Centek Engineering, Inc.
3-2 North Branford Road
Branford, Connecticut 06405
Phone: (203) 488-0580
Fax: (203) 488-8587

Steven L. Levine
Real Estate Consultant

HAND DELIVERED

May 13, 2016

Attorney Melanie Bachman
Acting Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051

Notice of Exempt Modification: Existing Telecommunications Facility at 136 Vinegar Hill Road, Ledyard

Dear Ms. Bachman:

In order to accommodate technological changes, implement Uniform Mobile Telecommunications System ("UMTS") and/or Long Term Evolution ("LTE") capabilities, and enhance system performance in the State of Connecticut, New Cingular Wireless PCS, LLC ("AT&T") plans to modify the equipment configurations at many of its existing cell sites. Please accept this letter and attachments as notification, pursuant to R.C.S.A. Section 16-50j-73, of construction which constitutes an exempt modification pursuant to R.C.S.A. Section 16-50j-72(b)(2). In compliance with R.C.S.A. Section 16-50j-73, copies of this letter are being sent to the chief elected official of the municipality in which the affected cell site is located, the property owner of record, and the tower owner or operator.

UMTS technology offers services to mobile computer and phone users anywhere in the world. Based on the Global System for Mobile ("GSM") communication standard, UMTS is the planned worldwide standard for mobile users. UMTS, fully implemented, gives computer and phone users high-speed access to the Internet as they travel. They have the same capabilities even when they roam, through both terrestrial wireless and satellite transmissions.

LTE is a high-performance air interface for cellular mobile communications. It is designed to increase the capacity and speed of mobile telephone networks.

Attached is a summary of the planned modifications, including power density calculations reflecting the change in AT&T's operations at the site. Also included is documentation of the structural sufficiency of the tower to accommodate the revised antenna configuration.

The changes to the facility do not constitute modifications as defined in Connecticut General Statutes ("C.G.S.") Section 16-50i(d) because the general physical and environmental characteristics of the site will not be significantly changed or altered. Rather, the planned changes to the facility fall squarely within those activities explicitly provided for in R.C.S.A. Section 16-50j-72(b)(2).

1. The height of the overall structure will not increase.

2. The proposed changes will not extend the site boundaries.

3. The proposed changes will not increase the noise level at the site boundary by six decibels or more, or to levels that exceed state and local criteria.

4. The changes will not add radio frequency sending or receiving capability which increases the total radio frequency electromagnetic radiation power density measured at the site boundary to or above the standards adopted by the Federal Communications Commission pursuant to Section 704 of the Telecommunications Act of 1996, as amended, and the State Department of Energy and Environmental Protection, pursuant to Section 22a-162 of the Connecticut General Statutes.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. With recommended modifications to the structure, the proposed equipment changes will not impair the structural integrity of the facility, as determined in a certification provided by a professional engineer licensed in Connecticut.

For the foregoing reasons, AT&T respectfully submits that the proposed changes at the referenced site constitute exempt modifications under R.C.S.A. Section 16-50j-72(b)(2).

Please feel free to call me at (860) 830-0380 with questions concerning this matter. Thank you for your consideration.

Sincerely,

Steven L. Levine
Real Estate Consultant

cc: Honorable Michael Finkelstein, Town of Ledyard
Property Owner of Record – State of Connecticut – Dept. of Pub. Safety (by email)
Tower Owner / Operator – State of Connecticut – Dept. of Pub. Safety (by email)

Attachments

NEW CINGULAR WIRELESS PCS, LLC
Equipment Modification

136 Vinegar Hill Road, Ledyard, CT
Geographic Coordinates: N 41-25-31.7 W 72-03-21.7
Site Number 2283
Prior Decisions: Petition 774
EM 4/13 (Expired)

Tower Owner/Manager: State of Connecticut – Department of Public Safety

Land Owner of Record: State of Connecticut – Department of Public Safety
Please refer to the attached Assessor's property record and map.

Original Permitting: There are no prior approval conditions that would be violated by the proposed modifications.

- 1980 - Petition 55. The Council originally approved the 136 Vinegar Hill Road tower facility as a 180-ft self-supporting lattice tower for use by the State Police and Coastal Cable TV.
- 1985 - State Police Petition 141. Microwave dishes added.
- 1989 - State Police Notice of Exempt Modification for replacement of the existing tower with a new 180-ft SSL, installation of new equipment, construction of an equipment building, and installation of a fence.
- 1998 - State Police Notice of Exempt Modification for the first use of the tower for cellular communications (Omnipoint).
- 2006 - Petition 774. Jointly filed by Omnipoint and AT&T for installation of a powermount in the existing SSL, thereby extending the structure to 199 feet a.g.l. overall height; for addition of AT&T cellular communications capability at the facility; and for construction of new equipment areas for Omnipoint and AT&T.
- 2013 - EM-CING-072-130328. Installation of equipment by AT&T for UMTS and LTE frequencies.
- 2014 - The 2013 approval expired without installation of the approved equipment by AT&T.

