EVERSOURCE ENERGY

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

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

November 4, 2020

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

RE: **Notice of Exempt Modification**
Eversource Site – West Hartland
2 Center Hill Road, West Hartland, CT
Latitude: 41-58-43.5 N / Longitude: 72-58-56.0 W

Dear Ms. Bachman:

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource") currently maintains multiple antennas on an existing 180-foot self-support tower located at 2 Center Hill Road in West Hartland. See Attachment A, Parcel Map and Property Card. The property is owned by The Town of Hartland and the tower is managed by Navigator Properties, LLC (a/k/a/ Mariner Tower). Eversource and Navigator have entered into an agreement allowing the modification of Eversource's equipment on the existing tower. See Attachment B, Letter of Authorization. Eversource plans to install two 5-foot 6-inch tall dipole antennas, to be mounted at 107.25 feet above ground level ("AGL") and 180 feet AGL, and two 7/8-inch diameter coaxial cables. Eversource also plans to install one 6-foot 7-inch diameter microwave dish, to be mounted at 124 feet AGL with one elliptical waveguide cable. There will be no changes to the fenced compound, the tower or the existing antennas and equipment on the tower. The tower and existing and proposed equipment are depicted on Attachment C, Construction Drawings, dated August 11, 2020 and Attachment D, Structural Analysis, dated June 11, 2020. The Connecticut Siting Council assumed jurisdiction over the tower via TS-VER-065-080201.

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

Please accept this letter as notification, pursuant to Regulations of Connecticut State Agencies ("R.C.S.A.") §16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this notice is being delivered to Magi Winslow, First Selectman for the Town of Hartland and J.P. Langlois, Building Official and Zoning

Enforcement for the Town of Hartland via the United States Postal Service or private carrier. Proof of delivery is attached. See Attachment E, 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 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 September 2, 2020 (Attachment F – Power Density Report)[1].
5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.
6. The existing structure and its foundation can support the proposed loading.

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

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

By: ______________________________
Kathleen M. Shanley
Manager – Transmission Siting

cc: Magi Winslow, First Selectman, Town of Hartland
J.P. Langlois, Building Official and Zoning Enforcement, Town of Hartland
Navigator Properties, LLC

Attachments

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

[1] Any inactive or receive-only antennas are not included in the Power Density Report, as they are irrelevant in terms of the % MPE calculations.

ATTACHMENT A – PARCEL MAP AND PROPERTY CARD


Legend
Approximate Tower Location
5
3.33 AC
6
3.35 AC
7
3.635 AC
4
10.37 AC
8
16.01 AC
2
3
1.9 AC
2
29.113 AC
001A
11.275 AC
6
5.5 AC
5
2.95 AC
7
36.20 AC
ROAD
CENTER
258.38'
270.00'
300.00'
500.00'
770.00'
630.00'
1000.00'
785.00'
550.00'
668.25'
638.87'
640.41'
344.48'
335.00'
300.00'
696.16'
749.47'
561.41'
370.91'
203.87'
738.15'
534.28'
686.07'
347.79'
379.51'
250.00'
421.01'
270.61'
494.24'
411.02'
392.43'
412.55'
432.67'

26-23-003 TOWN OF HARTLAND CENTER HILL RD 901

Tax ID 26-23-003 Printed 03/04/2020 Card No. 1 of 1

ADMINISTRATIVE INFORMATION

PARCEL NUMBER
26-23-003

Parent Parcel Number

Property Address
CENTER HILL RD

Neighborhood
2 West Hartland

Property Class
901 Exempt BAAX Municipal

TAXING DISTRICT INFORMATION

Jurisdiction 065

Area 065

Routing Number 98100977

OWNERSHIP

TOWN OF HARTLAND
22 SOUTH RD
EAST HARTLAND, CT 06027

Census Tract: 3301

TRANSFER OF OWNERSHIP

Date

EXEMPT

VALUATION RECORD

Assessment Year		10/01/2005	10/01/2008	10/01/2011	10/01/2015
Reason for Change		2005	NC	2011 Reval	2015 Reval
VALUATION	L	5550	5550	24050	67550
Market Value	B	0	300000	300000	300000
	T	5550	305550	324050	367550
VALUATION	L	3890	3890	16840	47290
70% Assessed/Use	B	0	210000	210000	210000
	T	3890	213890	226840	257290

Site Description

Topography:
Rolling

Public Utilities:
Electric

Street or Road:
Paved

Neighborhood:

Zoning:
R-1

Legal Acres:
1.8500

LAND DATA AND CALCULATIONS

Land Type	Rating Soil ID -or- Actual Frontage	Measured Acreage -or- Effective Frontage	Table Effective Depth	Prod. Factor -or- Depth Factor -or- Square Feet	Base Rate	Adjusted Rate	Extended Value	Influence Factor	Value
1 Primary Commercial		0.5000		1.00	100000.00	100000.00	50000		50000
2 Secondary Comm/Indust Land		1.3500		1.00	13000.00	13000.00	17550		17550

G: GENERAL NOTES
ADDED TOWER 12/2008 FOR 08 GL.
L: LAND NOTES
SEE LAND RECORDS V82/P88 FOR EASEMENT GRANTED
TO CL&P.

Permit Number Type	FilingDate	Est. Cost Est. SqFt	Field Visit

Supplemental Cards

TRUE TAX VALUE 67550

Supplemental Cards
TOTAL LAND VALUE 67550

ATTACHMENT B – LETTER OF AUTHORIZATION

MARINER TOWER

October 27, 2020

Ms. Magi Winslow
First Selectman
Hartland Town Hall
22 South Road
East Hartland, CT 06027

Dear Ms. Winslow,

Navigator Properties, LLC, (Mariner Tower) authorizes The Connecticut Light and Power Company, d/b/a Eversource Energy, to apply for all permits related to the installation of their First Amendment to Lease Agreement equipment at the Tower Site located at 301 Center Hill Road, Route 181, West Hartland, CT.

Sincerely,

Nancy Auman
Director of Administration

ATTACHMENT C – CONSTRUCTION DRAWINGS

EVERSOURCE ENERGY

WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

PROJECT SUMMARY

THE GENERAL SCOPE OF WORK CONSISTS OF THE FOLLOWING:

1. INSTALL (2) NEW DIPOLE ANTENNAS, (1) AT ELEVATION 112'–9"± AGL AND (1) AT ELEVATION 185'–6"± AGL
2. INSTALL (1) NEW MICROWAVE DISH AT ELEVATION 127'–0"± AGL
3. INSTALL (1) NEW RACK WITH DMR EQUIPMENT IN EXISTING SHELTER

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:	WEST HARTLAND
SITE ADDRESS:	2 CENTER HILL RD WEST HARTLAND, CT 06091
MAP:	26
BLOCK:	23
LOT:	003
ZONE:	R–1
LATITUDE:	41° 58' 43.5" N
LONGITUDE:	72° 58' 56.0" W
ELEVATION:	1228'± AMSL
FEMA/FIRM DESIGNATION:	X
ACREAGE:	1.85

CONTACT INFORMATION

APPLICANTS:
EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037

PROPERTY OWNER:
TOWN OF HARTLAND
22 SOUTH RD
EAST HARTLAND, CT 06027

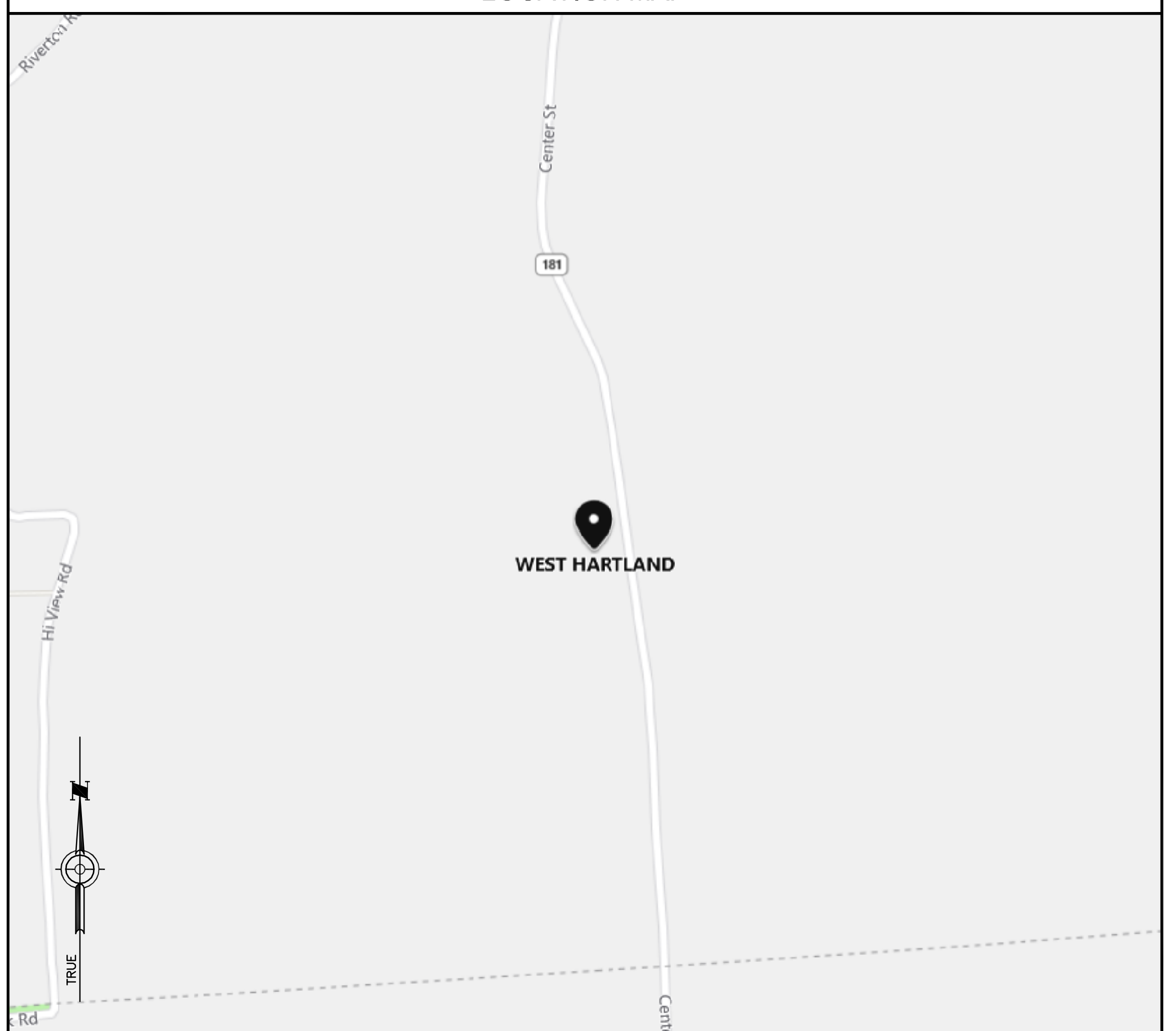
EVERSOURCE ENERGY PROJECT MANAGER:
NIKOLL PRECI
(860) 655–3079

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
C–3	MICROWAVE DISH MOUNT DETAILS
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:	JJR

REV	DATE	DESCRIPTION
0	08/11/20	ISSUED FOR FILING

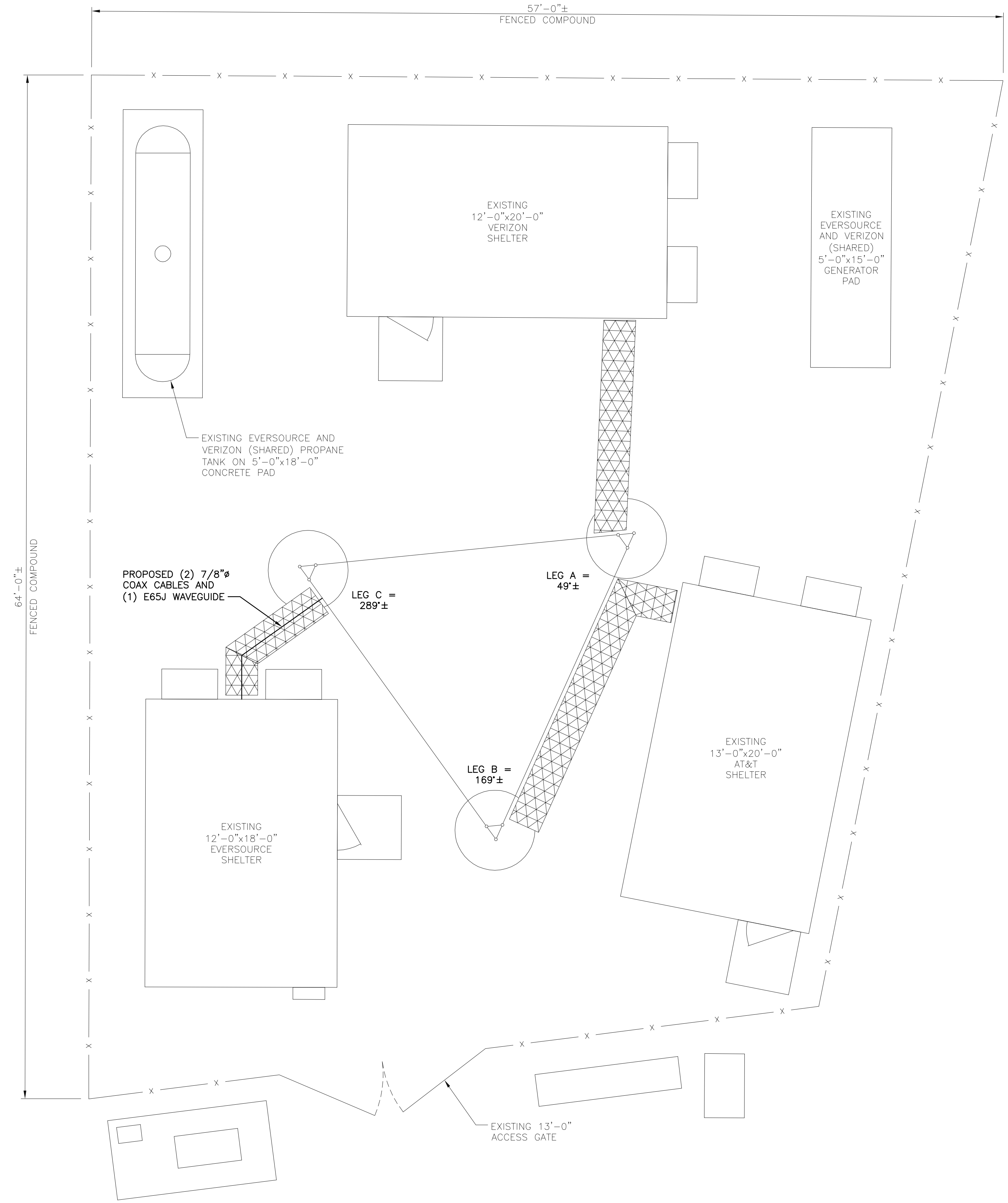
08/11/2020

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

WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

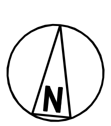
SHEET TITLE
TITLE SHEET

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
CHECKED BY:	JJR

REV	DATE	DESCRIPTION
0	08/11/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED
PROFESSIONAL ENGINEER

08/11/2020

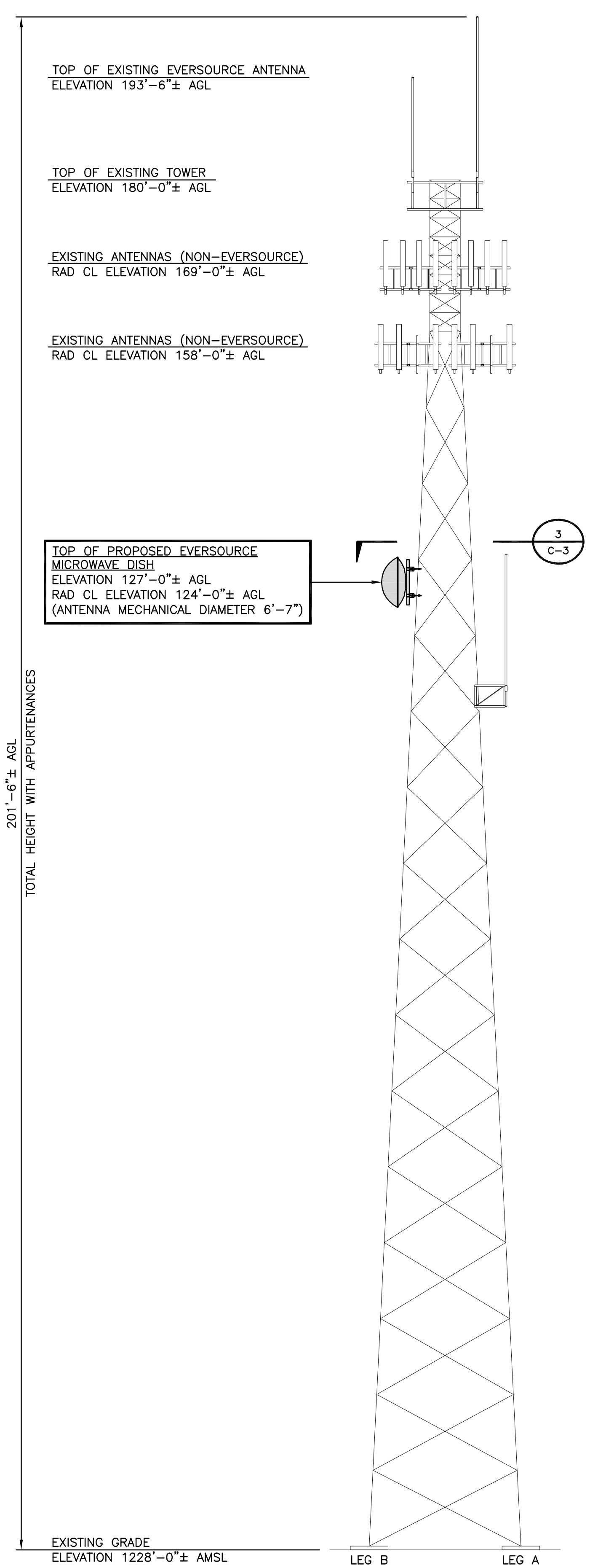
WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

SHEET TITLE

SITE PLAN

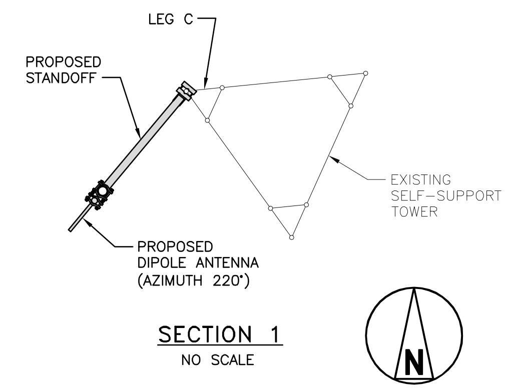
SHEET NUMBER

C-1



TOWER ELEVATION FACE BA

NO SCALE

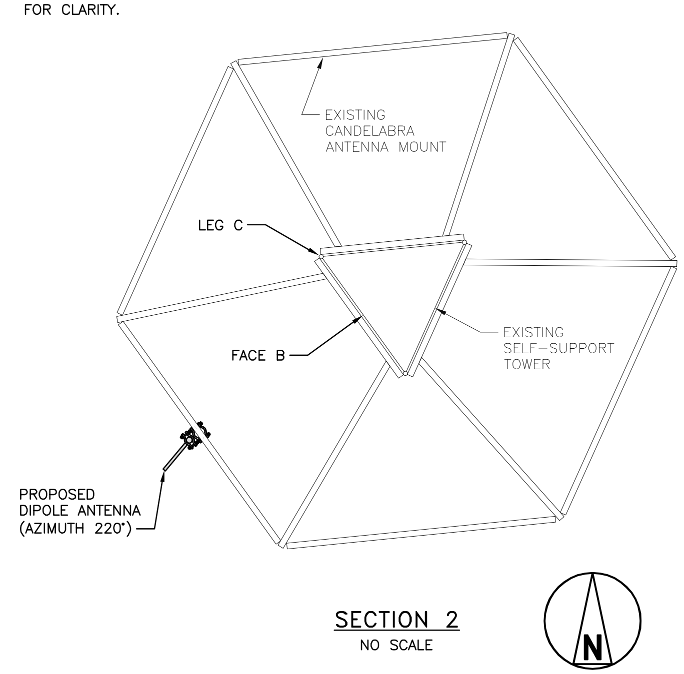


SECTION 1

NO SCALE

NOTES

1. ATTACH PROPOSED DIPOLE TO MIDDLE VERTICAL PIPE OF CANDELABRA ANTENNA MOUNT.
2. OTHER ANTENNAS NOT SHOWN FOR CLARITY.



SECTION 2

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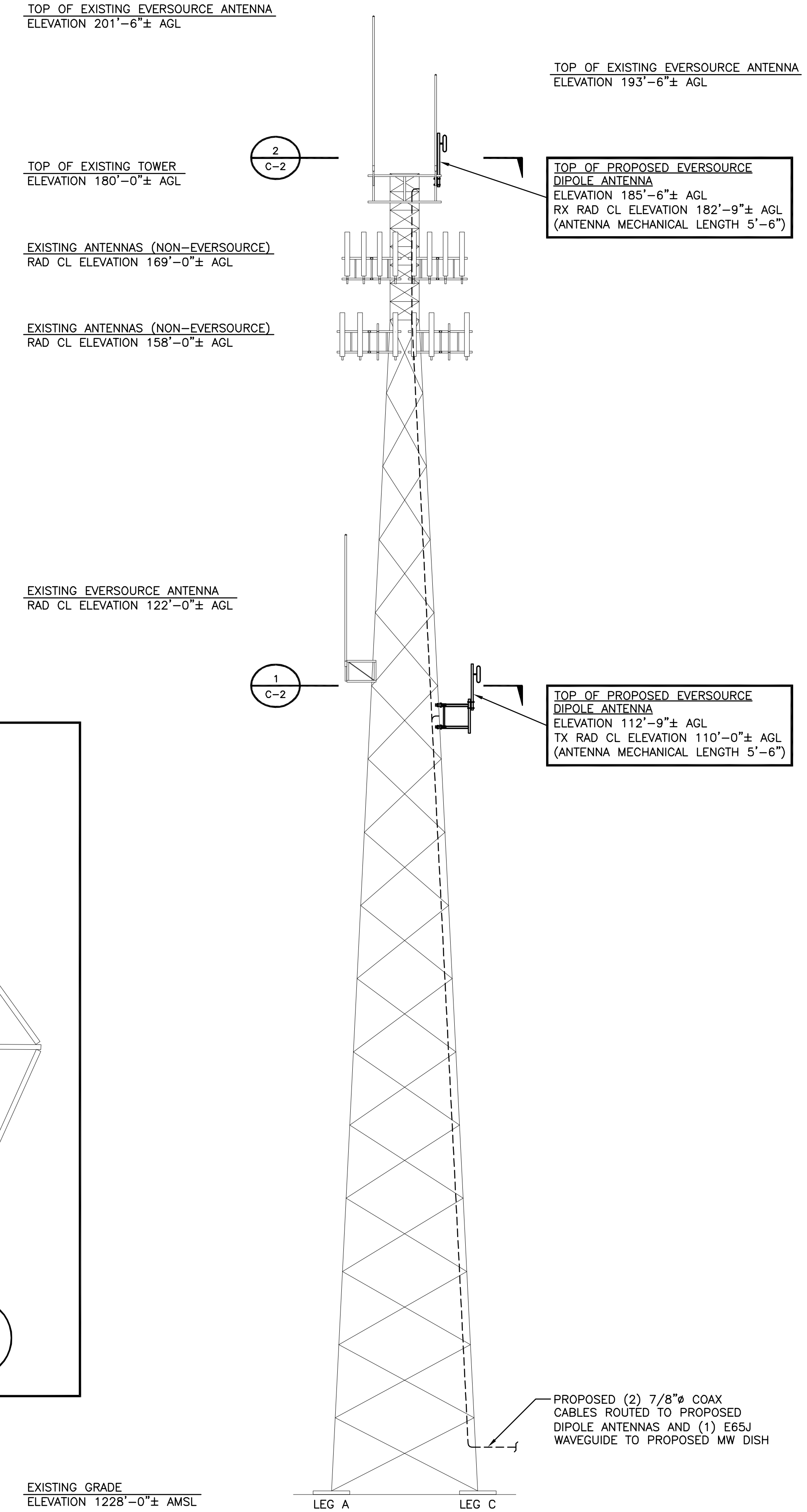

TOWER ELEVATION FACE AC

NO SCALE

EVERSOURCE ENERGY

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

BLACK & VEATCH

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

PROJECT NO:	403093
DRAWN BY:	TYW
CHECKED BY:	JJR

REV	DATE	DESCRIPTION
0	08/11/20	ISSUED FOR FILING

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

08/11/2020

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WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

SHEET TITLE

TOWER ELEVATION & ANTENNA EQUIPMENT

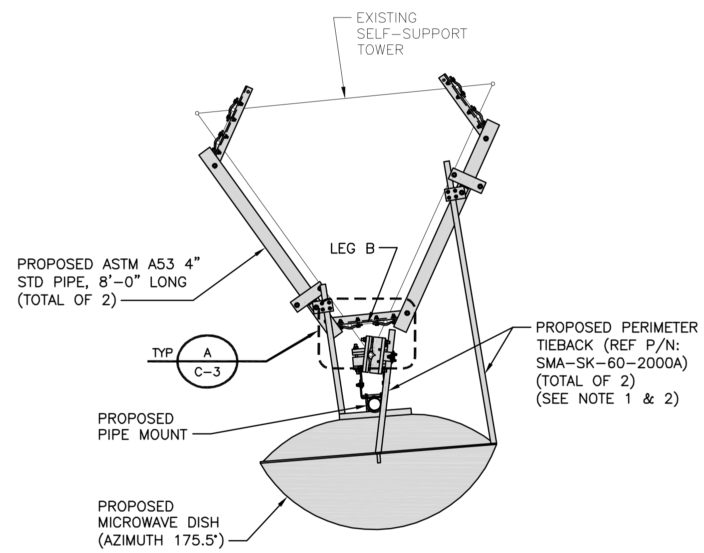
SHEET NUMBER

C-2

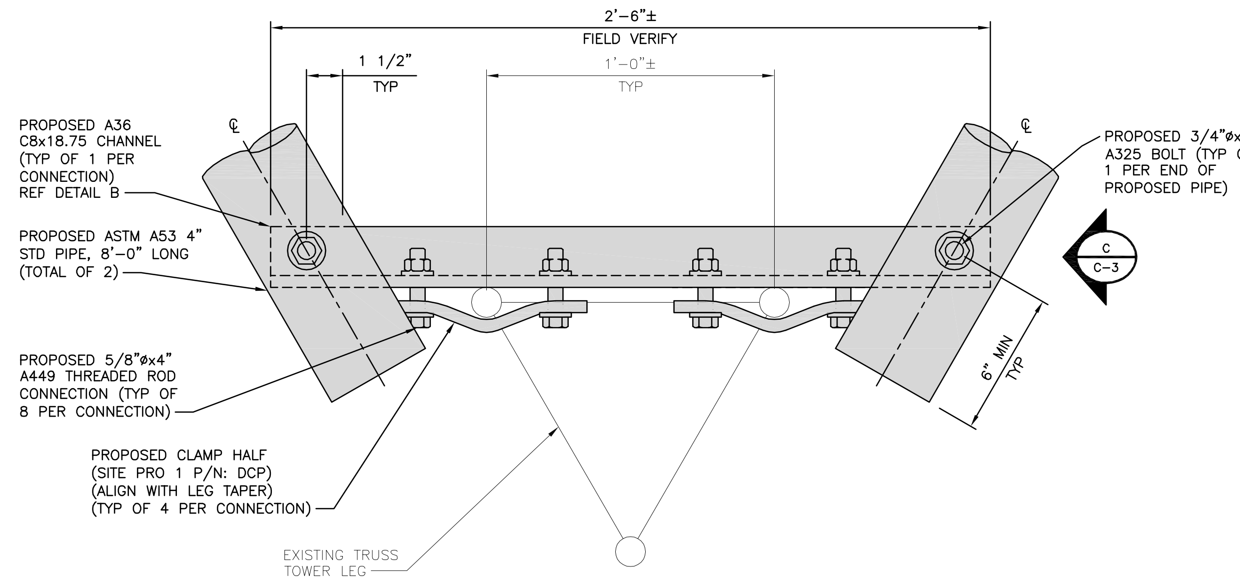
NOTES

1. ATTACH INNER SWAYBAR TIEBACK AND LEFT PERIMETER TIEBACK TO PROPOSED 4" STD PIPE. REFER TO ALLOWABLE TIEBACK ANGLE DIAGRAM.
2. ATTACH TOP PERIMETER TIEBACK TO EXISTING TOWER LEG. REFER TO ALLOWABLE TIE BACK ANGLE DIAGRAM.
3. TRIM TIEBACK PIPE AS REQUIRED TO MAINTAIN A 6" DISTANCE BETWEEN ENDS OF CLAMPS AND END OF PIPE.

