2.129 2.501 3.272	0.030 0.044 0.061 0.109
SD210	C	From Leg	1.000 0.000 0.000	0.000	24.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.083 3.787 5.517 9.055	2.083 3.787 5.517 9.055	0.031 0.053 0.085 0.184
Side Arm Mount [SO 701-1]	C	From Leg	0.000 0.000 0.000	0.000	24.000	No Ice 1/2" Ice 1" Ice 2" Ice	0.850 1.140 1.430 2.010	1.670 2.340 3.010 4.350	0.065 0.079 0.093 0.121
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ANT220F6	A	From Leg	6.000 0.000 8.000	90.000	187.000	No Ice 1/2" Ice 1" Ice 2" Ice	3.919 5.375 6.848 9.844	3.919 5.375 6.848 9.844	0.035 0.064 0.101 0.205
USF-4U [4' SO 203-1 + Vert. Pipe Support]	A	From Leg	2.000 0.000 0.000	0.000	187.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.956 3.757 4.634 6.575	5.636 6.730 7.914 10.428	0.177 0.220 0.277 0.435
871F-70-2	A	From Leg	6.000 0.000 3.000	90.000	165.000	No Ice 1/2" Ice 1" Ice 2" Ice	1.045 1.619 2.193 3.342	1.800 3.214 4.628 7.457	0.013 0.029 0.045 0.077
USF-4U [4' SO 203-1 + Vert. Pipe Support]	A	From Leg	2.000 0.000 0.000	0.000	165.000	No Ice 1/2" Ice 1" Ice 2" Ice	2.956 3.757 4.634 6.575	5.636 6.730 7.914 10.428	0.177 0.220 0.277 0.435
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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)
8' Dish	B	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		192.000	8.000	No Ice 1/2" Ice 1" Ice 2" Ice	50.265 51.318 52.371 54.476	0.470 1.010 1.550 2.630
4' Dish	A	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		162.000	4.000	No Ice 1/2" Ice 1" Ice 2" Ice	12.570 13.100 13.620 14.680	0.079 0.150 0.210 0.350
8' Dish	B	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		137.000	8.000	No Ice 1/2" Ice 1" Ice 2" Ice	50.265 51.318 52.371 54.476	0.470 1.010 1.550 2.630
4' Dish	A	Paraboloid w/Shroud (HP)	From Leg	0.500 0.000 0.000	Worst		137.000	4.000	No Ice 1/2" Ice 1" Ice 2" Ice	12.570 13.100 13.620 14.680	0.090 0.150 0.220 0.350
8' Dish	B	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		116.000	8.000	No Ice 1/2" Ice 1" Ice 2" Ice	50.265 51.318 52.371 54.476	0.470 1.010 1.550 2.630
6' Dish	C	Paraboloid w/Radome	From Leg	0.500 0.000 2.000	Worst		108.000	6.000	No Ice 1/2" Ice 1" Ice 2" Ice	28.270 29.070 29.870 31.470	0.380 0.620 0.860 1.340
6' Dish	B	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		102.000	6.000	No Ice 1/2" Ice 1" Ice 2" Ice	28.270 29.070 29.870 31.470	0.380 0.620 0.860 1.340
6' Dish	B	Paraboloid w/Radome	From Leg	0.500 0.000 0.000	Worst		78.000	6.000	No Ice 1/2" Ice 1" Ice 2" Ice	28.270 29.070 29.870 31.470	0.380 0.620 0.860 1.340
4' Dish	B	Paraboloid w/Shroud (HP)	From Leg	0.500 0.000 0.000	Worst		70.000	4.000	No Ice 1/2" Ice 1" Ice 2" Ice	12.570 13.100 13.620 14.680	0.079 0.150 0.210 0.350
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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

Comb. No.	Description
18	1.2 Dead+1.0 Wind 240 deg - No Ice
19	0.9 Dead+1.0 Wind 240 deg - No Ice
20	1.2 Dead+1.0 Wind 270 deg - No Ice
21	0.9 Dead+1.0 Wind 270 deg - No Ice
22	1.2 Dead+1.0 Wind 300 deg - No Ice
23	0.9 Dead+1.0 Wind 300 deg - No Ice
24	1.2 Dead+1.0 Wind 330 deg - No Ice
25	0.9 Dead+1.0 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice+1.0 Temp
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum 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	196 - 180	Leg	Max Tension	7	7.784	-0.546	0.340
			Max. Compression	2	-10.292	0.572	0.226
			Max. Mx	14	7.035	0.935	-0.226
			Max. My	20	-1.210	-0.037	1.382
			Max. Vy	6	-0.782	-0.500	0.287
			Max. Vx	16	-1.273	-0.000	-0.115
		Diagonal	Max Tension	13	2.853	0.000	0.000
			Max. Compression	24	-2.887	0.000	0.000
			Max. Mx	37	0.719	0.025	-0.000
			Max. My	6	-1.506	0.006	-0.003
			Max. Vy	37	-0.030	0.025	-0.000
			Max. Vx	6	0.001	0.000	0.000
		Top Girt	Max Tension	7	0.175	0.000	0.000
			Max. Compression	18	-0.201	0.000	0.000
			Max. Mx	26	-0.074	-0.078	0.000
			Max. My	26	-0.073	0.000	0.000
			Max. Vy	26	0.047	0.000	0.000
			Max. Vx	26	-0.000	0.000	0.000
T2	180 - 160	Leg	Max Tension	7	32.841	-0.187	0.010
			Max. Compression	18	-38.442	0.322	-0.089
			Max. Mx	18	-16.518	0.889	-0.387
			Max. My	8	-1.993	0.073	0.938
			Max. Vy	19	-3.889	0.887	-0.387
			Max. Vx	20	2.068	-0.057	-0.938
		Diagonal	Max Tension	16	4.404	0.000	0.000
			Max. Compression	16	-4.408	0.000	0.000
			Max. Mx	37	0.962	0.045	-0.006
			Max. My	28	-1.320	0.040	0.007

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vy	37	0.044	0.045	-0.006
			Max. Vx	28	-0.003	0.000	0.000
		Top Girt	Max Tension	3	0.254	0.000	0.000
			Max. Compression	14	-0.270	0.000	0.000
			Max. Mx	26	-0.028	-0.092	0.000
			Max. My	26	-0.034	0.000	0.003
			Max. Vy	26	-0.054	0.000	0.000
			Max. Vx	26	-0.002	0.000	0.000
T3	160 - 140	Leg	Max Tension	7	57.475	-0.230	-0.005
			Max. Compression	18	-67.065	0.733	0.085
			Max. Mx	22	55.036	-0.765	0.102
			Max. My	24	-2.829	-0.029	0.794
			Max. Vy	22	0.188	-0.765	0.102
			Max. Vx	12	0.310	-0.011	-0.794
		Diagonal	Max Tension	16	5.435	0.000	0.000
			Max. Compression	4	-5.490	0.000	0.000
			Max. Mx	37	0.970	0.083	0.012
			Max. My	38	1.252	0.079	0.012
			Max. Vy	37	0.064	0.083	0.012
			Max. Vx	38	-0.004	0.000	0.000
T4	140 - 120	Leg	Max Tension	7	86.563	-0.315	0.094
			Max. Compression	18	-100.775	0.842	0.179
			Max. Mx	18	-88.646	0.969	0.122
			Max. My	4	-5.235	0.006	1.325
			Max. Vy	22	-0.594	-0.765	0.102
			Max. Vx	4	-0.721	-0.034	-0.787
		Diagonal	Max Tension	4	6.895	0.000	0.000
			Max. Compression	4	-6.948	0.000	0.000
			Max. Mx	33	1.172	0.128	-0.018
			Max. My	32	1.703	0.125	-0.018
			Max. Vy	33	0.086	0.128	-0.018
			Max. Vx	32	0.005	0.000	0.000
T5	120 - 100	Leg	Max Tension	15	117.438	-0.530	-0.140
			Max. Compression	18	-138.102	1.455	0.190
			Max. Mx	19	-135.855	1.457	0.190
			Max. My	16	-7.652	-0.053	1.355
			Max. Vy	22	0.456	-0.945	0.181
			Max. Vx	16	-0.734	-0.048	0.992
		Diagonal	Max Tension	8	8.996	0.000	0.000
			Max. Compression	8	-9.027	0.000	0.000
			Max. Mx	33	1.367	0.183	-0.025
			Max. My	38	-1.379	0.161	0.027
			Max. Vy	33	0.111	0.183	-0.025
			Max. Vx	38	-0.006	0.000	0.000
T6	100 - 80	Leg	Max Tension	23	147.840	-0.862	0.156
			Max. Compression	18	-173.953	1.658	0.157
			Max. Mx	18	-173.953	1.658	0.157
			Max. My	12	-13.893	0.024	-1.463
			Max. Vy	6	-0.235	-1.402	-0.191
			Max. Vx	12	0.304	-0.057	-1.437
		Diagonal	Max Tension	8	10.846	0.000	0.000
			Max. Compression	8	-10.908	0.000	0.000
			Max. Mx	33	1.669	0.302	-0.043
			Max. My	38	-2.214	0.280	0.044
			Max. Vy	33	0.149	0.302	-0.043
			Max. Vx	38	-0.009	0.000	0.000
T7	80 - 60	Leg	Max Tension	23	181.278	-1.208	0.190
			Max. Compression	10	-213.789	1.386	-0.170
			Max. Mx	18	-192.592	1.658	0.157
			Max. My	12	-15.329	-0.067	-1.475
			Max. Vy	6	-0.464	-1.555	-0.159
			Max. Vx	18	0.595	-0.813	1.363
		Diagonal	Max Tension	8	12.679	0.000	0.000
			Max. Compression	8	-12.780	0.000	0.000
			Max. Mx	33	1.975	0.381	-0.050
			Max. My	32	-1.706	0.326	-0.052
			Max. Vy	33	0.175	0.381	-0.050
			Max. Vx	32	0.009	0.000	0.000
T8	60 - 40	Leg	Max Tension	23	214.923	-1.138	0.153

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	10	-253.877	1.883	-0.258
			Max. Mx	29	13.417	-2.307	-0.019
			Max. My	12	-19.091	-0.103	-1.546
			Max. Vy	29	0.384	-2.307	-0.019
			Max. Vx	12	0.294	-0.103	-1.546
		Diagonal	Max Tension	8	13.181	0.000	0.000
			Max. Compression	10	-13.440	0.000	0.000
			Max. Mx	33	2.352	0.433	-0.059
			Max. My	32	-1.385	0.375	-0.060
			Max. Vy	33	0.188	0.433	-0.059
			Max. Vx	32	0.010	0.000	0.000
T9	40 - 20	Leg	Max Tension	23	246.388	-1.121	0.164
			Max. Compression	10	-292.483	1.865	-0.147
			Max. Mx	33	35.505	-6.088	-0.082
			Max. My	12	-22.440	-0.153	-1.897
			Max. Vy	29	0.989	-6.082	-0.011
			Max. Vx	12	-0.375	-0.153	-1.897
		Diagonal	Max Tension	8	13.622	0.000	0.000
			Max. Compression	10	-14.112	0.000	0.000
			Max. Mx	33	0.288	0.645	-0.078
			Max. My	32	4.855	0.529	-0.089
			Max. Vy	33	0.240	0.645	-0.078
			Max. Vx	32	0.014	0.000	0.000
T10	20 - 0	Leg	Max Tension	23	276.845	-2.210	0.115
			Max. Compression	10	-330.824	0.000	-0.000
			Max. Mx	35	-163.709	9.529	-0.048
			Max. My	12	-26.020	-0.211	-3.948
			Max. Vy	29	-1.516	-6.082	-0.011
			Max. Vx	12	-0.602	-0.211	-3.948
		Diagonal	Max Tension	8	14.873	0.000	0.000
			Max. Compression	10	-16.197	0.000	0.000
			Max. Mx	33	-1.849	0.801	-0.081
			Max. My	32	7.827	0.417	-0.093
			Max. Vy	33	0.252	0.801	-0.081
			Max. Vx	32	0.013	0.000	0.000

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	18	339.124	35.513	-19.645
	Max. H_x	18	339.124	35.513	-19.645
	Max. H_z	5	-243.644	-24.803	17.416
	Min. Vert	7	-279.089	-30.062	16.541
	Min. H_x	7	-279.089	-30.062	16.541
	Min. H_z	18	339.124	35.513	-19.645
Leg B	Max. Vert	10	340.631	-36.993	-18.476
	Max. H_x	23	-284.474	31.584	15.444
	Max. H_z	23	-284.474	31.584	15.444
	Min. Vert	23	-284.474	31.584	15.444
	Min. H_x	10	340.631	-36.993	-18.476
	Min. H_z	10	340.631	-36.993	-18.476
Leg A	Max. Vert	2	334.589	-1.574	40.660
	Max. H_x	19	-144.453	3.497	-17.862
	Max. H_z	2	334.589	-1.574	40.660
	Min. Vert	15	-281.761	1.531	-34.524
	Min. H_x	6	171.737	-3.180	20.220
	Min. H_z	15	-281.761	1.531	-34.524

