EVERSOURCE ENERGY

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

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

September 9, 2020

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

RE: **Notice of Exempt Modification**
Eversource Site # 1900
705 West Johnson Avenue, Cheshire, CT 06410
Latitude: 41-33-21.1 N / Longitude: 72-55-1.9 W

Dear Ms. Bachman:

The Connecticut Light and Power Company doing business as Eversource Energy ("Eversource") currently maintains 2 antennas at various mounting heights on an existing 140-foot self-support tower located at 705 West Johnson Avenue in Cheshire. 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 137 feet above ground level ("AGL") and two 7/8-inch diameter coaxial cables. Eversource also plans to install one new 1,000-gallon propane tank and one new 24 kW generator, both on new concrete pads. There will be no changes to the area of the fenced compound, the tower, or the existing antennas and equipment. The tower and existing and proposed equipment on the tower are depicted on Attachment B, Construction Drawings, dated May 13, 2020 and Attachment C, Structural Analysis, dated March 26, 2020. The Connecticut Siting Council approved the extension of the tower at this location in Petition No. 827 in September 2007.

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 Rob Oris, Jr., Town Council Chairman for the Town of Cheshire, Sean M. Kimball, Town Manager for the Town of Cheshire and William S. Voelker, AICP, Town Planner for the Town of Cheshire, via 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; an existing-omni-directional antenna extends to 12’ above the top of the tower; the proposed omni-directional (whip) antenna will extend 22’ above the top 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 7, 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.; and,
6. The existing structure and its foundation can support the proposed loading.

For the foregoing reasons, Eversource respectfully submits that the proposed modifications to the above referenced telecommunications facility constitute an exempt modification under R.C.S.A. § 16-50j-72(b)(2). One original copy of this notice is 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 Rob Oris, Jr., Town Council Chairman, Town of Cheshire
Sean M. Kimball, Town Manager, Town of Cheshire
William S. Voelker, AICP, Town Planner, Town of Cheshire

Attachments

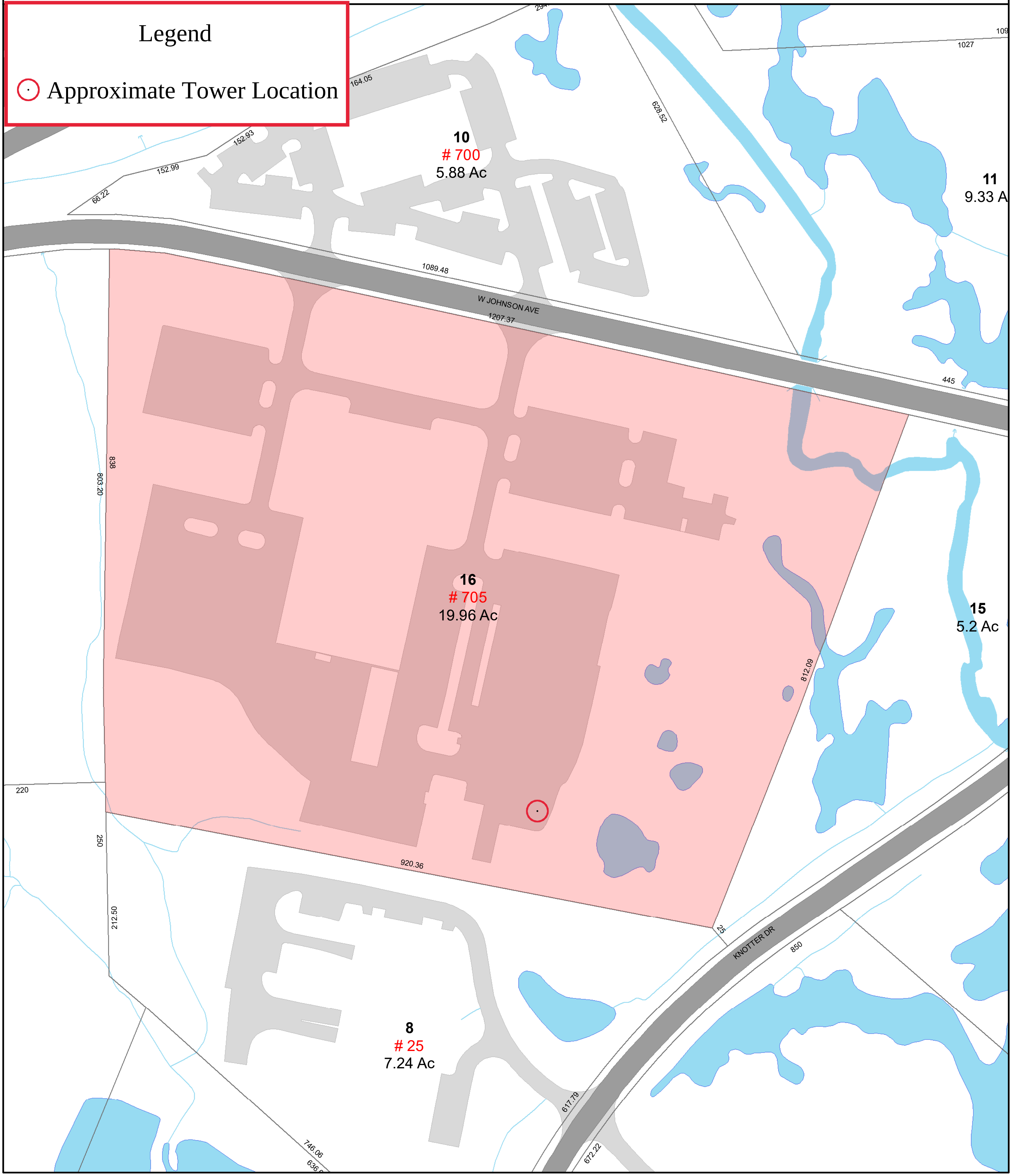
A. Parcel Map and Property Card
B. Construction Drawings
C. Structural Analysis
D. Proof of Delivery of Notice
E. Power Density Report

[1] Please note that the Power Density Report denotes each channel as a transmitter. The depiction of antennas in the Structural Analysis and Construction Drawings accurately reflects the number of antennas. Also, the “Antenna Height” column on Table 1 in the Power Density Report reflects the Transmit or “TX” antenna centerline.

ATTACHMENT A – PARCEL MAP AND PROPERTY CARD

Town of Cheshire, Connecticut - Assessment Parcel Map

Parcel: 00001900 **Location:** 705 W JOHNSON AVE



Approximate Scale: 1 inch = 182 feet

0 90 180 270 360

Feet

Map Produced: April 2019

Disclaimer: This map is for informational purposes only All information is subject to verification by any user. The Town of Cheshire and its mapping contractors assume no legal responsibility for the information contained herein.

Town of Cheshire, CT

Property Listing Report

Map Block Lot	2-16	Building #	1	Unique Identifier	00001900

Property Information

Property Location	705 W JOHNSON AVE	Owner	CONN LIGHT & POWER CO
Mailing Address	P O BOX 270 HARTFORD CT 06141	Co-Owner	
		Book / Page	2227/0294
Land Use	Office Building	Land Class	Commercial
Zoning Code	I-2	Census Tract	3432
Neighborhood	I-3C	Acreage	19.96

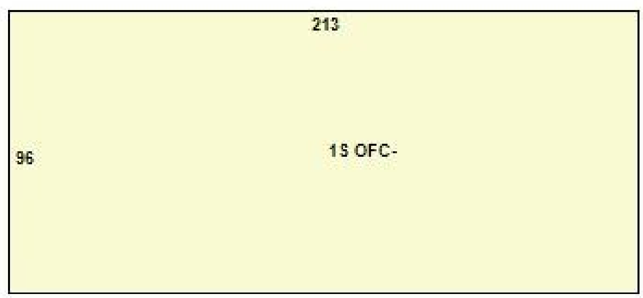
Valuation Summary

(Assessed value = 70% of Appraised Value)

Item	Appraised	Assessed
Buildings	2503627	1752540
Outbuildings	133450	93420
Land	646393	452470
Total	3283470	2298430

Utility Information

Electric	No
Gas	No
Sewer	No
Public Water	No
Well	No



Primary Construction Details

Year Built	1978	Heating Fuel	Heat Pump	Building Use	Office Building
Building Desc.	Commercial	Heating Type	FHA	Building Condition	Good
Building Style		AC Type	Central	Frame Type	Average/Low
Stories	1.00	Bedrooms	0	Fireplaces	0
Exterior Walls	Glass	Full Bathrooms	0	Bsmt Gar	0
Exterior Walls 2	B. V. Solid	Half Bathrooms	0	Fin Bsmt Area	
Interior Walls	Drywall	Extra Fixtures	0	Fin Bsmt Quality	
Interior Walls 2		Total Rooms	0	Building Grade	-30
Interior Floors 1	Carpet	Bath Style	NA	Roof Style	Flat
Interior Floors 2		Kitchen Style		Roof Cover	Composite Built Up
		Occupancy	0	Report Created On	2/27/2020

Town of Cheshire, CT

Property Listing Report | Map Block Lot 2-16 | Building # 1 | Unique Identifier 00001900

Detached Outbuildings

Type	Description	Area (sq ft)	Condition	Year Built
Paving	Paving	132780	Average	1978
Fencing	Fencing	1600	Average	1978
Canopy	Metal	5320	Average	1978
Fencing	Fencing	7200	Average	1978
Fencing	Fencing	7200	Average	1978
Shed	Metal	414	Average	2018

Attached Extra Features

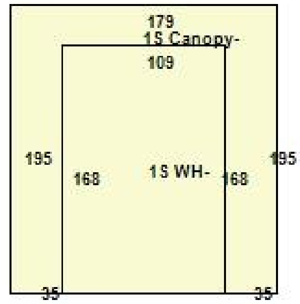
Type	Description	Area (sq ft)	Condition	Year Built

Sales History

Owner of Record	Book/ Page	Sale Date	Sale Price
CONN LIGHT & POWER CO	2227_0294	1/19/2016	0
CONNECTICUT LIGHT AND POWER COMPANY THE	2227_ 294	7/21/2008	790220
INTERET REALTY CORP	321_ 173	12:00:00 AM	0

Town of Cheshire, CT

Property Listing Report | Map Block Lot 2-16 | Building # 2 | Unique Identifier 00001900



Primary Construction Details

Year Built	1978
Building Desc.	Warehouse
Building Style	
Stories	1.00
Exterior Walls	Concrete Block
Exterior Walls 2	
Interior Walls	Other
Interior Walls 2	
Interior Floors 1	Concrete
Interior Floors 2	

Heating Fuel	
Heating Type	Electric Baseboard
AC Type	
Bedrooms	0
Full Bathrooms	0
Half Bathrooms	0
Extra Fixtures	0
Total Rooms	0
Bath Style	NA
Kitchen Style	
Occupancy	0

Building Use	Commercial
Building Condition	Average
Frame Type	Average
Fireplaces	0
Bsmt Gar	0
Fin Bsmt Area	
Fin Bsmt Quality	
Building Grade	-10
Roof Style	
Roof Cover	

Attached Extra Features

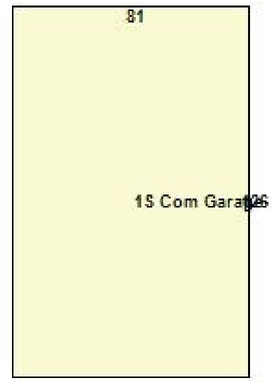
Type	Description	Area (sq ft)	Condition	Year Built
Canopy	Canopy	16593	Average	1978

Report Created On 2/27/2020

Town of Cheshire, CT

Property Listing Report

Map Block Lot	2-16	Building #	3	Unique Identifier	00001900



Primary Construction Details

Year Built	1978
Building Desc.	Commercial Garage
Building Style	
Stories	0.00
Exterior Walls	
Exterior Walls 2	
Interior Walls	
Interior Walls 2	
Interior Floors 1	
Interior Floors 2	

Heating Fuel	
Heating Type	
AC Type	
Bedrooms	0
Full Bathrooms	0
Half Bathrooms	0
Extra Fixtures	0
Total Rooms	0
Bath Style	NA
Kitchen Style	
Occupancy	0

Building Use	Commercial
Building Condition	Average
Frame Type	Average
Fireplaces	0
Bsmt Gar	0
Fin Bsmt Area	
Fin Bsmt Quality	
Building Grade	0
Roof Style	
Roof Cover	

Attached Extra Features

Type	Description	Area (sq ft)	Condition	Year Built

ATTACHMENT B – CONSTRUCTION DRAWINGS

EVERSOURCE ENERGY

CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

PROJECT SUMMARY

THE GENERAL SCOPE OF WORK CONSISTS OF THE FOLLOWING:

1. INSTALL (1) NEW RACK WITH DMR EQUIPMENT IN EXISTING RADIO SHELTER
2. INSTALL NEW GENERATOR AT ELEVATION 0'–0"± AGL
3. INSTALL NEW PROPANE TANK AT ELEVATION 0'–0"± AGL
4. INSTALL (1) NEW OMNI/WHIP ANTENNA AT ELEVATION 162'–0"± AGL

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:	CHESHIRE AWC
SITE ID NUMBER:	#00001900
SITE ADDRESS:	705 WEST JOHNSON AVE CHESHIRE, CT 06410
MAP:	2
BLOCK:	16
LOT:	173230
ZONE:	I–2
LATITUDE:	41° 33' 21.1" N
LONGITUDE:	72° 55' 1.9" W
ELEVATION:	132'± AMSL
FEMA/FIRM DESIGNATION:	X
ACREAGE:	19.96± AC (BOOK: 2227, PAGE: 0294)

CONTACT INFORMATION

APPLICANTS:
EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037

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

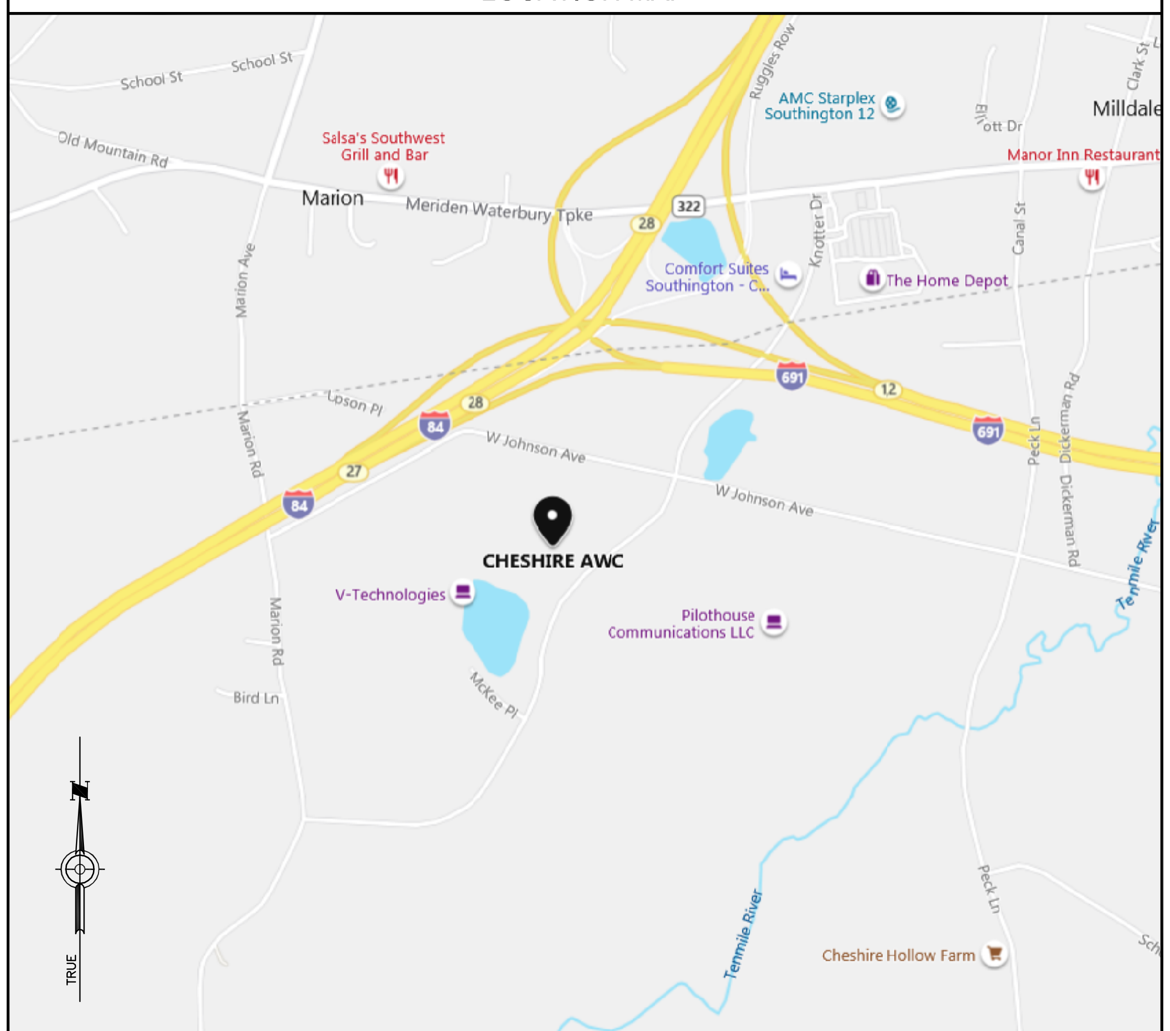
EVERSOURCE ENERGY PROJECT MANAGER:
NIKOLL PRECI
(860) 655–3079

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
S–1	GENERATOR & PROPANE TANK CONCRETE PAD DETAILS
M–1	GENERATOR & PROPANE TANK EQUIPMENT DETAILS
M–2	GENERATOR & PROPANE TANK EQUIPMENT DETAILS
E–1	UTILITY PLAN & DETAILS
G–1	GROUNDING PLAN
G–2	GROUNDING DETAILS
G–3	GROUNDING DETAILS
G–4	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	05/13/20	ISSUED FOR FILING

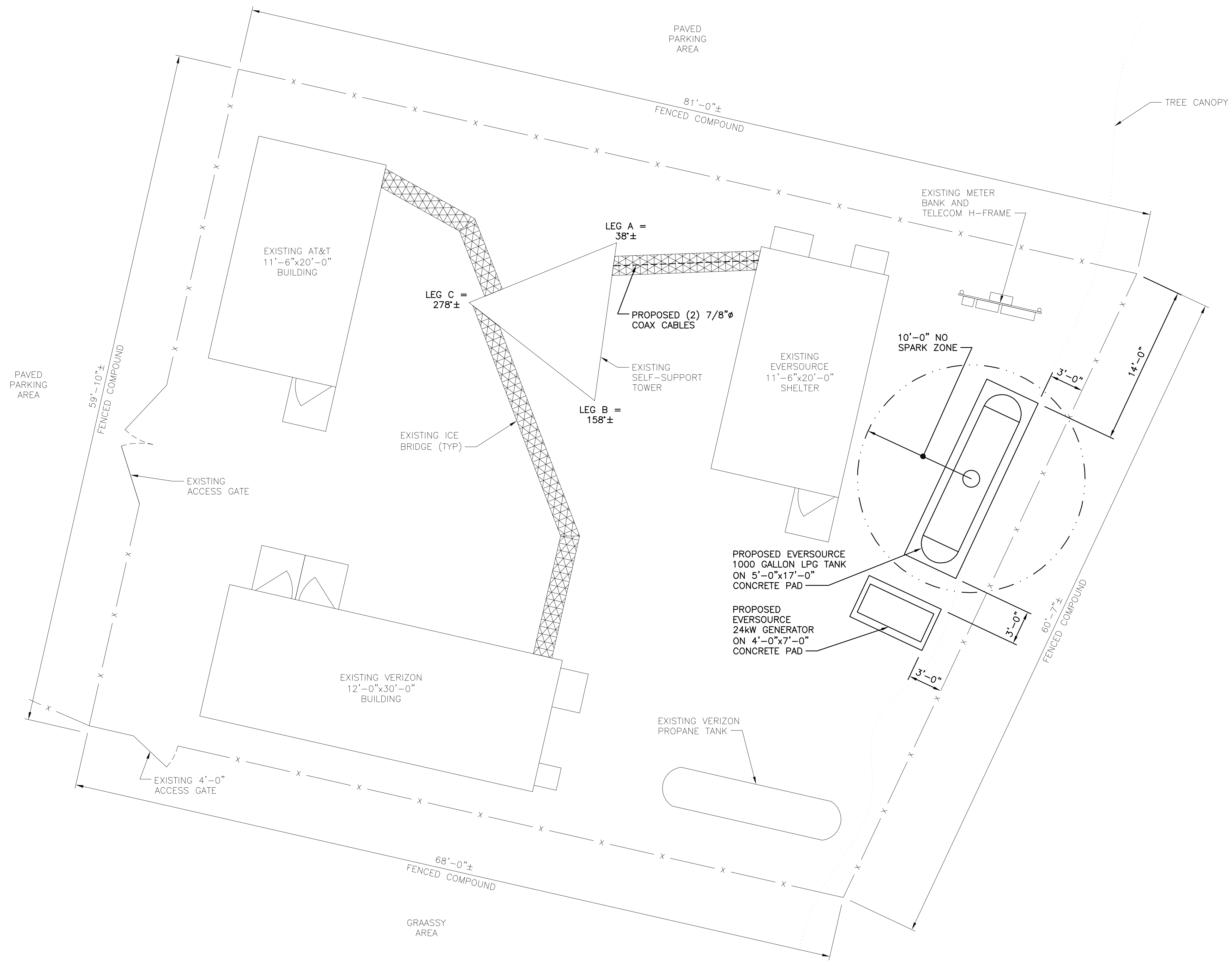
STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED PROFESSIONAL ENGINEER
05/13/2020

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

CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE
TITLE SHEET

SHEET NUMBER
T-1



SITE PLAN
NO SCALE

EVERSOURCE
ENERGY

107 SELDEN STREET
BERLIN, CT 06037
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BLACK & VEATCH

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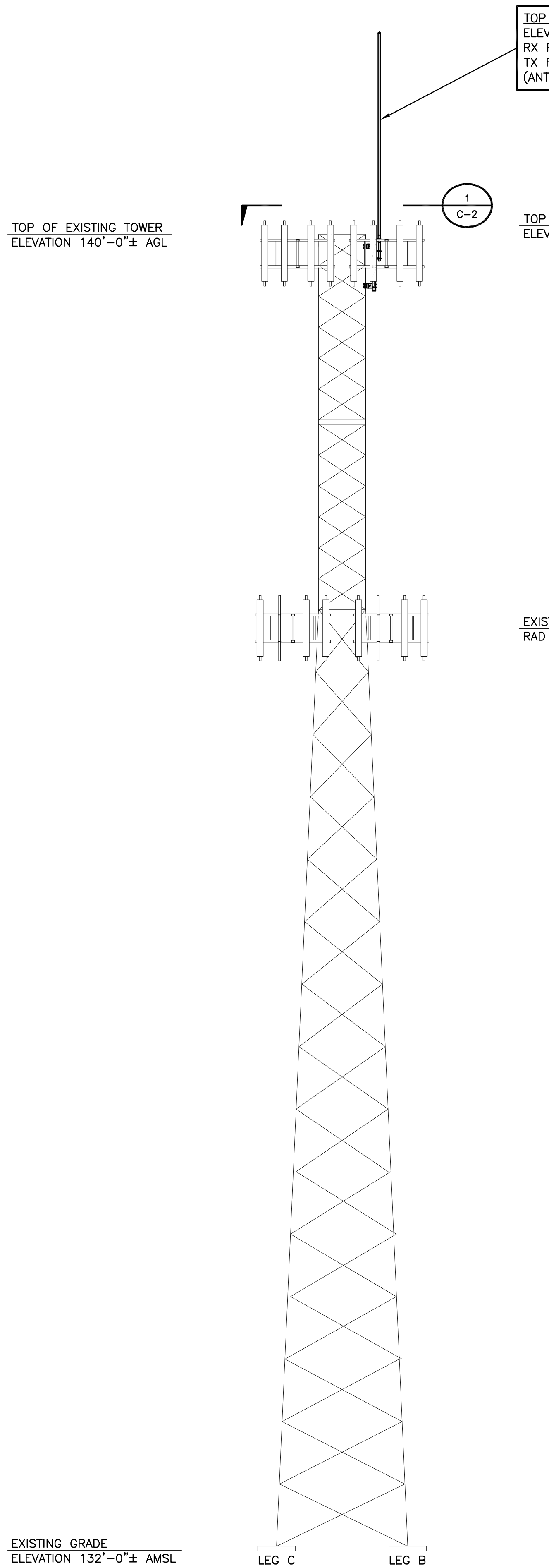
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

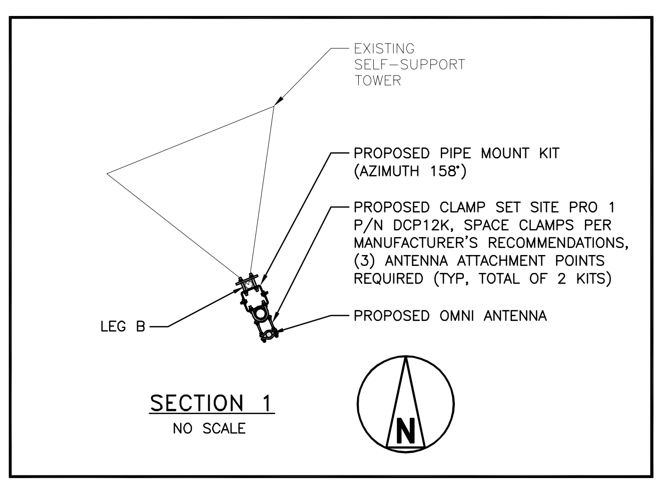
SHEET TITLE
SITE PLAN

SHEET NUMBER
C-1



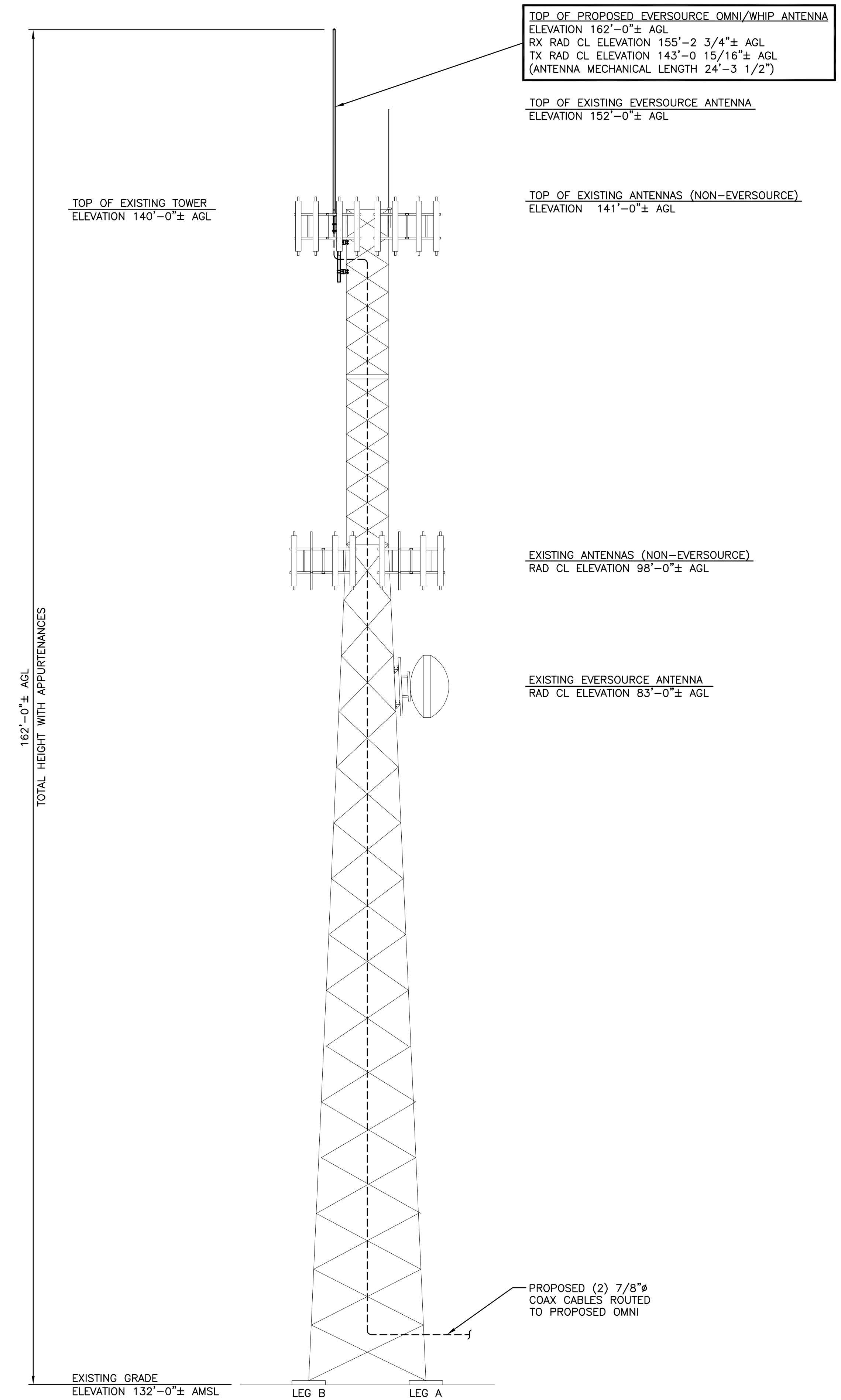
TOWER ELEVATION FACE CB

NO SCALE



SECTION 1

NO SCALE



TOWER ELEVATION FACE BA

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

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CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE

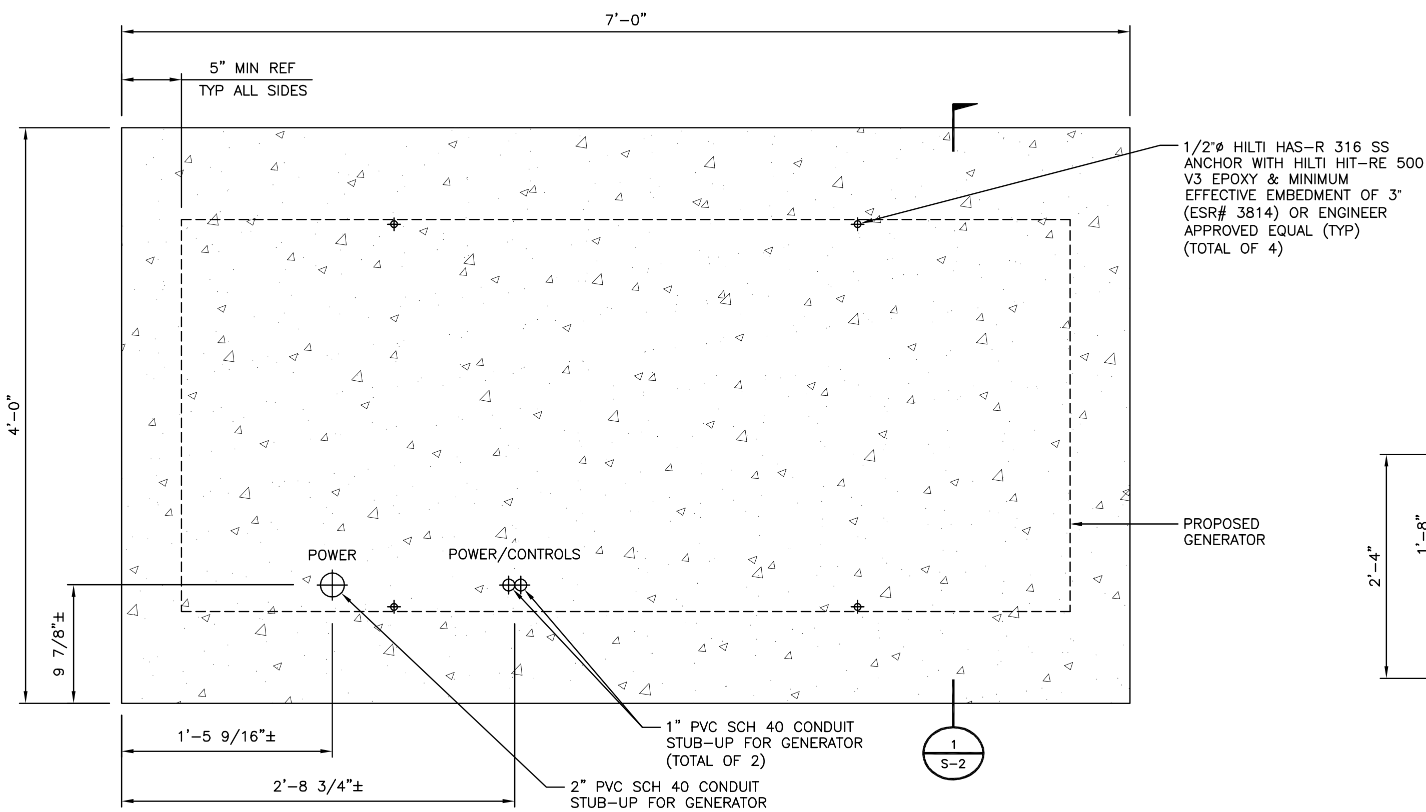
TOWER ELEVATION

SHEET NUMBER

C-2

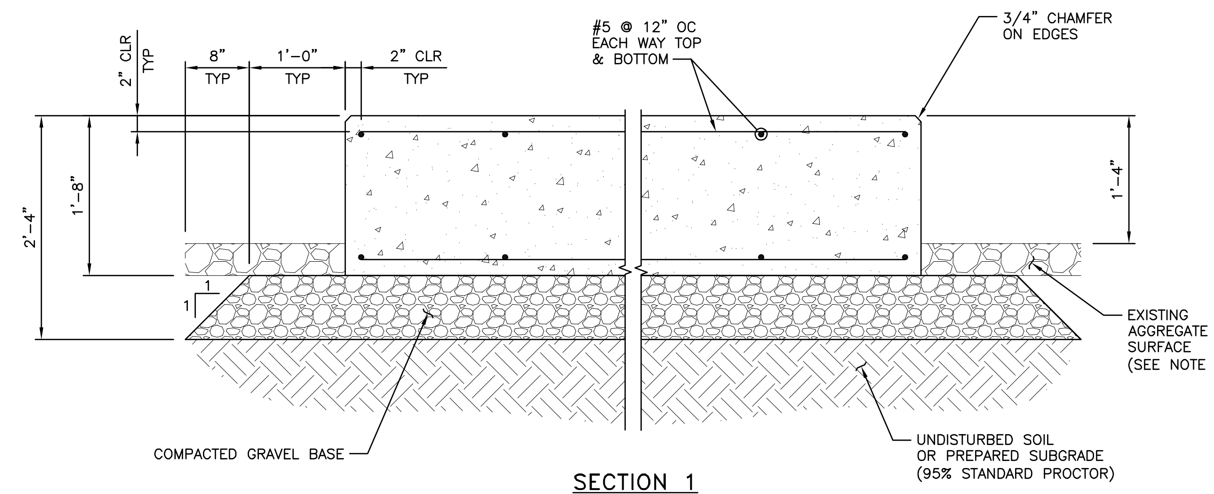
NOTES

1. MATCH EXISTING THICKNESS OF AGGREGATE SURFACE WHEN CONSTRUCTION IS COMPLETE.
2. CONTRACTOR TO REPLACE TOP SOIL WITH COMPACT SUBGRADE AND FINISH TO MATCH EXISTING GRADE.



