EVERSOURCE ENERGY

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

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

May 22, 2020

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

RE: **Notice of Exempt Modification**
Eversource Site # 3932
135 New Road, Madison, CT 06443
Latitude: 41-17-36.3 N / Longitude: 72-34-42.2 W

Dear Ms. Bachman:

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource") currently maintains three antennas and one microwave dish mounted near the top of an existing 181-foot guyed tower located at 135 New Road in Madison. See Attachment A, Parcel Map and Property Card. The tower and property are owned by Eversource. Eversource plans to install one 24-foot tall omni-directional antenna to be mounted at 177 feet above ground level ("AGL") and two 7/8-inch diameter coaxial cables. There will be no changes to the area of the fenced compound, the tower or the existing antennas and equipment currently mounted on the tower. The tower and existing and proposed equipment on the tower are depicted on Attachment B, Construction Drawings, dated March 9, 2020 and Attachment C, Structural Analysis, dated March 4, 2020.

While the Connecticut Siting Council telecommunications database does not provide a docket or petition number for the approval of this structure, it does reference this structure in connection with prior exempt modification filings captioned EM-OCI-076-980825, EM-METRICOM-076-001226, EM-AT&T-076-020927, and EM-T-MOBILE-076-140508. 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 Peggy Lyons, First Selectwoman for the Town of Madison and David Anderson, Town Planner for the Town of Madison via the United States Postal Service or private carrier. Proof of delivery is attached. See Attachment D, Proof of Delivery of Notice.

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

1. There will be no change to the height of the existing tower.
2. The proposed modifications will not require the extension of the site boundary.
3. The proposed modification will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.
4. The operation of the new antennas will not increase radio frequency emissions at the facility to a level at or above the Federal Communications Commission safety standard as shown in the attached Radio Frequency Emissions Report, dated April 2, 2020 (Attachment E – 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). Two copies of this notice and a check in the amount of $625 are enclosed.

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

By:

Kathleen M. Shanley
Manager – Transmission Siting

cc: Honorable Peggy Lyons, First Selectwoman, Town of Madison
David Anderson, Town Planner, Town of Madison

Attachments

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

[1] It should be noted that the number of transmitting antennas accounted for in the Power Density Report does account for multiple channels for singular antennas. As such, the number of antennas depicted on the Structural Analysis, Construction Drawings and Power Density Report differ. Also, the "Antenna Height" column on Table 1 in the Power Density Report only accounts for the centerline of the Transmit or "TX" antenna centerline.

ATTACHMENT A – PARCEL MAP AND PROPERTY CARD

135 New Road, Madison, CT 06443

Legend

- Approximate Tower Location

Location

Notes

This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

1,125 0 563 1,125

Feet

1: 6,751

N

135 NEW RD

Location	135 NEW RD	**MBLU**	60/ 8/ / /
Acct#	00379700	**Owner**	CONNECTICUT LIGHT AND POWER CO
Assessment	$3,681,500	**Appraisal**	$6,186,900
PID	3932	**Building Count**	2

Current Value

Appraisal					
Valuation Year	**Building**	**Extra Features**	**Outbuildings**	**Land**	**Total**
2018	$3,705,600	$27,500	$1,054,700	$1,399,100	$6,186,900

Assessment					
Valuation Year	**Building**	**Extra Features**	**Outbuildings**	**Land**	**Total**
2018	$2,594,000	$19,300	$738,300	$329,900	$3,681,500

Parcel Addreses

Additional Addresses		
Address	**City, State Zip**	**Type**
135 NEW RD		Primary

Owner of Record

Owner	CONNECTICUT LIGHT AND POWER CO	**Sale Price**	$0
Co-Owner		**Book & Page**	139/ 397
Care Of		**Sale Date**	

Ownership History

Ownership History			
Owner	**Sale Price**	**Book & Page**	**Sale Date**
CONNECTICUT LIGHT AND POWER CO	$0	139/ 397	

Building Information

Building 1 : Section 1

Year Built: 1978
Living Area: 29,608

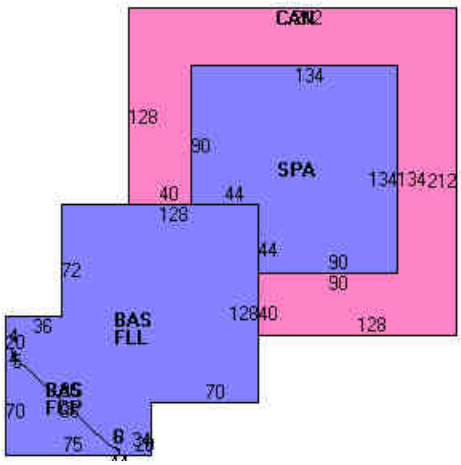
Building Attributes

Field	Description
STYLE	Office Bldg
MODEL	Commercial
Stories:	2
Exterior Wall 1	Stone/Masonry
Exterior Wall 2	Concr/Cinder
Roof Structure	Flat
Roof Cover	T+G/Rubber
Interior Wall 1	Minim/Masonry
Interior Wall 2	Drywall
Interior Floor 1	Concr-Finished
Interior Floor 2	Carpet
Heating Fuel	Electric
Heating Type	Forced Air-Duc
AC Type	Central
Bldg Use	Office Building
Total Rooms	
Total Bedrms	00
Total Baths	0
Fireplace	
Xtra Fireplaces	
Heat/AC	Heat A/C Split
Frame Type	Masonary
Baths/Plumbing	Average
Ceiling/Wall	Ceil and Wall
Rooms/Prtns	Average
Wall Height	14

Building Photo

(http://images.vgsi.com/photos/MadisonCTPhotos//\01\01\34/90

Building Layout



(http://images.vgsi.com/photos/MadisonCTPhotos//Sketches/393

Building Sub-Areas (sq ft)			
Code	**Description**	**Gross Area**	**Living Area**
BAS	First Floor	21,598	21,598
SPA	Service Production Area	16,020	8,010
CAN	Canopy	21,868	0
FCP	Carport	2,550	0
FLL	Finished Lower Level	19,048	0
		81,084	29,608

Building 2 : Section 1

Year Built: 1978
Living Area: 7,042

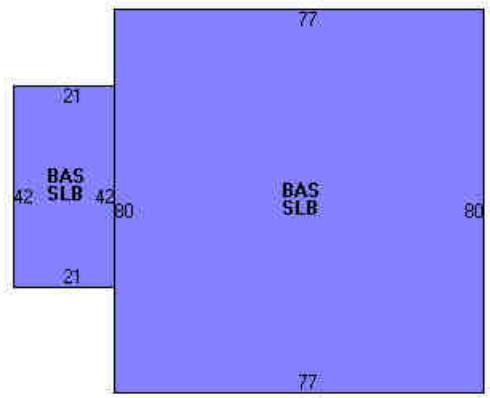
Building Attributes : Bldg 2 of 2	
Field	**Description**
STYLE	Service Shop
MODEL	Commercial

Stories:	1
Exterior Wall 1	Brick/Masonry
Exterior Wall 2	
Roof Structure	Flat
Roof Cover	T+G/Rubber
Interior Wall 1	Minim/Masonry
Interior Wall 2	
Interior Floor 1	Concr-Finished
Interior Floor 2	
Heating Fuel	Electric
Heating Type	Electr Basebrd
AC Type	None
Bldg Use	Office Building
Total Rooms	
Total Bedrms	00
Total Baths	0
Fireplace	
Xtra Fireplaces	
Heat/AC	None
Frame Type	Masonary
Baths/Plumbing	None
Ceiling/Wall	None
Rooms/Prtns	LIght
Wall Height	24

Building Photo

(http://images.vgsi.com/photos/MadisonCTPhotos//\01\01\34/91

Building Layout



(http://images.vgsi.com/photos/MadisonCTPhotos//Sketches/393

Building Sub-Areas (sq ft)			
Code	**Description**	**Gross Area**	**Living Area**
BAS	First Floor	7,042	7,042
SLB	Slab	7,042	0
		14,084	7,042

Extra Features

Extra Features				
Code	**Description**	**Size**	**Value**	**Bldg #**
LDL1	Load Levelers	1 UNITS	$1,700	1
MEZ1	Mezzanine Unf	3960 S.F.	$18,400	1
MEZ1	Mezzanine Unf	1600 S.F.	$7,400	2

Land

Land Use

Land Line Valuation

Use Code 3400
Description Office Building
Zone RU-2

Size (Acres) 37.98

Outbuildings

Outbuildings						
Code	**Description**	**Sub Code**	**Sub Description**	**Size**	**Value**	**Bldg #**
PAV1	Paving Asphalt			400000 S.F.	$280,000	1
LT12	Lights(4)			26 UNITS	$52,000	1
LT10	Lights (2)			3 UNITS	$3,000	1
LT9	Lights			18 UNITS	$12,600	1
FN3	Fence 6'			6000 L.F.	$36,000	1
SHD1	Shed			96 S.F.	$600	1
SHD1	Shed			120 S.F.	$800	1
SHD6	Pump Sta.			192 S.F.	$14,400	1
SHD1	Shed			96 S.F.	$600	1
SHD1	Shed			80 S.F.	$300	1
CEL	Cell Tower			4 UNITS	$654,400	1

/

ATTACHMENT B – CONSTRUCTION DRAWINGS

EVERSOURCE ENERGY

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

PROJECT SUMMARY

THE GENERAL SCOPE OF WORK CONSISTS OF THE FOLLOWING:

1. INSTALL (1) NEW OMNI/WHIP ANTENNA AT ELEVATION 202'–0"± AGL
2. INSTALL (1) NEW RACK WITH DMR EQUIPMENT IN EXISTING BUILDING

GOVERNING CODES

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

GENERAL NOTES

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

SITE INFORMATION

SITE NAME:	MADISON AWC
SITE ID NUMBER:	#3932
SITE ADDRESS:	135 NEW ROAD MADISON, CT 06443
MAP:	60
BLOCK:	8
ZONE:	RU–2
LATITUDE:	41° 17' 36.3" N
LONGITUDE:	72° 34' 42.2" W
ELEVATION:	62'–6"± AMSL
FEMA/FIRM DESIGNATION:	X
ACREAGE:	38 ± AC (BOOK 139, PAGE: 397)

CONTACT INFORMATION

APPLICANTS:
EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037

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

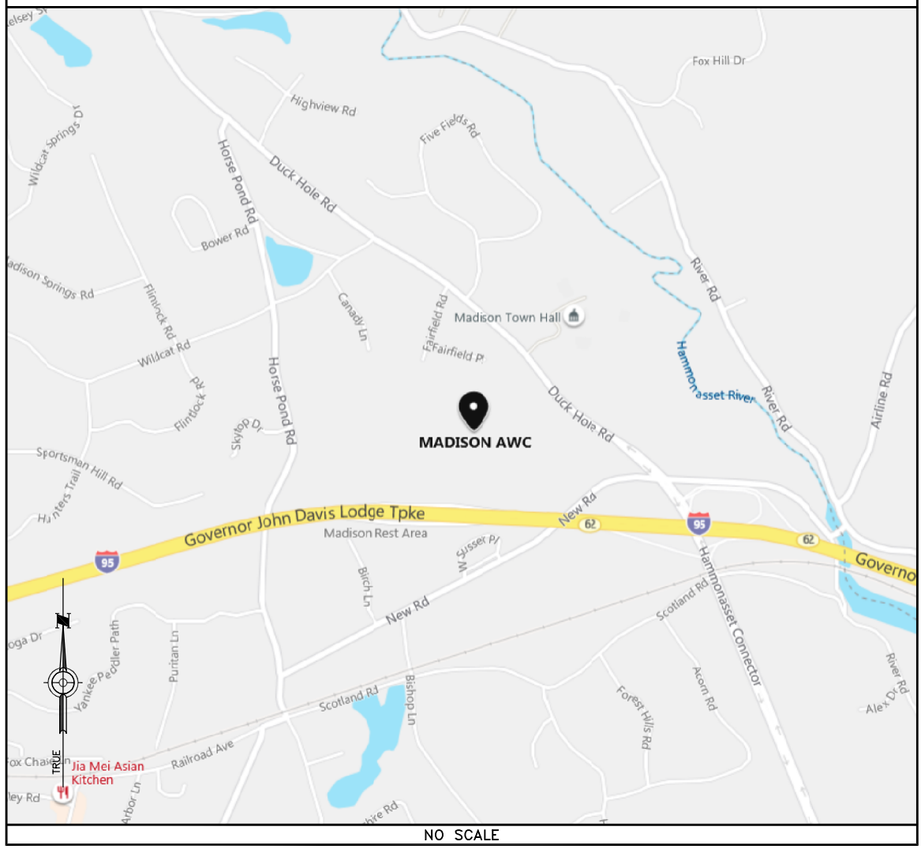
EVERSOURCE ENERGY
PROJECT MANAGER:
NIKOLL PRECI
(860) 655–3079

POWER PROVIDER:
EVERSOURCE ENERGY
(800) 286–2000

TELCO PROVIDER:
FRONTIER
(800) 921–8102

CALL BEFORE YOU DIG:
(800) 922–4455

LOCATION MAP



NO SCALE

DESIGN TYPE

SITE UPGRADE
SELF–SUPPORT TOWER

DRAWING INDEX

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

DO NOT SCALE DRAWINGS

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

UNDERGROUND SERVICE ALERT

UTILITIES PROTECTION CENTER, INC.
811

48 HOURS BEFORE YOU DIG

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

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

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

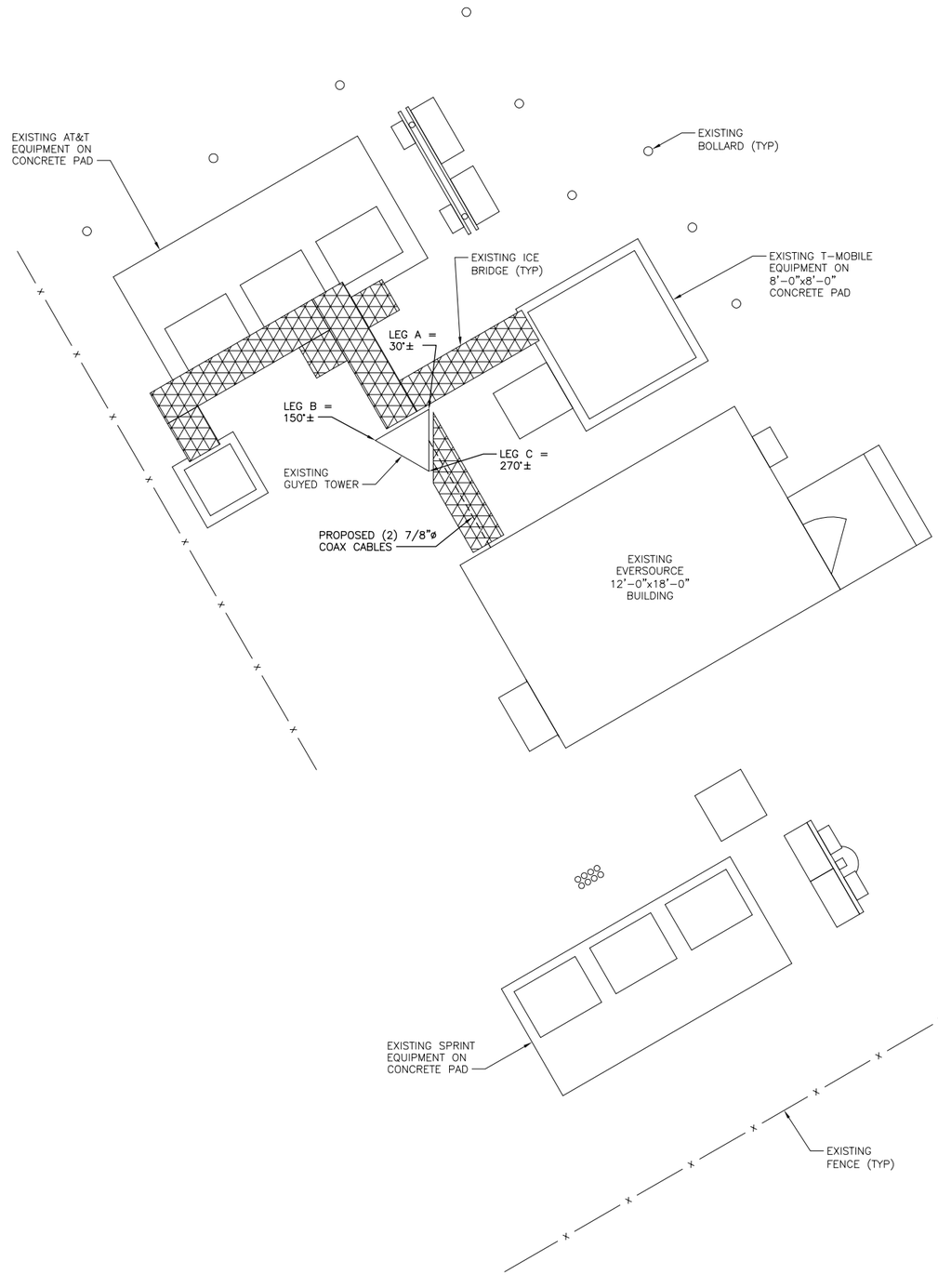
REV	DATE	DESCRIPTION
0	03/09/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED PROFESSIONAL ENGINEER
03/09/2020

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
TITLE SHEET

SHEET NUMBER
T-1



SITE PLAN
NO SCALE

N

EVERSOURCE ENERGY
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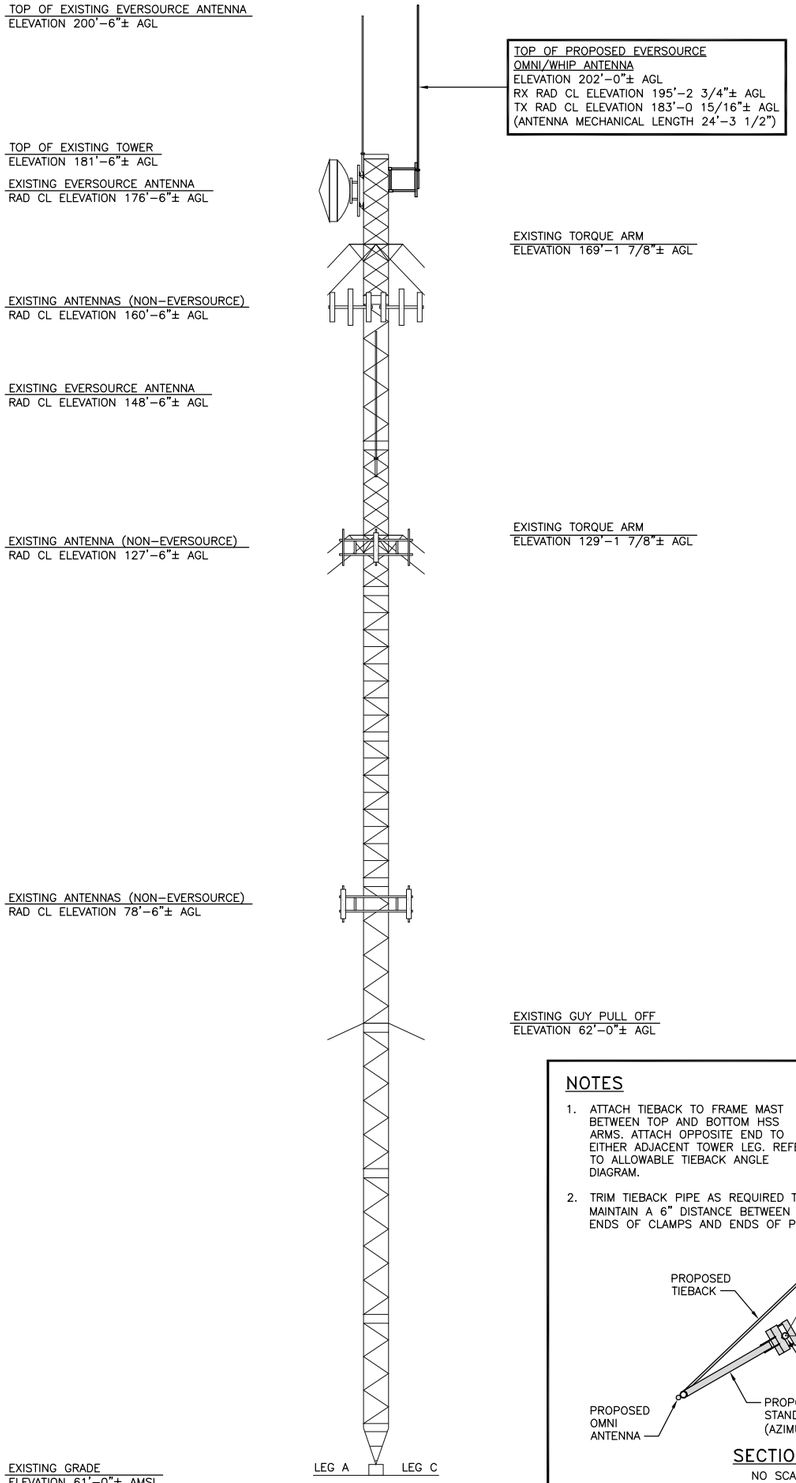
03/09/2020

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
SITE PLAN

SHEET NUMBER
C-1



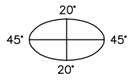
TOWER ELEVATION FACE AC

NO SCALE

NOTES

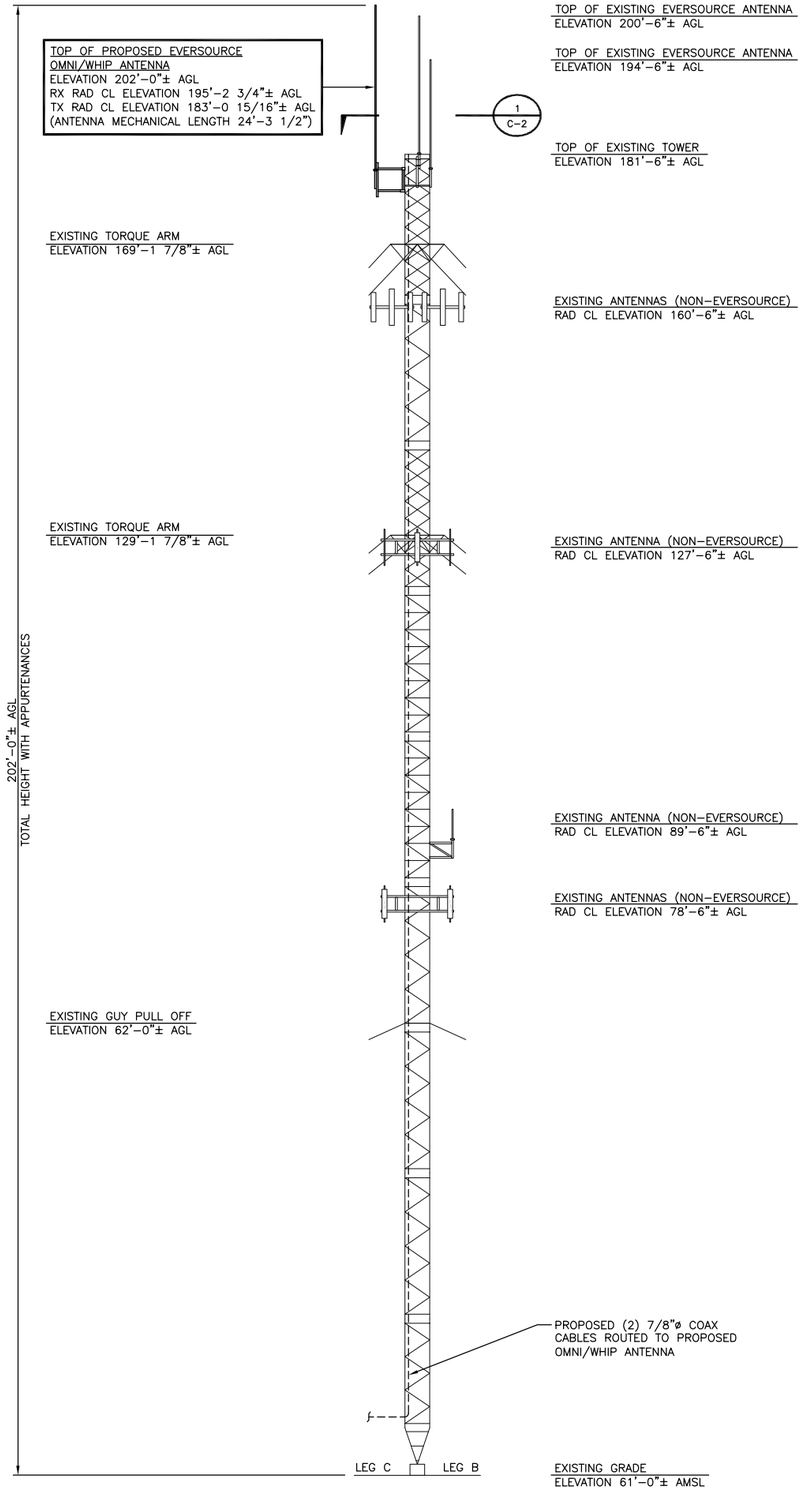
1. ATTACH TIEBACK TO FRAME MAST BETWEEN TOP AND BOTTOM HSS ARMS. ATTACH OPPOSITE END TO EITHER ADJACENT TOWER LEG. REFER TO ALLOWABLE TIEBACK ANGLE DIAGRAM.
2. TRIM TIEBACK PIPE AS REQUIRED TO MAINTAIN A 6" DISTANCE BETWEEN ENDS OF CLAMPS AND ENDS OF PIPE.

ALLOWABLE TIEBACK ANGLE
±20 DEGREES VERTICAL
±45 DEGREES HORIZONTAL



SECTION 1

NO SCALE



TOWER ELEVATION FACE CB

NO SCALE

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

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

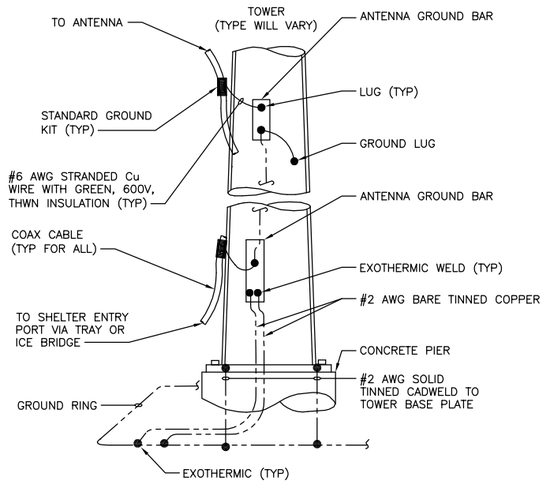
PROJECT NO:	403093
DRAWN BY:	TYW
CHECKED BY:	TH

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

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
TOWER ELEVATION

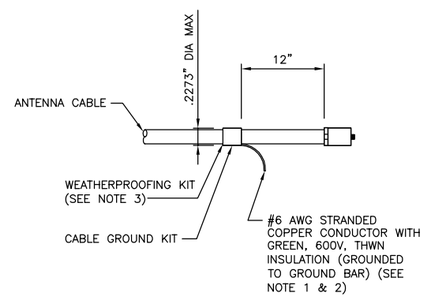
SHEET NUMBER
C-2



NOTE

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

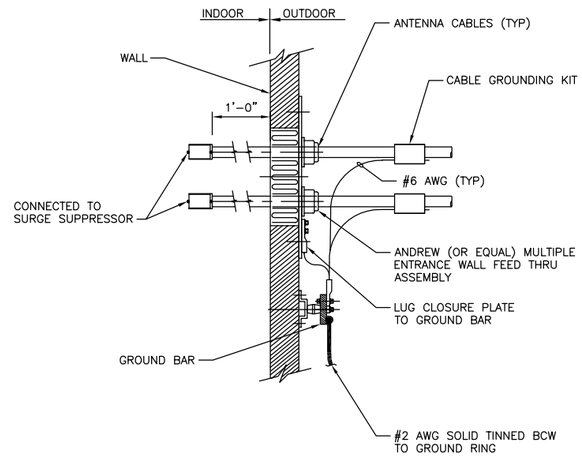
ANTENNA CABLE GROUNDING
NO SCALE



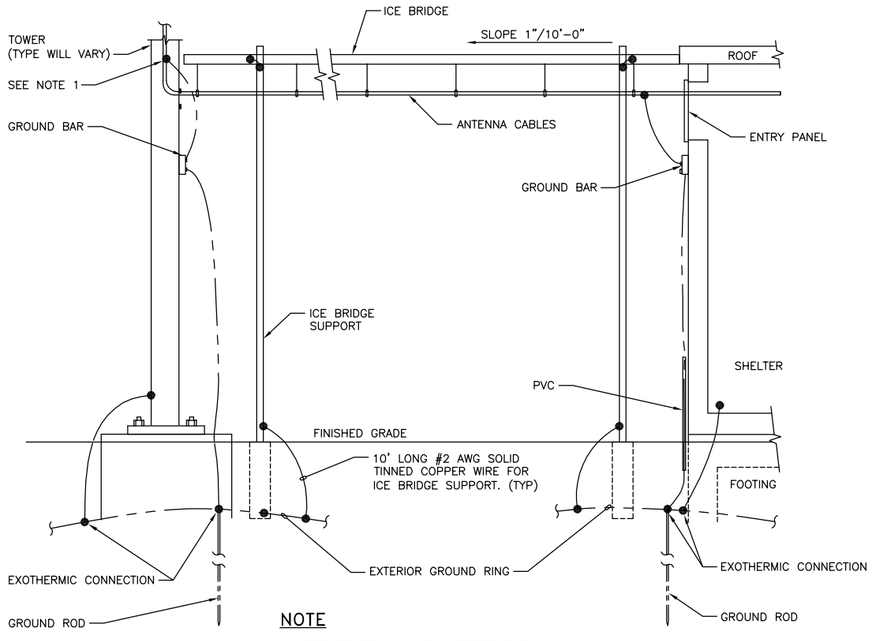
NOTES

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

CONNECTION OF CABLE GROUND
KIT TO ANTENNA CABLE
NO SCALE



CABLE INSTALLATION WITH WALL
FEED THRU ASSEMBLY
NO SCALE



NOTE

1. PROVIDE GROUND KIT 6" BEFORE TURN

ICE BRIDGE AND ANTENNA
CABLE DETAIL
NO SCALE

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

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

STATE OF CONNECTICUT
MARK P. STILE
34358
LICENSED
PROFESSIONAL ENGINEER
03/09/20

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
GROUNDING
DETAILS

SHEET NUMBER
G-1

DESIGN BASIS

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

GENERAL CONDITIONS

1. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO COMPLY WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL BUILDING CODES, PERMIT CONDITIONS AND SAFETY CODES DURING CONSTRUCTION.

2. THE ENGINEER IS NOT: A GUARANTOR OF THE INSTALLING CONTRACTOR'S WORK; RESPONSIBLE FOR SAFETY IN, ON OR ABOUT THE WORK SITE; IN CONTROL OF THE SAFETY OR ADEQUACY OF ANY BUILDING COMPONENT, SCAFFOLDING OR SUPERINTENDING THE WORK.

3. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL PERMITS, INSPECTIONS, TESTING AND CERTIFICATES NEEDED FOR LEGAL OCCUPANCY OF THE FINISHED PROJECT.

4. THE CONTRACTOR IS RESPONSIBLE TO REVIEW THIS COMPLETE PLAN SET AND VERIFY THE EXISTING CONDITIONS SHOWN IN THESE PLANS AS THEY RELATE TO THE WORK PRIOR TO SUBMITTING PRICE. SIGNIFICANT DEVIATIONS FROM WHAT IS SHOWN AFFECTING THE WORK SHALL BE REPORTED IMMEDIATELY TO THE CONSTRUCTION MANAGER.

5. DETAILS INCLUDED IN THIS PLAN SET ARE TYPICAL AND APPLY TO SIMILAR CONDITIONS.

6. EXISTING ELECTRICAL AND MECHANICAL FIXTURES, PIPING, WIRING, AND EQUIPMENT OBSTRUCTING THE WORK SHALL BE REMOVED AND/OR RELOCATED AS DIRECTED BY THE CONSTRUCTION MANAGER. TEMPORARY SERVICE INTERRUPTIONS MUST BE COORDINATED WITH OWNER.

7. THE CONTRACTOR SHALL DILIGENTLY PROTECT THE EXISTING BUILDING/SITE CONDITIONS AND THOSE OF ANY ADJOINING BUILDING/SITES AND RESTORE ANY DAMAGE CAUSED BY HIS ACTIVITIES TO THE PRE-CONSTRUCTION CONDITION.

8. THE CONTRACTOR SHALL SAFEGUARD AGAINST: CREATING A FIRE HAZARD, AFFECTING TENANT EGRESS OR COMPROMISING BUILDING SITE SECURITY MEASURES.

9. THE CONTRACTOR SHALL REMOVE ALL DEBRIS AND CONSTRUCTION WASTE FROM THE SITE EACH DAY. WORK AREAS SHALL BE SWEPT AND MADE CLEAN AT THE END OF EACH WORK DAY.

10. THE CONTRACTOR'S HOURS OF WORK SHALL BE IN ACCORDANCE WITH LOCAL CODES AND ORDINANCES AND BE APPROVED BY OWNER.

11. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CONSTRUCTION MANAGER IF ASBESTOS IS ENCOUNTERED DURING THE EXECUTION OF HIS WORK. THE CONTRACTOR SHALL CEASE ALL ACTIVITIES WHERE THE ASBESTOS MATERIAL IS FOUND UNTIL NOTIFIED BY THE CONSTRUCTION MANAGER TO RESUME OPERATIONS.

THERMAL & MOISTURE PROTECTION

1. FIRE-STOP ALL PENETRATIONS FOR ELECTRICAL CONDUITS OR WAVEGUIDE CABLING THROUGH BUILDING WALLS, FLOORS, AND CEILINGS SHALL BE FIRESTOPPED WITH ACCEPTED MATERIALS TO MAINTAIN THE FIRE RATING OF THE EXISTING ASSEMBLY. ALL FILL MATERIAL SHALL BE SHAPED, FITTED, AND PERMANENTLY SECURED IN PLACE. FIRESTOPPING SHALL BE INSTALLED IN ACCORDANCE WITH ASTM E814.

2. HILTI CP620 FIRE FOAM OR 3M FIRE BARRIER FILL, VOID OR CAVITY MATERIAL OR ACCEPTED EQUAL SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND ASSOCIATED UNDERWRITERS LABORATORIES (UL) SYSTEM NUMBER.

3. FIRESTOPPING SHALL BE APPLIED AS SOON AS PRACTICABLE AFTER PENETRATIONS ARE MADE AND EQUIPMENT INSTALLED.

4. FIRESTOPPED PENETRATIONS SHALL BE LEFT EXPOSED AND MADE AVAILABLE FOR INSPECTION BEFORE CONCEALING SUCH PENETRATIONS. FIRESTOPPING MATERIAL CERTIFICATES SHALL BE MADE AVAILABLE AT THE TIME OF INSPECTION.