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	56.159	0.000	-0.000	36.571	23.310	0.000
1.2 Dead+1.0 Wind 0 deg - No Ice	67.390	0.675	-65.332	-6825.295	-81.103	-67.062
0.9 Dead+1.0 Wind 0 deg - No Ice	50.543	0.675	-65.332	-6836.266	-88.096	-67.062
1.2 Dead+1.0 Wind 30 deg - No Ice	67.390	31.195	-53.365	-5641.523	-3306.963	-16.348
0.9 Dead+1.0 Wind 30 deg - No Ice	50.543	31.195	-53.365	-5652.494	-3313.956	-16.348
1.2 Dead+1.0 Wind 60 deg - No Ice	67.390	52.304	-30.592	-3264.190	-5574.501	31.590
0.9 Dead+1.0 Wind 60 deg - No Ice	50.543	52.304	-30.592	-3275.161	-5581.494	31.590
1.2 Dead+1.0 Wind 90 deg - No Ice	67.390	61.717	-0.675	-65.189	-6566.420	70.820
0.9 Dead+1.0 Wind 90 deg - No Ice	50.543	61.717	-0.675	-76.161	-6573.413	70.820
1.2 Dead+1.0 Wind 120 deg - No Ice	67.390	57.613	32.878	3484.387	-6022.021	106.486
0.9 Dead+1.0 Wind 120 deg - No Ice	50.543	57.613	32.878	3473.416	-6029.014	106.486
1.2 Dead+1.0 Wind 150 deg - No Ice	67.390	31.360	55.000	5866.882	-3260.450	109.454
0.9 Dead+1.0 Wind 150 deg - No Ice	50.543	31.360	55.000	5855.910	-3267.443	109.454
1.2 Dead+1.0 Wind 180 deg - No Ice	67.390	-0.675	60.933	6540.695	137.047	67.062
0.9 Dead+1.0 Wind 180 deg - No Ice	50.543	-0.675	60.933	6529.724	130.054	67.062
1.2 Dead+1.0 Wind 210 deg - No Ice	67.390	-31.195	53.365	5729.294	3362.907	16.348
0.9 Dead+1.0 Wind 210 deg - No Ice	50.543	-31.195	53.365	5718.323	3355.914	16.348
1.2 Dead+1.0 Wind 240 deg - No Ice	67.390	-56.114	32.792	3538.147	5952.929	-31.590
0.9 Dead+1.0 Wind 240 deg - No Ice	50.543	-56.114	32.792	3527.175	5945.935	-31.590
1.2 Dead+1.0 Wind 270 deg - No Ice	67.390	-61.717	0.675	152.961	6622.364	-70.820
0.9 Dead+1.0 Wind 270 deg - No Ice	50.543	-61.717	0.675	141.989	6615.371	-70.820
1.2 Dead+1.0 Wind 300 deg - No Ice	67.390	-53.803	-30.678	-3210.430	5755.482	-106.486
0.9 Dead+1.0 Wind 300 deg - No Ice	50.543	-53.803	-30.678	-3221.402	5748.489	-106.486
1.2 Dead+1.0 Wind 330 deg - No Ice	67.390	-31.360	-55.000	-5779.110	3316.395	-109.454
0.9 Dead+1.0 Wind 330 deg - No Ice	50.543	-31.360	-55.000	-5790.081	3309.402	-109.454
1.2 Dead+1.0 Ice+1.0 Temp	178.070	0.000	-0.000	200.717	208.570	0.000
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	178.070	0.162	-19.166	-1859.199	182.518	-35.810
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	178.070	9.347	-16.027	-1539.949	-808.500	-16.411
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	178.070	15.765	-9.196	-809.464	-1509.962	5.001
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	178.070	18.410	-0.162	174.666	-1793.723	24.801
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	178.070	16.515	9.441	1214.753	-1568.740	40.340
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	178.070	9.289	16.252	1957.215	-787.558	45.342
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	178.070	-0.162	18.560	2211.043	234.621	35.810
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	178.070	-9.347	16.027	1941.384	1225.639	16.411

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 240 deg+1.0 Ice+1.0 Temp	178.070	-16.290	9.499	1235.694	1970.048	-5.001
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	178.070	-18.410	0.162	226.769	2210.863	-24.801
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	178.070	-15.989	-9.138	-788.522	1942.934	-40.340
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	178.070	-9.289	-16.252	-1555.780	1204.698	-45.342
Dead+Wind 0 deg - Service	56.159	0.156	-15.052	-1546.088	-1.821	-15.451
Dead+Wind 30 deg - Service	56.159	7.187	-12.295	-1273.347	-745.059	-3.767
Dead+Wind 60 deg - Service	56.159	12.051	-7.048	-725.609	-1267.500	7.278
Dead+Wind 90 deg - Service	56.159	14.219	-0.156	11.441	-1496.038	16.317
Dead+Wind 120 deg - Service	56.159	13.274	7.575	829.263	-1370.608	24.534
Dead+Wind 150 deg - Service	56.159	7.225	12.672	1378.190	-734.342	25.218
Dead+Wind 180 deg - Service	56.159	-0.156	14.039	1533.436	48.441	15.451
Dead+Wind 210 deg - Service	56.159	-7.187	12.295	1346.490	791.679	3.767
Dead+Wind 240 deg - Service	56.159	-12.929	7.555	841.649	1388.420	-7.278
Dead+Wind 270 deg - Service	56.159	-14.219	0.156	61.702	1542.658	-16.317
Dead+Wind 300 deg - Service	56.159	-12.396	-7.068	-713.223	1342.928	-24.534
Dead+Wind 330 deg - Service	56.159	-7.225	-12.672	-1305.047	780.963	-25.218

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.000	-56.159	0.000	0.000	56.159	0.000	0.000%
2	0.675	-67.390	-65.332	-0.675	67.390	65.332	0.000%
3	0.675	-50.543	-65.332	-0.675	50.543	65.332	0.000%
4	31.195	-67.390	-53.365	-31.195	67.390	53.365	0.000%
5	31.195	-50.543	-53.365	-31.195	50.543	53.365	0.000%
6	52.304	-67.390	-30.592	-52.304	67.390	30.592	0.000%
7	52.304	-50.543	-30.592	-52.304	50.543	30.592	0.000%
8	61.717	-67.390	-0.675	-61.717	67.390	0.675	0.000%
9	61.717	-50.543	-0.675	-61.717	50.543	0.675	0.000%
10	57.613	-67.390	32.878	-57.613	67.390	-32.878	0.000%
11	57.613	-50.543	32.878	-57.613	50.543	-32.878	0.000%
12	31.360	-67.390	55.000	-31.360	67.390	-55.000	0.000%
13	31.360	-50.543	55.000	-31.360	50.543	-55.000	0.000%
14	-0.675	-67.390	60.933	0.675	67.390	-60.933	0.000%
15	-0.675	-50.543	60.933	0.675	50.543	-60.933	0.000%
16	-31.195	-67.390	53.365	31.195	67.390	-53.365	0.000%
17	-31.195	-50.543	53.365	31.195	50.543	-53.365	0.000%
18	-56.114	-67.390	32.792	56.114	67.390	-32.792	0.000%
19	-56.114	-50.543	32.792	56.114	50.543	-32.792	0.000%
20	-61.717	-67.390	0.675	61.717	67.390	-0.675	0.000%
21	-61.717	-50.543	0.675	61.717	50.543	-0.675	0.000%
22	-53.803	-67.390	-30.678	53.803	67.390	30.678	0.000%
23	-53.803	-50.543	-30.678	53.803	50.543	30.678	0.000%
24	-31.360	-67.390	-55.000	31.360	67.390	55.000	0.000%
25	-31.360	-50.543	-55.000	31.360	50.543	55.000	0.000%
26	0.000	-178.070	0.000	-0.000	178.070	0.000	0.000%
27	0.162	-178.070	-19.166	-0.162	178.070	19.166	0.000%
28	9.347	-178.070	-16.027	-9.347	178.070	16.027	0.000%
29	15.765	-178.070	-9.196	-15.765	178.070	9.196	0.000%
30	18.410	-178.070	-0.162	-18.410	178.070	0.162	0.000%
31	16.515	-178.070	9.441	-16.515	178.070	-9.441	0.000%
32	9.289	-178.070	16.252	-9.289	178.070	-16.252	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	*PX K*	*PY K*	*PZ K*	*PX K*	*PY K*	*PZ K*	*% Error*
33	-0.162	-178.070	18.560	0.162	178.070	-18.560	0.000%
34	-9.347	-178.070	16.027	9.347	178.070	-16.027	0.000%
35	-16.290	-178.070	9.499	16.290	178.070	-9.499	0.000%
36	-18.410	-178.070	0.162	18.410	178.070	-0.162	0.000%
37	-15.989	-178.070	-9.138	15.989	178.070	9.138	0.000%
38	-9.289	-178.070	-16.252	9.289	178.070	16.252	0.000%
39	0.156	-56.159	-15.052	-0.156	56.159	15.052	0.000%
40	7.187	-56.159	-12.295	-7.187	56.159	12.295	0.000%
41	12.051	-56.159	-7.048	-12.051	56.159	7.048	0.000%
42	14.219	-56.159	-0.156	-14.219	56.159	0.156	0.000%
43	13.274	-56.159	7.575	-13.274	56.159	-7.575	0.000%
44	7.225	-56.159	12.672	-7.225	56.159	-12.672	0.000%
45	-0.156	-56.159	14.039	0.156	56.159	-14.039	0.000%
46	-7.187	-56.159	12.295	7.187	56.159	-12.295	0.000%
47	-12.929	-56.159	7.555	12.929	56.159	-7.555	0.000%
48	-14.219	-56.159	0.156	14.219	56.159	-0.156	0.000%
49	-12.396	-56.159	-7.068	12.396	56.159	7.068	0.000%
50	-7.225	-56.159	-12.672	7.225	56.159	12.672	0.000%

Maximum Tower Deflections - Service Wind

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*
T1	196 - 180	2.861	47	0.122	0.019
T2	180 - 160	2.447	47	0.120	0.022
T3	160 - 140	1.945	47	0.110	0.023
T4	140 - 120	1.496	47	0.096	0.020
T5	120 - 100	1.106	47	0.080	0.017
T6	100 - 80	0.779	47	0.065	0.014
T7	80 - 60	0.514	47	0.053	0.011
T8	60 - 40	0.300	47	0.040	0.008
T9	40 - 20	0.141	43	0.027	0.005
T10	20 - 0	0.044	43	0.012	0.003

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	*Appurtenance*	*Gov. Load Comb.*	*Deflection in*	*Tilt °*	*Twist °*	*Radius of Curvature ft*
192.000	8' Dish	47	2.757	0.122	0.020	Inf
188.000	DB222-C	47	2.653	0.122	0.020	807504
187.000	ANT220F6	47	2.627	0.121	0.021	717803
186.000	DB220-A	47	2.601	0.121	0.021	646010
183.000	Side Arm Mount [SO 308-1]	47	2.524	0.121	0.021	493054
182.000	OGT9-806	47	2.498	0.121	0.022	450330
173.000	DB220-A	47	2.267	0.117	0.023	169849
170.000	Side Arm Mount [SO 308-1]	47	2.191	0.116	0.023	133598
168.000	SD110	47	2.141	0.115	0.023	116350
165.000	871F-70-2	47	2.067	0.113	0.023	97474
163.000	DB630	47	2.018	0.111	0.023	88217
162.000	4' Dish	47	1.993	0.111	0.023	84661
155.000	SD110	47	1.827	0.106	0.022	78718
152.000	SD110	47	1.758	0.104	0.022	79964
150.000	SD110	47	1.713	0.103	0.022	80816
145.000	PD458-1	47	1.603	0.100	0.021	83029
143.000	PD1142-1	47	1.560	0.098	0.021	83890
139.000	PD220	47	1.475	0.095	0.020	84258
137.000	8' Dish	47	1.434	0.094	0.020	83421
130.000	PD220	47	1.294	0.088	0.019	79384
128.000	DB586-Y	47	1.255	0.087	0.019	78286

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
116.000	8' Dish	47	1.036	0.077	0.017	74180
110.000	6' Dish	47	0.935	0.072	0.016	74166
108.000	15' Hori. 5"x5" Tube	47	0.902	0.071	0.015	74162
107.000	PD220	47	0.886	0.070	0.015	74160
102.000	6' Dish	47	0.809	0.066	0.014	74331
98.000	3' Yagi	47	0.750	0.064	0.014	76394
78.000	6' Dish	47	0.491	0.052	0.011	99877
70.000	4' Dish	47	0.401	0.047	0.010	95636
24.000	SD210	43	0.058	0.015	0.003	74261

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	196 - 180	12.234	18	0.521	0.081
T2	180 - 160	10.462	18	0.513	0.095
T3	160 - 140	8.320	18	0.468	0.099
T4	140 - 120	6.411	10	0.411	0.088
T5	120 - 100	4.750	10	0.342	0.076
T6	100 - 80	3.352	10	0.277	0.060
T7	80 - 60	2.216	10	0.228	0.048
T8	60 - 40	1.298	10	0.173	0.036
T9	40 - 20	0.611	11	0.114	0.023
T10	20 - 0	0.191	11	0.051	0.012

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
192.000	8' Dish	18	11.790	0.521	0.085	322667
188.000	DB222-C	18	11.346	0.520	0.089	201667
187.000	ANT220F6	18	11.236	0.519	0.090	179259
186.000	DB220-A	18	11.125	0.519	0.091	161333
183.000	Side Arm Mount [SO 308-1]	18	10.793	0.517	0.093	122954
182.000	OGT9-806	18	10.683	0.516	0.094	111961
173.000	DB220-A	18	9.696	0.501	0.099	39202
170.000	Side Arm Mount [SO 308-1]	18	9.372	0.494	0.099	30808
168.000	SD110	18	9.157	0.489	0.100	26949
165.000	871F-70-2	18	8.839	0.481	0.100	22686
163.000	DB630	18	8.629	0.476	0.100	20581
162.000	4' Dish	18	8.525	0.473	0.100	19771
155.000	SD110	18	7.816	0.454	0.097	18450
152.000	SD110	18	7.522	0.446	0.096	18761
150.000	SD110	10	7.330	0.440	0.095	18974
145.000	PD458-1	10	6.864	0.426	0.092	19529
143.000	PD1142-1	10	6.681	0.420	0.090	19746
139.000	PD220	10	6.322	0.408	0.087	19843
137.000	8' Dish	10	6.146	0.401	0.086	19638
130.000	PD220	10	5.550	0.377	0.083	18647
128.000	DB586-Y	10	5.385	0.371	0.081	18378
116.000	8' Dish	10	4.449	0.328	0.073	17369
110.000	6' Dish	10	4.017	0.308	0.068	17358
108.000	15' Hori. 5"x5" Tube	10	3.879	0.301	0.066	17354
107.000	PD220	10	3.810	0.298	0.066	17352
102.000	6' Dish	10	3.480	0.283	0.062	17386
98.000	3' Yagi	10	3.227	0.271	0.059	17865
78.000	6' Dish	10	2.115	0.223	0.047	23361
70.000	4' Dish	10	1.730	0.201	0.042	22389
24.000	SD210	11	0.253	0.063	0.014	17436