Lease Area: The attached site plan exhibit from the 1998 Notice of Exempt Modification shows the overall facility compound layout approved in 1998 to be substantially as it appears today. The 2006 Petition 774 site plan, attached, shows addition of the AT&T and Omnipoint equipment areas within the previously-approved facility footprint. Comparison of the 1998 and 2006 site plan exhibits with the attached proposed Construction Drawings confirms that all proposed equipment modifications will occur either on the existing tower structure or within AT&T's existing equipment shelter. Accordingly, the proposed modifications will extend neither AT&T's lease area nor the overall site boundaries.

Equipment configuration: 180-ft. SSL Tower with a power mount extension,
total height, 199 ft a.g.l.

Note: The approval for EM-CING-072-130328 expired without
installation of the equipment modifications.

Current and/or approved: Three PowerWave 7770 antennas @ 197 ft c.l. (flush-mounted)
Six Powerwave TMA's @ 197 ft
Six runs 1 5/8 inch coax
Equipment shelter

Planned Modifications: Remove all AT&T equipment from the power mount pole.
Perform structural modifications per structural analysis.
Install a SitePro Triple T-Arm Mount @ 196 ft.
Install one Valmont Universal Ring Mount @ 196 ft.
Re-install three PowerWave 7770 antennas @ 196 ft c.l.
Re-install six Powerwave TMA's @ 196 ft.
Install one Andrew SBNH-1D6565C antenna @ 196 ft c.l.
Install two Powerwave P65-17-XLH-RR antennas @ 196 ft c.l.
Install one Raycap DC6-48-60-18-8F surge arrestor @ 196 ft.
Install three RRUS-11 remote radio heads @ 196 ft.
Install three RRUS-12 remote radio heads @ 196 ft.
Install one fiber cable and two DC control cables.

Power Density:

Worst-case calculations with 10 dB reduction for existing wireless operations at the site indicate a radio frequency electromagnetic radiation power density, measured at six feet above ground level beside the tower, of approximately 0.8 % of the standard adopted by the FCC. As depicted in the second table below, the total radio frequency electromagnetic radiation power density following proposed modifications would be approximately 1.1 % of the standard.

Existing

Company	Frequency (MHz)	Centerline Ht (feet)	Number of Channels	Power Per Channel (Watts)	Power Density (mW/cm^2)	Standard Limits (mW/cm^2)	Percent of Limit
Other Users *							0.36
AT&T GSM	880	196.6	6	296	0.0176	0.5867	0.30
AT&T GSM	1900	196.6	3	427	0.0127	1.0000	0.13
Total							**0.8%**

***** Per CSC records. The approval for EM-CING-072-130328 expired without installation of the approved equipment modifications. AT&T data are taken from Petition 774.

Proposed

Company	Frequency (MHz)	Antenna (Total for all sectors)	Centerline Ht (feet)	Number of Channels	Power Per Channel (Watts)	Power Density (mW/cm^2)	Standard Limits (mW/cm^2)	Percent of Limit
Other Users *								0.36
AT&T LTE	740	P65-17-XLH 2 antennas Andrew 1 antenna	196	1	1476	0.0147	0.4933	0.30
AT&T LTE	1900	P65-17-XLH 2 antennas Andrew 1 antenna	196	1	2421	0.0241	1.0000	0.24
AT&T UMTS	880	PW 7770 3 antennas	196	2	273	0.0054	0.5867	0.09
AT&T UMTS	1900	PW 7770 3 antennas	196	2	425	0.0085	1.0000	0.08
AT&T GSM	880	PW 7770 3 antennas	196	1	123	0.0012	0.5867	0.02
Total								**1.1%**

***** Per CSC records

Structural information:

The attached structural analysis (AECOM, 8/1/16) demonstrates that the tower and foundation will have adequate structural capacity to accommodate the proposed equipment modifications upon completion of the recommended structural modifications.