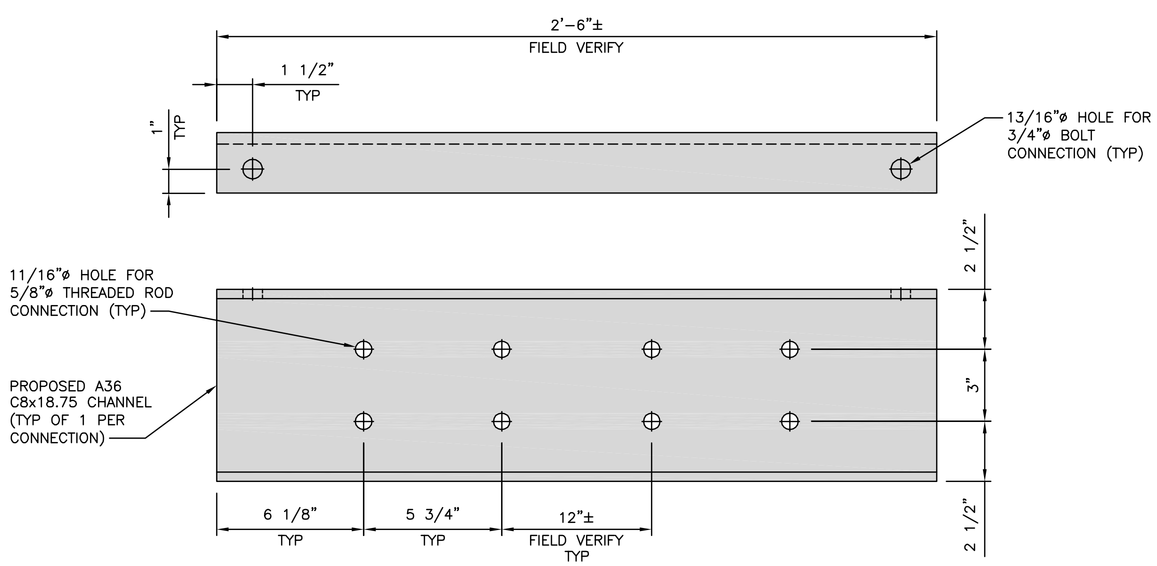
ALLOWABLE TIEBACK ANGLE
±15 DEGREES VERTICAL
±15 DEGREES HORIZONTAL



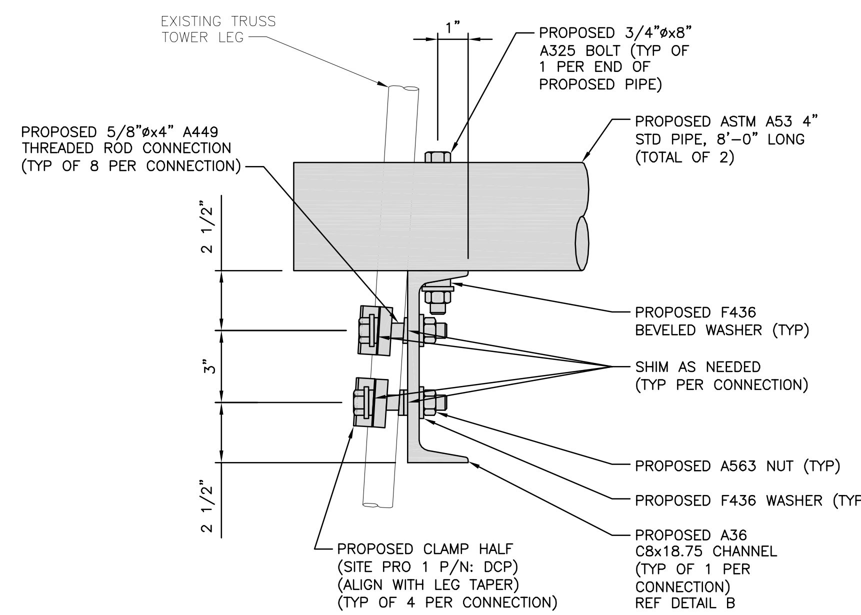
SECTION 3
NO SCALE



DETAIL A
NO SCALE



DETAIL B
CHANNEL DETAIL
NO SCALE



DETAIL C
CONNECTION ELEVATION DETAIL
NO SCALE

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

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

PROJECT NO:	403093
DRAWN BY:	TYW
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REV	DATE	DESCRIPTION
0	08/11/20	ISSUED FOR FILING

STATE OF CONNECTICUT JOSHUA J. RILEY 33208 LICENSED PROFESSIONAL ENGINEER
08/11/2020

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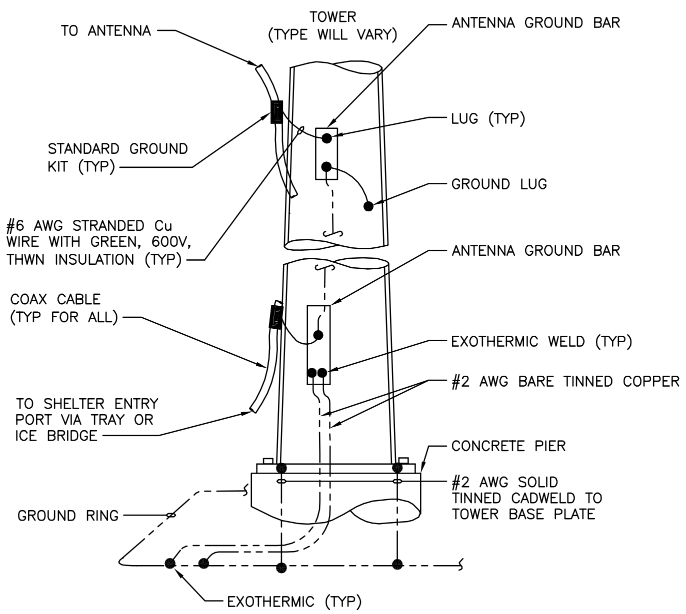
WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

SHEET TITLE
MICROWAVE DISH MOUNT DETAILS

SHEET NUMBER
C-3

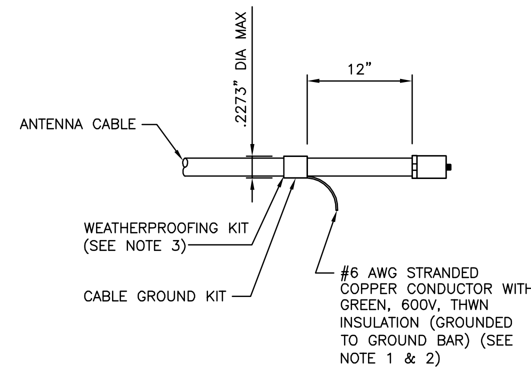


NOTE

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

ANTENNA CABLE GROUNDING

NO SCALE

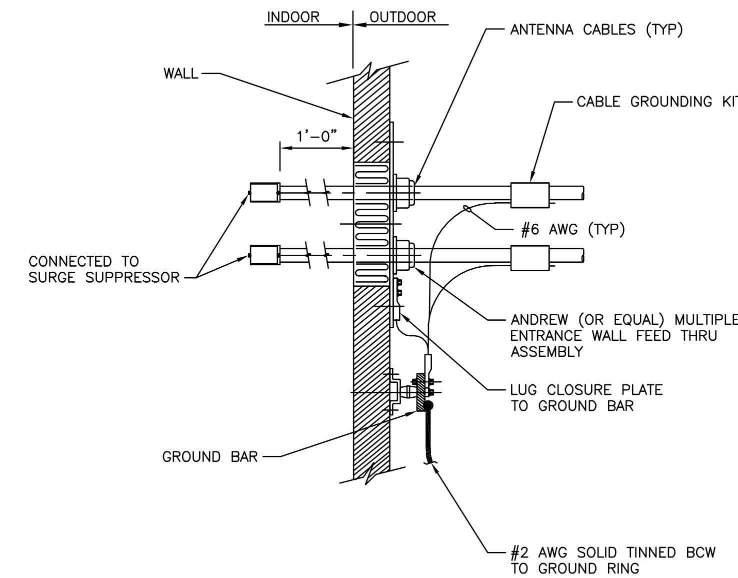


NOTES

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

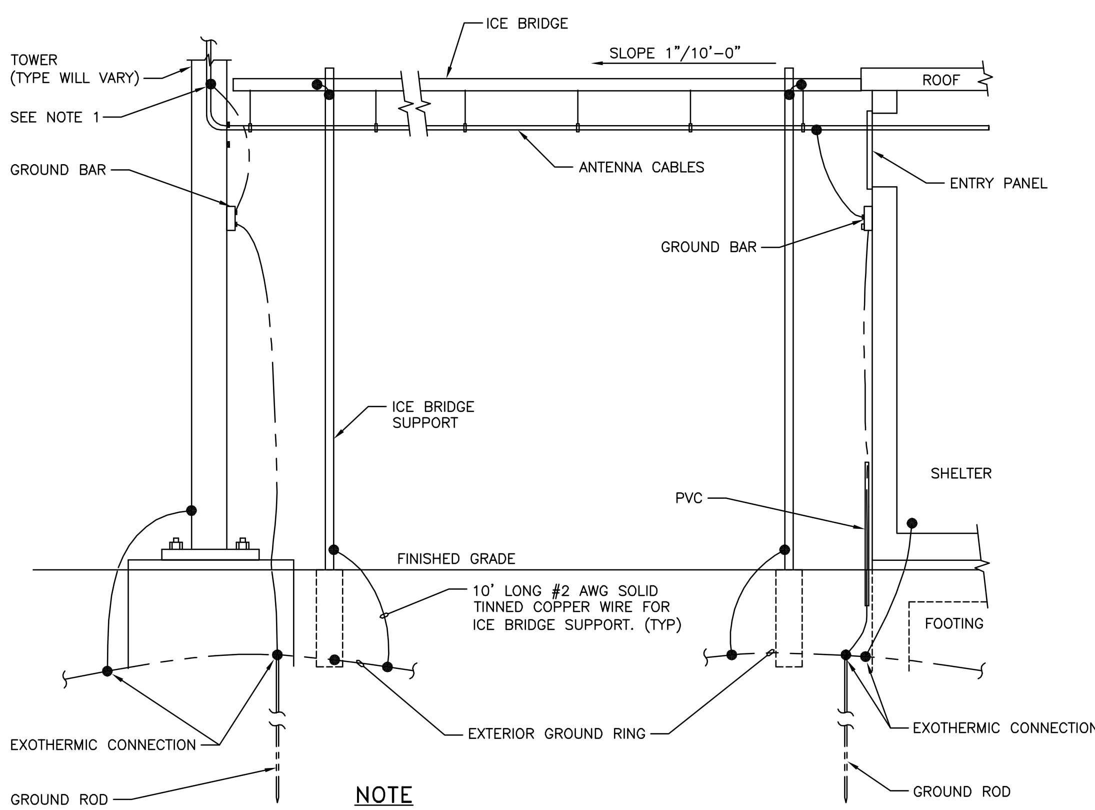
CONNECTION OF CABLE GROUND KIT TO ANTENNA CABLE

NO SCALE



CABLE INSTALLATION WITH WALL FEED THRU ASSEMBLY

NO SCALE



NOTE

1. PROVIDE GROUND KIT 6" BEFORE TURN

ICE BRIDGE AND ANTENNA CABLE DETAIL

NO SCALE

EVERSOURCE ENERGY

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

BLACK & VEATCH

6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
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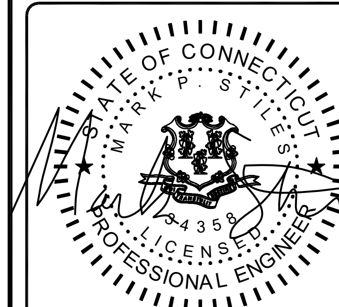

08/11/2020

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WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

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 AND ASTM 572, GR 50
ANGLE:	ASTM A570, GR 50 AND ASTM A36
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:	JJR

REV	DATE	DESCRIPTION
0	08/11/20	ISSUED FOR FILING

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WEST HARTLAND
2 CENTER HILL RD
WEST HARTLAND, CT 06091

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.

GROUNDING

1. #6 THWN SHALL BE STRANDED #6 COPPER WITH GREEN THWN INSULATION SUITABLE FOR WET INSTALLATIONS.
2. #2 THWN SHALL BE STRANDED #2 COPPER WITH THWN INSULATION SUITABLE FOR WET INSTALLATIONS.
3. #2 BARE TINNED SHALL BE SOLID COPPER TINNED. ALL BURIED WIRE SHALL MEET THIS CRITERIA.
4. ALL LUGS SHALL BE 2–HOLE, LONG BARREL, TINNED SOLID COPPER UNLESS OTHERWISE SPECIFIED, LUGS SHALL BE THOMAS AND BETTS SERIES 548##BE OR EQUIVALENT (IE #2 THWN – 54856BE, #2 SOLID – 54856BE, AND #6 THWN – 54852BE).
5. ALL HARDWARE, BOLTS, NUTS, AND WASHERS SHALL BE 18–8 STAINLESS STEEL. EVERY CONNECTION SHALL BE BOLT–FLAT WASHER–BUSS–LUG–FLAT WASHER–BELLEVILLE WASHER–NUT IN THAT EXACT ORDER. BACK–TO–BACK LUGGING, BOLT–FLAT WASHER–LUG–BUSS–LUG–FLAT WASHER–BELLEVILLE WASHER–NUT, IN THAT EXACT ORDER, IS ACCEPTED WHERE NECESSARY TO CONNECT MANY LUGS TO A BUSS BAR. STACKING OF LUGS, BUSS–LUG–LUG, IS NOT ACCEPTABLE.
6. WHERE CONNECTIONS ARE MADE TO STEEL OR DISSIMILAR METALS, A THOMAS AND BETTS DRAGON TOOTH WASHER MODEL DTWXXX SHALL BE USED BETWEEN THE LUG AND THE STEEL, BOLT–FLAT WASHER–STEEL–DRAGON TOOTH WASHER–LUG–FLAT WASHER–BELEVILE WASHER–NUT.
7. ALL CONNECTIONS, INTERIOR AND EXTERIOR, SHALL BE MADE WITH THOMAS AND BETTS KPOR–SHIELD. COAT ALL WIRES BEFORE LUGGING AND COAT ALL SURFACES BEFORE CONNECTING.
8. THE MINIMUM BEND RADIUS SHALL BE 8 INCHES FOR #6 WIRE AND SMALLER AND 12 INCHES FOR WIRE LARGER THAN #6.
9. ALL CONNECTIONS TO THE GROUND RING SHALL BE EXOTHERMIC WELD.
10. BOND THE FENCE TO THE GROUND RING AT EACH CORNER, AND AT EACH GATE POST WITH #2 SOLID TINNED WIRE. EXOTHERMIC WELD BOTH ENDS.
11. GROUND KITS SHALL BE SOLID COPPER STRAP WITH #6 WIRE 2–HOLE COMPRESSION CRIMPED LUGS AND SHALL BE SEALED ACCORDING TO MANUFACTURER INSTRUCTIONS.
12. FERROUS METAL CLIPS WHICH COMPLETELY SURROUND THE GROUNDING CONDUCTOR SHALL BE USED.
13. GROUND BARS SHALL BE FURNISHED AND INSTALLED WITH PRE–DRILLED HOLE DIAMETERS AND SPACINGS. GROUND BARS SHALL NEITHER BE FIELD FABRICATED NOR NEW HOLES DRILLED. GROUND LUGS SHALL MATCH THE SPACING ON THE BAR. HARDWARE DIAMETER SHALL BE MINIMUM 3.8 INCH.
14. MGB GROUND CONNECTION SHALL BE EXOTHERMIC WELDED TO THE GROUND SYSTEM.
15. ALL CABLE TRAY AND/OR PLATFORM STEEL SHALL BE BONDED TOGETHER WITH JUMPERS (#6 IN EQUIPMENT ROOM, #2 ELSEWHERE AND HOMERUN).

ANTENNA & CABLE NOTES

1. THE CONTRACTOR SHALL FURNISH AND INSTALL ALL TRANSMISSION CABLES, JUMPERS, CONNECTORS, GROUNDING STRAPS, ANTENNAS, MOUNTS AND HARDWARE. ALL MATERIALS SHALL BE INSPECTED BY THE CONTRACTOR FOR DAMAGE UPON DELIVERY. JUMPERS SHALL BE SUPPLIED AT ANTENNAS AND EQUIPMENT INSIDE SHELTER COORDINATE LENGTH OF JUMP CABLES WITH EVERSOURCE. COORDINATE AND VERIFY ALL OF THE MATERIALS TO BE PROVIDED WITH EVERSOURCE PRIOR TO SUBMITTING BID AND ORDERING MATERIALS.
2. AFTER INSTALLATION, THE TRANSMISSION LINE SYSTEM SHALL BE PIM/SWEEP TESTED FOR PROPER INSTALLATION AND DAMAGE WITH ANTENNAS CONNECTED. CONTRACTOR TO OBTAIN LATEST TESTING PROCEDURES FROM EVERSOURCE PRIOR TO BIDDING.
3. ANTENNA CABLES SHALL BE COLOR CODED AT THE FOLLOWING LOCATIONS:
   - AT THE ANTENNAS.
   - AT THE WAVEGUIDE ENTRY PLATE ON BOTH SIDES OF THE EQUIPMENT SHELTER WALL.
   - JUMPER CABLES AT THE EQUIPMENT ENTER.
4. SYSTEM INSTALLATION:
   THE CONTRACTOR SHALL INSTALL ALL CABLES AND ANTENNAS TO THE MANUFACTURER'S SPECIFICATIONS. THE CONTRACTOR IS RESPONSIBLE FOR THE PROCUREMENT AND INSTALLATION OF THE FOLLOWING:
   - ALL CONNECTORS, ASSOCIATED CABLE MOUNTING, AND GROUNDING HARDWARE.
   - WALL MOUNTS, STANDOFFS, AND ASSOCIATED HARDWARE.
   - 1/2 INCH HELIAX ANTENNA JUMPERS OF APPROPRIATE LENGTHS.
5. MINIMUM BENDING RADIUS FOR COAXIAL CABLES:
   - 7/8 INCH, RMIN = 15 INCHES
   - 1 5/8 INCH, RMIN = 25 INCHES
6. CABLE SHALL BE INSTALLED WITH A MINIMUM NUMBER OF BENDS WHERE POSSIBLE. CABLE SHALL NOT BE LEFT UNTERMINATED AND SHALL BE SEALED IMMEDIATELY AFTER BEING INSTALLED.
7. ALL CABLE CONNECTIONS OUTSIDE SHALL BE COVERED WITH WATERPROOF SPLICING KIT.
8. CONTRACTOR SHALL VERIFY EXACT LENGTH AND DIRECTION OF TRAVEL IN FIELD PRIOR TO CONSTRUCTION.
9. CABLE SHALL BE FURNISHED WITHOUT SPLICES AND WITH CONNECTORS AT EACH END.

EVERSOURCE ENERGY

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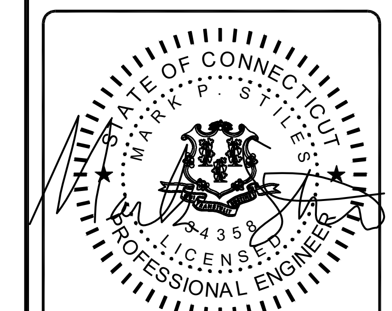

08/11/2020

WEST HARTLAND
2 CENTER HILL RD
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SHEET TITLE

NOTES & SPECIFICATIONS

SHEET NUMBER

N-2

SYMBOLS

Symbol	Description
●	EXOTHERMIC CONNECTION
■	COMPRESSION CONNECTION
	5/8"øx10'-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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NOTES & SPECIFICATIONS

SHEET NUMBER

N-3

REFERENCE CUTSHEETS

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.

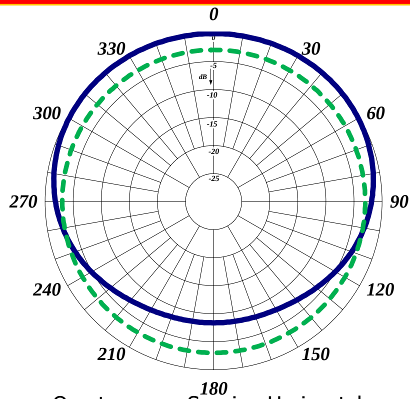
Electrical Specifications	871F-70-2	872F-70-2	874F-70-2
Frequency Range, MHz	215-225	215-225	215-225
Nominal Gain, dBd	2.0-2.5	5.0-5.5	8.0-8.5
Number of Dipoles	1	2	4
Bandwidth 1.5:1 VSWR, MHz	10	10	10
Polarization	Vertical	Vertical	Vertical
Pattern	Offset / bi	Offset / bi	Offset / bi
Power Rating, Watts	200	300	500
Nominal Impedance, Ohms	50	50	50
Lightning Protection	DC Ground	DC Ground	DC Ground
Standard Termination	Type DIN 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, ft^2 (m^2)	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

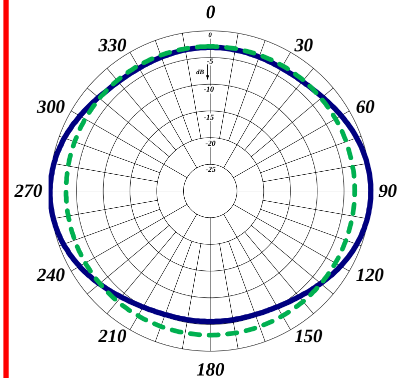
ONE SITE PRO 1 P/N DCP12K CLAMP SET REQUIRED.

220MHz EXPOSED DIPOLES 215-225 MHz

871F-70-2



Quarter-wave Spacing Horizontal



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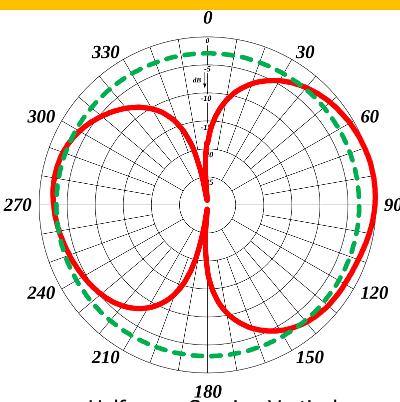
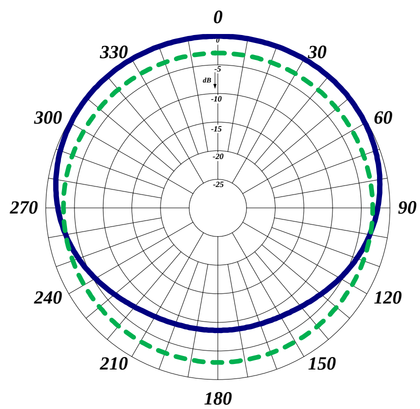


Half-wave Spacing Vertical

872F-70-2



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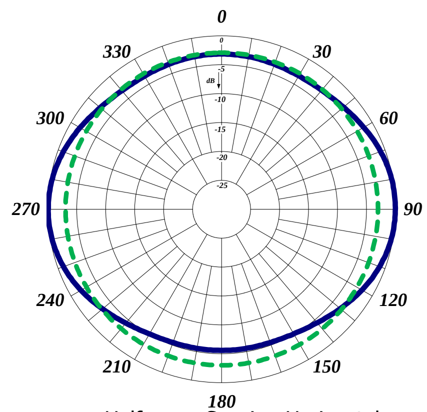

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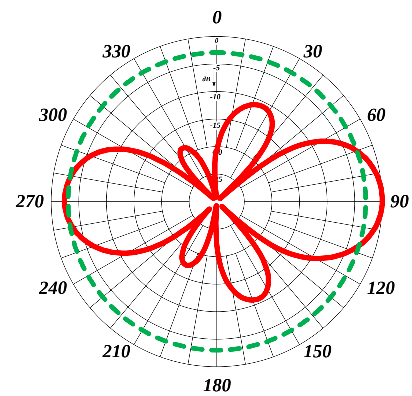
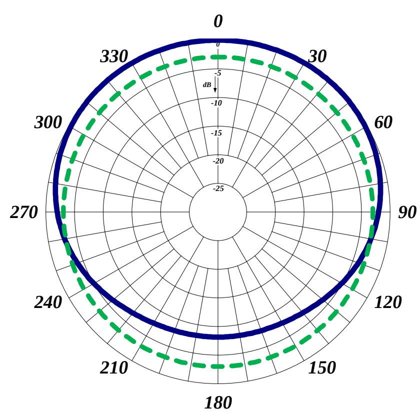
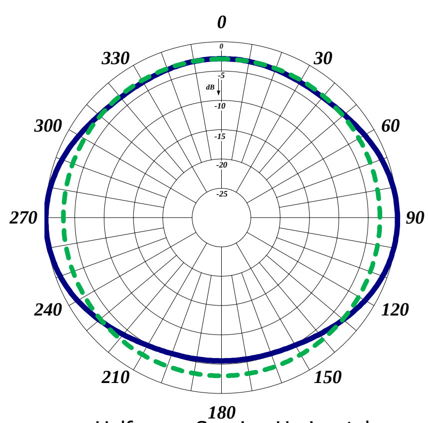


Half-wave Spacing Vertical

874F-70-2



Quarter-wave Spacing Horizontal



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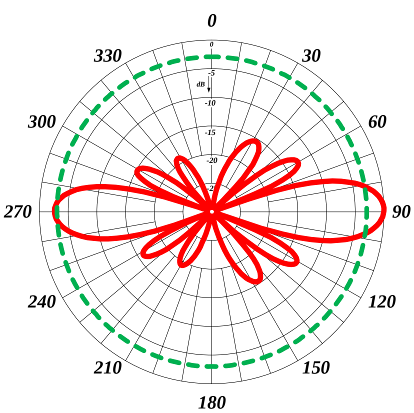


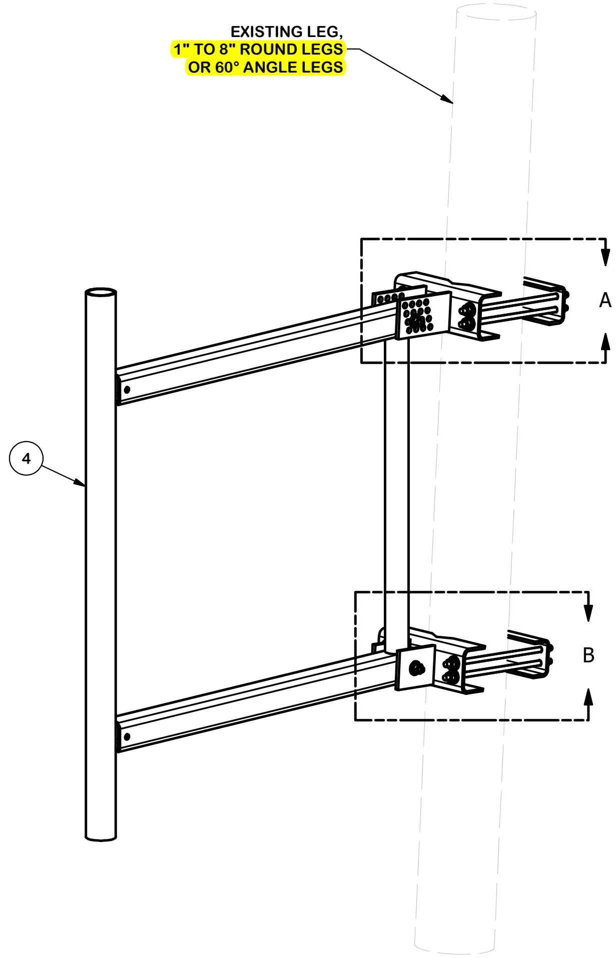
Half-wave Spacing Vertical

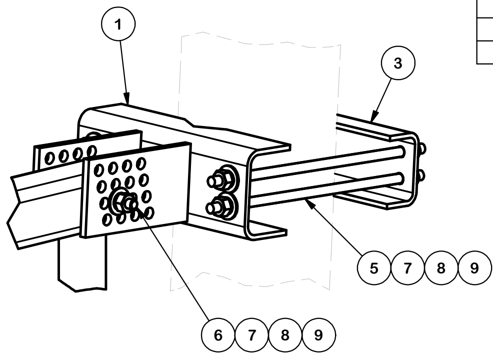
COMPROD
Simplifying RF Solutions

Tel: US 1.877.825.2007 / CAN 1.800.603.1454
www.comprodcom.com
Email: sales@comprodcom.com
Fax: 1.800.554.1033

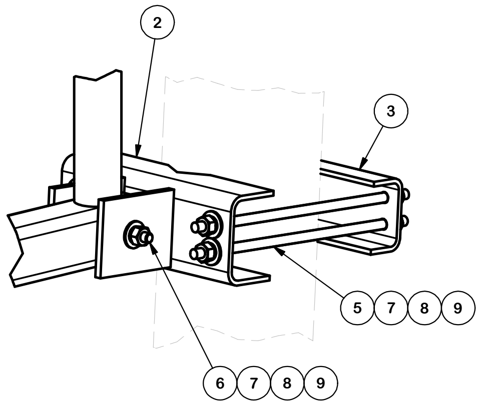
TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 1.5" ± DIAMETER.

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

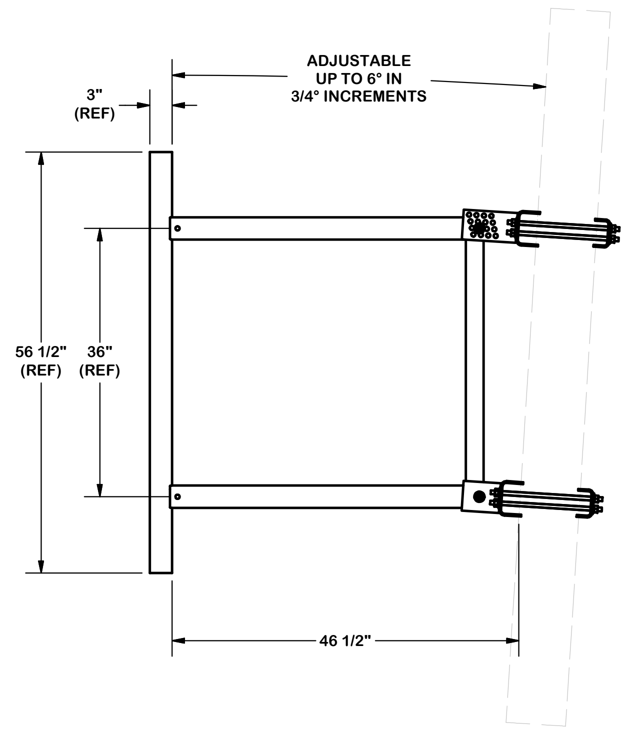




DETAIL A



DETAIL B



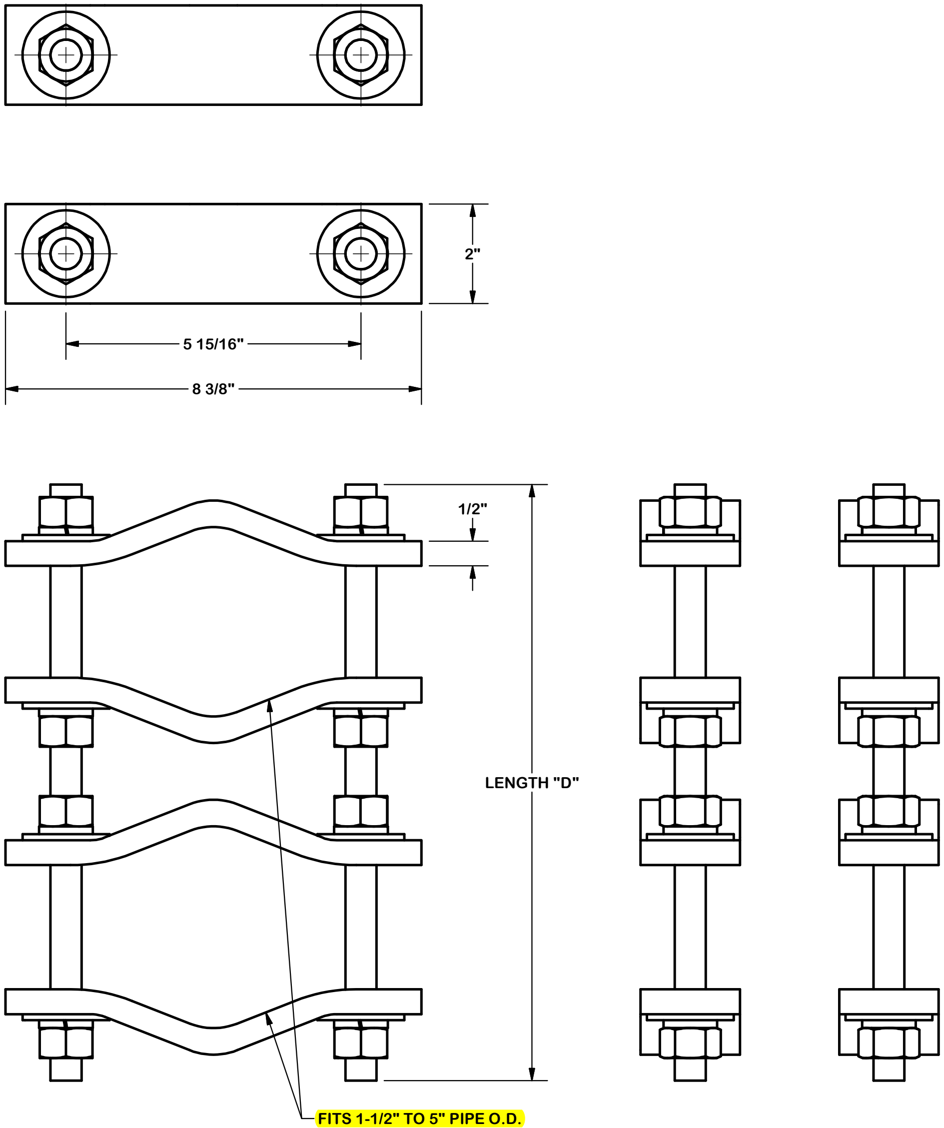
TOLERANCE NOTES

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

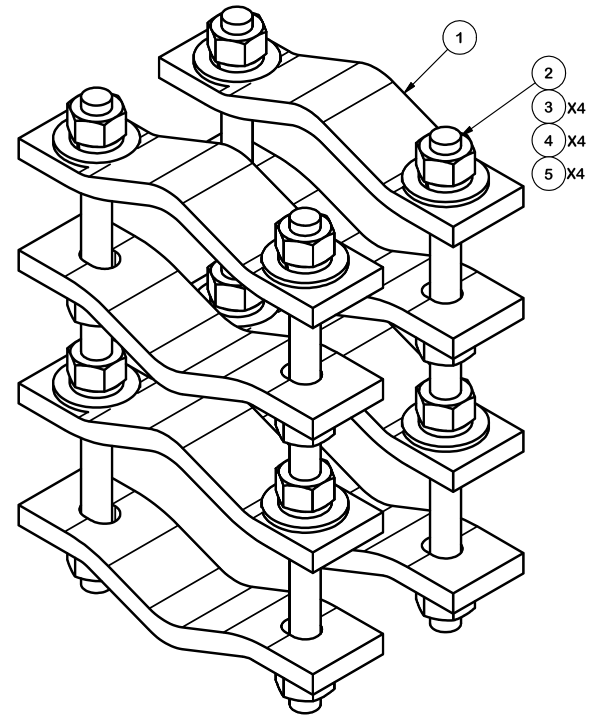
SITE PRO 1
A valmont COMPANY
Engineering Support Team:
1-888-753-7446
Locations:
New York, NY
Atlanta, GA
Los Angeles, CA
Plymouth, IN
Salem, OR
Dallas, TX

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

PRODUCT DATASHEET

PAD6-W59BC

RADIO FREQUENCY SYSTEMS
The Clear Choice®

TrunkLine Antenna, Standard (FCC 101, Cat A) , Single Polarized, 6 ft

RFS Microwave Antennas are designed for microwave systems in all common frequency ranges from 4 GHz to 24 GHz. This allows the use of antennas in areas where extreme wind conditions are normal. The antennas utilise a conventional feed system and are available in three performance classes offering complete flexibility when designing a network. Standard Performance antennas are economical solutions for systems where side lobe suppression is of less importance. These antennas are required for use in networks where there is a low interference potential. Antennas are available in 2 ft (0.6m) to 12 ft (3.7m) diameters. Antennas from 4ft up to 12 ft (3.7m) can be equipped with a moulded radome to reduce wind load and to protect the feed against the accumulation of ice and snow.