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	196	Leg	A325N	0.875	4	1.946	41.556	0.047	1.05	Bolt Tension
		Diagonal	A325N	0.625	1	2.853	6.831	0.418	1.05	Member Block Shear
		Top Girt	A325N	0.625	1	0.175	5.505	0.032	1.05	Member Block Shear
T2	180	Leg	A325N	1.000	4	8.210	54.517	0.151	1.05	Bolt Tension
		Diagonal	A325N	0.625	1	4.404	10.440	0.422	1.05	Member Bearing
		Top Girt	A325N	0.625	1	0.254	9.488	0.027	1.05	Member Block Shear
T3	160	Leg	A325N	1.000	6	9.579	54.517	0.176	1.05	Bolt Tension
		Diagonal	A325N	0.625	1	5.435	10.440	0.521	1.05	Member Bearing
T4	140	Leg	A325N	1.000	6	14.427	54.517	0.265	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	6.895	14.137	0.488	1.05	Member Bearing
T5	120	Leg	A325N	1.000	8	14.680	54.517	0.269	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	8.996	14.137	0.636	1.05	Member Bearing
T6	100	Leg	A325N	1.000	8	18.480	54.517	0.339	1.05	Bolt Tension
		Diagonal	A325N	0.750	1	10.846	17.672	0.614	1.05	Member Bearing
T7	80	Leg	A325N	1.000	8	22.648	54.517	0.415	1.05	Bolt Tension
		Diagonal	A325N	0.875	1	12.679	24.863	0.510	1.05	Member Bearing
T8	60	Leg	A325N	1.000	8	26.865	54.517	0.493	1.05	Bolt Tension
		Diagonal	A325N	0.875	1	13.181	24.863	0.530	1.05	Member Bearing
T9	40	Leg	A325N	1.000	12	20.532	54.517	0.377	1.05	Bolt Tension
		Diagonal	A325N	0.875	1	13.622	24.863	0.548	1.05	Member Bearing
T10	20	Diagonal	A325N	0.875	1	16.197	27.059	0.599	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	196 - 180	ROHN 3 EH	16.000	3.979	42.0 K=1.00	3.016	-10.292	119.278	0.086 [1]
T2	180 - 160	ROHN 4 EH	20.036	4.988	40.5 K=1.00	4.407	-38.442	175.883	0.219 [1]
T3	160 - 140	ROHN 5 EH	20.036	6.679	43.6 K=1.00	6.112	-67.065	239.378	0.280 [1]
T4	140 - 120	ROHN 6 EHS	20.033	6.678	36.0 K=1.00	6.713	-100.775	274.771	0.367 [1]
T5	120 - 100	ROHN 6 EH	20.036	6.679	36.5 K=1.00	8.405	-138.102	343.092	0.403 [1]
T6	100 - 80	ROHN 8 EH	20.036	10.018	41.8 K=1.00	12.763	-173.953	505.535	0.344 [1]
T7	80 - 60	ROHN 8 EH	20.033	10.017	41.8 K=1.00	12.763	-213.789	505.555	0.423 [1]
T8	60 - 40	ROHN 8 EH	20.034	10.017	41.8 K=1.00	12.763	-253.877	505.550	0.502 [1]
T9	40 - 20	ROHN 8 EH	20.038	10.019	41.8 K=1.00	12.763	-292.483	505.526	0.579 [1]
T10	20 - 0	ROHN 10 EH	20.034	10.017	33.1	16.101	-330.824	668.655	0.495 [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

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	196 - 180	L1 3/4x1 3/4x3/16	7.837	3.634	127.0 K=1.00	0.621	-2.887	11.025	0.262 [1]
T2	180 - 160	L2x2x1/4	9.915	4.770	146.4 K=1.00	0.938	-4.408	12.529	0.352 [1]
T3	160 - 140	L2 1/2x2 1/2x1/4	12.500	6.062	148.2 K=1.00	1.190	-5.490	15.517	0.354 [1]
T4	140 - 120	L3x3x1/4	14.245	6.863	139.1 K=1.00	1.440	-6.948	21.296	0.326 [1]
T5	120 - 100	L3 1/2x3 1/2x1/4	16.092	7.797	134.8 K=1.00	1.690	-9.027	26.613	0.339 [1]
T6	100 - 80	L4x4x5/16	19.345	9.423	142.9 K=1.00	2.400	-10.908	33.616	0.324 [1]
T7	80 - 60	L4x4x3/8	21.102	10.276	156.5 K=1.00	2.860	-12.780	33.429	0.382 [1]
T8	60 - 40	L4x4x3/8	22.896	11.178	170.2 K=1.00	2.860	-13.440	28.249	0.476 [1]
T9	40 - 20	L5x5x3/8	24.805	12.150	147.3 K=1.00	3.610	-14.112	47.642	0.296 [1]
T10	20 - 0	L5x5x3/8	26.691	12.984	157.4 K=1.00	3.610	-16.197	41.718	0.388 [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	196 - 180	L1 3/4x1 3/4x3/16	6.690	6.159	215.2 K=1.00	0.621	-0.201	3.839	0.052 [1]
		KL/R > 200 (C) - 5							
T2	180 - 160	L2x2x1/4	6.769	6.144	188.6 K=1.00	0.938	-0.270	7.552	0.036 [1]

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	196 - 180	ROHN 3 EH	16.000	3.979	42.0	3.016	7.784	135.717	0.057 [1]
T2	180 - 160	ROHN 4 EH	20.036	4.988	40.5	4.407	32.841	198.335	0.166 [1]
T3	160 - 140	ROHN 5 EH	20.036	6.679	43.6	6.112	57.475	275.039	0.209 [1]
T4	140 - 120	ROHN 6 EHS	20.033	6.678	36.0	6.713	86.563	302.097	0.287 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $P_u / \phi P_n$
T5	120 - 100	ROHN 6 EH	20.036	6.679	36.5	8.405	117.438	378.222	0.310 [1]
T6	100 - 80	ROHN 8 EH	20.036	10.018	41.8	12.763	147.840	574.322	0.257 [1]
T7	80 - 60	ROHN 8 EH	20.033	10.017	41.8	12.763	181.188	574.322	0.315 [1]
T8	60 - 40	ROHN 8 EH	20.034	10.017	41.8	12.763	214.923	574.322	0.374 [1]
T9	40 - 20	ROHN 8 EH	20.038	10.019	41.8	12.763	246.388	574.322	0.429 [1]
T10	20 - 0	ROHN 10 EH	20.034	10.017	33.1	16.101	276.845	724.530	0.382 [1]

[1] $P_u / \phi P_n$ 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 $P_u / \phi P_n$
T1	196 - 180	L1 3/4x1 3/4x3/16	7.837	3.634	83.9	0.360	2.853	15.675	0.182 [1]
T2	180 - 160	L2x2x1/4	9.915	4.770	96.3	0.563	4.404	24.485	0.180 [1]
T3	160 - 140	L2 1/2x2 1/2x1/4	12.500	6.062	96.5	0.752	5.435	32.707	0.166 [1]
T4	140 - 120	L3x3x1/4	14.245	6.863	90.3	0.916	6.895	44.652	0.154 [1]
T5	120 - 100	L3 1/2x3 1/2x1/4	16.092	7.797	87.3	1.103	8.996	53.793	0.167 [1]
T6	100 - 80	L4x4x5/16	19.345	9.423	92.5	1.595	10.846	77.752	0.139 [1]
T7	80 - 60	L4x4x3/8	21.102	10.276	101.7	1.864	12.679	90.858	0.140 [1]
T8	60 - 40	L4x4x3/8	22.896	11.178	110.5	1.864	13.181	90.858	0.145 [1]
T9	40 - 20	L5x5x3/8	24.805	12.150	94.6	2.426	13.622	118.280	0.115 [1]
T10	20 - 0	L5x5x3/8	26.691	12.984	101.0	2.426	14.873	118.280	0.126 [1]

[1] $P_u / \phi P_n$ 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	196 - 180	L1 3/4x1 3/4x3/16	6.690	6.159	143.0	0.360	0.175	15.675	0.011 [1]
T2	180 - 160	L2x2x1/4	6.769	6.144	126.0	0.563	0.254	24.485	0.010 [1]

[1] $P_u / \phi P_n$ controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T1	196 - 180	Leg	ROHN 3 EH	3	-10.292	125.242	8.2	Pass
T2	180 - 160	Leg	ROHN 4 EH	31	-38.442	184.677	20.8	Pass
T3	160 - 140	Leg	ROHN 5 EH	61	-67.065	251.347	26.7	Pass
T4	140 - 120	Leg	ROHN 6 EHS	82	-100.775	288.510	34.9	Pass
T5	120 - 100	Leg	ROHN 6 EH	103	-138.102	360.247	38.3	Pass
T6	100 - 80	Leg	ROHN 8 EH	124	-173.953	530.812	32.8	Pass
T7	80 - 60	Leg	ROHN 8 EH	140	-213.789	530.833	40.3	Pass
T8	60 - 40	Leg	ROHN 8 EH	155	-253.877	530.827	47.8	Pass
T9	40 - 20	Leg	ROHN 8 EH	170	-292.483	530.802	55.1	Pass
T10	20 - 0	Leg	ROHN 10 EH	185	-330.824	702.088	47.1	Pass
T1	196 - 180	Diagonal	L1 3/4x1 3/4x3/16	10	-2.887	11.576	24.9 39.8 (b)	Pass
T2	180 - 160	Diagonal	L2x2x1/4	42	-4.408	13.155	33.5 40.2 (b)	Pass
T3	160 - 140	Diagonal	L2 1/2x2 1/2x1/4	68	-5.490	16.293	33.7 49.6 (b)	Pass
T4	140 - 120	Diagonal	L3x3x1/4	89	-6.948	22.361	31.1 46.4 (b)	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T5	120 - 100	Diagonal	L3 1/2x3 1/2x1/4	107	-9.027	27.943	32.3 60.6 (b)	Pass
T6	100 - 80	Diagonal	L4x4x5/16	128	-10.908	35.297	30.9 58.5 (b)	Pass
T7	80 - 60	Diagonal	L4x4x3/8	143	-12.780	35.100	36.4 48.6 (b)	Pass
T8	60 - 40	Diagonal	L4x4x3/8	158	-13.440	29.661	45.3 50.5 (b)	Pass
T9	40 - 20	Diagonal	L5x5x3/8	173	-14.112	50.024	28.2 52.2 (b)	Pass
T10	20 - 0	Diagonal	L5x5x3/8	188	-16.197	43.804	37.0 57.0 (b)	Pass
T1	196 - 180	Top Girt	L1 3/4x1 3/4x3/16	5	-0.201	4.031	5.0	Pass
T2	180 - 160	Top Girt	L2x2x1/4	34	-0.270	7.929	3.4	Pass
							Summary	
						Leg (T9)	55.1	Pass
						Diagonal (T5)	60.6	Pass
						Top Girt (T1)	5.0	Pass
						Bolt Checks	60.6	Pass
						RATING =	**60.6**	**Pass**

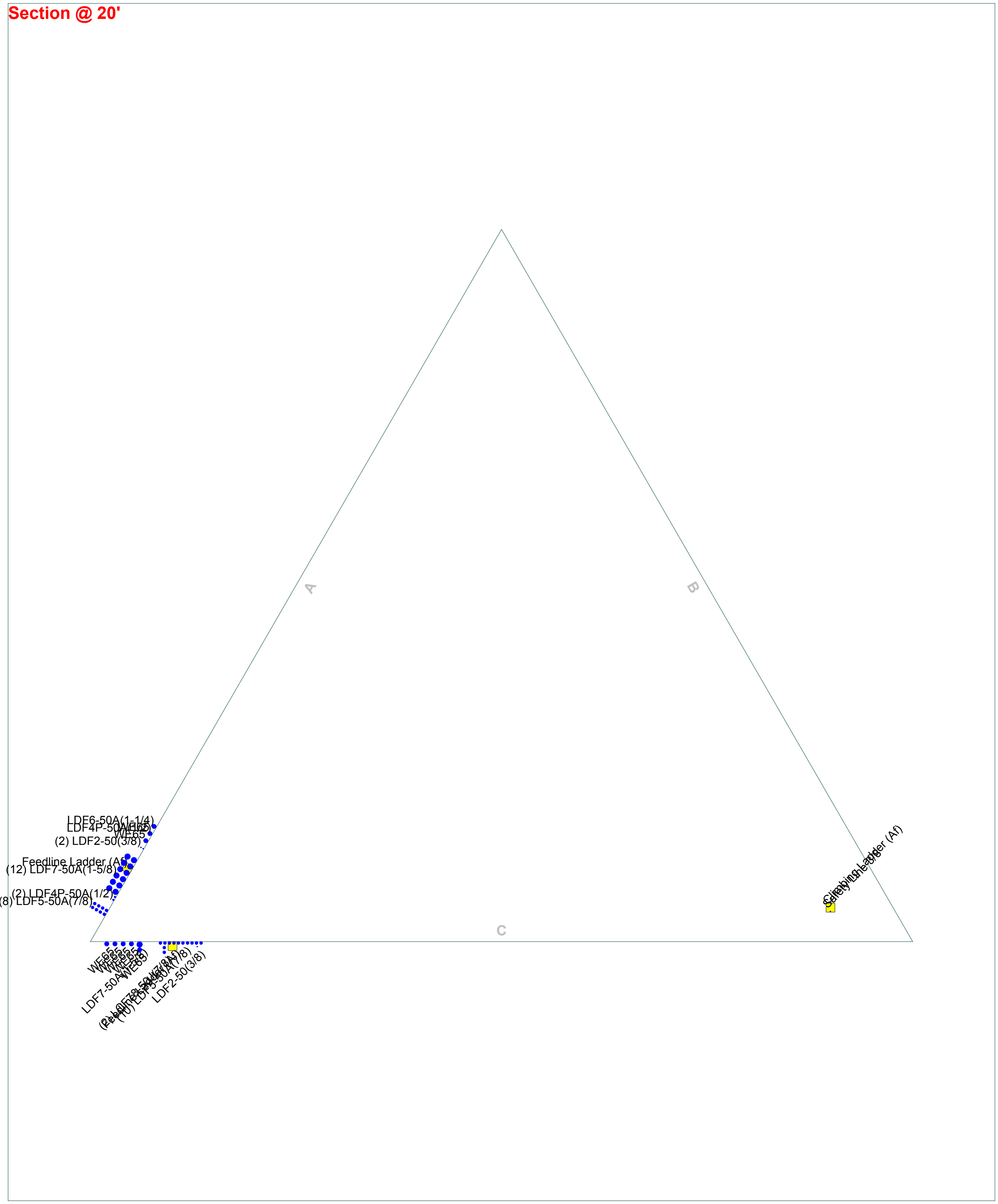
APPENDIX B

BASE LEVEL DRAWING

Feed Line Plan

20'