Town of Ledyard Property Summary Report

136 VINEGAR HILL RD

PARCEL ID:	93-2540-136
LOCATION:	136 VINEGAR HILL RD
OWNER NAME:	H STATE OF CONNECTICUT / RE: POLICE CALL TOWER

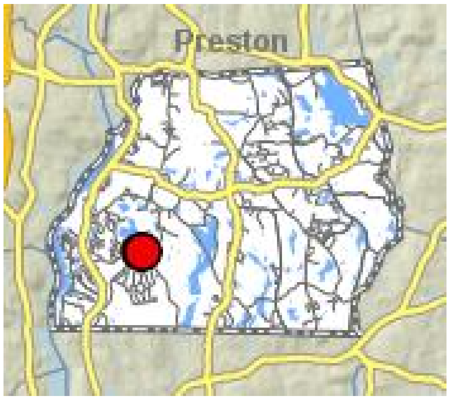
OWNER OF RECORD

H STATE OF CONNECTICUT

RE: POLICE CALL TOWER

-

HARTFORD, CT -



LIVING AREA:	900	**ZONING:**	R40	**ACREAGE:**	0.52 AC

SALES HISTORY

OWNER	BOOK / PAGE	SALE DATE	SALE PRICE
H STATE OF CONNECTICUT RE: POLICE CALL TOWER	00014/0282	04-Apr-1941	$0.00

CURRENT APPRAISED VALUE

TOTAL:	$144,830.00	**IMPROVEMENTS:**	$102,270.00	**LAND:**	$42,560.00

ASSESSING HISTORY

FISCAL YEAR	TOTAL VALUE	IMPROVEMENT VALUE	LAND VALUE
2015	$144,830.00	$102,270.00	$42,560.00
2014	$147,070.00	$102,270.00	$44,800.00
2013	$147,070.00	$102,270.00	$44,800.00
2012	$147,070.00	$102,270.00	$44,800.00
2011	$147,070.00	$102,270.00	$44,800.00

Town of Ledyard Property Summary Report

136 VINEGAR HILL RD

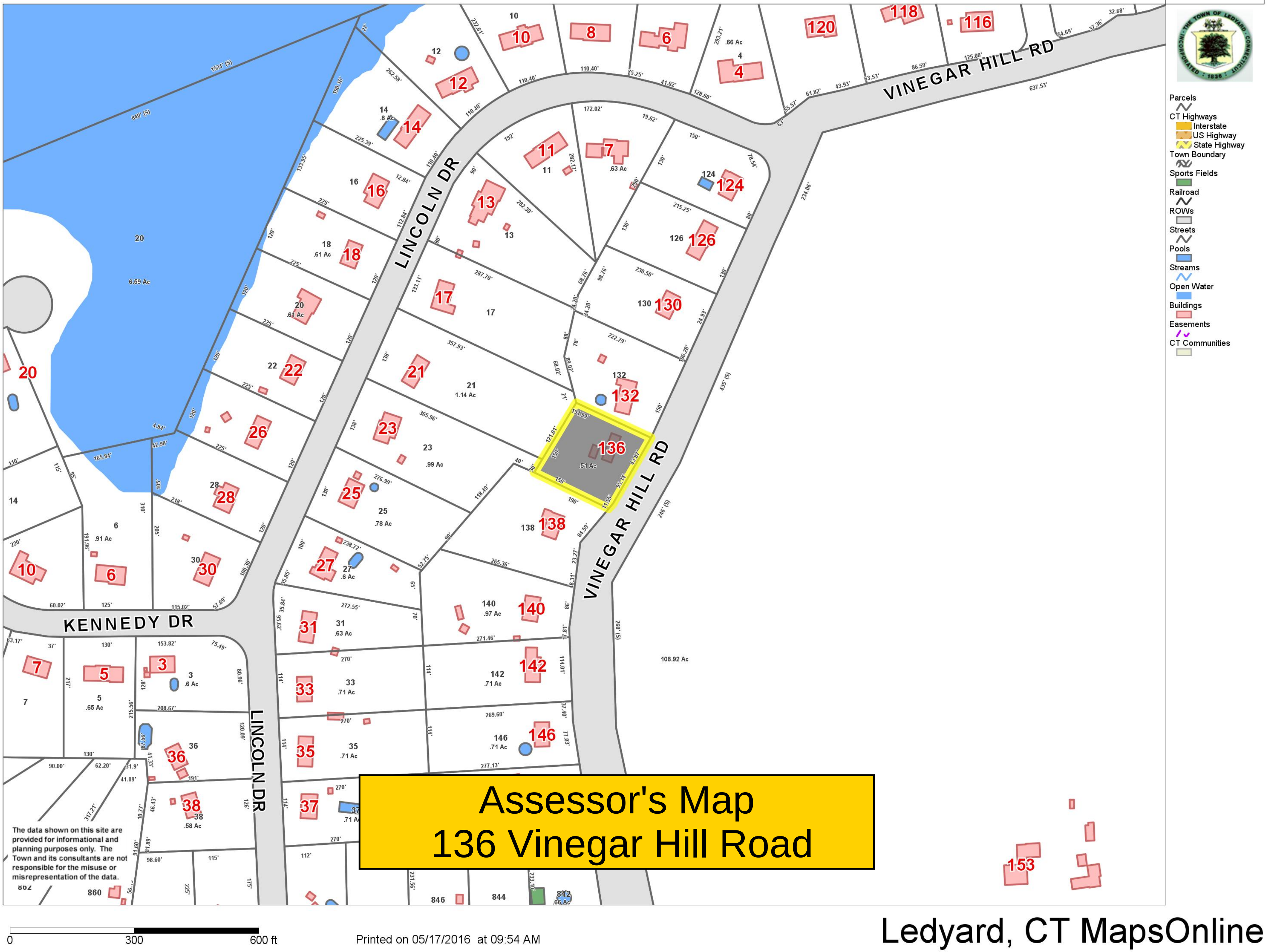
PARCEL ID:	93-2540-136
LOCATION:	136 VINEGAR HILL RD
OWNER NAME:	H STATE OF CONNECTICUT / RE: POLICE CALL TOWER