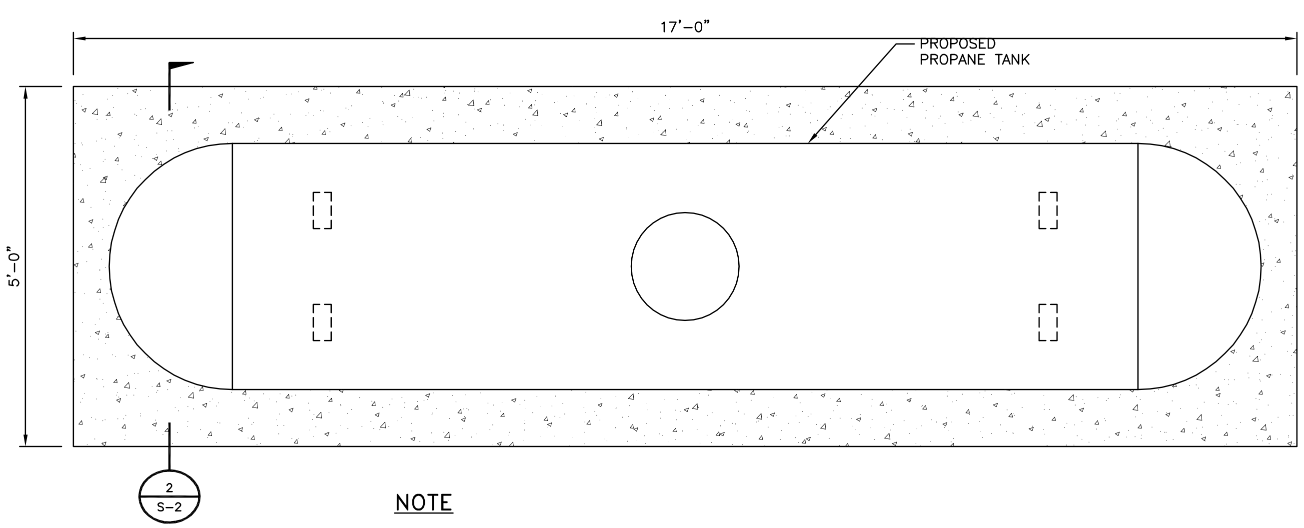
GENERATOR FOUNDATION PLAN

NO SCALE



SECTION 1
FOUNDATION DETAIL

NO SCALE

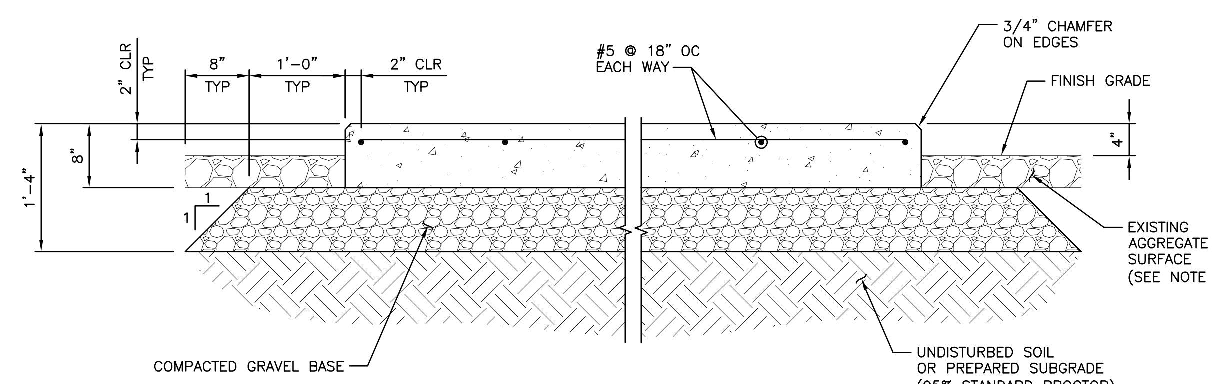


NOTE

1. ANCHORAGE TO BE (1) 5/8"ø HAS-R 316 SS ANCHOR PER LEG WITH HILTI-RE 500 V3 EPOXY & MINIMUM EFFECTIVE EMBEDMENT OF 5" (ESR# 3814) OR ENGINEER APPROVED EQUAL (TYP) (TOTAL OF 4).

PROPANE TANK FOUNDATION PLAN

NO SCALE



SECTION 2
FOUNDATION DETAIL

NO SCALE

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

BLACK & VEATCH
6800 W 115TH ST, SUITE 2292
OVERLAND PARK, KS 66211
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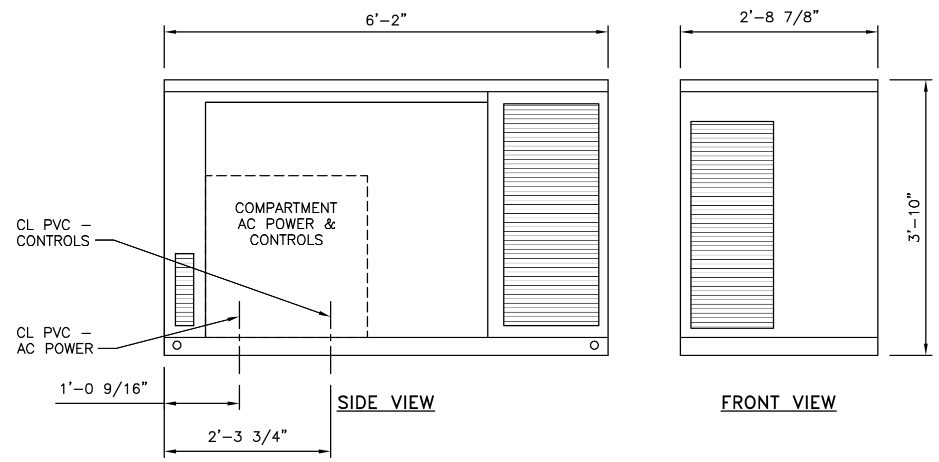
CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE
GENERATOR & PROPANE TANK CONCRETE PAD DETAILS

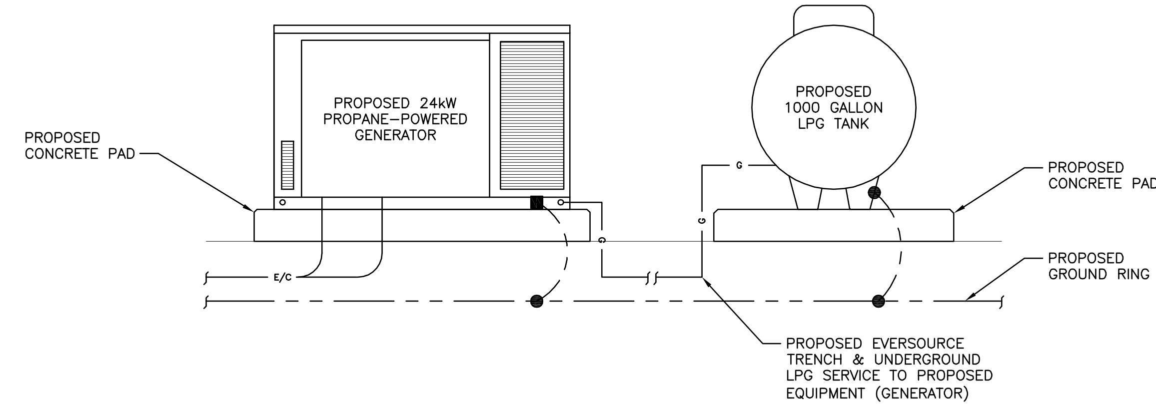
SHEET NUMBER
S-1



KOHLER POWER SYSTEMS 24kW
PROPANE-POWERED GENERATOR MODEL
24RCL, 120/240V, 1ø, 60 Hz

PROPANE GENERATOR SCHEMATICS

NO SCALE

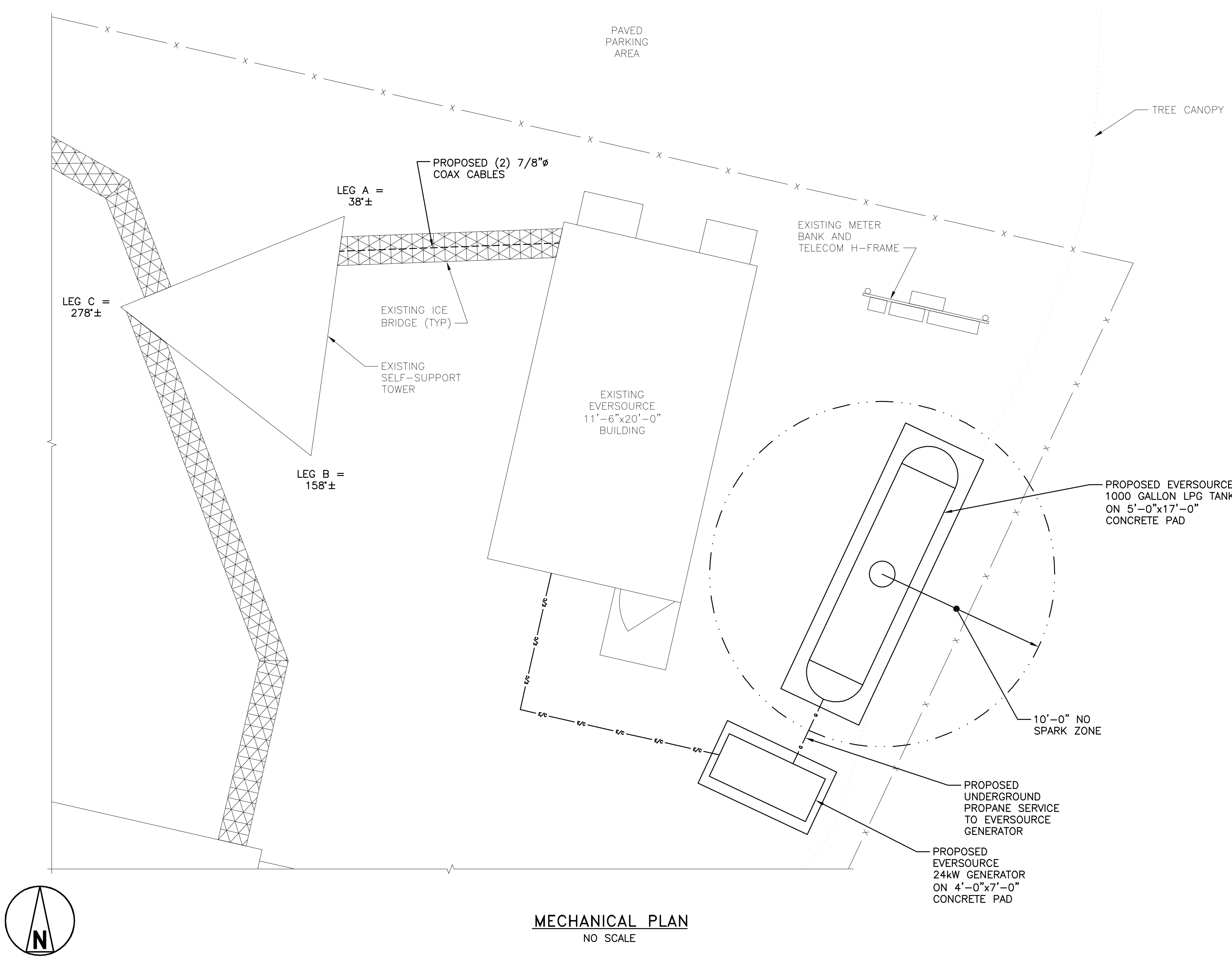


NOTES

1. ALL VALVES USED IN METALLIC PIPING SYSTEMS MUST HAVE PRESSURE CONTAINING PARTS OF STEEL, DUCTILE (NODULAR) IRON, MALLEABLE IRON OR BRASS.
2. ALL MATERIALS USED, INCLUDING VALVE SEAT DISCS, PACKING, SEALS AND DIAPHRAGMS MUST BE RESISTANT TO THE ACTION OF LP GAS UNDER SERVICE CONDITIONS. MANY VALVES ARE LISTED BY INDEPENDENT TESTING LABORATORIES FOR USE IN LP GAS SERVICE. THESE CAN BE USED AS RECOMMENDED BY THE MANUFACTURER. OTHER VALVES CAN BE USED, BUT MUST COMPLY WITH THE REQUIREMENTS OF NFPA 58 AND SHOULD BE RECOMMENDED BY THE MANUFACTURER FOR LP GAS SERVICE TO BE SURE THAT ALL THE COMPONENT PARTS OF THE VALVE ARE APPROVED FOR LP GAS SERVICE.
3. GROUND GENERATOR AND TANK TO GND RING. REFER TO SHEET G-1 FOR WIRE SIZES.
4. GENERATOR SHALL BE ORIENTED TO EXHAUST TOWARDS THE EASTERN FENCE.

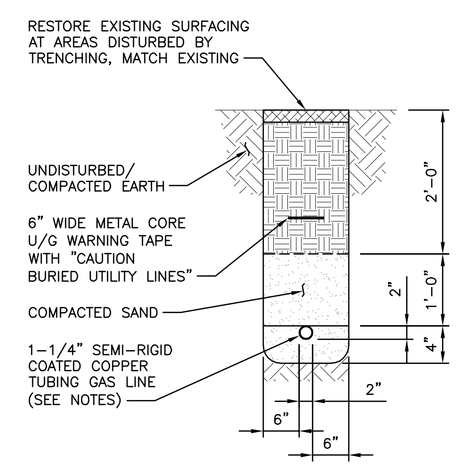
PROPANE CONNECTION DIAGRAM

NO SCALE



MECHANICAL PLAN

NO SCALE



NOTES

SEMI-RIGID COATED COPPER TUBING GAS LINE INSTALLED UNDERGROUND SHALL BE INSTALLED IN ACCORDANCE WITH NFPA54. UNDERGROUND PIPING SHALL COMPLY WITH THE FOLLOWING:

1. THE PIPING SHALL BE MADE OF CORROSION RESISTANT MATERIAL THAT IS SUITABLE FOR BURIAL.
2. PIPE SHALL HAVE A FACTORY APPLIED ELECTRICALLY INSULATING COATING. FITTINGS AND JOINTS BETWEEN SECTIONS OF COATED PIPE SHALL BE COATED IN ACCORDANCE WITH COATING MANUFACTURER'S INSTRUCTIONS.
3. THE PIPING SHALL HAVE A DIAELECTIC UNION INSTALLED ON BOTH SIDES.

PROPANE GAS TRENCH

NO SCALE

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

BLACK & VEATCH
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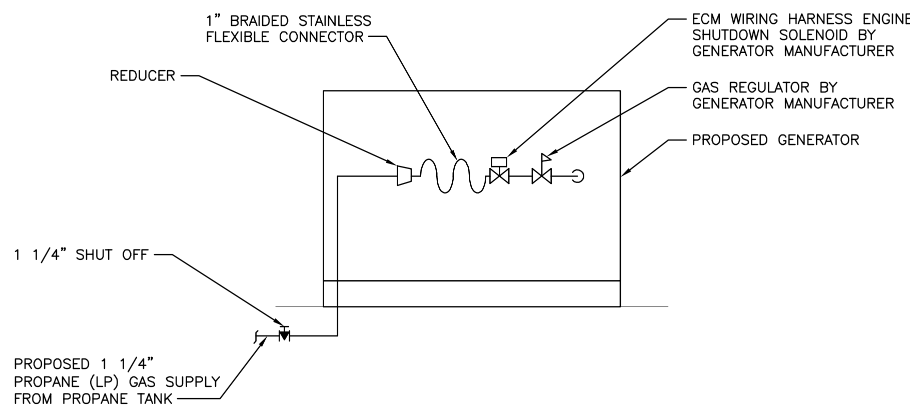
CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE

GENERATOR & PROPANE TANK EQUIPMENT DETAILS

SHEET NUMBER

M-1

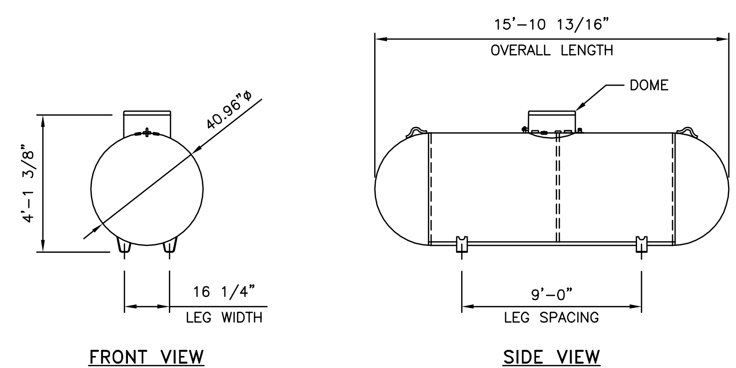


NOTE

1. INSTALL COMPONENTS IN ACCORDANCE WITH GENERATOR MANUFACTURER'S INSTRUCTIONS.

PROPANE CONNECTION DIAGRAM

NO SCALE



NOTES

1. 1000 USWG AMSE VIII, DIV. 1 ABOVE GROUND LPG TANK AS MANUFACTURED BY ARCOSA TANK, LLC:
   * WWW.ARCOSATANK.COM
   * PH: 1-214-202-9258
   * WEIGHT (EMPTY) = 1729 lbs
2. LPG TANK TO BE BOLTED TO CONCRETE SLAB.
3. GROUND TANK STAND (SHEET G-1).
4. PROVIDE TANK MANUFACTURER SHOP DRAWING FOR REVIEW BY ENGINEER OF RECORD PRIOR TO PURCHASE.

PROPANE TANK SCHEMATICS

NO SCALE

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

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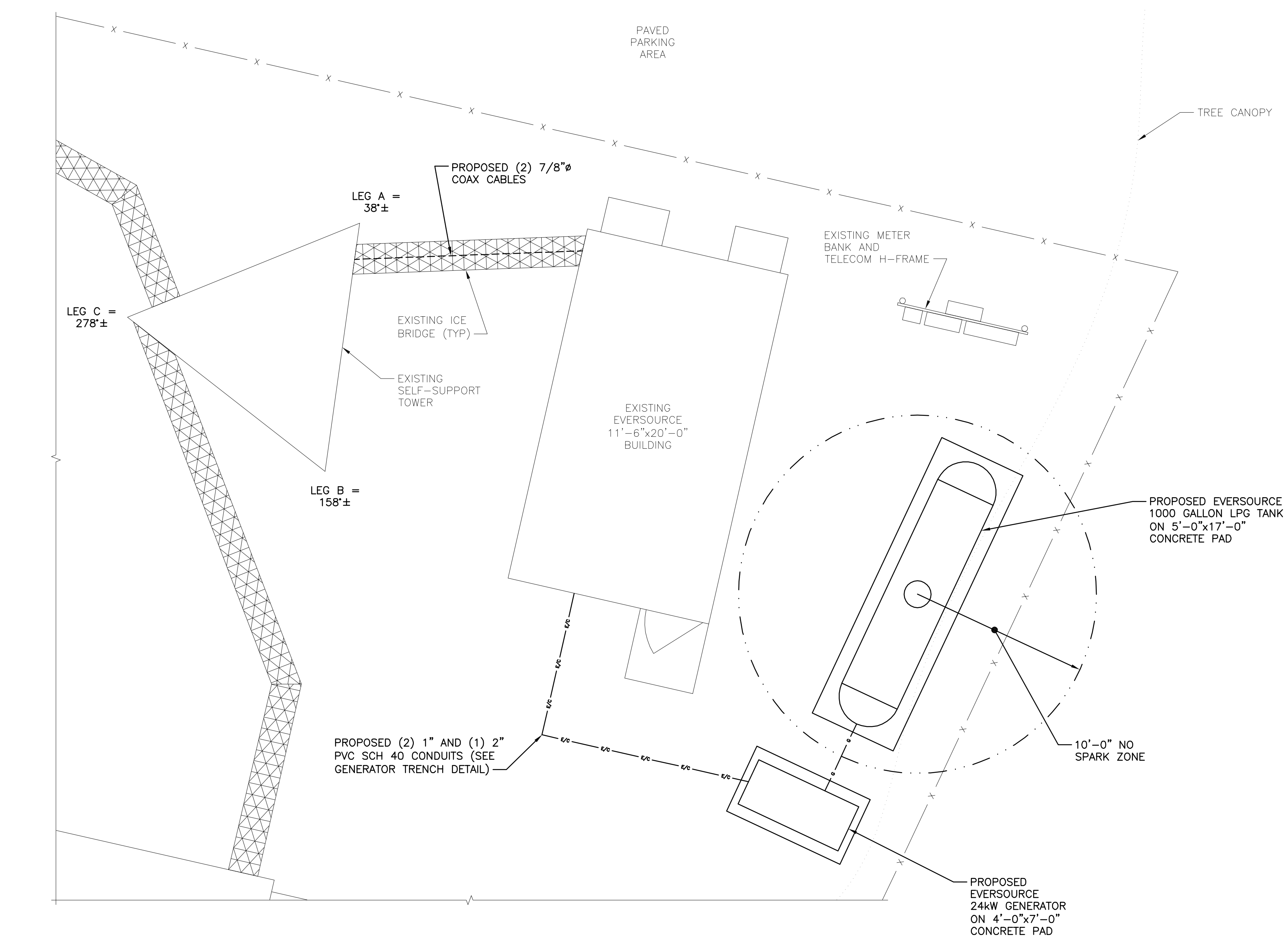
CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE

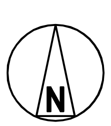
GENERATOR & PROPANE TANK EQUIPMENT DETAILS

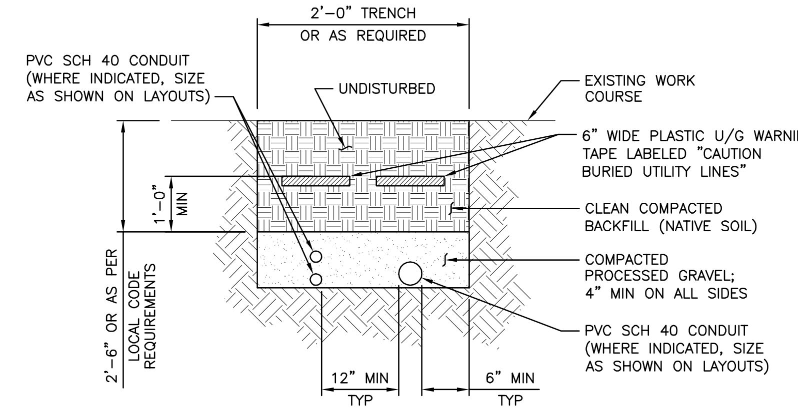
SHEET NUMBER

M-2

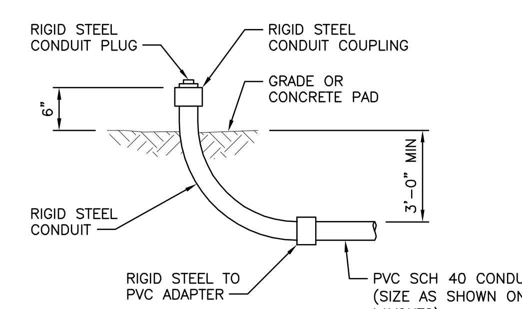


UTILITY PLAN
NO SCALE





GENERATOR TRENCH DETAIL
NO SCALE



STUB-UP CONDUIT DETAIL
NO SCALE

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

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

PROJECT NO:	403093
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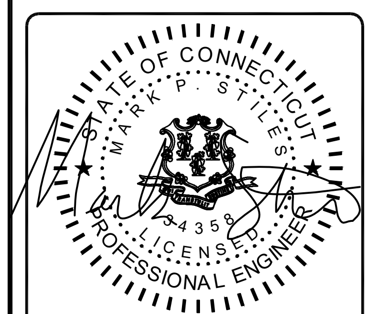

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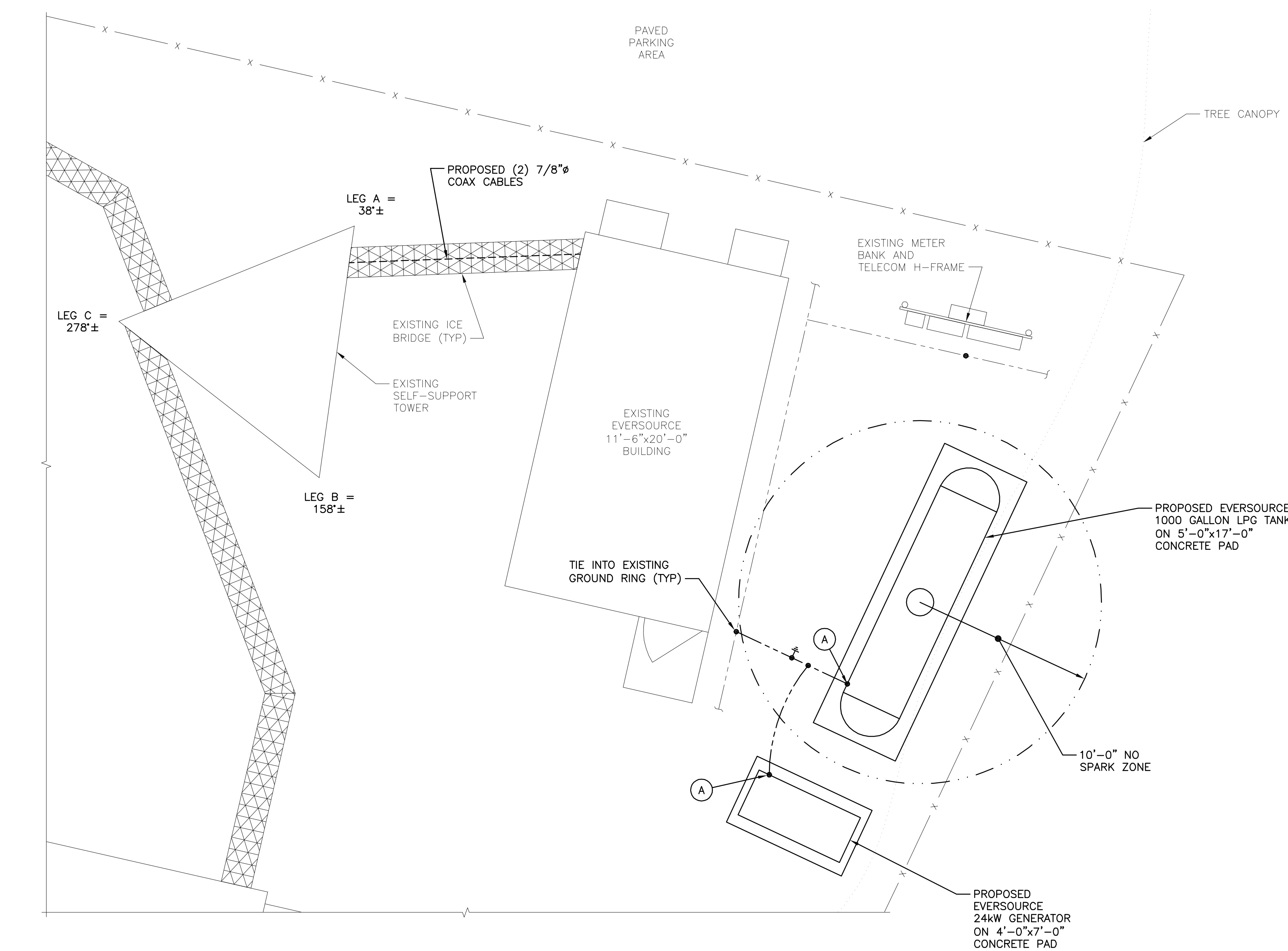
CHESHIRE, CT 06410

SHEET TITLE
UTILITY PLAN & DETAILS

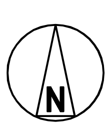
SHEET NUMBER
E-1

LEGEND

- ● EXOTHERMIC (UNLESS NOTED OTHERWISE).
- ■ COMPRESSION CONNECTION (TWO HOLE LUG OR EQUIVALENT).
- 5/8"øx10'-0" COPPER CLAD STEEL GROUND ROD.
- ---- GROUND WIRE.



GROUNDING PLAN
NO SCALE



KEY NOTES

(A) GENERATOR/TANK GROUND: EXTEND #2 TINNED CU WIRE FROM EXISTING BURIED GROUND RING TO GENERATOR/TANK AND EXOTHERMICALLY WELD.

NOTES

1. ALL GROUNDING SYSTEM CONDUCTORS AND CONNECTIONS BELOW GRADE SHALL BE THERMAL WELDS AT GROUND RODS AND AT A MINIMUM OF 36" BELOW GRADE, OR 6" BELOW FROST LINE, WHICH EVER IS GREATER OF THE TWO DIMENSIONS.
2. ALL INSTALLATIONS SHALL BE FIELD VERIFIED.
3. ALL GROUND WIRE SHALL BE #2 AWG BARE COPPER TINNED UNLESS NOTED OTHERWISE.
4. ALL GROUND WIRES SHALL PROVIDE A STRAIGHT DOWNWARD PATH TO GROUND WITH GRADUAL BEND AS REQUIRED. GROUND WIRES SHALL NOT BE LOOPED OR SHARPLY BENT.
5. THE CONTRACTOR SHALL COORDINATE INSTALLATION OF GROUND RODS AND GROUND RING WITH FOUNDATION AND UNDERGROUND CONDUIT.
6. EACH EQUIPMENT CABINET SHALL BE CONNECTED WITH #2 AWG INSULATED SOLID TINNED COPPER WIRE TO GROUND BAR. EQUIPMENT CABINETS SHALL EACH HAVE (2) LUG CONNECTIONS.
7. KOPR-SHIELD ANTI-OXIDATION COMPOUND SHALL BE USED ON ALL COMPRESSION GROUNDING CONNECTIONS.
8. ALL EXOTHERMIC CONNECTIONS SHALL BE INSTALLED UTILIZING THE PROPER CONNECTION/MOLD AND MATERIALS FOR THE PARTICULAR APPLICATION.
9. ALL BOLTED GROUNDING CONNECTIONS SHALL BE INSTALLED WITH AN EXTERNAL TOOTHED LOCK WASHER. GROUNDING BUS BARS MAY HAVE PRE PUNCHED HOLES OR TAPPED HOLES. ALL HARDWARE SHALL BE 3/8" STAINLESS STEEL.
10. EXTERNAL GROUNDING CONDUCTOR SHALL NOT BE INSTALLED OR ROUTED THROUGH HOLES IN ANY METAL OBJECTS, CONDUITS, OR SUPPORTS TO PRECLUDE ESTABLISHING A MAGNETIC CHOKE POINT.
11. PLASTIC CLIPS SHALL BE USED TO FASTEN AND SUPPORT GROUNDING CONDUCTORS. FERROUS METAL CLIPS WHICH COMPLETELY SURROUND THE GROUNDING CONDUCTOR SHALL NOT BE USED.
12. STANDARD BUS BARS MGB, GWB, IGB, TELCO GB, FIBER GB, AND POWER GB SHALL BE FURNISHED AND INSTALLED BY THE SUBCONTRACTOR. THEY SHALL NOT BE FABRICATED OR MODIFIED IN THE FIELD. ALL GROUNDING BUSES SHALL BE IDENTIFIED WITH MINIMUM 3/4" LETTERS BY WAY OF STENCILING OR DESIGNATION PLATE.
13. IF COAX ON ICE BRIDGE IS MORE THAT 6' FROM THE GROUND BAR AT THE BASE OF THE TOWER, A SECOND GROUND BAR WILL BE NEEDED AT THE END OF THE ICE BRIDGE RUN TO GROUND THE COAX GROUND KIT AND THE IN-LINE SURGE ARRESTORS.
14. CONTRACTOR SHALL REPAIR/PLACE EXISTING GROUNDING SYSTEM COMPONENTS DAMAGED DURING CONSTRUCTION AT THE CONTRACTORS EXPENSE.

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

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STATE OF CONNECTICUT
MARK P. STILES
34358
LICENSED
PROFESSIONAL ENGINEER
05/13/2020

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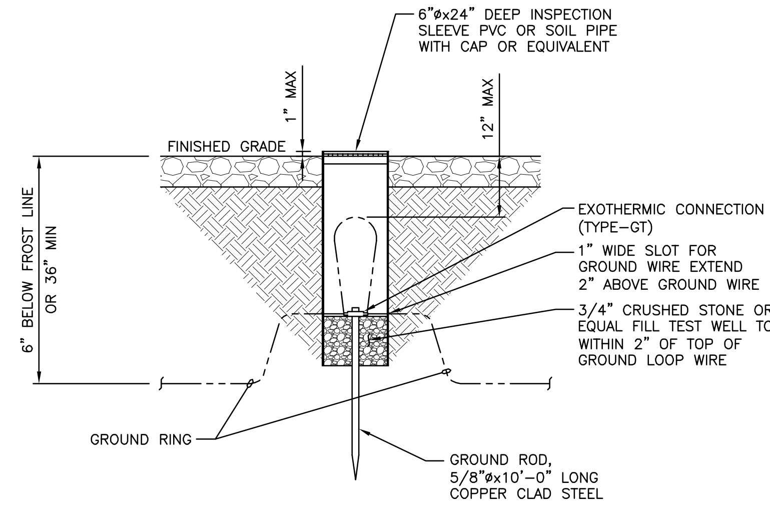
CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE
GROUNDING PLAN

SHEET NUMBER
G-1

CADWELD CONNECTIONS OR APPROVED EQUAL			BURNDY CONNECTIONS OR APPROVED EQUAL
HORIZONTAL SPLICE SPLICE OF HORIZONTAL CABLES TYPE SS	PARALLEL HORIZONTAL CONDUCTORS PARALLEL THROUGH CONNECTION OF HORIZONTAL CABLES TYPE PT	VERTICAL PIPE CABLE DOWN AT 45° TO RANGE OF VERTICAL PIPES TYPE VS	BOND JUMPER FIELD FABRICATED GREEN STRANDED INSULATED TYPE 2-YA-2
HORIZONTAL STEEL SURFACE TO FLAT STEEL SURFACE OR HORIZONTAL PIPE TYPE HS	PARALLEL HORIZONTAL CONDUCTORS PARALLEL DEAD END TAP OR HORIZONTAL THRU CONDUCTOR TYPE PC	VERTICAL STEEL SURFACE CABLE DOWN AT 45° TO VERTICAL STEEL SURFACE INCLUDING PIPE TYPE VS	COPPER LUGS TWO HOLE – LONG BARREL LENGTH TYPE YA-2
HORIZONTAL TEE TEE OF HORIZONTAL RUN AND TAP CABLES TYPE TA	THROUGH CABLE TO GROUND ROD THROUGH CABLE TO TOP OF GROUND ROD TYPE GT		

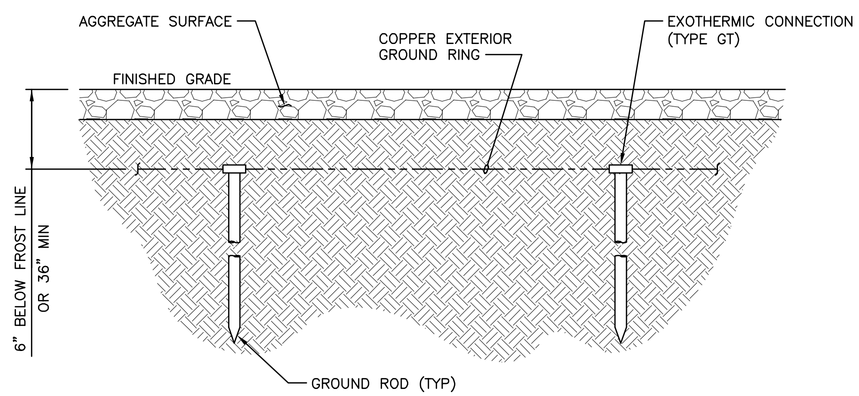


GROUND ROD WITH INSPECTION SLEEVE

NO SCALE

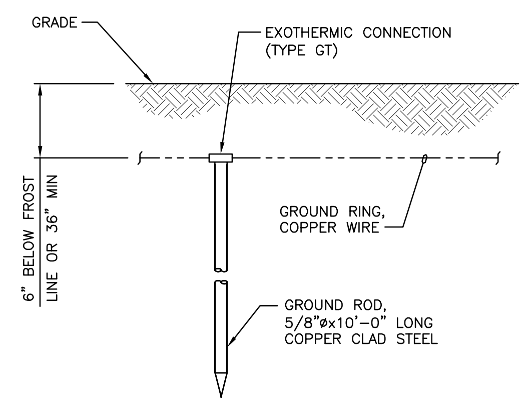
NOTES

1. REFER TO SHEET G-1 FOR WIRE SIZES.



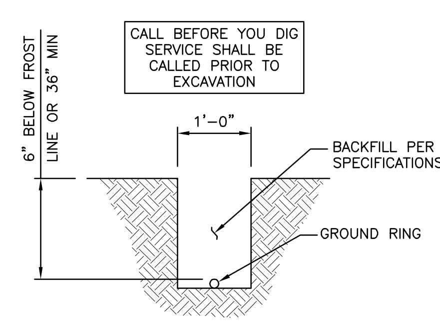
GROUND RING DETAIL

NO SCALE



GROUND ROD

NO SCALE



NOTES

1. ALL EXOTHERMIC WELD CONNECTIONS SHALL BE BELOW FROST LINE.

GROUND RING TRENCH

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

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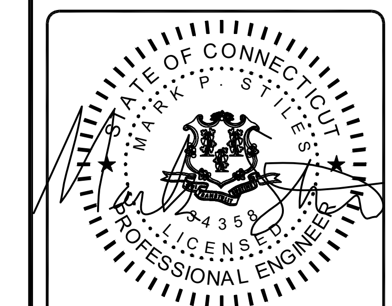

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CHESHIRE AWC
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CHESHIRE, CT 06410

SHEET TITLE

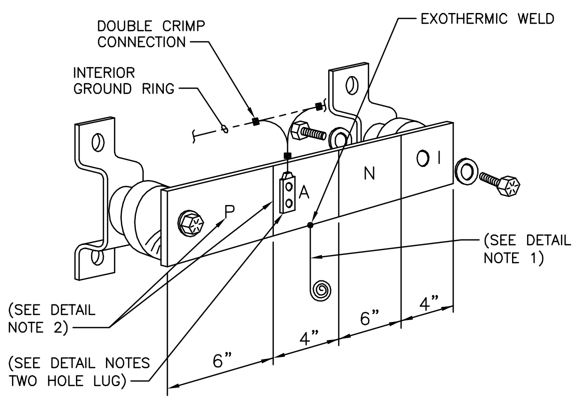
GROUNDING DETAILS

SHEET NUMBER

G-2

NOTES

1. ALL LUGS SHALL BE 2-HOLE, LONG BARREL, TINNED SOLID COPPER UNLESS OTHERWISE SPECIFIED, USING THE PROPER U.L. TOOL AND CIRCUMFERENTIAL HEXAGON DIE. LUGS SHALL BE THOMAS AND BETTS SERIES 548##BE, BURNDY, ERICO OR EQUIVALENT. BOLT HOLE DIAMETER AND SPACING ON ALL GROUND LUGS SHALL MATCH HOLE DIAMETER AND SPACING OF THE GROUND BAR. ANGLE LUGS MAY BE USED IF CONSTRUCTION CONDITIONS DICTATE. REFER TO DETAIL "G".
2. AN ANTI-OXIDATION COMPOUND SHALL BE APPLIED BETWEEN THE LUG AND GROUND BAR ONLY. DO NOT COVER THE LUG. THE ANTI-OXIDATION COMPOUND SHALL BE THOMAS AND BETTS "KOPR-SHIELD" OR BURNDY PENETROX-E.
3. GROUND BARS SHALL BE ATTACHED TO THE ANTENNA SUPPORT STRUCTURES WITH U.L. APPROVED MOUNTING DEVICES. GROUND CLAMPS MAY BE USED TO MOUNT THE GROUND BAR TO AVAILABLE FLANGES, COAX PORT RIMS, ETC. STEEL STRAPS MAY BE USED TO ATTACH GROUND BAR TO A MONOPOLE IF NO CONVENIENT CLAMPING SURFACES ARE PRESENT. ALL CONNECTING SURFACES SHALL BE CLEAN AND FREE OF DIRT, OIL AND CORROSION. GALVANIZED SURFACES SHALL BE POLISHED WITH A STEEL BRUSH. DO NOT DRILL HOLES OR USE EXOTHERMIC WELDS TO CONNECT GROUND LEADS TO A STEEL TOWER EXCEPT ON STEEL TABS OR FLANGES SPECIFICALLY DESIGNED FOR THAT PURPOSE.