Antenna

FEATURES / BENEFITS

- Field-proven reliability and long life
- Withstanding winds up to 200 km/h (125 mph), an optional sway bar is available for added assurance in case mistakes are made during installation
- A single-piece configuration and compact packaging to reduce transportation costs
- Frequencies ranging from 4 GHz to 15 GHz with support for two wideband frequency ranges (5.725-6.875 and 7.125-8.5 GHz) to reduce antenna requirements and simplify logistics

Technical Features

GENERAL SPECIFICATIONS

Product Type		Point to point antennas
Profile		TrunkLine
Performance		Improved Performance
Polarization		Single
Antenna Input		CPR137G
Reflector		1-part
Radome		Optional
Antenna color		White RAL 9010
Swaybar		1: (2.0 m x Ø60 mm)

ELECTRICAL SPECIFICATIONS

Frequency	GHz	5.925 - 6.875
3dB beamwidth	degrees	1.7
Low Band Gain	dBi	38.4
Mid Band Gain	dBi	39.1
High Band Gain	dBi	39.7
F/B Ratio	dB	55.0
XPD	dB	30.0
Max VSWR / R L	VSWR / dB	1.08 (28.3)
Regulatory Compliance		FCC Category A

MECHANICAL SPECIFICATIONS

Diameter	ft (m)	6 (1.8)
Elevation Adjustment	degrees	± 5
Azimuth Adjustment	degrees	± 5
Polarization Adjustment	degrees	± 5
Mounting Pipe Diameter minimum	mm (in)	114 (4.5)
Mounting Pipe Diameter maximum	mm (in)	114 (4.5)
Approximate Weight	kg (lb)	65 (141)
Survival Windspeed	km/h (mph)	200 (125)
Operational Windspeed	km/h (mph)	190 (118)

STRUCTURE

Radome Material		Fiberglass

FURTHER ACCESSORIES

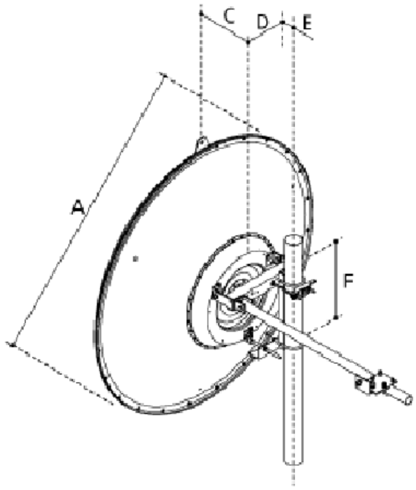
optional Swaybar		1: SMA-SK-60-2000A (2.0 m x Ø60mm)
Further Accessories		SMA-SKO-UNIVERSAL-L : Universal sway bar fixation kit

RADIO FREQUENCY SYSTEMS
The Clear Choice®

TrunkLine Antenna, Standard (FCC 101, Cat A) , Single Polarized, 6 ft

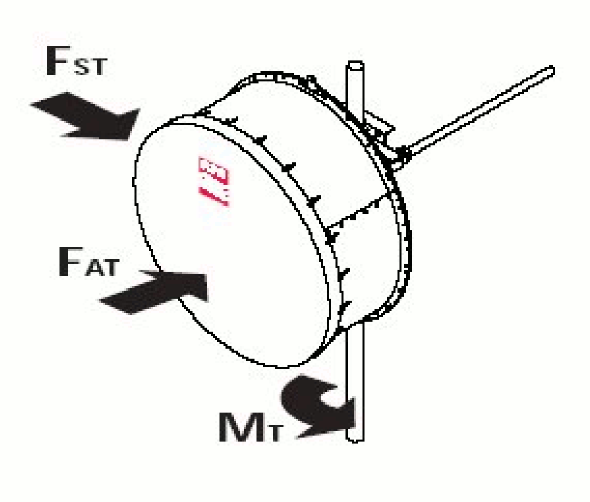
Mount Outline

Dimension A	mm (in)	2000 (79)
Dimension C	mm (in)	364 (14.3)
Dimension D for 114mm (4.5in) Pipe	mm (in)	175 (6.9)
Dimension E	mm (in)	283 (11.1)
Dimension F	mm (in)	590 (23.2)



Wind Load

FST Side force max. @ survival wind speed	N (lb)	2910 (651)
FAT Axial force max. @ survival wind speed	N (lb)	9900 (2217)
MT Torque maximum @ survival wind speed	Nm (lb ft)	3055 (2270)



External Document Links

Complete Antenna installation

RPE (IQ-Link format)

RPE (PDF format)

RPE (Pathloss format)

Notes

Only available in North America

(2) PERIMETER SWAY BARS REQUIRED (CONNECTIONS TO BE LOCATED ON THE TOP AND LEFT PERIMETER QUADRANTS)
NOTE: ANTENNA TO BE INSTALLED WITH A RIGHT OFFSET (WITH RESPECT TO THE T-MOUNT INCLUDED WITH THE ANTENNA) SO THAT THE INCLUDED SWAY BAR THAT ATTACHES TO THE T-MOUNT IS OFFSET RIGHT

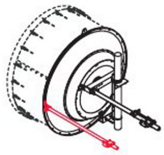
PRODUCT DATASHEET

SMA-SK-60-2000A

RADIO FREQUENCY SYSTEMS
The Clear Choice®

Perimeter Sway Bar for Parabolic Antennas 6ft

The perimeter sway bar reduces vibration of the reflector and increases stability of the antenna in worst case conditions.
If the perimeter sway bar is installed on a SU6/SUX6/UXA6 "high wind duty" antenna (survival windspeed = 155 mph or 252 km/h), then the operational wind speed of this antenna in increased up to 155 mph (252 km/h).



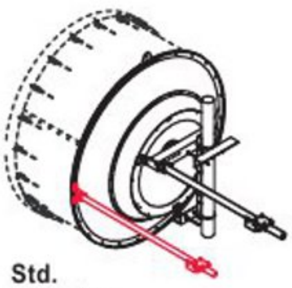
Technical Features

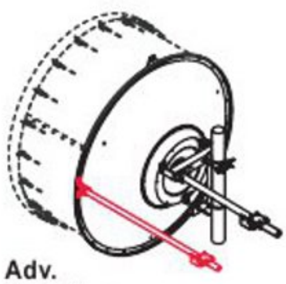
MECHANICAL PROPERTIES

Diameter	m (ft)	1.8 (6)
Weight	kg (lb)	16 (35.3)
Sway bar length	m (ft)	1.9 (6.23)
Sway bar diameter	mm (in)	60 (2.4)

STRUCTURE

Product Type		Reinforcement Hardware
Kit Type		Perimeter Sway Bar
Material		Hot-dip galvanised steel





External Document Links

Sway bar installation kit

Notes

The perimeter sway bar includes only the red marked parts and fixing hardware.

Only applicable for antennas PAD, PADX, DA, DAX, SU, SUX, UA, UDA, UXA antennas in 6ft.

Diameter of the sway bar: 60 mm (2.4 in)

Length of the sway bar: 1900 mm (74.8 in)

(3) SWAY BAR / TOWER CONNECTING KITS REQUIRED (1 PER SWAY BAR)

Addendum

NMT 758-00(e)

Sway Bar / Tower Connecting Kit (SMA-SKO-UNIVERSAL-L)
6-8-10-12-15 ft antennas

The sway bar / tower connecting kit allows the attachment of the sway bar extremity on tower with pipe or L-section structure profiles:

- Tower pipe compatibility: Ø 60 up to 114 mm
- Tower L-section compatibility: L 60x60 up to L 110x110 mm
- Sway bar compatibility: FS sway bar models (Ø 60 mm)
- Antenna compatibility: from 6Ft to 15Ft

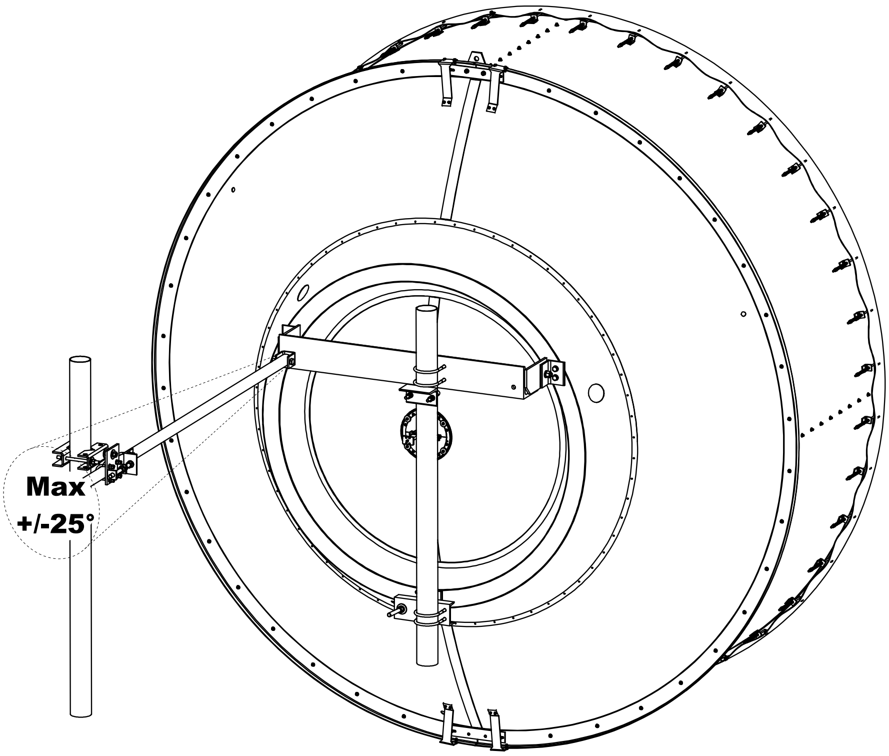
Notes:

For 6 ft antennas, fine azimuth and elevation adjustments have to be done before the sway bar attachment to the sway bar / tower connecting kit.

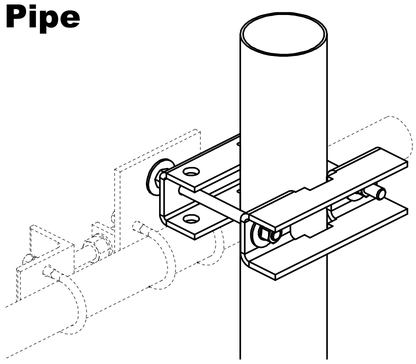
For 8, 10 and 12 ft antennas, as the fine azimuth adjustment system is integrated on the sway bar extremity, you must adjust fine elevation before sway bar attachment.

These installation instructions have been written for qualified, skilled personnel. The antenna shall be inspected once per year by qualified personnel to verify proper installation, maintenance, and condition of equipment. It is important to adhere precisely to all parts of the installation instructions. RFS disclaim any responsibility resulting from improper or unsafe installation. RFS reserves the right to alter details at any time, especially with respect to technical improvements.

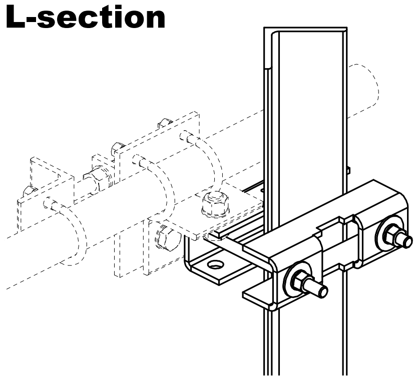
Sway bar kit installation overview (12ft antenna)



OPTION 1
Pipe



OPTION 2
L-section



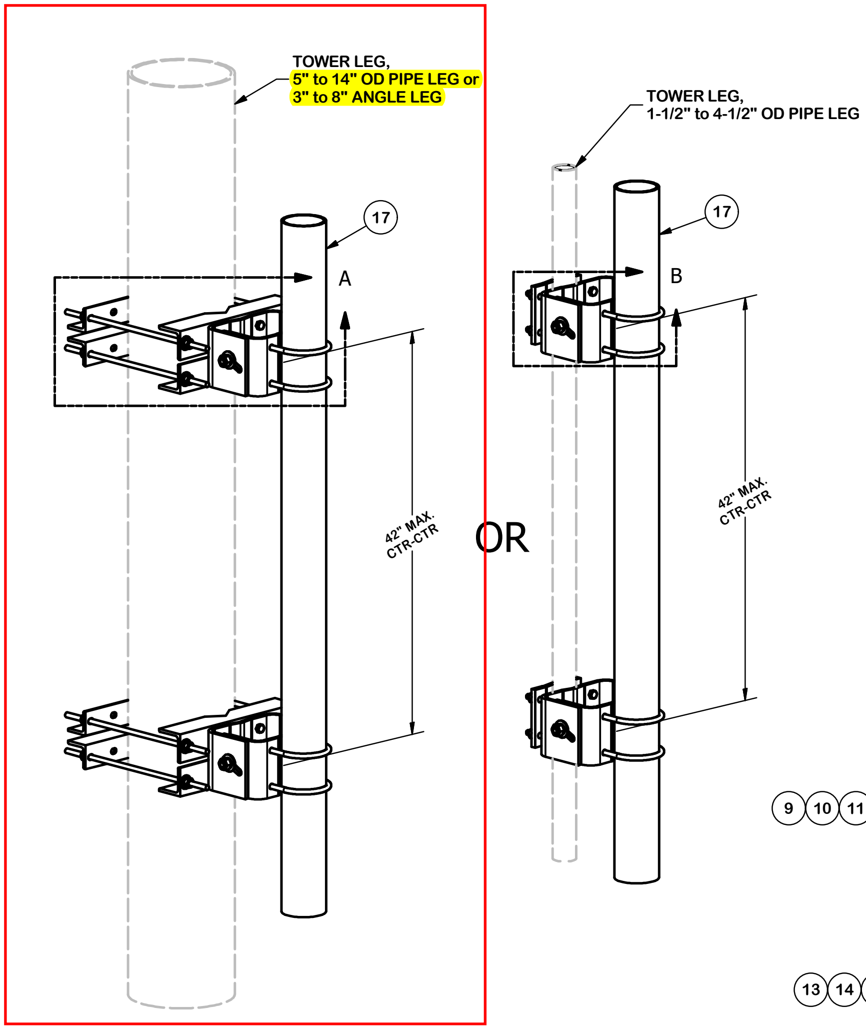
Kit supplies

Description	Qty	Description	Qty
Clamp 1 Univ. Sway-bar Kit 6-15	1	Assembly grease	1
Clamp 2 Univ. Sway-bar Kit 6-15	1		
Equipped threaded rod 1 M16/250	1		
Equipped threaded rod 1 M16/250	1		
Strut Univ. Sway-bar Kit 6-15	1		

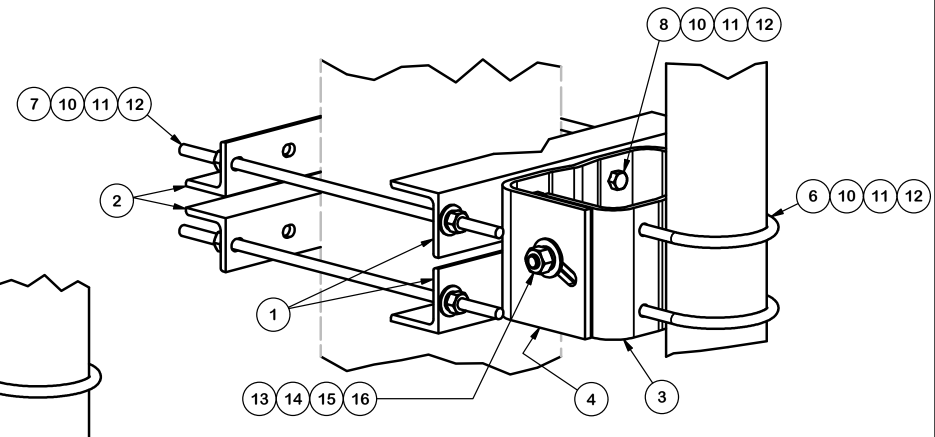
Tools and equipment required for installation

- Torque wrench 140 to 240 Nm with hex open/ring ends adapters M16(24), M20(30)
- Combination wrenches for hexagon bolts M16 (24), M20 (30)

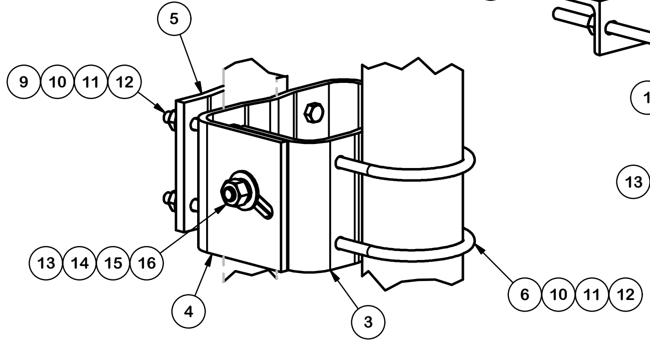
( ) opening of spanner



PARTS LIST						
ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	4	X-158320	ANGLE CLAMP	16 1/2 in	8.51	34.03
2	4	X-126501	BRACKET ANGLE LEG MOUNTING	16 1/2 in	7.13	28.51
3	2	X-154463	UNIVERSAL PIPE MOUNTING PLATE (INNER)	16 11/32 in	10.52	21.03
4	2	X-155561	UNIVERSAL PIPE MOUNTING PLATE (OUTER)	20 9/32 in	13.16	26.31
5	2	X-159999	BACKING PLATE	6 9/16 in	5.73	11.46
6	4	X-UB1458	1/2" X 4-5/8" X 7" X 3" GALV U-BOLT		0.97	3.89
7	8	G12R-20	1/2" x 20" GALV. THREADED ROD		1.12	8.92
8	8	G1203	1/2" x 3" HDG HEX BOLT GR5 FULL THREAD	3 in	0.22	1.74
9	8	G1204	1/2" x 4" HDG HEX BOLT GR5 FULL THREAD	4 in	0.27	2.16
9	8	G12065	1/2" x 6-1/2" HDG HEX BOLT GR5 FULL THREAD	5 1/2 in	0.41	3.28
10	32	G12FW	1/2" HDG USS FLATWASHER	3/32 in	0.03	1.09
11	32	G12LW	1/2" HDG LOCKWASHER	1/8 in	0.01	0.44
12	32	G12NUT	1/2" HDG HEAVY 2H HEX NUT		0.07	2.29
13	4	G5802	5/8" x 2" HDG HEX BOLT GR5		0.27	1.08
14	8	G58FW	5/8" HDG USS FLATWASHER	1/8 in	0.07	0.56
15	4	G58LW	5/8" HDG LOCKWASHER		0.03	0.10
16	4	G58NUT	5/8" HDG HEAVY 2H HEX NUT		0.13	0.52
17	1	P472	4-1/2" X 72" SCH. 40 GALVANIZED PIPE	72 in	64.81	64.81
					TOTAL WT. #	148.00



DETAIL A
USED FOR 5" to 14" OD PIPE LEGS & 3" to 8" ANGLE LEGS



DETAIL B
USED FOR 1-1/2" to 4-1/2" OD PIPE LEGS

TAPER NOTE:
THE MAXIMUM TAPER ADJUSTMENT IS 5.7° BASED UPON 30" SPACING OF ADJUSTABLE MOUNTING BRACKETS.

THE MAXIMUM TAPER ADJUSTMENT IS 3.8° BASED UPON 45" SPACING OF ADJUSTABLE MOUNTING BRACKET.

TOWER TRUSS LEG WIDTH AT PROPOSED ANTENNA ATTACHMENT = 13.5"± (1.25" SOLID ROUND MEMBERS IN A 12" TRUSS LEG)
NOTE: LARGE LEG ADAPTER INCLUDED SHALL BE USED TO MOUNT AROUND ENTIRE TRUSS LEG.

REV	DESCRIPTION OF REVISIONS	CPD	BY	DATE
B	DESCRIPTION CHANGE: 10-3/4" OD TO 14" OD PIPE LEG. NO PART CHANGE		JT	2/27/2020
A	CHANGED THE AMOUNT OF 5/8" FLATWASHER FROM 4 TO 8		MS	12/18/2015

REVISION HISTORY

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")

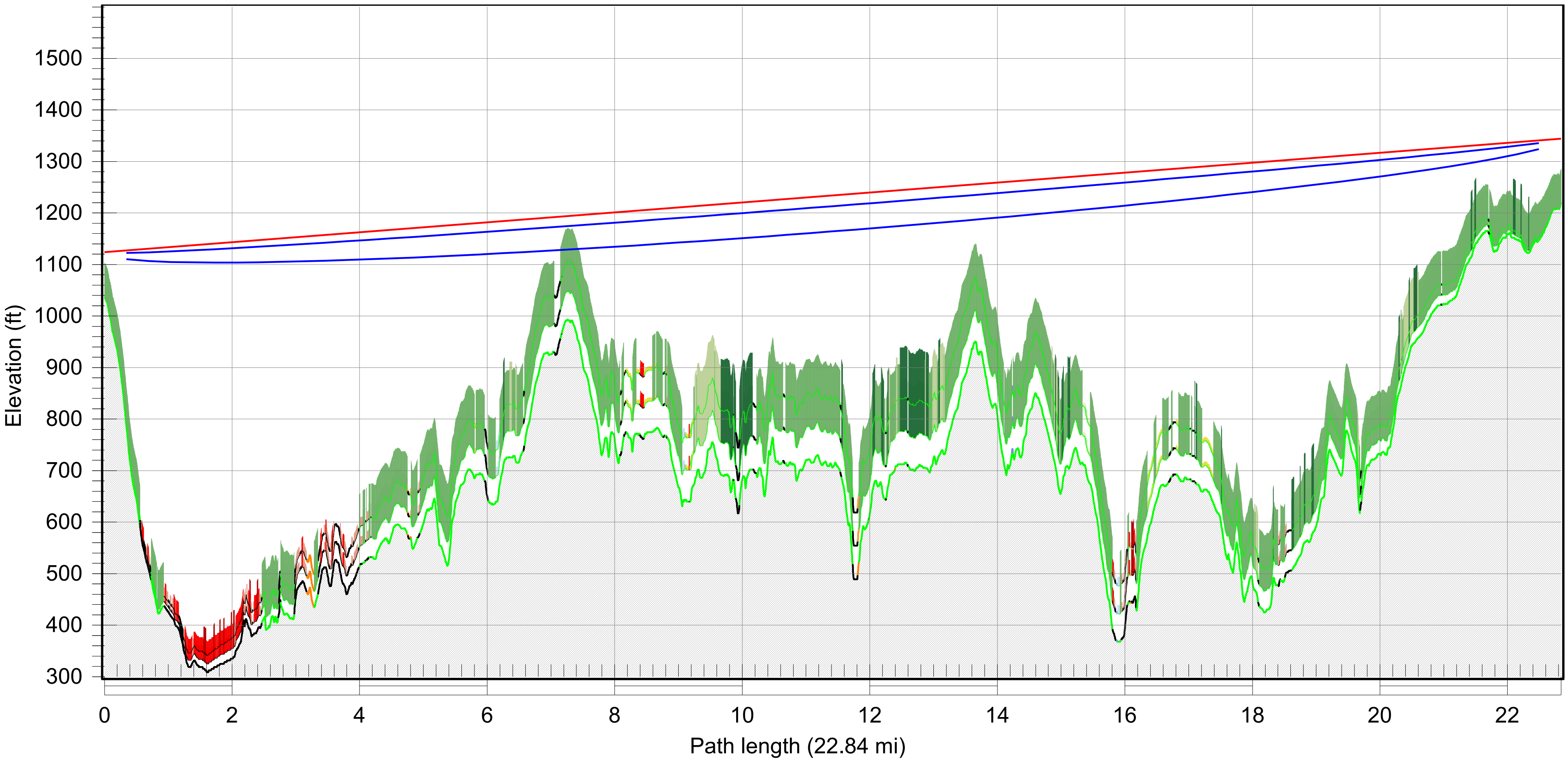
DESCRIPTION
R5 PIPE MOUNT w/ LARGE LEG ADAPTER FOR 1-1/2" to 14" OD PIPE LEGS & 3" TO 8" ANGLE LEGS

CPD NO.	DRAWN BY	ENG. APPROVAL	PART NO.
4718	RH18 3/30/2010		R5-LL

CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	01	CUSTOMER	BMC 4/21/2010	R5-LL

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

Pathloss



CT_SouthMtnRS_ES_130ft_SST	
Latitude	41 38 56.00 N
Longitude	072 56 50.00 W
Azimuth	355.47°
Elevation	1037 ft ASL
Antenna CL	87.0 ft AGL

Frequency (MHz) = 6071.0
K = 1.33, 0.67
%F1 = 100.00, 30.00

CT_WHartland_NESM_180ft_SST	
Latitude	41 58 43.50 N
Longitude	072 58 56.00 W
Azimuth	175.45°
Elevation	1220 ft ASL
Antenna CL	124.0 ft AGL

Microwave Path Data Sheet
COMSEARCH

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)636-5234 www.comsearch.com

PCN Date: 09/18/2019 — New Path
Job Number: 190918COMSDS04 — RCN Number: 19091852

Administrative Information	**SOUTH MTN CT**	**W HARTLAND CT**
City/County	Bristol/Hartford	/Hartford
Status / License Basis	Engineering Proposal / PRIMARY OPERATION	Engineering Proposal / PRIMARY OPERATION
Call Sign	KVG93	
Licensee Code	S68716	S68716
Licensee Name	Eversource Energy Service Company	Eversource Energy Service Company
Radio Service / Station Class	MG -- Microwave Industrial/Business Pool	FXO -- Fixed

Site Information		
Latitude (NAD 83)	41 ° 38’ 56.0" N	41 ° 58’ 43.5" N
Longitude (NAD 83)	72 ° 56’ 50.0" W	72 ° 58’ 56.0" W
Ground Elevation (m/ft-AMSL)	310.60 / 1019.0	371.71 / 1219.5
Antenna Structure Registration #		
Path Azimuth (°)	355.473	175.450
Path Length (km / miles)	36.753 / 22.837	

Transmit Antenna	44008C	44008C
Manufacturer	RFS	RFS
Model	PAD6-59B	PAD6-59B
Gain(dBi) / Beamwidth(°) / Tilt(°)	38.7 / 1.80 / -0.01	38.7 / 1.80 / -0.24
Centerline (m / ft - AGL)	26.52 / 87.0	37.80 / 124.0

Receive Antenna	Same As Transmit	
Manufacturer		
Model		
Gain (dBi) / Beamwidth (°)		
Centerline (m / ft - AGL)		

Diversity Receive Antenna		
Manufacturer		
Model		
Gain (dBi) / Beamwidth (°)		
Centerline (m / ft - AGL)		

Radio Information	TEEV61			TEEV61		
Manufacturer	Aviat Networks, Inc.			Aviat Networks, Inc.		
Model	I600V4EHPL6-30M 256Q 179			I600V4EHPL6-30M 256Q 179		
Model Description	ECLIPSE IRU 600 RAC 60-6X MAX TP			ECLIPSE IRU 600 RAC 60-6X MAX TP		
Emission Designator / Modulation	30M0D7W	256 QAM		30M0D7W	256 QAM	
Loading	1 CH DIG 179000.000			1 CH DIG 179000.000		
Stability (%)	0.0005			0.0005		
	Nominal	Coordinated	Maximum	Nominal	Coordinated	Maximum
Power (dBm)		37.0			37.0	
Received Level (dBm)		-31.9			-31.9	
EIRP (dBm)		72.6			72.1	
Fixed Loss: Tx / Common (dB)	0.0 / 3.1			0.0 / 3.6		
Free Space Loss (dB)			139.6			

Transmit Frequencies (MHz)	5945.2000V(11T)	6197.2400V(21T)

ATTACHMENT D – STRUCTURAL ANALYSIS REPORT

Date: **June 11, 2020**

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

Subject:	**Structural Analysis Report**	
Eversource Designation:	**Site Number:** **Site Name:**	ES-033 WHartland
Engineering Firm Designation:	**Black & Veatch Corp. Project Number:**	403093
Site Data:	**2 Center Hill Rd, Hartford County, CT** **Latitude *41° 58' 43.5"*, Longitude *72° 58' 56"*** **180 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:

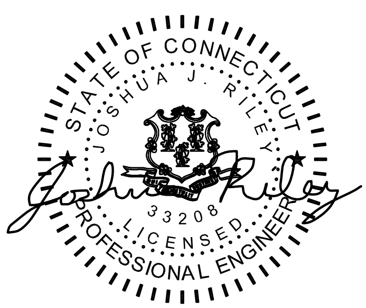
LC1: Proposed Equipment Configuration **Sufficient Capacity – 52.2%**

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: Saranphat Klurvudthikul / Joshua J. Riley

Respectfully submitted by:

Joshua J. Riley, P.E.
Professional Engineer



06/11/2020

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Table 2 - Other Considered Equipment

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3.2) Assumptions

4) ANALYSIS RESULTS
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tnxTower Output

6) APPENDIX B
Base Level Drawing

7) APPENDIX C
Additional Calculations

1) INTRODUCTION

This tower is a 180 ft Self Support tower designed by Valmont in September of 2006.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	III
Wind Speed:	125 mph ultimate
Exposure Category:	B
Topographic Factor:	1
Ice Thickness:	1.5 in
Wind Speed with Ice:	50 mph
Seismic Ss:	0.175
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
180.0	182.75	1	comprod	871F-70-2	1	7/8	-
	180.0	1	site pro 1	DCP12K Clamp Set			
124.0	124.0	1	rfs	PAD6-W59BC	1	E65J	-
		1	site pro 1	R5-LL [PM 602-1]			
107.25	110.0	1	comprod	871F-70-2	1	7/8	-
	107.25	1	site pro 1	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
177.5	189.5	1	antennae	2" Dia 20' Omni	2	7/8	1
	185.5	1	kreco	CO-41A			
	177.5	2	tower mounts	Side Arm Mount [6' SO 311-3]			
		2	tower mounts	Side Arm Mount [SO 311-3]			
167.0	169.0	3	antel	BXA-171085-12BF w/ Mount Pipe	12	1-5/8	1
		3	antel	BXA-70080/6CF w/ Mount Pipe			
		6	antel	LPA-80063/6CF w/ Mount Pipe			
	167.0	1	tower mounts	Pipe Mount [PM 602-3]			
		1	tower mounts	Sector Mount [SM 407-3]			
		3	miscl	Diplexer			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
157.0	158.0	3	kmw communications	AM-X-CD-16-65-00T-RET w/ Mount Pipe	12 2 1	1-5/8 3/4 5/16	1
		6	powerwave panel antennas	7770.00 w/ Mount Pipe			
	157.0	1	tower mounts	Pipe Mount [PM 602-3]			
		1	tower mounts	Sector Mount [SM 407-3]			
		3	ericsson	RRUS 11			
		6	powerwave technologies	LGP18601			
	151.0	1	raycap	DC6-48-60-18-8F			
112.0	122.0	1	unknown	20' x 2.5" Omni	1	7/8	1
	112.0	1	tower mounts	Side Arm Mount [SO 202-1]			

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 08/19/2005	-	Eversource
TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	Valmont, dated 9/27/2006	-	Eversource
TOWER MANUFACTURER DRAWINGS	Valmont, dated 9/27/2006	-	Eversource
TOWER STRUCTURAL ANALYSIS REPORTS	All-Points Technology Corporation, dated 12/22/2015	-	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) 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.
4) Tower loading is based on 2018 drone mapping photos.
5) 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.