5. ANY BUILDING ROOF PENETRATION AND/OR RESTORATION SHALL BE PERFORMED SO THAT THE ROOF WARRANTY IN PLACE IS NOT COMPROMISED. CONTRACTOR SHALL ARRANGE FOR OWNER'S ROOFING CONTRACTOR TO PERFORM ANY AND ALL ROOFING WORK IF SO REQUIRED BY EXISTING ROOF WARRANTY. OTHERWISE, ROOF SHALL BE MADE WATERTIGHT WITH LIKE CONSTRUCTION AS SOON AS PRACTICABLE AND AT COMPLETION OF CONSTRUCTION.

6. ALL PENETRATIONS INTO AND/OR THROUGH BUILDING EXTERIOR WALLS SHALL BE SEALED WITH SILICONE SEALER.

7. WHERE CONDUIT AND CABLES PENETRATES FIRE RATED WALLS AND FLOORS, FIRE GROUT ALL PENETRATIONS IN ORDER TO MAINTAIN THE FIRE RATING USING A LISTED FIRE SEALING DEVICE OR GROUT.

8. CONTRACTOR TO REMOVE AND RE-INSTALL ALL FIRE PROOFING AS REQUIRED DURING CONSTRUCTION.

SUBMITTALS

1. CONTRACTOR TO SUBMIT SHOP DRAWINGS TO ENGINEER FOR REVIEW PRIOR TO FABRICATION.

2. CONTRACTOR TO NOTIFY ENGINEER FOR INSPECTION PRIOR TO CLOSING PENETRATIONS.

3. CONTRACTORS SHALL VERIFY ALL DIMENSIONS AND CONDITIONS IN THE FIELD PRIOR TO FABRICATION AND ERECTION OF ANY MATERIAL. THE ENGINEER SHALL BE NOTIFIED OF ANY CONDITIONS WHICH PRECLUDE COMPLETION OF THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

4. ALL STEEL MATERIAL EXPOSED TO WEATHER SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A123 " ZINC (HOT-DIPPED GALVANIZED) COATINGS" ON IRON AND STEEL PRODUCTS.

5. THE ENGINEER SHALL BE NOTIFIED OF ANY INCORRECTLY FABRICATED, DAMAGED OR OTHERWISE MISFITTING OR NONCONFORMING MATERIALS OR CONDITIONS FOR REMEDIAL OR CORRECTIVE ACTION. ANY SUCH ACTION SHALL REQUIRE ENGINEER REVIEW.

STEEL

1. MATERIAL:

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

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

2. DAMAGED GALVANIZED SURFACES SHALL BE CLEANED WITH A WIRE BRUSH AND PAINTED WITH TWO COATS OF COLD ZINC, "GALVANOX", "DRY GALV", "ZINC IT", OR APPROVED EQUIVALENT, IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES. TOUCH UP DAMAGED NON GALVANIZED STEEL WITH SAME PAINT IN SHOP OR FIELD.

3. DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE AISC "MANUAL OF STEEL CONSTRUCTION" 13TH EDITION.

4. THE STEEL STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER COMPLETION. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE AND TO INSURE THE SAFETY OF THE BUILDING AND ITS COMPONENT PARTS DURING ERECTION.

5. ALL STEEL ELEMENTS SHALL BE INSTALLED PLUMB AND LEVEL.

6. TOWER MANUFACTURER'S DESIGNS SHALL PREVAIL FOR TOWER.

SITE GENERAL

1. CONTRACTOR SHALL FOLLOW CONDITIONS OF ALL APPLICABLE PERMITS AND WORK IN ACCORDANCE WITH OSHA REGULATIONS.

2. THESE PLANS DEPICT KNOWN UNDERGROUND STRUCTURES, CONDUITS, AND/OR PIPELINES. THE LOCATIONS FOR THESE ELEMENTS ARE BASED UPON THE VARIOUS RECORD DRAWINGS AVAILABLE. THE CONTRACTOR IS HEREBY ADVISED THAT THESE DRAWINGS MAY NOT ACCURATELY DEPICT AS-BUILT LOCATIONS AND OTHER UNKNOWN STRUCTURES. THE CONTRACTOR SHALL THEREFORE DETERMINE THE EXACT LOCATION OF EXISTING UNDERGROUND ELEMENTS AND EXCAVATE WITH CARE AFTER CALLING MARKOUT SERVICE AT 1-800-272-4480 48 HOURS BEFORE DIGGING, DRILLING OR BLASTING.

3. ALL EXISTING ACTIVE SEWER, WATER, GAS, ELECTRIC, FIBER OPTIC, AND OTHER UTILITIES WHERE ENCOUNTERED, SHALL BE PROTECTED AT ALL TIMES, AND WHERE REQUIRED FOR THE PROPER EXECUTION, SHALL BE RELOCATED AS DIRECTED BY ENGINEER. EXTREME CAUTION SHOULD BE USED BY THE CONTRACTOR WHEN EXCAVATING OR PIER DRILLING AROUND OR NEAR UTILITIES. CONTRACTOR SHALL HAND DIG UTILITIES AS NEEDED. CONTRACTOR SHALL PROVIDE, BUT IS NOT LIMITED TO, APPROPRIATE A) FALL PROTECTION, B) CONFINED SPACE ENTRY, C) ELECTRICAL SAFETY, AND D) TRENCHING AND EXCAVATION.

4. IF NECESSARY, RUBBISH, STUMPS, DEBRIS, STICKS, STONES, AND OTHER REFUSE SHALL BE REMOVED FROM THE SITE AND DISPOSED OF LEGALLY.

5. ALL EXISTING INACTIVE SEWER, WATER, GAS, ELECTRIC, FIBER OPTIC, OR OTHER UTILITIES, WHICH INTERFERE WITH THE EXECUTION OF THE WORK, SHALL BE REMOVED, AND/OR CAPPED, PLUGGED OR OTHERWISE DISCONTINUED AT THE POINTS WHICH WILL NOT INTERFERE WITH THE EXECUTION OF THE WORK, SUBJECT TO THE APPROVAL OF THE CONSTRUCTION MANAGER.

6. CONTRACTOR IS RESPONSIBLE FOR REPAIRING OR REPLACING STRUCTURES OR UTILITIES DAMAGED DURING CONSTRUCTION.

7. CONTRACTOR SHALL PROTECT EXISTING PAVED AND GRAVEL SURFACES, CURBS, LANDSCAPE AND STRUCTURES AND RESTORE SITE OR PRE-CONSTRUCTION CONDITION WITH AS GOOD, OR BETTER, MATERIALS. NEW MATERIALS SHALL MATCH EXISTING THICKNESS AND TYPE.

8. THE CONTRACTOR SHALL SHORE ALL TRENCH EXCAVATIONS GREATER THAN 5 FEET IN DEPTH OR LESS WHERE SOIL CONDITIONS ARE DEEMED UNSTABLE. ALL SHEETING AND/OR SHORING METHODS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER.

9. THE CONTRACTOR IS RESPONSIBLE FOR MANAGING GROUNDWATER LEVELS IN THE VICINITY OF EXCAVATIONS TO PROTECT ADJACENT PROPERTIES AND NEW WORK. GROUNDWATER SHALL BE DRAINED IN ACCORDANCE WITH LOCAL SEDIMENTATION AND EROSION CONTROL GUIDELINES.

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PHONE: (913) 458-3595

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

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

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
NOTES & SPECIFICATIONS

SHEET NUMBER
N-1

ELECTRICAL

1. CONTRACTOR SHALL VERIFY EXISTING ELECTRIC SERVICE TYPE AND CAPACITY AND ORDER NEW ELECTRIC SERVICE FROM LOCAL ELECTRIC UTILITY, WHERE APPLICABLE.
2. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH ALL APPLICABLE CODES, AND SHALL BE ACCEPTABLE TO ALL AUTHORITIES HAVING JURISDICTION. WHERE A CONFLICT EXISTS BETWEEN CODES, PLAN AND SPECIFICATIONS, OR AUTHORITIES HAVING JURISDICTION, THE MORE STRINGENT AUTHORITIES SHALL APPLY.
3. CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, INSURANCE, EQUIPMENT, INSTALLATION, CONSTRUCTION TOOLS, TRANSPORTATION, ETC, FOR A COMPLETE AND PROPERLY OPERATIVE SYSTEM ENERGIZED THROUGHOUT AND AS INDICATED ON THE DRAWINGS AND AS SPECIFIED HEREIN AND/OR OTHERWISE REQUIRED.
4. ALL ELECTRICAL CONDUCTORS SHALL BE 100% COPPER AND SHALL HAVE TYPE THHN INSULATION UNLESS INDICATED OTHERWISE.
5. CONDUIT SHALL BE THREADED RIGID GALVANIZED STEEL OR EMT WITH ONLY COMPRESSION TYPE COUPLINGS AND CONNECTORS, ALL MADE UP WRENCH TIGHT.
6. ALL BURIED CONDUIT SHALL BE MINIMUM SCH 40 PVC UNLESS NOTED OTHERWISE, OR AS PER LOCAL CODE REQUIREMENTS.
7. PROVIDE FLEXIBLE STEEL CONDUIT OR LIQUID TIGHT FLEXIBLE STEEL CONDUIT TO ALL VIBRATING EQUIPMENT, INCLUDING HVAC UNITS, TRANSFORMERS, MOTORS, ETC, OR WHERE EQUIPMENT IS PLACED UPON A SLAB ON GRADE.
8. ALL BRANCH CIRCUITS AND FEEDERS SHALL HAVE A SEPARATE GREEN INSULATED EQUIPMENT GROUNDING CONDUCTOR BONDED TO ALL ENCLOSURES, PULLBOXES, ETC.
9. CONDUIT AND CABLE WITHIN CORRIDORS SHALL BE CONCEALED AND EXPOSED ELSEWHERE, UNLESS NOTED OTHERWISE.
10. ELECTRICAL MATERIALS INSTALLED ON ROOFTOP SHALL BE LISTED FOR NEMA 3R USE. –AND ALL WIRING WITHIN A VENTILATION DUCT SHALL BE LISTED FOR SUCH USE. IN GENERAL WIRING METHODS WITHIN A DUCT SHALL BE AN MC CABLE WITH SMOOTH OR CORRUGATED METAL JACKET AND HAVE NO OUTER COVERING OVER THE METAL JACKET. INTERLOCKED ARMOR TYPE OF MC CABLE IS NOT ACCEPTABLE FOR THIS APPLICATION. CONTRACTOR CAN ALSO USE TYPE MI CABLE IN THE VENTILATION DUCT PROVIDED IT DOES NOT HAVE ANY OUTER COVERINGS OVER THE METAL EXTERIOR.
11. WIRING DEVICES SHALL BE SPECIFICATION GRADE, AND WIRING DEVICE COVER PLATES SHALL BE PLASTIC WITH ENGRAVING AS SPECIFIED.
12. GROUNDING SYSTEM RESISTANCE SHALL BE MEASURED, RECORDED, AND DATED USING MEGGER DET14 OR SIMILAR INSTRUMENT. GROUND RESISTANCE SHALL NOT EXCEED 5 OHMS. IF THE RESISTANCE VALUE IS EXCEEDED, NOTIFY CONSTRUCTION MANAGER FOR FURTHER INSTRUCTION.
13. COORDINATE WITH BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK INVOLVING EXISTING SYSTEMS OR EQUIPMENT IN ORDER TO DETERMINE THE EFFECT, IF ANY, ON OTHER TENANTS WITHIN THE BUILDING, AND TO DETERMINE THE APPROPRIATE TIME FOR PERFORMING THIS WORK.
14. THE CONTRACTOR SHALL BE REQUIRED TO VISIT THE SITE PRIOR TO SUBMITTING BID IN ORDER TO DETERMINE THE EXTENT OF THE EXISTING CONDITIONS.
15. ALL CONDUCTOR ENDS SHALL BE TAGGED AND ELECTRICAL EQUIPMENT LABELED WITH ENGRAVED IDENTIFICATION PLATES.
16. CONTRACTOR IS RESPONSIBLE FOR ALL CONTROL WIRING AND ALARM TIE–INS.

GROUNDING

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

ANTENNA & CABLE NOTES

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

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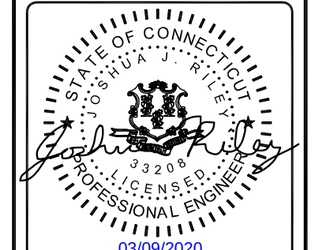

03/09/2020

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE
NOTES
& SPECIFICATIONS

SHEET NUMBER
N-2

SYMBOLS

●	EXOTHERMIC CONNECTION
■	COMPRESSION CONNECTION
	5/8"ø x 10'-0" COPPER CLAD STEEL GROUND ROD.
	TEST GROUND ROD WITH INSPECTION SLEEVE
	GROUNDING CONDUCTOR
(A)	KEY NOTES
CHAINLINK FENCE	X X X X X
WOOD FENCE	
LEASE AREA	
ICE BRIDGE	
CABLE TRAY	
GAS LINE	G G G G G
UNDERGROUND ELECTRICAL/TELCO	E/T E/T E/T E/T
UNDERGROUND ELECTRICAL/CONTROL	E/C E/C E/C E/C
UNDERGROUND ELECTRICAL	E E E E E
UNDERGROUND TELCO	T T T T T
PROPERTY LINE (PL)	

ABBREVIATIONS

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

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STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED PROFESSIONAL ENGINEER
03/09/2020

MADISON AWC
135 NEW ROAD
MADISON, CT 06443

SHEET TITLE

NOTES
& SPECIFICATIONS

SHEET NUMBER

N-3

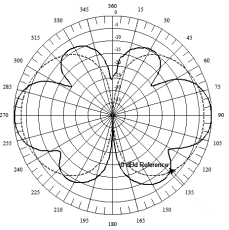
REFERENCE CUTSHEETS

VHF Omni Antennas (160-222 MHz)

		160-174 MHz						217-222 MHz									
	Model Number	DS1G03F36U-N	DS1G03F36U-D	DS1G06F36U-N	DS1G06F36U-D	DS1G03F36D-N	DS1G03F36D-D	DS2C00F36U-N	DS2C00F36U-D	DS2C03F36U-N	DS2C03F36U-D	DS2C06F36U-N	DS2C06F36U-D	DS2C00F36D-N	DS2C00F36D-D	DS2C03F36D-N	DS2C03F36D-D
	Input Connector	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN	N(F)	7/16 DIN
	Type	Single		Single		Dual		Single		Single		Single		Dual		Dual	
ELECTRICAL	**Bandwidth**, MHz	14		14		14		5		5		5		5		5	
ELECTRICAL	**Power**, Watts	500		500		350		500		500		500		350		350	
ELECTRICAL	**Gain**, dBd	3		6		3		0		3		6		0		3	
ELECTRICAL	**Horizontal Beamwidth**, degrees	360		360		360		360		360		360		360		360	
ELECTRICAL	**Vertical Beamwidth**, degrees	30		16		30		60		30		16		60		30	
ELECTRICAL	**Beam Tilt**, degrees	0		0		0		0		0		0		0		0	
ELECTRICAL	**Isolation (minimum)**, dB	N/A		N/A		30		N/A		N/A		N/A		30		30	
MECHANICAL	**Number of Connectors**	1		1		2		1		1		1		2		2	
MECHANICAL	**Flat Plate Area**, $ft^2(m^2)$	2.53 (0.24)		4.38 (0.41)		4.5 (0.42)		1.9 (0.18)		1.9 (0.18)		2.58 (0.24)		2.4 (0.22)		4.1 (0.38)	
MECHANICAL	**Lateral Windload Thrust**, lbf(N)	95 (423)		164 (730)		169 (752)		53 (236)		69 (307)		108 (480)		90 (400)		169 (752)	
MECHANICAL	**Survival Wind Speed**																
MECHANICAL	**without ice**, mph(kph)	110 (177)		75 (121)		75 (121)		222 (357)		172 (277)		110 (177)		130 (209)		75 (121)	
MECHANICAL	**with 0.5" radial ice**, mph(kph)	93 (150)		60 (97)		65 (105)		193 (311)		150 (241)		96 (154)		115 (185)		65 (105)	
MECHANICAL	**Mounting Hardware** included	DSH3V3R		DSH3V3N		DSH3V3N		DSH2V3R		DSH2V3R		DSH3V3N		DSH3V3R		DSH3V3N	
DIMENSIONS	**Length**, ft(m)	12.7 (3.9)		21.9 (6.7)		22.3 (6.8)		7.7 (2.3)		9.9 (3)		18.1 (5.5)		13.6 (4.1)		24.3 (7.4)	
DIMENSIONS	**Radome O.D.**, in(cm)	3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)		3 (7.6)	
DIMENSIONS	**Mast O.D.**, in(cm)	2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)		2.5 (6.4)	
DIMENSIONS	**Net Weight** w/o bracket, lb(kg)	37 (16.8)		60 (27.2)		63 (28.6)		19 (8.6)		26 (11.8)		47 (21.3)		40 (18.1)		70 (31.8)	
DIMENSIONS	**Shipping Weight**, lb(kg)	67 (30.4)		90 (40.8)		93 (42.2)		39 (17.7)		56 (25.4)		77 (34.9)		70 (31.8)		100 (45.4)	

VERTICAL PATTERNS

DS1G03F36U-N
DS1G03F36U-D



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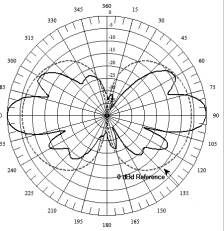

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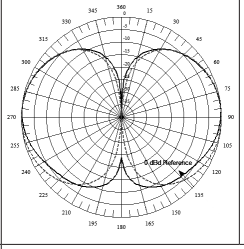

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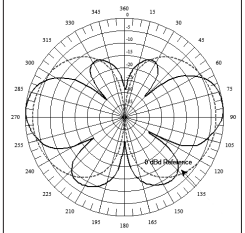

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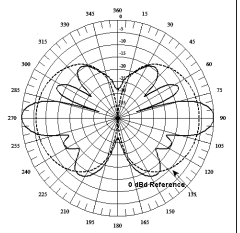

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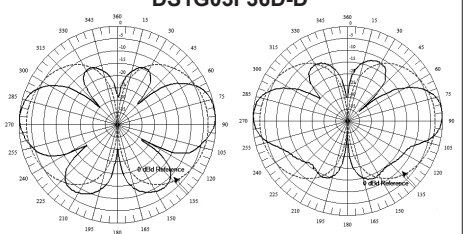

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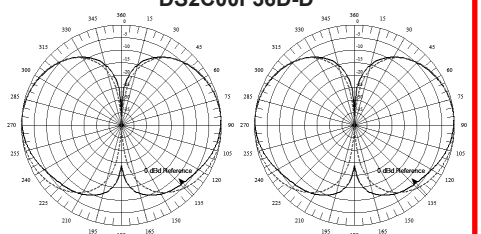

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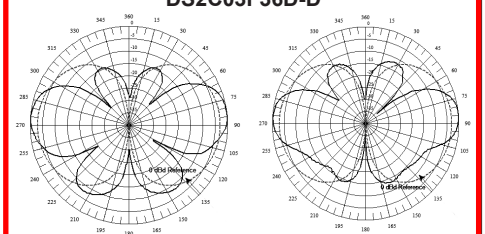
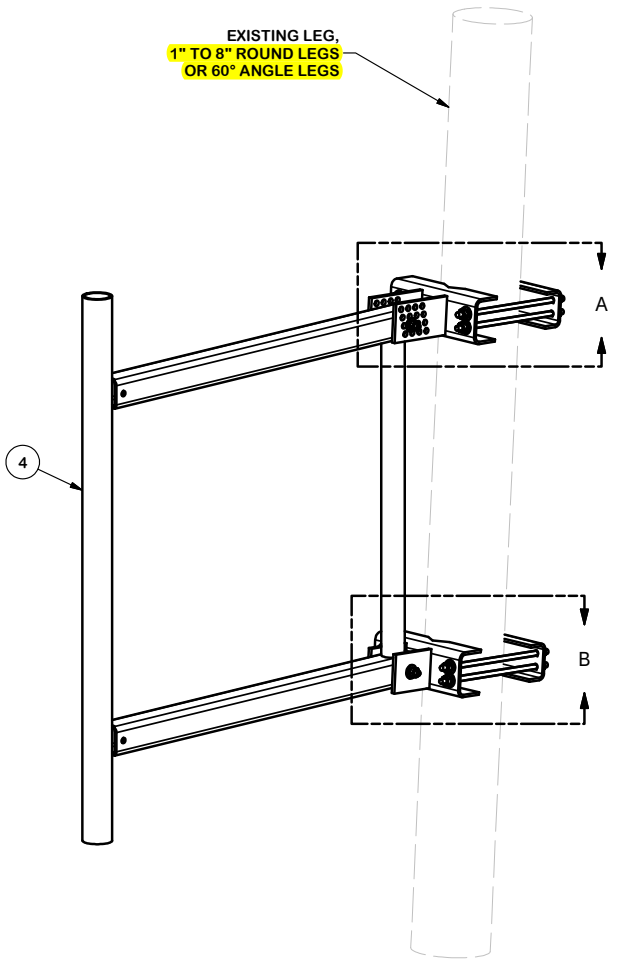
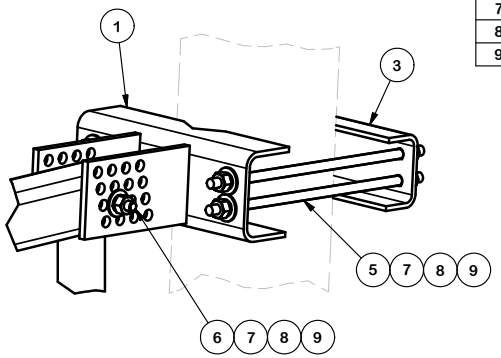


Top Bottom

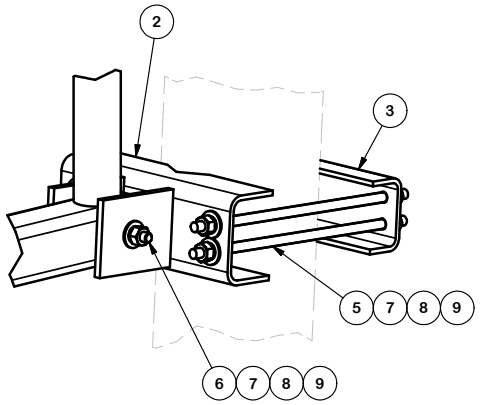
TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 2.875" ± DIAMETER.

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

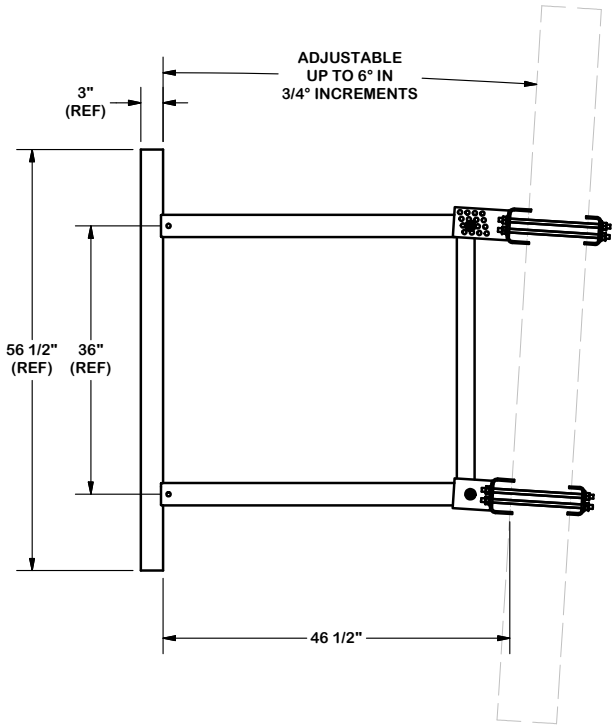




DETAIL A



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

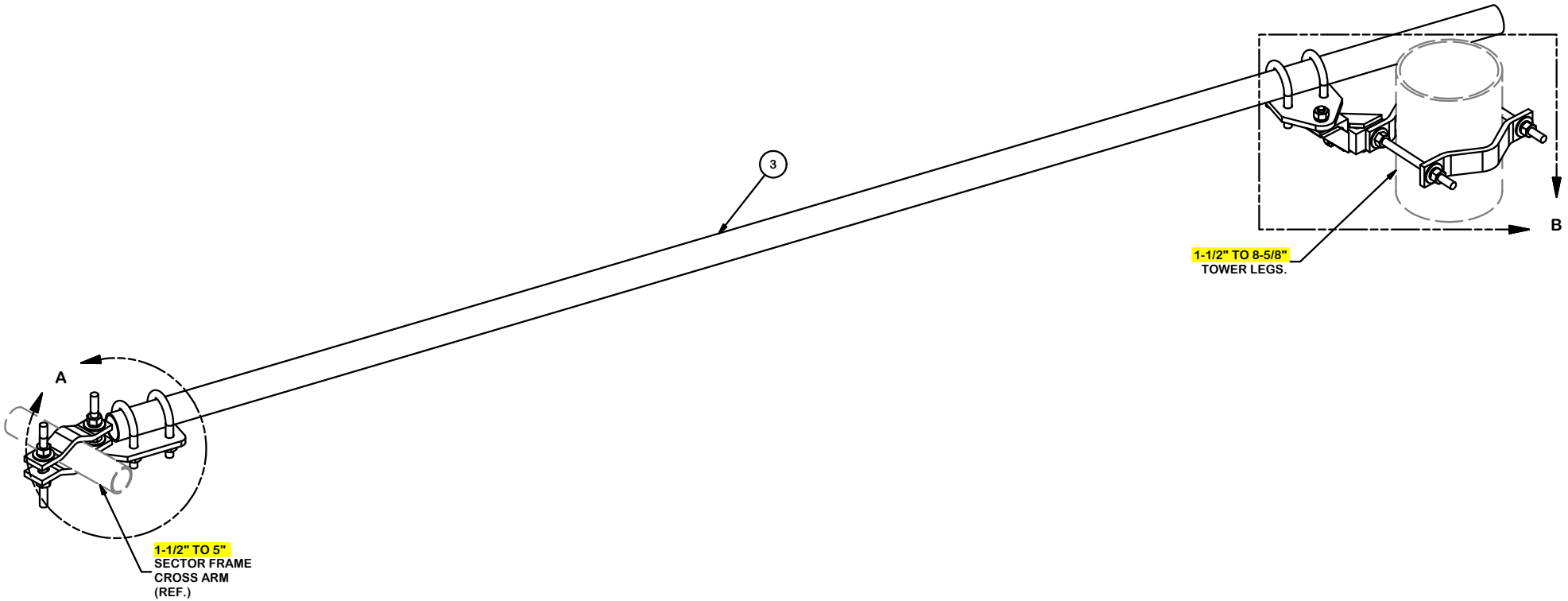
SITE PRO 1 — A valmont COMPANY
Engineering Support Team: 1-888-753-7446
Locations: New York, NY; Atlanta, GA; Los Angeles, CA; Plymouth, IN; Salem, OR; Dallas, TX

CPD NO.	DRAWN BY	ENG. APPROVAL	PART NO.	PAGE
	RCH 2/4/2011		USF-4U	1 OF 1

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

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

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



TOLERANCE NOTES

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

DESCRIPTION: SLIDING PIPE TIE BACK ASSEMBLY

SITE PRO 1 — A valmont COMPANY

Engineering Support Team: 1-888-753-7446

Locations:
New York, NY
Atlanta, GA
Los Angeles, CA
Plymouth, IN
Salem, OR
Dallas, TX

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

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

ATTACHMENT C – STRUCTURAL ANALYSIS REPORT

Date: **March 4, 2020**

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

Subject:	**Structural Analysis Report**	
Eversource Designation:	**Site Number:**	ES-008
	Site Name:	MadisonAWC
Engineering Firm Designation:	**Black & Veatch Corp. Project Number:**	403093
Site Data:	**135 New Road, Madison, CT 06443** **Latitude *41° 17' 36.3"*, Longitude *-72° 34' 42.2"*** **180 Foot - Guyed 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 – 91.7%**

This analysis utilizes an ultimate 3-second gust wind speed of 140 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: Anup Chitale

Respectfully submitted by:

Joshua J. Riley, P.E.

Professional Engineer

03/04/2020

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 180 ft Guyed tower manufactured by UNR-Rohn.

2) ANALYSIS CRITERIA

TIA-222 Revision:	TIA-222-H
Risk Category:	III
Wind Speed:	140 mph ultimate
Exposure Category:	B
Topographic Factor:	1
Ice Thickness:	1.5 in
Wind Speed with Ice:	50 mph
Seismic Ss:	0.171
Seismic S1:	0.060
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
177.0	190.0	1	dbspectra	DS2C03F36D-D	2	7/8	-
	177.0	1	site pro 1	USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]			

Table 2 - Other Considered Equipment

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
180.5	190.5	2	unknown	20' x 2" Dia Omni	1	1-5/8	1
	187.5	1	unknown	14' x 3" Dia Omni	1 1	7/8 1/2	
176.5	176.5	1	unknown	8.5' Dish	1	EW63	1
		1	tower mounts	Pipe Mount [PM 602-1]			
160.5	160.5	3	andrew	LNX-6515DS w/ Mount Pipe	7 1	1-5/8 1-1/4	1
		1	tower mounts	Pipe Mount [PM 602-3]			
		6	ericsson	AIR 21			
		3	ericsson	KRY 112 144/1			
		3	ericsson	RRUS 11			
138.5	148.5	1	unknown	20'x3" Omni	2	7/8	1
127.5	127.5	3	rfs celwave	APXVSPP18-C_TIA w/ Mount Pipe	3	1-1/4	1
		1	tower mounts	Sector Mount [SM 502-3]			
		3	alcatel lucent	FD-RRH-4x45-1900			
		3	alcatel lucent	FD-RRH-2x50-800			
89.5	89.5	1	andrew	GPS	1	1/2	1
		1	tower mounts	Side Arm Mount [SO 203-1]			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
78.5	78.5	1	tower mounts	Sector Mount [SM 502-3]	6 1 2	7/8 5/8 #8DC Control	1
		3	kmw communications	AM-X-CD-14-65-00T-RET w/ Mount Pipe			
		6	lucent	LGP21401			
		3	powerwave panel antennas	7770.00 w/ Mount Pipe			
		-	-	18"x18"x 6" Equipment			
	76.5	1	raycap	DC6-48-60-18-8F			

Note:
1) Existing Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
TOWER STRUCTURAL ANALYSIS REPORTS	Centek Engineering, Inc., dated 09/20/2018	Tower geometry	Eversource
TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	FDH Engineering, Inc. dated 01/05/2011	-	Eversource
TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	H.E. Bergeron Engineers, P.A. dated 09/23/2003	-	Eversource
GEOTECHNICAL REPORTS	Dr. Clarence Welti, P.E., P.C. dated 06/16/1997	-	Eversource

3.1) Analysis Method

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

3.2) Assumptions

1) Tower and structures were built and maintained in accordance with the manufacturer's specifications.
2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
3) The existing base plate grout was considered in this analysis. Grout must be maintained and inspected periodically and must be replaced if damaged or cracked.
4) This analysis was performed under the assumption that all information provided to Black & Veatch is current and correct. This is to include site data, appurtenance loading, tower/foundation details, and geotechnical data.
5) Tower loading is based on 2018 drone mapping photos.