SITEPRO – 1/4"X4"X20"
TINNED GROUND BAR KIT
TINMG420U-K

EACH GROUND CONDUCTOR TERMINATING ON ANY GROUND BAR SHALL HAVE AN IDENTIFICATION TAG ATTACHED AT EACH END THAT WILL IDENTIFY ITS ORIGIN AND DESTINATION

SECTION "P" – SURGE PROTECTORS

CELL REFERENCE GROUND BAR (IF CO-LOCATED)
GENERATOR FRAMEWORK (IF AVAILABLE) (#2)
TELCO GROUND BAR (#2)
COMMERCIAL POWER COMMON NEUTRAL/GROUND BOND (#3/0)
FIBER GROUND BAR (#2)

SECTION "A" – SURGE ABSORBERS

INTERIOR GROUND RING (#2)
EXTERNAL EARTH GROUND FIELD (BURIED GROUND RING) (#2)

SECTION "N" – NON-ISOLATED GROUND ZONE EQUIPMENT

MISC NON-ISOLATED GROUND ZONE
BATTERY RACK

SECTION "I" – ISOLATED GROUND ZONE

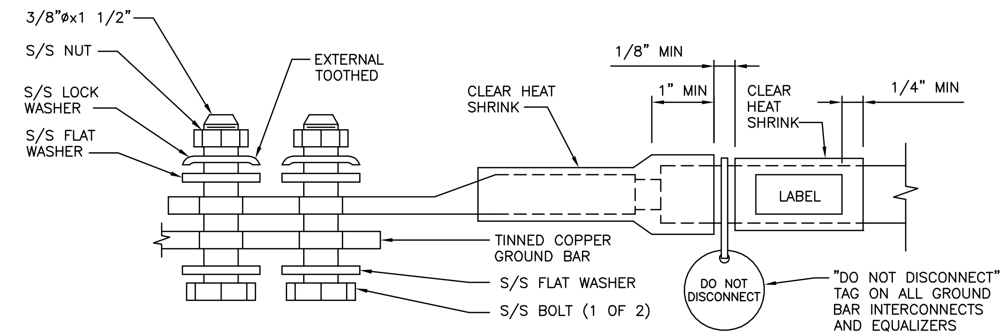
ALL ISOLATED GROUND REFERENCE
GROUND WINDOW BAR

DETAIL NOTES

1. EXOTHERMIC ALLY WELD #2 AWG BARE TINNED SOLID COPPER CONDUCTOR TO GROUND BAR. ROUTE CONDUCTOR TO BURIED GROUND RING AND PROVIDE EXOTHERMIC WELD.
2. EC SHALL USE PERMANENT MARKER TO DRAW THE LINES BETWEEN EACH SECTION AND LABEL EACH SECTION ("P", "A", "N", "I") WITH 1" HIGH LETTERS.

(MGB) REFERENCE GROUND BAR

NO SCALE

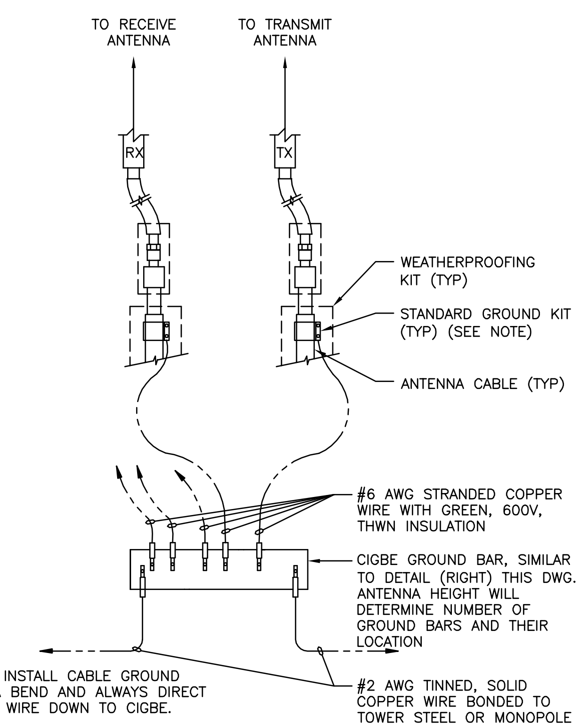


NOTES

1. ALL HARDWARE 18-8 STAINLESS STEEL INCLUDING LOCK WASHERS, COAT ALL SURFACES WITH AN ANTI-OXIDANT COMPOUND BEFORE MATING.
2. ALL HARDWARE SHALL BE S/S 3/8 INCH DIAMETER OR LARGER.
3. FOR GROUND BOND TO STEEL ONLY: INSERT A CADMIUM FLAT WASHER BETWEEN LUG AND STEEL, COAT ALL SURFACES WITH AN ANTI-OXIDANT COMPOUND BEFORE MATING.

TWO HOLE LUG

NO SCALE

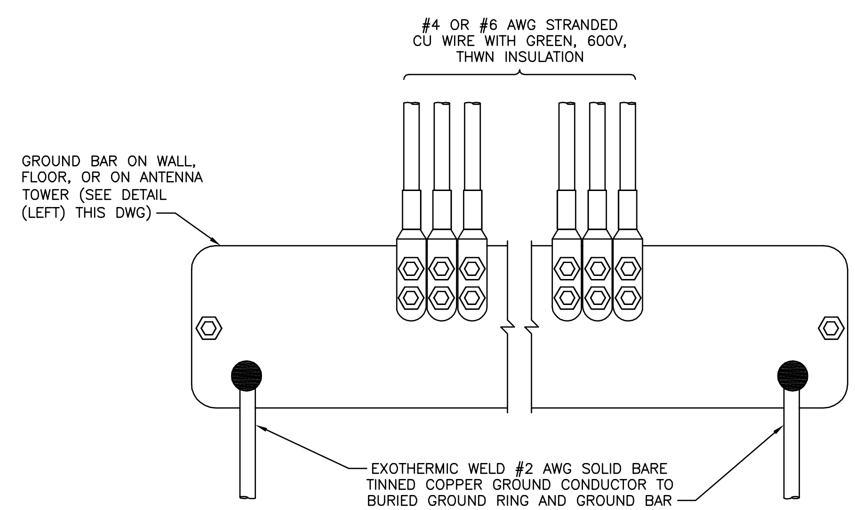


NOTE

1. DO NOT INSTALL CABLE GROUND KIT AT A BEND AND ALWAYS DIRECT GROUND WIRE DOWN TO CIGBE.

CONNECTION OF GROUND WIRE TO EXTERIOR GROUNDING BAR

NO SCALE



NOTE

1. NUT & WASHER SHALL BE PLACED ON THE FRONT SIDE OF THE GROUND BAR AND BOLTED ON THE BACK SIDE.

INSTALLATION OF GROUND WIRE TO EXTERIOR GROUNDING BAR

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

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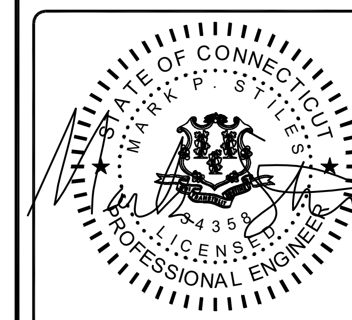

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CHESHIRE AWC
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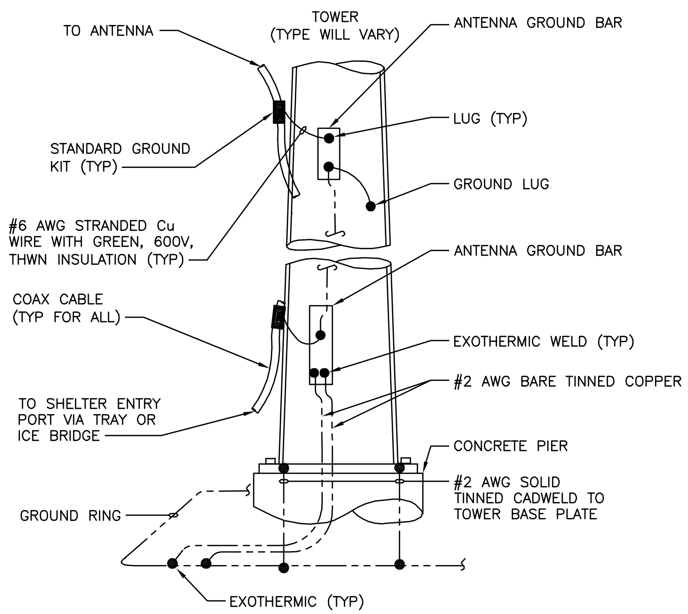
CHESHIRE, CT 06410

SHEET TITLE
GROUNDING DETAILS

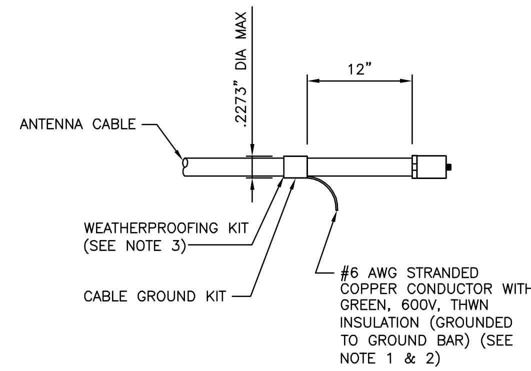
SHEET NUMBER
G-3



NOTE

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

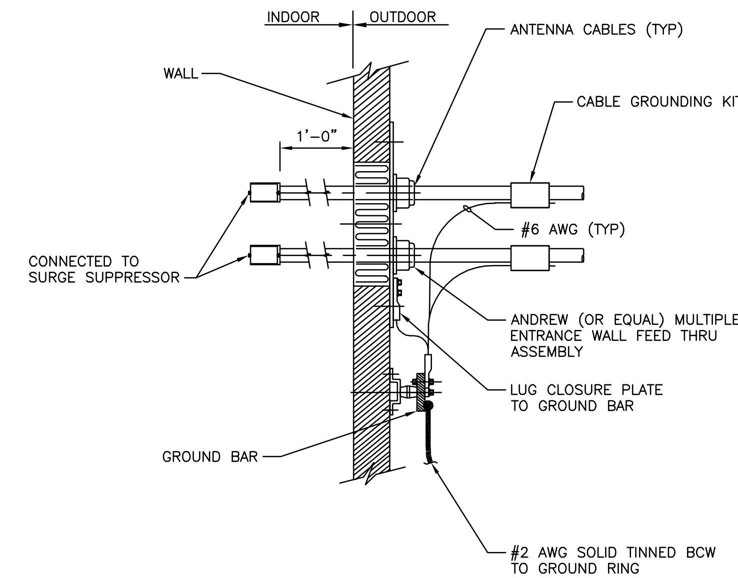
ANTENNA CABLE GROUNDING
NO SCALE



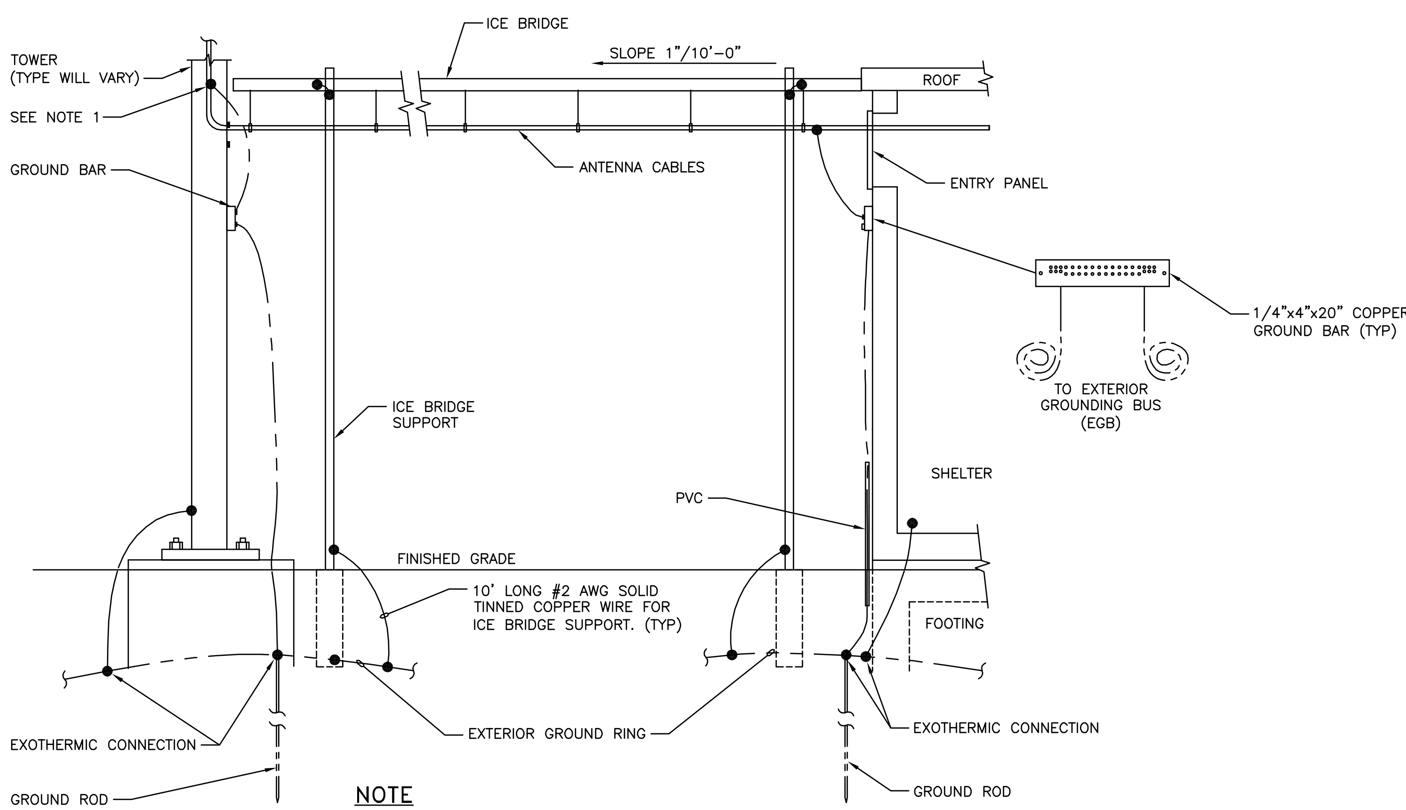
NOTES

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

CONNECTION OF CABLE GROUND KIT TO ANTENNA CABLE
NO SCALE



CABLE INSTALLATION WITH WALL FEED THRU ASSEMBLY
NO SCALE



NOTE

1. PROVIDE GROUND KIT 6" BEFORE TURN

ICE BRIDGE AND ANTENNA CABLE DETAIL
NO SCALE

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

BLACK & VEATCH
6800 W 115TH ST, SUITE 2292
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CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE
GROUNDING DETAILS

SHEET NUMBER
G-4

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.

CONCRETE

1. ALL CONCRETE CONSTRUCTION SHALL BE DONE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE (ACI) CODES 301 & 318, LATEST REVISION.
2. FOUNDATION WORK SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S DESIGNS AND SPECIFICATIONS.
3. ALL CONCRETE USED SHALL BE 4000 PSI (28 DAY COMPRESSIVE STRENGTH) UNLESS NOTED OTHERWISE. THE CONCRETE MIX DESIGN SHALL USE THE FOLLOWING MATERIALS AND PARAMETERS:

PORTLAND CEMENT:	ASTM C150, TYPE 1
AGGREGATE:	ASTM C33, 1 INCH MIX
WATER:	POTABLE
ADMIXTURE:	NON-CHLORIDE
AIR:	6%*
SLUMP:	4 INCH UNLESS NOTED OTHERWISE

   *ALL CONCRETE EXPOSED TO FREEZING WEATHER SHALL CONTAIN ENTRAINED AIR PER ACI 211 TABLE 4.2.1 OF ACI 318-05.

4. ALL REINFORCING STEEL SHALL BE ASTM A615, GR 60 (DEFORMED) UNLESS NOTED OTHERWISE. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 WELDED STEEL WIRE FABRIC UNLESS NOTED OTHERWISE. SPLICES SHALL BE CLASS 'B' AND ALL HOOKS SHALL BE ACI STANDARD UNLESS NOTED OTHERWISE. REINFORCING BARS SHALL BE COLD BENT WHERE REQUIRED AND TIES (NOT WELDED).
5. THE FOLLOWING MINIMUM CONCRETE COVER SHALL BE PROVIDED FOR REINFORCING STEEL UNLESS SHOWN OTHERWISE ON DRAWINGS:

   CONCRETE CAST AGAINST EARTH = 3 INCHES
   CONCRETE EXPOSED TO EARTH OR WEATHER:
   #6 AND LARGER = 2 INCHES
   #5 AND SMALLER AND WWF = 1 1/2 INCHES
   CONCRETE NOT EXPOSED TO EARTH OR WEATHER OR NOT CAST AGAINST THE GROUND:
   SLAB AND WALL = 3/4 INCHES
   BEAMS AND COLUMNS = 1 1/2 INCHES

6. A 3/4 INCH CHAMFER SHALL BE PROVIDED AT ALL EXPOSED EDGES OF CONCRETE, UNLESS NOTED OTHERWISE, IN ACCORDANCE WITH ACI 301 SECTION 4.2.4.
7. CONCRETE SHALL REPLACED IN A UNIFORM MANNER AND CONSOLIDATED IN PLACE.
8. CONCRETE FOOTINGS SHALL BE CAST AGAINST LEVEL, COMPACTED, NON-FROZEN BASE SOIL FREE OF STANDING WATER.

STEEL

1. MATERIAL:

WIDE FLANGE:	ASTM A572, GR 50
TUBING:	ASTM A500, GR C
PIPE:	ASTM A53, GR B AND ASTM 572, GR 50
ANGLE:	ASTM A570, GR 50 AND ASTM A36
BOLTS:	ASTM A325
GRATING:	TYPE GW-2 (1"x3/16" BARS)
MISC. MATERIAL:	ASTM A36

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

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

SITE GENERAL

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

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

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

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

REV	DATE	DESCRIPTION
0	05/13/20	ISSUED FOR FILING

STATE OF CONNECTICUT
JOSHUA J. RILEY
33208
LICENSED
PROFESSIONAL ENGINEER
05/13/2020

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

CHESHIRE AWC
705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE
NOTES & SPECIFICATIONS

SHEET NUMBER
N-1

EXCAVATION

1. CONTRACTOR SHALL GRADE ONLY AREAS SHOWN TO BE MODIFIED HEREIN AND ONLY TO THE EXTENT REQUIRED TO SHED OVERLAND WATER FLOW AWAY FROM SITE. SLOPES SHALL NOT BE STEEPER THAN 3:1 (HORIZONTAL:VERITICAL), UNLESS NOTED OTHERWISE. SEDIMENTATION AND EROSION CONTROLS SHOWN AND SPECIFIED SHALL BE ESTABLISHED BEFORE STRIPPING EXISTING VEGETATION.
2. ORGANIC MATERIAL AND DEBRIS SHALL BE STRIPPED AND STOCKPILED BEFORE ADDING FILL MATERIAL.
3. NO FILL OR EMBANKMENT MATERIAL SHALL BE PLACED ON FROZEN GROUND. FROZEN MATERIALS, SNOW OR ICE SHALL NOT BE PLACED IN ANY FILL OR EMBANKMENT.
4. ALL FILL SHALL BE PLACED IN ONE FOOT LIFTS AND COMPACTED IN PLACE. STRUCTURAL FILL SHALL BE COMPACTED TO 95% OF ITS MAXIMUM DRY UNIT WEIGHT TESTED IN ACCORDANCE WITH ASTM D1557.
5. EXCAVATIONS FOR FOOTINGS SHALL BE CUT LEVEL TO THE REQUIRED DEPTH AND TO UNDISTURBED SOIL. REPORT UNSUITABLE SOIL CONDITIONS TO THE CONSTRUCTION MANAGER.
6. TRENCH EXCAVATIONS SHALL BE BACKFILLED AT THE END OF EACH DAY.
7. SURPLUS MATERIAL SHALL BE REMOVED FROM THE SITE.
8. TOWER FOUNDATION EXCAVATION, BACKFILL AND COMPACTION SHALL BE IN ACCORDANCE WITH THE TOWER MANUFACTURER'S DESIGNS AND SPECIFICATIONS.

MATERIAL

1. NATIVE GENERAL MATERIAL MAY BE USED FOR TRENCH BACKFILL WHERE SELECT MATERIAL IS NOT SPECIFIED. GRAVEL MATERIAL FOR CONDUIT TRENCH BACKFILL SHALL NOT CONTAIN ROCK GREATER THAN 2 INCHES IN DIAMETER.
2. BANK OR CRUSHED GRAVEL SHALL CONSIST OF TOUGH, DURABLE PARTICLES OF CRUSHED OR UNCRUSHED GRAVEL FREE OF SOFT, THIN, ELONGATED OR LAMINATED PIECES AND MEET THE GRADATION REQUIREMENTS.
3. PROCESSED AGGREGATE BASE SHALL CONSIST OF COURSE AND FINE AGGREGATES COMBINED AND MIXED SO THAT THE RESULTING MATERIAL CONFORMS TO THE GRADATION REQUIREMENTS. COURSE AGGREGATE SHALL BE EITHER GRAVEL OR BROKEN STONE AND FINE AGGREGATE SHALL CONSIST OF SAND.

SQUARE MESH SIEVES	PERCENT PASSING BY WEIGHT: BANK GRAVEL FILL	BANK GRAVEL BASE	PROCESSED AGG BASE
		100	
PASS 5"		100	90–100
PASS 3 1/2"		100	
PASS 2 1/4"		95–100	
PASS 2"		55–100	
PASS 1 1/2"			
PASS 1"			
PASS 3/4"			50–75
PASS 1/4"	25–60	25–60	25–45
PASS #10	15–45	15–45	
PASS #40	2–25	5–25	5–20
PASS #100	0–10	0–10	2–12
PASS #200	0–5	0–5	

4. FILL MATERIAL SHALL BE FREE OR ORGANIC MATERIAL, ICE, TRASH AND DEBRIS.
5. REFER TO MOST CURRENT GEOTECHNICAL ENGINEERING REPORT FOR ALL FILL MATERIAL REQUIREMENTS.

ELECTRICAL

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

GROUNDING

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

ANTENNA & CABLE NOTES

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

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

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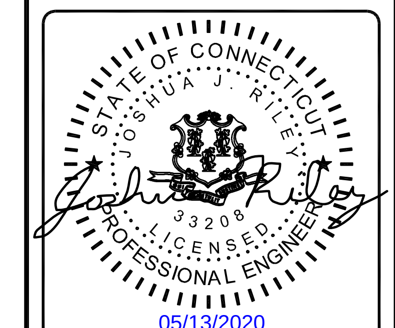

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705 WEST JOHNSON AVE
CHESHIRE, CT 06410

SHEET TITLE

NOTES & SPECIFICATIONS

SHEET NUMBER

N-2

SYMBOLS

●	EXOTHERMIC CONNECTION
■	COMPRESSION CONNECTION
	5/8"øx10'-0" COPPER CLAD STEEL GROUND ROD.
	TEST GROUND ROD WITH INSPECTION SLEEVE
— - - -	GROUNDING CONDUCTOR
(A)	KEY NOTES

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

ABBREVIATIONS

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

EVERSOURCE ENERGY
107 SELDEN STREET
BERLIN, CT 06037
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REFERENCE CUTSHEETS

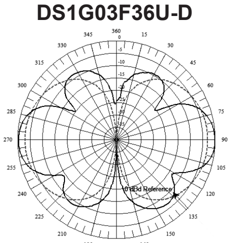
VHF Omni Antennas (160-222 MHz)

		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**, ft²(m²)	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** **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)	

DS2C03F36D-D

VERTICAL PATTERNS

DS1G03F36U-N
DS1G03F36U-D



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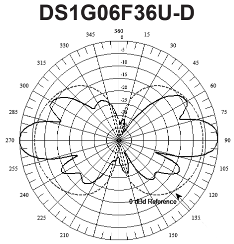
DS1G06F36U-D



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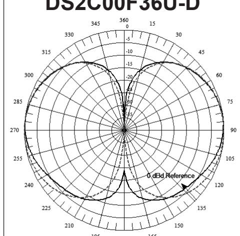

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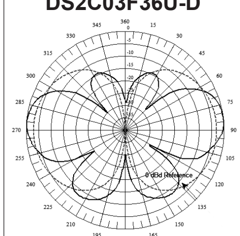

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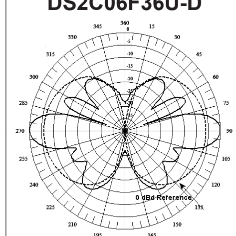

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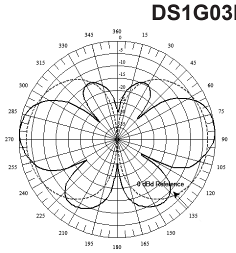

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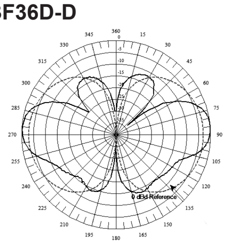

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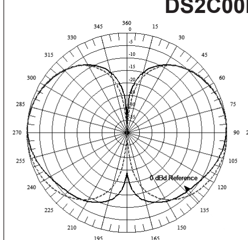

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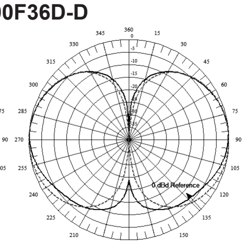

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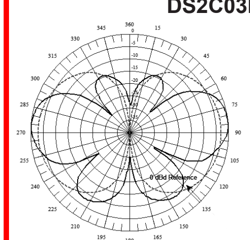

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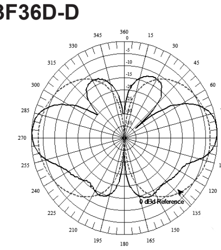
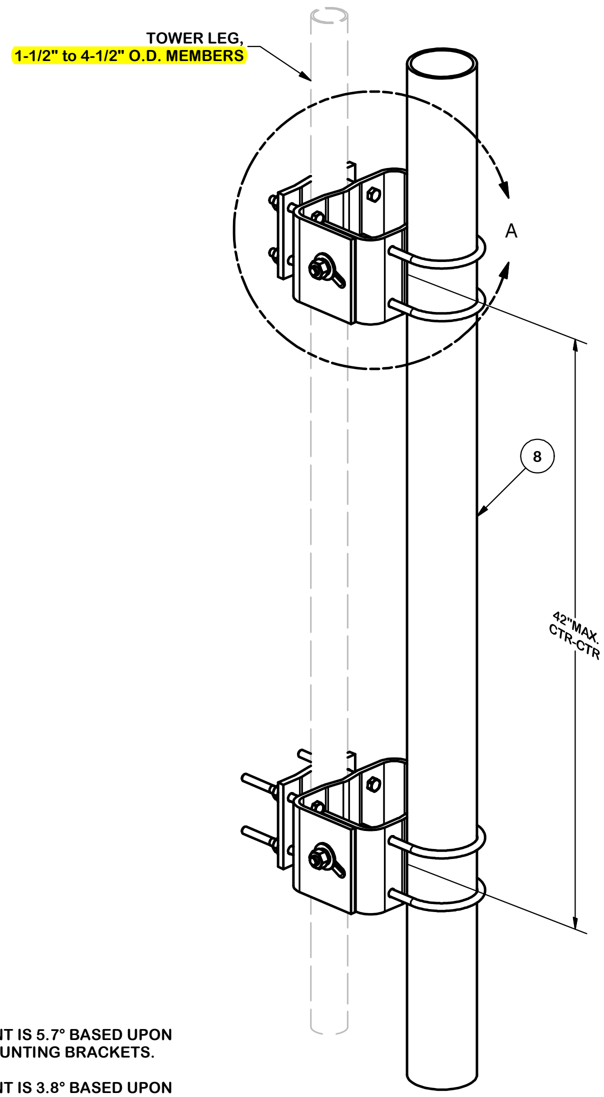


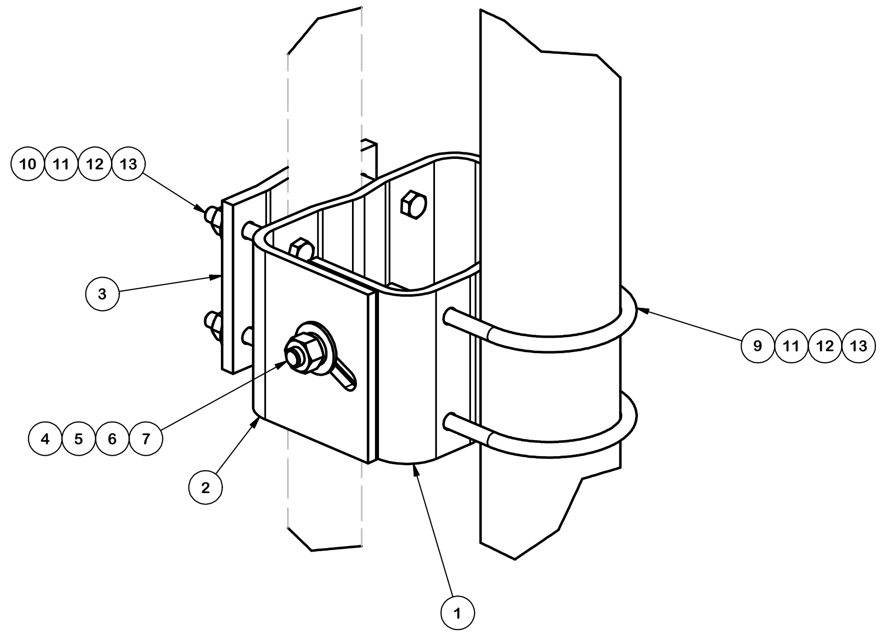
Bottom

TOWER/MAST SIZE AT PROPOSED ANTENNA ATTACHMENT = 1.75" ± DIAMETER.



PARTS LIST

ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	2	X-154463	UNIVERSAL PIPE MOUNTING PLATE (INNER)	16 11/32 in	10.52	21.03
2	2	X-155561	UNIVERSAL PIPE MOUNTING PLATE (OUTER)	20 9/32 in	13.16	26.31
3	2	X-159999	BACKING PLATE	6 9/16 in	5.73	11.46
4	4	G5802	5/8" x 2" HDG HEX BOLT GR5		0.27	1.08
5	4	G58FW	5/8" HDG USS FLATWASHER	1/8 in	0.07	0.28
6	4	G58LW	5/8" HDG LOCKWASHER	5/32 in	0.03	0.10
7	4	G58NUT	5/8" HDG HEAVY 2H HEX NUT	5/8 in	0.13	0.52
8	1	P472	4-1/2" X 72" SCH. 40 GALVANIZED PIPE		64.89	64.89
9	4	X-UB1458	1/2" X 4-5/8" X 7" X 3" GALV U-BOLT		0.97	3.89
10	8	G1204	1/2" x 4" HDG HEX BOLT GR5 FULL THREAD	4 in	0.27	2.16
10	8	G12065	1/2" x 6-1/2" HDG HEX BOLT GR5 FULL THREAD	6 1/2 in	0.41	3.28
11	16	G12FW	1/2" HDG USS FLATWASHER	3/32 in	0.03	0.55
12	16	G12LW	1/2" HDG LOCKWASHER	1/8 in	0.01	0.22
13	16	G12NUT	1/2" HDG HEAVY 2H HEX NUT		0.07	1.15
					TOTAL WT. #	136.92



DETAIL A

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

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

TOLERANCE NOTES

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

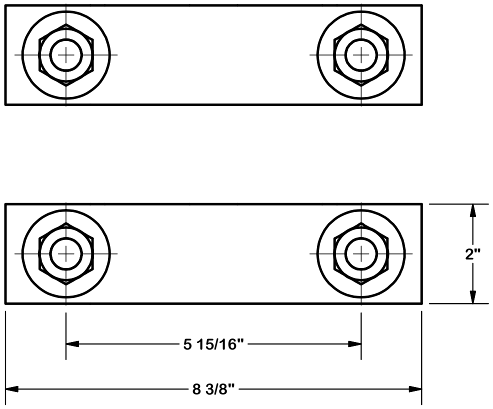
DESCRIPTION
R5 UNIVERSAL PIPE MOUNT KIT
WITH 4-1/2" PIPE

SITE PRO 1
A valmont COMPANY

Engineering Support Team:
1-888-753-7446

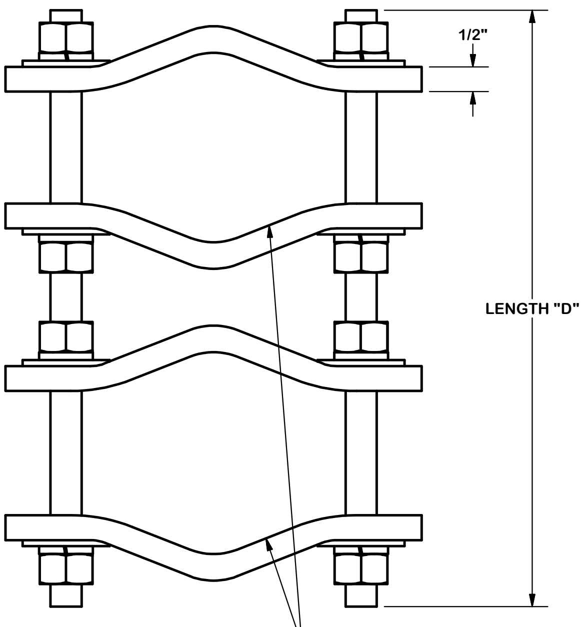
Locations:
New York, NY
Atlanta, GA
Los Angeles, CA
Plymouth, IN
Salem, OR
Dallas, TX

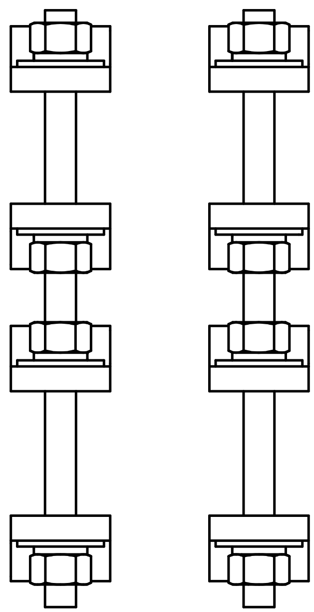
CPD NO.		DRAWN BY	ENG. APPROVAL	PART NO.
4718		RH18 3/29/2010		R5
CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	01	CUSTOMER	BMC 11/12/2015	R5

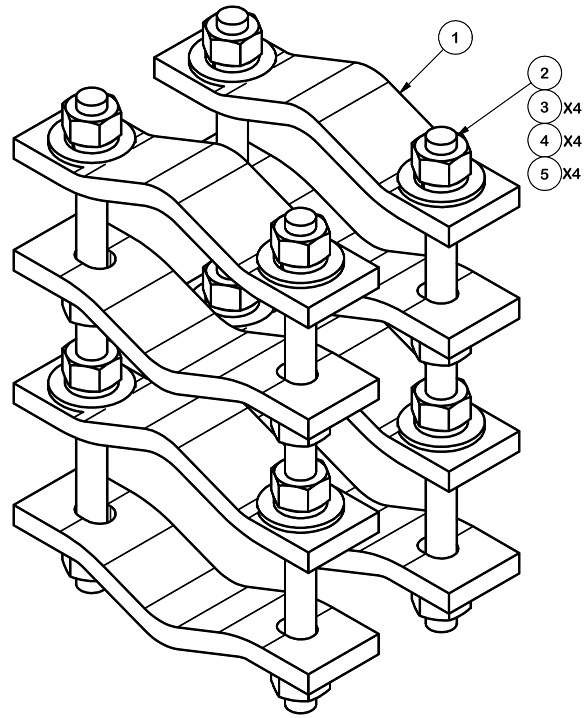


PARTS LIST						
ITEM	QTY	PART NO.	PART DESCRIPTION	LENGTH	UNIT WT.	NET WT.
1	8	DCP	CLAMP HALF, 1/2" THICK, 8-3/8"		2.40	19.20
2	B	C	5/8" THREADED ROD	D	E	F
3	16	G58NUT	5/8" HDG HEAVY 2H HEX NUT		0.13	2.08
4	16	G58LW	5/8" HDG LOCKWASHER		0.03	0.42
5	16	G58FW	5/8" HDG USS FLATWASHER		0.07	1.13

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







TOLERANCE NOTES

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

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

SITE PRO 1 — A valmont COMPANY

Engineering Support Team:
1-888-753-7446

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

CPD NO.	DRAWN BY	ENG. APPROVAL	PART NO.
	KC8 8/21/2012		SEE ASSEMBLY "A"

CLASS	SUB	DRAWING USAGE	CHECKED BY	DWG. NO.
81	01	CUSTOMER	CEK 1/22/2013	DCPxxK

KOHLER.