BUILDING # 1

YEAR BUILT	1995	**ROOF STRUCTURE**	Reinforc Concr
STYLE	Other State	**ROOF COVER**	Concrete Tile
MODEL	Ind or Comm	**FLOOR COVER 1**	Concr-Finished
GRADE	Average	**FLOOR COVER 2**	
STORIES	1	**HEAT FUEL**	Electric
OCCUPANCY	State M96	**HEAT TYPE**	None
EXT WALL 1	Concr/Cinder	**AC TYPE**	None
EXT WALL 2		**BEDROOMS**	
INT WALLS 1	Minim/Masonry	**FULL BATHS**	0
INT WALLS 2		**HALF BATHS**	
		TOT ROOMS	

OUTBUILDINGS

DESCRIPTION	CODE	UNITS
RADIO TOWER		180
Fence- 8ft Chn	FN4	346 L.F.



Assessor's Map
136 Vinegar Hill Road

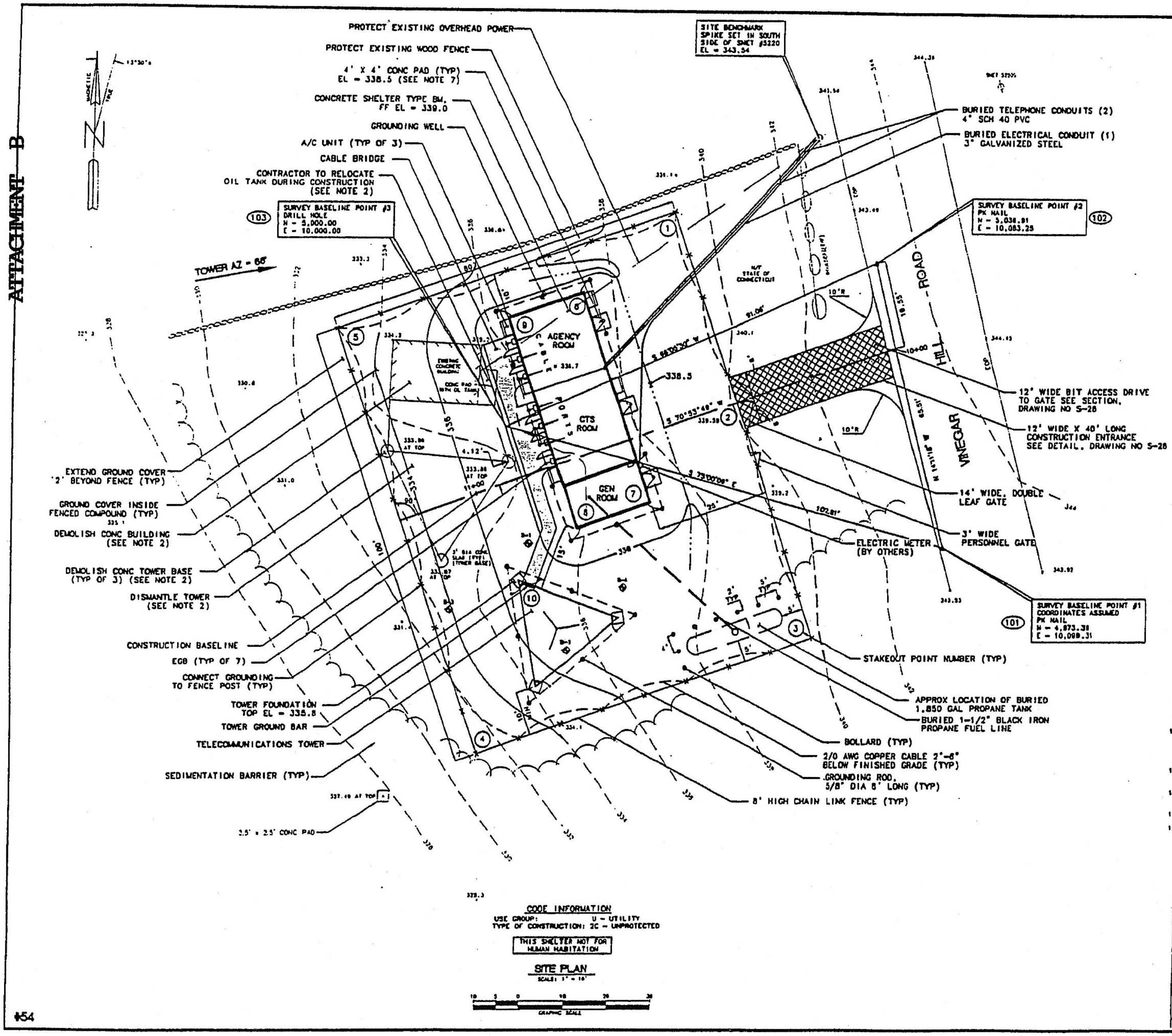
The data shown on this site are provided for informational and planning purposes only. The Town and its consultants are not responsible for the misuse or misrepresentation of the data.