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	181.5 - 161.5	Leg	Pipe 2.5 STD	3	-15.17	71.89	21.1	Pass
T2	161.5 - 141.5	Leg	Pipe 2.5 STD	58	-22.20	62.19	35.7	Pass
T3	141.5 - 121.5	Leg	Pipe 2.5 STD	91	-37.93	75.48	50.3	Pass
T4	121.5 - 101.5	Leg	Pipe 2.5 STD	148	-42.89	75.48	56.8	Pass
T5	101.5 - 81.5	Leg	Pipe 2.5 STD	202	-43.56	75.48	57.7	Pass
T6	81.5 - 61.5	Leg	Pipe 2.5 STD	257	-49.68	62.19	79.9	Pass
T7	61.5 - 41.5	Leg	Pipe 2.5 STD	291	-53.89	62.19	86.7	Pass
T8	41.5 - 21.5	Leg	Pipe 2.5 STD	324	-52.98	59.23	89.5	Pass
T9	21.5 - 6.5	Leg	Pipe 2.5 STD	357	-54.18	59.89	90.5	Pass
T10	6.5 - 1.5	Leg	Pipe 2.5 STD	384	-58.76	72.64	80.9	Pass
T1	181.5 - 161.5	Diagonal	L1 3/4x1 3/4x3/16	31	2.53	17.26	14.6 42.1 (b)	Pass
T2	161.5 - 141.5	Diagonal	TS1.5x16ga	69	-1.72	5.88	29.3 36.9 (b)	Pass
T3	141.5 - 121.5	Diagonal	L2x2x3/16	113	2.67	20.48	13.0 41.0 (b)	Pass
T4	121.5 - 101.5	Diagonal	L2 1/2x2 1/2x1/2	199	-3.45	55.87	6.2 23.8 (b)	Pass
T5	101.5 - 81.5	Diagonal	TS1.5x16ga	212	-2.01	5.88	34.2 37.4 (b)	Pass
T6	81.5 - 61.5	Diagonal	L2 1/2x2 1/2x1/2	273	-4.43	55.87	7.9 30.7 (b)	Pass
T7	61.5 - 41.5	Diagonal	L2 1/2x2 1/2x1/2	320	-3.51	55.87	6.3 24.2 (b)	Pass
T8	41.5 - 21.5	Diagonal	TS1.5x16ga	353	-1.79	5.88	30.4 37.5 (b)	Pass
T9	21.5 - 6.5	Diagonal	L2 1/2x2 1/2x1/2	366	-1.54	56.05	2.8 10.6 (b)	Pass
T4	121.5 - 101.5	Horizontal	L2 1/2x2 1/2x1/2	174	1.17	71.98	1.6 8.1 (b)	Pass
T5	101.5 - 81.5	Horizontal	L2 1/2x2 1/2x1/2	227	0.80	71.98	1.1 5.5 (b)	Pass
T10	6.5 - 1.5	Horizontal	C12x20.7	391	0.02	207.18	1.0	Pass
T1	181.5 - 161.5	Top Girt	L1 3/4x1 3/4x3/16	4	-0.11	14.26	0.8 1.2 (b)	Pass
T2	161.5 - 141.5	Top Girt	TS1.5x16ga	61	-0.90	6.73	13.4 21.0 (b)	Pass
T3	141.5 - 121.5	Top Girt	L2x2x3/16	96	0.46	20.48	2.2 7.0 (b)	Pass
T4	121.5 - 101.5	Top Girt	L2 1/2x2 1/2x1/2	153	1.67	64.23	2.6 11.5 (b)	Pass
T5	101.5 - 81.5	Top Girt	TS1.5x16ga	205	0.35	8.95	3.9 8.1 (b)	Pass
T6	81.5 - 61.5	Top Girt	L2 1/2x2 1/2x1/2	259	0.99	64.23	1.5 6.8 (b)	Pass
T7	61.5 - 41.5	Top Girt	TS1.5x16ga	293	-1.60	6.73	23.8 43.2 (b)	Pass
T8	41.5 - 21.5	Top Girt	TS1.5x16ga	326	-0.71	6.73	10.5 19.0 (b)	Pass
T9	21.5 - 6.5	Top Girt	L2 1/2x2 1/2x1/2	360	0.31	64.23	0.5 2.1 (b)	Pass
T10	6.5 - 1.5	Top Girt	C12x20.7	386	8.47	197.32	4.3	Pass

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
T1	181.5 - 161.5	Bottom Girt	L1 3/4x1 3/4x3/16	8	-0.62	14.26	4.4 9.8 (b)	Pass
T2	161.5 - 141.5	Bottom Girt	TS1.5x16ga	65	-0.80	6.73	11.8 17.2 (b)	Pass
T3	141.5 - 121.5	Bottom Girt	L2x2x3/16	97	0.86	20.48	4.2 13.3 (b)	Pass
T4	121.5 - 101.5	Bottom Girt	L2 1/2x2 1/2x1/2	156	0.55	64.23	0.9 3.8 (b)	Pass
T5	101.5 - 81.5	Bottom Girt	TS1.5x16ga	209	-0.57	6.73	8.4 14.8 (b)	Pass
T6	81.5 - 61.5	Bottom Girt	L2 1/2x2 1/2x1/2	262	3.88	64.23	6.0 26.7 (b)	Pass
T7	61.5 - 41.5	Bottom Girt	TS1.5x16ga	296	-0.79	6.73	11.8 21.2 (b)	Pass
T8	41.5 - 21.5	Bottom Girt	TS1.5x16ga	329	0.24	8.95	2.7 5.6 (b)	Pass
T9	21.5 - 6.5	Bottom Girt	L2 1/2x2 1/2x1/2	362	4.32	64.23	6.7 29.8 (b)	Pass
T10	6.5 - 1.5	Bottom Girt	C12x20.7	388	-3.26	197.29	6.4	Pass
T1	181.5 - 161.5	Guy A@169.154	9/16	407	9.63	22.05	43.7	Pass
T3	141.5 - 121.5	Guy A@129.154	9/16	425	9.65	22.05	43.8	Pass
T6	81.5 - 61.5	Guy A@62.1146	3/4	435	13.89	36.73	37.8	Pass
T1	181.5 - 161.5	Guy B@169.154	9/16	401	9.46	22.05	42.9	Pass
T3	141.5 - 121.5	Guy B@129.154	9/16	418	9.36	22.05	42.5	Pass
T6	81.5 - 61.5	Guy B@62.1146	3/4	434	13.78	36.73	37.5	Pass
T1	181.5 - 161.5	Guy C@169.154	9/16	394	9.32	22.05	42.3	Pass
T3	141.5 - 121.5	Guy C@129.154	9/16	412	9.60	22.05	43.5	Pass
T6	81.5 - 61.5	Guy C@62.1146	3/4	430	13.52	36.73	36.8	Pass
T6	81.5 - 61.5	Top Guy Pull-Off@62.1146	4 1/2x3/8	431	2.91	48.17	6.0	Pass
T1	181.5 - 161.5	Torque Arm Top@169.154	P4x.237	409	13.50	107.98	12.5	Pass
T3	141.5 - 121.5	Torque Arm Top@129.154	P4x.237	421	12.38	107.98	11.5	Pass
T1	181.5 - 161.5	Torque Arm Bottom@169.154	P4x.237	399	-14.15	101.79	13.9	Pass
T3	141.5 - 121.5	Torque Arm Bottom@129.154	P4x.237	417	-13.17	101.79	12.9	Pass
							Summary	
						Leg (T9)	90.5	Pass
						Diagonal (T1)	42.1	Pass
						Horizontal (T4)	8.1	Pass
						Top Girt (T7)	43.2	Pass
						Bottom Girt (T9)	29.8	Pass
						Guy A (T3)	43.8	Pass
						Guy B (T1)	42.9	Pass
						Guy C (T3)	43.5	Pass
						Top Guy Pull-Off (T6)	6.0	Pass

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
						Torque Arm Top (T1)	12.5	Pass
						Torque Arm Bottom (T1)	13.9	Pass
						Bolt Checks	43.2	Pass
						Rating =	**90.5**	**Pass**

Table 5 - Tower Component Stresses vs. Capacity - LC1

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Base Foundation	0	17.3	Pass
	Base Foundation Soil Interaction		91.7	Pass
1	Guy Anchor Foundation Structural (Inner)	0	14.1	Pass
	Guy Anchor Foundation Soil Interaction (Inner)		53.7	Pass
1	Guy Anchor Foundation Structural (Outer)	0	38.4	Pass
	Guy Anchor Foundation Soil Interaction (Outer)		80.2	Pass

Structure Rating (max from all components) =	**91.7%**

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

4.1) Recommendations

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

Maximum Tower Deflections - Service Wind

Section No.	*Elevation*	*Horz. Deflection*	*Gov. Load*	*Tilt*	*Twist*	*Check**
	ft	*in*	*Comb.*	°	°	
T1	181.5 - 161.5	0.754	33	0.0225	0.0736	OK
T2	161.5 - 141.5	0.692	33	0.0127	0.061	OK
T3	141.5 - 121.5	0.653	33	0.0086	0.0341	OK
T4	121.5 - 101.5	0.654	29	0.0153	0.0334	OK
T5	101.5 - 81.5	0.678	31	0.013	0.0397	OK
T6	81.5 - 61.5	0.555	31	0.0428	0.0441	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?*
176.5	8.5' Dish	0.0181	0.0716	8	10	10 dB	0.664	Not Exceeded

*Limit per TIA-222-H Annex D

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °	Combined Max	Check*
T1	181.5 - 161.5	3.049	33	0.0943	0.2795	0.295	OK
T2	161.5 - 141.5	2.746	33	0.0518	0.2387	0.244	OK
T3	141.5 - 121.5	2.505	33	0.0546	0.1378	0.148	OK
T4	121.5 - 101.5	2.387	33	0.0598	0.1266	0.140	OK
T5	101.5 - 81.5	2.319	29	0.0624	0.1404	0.154	OK
T6	81.5 - 61.5	1.905	31	0.1518	0.1592	0.220	OK

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

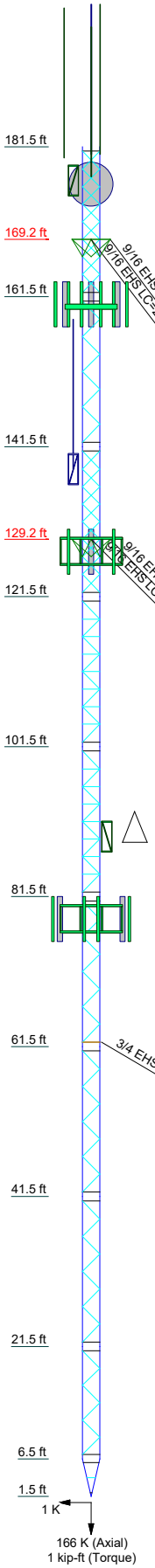
Critical Deflections of Tower at the MW Dish Elevations - Design Wind

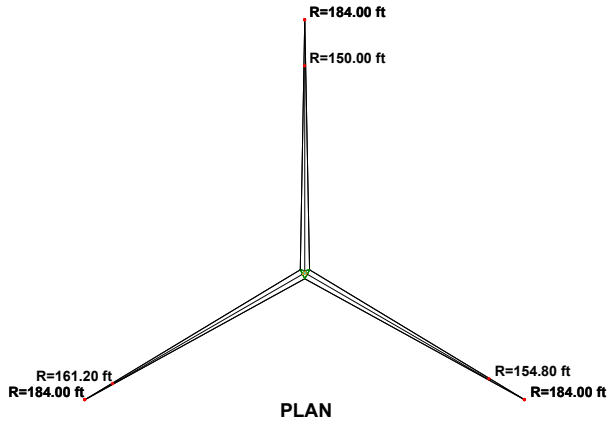
Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
176.5	8.5' Dish	33	2.971	0.0795	0.2741	297615.000

APPENDIX A

TNXTOWER OUTPUT

Section	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
Legs						Pipe 2.5 STD				
Leg Grade						A572-50				
Diagonals	N.A.	L2 1/2x2 1/2x1/2	TS1.5x16ga	L2 1/2x2 1/2x1/2			L2 1/2x2 1/2x1/2	L2x2x3/16	TS1.5x16ga	L1 3/4x1 3/4x3/16
Diagonal Grade	N.A.	A36	A53-B-35	A36			A36		A53-B-35	A36
Top Girts	A	L2 1/2x2 1/2x1/2	TS1.5x16ga	L2 1/2x2 1/2x1/2			L2 1/2x2 1/2x1/2	L2x2x3/16	TS1.5x16ga	L1 3/4x1 3/4x3/16
Bottom Girts	A	L2 1/2x2 1/2x1/2	TS1.5x16ga	L2 1/2x2 1/2x1/2			L2 1/2x2 1/2x1/2	L2x2x3/16	TS1.5x16ga	L1 3/4x1 3/4x3/16
Horizontals	A		N.A.			L2 1/2x2 1/2x1/2			N.A.	
Top Guy Pull-Offs			N.A.		4 1/2x3/8			N.A.		
Face Width (ft)							72 @ 2.34635			3.41
# Panels @ (ft)	3 @ 2	7 @ 2.29514								
Weight (K)	10.8		0.5	1.2	1.4	1.1	1.9	1.5	0.5	1.4





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
20' x 2" Dia Omni	180.5	20'x3" Omni	138.5
14' x 3" Dia Omni	180.5	(2) 6' x 2" Mount Pipe	127.5
20' x 2" Dia Omni	180.5	APXVSPP18-C_TIA w/ Mount Pipe	127.5
DS2C03F36D-D	177	APXVSPP18-C_TIA w/ Mount Pipe	127.5
USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]	177	APXVSPP18-C_TIA w/ Mount Pipe	127.5
		FD-RRH-2x50-800	127.5
Pipe Mount [PM 602-1]	176.5	FD-RRH-2x50-800	127.5
8.5' Dish	176.5	FD-RRH-2x50-800	127.5
8'x4" Std Horizontal Mount Pipe	160.5	FD-RRH-4x45-1900	127.5
6'x2" Horizontal Pipe	160.5	FD-RRH-4x45-1900	127.5
LNX-6515DS w/ Mount Pipe	160.5	FD-RRH-4x45-1900	127.5
LNX-6515DS w/ Mount Pipe	160.5	Sector Mount [SM 502-3]	127.5
LNX-6515DS w/ Mount Pipe	160.5	(2) 6' x 2" Mount Pipe	127.5
(2) AIR 21	160.5	(2) 6' x 2" Mount Pipe	127.5
(2) AIR 21	160.5	Side Arm Mount [SO 203-1]	89.5
(2) AIR 21	160.5	GPS	89.5
KRY 112 TMA	160.5	7770.00 w/ Mount Pipe	78.5
KRY 112 TMA	160.5	AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	78.5
KRY 112 TMA	160.5		
RRUS 11	160.5	AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	78.5
RRUS 11	160.5		
RRUS 11	160.5	AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	78.5
8'x4" Std Horizontal Mount Pipe	160.5		
Pipe Mount [PM 602-3]	160.5	(2) LGP21401 TMA	78.5
8'x4" Std Horizontal Mount Pipe	160.5	(2) LGP21401 TMA	78.5
8' x 2" Horizontal Mount Pipe	148.5	(2) LGP21401 TMA	78.5
7' Hor x 2.5" x 2.5" Angle Mount	138.5	18"x18"x 6" Equipment	78.5
7' Hor x 2.5" x 2.5" Angle Mount	138.5	DC6-48-60-18-8F	78.5
7' Hor x 2.5" x 2.5" Angle Mount	138.5	7770.00 w/ Mount Pipe	78.5
7' Hor x 2.5" x 2.5" Angle Mount	138.5	7770.00 w/ Mount Pipe	78.5
6' x 3" Mount Pipe	138.5	Sector Mount [SM 502-3]	78.5
20' x 2" Mount Pipe	138.5		

SYMBOL LIST

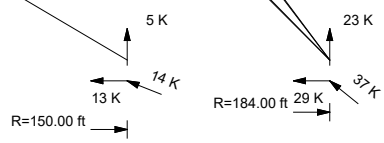
MARK	SIZE	MARK	SIZE
A	C12x20.7		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A53-B-35	35 ksi	60 ksi
A36	36 ksi	58 ksi			

TOWER DESIGN NOTES

1. Tower designed for Exposure B to the TIA-222-H Standard.
2. Tower designed for a 140 mph basic wind in accordance with the TIA-222-H Standard.
3. Tower is also designed for a 50 mph basic wind with 1.50 in ice. Ice is considered to increase in thickness with height.
4. Deflections are based upon a 60 mph wind.
5. Tower Risk Category III.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 90.5%



ALL REACTIONS ARE FACTORED

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Job: ***ES-008 MadisonAWC***		
Project: ***403093 (MadisonAWC)***		
Client:	Drawn by: Josh Riley	App'd:
Code: TIA-222-H	Date: 02/25/20	Scale: NTS
Path:		Dwg No. E-1

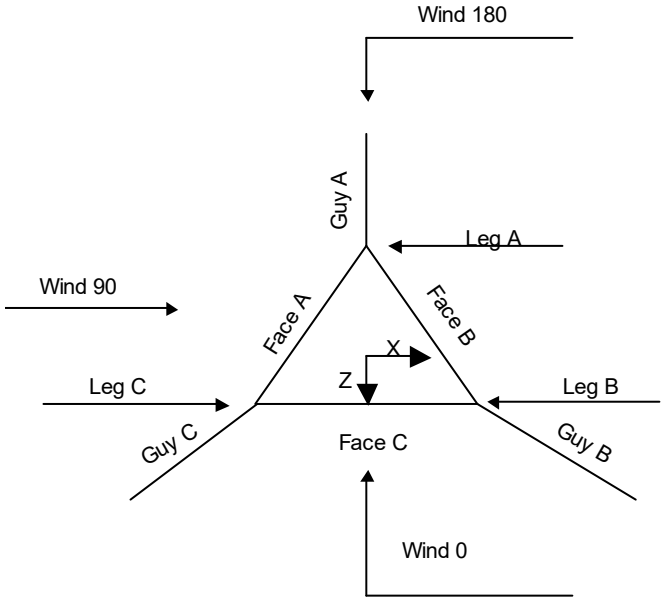
Tower Input Data

The main tower is a 3x guyed tower with an overall height of 181.50 ft above the ground line.
The base of the tower is set at an elevation of 1.50 ft above the ground line.
The face width of the tower is 3.41 ft at the top and tapered at the base.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

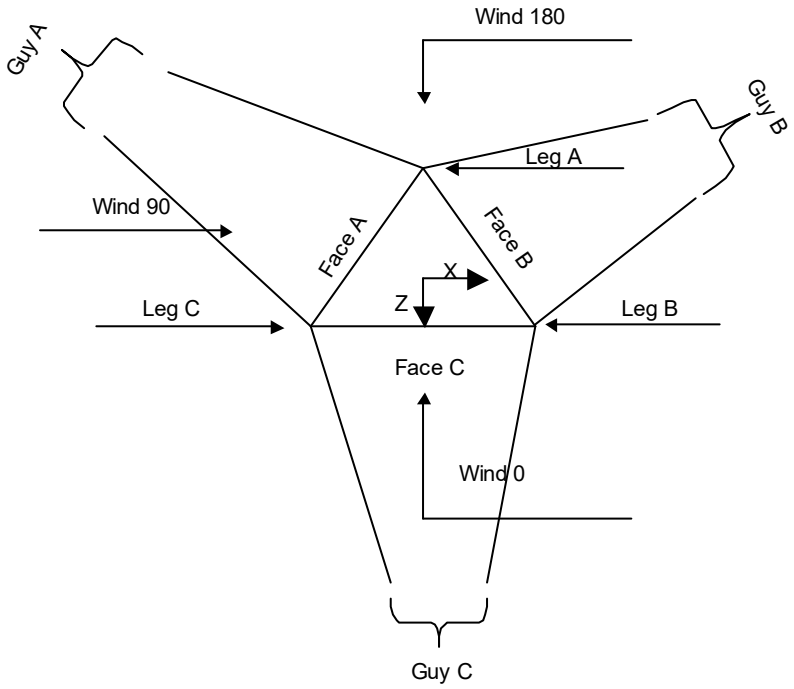
1. Tower base elevation above sea level: 64.50 ft.
2. Basic wind speed of 140 mph.
3. Risk Category III.
4. Exposure Category B.
5. Simplified Topographic Factor Procedure for wind speed-up calculations is used.
6. Topographic Category: 1.
7. Crest Height: 0.00 ft.
8. Nominal ice thickness of 1.5000 in.
9. Ice thickness is considered to increase with height.
10. Ice density of 56 pcf.
11. A wind speed of 50 mph is used in combination with ice.
12. Temperature drop of 50 °F.
13. Deflections calculated using a wind speed of 60 mph.
14. Pressures are calculated at each section.
15. Safety factor used in guy design is 0.9524.
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



Corner & Starmount Guyed Tower



Face Guyed

Tower Section Geometry

Tower Section	*Tower Elevation*	*Assembly Database*	*Description*	*Section Width*	*Number of Sections*	*Section Length*
	ft			*ft*		*ft*
T1	181.50-161.50			3.41	1	20.00
T2	161.50-141.50			3.41	1	20.00
T3	141.50-121.50			3.41	1	20.00
T4	121.50-101.50			3.41	1	20.00
T5	101.50-81.50			3.41	1	20.00
T6	81.50-61.50			3.41	1	20.00
T7	61.50-41.50			3.41	1	20.00
T8	41.50-21.50			3.41	1	20.00
T9	21.50-6.50			3.41	1	15.00
T10	6.50-1.50			3.41	1	5.00

Tower Section Geometry *(cont'd)*

Tower Section	*Tower Elevation*	*Diagonal Spacing*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset*	*Bottom Girt Offset*
	ft	*ft*				*in*	*in*
T1	181.50-161.50	2.35	X Brace	No	Yes	7.3750	7.3750
T2	161.50-141.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T3	141.50-121.50	2.35	X Brace	No	Yes	7.3750	7.3750

Tower Section	*Tower Elevation*	*Diagonal Spacing*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset*	*Bottom Girt Offset*
	ft	*ft*				*in*	*in*
T4	121.50-101.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T5	101.50-81.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T6	81.50-61.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T7	61.50-41.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T8	41.50-21.50	2.35	K Brace Left	No	Yes	7.3750	7.3750
T9	21.50-6.50	2.30	K Brace Left	No	Yes	7.3750	7.3750
T10	6.50-1.50	2.00	X Brace	No	Yes	6.0000	6.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Type*	*Leg Size*	*Leg Grade*	*Diagonal Type*	*Diagonal Size*	*Diagonal Grade*
T1 181.50-161.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T2 161.50-141.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T3 141.50-121.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L2x2x3/16	A36 (36 ksi)
T4 121.50-101.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T5 101.50-81.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T6 81.50-61.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T7 61.50-41.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T8 41.50-21.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T9 21.50-6.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T10 6.50-1.50	Pipe	Pipe 2.5 STD	A572-50 (50 ksi)	Equal Angle		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 181.50-161.50	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)	Equal Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T2 161.50-141.50	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T3 141.50-121.50	Equal Angle	L2x2x3/16	A36 (36 ksi)	Equal Angle	L2x2x3/16	A36 (36 ksi)
T4 121.50-101.50	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T5 101.50-81.50	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T6 81.50-61.50	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T7 61.50-41.50	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T8 41.50-21.50	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)	Pipe	TS1.5x16ga	A53-B-35 (35 ksi)
T9 21.50-6.50	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A36 (36 ksi)
T10 6.50-1.50	Channel	C12x20.7	A36 (36 ksi)	Channel	C12x20.7	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
T4 121.50-101.50	None	Flat Bar		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A572-50 (50 ksi)
T5 101.50-81.50	None	Flat Bar		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/2	A572-50 (50 ksi)
T10 6.50-1.50	None	Single Angle		A36 (36 ksi)	Channel	C12x20.7	A36 (36 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 181.50-161.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	Mid-Pt	Mid-Pt	36.0000
T2 161.50-141.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T3 141.50-121.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T4 121.50-101.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T5 101.50-81.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T6 81.50-61.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T7 61.50-41.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T8 41.50-21.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T9 21.50-6.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T10 6.50-1.50	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1 181.50-161.50	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2 161.50-141.50	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T3 141.50-121.50	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 121.50-101.50	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T5 101.50-81.50	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T6 81.50-	Yes	Yes	1	1	1	1	1	1	1	1

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
61.50				1	1	1	1	1	1	1
T7 61.50-41.50	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T8 41.50-21.50	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T9 21.50-6.50	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1
T10 6.50-1.50	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1

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

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg		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 181.50-161.50	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
T2 161.50-141.50	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
T3 141.50-121.50	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
T4 121.50-101.50	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 101.50-81.50	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 81.50-61.50	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 61.50-41.50	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 41.50-21.50	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 21.50-6.50	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
T10 6.50-1.50	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 181.50-161.50	Flange	0.7500 A325N	0	0.5000 A325N	1	0.5000 A325N	1	0.5000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 161.50-141.50	Flange	0.7500 A325N	4	0.5000 A325N	1	0.5000 A325N	1	0.5000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T3 141.50-121.50	Flange	0.7500 A325N	4	0.5000 A325N	1	0.5000 A325N	1	0.5000 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T4 121.50-101.50	Flange	0.7500 A325N	4	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	1	0.6250 A325N	0
T5 101.50-81.50	Flange	0.7500 A325N	4	0.5000 A325N	1	0.5000 A325N	1	0.5000 A325N	1	0.6250 A325N	0	0.6250 A325N	1	0.6250 A325N	0

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.
T6 81.50-61.50	Flange	0.7500 A325N	4	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	1	1.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T7 61.50-41.50	Flange	0.7500 A325N	4	0.6250 A325N	1	0.5000 A325N	1	0.5000 A325N	1	1.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T8 41.50-21.50	Flange	0.7500 A325N	4	0.5000 A325N	1	0.5000 A325N	1	0.5000 A325N	1	1.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T9 21.50-6.50	Flange	0.7500 A325N	4	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	1	1.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T10 6.50-1.50	Flange	0.7500 A325N	4	0.0000 A325N	0	0.0000 A325N	0	0.0000 A325N	0	1.0000 A325N	0	0.6250 A325N	0	0.6250 A325N	0

Guy Data

Guy Elevation ft	Guy Grade		Guy Size	Initial Tension K	%	Guy Modulus ksi	Guy Weight plf	L_u ft	Anchor Radius ft	Anchor Azimuth Adj. °	Anchor Elevation ft	End Fitting Efficiency %
169.154	EHS	A	9/16	3.50	10%	23000	0.671	248.23	184.00	0.0000	0.00	100%
		B	9/16	3.50	10%	23000	0.671	248.23	184.00	0.0000	0.00	100%
		C	9/16	3.50	10%	23000	0.671	248.23	184.00	0.0000	0.00	100%
129.154	EHS	A	9/16	3.50	10%	23000	0.671	222.94	184.00	0.0000	0.00	100%
		B	9/16	3.50	10%	23000	0.671	222.94	184.00	0.0000	0.00	100%
		C	9/16	3.50	10%	23000	0.671	222.94	184.00	0.0000	0.00	100%
62.1146	EHS	A	3/4	5.83	10%	24000	1.155	160.42	150.00	0.0000	0.00	100%
		B	3/4	5.83	10%	24000	1.155	164.86	154.80	0.0000	0.00	100%
		C	3/4	5.83	10%	24000	1.155	170.80	161.20	0.0000	0.00	100%

Guy Data *(cont'd)*

Guy Elevation ft	Mount Type	Torque-Arm Spread ft	Torque-Arm Leg Angle °	Torque-Arm Style	Torque-Arm Grade	Torque-Arm Type	Torque-Arm Size
169.154	Torque Arm	7.33	30.0000	Bat Ear	A36 (36 ksi)	Pipe	P4x.237
129.154	Torque Arm	7.33	30.0000	Bat Ear	A36 (36 ksi)	Pipe	P4x.237
62.1146	Corner						

Guy Data *(cont'd)*

Guy Elevation ft	Diagonal Grade	Diagonal Type	Upper Diagonal Size	Lower Diagonal Size	Is Strap.	Pull-Off Grade	Pull-Off Type	Pull-Off Size
169.15	A572-50 (50 ksi)	Solid Round				A36 (36 ksi)	Solid Round	
129.15	A572-50 (50 ksi)	Solid Round				A36 (36 ksi)	Solid Round	
62.11	A572-50 (50 ksi)	Solid Round			Yes	A36 (36 ksi)	Flat Bar	4 1/2x3/8

Guy Data *(cont'd)*

Guy Elevation ft	Cable Weight A K	Cable Weight B K	Cable Weight C K	Cable Weight D K	Tower Intercept A ft	Tower Intercept B ft	Tower Intercept C ft	Tower Intercept D ft
169.154	0.17	0.17	0.17		5.82 4.2 sec/pulse	5.82 4.2 sec/pulse	5.82 4.2 sec/pulse	
129.154	0.15	0.15	0.15		4.71 3.7 sec/pulse	4.71 3.7 sec/pulse	4.71 3.7 sec/pulse	
62.1146	0.19	0.19	0.20		2.54 2.7 sec/pulse	2.68 2.8 sec/pulse	2.87 2.9 sec/pulse	

Guy Data *(cont'd)*

Guy Elevation ft	Calc K Single Angles	Calc K Solid Rounds	Torque Arm K_x	Torque Arm K_y	Pull Off K_x	Pull Off K_y	Diagonal K_x	Diagonal K_y
169.154	No	No	1	1	1	1	1	1
129.154	No	No	1	1	1	1	1	1
62.1146	No	No			1	1	1	1

Guy Data *(cont'd)*

Guy Elevation ft	Torque-Arm Bolt Size in	Torque-Arm Number	Torque-Arm Net Width Deduct in	Torque-Arm U	Pull Off Bolt Size in	Pull Off Number	Pull Off Net Width Deduct in	Pull Off U	Diagonal Bolt Size in	Diagonal Number	Diagonal Net Width Deduct in	Diagonal U
169.154	0.0000 A325N	0	0.0000	1	0.6250 A325N	0	0.0000	0.75	0.6250 A325N	0	0.0000	0.75
129.154	0.0000 A325N	0	0.0000	1	0.6250 A325N	0	0.0000	0.75	0.6250 A325N	0	0.0000	0.75
62.1146	0.6250 A325N	0	0.0000	0.75	0.6250 A325N	4	0.0000	0.75	0.6250 A325N	0	0.0000	0.75

Guy Pressures

Guy Elevation ft	Guy Location	z ft	q_z psf	q_z Ice psf	Ice Thickness in
169.154	A	84.58	40	5	1.8952
	B	84.58	40	5	1.8952
	C	84.58	40	5	1.8952
129.154	A	64.58	37	5	1.8448
	B	64.58	37	5	1.8448
	C	64.58	37	5	1.8448
62.1146	A	31.06	30	4	1.7146
	B	31.06	30	4	1.7146
	C	31.06	30	4	1.7146

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
LDF7-50A(1-5/8)	B	No	No	Ar (CaAa)	181.50 - 6.50	0.0000	0.36	1	1	0.5000	1.9800		0.82
LDF5-50A(7/8)	A	No	No	Ar (CaAa)	181.50 - 6.50	0.0000	0.48	1	1	0.5000	1.0300		0.33
LDF4P-50A(1/2)	A	No	No	Ar (CaAa)	181.50 - 6.50	0.0000	0.45	1	1	0.5000	0.6300		0.15
***													
EW63	B	No	No	Ar (CaAa)	176.50 - 6.50	0.0000	0.43	1	1	0.5000	1.5742		0.51
***													
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	160.50 - 6.50	0.0000	-0.35	1	1	0.5000	1.9800		0.82
C4006L-NFNF(1-1/4)	A	No	No	Ar (CaAa)	160.50 - 6.50	2.0000	-0.35	1	1	0.5000	1.2800		0.56
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	160.50 - 6.50	0.0000	-0.22	6	3	0.5000	2.0100		0.82
***													
LDF5-50A(7/8)	C	No	No	Ar (CaAa)	148.50 - 6.50	0.0000	-0.45	2	2	0.5000	1.0900		0.33
***													
LDF6-50A(1-1/4)	C	No	No	Ar (CaAa)	127.50 - 6.50	0.0000	0	3	3	0.5000	1.5500		0.60
***													
***													
LDF4P-50A(1/2)	C	No	No	Ar (CaAa)	89.50 - 6.50	0.0000	-0.35	1	1	0.5000	0.6300		0.15
***													
VXL5-50(7/8)	A	No	No	Ar (CaAa)	78.50 - 6.50	0.0000	0.2	6	2	0.5000	1.0900		0.29
RG6-Fiber	A	No	No	Ar (CaAa)	78.50 - 6.50	0.0000	0.2	1	1	0.5000	0.6250		0.50
#8 AWG Copper Wire	A	No	No	Ar (CaAa)	78.50 - 6.50	0.0000	0.22	2	2	0.3400	0.3430		0.05
***													
** Proposed for Discrete Loads													
LCF78-50A(7/8)	B	No	No	Ar (CaAa)	181.50 - 6.50	0.0000	-0.48	2	2	0.5000	1.0900		0.34
***													
***													
***													

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	C_AA_A ft^2/ft	Weight plf
***								
***								
***								
***								
***								

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
T1	181.50-161.50	A	0.000	0.000	3.320	0.000	0.01
		B	0.000	0.000	10.681	0.000	0.04
		C	0.000	0.000	0.000	0.000	0.00
T2	161.50-141.50	A	0.000	0.000	32.428	0.000	0.13
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	1.526	0.000	0.00
T3	141.50-121.50	A	0.000	0.000	33.960	0.000	0.14
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	7.150	0.000	0.02
T4	121.50-101.50	A	0.000	0.000	33.960	0.000	0.14
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	13.660	0.000	0.05
T5	101.50-81.50	A	0.000	0.000	33.960	0.000	0.14
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	14.164	0.000	0.05
T6	81.50-61.50	A	0.000	0.000	47.307	0.000	0.18
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	14.920	0.000	0.05
T7	61.50-41.50	A	0.000	0.000	49.662	0.000	0.18
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	14.920	0.000	0.05
T8	41.50-21.50	A	0.000	0.000	49.662	0.000	0.18
		B	0.000	0.000	11.468	0.000	0.04
		C	0.000	0.000	14.920	0.000	0.05
T9	21.50-6.50	A	0.000	0.000	37.246	0.000	0.14
		B	0.000	0.000	8.601	0.000	0.03
		C	0.000	0.000	11.190	0.000	0.04
T10	6.50-1.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00

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	181.50-161.50	A	2.034	0.000	0.000	19.592	0.000	0.29
		B		0.000	0.000	41.794	0.000	0.58
		C		0.000	0.000	0.000	0.000	0.00
T2	161.50-141.50	A	2.009	0.000	0.000	74.016	0.000	1.25
		B		0.000	0.000	44.239	0.000	0.62
		C		0.000	0.000	7.371	0.000	0.08
T3	141.50-121.50	A	1.981	0.000	0.000	76.241	0.000	1.27
		B		0.000	0.000	43.815	0.000	0.61
		C		0.000	0.000	29.170	0.000	0.32
T4	121.50-101.50	A	1.948	0.000	0.000	75.495	0.000	1.25
		B		0.000	0.000	43.329	0.000	0.59
		C		0.000	0.000	48.112	0.000	0.56
T5	101.50-81.50	A	1.910	0.000	0.000	74.617	0.000	1.22
		B		0.000	0.000	42.757	0.000	0.58
		C		0.000	0.000	51.145	0.000	0.59
T6	81.50-61.50	A	1.864	0.000	0.000	116.019	0.000	1.69
		B		0.000	0.000	42.058	0.000	0.56
		C		0.000	0.000	55.656	0.000	0.65
T7	61.50-41.50	A	1.804	0.000	0.000	121.043	0.000	1.72
		B		0.000	0.000	41.156	0.000	0.53
		C		0.000	0.000	54.585	0.000	0.62
T8	41.50-21.50	A	1.717	0.000	0.000	117.489	0.000	1.62
		B		0.000	0.000	39.859	0.000	0.50
		C		0.000	0.000	53.046	0.000	0.58
T9	21.50-6.50	A	1.583	0.000	0.000	83.997	0.000	1.11
		B		0.000	0.000	28.391	0.000	0.34
		C		0.000	0.000	38.002	0.000	0.40
T10	6.50-1.50	A	1.397	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00

Feed Line Center of Pressure

Section	Elevation	CP_X	CP_Z	CP_X Ice	CP_Z Ice
	ft	in	in	in	in
T1	181.50-161.50	1.5566	-1.8287	1.0954	-1.9340
T2	161.50-141.50	-2.2608	-0.8909	-1.0851	-2.0253
T3	141.50-121.50	-1.1251	-0.2522	-0.1577	-0.6364
T4	121.50-101.50	-1.0332	0.0779	-0.1685	-0.3730
T5	101.50-81.50	-1.1414	0.1534	-0.0522	-0.3011
T6	81.50-61.50	-1.5371	-0.9063	-0.5453	-1.5479
T7	61.50-41.50	-1.7344	-1.1507	-0.7193	-1.8968
T8	41.50-21.50	-2.0470	-1.3170	-0.7993	-2.0455
T9	21.50-6.50	-1.6656	-1.1117	-0.7393	-1.8584
T10	6.50-1.50	0.0000	0.0000	0.0000	0.0000