Model: 24RCL

Multi-Fuel
Natural Gas/LPG

ISO 9001 KOHLER. NATIONALLY REGISTERED

The Kohler® Advantage

- **High Quality Power**
  Kohler home generators provide advanced voltage and frequency regulation along with ultra-low levels of harmonic distortion for excellent generator power quality to protect your valuable electronics.
- **Extraordinary Reliability**
  Kohler is known for extraordinary reliability and performance and backs that up with a premium five-year or 2000 hour limited warranty.
- **All-Aluminum Sound Enclosure**
- **Quiet Operation**
  Kohler home generators provide quiet, neighborhood-friendly performance.

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The generator set accepts rated load in one step.
- A standard five-year or 2000 hour limited warranty covers all systems and components.
- Quick-ship (QS) models with selected features are available. See your Kohler distributor for details.
- Meets 291 kph (181 mph) wind load rating.
- RDC2 Controller
  - One digital controller manages both the generator set and transfer switch functions (with optional Model RXT transfer switch).
  - Designed for today's most sophisticated electronics.
  - Electronic speed control responds quickly to varying household demand.
  - Digital voltage regulation protects your valuable electronics from harmonic distortion and unstable power quality.
  - Two-line, backlit LCD screen is easy to read in all lighting conditions, including direct sunlight and low light.
- Engine Features
  - Powerful and reliable 2.2 L liquid-cooled engine
  - Electronic engine management system.
  - Simple field conversion between natural gas and LPG fuels while maintaining emission certification.
- Innovative Cooling System
  - Electronically controlled fan speeds minimize generator set sound signature.
- Certifications
  - The 60 Hz generator set engine is certified by the Environmental Protection Agency (EPA) to conform to the New Source Performance Standard (NSPS) for stationary spark-ignited emissions.
  - UL 2200/cUL listing is available (60 Hz only).
  - CSA certification is available (60 Hz only).
  - Accepted by the Massachusetts Board of Registration of Plumbers and Gas Fitters.
- Approved for stationary standby applications in locations served by a reliable utility source.

Generator Set Ratings

				Standby Ratings			
				Natural Gas		LPG	
Alternator	Voltage	Ph	Hz	kW/kVA	Amps	kW/kVA	Amps
4E5.0	120/240	1	60	21/21	87	24/24	100
4D5.0	120/208	3	60	21/26	73	23/28	80
	127/220	3	60	21/26	69	23/28	75
	120/240	3	60	21/26	63	23/28	69
	277/480	3	60	21/26	32	23/28	35
	220/380*	3	50	16/20	30	17/22	33
	230/400	3	50	16/21	30	18/23	33
	240/416*	3	50	16/21	29	18/23	32

* 50 Hz models are factory-connected as 230/400 volts. Field-adjustable to 220/380 or 240/416 volts by an authorized service technician.

RATINGS: All three-phase units are rated at 0.8 power factor. All single-phase units are rated at 1.0 power factor. Due to manufacturing variations, the ratings tolerance is ±5%. *Standby Ratings:* Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads with an average load factor of 80% for the duration of a power outage. No overload capacity is specified for this rating. Ratings are in accordance with ISO-3046/1, BS 5514, AS 2789, and DIN 6271. GENERAL GUIDELINES FOR DERATING: *Altitude:* Derate 1.3% per 100 m (328 ft.) elevation above 200 m (656 ft.). *Temperature:* Derate 3.0% per 10°C (18°F) temperature above 25°C (77°F). Availability is subject to change without notice. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler generator distributor for availability.

Alternator Specifications

Specifications	Alternator
Manufacturer	Kohler
Type	4-Pole, Rotating Field
Exciter type	Brushless, Wound-Field
Leads: quantity, type	
4E5.0	4, 120/240
4D5.0	12, Reconnectable
Voltage regulator	Solid State, Volts/Hz
Insulation:	NEMA MG1
Material	Class H
Temperature rise	130°C, Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible Disc
Voltage regulation, no-load to full-load	±1.0% Maximum
Unbalanced load capability	100% of Rated Standby Current
One-step load acceptance	100% of Rating
Peak motor starting kVA:	(35% dip for voltages below)
240 V 4E5.0 (4 lead)	37 (60 Hz)
480 V, 400 V 4D5.0 (12 lead)	59 (60 Hz) 44 (50 Hz)

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and drip-proof construction.
- Windings are vacuum-impregnated with epoxy varnish for dependability and long life.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.
- Total harmonic distortion (THD) from no load to full load with a linear load is less than 5%.

Application Data

Engine

Engine Specifications	60 Hz	50 Hz
Manufacturer	Kohler	
Engine: model, type	Residential Powertrain KG2204, 2.2 L, 4-Cycle Natural Aspiration	
Cylinder arrangement	In-line 4	
Displacement, L (cu. in.)	2.2 (134.25)	
Bore and stroke, mm (in.)	91 x 86 (3.5 x 3.4)	
Compression ratio	10.5:1	
Piston speed, m/min. (ft./min.)	310 (1016)	258 (847)
Main bearings: quantity, type	5, plain alloy steel	
Rated rpm	1800	1500
Max. power at rated rpm, kW (HP)		
LPG	30 (40)	NA
Natural Gas	27 (36)	NA
Cylinder head material	Cast Iron	
Piston type and material	High Silicon Aluminum	
Crankshaft material	Nodular Iron	
Valve (exhaust) material	Forged Steel	
Governor type	Electronic	
Frequency regulation, no-load to full-load	Isochronous	
Frequency regulation, steady state	±1.0%	
Frequency	Fixed	
Air cleaner type	Dry	

Engine Electrical

Engine Electrical System	
Ignition system	Electronic
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	14
Ampere rating	90
Starter motor rated voltage (DC)	12
Battery, recommended rating for −18°C (0°F):	
Qty., cold cranking amps (CCA)	One, 630
Battery voltage (DC)	12
Battery group size	24

Exhaust

Exhaust System	60 Hz	50 Hz
Exhaust manifold type	Dry	
Exhaust temperature at rated kW, dry exhaust, °C (°F)	633 (1171)	
Maximum allowable back pressure, kPa (in. Hg)	7.5 (2.2)	

Fuel

Fuel System	
Fuel type	Natural Gas or LPG
Fuel supply line inlet	1 in. NPT
Natural gas fuel supply pressure, kPa (in. H_2O)	1.24−2.74 (5-11)
LPG vapor withdrawal fuel supply pressure, kPa (in. H_2O)	1.24−2.74 (5-11)

~0.18 psi

0.4 psi

Fuel Composition Limits *	Nat. Gas	LP Gas
Methane, % by volume	90 min.	—
Ethane, % by volume	4.0 max.	—
Propane, % by volume	1.0 max.	85 min.
Propene, % by volume	0.1 max.	5.0 max.
C_4 and higher, % by volume	0.3 max.	2.5 max.
Sulfur, ppm mass	25 max.	
Lower heating value, MJ/m^3 (Btu/ft^3), min.	33.2 (890)	84.2 (2260)

* Fuels with other compositions may be acceptable. If your fuel is outside the listed specifications, contact your local distributor for further analysis and advice.

Lubrication

Lubricating System	
Type	Full Pressure
Oil pan capacity, L (qt.)	4.2 (4.4)
Oil added during oil change (on average), L (qt.)	3.3 (3.5)
Oil filter: quantity, type	1, Cartridge

Application Data

Cooling

Radiator System	60 Hz	50 Hz
Ambient temperature, °C (°F)	45 (113)	
Engine jacket water capacity, L (gal.)	2.65 (0.7)	
Radiator system capacity, including engine, L (gal.)	13.2 (3.5)	
Water pump type	Centrifugal	
Fan diameter, mm (in.)	qty. 3 @ 406 (16)	
Fan power requirements (powered by engine battery charging alternator)	12VDC, 18 amps each	

Operation Requirements

Air Requirements	60 Hz	50 Hz
Radiator-cooled cooling air, m^3/min. (scfm)†	51 (1800)	51 (1800)
Combustion air, m^3/min. (cfm)	1.4 (49)	1.2 (42)
Air over engine, m^3/min. (cfm)	25 (900)	25 (900)

† Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Fuel Consumption‡

Natural Gas, m^3/hr. (cfh) at % load	60 Hz	50 Hz
100%	8.5 (301)	7.8 (275)
75%	6.3 (223)	6.4 (225)
50%	5.6 (199)	5.4 (192)
25%	4.0 (140)	3.3 (116)
Exercise	2.8 (97)	2.9 (103)

LP Gas, m^3/hr. (cfh) at % load	60 Hz	50 Hz
100%	3.2 (113)	2.7 (96)
75%	2.8 (97)	2.3 (81)
50%	2.4 (84)	2.0 (72)
25%	1.8 (63)	1.7 (60)
Exercise	1.4 (51)	1.4 (48)

‡ Nominal Fuel Rating: Natural gas, 37 MJ/m^3 (1000 Btu/ft^3)
LP Vapor, 93 MJ/m^3 (2500 Btu/ft^3)

LP vapor conversion factors:
8.58 $ft.^3$ = 1 lb.
0.535 m^3 = 1 kg.
36.39 $ft.^3$ = 1 gal.

Sound Enclosure Features

- Sound-attenuating enclosure uses acoustic insulation that meets UL 94 HF1 flammability classification and repels moisture absorption.
- Internally mounted critical silencer.
- Skid-mounted, aluminum construction with two removable access panels.
- Fade-, scratch-, and corrosion-resistant Kohler® cashmere powder-baked finish.

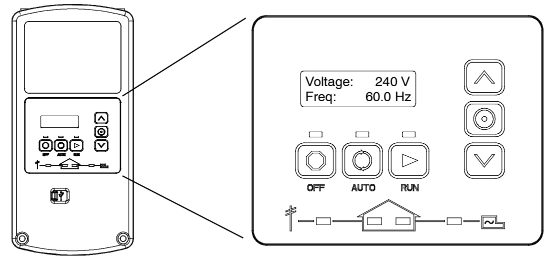
Sound Data

Model 24RCL 8 point logarithmic average sound levels are 54 dB(A) during weekly engine exercise and 61 dB(A) during full-speed generator diagnostics and normal operation. For comparison to competitor ratings, the lowest point sound levels are 52 dB(A) and 60 dB(A) respectively.*

All sound levels are measured at 7 meters with no load.

* Lowest of 8 points measured around the generator. Sound levels at other points around generator may vary depending on installation parameters.

RDC2 Controller



The RDC2 controller provides integrated control for the generator set, Kohler® Model RXT transfer switch, programmable interface module (PIM), and load management.

The RDC2 controller's 2-line LCD screen displays status messages and system settings that are clear and easy to read, even in direct sunlight or low light.

RDC2 Controller Features

- Membrane keypad
  - OFF, AUTO, and RUN push buttons
  - Select and arrow buttons for access to system configuration and adjustment menus
- LED indicators for OFF, AUTO, and RUN modes
- LED indicators for utility power and generator set source availability and ATS position (Model RXT transfer switch required)
- LCD screen
  - Two lines x 16 characters per line
  - Backlit display with adjustable contrast for excellent visibility in all lighting conditions
- Scrolling system status display
  - Generator set status
  - Voltage and frequency
  - Engine temperature
  - Oil pressure
  - Battery voltage
  - Engine runtime hours
- Date and time displays
- Smart engine cooldown senses engine temperature
- Digital isochronous governor to maintain steady-state speed at all loads
- Digital voltage regulation: ±1.0% RMS no-load to full-load
- Automatic start with programmed cranking cycle
- Programmable exerciser can be set to start automatically on any future day and time, and to run every week or every two weeks
- Exercise modes
  - Unloaded exercise with complete system diagnostics
  - Unloaded full-speed exercise
  - Loaded full-speed exercise (Model RXT ATS required)
- Front-access mini USB connector for SiteTech™ connection
- Integral Ethernet connector for Kohler® OnCue® Plus
- Built-in 2.5 amp battery charger
- Remote two-wire start/stop capability for optional connection of a Model RDT transfer switch

See additional controller features on the next page.

KOHLER

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Additional RDC2 Controller Features

- Diagnostic messages
  - Displays diagnostic messages for the engine, generator, Model RXT transfer switch, programmable interface module (PIM), and load management device
  - Over 70 diagnostic messages can be displayed
- Maintenance reminders
- System settings
  - System voltage, frequency, and phase
  - Voltage adjustment
  - Measurement system, English or metric
- ATS status (Model RXT ATS required)
  - Source availability
  - ATS position (normal/utility or emergency/generator)
  - Source voltage and frequency
- ATS control (Model RXT ATS required)
  - Source voltage and frequency settings
  - Engine start time delay
  - Transfer time delays
  - Fixed pickup and dropout settings
  - Voltage calibration
- Programmable interface module (PIM) status displays
  - Input status (active/inactive)
  - Output status (active/inactive)
- Load control menus
  - Load status
  - Test function

Generator Set Standard Features

- Aluminum sound enclosure with enclosed silencer
- Battery rack and cables
- Electronic, isochronous governor
- Flexible fuel line
- Gas fuel system (includes fuel mixer, electronic secondary gas regulator, two gas solenoid valves, and flexible fuel line between the engine and the skid-mounted fuel system components)
- Integral vibration isolation
- Line circuit breaker
- Oil drain extension
- OnCue® Plus Generator Management System
- Operation and installation literature
- RDC2 controller with built-in battery charger
- Standard five-year or 2000 hour limited warranty

Available Options

Approvals and Listings

❑ UL 2200/cUL Listing (60 Hz only)
❑ CSA Approval (60 Hz only)

Controller Accessories

❑ Lockable Emergency Stop (lockout/tagout)
❑ Programmable Interface Module (PIM) (provides 2 digital inputs and 6 relay outputs)

Electrical System

❑ Battery
❑ Battery Heater

Available Options, Continued

Starting Aids

❑ Oil Pan Heater, 120 V, 1 Ph
❑ Oil Pan Heater, 240 V, 1 Ph

Recommended for ambient temperatures below 0°C (32°F).

Automatic Transfer Switches and Accessories

❑ Model RDT Automatic Transfer Switch
❑ Model RXT Automatic Transfer Switch
❑ Model RXT Automatic Transfer Switch with Combined Interface/Load Management Board
❑ Load Shed Kit for RDT or RXT
❑ Power Relay Modules (use up to 4 relay modules for each load management device)

Miscellaneous

❑ Rated Power Factor Testing

Literature

❑ General Maintenance Literature Kit
❑ Overhaul Literature Kit
❑ Production Literature Kit

Warranty

❑ Extended 5-Year/2000 Hour Comprehensive Limited Warranty

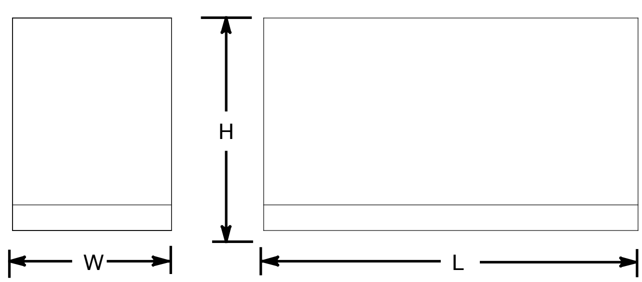
Other Options

❑ ____
❑ ____

Dimensions and Weights

Overall Size, L x W x H, mm (in.):	1880 x 836 x 1169 (74 x 32.9 x 46.0)
Shipping Weight, wet, kg (lb.):	572 (1260)

Weight includes generator set with engine fluids, sound enclosure, silencer, and packaging.



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

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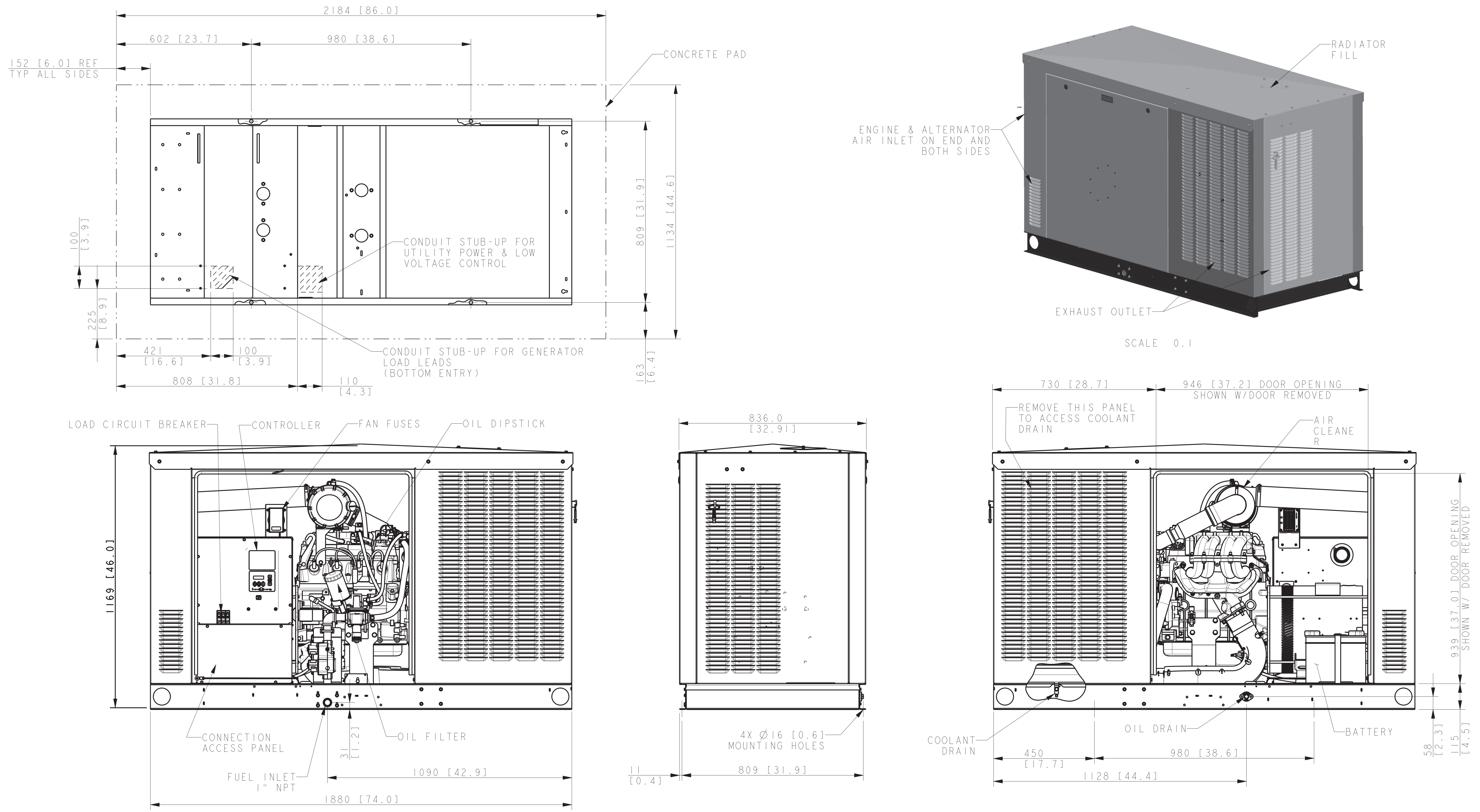


NOTE: DIMENSIONS IN [ ] ARE ENGLISH STANDARD EQUIVALENTS.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	10-31-13	NEW DRAWING [CT79277]	DRA
A	6-3-14	(C-8) 225 WAS 211, 100 WAS 123, (C-7) 421 WAS 392, 100 WAS 216 [CT83066]	DRA
B	6-10-15	UPDATED VIEWS TO SHOW CROSS BENT, PITCHED ROOF [CT115573]	BGP
C	2-25-19	SEE SHEET 2 [CT193814]	HM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DRA	10-31-13
CHECKED	GFR	10-31-13
APPROVED	JJR	10-31-13

KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

TITLE
DIMENSION PRINT

SCALE 0.13 | CAD NO. | SHEET 1 of 2

DWG NO. ADV-8641 D

24RCL

ATTACHMENT C – STRUCTURAL ANALYSIS REPORT

Date: **March 26, 2020**

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

Subject:	**Structural Analysis Report**	
Eversource Designation:	**Site Number:** **Site Name:**	ES-001 CheshireAWC
Engineering Firm Designation:	**Black & Veatch Corp. Project Number:**	403093
Site Data:	**705 West Johnson Avenue, Cheshire, New Haven County, CT** **Latitude *41° 33' 21.1"*, Longitude *-72° 55' 1.9"*** **140 Foot - Self Support Tower**	

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

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

LC1: Proposed Equipment Configuration **Sufficient Capacity – 88.7%**

This analysis utilizes an ultimate 3-second gust wind speed of 135 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: Changzhi Zang / Teddy Haile-Mariam

Respectfully submitted by:

Joshua J. Riley, P.E.
Professional Engineer

STATE OF CONNECTICUT JOSHUA J. RILEY 33208 LICENSED PROFESSIONAL ENGINEER

03/26/2020

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 140 ft Self Support tower manufactured by Central Tower in October of 2004.

2) ANALYSIS CRITERIA

TIA-222 Revision: TIA-222-H
Risk Category: III
Wind Speed: 135 mph ultimate
Exposure Category: C
Topographic Factor: 1
Ice Thickness: 1.5 in
Wind Speed with Ice: 50 mph
Seismic Ss: 0.186
Seismic S_1: 0.064
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
137.0	150.0	1	dbspectra	DS2C03F36D-D	2	7/8	-
	137.0	1	site pro 1	R5-LL [PM 601-1]			

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
140.0	146.0	1	celwave	PD1142-2C	1 2	1 5/8 7/8	1
138.0	138.0	6	andrew	SBNHH-1D65B w/Mount Pipe	14	1 5/8	1
		3	antel	BXA-70063/6CF w/ Mount Pipe			
		1	tower mounts	Sector Mount [SM 409-3]			
		3	decibel	DB854DG65ESX w/Mount Pipe			
		6	rfs celwave	FD9R6004/2C-3L			
		3	alcatel lucent	RRH2x60-700			
		3	alcatel lucent	RRH2x60-AWS			
		1	rfs miscl	DB-T1-6Z-8AB-0Z			
98.0	98.0	6	cci antennas	DTMABP7819VG12A	12 1 1	1-5/8 Conduit 1/4	1
		3	cci antennas	HPA-65R-BUU-H6 w/ Mount Pipe			
		1	tower mounts	Sector Mount [SM 409-3]			
		3	ericsson	RRUS 11			
		3	ericsson	RRUS 12			
		3	ericsson	RRUS A2 MODULE			
		6	kmw	AM-X-CD-16-65-00T-RET			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
			communications	w/ Mount Pipe			
		1	raycap	DC6-48-60-18-8F			
83.0	83.0	1	andrew	PL4-107	1	EW90	1
		1	tower mounts	Pipe Mount [PM 602-1]			

Note:
1) Existing Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
GEOTECHNICAL REPORTS	Dr. Clarence Welti, P.E., P.C., dated 09/20/2004	-	Eversource
TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	URS Corp., dated 10/26/2004	-	Eversource
TOWER MANUFACTURER DRAWINGS	Central Tower, dated 10/3/2004	-	Eversource
TOWER STRUCTURAL ANALYSIS REPORTS	Centek Engineering, dated 3/16/2017	-	Eversource
TOWER STRUCTURAL ANALYSIS REPORTS	All-Points Technology Corp. dated 03/20/2018	-	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 tower loading is based on 2018 drone mapping photos and the previous tower analysis.
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.

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.

Table 4 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
T1	140 - 120	Leg	1 3/4	3	-28.60	62.31	45.9	Pass
T2	120 - 100	Leg	2 1/2	48	-72.49	172.77	42.0	Pass
T3	100 - 80	Leg	3 1/2	93	-107.72	246.30	43.7	Pass
T4	80 - 60	Leg	3 3/4	114	-143.06	305.99	46.8	Pass
T5	60 - 40	Leg	4	135	-176.74	371.39	47.6	Pass
T6	40 - 20	Leg	4 1/4	156	-209.56	442.35	47.4	Pass
T7	20 - 0	Leg	4 1/2	177	-241.10	518.69	46.5	Pass
T1	140 - 120	Diagonal	3/4	15	-3.31	3.73	88.7	Pass
T2	120 - 100	Diagonal	7/8	60	-4.37	7.09	61.6	Pass
T3	100 - 80	Diagonal	L2x2x1/4	98	-5.23	14.95	35.0 41.0 (b)	Pass
T4	80 - 60	Diagonal	L2 1/2x2 1/2x3/16	119	-5.70	17.53	32.5 48.2 (b)	Pass
T5	60 - 40	Diagonal	L2 1/2x2 1/2x3/16	140	-6.25	13.51	46.3 52.6 (b)	Pass
T6	40 - 20	Diagonal	L2 1/2x2 1/2x1/4	161	-6.82	13.74	49.7	Pass
T7	20 - 0	Diagonal	L3x3x3/16	182	-7.39	14.80	50.0 55.4 (b)	Pass
T1	140 - 120	Top Girt	3/4	5	-0.34	2.22	15.5	Pass
T2	120 - 100	Top Girt	7/8	50	-0.02	4.21	0.5	Pass
T1	140 - 120	Bottom Girt	3/4	7	-0.29	2.22	12.9	Pass
T2	120 - 100	Bottom Girt	7/8	52	-0.64	4.21	15.2	Pass
							Summary	
						Leg (T5)	47.6	Pass
						Diagonal (T1)	88.7	Pass
						Top Girt (T1)	15.5	Pass
						Bottom Girt (T2)	15.2	Pass
						Bolt Checks	55.4	Pass
						Rating =	88.7	Pass

Table 5 - Tower Component Stresses vs. Capacity - LC1

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	52.1	Pass
1	Base Foundation	0	51.6	Pass
	Base Foundation Soil Interaction		40.5	Pass

Structure Rating (max from all components) =	88.7%

Notes:

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

4.1) Recommendations

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

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °	*Check**
T1	140 - 120	1.903	45	0.13	0.0509	OK
T2	120 - 100	1.361	39	0.1144	0.0484	OK
T3	100 - 80	0.913	39	0.0857	0.0406	OK
T4	80 - 60	0.582	39	0.0647	0.0317	OK
T5	60 - 40	0.333	39	0.0457	0.0232	OK
T6	40 - 20	0.157	39	0.0287	0.0143	OK

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

1) Maximum Rotation = 4 Degrees

2) Maximum Deflection = 0.03 * Tower Height = 50 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?*
83	PL4-107	0.0675	0.033	4	10	10 dB	1.328	Not Exceeded

*Limit per TIA-222-H Annex D

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °	*Combined Max*	*Check**
T1	140 - 120	5.835	39	0.3956	0.1559	0.425	OK
T2	120 - 100	4.18	39	0.3491	0.1481	0.379	OK
T3	100 - 80	2.805	39	0.2623	0.1244	0.290	OK
T4	80 - 60	1.788	39	0.1988	0.0971	0.221	OK
T5	60 - 40	1.023	39	0.1405	0.071	0.157	OK
T6	40 - 20	0.482	39	0.0883	0.0439	0.099	OK

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

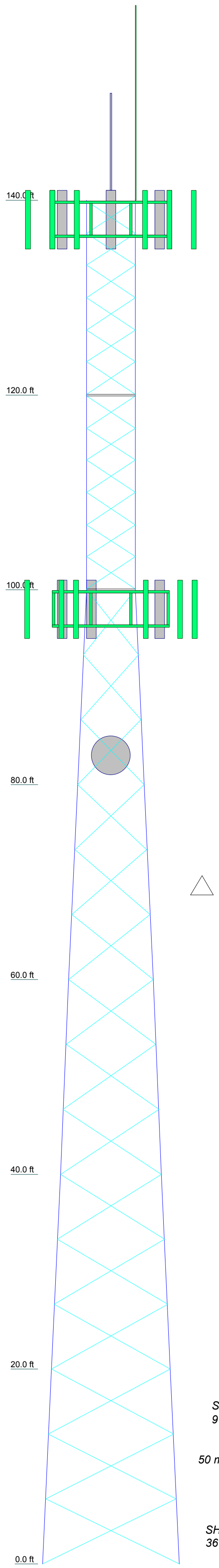
Critical Deflections of Tower at the MW Dish Elevations - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
83	PL4-107	39	1.922	0.2073	0.1011	19408.000

APPENDIX A

TNXTOWER OUTPUT

Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Bottom Girts	Face Width (ft)	# Panels @ (ft)	Weight (K)
T1	SR 1 3/4	A572-50	SR 3/4	A36	SR 3/4	SR 3/4	5	12 @ 3.30556	0.9
T2	SR 2 1/2		SR 7/8		SR 7/8	SR 7/8			1.5
T3	SR 3 1/2		L2x2x1/4		N.A.	N.A.		15 @ 6.66667	2.6
T4	SR 3 3/4		L2 1/2x2 1/2x3/16				6.8		3.0
T5	SR 4						8.6		3.4
T6	SR 4 1/4		L2 1/2x2 1/2x1/4				10.4		4.0
T7	SR 4 1/2		L3x3x3/16				12.2		4.4
							14		19.8



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
PD1142-2C	140	6' x 2" Mount Pipe	98
Sector Mount [SM 409-3]	138	(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	98
(2) SBNHH-1D65B_TIA w/ Mount Pipe	138	(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	98
(2) SBNHH-1D65B_TIA w/ Mount Pipe	138	(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	98
(2) SBNHH-1D65B_TIA w/ Mount Pipe	138	HPA-65R-BUU-H4 w/ Mount Pipe	98
BXA-70063/6CF w/ Mount Pipe	138	HPA-65R-BUU-H4 w/ Mount Pipe	98
BXA-70063/6CF w/ Mount Pipe	138	HPA-65R-BUU-H4 w/ Mount Pipe	98
BXA-70063/6CF w/ Mount Pipe	138	(2) DTMABP7819VG12A	98
DB854DG65ESX w/Mount Pipe	138	(2) DTMABP7819VG12A	98
DB854DG65ESX w/Mount Pipe	138	(2) DTMABP7819VG12A	98
DB854DG65ESX w/Mount Pipe	138	RRUS 11	98
(2) FD9R6004/2C-3L	138	RRUS 11	98
(2) FD9R6004/2C-3L	138	RRUS 11	98
(2) FD9R6004/2C-3L	138	RRUS 12	98
RRH2x60-700	138	RRUS 12	98
RRH2x60-700	138	RRUS 12	98
RRH2x60-700	138	RRUS A2 MODULE	98
RRH2x60-AWS	138	RRUS A2 MODULE	98
RRH2x60-AWS	138	RRUS A2 MODULE	98
RRH2x60-AWS	138	DC6-48-60-18-8F	98
DB-T1-6Z-8AB-0Z	138	Sector Mount [SM 409-3]	98
DS2C03F36D-D	137	6' x 2" Mount Pipe	98
R5-LL (Pipe Mount [PM 601-1])	137	Pipe Mount [PM 602-1]	83
6' x 2" Mount Pipe	98	PL4-107	83

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in New Haven County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-H Standard.
3. Tower designed for a 135 mph basic wind in accordance with the TIA-222-H Standard.
4. Tower is also designed for a 50 mph basic wind with 1.50 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Risk Category III.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 88.7%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 246 K
SHEAR: 22 K

UPLIFT: -220 K
SHEAR: 20 K

AXIAL 91 K
SHEAR 9 K
MOMENT 772 kip-ft
TORQUE 7 kip-ft
50 mph WIND - 1.5000 in ICE

AXIAL 36 K
SHEAR 36 K
MOMENT 2836 kip-ft
TORQUE 34 kip-ft
REACTIONS - 135 mph WIND

BLACK & VEATCH Building a world of difference.	*Black & Veatch Corp.* 6800 W. 115th St., Suite 2292 Overland Park, KS 66211 Phone: (913) 458-6909 FAX:	Job: ***ES-001 CheshireAWC***
		Project: ***403093***
		Client: Eversource / Drawn by: Preechaya Sirisuwan / App'd:
		Code: TIA-222-H / Date: 02/19/20 / Scale: NTS
		Path: C:\Users\sir94358\Desktop\Eversource\4. CheshireAWC\Structural\Rev. H\CheshireAWC Structural Analysis.eri / Dwg No. E-1

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 140.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 5.00 ft at the top and 14.00 ft at the base.
This tower is designed using the TIA-222-H standard.
The following design criteria apply:

1) Tower is located in New Haven County, Connecticut.
2) Tower base elevation above sea level: 132.00 ft.
3) Basic wind speed of 135 mph.
4) Risk Category III.
5) Exposure Category C.
6) Simplified Topographic Factor Procedure for wind speed-up calculations is used.
7) Topographic Category: 1.
8) Crest Height: 0.00 ft.
9) Nominal ice thickness of 1.5000 in.
10) Ice thickness is considered to increase with height.
11) Ice density of 56 pcf.
12) A wind speed of 50 mph is used in combination with ice.
13) Temperature drop of 50 °F.
14) Deflections calculated using a wind speed of 60 mph.
15) Pressures are calculated at each section.
16) Stress ratio used in tower member design is 1.05.
17) Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

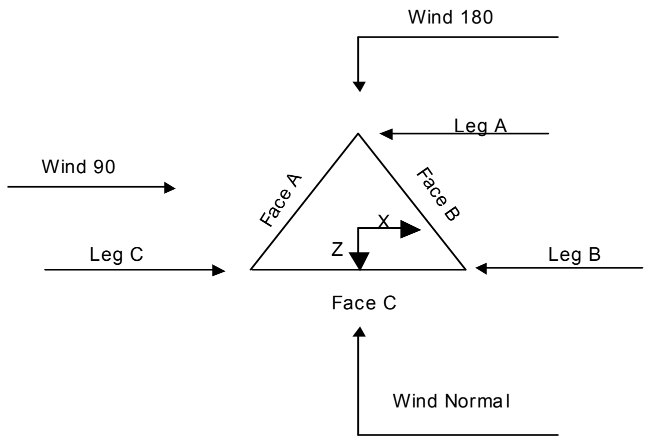
Consider Moments - Legs
Consider Moments - Horizontals
Consider Moments - Diagonals
Use Moment Magnification
Use Code Stress Ratios
√ Use Code Safety Factors - Guys
Escalate Ice
Always Use Max Kz
Use Special Wind Profile
√ Include Bolts In Member Capacity
Leg Bolts Are At Top Of Section
√ Secondary Horizontal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

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

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

Poles

Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets
Pole Without Linear Attachments
Pole With Shroud Or No Appurtenances
Outside and Inside Corner Radii Are Known



Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	140.00-120.00			5.00	1	20.00
T2	120.00-100.00			5.00	1	20.00
T3	100.00-80.00			5.00	1	20.00
T4	80.00-60.00			6.80	1	20.00
T5	60.00-40.00			8.60	1	20.00
T6	40.00-20.00			10.40	1	20.00
T7	20.00-0.00			12.20	1	20.00