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	180 - 160	Leg	1 1/2	3	-19.97	52.29	38.2	Pass
T2	160 - 140	Leg	BV_Valmont 195554	62	-28.61	150.01	33.5	Pass
T3	140 - 120	Leg	BV_Valmont 195554	82	-73.91	150.01	49.3	Pass
T4	120 - 100	Leg	Valmont 195555	97	-100.44	226.02	44.4	Pass
T5	100 - 80	Leg	BV_Valmont 195557	112	-125.81	316.56	39.7	Pass
T6	80 - 60	Leg	BV_Valmont 195557	127	-149.66	316.56	47.3	Pass
T7	60 - 40	Leg	BV_Valmont 195546	142	-173.59	420.94	41.2	Pass
T8	40 - 20	Leg	BV_Valmont 195546	157	-196.79	420.94	46.8	Pass
T9	20 - 0	Leg	BV_Valmont 195560	172	-219.14	539.08	40.6	Pass
T1	180 - 160	Diagonal	3/4	15	-2.55	6.05	42.1	Pass
T2	160 - 140	Diagonal	L2 1/2x2 1/2x3/16	71	-5.04	18.45	27.3 45.2 (b)	Pass
T3	140 - 120	Diagonal	L2 1/2x2 1/2x3/16	85	-4.66	14.57	32.0 40.8 (b)	Pass
T4	120 - 100	Diagonal	L2 1/2x2 1/2x3/16	100	-4.88	11.52	42.4 43.7 (b)	Pass
T5	100 - 80	Diagonal	L3x3x3/16	115	-5.04	16.11	31.3 40.6 (b)	Pass
T6	80 - 60	Diagonal	L3x3x3/16	130	-5.21	13.01	40.0 41.8 (b)	Pass
T7	60 - 40	Diagonal	L3x3x5/16	145	-5.65	17.12	33.0	Pass
T8	40 - 20	Diagonal	L3x3x5/16	160	-6.05	14.16	42.8	Pass
T9	20 - 0	Diagonal	L3 1/2x3 1/2x5/16	175	-7.28	19.10	38.1	Pass
T1	180 - 160	Horizontal	3/4	13	-0.45	3.48	12.8	Pass
T1	180 - 160	Top Girt	3/4	6	-0.28	3.48	8.1	Pass
T2	160 - 140	Top Girt	L2 1/2x2 1/2x3/16	65	0.40	23.67	1.7 3.6 (b)	Pass
							Summary	
						Leg (T3)	49.3	Pass
						Diagonal (T2)	45.2	Pass
						Horizontal (T1)	12.8	Pass
						Top Girt (T1)	8.1	Pass
						Bolt Checks	45.2	Pass
						RATING =	49.3	Pass

Table 5 - Tower Component Stresses vs. Capacity - LC1

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	36.6	Pass
1	Base Foundation	0	17.4	Pass
	Base Foundation Soil Interaction		52.2	Pass

Structure Rating (max from all components) =	52.2%

Note:
1) See additional documentation in “Appendix C – Additional Calculations” for calculations supporting the % capacity. 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	180 - 160	3.59	39	0.1999	0.0119	OK
T2	160 - 140	2.757	39	0.1844	0.0126	OK
T3	140 - 120	2.011	39	0.1575	0.0131	OK
T4	120 - 100	1.41	39	0.1203	0.0111	OK
T5	100 - 80	0.946	39	0.0919	0.0073	OK
T6	80 - 60	0.59	39	0.0702	0.0051	OK

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

1) Maximum Rotation = 4 Degrees

2) Maximum Deflection = 0.03 * Tower Height = 65 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?*
124	PAD6-W59BC	0.1275	0.0117	6.58	10	10 dB	0.807	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*
T1	180 - 160	9.329	39	0.521	0.031	0.522
T2	160 - 140	7.161	39	0.4796	0.0327	0.481
T3	140 - 120	5.221	39	0.4089	0.0341	0.410
T4	120 - 100	3.661	39	0.3121	0.029	0.313
T5	100 - 80	2.458	39	0.2385	0.0191	0.239
T6	80 - 60	1.533	39	0.1821	0.0132	0.183

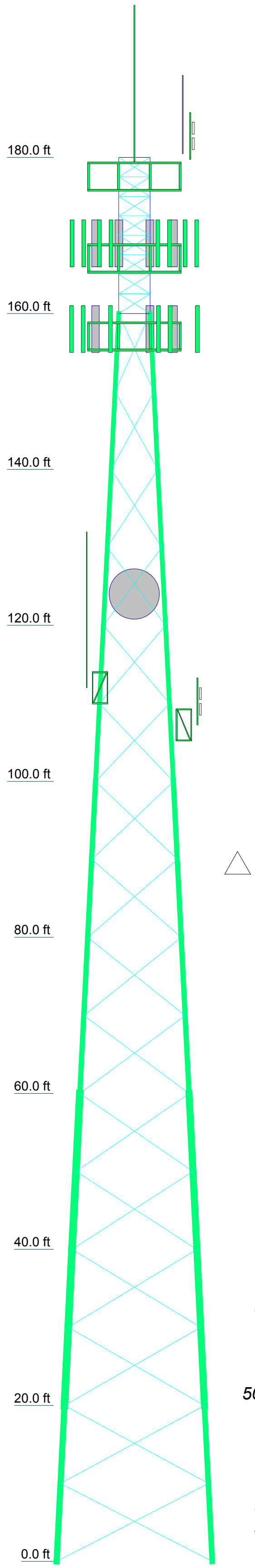
Critical Deflections of Tower at the MW Dish Elevations - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
124	PAD6-W59BC	39	3.942	0.3308	0.0306	12780.000

APPENDIX A

TNXTOWER OUTPUT

Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Horizontals	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	SR 1 1/2	A572-50	SR 3/4	A572-50	SR 3/4	SR 3/4	4	8 @ 2.5	0.8
T2	BV_Valmont 195554		L2 1/2x2 1/2x3/16	A36	L2 1/2x2 1/2x3/16	N.A.		16 @ 10	1.9
T3					N.A.		6		1.9
T4	Valmont 195555						8		2.3
T5	BV_Valmont 195557		L3x3x3/16				10		2.9
T6							12		3.0
T7	BV_Valmont 195546		L3x3x5/16				14		4.5
T8							16		4.6
T9	BV_Valmont 195560		L3 1/2x3 1/2x5/16				18		5.3
							20		27.2



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
DCP12K Clamp Set	180	AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	157
871F-70-2	180	AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	157
5' Hor x 3.5" Square Tube	179.5	AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	157
5' Hor x 3.5" Square Tube	179.5	(2) 7770.00 w/ Mount Pipe	157
5' Hor x 3.5" Square Tube	179.5	(2) 7770.00 w/ Mount Pipe	157
2" Dia 20' Omni	177.5	(2) 7770.00 w/ Mount Pipe	157
CO-41A	177.5	(2) 7020.00 : RET	157
(2) Side Arm Mount [6' SO 311-3]	177.5	(2) 7020.00 : RET	157
(2) Side Arm Mount [SO 311-3]	177.5	(2) 7020.00 : RET	157
5' Hor x 3.5" Square Tube	175	(2) LGP18601	157
5' Hor x 3.5" Square Tube	175	(2) LGP18601	157
5' Hor x 3.5" Square Tube	175	(2) LGP18601	157
(2) LPA-80063/6CF w/ Mount Pipe	167	RRUS 11	157
(2) LPA-80063/6CF w/ Mount Pipe	167	RRUS 11	157
(2) LPA-80063/6CF w/ Mount Pipe	167	RRUS 11	157
BXA-70080/6CF w/ Mount Pipe	167	DC6-48-60-18-8F	157
BXA-70080/6CF w/ Mount Pipe	167	Sector Mount [SM 407-3]	157
BXA-70080/6CF w/ Mount Pipe	167	Pipe Mount [PM 602-3]	157
BXA-171085-12BF w/ Mount Pipe	167	R5-LL [PM 602-1]	124
BXA-171085-12BF w/ Mount Pipe	167	PAD6-W59BC	124
BXA-171085-12BF w/ Mount Pipe	167	Side Arm Mount [SO 301-1]	112
Diplexer	167	20' x 2.5" Omni	112
Diplexer	167	871F-70-2	107.25
Diplexer	167	USF-4U [4' SO 203-1 + Vert. Pipe Support]	107.25
Sector Mount [SM 407-3]	167		
Pipe Mount [PM 602-3]	167		
8'x2" Antenna Mount Pipe	157		
8'x2" Antenna Mount Pipe	157		
8'x2" Antenna Mount Pipe	157		

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 Hartford County, Connecticut.
2. Tower designed for Exposure B 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 0.00 ft
8. TOWER RATING: 49.3%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:

DOWN: 225 K
SHEAR: 23 K

UPLIFT: -191 K
SHEAR: 20 K

AXIAL 142 K
SHEAR 11 K
MOMENT 1237 kip-ft
TORQUE 4 kip-ft
50 mph WIND - 1.5000 in ICE

AXIAL 49 K
SHEAR 35 K
MOMENT 3619 kip-ft
TORQUE 14 kip-ft
REACTIONS - 125 mph WIND

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Job: ***ES-033 WHartland***		
Project: ***403093 (WHartland)***		
Client: Eversource	Drawn by: TH	App'd:
Code: TIA-222-H	Date: 05/18/20	Scale: NTS
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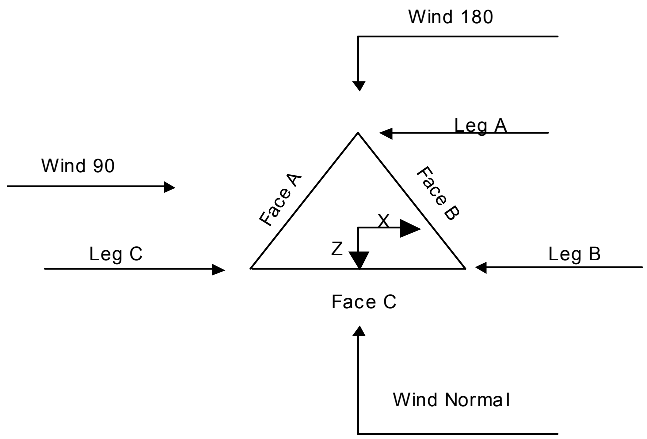
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 180.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 4.00 ft at the top and 20.00 ft at the base.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

1) Tower is located in Hartford County, Connecticut.
2) Tower base elevation above sea level: 1228.00 ft.
3) Basic wind speed of 125 mph.
4) Risk Category III.
5) Exposure Category B.
6) Simplified Topographic Factor Procedure for wind speed-up calculations is used.
7) Topographic Category: 1.
8) Crest Height: 0.00 ft.
9) Nominal ice thickness of 1.5000 in.
10) Ice thickness is considered to increase with height.
11) Ice density of 56 pcf.
12) A wind speed of 50 mph is used in combination with ice.
13) Temperature drop of 50 °F.
14) Deflections calculated using a wind speed of 60 mph.
15) Pressures are calculated at each section.
16) Stress ratio used in tower member design is 1.05.
17) Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Horizontals		Assume Legs Pinned	√	Calculate Redundant Bracing Forces
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Ignore Redundant Members in FEA
	Use Moment Magnification	√	Use Clear Spans For Wind Area	√	SR Leg Bolts Resist Compression
	Use Code Stress Ratios	√	Use Clear Spans For KL/r		All Leg Panels Have Same Allowable
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		Offset Girt At Foundation
	Escalate Ice	√	Bypass Mast Stability Checks	√	Consider Feed Line Torque
	Always Use Max Kz	√	Use Azimuth Dish Coefficients	√	Include Angle Block Shear Check
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Use TIA-222-H Bracing Resist. Exemption
√	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Use TIA-222-H Tension Splice Exemption
	Leg Bolts Are At Top Of Section		Add IBC .6D+W Combination		**Poles**
√	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Include Shear-Torsion Interaction
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Always Use Sub-Critical Flow
√	SR Members Have Cut Ends		Treat Feed Line Bundles As Cylinder		Use Top Mounted Sockets
	SR Members Are Concentric		Ignore KL/ry For 60 Deg. Angle Legs		Pole Without Linear Attachments
					Pole With Shroud Or No Appurtenances
					Outside and Inside Corner Radii Are Known



Triangular Tower

Tower Section Geometry

Tower Section	*Tower Elevation* *ft*	*Assembly Database*	*Description*	*Section Width* *ft*	*Number of Sections*	*Section Length* *ft*
T1	180.00-160.00			4.00	1	20.00
T2	160.00-140.00			4.00	1	20.00
T3	140.00-120.00			6.00	1	20.00
T4	120.00-100.00			8.00	1	20.00
T5	100.00-80.00			10.00	1	20.00
T6	80.00-60.00			12.00	1	20.00
T7	60.00-40.00			14.00	1	20.00
T8	40.00-20.00			16.00	1	20.00
T9	20.00-0.00			18.00	1	20.00

Tower Section Geometry *(cont'd)*

Tower Section	*Tower Elevation* *ft*	*Diagonal Spacing* *ft*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset* *in*	*Bottom Girt Offset* *in*
T1	180.00-160.00	2.50	X Brace	No	Steps	0.0000	0.0000
T2	160.00-140.00	10.00	X Brace	No	No	0.0000	0.0000
T3	140.00-120.00	10.00	X Brace	No	No	0.0000	0.0000
T4	120.00-100.00	10.00	X Brace	No	No	0.0000	0.0000
T5	100.00-80.00	10.00	X Brace	No	No	0.0000	0.0000
T6	80.00-60.00	10.00	X Brace	No	No	0.0000	0.0000
T7	60.00-40.00	10.00	X Brace	No	No	0.0000	0.0000
T8	40.00-20.00	10.00	X Brace	No	No	0.0000	0.0000
T9	20.00-0.00	10.00	X Brace	No	No	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 180.00-160.00	Solid Round	1 1/2	A572-50 (50 ksi)	Solid Round	3/4	A572-50 (50 ksi)
T2 160.00-140.00	Truss Leg	BV_Valmont 195554	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T3 140.00-120.00	Truss Leg	BV_Valmont 195554	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T4 120.00-100.00	Truss Leg	Valmont 195555	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T5 100.00-80.00	Truss Leg	BV_Valmont 195557	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)
T6 80.00-60.00	Truss Leg	BV_Valmont 195557	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)
T7 60.00-40.00	Truss Leg	BV_Valmont 195546	A572-50 (50 ksi)	Equal Angle	L3x3x5/16	A36 (36 ksi)
T8 40.00-20.00	Truss Leg	BV_Valmont 195546	A572-50 (50 ksi)	Equal Angle	L3x3x5/16	A36 (36 ksi)
T9 20.00-0.00	Truss Leg	BV_Valmont 195560	A572-50 (50 ksi)	Equal Angle	L3 1/2x3 1/2x5/16	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 180.00-160.00	Solid Round	3/4	A572-50 (50 ksi)	Solid Round		A36 (36 ksi)
T2 160.00-140.00	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)	Solid Round		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 180.00-160.00	None	Flat Bar		A36 (36 ksi)	Solid Round	3/4	A572-50 (50 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
T1 180.00-160.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T2 160.00-140.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T3 140.00-120.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T4 120.00-100.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T5 100.00-	0.00	0.0000	A36	1.05	1	1.05	36.0000	36.0000	36.0000

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
80.00			(36 ksi)						
T6 80.00-60.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T7 60.00-40.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T8 40.00-20.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T9 20.00-0.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000

Tower Section Geometry *(cont'd)*

			K Factors[1]							
Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1 180.00-160.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2 160.00-140.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T3 140.00-120.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 120.00-100.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T5 100.00-80.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T6 80.00-60.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T7 60.00-40.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T8 40.00-20.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T9 20.00-0.00	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)*

	Truss-Leg K Factors					
	Truss-Legs Used As Leg Members			Truss-Legs Used As Inner Members		
Tower Elevation ft	Leg Panels	X Brace Diagonals	Z Brace Diagonals	Leg Panels	X Brace Diagonals	Z Brace Diagonals
T2 160.00-140.00	1	0.5	0.85	1	0.5	0.85
T3 140.00-120.00	1	0.5	0.85	1	0.5	0.85
T4 120.00-100.00	1	0.5	0.85	1	0.5	0.85
T5 100.00-80.00	1	0.5	0.85	1	0.5	0.85
T6 80.00-60.00	1	0.5	0.85	1	0.5	0.85
T7 60.00-40.00	1	0.5	0.85	1	0.5	0.85

T8 40.00-20.00	1	0.5	0.85	1	0.5	0.85
T9 20.00-0.00	1	0.5	0.85	1	0.5	0.85

Tower Section Geometry *(cont'd)*

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*
T1 180.00-160.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	1	0.0000	0.75
T2 160.00-140.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	1	0.0000	0.75
T3 140.00-120.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	1	0.0000	0.75
T4 120.00-100.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T5 100.00-80.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T6 80.00-60.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T7 60.00-40.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T8 40.00-20.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T9 20.00-0.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Connection Type*	*Leg*		*Diagonal*		*Top Girt*		*Bottom Girt*		*Mid Girt*		*Long Horizontal*		*Short Horizontal*	
		Bolt Size in	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*	*Bolt Size in*	*No.*
T1 180.00-160.00	Flange	1.0000 A325N	6	0.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 160.00-140.00	Flange	1.0000 A325N	6	1.0000 A325N	1	1.0000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T3 140.00-120.00	Flange	1.0000 A325N	6	1.0000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T4 120.00-100.00	Flange	1.0000 A325N	6	1.0000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T5 100.00-80.00	Flange	1.0000 A325N	6	1.0000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T6 80.00-60.00	Flange	1.0000 A325N	6	1.0000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T7 60.00-40.00	Flange	1.2500 A325N	6	1.2500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T8 40.00-20.00	Flange	1.2500 A325N	6	1.2500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T9 20.00-0.00	Flange	1.2500 A325N	0	1.2500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Safety Line 3/8 ***	A	No	No	Ar (CaAa)	180.00 - 8.00	0.0000	0.5	1	1	0.3750	0.3750		0.22
Feedline Bracket (Af)	A	No	No	Af (CaAa)	152.00 - 8.00	-7.0000	0.4	1	1	1.5000	1.5000		8.40
Feedline Bracket (Af)	B	No	No	Af (CaAa)	172.50 - 8.00	-7.0000	0.4	1	1	1.5000	1.5000		8.40
Feedline Bracket (Af) ***	C	No	No	Af (CaAa)	160.00 - 8.00	-7.0000	0.4	1	1	1.5000	1.5000		8.40
LDF5-50A(7/8) ***	B	No	No	Ar (CaAa)	180.00 - 8.00	-7.0000	0.4	2	2	0.5000	1.0300		0.33
LDF7-50A(1-5/8) ***	C	No	No	Ar (CaAa)	166.50 - 8.00	-10.0000	0.4	12	6	0.5000	1.9800		0.82
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	157.00 - 8.00	-10.0000	0.4	12	6	0.5000	1.9800		0.82
WR-VG86ST-BRD(3/4)	A	No	No	Ar (CaAa)	157.00 - 8.00	-14.0000	0.4	2	2	0.5000	0.7950		0.58
ATCB-B01(5/16) ***	A	No	No	Ar (CaAa)	157.00 - 8.00	-14.0000	0.4	1	1	0.3150	0.3150		0.07
LDF5-50A(7/8) ***Proposed***	B	No	No	Ar (CaAa)	112.00 - 8.00	-7.0000	0.4	1	1	0.5000	1.0300		0.33
E65(ELLIPTICAL)	B	No	No	Ar (CaAa)	124.00 - 0.00	-7.0000	0.42	1	1	0.5000	2.0000		0.67
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	180.00 - 107.25	-7.0000	0.415	1	1	0.5000	1.0300		0.33
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	107.25 - 0.00	-7.0000	0.415	2	2	0.5000	1.0300		0.33

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	180.00-160.00	A	0.000	0.000	0.750	0.000	0.00
		B	0.000	0.000	11.365	0.000	0.13
		C	0.000	0.000	15.444	0.000	0.06
T2	160.00-140.00	A	0.000	0.000	47.380	0.000	0.29
		B	0.000	0.000	13.240	0.000	0.19
		C	0.000	0.000	52.520	0.000	0.36
T3	140.00-120.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	14.040	0.000	0.20
		C	0.000	0.000	52.520	0.000	0.36
T4	120.00-100.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	18.476	0.000	0.21
		C	0.000	0.000	52.520	0.000	0.36
T5	100.00-80.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	19.300	0.000	0.21
		C	0.000	0.000	52.520	0.000	0.36
T6	80.00-60.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	19.300	0.000	0.21
		C	0.000	0.000	52.520	0.000	0.36
T7	60.00-40.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	19.300	0.000	0.21
		C	0.000	0.000	52.520	0.000	0.36

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
T8	40.00-20.00	A	0.000	0.000	57.080	0.000	0.39
		B	0.000	0.000	19.300	0.000	0.21
		C	0.000	0.000	52.520	0.000	0.36
T9	20.00-0.00	A	0.000	0.000	34.248	0.000	0.24
		B	0.000	0.000	14.828	0.000	0.14
		C	0.000	0.000	31.512	0.000	0.22

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	180.00-160.00	A	2.032	0.000	0.000	8.879	0.000	0.12
		B		0.000	0.000	49.991	0.000	0.68
		C		0.000	0.000	16.509	0.000	0.35
T2	160.00-140.00	A	2.007	0.000	0.000	83.503	0.000	1.52
		B		0.000	0.000	54.458	0.000	0.81
		C		0.000	0.000	63.658	0.000	1.44
T3	140.00-120.00	A	1.978	0.000	0.000	99.790	0.000	1.86
		B		0.000	0.000	56.327	0.000	0.84
		C		0.000	0.000	63.355	0.000	1.43
T4	120.00-100.00	A	1.946	0.000	0.000	98.949	0.000	1.83
		B		0.000	0.000	71.043	0.000	1.07
		C		0.000	0.000	63.007	0.000	1.41
T5	100.00-80.00	A	1.907	0.000	0.000	97.958	0.000	1.80
		B		0.000	0.000	73.974	0.000	1.11
		C		0.000	0.000	62.596	0.000	1.39
T6	80.00-60.00	A	1.860	0.000	0.000	96.744	0.000	1.76
		B		0.000	0.000	72.743	0.000	1.07
		C		0.000	0.000	62.093	0.000	1.36
T7	60.00-40.00	A	1.798	0.000	0.000	95.168	0.000	1.70
		B		0.000	0.000	71.143	0.000	1.03
		C		0.000	0.000	61.441	0.000	1.33
T8	40.00-20.00	A	1.709	0.000	0.000	92.874	0.000	1.63
		B		0.000	0.000	68.815	0.000	0.97
		C		0.000	0.000	60.491	0.000	1.28
T9	20.00-0.00	A	1.531	0.000	0.000	52.995	0.000	0.89
		B		0.000	0.000	49.520	0.000	0.63
		C		0.000	0.000	35.166	0.000	0.72

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	180.00-160.00	-1.5598	3.0617	1.0043	1.3122
T2	160.00-140.00	-3.8233	-3.4482	-0.2957	-0.9442
T3	140.00-120.00	-4.9376	-5.7048	-0.6148	-3.2254
T4	120.00-100.00	-4.9994	-6.1207	0.3120	-3.8200
T5	100.00-80.00	-5.3629	-6.6832	0.6483	-4.6383
T6	80.00-60.00	-6.1173	-7.6408	0.6206	-5.6859
T7	60.00-40.00	-6.2551	-7.7439	0.4831	-6.1100
T8	40.00-20.00	-6.8420	-8.4887	0.2873	-6.8018
T9	20.00-0.00	-3.6031	-5.2262	1.9022	-3.8042

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	Safety Line 3/8	160.00 - 180.00	0.6000	0.4462
T1	4	Feedline Bracket (Af)	160.00 - 172.50	0.6000	0.4462
T1	7	LDF5-50A(7/8)	160.00 - 180.00	0.6000	0.4462
T1	9	LDF7-50A(1-5/8)	160.00 - 166.50	0.6000	0.4462
T1	18	LDF5-50A(7/8)	160.00 - 180.00	0.6000	0.4462
T2	1	Safety Line 3/8	140.00 - 160.00	0.6000	0.2144
T2	3	Feedline Bracket (Af)	140.00 - 152.00	0.6000	0.2144
T2	4	Feedline Bracket (Af)	140.00 - 160.00	0.6000	0.2144
T2	5	Feedline Bracket (Af)	140.00 - 160.00	0.6000	0.2144
T2	7	LDF5-50A(7/8)	140.00 - 160.00	0.6000	0.2144
T2	9	LDF7-50A(1-5/8)	140.00 - 160.00	0.6000	0.2144
T2	11	LDF7-50A(1-5/8)	140.00 - 157.00	0.6000	0.2144
T2	12	WR-VG86ST-BRD(3/4)	140.00 - 157.00	0.6000	0.2144
T2	13	ATCB-B01(5/16)	140.00 - 157.00	0.6000	0.2144
T2	18	LDF5-50A(7/8)	140.00 - 160.00	0.6000	0.2144
T3	1	Safety Line 3/8	120.00 - 140.00	0.6000	0.4028
T3	3	Feedline Bracket (Af)	120.00 - 140.00	0.6000	0.4028
T3	4	Feedline Bracket (Af)	120.00 - 140.00	0.6000	0.4028
T3	5	Feedline Bracket (Af)	120.00 - 140.00	0.6000	0.4028
T3	7	LDF5-50A(7/8)	120.00 - 140.00	0.6000	0.4028
T3	9	LDF7-50A(1-5/8)	120.00 - 140.00	0.6000	0.4028
T3	11	LDF7-50A(1-5/8)	120.00 - 140.00	0.6000	0.4028
T3	12	WR-VG86ST-BRD(3/4)	120.00 - 140.00	0.6000	0.4028
T3	13	ATCB-B01(5/16)	120.00 - 140.00	0.6000	0.4028
T3	17	E65(ELLIPTICAL)	120.00 - 124.00	0.6000	0.4028
T3	18	LDF5-50A(7/8)	120.00 - 140.00	0.6000	0.4028
T4	1	Safety Line 3/8	100.00 - 120.00	0.6000	0.5011
T4	3	Feedline Bracket (Af)	100.00 - 120.00	0.6000	0.5011
T4	4	Feedline Bracket (Af)	100.00 - 120.00	0.6000	0.5011
T4	5	Feedline Bracket (Af)	100.00 - 120.00	0.6000	0.5011
T4	7	LDF5-50A(7/8)	100.00 - 120.00	0.6000	0.5011
T4	9	LDF7-50A(1-5/8)	100.00 - 120.00	0.6000	0.5011
T4	11	LDF7-50A(1-5/8)	100.00 - 120.00	0.6000	0.5011
T4	12	WR-VG86ST-BRD(3/4)	100.00 - 120.00	0.6000	0.5011
T4	13	ATCB-B01(5/16)	100.00 -	0.6000	0.5011

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
			120.00		
T4	15	LDF5-50A(7/8)	100.00 - 112.00	0.6000	0.5011
T4	17	E65(ELLIPTICAL)	100.00 - 120.00	0.6000	0.5011
T4	18	LDF5-50A(7/8)	107.25 - 120.00	0.6000	0.5011
T4	19	LDF5-50A(7/8)	100.00 - 107.25	0.6000	0.5011
T5	1	Safety Line 3/8	80.00 - 100.00	0.6000	0.5583
T5	3	Feedline Bracket (Af)	80.00 - 100.00	0.6000	0.5583
T5	4	Feedline Bracket (Af)	80.00 - 100.00	0.6000	0.5583
T5	5	Feedline Bracket (Af)	80.00 - 100.00	0.6000	0.5583
T5	7	LDF5-50A(7/8)	80.00 - 100.00	0.6000	0.5583
T5	9	LDF7-50A(1-5/8)	80.00 - 100.00	0.6000	0.5583
T5	11	LDF7-50A(1-5/8)	80.00 - 100.00	0.6000	0.5583
T5	12	WR-VG86ST-BRD(3/4)	80.00 - 100.00	0.6000	0.5583
T5	13	ATCB-B01(5/16)	80.00 - 100.00	0.6000	0.5583
T5	15	LDF5-50A(7/8)	80.00 - 100.00	0.6000	0.5583
T5	17	E65(ELLIPTICAL)	80.00 - 100.00	0.6000	0.5583
T5	19	LDF5-50A(7/8)	80.00 - 100.00	0.6000	0.5583
T6	1	Safety Line 3/8	60.00 - 80.00	0.6000	0.6000
T6	3	Feedline Bracket (Af)	60.00 - 80.00	0.6000	0.6000
T6	4	Feedline Bracket (Af)	60.00 - 80.00	0.6000	0.6000
T6	5	Feedline Bracket (Af)	60.00 - 80.00	0.6000	0.6000
T6	7	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T6	9	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T6	11	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T6	12	WR-VG86ST-BRD(3/4)	60.00 - 80.00	0.6000	0.6000
T6	13	ATCB-B01(5/16)	60.00 - 80.00	0.6000	0.6000
T6	15	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T6	17	E65(ELLIPTICAL)	60.00 - 80.00	0.6000	0.6000
T6	19	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T7	1	Safety Line 3/8	40.00 - 60.00	0.6000	0.6000
T7	3	Feedline Bracket (Af)	40.00 - 60.00	0.6000	0.6000
T7	4	Feedline Bracket (Af)	40.00 - 60.00	0.6000	0.6000
T7	5	Feedline Bracket (Af)	40.00 - 60.00	0.6000	0.6000
T7	7	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T7	9	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T7	11	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T7	12	WR-VG86ST-BRD(3/4)	40.00 - 60.00	0.6000	0.6000
T7	13	ATCB-B01(5/16)	40.00 - 60.00	0.6000	0.6000
T7	15	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T7	17	E65(ELLIPTICAL)	40.00 - 60.00	0.6000	0.6000
T7	19	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T8	1	Safety Line 3/8	20.00 - 40.00	0.6000	0.6000
T8	3	Feedline Bracket (Af)	20.00 - 40.00	0.6000	0.6000
T8	4	Feedline Bracket (Af)	20.00 - 40.00	0.6000	0.6000
T8	5	Feedline Bracket (Af)	20.00 - 40.00	0.6000	0.6000
T8	7	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T8	9	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T8	11	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T8	12	WR-VG86ST-BRD(3/4)	20.00 - 40.00	0.6000	0.6000
T8	13	ATCB-B01(5/16)	20.00 - 40.00	0.6000	0.6000
T8	15	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T8	17	E65(ELLIPTICAL)	20.00 - 40.00	0.6000	0.6000
T8	19	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T9	1	Safety Line 3/8	8.00 - 20.00	0.6000	0.6000
T9	3	Feedline Bracket (Af)	8.00 - 20.00	0.6000	0.6000
T9	4	Feedline Bracket (Af)	8.00 - 20.00	0.6000	0.6000
T9	5	Feedline Bracket (Af)	8.00 - 20.00	0.6000	0.6000
T9	7	LDF5-50A(7/8)	8.00 - 20.00	0.6000	0.6000
T9	9	LDF7-50A(1-5/8)	8.00 - 20.00	0.6000	0.6000
T9	11	LDF7-50A(1-5/8)	8.00 - 20.00	0.6000	0.6000
T9	12	WR-VG86ST-BRD(3/4)	8.00 - 20.00	0.6000	0.6000
T9	13	ATCB-B01(5/16)	8.00 - 20.00	0.6000	0.6000
T9	15	LDF5-50A(7/8)	8.00 - 20.00	0.6000	0.6000
T9	17	E65(ELLIPTICAL)	0.00 - 20.00	0.6000	0.6000
T9	19	LDF5-50A(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 ft^2	C_AA_A Side ft^2	Weight K
(2) Side Arm Mount [6' SO 311-3]	C	None		0.0000	177.50	No Ice	14.56	14.56	0.37
						1/2" Ice	21.86	21.86	0.57
						1" Ice	29.16	29.16	0.76
							43.76	43.76	1.15

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*
						2" Ice			
(2) Side Arm Mount [SO 311-3]	C	None		0.0000	177.50	No Ice 1/2" Ice 1" Ice 2" Ice	7.28 10.93 14.58 21.88	7.28 10.93 14.58 21.88	0.19 0.28 0.38 0.57
5' Hor x 3.5" Square Tube	A	From Face	0.50 0.00 0.00	0.0000	179.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
5' Hor x 3.5" Square Tube	B	From Face	0.50 0.00 0.00	0.0000	179.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
5' Hor x 3.5" Square Tube	C	From Face	0.50 0.00 0.00	0.0000	179.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
5' Hor x 3.5" Square Tube	A	From Face	0.50 0.00 0.00	0.0000	175.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
5' Hor x 3.5" Square Tube	B	From Face	0.50 0.00 0.00	0.0000	175.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
5' Hor x 3.5" Square Tube	C	From Face	0.50 0.00 0.00	0.0000	175.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.75 2.11 2.47 3.22	0.10 0.14 0.19 0.32	0.04 0.06 0.08 0.14
2" Dia 20' Omni	C	From Face	6.00 0.00 12.00	0.0000	177.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.00 6.03 8.07 12.20	4.00 6.03 8.07 12.20	0.02 0.05 0.10 0.22
CO-41A	B	From Face	6.00 0.00 8.00	0.0000	177.50	No Ice 1/2" Ice 1" Ice 2" Ice	3.15 4.38 5.63 7.77	3.15 4.38 5.63 7.77	0.01 0.04 0.07 0.15
***									
Sector Mount [SM 407-3]	C	None		0.0000	167.00	No Ice 1/2" Ice 1" Ice 2" Ice	20.49 30.39 40.29 60.09	20.49 30.39 40.29 60.09	0.96 1.38 1.80 2.64
Pipe Mount [PM 602-3]	C	None		0.0000	167.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.68 9.50 11.32 14.96	7.68 9.50 11.32 14.96	0.28 0.35 0.43 0.58
(2) LPA-80063/6CF w/ Mount Pipe	A	From Leg	4.00 0.00 2.00	0.0000	167.00	No Ice 1/2" Ice 1" Ice 2" Ice	9.83 10.40 10.93 12.03	10.22 11.38 12.27 14.09	0.05 0.14 0.25 0.48
(2) LPA-80063/6CF w/ Mount Pipe	B	From Leg	4.00 0.00 2.00	0.0000	167.00	No Ice 1/2" Ice	9.83 10.40 10.93	10.22 11.38 12.27	0.05 0.14 0.25

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* ft ft ft	*Azimuth Adjustment* °	*Placement* ft		C_AA_A *Front* ft^2	C_AA_A *Side* ft^2	*Weight* K
						1" Ice			
						2" Ice	12.03	14.09	0.48
(2) LPA-80063/6CF w/ Mount Pipe	C	From Leg	4.00	0.0000	167.00	No Ice	9.83	10.22	0.05
			0.00			1/2" Ice	10.40	11.38	0.14
			2.00			1" Ice	10.93	12.27	0.25
						2" Ice	12.03	14.09	0.48
BXA-70080/6CF w/ Mount Pipe	A	From Leg	4.00	0.0000	167.00	No Ice	5.22	5.32	0.06
			-2.00			1/2" Ice	5.91	6.02	0.11
			2.00			1" Ice	6.62	6.73	0.17
						2" Ice	8.10	8.21	0.32
BXA-70080/6CF w/ Mount Pipe	B	From Leg	4.00	0.0000	167.00	No Ice	5.22	5.32	0.06
			-2.00			1/2" Ice	5.91	6.02	0.11
			2.00			1" Ice	6.62	6.73	0.17
						2" Ice	8.10	8.21	0.32
BXA-70080/6CF w/ Mount Pipe	C	From Leg	4.00	0.0000	167.00	No Ice	5.22	5.32	0.06
			-2.00			1/2" Ice	5.91	6.02	0.11
			2.00			1" Ice	6.62	6.73	0.17
						2" Ice	8.10	8.21	0.32
BXA-171085-12BF w/ Mount Pipe	A	From Leg	4.00	0.0000	167.00	No Ice	4.97	5.23	0.04
			2.00			1/2" Ice	5.52	6.39	0.09
			2.00			1" Ice	6.04	7.26	0.14
						2" Ice	7.09	9.05	0.27
BXA-171085-12BF w/ Mount Pipe	B	From Leg	4.00	0.0000	167.00	No Ice	4.97	5.23	0.04
			2.00			1/2" Ice	5.52	6.39	0.09
			2.00			1" Ice	6.04	7.26	0.14
						2" Ice	7.09	9.05	0.27
BXA-171085-12BF w/ Mount Pipe	C	From Leg	4.00	0.0000	167.00	No Ice	4.97	5.23	0.04
			2.00			1/2" Ice	5.52	6.39	0.09
			2.00			1" Ice	6.04	7.26	0.14
						2" Ice	7.09	9.05	0.27
Diplexer	A	From Leg	4.00	0.0000	167.00	No Ice	0.29	0.10	0.01
			0.00			1/2" Ice	0.36	0.14	0.01
			0.00			1" Ice	0.44	0.19	0.01
						2" Ice	0.62	0.32	0.02
Diplexer	B	From Leg	4.00	0.0000	167.00	No Ice	0.29	0.10	0.01
			0.00			1/2" Ice	0.36	0.14	0.01
			0.00			1" Ice	0.44	0.19	0.01
						2" Ice	0.62	0.32	0.02
Diplexer	C	From Leg	4.00	0.0000	167.00	No Ice	0.29	0.10	0.01
			0.00			1/2" Ice	0.36	0.14	0.01
			0.00			1" Ice	0.44	0.19	0.01
						2" Ice	0.62	0.32	0.02
***									
Sector Mount [SM 407-3]	C	None		0.0000	157.00	No Ice	20.49	20.49	0.96
						1/2" Ice	30.39	30.39	1.38
						1" Ice	40.29	40.29	1.80
						2" Ice	60.09	60.09	2.64
Pipe Mount [PM 602-3]	C	None		0.0000	157.00	No Ice	7.68	7.68	0.28
						1/2" Ice	9.50	9.50	0.35
						1" Ice	11.32	11.32	0.43
						2" Ice	14.96	14.96	0.58
8'x2" Antenna Mount Pipe	A	From Leg	4.00	0.0000	157.00	No Ice	1.90	1.90	0.03
			-2.00			1/2"	2.73	2.73	0.04