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	LDF7-50A(1-5/8)	161.50 - 181.50	0.6000	0.2909
T1	2	LDF5-50A(7/8)	161.50 - 181.50	0.6000	0.2909
T1	3	LDF4P-50A(1/2)	161.50 - 181.50	0.6000	0.2909
T1	5	EW63	161.50 - 176.50	0.6000	0.2909
T1	23	LCF78-50A(7/8)	161.50 - 181.50	0.6000	0.2909
T2	1	LDF7-50A(1-5/8)	141.50 - 161.50	0.6000	0.4974
T2	2	LDF5-50A(7/8)	141.50 - 161.50	0.6000	0.4974
T2	3	LDF4P-50A(1/2)	141.50 - 161.50	0.6000	0.4974
T2	5	EW63	141.50 - 161.50	0.6000	0.4974
T2	7	LDF7-50A(1-5/8)	141.50 - 160.50	0.6000	0.4974
T2	8	C4006L-NFNF(1-1/4)	141.50 - 160.50	0.6000	0.4974
T2	9	LDF7-50A(1-5/8)	141.50 - 160.50	0.6000	0.4974
T2	11	LDF5-50A(7/8)	141.50 - 148.50	0.6000	0.4974
T2	23	LCF78-50A(7/8)	141.50 - 161.50	0.6000	0.4974
T3	1	LDF7-50A(1-5/8)	121.50 - 141.50	0.6000	0.2827
T3	2	LDF5-50A(7/8)	121.50 - 141.50	0.6000	0.2827
T3	3	LDF4P-50A(1/2)	121.50 - 141.50	0.6000	0.2827
T3	5	EW63	121.50 - 141.50	0.6000	0.2827
T3	7	LDF7-50A(1-5/8)	121.50 - 141.50	0.6000	0.2827
T3	8	C4006L-NFNF(1-1/4)	121.50 - 141.50	0.6000	0.2827
T3	9	LDF7-50A(1-5/8)	121.50 -	0.6000	0.2827

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
T3	11	LDF5-50A(7/8)	141.50 121.50 -	0.6000	0.2827
T3	13	LDF6-50A(1-1/4)	141.50 121.50 -	0.6000	0.2827
T3	23	LCF78-50A(7/8)	127.50 121.50 -	0.6000	0.2827
T4	1	LDF7-50A(1-5/8)	141.50 101.50 -	0.6000	0.3104
T4	2	LDF5-50A(7/8)	121.50 101.50 -	0.6000	0.3104
T4	3	LDF4P-50A(1/2)	121.50 101.50 -	0.6000	0.3104
T4	5	EW63	121.50 101.50 -	0.6000	0.3104
T4	7	LDF7-50A(1-5/8)	121.50 101.50 -	0.6000	0.3104
T4	8	C4006L-NFNF(1-1/4)	121.50 101.50 -	0.6000	0.3104
T4	9	LDF7-50A(1-5/8)	121.50 101.50 -	0.6000	0.3104
T4	11	LDF5-50A(7/8)	121.50 101.50 -	0.6000	0.3104
T4	13	LDF6-50A(1-1/4)	121.50 101.50 -	0.6000	0.3104
T4	23	LCF78-50A(7/8)	121.50 101.50 -	0.6000	0.3104
T5	1	LDF7-50A(1-5/8)	121.50 81.50 -	0.6000	0.3611
T5	2	LDF5-50A(7/8)	101.50 81.50 -	0.6000	0.3611
T5	3	LDF4P-50A(1/2)	101.50 81.50 -	0.6000	0.3611
T5	5	EW63	101.50 81.50 -	0.6000	0.3611
T5	7	LDF7-50A(1-5/8)	101.50 81.50 -	0.6000	0.3611
T5	8	C4006L-NFNF(1-1/4)	101.50 81.50 -	0.6000	0.3611
T5	9	LDF7-50A(1-5/8)	101.50 81.50 -	0.6000	0.3611
T5	11	LDF5-50A(7/8)	101.50 81.50 -	0.6000	0.3611
T5	13	LDF6-50A(1-1/4)	101.50 81.50 -	0.6000	0.3611
T5	16	LDF4P-50A(1/2)	101.50 81.50 -	0.6000	0.3611
T5	23	LCF78-50A(7/8)	89.50 81.50 -	0.6000	0.3611
T6	1	LDF7-50A(1-5/8)	101.50 61.50 -	0.6000	0.4458
T6	2	LDF5-50A(7/8)	81.50 61.50 -	0.6000	0.4458
T6	3	LDF4P-50A(1/2)	81.50 61.50 -	0.6000	0.4458
T6	5	EW63	81.50 61.50 -	0.6000	0.4458
T6	7	LDF7-50A(1-5/8)	81.50 61.50 -	0.6000	0.4458
T6	8	C4006L-NFNF(1-1/4)	81.50 61.50 -	0.6000	0.4458
T6	9	LDF7-50A(1-5/8)	81.50 61.50 -	0.6000	0.4458
T6	11	LDF5-50A(7/8)	81.50 61.50 -	0.6000	0.4458
T6	13	LDF6-50A(1-1/4)	81.50 61.50 -	0.6000	0.4458
T6	16	LDF4P-50A(1/2)	81.50 61.50 -	0.6000	0.4458
			81.50		

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	*K_a No Ice*	*K_a Ice*
T6	18	VXL5-50(7/8)	61.50 - 78.50	0.6000	0.4458
T6	19	RG6-Fiber	61.50 - 78.50	0.6000	0.4458
T6	20	#8 AWG Copper Wire	61.50 - 78.50	0.6000	0.4458
T6	23	LCF78-50A(7/8)	61.50 - 81.50	0.6000	0.4458
T7	1	LDF7-50A(1-5/8)	41.50 - 61.50	0.6000	0.4900
T7	2	LDF5-50A(7/8)	41.50 - 61.50	0.6000	0.4900
T7	3	LDF4P-50A(1/2)	41.50 - 61.50	0.6000	0.4900
T7	5	EW63	41.50 - 61.50	0.6000	0.4900
T7	7	LDF7-50A(1-5/8)	41.50 - 61.50	0.6000	0.4900
T7	8	C4006L-NFNF(1-1/4)	41.50 - 61.50	0.6000	0.4900
T7	9	LDF7-50A(1-5/8)	41.50 - 61.50	0.6000	0.4900
T7	11	LDF5-50A(7/8)	41.50 - 61.50	0.6000	0.4900
T7	13	LDF6-50A(1-1/4)	41.50 - 61.50	0.6000	0.4900
T7	16	LDF4P-50A(1/2)	41.50 - 61.50	0.6000	0.4900
T7	18	VXL5-50(7/8)	41.50 - 61.50	0.6000	0.4900
T7	19	RG6-Fiber	41.50 - 61.50	0.6000	0.4900
T7	20	#8 AWG Copper Wire	41.50 - 61.50	0.6000	0.4900
T7	23	LCF78-50A(7/8)	41.50 - 61.50	0.6000	0.4900
T8	1	LDF7-50A(1-5/8)	21.50 - 41.50	0.6000	0.5389
T8	2	LDF5-50A(7/8)	21.50 - 41.50	0.6000	0.5389
T8	3	LDF4P-50A(1/2)	21.50 - 41.50	0.6000	0.5389
T8	5	EW63	21.50 - 41.50	0.6000	0.5389
T8	7	LDF7-50A(1-5/8)	21.50 - 41.50	0.6000	0.5389
T8	8	C4006L-NFNF(1-1/4)	21.50 - 41.50	0.6000	0.5389
T8	9	LDF7-50A(1-5/8)	21.50 - 41.50	0.6000	0.5389
T8	11	LDF5-50A(7/8)	21.50 - 41.50	0.6000	0.5389
T8	13	LDF6-50A(1-1/4)	21.50 - 41.50	0.6000	0.5389
T8	16	LDF4P-50A(1/2)	21.50 - 41.50	0.6000	0.5389
T8	18	VXL5-50(7/8)	21.50 - 41.50	0.6000	0.5389
T8	19	RG6-Fiber	21.50 - 41.50	0.6000	0.5389
T8	20	#8 AWG Copper Wire	21.50 - 41.50	0.6000	0.5389
T8	23	LCF78-50A(7/8)	21.50 - 41.50	0.6000	0.5389
T9	1	LDF7-50A(1-5/8)	6.50 - 21.50	0.6000	0.5021
T9	2	LDF5-50A(7/8)	6.50 - 21.50	0.6000	0.5021
T9	3	LDF4P-50A(1/2)	6.50 - 21.50	0.6000	0.5021
T9	5	EW63	6.50 - 21.50	0.6000	0.5021
T9	7	LDF7-50A(1-5/8)	6.50 - 21.50	0.6000	0.5021

Tower Section	*Feed Line Record No.*	*Description*	*Feed Line Segment Elev.*	K_a *No Ice*	K_a *Ice*
T9	8	C4006L-NFNF(1-1/4)	6.50 - 21.50	0.6000	0.5021
T9	9	LDF7-50A(1-5/8)	6.50 - 21.50	0.6000	0.5021
T9	11	LDF5-50A(7/8)	6.50 - 21.50	0.6000	0.5021
T9	13	LDF6-50A(1-1/4)	6.50 - 21.50	0.6000	0.5021
T9	16	LDF4P-50A(1/2)	6.50 - 21.50	0.6000	0.5021
T9	18	VXL5-50(7/8)	6.50 - 21.50	0.6000	0.5021
T9	19	RG6-Fiber	6.50 - 21.50	0.6000	0.5021
T9	20	#8 AWG Copper Wire	6.50 - 21.50	0.6000	0.5021
T9	23	LCF78-50A(7/8)	6.50 - 21.50	0.6000	0.5021

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
20' x 2" Dia Omni	A	From Leg	0.00 0.00 10.00	0.0000	180.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.00 6.03 8.06 12.12	4.00 6.03 8.06 12.12	0.02 0.05 0.08 0.14
14' x 3" Dia Omni	C	From Face	4.00 0.00 7.00	0.0000	180.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.20 5.63 7.06 9.92	4.20 5.63 7.06 9.92	0.04 0.07 0.10 0.16
20' x 2" Dia Omni	B	From Leg	0.00 0.00 10.00	0.0000	180.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.00 6.03 8.06 12.12	4.00 6.03 8.06 12.12	0.02 0.05 0.08 0.14
***									
Pipe Mount [PM 602-1]	A	From Leg	0.50 0.00 0.00	0.0000	176.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.78 3.21 3.64 4.54	2.78 3.21 3.64 4.54	0.09 0.11 0.14 0.21
***									
Pipe Mount [PM 602-3]	B	None		0.0000	160.50	No Ice 1/2" Ice 1" Ice 2" Ice	6.67 7.70 8.74 10.90	6.67 7.70 8.74 10.90	0.28 0.34 0.42 0.63
8'x4" Std Horizontal Mount Pipe	A	From Leg	3.00 0.00 0.00	0.0000	160.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.50 2.59 3.10 4.13	1.50 2.59 3.10 4.13	0.09 0.35 0.62 1.19
8'x4" Std Horizontal Mount Pipe	B	From Leg	3.00 0.00 0.00	0.0000	160.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.50 2.59 3.10 4.13	1.50 2.59 3.10 4.13	0.09 0.35 0.62 1.19
8'x4" Std Horizontal Mount Pipe	C	From Leg	3.00 0.00 0.00	0.0000	160.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.50 2.59 3.10 4.13	1.50 2.59 3.10 4.13	0.09 0.35 0.62 1.19
6'x2" Horizontal Pipe	C	From Leg	3.00	0.0000	160.50	No Ice	1.43	0.01	0.02

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			1/2"	1.92	0.04	0.03
			0.00			Ice	2.29	0.07	0.05
						1" Ice	3.06	0.13	0.09
						2" Ice			
LNX-6515DS w/ Mount Pipe	A	From Leg	3.00	0.0000	160.50	No Ice	11.68	9.84	0.08
			0.00			1/2"	12.40	11.37	0.17
			0.00			Ice	13.14	12.91	0.27
						1" Ice	14.51	15.27	0.50
						2" Ice			
LNX-6515DS w/ Mount Pipe	B	From Leg	3.00	0.0000	160.50	No Ice	11.68	9.84	0.08
			0.00			1/2"	12.40	11.37	0.17
			0.00			Ice	13.14	12.91	0.27
						1" Ice	14.51	15.27	0.50
						2" Ice			
LNX-6515DS w/ Mount Pipe	C	From Leg	3.00	0.0000	160.50	No Ice	11.68	9.84	0.08
			0.00			1/2"	12.40	11.37	0.17
			0.00			Ice	13.14	12.91	0.27
						1" Ice	14.51	15.27	0.50
						2" Ice			
(2) AIR 21	A	From Leg	3.00	0.0000	160.50	No Ice	6.05	4.36	0.09
			0.00			1/2"	6.42	4.70	0.13
			0.00			Ice	6.80	5.06	0.18
						1" Ice	7.57	5.79	0.29
						2" Ice			
(2) AIR 21	B	From Leg	3.00	0.0000	160.50	No Ice	6.05	4.36	0.09
			0.00			1/2"	6.42	4.70	0.13
			0.00			Ice	6.80	5.06	0.18
						1" Ice	7.57	5.79	0.29
						2" Ice			
(2) AIR 21	C	From Leg	3.00	0.0000	160.50	No Ice	6.05	4.36	0.09
			0.00			1/2"	6.42	4.70	0.13
			0.00			Ice	6.80	5.06	0.18
						1" Ice	7.57	5.79	0.29
						2" Ice			
KRY 112 TMA	A	From Leg	3.00	0.0000	160.50	No Ice	0.35	0.17	0.01
			0.00			1/2"	0.43	0.23	0.01
			0.00			Ice	0.51	0.30	0.02
						1" Ice	0.70	0.46	0.03
						2" Ice			
KRY 112 TMA	B	From Leg	3.00	0.0000	160.50	No Ice	0.35	0.17	0.01
			0.00			1/2"	0.43	0.23	0.01
			0.00			Ice	0.51	0.30	0.02
						1" Ice	0.70	0.46	0.03
						2" Ice			
KRY 112 TMA	C	From Leg	3.00	0.0000	160.50	No Ice	0.35	0.17	0.01
			0.00			1/2"	0.43	0.23	0.01
			0.00			Ice	0.51	0.30	0.02
						1" Ice	0.70	0.46	0.03
						2" Ice			
RRUS 11	A	From Leg	3.00	0.0000	160.50	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	3.00	0.0000	160.50	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	3.00	0.0000	160.50	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			

***

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*
8' x 2" Horizontal Mount Pipe	C	From Leg	3.00 0.00 10.00	0.0000	148.50	No Ice 1/2" Ice 1" Ice 2" Ice	0.79 1.59 2.08 3.10	0.79 1.59 2.08 3.10	0.03 0.28 0.54 1.09
20' x 2" Mount Pipe	A	From Face	3.00 0.00 10.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.75 6.78 8.82 12.96	4.75 6.78 8.82 12.96	0.09 0.12 0.17 0.31
20'x3" Omni	A	From Face	3.00 0.00 10.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	4.00 6.00 8.00 12.00	4.00 6.00 8.00 12.00	0.06 0.10 0.14 0.23
6' x 3" Mount Pipe	A	From Face	3.00 0.00 0.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.77 2.13 2.50 3.27	1.77 2.13 2.50 3.27	0.03 0.04 0.06 0.11
7' Hor x 2.5" x 2.5" Angle Mount	A	From Leg	1.50 0.00 3.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.92 3.60 3.94 4.74	0.02 0.07 0.13 0.32	0.03 0.05 0.07 0.13
7' Hor x 2.5" x 2.5" Angle Mount	C	From Leg	1.50 0.00 3.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.92 3.60 3.94 4.74	0.02 0.07 0.13 0.32	0.03 0.05 0.07 0.13
7' Hor x 2.5" x 2.5" Angle Mount	A	From Leg	1.50 0.00 -3.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.92 3.60 3.94 4.74	0.02 0.07 0.13 0.32	0.03 0.05 0.07 0.13
7' Hor x 2.5" x 2.5" Angle Mount	C	From Leg	1.50 0.00 -3.00	0.0000	138.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.92 3.60 3.94 4.74	0.02 0.07 0.13 0.32	0.03 0.05 0.07 0.13
***									
Sector Mount [SM 502-3]	C	None		0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	29.82 42.21 54.43 78.49	29.82 42.21 54.43 78.49	1.67 2.27 3.05 5.18
(2) 6' x 2" Mount Pipe	A	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.43 1.92 2.29 3.06	1.43 1.92 2.29 3.06	0.02 0.03 0.05 0.09
(2) 6' x 2" Mount Pipe	B	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.43 1.92 2.29 3.06	1.43 1.92 2.29 3.06	0.02 0.03 0.05 0.09
(2) 6' x 2" Mount Pipe	C	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.43 1.92 2.29 3.06	1.43 1.92 2.29 3.06	0.02 0.03 0.05 0.09
APXVSPP18-C_TIA w/ Mount Pipe	A	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice	8.26 8.82 9.35 10.42	7.47 8.66 9.56 11.39	0.09 0.16 0.24 0.42

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			
APXVSPP18-C_TIA w/ Mount Pipe	B	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	8.26 8.82 9.35 10.42	7.47 8.66 9.56 11.39	0.09 0.16 0.24 0.42
APXVSPP18-C_TIA w/ Mount Pipe	C	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	8.26 8.82 9.35 10.42	7.47 8.66 9.56 11.39	0.09 0.16 0.24 0.42
FD-RRH-2x50-800	A	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.06 2.24 2.43 2.83	1.36 1.52 1.68 2.03	0.05 0.07 0.09 0.14
FD-RRH-2x50-800	B	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.06 2.24 2.43 2.83	1.36 1.52 1.68 2.03	0.05 0.07 0.09 0.14
FD-RRH-2x50-800	C	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.06 2.24 2.43 2.83	1.36 1.52 1.68 2.03	0.05 0.07 0.09 0.14
FD-RRH-4x45-1900	A	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.32 2.53 2.74 3.19	2.24 2.44 2.65 3.09	0.06 0.08 0.11 0.17
FD-RRH-4x45-1900	B	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.32 2.53 2.74 3.19	2.24 2.44 2.65 3.09	0.06 0.08 0.11 0.17
FD-RRH-4x45-1900	C	From Leg	3.00 0.00 0.00	0.0000	127.50	No Ice 1/2" Ice 1" Ice 2" Ice	2.32 2.53 2.74 3.19	2.24 2.44 2.65 3.09	0.06 0.08 0.11 0.17
***									
Side Arm Mount [SO 203-1]	B	From Leg	1.50 0.00 0.00	0.0000	89.50	No Ice 1/2" Ice 1" Ice 2" Ice	1.78 2.24 2.75 3.89	3.79 4.47 5.21 6.78	0.13 0.15 0.19 0.29
GPS	B	From Leg	3.00 0.00 0.00	0.0000	89.50	No Ice 1/2" Ice 1" Ice 2" Ice	0.13 0.18 0.23 0.37	0.13 0.18 0.23 0.37	0.00 0.00 0.00 0.01
***									
Sector Mount [SM 502-3]	C	None		0.0000	78.50	No Ice 1/2" Ice 1" Ice 2" Ice	29.82 42.21 54.43 78.49	29.82 42.21 54.43 78.49	1.67 2.27 3.05 5.18
7770.00 w/ Mount Pipe	A	From Leg	3.00 6.00 0.00	0.0000	78.50	No Ice 1/2" Ice 1" Ice 2" Ice	5.75 6.18 6.61 7.49	4.25 5.01 5.71 7.16	0.06 0.11 0.16 0.29
7770.00 w/ Mount Pipe	B	From Leg	3.00 6.00	0.0000	78.50	No Ice 1/2"	5.75 6.18	4.25 5.01	0.06 0.11

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	6.61	5.71	0.16
						1" Ice	7.49	7.16	0.29
						2" Ice			
7770.00 w/ Mount Pipe	C	From Leg	3.00	0.0000	78.50	No Ice	5.75	4.25	0.06
			6.00			1/2"	6.18	5.01	0.11
			0.00			Ice	6.61	5.71	0.16
						1" Ice	7.49	7.16	0.29
						2" Ice			
AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	A	From Leg	3.00	0.0000	78.50	No Ice	5.23	4.02	0.05
			-6.00			1/2"	5.62	4.63	0.10
			0.00			Ice	6.01	5.26	0.15
						1" Ice	6.83	6.53	0.27
						2" Ice			
AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	B	From Leg	3.00	0.0000	78.50	No Ice	5.23	4.02	0.05
			-6.00			1/2"	5.62	4.63	0.10
			0.00			Ice	6.01	5.26	0.15
						1" Ice	6.83	6.53	0.27
						2" Ice			
AM-X-CD-14-65-00T-RET_TIA w/ Mount Pipe	C	From Leg	3.00	0.0000	78.50	No Ice	5.23	4.02	0.05
			-6.00			1/2"	5.62	4.63	0.10
			0.00			Ice	6.01	5.26	0.15
						1" Ice	6.83	6.53	0.27
						2" Ice			
(2) LGP21401 TMA	A	From Leg	3.00	0.0000	78.50	No Ice	0.82	0.35	0.02
			0.00			1/2"	0.94	0.44	0.02
			0.00			Ice	1.06	0.54	0.03
						1" Ice	1.34	0.76	0.05
						2" Ice			
(2) LGP21401 TMA	B	From Leg	3.00	0.0000	78.50	No Ice	0.82	0.35	0.02
			0.00			1/2"	0.94	0.44	0.02
			0.00			Ice	1.06	0.54	0.03
						1" Ice	1.34	0.76	0.05
						2" Ice			
(2) LGP21401 TMA	C	From Leg	3.00	0.0000	78.50	No Ice	0.82	0.35	0.02
			0.00			1/2"	0.94	0.44	0.02
			0.00			Ice	1.06	0.54	0.03
						1" Ice	1.34	0.76	0.05
						2" Ice			
18"x18"x 6" Equipment	C	From Face	0.00	0.0000	78.50	No Ice	2.70	0.92	0.02
			0.00			1/2"	2.90	1.05	0.04
			0.00			Ice	3.11	1.19	0.06
						1" Ice	3.56	1.49	0.11
						2" Ice			
DC6-48-60-18-8F	C	From Leg	0.00	0.0000	78.50	No Ice	0.92	0.92	0.02
			0.00			1/2"	1.46	1.46	0.04
			-2.00			Ice	1.64	1.64	0.06
						1" Ice	2.04	2.04	0.11
						2" Ice			
Proposed DS2C03F36D-D	C	From Leg	4.00	0.0000	177.00	No Ice	7.29	7.29	0.07
			0.00			1/2"	9.75	9.75	0.12
			13.00			Ice	12.23	12.23	0.19
						1" Ice	17.24	17.24	0.37
						2" Ice			
USF-4U w/ Tieback [4' SO 203-1 + Vert. Pipe Support]	C	From Leg	2.00	0.0000	177.00	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			
***									
***									
***									

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
8.5' Dish	A	Paraboloid w/Radome	From Leg	1.00 0.00 0.00	0.0000		176.50	8.50	No Ice 1/2" Ice 1" Ice 2" Ice	56.75 57.56 58.37 59.99	0.07 0.30 0.53 0.99

Load Combinations

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

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	181.5 - 161.5	Leg	Max Tension	8	13.94	0.02	-0.09
			Max. Compression	18	-16.11	0.01	-0.08

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Mx	11	-6.54	1.03	0.04
			Max. My	2	-5.67	-0.01	0.93
			Max. Vy	5	-1.34	-0.97	0.07
			Max. Vx	2	1.20	-0.01	0.93
		Diagonal	Max Tension	5	2.53	-0.02	0.01
			Max. Compression	3	-2.33	0.00	0.00
			Max. Mx	9	0.82	-0.03	0.00
			Max. My	3	-1.81	-0.01	0.02
			Max. Vy	15	-0.03	0.03	-0.00
			Max. Vx	3	-0.01	-0.01	0.02
		Top Girt	Max Tension	2	0.06	0.00	0.00
			Max. Compression	8	-0.11	0.00	0.00
			Max. Mx	26	-0.05	-0.02	0.00
			Max. My	7	-0.02	0.00	0.00
			Max. Vy	26	0.02	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Bottom Girt	Max Tension	11	0.59	0.00	0.00
			Max. Compression	4	-0.62	0.00	0.00
			Max. Mx	21	0.09	-0.02	0.00
			Max. My	20	-0.08	0.00	0.00
			Max. Vy	21	0.02	0.00	0.00
			Max. Vx	20	0.00	0.00	0.00
		Guy A	Bottom Tension	8	9.52		
			Top Tension	8	9.63		
			Top Cable Vert	8	6.67		
			Top Cable Norm	8	6.94		
			Top Cable Tan	8	0.00		
			Bot Cable Vert	8	-6.34		
			Bot Cable Norm	8	7.09		
			Bot Cable Tan	8	0.00		
		Guy B	Bottom Tension	25	8.89		
			Top Tension	12	9.46		
			Top Cable Vert	25	6.93		
			Top Cable Norm	25	6.44		
			Top Cable Tan	25	0.00		
			Bot Cable Vert	12	-5.92		
			Bot Cable Norm	12	6.64		
			Bot Cable Tan	12	0.00		
		Guy C	Bottom Tension	17	9.02		
			Top Tension	4	9.32		
			Top Cable Vert	17	6.84		
			Top Cable Norm	17	6.33		
			Top Cable Tan	17	0.00		
			Bot Cable Vert	4	-6.01		
			Bot Cable Norm	4	6.73		
			Bot Cable Tan	4	0.00		
		Torque Arm Top	Max Tension	23	13.50	0.00	0.00
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	19	12.09	0.05	0.00
			Max. My	7	5.72	0.00	0.00
			Max. Vy	19	-0.05	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Torque Arm Bottom	Max Tension	2	0.76	0.00	0.00
			Max. Compression	8	-14.14	0.00	0.00
			Max. Mx	19	-12.27	0.06	0.00
			Max. My	4	-13.01	0.00	0.00
			Max. Vy	19	-0.05	0.00	0.00
			Max. Vx	4	-0.00	0.00	0.00
T2	161.5 - 141.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-22.20	-0.02	0.03
			Max. Mx	11	-10.45	-0.86	0.05
			Max. My	8	-9.41	0.14	0.76
			Max. Vy	5	-1.33	-0.15	0.02
			Max. Vx	2	1.20	-0.07	0.19
		Diagonal	Max Tension	12	1.59	0.00	0.00
			Max. Compression	4	-1.72	0.00	0.00
			Max. Mx	19	0.11	0.02	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. My	20	0.17	0.00	-0.00
			Max. Vy	19	-0.02	0.00	0.00
			Max. Vx	20	0.00	0.00	0.00
		Top Girt	Max Tension	11	0.90	0.00	0.00
			Max. Compression	5	-0.90	0.00	0.00
			Max. Mx	21	-0.21	0.01	0.00
			Max. My	20	-0.02	0.00	-0.00
			Max. Vy	21	0.02	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Bottom Girt	Max Tension	3	0.74	0.00	0.00
			Max. Compression	12	-0.80	0.00	0.00
			Max. Mx	25	-0.05	0.01	0.00
			Max. Vy	22	0.02	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
T3	141.5 - 121.5	Leg	Max Tension	8	5.73	0.01	-0.21
			Max. Compression	18	-38.79	0.00	-0.22
			Max. Mx	6	-12.42	-0.79	-0.30
			Max. My	2	-14.79	0.05	0.84
			Max. Vy	6	-1.17	-0.79	-0.30
			Max. Vx	2	1.30	0.05	0.84
		Diagonal	Max Tension	7	2.67	0.00	0.00
			Max. Compression	9	-2.58	-0.00	-0.01
			Max. Mx	19	-0.42	0.08	0.00
			Max. My	3	-1.54	-0.01	0.02
			Max. Vy	19	-0.05	0.08	0.00
			Max. Vx	3	-0.01	-0.01	0.02
		Top Girt	Max Tension	19	0.46	0.00	0.00
			Max. Compression	12	-0.15	0.00	0.00
			Max. Mx	22	0.29	-0.02	0.00
			Max. My	7	0.16	0.00	0.00
			Max. Vy	22	0.03	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Bottom Girt	Max Tension	2	0.86	0.00	0.00
			Max. Compression	12	-0.37	0.00	0.00
			Max. Mx	14	0.53	-0.02	0.00
			Max. Vy	14	-0.03	0.00	0.00
		Guy A	Bottom Tension	8	9.57		
			Top Tension	8	9.65		
			Top Cable Vert	8	5.68		
			Top Cable Norm	8	7.80		
			Top Cable Tan	8	0.00		
			Bot Cable Vert	8	-5.42		
			Bot Cable Norm	8	7.88		
			Bot Cable Tan	8	0.00		
		Guy B	Bottom Tension	12	9.28		
			Top Tension	12	9.36		
			Top Cable Vert	12	5.52		
			Top Cable Norm	12	7.57		
			Top Cable Tan	12	0.00		
			Bot Cable Vert	12	-5.26		
			Bot Cable Norm	12	7.64		
			Bot Cable Tan	12	0.00		
		Guy C	Bottom Tension	4	9.51		
			Top Tension	4	9.60		
			Top Cable Vert	4	5.65		
			Top Cable Norm	4	7.76		
			Top Cable Tan	4	0.00		
			Bot Cable Vert	4	-5.39		
			Bot Cable Norm	4	7.84		
			Bot Cable Tan	4	0.00		
		Torque Arm Top	Max Tension	15	12.38	0.00	0.00
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	19	11.11	0.05	0.00
			Max. My	2	9.88	0.00	-0.00
			Max. Vy	19	0.05	0.00	0.00
			Max. Vx	2	0.00	0.00	0.00
		Torque Arm Bottom	Max Tension	6	2.56	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	8	-13.17	0.00	0.00
			Max. Mx	19	-10.40	0.06	0.00
			Max. My	4	-12.94	0.00	0.00
			Max. Vy	19	-0.05	0.00	0.00
			Max. Vx	4	-0.00	0.00	0.00
T4	121.5 - 101.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	17	-43.60	-0.15	-0.30
			Max. Mx	19	-38.90	0.72	-0.02
			Max. My	2	-17.46	-0.05	-0.76
			Max. Vy	6	-1.16	-0.07	0.04
			Max. Vx	2	1.30	0.08	0.04
		Diagonal	Max Tension	6	3.01	0.00	0.00
			Max. Compression	11	-3.45	0.00	0.00
			Max. Mx	19	-0.04	-0.04	0.00
			Max. My	20	-0.19	0.00	0.00
			Max. Vy	19	-0.04	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Horizontal	Max Tension	19	1.17	0.00	0.00
			Max. Compression	17	-0.74	0.00	0.00
			Max. Mx	16	1.12	-0.03	0.00
			Max. My	7	0.49	0.00	0.00
			Max. Vy	16	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Top Girt	Max Tension	2	1.67	0.00	0.00
			Max. Compression	8	-1.39	0.00	0.00
			Max. Mx	18	0.14	-0.03	0.00
			Max. My	20	0.17	0.00	0.00
			Max. Vy	18	0.04	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Bottom Girt	Max Tension	7	0.55	0.00	0.00
			Max. Compression	10	-0.20	0.00	0.00
			Max. Mx	14	0.43	-0.03	0.00
			Max. My	7	0.01	0.00	0.00
			Max. Vy	14	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
T5	101.5 - 81.5	Leg	Max Tension	6	0.42	0.10	-0.09
			Max. Compression	17	-43.61	-0.18	-0.28
			Max. Mx	19	-41.96	0.48	-0.01
			Max. My	8	-12.54	0.03	0.43
			Max. Vy	11	-0.85	0.09	-0.02
			Max. Vx	8	0.86	-0.05	-0.10
		Diagonal	Max Tension	13	1.61	0.00	0.00
			Max. Compression	7	-2.01	0.00	0.00
			Max. Mx	18	0.18	0.02	0.00
			Max. My	20	-0.37	0.00	-0.00
			Max. Vy	18	-0.02	0.00	0.00
			Max. Vx	20	-0.00	0.00	0.00
		Horizontal	Max Tension	22	0.80	0.00	0.00
			Max. Compression	17	-0.75	0.00	0.00
			Max. Mx	18	0.70	-0.03	0.00
			Max. My	7	0.55	0.00	0.00
			Max. Vy	18	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Top Girt	Max Tension	22	0.35	0.00	0.00
			Max. Compression	6	-0.05	0.00	0.00
			Max. Mx	14	0.22	0.01	0.00
			Max. Vy	14	0.02	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
		Bottom Girt	Max Tension	9	0.64	0.00	0.00
			Max. Compression	12	-0.57	0.00	0.00
			Max. Mx	17	0.29	0.01	0.00
			Max. My	7	0.50	0.00	-0.00
			Max. Vy	17	0.02	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
T6	81.5 - 61.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	15	-54.23	0.14	0.16
			Max. Mx	5	-33.49	-1.00	-0.00
			Max. My	2	-33.94	0.17	1.01