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	140.00-120.00	3.31	X Brace	No	No	1.0000	1.0000
T2	120.00-100.00	3.31	X Brace	No	No	1.0000	1.0000
T3	100.00-80.00	6.67	X Brace	No	No	0.0000	0.0000
T4	80.00-60.00	6.67	X Brace	No	No	0.0000	0.0000
T5	60.00-40.00	6.67	X Brace	No	No	0.0000	0.0000
T6	40.00-20.00	6.67	X Brace	No	No	0.0000	0.0000
T7	20.00-0.00	6.67	X Brace	No	No	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Type*	*Leg Size*	*Leg Grade*	*Diagonal Type*	*Diagonal Size*	*Diagonal Grade*
T1 140.00-120.00	Solid Round	1 3/4	A572-50 (50 ksi)	Solid Round	3/4	A36 (36 ksi)
T2 120.00-100.00	Solid Round	2 1/2	A572-50 (50 ksi)	Solid Round	7/8	A36 (36 ksi)
T3 100.00-80.00	Solid Round	3 1/2	A572-50 (50 ksi)	Equal Angle	L2x2x1/4	A36 (36 ksi)
T4 80.00-60.00	Solid Round	3 3/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T5 60.00-40.00	Solid Round	4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T6 40.00-20.00	Solid Round	4 1/4	A572-50 (50 ksi)	Equal Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)
T7 20.00-0.00	Solid Round	4 1/2	A572-50 (50 ksi)	Equal Angle	L3x3x3/16	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Top Girt Type*	*Top Girt Size*	*Top Girt Grade*	*Bottom Girt Type*	*Bottom Girt Size*	*Bottom Girt Grade*
T1 140.00-120.00	Solid Round	3/4	A36 (36 ksi)	Solid Round	3/4	A36 (36 ksi)
T2 120.00-100.00	Solid Round	7/8	A36 (36 ksi)	Solid Round	7/8	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Gusset Area (per face)* *ft²*	*Gusset Thickness* *in*	*Gusset Grade*	*Adjust. Factor A_f*	*Adjust. Factor A_r*	*Weight Mult.*	*Double Angle Stitch Bolt Spacing Diagonals* *in*	*Double Angle Stitch Bolt Spacing Horizontals* *in*	*Double Angle Stitch Bolt Spacing Redundants* *in*
T1 140.00-120.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T2 120.00-100.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T3 100.00-80.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T4 80.00-60.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T5 60.00-40.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T6 40.00-20.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000
T7 20.00-0.00	0.00	0.0000	A36 (36 ksi)	1.05	1	1.05	36.0000	36.0000	36.0000

Tower Section Geometry *(cont'd)*

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 140.00-120.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T2 120.00-100.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T3 100.00-80.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T4 80.00-60.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T5 60.00-40.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T6 40.00-20.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1
T7 20.00-0.00	Yes	Yes	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1

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

Tower Section Geometry *(cont'd)*

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 140.00-120.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75
T2 120.00-100.00	0.0000	1	0.0000	1	0.0000	1	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75
T3 100.00-80.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T4 80.00-60.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T5 60.00-40.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T6 40.00-20.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T7 20.00-0.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
		Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.
T1 140.00-120.00	Flange	1.0000 A325N	4	0.7500 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 120.00-100.00	Flange	1.0000 A325N	6	0.7500 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T3 100.00-80.00	Flange	1.1250 A325N	6	0.7500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T4 80.00-60.00	Flange	1.1250 A325N	6	0.7500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	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.
T5 60.00-40.00	Flange	1.2500 A325N	6	0.7500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T6 40.00-20.00	Flange	1.2500 A325N	6	0.7500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T7 20.00-0.00	Flange	1.2500 A449	0	0.7500 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Safety Line 3/8	C	No	No	Ar (CaAa)	140.00 - 0.00	0.0000	0.5	1	1	0.3750	0.3750		0.22
Feedline Ladder (Af)	C	No	No	Af (CaAa)	138.00 - 0.00	0.0000	0.4	1	1	3.0000	3.0000		8.40
Feedline Ladder (Af)	A	No	No	Af (CaAa)	98.00 - 0.00	0.0000	-0.4	1	1	3.0000	3.0000		8.40
Feedline Ladder (Af)	B	No	No	Af (CaAa)	140.00 - 0.00	0.0000	-0.4	1	1	3.0000	3.0000		8.40
***													
LDF7-50A(1-5/8)	B	No	No	Ar (CaAa)	140.00 - 8.00	0.0000	-0.42	1	1	0.5000	1.9800		0.82
VXL5-50(7/8)	B	No	No	Ar (CaAa)	140.00 - 8.00	0.0000	-0.4	2	2	0.5000	1.0800		0.29
***													
LDF7-50A(1-5/8)	C	No	No	Ar (CaAa)	138.00 - 8.00	0.0000	0.38	14	7	0.5000	1.9800		0.82
***													
LDF7-50A(1-5/8)	A	No	No	Ar (CaAa)	98.00 - 8.00	0.0000	-0.35	12	6	0.5000	1.9800		0.82
2" innerduct conduit	A	No	No	Ar (CaAa)	98.00 - 8.00	0.0000	-0.42	1	1	0.5000	2.0000		0.20
LDF1-50A(1/4)	A	No	No	Ar (CaAa)	98.00 - 8.00	0.0000	-0.4	1	1	0.3450	0.3450		0.06
***													
EW90	B	No	No	Ar (CaAa)	83.00 - 8.00	0.0000	-0.35	1	1	0.5000	0.9869		0.32
** Proposed for Discrete Loads													
LDF5-50A(7/8)	B	No	No	Ar (CaAa)	137.00 - 0.00	0.0000	-0.44	2	2	0.5000	1.0300		0.33

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	140.00-120.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	21.782	0.000	0.21
		C	0.000	0.000	59.646	0.000	0.36
T2	120.00-100.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	22.400	0.000	0.21
		C	0.000	0.000	66.190	0.000	0.40
T3	100.00-80.00	A	0.000	0.000	55.989	0.000	0.33
		B	0.000	0.000	22.696	0.000	0.21
		C	0.000	0.000	66.190	0.000	0.40

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T4	80.00-60.00	A	0.000	0.000	62.210	0.000	0.37
		B	0.000	0.000	24.374	0.000	0.22
		C	0.000	0.000	66.190	0.000	0.40
T5	60.00-40.00	A	0.000	0.000	62.210	0.000	0.37
		B	0.000	0.000	24.374	0.000	0.22
		C	0.000	0.000	66.190	0.000	0.40
T6	40.00-20.00	A	0.000	0.000	62.210	0.000	0.37
		B	0.000	0.000	24.374	0.000	0.22
		C	0.000	0.000	66.190	0.000	0.40
T7	20.00-0.00	A	0.000	0.000	41.326	0.000	0.29
		B	0.000	0.000	20.272	0.000	0.20
		C	0.000	0.000	44.014	0.000	0.31

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
T1	140.00-120.00	A	1.978	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	68.016	0.000	1.07
		C		0.000	0.000	75.308	0.000	1.62
T2	120.00-100.00	A	1.946	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	70.372	0.000	1.08
		C		0.000	0.000	82.238	0.000	1.76
T3	100.00-80.00	A	1.907	0.000	0.000	78.788	0.000	1.59
		B		0.000	0.000	70.961	0.000	1.08
		C		0.000	0.000	81.677	0.000	1.73
T4	80.00-60.00	A	1.860	0.000	0.000	86.661	0.000	1.73
		B		0.000	0.000	77.892	0.000	1.16
		C		0.000	0.000	80.991	0.000	1.70
T5	60.00-40.00	A	1.798	0.000	0.000	85.516	0.000	1.68
		B		0.000	0.000	76.292	0.000	1.12
		C		0.000	0.000	80.100	0.000	1.66
T6	40.00-20.00	A	1.709	0.000	0.000	83.850	0.000	1.61
		B		0.000	0.000	73.964	0.000	1.05
		C		0.000	0.000	78.803	0.000	1.59
T7	20.00-0.00	A	1.531	0.000	0.000	54.777	0.000	1.04
		B		0.000	0.000	55.010	0.000	0.77
		C		0.000	0.000	54.939	0.000	1.07

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	140.00-120.00	-10.5308	-3.7823	-6.1674	-4.2979
T2	120.00-100.00	-10.2980	-3.0747	-6.3239	-3.9908
T3	100.00-80.00	-13.1347	0.9841	-12.3501	-1.0781
T4	80.00-60.00	-15.3579	1.0325	-14.7944	-1.8970
T5	60.00-40.00	-17.7709	1.2157	-17.2892	-2.1628
T6	40.00-20.00	-19.8669	1.3747	-19.5012	-2.3554
T7	20.00-0.00	-15.4025	0.2455	-16.7796	-2.5553

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	Safety Line 3/8	120.00 - 140.00	0.6000	0.5414
T1	2	Feedline Ladder (Af)	120.00 - 138.00	0.6000	0.5414
T1	4	Feedline Ladder (Af)	120.00 - 140.00	0.6000	0.5414
T1	6	LDF7-50A(1-5/8)	120.00 - 140.00	0.6000	0.5414
T1	7	VXL5-50(7/8)	120.00 - 140.00	0.6000	0.5414
T1	9	LDF7-50A(1-5/8)	120.00 - 138.00	0.6000	0.5414
T1	18	LDF5-50A(7/8)	120.00 - 137.00	0.6000	0.5414
T2	1	Safety Line 3/8	100.00 - 120.00	0.6000	0.5256
T2	2	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.5256
T2	4	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.5256
T2	6	LDF7-50A(1-5/8)	100.00 - 120.00	0.6000	0.5256
T2	7	VXL5-50(7/8)	100.00 - 120.00	0.6000	0.5256
T2	9	LDF7-50A(1-5/8)	100.00 - 120.00	0.6000	0.5256
T2	18	LDF5-50A(7/8)	100.00 - 120.00	0.6000	0.5256
T3	1	Safety Line 3/8	80.00 - 100.00	0.6000	0.6000
T3	2	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T3	3	Feedline Ladder (Af)	80.00 - 98.00	0.6000	0.6000
T3	4	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T3	6	LDF7-50A(1-5/8)	80.00 - 100.00	0.6000	0.6000
T3	7	VXL5-50(7/8)	80.00 - 100.00	0.6000	0.6000
T3	9	LDF7-50A(1-5/8)	80.00 - 100.00	0.6000	0.6000
T3	11	LDF7-50A(1-5/8)	80.00 - 98.00	0.6000	0.6000
T3	12	2" innerduct conduit	80.00 - 98.00	0.6000	0.6000
T3	13	LDF1-50A(1/4)	80.00 - 98.00	0.6000	0.6000
T3	15	EW90	80.00 - 83.00	0.6000	0.6000
T3	18	LDF5-50A(7/8)	80.00 - 100.00	0.6000	0.6000
T4	1	Safety Line 3/8	60.00 - 80.00	0.6000	0.6000
T4	2	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T4	3	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T4	4	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T4	6	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T4	7	VXL5-50(7/8)	60.00 - 80.00	0.6000	0.6000
T4	9	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T4	11	LDF7-50A(1-5/8)	60.00 - 80.00	0.6000	0.6000
T4	12	2" innerduct conduit	60.00 - 80.00	0.6000	0.6000
T4	13	LDF1-50A(1/4)	60.00 - 80.00	0.6000	0.6000
T4	15	EW90	60.00 - 80.00	0.6000	0.6000
T4	18	LDF5-50A(7/8)	60.00 - 80.00	0.6000	0.6000
T5	1	Safety Line 3/8	40.00 - 60.00	0.6000	0.6000
T5	2	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T5	3	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T5	4	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T5	6	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T5	7	VXL5-50(7/8)	40.00 - 60.00	0.6000	0.6000
T5	9	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T5	11	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T5	12	2" innerduct conduit	40.00 - 60.00	0.6000	0.6000
T5	13	LDF1-50A(1/4)	40.00 - 60.00	0.6000	0.6000
T5	15	EW90	40.00 - 60.00	0.6000	0.6000
T5	18	LDF5-50A(7/8)	40.00 - 60.00	0.6000	0.6000
T6	1	Safety Line 3/8	20.00 - 40.00	0.6000	0.6000
T6	2	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T6	3	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T6	4	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T6	6	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T6	7	VXL5-50(7/8)	20.00 - 40.00	0.6000	0.6000
T6	9	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T6	11	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T6	12	2" innerduct conduit	20.00 - 40.00	0.6000	0.6000
T6	13	LDF1-50A(1/4)	20.00 - 40.00	0.6000	0.6000
T6	15	EW90	20.00 - 40.00	0.6000	0.6000
T6	18	LDF5-50A(7/8)	20.00 - 40.00	0.6000	0.6000
T7	1	Safety Line 3/8	0.00 - 20.00	0.6000	0.6000
T7	2	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T7	3	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T7	4	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T7	6	LDF7-50A(1-5/8)	8.00 - 20.00	0.6000	0.6000
T7	7	VXL5-50(7/8)	8.00 - 20.00	0.6000	0.6000
T7	9	LDF7-50A(1-5/8)	8.00 - 20.00	0.6000	0.6000
T7	11	LDF7-50A(1-5/8)	8.00 - 20.00	0.6000	0.6000
T7	12	2" innerduct conduit	8.00 - 20.00	0.6000	0.6000
T7	13	LDF1-50A(1/4)	8.00 - 20.00	0.6000	0.6000
T7	15	EW90	8.00 - 20.00	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T7	18	LDF5-50A(7/8)	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
PD1142-2C	A	From Leg	0.00 0.00 6.00	0.0000	140.00	No Ice 1/2" Ice 1" Ice 2" Ice	2.39 3.36 3.83 4.79	2.39 3.36 3.83 4.79	0.01 0.03 0.06 0.13
***									
Sector Mount [SM 409-3]	C	None		0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	22.33 31.79 41.13 59.78	22.33 31.79 41.13 59.78	1.03 1.48 2.07 3.67
(2) SBNHH-1D65B_TIA w/ Mount Pipe	A	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	8.44 9.00 9.53 10.62	7.10 8.30 9.21 11.06	0.07 0.14 0.21 0.40
(2) SBNHH-1D65B_TIA w/ Mount Pipe	B	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	8.44 9.00 9.53 10.62	7.10 8.30 9.21 11.06	0.07 0.14 0.21 0.40
(2) SBNHH-1D65B_TIA w/ Mount Pipe	C	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	8.44 9.00 9.53 10.62	7.10 8.30 9.21 11.06	0.07 0.14 0.21 0.40
BXA-70063/6CF w/ Mount Pipe	A	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.82 8.37 8.89 9.94	5.41 6.56 7.42 9.20	0.04 0.10 0.17 0.33
BXA-70063/6CF w/ Mount Pipe	B	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.82 8.37 8.89 9.94	5.41 6.56 7.42 9.20	0.04 0.10 0.17 0.33
BXA-70063/6CF w/ Mount Pipe	C	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.82 8.37 8.89 9.94	5.41 6.56 7.42 9.20	0.04 0.10 0.17 0.33
DB854DG65ESX w/Mount Pipe	A	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	6.00 6.64 7.16 8.23	4.41 5.45 6.20 7.70	0.04 0.10 0.15 0.29
DB854DG65ESX w/Mount Pipe	B	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice 1" Ice 2" Ice	6.00 6.64 7.16 8.23	4.41 5.45 6.20 7.70	0.04 0.10 0.15 0.29
DB854DG65ESX w/Mount Pipe	C	From Leg	4.00 0.00 0.00	0.0000	138.00	No Ice 1/2" Ice	6.00 6.64 7.16	4.41 5.45 6.20	0.04 0.10 0.15

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert	Azimuth Adjustment	Placement		C_AA_A Front	C_AA_A Side	Weight
			ft ft ft	°	ft		ft^2	ft^2	K
						1" Ice	8.23	7.70	0.29
						2" Ice			
(2) FD9R6004/2C-3L	A	From Leg	4.00	0.0000	138.00	No Ice	0.31	0.08	0.00
			0.00			1/2"	0.39	0.12	0.01
			0.00			Ice	0.47	0.17	0.01
						1" Ice	0.65	0.29	0.02
						2" Ice			
(2) FD9R6004/2C-3L	B	From Leg	4.00	0.0000	138.00	No Ice	0.31	0.08	0.00
			0.00			1/2"	0.39	0.12	0.01
			0.00			Ice	0.47	0.17	0.01
						1" Ice	0.65	0.29	0.02
						2" Ice			
(2) FD9R6004/2C-3L	C	From Leg	4.00	0.0000	138.00	No Ice	0.31	0.08	0.00
			0.00			1/2"	0.39	0.12	0.01
			0.00			Ice	0.47	0.17	0.01
						1" Ice	0.65	0.29	0.02
						2" Ice			
RRH2x60-700	A	From Leg	4.00	0.0000	138.00	No Ice	3.50	1.82	0.06
			0.00			1/2"	3.76	2.05	0.08
			0.00			Ice	4.03	2.29	0.11
						1" Ice	4.58	2.79	0.17
						2" Ice			
RRH2x60-700	B	From Leg	4.00	0.0000	138.00	No Ice	3.50	1.82	0.06
			0.00			1/2"	3.76	2.05	0.08
			0.00			Ice	4.03	2.29	0.11
						1" Ice	4.58	2.79	0.17
						2" Ice			
RRH2x60-700	C	From Leg	4.00	0.0000	138.00	No Ice	3.50	1.82	0.06
			0.00			1/2"	3.76	2.05	0.08
			0.00			Ice	4.03	2.29	0.11
						1" Ice	4.58	2.79	0.17
						2" Ice			
RRH2x60-AWS	A	From Leg	4.00	0.0000	138.00	No Ice	3.50	2.10	0.06
			0.00			1/2"	3.76	2.34	0.08
			0.00			Ice	4.03	2.58	0.11
						1" Ice	4.58	3.09	0.18
						2" Ice			
RRH2x60-AWS	B	From Leg	4.00	0.0000	138.00	No Ice	3.50	2.10	0.06
			0.00			1/2"	3.76	2.34	0.08
			0.00			Ice	4.03	2.58	0.11
						1" Ice	4.58	3.09	0.18
						2" Ice			
RRH2x60-AWS	C	From Leg	4.00	0.0000	138.00	No Ice	3.50	2.10	0.06
			0.00			1/2"	3.76	2.34	0.08
			0.00			Ice	4.03	2.58	0.11
						1" Ice	4.58	3.09	0.18
						2" Ice			
DB-T1-6Z-8AB-0Z	C	From Leg	4.00	0.0000	138.00	No Ice	4.80	2.00	0.04
			0.00			1/2"	5.07	2.19	0.08
			0.00			Ice	5.35	2.39	0.12
						1" Ice	5.93	2.81	0.21
						2" Ice			
***									
Sector Mount [SM 409-3]	C	None		0.0000	98.00	No Ice	22.33	22.33	1.03
						1/2"	31.79	31.79	1.48
						Ice	41.13	41.13	2.07
						1" Ice	59.78	59.78	3.67
						2" Ice			
6' x 2" Mount Pipe	A	From Leg	4.00	0.0000	98.00	No Ice	1.43	1.43	0.02
			2.00			1/2"	1.92	1.92	0.03
			0.00			Ice	2.29	2.29	0.05
						1" Ice	3.06	3.06	0.09
						2" Ice			
6' x 2" Mount Pipe	B	From Leg	4.00	0.0000	98.00	No Ice	1.43	1.43	0.02
			2.00			1/2"	1.92	1.92	0.03

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	2.29	2.29	0.05
						1" Ice	3.06	3.06	0.09
						2" Ice			
6' x 2" Mount Pipe	C	From Leg	4.00	0.0000	98.00	No Ice	1.43	1.43	0.02
			2.00			1/2"	1.92	1.92	0.03
			0.00			Ice	2.29	2.29	0.05
						1" Ice	3.06	3.06	0.09
						2" Ice			
(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	A	From Leg	4.00	0.0000	98.00	No Ice	4.63	3.27	0.07
			0.00			1/2"	5.06	3.69	0.13
			0.00			Ice	5.51	4.12	0.20
						1" Ice	6.43	5.00	0.38
						2" Ice			
(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	B	From Leg	4.00	0.0000	98.00	No Ice	4.63	3.27	0.07
			0.00			1/2"	5.06	3.69	0.13
			0.00			Ice	5.51	4.12	0.20
						1" Ice	6.43	5.00	0.38
						2" Ice			
(2) AM-X-CD-16-65-00T-RET w/ Mount Pipe	C	From Leg	4.00	0.0000	98.00	No Ice	4.63	3.27	0.07
			0.00			1/2"	5.06	3.69	0.13
			0.00			Ice	5.51	4.12	0.20
						1" Ice	6.43	5.00	0.38
						2" Ice			
HPA-65R-BUU-H4 w/ Mount Pipe	A	From Leg	4.00	0.0000	98.00	No Ice	5.90	4.02	0.06
			-2.00			1/2"	6.42	4.50	0.11
			0.00			Ice	6.96	5.00	0.16
						1" Ice	8.08	6.04	0.31
						2" Ice			
HPA-65R-BUU-H4 w/ Mount Pipe	B	From Leg	4.00	0.0000	98.00	No Ice	5.90	4.02	0.06
			-2.00			1/2"	6.42	4.50	0.11
			0.00			Ice	6.96	5.00	0.16
						1" Ice	8.08	6.04	0.31
						2" Ice			
HPA-65R-BUU-H4 w/ Mount Pipe	C	From Leg	4.00	0.0000	98.00	No Ice	5.90	4.02	0.06
			-2.00			1/2"	6.42	4.50	0.11
			0.00			Ice	6.96	5.00	0.16
						1" Ice	8.08	6.04	0.31
						2" Ice			
(2) DTMABP7819VG12A	A	From Leg	4.00	0.0000	98.00	No Ice	0.98	0.34	0.02
			0.00			1/2"	1.10	0.42	0.03
			0.00			Ice	1.23	0.51	0.04
						1" Ice	1.52	0.71	0.06
						2" Ice			
(2) DTMABP7819VG12A	B	From Leg	4.00	0.0000	98.00	No Ice	0.98	0.34	0.02
			0.00			1/2"	1.10	0.42	0.03
			0.00			Ice	1.23	0.51	0.04
						1" Ice	1.52	0.71	0.06
						2" Ice			
(2) DTMABP7819VG12A	C	From Leg	4.00	0.0000	98.00	No Ice	0.98	0.34	0.02
			0.00			1/2"	1.10	0.42	0.03
			0.00			Ice	1.23	0.51	0.04
						1" Ice	1.52	0.71	0.06
						2" Ice			
RRUS 11	A	From Leg	4.00	0.0000	98.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07
			0.00			Ice	3.21	1.49	0.10
						1" Ice	3.66	1.83	0.15
						2" Ice			
RRUS 11	B	From Leg	4.00	0.0000	98.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07
			0.00			Ice	3.21	1.49	0.10
						1" Ice	3.66	1.83	0.15
						2" Ice			
RRUS 11	C	From Leg	4.00	0.0000	98.00	No Ice	2.78	1.19	0.05
			0.00			1/2"	2.99	1.33	0.07

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 1" Ice 2" Ice	3.21 3.66	1.49 1.83	0.10 0.15
RRUS 12	A	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	3.15 3.36 3.59 4.07	1.29 1.44 1.60 1.95	0.06 0.08 0.11 0.17
RRUS 12	B	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	3.15 3.36 3.59 4.07	1.29 1.44 1.60 1.95	0.06 0.08 0.11 0.17
RRUS 12	C	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	3.15 3.36 3.59 4.07	1.29 1.44 1.60 1.95	0.06 0.08 0.11 0.17
RRUS A2 MODULE	A	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.60 1.76 1.92 2.28	0.39 0.48 0.58 0.80	0.02 0.03 0.04 0.07
RRUS A2 MODULE	B	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.60 1.76 1.92 2.28	0.39 0.48 0.58 0.80	0.02 0.03 0.04 0.07
RRUS A2 MODULE	C	From Leg	4.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.60 1.76 1.92 2.28	0.39 0.48 0.58 0.80	0.02 0.03 0.04 0.07
DC6-48-60-18-8F	C	From Leg	1.00 0.00 0.00	0.0000	98.00	No Ice 1/2" Ice 1" Ice 2" Ice	0.92 1.46 1.64 2.04	0.92 1.46 1.64 2.04	0.02 0.04 0.06 0.11
***									
Pipe Mount [PM 602-1]	A	From Leg	0.00 0.00 0.00	0.0000	83.00	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
*** PROPOSED ***									
DS2C03F36D-D	B	From Leg	0.00 0.00 13.00	-45.0000	137.00	No Ice 1/2" Ice 1" Ice 2" Ice	7.26 9.75 12.23 17.24	7.26 9.75 12.23 17.24	0.07 0.12 0.19 0.37
R5-LL (Pipe Mount [PM 601-1])	B	From Leg	0.00 0.00 0.00	0.0000	137.00	No Ice 1/2" Ice 1" Ice 2" Ice	1.32 1.58 1.84 2.40	1.32 1.58 1.84 2.40	0.07 0.08 0.09 0.13

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft²	Weight K
PL4-107	A	Paraboloid w/Radome	From Leg	1.00 0.00 0.00	0.0000		83.00	4.00	No Ice 1/2" Ice 1" Ice 2" Ice	12.60 13.09 13.58 14.56	0.10 0.17 0.24 0.37

Load Combinations

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

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
T1	140 - 120	Leg	Max Tension	15	29.51	0.00	0.11
			Max. Compression	2	-31.91	-0.02	0.24
			Max. Mx	8	-2.26	1.11	-0.01
			Max. My	14	-1.75	0.03	1.13
			Max. Vy	18	-3.33	0.19	-0.12
			Max. Vx	2	-4.06	-0.02	0.24
		Diagonal	Max Tension	5	3.29	0.00	0.00
			Max. Compression	16	-3.31	0.00	0.00
			Max. Mx	35	0.68	-0.01	-0.00
			Max. My	8	-2.82	-0.00	0.00
			Max. Vy	35	0.01	-0.01	-0.00
			Max. Vx	8	-0.00	-0.00	0.00
		Top Girt	Max Tension	7	0.33	0.00	0.00
			Max. Compression	18	-0.34	0.00	0.00
			Max. Mx	26	-0.04	0.03	0.00
			Max. Vy	26	0.02	0.00	0.00
		Bottom Girt	Max Tension	14	0.30	0.00	0.00
			Max. Compression	3	-0.29	0.00	0.00
			Max. Mx	26	0.02	0.03	0.00
			Max. Vy	26	0.02	0.00	0.00
T2	120 - 100	Leg	Max Tension	15	72.91	0.07	-0.43
			Max. Compression	2	-76.75	-0.11	0.94
			Max. Mx	22	67.19	0.80	0.41
			Max. My	14	72.37	0.11	-0.95
			Max. Vy	10	5.01	-0.80	-0.41
			Max. Vx	2	-6.33	-0.11	0.94
		Diagonal	Max Tension	5	4.34	0.00	0.00
			Max. Compression	16	-4.37	0.00	0.00
			Max. Mx	34	0.40	-0.01	0.00
			Max. My	24	3.49	-0.00	-0.00
			Max. Vy	34	0.01	-0.01	0.00
			Max. Vx	24	-0.00	0.00	0.00
		Top Girt	Max Tension	22	0.03	0.00	0.00
			Max. Compression	19	-0.02	0.00	0.00
			Max. Mx	26	0.02	0.03	0.00
			Max. Vy	26	-0.02	0.00	0.00
		Bottom Girt	Max Tension	3	0.57	0.00	0.00
			Max. Compression	14	-0.64	0.00	0.00
			Max. Mx	26	-0.13	0.03	0.00
			Max. Vy	26	-0.02	0.00	0.00
T3	100 - 80	Leg	Max Tension	15	99.88	-0.23	-0.08
			Max. Compression	2	-107.72	0.29	0.07
			Max. Mx	14	77.06	-0.95	-0.11
			Max. My	12	-3.98	-0.05	1.06
			Max. Vy	14	-0.88	-0.95	-0.11
			Max. Vx	12	-0.82	-0.00	-0.50
		Diagonal	Max Tension	15	5.10	0.00	0.00
			Max. Compression	2	-5.23	0.00	0.00
			Max. Mx	37	0.87	0.03	0.00
			Max. My	14	-3.87	-0.01	-0.01
			Max. Vy	37	0.03	0.03	0.00
			Max. Vx	14	0.00	0.00	0.00
T4	80 - 60	Leg	Max Tension	15	131.89	-0.23	-0.08
			Max. Compression	2	-143.06	0.22	0.07
			Max. Mx	14	109.59	-0.34	-0.08
			Max. My	18	48.58	-0.18	-0.39
			Max. Vy	14	-0.08	-0.34	-0.08
			Max. Vx	12	-0.15	-0.02	-0.39
		Diagonal	Max Tension	15	5.53	0.00	0.00
			Max. Compression	2	-5.70	0.00	0.00
			Max. Mx	37	0.97	0.05	-0.01
			Max. My	2	-5.48	-0.00	0.01
			Max. Vy	37	0.04	0.05	-0.01
			Max. Vx	33	0.00	0.00	0.00
T5	60 - 40	Leg	Max Tension	15	161.73	-0.21	-0.06

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	2	-176.74	0.34	0.10
			Max. Mx	3	-174.81	0.34	0.10
			Max. My	13	-6.83	-0.01	-0.41
			Max. Vy	6	0.08	-0.32	0.03
			Max. Vx	25	-0.14	-0.01	0.41
		Diagonal	Max Tension	2	6.03	0.00	0.00
			Max. Compression	2	-6.25	0.00	0.00
			Max. Mx	37	1.12	0.06	-0.01
			Max. My	33	1.08	0.06	-0.01
			Max. Vy	37	0.05	0.06	-0.01
			Max. Vx	33	0.00	0.00	0.00
T6	40 - 20	Leg	Max Tension	15	189.92	-0.28	-0.07
			Max. Compression	2	-209.56	0.19	0.03
			Max. Mx	31	-71.80	0.68	0.00
			Max. My	13	-6.97	-0.01	-0.41
			Max. Vy	29	-0.19	-0.48	0.01
			Max. Vx	12	-0.13	-0.01	-0.41
		Diagonal	Max Tension	2	6.66	0.00	0.00
			Max. Compression	2	-6.82	0.00	0.00
			Max. Mx	37	0.72	0.10	-0.01
			Max. My	33	-1.79	0.08	-0.01
			Max. Vy	37	0.06	0.10	-0.01
			Max. Vx	33	0.00	0.00	0.00
T7	20 - 0	Leg	Max Tension	15	216.39	-0.29	-0.04
			Max. Compression	2	-241.10	0.00	-0.00
			Max. Mx	31	-83.95	1.23	0.00
			Max. My	13	-9.78	-0.03	-0.61
			Max. Vy	29	-0.36	-1.12	0.00
			Max. Vx	13	-0.18	-0.03	-0.61
		Diagonal	Max Tension	2	6.95	0.00	0.00
			Max. Compression	2	-7.39	0.00	0.00
			Max. Mx	37	-0.08	0.13	0.01
			Max. My	27	2.26	0.06	0.01
			Max. Vy	37	0.07	0.13	0.01
			Max. Vx	27	-0.00	0.00	0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	18	227.27	17.06	-10.39
	Max. H_x	18	227.27	17.06	-10.39
	Max. H_z	5	-181.68	-13.19	9.95
	Min. Vert	7	-197.17	-15.13	9.25
	Min. H_x	7	-197.17	-15.13	9.25
	Min. H_z	16	206.30	14.42	-10.68
Leg B	Max. Vert	10	230.91	-18.38	-9.74
	Max. H_x	23	-205.33	16.49	8.67
	Max. H_z	23	-205.33	16.49	8.67
	Min. Vert	23	-205.33	16.49	8.67
	Min. H_x	10	230.91	-18.38	-9.74
	Min. H_z	10	230.91	-18.38	-9.74
Leg A	Max. Vert	2	245.99	-1.37	21.86
	Max. H_x	19	-98.29	2.46	-9.07
	Max. H_z	2	245.99	-1.37	21.86
	Min. Vert	15	-220.43	1.34	-19.80
	Min. H_x	6	115.44	-2.35	9.89
	Min. H_z	15	-220.43	1.34	-19.80

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	30.38	0.00	0.00	2.94	15.05	0.00
1.2 Dead+1.0 Wind 0 deg - No Ice	36.45	0.05	-35.55	-2835.11	11.22	-32.82
0.9 Dead+1.0 Wind 0 deg - No Ice	27.34	0.05	-35.55	-2835.99	6.71	-32.82
1.2 Dead+1.0 Wind 30 deg - No Ice	36.45	16.47	-28.45	-2316.86	-1328.38	-20.89
0.9 Dead+1.0 Wind 30 deg - No Ice	27.34	16.47	-28.45	-2317.74	-1332.90	-20.89
1.2 Dead+1.0 Wind 60 deg - No Ice	36.45	26.60	-15.34	-1252.36	-2159.92	-10.99
0.9 Dead+1.0 Wind 60 deg - No Ice	27.34	26.60	-15.34	-1253.24	-2164.43	-10.99
1.2 Dead+1.0 Wind 90 deg - No Ice	36.45	31.10	0.02	2.36	-2486.62	-0.72
0.9 Dead+1.0 Wind 90 deg - No Ice	27.34	31.10	0.02	1.48	-2491.14	-0.72
1.2 Dead+1.0 Wind 120 deg - No Ice	36.45	29.30	16.93	1334.84	-2291.94	18.02
0.9 Dead+1.0 Wind 120 deg - No Ice	27.34	29.30	16.93	1333.95	-2296.46	18.02
1.2 Dead+1.0 Wind 150 deg - No Ice	36.45	17.12	29.68	2383.10	-1354.51	34.42
0.9 Dead+1.0 Wind 150 deg - No Ice	27.34	17.12	29.68	2382.21	-1359.03	34.42
1.2 Dead+1.0 Wind 180 deg - No Ice	36.45	-0.05	34.19	2783.95	24.91	32.82
0.9 Dead+1.0 Wind 180 deg - No Ice	27.34	-0.05	34.19	2783.07	20.39	32.82
1.2 Dead+1.0 Wind 210 deg - No Ice	36.45	-16.54	28.58	2334.27	1370.35	20.90
0.9 Dead+1.0 Wind 210 deg - No Ice	27.34	-16.54	28.58	2333.38	1365.83	20.90
1.2 Dead+1.0 Wind 240 deg - No Ice	36.45	-27.94	16.20	1303.05	2259.33	11.04
0.9 Dead+1.0 Wind 240 deg - No Ice	27.34	-27.94	16.20	1302.17	2254.81	11.04
1.2 Dead+1.0 Wind 270 deg - No Ice	36.45	-31.10	0.12	16.05	2522.75	0.72
0.9 Dead+1.0 Wind 270 deg - No Ice	27.34	-31.10	0.12	15.16	2518.23	0.72
1.2 Dead+1.0 Wind 300 deg - No Ice	36.45	-27.97	-16.07	-1284.15	2264.79	-18.06
0.9 Dead+1.0 Wind 300 deg - No Ice	27.34	-27.97	-16.07	-1285.03	2260.27	-18.06
1.2 Dead+1.0 Wind 330 deg - No Ice	36.45	-17.05	-29.56	-2365.69	1384.80	-34.43
0.9 Dead+1.0 Wind 330 deg - No Ice	27.34	-17.05	-29.56	-2366.57	1380.29	-34.43
1.2 Dead+1.0 Ice+1.0 Temp	90.93	-0.00	0.00	9.29	66.28	0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp	90.93	0.01	-8.93	-724.93	65.24	-7.47
1.2 Dead+1.0 Wind 30 deg+1.0 Ice+1.0 Temp	90.93	4.33	-7.48	-612.80	-293.91	-6.11
1.2 Dead+1.0 Wind 60 deg+1.0 Ice+1.0 Temp	90.93	7.28	-4.20	-340.74	-540.41	-4.29
1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp	90.93	8.42	0.00	9.12	-630.10	-1.42
1.2 Dead+1.0 Wind 120 deg+1.0 Ice+1.0 Temp	90.93	7.54	4.36	365.34	-551.03	3.00
1.2 Dead+1.0 Wind 150 deg+1.0 Ice+1.0 Temp	90.93	4.39	7.61	636.28	-295.52	6.73
1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp	90.93	-0.01	8.77	737.37	67.32	7.47
1.2 Dead+1.0 Wind 210 deg+1.0 Ice+1.0 Temp	90.93	-4.34	7.50	632.97	427.37	6.11

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
1.2 Dead+1.0 Wind 240 deg+1.0 Ice+1.0 Temp	90.93	-7.44	4.30	364.63	680.28	4.29
1.2 Dead+1.0 Wind 270 deg+1.0 Ice+1.0 Temp	90.93	-8.42	0.02	11.21	762.67	1.42
1.2 Dead+1.0 Wind 300 deg+1.0 Ice+1.0 Temp	90.93	-7.39	-4.25	-341.45	676.28	-3.01
1.2 Dead+1.0 Wind 330 deg+1.0 Ice+1.0 Temp	90.93	-4.38	-7.59	-616.11	427.18	-6.73
Dead+Wind 0 deg - Service	30.38	0.01	-7.02	-557.77	13.70	-6.48
Dead+Wind 30 deg - Service	30.38	3.25	-5.62	-455.40	-250.91	-4.13
Dead+Wind 60 deg - Service	30.38	5.25	-3.03	-245.13	-415.17	-2.17
Dead+Wind 90 deg - Service	30.38	6.14	0.00	2.71	-479.70	-0.14
Dead+Wind 120 deg - Service	30.38	5.79	3.34	265.92	-441.24	3.56
Dead+Wind 150 deg - Service	30.38	3.38	5.86	472.98	-256.07	6.80
Dead+Wind 180 deg - Service	30.38	-0.01	6.75	552.16	16.40	6.48
Dead+Wind 210 deg - Service	30.38	-3.27	5.64	463.34	282.17	4.13
Dead+Wind 240 deg - Service	30.38	-5.52	3.20	259.64	457.77	2.18
Dead+Wind 270 deg - Service	30.38	-6.14	0.02	5.42	509.81	0.14
Dead+Wind 300 deg - Service	30.38	-5.52	-3.17	-251.41	458.85	-3.57
Dead+Wind 330 deg - Service	30.38	-3.37	-5.84	-465.05	285.03	-6.80