Round	Flat	App In Face	App Out Face



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Job: ***ES-086 SoapstoneRS***		
Project: ***403093***		
Client: Eversource	Drawn by: Aditya Kulkarni	App'd:
Code: TIA-222-H	Date: 02/19/20	Scale: NTS
Path:		Dwg No. E-7

APPENDIX C

ADDITIONAL CALCULATIONS

References

ANCHOR ROD ANALYSIS

Project Information

Site Name: ES-086 SoapstoneRS

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

$Axial\_C := 341 \cdot kip$

$Shear\_C := 41 \cdot kip$

Uplift

$Axial\_U := 284 \cdot kip$

$Shear\_U := 35 \cdot kip$

Anchor Rod Data

Diameter of Anchor Rod: $D := 1 \cdot in$

Number of Anchor Rods: $N := 12$

Length from top of concrete to bottom of anchor rod leveling nut: $lar := 1.75 \cdot in$

Anchor Rod Grade: F1554-105 (selected) / 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: 8-Thread)

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

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

Threads per Inch: $n = 8$ (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)

$$Z := \frac{1}{6} \cdot \left(D - \frac{0.9743in}{n}\right)^3 = 0.113 \cdot in^3$$

Radius of Gyration:

$$r := \left(\frac{1}{4}\right) \cdot \left(D - \frac{0.9743in}{n}\right) = 0.22 \cdot in$$

Net Area of Anchor Rod:

$$An := \frac{\pi}{4} \cdot \left(D - \frac{0.9743in}{n}\right)^2 = 0.606 \cdot in^2$$

TIA-222-G/H Section 4.9.6.1

Nominal Unthreaded Area of Anchor Rod:

$$Ab := \frac{\pi}{4} \cdot (D)^2 = 0.785 \cdot in^2$$

Anchor Rod Design Capacities

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

$Rnt := Fu \cdot An = 75.718 \cdot kip$

$\phi t = 0.75$

$\phi Rnt := \phi t \cdot Rnt = 56.788 \cdot kip$

Design Compression Strength:

$Rnc := Fy \cdot An = 63.603 \cdot kip$

$\phi c = 1$

$\phi Rnc := \phi c \cdot Rnc = 63.603 \cdot kip$

Design Buckling Strength: TIA-222-H Section 4.5.4.2

$K_0 := 1.2$

$Fcr = 104.88 \cdot ksi$

$Fe = 3.832 \times 10^4 \cdot ksi$

$Rnb := Fcr \cdot An = 63.53 \cdot kip$

$\phi c = 1$

$\phi Rnb := \phi c \cdot Rnb = 63.53 \cdot kip$

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

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

$Rnv = 49.087 \cdot kip$

$Rnvc := 0.6 \cdot Fy \cdot 0.5 \cdot An = 19.081 \cdot kip$ TIA-222-H Section 4.9.9

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

$\phi Rnv := \phi v \cdot Rnv = 36.816 \cdot kip$ $\phi Rnvc := \phi c \cdot Rnvc = 19.081 \cdot kip$

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

$Rmn := Fy \cdot Z = 11.853 \cdot kip \cdot in$

$\phi f = 0.9$

$\phi Rmn := \phi f \cdot Rmn = 10.668 \cdot kip \cdot in$

Anchor Rod Loading Demands

Tension Demand:

$$Put := \frac{Axial\_U}{N} = 23.667 \cdot kip$$

Compression Demand:

$$Puc := \frac{Axial\_C}{N} = 28.417 \cdot kip$$

Shear Demand:

$$Vut := \frac{Shear\_U}{N} = 2.917 \cdot kip$$

$$Vuc := \frac{Shear\_C}{N} = 3.417 \cdot kip$$

Moment Demand:

$$Mut := 0.65 \cdot lar \cdot Vut = 0.948 \cdot kip \cdot in$$

$$Muc := 0.65 \cdot lar \cdot Vuc = 1.11 \cdot kip \cdot in$$

Anchor Rod Interaction Check TIA-222-G Section 4.9.9

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

$$SR\_g = 0.51$$

Anchor Rod Interaction Check TIA-222-H Section 4.9.9

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

$SR\_Pt = 0.18$

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

$SR\_Pc = 0.479$

$$SR := \begin{cases} SR\_g & \text{if } TIA = \text{"Rev-G"} \\ \max(SR\_Pt, SR\_Pc) & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"No"} \\ \frac{\max(SR\_Pt, SR\_Pc)}{1.05} & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"Yes"} \end{cases} = 0.456$$

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

Anchor Rod Results

Axial Tension Demand:	$Put = 23.667 \cdot kip$
Axial Tension Capacity:	$\phi Rnt = 56.788 \cdot kip$
Axial Compression Demand:	$Puc = 28.417 \cdot kip$
Axial Compression Capacity:	$\phi Rnc = 63.603 \cdot kip$
Shear Tension Demand:	$Vut = 2.917 \cdot kip$
Tension Shear Capacity:	$\phi Rnv = 36.816 \cdot kip$
Shear Compression Demand:	$Vuc = 3.417 \cdot kip$
Compresison Shear Capacity:	$\phi R_{nvc} = 19.081 \cdot kip$
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

$SR = 45.604 \cdot \%$

$Check_{SR}$ = "Passing"

SST Unit Base Foundation

ES-086
SoapstoneRS

TIA-222 Revision: H

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

Superstructure Analysis Reactions		
Global Moment, **M**:	6958	ft-kips
Global Axial, **P**:	67	kips
Global Shear, **V**:	66	kips
Leg Compression, $\mathbf{P_{comp}}$:	341	kips
Leg Comp. Shear, $\mathbf{V_{u\_comp}}$:	41	kips
Leg Uplift, $\mathbf{P_{uplift}}$:	284	kips
Leg Uplift. Shear, $\mathbf{V_{u\_uplift}}$:	35	kips
Tower Height, **H**:	196	ft
Base Face Width, **BW**:	25.25	ft
BP Dist. Above Fdn, $\mathbf{bp_{dist}}$:	3.5	in

Foundation Analysis Checks	Capacity	Demand	Rating*	Check
Lateral (Sliding) (kips)	371.60	66.00	**16.9%**	**Pass**
Bearing Pressure (ksf)	9.00	1.33	**14.1%**	**Pass**
*Overturning (kip*ft)*	17116.33	7373.25	**43.1%**	**Pass**
*Pier Flexure (Comp.) (kip*ft)*	2054.68	143.50	**6.7%**	**Pass**
*Pier Flexure (Tension) (kip*ft)*	1158.80	122.50	**10.1%**	**Pass**
Pier Compression (kip)	10122.78	351.02	**3.3%**	**Pass**
*Pad Flexure (kip*ft)*	6319.98	1429.73	**21.5%**	**Pass**
Pad Shear - 1-way (kips)	1123.63	201.68	**17.1%**	**Pass**
Pad Shear - Comp 2-way (ksi)	0.190	0.057	**28.5%**	**Pass**
*Flexural 2-way (Comp) (kip*ft)*	3881.64	86.10	**2.1%**	**Pass**
Pad Shear - Tension 2-way (ksi)	0.190	0.048	**24.2%**	**Pass**
*Flexural 2-way (Tension) (kip*ft)*	3881.64	73.50	**1.8%**	**Pass**

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

Soil Rating*:	**43.1%**
Structural Rating*:	**28.5%**

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, **dpier**:	4.5	ft
Ext. Above Grade, **E**:	1.00	ft
Pier Rebar Size, **Sc**:	9	
Pier Rebar Quantity, **mc**:	16	
Pier Tie/Spiral Size, **St**:	3	
Pier Tie/Spiral Quantity, **mt**:	5	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, $\mathbf{cc_{pier}}$:	3	in

Pad Properties		
Depth, **D**:	5.00	ft
Pad Width, **W**:	39.00	ft
Pad Thickness, **T**:	2.50	ft
Pad Rebar Size (Bottom), **Sp**:	9	
Pad Rebar Quantity (Bottom), **mp**:	58	
Pad Clear Cover, $\mathbf{cc_{pad}}$:	3	in

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

Soil Properties			
Total Soil Unit Weight, γ:	100	pcf	
Ultimate Gross Bearing, Qult:	12.000	ksf	<-- Toggle between Gross and Net
Cohesion, **Cu**:		ksf	
Friction Angle, φ:	30	degrees	
SPT Blow Count, $\mathbf{N_{blows}}$:	4		
Base Friction, μ:	0.45		
Neglected Depth, **N**:	3.3	ft	
Foundation Bearing on Rock?	No		
Groundwater Depth, **gw**:	n/a	ft	

TIA-222- H	ACI : 2014			

PHYSICAL PARAMETERS

Pier Height Above Water Table:	h_{pier_above} = (MIN(gw,D-T) + E)	h_{pier_above} =	3.5	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} =	8.35	kips
Pad Height Above Water Table:	h_{pad_above} = IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw)))	h_{pad_above} =	2.5	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} =	570.38	kips
Concrete weight:	W_c = V * δc	W_c =	595.4	kips
Soil weight:	W_s = (D - T) * (W² - 3*(dpier² / 4 * π)) * γ	W_s =	368.3	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} =	82.54	kips
Factored Total Weight for Compression:	$P_{factored\_comp}$ = φD * (Wc + Ws + P / 1.2)	$P_{factored\_comp}$ =	917.62	kips
Nominal Base Friction Resistance (Comp):	R_{s_comp} = P * μ	R_{s_comp} =	412.93	kips
Lateral Resistance (Comp):	ΦVn = Φs * (Pp_total + Rs_comp)	ΦVn =	371.60	kips

Check	**ΦVn =**	**371.60**	**kips**	**>=**	**Vu =**	**66.00**	**kips**	**RATING:**	**17.76%**	**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 =	10959.20	in²
Compressive Resistance (H/D < 3):	$ΦP_{n1}$ = 0.65*0.85 * F'c * A1 * MIN(√(A2/A1),2)				$ΦP_{n1}$ =	10122.78	kips
Rebar:	$s_{\_pier}$ = 9	d_{b_pier} =	1.128	in			
	$m_{\_pier}$ = 16	A_{b_pier} =	1	in²			
Provided area of steel:	A_{s_pier} = Ab_pier * m_pier				A_{s_pier} =	16.00	in²
Compressive Resistance (H/D >= 3):	$ΦP_{n2}$ = 0.65 * 0.8 * (0.85 * (F\c) * (A_1 - As_pier) + ((Fy) * As_pier))				$ΦP_{n2}$ =	4520.02	kips
	H/D = (D - T + E) / dpier				H/D =	0.78	
Utilized Compressive Resistance:	$ΦP_n$ = Pn1				$ΦP_n$ =	10122.78	kips
Applied Compressive Force:	P_u = Pcomp + 1.2 * Wpier				P_u =	351.02	kips

Check	$ΦP_n$ =	**10122.78**	**kips**	**>=**	**P_u =**	**351.02**	**kips**	**RATING:**	**3.47%**	**OK**

Pier Flexure

Cross-sectional area:	A_g = dpier² * π / 4	A_g =	2290.22	in^2	
Min. area of steel (pier):	A_{smin_pier} = Ag * 0.005	A_{smin_pier} =	11.45	in^2	
Cage Diameter:	d_o = dpier - 2 * cc - 2 * tie - d_b	d_o =	46.12	in	

Check **A_{s_pier} = 16.00 in^2 >= A_{smin_pier} = 11.45 in^2** — **OK**

Applied Moment to DSMC (Compression):	M_{u_comp} = IF(T>D,E,(D - T + E)) * Vu_comp	M_{u_comp} =	143.50	ft-kips	
Pier Moment Capacity (Compression):	$ΦM_{n\_comp}$ = *from DSMC*	$ΦM_{n\_comp}$ =	2054.68	ft-kips	

Check **M_{u_comp} = 143.50 ft-kips >= $ΦM_{n\_comp}$ = 2054.68 ft-kips** — **RATING: 6.98%** — **OK**

Applied Moment to DSMC (Tension):	$M_{u\_tension}$ = IF(T>D,E,(D - T + E)) * Vu_uplift	$M_{u\_tension}$ =	122.50	ft-kips	
Pier Moment Capacity (Tension):	$ΦM_{n\_tension}$ = *from DSMC*	$ΦM_{n\_tension}$ =	1158.80	ft-kips	

Check **M_{u_comp} = 122.50 ft-kips >= $ΦM_{n\_comp}$ = 1158.80 ft-kips** — **RATING: 10.57%** — **OK**