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
			0.00			Ice	3.40	3.40	0.06
						1" Ice	4.40	4.40	0.12
						2" Ice			
8'x2" Antenna Mount Pipe	B	From Leg	4.00	0.0000	157.00	No Ice	1.90	1.90	0.03
			-2.00			1/2"	2.73	2.73	0.04
			0.00			Ice	3.40	3.40	0.06
						1" Ice	4.40	4.40	0.12
						2" Ice			
8'x2" Antenna Mount Pipe	C	From Leg	4.00	0.0000	157.00	No Ice	1.90	1.90	0.03
			-2.00			1/2"	2.73	2.73	0.04
			0.00			Ice	3.40	3.40	0.06
						1" Ice	4.40	4.40	0.12
						2" Ice			
AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	A	From Leg	4.00	0.0000	157.00	No Ice	8.26	6.36	0.07
			2.00			1/2"	8.82	7.54	0.14
			1.00			Ice	9.35	8.43	0.21
						1" Ice	10.42	10.24	0.39
						2" Ice			
AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	B	From Leg	4.00	0.0000	157.00	No Ice	8.26	6.36	0.07
			2.00			1/2"	8.82	7.54	0.14
			1.00			Ice	9.35	8.43	0.21
						1" Ice	10.42	10.24	0.39
						2" Ice			
AM-X-CD-16-65-00T-RET_TIA w/ Mount Pipe	C	From Leg	4.00	0.0000	157.00	No Ice	8.26	6.36	0.07
			2.00			1/2"	8.82	7.54	0.14
			1.00			Ice	9.35	8.43	0.21
						1" Ice	10.42	10.24	0.39
						2" Ice			
(2) 7770.00 w/ Mount Pipe	A	From Leg	4.00	0.0000	157.00	No Ice	5.75	4.25	0.06
			0.00			1/2"	6.18	5.01	0.11
			1.00			Ice	6.61	5.71	0.16
						1" Ice	7.49	7.16	0.29
						2" Ice			
(2) 7770.00 w/ Mount Pipe	B	From Leg	4.00	0.0000	157.00	No Ice	5.75	4.25	0.06
			0.00			1/2"	6.18	5.01	0.11
			1.00			Ice	6.61	5.71	0.16
						1" Ice	7.49	7.16	0.29
						2" Ice			
(2) 7770.00 w/ Mount Pipe	C	From Leg	4.00	0.0000	157.00	No Ice	5.75	4.25	0.06
			0.00			1/2"	6.18	5.01	0.11
			1.00			Ice	6.61	5.71	0.16
						1" Ice	7.49	7.16	0.29
						2" Ice			
(2) 7020.00 : RET	A	From Leg	4.00	0.0000	157.00	No Ice	0.34	0.18	0.00
			0.00			1/2"	0.42	0.24	0.01
			0.00			Ice	0.51	0.31	0.01
						1" Ice	0.70	0.47	0.02
						2" Ice			
(2) 7020.00 : RET	B	From Leg	4.00	0.0000	157.00	No Ice	0.34	0.18	0.00
			0.00			1/2"	0.42	0.24	0.01
			0.00			Ice	0.51	0.31	0.01
						1" Ice	0.70	0.47	0.02
						2" Ice			
(2) 7020.00 : RET	C	From Leg	4.00	0.0000	157.00	No Ice	0.34	0.18	0.00
			0.00			1/2"	0.42	0.24	0.01
			0.00			Ice	0.51	0.31	0.01
						1" Ice	0.70	0.47	0.02
						2" Ice			
(2) LGP18601	A	From Leg	4.00	0.0000	157.00	No Ice	0.60	0.25	0.01
			0.00			1/2"	0.70	0.33	0.01
			0.00			Ice	0.81	0.41	0.02
						1" Ice	1.04	0.60	0.04
						2" Ice			
(2) LGP18601	B	From Leg	4.00	0.0000	157.00	No Ice	0.60	0.25	0.01
			0.00			1/2"	0.70	0.33	0.01

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*
			0.00			Ice	0.81	0.41	0.02
						1" Ice	1.04	0.60	0.04
						2" Ice			
(2) LGP18601	C	From Leg	4.00	0.0000	157.00	No Ice	0.60	0.25	0.01
			0.00			1/2"	0.70	0.33	0.01
			0.00			Ice	0.81	0.41	0.02
						1" Ice	1.04	0.60	0.04
						2" Ice			
RRUS 11	A	From Leg	4.00	0.0000	157.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07
			0.00			Ice	3.21	1.49	0.10
						1" Ice	3.66	1.83	0.15
						2" Ice			
RRUS 11	B	From Leg	4.00	0.0000	157.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07
			0.00			Ice	3.21	1.49	0.10
						1" Ice	3.66	1.83	0.15
						2" Ice			
RRUS 11	C	From Leg	4.00	0.0000	157.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07
			0.00			Ice	3.21	1.49	0.10
						1" Ice	3.66	1.83	0.15
						2" Ice			
DC6-48-60-18-8F	C	From Leg	0.50	0.0000	157.00	No Ice	0.92	0.92	0.02
			0.00			1/2"	1.46	1.46	0.04
			-6.00			Ice	1.64	1.64	0.06
						1" Ice	2.04	2.04	0.11
						2" Ice			
***									
Side Arm Mount [SO 301-1]	C	From Leg	0.00	0.0000	112.00	No Ice	1.00	0.90	0.02
			0.00			1/2"	1.39	1.42	0.03
			0.00			Ice	1.78	1.94	0.04
						1" Ice	2.56	2.98	0.06
						2" Ice			
20' x 2.5" Omni	C	From Leg	2.00	0.0000	112.00	No Ice	5.00	5.00	0.05
			0.00			1/2"	7.03	7.03	0.09
			10.00			Ice	9.06	9.06	0.12
						1" Ice	13.12	13.12	0.20
						2" Ice			
Proposed									
DCP12K Clamp Set	B	From Leg	6.00	0.0000	180.00	No Ice	0.00	0.00	0.00
			0.00			1/2"	0.00	0.00	0.00
			0.00			Ice	0.00	0.00	0.00
						1" Ice	0.00	0.00	0.00
						2" Ice			
871F-70-2	B	From Leg	6.00	0.0000	180.00	No Ice	1.04	1.80	0.01
			0.00			1/2"	1.62	3.21	0.03
			2.75			Ice	2.19	4.63	0.04
						1" Ice	3.34	7.46	0.08
						2" Ice			
***									
R5-LL [PM 602-1]	A	From Leg	0.50	0.0000	124.00	No Ice	5.25	1.58	0.09
			0.00			1/2"	6.50	1.95	0.12
			0.00			Ice	7.75	2.32	0.14
						1" Ice	10.25	3.06	0.19
						2" Ice			
***									
USF-4U [4' SO 203-1 + Vert. Pipe Support]	B	From Leg	2.00	0.0000	107.25	No Ice	2.96	5.64	0.18
			0.00			1/2"	3.76	6.73	0.22
			0.00			Ice	4.63	7.91	0.28
						1" Ice	6.57	10.43	0.43
						2" Ice			
871F-70-2	B	From Leg	4.00	90.0000	107.25	No Ice	1.04	1.80	0.01
			0.00			1/2"	1.62	3.21	0.03
			3.00			Ice	2.19	4.63	0.04

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
						1" Ice	3.34	7.46	0.08
						2" Ice			

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft²	Weight K
PAD6-W59BC	A	Paraboloid w/Radome	From Leg	1.00 0.00 0.00	10.5000		124.00	6.58	No Ice 1/2" Ice 1" Ice 2" Ice	34.04 34.91 35.77 37.51	0.14 0.29 0.47 0.83

Truss-Leg Properties

Section Designation	Area in²	Area Ice in²	Self Weight K	Ice Weight K	Equiv. Diameter in	Equiv. Diameter Ice in	Leg Area in²
BV_Valmont 195554	1956.3096	6735.2308	0.47	1.49	6.7927	23.3862	3.6816
BV_Valmont 195554	1956.3096	6710.0229	0.47	1.45	6.7927	23.2987	3.6816
Valmont 195555	2091.5938	6753.0482	0.59	1.44	7.2625	23.4481	5.3014
BV_Valmont 195557	2262.7455	6790.8768	0.74	1.45	7.8568	23.5794	7.2158
BV_Valmont 195557	2262.7455	6749.0373	0.74	1.39	7.8568	23.4342	7.2158
BV_Valmont 195546	1577.1390	3965.4416	1.04	0.79	10.9524	27.5378	9.4248
BV_Valmont 195546	1577.1390	3912.0702	1.04	0.73	10.9524	27.1672	9.4248
BV_Valmont 195560	2596.8716	6602.3322	1.12	1.08	9.0169	22.9248	11.9282

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

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

Maximum 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	180 - 160	Leg	Max Tension	15	17.10	-0.00	0.02
			Max. Compression	2	-19.97	-0.00	0.07
			Max. Mx	20	-0.66	-0.29	-0.00
			Max. My	14	-5.24	-0.00	0.28
			Max. Vy	20	0.90	0.18	0.02
			Max. Vx	14	-0.91	0.00	-0.20
		Diagonal	Max Tension	9	2.46	0.00	0.00
			Max. Compression	8	-2.55	0.00	0.00
			Max. Mx	31	0.62	-0.01	0.00
			Max. My	20	-1.05	-0.00	-0.00
			Max. Vy	31	0.01	-0.01	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Horizontal	Max Tension	14	0.62	0.00	0.00
			Max. Compression	3	-0.45	0.00	0.00
			Max. Mx	26	0.37	0.02	0.00
			Max. Vy	26	-0.02	0.00	0.00
		Top Girt	Max Tension	23	0.26	0.00	0.00
			Max. Compression	10	-0.28	0.00	0.00
			Max. Mx	26	-0.04	0.02	0.00
			Max. Vy	26	-0.02	0.00	0.00
T2	160 - 140	Leg	Max Tension	15	39.25	-2.90	0.00
			Max. Compression	2	-45.64	2.51	0.02

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Mx	14	23.73	-2.95	0.01
			Max. My	5	-2.03	-0.14	-3.31
			Max. Vy	14	0.65	-2.95	0.01
			Max. Vx	8	-0.69	-0.19	3.22
		Diagonal	Max Tension	24	5.06	0.00	0.00
			Max. Compression	24	-5.04	0.00	0.00
			Max. Mx	31	1.54	0.06	0.01
			Max. My	29	-1.86	0.02	-0.01
			Max. Vy	29	0.03	0.05	0.01
			Max. Vx	29	0.00	0.00	0.00
		Top Girt	Max Tension	14	0.40	0.00	0.00
			Max. Compression	3	-0.29	0.00	0.00
			Max. Mx	26	0.07	-0.03	0.00
			Max. My	26	0.23	0.00	0.00
			Max. Vy	26	0.03	0.00	0.00
			Max. Vx	26	-0.00	0.00	0.00
T3	140 - 120	Leg	Max Tension	15	64.70	-2.88	-0.04
			Max. Compression	2	-73.91	3.09	0.02
			Max. Mx	2	-73.91	3.09	0.02
			Max. My	20	-4.15	-0.11	-3.16
			Max. Vy	14	0.33	-3.08	-0.07
			Max. Vx	19	0.34	-1.52	-2.47
		Diagonal	Max Tension	13	4.56	0.00	0.00
			Max. Compression	12	-4.66	0.00	0.00
			Max. Mx	27	0.96	0.07	-0.01
			Max. My	34	1.21	0.06	0.01
			Max. Vy	29	0.04	0.06	-0.01
			Max. Vx	34	-0.00	0.00	0.00
T4	120 - 100	Leg	Max Tension	15	88.49	-2.84	-0.01
			Max. Compression	2	-100.44	3.21	0.01
			Max. Mx	3	-98.90	3.22	0.01
			Max. My	12	-6.36	-0.01	-3.20
			Max. Vy	14	0.16	-3.21	-0.02
			Max. Vx	24	-0.24	-0.03	2.91
		Diagonal	Max Tension	12	4.90	0.00	0.00
			Max. Compression	12	-4.88	0.00	0.00
			Max. Mx	29	1.12	0.08	-0.01
			Max. My	28	1.25	0.08	-0.01
			Max. Vy	29	0.05	0.08	-0.01
			Max. Vx	28	0.00	0.00	0.00
T5	100 - 80	Leg	Max Tension	15	110.65	-3.00	-0.02
			Max. Compression	2	-125.81	3.13	0.01
			Max. Mx	3	-111.49	3.22	0.01
			Max. My	12	-6.87	-0.01	-3.20
			Max. Vy	14	-0.14	-3.21	-0.02
			Max. Vx	8	0.18	-0.03	3.15
		Diagonal	Max Tension	12	4.98	0.00	0.00
			Max. Compression	12	-5.04	0.00	0.00
			Max. Mx	29	1.15	0.12	-0.02
			Max. My	37	-1.56	0.10	-0.02
			Max. Vy	29	0.07	0.12	-0.02
			Max. Vx	37	0.00	0.00	0.00
T6	80 - 60	Leg	Max Tension	15	130.97	-2.73	-0.01
			Max. Compression	2	-149.66	3.99	0.09
			Max. Mx	2	-149.66	3.99	0.09
			Max. My	13	-7.63	0.03	-3.57
			Max. Vy	11	-0.23	3.90	0.15
			Max. Vx	21	0.16	-0.02	-3.49
		Diagonal	Max Tension	12	5.13	0.00	0.00
			Max. Compression	12	-5.21	0.00	0.00
			Max. Mx	29	1.17	0.15	-0.02
			Max. My	37	1.15	0.15	-0.02
			Max. Vy	29	0.08	0.15	-0.02
			Max. Vx	37	0.00	0.00	0.00
T7	60 - 40	Leg	Max Tension	15	150.37	-2.97	-0.00
			Max. Compression	2	-173.59	3.23	0.01
			Max. Mx	2	-161.08	3.99	0.09
			Max. My	13	-8.01	0.03	-3.57
			Max. Vy	14	-0.23	-3.86	-0.11

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vx	21	-0.22	-0.02	-3.49
		Diagonal	Max Tension	12	5.57	0.00	0.00
			Max. Compression	12	-5.65	0.00	0.00
			Max. Mx	29	1.29	0.20	-0.03
			Max. My	37	-1.76	0.18	-0.03
			Max. Vy	29	0.10	0.20	-0.03
			Max. Vx	37	0.01	0.00	0.00
T8	40 - 20	Leg	Max Tension	15	168.74	-2.95	-0.01
			Max. Compression	2	-196.79	3.76	0.03
			Max. Mx	29	18.52	-5.92	0.02
			Max. My	13	-10.29	-0.10	-3.40
			Max. Vy	33	0.75	-5.91	-0.00
			Max. Vx	20	-0.21	-0.16	-3.21
		Diagonal	Max Tension	12	5.89	0.00	0.00
			Max. Compression	12	-6.05	0.00	0.00
			Max. Mx	29	2.16	0.23	-0.03
			Max. My	37	2.11	0.23	-0.03
			Max. Vy	29	0.11	0.23	-0.03
			Max. Vx	37	0.01	0.00	0.00
T9	20 - 0	Leg	Max Tension	15	186.09	-3.16	-0.01
			Max. Compression	2	-219.14	0.00	-0.00
			Max. Mx	27	-117.78	8.70	-0.01
			Max. My	13	-12.15	-0.22	-5.23
			Max. Vy	33	-1.32	-5.91	-0.00
			Max. Vx	13	-0.62	-0.22	-5.23
		Diagonal	Max Tension	15	6.59	0.00	0.00
			Max. Compression	10	-7.28	0.00	0.00
			Max. Mx	37	-0.90	0.31	-0.03
			Max. My	30	5.33	0.23	0.04
			Max. Vy	37	0.13	0.31	-0.03
			Max. Vx	30	-0.01	0.00	0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	18	212.95	18.93	-11.08
	Max. H_x	18	212.95	18.93	-11.08
	Max. H_z	7	-176.48	-15.92	9.32
	Min. Vert	7	-176.48	-15.92	9.32
	Min. H_x	7	-176.48	-15.92	9.32
	Min. H_z	18	212.95	18.93	-11.08
Leg B	Max. Vert	10	220.50	-19.67	-11.80
	Max. H_x	23	-185.29	16.71	10.10
	Max. H_z	23	-185.29	16.71	10.10
	Min. Vert	23	-185.29	16.71	10.10
	Min. H_x	10	220.50	-19.67	-11.80
	Min. H_z	10	220.50	-19.67	-11.80
Leg A	Max. Vert	2	225.20	-0.29	23.27
	Max. H_x	21	11.08	1.78	0.93
	Max. H_z	2	225.20	-0.29	23.27
	Min. Vert	15	-190.70	0.30	-20.01
	Min. H_x	8	16.09	-1.79	1.35
	Min. H_z	15	-190.70	0.30	-20.01

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

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	40.58	0.00	0.00	-4.03	4.06	0.00
1.2 Dead+1.0 Wind 0 deg - No Ice	48.69	0.00	-35.17	-3619.42	4.10	-9.84
0.9 Dead+1.0 Wind 0 deg - No Ice	36.52	0.00	-35.17	-3618.21	2.89	-9.84
1.2 Dead+1.0 Wind 30 deg - No Ice	48.69	16.27	-28.25	-2954.28	-1692.70	-4.36
0.9 Dead+1.0 Wind 30 deg - No Ice	36.52	16.27	-28.25	-2953.07	-1693.91	-4.36
1.2 Dead+1.0 Wind 60 deg - No Ice	48.69	26.98	-15.69	-1650.16	-2819.84	-3.84
0.9 Dead+1.0 Wind 60 deg - No Ice	36.52	26.98	-15.69	-1648.95	-2821.05	-3.84
1.2 Dead+1.0 Wind 90 deg - No Ice	48.69	32.16	0.06	2.52	-3332.79	-13.30
0.9 Dead+1.0 Wind 90 deg - No Ice	36.52	32.16	0.06	3.73	-3334.01	-13.30
1.2 Dead+1.0 Wind 120 deg - No Ice	48.69	29.97	17.51	1786.92	-3053.75	-13.13
0.9 Dead+1.0 Wind 120 deg - No Ice	36.52	29.97	17.51	1788.13	-3054.97	-13.13
1.2 Dead+1.0 Wind 150 deg - No Ice	48.69	17.11	29.90	3087.31	-1760.97	2.18
0.9 Dead+1.0 Wind 150 deg - No Ice	36.52	17.11	29.90	3088.52	-1762.19	2.18
1.2 Dead+1.0 Wind 180 deg - No Ice	48.69	-0.04	33.75	3512.73	9.77	10.61
0.9 Dead+1.0 Wind 180 deg - No Ice	36.52	-0.04	33.75	3513.94	8.55	10.61
1.2 Dead+1.0 Wind 210 deg - No Ice	48.69	-16.33	28.38	2958.62	1709.14	4.06
0.9 Dead+1.0 Wind 210 deg - No Ice	36.52	-16.33	28.38	2959.83	1707.92	4.06
1.2 Dead+1.0 Wind 240 deg - No Ice	48.69	-28.51	16.64	1714.81	2944.34	3.99
0.9 Dead+1.0 Wind 240 deg - No Ice	36.52	-28.51	16.64	1716.02	2943.12	3.99
1.2 Dead+1.0 Wind 270 deg - No Ice	48.69	-32.18	0.18	17.73	3341.75	13.37
0.9 Dead+1.0 Wind 270 deg - No Ice	36.52	-32.18	0.18	18.94	3340.53	13.37
1.2 Dead+1.0 Wind 300 deg - No Ice	48.69	-28.58	-16.48	-1710.27	2963.83	13.64
0.9 Dead+1.0 Wind 300 deg - No Ice	36.52	-28.58	-16.48	-1709.06	2962.61	13.64
1.2 Dead+1.0 Wind 330 deg - No Ice	48.69	-16.97	-29.62	-3062.24	1754.09	-1.79
0.9 Dead+1.0 Wind 330 deg - No Ice	36.52	-16.97	-29.62	-3061.03	1752.87	-1.79
1.2 Dead+1.0 Ice+1.0 Temp	141.51	0.00	0.00	-22.47	6.28	0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	141.51	0.00	-11.36	-1237.37	5.37	0.85
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	141.51	5.53	-9.60	-1057.43	-589.29	1.32
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	141.51	9.44	-5.48	-614.92	-1012.17	0.50
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	141.51	11.01	0.01	-21.96	-1176.29	-2.39
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	141.51	9.69	5.64	576.13	-1020.94	-3.57
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	141.51	5.57	9.72	1013.44	-586.50	-1.92
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	141.51	-0.01	11.11	1166.57	7.91	-0.71
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	141.51	-5.49	9.55	1001.82	595.45	-1.37
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	141.51	-9.56	5.56	572.27	1026.27	-0.48
1.2 Dead+1.0 Wind 270	141.51	-10.93	0.03	-17.77	1173.58	2.40

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
deg+1.0 Ice+1.0 Temp						
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	141.51	-9.53	-5.50	-609.13	1021.48	3.66
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	141.51	-5.55	-9.67	-1052.34	596.17	1.98
Dead+Wind 0 deg - Service	40.58	0.00	-8.10	-836.83	3.88	-2.27
Dead+Wind 30 deg - Service	40.58	3.75	-6.51	-683.58	-387.06	-1.01
Dead+Wind 60 deg - Service	40.58	6.22	-3.62	-383.11	-646.75	-0.88
Dead+Wind 90 deg - Service	40.58	7.41	0.01	-2.33	-764.94	-3.06
Dead+Wind 120 deg - Service	40.58	6.90	4.03	408.79	-700.65	-3.02
Dead+Wind 150 deg - Service	40.58	3.94	6.89	708.40	-402.79	0.50
Dead+Wind 180 deg - Service	40.58	-0.01	7.78	806.42	5.19	2.45
Dead+Wind 210 deg - Service	40.58	-3.76	6.54	678.75	396.72	0.93
Dead+Wind 240 deg - Service	40.58	-6.57	3.83	392.18	681.31	0.92
Dead+Wind 270 deg - Service	40.58	-7.41	0.04	1.17	772.88	3.08
Dead+Wind 300 deg - Service	40.58	-6.59	-3.80	-396.96	685.80	3.14
Dead+Wind 330 deg - Service	40.58	-3.91	-6.82	-708.45	407.08	-0.41

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	0.00	-40.58	0.00	0.00	40.58	0.00	0.000%
2	0.00	-48.69	-35.17	-0.00	48.69	35.17	0.000%
3	0.00	-36.52	-35.17	-0.00	36.52	35.17	0.000%
4	16.27	-48.69	-28.25	-16.27	48.69	28.25	0.000%
5	16.27	-36.52	-28.25	-16.27	36.52	28.25	0.000%
6	26.98	-48.69	-15.69	-26.98	48.69	15.69	0.000%
7	26.98	-36.52	-15.69	-26.98	36.52	15.69	0.000%
8	32.16	-48.69	0.06	-32.16	48.69	-0.06	0.000%
9	32.16	-36.52	0.06	-32.16	36.52	-0.06	0.000%
10	29.97	-48.69	17.51	-29.97	48.69	-17.51	0.000%
11	29.97	-36.52	17.51	-29.97	36.52	-17.51	0.000%
12	17.11	-48.69	29.90	-17.11	48.69	-29.90	0.000%
13	17.11	-36.52	29.90	-17.11	36.52	-29.90	0.000%
14	-0.04	-48.69	33.75	0.04	48.69	-33.75	0.000%
15	-0.04	-36.52	33.75	0.04	36.52	-33.75	0.000%
16	-16.33	-48.69	28.38	16.33	48.69	-28.38	0.000%
17	-16.33	-36.52	28.38	16.33	36.52	-28.38	0.000%
18	-28.51	-48.69	16.64	28.51	48.69	-16.64	0.000%
19	-28.51	-36.52	16.64	28.51	36.52	-16.64	0.000%
20	-32.18	-48.69	0.18	32.18	48.69	-0.18	0.000%
21	-32.18	-36.52	0.18	32.18	36.52	-0.18	0.000%
22	-28.58	-48.69	-16.48	28.58	48.69	16.48	0.000%
23	-28.58	-36.52	-16.48	28.58	36.52	16.48	0.000%
24	-16.97	-48.69	-29.62	16.97	48.69	29.62	0.000%
25	-16.97	-36.52	-29.62	16.97	36.52	29.62	0.000%
26	0.00	-141.51	0.00	0.00	141.51	-0.00	0.000%
27	0.00	-141.51	-11.36	-0.00	141.51	11.36	0.000%
28	5.53	-141.51	-9.60	-5.53	141.51	9.60	0.000%
29	9.44	-141.51	-5.48	-9.44	141.51	5.48	0.000%
30	11.01	-141.51	0.01	-11.01	141.51	-0.01	0.000%
31	9.69	-141.51	5.64	-9.69	141.51	-5.64	0.000%
32	5.57	-141.51	9.72	-5.57	141.51	-9.72	0.000%
33	-0.01	-141.51	11.11	0.01	141.51	-11.11	0.000%
34	-5.49	-141.51	9.55	5.49	141.51	-9.55	0.000%
35	-9.56	-141.51	5.56	9.56	141.51	-5.56	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
36	-10.93	-141.51	0.03	10.93	141.51	-0.03	0.000%
37	-9.53	-141.51	-5.50	9.53	141.51	5.50	0.000%
38	-5.55	-141.51	-9.67	5.55	141.51	9.67	0.000%
39	0.00	-40.58	-8.10	-0.00	40.58	8.10	0.000%
40	3.75	-40.58	-6.51	-3.75	40.58	6.51	0.000%
41	6.22	-40.58	-3.62	-6.22	40.58	3.62	0.000%
42	7.41	-40.58	0.01	-7.41	40.58	-0.01	0.000%
43	6.90	-40.58	4.03	-6.90	40.58	-4.03	0.000%
44	3.94	-40.58	6.89	-3.94	40.58	-6.89	0.000%
45	-0.01	-40.58	7.78	0.01	40.58	-7.78	0.000%
46	-3.76	-40.58	6.54	3.76	40.58	-6.54	0.000%
47	-6.57	-40.58	3.83	6.57	40.58	-3.83	0.000%
48	-7.41	-40.58	0.04	7.41	40.58	-0.04	0.000%
49	-6.59	-40.58	-3.80	6.59	40.58	3.80	0.000%
50	-3.91	-40.58	-6.82	3.91	40.58	6.82	0.000%

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	180 - 160	3.590	39	0.1999	0.0119
T2	160 - 140	2.757	39	0.1844	0.0126
T3	140 - 120	2.011	39	0.1575	0.0131
T4	120 - 100	1.410	39	0.1203	0.0111
T5	100 - 80	0.946	39	0.0919	0.0073
T6	80 - 60	0.590	39	0.0702	0.0051
T7	60 - 40	0.325	39	0.0480	0.0031
T8	40 - 20	0.148	39	0.0308	0.0019
T9	20 - 0	0.041	39	0.0135	0.0009

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180.00	DCP12K Clamp Set	39	3.590	0.1999	0.0119	200842
179.50	5' Hor x 3.5'' Square Tube	39	3.569	0.1996	0.0116	200842
177.50	(2) Side Arm Mount [6' SO 311-3]	39	3.484	0.1983	0.0112	200842
175.00	5' Hor x 3.5'' Square Tube	39	3.378	0.1966	0.0114	200842
167.00	Sector Mount [SM 407-3]	39	3.043	0.1907	0.0121	77247
157.00	Sector Mount [SM 407-3]	39	2.638	0.1813	0.0127	45721
124.00	PAD6-W59BC	39	1.518	0.1275	0.0117	33134
112.00	Side Arm Mount [SO 301-1]	39	1.210	0.1075	0.0096	38050
107.25	USF-4U [4' SO 203-1 + Vert. Pipe Support]	39	1.100	0.1009	0.0087	40921

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	180 - 160	15.542	2	0.8684	0.0516
T2	160 - 140	11.929	2	0.7991	0.0545
T3	140 - 120	8.698	2	0.6809	0.0568
T4	120 - 100	6.098	2	0.5197	0.0483

Section No.	*Elevation ft*	*Horz. Deflection in*	*Gov. Load Comb.*	*Tilt °*	*Twist °*
T5	100 - 80	4.094	2	0.3973	0.0319
T6	80 - 60	2.554	2	0.3033	0.0220
T7	60 - 40	1.407	2	0.2074	0.0135
T8	40 - 20	0.639	2	0.1330	0.0084
T9	20 - 0	0.177	2	0.0585	0.0038

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	*Appurtenance*	*Gov. Load Comb.*	*Deflection in*	*Tilt °*	*Twist °*	*Radius of Curvature ft*
180.00	DCP12K Clamp Set	2	15.542	0.8684	0.0516	47435
179.50	5' Hor x 3.5" Square Tube	2	15.450	0.8669	0.0505	47435
177.50	(2) Side Arm Mount [6' SO 311-3]	2	15.083	0.8608	0.0487	47435
175.00	5' Hor x 3.5" Square Tube	2	14.624	0.8532	0.0496	47435
167.00	Sector Mount [SM 407-3]	2	13.169	0.8269	0.0524	18244
157.00	Sector Mount [SM 407-3]	2	11.412	0.7853	0.0553	10733
124.00	PAD6-W59BC	2	6.567	0.5509	0.0509	7675
112.00	Side Arm Mount [SO 301-1]	2	5.233	0.4647	0.0417	8815
107.25	USF-4U [4' SO 203-1 + Vert. Pipe Support]	2	4.760	0.4362	0.0376	9470

Bolt Design Data

Section No.	*Elevation ft*	*Component Type*	*Bolt Grade*	*Bolt Size in*	*Number Of Bolts*	*Maximum Load per Bolt K*	*Allowable Load per Bolt K*	*Ratio Load / Allowable*	*Allowable Ratio*	*Criteria*
T1	180	Leg	A325N	1.0000	6	2.85	54.52	0.052	1.05	Bolt Tension
T2	160	Leg	A325N	1.0000	6	6.54	54.52	0.120	1.05	Bolt Tension
		Diagonal	A325N	1.0000	1	5.06	10.66	0.474	1.05	Member Block Shear
		Top Girt	A325N	1.0000	1	0.40	10.66	0.038	1.05	Member Block Shear
T3	140	Leg	A325N	1.0000	6	10.78	54.52	0.198	1.05	Bolt Tension
		Diagonal	A325N	1.0000	1	4.56	10.66	0.428	1.05	Member Block Shear
T4	120	Leg	A325N	1.0000	6	14.75	54.52	0.271	1.05	Bolt Tension
		Diagonal	A325N	1.0000	1	4.90	10.66	0.459	1.05	Member Block Shear
T5	100	Leg	A325N	1.0000	6	18.44	54.52	0.338	1.05	Bolt Tension
		Diagonal	A325N	1.0000	1	4.98	11.68	0.427	1.05	Member Block Shear
T6	80	Leg	A325N	1.0000	6	21.83	54.52	0.400	1.05	Bolt Tension
		Diagonal	A325N	1.0000	1	5.13	11.68	0.439	1.05	Member Block Shear
T7	60	Leg	A325N	1.2500	6	25.06	87.22	0.287	1.05	Bolt Tension
		Diagonal	A325N	1.2500	1	5.57	20.30	0.274	1.05	Member Block Shear
T8	40	Leg	A325N	1.2500	6	28.12	87.22	0.322	1.05	Bolt Tension
		Diagonal	A325N	1.2500	1	5.89	20.30	0.290	1.05	Member Block Shear
T9	20	Diagonal	A325N	1.2500	1	6.59	23.70	0.278	1.05	Member Block Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	1 1/2	20.00	2.50	80.0 K=1.00	1.7672	-19.97	49.80	0.401 [1]
T2	160 - 140	BV_Valmont 195554	20.03	10.02	45.0 K=1.00	3.6816	-45.64	142.87	0.319 [1]
T3	140 - 120	BV_Valmont 195554	20.03	10.02	45.0 K=1.00	3.6816	-73.91	142.87	0.517 [1]
T4	120 - 100	Valmont 195555	20.03	10.02	37.5 K=1.00	5.3014	-100.44	215.25	0.467 [1]
T5	100 - 80	BV_Valmont 195557	20.03	10.02	31.9 K=1.00	7.2158	-125.81	301.49	0.417 [1]
T6	80 - 60	BV_Valmont 195557	20.03	10.02	31.9 K=1.00	7.2158	-149.66	301.49	0.496 [1]
T7	60 - 40	BV_Valmont 195546	20.03	10.02	27.8 K=1.00	9.4248	-173.59	400.89	0.433 [1]
T8	40 - 20	BV_Valmont 195546	20.03	10.02	27.8 K=1.00	9.4248	-196.79	400.89	0.491 [1]
T9	20 - 0	BV_Valmont 195560	20.03	10.02	24.7 K=1.00	11.928 2	-219.14	513.41	0.427 [1]