Solution Summary

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
1	0.00	-30.38	0.00	0.00	30.38	0.00	0.000%
2	0.05	-36.45	-35.55	-0.05	36.45	35.55	0.000%
3	0.05	-27.34	-35.55	-0.05	27.34	35.55	0.000%
4	16.47	-36.45	-28.45	-16.47	36.45	28.45	0.000%
5	16.47	-27.34	-28.45	-16.47	27.34	28.45	0.000%
6	26.60	-36.45	-15.34	-26.60	36.45	15.34	0.000%
7	26.60	-27.34	-15.34	-26.60	27.34	15.34	0.000%
8	31.10	-36.45	0.02	-31.10	36.45	-0.02	0.000%
9	31.10	-27.34	0.02	-31.10	27.34	-0.02	0.000%
10	29.30	-36.45	16.93	-29.30	36.45	-16.93	0.000%
11	29.30	-27.34	16.93	-29.30	27.34	-16.93	0.000%
12	17.12	-36.45	29.68	-17.12	36.45	-29.68	0.000%
13	17.12	-27.34	29.68	-17.12	27.34	-29.68	0.000%
14	-0.05	-36.45	34.19	0.05	36.45	-34.19	0.000%
15	-0.05	-27.34	34.19	0.05	27.34	-34.19	0.000%
16	-16.54	-36.45	28.58	16.54	36.45	-28.58	0.000%
17	-16.54	-27.34	28.58	16.54	27.34	-28.58	0.000%
18	-27.94	-36.45	16.20	27.94	36.45	-16.20	0.000%
19	-27.94	-27.34	16.20	27.94	27.34	-16.20	0.000%
20	-31.10	-36.45	0.12	31.10	36.45	-0.12	0.000%
21	-31.10	-27.34	0.12	31.10	27.34	-0.12	0.000%
22	-27.97	-36.45	-16.07	27.97	36.45	16.07	0.000%
23	-27.97	-27.34	-16.07	27.97	27.34	16.07	0.000%
24	-17.05	-36.45	-29.56	17.05	36.45	29.56	0.000%
25	-17.05	-27.34	-29.56	17.05	27.34	29.56	0.000%
26	0.00	-90.93	0.00	0.00	90.93	0.00	0.000%
27	0.01	-90.93	-8.93	-0.01	90.93	8.93	0.000%
28	4.33	-90.93	-7.48	-4.33	90.93	7.48	0.000%
29	7.28	-90.93	-4.20	-7.28	90.93	4.20	0.000%
30	8.42	-90.93	0.00	-8.42	90.93	-0.00	0.000%
31	7.54	-90.93	4.36	-7.54	90.93	-4.36	0.000%
32	4.39	-90.93	7.61	-4.39	90.93	-7.61	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
33	-0.01	-90.93	8.77	0.01	90.93	-8.77	0.000%
34	-4.34	-90.93	7.50	4.34	90.93	-7.50	0.000%
35	-7.44	-90.93	4.30	7.44	90.93	-4.30	0.000%
36	-8.42	-90.93	0.02	8.42	90.93	-0.02	0.000%
37	-7.39	-90.93	-4.25	7.39	90.93	4.25	0.000%
38	-4.38	-90.93	-7.59	4.38	90.93	7.59	0.000%
39	0.01	-30.38	-7.02	-0.01	30.38	7.02	0.000%
40	3.25	-30.38	-5.62	-3.25	30.38	5.62	0.000%
41	5.25	-30.38	-3.03	-5.25	30.38	3.03	0.000%
42	6.14	-30.38	0.00	-6.14	30.38	-0.00	0.000%
43	5.79	-30.38	3.34	-5.79	30.38	-3.34	0.000%
44	3.38	-30.38	5.86	-3.38	30.38	-5.86	0.000%
45	-0.01	-30.38	6.75	0.01	30.38	-6.75	0.000%
46	-3.27	-30.38	5.64	3.27	30.38	-5.64	0.000%
47	-5.52	-30.38	3.20	5.52	30.38	-3.20	0.000%
48	-6.14	-30.38	0.02	6.14	30.38	-0.02	0.000%
49	-5.52	-30.38	-3.17	5.52	30.38	3.17	0.000%
50	-3.37	-30.38	-5.84	3.37	30.38	5.84	0.000%

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	140 - 120	1.903	45	0.1300	0.0509
T2	120 - 100	1.361	39	0.1144	0.0484
T3	100 - 80	0.913	39	0.0857	0.0406
T4	80 - 60	0.582	39	0.0647	0.0317
T5	60 - 40	0.333	39	0.0457	0.0232
T6	40 - 20	0.157	39	0.0287	0.0143
T7	20 - 0	0.051	39	0.0134	0.0074

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
140.00	PD1142-2C	45	1.903	0.1300	0.0509	178127
138.00	Sector Mount [SM 409-3]	45	1.846	0.1288	0.0508	178127
137.00	DS2C03F36D-D	45	1.818	0.1282	0.0507	178127
98.00	Sector Mount [SM 409-3]	39	0.875	0.0831	0.0397	37957
83.00	PL4-107	39	0.626	0.0675	0.0330	59258

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	140 - 120	9.653	3	0.6542	0.2577
T2	120 - 100	6.914	3	0.5777	0.2448
T3	100 - 80	4.639	3	0.4339	0.2056
T4	80 - 60	2.958	3	0.3288	0.1605
T5	60 - 40	1.692	3	0.2324	0.1174
T6	40 - 20	0.797	3	0.1460	0.0726
T7	20 - 0	0.257	3	0.0684	0.0374

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
140.00	PD1142-2C	3	9.653	0.6542	0.2577	35897
138.00	Sector Mount [SM 409-3]	3	9.370	0.6486	0.2570	35897
137.00	DS2C03F36D-D	3	9.229	0.6458	0.2567	35897
98.00	Sector Mount [SM 409-3]	3	4.446	0.4209	0.2012	7543
83.00	PL4-107	3	3.180	0.3429	0.1671	11745

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	140	Leg	A325N	1.0000	4	7.38	54.52	0.135	1.05	Bolt Tension
T2	120	Leg	A325N	1.0000	6	12.15	54.52	0.223	1.05	Bolt Tension
T3	100	Leg	A325N	1.1250	6	16.65	68.69	0.242	1.05	Bolt Tension
		Diagonal	A325N	0.7500	1	5.10	11.85	0.430	1.05	Member Block Shear
T4	80	Leg	A325N	1.1250	6	21.98	68.69	0.320	1.05	Bolt Tension
		Diagonal	A325N	0.7500	1	5.53	10.92	0.507	1.05	Member Block Shear
T5	60	Leg	A325N	1.2500	6	26.96	87.22	0.309	1.05	Bolt Tension
		Diagonal	A325N	0.7500	1	6.03	10.92	0.552	1.05	Member Block Shear
T6	40	Leg	A325N	1.2500	6	31.65	87.22	0.363	1.05	Bolt Tension
		Diagonal	A325N	0.7500	1	6.66	14.56	0.457	1.05	Member Block Shear
T7	20	Diagonal	A325N	0.7500	1	6.95	11.94	0.582	1.05	Member Block Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio P_u / ϕP_n
T1	140 - 120	1 3/4	20.00	3.31	90.7 K=1.00	2.4053	-28.60	59.34	0.482 [1]
T2	120 - 100	2 1/2	20.00	3.31	63.5 K=1.00	4.9087	-72.49	164.54	0.441 [1]
T3	100 - 80	3 1/2	20.03	6.68	91.6 K=1.00	9.6211	-107.72	234.57	0.459 [1]
T4	80 - 60	3 3/4	20.03	6.68	85.4 K=1.00	11.044 7	-143.06	291.42	0.491 [1]
T5	60 - 40	4	20.03	6.68	80.1 K=1.00	12.566 4	-176.74	353.71	0.500 [1]
T6	40 - 20	4 1/4	20.03	6.68	75.4 K=1.00	14.186 3	-209.56	421.28	0.497 [1]
T7	20 - 0	4 1/2	20.03	6.68	71.2 K=1.00	15.904 3	-241.10	493.99	0.488 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	140 - 120	3/4	5.99	2.91	167.6 K=0.90	0.4418	-3.31	3.55	0.931 [1]
T2	120 - 100	7/8	5.99	2.87	141.8 K=0.90	0.6013	-4.37	6.76	0.647 [1]
T3	100 - 80	L2x2x1/4	9.31	4.47	137.3 K=1.00	0.9380	-5.23	14.23	0.368 [1]
T4	80 - 60	L2 1/2x2 1/2x3/16	10.65	5.13	124.3 K=1.00	0.9020	-5.70	16.69	0.342 [1]
T5	60 - 40	L2 1/2x2 1/2x3/16	12.10	5.84	141.7 K=1.00	0.9020	-6.25	12.86	0.486 [1]
T6	40 - 20	L2 1/2x2 1/2x1/4	13.64	6.60	161.4 K=1.00	1.1900	-6.82	13.08	0.522 [1]
T7	20 - 0	L3x3x3/16	15.24	7.39	148.8 K=1.00	1.0900	-7.39	14.09	0.525 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	140 - 120	3/4	5.00	4.85	217.5 K=0.70	0.4418	-0.34	2.11	0.163 [1]
		KL/R > 200 (C) - 5							
T2	120 - 100	7/8	5.00	4.79	184.0 K=0.70	0.6013	-0.02	4.01	0.005 [1]

[1] P_u / ϕP_n controls

Bottom Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	140 - 120	3/4	5.00	4.85	217.5 K=0.70	0.4418	-0.29	2.11	0.136 [1]
		KL/R > 200 (C) - 7							
T2	120 - 100	7/8	5.00	4.79	184.0 K=0.70	0.6013	-0.64	4.01	0.160 [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	140 - 120	1 3/4	20.00	0.08	2.3	2.4053	29.51	108.24	0.273 [1]
T2	120 - 100	2 1/2	20.00	0.08	1.6	4.9087	72.91	220.89	0.330 [1]
T3	100 - 80	3 1/2	20.03	6.68	91.6	9.6211	99.88	432.95	0.231 [1]
T4	80 - 60	3 3/4	20.03	6.68	85.4	11.044 7	131.89	497.01	0.265 [1]
T5	60 - 40	4	20.03	6.68	80.1	12.566 4	161.73	565.49	0.286 [1]
T6	40 - 20	4 1/4	20.03	6.68	75.4	14.186 3	189.92	638.38	0.298 [1]
T7	20 - 0	4 1/2	20.03	6.68	71.2	15.904 3	216.39	715.69	0.302 [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	140 - 120	3/4	5.99	2.91	186.2	0.4418	3.29	14.31	0.230 [1]
T2	120 - 100	7/8	5.99	2.87	157.6	0.6013	4.34	19.48	0.223 [1]
T3	100 - 80	L2x2x1/4	9.31	4.47	91.9	0.5394	5.10	23.47	0.217 [1]
T4	80 - 60	L2 1/2x2 1/2x3/16	10.65	5.13	82.0	0.5535	5.53	24.08	0.230 [1]
T5	60 - 40	L2 1/2x2 1/2x3/16	12.10	5.84	93.0	0.5535	6.03	24.08	0.250 [1]
T6	40 - 20	L2 1/2x2 1/2x1/4	13.64	6.60	105.9	0.7284	6.66	31.69	0.210 [1]
T7	20 - 0	L3x3x3/16	14.70	7.12	93.4	0.6945	6.95	30.21	0.230 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	140 - 120	3/4	5.00	4.85	310.7	0.4418	0.33	14.31	0.023 [1]
T2	120 - 100	7/8	5.00	4.79	262.9	0.6013	0.03	19.48	0.002 [1]

[1] P_u / ϕP_n controls

Bottom Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	140 - 120	3/4	5.00	4.85	310.7	0.4418	0.30	14.31	0.021 [1]
T2	120 - 100	7/8	5.00	4.79	262.9	0.6013	0.57	19.48	0.029 [1]

[1] P_u / ϕP_n controls

Section Capacity Table

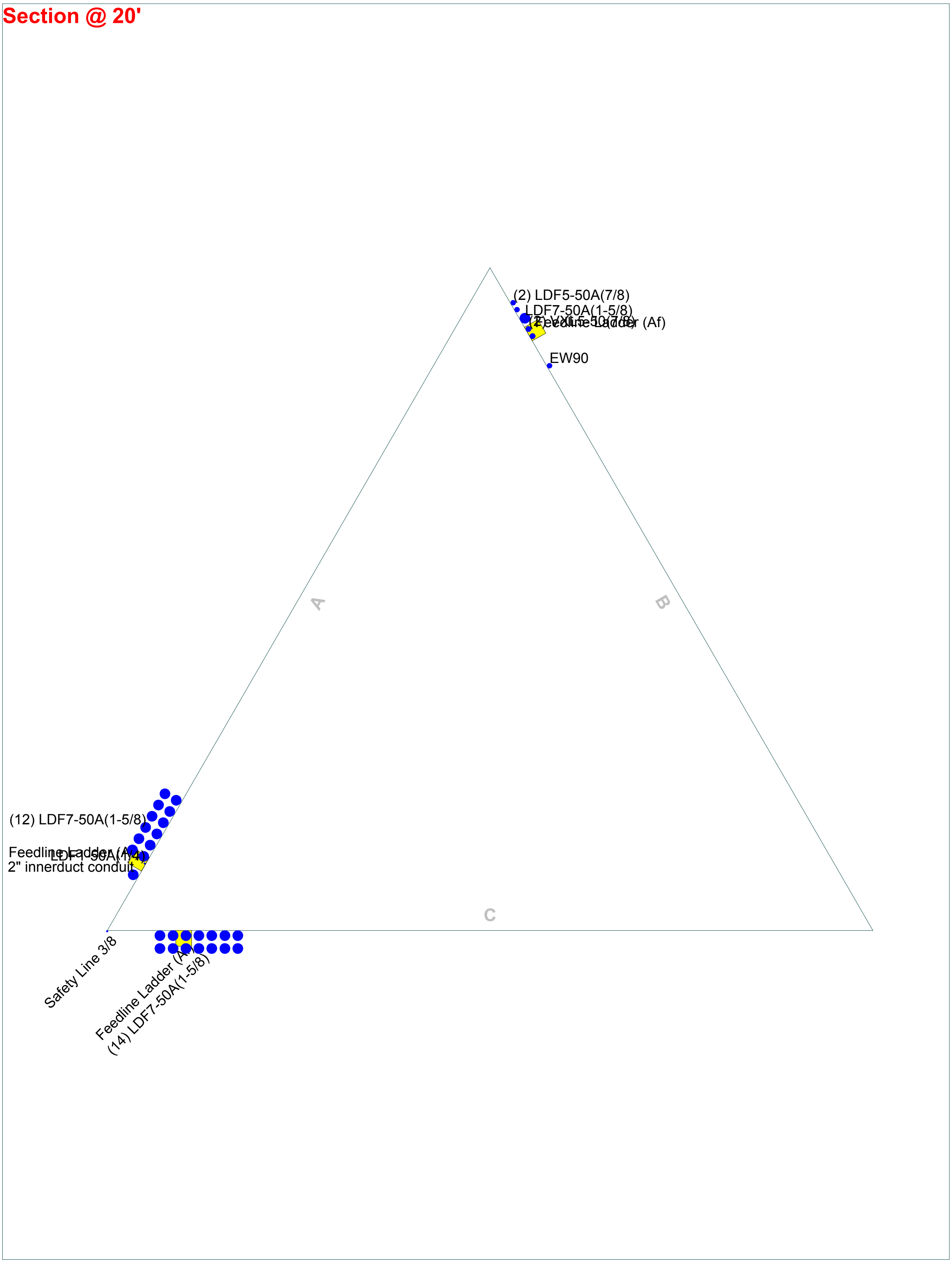
Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$øP_{allow}$ K	% Capacity	Pass Fail
T1	140 - 120	Leg	1 3/4	3	-28.60	62.31	45.9	Pass
T2	120 - 100	Leg	2 1/2	48	-72.49	172.77	42.0	Pass
T3	100 - 80	Leg	3 1/2	93	-107.72	246.30	43.7	Pass
T4	80 - 60	Leg	3 3/4	114	-143.06	305.99	46.8	Pass
T5	60 - 40	Leg	4	135	-176.74	371.39	47.6	Pass
T6	40 - 20	Leg	4 1/4	156	-209.56	442.35	47.4	Pass
T7	20 - 0	Leg	4 1/2	177	-241.10	518.69	46.5	Pass
T1	140 - 120	Diagonal	3/4	15	-3.31	3.73	88.7	Pass
T2	120 - 100	Diagonal	7/8	60	-4.37	7.09	61.6	Pass
T3	100 - 80	Diagonal	L2x2x1/4	98	-5.23	14.95	35.0 41.0 (b)	Pass
T4	80 - 60	Diagonal	L2 1/2x2 1/2x3/16	119	-5.70	17.53	32.5 48.2 (b)	Pass
T5	60 - 40	Diagonal	L2 1/2x2 1/2x3/16	140	-6.25	13.51	46.3 52.6 (b)	Pass
T6	40 - 20	Diagonal	L2 1/2x2 1/2x1/4	161	-6.82	13.74	49.7	Pass
T7	20 - 0	Diagonal	L3x3x3/16	182	-7.39	14.80	50.0 55.4 (b)	Pass
T1	140 - 120	Top Girt	3/4	5	-0.34	2.22	15.5	Pass
T2	120 - 100	Top Girt	7/8	50	-0.02	4.21	0.5	Pass
T1	140 - 120	Bottom Girt	3/4	7	-0.29	2.22	12.9	Pass
T2	120 - 100	Bottom Girt	7/8	52	-0.64	4.21	15.2	Pass
							Summary	
						Leg (T5)	47.6	Pass
						Diagonal (T1)	88.7	Pass
						Top Girt (T1)	15.5	Pass
						Bottom Girt (T2)	15.2	Pass
						Bolt Checks	55.4	Pass
						RATING =	**88.7**	**Pass**

APPENDIX B

BASE LEVEL DRAWING

Feed Line Plan
20'

Round Flat App In Face App Out Face



Black & Veatch Corp. 6800 W. 115th St., Suite 2292 Overland Park, KS 66211 Phone: (913) 458-6909 FAX:	Job: ***ES-001 CheshireAWC***		
	Project: ***403093***		
	Client: Eversource	Drawn by: Preechaya Sirisuwan	App'd:
	Code: TIA-222-H	Date: 02/20/20	Scale: NTS
	Path: C:\Users\sir94358\Desktop\Eversource\4. CheshireAWC\Structural\Rev. H\CheshireAWC Structural Analysis.eri		Dwg No. E-7

APPENDIX C

ADDITIONAL CALCULATIONS

References

ANCHOR ROD ANALYSIS

Project Information

Site Name:ES-001 CheshireAWC

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

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

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

Max Leg Reactions

Compression

$Axial\_C := 246 \cdot kip$

$Shear\_C := 22 \cdot kip$

Uplift

$Axial\_U := 220 \cdot kip$

$Shear\_U := 20 \cdot kip$

Anchor Rod Data

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

Number of Anchor Rods: $N := 6$

Length from top of concrete to bottom of anchor rod leveling nut: $lar := 1.25 \cdot in$

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

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

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

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

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

Threads per Inch: $n = 7$ (Thread selection invalid if n = 0)

Rod Ultimate Strength: $Fu = 105 \cdot ksi$

Rod Yield Strength: $Fy = 81 \cdot ksi$

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

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

Radius of Gyration:

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

Net Area of Anchor Rod:

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

TIA-222-G/H Section 4.9.6.1

Nominal Unthreaded Area of Anchor Rod:

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

Anchor Rod Design Capacities

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

$Rnt := Fu \cdot An = 101.756 \cdot kip$

$\phi t = 0.75$

$\phi Rnt := \phi t \cdot Rnt = 76.317 \cdot kip$

Design Compression Strength:

$Rnc := Fy \cdot An = 78.498 \cdot kip$

$\phi c = 1$

$\phi Rnc := \phi c \cdot Rnc = 78.498 \cdot kip$

Design Buckling Strength: TIA-222-H Section 4.5.4.2

$K_0 := 1.2$

$Fcr = 80.721 \cdot ksi$

$Fe = \blacksquare \cdot ksi$

$Rnb := Fcr \cdot An = 78.227 \cdot kip$

$\phi c = 1$

$\phi Rnb := \phi c \cdot Rnb = 78.227 \cdot kip$

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

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

$Rnv = 64.427 \cdot kip$

$Rnvc := 0.6 \cdot Fy \cdot 0.5 \cdot An = 23.549 \cdot kip$ TIA-222-H Section 4.9.9

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

$\phi Rnv := \phi v \cdot Rnv = 48.32 \cdot kip$ $\phi Rnvc := \phi c \cdot Rnvc = 23.549 \cdot kip$

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

$Rmn := Fy \cdot Z = 18.504 \cdot kip \cdot in$

$\phi f = 0.9$

$\phi Rmn := \phi f \cdot Rmn = 16.653 \cdot kip \cdot in$

Anchor Rod Loading Demands

Tension Demand:

$$Put := \frac{Axial\_U}{N} = 36.667 \cdot kip$$

Compression Demand:

$$Puc := \frac{Axial\_C}{N} = 41 \cdot kip$$

Shear Demand:

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

$$Vuc := \frac{Shear\_C}{N} = 3.667 \cdot kip$$

Moment Demand:

$$Mut := 0.65 \cdot lar \cdot Vut = 2.708 \cdot kip \cdot in$$

$$Muc := 0.65 \cdot lar \cdot Vuc = 2.979 \cdot kip \cdot in$$

Anchor Rod Interaction Check TIA-222-G Section 4.9.9

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

$$SR\_g = 0.633$$

Anchor Rod Interaction Check

TIA-222-H Section 4.9.9

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

$SR\_Pt = 0.236$

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

$SR\_Pc = 0.547$

$$SR := \begin{cases} SR\_g & \text{if } TIA = \text{"Rev-G"} \\ \max(SR\_Pt, SR\_Pc) & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"No"} \\ \frac{\max(SR\_Pt, SR\_Pc)}{1.05} & \text{if } TIA = \text{"Rev-H"} \wedge S15 = \text{"Yes"} \end{cases} = 0.521$$

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

Anchor Rod Results

Axial Tension Demand:	$Put = 36.667 \cdot kip$
Axial Tension Capacity:	$\phi Rnt = 76.317 \cdot kip$
Axial Compression Demand:	$Puc = 41 \cdot kip$
Axial Compression Capacity:	$\phi Rnc = 78.498 \cdot kip$
Shear Tension Demand:	$Vut = 3.333 \cdot kip$
Tension Shear Capacity:	$\phi Rnv = 48.32 \cdot kip$
Shear Compression Demand:	$Vuc = 3.667 \cdot kip$
Compresison Shear Capacity:	$\phi R_{nvc} = 23.549 \cdot kip$
Moment Tension Demand:	M_{ut} = "Moment Not Considered" ·kip·in
Moment Compression Demand:	M_{uc} = "Moment Not Considered" ·kip·in
Moment Capacity:	ϕR_{mn} = "Moment Not Considered" ·kip·in

Governing Stress Ratio

$SR = 52.052 \cdot \%$

$Check_{SR}$ = "Passing"

SST Unit Base Foundation

ES-001
CheshireAWC

TIA-222 Revision:	H

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

Superstructure Analysis Reactions		
Global Moment, **M**:	2836	ft-kips
Global Axial, **P**:	36	kips
Global Shear, **V**:	36	kips
Leg Compression, $\mathbf{P_{comp}}$:	246	kips
Leg Comp. Shear, $\mathbf{V_{u\_comp}}$:	22	kips
Leg Uplift, $\mathbf{P_{uplift}}$:	220	kips
Leg Uplift. Shear, $\mathbf{V_{u\_uplift}}$:	20	kips
Tower Height, **H**:	140	ft
Base Face Width, **BW**:	14	ft
BP Dist. Above Fdn, $\mathbf{bp_{dist}}$:	4	in

Foundation Analysis Checks	Capacity	Demand	Rating*	Check
Lateral (Sliding) (kips)	266.99	36.00	**12.8%**	**Pass**
Bearing Pressure (ksf)	4.50	1.01	**21.3%**	**Pass**
*Overturning (kip*ft)*	7557.25	3064.00	**40.5%**	**Pass**
*Pier Flexure (Comp.) (kip*ft)*	1555.30	99.00	**6.1%**	**Pass**
*Pier Flexure (Tension) (kip*ft)*	1028.72	90.00	**8.3%**	**Pass**
Pier Compression (kip)	5998.68	253.83	**4.0%**	**Pass**
*Pad Flexure (kip*ft)*	1775.18	796.77	**42.7%**	**Pass**
Pad Shear - 1-way (kips)	419.85	131.37	**29.8%**	**Pass**
Pad Shear - Comp 2-way (ksi)	0.164	0.089	**51.6%**	**Pass**
*Flexural 2-way (Comp) (kip*ft)*	931.83	59.40	**6.1%**	**Pass**
Pad Shear - Tension 2-way (ksi)	0.164	0.087	**50.7%**	**Pass**
*Flexural 2-way (Tension) (kip*ft)*	931.83	54.00	**5.5%**	**Pass**

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

Soil Rating*:	**40.5%**
Structural Rating*:	**51.6%**

Pier Properties		
Pier Shape:	Circular	
Pier Diameter, **dpier**:	4.0	ft
Ext. Above Grade, **E**:	0.50	ft
Pier Rebar Size, **Sc**:	7	
Pier Rebar Quantity, **mc**:	26	
Pier Tie/Spiral Size, **St**:	4	
Pier Tie/Spiral Quantity, **mt**:	9	
Pier Reinforcement Type:	Tie	
Pier Clear Cover, $\mathbf{cc_{pier}}$:	3	in

Pad Properties		
Depth, **D**:	5.50	ft
Pad Width, **W**:	32.00	ft
Pad Thickness, **T**:	1.50	ft
Pad Rebar Size (Bottom), **Sp**:	9	
Pad Rebar Quantity (Bottom), **mp**:	32	
Pad Clear Cover, $\mathbf{cc_{pad}}$:	3	in

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

Soil Properties			
Total Soil Unit Weight, γ:	125	pcf	
Ultimate Gross Bearing, Qult:	6.000	ksf	<-- Toggle between Gross and Net
Cohesion, **Cu**:	0.000	ksf	
Friction Angle, φ:	34	degrees	
SPT Blow Count, $\mathbf{N_{blows}}$:			
Base Friction, μ:	0.6		
Neglected Depth, **N**:	3.5	ft	
Foundation Bearing on Rock?	No		
Groundwater Depth, **gw**:	1.5	ft	

Version 3.2.0

TIA-222- H   ACI : 2014

PHYSICAL PARAMETERS

Pier Height Above Water Table:	h_{pier_above} = (MIN(gw,D-T) + E)	h_{pier_above} =	2	ft
Pier Height Below Water Table:	h_{pier_below} = ((D-T) - MIN(gw,D-T))	h_{pier_below} =	2.5	ft
Buoyant Weight of Pier:	W_{pier} = (π/4) * (dpier^2) * hpier_above * δc / 1000 + (π/4) * (dpier^2) * hpier_below * (δc-62.4) / 1000	W_{pier} =	6.52	kips
Pad Height Above Water Table:	h_{pad_above} = IF(gw<=D-T,0,IF(gw>D,T,T-(D-gw)))	h_{pad_above} =	0	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} =	1.5	ft
Buoyant Weight of Pad:	W_{pad} = (W^2) * hpad_above * δc / 1000 + (W^2) * hpad_below * (δc-62.4) / 1000	W_{pad} =	134.55	kips
Concrete weight:	W_c = V * δc	W_c =	154.1	kips
Soil weight:	W_s = (D - T) * (W² - 3*(dpier² / 4 * π)) * γ	W_s =	339.3	kips
EIA/TIA-222 Load Factor:	LF = 1	LF =	1.00	

LATERAL RESISTANCE

Total Nominal Pp Resistance:	P_{p_total} = Pp_pier *Ap_piers + Pp_pad * Ap_pad	P_{p_total} =	73.34	kips
Factored Total Weight for Compression:	$P_{factored\_comp}$ = φD * (Wc + Ws + P / 1.2)	$P_{factored\_comp}$ =	471.07	kips
Nominal Base Friction Resistance (Comp):	R_{s_comp} = P * μ	R_{s_comp} =	282.64	kips
Lateral Resistance (Comp):	ΦVn = Φs * (Pp_total + Rs_comp)	ΦVn =	266.99	kips

Check **ΦVn = 266.99 kips >= Vu = 36.00 kips** **RATING: 13.48% OK**

PIER REINFORCEMENT

Pier / Column Compression

Pier Cross-Sectional Area:	A_1 = dpier^2 * π/4	A_1 =	1809.56	in²
Support Area (2H:1V Slope):	A_2 = (MIN((2*(W/2-(2/3)*BW*cos(30°)+Offset)),(W-BW),dpier+4*T))²*(π/4)	A_2 =	11309.73	in²
Compressive Resistance (H/D < 3):	$ΦP_{n1}$ = 0.65*0.85 * F'c * A1 * MIN(√(A2/A1),2)	$ΦP_{n1}$ =	5998.68	kips
Rebar:	$s_{\_pier}$ = 7; $m_{\_pier}$ = 26	d_{b_pier} = 0.875 in; A_{b_pier} = 0.6 in²		
Provided area of steel:	A_{s_pier} = Ab_pier * m_pier	A_{s_pier} =	15.60	in²
Compressive Resistance (H/D >= 3):	$ΦP_{n2}$ = 0.65 * 0.8 * (0.85 * (F\c) * (A_1 - As_pier) + ((Fy) * As_pier))	$ΦP_{n2}$ =	2865.51	kips
	H/D = (D - T + E) / dpier	H/D =	1.13	
Utilized Compressive Resistance:	$ΦP_n$ = Pn1	$ΦP_n$ =	5998.68	kips
Applied Compressive Force:	P_u = Pcomp + 1.2 * Wpier	P_u =	253.83	kips

Check **$ΦP_n$ = 5998.68 kips >= P_u = 253.83 kips** **RATING: 4.23% OK**

Pier Flexure

Cross-sectional area:	A_g = dpier² * π / 4	A_g =	1809.56	in²
Min. area of steel (pier):	A_{smin_pier} = Ag * 0.005	A_{smin_pier} =	9.05	in²
Cage Diameter:	d_o = dpier - 2 * cc - 2 * tie - d_b	d_o =	40.13	in

Check **A_{s_pier} = 15.60 in² >= A_{smin_pier} = 9.05 in²** **OK**

Applied Moment to DSMC (Compression):	M_{u_comp} = IF(T>D,E,(D - T + E)) * Vu_comp	M_{u_comp} =	99.00	ft-kips
Pier Moment Capacity (Compression):	$ΦM_{n\_comp}$ = *from DSMC*	$ΦM_{n\_comp}$ =	1555.30	ft-kips

Check **M_{u_comp} = 99.00 ft-kips >= $ΦM_{n\_comp}$ = 1555.30 ft-kips** **RATING: 6.37% OK**

Applied Moment to DSMC (Tension):	$M_{u\_tension}$ = IF(T>D,E,(D - T + E)) * Vu_uplift	$M_{u\_tension}$ =	90.00	ft-kips
Pier Moment Capacity (Tension):	$ΦM_{n\_tension}$ = *from DSMC*	$ΦM_{n\_tension}$ =	1028.72	ft-kips

Check **M_{u_comp} = 90.00 ft-kips >= $ΦM_{n\_comp}$ = 1028.72 ft-kips** **RATING: 8.75% OK**

PAD REINFORCEMENT

Elastic Bearing Pressure for Soil Checks

Tower Cetroid offset from Fdn Centroid:	Offset = 0	Offset =	0.00	ft	
Distance from Leg to Edge of Pad:	L_{edge} = (1/2)*W - Offset - (1/3)*BW*sin(60°)	L_{edge} =	11.96	ft	
*Overturning Moment (0.9*D LC):*	$M_{o\_0.9}$ = M + V * (D + E + bpdist/12) + (0.9/1.2)*(P+3*Wpier*1.2)*Offset	$M_{o\_0.9}$ =	3058.00	ft-kips	
*Overturning Moment (1.2*D LC):*	$M_{o\_1.2}$ = M + V * (D + E + bpdist/12) + (1.2/1.2)*(P+3*Wpier*1.2)*Offset	$M_{o\_1.2}$ =	3058.00	ft-kips	
Compressive Load for Bearing:	$P_{bearing}$ = Wc + Ws + P / 1.2	$P_{bearing}$ =	523.41	kips	
*Load Eccentricity (0.9*D LC):*	$e_{c\_0.9}$ = Mo / 0.9*Pbearing	$e_{c\_0.9}$ =	6.49	ft	L/6 < e <= L/
*Load Eccentricity (1.2*D LC):*	$e_{c\_1.2}$ = Mo / 1.2*Pbearing	$e_{c\_1.2}$ =	4.87	ft	e <= L/6
Elastic Section Modulus.	S = W³ / 6	S =	5461.33	ft³	
*Positive Pressure (0.9*D LC):*	$P_{pos\_st\_0.9}$ = 0.9*Pbearing / Area + Mo / S	$P_{pos\_st\_0.9}$ =	1.02	ksf	
*Positive Pressure (1.2*D LC):*	$P_{pos\_st\_1.2}$ = 1.2*Pbearing / Area + Mo / S	$P_{pos\_st\_1.2}$ =	1.17	ksf	
*Negative Pressure (0.9*D LC):*	$P_{neg\_st\_0.9}$ = 0.9*Pbearing / Area - Mo / S **Note: The stress resultant is NOT within the kern. Bearing area has been adjusted below.**	$P_{neg\_st\_0.9}$ =	-0.10	ksf	
*Negative Pressure (1.2*D LC):*	$P_{neg\_st\_1.2}$ = 1.2*Pbearing / Area - Mo / S **Note: The resultant stress is within the kern. No adjustment is required.**	$P_{neg\_st\_1.2}$ =	0.05	ksf	
*Adjusted Pressure (0.9*D LC):*	$P_{adj\_0.9}$ = (2 * 0.9*Pbearing) / (3 * W * (W / 2 - ec_0.9))	$P_{adj\_0.9}$ =	1.03	ksf	
*Adjusted Pressure (1.2*D LC):*	$P_{adj\_1.2}$ = (2 * 1.2*Pbearing) / (3 * W * (W / 2 - ec_1.2))	$P_{adj\_1.2}$ =	1.18	ksf	
*Maximum Pressure (0.9*D LC):*	$q_{u\_st\_0.9}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_0.9}$ =	1.03	ksf	
*Maximum Pressure (1.2*D LC):*	$q_{u\_st\_1.2}$ = IF(Pneg ≥ 0, Ppos , Padj)	$q_{u\_st\_1.2}$ =	1.17	ksf	

One-Way Shear

Rebar: $s_{\_pad}$ = 9, $m_{\_pad}$ = 32 — *Equally spaced, top and bottom, both directions.* — d_{b_pad} = 1.128 in; A_{b_pad} = 1 in²

Effective depth:	d_c = T - cc - 1.5 * db	d_c =	13.3	in
Distance from Edge of Pad to Column Face:	d' = Ledge - dpier/2	d' =	10.0	ft
Distance from Edge of Pad to dc from Column Face:	d'' = d' - d_c / 12	d'' =	8.85	ft
Distance to qs (0.9D LC):	$L'_{\_0.9}$ = (W / 2 - ec_0.9) * 3	$L'_{\_0.9}$ =	28.53	ft
Distance to qs (1.2D LC):	$L'_{\_1.2}$ = (W / 2 - ec_1.2) * 3	$L'_{\_1.2}$ =	33.39	ft
*Slope of qs (0.9*D LC):*	$sq_{s\_0.9}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_0.9}$ =	0.04	kcf
*Slope of qs (1.2*D LC):*	$sq_{s\_1.2}$ = IF(L' > W, (Ppos - Pneg) / W, qu / L')	$sq_{s\_1.2}$ =	0.03	kcf
Nominal Shear Strength:	V_{n1} = 2 * W * √(F'c*1000) * dc	V_{n1} =	559.80	kips
Shear Reduction Factor:	φ_{shear} = 0.75	φ_{shear} =	0.75	
Design Shear Strength:	φV_{n1} = φshear * V_{n1}	φV_{n1} =	419.85	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:	1.5	0.125	47.79	63.72
Soil Below Water Table:	2.5	0.063	39.89	53.18
Pad Above Water Table:	0	0.150	0.00	0.00
Pad Below Water Table:	1.5	0.088	33.49	44.65
Total:			121.16	161.55