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vy	11	1.43	0.93	0.07
			Max. Vx	8	-1.45	-0.07	-0.97
		Diagonal	Max Tension	13	4.44	0.00	0.00
			Max. Compression	3	-4.43	0.00	0.00
			Max. Mx	18	1.21	-0.04	0.00
			Max. My	7	-1.90	0.00	0.00
			Max. Vy	18	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Top Girt	Max Tension	3	0.99	0.00	0.00
			Max. Compression	9	-0.73	0.00	0.00
			Max. Mx	14	0.19	-0.03	0.00
			Max. My	7	-0.46	0.00	0.00
			Max. Vy	14	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Bottom Girt	Max Tension	2	3.88	0.00	0.00
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	14	3.14	-0.03	0.00
			Max. My	7	2.90	0.00	0.00
			Max. Vy	14	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Guy A	Bottom Tension	8	13.82		
			Top Tension	8	13.89		
			Top Cable Vert	8	5.47		
			Top Cable Norm	8	12.77		
			Top Cable Tan	8	0.00		
			Bot Cable Vert	8	-5.24		
			Bot Cable Norm	8	12.79		
			Bot Cable Tan	8	0.00		
		Guy B	Bottom Tension	12	13.70		
			Top Tension	12	13.78		
			Top Cable Vert	12	5.28		
			Top Cable Norm	12	12.72		
			Top Cable Tan	12	0.00		
			Bot Cable Vert	12	-5.05		
			Bot Cable Norm	12	12.74		
			Bot Cable Tan	12	0.00		
		Guy C	Bottom Tension	4	13.44		
			Top Tension	4	13.52		
			Top Cable Vert	4	5.01		
			Top Cable Norm	4	12.55		
			Top Cable Tan	4	0.00		
			Bot Cable Vert	4	-4.77		
			Bot Cable Norm	4	12.57		
			Bot Cable Tan	4	0.00		
		Top Guy Pull-Off	Max Tension	2	2.91	0.00	0.00
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	14	2.36	0.03	0.00
			Max. My	7	2.17	0.00	-0.00
			Max. Vy	14	-0.04	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
T7	61.5 - 41.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	15	-54.24	0.08	-0.10
			Max. Mx	11	-8.61	-0.83	-0.06
			Max. My	8	-5.13	0.13	0.81
			Max. Vy	11	1.43	0.05	0.00
			Max. Vx	8	-1.45	0.03	-0.08
		Diagonal	Max Tension	13	3.32	0.00	0.00
			Max. Compression	7	-3.51	0.00	0.00
			Max. Mx	16	-1.08	-0.04	0.00
			Max. My	7	-1.17	0.00	0.00
			Max. Vy	16	0.04	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Top Girt	Max Tension	7	1.85	0.00	0.00
			Max. Compression	13	-1.60	0.00	0.00
			Max. Mx	14	0.10	0.01	0.00
			Max. My	7	1.85	0.00	-0.00
			Max. Vy	14	-0.01	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
		Bottom Girt	Max Tension	13	0.91	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	7	-0.79	0.00	0.00
			Max. Mx	14	0.12	0.01	0.00
			Max. My	7	-0.79	0.00	-0.00
			Max. Vy	14	-0.01	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
T8	41.5 - 21.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	21	-55.25	0.15	0.16
			Max. Mx	11	-22.73	-0.42	-0.02
			Max. My	8	-22.71	0.10	0.42
			Max. Vy	11	0.61	0.07	-0.07
			Max. Vx	8	-0.67	0.06	0.01
		Diagonal	Max Tension	13	1.61	0.00	0.00
			Max. Compression	7	-1.79	0.00	0.00
			Max. Mx	22	-0.04	0.01	0.00
			Max. My	23	0.12	0.00	-0.00
			Max. Vy	22	-0.01	0.00	0.00
			Max. Vx	23	0.00	0.00	0.00
		Top Girt	Max Tension	7	0.82	0.00	0.00
			Max. Compression	13	-0.71	0.00	0.00
			Max. Mx	14	0.08	0.01	0.00
			Max. My	7	0.82	0.00	-0.00
			Max. Vy	14	-0.01	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
		Bottom Girt	Max Tension	13	0.24	0.00	0.00
			Max. Compression	7	-0.15	0.00	0.00
			Max. Mx	14	0.10	0.01	0.00
			Max. Vy	14	-0.01	0.00	0.00
			Max. Vx	7	0.00	0.00	0.00
T9	21.5 - 6.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	22	-55.74	-0.03	-0.17
			Max. Mx	19	-55.35	-3.04	1.48
			Max. My	22	-55.58	0.24	-3.40
			Max. Vy	24	-5.88	2.83	1.87
			Max. Vx	20	6.82	0.20	-3.39
		Diagonal	Max Tension	9	1.15	0.00	0.00
			Max. Compression	2	-1.54	0.00	0.00
			Max. Mx	22	0.15	-0.03	0.00
			Max. My	23	0.16	0.00	0.00
			Max. Vy	22	-0.03	0.00	0.00
			Max. Vx	23	-0.00	0.00	0.00
		Top Girt	Max Tension	7	0.31	0.00	0.00
			Max. Compression	2	-0.16	0.00	0.00
			Max. Mx	23	0.20	-0.03	0.00
			Max. My	7	0.24	0.00	0.00
			Max. Vy	23	0.03	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
		Bottom Girt	Max Tension	19	4.32	0.00	0.00
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	23	4.10	-0.03	0.00
			Max. My	7	2.14	0.00	0.00
			Max. Vy	23	0.03	0.00	0.00
			Max. Vx	7	-0.00	0.00	0.00
T10	6.5 - 1.5	Leg	Max Tension	1	0.00	0.00	0.00
			Max. Compression	22	-59.88	-0.41	0.03
			Max. Mx	23	-52.57	-4.29	0.23
			Max. My	7	-22.93	-1.82	0.45
			Max. Vy	23	14.21	-4.25	0.30
			Max. Vx	7	-1.39	-0.64	0.41
		Horizontal	Max Tension	8	0.02	-0.55	-0.04
			Max. Compression	7	-0.01	0.27	0.05
			Max. Mx	7	0.00	-0.70	-0.06
			Max. My	7	0.00	-0.70	-0.06
			Max. Vy	7	-0.59	-0.66	-0.05
			Max. Vx	7	-0.07	-0.70	-0.06
		Top Girt	Max Tension	23	8.68	-3.03	-0.07
			Max. Compression	1	0.00	0.00	0.00
			Max. Mx	24	8.63	-3.04	-0.08
			Max. My	7	3.98	-1.80	-0.08
			Max. Vy	7	-0.36	-1.49	-0.05

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
		Bottom Girt	Max. Vx	7	-0.05	-1.80	-0.08
			Max Tension	1	0.00	0.00	0.00
			Max. Compression	19	-3.33	-1.13	-0.01
			Max. Mx	18	-3.32	-1.31	-0.02
			Max. My	2	-1.43	-0.12	0.08
			Max. Vy	7	-3.67	-1.02	-0.00
			Max. Vx	2	0.38	-0.74	-0.05

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Mast	Max. Vert	23	166.02	0.23	-0.15
	Max. H_x	11	70.12	1.22	-0.00
	Max. H_z	2	70.11	0.00	1.43
	Max. M_x	1	0.00	-0.00	-0.00
	Max. M_z	1	0.00	-0.00	-0.00
	Max. Torsion	13	0.90	0.65	1.12
	Min. Vert	1	54.41	-0.00	-0.00
	Min. H_x	5	69.76	-1.23	-0.02
	Min. H_z	8	70.93	-0.00	-1.28
	Min. M_x	1	0.00	-0.00	-0.00
	Min. M_z	1	0.00	-0.00	-0.00
	Min. Torsion	7	-0.96	-0.65	-1.13
Guy C @ 184 ft Elev 0 ft Azimuth 240 deg	Max. Vert	10	-1.10	-0.90	0.52
	Max. H_x	10	-1.10	-0.90	0.52
	Max. H_z	4	-22.00	-24.39	14.10
	Min. Vert	4	-22.00	-24.39	14.10
	Min. H_x	4	-22.00	-24.39	14.10
	Min. H_z	10	-1.10	-0.90	0.52
Guy B @ 184 ft Elev 0 ft Azimuth 120 deg	Max. Vert	6	-1.09	0.90	0.52
	Max. H_x	12	-22.11	24.49	14.15
	Max. H_z	12	-22.11	24.49	14.15
	Min. Vert	12	-22.11	24.49	14.15
	Min. H_x	6	-1.09	0.90	0.52
	Min. H_z	6	-1.09	0.90	0.52
Guy A @ 184 ft Elev 0 ft Azimuth 0 deg	Max. Vert	2	-1.07	-0.00	-1.02
	Max. H_x	11	-12.25	0.92	-15.40
	Max. H_z	2	-1.07	-0.00	-1.02
	Min. Vert	8	-23.04	0.01	-29.33
	Min. H_x	5	-12.16	-0.92	-15.28
	Min. H_z	8	-23.04	0.01	-29.33
Guy C @ 161.2 ft Elev 0 ft Azimuth 240 deg	Max. Vert	10	-0.29	-0.82	0.47
	Max. H_x	10	-0.29	-0.82	0.47
	Max. H_z	4	-4.77	-10.88	6.28
	Min. Vert	4	-4.77	-10.88	6.28
	Min. H_x	4	-4.77	-10.88	6.28
	Min. H_z	10	-0.29	-0.82	0.47
Guy B @ 154.8 ft Elev 0 ft Azimuth 120 deg	Max. Vert	6	-0.27	0.73	0.42
	Max. H_x	12	-5.05	11.03	6.37
	Max. H_z	12	-5.05	11.03	6.37
	Min. Vert	12	-5.05	11.03	6.37

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Guy A @ 150 ft Elev 0 ft Azimuth 0 deg	Min. H_x	6	-0.27	0.73	0.42
	Min. H_z	6	-0.27	0.73	0.42
	Max. Vert	2	-0.26	-0.00	-0.78
	Max. H_x	11	-2.71	0.16	-6.68
	Max. H_z	2	-0.26	-0.00	-0.78
	Min. Vert	8	-5.24	0.00	-12.79
	Min. H_x	5	-2.65	-0.16	-6.54
	Min. H_z	8	-5.24	0.00	-12.79

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	54.41	0.00	0.00	0.00	0.00	-0.00
1.2 Dead+1.0 Wind 0 deg - No Ice+1.0 Guy	70.11	-0.00	-1.43	0.00	0.00	-0.76
1.2 Dead+1.0 Wind 30 deg - No Ice+1.0 Guy	70.19	0.65	-1.12	0.00	0.00	-0.61
1.2 Dead+1.0 Wind 60 deg - No Ice+1.0 Guy	69.86	1.07	-0.60	0.00	0.00	-0.74
1.2 Dead+1.0 Wind 90 deg - No Ice+1.0 Guy	69.76	1.23	0.02	0.00	0.00	-0.54
1.2 Dead+1.0 Wind 120 deg - No Ice+1.0 Guy	70.07	1.21	0.71	0.00	0.00	0.40
1.2 Dead+1.0 Wind 150 deg - No Ice+1.0 Guy	71.05	0.65	1.13	0.00	0.00	0.96
1.2 Dead+1.0 Wind 180 deg - No Ice+1.0 Guy	70.93	0.00	1.28	0.00	0.00	0.76
1.2 Dead+1.0 Wind 210 deg - No Ice+1.0 Guy	71.20	-0.65	1.12	0.00	0.00	0.52
1.2 Dead+1.0 Wind 240 deg - No Ice+1.0 Guy	70.09	-1.21	0.69	0.00	0.00	0.65
1.2 Dead+1.0 Wind 270 deg - No Ice+1.0 Guy	70.12	-1.22	0.00	0.00	0.00	0.53
1.2 Dead+1.0 Wind 300 deg - No Ice+1.0 Guy	70.17	-1.07	-0.61	0.00	0.00	-0.35
1.2 Dead+1.0 Wind 330 deg - No Ice+1.0 Guy	70.40	-0.65	-1.12	0.00	0.00	-0.90
1.2 Dead+1.0 Ice+1.0 Temp+Guy	164.24	0.00	0.02	0.00	0.00	-0.03
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.84	0.00	-0.26	0.00	0.00	-0.14
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.12	0.12	-0.22	0.00	0.00	-0.14
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp+1.0 Guy	164.47	0.21	-0.10	0.00	0.00	-0.24
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.17	0.26	0.04	0.00	0.00	-0.25
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.93	0.24	0.16	0.00	0.00	-0.06
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.29	0.15	0.24	0.00	0.00	0.10
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp+1.0 Guy	164.66	0.00	0.28	0.00	0.00	0.08
1.2 Dead+1.0 Wind 210	165.33	-0.15	0.24	0.00	0.00	0.07

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
deg+1.0 Ice+1.0 Temp+1.0 Guy						
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp+1.0 Guy	166.02	-0.23	0.15	0.00	0.00	0.18
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.27	-0.25	0.04	0.00	0.00	0.20
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp+1.0 Guy	164.56	-0.21	-0.10	0.00	0.00	0.01
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp+1.0 Guy	165.18	-0.12	-0.22	0.00	0.00	-0.15
Dead+Wind 0 deg - Service+Guy	54.73	0.00	-0.27	0.00	0.00	-0.13
Dead+Wind 30 deg - Service+Guy	54.62	0.13	-0.23	0.00	0.00	-0.10
Dead+Wind 60 deg - Service+Guy	54.55	0.22	-0.12	0.00	0.00	-0.12
Dead+Wind 90 deg - Service+Guy	54.65	0.25	0.01	0.00	0.00	-0.08
Dead+Wind 120 deg - Service+Guy	54.77	0.24	0.14	0.00	0.00	0.07
Dead+Wind 150 deg - Service+Guy	54.70	0.14	0.23	0.00	0.00	0.16
Dead+Wind 180 deg - Service+Guy	54.64	0.00	0.26	0.00	0.00	0.12
Dead+Wind 210 deg - Service+Guy	54.72	-0.14	0.23	0.00	0.00	0.09
Dead+Wind 240 deg - Service+Guy	54.81	-0.23	0.14	0.00	0.00	0.10
Dead+Wind 270 deg - Service+Guy	54.70	-0.25	0.01	0.00	0.00	0.08
Dead+Wind 300 deg - Service+Guy	54.59	-0.22	-0.12	0.00	0.00	-0.07
Dead+Wind 330 deg - Service+Guy	54.65	-0.13	-0.23	0.00	0.00	-0.16

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.00	-22.22	0.00	0.00	22.22	-0.00	0.001%
2	0.10	-26.46	-33.56	-0.10	26.46	33.56	0.005%
3	16.11	-26.17	-28.13	-16.11	26.17	28.13	0.002%
4	27.11	-25.87	-15.74	-27.11	25.87	15.74	0.001%
5	31.45	-26.17	0.22	-31.44	26.17	-0.22	0.006%
6	28.68	-26.46	16.94	-28.68	26.46	-16.94	0.005%
7	16.41	-26.17	28.85	-16.41	26.17	-28.85	0.003%
8	-0.10	-25.87	32.89	0.09	25.87	-32.89	0.002%
9	-16.44	-26.17	28.71	16.44	26.17	-28.71	0.003%
10	-28.41	-26.47	16.89	28.41	26.47	-16.89	0.005%
11	-31.45	-26.17	0.41	31.44	26.17	-0.41	0.006%
12	-27.38	-25.87	-15.79	27.38	25.87	15.79	0.001%
13	-16.09	-26.17	-28.28	16.09	26.17	28.28	0.002%
14	0.00	-106.56	0.00	-0.00	106.56	0.00	0.001%
15	0.02	-106.83	-10.96	-0.02	106.83	10.96	0.001%
16	5.39	-106.56	-9.37	-5.39	106.56	9.37	0.003%
17	9.22	-106.28	-5.35	-9.22	106.28	5.35	0.003%
18	10.64	-106.56	0.02	-10.64	106.56	-0.02	0.001%
19	9.35	-106.83	5.46	-9.35	106.83	-5.46	0.001%
20	5.41	-106.56	9.44	-5.41	106.56	-9.44	0.001%
21	-0.02	-106.28	10.91	0.02	106.28	-10.90	0.003%
22	-5.43	-106.56	9.45	5.43	106.56	-9.45	0.003%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
23	-9.37	-106.83	5.48	9.36	106.83	-5.48	0.001%
24	-10.64	-106.56	0.06	10.63	106.56	-0.06	0.003%
25	-9.21	-106.28	-5.32	9.21	106.28	5.32	0.003%
26	-5.36	-106.56	-9.36	5.36	106.56	9.36	0.003%
27	0.02	-22.27	-6.16	-0.02	22.27	6.16	0.005%
28	2.96	-22.22	-5.17	-2.96	22.22	5.17	0.004%
29	4.98	-22.16	-2.89	-4.98	22.16	2.89	0.003%
30	5.78	-22.22	0.04	-5.77	22.22	-0.04	0.004%
31	5.27	-22.27	3.11	-5.27	22.27	-3.11	0.006%
32	3.01	-22.22	5.30	-3.01	22.22	-5.30	0.004%
33	-0.02	-22.16	6.04	0.02	22.16	-6.04	0.003%
34	-3.02	-22.22	5.27	3.02	22.22	-5.27	0.004%
35	-5.22	-22.27	3.10	5.22	22.27	-3.10	0.005%
36	-5.78	-22.22	0.08	5.77	22.22	-0.08	0.004%
37	-5.03	-22.16	-2.90	5.03	22.16	2.90	0.003%
38	-2.95	-22.22	-5.19	2.95	22.22	5.19	0.004%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	8	0.00000001	0.00004231
2	Yes	15	0.00000001	0.00009544
3	Yes	15	0.00000001	0.00003932
4	Yes	11	0.00000001	0.00003198
5	Yes	14	0.00000001	0.00009170
6	Yes	15	0.00000001	0.00009141
7	Yes	15	0.00000001	0.00004366
8	Yes	11	0.00000001	0.00003341
9	Yes	15	0.00000001	0.00004453
10	Yes	15	0.00000001	0.00008821
11	Yes	14	0.00000001	0.00009252
12	Yes	11	0.00000001	0.00003425
13	Yes	15	0.00000001	0.00003948
14	Yes	9	0.00000001	0.00008919
15	Yes	12	0.00000001	0.00004837
16	Yes	11	0.00010000	0.00009065
17	Yes	11	0.00000001	0.00007611
18	Yes	12	0.00000001	0.00004286
19	Yes	12	0.00000001	0.00005575
20	Yes	12	0.00000001	0.00004224
21	Yes	11	0.00000001	0.00006879
22	Yes	11	0.00010000	0.00008301
23	Yes	12	0.00000001	0.00004620
24	Yes	11	0.00010000	0.00008592
25	Yes	11	0.00000001	0.00006128
26	Yes	11	0.00010000	0.00009013
27	Yes	9	0.00000001	0.00008804
28	Yes	9	0.00000001	0.00006215
29	Yes	9	0.00000001	0.00004412
30	Yes	9	0.00000001	0.00006496
31	Yes	9	0.00000001	0.00009264
32	Yes	9	0.00000001	0.00006366
33	Yes	9	0.00000001	0.00003936
34	Yes	9	0.00000001	0.00005993
35	Yes	9	0.00000001	0.00008742
36	Yes	9	0.00000001	0.00006239
37	Yes	9	0.00000001	0.00004127
38	Yes	9	0.00000001	0.00006314

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	181.5 - 161.5	0.754	33	0.0225	0.0736
T2	161.5 - 141.5	0.692	33	0.0127	0.0610
T3	141.5 - 121.5	0.653	33	0.0086	0.0341
T4	121.5 - 101.5	0.654	29	0.0153	0.0334
T5	101.5 - 81.5	0.678	31	0.0130	0.0397
T6	81.5 - 61.5	0.555	31	0.0428	0.0441
T7	61.5 - 41.5	0.370	35	0.0368	0.0445
T8	41.5 - 21.5	0.272	35	0.0230	0.0423
T9	21.5 - 6.5	0.167	35	0.0336	0.0261
T10	6.5 - 1.5	0.046	35	0.0419	0.0217

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180.50	20' x 2" Dia Omni	33	0.750	0.0216	0.0732	652780
177.00	DS2C03F36D-D	33	0.739	0.0186	0.0718	652780
176.50	8.5' Dish	33	0.737	0.0181	0.0716	652780
169.15	Guy	33	0.714	0.0125	0.0677	264358
160.50	Pipe Mount [PM 602-3]	33	0.689	0.0124	0.0599	162957
148.50	8' x 2" Horizontal Mount Pipe	33	0.662	0.0079	0.0432	135136
138.50	20' x 2" Mount Pipe	33	0.650	0.0086	0.0312	117434
129.15	Guy	33	0.647	0.0128	0.0320	116185
127.50	Sector Mount [SM 502-3]	33	0.648	0.0137	0.0322	115248
89.50	Side Arm Mount [SO 203-1]	31	0.622	0.0315	0.0429	34647
78.50	Sector Mount [SM 502-3]	31	0.526	0.0448	0.0443	77291
62.11	Guy	35	0.374	0.0374	0.0444	32871

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	181.5 - 161.5	6.048	9	0.1808	0.5367
T2	161.5 - 141.5	5.502	9	0.1101	0.4666
T3	141.5 - 121.5	5.062	2	0.1162	0.2791
T4	121.5 - 101.5	5.069	2	0.0538	0.2419
T5	101.5 - 81.5	5.043	2	0.1303	0.2617
T6	81.5 - 61.5	4.225	2	0.2845	0.2847
T7	61.5 - 41.5	2.966	2	0.2598	0.2817
T8	41.5 - 21.5	2.137	2	0.1979	0.2635
T9	21.5 - 6.5	1.247	2	0.2612	0.1564
T10	6.5 - 1.5	0.334	2	0.3095	0.1299

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180.50	20' x 2" Dia Omni	9	6.019	0.1758	0.5352	164068
177.00	DS2C03F36D-D	9	5.921	0.1584	0.5294	164068
176.50	8.5' Dish	9	5.907	0.1560	0.5285	164068
169.15	Guy	9	5.705	0.1256	0.5087	66444
160.50	Pipe Mount [PM 602-3]	9	5.477	0.1098	0.4588	45045
148.50	8' x 2" Horizontal Mount Pipe	9	5.195	0.1214	0.3412	24283

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
138.50	20' x 2" Mount Pipe	2	5.052	0.1057	0.2604	21404
129.15	Guy	2	5.046	0.0646	0.2416	20457
127.50	Sector Mount [SM 502-3]	2	5.049	0.0631	0.2413	20303
89.50	Side Arm Mount [SO 203-1]	2	4.651	0.2378	0.2783	6042
78.50	Sector Mount [SM 502-3]	2	4.039	0.2917	0.2854	12509
62.11	Guy	2	2.999	0.2625	0.2816	5648

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	181.5	Diagonal	A325N	0.5000	1	2.53	5.71	0.442	1.05	Member Block Shear
		Top Girt	A325N	0.5000	1	0.11	8.84	0.013	1.05	Bolt Shear
		Bottom Girt	A325N	0.5000	1	0.59	5.71	0.103	1.05	Member Block Shear
T2	161.5	Leg	A325N	0.7500	4	1.34	30.10	0.045	1.05	Bolt Tension
		Diagonal	A325N	0.5000	1	1.59	4.09	0.388	1.05	Member Bearing
		Top Girt	A325N	0.5000	1	0.90	4.09	0.221	1.05	Member Bearing
		Bottom Girt	A325N	0.5000	1	0.74	4.09	0.180	1.05	Member Bearing
T3	141.5	Leg	A325N	0.7500	4	1.83	30.10	0.061	1.05	Bolt Tension
		Diagonal	A325N	0.5000	1	2.67	6.20	0.431	1.05	Member Bearing
		Top Girt	A325N	0.5000	1	0.46	6.20	0.073	1.05	Member Bearing
		Bottom Girt	A325N	0.5000	1	0.86	6.20	0.139	1.05	Member Bearing
T4	121.5	Leg	A325N	0.7500	4	3.23	30.10	0.107	1.05	Bolt Tension
		Diagonal	A325N	0.6250	1	3.45	13.81	0.250	1.05	Bolt Shear
		Horizontal	A325N	0.6250	1	1.17	13.81	0.085	1.05	Bolt Shear
		Top Girt	A325N	0.6250	1	1.67	13.81	0.121	1.05	Bolt Shear
		Bottom Girt	A325N	0.6250	1	0.55	13.81	0.040	1.05	Bolt Shear
T5	101.5	Leg	A325N	0.7500	4	3.63	30.10	0.121	1.05	Bolt Tension
		Diagonal	A325N	0.5000	1	1.61	4.09	0.393	1.05	Member Bearing
		Horizontal	A325N	0.6250	1	0.80	13.81	0.058	1.05	Bolt Shear
		Top Girt	A325N	0.5000	1	0.35	4.09	0.086	1.05	Member Bearing
		Bottom Girt	A325N	0.5000	1	0.64	4.09	0.155	1.05	Member Bearing
T6	81.5	Leg	A325N	0.7500	4	3.61	30.10	0.120	1.05	Bolt Tension
		Diagonal	A325N	0.6250	1	4.44	13.81	0.322	1.05	Bolt Shear
		Top Girt	A325N	0.6250	1	0.99	13.81	0.072	1.05	Bolt Shear
		Bottom Girt	A325N	0.6250	1	3.88	13.81	0.281	1.05	Bolt Shear
		Top Guy Pull-Off@62.1146	A325N	0.6250	4	0.73	13.81	0.053	1.05	Bolt Shear
T7	61.5	Leg	A325N	0.7500	4	4.52	30.10	0.150	1.05	Bolt Tension
		Diagonal	A325N	0.6250	1	3.51	13.81	0.254	1.05	Bolt Shear
		Top Girt	A325N	0.5000	1	1.85	4.09	0.453	1.05	Member Bearing
		Bottom Girt	A325N	0.5000	1	0.91	4.09	0.222	1.05	Member Bearing
T8	41.5	Leg	A325N	0.7500	4	4.31	30.10	0.143	1	Bolt Tension
		Diagonal	A325N	0.5000	1	1.61	4.09	0.394	1.05	Member Bearing
		Top Girt	A325N	0.5000	1	0.82	4.09	0.200	1.05	Member Bearing
		Bottom Girt	A325N	0.5000	1	0.24	4.09	0.059	1.05	Member Bearing
T9	21.5	Leg	A325N	0.7500	4	4.43	30.10	0.147	1	Bolt Tension

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
		Diagonal	A325N	0.6250	1	1.54	13.81	0.112	1.05	Bolt Shear
		Top Girt	A325N	0.6250	1	0.31	13.81	0.023	1.05	Bolt Shear
		Bottom Girt	A325N	0.6250	1	4.32	13.81	0.313	1.05	Bolt Shear
T10	6.5	Leg	A325N	0.7500	4	4.42	30.10	0.147	1	Bolt Tension

Guy Design Data

Section No.	Elevation ft	Size	Initial Tension K	Breaking Load K	Actual T_u K	Allowable ϕT_n K	Required S.F.	Actual S.F.
T1	169.15 (A) (406)	9/16 EHS	3.50	35.00	9.41	22.05	0.952	2.231
	169.15 (A) (407)	9/16 EHS	3.50	35.00	9.63	22.05	0.952	2.181
	169.15 (B) (400)	9/16 EHS	3.50	35.00	9.45	22.05	0.952	2.222
	169.15 (B) (401)	9/16 EHS	3.50	35.00	9.46	22.05	0.952	2.219
	169.15 (C) (394)	9/16 EHS	3.50	35.00	9.32	22.05	0.952	2.253
	169.15 (C) (395)	9/16 EHS	3.50	35.00	9.27	22.05	0.952	2.266
T3	129.15 (A) (424)	9/16 EHS	3.50	35.00	9.25	22.05	0.952	2.270
	129.15 (A) (425)	9/16 EHS	3.50	35.00	9.65	22.05	0.952	2.176
	129.15 (B) (418)	9/16 EHS	3.50	35.00	9.36	22.05	0.952	2.243
	129.15 (B) (419)	9/16 EHS	3.50	35.00	9.36	22.05	0.952	2.243
	129.15 (C) (412)	9/16 EHS	3.50	35.00	9.60	22.05	0.952	2.188
	129.15 (C) (413)	9/16 EHS	3.50	35.00	9.24	22.05	0.952	2.273
T6	62.11 (A) (435)	3/4 EHS	5.83	58.30	13.89	36.73	0.952	2.518
	62.11 (B) (434)	3/4 EHS	5.83	58.30	13.78	36.73	0.952	2.539
	62.11 (C) (430)	3/4 EHS	5.83	58.30	13.52	36.73	0.952	2.588

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	181.5 - 161.5	Pipe 2.5 STD	20.00	2.35	29.7 K=1.00	1.7040	-15.17	71.89	0.211 *1
T2	161.5 - 141.5	Pipe 2.5 STD	20.00	2.35	59.4 K=2.00	1.7040	-22.20	59.23	0.375 1
T3	141.5 - 121.5	Pipe 2.5 STD	20.00	2.35	29.7 K=1.00	1.7040	-37.93	71.89	0.528 1
T4	121.5 - 101.5	Pipe 2.5 STD	20.00	2.35	29.7	1.7040	-42.89	71.89	0.597 1

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T5	101.5 - 81.5	Pipe 2.5 STD	20.00	2.35	K=1.00 29.7	1.7040	-43.56	71.89	0.606 [1]
T6	81.5 - 61.5	Pipe 2.5 STD	20.00	2.35	K=1.00 59.4	1.7040	-49.68	59.23	0.839 [1]
T7	61.5 - 41.5	Pipe 2.5 STD	20.00	2.35	K=2.00 59.4	1.7040	-53.89	59.23	0.910 [1]
T8	41.5 - 21.5	Pipe 2.5 STD	20.00	2.35	K=2.00 59.4	1.7040	-52.98	59.23	0.895[*1]
T9	21.5 - 6.5	Pipe 2.5 STD	15.00	2.30	K=2.00 58.1	1.7040	-54.18	59.89	0.905[*1]
T10	6.5 - 1.5	Pipe 2.5 STD	5.37	2.15	K=2.00 27.2	1.7040	-58.76	72.64	0.809[*1]
					K=1.00				

[*] DL controls
[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	4.14	1.82	77.7 K=1.22	0.6211	-2.33	18.12	0.129 [1]
T2	161.5 - 141.5	TS1.5x16ga	4.14	3.85	90.6 K=1.00	0.2706	-1.72	5.60	0.308 [1]
T3	141.5 - 121.5	L2x2x3/16	4.14	1.82	71.6 K=1.29	0.7150	-2.58	21.59	0.119 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	4.14	3.61	104.5 K=1.17	2.2500	-3.45	53.21	0.065 [1]
T5	101.5 - 81.5	TS1.5x16ga	4.14	3.85	90.6 K=1.00	0.2706	-2.01	5.60	0.359 [1]
T6	81.5 - 61.5	L2 1/2x2 1/2x1/2	4.14	3.61	104.5 K=1.17	2.2500	-4.43	53.21	0.083 [1]
T7	61.5 - 41.5	L2 1/2x2 1/2x1/2	4.14	3.61	104.5 K=1.17	2.2500	-3.51	53.21	0.066 [1]
T8	41.5 - 21.5	TS1.5x16ga	4.14	3.85	90.6 K=1.00	0.2706	-1.79	5.60	0.319 [1]
T9	21.5 - 6.5	L2 1/2x2 1/2x1/2	4.11	3.58	104.1 K=1.18	2.2500	-1.54	53.38	0.029 [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 $\frac{P_u}{\phi P_n}$
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-0.74	67.12	0.011 [1]
T5	101.5 - 81.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-0.75	67.12	0.011 [1]
T10	6.5 - 1.5	C12x20.7	1.70	1.47	22.0 K=1.00	6.0900	-0.01	192.35	0.000 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	3.41	2.96	111.7 K=1.08	0.6211	-0.11	13.58	0.008 [1]
T2	161.5 - 141.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.90	6.41	0.141 [1]
T3	141.5 - 121.5	L2x2x3/16	3.41	2.96	105.1 K=1.17	0.7150	-0.15	16.80	0.009 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-1.39	57.47	0.024 [1]
T5	101.5 - 81.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.05	6.41	0.007 [1]
T6	81.5 - 61.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-0.73	57.47	0.013 [1]
T7	61.5 - 41.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-1.60	6.41	0.249 [1]
T8	41.5 - 21.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.71	6.41	0.110 [1]
T9	21.5 - 6.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-0.16	57.47	0.003 [1]

[1] P_u / ϕP_n controls

Bottom Girt Design Data (Compression)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	3.41	2.96	111.7 K=1.08	0.6211	-0.62	13.58	0.046 [1]
T2	161.5 - 141.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.80	6.41	0.124 [1]
T3	141.5 - 121.5	L2x2x3/16	3.41	2.96	105.1 K=1.17	0.7150	-0.37	16.80	0.022 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	96.1 K=1.33	2.2500	-0.20	57.47	0.004 [1]
T5	101.5 - 81.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.57	6.41	0.088 [1]
T7	61.5 - 41.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.79	6.41	0.124 [1]
T8	41.5 - 21.5	TS1.5x16ga	3.41	3.17	74.7 K=1.00	0.2706	-0.15	6.41	0.023 [1]
T10	6.5 - 1.5	C12x20.7	0.34	0.10	1.5 K=1.00	6.0900	-3.27	197.29	0.017 [*1]

[*] DL controls
[1] P_u / ϕP_n controls

Torque-Arm Bottom Design Data

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T1	181.5 - 161.5 (398)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.17	96.94	0.136 [1]
T1	181.5 - 161.5 (399)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-14.15	96.94	0.146 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	181.5 - 161.5 (404)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.48	96.94	0.139 [1]
T1	181.5 - 161.5 (405)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.15	96.94	0.136 [1]
T1	181.5 - 161.5 (410)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.47	96.94	0.139 [1]
T1	181.5 - 161.5 (411)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-14.08	96.94	0.145 [1]
T3	141.5 - 121.5 (416)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.02	96.94	0.134 [1]
T3	141.5 - 121.5 (417)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.17	96.94	0.136 [1]
T3	141.5 - 121.5 (422)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.07	96.94	0.135 [1]
T3	141.5 - 121.5 (423)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-12.97	96.94	0.134 [1]
T3	141.5 - 121.5 (428)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-12.90	96.94	0.133 [1]
T3	141.5 - 121.5 (429)	P4x.237	4.35	4.21	33.5 K=1.00	3.1741	-13.04	96.94	0.135 [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	181.5 - 161.5	Pipe 2.5 STD	20.00	2.35	29.7	1.7040	13.94	76.68	0.182 [1]
T3	141.5 - 121.5	Pipe 2.5 STD	20.00	2.35	29.7	1.7040	5.73	76.68	0.075 [1]
T5	101.5 - 81.5	Pipe 2.5 STD	20.00	2.35	29.7	1.7040	0.42	76.68	0.005 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	4.14	1.82	43.0	0.3779	2.53	16.44	0.154 [1]
T2	161.5 - 141.5	TS1.5x16ga	4.14	3.85	90.6	0.2706	1.59	8.52	0.186 [1]
T3	141.5 - 121.5	L2x2x3/16	4.14	1.82	37.4	0.4484	2.67	19.50	0.137 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	4.14	3.61	62.5	1.4063	3.01	61.17	0.049 [1]
T5	101.5 - 81.5	TS1.5x16ga	4.14	3.85	90.6	0.2706	1.61	8.52	0.189 [1]
T6	81.5 - 61.5	L2 1/2x2 1/2x1/2	4.14	3.61	62.5	1.4063	4.44	61.17	0.073 [1]
T7	61.5 - 41.5	L2 1/2x2 1/2x1/2	4.14	3.61	62.5	1.4063	3.32	61.17	0.054 [1]
T8	41.5 - 21.5	TS1.5x16ga	4.14	3.85	90.6	0.2706	1.61	8.52	0.189 [1]
T9	21.5 - 6.5	L2 1/2x2 1/2x1/2	4.11	3.58	62.1	1.4063	1.15	61.17	0.019 [1]

[1] P_u / ϕP_n controls

Horizontal Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	1.17	68.55	0.017 [1]
T5	101.5 - 81.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	0.80	68.55	0.012 [1]
T10	6.5 - 1.5	C12x20.7	1.70	1.47	22.0	6.0900	0.02	197.32	0.000 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	3.41	2.96	70.9	0.3779	0.06	16.44	0.004 [1]
T2	161.5 - 141.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.90	8.52	0.106 [1]
T3	141.5 - 121.5	L2x2x3/16	3.41	2.96	61.7	0.4484	0.46	19.50	0.023 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	1.67	61.17	0.027 [1]
T5	101.5 - 81.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.35	8.52	0.041 [1]
T6	81.5 - 61.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	0.99	61.17	0.016 [1]
T7	61.5 - 41.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	1.85	8.52	0.217 [1]
T8	41.5 - 21.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.82	8.52	0.096 [1]
T9	21.5 - 6.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	0.31	61.17	0.005 [1]
T10	6.5 - 1.5	C12x20.7	3.07	2.83	42.5	6.0900	8.47	197.32	0.043 [*1]