PAD REINFORCEMENT

Elastic Bearing Pressure for Soil Checks

Tower Cetroid offset from Fdn Centroid:	Offset = 0	Offset =	0.00	ft	
Distance from Leg to Edge of Pad:	L_{edge} = (1/2)*W - Offset - (1/3)*BW*sin(60°)	L_{edge} =	12.21	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	$M_{o\_0.9}$ =	7365.00	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	$M_{o\_1.2}$ =	7365.00	ft-kips	
Compressive Load for Bearing:	$P_{bearing}$ = Wc + Ws + P / 1.2	$P_{bearing}$ =	1019.58	kips	
*Load Eccentricity (0.9*D LC):*	$e_{c\_0.9}$ = Mo / 0.9*Pbearing	$e_{c\_0.9}$ =	8.03	ft	L/6 < e <= L/
*Load Eccentricity (1.2*D LC):*	$e_{c\_1.2}$ = Mo / 1.2*Pbearing	$e_{c\_1.2}$ =	6.02	ft	e <= L/6
Elastic Section Modulus:	S = W³ / 6	S =	9886.50	ft³	
*Positive Pressure (0.9*D LC):*	$P_{pos\_st\_0.9}$ = 0.9*Pbearing / Area + Mo / S	$P_{pos\_st\_0.9}$ =	1.35	ksf	
*Positive Pressure (1.2*D LC):*	$P_{pos\_st\_1.2}$ = 1.2*Pbearing / Area + Mo / S	$P_{pos\_st\_1.2}$ =	1.55	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.**	$P_{neg\_st\_0.9}$ =	-0.14	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.**	$P_{neg\_st\_1.2}$ =	0.06	ksf	
*Adjusted Pressure (0.9*D LC):*	$P_{adj\_0.9}$ = (2 * 0.9*Pbearing) / (3 * W * (W / 2 - ec_0.9))	$P_{adj\_0.9}$ =	1.37	ksf	
*Adjusted Pressure (1.2*D LC):*	$P_{adj\_1.2}$ = (2 * 1.2*Pbearing) / (3 * W * (W / 2 - ec_1.2))	$P_{adj\_1.2}$ =	1.55	ksf	
*Maximum Pressure (0.9*D LC):*	$q_{u\_st\_0.9}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_0.9}$ =	1.37	ksf	
*Maximum Pressure (1.2*D LC):*	$q_{u\_st\_1.2}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_1.2}$ =	1.55	ksf	

One-Way Shear

Rebar:	$s_{\_pad}$ = 9 $m_{\_pad}$ = 58	*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 =	25.3 in
Distance from Edge of Pad to Column Face:	d' = Ledge - dpier/2	d' =	10.0 ft
Distance from Edge of Pad to dc from Column Face:	d'' = d' - d_c / 12	d'' =	7.85 ft
Distance to qs (0.9D LC):	$L'_{\_0.9}$ = (W / 2 - ec_0.9) * 3	$L'_{\_0.9}$ =	34.42 ft
Distance to qs (1.2D LC):	$L'_{\_1.2}$ = (W / 2 - ec_1.2) * 3	$L'_{\_1.2}$ =	40.44 ft
*Slope of qs (0.9*D LC):*	$sq_{s\_0.9}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_0.9}$ =	0.04 kcf
*Slope of qs (1.2*D LC):*	$sq_{s\_1.2}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_1.2}$ =	0.04 kcf
Nominal Shear Strength:	V_{n1} = 2 * W * √(F'c*1000) * dc	V_{n1} =	1498.18 kips
Shear Reduction Factor:	$φ_{shear}$ = 0.75	$φ_{shear}$ =	0.75
Design Shear Strength:	$φV_{n1}$ = φshear * V_{n1}	$φV_{n1}$ =	1123.63 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:	2.5	0.100	68.90	91.87
Soil Below Water Table:	0	0.038	0.00	0.00
Pad Above Water Table:	2.5	0.150	103.35	137.80
Pad Below Water Table:	0	0.088	0.00	0.00
Total:			172.25	229.67

*Applied Shear (0.9*D LC):*	$V_{u1\_0.9}$ = 'Pad Shear and Moment Diagrams'!$AY$21	$V_{u1\_0.9}$ =	200.55 kips
*Applied Shear (1.2*D LC):*	$V_{u1\_1.2}$ = 'Pad Shear and Moment Diagrams'!$CG$21	$V_{u1\_1.2}$ =	201.48 kips

Check **$φV_{n1}$ = 1123.63 kips >= V_{u1} = 201.48 kips** **RATING: 17.93% 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} =	25.87 in
Radius of Two-Way Shear Plane:	r_{2way} = 0.5*(dpier + dc_2/12)	r_{2way} =	3.33 ft
Length to Edge of Pad from Pier Centroid:	L_{edge2} = W/2 - 2/3*SIN(60°)*BW + Offset	L_{edge2} =	4.92 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 =	1722.00	kip*in
Circular Critical Perimeter:	P_{crit_cir} = (dpier+dc_2/12)*PI() - $L$171)*12	P_{crit_cir} =	250.93	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_sq\_1}$ = 4*(dpier_sq+dc_2)	$P_{crit\_sq\_1}$ =	294.91	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_sq\_2}$ = 2*(dpier_sq + dc_2) + (W*12-BW*12)	$P_{crit\_sq\_2}$ =	312.46	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_sq\_3}$ = 2 * (dpier_sq + dc_2 + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_sq\_3}$ =	440.52	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_sq\_4}$ = 2 * (dpier_sq + dc_2 + Ledge2 * 12)	$P_{crit\_sq\_4}$ =	265.58	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_sq\_5}$ = dpier_sq + dc_2 + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30)) - Ledge	$P_{crit\_sq\_5}$ =	302.76	in
Area of Concrete in Shear:	A_c = ((dpier1 + dc_2)*PI()) * dc_2	A_c =	6491.94	in^2
Eq. Square Area of Concrete in Shear (1):	$A_{c\_sq\_1}$ = $P_{crit\_sq\_1}$ * d_{c_2}	$A_{c\_sq\_1}$ =	7629.99	in^2
Eq. Square Area of Concrete in Shear (2):	$A_{c\_sq\_2}$ = $P_{crit\_sq\_2}$ * d_{c_2}	$A_{c\_sq\_2}$ =	8083.87	in^2
Eq. Square Area of Concrete in Shear (3):	$A_{c\_sq\_3}$ = $P_{crit\_sq\_3}$ * d_{c_2}	$A_{c\_sq\_3}$ =	11397.12	in^2
Eq. Square Area of Concrete in Shear (4):	$A_{c\_sq\_4}$ = $P_{crit\_sq\_4}$ * d_{c_2}	$A_{c\_sq\_4}$ =	6871.14	in^2
Eq. Square Area of Concrete in Shear (5):	$A_{c\_sq\_5}$ = $P_{crit\_sq\_5}$ * d_{c_2}	$A_{c\_sq\_5}$ =	7833.00	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} =	9019188.21	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	$J_{c\_sq\_1}$ =	7125387.22	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	$J_{c\_sq\_2}$ =	6154913.62	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	$J_{c\_sq\_3}$ =	4533167.21	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	$J_{c\_sq\_4}$ =	4533167.21	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	$J_{c\_sq\_5}$ =	3562693.61	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})	$V_{u\_1.2}$ =	351.02	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}	$v_{u\_1.2\_controlling}$ =	0.057	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	$v_{u\_1.2\_controlling\_sq}$ =	0.057	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.190	ksi

Check **Φv_n = 0.190 ksi >= v_{u_demand} = 0.057 ksi** **RATING: 29.88% OK**

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

Distance To Outside Edge:	$dist_{outside}$ = MIN((W-BW)/2,BW/2)*2	$dist_{outside}$ =	13.75	ft
Effective Pad Width:	b_{pad} = MIN(dpier+3*T,W,dist_outside)	b_{pad} =	12.00	ft
Bar Spacing:	B_{s_pad} = Bs_pad (see design checks below)	B_{s_pad} =	8.09	in
Fraction of Bars in Effective Width:	$m_{effective}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad)	$m_{effective}$ =	17.81	
Area of Steel in Effective Width:	$A_{s\_effective}$ = VLOOKUP(Sp,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective}$ =	17.81	in²
Depth of Equivalent Rectangular Stress Block:	$a_{effective}$ = $A_{s\_effective}$ * Fy / (0.85 * F'c * b_{slab}*12)	$a_{effective}$ =	2.18	in
	β_{pad} = β_{pad} (see design checks below)	β_{pad} =	0.85	
Distance from Top to Nuetral Axis:	$c_{effective}$ = $a_{effective}$ / β_{pad}	$c_{effective}$ =	2.57	
Effective depth:	dc = dc (see One-Way Shear check above)	dc =	25.308	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	$\varepsilon_{s\_effective}$ =	0.02657	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)	$M_{n\_effective}$ =	2156.46	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective}$ =	1940.82	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$12	$B_{s\_pad\_top}$ =	12.00	in
Fraction of Bars in Effective Width:	$m_{effective\_top}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad_top)	$m_{effective\_top}$ =	17.81	
Area of Steel in Effective Width:	$A_{s\_effective\_top}$ = VLOOKUP(Sptop,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective\_top}$ =	17.81	in²
Depth of Equivalent Rectangular Stress Block:	$a_{effective\_top}$ = $A_{s\_effective\_top}$ * Fy / (0.85 * F'c * b_{slab}*12)	$a_{effective\_top}$ =	2.18	in
Distance from Top to Nuetral Axis:	$c_{effective\_top}$ = $a_{effective\_top}$ / β_{pad}	$c_{effective\_top}$ =	2.57	
Effective depth:	dc_top = T *12 - ccpad - 1.5 * VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)	d_{c_top} =	25.308	in
Strain in Steel:	$\varepsilon_{s\_effective\_top}$ = 0.003 * (dc_top-c_effective_top) / c_effective_top	$\varepsilon_{s\_effective\_top}$ =	0.02657	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)	$M_{n\_effective\_top}$ =	2156.46	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective\_top}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective\_top}$ =	1940.82	ft-kips
Applied Moment:	$Yf*M_{u\_comp}$ = $Yf*M_{u\_comp}$	$Yf*M_{u\_comp}$ =	86.1	ft-kips

Check	**$\varphi M_{n\_effective}$ = 3881.64 ksi**	**>=**	**$Yf*M_{u\_comp}$ = 86.10 ksi**	**RATING:**	**2.22%**	**OK**

Two-Way Shear (Uplift)

Moment applied at base of Pier:	M_{v_tens} =	$M_{u\_tension}$ * 12 in / ft	M_{v_tens} =	1470.00	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)	$d_{\_cage}$ =	46.12	in
Eq. Sq. Diameter of Longitudinal Rebar Cage:	$d_{\_cage\_sq}$ =	SQRT(PI())/2*d_cage	$d_{\_cage\_sq}$ =	40.87	in
Steel Embedment Length:	L_{embed} =	dc_2 (see One-Way Shear check above)	L_{embed} =	25.87	in
Radius of Two-Way Shear Plane:	r_{2way_tens} =	0.5*(d_cage/12 + Lembed/12)	r_{2way_tens} =	3.00	ft
	$r_{2way\_tens\_sq}$ =	0.5*(SQRT(PI())/2*d_cage/12 + Lembed/12)	$r_{2way\_tens\_sq}$ =	2.78	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} =	226.18	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_tens\_sq\_1}$ =	4*(d_cage_sq+Lembed)	$P_{crit\_tens\_sq\_1}$ =	266.99	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_tens\_sq\_2}$ =	2*(d_cage_sq + Lembed) + (W*12-BW*12)	$P_{crit\_tens\_sq\_2}$ =	298.49	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_tens\_sq\_3}$ =	2 * (d_cage_sq + Lembed) + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_tens\_sq\_3}$ =	426.56	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_tens\_sq\_4}$ =	2 * (d_cage_sq + Lembed + Ledge2 * 12)	$P_{crit\_tens\_sq\_4}$ =	251.62	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)) - l	$P_{crit\_tens\_sq\_5}$ =	295.78	in
Area of Concrete in Shear:	A_{c_tens} =	Pcrit_tens*Lembed	A_{c_tens} =	5851.62	in^2
Equivalent Square Area of Concrete in Shear:	$A_{c\_tens\_sq1}$ =	Pcrit_tens_sq1*Lembed	$A_{c\_tens\_sq1}$ =	6907.47	in^2
	$A_{c\_tens\_sq2}$ =	'Pcrit_tens_sq2*Lembed	$A_{c\_tens\_sq2}$ =	7722.61	in^2
	$A_{c\_tens\_sq3}$ =	Pcrit_tens_sq3*Lembed	$A_{c\_tens\_sq3}$ =	11035.86	in^2
	$A_{c\_tens\_sq4}$ =	Pcrit_tens_sq4*Lembed	$A_{c\_tens\_sq4}$ =	6509.88	in^2
	$A_{c\_tens\_sq5}$ =	Pcrit_tens_sq5*Lembed	$A_{c\_tens\_sq5}$ =	7652.37	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} =	4230402.61	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	$J_{c\_tens\_sq\_1}$ =	5321562.87	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	$J_{c\_tens\_sq\_2}$ =	4584123.99	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	$J_{c\_tens\_sq\_3}$ =	3398220.31	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	$J_{c\_tens\_sq\_4}$ =	3398220.31	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	$J_{c\_tens\_sq\_5}$ =	2660781.43	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),0)	$V_{u\_0.9\_tens}$ =	276.49	kip
*Controlling Shear Stress (0.9*D LC):*	$v_{u\_0.9\_controlling\_tens}$ =	$V_{u\_0.9}$ / A_{c_tens} + (γ_v * M_v * (d_{cage} + Lembed)/2) / J_{c_tens}	$v_{u\_0.9\_controlling\_tens}$ =	0.052	ksi
*Equivalent Square Shear Stress (0.9*D LC):*	$v_{u\_0.9\_tens\_sq}$ =	Vu_0.9_tens/Ac_tens_sq4 + (Ɣv * Mv_tens * (d_cage_sq + Lembed)/2) / Jc	$v_{u\_0.9\_tens\_sq}$ =	0.048	ksi
Shear Stress Capacity:	Φv_n =	φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.190	ksi

Check **Φv_n = 0.190 ksi >= v_{u_demand} = 0.048 ksi** **RATING: 25.43% OK**

Two-Way Shear (Uplift, Flexural Component)

Applied Moment:	$Yf*M_{u\_tension}$ = $Yf*M_{u\_tension}$	$Yf*M_{u\_tension}$ = 73.5