Printed on 05/17/2016 at 09:54 AM

Ledyard, CT MapsOnline

Site Plan - 1998 Exempt Mod Notice

ATTACHMENT B



CODE INFORMATION
USE GROUP: U - UTILITY
TYPE OF CONSTRUCTION: 2C - UNPROTECTED

THIS SHELTER NOT FOR HUMAN HABITATION

SITE PLAN
SCALE: 1" = 10'

GRAPHIC SCALE

VINEGAR HILL SITE CONSTRUCTION STAKEOUT FROM CONSTRUCTION BASELINE

POINT NUMBER	BASELINE STATION	BASELINE OFFSET	DESCRIPTION
1	10+38.25	45.00' R	FENCE CORNER
2	10+38.25	0.00' R	℄ ACCESS DRIVE & GATE
3	10+38.25	35.00' R	FENCE CORNER
4	11+18.25	35.00' R	FENCE CORNER
5	11+18.25	45.00' R	FENCE CORNER
6	10+63.25	25.00' R	FOUNDATION CORNER
7	10+63.25	13.00' R	FOUNDATION CORNER
8	10+41.25	13.00' R	FOUNDATION CORNER
9	10+41.20	35.00' R	FOUNDATION CORNER
10	10+67.00	21.30' R	TOWER LEG CORNER

PLAN NOTES:

1. CONTOURS SHOWN ARE IN ACCORDANCE WITH STANDARDS FOR TOPOGRAPHIC MAPPING AS SET FORTH IN CODE OF RECOMMENDED PRACTICE FOR STANDARDS OF ACCURACY OF SURVEY AND MAPS, PREPARED AND ADOPTED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS, INC. SEPTEMBER 13, 1989.
2. THE CONTRACTOR SHALL USE EXTREME CAUTION TO PROTECT THE EXISTING TELECOMMUNICATIONS SYSTEM (TOWER, SHELTER, POWER AND APPURTENANCES) DURING THE CONSTRUCTION OF THE PROPOSED FACILITIES. ANY DAMAGE BY THE CONTRACTOR TO EXISTING FACILITIES SHALL BE REPAIRED OR REPLACED AT NO ADDITIONAL COST TO THE OWNER. AFTER ACCEPTANCE OF THE NEW TELECOMMUNICATIONS SYSTEM, THE EXISTING CONCRETE PADS, OIL TANK, ELECTRIC SERVICES, TELECOMMUNICATIONS TOWER AND FENCING SHALL BE DEMOLISHED/DISMANTLED IN ACCORDANCE WITH THE SPECIFICATIONS AND IN CONJUNCTION WITH THIS PLAN.
3. CONTOURS AND ELEVATIONS REFER TO APPROXIMATE NATIONAL GEODETIC VERTICAL DATUM OF 1929 BASED UPON U.S. GEOLOGICAL SURVEY MAPPING.
4. CONCRETE PADS AT DOORWAYS SHALL SLOPE AWAY FROM SHELTER AT 1/8" PER 1'
5. GROUND RODS AND WIRE SHALL BE LOCATED A MINIMUM OF 2' FROM ALL FOUNDATION STRUCTURES. GROUND RODS SHALL BE DRIVEN VERTICALLY WITH THE TOP OF THE ROD LOCATED A MINIMUM DISTANCE OF 2' BELOW FINISHED GRADE.
6. ALL DISTURBED AREAS OUTSIDE OF THE GROUND COVER SHALL BE TOPDRESSED ACCORDING TO THE SPECIFICATIONS.
7. EXISTING UTILITY INFORMATION SHOWN HEREON IS NOT GUARANTEED TO BE CORRECT OR COMPLETE. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DETERMINING ACTUAL LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES INCLUDING SERVICES IN THE AREAS OF EXCAVATION.
8. SEE "SITE TOWER DATA SHEET" FOR TOWER DATA.
11. SURVEY INFORMATION SHOWN HEREON REFERENCES A MAP ENTITLED "TOPOGRAPHIC SURVEY, VINEGAR HILL SITE 54, TOWN OF LEDYARD" BY ANGUS McDONALD/GARY SHARPE & ASSOCIATES, INC., 233 BOSTON POST RD, OLD SAYBROOK, CT, DATED SEPT. 14, 1989.
10. ALL AREAS WITHIN THE GROUND COVER AREA SHALL BE CLEARED AND GRUBBED.
11. THE EXTERIOR FINISH OF THE SHELTER SHALL BE AN EARTHTONE EXPOSED AGGREGATE FINISH.
12. HORIZONTAL CONTROL IS BASED ON MAGNETIC BEARINGS.
13. CONTOURS AND SPOT ELEVATIONS ARE BASED ON ASSUMED ELEVATION 340.00 TAKEN FROM USC&GS QUAD MAP OF UNCASVILLE, CT, DATED 1958 AND PHOTOREVISED 1970.