*Applied Shear (0.9*D LC):*	$V_{u1\_0.9}$ = 'Pad Shear and Moment Diagrams'!$AY$21	$V_{u1\_0.9}$ =	129.00	kips
*Applied Shear (1.2*D LC):*	$V_{u1\_1.2}$ = 'Pad Shear and Moment Diagrams'!$CG$21	$V_{u1\_1.2}$ =	131.15	kips

Check **φV_{n1} = 419.85 kips >= V_{u1} = 131.15 kips** **RATING: 31.24% OK**

Two-Way Shear (Compression)

Avg. Effective Depth for Punching Shear:	d_{c_2} = T - cc - AVERAGE(0.5 * db , 1.5 * db)	d_{c_2} =	13.87	in
Radius of Two-Way Shear Plane:	r_{2way} = 0.5*(dpier + dc_2/12)	r_{2way} =	2.58	ft
Length to Edge of Pad from Pier Centroid:	L_{edge2} = W/2 - 2/3*SIN(60°)*BW + Offset	L_{edge2} =	7.92	ft
Length of Shear Perimeter to Deduct:	s = r_{2way} * (2 * ACOS(((r_{2way}-MAX(r_{2way}-L_{edge},0))/r_{2way}))	s =	0.00	ft
Pier Shape:	Pier Shape: Circular	Pier Shape:	Circular	
Pier Diameter:	d_{pier1} = d_{pier} * 12 in / ft	d_{pier1} =	48.00	in
Equivalent Square Pier Diameter:	d_{pier_sq} = √π / 2 * dpier	d_{pier_sq} =	42.54	in

Factor of transfer of Moment:	Y_f = 1/(1+(2/3)*√(dpier1/dpier1))	Y_f =	0.60	
Factor of transfer of eccentricity of Shear:	Y_v = 1 - Y_f	Y_v =	0.40	
Moment applied at base of Pier:	M_v = M_{u_comp} * 12 in / ft	M_v =	1188.00	kip*in
Circular Critical Perimeter:	P_{crit_cir} = (dpier+dc_2/12)*PI() - $L$171)*12	P_{crit_cir} =	194.38	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_sq\_1}$ = 4*(dpier_sq+dc_2)	$P_{crit\_sq\_1}$ =	225.64	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_sq\_2}$ = 2*(dpier_sq + dc_2) + (W*12-BW*12)	$P_{crit\_sq\_2}$ =	328.82	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_sq\_3}$ = 2 * (dpier_sq + dc_2 + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_sq\_3}$ =	399.83	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_sq\_4}$ = 2 * (dpier_sq + dc_2 + Ledge2 * 12)	$P_{crit\_sq\_4}$ =	302.83	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_sq\_5}$ = dpier_sq + dc_2 + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30)) - Ledge	$P_{crit\_sq\_5}$ =	307.91	in
Area of Concrete in Shear:	A_c = ((dpier1 + dc_2)*PI()) * dc_2	A_c =	2696.39	in^2
Eq. Square Area of Concrete in Shear (1):	$A_{c\_sq\_1} = P_{crit\_sq\_1} * d_{c\_2}$	$A_{c\_sq\_1}$ =	3130.13	in^2
Eq. Square Area of Concrete in Shear (2):	$A_{c\_sq\_2} = P_{crit\_sq\_2} * d_{c\_2}$	$A_{c\_sq\_2}$ =	4561.42	in^2
Eq. Square Area of Concrete in Shear (3):	$A_{c\_sq\_3} = P_{crit\_sq\_3} * d_{c\_2}$	$A_{c\_sq\_3}$ =	5546.40	in^2
Eq. Square Area of Concrete in Shear (4):	$A_{c\_sq\_4} = P_{crit\_sq\_4} * d_{c\_2}$	$A_{c\_sq\_4}$ =	4200.89	in^2
Eq. Square Area of Concrete in Shear (5):	$A_{c\_sq\_5} = P_{crit\_sq\_5} * d_{c\_2}$	$A_{c\_sq\_5}$ =	4271.38	in^2
Polar Moment of Inertia at assumed Critical Section:	J_{c_cir} = dc_2*(dpier1+dc_2)^3/6 + ((dpier1+dc_2)*(dc_2^3))/6 + (dc_2*(dpier1+dc_2))*(dpier1+dc_2)^2/(IF($L$169=0,2,4))	J_{c_cir} =	2217961.65	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section 1:	$J_{c\_sq\_1}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/2	$J_{c\_sq\_1}$ =	1685206.90	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_2}$ = (dc_2*(dpier_sq+dc_2)^3)/12 + ((dpier_sq+dc_2)*(dc_2^3))/12 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/2	$J_{c\_sq\_2}$ =	1465144.51	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_3}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_3}$ =	1062665.84	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_4}$ = (dc_2*(dpier_sq+dc_2)^3)/6 + ((dpier_sq+dc_2)*(dc_2^3))/6 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_4}$ =	1062665.84	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_sq\_5}$ = (dc_2*(dpier_sq+dc_2)^3)/12 + ((dpier_sq+dc_2)*(dc_2^3))/12 + (dc_2*(dpier_sq+dc_2)*(dpier_sq+dc_2)^2)/4	$J_{c\_sq\_5}$ =	842603.45	in^4
*Applied Shear Force (1.2*D LC):*	$V_{u\_1.2}$ = 1.2*W_{pier} + 1.2 * IF(OR($B$1="G",$B$1="H"), P_{comp} / 1.2, P_{comp})	$V_{u\_1.2}$ =	253.83	kip
*Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling} = V_{u\_1.2} / A_c + (Y_v * M_v * (d_{pier1} + dc\_2)/2) / J_{c\_1}$	$v_{u\_1.2\_controlling}$ =	0.101	ksi
*Eq. Sq. Controlling Shear Stress (1.2*D LC):*	$v_{u\_1.2\_controlling\_sq} = V_{u\_1.2} / A_c + (Y_v * M_v * (d_{pier\_sq} + dc\_2)/2) / J_c$	$v_{u\_1.2\_controlling\_sq}$ =	0.089	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.164	ksi

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

Distance To Outside Edge:	$dist_{outside}$ = MIN((W-BW)/2,BW/2)*2	$dist_{outside}$ =	14	ft
Effective Pad Width:	$b_{\_pad}$ = MIN(dpier+3*T,W,dist_outside)	$b_{\_pad}$ =	8.50	ft
Bar Spacing:	B_{s_pad} = Bs_pad (see design checks below)	B_{s_pad} =	12.16	in
Fraction of Bars in Effective Width:	$m_{\_effective}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad)	$m_{\_effective}$ =	8.39	
Area of Steel in Effective Width:	$A_{s\_effective}$ = VLOOKUP(Sp,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective}$ =	8.39	in^2
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective} = A_{s\_effective}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective}$ =	1.94	in
	$\beta_{pad} = \beta_{pad}$ (see design checks below)	β_{pad} =	0.85	
Distance from Top to Nuetral Axis:	$c_{\_effective} = a_{\_effective} / \beta_{pad}$	$c_{\_effective}$ =	2.28	
Effective depth:	dc = dc (see One-Way Shear check above)	dc =	13.308	in
Modulus of Elasticity of Steel:	E_s = 29000 ksi	E_s =	29000	ksi

Strain in Steel:	$\varepsilon_{s\_effective}$ = 0.003 * (dc-c) / c	$\varepsilon_{s\_effective}$ =	0.01453	in/in
Compression-Controlled Strain Limit::	ε_c = F_y / E_s	ε_c =	0.00207	in/in
Tension-Controlled Strain Limit::	ε_t = 0.005	ε_t =	0.00500	in/in
Flexure Strength Reduction Factor:	$\varphi flex_{\_effective}$ = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	$\varphi flex_{\_effective}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective}$ = $A_{s\_effective}$ * (F_y) * (dc - $a_{\_effective}$ / 2) * (1/12)	$M_{n\_effective}$ =	517.68	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective}$ =	465.91	ft-kips

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

Bar Spacing:	$B_{s\_pad\_top}$ = IF(Input!$S$6=TRUE,(W*12 - 2 * ccpad - VLOOKUP(sptop,Ref!$A$2:$C$1:	$B_{s\_pad\_top}$ =	8.50	in
Fraction of Bars in Effective Width:	$m_{\_effective\_top}$ = IF(b_pad=W,mp,12*b_pad/Bs_pad_top)	$m_{\_effective\_top}$ =	8.39	
Area of Steel in Effective Width:	$A_{s\_effective\_top}$ = VLOOKUP(Sptop,Ref!$A$2:$C$12,3,0)*m_slab	$A_{s\_effective\_top}$ =	8.39	in²
Depth of Equivalent Rectangular Stress Block:	$a_{\_effective\_top}$ = $A_{s\_effective\_top}$ * Fy / (0.85 * F'c * $b_{\_slab}$*12)	$a_{\_effective\_top}$ =	1.94	in
Distance from Top to Nuetral Axis:	$c_{\_effective\_top}$ = $a_{\_effective\_top}$ / β_{pad}	$c_{\_effective\_top}$ =	2.28	
Effective depth:	dc_top = T *12 - ccpad - 1.5 * VLOOKUP(sptop,Ref!$A$2:$C$12,2,0)	d_{c_top} =	13.308	in
Strain in Steel:	$\varepsilon_{s\_effective\_top}$ = 0.003 * (dc_top-c_effective_top) / c_effective_top	$\varepsilon_{s\_effective\_top}$ =	0.01453	in/in
Flexure Strength Reduction Factor:	$\varphi flex_{\_effective\_top}$ = IF(εs>=εt,0.9,IF(εs<=εc,0.65,0.65+(0.9-0.65)*((εs-εc)/(εt-εc))))	$\varphi flex_{\_effective\_top}$ =	0.9	
Nominal Flexural Strength:	$M_{n\_effective\_top}$ = $A_{s\_effective\_top}$ * (F_y) * (dc_top - $a_{\_effective\_top}$ / 2) * (1/12)	$M_{n\_effective\_top}$ =	517.68	ft-kips
Design Flexural Strength:	$\varphi M_{n\_effective\_top}$ = φflex_effective * Mn_effective	$\varphi M_{n\_effective\_top}$ =	465.91	ft-kips
Applied Moment:	$Yf*M_{u\_comp}$ = $Yf*M_{u\_comp}$	$Yf*M_{u\_comp}$ =	59.4	ft-kips

Check **$\varphi M_{n\_effective}$ = 931.83 ksi >= $Yf*M_{u\_comp}$ = 59.40 ksi** **RATING: 6.37% OK**

Two-Way Shear (Uplift)

Moment applied at base of Pier:	M_{v_tens} = $M_{u\_tension}$ * 12 in / ft	M_{v_tens} =	1080.00	kip*in
Diameter of Longitudinal Rebar Cage:	$d_{\_cage}$ = dpier*12-2*(ccpier+VLOOKUP(St,Ref!$A$2:$C$12,2,0))-VLOOKUP(Sc,Ref!$A$2:$C$12,2,0)	$d_{\_cage}$ =	40.13	in
Eq. Sq. Diameter of Longitudinal Rebar Cage:	$d_{\_cage\_sq}$ = SQRT(PI())/2*d_cage	$d_{\_cage\_sq}$ =	35.56	in
Steel Embedment Length:	L_{embed} = dc_2 (see One-Way Shear check above)	L_{embed} =	13.87	in
Radius of Two-Way Shear Plane:	r_{2way_tens} = 0.5*(d_cage/12 + Lembed/12)	r_{2way_tens} =	2.25	ft
	$r_{2way\_tens\_sq}$ = 0.5*(SQRT(PI())/2*d_cage/12 + Lembed/12)	$r_{2way\_tens\_sq}$ =	2.06	ft
Length of Shear Perimeter to Deduct:	s_{tens} = r_tens*RADIANS(2*ACOS(((r_tens-MAX(r_tens-Ledge,0))/r_tens))*180/PI())	s_{tens} =	0.00	ft
Eq. Sq. Length of Shear Perimeter to Deduct:	s_{tens_sq} = 0	s_{tens_sq} =	0.00	ft
Circular Critical Perimeter:	P_{crit_tens} = ((d_cage/12+Lembed/12)*PI() - stens)*12	P_{crit_tens} =	169.64	in
Equivalent Square Critical Perimeter 1:	$P_{crit\_tens\_sq\_1}$ = 4*(d_cage_sq+Lembed)	$P_{crit\_tens\_sq\_1}$ =	197.73	in
Equivalent Square Critical Perimeter 2:	$P_{crit\_tens\_sq\_2}$ = 2*(d_cage_sq + Lembed) + (W*12-BW*12)	$P_{crit\_tens\_sq\_2}$ =	314.86	in
Equivalent Square Critical Perimeter 3:	$P_{crit\_tens\_sq\_3}$ = 2 * (d_cage_sq + Lembed) + (W - BW * COS(RADIANS(30)) - Ledge2)*12)	$P_{crit\_tens\_sq\_3}$ =	385.87	in
Equivalent Square Critical Perimeter 4:	$P_{crit\_tens\_sq\_4}$ = 2 * (d_cage_sq + Lembed + Ledge2 * 12)	$P_{crit\_tens\_sq\_4}$ =	288.87	in
Equivalent Square Critical Perimeter 5:	$P_{crit\_tens\_sq\_5}$ = d_cage_sq + Lembed + 0.5*(W-BW)*12 + (W - BW * COS(RADIANS(30)) -	$P_{crit\_tens\_sq\_5}$ =	300.93	in
Area of Concrete in Shear:	A_{c_tens} = Pcrit_tens*Lembed	A_{c_tens} =	2353.20	in²
Equivalent Square Area of Concrete in Shear:	$A_{c\_tens\_sq1}$ = Pcrit_tens_sq1*Lembed	$A_{c\_tens\_sq1}$ =	2742.87	in²
	$A_{c\_tens\_sq2}$ = 'Pcrit_tens_sq2*Lembed	$A_{c\_tens\_sq2}$ =	4367.79	in²
	$A_{c\_tens\_sq3}$ = Pcrit_tens_sq3*Lembed	$A_{c\_tens\_sq3}$ =	5352.77	in²
	$A_{c\_tens\_sq4}$ = Pcrit_tens_sq4*Lembed	$A_{c\_tens\_sq4}$ =	4007.26	in²
	$A_{c\_tens\_sq5}$ = Pcrit_tens_sq5*Lembed	$A_{c\_tens\_sq5}$ =	4174.56	in²

Polar Moment of Inertia at assumed Critical Section:	J_{c_tens} = Lembed*(d_cage+Lembed)^3/6 + ((d_cage+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage+Lembed))*(d_cage+Lembed)^2/(IF(Ledge2=0,2,4))	J_{c_tens} =	934013.70	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section 1:	$J_{c\_tens\_sq\_1}$ = (Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/2	$J_{c\_tens\_sq\_1}$ =	1139031.98	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_2}$ = (Lembed*(d_cage_sq+Lembed)^3)/12 + ((d_cage_sq+Lembed)*(Lembed^3))/12 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/2	$J_{c\_tens\_sq\_2}$ =	988405.83	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_3}$ = (Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_3}$ =	720142.14	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_4}$ = (Lembed*(d_cage_sq+Lembed)^3)/6 + ((d_cage_sq+Lembed)*(Lembed^3))/6 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_4}$ =	720142.14	in^4
Eq. Square Polar Moment of Inertia at assumed Critical Section:	$J_{c\_tens\_sq\_5}$ = (Lembed*(d_cage_sq+Lembed)^3)/12 + ((d_cage_sq+Lembed)*(Lembed^3))/12 + (Lembed*(d_cage_sq+Lembed)*(d_cage_sq+Lembed)^2)/4	$J_{c\_tens\_sq\_5}$ =	569515.99	in^4
*Applied Shear Force (0.9*D LC):*	$V_{u\_0.9\_tens}$ = MAX(-0.9*Wpier + 0.9 * IF(OR($B$1="G",$B$1="H"), Puplift / 0.9, Puplift),0)	$V_{u\_0.9\_tens}$ =	214.13	kip
*Controlling Shear Stress (0.9*D LC):*	$v_{u\_0.9\_controlling\_tens}$ = $V_{u\_0.9}$ / A_{c_tens} + (Y_v * M_v * (d_{cage} + Lembed)/2) / J_{c_tens}	$v_{u\_0.9\_controlling\_tens}$ =	0.103	ksi
*Equivalent Square Shear Stress (0.9*D LC):*	$v_{u\_0.9\_tens\_sq}$ = Vu_0.9_tens/Ac_tens_sq1 + (Yv * Mv_tens * (d_cage_sq + Lembed)/2) / Jc	$v_{u\_0.9\_tens\_sq}$ =	0.087	ksi
Shear Stress Capacity:	Φv_n = φs * 4 * (√F'c*1000) / 1000	Φv_n =	0.164	ksi

Two-Way Shear (Uplift, Flexural Component)

Applied Moment:	Yf*$M_{u\_tension}$ = Yf*$M_{u\_tension}$	Yf*$M_{u\_tension}$ =	54	

Check **$\varphi M_{n\_effective}$ = 931.83 ksi >= Ÿf*$M_{u\_tension}$ = 54.00 ksi** **RATING: 5.80% 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} =	32.00	in^2
Depth of Equivalent Rectangular Stress Block:	a = A_{s_pad} * Fy / (0.85 * F'c * W)	a =	1.96	in
Distance from Top to Nuetral Axis:	c = a / β_{pad}	c =	2.31	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 =	0.01431	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 =	1972.42	ft-kips
Design Flexural Strength:	φM_n = φflex * Mn	φM_n =	1775.18	ft-kips
*Bearing Press. at Crit. Section (0.9*D LC):*	qmid_0.9 = qu_st_0.9 - sqs_0.9 * d'	qmid_0.9 =	0.67	ksf
*Bearing Press. at Crit. Section (1.2*D LC):*	qmid_1.2 = qu_st_1.2 - sqs_1.2 * d'	qmid_1.2 =	0.82	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:	1.5	0.125	53.78	71.70	4.979274058	267.77	357.02
Soil Below Water Table:	2.5	0.063	44.89	59.85	4.979274058	223.50	297.99
Pad Above Water Table:	0	0.150	0.00	0.00	4.979274058	0.00	0.00
Pad Below Water Table:	1.5	0.088	37.69	50.25	4.979274058	187.65	250.20
Total:			136.35	181.80		678.91	905.22

*Factored Bending Moment (0.9*D LC):*	Mu_pad_0.9 = 'Pad Shear and Moment Diagrams'!$AZ$21	Mu_pad_0.9 =	785.34	ft-kips

*Factored Bending Moment (1.2*D LC):*	Mu_pad_1.2 = 'Pad Shear and Moment Diagrams'!$CH$21	Mu_pad_1.2 =	795.39 ft-kips

Check	**φM_n = 1775.18 ft-kips**	**>=**	**M_{u_pad} = 795.39 ft-kips**	**RATING:**	**44.81%**	**OK**

PIER DESIGN CHECKS

Bar Spacing

Bar separation:	B_{s_pier} = (do * π) / m_pier - db_pier	B_{s_pier} =	3.97	in

Check	**18.00 in**	**>=**	**B_{s_pier} = 3.97 in**	**RATING:**	**22.07%**	**OK**

Vertical Rebar Development Length

Reinforcement location:	α_c = if space under bar > 12", 1.3, else use 1.0	α_c =	1.3	
Epoxy coating:	β_c = for non- epoxy coated, use 1.0	β_c =	1.0	
Max term:	$\alpha\beta_c$ = product of α x β not to exceed 1.7	$\alpha\beta_c$ =	1.3	
Reinforcement size:	γ_c = if bar size is 6 or less, 0.8, else use 1.0	γ_c =	1	
Light weight concrete:	λ_c = 1.0	λ_c =	1.0	
Spacing/cover:	$c_{\_c}$ = use smaller of half of bar spacing or concrete cover	$c_{\_c}$ =	2.4	in
Transverse bars:	k_{tr_c} = 0 in (per simplification)	k_{tr_c} =	0	in
Max term:	c_c' = MIN(2.5, (c_c + ktr_c) / db_c)	c_c' =	2.500	
Excess reinforcement:	R_c = Ast_c / As_c	R_c =	0.58	
Development (tensile):	$L_{dt}'_{\_c}$ = (3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ_c * γ_c * λ_c * R_c * db_c / c_c'	$L_{dt}'_{\_c}$ =	21.68	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} =	21.68	in
Development (comp.):	$L_{dc}'_{\_c}$ = 0.02 * db_c * Fy*1000 / √(F'c*1000)	$L_{dc}'_{\_c}$ =	19.17	in
	$L_{dc}''_{\_c}$ = 0.0003 * db_c * Fy*1000	$L_{dc}''_{\_c}$ =	15.75	in
Development length:	L_{dc_c} = MAX(8, Ldc'_c, Ldc''_c)	L_{dc_c} =	19.17	in
Length available in pier:	L_{vc} = D - T + E - cc	L_{vc} =	51.0	in

Check	**L_{vc} = 51.00 in**	**>=**	**L_{dt_c} = 21.68 in**	**OK**
Check	**L_{vc} = 51.00 in**	**>=**	**L_{dc_c} = 19.17 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}' =	13.4	in
Minimum length:	L_{dh_min} = the larger of: 8 * d_b or 6 in	L_{dh_min} =	7.0	in
Development length:	L_{dh} = MAX(Ldh_min, Ldh')	L_{dh} =	13.4	in

Check	**L_{vp} = 15.00 in**	**>=**	**L_{dh} = 13.42 in**	**OK**

Hook tail length:	L_{h_tail} = 12 * db beyond the bend radius	L_{h_tail} =	14.0	in
Length available in pad:	L_{h_pad} = 12*MIN((W/2-(2/3)*BW*cos(30°)+Offset-dpier/2),(W-BW-dpier)/2) + ccpier - ccpad	L_{h_pad} =	71.0	in

Check	**L_{h_pad} = 71.01 in**	**>=**	**L_{dh_tail} = 14.00 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:	$s_{\_t}$ = 4	d_{b_t} =	0.5	in			
	$m_{\_t}$ = 9	A_{b_t} =	0.2	in^2			
Allowable tie spacing per vertical rebar:	$B_{s\_t\_max1}$ = 8 / z * db_c				$B_{s\_t\_max1}$ =	14	in
per tie size:	$B_{s\_t\_max2}$ = 24 / z * db_t				$B_{s\_t\_max2}$ =	24	in

per pier diameter:	$B_{s\_t\_max3}$ =	di / (4 * z²)	$B_{s\_t\_max3}$ =	48	in
per seismic zone:	$B_{s\_t\_max4}$ =	12" in active seismic zones, else 18"	$B_{s\_t\_max4}$ =	18	in
Maximum tie spacing:	$B_{s\_t\_max}$ =	MIN(Bs_t_max1, Bs_t_max2, Bs_t_max3, Bs_t_max4)	$B_{s\_t\_max}$ =	14	in
Minimum required ties:	$m_{\_t\_min}$ =	(D - T + E) / Bs_t_max + 2	$m_{\_t\_min}$ =	6.00	

Check **$m_{\_t}$ = 9.00 >= $m_{\_t\_min}$ = 6.00** **OK**

PAD DESIGN CHECKS

Minimum Steel Required for Shrinkage

Shrinkage:	ρ_{sh} =	IF(Fy >= 60, 0.0018, 0.002)	ρ_{sh} =	0.0018	
Min. Required Shrinkage Steel:	$A_{st\_p\_sh}$ =	ρsh * W * T	$A_{st\_p\_sh}$ =	12.442	in^2

Check **A_{s_p} = 32.00 in^2 >= A_{st_p} = 12.44 in^2** **OK**

Bar Separation

Bar separation:	B_{s_pad} =	(W - 2 * cc - db) / (m - 1)	B_{s_pad} =	12.16	in

Check **18" >= B_{s_p} = 12.16 in >= 2"** **OK**

Pad Development Length

Reinforcement location:	α_p =	if space under bar > 12", 1.3, else use 1.0	α_p =	1	
Epoxy coating:	β_p =	for non- epoxy coated, use 1.0	β_p =	1.0	
Max term:	$\alpha\beta_p$ =	product of α x β not to exceed 1.7	$\alpha\beta_p$ =	1	
Reinforcement size:	γ_p =	if bar size is 6 or less, 0.8, else use 1.0	γ_p =	1	
Light weight concrete:	λ_p =	1.0	λ_p =	1.0	
Spacing/cover:	c_p =	use smaller of half of bar spacing or concrete cover	c_p =	3.56	in
Transverse bars:	k_{tr_p} =	0 in (per simplification)	k_{tr_p} =	0	in
Max term:	c_p' =	MIN(2.5, (c + ktr) / db)	c_p' =	2.500	
Required moment (φt = 0.9):	M_{nr} =	Mu_pad / φflex	M_{nr} =	883.8	ft-kips
Steel estimate:	A_{st_p}' =	Mn / (φt * Fy * dc)	A_{st_p}' =	14.758	in^2
	a_p =	Ast' * Fy / (β * F'c * W)	a_p =	0.90	in
Required steel:	$A_{st\_p\_st}$ =	M_{nr} / (Fy * (dc - ap / 2))	$A_{st\_p\_st}$ =	13.749	in^2
Excess reinforcement:	R_p =	Ast_p / As_p	R_p =	0.43	
Development (tensile):	L_d =	(3 / 40) * (Fy*1000 / √(F'c*1000)) * αβ * γ * λ * R * db / c'	L_d =	15.93	in
Minimum length:	L_{d_min} =	12 inches	L_{d_min} =	12.0	in
Development length:	L_{dp} =	MAX(Ld_min, Ldp')	L_{dp} =	15.93	in
Length available in pad:	L_{pad} =	12*MIN((W/2-(2/3)*BW*cos(30°)+Offset-dpier/2),(W-BW-dpier)/2)- ccpad	L_{pad} =	116.50	in

Check **L_{pad} = 116.50 in >= L_{dp} = 15.93 in** **OK**

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

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

Site Data

ES-001
CheshireAWC

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

Pier Properties		
Concrete:		
Pier Diameter =	4.0	ft
Concrete Area =	1809.6	in^2
Reinforcement:		
Clear Cover to **Tie**=	3.00	in
Horiz. **Tie** Bar Size=	4	
Vert. Cage Diameter =	3.34	ft
Vert. Cage Diameter =	40.13	in
Vertical Bar Size =	7	
Bar Diameter =	0.88	in
Bar Area =	0.6	in^2
Number of Bars =	26	
As Total=	15.6	in^2
A s/ Aconc, Rho:	0.0086	0.86%

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:	0.86%	OK

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn. Pn		
per ACI 318 (10-2)	2865.51	kips
at Mu=(ϕ=0.65)Mn=	970.31	ft-kips
Max Tu, (φ=0.9) Tn =	842.4	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces		
TIA Revision:	H	
Max. Factored Shaft Mu:	90	ft-kips **(* Note)**
Max. Factored Shaft Pu:	220	kips
Max Axial Force Type:	Tension	

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

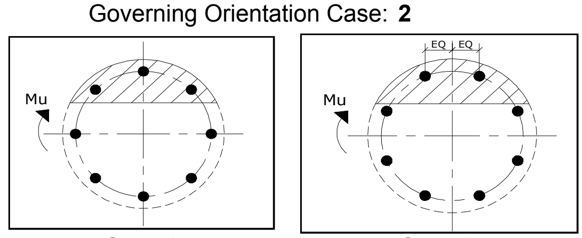
Load Factor	Shaft Factored Loads		
1.00	Mu:	90	ft-kips
1.00	Pu:	220	kips

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: **2**



Case 1 Case 2

Dist. From Edge to Neutral Axis:	**7.80**	in
Extreme Steel Strain, εt:	**0.0139**	

εt > 0.0050, Tension Controlled

Reduction Factor,φ:	**0.900**

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	-198.00	kips
Drilled Shaft Moment Capacity, φMn:	**1028.72**	ft-kips
Drilled Shaft Superimposed Mu:	**90.00**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**8.7%**

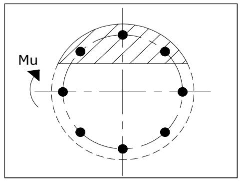
Maximum Allowable Moment of a Circular Pier

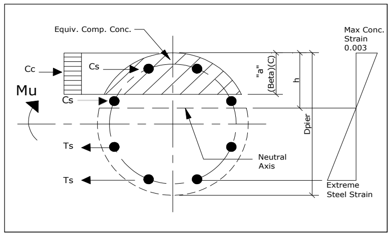
Pu: 220 kips (from Results Tab)
Axial Force type: Tension (from Results Tab)

For Internal Calculations:
Axial Load (Negative for Compression) = 220.00 kips

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

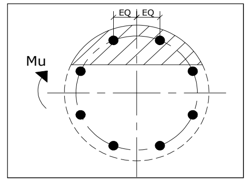
Case 1: Single Bar Near the Extreme Fiber





General Sketch (Variables) for both cases

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



Case 1

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.83 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to equivalent compression zone factor, a = 6.66 in
Distance from centroid to neutral axis = 16.17 in

Compression Zone

Area of steel in compression zone, Asc = 3.00 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 43.73 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 151.87 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 387.27 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -607.27 kips <-- ϕ Not Involved = Total Steel Pn
Case 1, φ= 0.900
Axial (comp=negative), Pu = 220.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -387.27 kips
Shaft Comp. Capacity, ϕPn= **-198.00** 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 = 3043.55 in^3
Distance between centroid of concrete in compression and centroid of pier = 20.04 in
Moment of concrete in compression = 7761.06 in-kips 646.755 ft-kips
Total reinforcement moment = 5963.56 in-kips 496.9632 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 13724.62 in-kips
Moment Capacity of Drilled Shaft, ϕMn = 12352.16 in-kips 1029.346 ft-kips

Case 1, φMn = 1029.35 ft-kips

Case 2

Neutral Axis

Distance from extreme edge to neutral axis, h = 7.80 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to equivalent compression zone factor, a = 6.63 in
Distance from centroid to neutral axis = 16.20 in

Compression Zone

Area of steel in compression zone, Asc = 2.40 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 43.63 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 150.92 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 384.85 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = -604.85 kips <-- ϕ Not Involved = Total Steel Pn
Case 2, φ= 0.900
Axial (comp=negative), Pu = 220.00 kips <-- Pu
Balance Force in concrete, Fs+Fu = -384.85 kips
Shaft Comp. Capacity, ϕPn= **-198.00** 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 = 3027.11 in^3
Distance between centroid of concrete in compression and centroid of pier = 20.06 in
Moment of concrete in compression = 7719.13 in-kips 643.2607 ft-kips
Total reinforcement moment = 5997.12 in-kips 499.7601 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 13716.25 in-kips
Moment Capacity of Drilled Shaft, ϕMn = 12344.62 in-kips 1028.719 ft-kips

Case 2, φMn = 1028.72 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 = 44.27 in
Equivalent compression zone factor = 0.85
Distance from extreme edge to equivalent compression zone factor, a = 37.63 in
Distance from centroid to neutral axis = -20.27 in

Compression Zone

Area of steel in compression zone, Asc = 11.40 in^2
Angle from centroid of pier to intersection of equivalent compression zone and edge of pier = 124.61 deg <-- 1/2 of total angle
Area of concrete in compression, Acc = 1521.95 in^2
Force in concrete = 0.85 * f`c * Acc, Fc = 3880.98 kips <-- ϕ Not Involved = Concrete Pn
Total reinforcement forces, Fs = 527.49 kips <-- ϕ Not Involved = Total Steel Pn
φ= 0.65
Magnified, Max Axial Comp, Pn, per ACI 318 (10-2)/(ϕ=0.65)= -4408.47 kips <-- (Pn per ACI 10-2)/ϕ
Balance Force in concrete, Fs+Fu = -3880.98 kips
Shaft Comp. Capacity, (ϕ=0.65)Pn= **2865.51** 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 = 5138.48 in^3
Distance between centroid of concrete in compression and centroid of pier = 3.38 in
Moment of concrete in compression = 13103.12 in-kips 1091.926 ft-kips
Total reinforcement moment = 4810.31 in-kips 400.8591 ft-kips
Nominal Moment strength of Drilled Shaft Mn = 17913.43 in-kips
Moment Capacity of Drilled Shaft, (ϕ=0.65)Mn = 11643.73 in-kips 970.3107 ft-kips

Case 3, at Pmax, (φ=0.65)Mn = 970.31 ft-kips

Final Results		
Governing Orientation Case=	**2**	
phi, φ=	0.900	
Shaft ϕ*Mn=	**1028.72**	ft-kips
Distance from Edge of Shaft to N.A.=	7.80	in
Shaft Beta=	0.85	
Maximum Tensile Strain=	-0.01390	<------------ ϵt > 0.0050, Tension Controlled
Shaft Tension Cap., φTn= (φ=0.9)*(Total As)(Fy)=	842.40	kips
Shaft Max Comp, (φ=0.65)(0.80)[0.85*f'c*(Ag-Ast)+Ast*Fy]=	2865.51	kips

TC

Individual Bars (Case 1)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	20.06	3.89	2.72	0.00149	0.60	43.26	24.42	490.00
2	13.85	19.48	3.31	2.14	0.00127	0.60	36.78	20.54	400.06
3	27.69	17.76	1.60	0.42	0.00061	0.60	17.73	9.11	161.75
4	41.54	15.02	-1.15	-2.33	-0.00044	0.00	-12.80	-7.68	-115.31
5	55.38	11.40	-4.77	-5.95	-0.00183	0.00	-53.02	-31.81	-362.53
6	69.23	7.11	-9.05	-10.23	-0.00347	0.00	-60.00	-36.00	-256.11
7	83.08	2.42	-13.75	-14.93	-0.00527	0.00	-60.00	-36.00	-87.06
8	96.92	-2.42	-18.59	-19.76	-0.00712	0.00	-60.00	-36.00	87.06
9	110.77	-7.11	-23.28	-24.46	-0.00892	0.00	-60.00	-36.00	256.11
10	124.62	-11.40	-27.57	-28.74	-0.01056	0.00	-60.00	-36.00	410.28
11	138.46	-15.02	-31.19	-32.36	-0.01195	0.00	-60.00	-36.00	540.61
12	152.31	-17.76	-33.93	-35.11	-0.01300	0.00	-60.00	-36.00	639.52
13	166.15	-19.48	-35.65	-36.82	-0.01366	0.00	-60.00	-36.00	701.26
14	180.00	-20.06	-36.23	-37.41	-0.01388	0.00	-60.00	-36.00	722.25
15	193.85	-19.48	-35.65	-36.82	-0.01366	0.00	-60.00	-36.00	701.26
16	207.69	-17.76	-33.93	-35.11	-0.01300	0.00	-60.00	-36.00	639.52
17	221.54	-15.02	-31.19	-32.36	-0.01195	0.00	-60.00	-36.00	540.61
18	235.38	-11.40	-27.57	-28.74	-0.01056	0.00	-60.00	-36.00	410.28
19	249.23	-7.11	-23.28	-24.46	-0.00892	0.00	-60.00	-36.00	256.11
20	263.08	-2.42	-18.59	-19.76	-0.00712	0.00	-60.00	-36.00	87.06
21	276.92	2.42	-13.75	-14.93	-0.00527	0.00	-60.00	-36.00	-87.06
22	290.77	7.11	-9.05	-10.23	-0.00347	0.00	-60.00	-36.00	-256.11
23	304.62	11.40	-4.77	-5.95	-0.00183	0.00	-53.02	-31.81	-362.53
24	318.46	15.02	-1.15	-2.33	-0.00044	0.00	-12.80	-7.68	-115.31
25	332.31	17.76	1.60	0.42	0.00061	0.60	17.73	9.11	161.75
26	346.15	19.48	3.31	2.14	0.00127	0.60	36.78	20.54	400.06
				Min-->	-0.01388	3.00		-607.27	5963.56
									496.9632

(Case 2)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	6.92	19.92	3.71	2.54	0.00143	0.60	41.44	23.33	464.67
2	20.77	18.76	2.56	1.39	0.00098	0.60	28.52	15.58	292.31
3	34.62	16.51	0.31	-0.86	0.00012	0.00	3.44	2.07	34.11
4	48.46	13.30	-2.90	-4.07	-0.00112	0.00	-32.34	-19.41	-258.16
5	62.31	9.32	-6.88	-8.05	-0.00265	0.00	-60.00	-36.00	-335.65
6	76.15	4.80	-11.40	-12.57	-0.00439	0.00	-60.00	-36.00	-172.85
7	90.00	0.00	-16.20	-17.37	-0.00623	0.00	-60.00	-36.00	0.00
8	103.85	-4.80	-21.00	-22.17	-0.00808	0.00	-60.00	-36.00	172.85
9	117.69	-9.32	-25.53	-26.70	-0.00982	0.00	-60.00	-36.00	335.65
10	131.54	-13.30	-29.51	-30.68	-0.01135	0.00	-60.00	-36.00	478.94
11	145.38	-16.51	-32.71	-33.88	-0.01259	0.00	-60.00	-36.00	594.40
12	159.23	-18.76	-34.96	-36.13	-0.01345	0.00	-60.00	-36.00	675.32
13	173.08	-19.92	-36.12	-37.29	-0.01390	0.00	-60.00	-36.00	716.98
14	186.92	-19.92	-36.12	-37.29	-0.01390	0.00	-60.00	-36.00	716.98
15	200.77	-18.76	-34.96	-36.13	-0.01345	0.00	-60.00	-36.00	675.32
16	214.62	-16.51	-32.71	-33.88	-0.01259	0.00	-60.00	-36.00	594.40
17	228.46	-13.30	-29.51	-30.68	-0.01135	0.00	-60.00	-36.00	478.94
18	242.31	-9.32	-25.53	-26.70	-0.00982	0.00	-60.00	-36.00	335.65
19	256.15	-4.80	-21.00	-22.17	-0.00808	0.00	-60.00	-36.00	172.85
20	270.00	0.00	-16.20	-17.37	-0.00623	0.00	-60.00	-36.00	0.00
21	283.85	4.80	-11.40	-12.57	-0.00439	0.00	-60.00	-36.00	-172.85
22	297.69	9.32	-6.88	-8.05	-0.00265	0.00	-60.00	-36.00	-335.65
23	311.54	13.30	-2.90	-4.07	-0.00112	0.00	-32.34	-19.41	-258.16
24	325.38	16.51	0.31	-0.86	0.00012	0.00	3.44	2.07	34.11
25	339.23	18.76	2.56	1.39	0.00098	0.60	28.52	15.58	292.31
26	353.08	19.92	3.71	2.54	0.00143	0.60	41.44	23.33	464.67
				Min-->	-0.01390	2.40		-604.85	5997.12
									499.7601