Check $\varphi M_{n\_effective}$ = **3881.64 ksi** >= $Yf*M_{u\_tension}$ = **73.50 ksi** **RATING: 1.89% 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} =	0.85	
Provided Steel:	A_{s_pad} = A_{b_pad} * $m_{\_pad}$	A_{s_pad} =	58.00	in^2
Depth of Equivalent Rectangular Stress Block:	a = A_{s_pad} * Fy / (0.85 * F'c * W)	a =	2.19	in
Distance from Top to Nuetral Axis:	c = a / β_{pad}	c =	2.57	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 =	0.02651	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 =	7022.20	ft-kips
Design Flexural Strength:	φM_n = φflex * Mn	φM_n =	6319.98	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 =	0.97	ksf
*Bearing Press. at Crit. Section (1.2*D LC):*	qmid_1.2 = qu_st_1.2 - sqs_1.2 * d'	qmid_1.2 =	1.17	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:	2.5	0.100	87.41	116.54	4.980476426	435.33	580.44
Soil Below Water Table:	0	0.038	0.00	0.00	4.980476426	0.00	0.00
Pad Above Water Table:	2.5	0.150	131.11	174.81	4.980476426	653.00	870.66
Pad Below Water Table:	0	0.088	0.00	0.00	4.980476426	0.00	0.00
Total:			218.52	291.36		1088.33	1451.10

*Factored Bending Moment (0.9*D LC):*	Mu_pad_0.9 = 'Pad Shear and Moment Diagrams'!$AZ$21	Mu_pad_0.9 =	1432.08	ft-kips
*Factored Bending Moment (1.2*D LC):*	Mu_pad_1.2 = 'Pad Shear and Moment Diagrams'!$CH$21	Mu_pad_1.2 =	1413.56	ft-kips

Check φM_n = **6319.98 ft-kips** >= M_{u_pad} = **1432.08 ft-kips** **RATING: 22.66% 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} =**	**16.00**	**in²**	**>=**	**A_{st_c} =**	**11.45**	**in²**			**OK**

Bar Spacing

	Bar separation:			B_{s_pier} = (do * π) / m_pier - db_pier			B_{s_pier} =	7.93	in	
Check		**18.00**	**in**	**>=**	**B_{s_pier} =**	**7.93**	**in**			**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 =	0.72		
Development (tensile):	$L_{dt}'_{\_c}$ =	(3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ_c * γ_c * λ_c * R_c * db_c / c_c'	$L_{dt}'_{\_c}$ =	29.87	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} =	29.87	in	
Development (comp.):	$L_{dc}'_{\_c}$ =	0.02 * db_c * Fy*1000 / √(F'c*1000)	$L_{dc}'_{\_c}$ =	21.40	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} =	21.40	in	
Length available in pier:	L_{vc} =	D - T + E - cc	L_{vc} =	39.0	in	

Check	**L_{vc} =**	**39.00**	**in**	**>=**	**L_{dt_c} =**	**29.87**	**in**	**OK**
Check	**L_{vc} =**	**39.00**	**in**	**>=**	**L_{dc_c} =**	**21.40**	**in**	**OK**

Length available in pad:	L_{vp} =	T - ccpad	L_{vp} =	27.0	in

Check	**L_{vp} =**	**27.00**	**in**	**>=**	**L_{dt_c} =**	**29.87**	**in**	**HOOKS**
Check	**L_{vp} =**	**27.00**	**in**	**>=**	**L_{dc_c} =**	**21.40**	**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}' =	15.0	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} =	15.0	in
Check	**L_{vp} =**	**27.00**	**in**	**>=**	**L_{dh} = 14.98 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} =	32.1	in
Check	**L_{h_pad} =**	**32.06**	**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:	$s_{\_t}$ =	3	d_{b_t} =	0.375	in			
	$m_{\_t}$ =	5	A_{b_t} =	0.11	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				$B_{s\_t\_max2}$ =	18	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	**$m_{\_t}$ =**	**5.00**		**>=**	**$m_{\_t\_min}$ = 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	$A_{st\_p\_sh}$ =	25.272	in^2

Check A_{s_p} = **58.00** in^2 **>=** A_{st_p} = **25.27** in^2 — **OK**

Bar Separation

Bar separation:	B_{s_pad} =	(W - 2 * cc - db) / (m - 1)	B_{s_pad} =	8.09	in

Check **18"** **>=** B_{s_p} = **8.09** **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} =	1591.2	ft-kips
Steel estimate:	A_{st_p}' =	Mn / (φt * Fy * dc)	A_{st_p}' =	13.972	in^2
	a_p =	Ast' * Fy / (β * F'c * W)	a_p =	0.53	in
Required steel:	$A_{st\_p\_st}$ =	M_{nr} / (Fy * (dc - ap / 2))	$A_{st\_p\_st}$ =	12.707	in^2
Excess reinforcement:	R_p =	Ast_p / As_p	R_p =	0.44	
Development (tensile):	L_d =	(3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ * γ * λ * R * db / c'	L_d =	18.18	in
Minimum length:	L_{d_min} =	12 inches	L_{d_min} =	12.0	in
Development length:	L_{dp} =	MAX(Ld_min, Ldp')	L_{dp} =	18.18	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} =	116.53	in

Check L_{pad} = **116.53** **in** **>=** L_{dp} = **18.18** **in** — **OK**

TIA-222- H

FACTORED LOADS

Axial Load 0.9D:	$P_{\_0.9D}$ = 0.9 * P / 1.2	$P_{\_0.9D}$ =	50.25	kip	
Axial Load 1.2D:	$P_{\_1.2D}$ = 1.2 * P / 1.2	$P_{\_1.2D}$ =	67.00	kip	
Shear Load:	V_u = V	V_u =	66.00	kip	
Moment:	M_u = Mu	M_u =	6958.00	kip*ft	

PASSIVE PRESSURE RESISTANCE

Force of Pp Applied on Pier:	$Force_{pier}$ = MIN(Vu,Sum(Pp!M2:M7))	$Force_{pier}$ =	0.00	kip	
Moment Arm of Pp on Pier:	M_{arm_pier} = D-T-Pp!O2 + T	M_{arm_pier} =	5.00	ft	
Force of Pp Applied on Pad:	$Force_{pad}$ = MIN(Vu-Forcepier,SUM(Pp!M8:M13))	$Force_{pad}$ =	66.00	kip	
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} =	0.79	ft	
Unfactored Moment Resistance due to Passive Pressure:	$M_{R\_Pp} = Force_{pier}*M_{arm\_pier}+Force_{pad}*M_{arm\_pad}$	M_{R_Pp} =	52.27	kip*ft	
Factored Moment Resistance due to Passive Pressure:	ΦM_{R_Pp} = Φs*MR_Pp	ΦM_{R_Pp} =	39.20	kip*ft	

PLASTIC BEARING PRESSURE & OVERTURNING MOMENT

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing	$P_{bearing\_0.9}$ =	917.62	kip	
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2}$ = P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing	$P_{bearing\_1.2}$ =	1223.50	kip	
*Factored Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9}$ = M + V * (MAX(T,D) + E + bpdist/12) + (0.9)*(P/1.2+3*Wpier)*Offset	$M_{overturning\_0.9}$ =	7365.00	kip*ft	
*Factored Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2}$ = M + V * (MAX(T,D) + E + bpdist/12) + (1.2)*(P/1.2+3*Wpier)*Offset	$M_{overturning\_1.2}$ =	7365.00	kip*ft	
Area of Pad:	Area = W²	Area =	1521.00	ft^2	
Plastic Section Modulus of Pad:	Z = W³ / 4	Z =	14829.75	ft³	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_p} = M_{overturning}/P_{bearing\_0.9}$	$pre\_ec_{\_0.9\_p}$ =	8.03	ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_p} = M_{overturning}/P_{bearing\_1.2}$	$pre\_ec_{\_1.2\_p}$ =	6.02	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_p}$ = *goal seek*	$ec_{\_0.9\_p}$ =	7.98	ft	e <= L/4
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_p}$ = *goal seek*	$ec_{\_1.2\_p}$ =	5.99	ft	e <= L/4
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9}$ = 0	$NBL_{\_0.9}$ =	0.00	ft	
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2}$ = 0	$NBL_{\_1.2}$ =	0.00	ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9} = \Phi M_{R\_Pp}$ + SUM($\Phi M_{R\_wedges\_0.9}$,$\Phi M_{R\_shear\_0.9}$)	$\Phi M_{Resisting\_0.9}$ =	39.20	kip*ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2} = \Phi M_{R\_Pp}$ + SUM($\Phi M_{R\_wedges\_1.2}$,$\Phi M_{R\_shear\_1.2}$)	$\Phi M_{Resisting\_1.2}$ =	39.20	kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_adj\_0.9} = M_{overturning} - \Phi M_{Resisting\_0.9}$	$M_{overturning\_0.9}$ =	7325.80	kip*ft	
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_adj\_1.2} = M_{overturning} - \Phi M_{Resisting\_1.2}$	$M_{overturning\_1.2}$ =	7325.80	kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9} = P_{bearing\_0.9}*ec_{\_0.9\_p} + \Phi M_{Resisting\_0.9}$	$\Phi M_{Resisting\_qu\_0.9}$ =	7365.00	kip*ft	
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2} = P_{bearing\_1.2}*ec_{\_1.2\_p} + \Phi M_{Resisting\_1.2}$	$\Phi M_{Resisting\_qu\_1.2}$ =	7365.00	kip*ft	
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_0.9} = M_{overturning} - \Phi M_{Resisting\_qu\_0.9}$	$\Delta M_{\_0.9}$ =	0.00	ft	
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{\_1.2} = M_{overturning} - \Phi M_{Resisting\_qu\_1.2}$	$\Delta M_{\_1.2}$ =	0.00	ft	

Bearing Pressures

*Orthogonal Bearing Pressure (0.9*D LC):*	$q_{u\_orth\_0.9}$ = MAX(Pbearing_0.9/Area + Moverturning_0.9/Z, Pbearing_0.9/Area - Moverturning_0.9/Z)	$q_{u\_orth\_0.9}$ =	1.10	ksf
*Orthogonal Bearing Pressure (1.2*D LC):*	$q_{u\_orth\_1.2}$ = MAX(Pbearing_1.2/Area + Moverturning_1.2/Z, Pbearing_1.2/Area - Moverturning_1.2/Z)	$q_{u\_orth\_1.2}$ =	1.30	ksf
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} =	12.00	ksf
Factored Ultimate Gross Bearing Pressure:	ΦQult = φs * Qult	Qa =	9.00	ksf

Check **ΦQult = 9.00 ksf >= q_u = 1.30 ksf** **RATING: 14.43% OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht =	2.50	ft
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw =	0.00	ft

Soil Wedge Projection Grade: $Wedge_{proj}$ = TAN(ϕ*PI()/180)*soilht — $Wedge_{proj}$ = 1.44 ft

Soil Wedge Projection at Water Table: $Wedge_{proj\_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw) — $Wedge_{proj\_gw}$ = 0.00 ft

Soil Wedges (Cohesionless Soil) (0.9*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	0.00	0.00	39.00	0.00
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	39.00	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	39.00	0.00
(1) Rear (above Water Table)	0.00	0.00	39.48	0.00
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	0.00	0.00		0.00

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	0.00
Soil Wedge Wt (kip)=	0.00

*Unfactored Resisting Moment of Wedges (0.9*D LC):* $M_{R\_wedges\_0.9}$ = Total Moment Arm * Soil Wedge Wt — $M_{R\_wedges\_0.9}$ = 0.00 kip*ft

*Factored Resisting Moment of Wedges (0.9*D LC):* $\Phi M_{R\_wedges\_0.9}$ = 0.75*MR_wedges_0.9 — $\Phi M_{R\_wedges\_0.9}$ = 0.00 kip*ft

Soil Wedges (Cohesionless Soil) (1.2*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	0.00	0.00	39.00	0.00
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	39.00	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	39.00	0.00
(1) Rear (above Water Table)	0.00	0.00	39.48	0.00
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	0.00	0.00		0.00

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	0.00
Soil Wedge Wt (kip)=	0.00

*Unfactored Resisting Moment of Wedges (1.2*D LC):* $M_{R\_wedges\_1.2}$ = Total Moment Arm * Soil Wedge Wt — $M_{R\_wedges\_1.2}$ = 0.00 kip*ft

*Factored Resisting Moment of Wedges (1.2*D LC):* $\Phi M_{R\_wedges\_1.2}$ = 0.75*MR_wedges_1.2 — $\Phi M_{R\_wedges\_1.2}$ = 0.00 kip*ft

Soil Shear Strength (Cohesive Soil)

Effective Soil Unit Weight: γ_{eff_shear} = γ — γ_{eff_shear} = 0.1000 kcf

Depth to Mid-Layer of Soil: $H_{\_shear}$ = ((D - T) - N) / 2 + N — $H_{\_shear}$ = 2.90 ft

Cohesion at Mid-Layer of Soil: S_u = 0 — S_u = 0.00 ksf

Soil Shear Strength (Cohesive Soil) (0.9*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	0.00	0.00	39.00	0.00
(2) Partial Sides	0.00	0.00	39.00	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (0.9*D LC):* $M_{R\_shear\_0.9}$ = Total Moment Arm * Soil Shear Strength — $M_{R\_shear\_0.9}$ = 0.00 kip*ft

*Factored Resisting Moment of Soil Shear (0.9*D LC):* $\Phi M_{R\_shear\_0.9}$ = 0.75 * (Total Moment Arm * Soil Shear Strength) — $\Phi M_{R\_shear\_0.9}$ = 0.00 kip*ft

Soil Shear Strength (Cohesive Soil) (1.2*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	0.00	0.00	39.00	0.00
(2) Partial Sides	0.00	0.00	39.00	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (1.2*D LC):* $M_{R\_shear\_1.2}$ = Total Moment Arm * Soil Shear Strength — $M_{R\_shear\_1.2}$ = 0.00 kip*ft

*Factored Resisting Moment of Soil Shear (1.2*D LC):* $\Phi M_{R\_shear\_1.2}$ = 0.75 * (Total Moment Arm * Soil Shear Strength) — $\Phi M_{R\_shear\_1.2}$ = 0.00 kip*ft

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (ORTHOGONAL)

*Compressive Load for Bearing (0.9*D LC):* $P_{\_100}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100 — $P_{\_100}$ = 932.97 kip

Preliminary Factored Overturning Moment: $pre\_M_{overturning\_100}$ = (W/2-($P_{\_100}$/ΦQult)/(2*W))*$P_{\_100}$ — $pre\_M_{overturning\_100}$ = 16953.01 kip*ft

*Preliminary Load Eccentricity (0.9*D LC):* $pre\_ec_{\_100}$ = $pre\_M_{overturning\_100}$ / $P_{\_100}$ — $pre\_ec_{\_100}$ = 18.17 ft