drawing title:
VINEGAR HILL
SITE PLAN

REVISIONS

mark	date	description

CAD no.: STN-WHP 03/23/93 13:11

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC WORKS

DRAWINGS PREPARED BY:
Gozinor, Inc.
WALLINGFORD, CONNECTICUT

project:
CONNECTICUT TELECOMMUNICATIONS SYSTEM

project no.: BI - N - 208

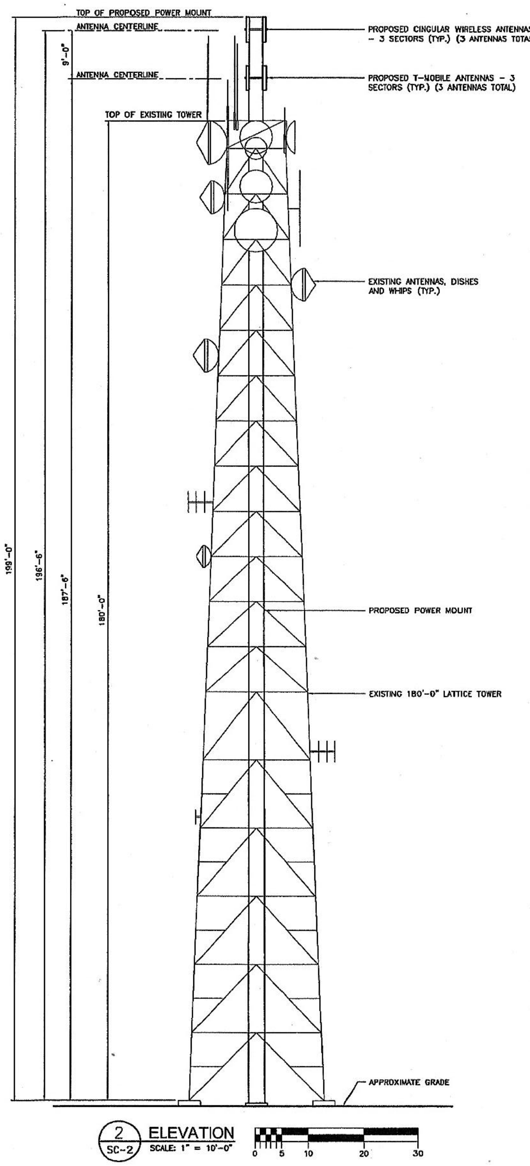
date FEBRUARY '93
scale AS SHOWN
drawn by J. DEOLKE
drawing no. S-21