[1] P_u / ϕP_n controls

Truss-Leg Diagonal Data

Section No.	Elevation ft	Diagonal Size	L_d ft	Kl/r	ϕP_n K	A in^2	V_u K	ϕV_n K	Stress Ratio
T2	160 - 140	0.4375	1.48	137.6	165.67	0.1503	0.71	2.02	0.352
T3	140 - 120	0.4375	1.48	137.6	165.67	0.1503	0.39	2.02	0.192
T4	120 - 100	0.4375	1.46	136.4	238.57	0.1503	0.24	2.05	0.116
T5	100 - 80	0.5	1.44	117.6	324.71	0.1963	0.19	3.47	0.054
T6	80 - 60	0.5	1.44	117.6	324.71	0.1963	0.23	3.47	0.067
T7	60 - 40	0.5	1.43	116.3	424.12	0.1963	0.24	3.54	0.069
T8	40 - 20	0.5	1.43	116.3	424.12	0.1963	0.75	3.54	0.212
T9	20 - 0	0.625	1.41	92.3	536.77	0.3068	1.32	7.20	0.184

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	3/4	4.72	2.28	131.6 K=0.90	0.4418	-2.55	5.76	0.442 [1]
T2	160 - 140	L2 1/2x2 1/2x3/16	11.42	4.98	120.8 K=1.00	0.9020	-5.04	17.58	0.287 [1]
T3	140 - 120	L2 1/2x2 1/2x3/16	12.50	5.63	136.4 K=1.00	0.9020	-4.66	13.87	0.336 [1]
T4	120 - 100	L2 1/2x2 1/2x3/16	13.80	6.33	153.4 K=1.00	0.9020	-4.88	10.97	0.445 [1]
T5	100 - 80	L3x3x3/16	15.24	7.08	142.6 K=1.00	1.0900	-5.04	15.35	0.328 [1]
T6	80 - 60	L3x3x3/16	16.80	7.88	158.7 K=1.00	1.0900	-5.21	12.39	0.420 [1]
T7	60 - 40	L3x3x5/16	18.45	8.68	176.8 K=1.00	1.7800	-5.65	16.30	0.347 [1]
T8	40 - 20	L3x3x5/16	20.16	9.54	194.4 K=1.00	1.7800	-6.05	13.48	0.449 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T9	20 - 0	L3 1/2x3 1/2x5/16	21.92	10.43	181.3 K=1.00	2.0900	-7.28	18.19	0.400 [1]

[1] P_u / ϕP_n controls

Horizontal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	3/4	4.00	3.88	173.6 K=0.70	0.4418	-0.45	3.31	0.134 [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	180 - 160	3/4	4.00	3.88	173.6 K=0.70	0.4418	-0.28	3.31	0.085 [1]
T2	160 - 140	L2 1/2x2 1/2x3/16	4.00	3.46	101.9 K=1.22	0.9020	-0.29	21.87	0.013 [1]

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	1 1/2	20.00	2.50	80.0	1.7672	17.10	79.52	0.215 [1]
T2	160 - 140	BV_Valmont 195554	20.03	10.02	45.0	3.6816	39.25	165.67	0.237 [1]
T3	140 - 120	BV_Valmont 195554	20.03	10.02	45.0	3.6816	64.70	165.67	0.391 [1]
T4	120 - 100	Valmont 195555	20.03	10.02	37.5	5.3014	88.49	238.57	0.371 [1]
T5	100 - 80	BV_Valmont 195557	20.03	10.02	31.9	7.2158	110.65	324.71	0.341 [1]
T6	80 - 60	BV_Valmont 195557	20.03	10.02	31.9	7.2158	130.97	324.71	0.403 [1]
T7	60 - 40	BV_Valmont 195546	20.03	10.02	27.8	9.4248	150.37	424.12	0.355 [1]
T8	40 - 20	BV_Valmont 195546	20.03	10.02	27.8	9.4248	168.74	424.12	0.398 [1]
T9	20 - 0	BV_Valmont 195560	20.03	10.02	24.7	11.928 2	186.09	536.77	0.347 [1]

[1] P_u / ϕP_n controls

Truss-Leg Diagonal Data

Section No.	Elevation ft	Diagonal Size	L_d ft	Kl/r	ϕP_n K	A in^2	V_u K	ϕV_n K	Stress Ratio
T2	160 - 140	0.4375	1.48	137.6	165.67	0.1503	0.71	2.02	0.352
T3	140 - 120	0.4375	1.48	137.6	165.67	0.1503	0.39	2.02	0.192
T4	120 - 100	0.4375	1.46	136.4	238.57	0.1503	0.24	2.05	0.116
T5	100 - 80	0.5	1.44	117.6	324.71	0.1963	0.19	3.47	0.054
T6	80 - 60	0.5	1.44	117.6	324.71	0.1963	0.23	3.47	0.067
T7	60 - 40	0.5	1.43	116.3	424.12	0.1963	0.24	3.54	0.069
T8	40 - 20	0.5	1.43	116.3	424.12	0.1963	0.75	3.54	0.212
T9	20 - 0	0.625	1.41	92.3	536.77	0.3068	1.32	7.20	0.184

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	3/4	4.72	2.28	146.2	0.4418	2.46	19.88	0.124 [1]
T2	160 - 140	L2 1/2x2 1/2x3/16	11.42	4.98	80.1	0.5183	5.06	22.55	0.224 [1]
T3	140 - 120	L2 1/2x2 1/2x3/16	12.50	5.63	90.0	0.5183	4.56	22.55	0.202 [1]
T4	120 - 100	L2 1/2x2 1/2x3/16	13.13	6.02	96.0	0.5183	4.90	22.55	0.217 [1]
T5	100 - 80	L3x3x3/16	14.50	6.73	88.6	0.6593	4.98	28.68	0.174 [1]
T6	80 - 60	L3x3x3/16	16.01	7.49	98.4	0.6593	5.13	28.68	0.179 [1]
T7	60 - 40	L3x3x5/16	18.45	8.68	116.2	1.0127	5.57	44.05	0.126 [1]
T8	40 - 20	L3x3x5/16	20.16	9.54	127.4	1.0127	5.89	44.05	0.134 [1]
T9	20 - 0	L3 1/2x3 1/2x5/16	21.92	10.43	118.6	1.2452	6.59	54.17	0.122 [1]

[1] P_u / ϕP_n controls

Horizontal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	3/4	4.00	3.88	248.0	0.4418	0.62	19.88	0.031 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	180 - 160	3/4	4.00	3.88	248.0	0.4418	0.26	19.88	0.013 [1]
T2	160 - 140	L2 1/2x2 1/2x3/16	4.00	3.46	59.8	0.5183	0.40	22.55	0.018 [1]

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T1	180 - 160	Leg	1 1/2	3	-19.97	52.29	38.2	Pass
T2	160 - 140	Leg	BV_Valmont 195554	62	-28.61	150.01	33.5	Pass
T3	140 - 120	Leg	BV_Valmont 195554	82	-73.91	150.01	49.3	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T4	120 - 100	Leg	Valmont 195555	97	-100.44	226.02	44.4	Pass
T5	100 - 80	Leg	BV_Valmont 195557	112	-125.81	316.56	39.7	Pass
T6	80 - 60	Leg	BV_Valmont 195557	127	-149.66	316.56	47.3	Pass
T7	60 - 40	Leg	BV_Valmont 195546	142	-173.59	420.94	41.2	Pass
T8	40 - 20	Leg	BV_Valmont 195546	157	-196.79	420.94	46.8	Pass
T9	20 - 0	Leg	BV_Valmont 195560	172	-219.14	539.08	40.6	Pass
T1	180 - 160	Diagonal	3/4	15	-2.55	6.05	42.1	Pass
T2	160 - 140	Diagonal	L2 1/2x2 1/2x3/16	71	-5.04	18.45	27.3 45.2 (b)	Pass
T3	140 - 120	Diagonal	L2 1/2x2 1/2x3/16	85	-4.66	14.57	32.0 40.8 (b)	Pass
T4	120 - 100	Diagonal	L2 1/2x2 1/2x3/16	100	-4.88	11.52	42.4 43.7 (b)	Pass
T5	100 - 80	Diagonal	L3x3x3/16	115	-5.04	16.11	31.3 40.6 (b)	Pass
T6	80 - 60	Diagonal	L3x3x3/16	130	-5.21	13.01	40.0 41.8 (b)	Pass
T7	60 - 40	Diagonal	L3x3x5/16	145	-5.65	17.12	33.0	Pass
T8	40 - 20	Diagonal	L3x3x5/16	160	-6.05	14.16	42.8	Pass
T9	20 - 0	Diagonal	L3 1/2x3 1/2x5/16	175	-7.28	19.10	38.1	Pass
T1	180 - 160	Horizontal	3/4	13	-0.45	3.48	12.8	Pass
T1	180 - 160	Top Girt	3/4	6	-0.28	3.48	8.1	Pass
T2	160 - 140	Top Girt	L2 1/2x2 1/2x3/16	65	0.40	23.67	1.7 3.6 (b)	Pass
							Summary	
						Leg (T3)	49.3	Pass
						Diagonal (T2)	45.2	Pass
						Horizontal (T1)	12.8	Pass
						Top Girt (T1)	8.1	Pass
						Bolt Checks	45.2	Pass
						RATING =	**49.3**	**Pass**

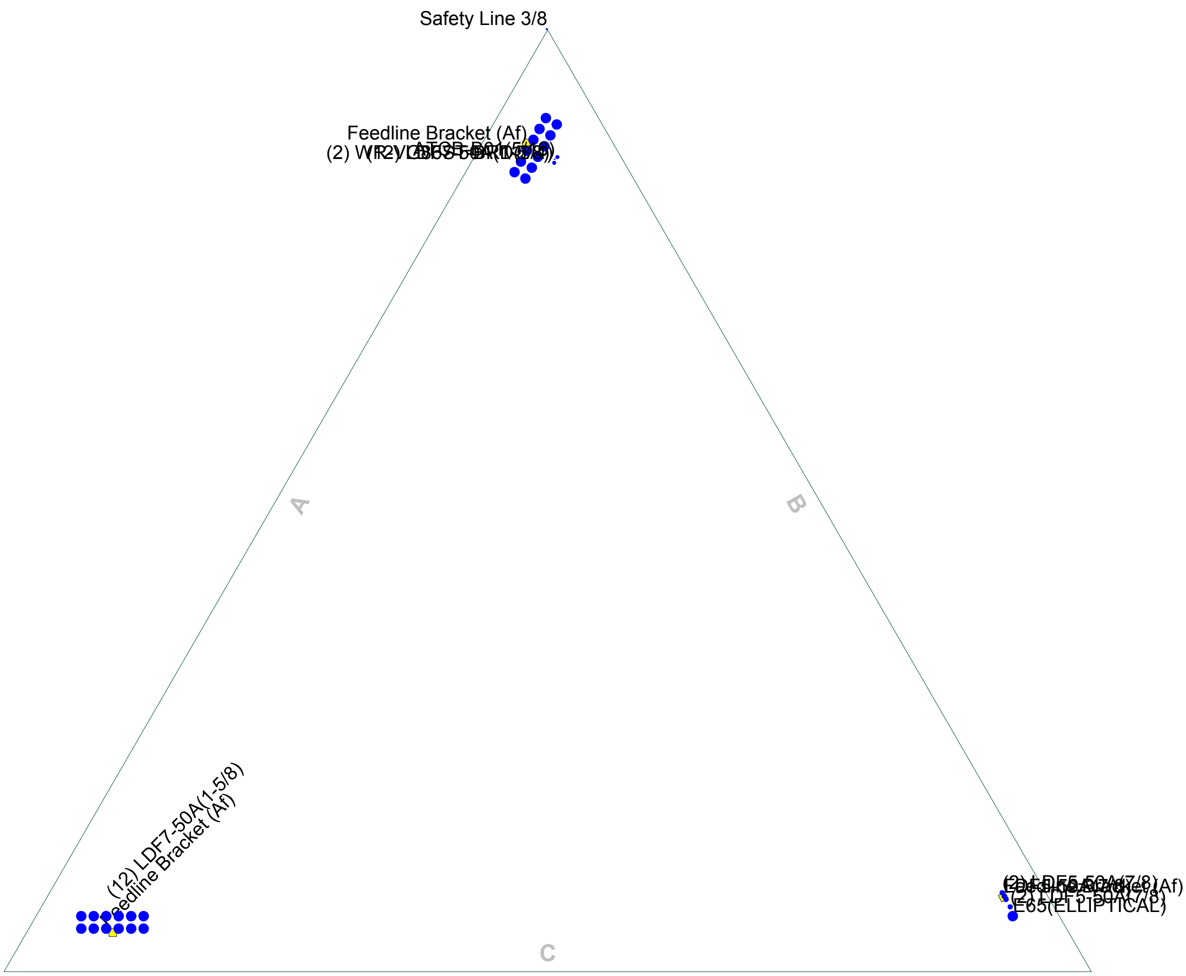
APPENDIX B

BASE LEVEL DRAWING

Feed Line Plan
20'

Round Flat App In Face App Out Face Truss-Leg

Section @ 20'



Black & Veatch Corp. 6800 W. 115th St., Suite 2292 Overland Park, KS 66211 Phone: FAX:	Job: ***ES-033 WHartland***		
	Project: ***403093 (WHartland)***		
	Client: Eversource	Drawn by: TH	App'd:
	Code: TIA-222-H	Date: 05/18/20	Scale: NTS
	Path: C:\Users\hai92311\OneDrive - Black & Veatch\My Desktop\Eversource\2019.11.11\WHartland - Structural\Rev. H\WHartland.eri		Dwg No. E-7

APPENDIX C

ADDITIONAL CALCULATIONS

References

ANCHOR ROD ANALYSIS

Project Information

Site Name:ES-033 WHartland

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

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

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

Max Leg Reactions

Compression	*Uplift*
$Axial\_C := 225 \cdot kip$	$Axial\_U := 191 \cdot kip$
$Shear\_C := 23 \cdot kip$	$Shear\_U := 20 \cdot kip$

Anchor Rod Data

Diameter of Anchor Rod: $D := 1.25 \cdot in$

Number of Anchor Rods: $N := 6$

Length from top of concrete to bottom of anchor rod leveling nut: $lar := 0.001 \cdot in$

Anchor Rod Grade: F1554-105 / **A687** (selected) / 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** (selected) / No

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

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

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

Threads per Inch: $n = 7$ (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)

$$Z := \frac{1}{6} \cdot \left(D - \frac{0.9743in}{n}\right)^3 = 0.228 \cdot in^3$$

Radius of Gyration:

$$r := \left(\frac{1}{4}\right) \cdot \left(D - \frac{0.9743in}{n}\right) = 0.278 \cdot in$$

Net Area of Anchor Rod:

$$An := \frac{\pi}{4} \cdot \left(D - \frac{0.9743in}{n}\right)^2 = 0.969 \cdot in^2$$

TIA-222-G/H Section 4.9.6.1

Nominal Unthreaded Area of Anchor Rod:

$$Ab := \frac{\pi}{4} \cdot (D)^2 = 1.227 \cdot in^2$$

Anchor Rod Design Capacities

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

$Rnt := Fu \cdot An = 121.139 \cdot kip$

$\phi t = 0.75$

$\phi Rnt := \phi t \cdot Rnt = 90.854 \cdot kip$

Design Compression Strength:

$Rnc := Fy \cdot An = 101.756 \cdot kip$

$\phi c = 1$

$\phi Rnc := \phi c \cdot Rnc = 101.756 \cdot kip$

Design Buckling Strength: TIA-222-H Section 4.5.4.2

$K_0 := 1.2$

$Fcr = 105 \cdot ksi$

$Fe = 1.533 \times 10^{10} \cdot ksi$

$Rnb := Fcr \cdot An = 101.756 \cdot kip$

$\phi c = 1$

$\phi Rnb := \phi c \cdot Rnb = 101.756 \cdot kip$

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

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

$Rnv = 76.699 \cdot kip$

$Rnvc := 0.6 \cdot Fy \cdot 0.5 \cdot An = 30.527 \cdot kip$ TIA-222-H Section 4.9.9

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

$\phi Rnv := \phi v \cdot Rnv = 57.524 \cdot kip$ $\phi Rnvc := \phi c \cdot Rnvc = 30.527 \cdot kip$

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

$Rmn := Fy \cdot Z = 23.986 \cdot kip \cdot in$

$\phi f = 0.9$

$\phi Rmn := \phi f \cdot Rmn = 21.588 \cdot kip \cdot in$

Anchor Rod Loading Demands

Tension Demand:

$$Put := \frac{Axial\_U}{N} = 31.833 \cdot kip$$

Compression Demand:

$$Puc := \frac{Axial\_C}{N} = 37.5 \cdot kip$$

Shear Demand:

$$Vut := \frac{Shear\_U}{N} = 3.333 \cdot kip$$

$$Vuc := \frac{Shear\_C}{N} = 3.833 \cdot kip$$

Moment Demand:

$$Mut := 0.65 \cdot lar \cdot Vut = 2.167 \times 10^{-3} \cdot kip \cdot in$$

$$Muc := 0.65 \cdot lar \cdot Vuc = 2.492 \times 10^{-3} \cdot kip \cdot in$$

Anchor Rod Interaction Check TIA-222-G Section 4.9.9

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

$$SR\_g = 0.417$$

Anchor Rod Interaction Check

TIA-222-H Section 4.9.9

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

$SR\_Pt = 0.126$

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

$SR\_Pc = 0.384$

$$SR := \begin{cases} SR\_g & \text{if } TIA = \text{"Rev-G"} \\ \max(SR\_Pt, SR\_Pc) & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"No"} \\ \frac{\max(SR\_Pt, SR\_Pc)}{1.05} & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"Yes"} \end{cases} = 0.366$$

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

Anchor Rod Results

Axial Tension Demand:	$Put = 31.833 \cdot kip$
Axial Tension Capacity:	$\phi Rnt = 90.854 \cdot kip$
Axial Compression Demand:	$Puc = 37.5 \cdot kip$
Axial Compression Capacity:	$\phi Rnc = 101.756 \cdot kip$
Shear Tension Demand:	$Vut = 3.333 \cdot kip$
Tension Shear Capacity:	$\phi Rnv = 57.524 \cdot kip$
Shear Compression Demand:	$Vuc = 3.833 \cdot kip$
Compresison Shear Capacity:	$\phi R_{nvc} = 30.527 \cdot kip$
Moment Tension Demand:	M_{ut} = "Moment Not Considered" ·kip·in
Moment Compression Demand:	M_{uc} = "Moment Not Considered" ·kip·in
Moment Capacity:	ϕR_{mn} = "Moment Not Considered" ·kip·in

Governing Stress Ratio

$SR = 36.6 \cdot \%$

$Check_{SR}$ = "Passing"

SST Unit Base Foundation

Site Number: ES-033
Site Name: WHartland

TIA-222 Revision: H

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

Superstructure Analysis Reactions		
Global Moment, **M**:	3619	ft-kips
Global Axial, **P**:	49	kips
Global Shear, **V**:	35	kips
Leg Compression, $\mathbf{P_{comp}}$:	225	kips
Leg Comp. Shear, $\mathbf{V_{u\_comp}}$:	23	kips
Leg Uplift, $\mathbf{P_{uplift}}$:	191	kips
Leg Uplift. Shear, $\mathbf{V_{u\_uplift}}$:	20	kips
Tower Height, **H**:	180	ft
Base Face Width, **BW**:	20	ft
BP Dist. Above Fdn, $\mathbf{bp_{dist}}$:	4	in

Foundation Analysis Checks	Capacity	Demand	Rating	Check
Lateral (Sliding) (kips)	224.60	35.00	**15.6%**	**Pass**
Bearing Pressure (ksf)	9.00	2.52	**28.0%**	**Pass**
*Overturning (kip*ft)*	7765.27	4050.34	**52.2%**	**Pass**
*Pier Flexure (Comp.) (kip*ft)*	1969.65	86.25	**4.4%**	**Pass**
*Pier Flexure (Tension) (kip*ft)*	1275.85	75.00	**5.9%**	**Pass**
Pier Compression (kip)	9294.83	238.25	**2.6%**	**Pass**
*Pad Flexure (kip*ft)*	4295.97	172.68	**4.0%**	**Pass**
Pad Shear - 1-way (kips)	859.13	34.04	**4.0%**	**Pass**
Pad Shear - Comp 2-way (ksi)	0.177	0.031	**17.4%**	**Pass**
*Flexural 2-way (Comp) (kip*ft)*	2543.04	51.75	**2.0%**	**Pass**
Pad Shear - Tension 2-way (ksi)	0.177	0.027	**15.1%**	**Pass**
*Flexural 2-way (Tension) (kip*ft)*	2543.04	45.00	**1.8%**	**Pass**

Soil Rating:	**52.2%**
Structural Rating:	**17.4%**

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, **dpier**:	5.0	ft
Ext. Above Grade, **E**:	0.50	ft
Pier Rebar Size, **Sc**:	8	
Pier Rebar Quantity, **mc**:	18	
Pier Tie/Spiral Size, **St**:	4	
Pier Tie/Spiral Quantity, **mt**:	5	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, $\mathbf{cc_{pier}}$:	3	in

Pad Properties		
Depth, **D**:	6.00	ft
Pad Width, **W**:	28.50	ft
Pad Thickness, **T**:	2.75	ft
Pad Rebar Size (Bottom), **Sp**:	9	
Pad Rebar Quantity (Bottom), **mp**:	35	
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:	110	pcf	
Ultimate Gross Bearing, Qult:	12.000	ksf	<-- Toggle between Gross and Net
Cohesion, **Cu**:	0.500	ksf	
Friction Angle, φ:		degrees	
SPT Blow Count, $\mathbf{N_{blows}}$:			
Base Friction, μ:	0.3		
Neglected Depth, **N**:	3.3	ft	
Foundation Bearing on Rock?	Yes		
Groundwater Depth, **gw**:	n/a	ft	

Version 3.2.1

TIA-222- H ACI : 2014

PHYSICAL PARAMETERS

Pier Height Above Water Table:	h_{pier_above} = (MIN(gw,D-T) + E)	h_{pier_above} =	3.75	ft
Pier Height Below Water Table:	h_{pier_below} = ((D-T) - MIN(gw,D-T))	h_{pier_below} =	0	ft
Buoyant Weight of Pier:	W_{pier} = (π/4) * (dpier^2) * hpier_above * δc / 1000 + (π/4) * (dpier^2) * hpier_below * (δc-62.4) / 1000	W_{pier} =	11.04	kips
Pad Height Above Water Table:	h_{pad_above} = IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw)))	h_{pad_above} =	2.75	ft
Pad Height Below Water Table:	h_{pad_below} = (T-IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw))))	h_{pad_below} =	0	ft
Buoyant Weight of Pad:	W_{pad} = (W^2) * hpad_above * δc / 1000 + (W^2) * hpad_below * (δc-62.4) / 1000	W_{pad} =	335.05	kips
Concrete weight:	W_c = V * δc	W_c =	368.2	kips
Soil weight:	W_s = (D - T) * (W² - 3*(dpier² / 4 * π)) * γ	W_s =	269.3	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} =	116.31	kips
Factored Total Weight for Compression:	$P_{factored\_comp}$ = φD * (Wc + Ws + P / 1.2)	$P_{factored\_comp}$ =	610.51	kips
Nominal Base Friction Resistance (Comp):	R_{s_comp} = P * μ	R_{s_comp} =	183.15	kips
Lateral Resistance (Comp):	ΦVn = Φs * (Pp_total + Rs_comp)	ΦVn =	224.60	kips

Check **ΦVn = 224.60 kips >= Vu = 35.00 kips** **RATING: 15.58% OK**

PIER REINFORCEMENT

Pier / Column Compression

Pier Cross-Sectional Area:	A_1 = dpier^2 * π/4	A_1 =	2827.43	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 =	8171.28	in²
Compressive Resistance (H/D < 3):	$ΦP_{n1}$ = 0.65*0.85 * F'c * A1 * MIN(√(A2/A1),2)	$ΦP_{n1}$ =	9294.83	kips
Rebar:	$s_{\_pier}$ = 8; $m_{\_pier}$ = 18; d_{b_pier} = 1 in; A_{b_pier} = 0.79 in^2			
Provided area of steel:	A_{s_pier} = Ab_pier * m_pier	A_{s_pier} =	14.22	in^2
Compressive Resistance (H/D >= 3):	$ΦP_{n2}$ = 0.65 * 0.8 * (0.85 * (F\c) * (A_1 - As_pier) + ((Fy) * As_pier))	$ΦP_{n2}$ =	4795.71	kips
	H/D = (D - T + E) / dpier	H/D =	0.75	
Utilized Compressive Resistance:	$ΦP_n$ = Pn1	$ΦP_n$ =	9294.83	kips
Applied Compressive Force:	P_u = Pcomp + 1.2 * Wpier	P_u =	238.25	kips

Check **$ΦP_n$ = 9294.83 kips >= P_u = 238.25 kips** **RATING: 2.56% OK**

Pier Flexure

Cross-sectional area:	A_g = dpier² * π / 4	A_g =	2827.43	in^2
Min. area of steel (pier):	A_{smin_pier} = Ag * 0.005	A_{smin_pier} =	14.14	in^2
Cage Diameter:	d_o = dpier - 2 * cc - 2 * tie - d_b	d_o =	52.00	in

Check **A_{s_pier} = 14.22 in^2 >= A_{smin_pier} = 14.14 in^2** **OK**

Applied Moment to DSMC (Compression):	M_{u_comp} = IF(T>D,E,(D - T + E)) * Vu_comp	M_{u_comp} =	86.25	ft-kips
Pier Moment Capacity (Compression):	$ΦM_{n\_comp}$ = *from DSMC*	$ΦM_{n\_comp}$ =	1969.65	ft-kips

Check **M_{u_comp} = 86.25 ft-kips >= $ΦM_{n\_comp}$ = 1969.65 ft-kips** **RATING: 4.38% OK**

Applied Moment to DSMC (Tension):	$M_{u\_tension}$ = IF(T>D,E,(D - T + E)) * Vu_uplift	$M_{u\_tension}$ =	75.00	ft-kips
Pier Moment Capacity (Tension):	$ΦM_{n\_tension}$ = *from DSMC*	$ΦM_{n\_tension}$ =	1275.85	ft-kips

Check **M_{u_comp} = 75.00 ft-kips >= $ΦM_{n\_comp}$ = 1275.85 ft-kips** **RATING: 5.88% OK**

PAD REINFORCEMENT

Elastic Bearing Pressure for Soil Checks

Tower Cetroid offset from Fdn Centroid:	Offset = (1/2-1/3)*BW*sin(60°)	Offset =	2.89	ft	
Distance from Leg to Edge of Pad:	L_{edge} = (1/2)*W - Offset - (1/3)*BW*sin(60°)	L_{edge} =	5.59	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	$M_{o\_0.9}$ =	4050.34	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	$M_{o\_1.2}$ =	4114.40	ft-kips	
Compressive Load for Bearing:	$P_{bearing}$ = Wc + Ws + P / 1.2	$P_{bearing}$ =	678.34	kips	
*Load Eccentricity (0.9*D LC):*	$e_{c\_0.9}$ = Mo / 0.9*Pbearing	$e_{c\_0.9}$ =	6.63	ft	L/6 < e <= L
*Load Eccentricity (1.2*D LC):*	$e_{c\_1.2}$ = Mo / 1.2*Pbearing	$e_{c\_1.2}$ =	5.05	ft	L/6 < e <= L
Elastic Section Modulus:	S = W³ / 6	S =	3858.19	ft³	
*Positive Pressure (0.9*D LC):*	$P_{pos\_st\_0.9}$ = 0.9*Pbearing / Area + Mo / S	$P_{pos\_st\_0.9}$ =	1.80	ksf	
*Positive Pressure (1.2*D LC):*	$P_{pos\_st\_1.2}$ = 1.2*Pbearing / Area + Mo / S	$P_{pos\_st\_1.2}$ =	2.07	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.**	$P_{neg\_st\_0.9}$ =	-0.30	ksf	
*Negative Pressure (1.2*D LC):*	$P_{neg\_st\_1.2}$ = 1.2*Pbearing / Area - Mo / S **Note: The stress resultant is NOT within the kern. Bearing area has been adjusted below.**	$P_{neg\_st\_1.2}$ =	-0.06	ksf	
*Adjusted Pressure (0.9*D LC):*	$P_{adj\_0.9}$ = (2 * 0.9*Pbearing) / (3 * W * (W / 2 - ec_0.9))	$P_{adj\_0.9}$ =	1.88	ksf	
*Adjusted Pressure (1.2*D LC):*	$P_{adj\_1.2}$ = (2 * 1.2*Pbearing) / (3 * W * (W / 2 - ec_1.2))	$P_{adj\_1.2}$ =	2.07	ksf	
*Maximum Pressure (0.9*D LC):*	$q_{u\_st\_0.9}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_0.9}$ =	1.88	ksf	
*Maximum Pressure (1.2*D LC):*	$q_{u\_st\_1.2}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_1.2}$ =	2.07	ksf	

One-Way Shear

Rebar:	$s_{\_pad}$ = 9 $m_{\_pad}$ = 35	*Equally spaced, top and bottom, both directions.*	d_{b_pad} = A_{b_pad} =	1.128 1	in in^2

Effective depth:	d_c = T - cc - 1.5 * db	d_c =	28.3	in
Distance from Edge of Pad to Column Face:	d' = Ledge - dpier/2	d' =	3.1	ft
Distance from Edge of Pad to dc from Column Face:	d'' = d' - d_c / 12	d'' =	0.73	ft
Distance to qs (0.9D LC):	$L'_{\_0.9}$ = (W / 2 - ec_0.9) * 3	$L'_{\_0.9}$ =	22.85	ft
Distance to qs (1.2D LC):	$L'_{\_1.2}$ = (W / 2 - ec_1.2) * 3	$L'_{\_1.2}$ =	27.59	ft
*Slope of qs (0.9*D LC):*	$sq_{s\_0.9}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_0.9}$ =	0.08	kcf
*Slope of qs (1.2*D LC):*	$sq_{s\_1.2}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_1.2}$ =	0.08	kcf
Nominal Shear Strength:	V_{n1} = 2 * W * √(F'c*1000) * dc	V_{n1} =	1145.51	kips
Shear Reduction Factor:	φ_{shear} = 0.75	φ_{shear} =	0.75	
Design Shear Strength:	φV_{n1} = φshear * V_{n1}	φV_{n1} =	859.13	kips

Resisting Weight above Critical Section:

	Thickness (ft)	Unit Weight (kcf)	Weight (kip) (0.9*D LC)	Weight (kip) (1.2*D LC)
Soil Above Water Table:	3.25	0.110	6.70	8.93
Soil Below Water Table:	0	0.048	0.00	0.00
Pad Above Water Table:	2.75	0.150	7.73	10.31
Pad Below Water Table:	0	0.088	0.00	0.00
Total:			14.43	19.24

*Applied Shear (0.9*D LC):*	$V_{u1\_0.9}$ = 'Pad Shear and Moment Diagrams'!$AY$21	$V_{u1\_0.9}$ =	24.35	kips
*Applied Shear (1.2*D LC):*	$V_{u1\_1.2}$ = 'Pad Shear and Moment Diagrams'!$CG$21	$V_{u1\_1.2}$ =	34.04	kips

Check **φV_{n1} = 859.13 kips >= V_{u1} = 34.04 kips** **RATING: 3.96% OK**

Two-Way Shear (Compression)