*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):* $ec_{\_100}$ = *goal seek* — $ec_{\_100}$ = 18.13 ft — L/4 < e <= l

*Non-Bearing Length (0.9*D LC):* $NBL_{\_100}$ = 2*ec_100 — $NBL_{\_100}$ = 36.26 ft

*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):* $\Phi M_{Resisting\_100}$ = ΦM_{R_Pp} + SUM($\Phi M_{R\_wedges\_100}$,$\Phi M_{R\_shear\_100}$) — $\Phi M_{Resisting\_100}$ = 163.32 kip*ft

Moment Created by Shear: M_{shear} = V_u * (D+E+bp_{dist}/12) — M_{shear} = 407.00 kip*ft

*Adjusted Overturning Moment (0.9*D LC):* $M_{overturning\_100}$ = $M_{u\_max\_100}$ - ΦM_{R_Pp} — $M_{overturning\_100}$ = 17077.13 kip*ft

*Total Resistance to Overturning (0.9*D LC):* $\Phi M_{Resisting\_qu\_100}$ = $P_{\_100}$*$ec_{\_100}$ + $\Phi M_{Resisting\_100}$ — $\Phi M_{Resisting\_qu\_100}$ = 17077.13 kip*ft

[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_100} = M_{overturning} - \Phi M_{Resisting\_qu\_100}$	$\Delta M_{\_100} =$ 0.00 ft
Maximum Applied Moment from Superstructure Analysis:	$M_{u\_max\_100} =$ pre_Moverturning_100 + ΦMResisting_100	$M_{u\_max\_100} =$ 17116.33 kip*ft

Check **Mu_max_100 = 17116.33 kip*ft >= Mu = 7365.00 kip*ft** **RATING: 43.03% OK**

Soil Wedges (Cohesionless Soil) (0.9*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	3.47	0.35	39.54	13.73
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	130.83	13.08	20.87	273.07
(2) Partial Sides (below Water Table)	0.00	0.00	20.87	0.00
(1) Rear (above Water Table)	70.36	7.04	39.48	277.81
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	204.67	20.47		564.60

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	8.09
Soil Wedge Wt (kip)=	20.47

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_100} =$ Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_100} =$ 165.49 kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$\Phi M_{R\_wedges\_100} =$ 0.75*MR_wedges_100	$\Phi M_{R\_wedges\_100} =$ 124.12 kip*ft

Soil Shear Strength (Cohesive Soil) (0.9*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	0.00	0.00	39.00	0.00
(2) Partial Sides	0.00	0.00	20.87	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (0.9*D LC):*	$M_{R\_shear\_100} =$ Total Moment Arm * Soil Shear Strength	$M_{R\_shear\_100} =$ 0.00 kip*ft
*Factored Resisting Moment of Soil Shear (0.9*D LC):*	$\Phi M_{R\_shear\_100} =$ 0.75 * (Total Moment Arm * Soil Shear Strength)	$\Phi M_{R\_shear\_100} =$ 0.00 kip*ft

PASSIVE PRESSURE RESISTANCE (DIAGONAL DIRECTION)

Force of Pp Applied on Pier:	$Force_{pier} =$ MIN(Vu,Sum(Pp!M2:M7)))	$Force_{pier} =$ 0.00 kip
Moment Arm of Pp on Pier:	$M_{arm\_pier} =$ D-T-Pp!O2 + T	$M_{arm\_pier} =$ 5.00 ft
Force of Pp Applied on Pad:	$Force_{pad\_dia} =$ MIN(V_u-$Force_{pier}$,SUM(Pp!M8:M13))	$Force_{pad\_dia} =$ 66.00 kip
Moment Arm of Pp on Pad:	$M_{arm\_pad} =$ D-Pp!O8	$M_{arm\_pad} =$ 0.79 ft
Unfactored Moment Resistance due to Passive Pressure:	$M_{R\_Pp\_dia} = Force_{pier} * M_{arm\_pier} + Force_{pad} * M_{arm\_pad}$	$M_{R\_Pp\_dia} =$ 52.27 kip*ft
Factored Moment Resistance due to Passive Pressure:	$\Phi M_{R\_Pp\_dia} = \Phi_s * M_{R\_Pp\_dia}$	$\Phi M_{R\_Pp\_dia} =$ 39.20 kip*ft

PLASTIC BEARING PRESSURE & OVERTURNING MOMENT (DIAGONAL DIRECTION)

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9\_dia} =$ P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing_dia	$P_{bearing\_0.9\_dia} =$ 931.52 kip	
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2\_dia} =$ P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing_dia	$P_{bearing\_1.2\_dia} =$ 1223.50 kip	
Factored Overturning Moment:	$M_{overturning} = M_u + V_u * (D+E+bp_{dist}/12)$	$M_{overturning} =$ 7365.00 kip*ft	
Area of Pad:	Area = W²	Area = 1521.00 ft²	
Plastic Section Modulus of Pad:	$Z_{\_dia} = W^3 / (3*SQRT(2))$	$Z_{\_dia} =$ 13981.62 ft³	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_p\_dia} = M_{overturning}/P_{bearing\_0.9\_dia}$	$pre\_ec_{\_0.9\_p\_dia} =$ 7.91 ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_p\_dia} = M_{overturning}/P_{bearing\_1.2\_dia}$	$pre\_ec_{\_1.2\_p\_dia} =$ 6.02 ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_p\_dia} =$ *goal seek*	$ec_{\_0.9\_p\_dia} =$ 7.71 ft	(L/4)*SQRT
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_p\_dia} =$ *goal seek*	$ec_{\_1.2\_p\_dia} =$ 5.99 ft	e <= (L/4)*S
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9\_dia} =$ SQRT(2)*ec_0.9_p_dia	$NBL_{\_0.9\_dia} =$ 10.91 ft	
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2\_dia} =$ 0	$NBL_{\_1.2\_dia} =$ 0.00 ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9} = \Phi M_{R\_Pp\_dia} + SUM(\Phi M_{R\_wedges\_0.9\_dia}, \Phi M_{R\_shear\_0.9\_dia})$	$\Phi M_{Resisting\_0.9\_dia} =$ 178.95 kip*ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2} = \Phi M_{R\_Pp\_dia} + SUM(\Phi M_{R\_wedges\_1.2\_dia}, \Phi M_{R\_shear\_1.2\_dia})$	$\Phi M_{Resisting\_1.2\_dia} =$ 39.20 kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9\_dia} = M_{overturning} - \Phi M_{Resisting\_0.9\_dia}$	$M_{overturning\_0.9\_dia} =$ 7186.05 kip*ft	
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2\_dia} = M_{overturning} - \Phi M_{Resisting\_1.2\_dia}$	$M_{overturning\_1.2\_dia} =$ 7325.80 kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9\_dia} = P_{bearing\_0.9\_dia} * ec_{\_0.9\_p\_dia} + \Phi M_{Resisting\_0.9\_dia}$	$\Phi M_{Resisting\_qu\_0.9\_dia} =$ 7365.00 kip*ft	
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2\_dia} = P_{bearing\_1.2\_dia} * ec_{\_1.2\_p\_dia} + \Phi M_{Resisting\_1.2\_dia}$	$\Phi M_{Resisting\_qu\_1.2\_dia} =$ 7365.00 kip*ft	
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_0.9\_dia} = M_{overturning} - \Phi M_{Resisting\_qu\_0.9\_dia}$	$\Delta M_{\_0.9\_dia} =$ 0.00 kip*ft	
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{\_1.2\_dia} = M_{overturning} - \Phi M_{Resisting\_qu\_1.2\_dia}$	$\Delta M_{\_1.2\_dia} =$ 0.00 kip*ft	

Bearing Pressures

*Diagonal Bearing Pressure (0.9*D LC):*	$q_{u\_dia\_0.9}$ = Pbearing_0.9_dia/((W-(SQRT(2))*ec_0.9_p_dia))^2	$q_{u\_dia\_0.9}$ = 1.18 ksf
*Diagonal Bearing Pressure (1.2*D LC):*	$q_{u\_dia\_1.2}$ = Pbearing_1.2_dia/Area + Moverturning_1.2_dia / Z_dia	$q_{u\_dia\_1.2}$ = 1.33 ksf
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} = 12.00 ksf
Factored Ultimate Gross Bearing Pressure:	ΦQult = φs * Qult	Qa = 9.00 ksf

Check **ΦQult = 9.00 ksf >= q_u = 1.33 ksf** **RATING: 14.76% OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht = 2.50 ft
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw = 0.00 ft
Soil Wedge Projection at Grade:	$Wedge_{\_proj}$ = TAN(ϕ*PI()/180)*soilht	$Wedge_{\_proj}$ = 1.44 ft
Soil Wedge Projection at Water Table:	$Wedge_{\_proj\_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw)	$Wedge_{\_proj\_gw}$ = 0.00 ft

Soil Wedges (Cohesionless Soil) (0.9*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	3.47	0.35	27.58	9.58
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(1) End Prism (above Water Table)	1.74	0.17	55.66	9.66
(1) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	39.37	3.94	23.46	92.37
(2) Partial Sides (below Water Table)	0.00	0.00	0.00	0.00
(2) Rear (above Water Table)	140.73	14.07	41.62	585.73
(2) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	185.30	18.53		697.34

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	10.05
Soil Wedge Wt (kip)=	18.53

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_0.9}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_0.9\_dia}$ = 186.32 kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$ΦM_{R\_wedges\_0.9}$ = 0.75*MR_wedges_0.9_dia	$ΦM_{R\_wedges\_0.9\_dia}$ = 139.74 kip*ft

Soil Wedges (Cohesionless Soil) (1.2*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	0.00	0.00	0.00	0.00
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(1) End Prism (above Water Table)	0.00	0.00	0.00	0.00
(1) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	27.32	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	0.00	0.00
(2) Rear (above Water Table)	0.00	0.00	41.62	0.00
(2) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	0.00	0.00		0.00

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	0.00
Soil Wedge Wt (kip)=	0.00

*Unfactored Resisting Moment of Wedges (1.2*D LC):*	$M_{R\_wedges\_1.2}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_1.2\_dia}$ = 0.00 kip*ft
*Factored Resisting Moment of Wedges (1.2*D LC):*	$ΦM_{R\_wedges\_1.2}$ = 0.75*MR_wedges_1.2_dia	$ΦM_{R\_wedges\_1.2\_dia}$ = 0.00 kip*ft

Soil Shear Strength (Cohesive Soil)

Soil Shear Strength (Cohesive Soil) (0.9*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) Rear	0.00	0.00	41.37	0.00
(2) Partial Sides	0.00	0.00	23.72	0.00
Total		0.00		0.00

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (0.9*D LC):*	$M_{R\_shear\_0.9}$ = Total Moment Arm * Soil Shear Strength	$M_{R\_shear\_0.9\_dia}$ = 0.00 kip*ft
*Factored Resisting Moment of Soil Shear (0.9*D LC):*	$ΦM_{R\_shear\_0.9}$ = 0.75 * (Total Moment Arm * Soil Shear Strength)	$ΦM_{R\_shear\_0.9\_dia}$ = 0.00 kip*ft

Soil Shear Strength (Cohesive Soil) (1.2*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) Rear	0.00	0.00	41.37	0.00
(2) Partial Sides	0.00	0.00	27.58	0.00
Total		0.00		0.00

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (1.2*D LC):*	$M_{R\_shear\_1.2}$ = Total Moment Arm * Soil Shear Strength	$M_{R\_shear\_1.2\_dia}$ = 0.00 kip*ft
*Factored Resisting Moment of Soil Shear (1.2*D LC):*	$ΦM_{R\_shear\_1.2}$ = 0.75 * (Total Moment Arm * Soil Shear Strength)	$ΦM_{R\_shear\_1.2\_dia}$ = 0.00 kip*ft

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (DIAGONAL)

*Compressive Load for Bearing (0.9*D LC):*	$P_{\_100\_dia}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100_dia	$P_{\_100\_dia}$ = 936.34 kip

Preliminary Factored Overturning Moment:	$pre\_M_{overturning\_100\_dia}$ = (P_100_dia/(SQRT(2)))*(W-SQRT(P_100_dia/ΦQult))	$pre\_M_{overturning\_100\_dia}$ = 19068.42 kip*ft
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_100\_dia}$ = $pre\_M_{overturning\_100\_dia}$ / $P_{bearing\_0.9}$	$pre\_ec_{\_100\_dia}$ = 20.36 ft
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_100\_dia}$ = *goal seek*	$ec_{\_100\_dia}$ = 20.32 ft (L/4)*SQRT
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_100\_dia}$ = SQRT(2)*ec_100_dia	$NBL_{\_100\_dia}$ = 28.74 ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_100\_dia}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_100\_dia}$,$\Phi M_{R\_shear\_100\_dia}$)	$\Phi M_{Resisting\_100\_dia}$ = 110.06 kip*ft
Moment Created by Shear:	M_{shear} = V_u * (D+E+bp_{dist}/12)	M_{shear} = 407.00 kip*ft
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_100\_dia}$ = $M_{u\_max\_100\_dia}$ - $\Phi M_{R\_Pp\_dia}$	$M_{overturning\_100\_dia}$ = 19139.28 kip*ft
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_100\_dia}$ = $P_{bearing\_0.9}$*$ec_{\_100\_dia}$ + $\Phi M_{Resisting\_100\_dia}$	$\Phi M_{Resisting\_qu\_100\_dia}$ = 19139.28 kip*ft
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_100\_dia}$ = $M_{overturning}$ - $\Phi M_{Resisting\_qu\_100\_dia}$	$\Delta M_{\_100\_dia}$ = 0.00 ft
Maximum Applied Moment from Superstructure Analysis:	$M_{u\_max\_100\_dia}$ = pre_Moverturning_100_dia + ΦMResisting_100_dia	$M_{u\_max\_100\_dia}$ = 19178.48 kip*ft

Check **Mu_max_100_dia = 19178.48 kip*ft >= Mu = 7365.00 kip*ft** **RATING: 38.40% OK**

Soil Wedges (Cohesionless Soil) (0.9*D LC)