[*] DL controls
[1] P_u / ϕP_n controls

Bottom Girt Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T1	181.5 - 161.5	L1 3/4x1 3/4x3/16	3.41	2.96	70.9	0.3779	0.59	16.44	0.036 [1]
T2	161.5 - 141.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.74	8.52	0.087 [1]
T3	141.5 - 121.5	L2x2x3/16	3.41	2.96	61.7	0.4484	0.86	19.50	0.044 [1]
T4	121.5 - 101.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	0.55	61.17	0.009 [1]
T5	101.5 - 81.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.64	8.52	0.075 [1]
T6	81.5 - 61.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	3.88	61.17	0.063 [1]
T7	61.5 - 41.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.91	8.52	0.107 [1]
T8	41.5 - 21.5	TS1.5x16ga	3.41	3.17	74.7	0.2706	0.24	8.52	0.028 [1]
T9	21.5 - 6.5	L2 1/2x2 1/2x1/2	3.41	2.93	51.5	1.4063	4.32	61.17	0.071 [1]

[1] P_u / ϕP_n controls

Top Guy Pull-Off Design Data (Tension)

Section No.	Elevation	Size	L	L_u	Kl/r	A	P_u	ϕP_n	Ratio $\frac{P_u}{\phi P_n}$
	ft		ft	ft		in^2	K	K	
T6	81.5 - 61.5	4 1/2x3/8	3.41	3.17	351.4	1.0547	2.91	45.88	0.063 [1]

[1] P_u / ϕP_n controls

Top Guy Pull-Off Bending Design Data

Section No.	Elevation ft	Size	M_{ux} kip-ft	ϕM_{nx} kip-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} kip-ft	ϕM_{ny} kip-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
T6	81.5 - 61.5	4 1/2x3/8	0.00	5.13	0.000	0.00	0.43	0.000

Top Guy Pull-Off Interaction Design Data

Section No.	Elevation ft	Size	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
T6	81.5 - 61.5	4 1/2x3/8	0.063	0.000	0.000	0.063 [1]	1.050	4.8.1

[1] P_u / ϕP_n controls

Torque-Arm Top Design Data

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	181.5 - 161.5 (396)	P4x.237	3.67	3.55	28.2	3.1741	13.36	102.84	0.130 [1]
T1	181.5 - 161.5 (397)	P4x.237	3.67	3.55	28.2	3.1741	13.37	102.84	0.130 [1]
T1	181.5 - 161.5 (402)	P4x.237	3.67	3.55	28.2	3.1741	13.45	102.84	0.131 [1]
T1	181.5 - 161.5 (403)	P4x.237	3.67	3.55	28.2	3.1741	13.45	102.84	0.131 [1]
T1	181.5 - 161.5 (408)	P4x.237	3.67	3.55	28.2	3.1741	13.49	102.84	0.131 [1]
T1	181.5 - 161.5 (409)	P4x.237	3.67	3.55	28.2	3.1741	13.50	102.84	0.131 [1]
T3	141.5 - 121.5 (414)	P4x.237	3.67	3.55	28.2	3.1741	12.34	102.84	0.120 [1]
T3	141.5 - 121.5 (415)	P4x.237	3.67	3.55	28.2	3.1741	12.32	102.84	0.120 [1]
T3	141.5 - 121.5 (420)	P4x.237	3.67	3.55	28.2	3.1741	12.24	102.84	0.119 [1]
T3	141.5 - 121.5 (421)	P4x.237	3.67	3.55	28.2	3.1741	12.38	102.84	0.120 [1]
T3	141.5 - 121.5 (426)	P4x.237	3.67	3.55	28.2	3.1741	12.25	102.84	0.119 [1]
T3	141.5 - 121.5 (427)	P4x.237	3.67	3.55	28.2	3.1741	12.35	102.84	0.120 [1]

[1] P_u / ϕP_n controls

Torque-Arm Bottom Design Data

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	181.5 - 161.5 (398)	P4x.237	4.35	4.21	33.5	3.1741	0.64	102.84	0.006 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	181.5 - 161.5 (399)	P4x.237	4.35	4.21	33.5	3.1741	0.70	102.84	0.007 [1]
T1	181.5 - 161.5 (404)	P4x.237	4.35	4.21	33.5	3.1741	0.72	102.84	0.007 [1]
T1	181.5 - 161.5 (405)	P4x.237	4.35	4.21	33.5	3.1741	0.74	102.84	0.007 [1]
T1	181.5 - 161.5 (410)	P4x.237	4.35	4.21	33.5	3.1741	0.65	102.84	0.006 [1]
T1	181.5 - 161.5 (411)	P4x.237	4.35	4.21	33.5	3.1741	0.76	102.84	0.007 [1]
T3	141.5 - 121.5 (416)	P4x.237	4.35	4.21	33.5	3.1741	2.43	102.84	0.024 [1]
T3	141.5 - 121.5 (417)	P4x.237	4.35	4.21	33.5	3.1741	2.50	102.84	0.024 [1]
T3	141.5 - 121.5 (422)	P4x.237	4.35	4.21	33.5	3.1741	2.56	102.84	0.025 [1]
T3	141.5 - 121.5 (423)	P4x.237	4.35	4.21	33.5	3.1741	2.47	102.84	0.024 [1]
T3	141.5 - 121.5 (428)	P4x.237	4.35	4.21	33.5	3.1741	2.41	102.84	0.023 [1]
T3	141.5 - 121.5 (429)	P4x.237	4.35	4.21	33.5	3.1741	2.46	102.84	0.024 [1]

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
T1	181.5 - 161.5	Leg	Pipe 2.5 STD	3	-15.17	71.89	21.1	Pass
T2	161.5 - 141.5	Leg	Pipe 2.5 STD	58	-22.20	62.19	35.7	Pass
T3	141.5 - 121.5	Leg	Pipe 2.5 STD	91	-37.93	75.48	50.3	Pass
T4	121.5 - 101.5	Leg	Pipe 2.5 STD	148	-42.89	75.48	56.8	Pass
T5	101.5 - 81.5	Leg	Pipe 2.5 STD	202	-43.56	75.48	57.7	Pass
T6	81.5 - 61.5	Leg	Pipe 2.5 STD	257	-49.68	62.19	79.9	Pass
T7	61.5 - 41.5	Leg	Pipe 2.5 STD	291	-53.89	62.19	86.7	Pass
T8	41.5 - 21.5	Leg	Pipe 2.5 STD	324	-52.98	59.23	89.5	Pass
T9	21.5 - 6.5	Leg	Pipe 2.5 STD	357	-54.18	59.89	90.5	Pass
T10	6.5 - 1.5	Leg	Pipe 2.5 STD	384	-58.76	72.64	80.9	Pass
T1	181.5 - 161.5	Diagonal	L1 3/4x1 3/4x3/16	31	2.53	17.26	14.6 42.1 (b)	Pass
T2	161.5 - 141.5	Diagonal	TS1.5x16ga	69	-1.72	5.88	29.3 36.9 (b)	Pass
T3	141.5 - 121.5	Diagonal	L2x2x3/16	113	2.67	20.48	13.0 41.0 (b)	Pass
T4	121.5 - 101.5	Diagonal	L2 1/2x2 1/2x1/2	199	-3.45	55.87	6.2 23.8 (b)	Pass
T5	101.5 - 81.5	Diagonal	TS1.5x16ga	212	-2.01	5.88	34.2 37.4 (b)	Pass
T6	81.5 - 61.5	Diagonal	L2 1/2x2 1/2x1/2	273	-4.43	55.87	7.9 30.7 (b)	Pass
T7	61.5 - 41.5	Diagonal	L2 1/2x2 1/2x1/2	320	-3.51	55.87	6.3 24.2 (b)	Pass
T8	41.5 - 21.5	Diagonal	TS1.5x16ga	353	-1.79	5.88	30.4 37.5 (b)	Pass
T9	21.5 - 6.5	Diagonal	L2 1/2x2 1/2x1/2	366	-1.54	56.05	2.8 10.6 (b)	Pass
T4	121.5 - 101.5	Horizontal	L2 1/2x2 1/2x1/2	174	1.17	71.98	1.6 8.1 (b)	Pass
T5	101.5 - 81.5	Horizontal	L2 1/2x2 1/2x1/2	227	0.80	71.98	1.1 5.5 (b)	Pass
T10	6.5 - 1.5	Horizontal	C12x20.7	391	0.02	207.18	1.0	Pass
T1	181.5 - 161.5	Top Girt	L1 3/4x1 3/4x3/16	4	-0.11	14.26	0.8 1.2 (b)	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
T2	161.5 - 141.5	Top Girt	TS1.5x16ga	61	-0.90	6.73	13.4 21.0 (b)	Pass
T3	141.5 - 121.5	Top Girt	L2x2x3/16	96	0.46	20.48	2.2 7.0 (b)	Pass
T4	121.5 - 101.5	Top Girt	L2 1/2x2 1/2x1/2	153	1.67	64.23	2.6 11.5 (b)	Pass
T5	101.5 - 81.5	Top Girt	TS1.5x16ga	205	0.35	8.95	3.9 8.1 (b)	Pass
T6	81.5 - 61.5	Top Girt	L2 1/2x2 1/2x1/2	259	0.99	64.23	1.5 6.8 (b)	Pass
T7	61.5 - 41.5	Top Girt	TS1.5x16ga	293	-1.60	6.73	23.8 43.2 (b)	Pass
T8	41.5 - 21.5	Top Girt	TS1.5x16ga	326	-0.71	6.73	10.5 19.0 (b)	Pass
T9	21.5 - 6.5	Top Girt	L2 1/2x2 1/2x1/2	360	0.31	64.23	0.5 2.1 (b)	Pass
T10	6.5 - 1.5	Top Girt	C12x20.7	386	8.47	197.32	4.3	Pass
T1	181.5 - 161.5	Bottom Girt	L1 3/4x1 3/4x3/16	8	-0.62	14.26	4.4 9.8 (b)	Pass
T2	161.5 - 141.5	Bottom Girt	TS1.5x16ga	65	-0.80	6.73	11.8 17.2 (b)	Pass
T3	141.5 - 121.5	Bottom Girt	L2x2x3/16	97	0.86	20.48	4.2 13.3 (b)	Pass
T4	121.5 - 101.5	Bottom Girt	L2 1/2x2 1/2x1/2	156	0.55	64.23	0.9 3.8 (b)	Pass
T5	101.5 - 81.5	Bottom Girt	TS1.5x16ga	209	-0.57	6.73	8.4 14.8 (b)	Pass
T6	81.5 - 61.5	Bottom Girt	L2 1/2x2 1/2x1/2	262	3.88	64.23	6.0 26.7 (b)	Pass
T7	61.5 - 41.5	Bottom Girt	TS1.5x16ga	296	-0.79	6.73	11.8 21.2 (b)	Pass
T8	41.5 - 21.5	Bottom Girt	TS1.5x16ga	329	0.24	8.95	2.7 5.6 (b)	Pass
T9	21.5 - 6.5	Bottom Girt	L2 1/2x2 1/2x1/2	362	4.32	64.23	6.7 29.8 (b)	Pass
T10	6.5 - 1.5	Bottom Girt	C12x20.7	388	-3.26	197.29	6.4	Pass
T1	181.5 - 161.5	Guy A@169.154	9/16	407	9.63	22.05	43.7	Pass
T3	141.5 - 121.5	Guy A@129.154	9/16	425	9.65	22.05	43.8	Pass
T6	81.5 - 61.5	Guy A@62.1146	3/4	435	13.89	36.73	37.8	Pass
T1	181.5 - 161.5	Guy B@169.154	9/16	401	9.46	22.05	42.9	Pass
T3	141.5 - 121.5	Guy B@129.154	9/16	418	9.36	22.05	42.5	Pass
T6	81.5 - 61.5	Guy B@62.1146	3/4	434	13.78	36.73	37.5	Pass
T1	181.5 - 161.5	Guy C@169.154	9/16	394	9.32	22.05	42.3	Pass
T3	141.5 - 121.5	Guy C@129.154	9/16	412	9.60	22.05	43.5	Pass
T6	81.5 - 61.5	Guy C@62.1146	3/4	430	13.52	36.73	36.8	Pass
T6	81.5 - 61.5	Top Guy Pull-Off@62.1146	4 1/2x3/8	431	2.91	48.17	6.0	Pass
T1	181.5 - 161.5	Torque Arm Top@169.154	P4x.237	409	13.50	107.98	12.5	Pass
T3	141.5 - 121.5	Torque Arm Top@129.154	P4x.237	421	12.38	107.98	11.5	Pass
T1	181.5 - 161.5	Torque Arm Bottom@169.154	P4x.237	399	-14.15	101.79	13.9	Pass
T3	141.5 - 121.5	Torque Arm Bottom@129.154	P4x.237	417	-13.17	101.79	12.9	Pass

Summary		
Leg (T9)	90.5	Pass
Diagonal (T1)	42.1	Pass
Horizontal (T4)	8.1	Pass
Top Girt (T7)	43.2	Pass
Bottom Girt (T9)	29.8	Pass
Guy A (T3)	43.8	Pass
Guy B (T1)	42.9	Pass
Guy C (T3)	43.5	Pass
Top Guy Pull-Off	6.0	Pass

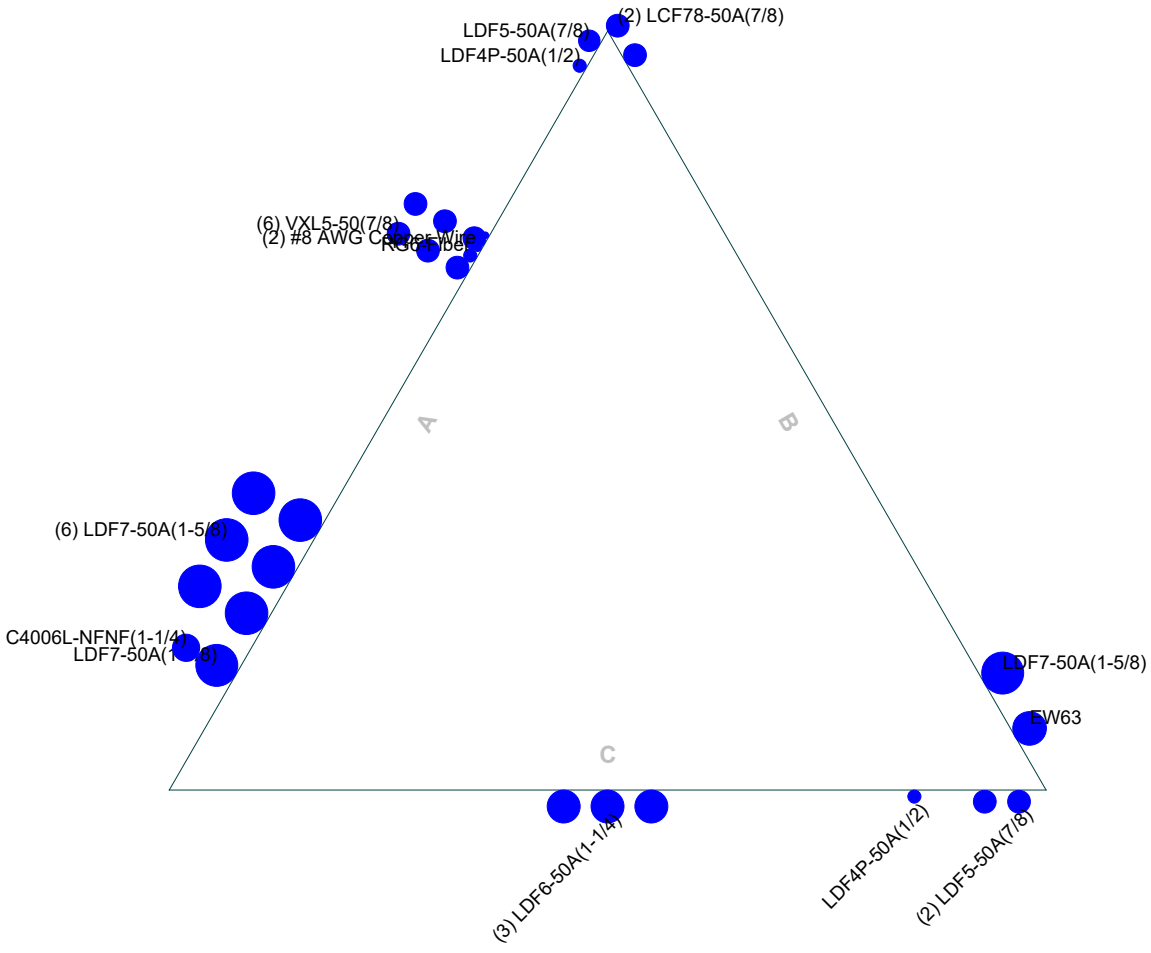
Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
						(T6) Torque Arm Top	12.5	Pass
						(T1) Torque Arm Bottom	13.9	Pass
						(T1) Bolt Checks	43.2	Pass
						RATING =	**90.5**	**Pass**

APPENDIX B

BASE LEVEL DRAWING

Feed Line Plan

Round Flat App In Face App Out Face



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Job: ***ES-008 MadisonAWC***		
Project: ***403093 (MadisonAWC)***		
Client:	Drawn by: Anup Chitale	App'd:
Code: TIA-222-H	Date: 02/20/20	Scale: NTS
Path: Y:\TELECOM\2020\Engineering\Projects\Ever Source SA\MadisonAWC\Structural\Rev. H\MadisonAWC Structural Analysis.eri		Dwg No. E-7

APPENDIX C

ADDITIONAL CALCULATIONS

Guyed Anchor Block Foundation

Checks capacity of anchor blocks for a guyed tower.

	ES-008
	Madison AWC
Location:	*Inner*

TIA-222 Revision:	H

Design Reactions		
Shear, **S**:	13.00	kips
Uplift, **Ua**:	5.00	kips
Resultant Force, **Rf**:	13.9	kips
Tower Height, **H**:	181.50	ft
Guy Anchor Radius, **R**:	150.00	ft
Resultant Angle to Horizontal, **θ**:	21.0	deg

Guy Anchor Properties		
Depth to Bottom of Deadman, **Da**:	6.7	ft
Anchor Width, **Wa**:	4.1	ft
Anchor Thickness, **Ta**:	2.3	ft
Anchor Length, **La**:	7.3	ft
Concrete Volume, **Vc**:	2.5	yd^3
Toe Width, **toe**:	0	ft
Guyed Anchor Top Rebar Size, **Sat**:	4	
No. of Bars in Top of Block:	3	
Guyed Anchor Front Rebar Size, **Saf**:	4	
No. of Bars in Front of Block:	2	
Stirrup Size:	3	

Material Properties		
Rebar Grade, **Fy**:	60	ksi
Concrete Strength, **F'c**:	4	ksi
Wt. Avg.Concrete Density, **δx**:	0.150	kcf
Clear Cover, **cc**:	4	in

Design Checks	Capacity	Demand	Rating*	Check
Lateral Capacity (kips):	23.06	13.00	**53.7%**	**Pass**
Uplift Capacity (kips):	35.97	5.00	**13.2%**	**Pass**
*Lateral Flexural Capacity (ft*kips):*	80.00	11.86	**14.1%**	**Pass**
*Uplift Flexural Capacity (ft*kips):*	61.74	4.56	**7.0%**	**Pass**

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

Soil Rating:	**53.7%**
Structural Rating:	**14.1%**
Anchor Shaft Rating:	**N/A**

Neglect Depth, **Neg**:	3.33	ft
Groundwater Level, **gw**:	N/A	ft

Soil Properties:	No. of Soil Layers?			1		
Layer	**φ, deg**	**cu, ksf**	**δ, pcf**	**d, ft**	**Ultimate fs (ksf)**	**N (blows/ft)**
1	30		110	6.70		

*key:

cu = Cohesion / Undrained Shear Strength
δ = Buoyant Soil Unit Weight

d = Depth to Bottom of Layer

Ultimate fs = Geotechnical Report-provided skin friction / adhesion

N = SPT Blow Count

SOIL WEIGHT (Accounts for toes if existing)

Volume of Soil (per Layer):	*V = Volume based on Truncated Pyraimd, V =(h/6)*(a*b+(a+c)*(b+d)+c*d)*			
Weight of Soil (per Layer):	*ws= V*δs*			
Weight of Soil Occupied by Concrete (per Layer):	Ws_c = *h*Wa*La*δ*	Ws_c =	0.00	kip
Gross Weight of Soil:	Ws_g = *Σ (V*δ)*	Ws_g =	32.67	kip
Net Weight of Soil:	*Ws =* $Ws_g - Ws_c$	W_s =	32.67	kip
Weight of Soil Wedges:	W_{wedges} = W_s *- SUM(X5:X13)*	W_{wedges} =	18.18	kip

ADHESION / SKIN FRICTION

Skin friction values are calculated based on Reese and O'Neill methodology (AASHTO 2010 Sections 10.8.3.5.1b and 10.8.3.5.2b)

COHESIVE SKIN FRICTION (CLAY)

Top of Layer (ft)	Cu (ksf)	Pa (ksf)	Su/Pa	α	Ultimate f_s (ksf)	Length of Block in Layer (ft)	Weighted f_s (ksf)
0.00	0	2.12	0.000	0.00	0.000	2.30	0.000
6.70	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00							

Ult. Adhesion / Skin Friction:	*Ultimate*	Ca =	**0.000**	ksf
All. Adhesion / Skin Friction:	*Allowable*	Ca =	**0.000**	ksf

LATERAL RESISTANCE

Soil Interaction Reduction Factor:	Φ_s = *0.75*	Φ_s =	0.75	
Passive Pressure applied to Anchor Block:	P_p = See Pp Sheet for Details	P_p =	1.83	ksf
Passive Pressure Resistance of Anchor Block:	R_p = Pp*Ta*La	R_p =	30.75	kip
Passive Pressure applied to Soil Plug:	P_{plug} = See Pp Sheet for Details	P_{plug} =	0.73	ksf
Passive Pressure Resistance of Soil Plug:	R_{plug} = Pp_plug * (Da-Ta) * La	R_{plug} =	23.32	kip

Resistance provided by Faces of Block:

COHESIVE SOIL (CCI Foundation Criteria Section 7.2.2)

R_{TOP} = $Ca*A_{top}$	R_{TOP} =	0.00	kip
R_{END} = $2*Ca*A_{end}*\cos\theta$	R_{END} =	0.00	kip

COHESIONLESS SOIL (CCI Foundation Criteria Section 7.2.3)

R_{TOP} = $2*fs*A_{top}$	R_{TOP} =	0.00	kip
R_{END} = $2*fs*A_{end}*\cos\theta$	R_{END} =	0.00	kip

SILTY SOIL (CCI Foundation Criteria Sections 4.6.3 & 7.2.2)

R_{TOP} = $Ca*A_{top}$	R_{TOP} =	0.00	kip

	R_{END} = 2*Ca*A_{end}*cosθ	R_{END} =	0.00	kip
Total Lateral Resistance:	ΦR$_n$ = Φ * (R_p + R_{TOP} + R_{END})	ΦR$_n$ =	23.06	kip
		RATING:	**56.37%**	

UPLIFT RESISTANCE

Soil Interaction Reduction Factor:	Φ_s = *0.75*	Φ_s =	0.75	
Dead Load Reduction Factor:	Φ_d = *0.9*	Φ_d =	0.9	
Weight of Concrete:	Wc = Vc * δx	Wc =	10.33	kip
	COHESIVE SOIL (CCI Foundation Criteria Section 7.1.3)			
Perimeter of Top of Block:	Po = 2*Wa+2*La	Po =	22.8	ft
Soil Shear:	Soil Shear = (Cu*Po*Df) / 2	Soil Shear =	0.00	kip
Concrete Adhesion (Front):	Front Adhesion = Ca*Ta*La (Ca is previously adjusted if Neg > (Da-Ta))	Front Adhesion =	0.00	kip
Concrete Adhesion (Ends):	End Adhesion = 2*Ca*Ta*Wa*sin(ϕ) (Ca is previously adjusted if Neg > (Da-Ta))	End Adhesion =	0.00	kip
	COHESIONLESS SOIL (CCI Foundation Criteria Section 7.1.4)			
Skin Friction (Front):	Front Friction = fs*Ta*La (fs is previously adjusted if Neg > (Da-Ta))	Front Friction =	0.00	kip
Skin Friction (Ends):	End Friction = 2*fs*Ta*Wa*sin(ϕ) (fs is previously adjusted if Neg > (Da-Ta))	End Friction =	0.00	kip
	SILTY SOIL (CCI Foundation Criteria Section 4.6.3 & 7.1.3)			
Concrete Adhesion (Front):	Front Adhesion = fs*Ta*La (fs is previously adjusted if Neg > (Da-Ta))	Front Adhesion =	0.00	kip
Concrete Adhesion (Ends):	End Adhesion = 2*fs*Ta*Wa*sin(ϕ) (fs is previously adjusted if Neg > (Da-Ta))	End Adhesion =	0.00	kip
Uplift Resistance:	ΦR$_n$ = Φ_d * (Ws - Wwedges + Wc) + Φ_s * (Cohesion + Wwedges + Σ (Adhesi	R_n =	35.97	kip
		RATING:	**13.90%**	

ANCHOR REINFORCEMENT (Lateral)

Modulus of Elasticity of Steel:	Es = 29000 ksi	Es =	29000	ksi
Beta Factor:	β = IF(F'c<=4000,0.85) IF(F'c>=8000,0.65) Otherwise (0.85-(((F'c-4000)/1000)*0.05)	β =	0.85	
Effective Beam Depth:	dc_s = Wa - cc - stirrups - db/2	dc_s =	44.58	in
	Rebar Size: s_s = 4 — Rebar Diameter:	d_{b_s} =	0.5	in
	Number of Rebar: m_s = 2 — Rebar Area:	A_{b_s} =	0.2	in^2
Total Steel Area:	$Atot_s$ = m_s * Ab_s	$Atot_s$ =	0.40	in^2
Depth of Equivalent Rectangular Stress Block:	a_s = Atot_s *Fy / (0.85 * F'c * Ta)	a_s =	0.26	in
Distance from Top to Nuetral Axis:	c_s = a_s/β	c_s =	0.30	in
Strain in Steel:	ε_{s_s} = 0.003 * (dc-c) / c	ε_{s_s} =	0.44144	in/in
Compression-Controlled Strain Limit::	ε_{c_s} = Fy / Es	ε_{c_s} =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_{t_s} = 0.005	ε_{t_s} =	0.00500	in/in

Flexure Strength Reduction Factor:	φflex$_s$ = if(strain_s >= strain_t) = 0.90
	if(strain_s <= strain_c) = 0.65
	if(strain_c < strain_s < strain_t) = 0.65 + (0.90 - 0.65)*(strain_s - strain_c) / (strain_t - strain_c)
		φflex$_s$ =	0.9	

Applied Uniform Load:	w_s = S / La	w_s =	1.781	kip/ft
Factored Applied Moment:	Mu_s = (w*La^2) / 8	Mu_s =	11.86	ft*kip
Nominal Moment Capacity:	Mn_s = Atot*Fy*(dc-a/2)	Mn_s =	88.89	ft*kip
Design Moment Capacity:	ΦMn_s = φflex * Mn_u	ΦMn_s =	80.00	ft*kip
		RATING:	**14.83%**	

ANCHOR REINFORCEMENT (Uplift)

Effective Beam Depth:	dc_u = Ta - cc - stirrups - db/2				dc_u =	22.98	in
	Rebar Size:	s_u =	4	Rebar Diameter:	d_{b_u} =	0.5	in
	Number of Rebar:	m_u =	3	Rebar Area:	A_{b_u} =	0.2	in^2
Total Steel Area:	$Atot_u$ = m_u * Ab_u				$Atot_u$ =	0.60	in^2
Depth of Equivalent Rectangular Stress Block:	a_u = Atot *Fy/ (0.85 * F'c * Wa)				a_u =	0.22	in
Distance from Top to Nuetral Axis:	c_u = a/β				c_u =	0.25	in
Strain in Steel:	ε_{s_u} = 0.003 * (dc-c) / c				ε_{s_u} =	0.26923	in/in
Compression-Controlled Strain Limit::	ε_{c_u} = Fy / Es				ε_{c_u} =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_{t_u} = 0.005				ε_{t_u} =	0.00500	in/in
Flexure Strength Reduction Factor:	$\varphi flex_u$ = if(strain_s >= strain_t) = 0.90				$\varphi flex_u$ =	0.9	
	if(strain_s <= strain_c) = 0.65						
	if(strain_c < strain_s < strain_t) = 0.65 + (0.90 - 0.65)*(strain_s - strain_c) / (strain_t - strain_c)						
Applied Uniform Load:	w_u = Ua / La				w_u =	0.685	kip/ft
Factored Applied Moment:	Mu_u = (w*La^2) / 8				Mu_u =	4.56	ft*kip
Nominal Moment Capacity:	Mn_u = Atot*Fy*(dc-a/2)				Mn_u =	68.60	ft*kip
Design Moment Capacity:	ΦMn_u = φflex * Mn_u				ΦMn_u =	61.74	ft*kip
					RATING:	**7.39%**	

Guyed Anchor Block Foundation

Checks capacity of anchor blocks for a guyed tower.

	ES-008
	Madison AWC
Location:	*Outer*

TIA-222 Revision:	H

Design Reactions		
Shear, **S**:	29.00	kips
Uplift, **Ua**:	23.00	kips
Resultant Force, **Rf**:	37.0	kips
Tower Height, **H**:	181.50	ft
Guy Anchor Radius, **R**:	184.00	ft
Resultant Angle to Horizontal, **θ**:	38.4	deg

Guy Anchor Properties		
Depth to Bottom of Deadman, **Da**:	7.5	ft
Anchor Width, **Wa**:	4.1	ft
Anchor Thickness, **Ta**:	2.5	ft
Anchor Length, **La**:	8.9	ft
Concrete Volume, **Vc**:	3.4	yd^3
Toe Width, **toe**:	0	ft
Guyed Anchor Top Rebar Size, **Sat**:	4	
No. of Bars in Top of Block:	3	
Guyed Anchor Front Rebar Size, **Saf**:	4	
No. of Bars in Front of Block:	2	
Stirrup Size:	3	

Material Properties		
Rebar Grade, **Fy**:	60	ksi
Concrete Strength, **F'c**:	4	ksi
Wt. Avg.Concrete Density, **δx**:	0.150	kcf
Clear Cover, **cc**:	4	in

Design Checks	Capacity	Demand	Rating*	Check
Lateral Capacity (kips):	34.42	29.00	**80.2%**	**Pass**
Uplift Capacity (kips):	50.44	23.00	**43.4%**	**Pass**
*Lateral Flexural Capacity (ft*kips):*	79.99	32.26	**38.4%**	**Pass**
*Uplift Flexural Capacity (ft*kips):*	68.18	25.59	**35.7%**	**Pass**

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

Soil Rating:	**80.2%**
Structural Rating:	**38.4%**
Anchor Shaft Rating:	**N/A**

Neglect Depth, **Neg**:	3.33	ft
Groundwater Level, **gw**:	N/A	ft

Soil Properties:	No. of Soil Layers?			1		
Layer	**φ, deg**	**cu, ksf**	**δ, pcf**	**d, ft**	**Ultimate fs (ksf)**	**N (blows/ft)**
1	30		110	7.50		

*key:

cu = Cohesion / Undrained Shear Strength
δ = Buoyant Soil Unit Weight

d = Depth to Bottom of Layer

Ultimate fs = Geotechnical Report-provided skin friction / adhesion

N = SPT Blow Count

SOIL WEIGHT (Accounts for toes if existing)

Volume of Soil (per Layer): $V =$ *Volume based on Truncated Pyraimd, V =(h/6)*(a*b+(a+c)*(b+d)+c*d)*

Weight of Soil (per Layer): $ws = V*\delta s$

Weight of Soil Occupied by Concrete (per Layer): $Ws_c = h*Wa*La*\delta$ — $Ws_c =$ 0.00 kip

Gross Weight of Soil: $Ws_g = \Sigma (V*\delta)$ — $Ws_g =$ 46.82 kip

Net Weight of Soil: $Ws = Ws_g - Ws_c$ — $W_s =$ 46.82 kip

Weight of Soil Wedges: $W_{wedges} = W_s$ - SUM(X5:X13) — $W_{wedges} =$ 26.75 kip

ADHESION / SKIN FRICTION

Skin friction values are calculated based on Reese and O'Neill methodology (AASHTO 2010 Sections 10.8.3.5.1b and 10.8.3.5.2b)

COHESIVE SKIN FRICTION (CLAY)

Top of Layer (ft)	Cu (ksf)	Pa (ksf)	Su/Pa	α	Ultimate f_s (ksf)	Length of Block in Layer (ft)	Weighted f_s (ksf)
0.00	0	2.12	0.000	0.00	0.000	2.50	0.000
7.50	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00	0	2.12	0.000	0.00	0.000	0.00	0.000
0.00							

Ult. Adhesion / Skin Friction: *Ultimate* Ca = **0.000** ksf

All. Adhesion / Skin Friction: *Allowable* Ca = **0.000** ksf

LATERAL RESISTANCE

Soil Interaction Reduction Factor: $\Phi_s = 0.75$ — $\Phi_s =$ 0.75

Passive Pressure applied to Anchor Block: $P_p =$ See Pp Sheet for Details — $P_p =$ 2.06 ksf

Passive Pressure Resistance of Anchor Block: $R_p = Pp*Ta*La$ — $R_p =$ 45.89 kip

Passive Pressure applied to Soil Plug: $P_{plug} =$ See Pp Sheet for Details — $P_{plug} =$ 0.83 ksf

Passive Pressure Resistance of Soil Plug: $R_{plug} =$ Pp_plug * (Da-Ta) * La — $R_{plug} =$ 36.71 kip

Resistance provided by Faces of Block:

COHESIVE SOIL (CCI Foundation Criteria Section 7.2.2)

$R_{TOP} = Ca*A_{top}$ — $R_{TOP} =$ 0.00 kip

$R_{END} = 2*Ca*A_{end}*\cos\theta$ — $R_{END} =$ 0.00 kip

COHESIONLESS SOIL (CCI Foundation Criteria Section 7.2.3)

$R_{TOP} = 2*fs*A_{top}$ — $R_{TOP} =$ 0.00 kip

$R_{END} = 2*fs*A_{end}*\cos\theta$ — $R_{END} =$ 0.00 kip

SILTY SOIL (CCI Foundation Criteria Sections 4.6.3 & 7.2.2)

$R_{TOP} = Ca*A_{top}$ — $R_{TOP} =$ 0.00 kip

	R_{END} = 2*Ca*A_{end}*cosθ	R_{END} =	0.00	kip
Total Lateral Resistance:	ΦR$_n$ = Φ * (R_p + R_{TOP} + R_{END})	ΦR$_n$ =	34.42	kip
		RATING:	**84.26%**	