Individual Bars (Case 3)

Bar #	Angle from first bar (deg)	Distance to center of shaft (in)	Distance to neutral axis (in)	Distance to equivalent comp. zone (in)	Strain	Area of steel in compression (in^2)	Stress (ksi)	Axial force (kips)	Moment (in-kips)
1	0.00	20.06	40.33	33.69	0.00273	0.60	60.00	34.47	691.55
2	13.85	19.48	39.75	33.11	0.00269	0.60	60.00	34.47	671.46
3	27.69	17.76	38.04	31.40	0.00258	0.60	60.00	34.47	612.34
4	41.54	15.02	35.29	28.65	0.00239	0.60	60.00	34.47	517.64
5	55.38	11.40	31.67	25.03	0.00215	0.60	60.00	34.47	392.85
6	69.23	7.11	27.39	20.75	0.00186	0.60	53.82	30.76	218.84
7	83.08	2.42	22.69	16.05	0.00154	0.60	44.59	25.22	61.00
8	96.92	-2.42	17.85	11.21	0.00121	0.60	35.08	19.52	-47.21
9	110.77	-7.11	13.16	6.52	0.00089	0.60	25.86	13.98	-99.48
10	124.62	-11.40	8.87	2.23	0.00060	0.60	17.44	8.93	-101.82
11	138.46	-15.02	5.25	-1.39	0.00036	0.00	10.33	6.20	-93.04
12	152.31	-17.76	2.51	-4.13	0.00017	0.00	4.93	2.96	-52.52
13	166.15	-19.48	0.79	-5.85	0.00005	0.00	1.56	0.93	-18.20
14	180.00	-20.06	0.21	-6.43	0.00001	0.00	0.41	0.25	-4.95
15	193.85	-19.48	0.79	-5.85	0.00005	0.00	1.56	0.93	-18.20
16	207.69	-17.76	2.51	-4.13	0.00017	0.00	4.93	2.96	-52.52
17	221.54	-15.02	5.25	-1.39	0.00036	0.00	10.33	6.20	-93.04
18	235.38	-11.40	8.87	2.23	0.00060	0.60	17.44	8.93	-101.82
19	249.23	-7.11	13.16	6.52	0.00089	0.60	25.86	13.98	-99.48
20	263.08	-2.42	17.85	11.21	0.00121	0.60	35.08	19.52	-47.21
21	276.92	2.42	22.69	16.05	0.00154	0.60	44.59	25.22	61.00
22	290.77	7.11	27.39	20.75	0.00186	0.60	53.82	30.76	218.84
23	304.62	11.40	31.67	25.03	0.00215	0.60	60.00	34.47	392.85
24	318.46	15.02	35.29	28.65	0.00239	0.60	60.00	34.47	517.64
25	332.31	17.76	38.04	31.40	0.00258	0.60	60.00	34.47	612.34
26	346.15	19.48	39.75	33.11	0.00269	0.60	60.00	34.47	671.46
				Min-->	0.00001	11.40		527.49	4810.31
									400.8591

TIA-222- H

FACTORED LOADS

Axial Load 0.9D:	$P_{\_0.9D}$ = 0.9 * P / 1.2	$P_{\_0.9D}$ =	27.00	kip
Axial Load 1.2D:	$P_{\_1.2D}$ = 1.2 * P / 1.2	$P_{\_1.2D}$ =	36.00	kip
Shear Load:	V_u = V	V_u =	36.00	kip
Moment:	M_u = Mu	M_u =	2836.00	kip*ft

PASSIVE PRESSURE RESISTANCE

Force of Pp Applied on Pier:	$Force_{pier}$ = MIN(Vu,Sum(Pp!M2:M7))	$Force_{pier}$ =	6.97	kip
Moment Arm of Pp on Pier:	M_{arm_pier} = D-T-Pp!O2 + T	M_{arm_pier} =	1.75	ft
Force of Pp Applied on Pad:	$Force_{pad}$ = MIN(Vu-Forcepier,SUM(Pp!M8:M13))	$Force_{pad}$ =	29.03	kip
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} =	0.72	ft
Unfactored Moment Resistance due to Passive Pressure:	M_{R_Pp} = $Force_{pier}$*M_{arm_pier}+$Force_{pad}$*M_{arm_pad}	M_{R_Pp} =	33.07	kip*ft
Factored Moment Resistance due to Passive Pressure:	ΦM_{R_Pp} = Φs*MR_Pp	ΦM_{R_Pp} =	24.80	kip*ft

PLASTIC BEARING PRESSURE & OVERTURNING MOMENT

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing	$P_{bearing\_0.9}$ =	471.07	kip	
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2}$ = P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing	$P_{bearing\_1.2}$ =	628.09	kip	
*Factored Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9}$ = M + V * (MAX(T,D) + E + bpdist/12) + (0.9)*(P/1.2+3*Wpier)*Offset	$M_{overturning\_0.9}$ =	3058.00	kip*ft	
*Factored Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2}$ = M + V * (MAX(T,D) + E + bpdist/12) + (1.2)*(P/1.2+3*Wpier)*Offset	$M_{overturning\_1.2}$ =	3058.00	kip*ft	
Area of Pad:	Area = W²	Area =	1024.00	ft^2	
Plastic Section Modulus of Pad:	Z = W³ / 4	Z =	8192	ft³	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_p}$ = $M_{overturning}$/$P_{bearing\_0.9}$	$pre\_ec_{\_0.9\_p}$ =	6.49	ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_p}$ = $M_{overturning}$/$P_{bearing\_1.2}$	$pre\_ec_{\_1.2\_p}$ =	4.87	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_p}$ = *goal seek*	$ec_{\_0.9\_p}$ =	6.44	ft	e <= L/4
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_p}$ = *goal seek*	$ec_{\_1.2\_p}$ =	4.83	ft	e <= L/4
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9}$ = 0	$NBL_{\_0.9}$ =	0.00	ft	
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2}$ = 0	$NBL_{\_1.2}$ =	0.00	ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9}$ = ΦM_{R_Pp} + SUM($\Phi M_{R\_wedges\_0.9}$,$\Phi M_{R\_shear\_0.9}$)	$\Phi M_{Resisting\_0.9}$ =	24.80	kip*ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2}$ = ΦM_{R_Pp} + SUM($\Phi M_{R\_wedges\_1.2}$,$\Phi M_{R\_shear\_1.2}$)	$\Phi M_{Resisting\_1.2}$ =	24.80	kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_adj\_0.9}$ = $M_{overturning}$ - $\Phi M_{Resisting\_0.9}$	$M_{overturning\_0.9}$ =	3033.20	kip*ft	
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_adj\_1.2}$ = $M_{overturning}$ - $\Phi M_{Resisting\_1.2}$	$M_{overturning\_1.2}$ =	3033.20	kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9}$ = $P_{bearing\_0.9}$*$ec_{\_0.9\_p}$ + $\Phi M_{Resisting\_0.9}$	$\Phi M_{Resisting\_qu\_0.9}$ =	3058.00	kip*ft	
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2}$ = $P_{bearing\_1.2}$*$ec_{\_1.2\_p}$ + $\Phi M_{Resisting\_1.2}$	$\Phi M_{Resisting\_qu\_1.2}$ =	3058.00	kip*ft	
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_0.9}$ = $M_{overturning}$-$\Phi M_{Resisting\_qu\_0.9}$	$\Delta M_{\_0.9}$ =	0.00	ft	
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{\_1.2}$ = $M_{overturning}$-$\Phi M_{Resisting\_qu\_1.2}$	$\Delta M_{\_1.2}$ =	0.00	ft	

Bearing Pressures

*Orthogonal Bearing Pressure (0.9*D LC):*	$q_{u\_orth\_0.9}$ = MAX(Pbearing_0.9/Area + Moverturning_0.9/Z, Pbearing_0.9/Area - Moverturning_0.9/Z)	$q_{u\_orth\_0.9}$ =	0.83	ksf
*Orthogonal Bearing Pressure (1.2*D LC):*	$q_{u\_orth\_1.2}$ = MAX(Pbearing_1.2/Area + Moverturning_1.2/Z, Pbearing_1.2/Area - Moverturning_1.2/Z)	$q_{u\_orth\_1.2}$ =	0.98	ksf
Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} =	6.00	ksf
Factored Ultimate Gross Bearing Pressure:	ΦQult = φs * Qult	Qa =	4.50	ksf

Check **ΦQult = 4.50 ksf >= q_u = 0.98 ksf** **RATING: 21.86% OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht =	4.00	ft
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw =	2.50	ft
Soil Wedge Projection Grade:	$Wedge_{\_proj}$ = TAN(ϕ*PI()/180)*soilht	$Wedge_{\_proj}$ =	2.70	ft

Soil Wedge Projection at Water Table: Wedge$_{_proj_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw) Wedge$_{_proj_gw}$ = 1.69 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	32.00	0.00
(2) End Prisms (below Water Table)	0.00	0.00	32.63	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	32.00	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	32.00	0.00
(1) Rear (above Water Table)	0.00	0.00	33.12	0.00
(1) Rear (below Water Table)	0.00	0.00	32.56	0.00
Total	0.00	0.00		0.00

Wedge Eccentricity relative to W/2:

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

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

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

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

Soil	Volume (ft³)	Soil Weight (kips)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) End Prisms (above Water Table)	0.00	0.00	32.00	0.00
(2) End Prisms (below Water Table)	0.00	0.00	32.63	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	32.00	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	32.00	0.00
(1) Rear (above Water Table)	0.00	0.00	33.12	0.00
(1) Rear (below Water Table)	0.00	0.00	32.56	0.00
Total	0.00	0.00		0.00

Wedge Eccentricity relative to W/2:

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

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

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

Soil Shear Strength (Cohesive Soil)

Effective Soil Unit Weight: γ_{eff_shear} = γ γ_{eff_shear} = 0.0860 kcf

Depth to Mid-Layer of Soil: $H_{\_shear}$ = ((D - T) - N) / 2 + N $H_{\_shear}$ = 3.75 ft

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

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	0.00	0.00	32.00	0.00
(2) Partial Sides	0.00	0.00	32.00	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

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

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

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

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	0.00	0.00	32.00	0.00
(2) Partial Sides	0.00	0.00	32.00	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

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

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

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

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (ORTHOGONAL)

*Compressive Load for Bearing (0.9*D LC):* $P_{\_100}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100 $P_{\_100}$ = 508.80 kip

Preliminary Factored Overturning Moment: pre_$M_{overturning_100}$ = (W/2-($P_{\_100}$/ΦQult)/(2*W))*$P_{\_100}$ pre_$M_{overturning_100}$ = 7241.94 kip*ft

*Preliminary Load Eccentricity (0.9*D LC):* pre_$ec_{_100}$ = pre_$M_{overturning_100}$ / $P_{\_100}$ pre_$ec_{_100}$ = 14.23 ft

*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):* $ec_{\_100}$ = *goal seek* $ec_{\_100}$ = 14.18 ft L/4 < e <= l

*Non-Bearing Length (0.9*D LC):* $NBL_{\_100}$ = 2*ec_100 $NBL_{\_100}$ = 28.37 ft

*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):* $\Phi M_{Resisting\_100}$ = ΦM_{R_Pp} + SUM($\Phi M_{R\_wedges\_100}$,$\Phi M_{R\_shear\_100}$) $\Phi M_{Resisting\_100}$ = 315.31 kip*ft

Moment Created by Shear: M_{shear} = V_u * (D+E+bp_{dist}/12) M_{shear} = 222.00 kip*ft

*Adjusted Overturning Moment (0.9*D LC):* $M_{overturning\_100}$ = $M_{u\_max\_100}$ - ΦM_{R_Pp} $M_{overturning\_100}$ = 7532.45 kip*ft

*Total Resistance to Overturning (0.9*D LC):* $\Phi M_{Resisting\_qu\_100}$ = $P_{\_100}$*$ec_{\_100}$ + $\Phi M_{Resisting\_100}$ $\Phi M_{Resisting\_qu\_100}$ = 7532.45 kip*ft

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

Maximum Applied Moment from Superstructure Analysis: $M_{u\_max\_100}$ = pre_Moverturning_100 + ΦMResisting_100 $M_{u\_max\_100}$ = 7557.25 kip*ft

Check	Mu_max_100 =	7557.25	kip*ft	>=	Mu =	3058.00	kip*ft	RATING:	40.46%	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)	14.67	1.83	33.13	60.77
(2) End Prisms (below Water Table)	4.74	0.30	32.63	9.68
(2) Partial Sides (above Water Table)	186.57	23.32	17.82	415.47
(2) Partial Sides (below Water Table)	119.60	7.49	17.82	133.38
(1) Rear (above Water Table)	105.22	13.15	33.12	435.57
(1) Rear (below Water Table)	67.45	4.22	32.56	137.49
Total	498.25	50.31		1192.36

Wedge Eccentricity relative to W/2:

Total Moment Arm (ft) =	7.70
Soil Wedge Wt (kip)=	50.31

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_100}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_100}$ = 387.34	kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$\Phi M_{R\_wedges\_100}$ = 0.75*MR_wedges_100	$\Phi M_{R\_wedges\_100}$ = 290.51	kip*ft

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
Rear	16.00	0.00	32.00	0.00
(2) Partial Sides	28.37	0.00	17.82	0.00
Total		0.00		0.00

Wedge Eccentricity relative to W/2:

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

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

PASSIVE PRESSURE RESISTANCE (DIAGONAL DIRECTION)

Force of Pp Applied on Pier:	$Force_{pier}$ = MIN(Vu,Sum(Pp!M2:M7)))	$Force_{pier}$ = 6.97	kip
Moment Arm of Pp on Pier:	M_{arm_pier} = D-T-Pp!O2 + T	M_{arm_pier} = 1.75	ft
Force of Pp Applied on Pad:	$Force_{pad\_dia}$ = MIN(V_u-$Force_{pier}$,SUM(Pp!M8:M13))	$Force_{pad\_dia}$ = 29.03	kip
Moment Arm of Pp on Pad:	M_{arm_pad} = D-Pp!O8	M_{arm_pad} = 0.72	ft
Unfactored Moment Resistance due to Passive Pressure:	$M_{R\_Pp\_dia}$ = $Force_{pier}$*M_{arm_pier}+$Force_{pad}$*M_{arm_pad}	$M_{R\_Pp\_dia}$ = 33.07	kip*ft
Factored Moment Resistance due to Passive Pressure:	$\Phi M_{R\_Pp\_dia}$ = Φ_s*$M_{R\_Pp\_dia}$	$\Phi M_{R\_Pp\_dia}$ = 24.80	kip*ft

PLASTIC BEARING PRESSURE & OVERTURNING MOMENT (DIAGONAL DIRECTION)

*Compressive Load for Bearing (0.9*D LC):*	$P_{bearing\_0.9\_dia}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_0.9_bearing_dia	$P_{bearing\_0.9\_dia}$ = 493.60	kip	
*Compressive Load for Bearing (1.2*D LC):*	$P_{bearing\_1.2\_dia}$ = P_1.2D+1.2*(Ws+Wc)+0.75*Wwedges_1.2_bearing_dia	$P_{bearing\_1.2\_dia}$ = 628.09	kip	
Factored Overturning Moment:	$M_{overturning}$ = M_u + V_u * (D+E+bp_{dist}/12)	$M_{overturning}$ = 3058.00	kip*ft	
Area of Pad:	Area = W²	Area = 1024.00	ft^2	
Plastic Section Modulus of Pad:	$Z_{\_dia}$ = W³ / (3*SQRT(2))	$Z_{\_dia}$ = 7723.49	ft³	
*Preliminary Load Eccentricity (0.9*D LC):*	$pre\_ec_{\_0.9\_p\_dia}$ = $M_{overturning}$/$P_{bearing\_0.9\_dia}$	$pre\_ec_{\_0.9\_p\_dia}$ = 6.20	ft	
*Preliminary Load Eccentricity (1.2*D LC):*	$pre\_ec_{\_1.2\_p\_dia}$ = $M_{overturning}$/$P_{bearing\_1.2\_dia}$	$pre\_ec_{\_1.2\_p\_dia}$ = 4.87	ft	
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_0.9\_p\_dia}$ = *goal seek*	$ec_{\_0.9\_p\_dia}$ = 5.83	ft	(L/4)*SQRT
*[Goal Seek] Load Eccentricity Iteration (1.2*D LC):*	$ec_{\_1.2\_p\_dia}$ = *goal seek*	$ec_{\_1.2\_p\_dia}$ = 4.83	ft	e <= (L/4)*S
*Non-Bearing Length (0.9*D LC):*	$NBL_{\_0.9\_dia}$ = SQRT(2)*ec_0.9_p_dia	$NBL_{\_0.9\_dia}$ = 8.25	ft	
*Non-Bearing Length (1.2*D LC):*	$NBL_{\_1.2\_dia}$ = 0	$NBL_{\_1.2\_dia}$ = 0.00	ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_0.9}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_0.9\_dia}$,$\Phi M_{R\_shear\_0.9\_dia}$)	$\Phi M_{Resisting\_0.9\_dia}$ = 179.16	kip*ft	
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (1.2*D LC):*	$\Phi M_{Resisting\_1.2}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_1.2\_dia}$,$\Phi M_{R\_shear\_1.2\_dia}$)	$\Phi M_{Resisting\_1.2\_dia}$ = 24.80	kip*ft	
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_0.9\_dia}$ = $M_{overturning}$ - $\Phi M_{Resisting\_0.9\_dia}$	$M_{overturning\_0.9\_dia}$ = 2878.84	kip*ft	
*Adjusted Overturning Moment (1.2*D LC):*	$M_{overturning\_1.2\_dia}$ = $M_{overturning}$ - $\Phi M_{Resisting\_1.2\_dia}$	$M_{overturning\_1.2\_dia}$ = 3033.20	kip*ft	
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_0.9\_dia}$ = $P_{bearing\_0.9\_dia}$*$ec_{\_0.9\_p\_dia}$ + $\Phi M_{Resisting\_0.9\_dia}$	$\Phi M_{Resisting\_qu\_0.9\_dia}$ = 3058.00	kip*ft	
*Total Resistance to Overturning (1.2*D LC):*	$\Phi M_{Resisting\_qu\_1.2\_dia}$ = $P_{bearing\_1.2\_dia}$*$ec_{\_1.2\_p\_dia}$ + $\Phi M_{Resisting\_1.2\_dia}$	$\Phi M_{Resisting\_qu\_1.2\_dia}$ = 3058.00	kip*ft	
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_0.9\_dia}$ = $M_{overturning}$-$\Phi M_{Resisting\_qu\_0.9\_dia}$	$\Delta M_{\_0.9\_dia}$ = 0.00	kip*ft	
[Goal Seek] Moment Comparison Iteration (1.2D LC):	$\Delta M_{\_1.2\_dia}$ = $M_{overturning}$-$\Phi M_{Resisting\_qu\_1.2\_dia}$	$\Delta M_{\_1.2\_dia}$ = 0.00	kip*ft	

Bearing Pressures

*Diagonal Bearing Pressure (0.9*D LC):*	$q_{u\_dia\_0.9}$ = Pbearing_0.9_dia/((W-(SQRT(2))*ec_0.9_p_dia))^2	$q_{u\_dia\_0.9}$ = 0.87	ksf
*Diagonal Bearing Pressure (1.2*D LC):*	$q_{u\_dia\_1.2}$ = Pbearing_1.2_dia/Area + Moverturning_1.2_dia / Z_dia	$q_{u\_dia\_1.2}$ = 1.01	ksf

Ultimate Gross Bearing Pressure:	Q_{ult} = Qult	Q_{ult} = 6.00 ksf
Factored Ultimate Gross Bearing Pressure:	ΦQult = φs * Qult	Qa = 4.50 ksf

Check **ΦQult = 4.50 ksf >= q_u = 1.01 ksf** **RATING: 22.36% OK**

Soil Wedges (Cohesionless Soil)

Soil (above pad) Height:	soilht = D-T	soilht = 4.00 ft
Soil (above pad & under water table) Height:	soilht_gw = MIN(soilht-gw,D-T)	soilht_gw = 2.50 ft
Soil Wedge Projection at Grade:	$Wedge_{proj}$ = TAN(ϕ*PI()/180)*soilht	$Wedge_{proj}$ = 2.70 ft
Soil Wedge Projection at Water Table:	$Wedge_{proj\_gw}$ = TAN(ϕ*PI()/180)*(soilht_gw)	$Wedge_{proj\_gw}$ = 1.69 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)	14.67	1.83	22.63	41.50
(2) End Prisms (below Water Table)	4.74	0.30	22.63	6.71
(1) End Prism (above Water Table)	7.34	0.92	46.80	42.92
(1) End Prisms (below Water Table)	2.37	0.15	45.85	6.80
(2) Partial Sides (above Water Table)	54.24	6.78	18.94	128.40
(2) Partial Sides (below Water Table)	34.77	2.18	19.41	42.26
(2) Rear (above Water Table)	75.54	9.44	34.72	327.83
(2) Rear (below Water Table)	134.90	8.44	34.24	289.14
Total	328.58	30.04		885.56

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

Total Moment Arm (ft) =	6.85
Soil Wedge Wt (kip)=	30.04

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_0.9}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_0.9\_dia}$ = 205.81 kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$ΦM_{R\_wedges\_0.9}$ = 0.75*MR_wedges_0.9_dia	$ΦM_{R\_wedges\_0.9\_dia}$ = 154.36 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	22.63	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	45.85	0.00
(2) Partial Sides (above Water Table)	0.00	0.00	21.85	0.00
(2) Partial Sides (below Water Table)	0.00	0.00	22.33	0.00
(2) Rear (above Water Table)	0.00	0.00	34.72	0.00
(2) Rear (below Water Table)	0.00	0.00	34.24	0.00
Total	0.00	0.00		0.00

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

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

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

Soil Shear Strength (Cohesive Soil)

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) Rear	32.00	0.00	33.94	0.00
(2) Partial Sides	8.25	0.00	19.71	0.00
Total		0.00		0.00

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

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

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

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

Plane	Area (ft²)	Resistance (kip)	Moment Arm (ft)	Unfactored Resisting Moment (kip*ft)
(2) Rear	0.00	0.00	33.94	0.00
(2) Partial Sides	0.00	0.00	22.63	0.00
Total		0.00		0.00

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

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

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

DETERMINE MOMENT THAT WOULD CAUSE 100% OVERTURNING (DIAGONAL)

*Compressive Load for Bearing (0.9*D LC):*	$P_{\_100\_dia}$ = P_0.9D+0.9*(Ws+Wc)+0.75*Wwedges_100_dia	$P_{\_100\_dia}$ = 504.26 kip
Preliminary Factored Overturning Moment:	pre_$M_{overturning_100_dia}$ = (P_100_dia/(SQRT(2)))*(W-SQRT(P_100_dia/ΦQult))	pre_$M_{overturning_100_dia}$ = 7635.64 kip*ft
*Preliminary Load Eccentricity (0.9*D LC):*	pre_$ec_{_100_dia}$ = pre_$M_{overturning_100_dia}$ / $P_{bearing\_0.9}$	pre_$ec_{_100_dia}$ = 15.14 ft
*[Goal Seek] Load Eccentricity Iteration (0.9*D LC):*	$ec_{\_100\_dia}$ = *goal seek*	$ec_{\_100\_dia}$ = 15.09 ft (L/4)*SQRT

*Non-Bearing Length (0.9*D LC):*	$NBL_{\_100\_dia}$ = SQRT(2)*ec_100_dia	$NBL_{\_100\_dia}$ =	21.34 ft
*Total Factored Resisting Moment due to Pp and Soil Wedges / Shear (0.9*D LC):*	$\Phi M_{Resisting\_100\_dia}$ = $\Phi M_{R\_Pp\_dia}$ + SUM($\Phi M_{R\_wedges\_100\_dia}$,$\Phi M_{R\_shear\_100\_dia}$)	$\Phi M_{Resisting\_100\_dia}$ =	60.52 kip*ft
Moment Created by Shear:	M_{shear} = V_u * (D+E+bp_{dist}/12)	M_{shear} =	222.00 kip*ft
*Adjusted Overturning Moment (0.9*D LC):*	$M_{overturning\_100\_dia}$ = $M_{u\_max\_100\_dia}$ - $\Phi M_{R\_Pp\_dia}$	$M_{overturning\_100\_dia}$ =	7671.36 kip*ft
*Total Resistance to Overturning (0.9*D LC):*	$\Phi M_{Resisting\_qu\_100\_dia}$ = $P_{bearing\_0.9}$*$ec_{\_100\_dia}$ + $\Phi M_{Resisting\_100\_dia}$	$\Phi M_{Resisting\_qu\_100\_dia}$ =	7671.36 kip*ft
[Goal Seek] Moment Comparison Iteration (0.9D LC):	$\Delta M_{\_100\_dia}$ = $M_{overturning}$ - $\Phi M_{Resisting\_qu\_100\_dia}$	$\Delta M_{\_100\_dia}$ =	0.00 ft
Maximum Applied Moment from Superstructure Analysis:	$M_{u\_max\_100\_dia}$ = pre_Moverturning_100_dia + ΦMResisting_100_dia	$M_{u\_max\_100\_dia}$ =	7696.16 kip*ft

Check **Mu_max_100_dia = 7696.16 kip*ft >= Mu = 3058.00 kip*ft** **RATING: 39.73% 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)	14.67	1.83	22.63	41.50
(2) End Prisms (below Water Table)	4.74	0.30	22.63	6.71
(1) End Prism (above Water Table)	7.34	0.92	46.80	42.92
(1) End Prisms (below Water Table)	2.37	0.15	45.85	6.80
(2) Partial Sides (above Water Table)	140.37	17.55	14.31	251.02
(2) Partial Sides (below Water Table)	89.98	5.63	14.78	83.27
(2) Rear (above Water Table)	75.54	9.44	34.72	327.83
(2) Rear (below Water Table)	134.90	8.44	34.24	289.14
Total	469.92	44.26		1049.20

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

Total Moment Arm (ft) =	1.08
Soil Wedge Wt (kip)=	44.26

*Unfactored Resisting Moment of Wedges (0.9*D LC):*	$M_{R\_wedges\_100\_dia}$ = Total Moment Arm * Soil Wedge Wt	$M_{R\_wedges\_100\_dia}$ =	47.63 kip*ft
*Factored Resisting Moment of Wedges (0.9*D LC):*	$\Phi M_{R\_wedges\_100\_dia}$ = 0.75*MR_wedges_100_dia	$\Phi M_{R\_wedges\_100\_dia}$ =	35.72 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	32.00	0.00	33.94	0.00
(2) Partial Sides	21.34	0.00	15.08	0.00
Total		0.00		0.00

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

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

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

ATTACHMENT D – PROOF OF DELIVERY OF NOTICE

ORIGIN ID:RSPA (860) 663-1697
SCOTT M. CHASSE
ALL-POINTS TECHNOLOGY CORP, P.C
3 SADDLEBROOK DRIVE

KILLINGWORTH, CT 06419
UNITED STATES US

SHIP DATE: 08SEP20
ACTWGT: 1.00 LB
CAD: 4762401/INET4280

BILL SENDER

TO ATTN: WILLIAM S. VOELKER, AICP
TOWN OF CHESHIRE
84 SOUTH MAIN STREET

CHESHIRE CT 06410
(203) 271-6670 REF:
INV:
PO: DEPT:

56BJ6/1545/B766

FedEx Express

J202020071401uv

TRK# 0201 7714 6898 9741

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STANDARD OVERNIGHT

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ALL-POINTS TECHNOLOGY CORP, P.C
3 SADDLEBROOK DRIVE

KILLINGWORTH, CT 06419
UNITED STATES US

SHIP DATE: 08SEP20
ACTWGT: 1.00 LB
CAD: 4762401/INET4280

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TO **ATTN: HONORABLE ROB ORIS, JR.**
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84 SOUTH MAIN STREET

CHESHIRE CT 06410
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3 SADDLEBROOK DRIVE

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UNITED STATES US

SHIP DATE: 08SEP20
ACTWGT: 1.00 LB
CAD: 4762401/INET4280

BILL SENDER

TO ATTN: SEAN M. KIMBALL, TOWN MANAGER
TOWN OF CHESHIRE
84 SOUTH MAIN STREET

CHESHIRE CT 06410
(203) 271-6660 REF:
INV:
PO: DEPT:

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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-001

705 West Johnson Ave

Cheshire, CT 06410

April 7, 2020

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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 705 West Johnson Ave in Cheshire, CT.

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

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

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

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

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

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

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

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

3. Power Density Calculation Methods

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

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

Where:

EIRP = Effective Isotropic Radiated Power = 1.64 x ERP

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

H = Horizontal Distance from antenna

V = Vertical Distance from radiation center of antenna

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

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

4. Calculated % MPE Results

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. Please refer to Attachment C for the vertical pattern of the proposed Eversource antenna. Likewise, the other transmit antennas exhibit similar directionality of varying vertical beamwidths. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the facility. The calculated results in Table 1 include a nominal of 10 dB off-beam pattern loss for the omnidirectional and panel antennas, and 30 dB off-beam pattern loss for the highly directional microwave dish to account for the lower relative gain below the antennas. Any inactive or receive-only antennas are not listed in the table unless specified otherwise, as 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
CL&P whip	103	low band	1	120	0.0046	1.0000	0.05%
CL&P whip	103	150	1	120	0.0046	0.2000	0.23%
CL&P microwave	78	very strongly directional & horizontal - no significant RF to reach the ground					
Future CL&P whip	85	450	1	250	0.0144	0.3000	0.48%
MetroPCS CDMA	120	2135	3	727	0.0060	1.0000	0.60%
MetroPCS LTE	120	2130	1	1200	0.0033	1.0000	0.33%
AT&T-UMTS	98	850	2	728	0.0062	0.5667	1.09%
AT&T-PCS-UMTS	98	1900	2	1005	0.0085	1.0000	0.85%
AT&T-GSM	98	850	2	728	0.0062	0.5667	1.09%
AT&T-PCS-LTE	98	1900	2	1791	0.0152	1.0000	1.52%
AT&T-LTE	98	700	2	940	0.0080	0.4667	1.71%
Verizon	138	1970	4	1406	0.0116	1.0000	1.16%
Verizon	138	880	1	588	0.0012	0.5867	0.21%
Verizon	138	869	4	364	0.0030	0.5793	0.52%
Verizon	138	2145	4	1414	0.0117	1.0000	1.17%
Verizon	138	746	4	1039	0.0086	0.4973	1.72%
Eversource	146	37.76	1	120	0.0002	0.2000	0.11%
Eversource	83	10835	1	473	0.0000	1.0000	0.00%
Eversource	143	217	4	124	0.0010	0.2000	0.48%
						Total	**12.57%**

Table 1: Proposed Tower % MPE [1] [2] [3]

The CT Siting Council power density database reflects entries for existing CL&P (now Eversource), which are shown as grey in the table above. These entries have been replaced by the green shaded entries in the calculations and are based upon updated operating parameters provided by Eversource through its agents as part of this project. The blue entry reflects the parameters of the proposed Eversource transmit antenna. Therefore, the total % MPE calculated is based upon only the unshaded, green shaded, and blue shaded entries in the table. Please note that the MetroPCS antennas have not been installed per the Structural Analysis Report but have been retained in the cumulative % MPE calculations, nonetheless.

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

[2] The antenna heights listed are in reference to Black & Veatch Structural Analysis Report dated March 26, 2020. The height for the MetroPCS antennas is based on the CSC database since they are not shown in Structure Analysis Report.

[3] The proposed Eversource antenna consists of two internally stacked antennas – the upper antenna is intended for receive-only, whereas the lower internal antenna is for transmit. The transmit antenna height listed in the table has been adjusted accordingly based on the overall physical antenna centerline listed in the Black & Veatch Structural Analysis Report dated March 26, 2020.

5. Conclusion

The above analysis concludes that RF exposure at ground level with the proposed antenna installation will be below the maximum power density limits as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Using the conservative calculation methods discussed herein, the highest expected percent of Maximum Permissible Exposure at ground level with the proposed installation is **12.57% 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

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

April 7, 2020
Date

Keith Vellante

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

April 7, 2020
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[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)
0.3-3.0	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[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	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)

[4] 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

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

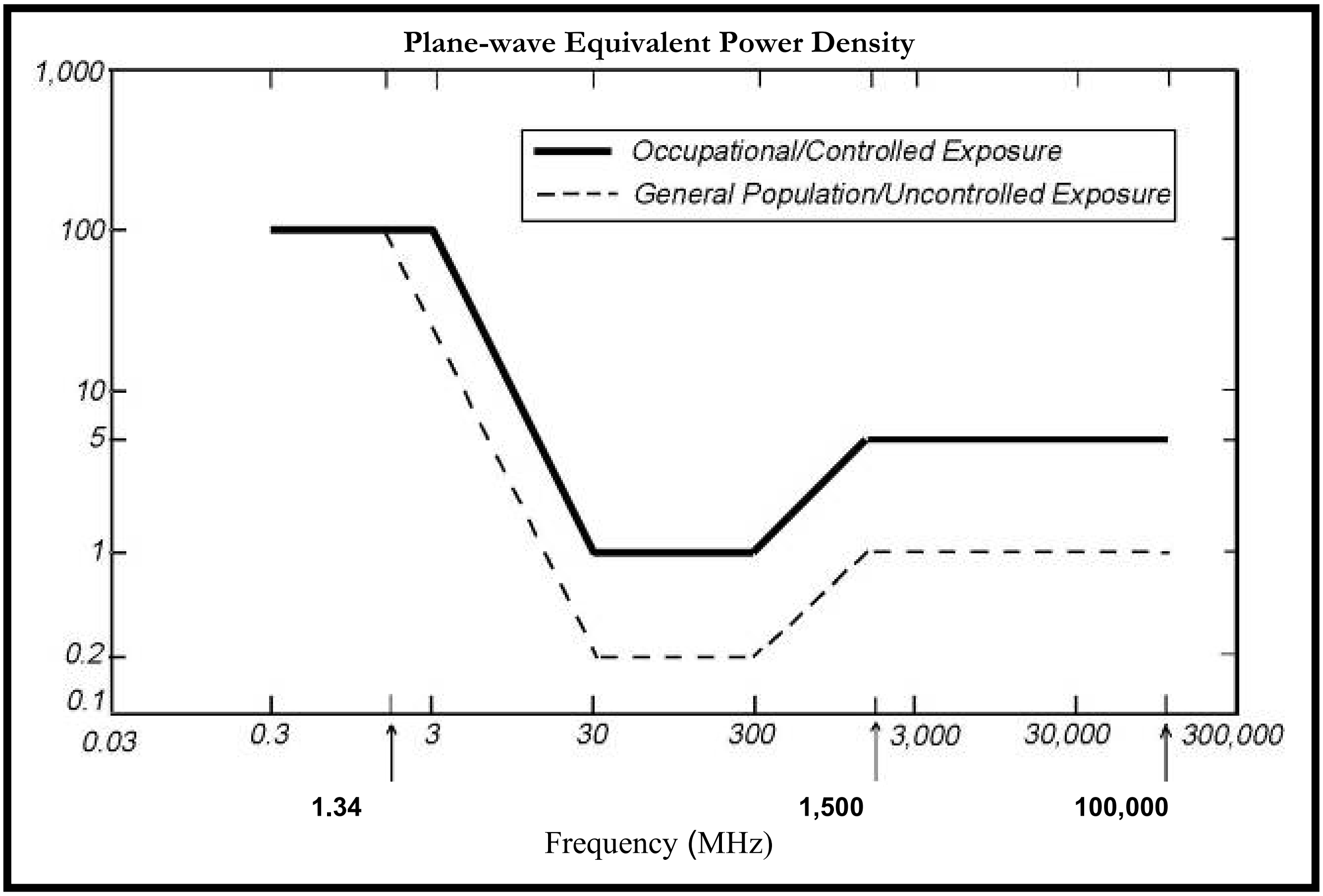

Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: Eversource Antenna Data Sheets and Electrical Patterns

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