Avg. Effective Depth for Punching Shear:	d_{c_2} = T - cc - AVERAGE(0.5 * db , 1.5 * db)	d_{c_2} =	28.87	in
Radius of Two-Way Shear Plane:	r_{2way} = 0.5*(dpier + dc_2/12)	r_{2way} =	3.70	ft
Length to Edge of Pad from Pier Centroid:	L_{edge2} = W/2 - 2/3*SIN(60°)*BW + Offset	L_{edge2} =	5.59	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} =	60.00	in
Equivalent Square Pier Diameter:	d_{pier_sq} =	√π / 2 * dpier	d_{pier_sq} =	53.17	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 =	1035.00	kip*in
Circular Critical Perimeter:	P_{crit_cir} =	(dpier+dc_2/12)*PI() - $L$171)*12	P_{crit_cir} =	279.20	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_sq\_1}$ =	4*(dpier_sq+dc_2)	$P_{crit\_sq\_1}$ =	328.18	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_sq\_2}$ =	2*(dpier_sq + dc_2) + (W*12-BW*12)	$P_{crit\_sq\_2}$ =	266.09	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_sq\_3}$ =	2 * (dpier_sq + dc_2 + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_sq\_3}$ =	298.25	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_sq\_4}$ =	2 * (dpier_sq + dc_2 + Ledge2 * 12)	$P_{crit\_sq\_4}$ =	298.25	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_sq\_5}$ =	dpier_sq + dc_2 + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30)) - Led	$P_{crit\_sq\_5}$ =	200.12	in
Area of Concrete in Shear:	A_c =	((dpier1 + dc_2)*PI()) * dc_2	A_c =	8061.05	in^2
Eq. Square Area of Concrete in Shear (1):	$A_{c\_sq\_1}$ =	$P_{crit\_sq\_1} * d_{c\_2}$	$A_{c\_sq\_1}$ =	9475.28	in^2
Eq. Square Area of Concrete in Shear (2):	$A_{c\_sq\_2}$ =	$P_{crit\_sq\_2} * d_{c\_2}$	$A_{c\_sq\_2}$ =	7682.59	in^2
Eq. Square Area of Concrete in Shear (3):	$A_{c\_sq\_3}$ =	$P_{crit\_sq\_3} * d_{c\_2}$	$A_{c\_sq\_3}$ =	8610.93	in^2
Eq. Square Area of Concrete in Shear (4):	$A_{c\_sq\_4}$ =	$P_{crit\_sq\_4} * d_{c\_2}$	$A_{c\_sq\_4}$ =	8610.93	in^2
Eq. Square Area of Concrete in Shear (5):	$A_{c\_sq\_5}$ =	$P_{crit\_sq\_5} * d_{c\_2}$	$A_{c\_sq\_5}$ =	5777.94	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} =	13867269.03	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	$J_{c\_sq\_1}$ =	10959557.48	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	$J_{c\_sq\_2}$ =	9466198.35	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	$J_{c\_sq\_3}$ =	6973137.87	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	$J_{c\_sq\_4}$ =	6973137.87	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	$J_{c\_sq\_5}$ =	5479778.74	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})	$V_{u\_1.2}$ =	238.25	kip
*Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling}$ =	$V_{u\_1.2} / A_c + (Y_v * M_v * (d_{pier1} + dc\_2)/2) / J_{c\_1}$	$v_{u\_1.2\_controlling}$ =	0.031	ksi
*Eq. Sq. Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling\_sq}$ =	$V_{u\_1.2} / A_c + (Y_v * M_v * (d_{pier\_sq} + dc\_2)/2) / J_c$	$v_{u\_1.2\_controlling\_sq}$ =	0.044	ksi
Shear Stress Capacity:	Φv_n =	φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.177	ksi

Check **Φv_n = 0.177 ksi >= v_{u_demand} = 0.031 ksi** **RATING: 17.40% OK**

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

Distance To Outside Edge:	$dist_{outside}$ =	MIN((W-BW)/2,BW/2)*2	$dist_{outside}$ =	8.5	ft
Effective Pad Width:	$b_{\_pad}$ =	MIN(dpier+3*T,W,dist_outside)	$b_{\_pad}$ =	8.50	ft
Bar Spacing:	B_{s_pad} =	Bs_pad (see design checks below)	B_{s_pad} =	9.85	in
Fraction of Bars in Effective Width:	$m_{\_effective}$ =	IF(b_pad=W,mp,12*b_pad/Bs_pad)	$m_{\_effective}$ =	10.36	
Area of Steel in Effective Width:	$A_{s\_effective}$ =	VLOOKUP(Sp,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective}$ =	10.36	in²
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective}$ =	$A_{s\_effective}$ * Fy / (0.85 * F'c * b_{slab}*12)	$a_{\_effective}$ =	2.05	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}	$c_{\_effective}$ =	2.41	
Effective depth:	dc = dc (see One-Way Shear check above)	dc =	28.308	in
Modulus of Elasticity of Steel:	E_s = 29000 ksi	E_s =	29000	ksi
Strain in Steel:	$\varepsilon_{s\_effective}$ = 0.003 * (dc-c) / c	$\varepsilon_{s\_effective}$ =	0.03225	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)	$M_{n\_effective}$ =	1412.80	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective}$ =	1271.52	ft-kips

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

Bar Spacing:	$B_{s\_pad\_top}$ = IF(Input!$S$6=TRUE,(W*12 - 2 * ccpad - VLOOKUP(sptop,Ref!$A$2:C	$B_{s\_pad\_top}$ =	8.50	in
Fraction of Bars in Effective Width:	$m_{\_effective\_top}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad_top)	$m_{\_effective\_top}$ =	10.36	
Area of Steel in Effective Width:	$A_{s\_effective\_top}$ = VLOOKUP(Sptop,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective\_top}$ =	10.36	in²
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective\_top}$ = $A_{s\_effective\_top}$ * Fy / (0.85 * F'c * b_{slab}*12)	$a_{\_effective\_top}$ =	2.05	in
Distance from Top to Nuetral Axis:	$c_{\_effective\_top}$ = $a_{\_effective\_top}$ / β_{pad}	$c_{\_effective\_top}$ =	2.41	
Effective depth:	dc_top = T *12 - ccpad - 1.5 * VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)	d_{c_top} =	28.308	in
Strain in Steel:	$\varepsilon_{s\_effective\_top}$ = 0.003 * (dc_top-c_effective_top) / c_effective_top	$\varepsilon_{s\_effective\_top}$ =	0.03225	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)	$M_{n\_effective\_top}$ =	1412.80	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective\_top}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective\_top}$ =	1271.52	ft-kips
Applied Moment:	$Yf*M_{u\_comp}$ = $Yf*M_{u\_comp}$	$Yf*M_{u\_comp}$ =	51.75	ft-kips

Check **$\varphi M_{n\_effective}$ = 2543.04 ksi >= $Yf*M_{u\_comp}$ = 51.75 ksi** **RATING: 2.03% OK**

Two-Way Shear (Uplift)

Moment applied at base of Pier:	M_{v_tens} = $M_{u\_tension}$ * 12 in / ft	M_{v_tens} =	900.00	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)	$d_{\_cage}$ =	52.00	in
Eq. Sq. Diameter of Longitudinal Rebar Cage:	$d_{\_cage\_sq}$ = SQRT(PI())/2*d_cage	$d_{\_cage\_sq}$ =	46.08	in
Steel Embedment Length:	L_{embed} = dc_2 (see One-Way Shear check above)	L_{embed} =	28.87	in
Radius of Two-Way Shear Plane:	r_{2way_tens} = 0.5*(d_cage/12 + Lembed/12)	r_{2way_tens} =	3.37	ft
	$r_{2way\_tens\_sq}$ = 0.5*(SQRT(PI())/2*d_cage/12 + Lembed/12)	$r_{2way\_tens\_sq}$ =	3.12	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} =	254.07	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_tens\_sq\_1}$ = 4*(d_cage_sq+Lembed)	$P_{crit\_tens\_sq\_1}$ =	299.82	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_tens\_sq\_2}$ = 2*(d_cage_sq + Lembed) + (W*12-BW*12)	$P_{crit\_tens\_sq\_2}$ =	251.91	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_tens\_sq\_3}$ = 2 * (d_cage_sq + Lembed) + (W - BW * COS(RADIANS(30)) - Ledge2)*12	$P_{crit\_tens\_sq\_3}$ =	284.07	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_tens\_sq\_4}$ = 2 * (d_cage_sq + Lembed + Ledge2 * 12)	$P_{crit\_tens\_sq\_4}$ =	284.07	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_tens\_sq\_5}$ = d_cage_sq + Lembed + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30))	$P_{crit\_tens\_sq\_5}$ =	193.03	in
Area of Concrete in Shear:	A_{c_tens} = Pcrit_tens*Lembed	A_{c_tens} =	7335.42	in^2
Equivalent Square Area of Concrete in Shear:	$A_{c\_tens\_sq1}$ = Pcrit_tens_sq1*Lembed	$A_{c\_tens\_sq1}$ =	8656.50	in^2

	$A_{c\_tens\_sq2}$ = 'Pcrit_tens_sq2*Lembed	$A_{c\_tens\_sq2}$ =	7273.19	in^2
	$A_{c\_tens\_sq3}$ = Pcrit_tens_sq3*Lembed	$A_{c\_tens\_sq3}$ =	8201.54	in^2
	$A_{c\_tens\_sq4}$ = Pcrit_tens_sq4*Lembed	$A_{c\_tens\_sq4}$ =	8201.54	in^2
	$A_{c\_tens\_sq5}$ = Pcrit_tens_sq5*Lembed	$A_{c\_tens\_sq5}$ =	5573.24	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} =	6687371.96	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	$J_{c\_tens\_sq\_1}$ =	8406568.09	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	$J_{c\_tens\_sq\_2}$ =	7242997.26	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_3}$ = (Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_3}$ =	5366854.88	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	$J_{c\_tens\_sq\_4}$ =	5366854.88	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	$J_{c\_tens\_sq\_5}$ =	4203284.05	in^4
*Applied Shear Force (0.9*D LC):*	$V_{u\_0.9\_tens}$ = MAX(-0.9*Wpier + 0.9 * IF(OR($B$1="G",$B$1="H"), Puplift / 0.9, Puplift),	$V_{u\_0.9\_tens}$ =	181.06	kip
*Controlling Shear Stress (0.9*D LC):*	$v_{u\_0.9\_controlling\_tens}$ = $V_{u\_0.9}$ / A_{c_tens} + (Y_v * M_v * (d_{cage} + Lembed)/2) / J_{c_tens}	$v_{u\_0.9\_controlling\_tens}$ =	0.027	ksi
*Equivalent Square Shear Stress (0.9*D LC):*	$v_{u\_0.9\_tens\_sq}$ = Vu_0.9_tens/Ac_tens_sq5 + (Yv * Mv_tens * (d_cage_sq + Lembed)/2) /	$v_{u\_0.9\_tens\_sq}$ =	0.036	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.177	ksi

Check **Φv_n = 0.177 ksi >= v_{u_demand} = 0.027 ksi** **RATING: 15.13% OK**

Two-Way Shear (Uplift, Flexural Component)

Applied Moment:	Yf*$M_{u\_tension}$ = Yf*$M_{u\_tension}$	Yf*$M_{u\_tension}$ =	45	

Check **$\varphi M_{n\_effective}$ = 2543.04 ksi >= 'f*$M_{u\_tension}$ = 45.00 ksi** **RATING: 1.77% 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} =	35.00	in^2
Depth of Equivalent Rectangular Stress Block:	a = A_{s_pad} * Fy / (0.85 * F'c * W)	a =	2.06	in
Distance from Top to Nuetral Axis:	c = a / β_{pad}	c =	2.43	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 =	0.03197	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 =	4773.30	ft-kips
Design Flexural Strength:	φM_n = φflex * Mn	φM_n =	4295.97	ft-kips
*Bearing Press. at Crit. Section (0.9*D LC):*	qmid_0.9 = qu_st_0.9 - sqs_0.9 * d'	qmid_0.9 =	1.62	ksf
*Bearing Press. at Crit. Section (1.2*D LC):*	qmid_1.2 = qu_st_1.2 - sqs_1.2 * d'	qmid_1.2 =	1.84	ksf

Resisting Weight above Critical Section:

	Thickness (ft)	Unit Weight (kcf)	Weight (kip) (0.9*D LC)	Weight (kip) (1.2*D LC)	Moment Arm (ft)	Resisting Moment (ft-kips) (0.9*D LC)	Resisting Moment (ft-kips) (1.2*D LC)
Soil Above Water Table:	3.25	0.110	28.33	37.78	1.544872981	43.77	58.36
Soil Below Water Table:	0	0.048	0.00	0.00	1.544872981	0.00	0.00

Pad Above Water Table:	2.75	0.150	32.69	43.59	1.544872981	50.50	67.34
Pad Below Water Table:	0	0.088	0.00	0.00	1.544872981	0.00	0.00
Total:			61.02	81.37		94.27	125.70

*Factored Bending Moment (0.9*D LC):*	Mu_pad_0.9 = 'Pad Shear and Moment Diagrams'!$AZ$21	Mu_pad_0.9 =	151.39	ft-kips
*Factored Bending Moment (1.2*D LC):*	Mu_pad_1.2 = 'Pad Shear and Moment Diagrams'!$CH$21	Mu_pad_1.2 =	172.68	ft-kips

Check φM_n = **4295.97 ft-kips** **>=** M_{u_pad} = **172.68 ft-kips** **RATING: 4.02% OK**

PIER DESIGN CHECKS

Minimum Steel

Min. area of steel (pier):	A_{st_c} = Ag * 0.005	A_{st_c} =	14.14	in^2

Check A_{s_pier} = **14.22 in²** **>=** A_{st_c} = **14.14 in²** **RATING: 99.42% OK**

Bar Spacing

Bar separation:	B_{s_pier} = (do * π) / m_pier - db_pier	B_{s_pier} =	8.08	in

Check **18.00 in** **>=** B_{s_pier} = **8.08 in** **RATING: 44.87% 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 =	3.5	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 =	0.99	
Development (tensile):	$L_{dt'\_c}$ = (3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ_c * γ_c * λ_c * R_c * db_c / c_c'	$L_{dt'\_c}$ =	39.32	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} =	39.32	in
Development (comp.):	$L_{dc'\_c}$ = 0.02 * db_c * Fy*1000 / √(F'c*1000)	$L_{dc'\_c}$ =	20.28	in
	$L_{dc''\_c}$ = 0.0003 * db_c * Fy*1000	$L_{dc''\_c}$ =	18.00	in
Development length:	L_{dc_c} = MAX(8, Ldc'_c, Ldc"_c)	L_{dc_c} =	20.28	in
Length available in pier:	L_{vc} = D - T + E - cc	L_{vc} =	42.0	in

Check L_{vc} = **42.00 in** **>=** L_{dt_c} = **39.32 in** **OK**

Check L_{vc} = **42.00 in** **>=** L_{dc_c} = **20.28 in** **OK**

Length available in pad:	L_{vp} = T - ccpad	L_{vp} =	30.0	in

Check L_{vp} = **30.00 in** **>=** L_{dt_c} = **39.32 in** **HOOKS**

Check L_{vp} = **30.00 in** **>=** L_{dc_c} = **20.28 in** **OK**

Vertical Rebar Hook Ending

Bar size & clear cover:	α_h = =if bar <= 11, and cc >= 2.5", use 0.7, else use 1.0	α_h =	0.7	
Epoxy coating:	β_h = for non- epoxy coated, use 1.0	β_h =	1.0	
Light weight concrete:	λ_h = 1.0	λ_h =	1.0	
Development (hook):	L_{dh}' = 0.02 * αh * βh * λh * Fy*1000 / √(F'c*1000) * db_c	L_{dh}' =	14.2	in

Minimum length:	L_{dh_min} = the larger of: 8 * d_b or 6 in	L_{dh_min} =	8.0	in
Development length:	L_{dh} = MAX(Ldh_min, Ldh')	L_{dh} =	14.2	in
Check	**L_{vp} = 30.00 in >= L_{dh} = 14.20 in**			**OK**
Hook tail length:	L_{h_tail} = 12 * db beyond the bend radius	L_{h_tail} =	16.0	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} =	21.0	in
Check	**L_{h_pad} = 21.00 in >= L_{dh_tail} = 16.00 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 =	1	
Tie parameters:	$s_{\_t}$ = 4; $m_{\_t}$ = 5	d_{b_t} = 0.5 in; A_{b_t} = 0.2 in^2		
Allowable tie spacing per vertical rebar:	$B_{s\_t\_max1}$ = 8 / z * db_c	$B_{s\_t\_max1}$ =	8	in
per tie size:	$B_{s\_t\_max2}$ = 24 / z * db_t	$B_{s\_t\_max2}$ =	12	in

per pier diameter:	$B_{s\_t\_max3}$ = di / (4 * z²)	$B_{s\_t\_max3}$ =	15	in
per seismic zone:	$B_{s\_t\_max4}$ = 12" in active seismic zones, else 18"	$B_{s\_t\_max4}$ =	12	in
Maximum tie spacing:	$B_{s\_t\_max}$ = MIN(Bs_t_max1, Bs_t_max2, Bs_t_max3, Bs_t_max4)	$B_{s\_t\_max}$ =	8	in

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	$A_{st\_p\_sh}$ =	20.315	in^2

Check **A_{s_p} = 35.00 in^2 >= A_{st_p} = 20.31 in^2** **OK**

Bar Separation

Bar separation:	B_{s_pad} = (W - 2 * cc - db) / (m - 1)	B_{s_pad} =	9.85	in

Check **18" >= B_{s_p} = 9.85 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} =	191.9	ft-kips
Steel estimate:	A_{st_p}' = Mn / (φt * Fy * dc)	A_{st_p}' =	1.506	in^2
	a_p = Ast' * Fy / (β * F'c * W)	a_p =	0.09	in
Required steel:	$A_{st\_p\_st}$ = M_{nr} / (Fy * (dc - ap / 2))	$A_{st\_p\_st}$ =	1.358	in^2
Excess reinforcement:	R_p = Ast_p / As_p	R_p =	0.58	
Development (tensile):	L_d = (3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ * γ * λ * R * db / c'	L_d =	25.90	in
Minimum length:	L_{d_min} = 12 inches	L_{d_min} =	12.0	in
Development length:	L_{dp} = MAX(Ld_min, Ldp')	L_{dp} =	25.90	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} =	34.08	in

Check **L_{pad} = 34.08 in >= L_{dp} = 25.90 in** **OK**

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

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

Site Data

BU#:	*ES-033*
Site Name:	*WHartland*
App #:	

Maximum Shaft Superimposed Forces		
TIA Revision:	H	
Max. Factored Shaft Mu:	75	ft-kips **(* Note)**
Max. Factored Shaft Pu:	191	kips
Max Axial Force Type:	Tension	

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

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

Load Factor	Shaft Factored Loads		
1.00	Mu:	75	ft-kips
1.00	Pu:	191	kips

Pier Properties		
Concrete:		
Pier Diameter =	5.0	ft
Concrete Area =	2827.4	in^2
Reinforcement:		
Clear Cover to **Tie**=	3.00	in
Horiz. **Tie** Bar Size=	4	
Vert. Cage Diameter =	4.33	ft
Vert. Cage Diameter =	52.00	in
Vertical Bar Size =	8	
Bar Diameter =	1.00	in
Bar Area =	0.79	in^2
Number of Bars =	18	
As Total=	14.22	in^2
A s/ Aconc, Rho:	0.0050	0.50%

Material Properties		
Concrete Comp. strength, f'c =	3500	psi
Reinforcement yield strength, Fy =	60	ksi
Reinforcing Modulus of Elasticity, E =	29000	ksi
Reinforcement yield strain =	0.00207	
Limiting compressive strain =	0.003	
ACI 318 Code		
Select Analysis ACI Code=	2014	

SOLVE <-- Press Upon Completing All Input

ACI 10.5 , ACI 21.10.4, and IBC 1810.

Min As for Flexural, Tension Controlled, Shafts:

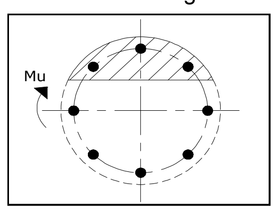
(3)*(Sqrt(f'c)/Fy:	0.0030
200 / Fy:	0.0033

Minimum Rho Check:

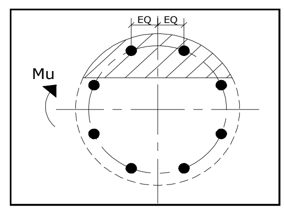
Assumed Min. Rho:	0.50%	
Provided Rho:	0.50%	OK

Results:

Governing Orientation Case: **1**



Case 1



Case 2

Dist. From Edge to Neutral Axis:	**7.02**	in
Extreme Steel Strain, εt:	**0.0209**	
	εt > 0.0050, Tension Controlled	
Reduction Factor,φ:	**0.900**	

Ref. Shaft Max Axial Capacities, φ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn. Pn		
per ACI 318 (10-2)	4795.71	kips
at Mu=(φ=0.65)Mn=	2081.41	ft-kips
Max Tu, (φ=0.9) Tn =	767.88	kips
at Mu=φ=(0.90)Mn=	0.00	ft-kips

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	-171.90	kips
Drilled Shaft Moment Capacity, φMn:	**1275.85**	ft-kips
Drilled Shaft Superimposed Mu:	**75.00**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**5.9%**

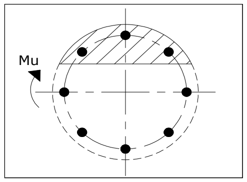
Maximum Allowable Moment of a Circular Pier

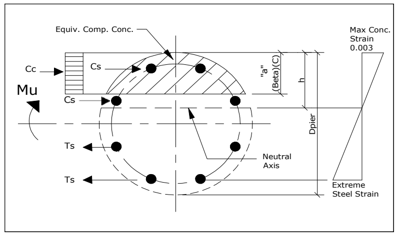
Pu: 191 kips (from Results Tab)
Axial Force type: Tension (from Results Tab)

For Internal Calculations:
Axial Load (Negative for Compression) = 191.00 kips

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

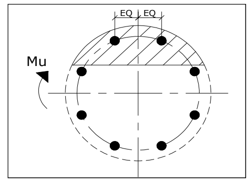
Case 1: Single Bar Near the Extreme Fiber





General Sketch (Variables) for both cases

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



Case 1

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.02 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to
equivalent compression zone factor, a = 5.97 in
Distance from centroid to neutral axis = 22.98 in

Compression Zone

Area of steel in compression zone, Asc = 2.37 in^2
Angle from centroid of pier to intersection of
equivalent compression zone and edge of pier = 36.76 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 145.96 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 434.23 kips <-- φ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -625.23 kips <-- φ Not Involved = Total Steel Pn
Case 1, φ= 0.900
Axial (comp=negative), Pu = 191.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -434.23 kips
Shaft Comp. Capacity, φPn= **-171.90** kips <--φ Pn=Pu

Sum of the axial forces in the shaft = 0.00 kips **No Good**

Maximum Moment

First moment of the concrete
area in compression about the centoid = 3859.42 in^3
Distance between centroid of concrete
in compression and centroid of pier = 26.44 in
Moment of concrete in compression = 11481.76 in-kips 956.8136 ft-kips
Total reinforcement moment = 5529.52 in-kips 460.7932 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 17011.28 in-kips
Moment Capacity of Drilled Shaft, φMn = 15310.15 in-kips 1275.846 ft-kips

Case 1, φMn = 1275.85 ft-kips

Case 2

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.03 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to
equivalent compression zone factor, a = 5.97 in
Distance from centroid to neutral axis = 22.97 in

Compression Zone

Area of steel in compression zone, Asc = 1.58 in^2
Angle from centroid of pier to intersection of
equivalent compression zone and edge of pier = 36.78 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 146.14 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 434.78 kips <-- φ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -625.78 kips <-- φ Not Involved = Total Steel Pn
Case 2, φ= 0.900
Axial (comp=negative), Pu = 191.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -434.78 kips
Shaft Comp. Capacity, φPn= **-171.90** kips <--φ Pn=Pu

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

Maximum Moment

First moment of the concrete
area in compression about the centoid = 3863.81 in^3
Distance between centroid of concrete
in compression and centroid of pier = 26.44 in
Moment of concrete in compression = 11494.85 in-kips 957.904 ft-kips
Total reinforcement moment = 5558.01 in-kips 463.1672 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 17052.85 in-kips
Moment Capacity of Drilled Shaft, φMn = 15347.57 in-kips 1278.964 ft-kips

Case 2, φMn = 1278.96 ft-kips

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

Neutral Axis

Distance from extreme edge to neutral axis, h = 54.11 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to
equivalent compression zone factor, a = 45.99 in
Distance from centroid to neutral axis = -24.11 in

Compression Zone

Area of steel in compression zone, Asc = 10.27 in^2
Angle from centroid of pier to intersection of
equivalent compression zone and edge of pier = 122.22 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 2325.75 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 6919.12 kips <-- φ Not Involved = Concrete Pn
Total reinforcement forces, Fs = 458.89 kips <-- φ Not Involved = Total Steel Pn
φ= 0.65
Magnified, Max Axial Comp, Pn, per ACI 318 (10-2)/(φ=0.65)= -7378.01 kips <-- (Pn per ACI 10-2)/φ
Balance Force in concrete, Fs+Fu = -6919.12 kips
Shaft Comp. Capacity, (φ=0.65)Pn= **4795.70** kips <--φ Pn=Pu

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

Maximum Moment

First moment of the concrete
area in compression about the centoid = 10899.73 in^3
Distance between centroid of concrete
in compression and centroid of pier = 4.69 in
Moment of concrete in compression = 32426.68 in-kips 2702.224 ft-kips
Total reinforcement moment = 5999.41 in-kips 499.9511 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 38426.10 in-kips
Moment Capacity of Drilled Shaft, (φ=0.65)Mn = 24976.96 in-kips 2081.414 ft-kips

Case 3, at Pmax, (φ=0.65)Mn = 2081.41 ft-kips

Final Results		
Governing Orientation Case=	**1**	
phi, φ=	0.900	
Shaft φ*Mn=	**1275.85**	ft-kips
Distance from Edge of Shaft to N.A.=	7.02	in
Shaft Beta=	0.85	
Maximum Tensile Strain=	-0.02093	<------------ εt > 0.0050, Tension Controlled — TC
Shaft Tension Cap., φTn= (φ=0.9)*(Total As)(Fy)=	767.88	kips
Shaft Max Comp, (φ=0.65)(0.80)[0.85*f'c*(Ag-Ast)+Ast*Fy]=	4795.71	kips

Individual Bars (Case 1)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	26.00	3.02	1.97	0.00129	0.79	37.43	27.22	707.63
2	20.00	24.43	1.45	0.40	0.00062	0.79	17.99	11.86	289.88
3	40.00	19.92	-3.06	-4.12	-0.00131	0.00	-37.96	-29.99	-597.29
4	60.00	13.00	-9.98	-11.03	-0.00427	0.00	-60.00	-47.40	-616.20
5	80.00	4.51	-18.47	-19.52	-0.00789	0.00	-60.00	-47.40	-214.00
6	100.00	-4.51	-27.49	-28.55	-0.01175	0.00	-60.00	-47.40	214.00
7	120.00	-13.00	-35.98	-37.03	-0.01538	0.00	-60.00	-47.40	616.20
8	140.00	-19.92	-42.90	-43.95	-0.01833	0.00	-60.00	-47.40	944.07
9	160.00	-24.43	-47.41	-48.47	-0.02026	0.00	-60.00	-47.40	1158.08
10	180.00	-26.00	-48.98	-50.03	-0.02093	0.00	-60.00	-47.40	1232.40
11	200.00	-24.43	-47.41	-48.47	-0.02026	0.00	-60.00	-47.40	1158.08
12	220.00	-19.92	-42.90	-43.95	-0.01833	0.00	-60.00	-47.40	944.07
13	240.00	-13.00	-35.98	-37.03	-0.01538	0.00	-60.00	-47.40	616.20
14	260.00	-4.51	-27.49	-28.55	-0.01175	0.00	-60.00	-47.40	214.00
15	280.00	4.51	-18.47	-19.52	-0.00789	0.00	-60.00	-47.40	-214.00
16	300.00	13.00	-9.98	-11.03	-0.00427	0.00	-60.00	-47.40	-616.20
17	320.00	19.92	-3.06	-4.12	-0.00131	0.00	-37.96	-29.99	-597.29
18	340.00	24.43	1.45	0.40	0.00062	0.79	17.99	11.86	289.88

(Case 2)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	10.00	25.61	2.63	1.58	0.00112	0.79	32.58	23.39	598.80
2	30.00	22.52	-0.46	-1.51	-0.00020	0.00	-5.66	-4.48	-100.76
3	50.00	16.71	-6.26	-7.32	-0.00267	0.00	-60.00	-47.40	-792.17
4	70.00	8.89	-14.08	-15.14	-0.00601	0.00	-60.00	-47.40	-421.51
5	90.00	0.00	-22.97	-24.03	-0.00981	0.00	-60.00	-47.40	0.00
6	110.00	-8.89	-31.87	-32.92	-0.01361	0.00	-60.00	-47.40	421.51
7	130.00	-16.71	-39.69	-40.74	-0.01695	0.00	-60.00	-47.40	792.17
8	150.00	-22.52	-45.49	-46.54	-0.01942	0.00	-60.00	-47.40	1067.29
9	170.00	-25.61	-48.58	-49.63	-0.02074	0.00	-60.00	-47.40	1213.68
10	190.00	-25.61	-48.58	-49.63	-0.02074	0.00	-60.00	-47.40	1213.68
11	210.00	-22.52	-45.49	-46.54	-0.01942	0.00	-60.00	-47.40	1067.29
12	230.00	-16.71	-39.69	-40.74	-0.01695	0.00	-60.00	-47.40	792.17
13	250.00	-8.89	-31.87	-32.92	-0.01361	0.00	-60.00	-47.40	421.51
14	270.00	0.00	-22.97	-24.03	-0.00981	0.00	-60.00	-47.40	0.00
15	290.00	8.89	-14.08	-15.14	-0.00601	0.00	-60.00	-47.40	-421.51
16	310.00	16.71	-6.26	-7.32	-0.00267	0.00	-60.00	-47.40	-792.17
17	330.00	22.52	-0.46	-1.51	-0.00020	0.00	-5.66	-4.48	-100.76
18	350.00	25.61	2.63	1.58	0.00112	0.79	32.58	23.39	598.80

Individual Bars (Case 3)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	26.00	50.11	41.99	0.00278	0.79	60.00	45.05	1171.29
2	20.00	24.43	48.54	40.43	0.00269	0.79	60.00	45.05	1100.66
3	40.00	19.92	44.03	35.91	0.00244	0.79	60.00	45.05	897.26
4	60.00	13.00	37.11	28.99	0.00206	0.79	59.67	44.79	582.23
5	80.00	4.51	28.63	20.51	0.00159	0.79	46.02	34.01	153.55
6	100.00	-4.51	19.60	11.48	0.00109	0.79	31.51	22.54	-101.77
7	120.00	-13.00	11.11	2.99	0.00062	0.79	17.86	11.76	-152.92
8	140.00	-19.92	4.19	-3.92	0.00023	0.00	6.74	5.33	-106.10
9	160.00	-24.43	-0.32	-8.44	-0.00002	0.00	-0.52	-0.41	9.96
10	180.00	-26.00	-1.89	-10.01	-0.00010	0.00	-3.04	-2.40	62.38
11	200.00	-24.43	-0.32	-8.44	-0.00002	0.00	-0.52	-0.41	9.96
12	220.00	-19.92	4.19	-3.92	0.00023	0.00	6.74	5.33	-106.10
13	240.00	-13.00	11.11	2.99	0.00062	0.79	17.86	11.76	-152.92
14	260.00	-4.51	19.60	11.48	0.00109	0.79	31.51	22.54	-101.77
15	280.00	4.51	28.63	20.51	0.00159	0.79	46.02	34.01	153.55
16	300.00	13.00	37.11	28.99	0.00206	0.79	59.67	44.79	582.23
17	320.00	19.92	44.03	35.91	0.00244	0.79	60.00	45.05	897.26
18	340.00	24.43	48.54	40.43	0.00269	0.79	60.00	45.05	1100.66

TIA-222- H

Solve

*Highlighted cells have been modified

FACTORED LOADS

Axial Load 0.9D:	$P_{\_0.9D}$ = 0.9 * Pcomp / 1.2	$P_{\_0.9D}$ =	36.75	kip
Axial Load 1.2D:	$P_{\_1.2D}$ = 1.2 * Pcomp / 1.2	$P_{\_1.2D}$ =	49.00	kip
Shear Load:	V_u = Vu_comp	V_u =	35.00	kip
Moment:	M_u = Mu	M_u =	3619.00	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} =	6.00	ft
Force of Pp Applied on Pad:	$Force_{pad}$ = MIN(Vu-$Force_{pier}$,SUM(Pp!M8:M13))	$Force_{pad}$ =	35.00	kip
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} =	1.31	ft
Unfactored Moment Resistance due to Passive Pressure:	$M_{R\_Pp} = Force_{pier}*M_{arm\_pier}+Force_{pad}*M_{arm\_pad}$	M_{R_Pp} =	45.70	kip*ft
Factored Moment Resistance due to Passive Pressure:	$\Phi M_{R\_Pp} = \Phi_s*M_{R\_Pp}$	ΦM_{R_Pp} =	34.28	kip*ft