UPLIFT RESISTANCE

Soil Interaction Reduction Factor:	Φ_s = *0.75*	Φ_s =	0.75	
Dead Load Reduction Factor:	Φ_d = *0.9*	Φ_d =	0.9	
Weight of Concrete:	Wc = Vc * δx	Wc =	13.68	kip
	COHESIVE SOIL (CCI Foundation Criteria Section 7.1.3)			
Perimeter of Top of Block:	Po = 2*Wa+2*La	Po =	26	ft
Soil Shear:	Soil Shear = (Cu*Po*Df) / 2	Soil Shear =	0.00	kip
Concrete Adhesion (Front):	Front Adhesion = Ca*Ta*La (Ca is previously adjusted if Neg > (Da-Ta))	Front Adhesion =	0.00	kip
Concrete Adhesion (Ends):	End Adhesion = 2*Ca*Ta*Wa*sin(ϕ) (Ca is previously adjusted if Neg > (Da-Ta))	End Adhesion =	0.00	kip
	COHESIONLESS SOIL (CCI Foundation Criteria Section 7.1.4)			
Skin Friction (Front):	Front Friction = fs*Ta*La (fs is previously adjusted if Neg > (Da-Ta))	Front Friction =	0.00	kip
Skin Friction (Ends):	End Friction = 2*fs*Ta*Wa*sin(ϕ) (fs is previously adjusted if Neg > (Da-Ta))	End Friction =	0.00	kip
	SILTY SOIL (CCI Foundation Criteria Section 4.6.3 & 7.1.3)			
Concrete Adhesion (Front):	Front Adhesion = fs*Ta*La (fs is previously adjusted if Neg > (Da-Ta))	Front Adhesion =	0.00	kip
Concrete Adhesion (Ends):	End Adhesion = 2*fs*Ta*Wa*sin(ϕ) (fs is previously adjusted if Neg > (Da-Ta))	End Adhesion =	0.00	kip
Uplift Resistance:	ΦR$_n$ = Φ_d * (Ws - Wwedges + Wc) + Φ_s * (Cohesion + Wwedges + Σ (Adhesi	R_n =	50.44	kip
		RATING:	**45.60%**	

ANCHOR REINFORCEMENT (Lateral)

Modulus of Elasticity of Steel:	Es = 29000 ksi			Es =	29000	ksi
Beta Factor:	β = IF(F'c<=4000,0.85) IF(F'c>=8000,0.65) Otherwise (0.85-(((F'c-4000)/1000)*0.05)			β =	0.85	
Effective Beam Depth:	dc_s = Wa - cc - stirrups - db/2			dc_s =	44.58	in
	Rebar Size:	s_s = 4	Rebar Diameter:	d_{b_s} =	0.5	in
	Number of Rebar:	m_s = 2	Rebar Area:	A_{b_s} =	0.2	in^2
Total Steel Area:	$Atot_s$ = m_s * Ab_s			$Atot_s$ =	0.40	in^2
Depth of Equivalent Rectangular Stress Block:	a_s = Atot_s *Fy / (0.85 * F'c * Ta)			a_s =	0.27	in
Distance from Top to Nuetral Axis:	c_s = a_s/β			c_s =	0.32	in
Strain in Steel:	ε_{s_s} = 0.003 * (dc-c) / c			ε_{s_s} =	0.41970	in/in
Compression-Controlled Strain Limit::	ε_{c_s} = Fy / Es			ε_{c_s} =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_{t_s} = 0.005			ε_{t_s} =	0.00500	in/in

Flexure Strength Reduction Factor:	φflex$_s$ = if(strain_s >= strain_t) = 0.90
	if(strain_s <= strain_c) = 0.65
	if(strain_c < strain_s < strain_t) = 0.65 + (0.90 - 0.65)*(strain_s - strain_c) / (strain_t - strain_c)
				φflex$_s$ =	0.9	

Applied Uniform Load:	w_s = S / La			w_s =	3.258	kip/ft
Factored Applied Moment:	Mu_s = (w*La^2) / 8			Mu_s =	32.26	ft*kip
Nominal Moment Capacity:	Mn_s = Atot*Fy*(dc-a/2)			Mn_s =	88.88	ft*kip
Design Moment Capacity:	ΦMn_s = φflex * Mn_u			ΦMn_s =	79.99	ft*kip
				RATING:	**40.33%**	

ANCHOR REINFORCEMENT (Uplift)

Effective Beam Depth:	dc_u = Ta - cc - stirrups - db/2				dc_u =	25.38	in
	Rebar Size:	s_u =	4	Rebar Diameter:	d_{b_u} =	0.5	in
	Number of Rebar:	m_u =	3	Rebar Area:	A_{b_u} =	0.2	in^2
Total Steel Area:	$Atot_u$ = m_u * Ab_u				$Atot_u$ =	0.60	in^2
Depth of Equivalent Rectangular Stress Block:	a_u = Atot *Fy/ (0.85 * F'c * Wa)				a_u =	0.25	in
Distance from Top to Nuetral Axis:	c_u = a/β				c_u =	0.29	in
Strain in Steel:	ε_{s_u} = 0.003 * (dc-c) / c				ε_{s_u} =	0.26008	in/in
Compression-Controlled Strain Limit::	ε_{c_u} = Fy / Es				ε_{c_u} =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_{t_u} = 0.005				ε_{t_u} =	0.00500	in/in

Flexure Strength Reduction Factor:	$\varphi flex_u$ = if(strain_s >= strain_t) = 0.90
	if(strain_s <= strain_c) = 0.65
	if(strain_c < strain_s < strain_t) = 0.65 + (0.90 - 0.65)*(strain_s - strain_c) / (strain_t - strain_c)
					$\varphi flex_u$ =	0.9	

Applied Uniform Load:	w_u = Ua / La				w_u =	2.584	kip/ft
Factored Applied Moment:	Mu_u = (w*La^2) / 8				Mu_u =	25.59	ft*kip
Nominal Moment Capacity:	Mn_u = Atot*Fy*(dc-a/2)				Mn_u =	75.76	ft*kip
Design Moment Capacity:	ΦMn_u = $\varphi flex$ * Mn_u				ΦMn_u =	68.18	ft*kip
					RATING:	**37.53%**	

Pier and Pad Foundation

ES-008
MadisonAWC

TIA-222 Revision:	H
Tower Type:	Guyed

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

Superstructure Analysis Reactions		
Compression, P_{comp}:	166.02	kips
Base Shear, Vu_comp:	1.43	kips
Moment, M_u:	0	ft-kips
Tower Height, **H**:	180	ft
BP Dist. Above Fdn, bp_{dist}:	0	in
Bolt Circle / Bearing Plate Width, **BC**:		in

Pier Properties		
Pier Shape:	Square	
Pier Diameter, **dpier**:	2	ft
Ext. Above Grade, **E**:	1.5	ft
Pier Rebar Size, **Sc**:	5	
Pier Rebar Quantity, **mc**:	7	
Pier Tie/Spiral Size, **St**:	3	
Pier Tie/Spiral Quantity, **mt**:	7	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, cc_{pier}:	3	in

Pad Properties		
Depth, **D**:	6.2	ft
Pad Width, **W**:	4.7	ft
Pad Thickness, **T**:	2	ft
Pad Rebar Size (Bottom), **Sp**:	5	
Pad Rebar Quantity (Bottom), **mp**:	7	
Pad Clear Cover, cc_{pad}:	3	in

Material Properties		
Rebar Grade, **Fy**:	60	ksi
Concrete Compressive Strength, **F'c**:	3	ksi
Dry Concrete Density, δc:	150	pcf

Soil Properties		
Total Soil Unit Weight, γ:	120	pcf
Ultimate Gross Bearing, Qult:	16.000	ksf
Cohesion, **Cu**:		ksf
Friction Angle, φ:	30	degrees
SPT Blow Count, N_{blows}:	60	
Base Friction, μ:		
Neglected Depth, **N**:	3.30	ft
Foundation Bearing on Rock?	Yes	
Groundwater Depth, **gw**:	N/A	ft

<--Toggle between Gross and Net

Foundation Analysis Checks				
	Capacity	**Demand**	**Rating***	**Check**
Lateral (Sliding) (kips)	53.72	1.43	**2.5%**	**Pass**
Bearing Pressure (ksf)	9.60	9.24	**91.7%**	**Pass**
*Overturning (kip*ft)*	41.55	11.01	**26.5%**	**Pass**
*Pier Flexure (Comp.) (kip*ft)*	176.74	8.15	**4.4%**	**Pass**
Pier Compression (kip)	1909.44	170.12	**8.5%**	**Pass**
*Pad Flexure (kip*ft)*	191.49	34.72	**17.3%**	**Pass**
Pad Shear - 1-way (kips)	92.96	0.00	**0.0%**	**Pass**
Pad Shear - 2-way (Comp) (ksi)	0.164	0.000	**0.0%**	**Pass**
*Flexural 2-way (Comp) (kip*ft)*	382.98	4.89	**1.2%**	**Pass**

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

Soil Rating*:	**91.7%**
Structural Rating*:	**17.3%**

TIA-222- H ACI : 2014

PHYSICAL PARAMETERS

Pier Height Above Water Table:	h_{pier_above} = (MIN(gw,D-T) + E)	h_{pier_above} =	5.7	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} = (dpier^2) * hpier_above * δc / 1000 + (dpier^2) * hpier_below * (δc-62.4) /1000	W_{pier} =	3.42	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	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} =	6.63	kips	
Concrete weight:	W_c = V * δc	W_c =	10.0	kips	
Soil weight:	W_s = (D - T) * (W² - dpier²) * γ	W_s =	9.1	kips	
EIA/TIA-222 Load Factor:	LF = 1	LF =	1.00		
Soil Depth from Top of Pad to Mid. Layer (Cohesionless Soil):	$H_{cohesionless}$ = T / 2	$H_{cohesionless}$ =	1.00	ft	
Soil Depth from Grade to Mid. Layer (Silty Soil):	H_{silty} = (D-T)+T/2	H_{silty} =	5.20	ft	

LATERAL RESISTANCE

Total Nominal Pp Resistance:	P_{p_total} = Pp_pier *Ap_pier + Pp_pad * Ap_pad	P_{p_total} =	20.03	kips	
Factored Total Weight for Compression:	$P_{factored\_comp}$ = φD * (Wc + Ws + Pcomp / 1.2)	$P_{factored\_comp}$ =	141.76	kips	
Nominal Base Friction Resistance (Comp):	R_{s_comp} = P * TAN((2/3)*ϕ)	R_{s_comp} =	51.60	kips	
Lateral Resistance (Comp):	Va_comp = Φs * (Pp_total + Rs_comp)	Va_comp =	53.72	kips	

Check **Va_comp = 53.72 kips >= Vu_comp = 1.43 kips** **RATING:** **2.66%** **OK**

PIER REINFORCEMENT

Pier / Column Compression

Pier Cross-Sectional Area:	A_1 = dpier^2	A_1 =	576.00	in²	
Support Area (2H:1V Slope):	A_2 = (MIN(W, dpier + 4 * T))²	A_2 =	3180.96	in²	
Compressive Resistance (H/D < 3):	$ΦP_{n1}$ = 0.65*0.85 * F'c * A1 * MIN(√(A2/A1),2)	$ΦP_{n1}$ =	1909.44	kips	
Rebar:	$s_{\_pier}$ = 5 $m_{\_pier}$ = 7	d_{b_pier} = 0.625 in A_{b_pier} = 0.31 in²			
Provided area of steel:	A_{s_pier} = Ab_pier * m_pier	A_{s_pier} =	2.17	in²	
Compressive Resistance (H/D >= 3):	$ΦP_{n2}$ = 0.65 * 0.8 * (0.85 * (F\c) * (A_1 - As_pier) + ((Fy) * As_pier))	$ΦP_{n2}$ =	828.60	kips	
	H/D = (D - T + E) / dpier	H/D =	2.85		
Utilized Compressive Resistance:	$ΦP_n$ = Pn1	$ΦP_n$ =	1909.44	kips	
Applied Compressive Force:	P_u = Pcomp + 1.2 * Wpier	P_u =	170.12	kips	

Check **$ΦP_n$ = 1909.44 kips >= P_u = 170.12 kips** **RATING:** **8.91%** **OK**

Pier Flexure

Applied Moment to DSMC (Compression):	M_{u_comp} = (D - T + E) * Vu + Mu	M_{u_comp} =	8.15	ft-kips	
Pier Moment Capacity (Compression):	$ΦM_{n\_comp}$ = *from DSMC*	$ΦM_{n\_comp}$ =	176.74	ft-kips	

Check **M_{u_comp} = 8.15 ft-kips >= $ΦM_{n\_comp}$ = 176.74 ft-kips** **RATING:** **4.61%** **OK**

PAD REINFORCEMENT

Elastic Bearing Pressure for Soil Checks

Overturning Moment:	Mo = M + Vu_comp * (D + E + bpdist/12)	Mo =	11.01	ft-kips

Compressive Load for Bearing:	$P_{bearing}$ = Wc + Ws + Pcomp / 1.2		$P_{bearing}$ =	157.51	kips	
*Load Eccentricity (0.9*D LC):*	ec_0.9 = Mo / 0.9*Pbearing		ec_0.9 =	0.08	ft	e <= L/6
*Load Eccentricity (1.2*D LC):*	ec_1.2 = Mo / 1.2*Pbearing		ec_1.2 =	0.06	ft	e <= L/6
Elastic Section Modulus:	S = W³ / 6		S =	17.30	ft³	
*Positive Pressure 0.9*D LC):*	Ppos_0.9 = 0.9*Pbearing / Area + Mo / S		$P_{pos\_st\_0.9}$ =	7.05	ksf	
*Positive Pressure (1.2*D LC):*	Ppos_1.2 = 1.2*Pbearing / Area + Mo / S		$P_{pos\_st\_1.2}$ =	9.19	ksf	
*Negative Pressure (0.9*D LC):*	Pneg_0.9 = 0.9*Pbearing / Area - Mo / S Note: The resultant stress is within the kern. No adjustment is required.		$P_{neg\_st\_0.9}$ =	5.78	ksf	
*Negative Pressure (1.2*D LC):*	Pneg_1.2 = 1.2*Pbearing / Area - Mo / S Note: The resultant stress is within the kern. No adjustment is required.		$P_{neg\_st\_1.2}$ =	7.92	ksf	
*Adjusted Pressure (0.9*D LC):*	Padj_0.9 = 2*0.9*Pbearing/(3*W*(W/2-ec_0.9))		$P_{adj\_0.9}$ =	8.85	ksf	
*Adjusted Pressure (1.2*D LC):*	Padj_1.2 = 2*1.2*Pbearing/(3*W*(W/2-ec_0.9))		$P_{adj\_1.2}$ =	11.70	ksf	
*Maximum Pressure (0.9*D LC):*	$q_{u1\_0.9}$ = IF(Pneg ≥ 0, Ppos , Padj)		$q_{u\_st\_0.9}$ =	7.05	ksf	
*Maximum Pressure (1.2*D LC):*	$q_{u1\_1.2}$ = IF(Pneg ≥ 0, Ppos , Padj)		$q_{u\_st\_1.2}$ =	9.19	ksf	

One-Way Shear

Rebar: $s_{\_pad}$ = 5 *Equally spaced;* d_{b_pad} = 0.625 in
$m_{\_pad}$ = 7 *bottom layer in one direction* A_{b_pad} = 0.31 in^2

Effective depth:	d_c = T - cc - 1.5 * db	d_c =	20.1	in	
Distance from Edge of Pad to Column Face:	d' = W / 2 - dpier / 2	d' =	1.4	ft	
Distance from Edge of Pad to dc from Column Face:	d'' = d' - d_c / 12	d'' =	0.00	ft	
Distance to qs (0.9D LC):	L' _0.9 = (W / 2 - ec_0.9) * 3	L' _0.9 =	6.82	ft	
Distance to qs (1.2D LC):	L' _1.2 = (W / 2 - ec_1.2) * 3	L' _1.2 =	6.88	ft	
*Slope of qs (0.9*D LC):*	sqs_0.9 = IF(L' > W, (Ppos - Pneg) / W, qu / L')	sqs_0.9 =	0.27	kcf	
*Slope of qs (1.2*D LC):*	sqs_1.2 = IF(L' > W, (Ppos - Pneg) / W, qu / L')	sqs_1.2 =	0.27	kcf	
Nominal Shear Strength:	V_{n1} = 2 * W * √(F'c*1000) * dc	V_{n1} =	123.95	kips	
Shear Reduction Factor:	φ_{shear} = 0.75	φ_{shear} =	0.75		
Design Shear Strength:	φV_{n1} = φshear * V_{n1}	φV_{n1} =	92.96	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:	4.2	0.120	0.00	0.00
Soil Below Water Table:	0	0.058	0.00	0.00
Pad Above Water Table:	2	0.150	0.00	0.00
Pad Below Water Table:	0	0.088	0.00	0.00
Total:			0.00	0.00

*Applied Shear (0.9*D LC):*	$V_{u1\_0.9}$ = sqs_0.9 * MIN(L'_0.9,d'') * (W / 2 - dpier / 2 - dc) * W	$V_{u1\_0.9}$ =	0.00	kips
*Applied Shear (1.2*D LC):*	$V_{u1\_1.2}$ = sqs_1.2 * MIN(L'_1.2,d'') * (W / 2 - dpier / 2 - dc) * W	$V_{u1\_1.2}$ =	0.00	kips

Check **φV_{n1} = 92.96 kips >= V_{u1} = 0.00 kips** **RATING: 0.00% OK**

Two-Way Shear (Compression)

Pier Shape:	Pier Shape: Square	Pier Shape:	Square		
Pier Diameter:	d_{pier1} = d_{pier} * 12 in / ft	d_{pier1} =	24.00	in	
Equivalent Square Pier Diameter:	d_{pier_sq} = dpier	d_{pier_sq} =	24.00	in	
Avg. Effective Depth for Punching Shear:	d_{c_2} = T - cc_{pad} - AVERAGE(0.5 * $_{db\_pad}$, 1.5 * d_{b_pad})	d_{c_2} =	20.38	in	
Area of Concrete in Shear:	A_c = (4 * (dpier1 + dc_2)) * dc_2)	A_c =	3616.56	in^2	
Eq. Square Area of Concrete in Shear:	A_{c_sq} = (4*(dpier_sq+dc_2))*dc_2	A_{c_sq} =	3616.56	in^2	
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 =	97.81	kip*in	
Polar Moment of Inertia at assumed Critical Section:	J_{c_1} = (dc_2*(dpier1+dc_2)^3)/6 + ((dpier1+dc_2)*(dc_2^3))/6 + (dc_2*(dpier1+dc_2)*(dpier1+dc_2)^2)/2	J_{c_1} =	1249477.61	in^4	

Eq. Square Polar Moment of Inertia at assumed Critical Section:	J_{c_sq} = (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} =	1249477.61	in^4
*Net Bearing Resistance at front of Pier (1.2*D LC):*	$q_{u\_AB\_1.2}$ = MAX((qu_st_1.2 - sqs_1.2*(W/2 - (dpier1/12+dc_2/12)/2) - 1.2*(Wpad+Ws)/Area)/144,0)	$q_{u\_AB\_1.2}$ =	0.06	ksi
*Net Bearing Resistance at rear of Pier (1.2*D LC):*	$q_{u\_CD\_1.2}$ = MAX((qu_st_1.2 - sqs_1.2*(W/2 + (dpier1/12+dc_2/12)/2) - 1.2*(Wpad+Ws)/Area)/144,0)	$q_{u\_CD\_1.2}$ =	0.05	ksi
*Net Bearing Resistance at front of Pier_sq (1.2*D LC):*	$q_{u\_AB\_1.2\_sq}$ = MAX((qu_st_1.2 - sqs_1.2*(W/2 - (dpier_sq/12+MIN(dc_2,(T*12)*3)/12)/2) - 1.2*(Wpad+Ws)/Area)/144,0)	$q_{u\_AB\_1.2\_sq}$ =	0.06	ksi
*Net Bearing Resistance at rear of Pier_sq (1.2*D LC):*	$q_{u\_CD\_1.2\_sq}$ = MAX((qu_st_1.2 - sqs_1.2*(W/2 + (dpier_sq/12+dc_2/12)/2) - 1.2*(Wpad+Ws)/Area)/144,0)	$q_{u\_CD\_1.2\_sq}$ =	0.05	ksi
*Applied Shear Force (1.2*D LC):*	$V_{u\_1.2}$ = 1.2*Wpier + 1.2 * IF(OR($B$1="G",$B$1="H"), Pcomp / 1.2, Pcomp)	$V_{u\_1.2}$ =	170.12	kip
*Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling}$ = MAX(0,IF(L_0.9 <= W/2 + dpier/2 + (dc_2/12)/2, 0, Vu_0.9/Ac + (Yv * Mv * (dpier1 + dc_2)/2) / Jc_1 - MIN(qu_AB_0.9,qu_CD_0.9)))	$v_{u\_1.2\_controlling}$ =	0.000	ksi
*Eq. Sq. Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling\_sq}$ = MAX(0,Vu_1.2/Ac_sq + (Yv * Mv * (dpier_sq + dc_2)/2) / Jc_sq - MIN(qu_AB_1.2_sq,qu_CD_1.2_sq))	$v_{u\_1.2\_controlling\_sq}$ =	0.000	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.164	ksi

Check	**Φv_n =**	**0.164**	**ksi**	**>=**	**v_{u_demand} =**	**0.000**	**ksi**	**RATING:**	**0.00%**	**OK**

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

Effective Pad Width:	$b_{\_pad}$ = MIN(dpier+3*T,W)	$b_{\_pad}$ =	4.7	ft
Bar Spacing:	B_{s_pad} = Bs_pad (see design checks below)	B_{s_pad} =	8.30	in
Fraction of Bars in Effective Width:	$m_{\_effective}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad)	$m_{\_effective}$ =	7.00	
Area of Steel in Effective Width:	$A_{s\_effective}$ = VLOOKUP(Sp,Ref!$A$2:$C$12,3,0)*m_effective	$A_{s\_effective}$ =	2.17	in^2
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective}$ = $A_{s\_effective}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective}$ =	0.91	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}	$c_{\_effective}$ =	1.07	
Effective depth:	dc = dc (see One-Way Shear check above)	dc =	20.0625	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	$\varepsilon_{s\_effective}$ =	0.05351	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$_{_effective}$ = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	φflex$_{_effective}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective}$ = $A_{s\_effective}$ * (F_y) * (dc - $a_{\_effective}$ / 2) * (1/12)	$M_{n\_effective}$ =	212.77	ft-kips
Design Flexural Strength:	φ$M_{n_effective}$ = φflex_effective * Mn_effective	φ$M_{n_effective}$ =	191.49	ft-kips

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

Bar Spacing:	$B_{s\_pad\_top}$ = (W*12 - 2 * ccpad - VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)) / (mptop - 1)	$B_{s\_pad\_top}$ =	4.70	in
Fraction of Bars in Effective Width:	$m_{\_effective\_top}$ = IF(b_pad=W,mptop,12*b_pad/Bs_pad_top)	$m_{\_effective\_top}$ =	7.00	
Area of Steel in Effective Width:	$A_{s\_effective\_top}$ = VLOOKUP(sptop,Ref!$A$2:$C$12,3,0)*m_effective_top	$A_{s\_effective\_top}$ =	2.17	in^2
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective\_top}$ = $A_{s\_effective\_top}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective\_top}$ =	0.91	in
Distance from Top to Nuetral Axis:	$c_{\_effective\_top}$ = $a_{\_effective\_top}$ / β_{pad}	$c_{\_effective\_top}$ =	1.07	
Effective depth:	d_{c_top} = T *12 - ccpad - 1.5 * VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)	d_{c_top} =	20.0625	in
Strain in Steel:	$\varepsilon_{s\_effective\_top}$ = 0.003 * (dc_top - c_effective_top) / c_effective_top	$\varepsilon_{s\_effective\_top}$ =	0.05351	in/in
Flexure Strength Reduction Factor:	φflex$_{_effective_top}$ = IF(εs_top>=εt,0.9,IF(εs_top<=εc,0.65,0.65+(0.9-0.65)*((εs_top-εc)/(εt-εc))))	φflex$_{_effective_top}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective\_top}$ = $A_{s\_effective\_top}$ * (F_y) * (dc_top - $a_{\_effective\_top}$ / 2) * (1/12)	$M_{n\_effective\_top}$ =	212.77	ft-kips
Design Flexural Strength:	φ$M_{n_effective_top}$ = φflex_effective * Mn_effective	φ$M_{n_effective_top}$ =	191.49	ft-kips
Applied Moment:	Yf*M_{u_comp} = Yf*M_{u_comp}	Yf*M_{u_comp} =	4.8906	ft-kips

Check	**φ$M_{n_effective}$ =**	**382.98**	**ksi**	**>=**	**Yf*M_{u_comp} =**	**4.89**	**ksi**	**RATING:**	**1.28%**	**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} =	2.17	in^2
Depth of Equivalent Rectangular Stress Block:	a =	$A_{s\_pad} * Fy / (0.85 * F'c * W)$	a =	0.91	in
Distance from Top to Nuetral Axis:	c =	a / β_{pad}	c =	1.07	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 =	0.05351	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 =	212.77	ft-kips
Design Flexural Strength:	φM_n =	φflex * Mn	φM_n =	191.49	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 =	6.69	ksf
*Bearing Press. at Crit. Section (1.2*D LC):*	qmid_1.2 =	qu_st_1.2 - sqs_1.2 * d'	qmid_1.2 =	8.83	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:	4.2	0.120	2.88	3.84	0.675	1.94	2.5902828
Soil Below Water Table:	0	0.058	0.00	0.00	0.675	0.00	0
Pad Above Water Table:	2	0.150	1.71	2.28	0.675	1.16	1.541835
Pad Below Water Table:	0	0.088	0.00	0.00	0.675	0.00	0
Total:			4.59	6.12		3.10	4.13

*Factored Bending Moment (0.9*D LC):*	Mu_pad_0.9 =	((0.5*(qu_0.9-qmid_0.9))*(d\^2)*(2/3)+(0.5*qmid_0.9*(d\^2))-(0.5*Wg_0.9*(d\^2)))*W	Mu_pad_0.9 =	26.59	ft-kips
*Factored Bending Moment (1.2*D LC):*	Mu_pad_1.2 =	((0.5*(qu_1.2-qmid_1.2))*(d\^2)*(2/3)+(0.5*qmid_1.2*(d\^2))-(0.5*Wg_1.2*(d\^2)))*W	Mu_pad_1.2 =	34.72	ft-kips

Check **φM_n = 191.49 ft-kips >= M_{u_pad} = 34.72 ft-kips** **RATING: 18.13%** **OK**

PIER DESIGN CHECKS

Bar Spacing

Bar separation:	B_{s_pier} =	(do * π) / m_pier - db_pier	B_{s_pier} =	6.84	in

Check **18.00 in >= B_{s_pier} = 6.84 in** **OK**

Vertical Rebar Development Length

Reinforcement location:	α_c =	if space under bar > 12", 1.3, else use 1.0	α_c =	1.3	
Epoxy coating:	β_c =	for non- epoxy coated, use 1.0	β_c =	1.0	
Max term:	$\alpha\beta_c$ =	product of α x β not to exceed 1.7	$\alpha\beta_c$ =	1.3	
Reinforcement size:	γ_c =	if bar size is 6 or less, 0.8, else use 1.0	γ_c =	0.8	
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	$c_{\_c}$ =	3.3	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 =	1.33	
Development (tensile):	$L_{dt'\_c}$ =	(3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ_c * γ_c * λ_c * R_c * db_c / c_c'	$L_{dt'\_c}$ =	28.35	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} =	28.35	in
Development (comp.):	$L_{dc'\_c}$ =	0.02 * db_c * Fy*1000 / √(F'c*1000)	$L_{dc'\_c}$ =	13.69	in
	$L_{dc''\_c}$ =	0.0003 * db_c * Fy*1000	$L_{dc''\_c}$ =	11.25	in
Development length:	L_{dc_c} =	MAX(8, Ldc'_c, Ldc"_c)	L_{dc_c} =	13.69	in
Length available in pier:	L_{vc} =	D - T + E - cc	L_{vc} =	65.4	in

Check	L_{vc} =	**65.40**	**in**	**>=**	L_{dt_c} =	**28.35**	**in**					**OK**
Check	L_{vc} =	**65.40**	**in**	**>=**	L_{dc_c} =	**13.69**	**in**					**OK**
	Length available in pad:			L_{vp} = T - ccpad						L_{vp} =	21.0	in
Check	L_{vp} =	**21.00**	**in**	**>=**	L_{dt_c} =	**28.35**	**in**					**HOOKS**
Check	L_{vp} =	**21.00**	**in**	**>=**	L_{dc_c} =	**13.69**	**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}' =	9.6	in
	Minimum length:			L_{dh_min} = the larger of: 8 * d_b or 6 in						L_{dh_min} =	6.0	in
	Development length:			L_{dh} = MAX(Ldh_min, Ldh')						L_{dh} =	9.6	in
Check	L_{vp} =	**21.00**	**in**	**>=**	L_{dh} =	**9.59**	**in**					**OK**
	Hook tail length:			L_{h_tail} = 12 * db beyond the bend radius						L_{h_tail} =	10.0	in
	Length available in pad:			L_{h_pad} = (W - dpier) / 2 + ccpier - ccpad						L_{h_pad} =	16.2	in
Check	L_{h_pad} =	**16.20**	**in**	**>=**	L_{dh_tail} =	**10.00**	**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 =	0.5	
	Tie parameters:			s_t = 3 m_t = 7			d_{b_t} = 0.375 in A_{b_t} = 0.11 in^2					
	Allowable tie spacing per vertical rebar:			$B_{s\_t\_max1}$ = 8 / z * db_c						$B_{s\_t\_max1}$ =	10	in
	per tie size:			$B_{s\_t\_max2}$ = 24 / z * db_t						$B_{s\_t\_max2}$ =	18	in

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#:
Site Name: *MadisonAWC*
App #:

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

Pier Properties

Concrete:

Pier Diameter =	2.0	ft
Concrete Area =	452.4	in^2

Reinforcement:

Clear Cover to **Tie**=	3.00	in
Horiz. **Tie** Bar Size=	3	
Vert. Cage Diameter =	1.39	ft
Vert. Cage Diameter =	16.63	in
Vertical Bar Size =	5	
Bar Diameter =	0.63	in
Bar Area =	0.31	in^2
Number of Bars =	7	
As Total=	2.17	in^2
A s/ Aconc, Rho:	0.0048	0.48%

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

(3)*(Sqrt(f'c)/Fy:	0.0027
200 / Fy:	0.0033

Minimum Rho Check:

Assumed Min. Rho:	0.50%
Provided Rho:	0.48%

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn. Pn per ACI 318 (10-2)	664.69	kips
at Mu=(ϕ=0.65)Mn=	111.22	ft-kips
Max Tu, (φ=0.9) Tn =	117.18	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces

TIA Revision:	H	
Max. Factored Shaft Mu:	8.151	ft-kips **(* Note)**
Max. Factored Shaft Pu:	166.02	kips
Max Axial Force Type:	Comp.	