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	3.47	0.35	27.58	9.58
(2) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(1) End Prism (above Water Table)	1.74	0.17	55.66	9.66
(1) End Prisms (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	103.71	10.37	17.16	177.97
(2) Partial Sides (below Water Table)	0.00	0.00	0.00	0.00
(2) Rear (above Water Table)	140.73	14.07	41.62	585.73
(2) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	249.65	24.96		782.94

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	3.78
Soil Wedge Wt (kip)=	24.96

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_100\_dia}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_100\_dia}$ = 94.48 kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$\Phi M_{R\_wedges\_100\_dia}$ = 0.75*MR_wedges_100_dia	$\Phi M_{R\_wedges\_100\_dia}$ = 70.86 kip*ft

Soil Shear Strength (Cohesive Soil) (0.9*D LC)

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) Rear	0.00	0.00	41.37	0.00
(2) Partial Sides	0.00	0.00	17.42	0.00
Total		0.00		0.00

Eccentricity relative to W/2*SQRT(2):

Total Moment Arm (ft) =	0.00
Soil Shear Strength (kip)=	0.00

*Unfactored Resisting Moment of Soil Shear (0.9*D LC):*	$M_{R\_shear\_100\_dia}$ = Total Moment Arm * Soil Shear Strength	$M_{R\_shear\_100\_dia}$ = 0.00 kip*ft
*Factored Resisting Moment of Soil Shear (0.9*D LC):*	$\Phi M_{R\_shear\_100\_dia}$ = 0.75 * (Total Moment Arm * Soil Shear Strength)	$\Phi M_{R\_shear\_100\_dia}$ = 0.00 kip*ft

ATTACHMENT D – PROOF OF DELIVERY OF NOTICE

Ref: SOAPSTONE CSC FI Date: 12Mar20
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 0367

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

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 12MAR20
ACTWGT: 1.05 LB MAN
CAD: 0765627/CAFE3311

BILL THIRD PARTY

565C2/64E0/05A2

TO **MARTIN J. CONNOR, CITY PLANNER**
CITY OF TORRINGTON
140 MAIN STREET

TORRINGTON CT 06790
REF: SOAPSTONE CSC FILING
DEPT: BL GRAPHICS

FedEx Express

E

J191219082001uv

FRI – 13 MAR 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **1714 2090 0367**

00 HFDA

06790
CT-US **BDL**

Part # 156148-434 RIT2 EXP 06/20

Ref: SOAPSTONE CSC FI Date: 12Mar20
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 0356

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

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 12MAR20
ACTWGT: 1.05 LB
CAD: 0765627/CAFE3311

BILL THIRD PARTY

565C2/64E0/05A2

TO **MAYOR ELINOR CARBONE**
CITY OF TORRINGTON
140 MAIN STREET

TORRINGTON CT 06790
REF: SOAPSTONE CSC FILING
DEPT: BL GRAPHICS

FedEx Express

E

J191219082001uv

FRI – 13 MAR 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **1714 2090 0356**

00 HFDA

06790
CT-US **BDL**

Part # 156148-434 RIT2 EXP 06/20

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

EVERSOURCE ENERGY

ES-086

1554 Highland Ave

Torrington, CT 06790

February 6, 2020

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1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed Eversource installation to be located at 1554 Highland Avenue in Torrington, CT.

Eversource is proposing to install two omnidirectional antennas as part of its 220 MHz communications system – one receive antenna, and one transmit antenna.

This report considers the planned and existing antenna configuration as provided by Eversource along with power density information of the other existing antennas to calculate the cumulative % 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

Due the quantity of antennas and size of the table, the % MPE results are shown in Table 1 of Appendix A on the following page. The table outlines the power density information for the site. The proposed Eversource omnidirectional antenna has a narrow beamwidth of 78°; 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 antenna relative to the horizon, and consequently lower power density levels around the base of the facility. Please refer to Attachment D for the vertical pattern of the proposed Eversource antenna. The calculated results in Table 1 include a nominal 10 dB off-beam pattern loss for the omnidirectional antennas and 30 dB off-beam pattern loss for the highly directional microwave dishes to account for the lower relative gain below the antennas.

The latest version of the CSC power density database (dated 12/13/2019) included multiple entries for CSP (CT State Police) and a single entry for CL&P, now known as Eversource. Based upon information provided as part of this analysis by Eversource through its agents, there are a number of existing Eversource transmitters located at this facility that are not included in the CSC power density database. For completeness, power density information for those antennas has also been included in Table 1 and shown by the green entries in the table. Power density information for the proposed transmit antenna is shown by the blue entry.

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 **2.51% 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.

Sokol Andoni (signature) — February 6, 2020

Report Prepared By: Sokol Andoni, RF Engineer, C Squared Systems, LLC — Date

Keith Vellante (signature) — February 6, 2020

Reviewed/Approved By: Keith Vellante, Director – RF Services, C Squared Systems, LLC — Date

Attachment A: % MPE Table

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
CSP - Antenna 1	140	154.46	1	250	0.0005	0.2000	0.25%
CSP - Antenna 2	140	37.56	1	120	0.0002	0.2000	0.12%
CSP - Antenna 3	*140*	*48.40*	*1*	*60*	*0.0001*	*0.2000*	*0.06%*
CSP - Antenna 4	140	952.37	1	60	0.0001	0.6349	0.02%
CSP - Antenna 5	135	6685	1	1	0.0000	1.0000	0.00%
CSP - Antenna 6	115	6645	1	1	0.0000	1.0000	0.00%
CSP - Antenna 7	115	196400	1	0.05	0.0000	1.0000	0.00%
CSP - Antenna 8	180	866.01	1	250	0.0003	0.5773	0.05%
CSP - Antenna 9	180	866.14	1	250	0.0003	0.5774	0.05%
CSP - Antenna 10	180	866.30	1	250	0.0003	0.5775	0.05%
CSP - Antenna 11	180	866.51	1	250	0.0003	0.5777	0.05%
CSP - Antenna 12	180	866.61	1	250	0.0003	0.5777	0.05%
CSP - Antenna 13	180	866.75	1	250	0.0003	0.5778	0.05%
CSP - Antenna 14	192	6700	1	1	0.0000	1.0000	0.00%
CSP - Antenna 15	191	6675	1	1	0.0000	1.0000	0.00%
CSP - Antenna 16	100	6705	1	1	0.0000	1.0000	0.00%
CSP - Antenna 17	60	6700	1	1	0.0000	1.0000	0.00%
CSP - Antenna 18	115	37.80	1	100	0.0003	0.2000	0.15%
CSP - Antenna 19	180	866.86	1	25	0.0000	0.5779	0.01%
CSP - Antenna 20	180	867.01	1	25	0.0000	0.5780	0.01%
CSP - Antenna 21	180	867.08	1	25	0.0000	0.5781	0.01%
CSP - Antenna 22	180	867.23	1	25	0.0000	0.5782	0.01%
CSP - Antenna 23	180	867.51	1	25	0.0000	0.5783	0.01%
CSP - Antenna 24	180	868.01	1	25	0.0000	0.5787	0.01%
CSP - Antenna 25	180	868.16	1	25	0.0000	0.5788	0.01%
CSP - Antenna 26	180	868.56	1	25	0.0000	0.5790	0.01%
CSP - Antenna 27	180	868.61	1	25	0.0000	0.5791	0.01%
CL&P	*162*	*11485*	*1*	*485*	*0.0007*	*1.0000*	*0.07%*
Eversource	173	173.25	1	100	0.0001	0.2000	0.06%
Eversource	168	48.40	1	100	0.0001	0.2000	0.07%
Eversource	167	451.68	1	100	0.0001	0.3011	0.05%
Eversource	162	10495	1	484	0.0000	1.0000	0.00%
Eversource	149	154.56	1	900	0.0016	0.2000	0.79%
Eversource	137	6555	1	9226	0.0002	1.0000	0.02%
Eversource	124	952.37	1	255	0.0007	0.6349	0.10%
Eversource	116	6271.37	1	4732	0.0001	1.0000	0.01%
Eversource	98	173.40	1	60	0.0003	0.2000	0.13%
Eversource	78	6019.33	1	4732	0.0003	1.0000	0.03%
Eversource	168	217	4	124	0.0007	0.2000	0.34%
						Total	2.51%

Table 1: Proposed Facility % MPE[1] [2] [3] [4] [5]

[1] The existing CSC filing for Eversource (f.k.a. CL&P) and should be removed and replaced with the updated Eversource values provided in Table 1. 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 proposed antenna height listed for Eversource is in reference to Black & Veatch Structural Analysis Report dated 12/5/2019.

[3] Heights listed for the existing Eversource antennas are in reference to the Antenna Inventory dated December 24, 2019.

[4] The ERP values for the Eversource microwave dish antennas are based on the licenses shown on FCC database.

[5] The "CSP-Antenna 3" information should be removed from the CSC filing. This frequency is licensed to Eversource and included in a new entry.

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

(A) Limits for Occupational/Controlled 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)
0.3-3.0	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[7]

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)

[6] 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

[7] 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

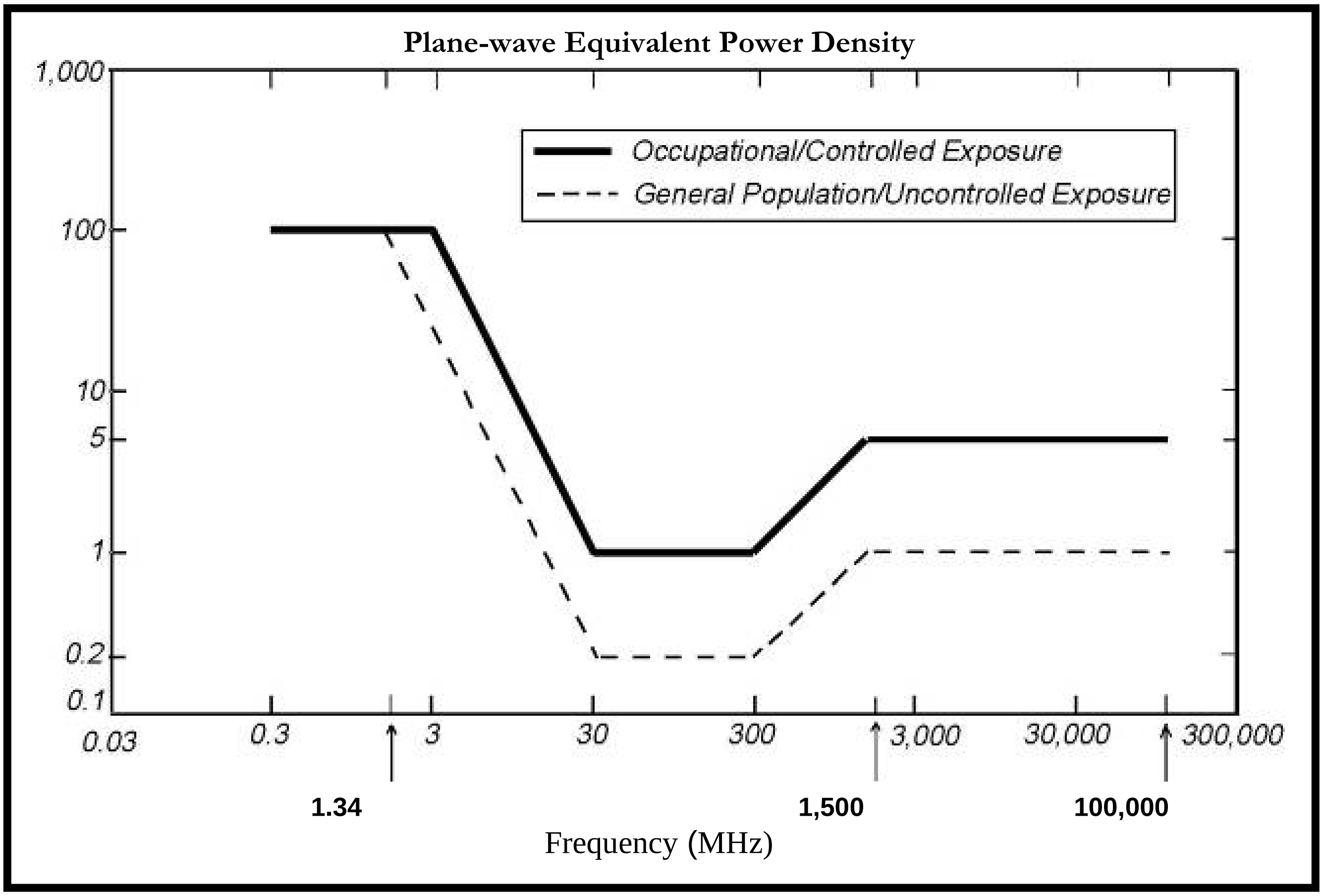
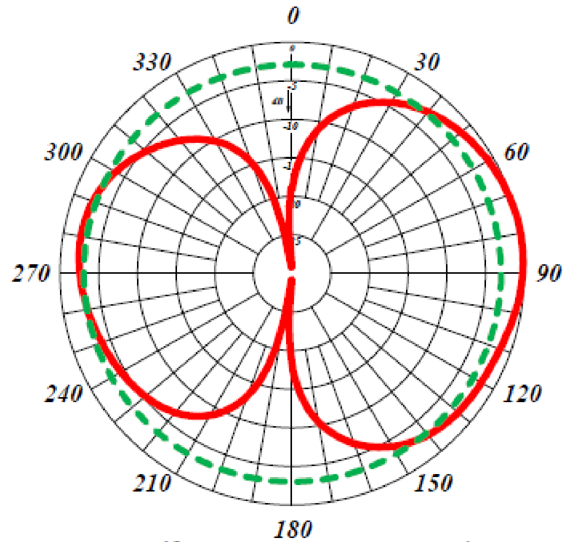


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

C2 Systems

Attachment D: Eversource Antenna Data Sheets and Electrical Patterns

217 MHz		 Half-wave Spacing Vertical
Manufacturer:	Comprod	
Model #:	871F-70-2	
Frequency Band:	215-225 MHz	
Gain:	2.5 dBd	
Vertical Beamwidth:	78°	
Horizontal Beamwidth:	360°	
Polarization:	Vertical	
Length:	66”	

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