#54

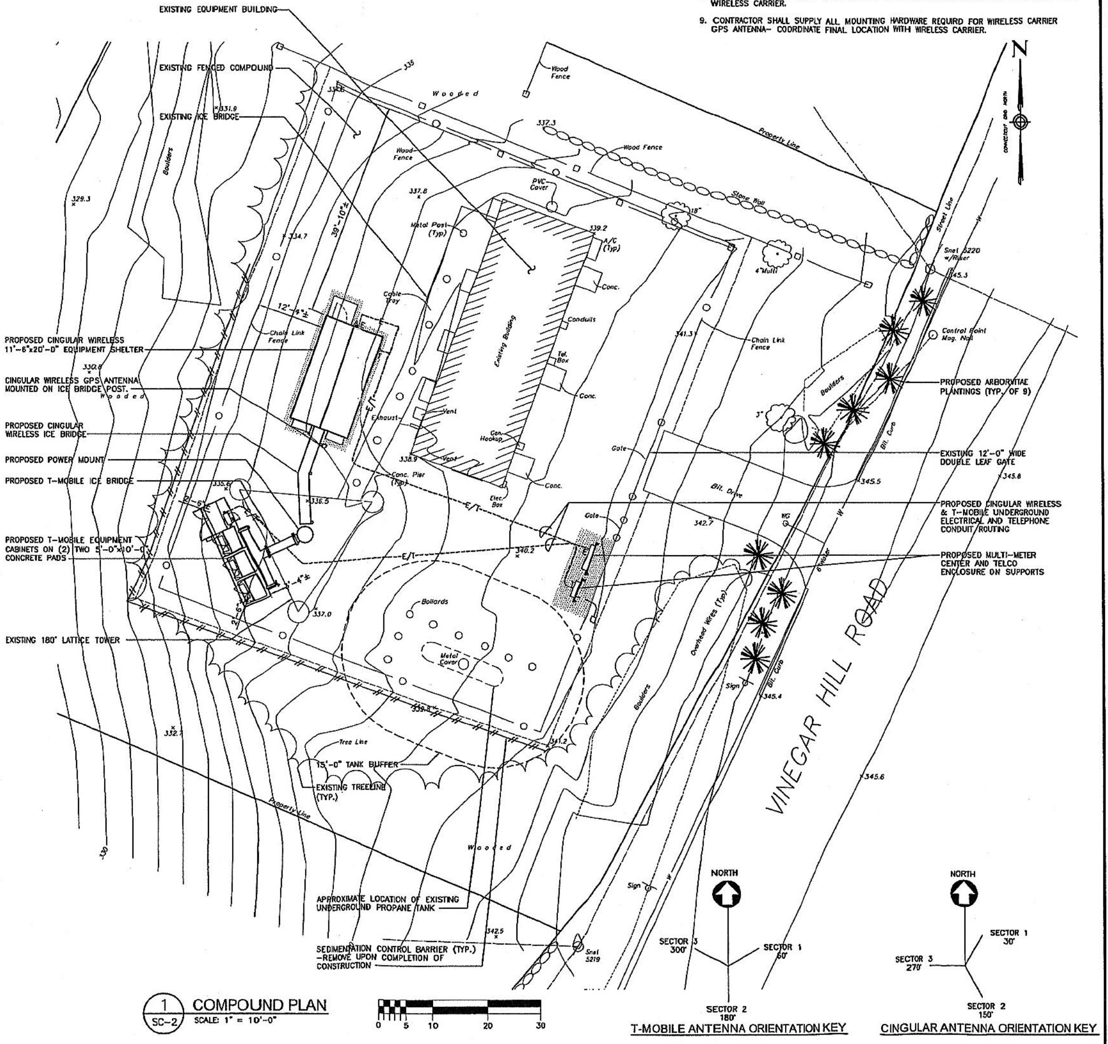
Site Plan - 2006 Petition 774

NOTES

1. THE PROPOSED FACILITY IS UNMANNED AND DOES NOT REQUIRE WATER OR SEWER SERVICE.
2. THE PROPOSED EQUIPMENT SHELTER WILL NOT BE USED FOR HUMAN HABITATION. OCCUPANCY WILL BE LIMITED TO PERIODIC MAINTENANCE AND INSPECTION, APPROXIMATELY ONCE PER MONTH.
3. THE PROPOSED FACILITY WILL NOT EMIT ANY NOISE, SMOKE, DUST OR ODORS.
4. THE PROPOSED FACILITY WILL NOT REQUIRE OUTDOOR STORAGE OR SOLID WASTE CONTAINERS.
5. NO LIGHTING IS PROPOSED.
6. NO COMMERCIAL SIGNS ARE PROPOSED.
7. FINAL LOCATIONS FOR ALL ICE BRIDGE SUPPORTS TO BE DETERMINED IN FIELD.
8. CONTRACTOR SHALL VERIFY LOCATIONS OF CABLE ENTRY AND EXIT PORTS. COORDINATE WITH WIRELESS CARRIER.
9. CONTRACTOR SHALL SUPPLY ALL MOUNTING HARDWARE REQUIRD FOR WIRELESS CARRIER GPS ANTENNA– COORDINATE FINAL LOCATION WITH WIRELESS CARRIER.



2
SC-2
ELEVATION
SCALE: 1" = 10'-0"



1
SC-2
COMPOUND PLAN
SCALE: 1" = 10'-0"

OMNIPOINT COMMUNICATIONS, INC.
A WHOLLY-OWNED SUBSIDIARY
OF T-MOBILE USA, INC.
100 FILLEY STREET
BLOOMFIELD, CT 06002
OFFICE: (860)-692-7100
FAX: (860)-692-7159

cingular
WIRELESS

A&E FIRM
URS CORPORATION AES
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
1-(860)-529-8882

A&E SEAL

PROJECT NO: 36922150
JOB NO: VS1–038
DRAWN BY: RRH
CHECKED BY:

ISSUED FOR

0	06-06-06	REVIEW

THE INFORMATION CONTAINED IN THIS SET OF DOCUMENTS IS PROPRIETARY BY NATURE. ANY USE OR DISCLOSURE OTHER THAN THAT WHICH RELATES TO T-MOBILE & CINGULAR WIRELESS IS STRICTLY PROHIBITED.