ELASTIC BEARING PRESSURE & OVERTURNING MOMENT

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9\_e}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing_e	$P_{bearing\_0.9\_e}$ =	610.51	kip
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2\_e}$ = P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing_e	$P_{bearing\_1.2\_e}$ =	814.01	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	$M_{overturning\_0.9}$ =	4050.34	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	$M_{overturning\_1.2}$ =	4114.40	kip*ft
Area of Pad:	Area = W²	Area =	812.25	ft²
Elastic Section Modulus of Pad:	S = W³ / 6	S =	3858.19	ft³
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_e} = M_{overturning}/P_{bearing\_0.9}$	$pre\_ec_{\_0.9\_e}$ =	6.63	ft
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_e} = M_{overturning}/P_{bearing\_1.2}$	$pre\_ec_{\_1.2\_e}$ =	5.05	ft
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_e}$ = *goal seek*	$ec_{\_0.9\_e}$ =	6.58	ft — L/6 < e <= L/2
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_e}$ = *goal seek*	$ec_{\_1.2\_e}$ =	5.01	ft — L/6 < e <= L/2
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9\_e}$ = W-(W/2-ec_0.9_e)*3	$NBL_{\_0.9\_e}$ =	5.48	ft
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2\_e}$ = W-(W/2-ec_1.2_e)*3	$NBL_{\_1.2\_e}$ =	0.79	ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9\_e} = \Phi M_{R\_Pp}$ + SUM($\Phi M_{R\_wedges\_0.9}$,$\Phi M_{R\_shear\_0.9}$)	$\Phi M_{Resisting\_0.9\_e}$ =	34.28	kip*ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2\_e} = \Phi M_{R\_Pp}$ + SUM($\Phi M_{R\_wedges\_1.2}$,$\Phi M_{R\_shear\_1.2}$)	$\Phi M_{Resisting\_1.2\_e}$ =	34.28	kip*ft
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9\_e} = M_{overturning} - \Phi M_{Resisting\_0.9}$	$M_{overturning\_0.9\_e}$ =	4016.06	kip*ft
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2\_e} = M_{overturning} - \Phi M_{Resisting\_1.2}$	$M_{overturning\_1.2\_e}$ =	4080.12	kip*ft
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9\_e} = P_{bearing\_0.9}*ec_{\_0.9\_p} + \Phi M_{Resisting\_0.9}$	$\Phi M_{Resisting\_qu\_0.9\_e}$ =	4050.34	kip*ft
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2\_e} = P_{bearing\_1.2}*ec_{\_1.2\_p} + \Phi M_{Resisting\_1.2}$	$\Phi M_{Resisting\_qu\_1.2\_e}$ =	4114.40	kip*ft
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_0.9\_e} = M_{overturning} - \Phi M_{Resisting\_qu\_0.9}$	$\Delta M_{\_0.9\_e}$ =	0.00	kip*ft
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{\_1.2\_e} = M_{overturning} - \Phi M_{Resisting\_qu\_1.2}$	$\Delta M_{\_1.2\_e}$ =	0.00	kip*ft

Bearing Pressures

*Orthogonal Bearing Pressure (0.9*D LC):*	$q_{u\_orth\_0.9\_e}$ = ((2/3)*Pbearing_0.9_e) / (W*(W/2-ec_0.9_e))	$q_{u\_orth\_0.9\_e}$ =	1.86	ksf
*Orthogonal Bearing Pressure (1.2*D LC):*	$q_{u\_orth\_1.2\_e}$ = ((2/3)*Pbearing_1.2_e) / (W*(W/2-ec_1.2_e))	$q_{u\_orth\_1.2\_e}$ =	2.06	ksf
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} =	12.00	ksf
Factored Ultimate Gross Bearing Pressure:	Qa = φs * Qult	Qa =	9.00	ksf

Check **Qa = 9.00 ksf >= q_u = 2.06 ksf** **RATING: 22.90% OK**

Soil Wedges (Cohesionless Soil)

1 1

Soil (above pad) Height:	soilht = D-T	soilht =	3.25	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:	$Wedge_{\_proj}$ = 0	$Wedge_{\_proj}$ =	0.00	ft
Soil Wedge Projection at Water Table:	$Wedge_{\_proj\_gw}$ = 0	$Wedge_{\_proj\_gw}$ =	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	28.50	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	25.76	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	25.76	0.00
(1) Rear (above Water Table)	0.00	0.00	28.50	0.00
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00
Total	0.00	0.00		0.00

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):*	$M_{R\_wedges\_0.9\_e}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_0.9\_e}$ =	0.00	kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$\Phi M_{R\_wedges\_0.9\_e}$ = 0.75*MR_wedges_0.9_e	$\Phi M_{R\_wedges\_0.9\_e}$ =	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	28.50	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	28.11	0.00

(2) Partial Sides (below Water Table)	0.00	0.00	28.11	0.00	Eccentricity relative to W/2:	
(1) Rear (above Water Table)	0.00	0.00	28.50	0.00	Total Moment Arm (ft) =	0.00
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00		
Total	0.00	0.00		0.00	Soil Wedge Wt (kip)=	0.00

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

*Factored Resisting Moment of Wedges (1.2*D LC):* $\Phi M_{R\_wedges\_1.2\_e}$ = 0.75*MR_wedges_1.2_e — $\Phi M_{R\_wedges\_1.2\_e}$ = 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)	Eccentricity relative to W/2:	
Rear	0.00	0.00	28.50	0.00	Total Moment Arm (ft) =	0.00
(2) Partial Sides	0.00	0.00	25.76	0.00		
Total		0.00		0.00	Soil Shear Strength (kip)=	0.00

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

*Factored Resisting Moment of Soil Shear (0.9*D LC):* $\Phi M_{R\_shear\_0.9\_e}$ = 0.75 * (Total Moment Arm * Soil Shear Strength) — $\Phi M_{R\_shear\_0.9\_e}$ = 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)	Eccentricity relative to W/2:	
Rear	0.00	0.00	28.50	0.00	Total Moment Arm (ft) =	0.00
(2) Partial Sides	0.00	0.00	28.11	0.00		
Total		0.00		0.00	Soil Shear Strength (kip)=	0.00

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

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

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (ORTHOGONAL)

*Compressive Load for Bearing (0.9*D LC):*	$P_{\_100\_e}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100_e	$P_{\_100\_e}$ =	610.51	kip	
Preliminary Factored Overturning Moment:	$pre\_M_{overturning\_100\_e}$ = P_100_e * (W/2 - ((2/3) * P_100_e) / (W * ΦQult))	$pre\_M_{overturning\_100\_e}$ =	7731.00	kip*ft	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_100\_e}$ = $pre\_M_{overturning\_100}$ / $P_{\_100}$	$pre\_ec_{\_100\_e}$ =	12.66	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_100\_e}$ = *goal seek*	$ec_{\_100\_e}$ =	12.61	ft	L/6 < e <= L/2
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_100\_e}$ = W-(W/2-ec_100_e)*3	$NBL_{\_100\_e}$ =	23.57	ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_100\_e}$ = ΦM_{R_Pp} + SUM($\Phi M_{R\_wedges\_100}$,$\Phi M_{R\_shear\_100}$)	$\Phi M_{Resisting\_100\_e}$ =	34.28	kip*ft	
Moment Created by Shear:	M_{shear_e} = V_u * (D+E+bp_{dist}/12)	M_{shear_e} =	239.17	kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_100\_e}$ = $M_{u\_max\_100}$ - ΦM_{R_Pp}	$M_{overturning\_100\_e}$ =	7731.00	kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_100\_e}$ = $P_{\_100}$*$ec_{\_100}$ + $\Phi M_{Resisting\_100}$	$\Phi M_{Resisting\_qu\_100\_e}$ =	7731.00	kip*ft	
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_100\_e}$ = $M_{overturning}$ - $\Phi M_{Resisting\_qu\_100}$	$\Delta M_{\_100\_e}$ =	0.00	ft	
Maximum Applied Moment from Superstructure Analysis:	$M_{u\_max\_100\_e}$ = pre_Moverturning_100 + ΦMResisting_100	$M_{u\_max\_100\_e}$ =	7765.27	kip*ft	

Check — **Mu_max_100_e = 7765.27 kip*ft >= Mu = 4050.34 kip*ft** — **RATING: 52.16% 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)	0.00	0.00	28.50	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	16.71	0.00		
(2) Partial Sides (below Water Table)	0.00	0.00	16.71	0.00	Eccentricity relative to W/2:	
(1) Rear (above Water Table)	0.00	0.00	28.50	0.00	Total Moment Arm (ft) =	0.00
(1) Rear (below Water Table)	0.00	0.00	0.00	0.00		
Total	0.00	0.00		0.00	Soil Wedge Wt (kip)=	0.00

*Unfactored Resisting Moment of Wedges (0.9*D LC):* $M_{R\_wedges\_100\_e}$ = Total Moment Arm * Soil Wedge Wt — $M_{R\_wedges\_100\_e}$ = 0.00 kip*ft

*Factored Resisting Moment of Wedges (0.9*D LC):* $\Phi M_{R\_wedges\_100\_e}$ = 0.75*MR_wedges_100_e — $\Phi M_{R\_wedges\_100\_e}$ = 0.00 kip*ft

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)	Eccentricity relative to W/2:	
Rear	0.00	0.00	28.50	0.00	Total Moment Arm (ft) =	0.00
(2) Partial Sides	0.00	0.00	16.71	0.00		
Total		0.00		0.00	Soil Shear Strength (kip)=	0.00

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

*Factored Resisting Moment of Soil Shear (0.9*D LC):* $\Phi M_{R\_shear\_100\_e}$ = 0.75 * (Total Moment Arm * Soil Shear Strength) — $\Phi M_{R\_shear\_100\_e}$ = 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} =	6.00	ft
Force of Pp Applied on Pad:	$Force_{pad\_dia}$ = MIN(Vu-$Force_{pier}$,SUM(Pp!M8:M13))	$Force_{pad\_dia}$ =	35.00	kip
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} =	1.31	ft
Unfactored Moment Resistance due to Passive Pressure:	M_{R_Pp} = $Force_{pier}$*M_{arm_pier}+$Force_{pad}$*M_{arm_pad}	M_{R_Pp} =	45.70	kip*ft
Factored Moment Resistance due to Passive Pressure:	$\Phi M_{R\_Pp\_dia}$ = Φ_s*M_{R_Pp}	$\Phi M_{R\_Pp\_dia}$ =	34.28	kip*ft

PLASTIC BEARING PRESSURE & OVERTURNING MOMENT (DIAGONAL DIRECTION)

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9\_dia\_e}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing_dia_e	$P_{bearing\_0.9\_dia\_e}$ =	610.51	kip	
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2\_dia\_e}$ = P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing_dia_e	$P_{bearing\_1.2\_dia\_e}$ =	814.01	kip	
Factored Overturning Moment:	$M_{overturning}$ = M_u + V_u * (D+E+bp_{dist}/12)	$M_{overturning}$ =	3858.17	kip*ft	
Area of Pad:	Area = W²	Area =	812.25	ft²	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_e\_dia}$ = $M_{overturning}$/$P_{bearing\_0.9\_dia\_e}$	$pre\_ec_{\_0.9\_e\_dia}$ =	6.63	ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_e\_dia}$ = $M_{overturning}$/$P_{bearing\_1.2\_dia\_e}$	$pre\_ec_{\_1.2\_e\_dia}$ =	4.98	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_e\_dia}$ = *goal seek*	$ec_{\_0.9\_e\_dia}$ =	6.58	ft	(L/6)*SQRT(2)/2 < e <= (L/2)*SQRT(2)

*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_e\_dia}$ = *goal seek*	$ec_{\_1.2\_e\_dia}$ = 4.93	ft
Elastic Section Modulus in Diagonal Direction:	$S_{\_dia}$ = (W³)/(6*SQRT(2))	$S_{\_dia}$ = 2728.15	ft³
*Slope of Bearing Pressure in Diagonal Direction (0.9*D LC):*	$slope_{\_dia\_e\_0.9}$ = D_1*($q_{max\_dia\_0.9\_e}$/(W/2*SQRT(2)+D_1))	$slope_{\_dia\_e\_0.9}$ = 0.69	ft/ft

(L/6)*SQRT(2)/2 < e <= (L/2)*SQRT(2)

*Diagonal Bearing Pressure Solution (if bearing area is > Area/2) (0.9*D LC):*

	Wedge 1	Wedge 2	Total
	7.95	2.43	
Volume (ft³):	95.64	514.87	610.51
Distance to Centroid from Center of Foundation (ft):	-2.45	8.26	6.58

*Slope of Bearing Pressure in Diagonal Direction (1.2*D LC):*	$slope_{\_dia\_e\_1.2}$ = D_2*($q_{max\_dia\_1.2\_e}$/(W/2*SQRT(2)+D_2))	$slope_{\_dia\_e\_1.2}$ = 0.99	ft/ft

*Diagonal Bearing Pressure Solution (if bearing area is > Area/2) (1.2*D LC):*

	Wedge 1	Wedge 2	Total
	13.08	2.52	
Volume (ft³):	204.76	609.25	814.01
Distance to Centroid from Center of Foundation (ft):	-3.76	7.86	4.94

*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9\_dia\_e}$ = 0	$NBL_{\_0.9\_dia\_e}$ = 17.25	ft
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2\_dia\_e}$ = 0	$NBL_{\_1.2\_dia\_e}$ = 10.00	ft
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9\_dia\_e\_2}$ = 0	$NBL_{\_0.9\_dia\_e\_2}$ = 0.00	ft
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2\_dia\_e\_2}$ = 0	$NBL_{\_1.2\_dia\_e\_2}$ = 0.00	ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$ΦM_{Resisting\_0.9\_dia\_e}$ = $ΦM_{R\_Pp\_dia}$ + SUM($ΦM_{R\_wedges\_0.9\_dia\_e}$,$ΦM_{R\_shear\_0.9\_dia\_e}$)	$ΦM_{Resisting\_0.9\_dia\_e}$ = 34.28	kip*ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$ΦM_{Resisting\_1.2\_dia\_e}$ = $ΦM_{R\_Pp\_dia}$ + SUM($ΦM_{R\_wedges\_1.2\_dia\_e}$,$ΦM_{R\_shear\_1.2\_dia\_e}$)	$ΦM_{Resisting\_1.2\_dia\_e}$ = 34.28	kip*ft
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9\_dia\_e}$ = $M_{overturning}$ - $ΦM_{Resisting\_0.9\_dia\_e}$	$M_{overturning\_0.9\_dia\_e}$ = 4016.06	kip*ft
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2\_dia\_e}$ = $M_{overturning}$ - $ΦM_{Resisting\_1.2\_dia\_e}$	$M_{overturning\_1.2\_dia\_e}$ = 4016.06	kip*ft
*Total Resistance to Overturning (0.9*D LC):*	$ΦM_{Resisting\_qu\_0.9\_dia\_e}$ = $P_{bearing\_0.9\_dia\_e}$*$ec_{\_0.9\_e\_dia}$ + $ΦM_{Resisting\_0.9\_dia\_e}$	$ΦM_{Resisting\_qu\_0.9\_dia\_e}$ = 4050.34	kip*ft
*Total Resistance to Overturning (1.2*D LC):*	$ΦM_{Resisting\_qu\_1.2\_dia\_e}$ = $P_{bearing\_1.2\_dia\_e}$*$ec_{\_1.2\_e\_dia}$ + $ΦM_{Resisting\_1.2\_dia\_e}$	$ΦM_{Resisting\_qu\_1.2\_dia\_e}$ = 4050.34	kip*ft
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$ΔM_{\_0.9\_dia\_e}$ = $M_{overturning}$-$ΦM_{Resisting\_qu\_0.9\_dia\_e}$	$ΔM_{\_0.9\_dia\_e}$ = 0.00	kip*ft
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$ΔM_{\_1.2\_dia\_e}$ = $M_{overturning}$-$ΦM_{Resisting\_qu\_1.2\_dia\_e}$	$ΔM_{\_1.2\_dia\_e}$ = 0.00	kip*ft

Bearing Pressures

*Diagonal Bearing Pressure (0.9*D LC):*	$q_{u\_dia\_0.9\_e}$ = qmax_dia_0.9_e	$q_{u\_dia\_0.9\_e}$ = 2.43	ksf
*Diagonal Bearing Pressure (1.2*D LC):*	$q_{u\_dia\_1.2\_e}$ = qmax_dia_1.2_e	$q_{u\_dia\_1.2\_e}$ = 2.52	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 = 2.52 ksf** **RATING: 27.98% OK**

Soil Wedges (Cohesionless Soil)

1 1

Soil (above pad) Height:	soilht = D-T	soilht = 3.25	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:	$Wedge_{\_proj}$ = 0	$Wedge_{\_proj}$ = 0.00	ft
Soil Wedge Projection at Water Table:	$Wedge_{\_proj\_gw}$ = 0	$Wedge_{\_proj\_gw}$ = 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	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) Rear Sides (above Water Table)	0.00	0.00	0.00	0.00
(2) Rear Sides (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (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 (0.9*D LC):*	$M_{R\_wedges\_0.9}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_0.9\_dia\_e}$ = 0.00	kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$ΦM_{R\_wedges\_0.9}$ = 0.75*MR_wedges_0.9_dia	$ΦM_{R\_wedges\_0.9\_dia\_e}$ = 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	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	0.00	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	0.00	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	$M_{R\_wedges\_1.2\_dia\_e}$ = 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	$ΦM_{R\_wedges\_1.2\_dia\_e}$ = 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	34.20	0.00
(2) Partial Sides	0.00	0.00	20.15	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	$M_{R\_shear\_0.9\_dia\_e}$ = 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)	$ΦM_{R\_shear\_0.9\_dia\_e}$ = 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	36.77	0.00
(2) Partial Sides	0.00	0.00	20.15	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 — $M_{R\_shear\_1.2\_dia\_e}$ = 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) — $\Phi M_{R\_shear\_1.2\_dia\_e}$ = 0.00 kip*ft

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (DIAGONAL)

*Compressive Load for Bearing (0.9*D LC):* $P_{\_100\_dia\_e}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100_dia_e — $P_{\_100\_dia\_e}$ = 610.51 kip

Preliminary Factored Overturning Moment: pre_$M_{overturning_100_dia_e}$ = P_100_dia_e*(W*SQRT(2) - SQRT(6*P_100_dia_e/(2*ΦQult)))/2 — pre_$M_{overturning_100_dia_e}$ = 7948.70 kip*ft

*Preliminary Load Eccentricity (0.9*D LC):* pre_$ec_{_100_dia_e}$ = pre_$M_{overturning_100_dia_e}$/$P_{\_100\_dia\_e}$ — pre_$ec_{_100_dia_e}$ = 13.02 ft

*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):* $ec_{\_100\_dia\_e}$ = *goal seek* — $ec_{\_100\_dia\_e}$ = 12.96 ft

*Non-Bearing Length (0.9*D LC):* $NBL_{\_100\_dia\_e}$ = W — $NBL_{\_100\_dia\_e}$ = 28.50 ft

*Non-Bearing Length (0.9*D LC):* $NBL_{\_100\_dia\_e\_2}$ = MIN((2*ec_100_dia_e - W/2*SQRT(2))*SQRT(2),W) — $NBL_{\_100\_dia\_e\_2}$ = 8.17 ft

*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):* $\Phi M_{Resisting\_100\_dia\_e}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_100\_dia}$,$\Phi M_{R\_shear\_100\_dia}$) — $\Phi M_{Resisting\_100\_dia\_e}$ = 34.28 kip*ft

Moment Created by Shear: M_{shear_e} = V_u * (D+E+bp_{dist}/12) — M_{shear_e} = 239.17 kip*ft

*Adjusted Overturning Moment (0.9*D LC):* $M_{overturning\_100\_dia\_e}$ = $M_{u\_max\_100\_dia}$ - $\Phi M_{R\_Pp\_dia}$ — $M_{overturning\_100\_dia\_e}$ = 7948.70 kip*ft

*Total Resistance to Overturning (0.9*D LC):* $\Phi M_{Resisting\_qu\_100\_dia\_e}$ = $P_{\_100\_dia\_e}$*$ec_{\_100\_dia\_e}$ + $\Phi M_{Resisting\_100\_dia\_e}$ — $\Phi M_{Resisting\_qu\_100\_dia\_e}$ = 7948.70 kip*ft

[Goal Seek] Moment Comparison Iteration (0.9D LC): $\Delta M_{\_100\_dia\_e}$ = $M_{overturning}$ - $\Phi M_{Resisting\_qu\_100\_dia}$ — $\Delta M_{\_100\_dia\_e}$ = 0.00 ft

Maximum Applied Moment from Superstructure Analysis: $M_{u\_max\_100\_dia\_e}$ = pre_Moverturning_100_dia + ΦMResisting_100_dia — $M_{u\_max\_100\_dia\_e}$ = 7982.98 kip*ft

Check	Mu_max_100_dia_e =	7982.98	kip*ft	>=	Mu =	4016.06	kip*ft	RATING:	50.31%	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)	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) Rear Sides (above Water Table)	0.00	0.00	0.00	0.00
(2) Rear Sides (below Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	0.00	0.00
(2) Partial Sides (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 (0.9*D LC):* $M_{R\_wedges\_100\_dia\_e}$ = Total Moment Arm * Soil Wedge Wt — $M_{R\_wedges\_100\_dia\_e}$ = 0.00 kip*ft

*Factored Resisting Moment of Wedges (0.9*D LC):* $\Phi M_{R\_wedges\_100\_dia\_e}$ = 0.75*MR_wedges_100_dia_e — $\Phi M_{R\_wedges\_100\_dia\_e}$ = 0.00 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	30.23	0.00
(2) Partial Sides	0.00	0.00	17.27	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):* $M_{R\_shear\_100\_dia\_e}$ = Total Moment Arm * Soil Shear Strength — $M_{R\_shear\_100\_dia\_e}$ = 0.00 kip*ft

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

ATTACHMENT E – PROOF OF DELIVERY OF NOTICE

Ref: CT587100-ES-033 Date: 03Nov20 SHIPPING: 0.00
Dep: BL GRAPHICS Wgt: 1.05 LBS SPECIAL: 0.00
HANDLING: 0.00
DV: 0.00 TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT
TRCK: 9151 3346 6728

ORIGIN ID:RSPA (800) 301-3077

BL COMPANIES
355 RESEARCH PARKWAY

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 03NOV20
ACTWGT: 1.05 LB
CAD: 0765627/CAFE3407

BILL THIRD PARTY

56DC3/51D8/05A2

TO

CONNECTICUT SITING COUNCIL
10 FRANKLIN SQUARE

NEW BRITAIN CT 06051

REF: CT587100-ES-033

DEPT: BL GRAPHICS

FedEx
Express

E

J201019110601uv

WED - 04 NOV 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **9151 3346 6728**

00 BDLA

06051
CT-US **BDL**

Part # 156148-434 RIT EXP 09/21

Ref: CT587100-ES-033 Date: 03Nov20 SHIPPING: 0.00
Dep: BL GRAPHICS Wgt: 1.05 LBS SPECIAL: 0.00
HANDLING: 0.00
DV: 0.00 TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT
TRCK: 9151 3346 6717

ORIGIN ID:RSPA (800) 301-3077

BL COMPANIES
355 RESEARCH PARKWAY

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 03NOV20
ACTWGT: 1.05 LB MAN
CAD: 0765627/CAFE3407

BILL THIRD PARTY

56DC3/51D8/05A2

TO **J.P. LANGLOIS, BUILDING OFFICIAL**
TOWN OF HARTLAND
22 SOUTH ROAD

EAST HARTLAND CT 06027
REF: CT587100-ES-033

DEPT: BL GRAPHICS

FedEx Express

E

J201019110601uv

WED - 04 NOV 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **9151 3346 6717**

00 EHTA

06027
CT-US **BDL**

Part # 156148-434 RIT EXP 09/21

Ref: CT587100-ES-033 Date: 03Nov20 SHIPPING: 0.00
Dep: BL GRAPHICS Wgt: 1.05 LBS SPECIAL: 0.00
HANDLING: 0.00
DV: 0.00 TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT
TRCK: 9151 3346 6706

ORIGIN ID:RSPA (800) 301-3077

BL COMPANIES
355 RESEARCH PARKWAY

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 03NOV20
ACTWGT: 1.05 LB
CAD: 0765627/CAFE3407

BILL THIRD PARTY

56DC3/51D8/05A2

TO **HONORABLE MAGI WINSLOW**
TOWN OF HARTLAND
22 SOUTH ROAD

EAST HARTLAND CT 06027
REF: CT587100-ES-033

DEPT: BL GRAPHICS

FedEx
Express

E

J201019110601uv

WED - 04 NOV 10:30A
PRIORITY OVERNIGHT

TRK# 0201 **9151 3346 6706**

00 EHTA

06027
CT-US **BDL**

Part # 156148-434 RIT EXP 09/21

SENDER: *COMPLETE THIS SECTION*	*COMPLETE THIS SECTION ON DELIVERY*
■ Complete items 1, 2, and 3. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X ☐ Agent ☐ Addressee B. Received by *(Printed Name)* — C. Date of Delivery
1. Article Addressed to: Navigator Properties C/O Mariner Tower P.O Box 2600 Kennebunkport, ME 04046	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No
9590 9402 1273 5246 1340 37	3. Service Type ☐ Adult Signature ☐ Adult Signature Restricted Delivery ☐ Certified Mail® ☐ Certified Mail Restricted Delivery ☐ Collect on Delivery ☐ Collect on Delivery Restricted Delivery ☐ Insured Mail ☐ Insured Mail Restricted Delivery (over $500) ☐ Priority Mail Express® ☐ Registered Mail™ ☐ Registered Mail Restricted Delivery ☐ Return Receipt for Merchandise ☐ Signature Confirmation™ ☒ Signature Confirmation Restricted Delivery
2. Article Number *(Transfer from service label)*	

PS Form 3811, July 2015 PSN 7530-02-000-9053 — Domestic Return Receipt

ATTACHMENT F - 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-033

2 Center Hill Road

West Hartland, CT 06091

September 2, 2020

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3. Power Density Calculation Methods..2
4. Calculated % MPE Results..3
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1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed Eversource installation on the self-support tower at 2 Center Hill Road in West Hartland, CT.

Eversource is proposing to install two omnidirectional antennas as part of its 220 MHz communications system, and one microwave dish for backhaul communications. Of the two proposed omnidirectional antennas, one is a transmit antenna and one is a receive-only antenna.

This report considers the proposed antenna configuration as detailed by Eversource along with power density information for the existing antennas to calculate the cumulative % MPE of the facility at ground level.

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

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

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

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

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

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

3. Power Density Calculation Methods

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

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

Where:

EIRP = Effective Isotropic Radiated Power = 1.64 x ERP

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

H = Horizontal Distance from antenna

V = Vertical Distance from radiation center of antenna

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

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

4. Calculated % MPE Results

Table 1 below outlines the power density information for the site. The proposed Eversource omnidirectional transmit antenna and microwave antennas have vertical beamwidths of 110° and 1.7°, respectively; therefore, the majority of the RF power is focused out towards the horizon. Please refer to Attachment C, for the vertical patterns of the proposed Eversource antennas. Likewise, the other transmit antennas exhibit similar directionality of varying vertical beamwidths. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the facility. The calculated results in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below any panel and omni-directional antennas, and a nominal 30 dB off-beam pattern loss for the highly directional point-to-point microwave antenna to account for the lower relative gain below the antennas. Any inactive or receive-only antennas are not included in the table, as they are irrelevant in terms of the % MPE calculations. The blue shaded entries represent the proposed antennas, whereas the green shaded entries represent the existing Eversource transmit antennas on the tower.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	% MPE
Verizon	169	1970	3	327	0.0013	1.0000	0.13%
Verizon	169	869	9	345	0.0042	0.5793	0.73%
Verizon	169	2145	1	670	0.0009	1.0000	0.09%
Verizon	169	698	1	571	0.0008	0.4653	0.17%
AT&T	158	880	2	565	0.0018	0.5867	0.30%
AT&T	158	1900	2	875	0.0027	1.0000	0.27%
AT&T	158	880	1	283	0.0004	0.5867	0.08%
AT&T	158	1900	4	525	0.0033	1.0000	0.33%
AT&T	158	734	1	1313	0.0020	0.4893	0.42%
Eversource	189.5	220	1	500	0.0005	0.2000	0.27%
Eversource	185.5	48.4	1	500	0.0006	0.2000	0.28%
Eversource	124	6197.24	1	11143	0.0003	1.0000	0.03%
Eversource	110	217	4	124	0.0017	0.2000	0.83%
						Total	**3.91%**

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

[1] Antenna heights listed for all operators are based upon the Black & Veatch Structural Analysis Report dated June 11, 2020.

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

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 composite percent of Maximum Permissible Exposure expected at ground level with the proposed installation is **3.91% 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.

Keith Vellante

September 2, 2020

Report Prepared By: Keith Vellante
Director of RF Services
C Squared Systems, LLC

Date

Attachment A: References

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

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

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

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

(A) Limits for Occupational/Controlled Exposure[3]

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[4]

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)

[3] 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

[4] 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

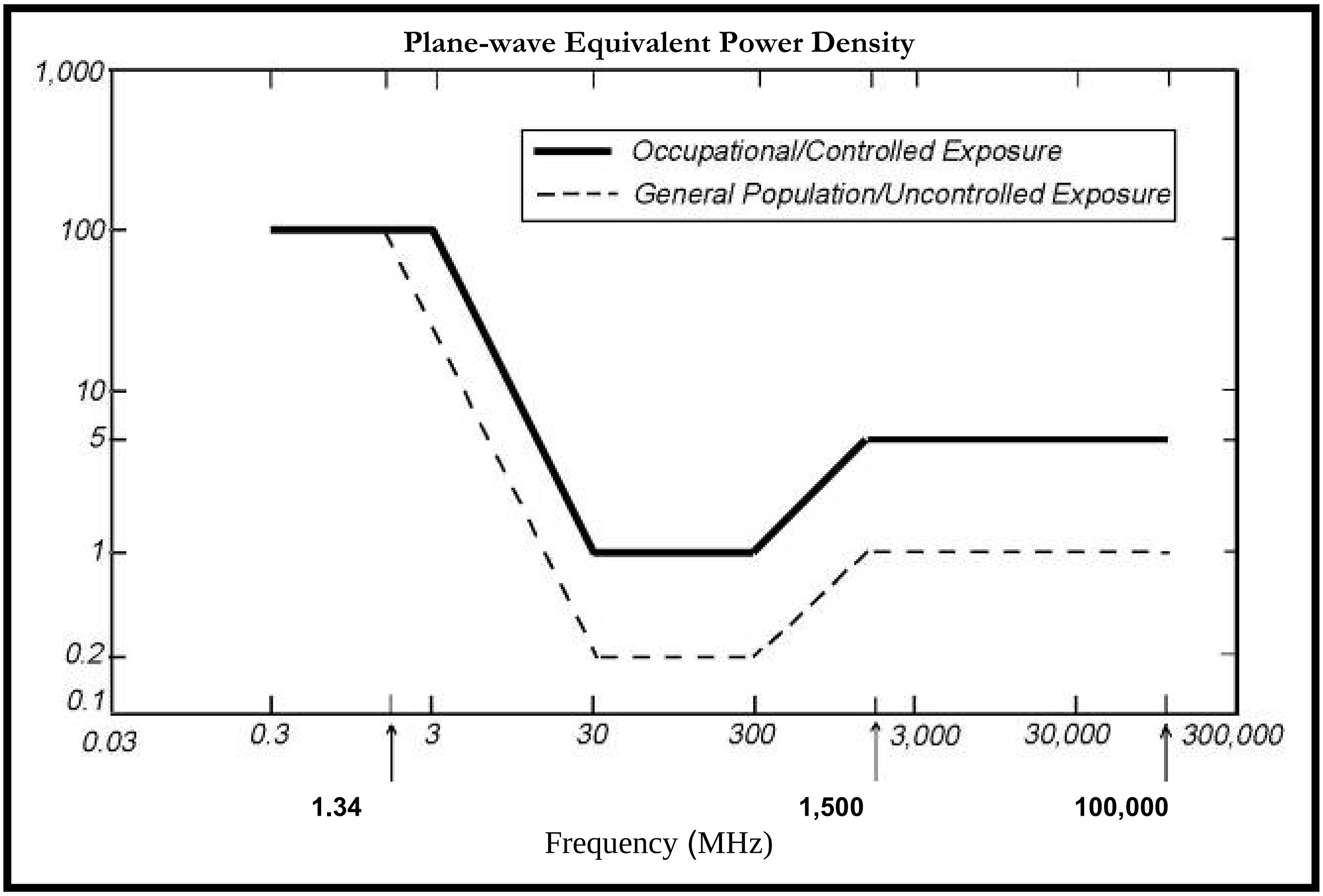
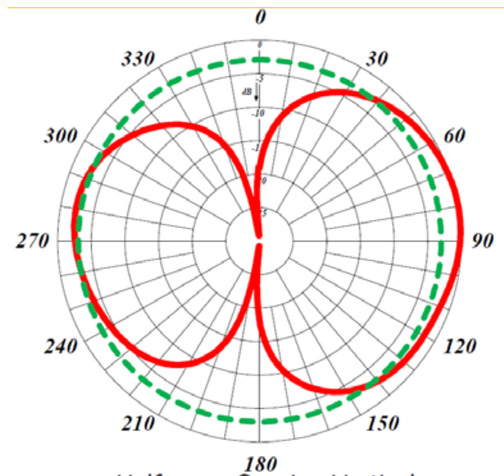


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

C2 Systems

Attachment C: Eversource Antenna Data Sheet and Electrical Patterns

217 MHz	
Manufacturer:	Comprod
Model #:	871F-70-220
Frequency Band:	215-225 MHz
Gain:	2.5 dBd
Vertical Beamwidth:	110°
Horizontal Beamwidth:	360°
Polarization:	Vertical
Length:	66”



Half-wave Spacing Vertical

6197.24 MHz	
Manufacturer:	RFS
Model #:	PAD6-59
Frequency Band:	5.925-6.875 MHz
Gain:	38.4 dBi
Vertical Beamwidth:	1.7°
Horizontal Beamwidth:	1.7°
Polarization:	Single
Diameter:	6’