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

Load Factor	Shaft Factored Loads		
1.00	Mu:	8.151	ft-kips
1.00	Pu:	166.02	kips

Material Properties

Concrete Comp. strength, f'c =	3000	psi
Reinforcement yield strength, Fy =	60	ksi
Reinforcing Modulus of Elasticity, E =	29000	ksi
Reinforcement yield strain =	0.00207	
Limiting compressive strain =	0.003	

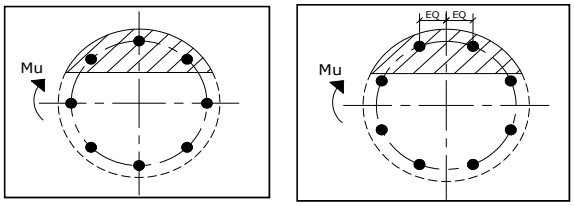
ACI 318 Code

Select Analysis ACI Code=	2014

SOLVE <-- Press Upon Completing All Input

Results:

Governing Orientation Case: **1**



Case 1 Case 2

Dist. From Edge to Neutral Axis:	**7.09**	in
Extreme Steel Strain, εt:	**0.0056**	
	εt > 0.0050, Tension Controlled	
Reduction Factor,φ:	**0.900**	

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	149.42	kips
Drilled Shaft Moment Capacity, φMn:	**176.74**	ft-kips
Drilled Shaft Superimposed Mu:	**8.15**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**4.6%**

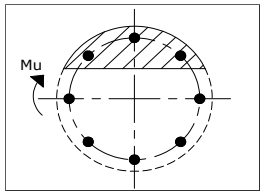
Maximum Allowable Moment of a Circular Pier

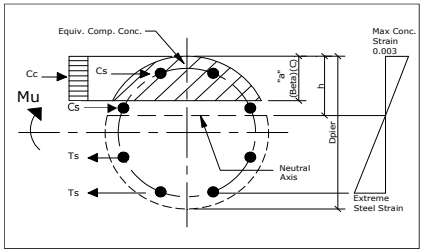
Pu: 166.02 kips (from Results Tab)
Axial Force type: Comp. (from Results Tab)

For Internal Calculations:
Axial Load (Negative for Compression) = -166.02 kips

	Case 1	Case 2	
Reduction factor, ϕ2002 =	0.9	0.9	<-- 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 =	0.9	0.9	<-- 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 =	0.9	0.9	<-- 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).
I ACI code:	0.9	0.9	

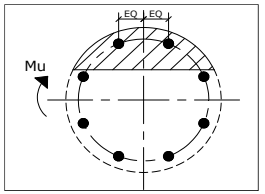
Case 1: Single Bar Near the Extreme Fiber





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 =	7.08	in	
Equivalent compression zone factor =	0.85		
Distance from extreme edge to equivalent compression zone factor, a =	6.01	in	
Distance from centroid to neutral axis =	4.92	in	

Compression Zone

Area of steel in compression zone, Asc =	0.31	in^2	
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier =	60.08	deg	<-- 1/2 of total angle
Area of concrete in compression, Acc =	88.75	in^2	
Force in concrete = 0.85 * f'c * Acc, Fc =	226.32	kips	<-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs =	-60.30	kips	<-- ϕ Not Involved = Total Steel Pn
Case 1, φ=	0.900		
Axial (comp=negative), Pu =	-166.02	kips	<-- Pu
Balance Force in concrete, Fs+Fu =	-226.32	kips	
Shaft Comp. Capacity, ϕPn=	**149.42**	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 =	750.10	in^3	
Distance between centroid of concrete in compression and centroid of pier =	8.45	in	
Moment of concrete in compression =	1912.77	in-kips	159.3971 ft-kips
Total reinforcement moment =	458.44	in-kips	38.20338 ft-kips
Nominal Moment strength of Drilled Shaft Mn =	2371.21	in-kips	
Moment Capacity of Drilled Shaft, ϕMn =	2134.09	in-kips	177.8404 ft-kips

Case 1, φMn = 177.84 ft-kips

Case 2

Neutral Axis

Distance from extreme edge to neutral axis, h =	7.09	in	
Equivalent compression zone factor =	0.85		
Distance from extreme edge to equivalent compression zone factor, a =	6.03	in	
Distance from centroid to neutral axis =	4.91	in	

Compression Zone

Area of steel in compression zone, Asc =	0.62	in^2	
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier =	60.16	deg	<-- 1/2 of total angle
Area of concrete in compression, Acc =	89.03	in^2	
Force in concrete = 0.85 * f'c * Acc, Fc =	227.03	kips	<-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs =	-61.01	kips	<-- ϕ Not Involved = Total Steel Pn
Case 2, φ=	0.900		
Axial (comp=negative), Pu =	-166.02	kips	<-- Pu
Balance Force in concrete, Fs+Fu =	-227.03	kips	
Shaft Comp. Capacity, ϕPn=	**149.42**	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 =	751.76	in^3	
Distance between centroid of concrete in compression and centroid of pier =	8.44	in	
Moment of concrete in compression =	1917.00	in-kips	159.75 ft-kips
Total reinforcement moment =	439.59	in-kips	36.63208 ft-kips
Nominal Moment strength of Drilled Shaft Mn =	2356.59	in-kips	
Moment Capacity of Drilled Shaft, ϕMn =	2120.93	in-kips	176.7439 ft-kips

Case 2, φMn = 176.74 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 =	21.59	in	
Equivalent compression zone factor =	0.85		
Distance from extreme edge to equivalent compression zone factor, a =	18.35	in	
Distance from centroid to neutral axis =	-9.59	in	

Compression Zone

Area of steel in compression zone, Asc =	1.55	in^2	
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier =	121.95	deg	<-- 1/2 of total angle
Area of concrete in compression, Acc =	371.16	in^2	
Force in concrete = 0.85 * f'c * Acc, Fc =	946.47	kips	<-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs =	76.14	kips	<-- ϕ Not Involved = Total Steel Pn
φ=	0.65		
Magnified, Max Axial Comp, Pn, per ACI 318 (10-2)/(ϕ=0.65)=	-1022.61	kips	<-- (Pn per ACI 10-2)/ϕ
Balance Force in concrete, Fs+Fu =	-946.47	kips	
Shaft Comp. Capacity, (ϕ=0.65)Pn=	**664.69**	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 =	703.68	in^3	
Distance between centroid of concrete in compression and centroid of pier =	1.90	in	
Moment of concrete in compression =	1794.38	in-kips	149.5316 ft-kips
Total reinforcement moment =	258.99	in-kips	21.58284 ft-kips
Nominal Moment strength of Drilled Shaft Mn =	2053.37	in-kips	
Moment Capacity of Drilled Shaft, (ϕ=0.65)Mn =	1334.69	in-kips	111.2244 ft-kips

Case 3, at Pmax, (φ=0.65)Mn = 111.22 ft-kips

Final Results		
Governing Orientation Case=	**2**	
phi, φ=	0.900	
Shaft ϕ*Mn=	**176.74**	ft-kips
Distance from Edge of Shaft to N.A.=	7.09	in
Shaft Beta=	0.85	
Maximum Tensile Strain=	-0.00559	<---------- et > 0.0050, Tension Controlled
Shaft Tension Cap., φTn= (φ=0.9)*(Total As)(Fy)=	117.18	kips
Shaft Max Comp, (φ=0.65)(0.80)[0.85*f'c*(Ag-Ast)+Ast*Fy]=	664.69	kips

TC

Individual Bars

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	8.31	3.39	2.33	0.00144	0.31	41.66	12.13	100.79
2	51.43	5.18	0.26	-0.80	0.00011	0.00	3.19	0.99	5.12
3	102.86	-1.85	-6.77	-7.83	-0.00287	0.00	-60.00	-18.60	34.40
4	154.29	-7.49	-12.41	-13.47	-0.00526	0.00	-60.00	-18.60	139.30
5	205.71	-7.49	-12.41	-13.47	-0.00526	0.00	-60.00	-18.60	139.30
6	257.14	-1.85	-6.77	-7.83	-0.00287	0.00	-60.00	-18.60	34.40
7	308.57	5.18	0.26	-0.80	0.00011	0.00	3.19	0.99	5.12

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	25.71	7.49	2.58	1.52	0.00109	0.31	31.67	9.03	67.60
2	77.14	1.85	-3.06	-4.12	-0.00129	0.00	-37.52	-11.63	-21.51
3	128.57	-5.18	-10.09	-11.15	-0.00427	0.00	-60.00	-18.60	96.40
4	180.00	-8.31	-13.22	-14.28	-0.00559	0.00	-60.00	-18.60	154.61
5	231.43	-5.18	-10.09	-11.15	-0.00427	0.00	-60.00	-18.60	96.40
6	282.86	1.85	-3.06	-4.12	-0.00129	0.00	-37.52	-11.63	-21.51
7	334.29	7.49	2.58	1.52	0.00109	0.31	31.67	9.03	67.60

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	8.31	17.90	14.66	0.00249	0.31	60.00	17.81	148.04
2	51.43	5.18	14.77	11.53	0.00205	0.31	59.53	17.66	91.54
3	102.86	-1.85	7.74	4.50	0.00108	0.31	31.19	8.88	-16.42
4	154.29	-7.49	2.10	-1.14	0.00029	0.00	8.46	2.62	-19.65
5	205.71	-7.49	2.10	-1.14	0.00029	0.00	8.46	2.62	-19.65
6	257.14	-1.85	7.74	4.50	0.00108	0.31	31.19	8.88	-16.42
7	308.57	5.18	14.77	11.53	0.00205	0.31	59.53	17.66	91.54

TIA-222- H

FACTORED LOADS

Axial Load 0.9D:	$P_{\_0.9D}$ = 0.9 * Pcomp / 1.2	$P_{\_0.9D}$ =	124.52	kip
Axial Load 1.2D:	$P_{\_1.2D}$ = 1.2 * Pcomp / 1.2	$P_{\_1.2D}$ =	166.02	kip
Shear Load:	V_u = Vu_comp	V_u =	1.43	kip
Moment:	M_u = Mu	M_u =	0.00	kip*ft

PASSIVE PRESSURE RESISTANCE

Force of Pp Applied on Pier:	$Force_{pier}$ = MIN(Vu,Sum(Pp!M2:M7))	$Force_{pier}$ =	1.43	kip
Moment Arm of Pp on Pier:	M_{arm_pier} = D-T-Pp!O2 + T	M_{arm_pier} =	2.43	ft
Force of Pp Applied on Pad:	$Force_{pad}$ = MIN(Vu-Forcepier,SUM(Pp!M8:M13))	$Force_{pad}$ =	0.00	kip
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} =	0.94	ft
Unfactored Moment Resistance due to Passive Pressure:	$M_{R\_Pp} = Force_{pier}*M_{arm\_pier}+Force_{pad}*M_{arm\_pad}$	M_{R_Pp} =	3.48	kip*ft
Factored Moment Resistance due to Passive Pressure:	$\Phi M_{R\_Pp} = \Phi_s*M_{R\_Pp}$	ΦM_{R_Pp} =	2.61	kip*ft

PLASTIC 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	$P_{bearing\_0.9\_e}$ =	141.76	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	$P_{bearing\_1.2\_e}$ =	189.02	kip	
Factored Overturning Moment:	$M_{overturning} = M_u + V_u * (D+E+bp_{dist}/12)$	$M_{overturning}$ =	11.01	kip*ft	
Area of Pad:	Area = W²	Area =	22.09	ft²	
Elastic Section Modulus of Pad:	S = W³ / 6	S =	17.30	ft³	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{0.9\_e} = M_{overturning}/P_{bearing\_0.9}$	$pre\_ec_{0.9\_e}$ =	0.08	ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{1.2\_e} = M_{overturning}/P_{bearing\_1.2}$	$pre\_ec_{1.2\_e}$ =	0.06	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{0.9\_e}$ = *goal seek*	$ec_{0.9\_e}$ =	0.06	ft	e <= L/6
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{1.2\_e}$ = *goal seek*	$ec_{1.2\_e}$ =	0.04	ft	e <= L/6
*Non-Bearing Length (0.9*D LC):*	$NBL_{0.9\_e}$ = 0	$NBL_{0.9\_e}$ =	0.00	ft	
*Non-Bearing Length (1.2*D LC):*	$NBL_{1.2\_e}$ = 0	$NBL_{1.2\_e}$ =	0.00	ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9\_e} = \Phi M_{R\_Pp} + SUM(\Phi M_{R\_wedges\_0.9}, \Phi M_{R\_shear\_0.9})$	$\Phi M_{Resisting\_0.9\_e}$ =	2.61	kip*ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2\_e} = \Phi M_{R\_Pp} + SUM(\Phi M_{R\_wedges\_1.2}, \Phi M_{R\_shear\_1.2})$	$\Phi M_{Resisting\_1.2\_e}$ =	2.61	kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9\_e} = M_{overturning} - \Phi M_{Resisting\_0.9}$	$M_{overturning\_0.9\_e}$ =	8.40	kip*ft	
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2\_e} = M_{overturning} - \Phi M_{Resisting\_1.2}$	$M_{overturning\_1.2\_e}$ =	8.40	kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9\_e} = P_{bearing\_0.9}*ec_{0.9\_p} + \Phi M_{Resisting\_0.9}$	$\Phi M_{Resisting\_qu\_0.9\_e}$ =	11.01	kip*ft	
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2\_e} = P_{bearing\_1.2}*ec_{1.2\_p} + \Phi M_{Resisting\_1.2}$	$\Phi M_{Resisting\_qu\_1.2\_e}$ =	11.01	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):*	$q_{u\_orth\_0.9\_e}$ = Pbearing_0.9_e/Area + Moverturning_0.9/S	$q_{u\_orth\_0.9\_e}$ =	6.90	ksf
*Orthogonal Bearing Pressure (1.2*D LC):*	$q_{u\_orth\_1.2\_e}$ = Pbearing_1.2_e/Area + Moverturning_1.2/S	$q_{u\_orth\_1.2\_e}$ =	9.04	ksf
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} =	16.00	ksf
Factored Ultimate Gross Bearing Pressure:	Qa = φs * Qult	Qa =	9.60	ksf

Check **Qa =** 9.60 ksf **>=** q_u = 9.04 ksf **RATING:** 94.19% **OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht =	4.20	ft
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw =	0.00	ft
Soil Wedge Projection at Grade:	$Wedge_{proj}$ = TAN(ϕ*PI()/180)*soilht	$Wedge_{proj}$ =	2.42	ft
Soil Wedge Projection at Water Table:	$Wedge_{proj\_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw)	$Wedge_{proj\_gw}$ =	0.00	ft

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

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)

(2) End Prisms (above Water Table)	0.00	0.00	4.70	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	4.70	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	4.70	0.00
(1) Rear (above Water Table)	0.00	0.00	5.51	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	4.70	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	4.70	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	4.70	0.00
(1) Rear (above Water Table)	0.00	0.00	5.51	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 (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)
Rear	0.00	0.00	4.70	0.00
(2) Partial Sides	0.00	0.00	4.70	0.00
Total		0.00		0.00

Eccentricity relative to W/2:

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

*Unfactored Resisting Moment of Soil Shear (0.9*D LC):* $M_{R\_shear\_0.9\_e}$ = 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)
Rear	0.00	0.00	4.70	0.00
(2) Partial Sides	0.00	0.00	4.70	0.00
Total		0.00		0.00

Eccentricity relative to W/2:

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

*Unfactored Resisting Moment of Soil Shear (1.2*D LC):* $M_{R\_shear\_1.2\_e}$ = 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 → $P_{\_100\_e}$ = 141.76 kip

Preliminary Factored Overturning Moment: $pre\_M_{overturning\_100\_e}$ = (ΦQult - P_100_e/Area) * S → $pre\_M_{overturning\_100\_e}$ = 55.07 kip*ft

*Preliminary Load Eccentricity (0.9*D LC):* $pre\_ec_{\_100\_e}$ = $pre\_M_{overturning\_100}$ / $P_{\_100}$ → $pre\_ec_{\_100\_e}$ = 0.39 ft

*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):* $ec_{\_100\_e}$ = *goal seek* → $ec_{\_100\_e}$ = 0.37 ft e <= L/6

*Non-Bearing Length (0.9*D LC):* $NBL_{\_100\_e}$ = 0 → $NBL_{\_100\_e}$ = 0.00 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($\Phi M_{R\_wedges\_100}$,$\Phi M_{R\_shear\_100}$) → $\Phi M_{Resisting\_100\_e}$ = 2.61 kip*ft

Moment Created by Shear: M_{shear_e} = V_u * (D+E+bp_{dist}/12) → M_{shear_e} = 11.01 kip*ft

*Adjusted Overturning Moment (0.9*D LC):* $M_{overturning\_100\_e}$ = $M_{u\_max\_100}$ - ΦM_{R_Pp} → $M_{overturning\_100\_e}$ = 55.07 kip*ft

*Total Resistance to Overturning (0.9*D LC):* $\Phi M_{Resisting\_qu\_100\_e}$ = $P_{\_100}$*$ec_{\_100}$ + $\Phi M_{Resisting\_100}$ → $\Phi M_{Resisting\_qu\_100\_e}$ = 55.07 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 → $M_{u\_max\_100\_e}$ = 57.68 kip*ft

Check **Mu_max_100_e =** **57.68** **kip*ft** **>=** **Mu =** **11.01** **kip*ft** **RATING:** **19.09%** **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	4.70	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	4.70	0.00

(2) Partial Sides (below Water Table)	0.00	0.00	4.70	0.00	Eccentricity relative to W/2:	
(1) Rear (above Water Table)	0.00	0.00	5.51	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	4.70	0.00	Total Moment Arm (ft) =	0.00
(2) Partial Sides	0.00	0.00	4.70	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)) → $Force_{pier}$ = 1.43 kip

Moment Arm of Pp on Pier: M_{arm_pier} = D-T-Pp!O2 + T → M_{arm_pier} = 2.43 ft

Force of Pp Applied on Pad: $Force_{pad\_dia}$ = MIN(Vu-$Force_{pier}$,SUM(Pp!M8:M13))*(T*W*SQRT(2))/(T*W)) → $Force_{pad\_dia}$ = 0.00 kip

Moment Arm of Pp on Pad: M_{arm_pad} = D-Pp!O8 → M_{arm_pad} = 0.94 ft

Unfactored Moment Resistance due to Passive Pressure: M_{R_Pp} = $Force_{pier}$*M_{arm_pier}+$Force_{pad}$*M_{arm_pad} → M_{R_Pp} = 3.48 kip*ft

Factored Moment Resistance due to Passive Pressure: $\Phi M_{R\_Pp\_dia}$ = Φ_s*M_{R_Pp} → $\Phi M_{R\_Pp\_dia}$ = 2.61 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 → $P_{bearing\_0.9\_dia\_e}$ = 141.76 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 → $P_{bearing\_1.2\_dia\_e}$ = 189.02 kip

Factored Overturning Moment: $M_{overturning}$ = M_u + V_u * (D+E+bp_{dist}/12) → $M_{overturning}$ = 11.01 kip*ft

Area of Pad: Area = W² → Area = 22.09 ft²

*Preliminary Load Eccentricity (0.9*D LC):* $pre\_ec_{0.9\_e\_dia}$ = $M_{overturning}$/$P_{bearing\_0.9\_dia\_e}$ → $pre\_ec_{0.9\_e\_dia}$ = 0.08 ft

*Preliminary Load Eccentricity (1.2*D LC):* $pre\_ec_{1.2\_e\_dia}$ = $M_{overturning}$/$P_{bearing\_1.2\_dia\_e}$ → $pre\_ec_{1.2\_e\_dia}$ = 0.06 ft

*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):* $ec_{0.9\_e\_dia}$ = *goal seek* → $ec_{0.9\_e\_dia}$ = 0.06 ft e <= (L/6)*S

*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):* $ec_{1.2\_e\_dia}$ = *goal seek* → $ec_{1.2\_e\_dia}$ = 0.04 ft e <= (L/6)*S

S_{dia} = (W³)/(6*SQRT(2)) → S_{dia} = 12.24 ft³

*Non-Bearing Length (0.9*D LC):* $NBL_{0.9\_dia\_e}$ = 0 → $NBL_{0.9\_dia\_e}$ = 0.00 ft

*Non-Bearing Length (1.2*D LC):* $NBL_{1.2\_dia\_e}$ = 0 → $NBL_{1.2\_dia\_e}$ = 0.00 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):* $\Phi M_{Resisting\_0.9\_dia\_e}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_0.9\_dia\_e}$,$\Phi M_{R\_shear\_0.9\_dia\_e}$) → $\Phi M_{Resisting\_0.9\_dia\_e}$ = 2.61 kip*ft

*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):* $\Phi M_{Resisting\_1.2\_dia\_e}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_1.2\_dia\_e}$),$\Phi M_{R\_shear\_1.2\_dia\_e}$) → $\Phi M_{Resisting\_1.2\_dia\_e}$ = 2.61 kip*ft

*Adjusted Overturning Moment (0.9*D LC):* $M_{overturning\_0.9\_dia\_e}$ = $M_{overturning}$ - $\Phi M_{Resisting\_0.9\_dia\_e}$ → $M_{overturning\_0.9\_dia\_e}$ = 8.40 kip*ft

*Adjusted Overturning Moment (1.2*D LC):* $M_{overturning\_1.2\_dia\_e}$ = $M_{overturning}$ - $\Phi M_{Resisting\_1.2\_dia\_e}$ → $M_{overturning\_1.2\_dia\_e}$ = 8.40 kip*ft

*Total Resistance to Overturning (0.9*D LC):* $\Phi M_{Resisting\_qu\_0.9\_dia\_e}$ = $P_{bearing\_0.9\_dia\_e}$*$ec_{0.9\_e\_dia}$ + $\Phi M_{Resisting\_0.9\_dia\_e}$ → $\Phi M_{Resisting\_qu\_0.9\_dia\_e}$ = 11.01 kip*ft

*Total Resistance to Overturning (1.2*D LC):* $\Phi M_{Resisting\_qu\_1.2\_dia\_e}$ = $P_{bearing\_1.2\_dia\_e}$*$ec_{1.2\_e\_dia}$ + $\Phi M_{Resisting\_1.2\_dia\_e}$ → $\Phi M_{Resisting\_qu\_1.2\_dia\_e}$ = 11.01 kip*ft

[Goal Seek] Moment Comparison Iteration (0.9D LC): $\Delta M_{0.9\_dia\_e}$ = $M_{overturning}$-$\Phi M_{Resisting\_qu\_0.9\_dia\_e}$ → $\Delta M_{0.9\_dia\_e}$ = 0.00 kip*ft

[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{1.2\_dia\_e} = M_{overturning} - \Phi M_{Resisting\_qu\_1.2\_dia\_e}$		$\Delta M_{1.2\_dia\_e}$ =	0.00	kip*ft	

Bearing Pressures

*Diagonal Bearing Pressure (0.9*D LC):*	$q_{u\_dia\_0.9\_e}$ = Pbearing_0.9_dia_e/Area + Moverturning_0.9_dia_e/S_dia	$q_{u\_dia\_0.9\_e}$ =	7.10	ksf	
*Diagonal Bearing Pressure (1.2*D LC):*	$q_{u\_dia\_1.2\_e}$ = Pbearing_1.2_dia_e/Area + Moverturning_1.2_dia_e/S_dia	$q_{u\_dia\_1.2\_e}$ =	9.24	ksf	
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} =	16.00	ksf	
Factored Ultimate Gross Bearing Pressure:	ΦQult = φs * Qult	Qa =	9.60	ksf	

Check	**ΦQult =**	**9.60**	**ksf**	**>=**	**q_u =**	**9.24**	**ksf**	**RATING:**	**96.29%**	**OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht =	4.20	ft	
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw =	0.00	ft	
Soil Wedge Projection at Grade:	$Wedge_{proj}$ = TAN(ϕ*PI()/180)*soilht	$Wedge_{proj}$ =	2.42	ft	
Soil Wedge Projection at Water Table:	$Wedge_{proj\_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw)	$Wedge_{proj\_gw}$ =	0.00	ft	

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

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	0.00	0.00	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):*	$\Phi M_{R\_wedges\_0.9}$ = 0.75*MR_wedges_0.9_dia_e	$\Phi M_{R\_wedges\_0.9\_dia\_e}$ =	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):*	$\Phi M_{R\_wedges\_1.2}$ = 0.75*MR_wedges_1.2_dia_e	$\Phi M_{R\_wedges\_1.2\_dia\_e}$ =	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	6.65	0.00
(2) Partial Sides	0.00	0.00	3.32	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):*	$\Phi M_{R\_shear\_0.9}$ = 0.75 * (Total Moment Arm * Soil Shear Strength)	$\Phi M_{R\_shear\_0.9\_dia\_e}$ =	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	6.65	0.00
(2) Partial Sides	0.00	0.00	3.32	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	$P_{100\_dia\_e}$ =	141.76	kip

Preliminary Factored Overturning Moment:	$pre\_M_{overturning\_100\_dia\_e}$ = (ΦQult-P_100_dia_e/Area)*S_dia	$pre\_M_{overturning\_100\_dia\_e}$ =	38.94	kip*ft
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{100\_dia\_e}$ = $pre\_M_{overturning\_100\_dia\_e}/P_{\_100\_dia\_e}$	$pre\_ec_{100\_dia\_e}$ =	0.27	ft
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{100\_dia\_e}$ = *goal seek*	$ec_{100\_dia\_e}$ =	0.26	ft

*Non-Bearing Length (0.9*D LC):*	$NBL_{100\_dia\_e}$ = 0	$NBL_{100\_dia\_e}$ =	0.00	ft
*Non-Bearing Length (0.9*D LC):*	$NBL_{100\_dia\_e\_2}$ = 0	$NBL_{100\_dia\_e\_2}$ =	0.00	ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$ΦM_{Resisting\_100\_dia\_e}$ = $ΦM_{R\_Pp\_dia}$ + SUM($ΦM_{R\_wedges\_100\_dia}$,$ΦM_{R\_shear\_100\_dia}$)	$ΦM_{Resisting\_100\_dia\_e}$ =	2.61	kip*ft
Moment Created by Shear:	M_{shear_e} = V_u * (D+E+bp_{dist}/12)	M_{shear_e} =	11.01	kip*ft
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_100\_dia\_e}$ = $M_{u\_max\_100\_dia}$ - $ΦM_{R\_Pp\_dia}$	$M_{overturning\_100\_dia\_e}$ =	38.94	kip*ft
*Total Resistance to Overturning (0.9*D LC):*	$ΦM_{Resisting\_qu\_100\_dia\_e}$ = $P_{\_100\_dia\_e}$*$ec_{100\_dia\_e}$ + $ΦM_{Resisting\_100\_dia\_e}$	$ΦM_{Resisting\_qu\_100\_dia\_e}$ =	38.94	kip*ft
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$ΔM_{\_100\_dia\_e}$ = $M_{overturning}$ - $ΦM_{Resisting\_qu\_100\_dia}$	$ΔM_{\_100\_dia\_e}$ =	0.00	kip*ft
Maximum Applied Moment from Superstructure Analysis:	$M_{u\_max\_100\_dia\_e}$ = pre_Moverturning_100_dia + ΦMResisting_100_dia	$M_{u\_max\_100\_dia\_e}$ =	41.55	kip*ft

Check **Mu_max_100_dia_e =** **41.55** **kip*ft** **>=** **Mu =** **11.01** **kip*ft** **RATING:** **26.50%** **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):*	$ΦM_{R\_wedges\_100\_dia\_e}$ = 0.75*MR_wedges_100_dia_e	$ΦM_{R\_wedges\_100\_dia\_e}$ =	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	6.65	0.00
(2) Partial Sides	0.00	0.00	3.32	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):*	$ΦM_{R\_shear\_100\_dia\_e}$ = 0.75 * (Total Moment Arm * Soil Shear Strength)	$ΦM_{R\_shear\_100\_dia\_e}$ =	0.00	kip*ft

ATTACHMENT D – PROOF OF DELIVERY OF NOTICE

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

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 22MAY20
ACTWGT: 1.45 LB
CAD: 0765627/CAFE3311

BILL THIRD PARTY

TO **FIRST SELECTWOMAN PEGGY LYONS**
TOWN OF MADISON
8 CAMPUS DRIVE

MADISON CT 06443

REF: MADISON-BLACK&VEATCH

DEPT: BL GRAPHICS

565C3/2925/0562

FedEx Express

J191219082001av

TRK# 0201 **1714 2090 3848**

TUE - 26 MAY 10:30A
PRIORITY OVERNIGHT

00 RSPA

06443
CT-US **BDL**

Align bottom of peel-and-stick airbill or pouch here.

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

MERIDEN, CT 06450
UNITED STATES US

SHIP DATE: 22MAY20
ACTWGT: 1.45 LB MAN
CAD: 0765627/CAFE3311

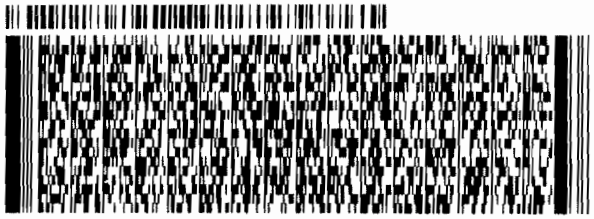
BILL THIRD PARTY

TO **DAVID ANDERSON TOWN PLANNER**
TOWN OF MADISON
8 CAMPUS DRIVE

MADISON CT 06443

REF: MADISON-BLACK&VEATCH

DEPT: BL GRAPHICS



FedEx Express

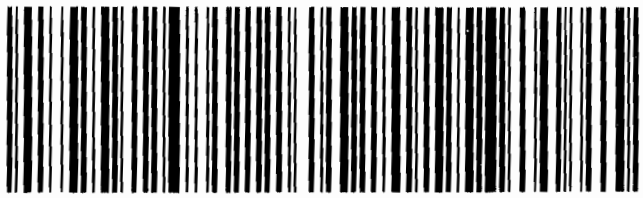
J191219082001 AM

TRK# 0201 **1714 2090 3859**

TUE - 26 MAY 10:30A
PRIORITY OVERNIGHT

00 RSPA

06443
CT-US **BDL**



Align bottom of peel-and-stick airbill or pouch here.

ATTACHMENT E - POWER DENSITY REPORT

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

Calculated Radio Frequency Emissions Report

EVERSOURCE ENERGY

ES-008

135 New Road

Madison, CT 06443

April 2, 2020

Table of Contents

List of Tables

List of Figures

1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed Eversource installation to be located at 135 New Road in Madison, CT.

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

This report considers the proposed antenna configuration as detailed by Eversource along with power density information for the known existing antennas and field measurements of % MPE (Maximum Permissible Exposure) documented in the CT Siting Council's database to determine 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 antenna has a relatively narrow vertical beamwidth of 30°; therefore, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the facility. 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. Please refer to Attachment C, for the vertical pattern of the proposed Eversource antenna. Any inactive or receive-only antennas are not included in the table since they are irrelevant in terms of the % MPE calculations.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	% MPE	
AT&T	78.5	1900	2	500	0.0068	1.0000	0.68%	
AT&T	78.5	880	1	500	0.0034	0.5867	0.58%	
AT&T	78.5	1900	1	427	0.0029	1.0000	0.29%	2.94%
AT&T	78.5	880	2	296	0.0041	0.5867	0.69%	
AT&T	78.5	740	1	500	0.0034	0.4933	0.69%	
T-Mobile	160.5	2100	2	2335	0.0070	1.0000	0.70%	
T-Mobile	160.5	1900	4	1167	0.0070	1.0000	0.70%	1.69%
T-Mobile	160.5	700	1	865	0.0013	0.4667	0.28%	
Sprint	127.5	1900	2	693	0.0034	1.0000	0.34%	0.51%
Sprint	127.5	850	1	390	0.0010	0.5667	0.17%	
Verizon	95	1970	7	447	0.0142	1.0000	1.42%	
Verizon	95	869	9	416	0.0170	0.5793	2.94%	6.61%
Verizon	95	2145	1	2812	0.0128	1.0000	1.28%	
Verizon	95	746	1	1067	0.0048	0.4973	0.97%	
Eversource	190.5	936	1	240	0.0003	0.6240	0.04%	
Eversource	190.5	451.475	1	251	0.0003	0.3010	0.09%	
Eversource	187.5	49.36	1	100	0.0001	0.2000	0.05%	1.06%
Eversource	176.5	6695	1	871	0.0000	1.0000	0.00%	
Eversource	148.5	154.46375	1	990	0.0018	0.2000	0.88%	
Eversource	183	217	4	124	0.0006	0.2000	0.29%	
						Total	**13.09%**	

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

The latest Siting Council power density database (12/13.2019) includes many "Unidentified" operators with a cumulative power density measurement of 13.37%, which was recorded on 4/13/2011 as part of AT&T's application to the Council for its installation. In reviewing the structural analysis report along with Eversource's latest antenna inventory, it is understood that all antennas, apart from AT&T, T-Mobile, Sprint, and Verizon (not currently installed), are operated by Eversource and have been accounted for in the table above.

If we are to assume the April 2011 measurement is in addition to the cumulative % MPE calculated above for an even more conservative review, the total % MPE would be 26.46% and remain below the FCC MPE limit. These % MPE totals also include Verizon, which is not currently installed as per the structural analysis report.

[1] Antenna heights listed (except for Verizon) are based upon the Black & Veatch Structural Analysis Report dated March 4, 2020. The Verizon antennas are not installed per the structural analysis but have been left in table based upon their CSC power density record.

[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 **13.09% of the FCC General Population/Uncontrolled limit**.

If assuming the % MPE measurement from April 2011 does not include any contributions from the antennas listed for an even more conservative review, the composite (measured + calculated) power density would be **26.46% of the FCC General Population/Uncontrolled limit**.

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

6. Statement of Certification

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

	Sokol Andoni	April 2, 2020
Report Prepared By:	Sokol Andoni Associate RF Engineer C Squared Systems, LLC	Date
	Keith Vellante	April 2, 2020
Reviewed/Approved 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

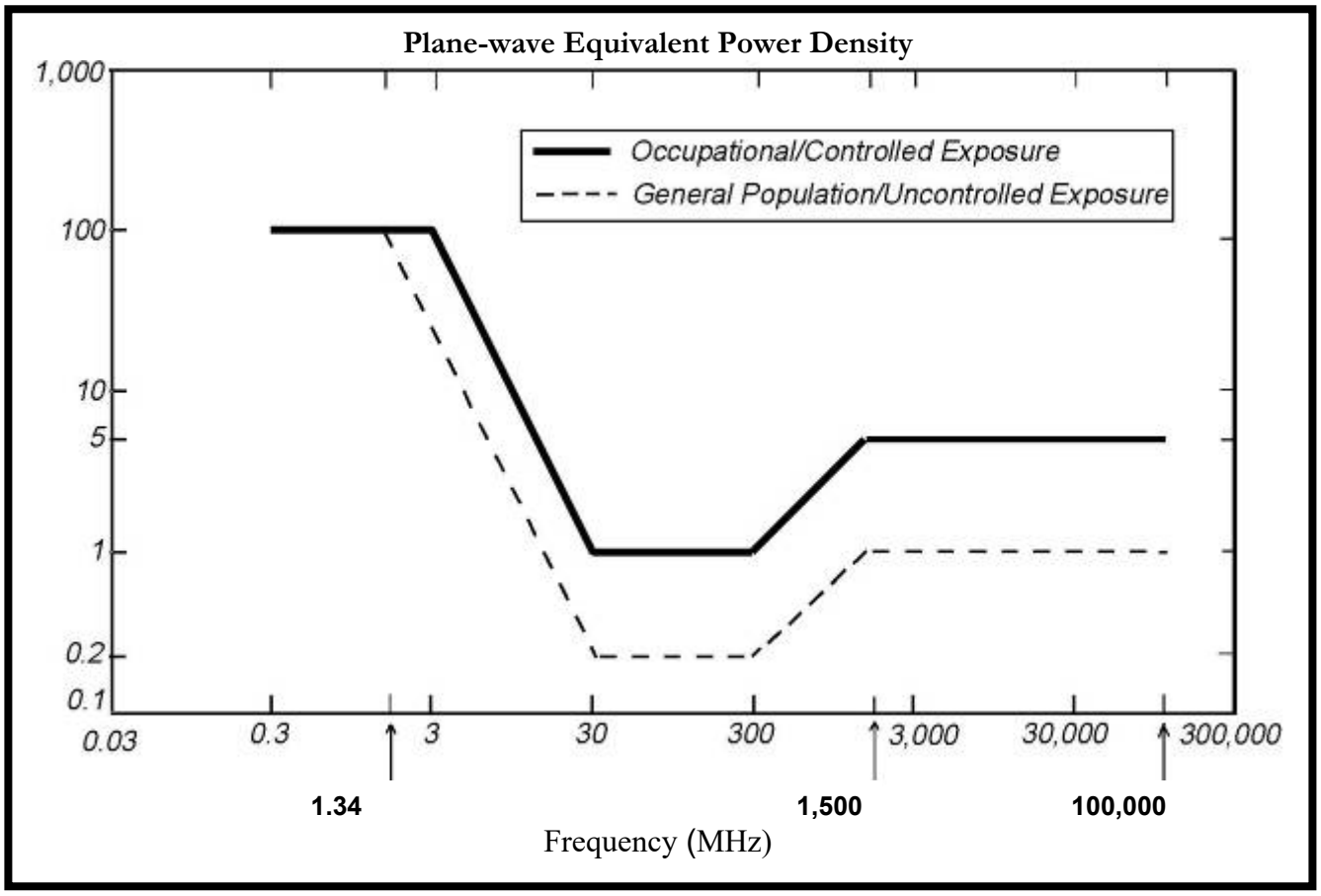


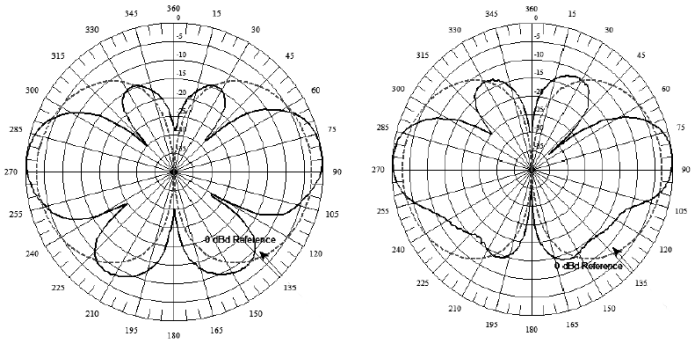
Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: Eversource Antenna Data Sheet and Electrical Patterns

217 MHz

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

DS2C03F36D-N
DS2C03F36D-D



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