LEDYARD

136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT

SCALE: AS NOTED

COMPOUND PLAN
AND ELEVATION

SC-2

PROJECT INFORMATION

SCOPE OF WORK:	TELECOMMUNICATIONS FACILITY UPGRADE (LTE 1C/2C 2017 UPGRADE):
SITE ADDRESS:	136 VINEGAR HILL ROAD GALES FERRY, CT 06335
LATITUDE:	41.425546° N, 41° 25' 31.96" N
LONGITUDE:	72.056943° W, 72° 3' 24.99" W
TYPE OF SITE:	MONOPOLE TOWER / INDOOR EQUIPMENT
TOWER HEIGHT:	199'
RAD CENTER:	196'±
CURRENT USE:	TELECOMMUNICATIONS FACILITY
PROPOSED USE:	TELECOMMUNICATIONS FACILITY

at&t

SITE NUMBER: CT2283

SITE NAME: LEDYARD - VINEGAR HILL ROAD

PROJECT: LTE 1C/2C 2017 UPGRADE

DRAWING INDEX

SHEET NO.	DESCRIPTION	REV.
T-1	TITLE SHEET	1
GN-1	GENERAL NOTES	1
A-1	COMPOUND & EQUIPMENT PLANS	1
A-2	ANTENNA LAYOUTS & ELEVATION	1
A-3	DETAILS	1
RF-1	RF PLUMBING DIAGRAM	1
G-1	GROUNDING DETAILS	1

VICINITY MAP

DIRECTIONS TO SITE:

START OUT GOING NORTHEAST ON ENTERPRISE DR TOWARD CAPITOL BLVD. 0.4 MI TURN LEFT ONTO CAPITOL BLVD. 0.2 MI TURN LEFT ONTO WEST ST. 0.2 MI TAKE RAMP LEFT FOR I-91 N. 4.5 MI AT EXIT 25, TAKE RAMP RIGHT FOR CT-3 NORTH TOWARD GLASTONBURY. 2.4 MI TAKE RAMP RIGHT FOR CT-2 EAST TOWARD NORWICH. 31.9 MI KEEP STRAIGHT ONTO CT-2 E / CT-32 S. 0.6 MI AT EXIT 28S, TAKE RAMP RIGHT FOR I-395 SOUTH TOWARD NEW HAVEN. 3.9 MI AT EXIT 79A, TAKE RAMP RIGHT FOR CT-2A EAST TOWARD PRESTON / LEDYARD. 2.6 MI ROAD NAME CHANGES TO CT-2A. 0.6 MI TURN RIGHT ONTO CT-12 / MILITARY HWY. 4.4 MI TURN LEFT ONTO CHRISTY HILL RD. 1.3 MI BEAR LEFT ONTO LONG COVE RD. 0.2 MI TURN LEFT ONTO VINEGAR HILL RD. 0.2 MI ARRIVE AT 136 VINEGAR HILL RD, GALES FERRY, CT 06335.

GENERAL NOTES

1. THIS DOCUMENT IS THE CREATION, DESIGN, PROPERTY AND COPYRIGHTED WORK OF AT&T. ANY DUPLICATION OR USE WITHOUT EXPRESS WRITTEN CONSENT IS STRICTLY PROHIBITED. DUPLICATION AND USE BY GOVERNMENT AGENCIES FOR THE PURPOSES OF CONDUCTING THEIR LAWFULLY AUTHORIZED REGULATORY AND ADMINISTRATIVE FUNCTIONS IS SPECIFICALLY ALLOWED.
2. THE FACILITY IS AN UNMANNED PRIVATE AND SECURED EQUIPMENT INSTALLATION. IT IS ONLY ACCESSED BY TRAINED TECHNICIANS FOR PERIODIC ROUTINE MAINTENANCE AND THEREFORE DOES NOT REQUIRE ANY WATER OR SANITARY SEWER SERVICE. THE FACILITY IS NOT GOVERNED BY REGULATIONS REQUIRING PUBLIC ACCESS PER ADA REQUIREMENTS.
3. CONTRACTOR SHALL VERIFY ALL PLANS AND EXISTING DIMENSIONS AND CONDITIONS ON THE JOB SITE AND SHALL IMMEDIATELY NOTIFY THE AT&T MOBILITY REPRESENTATIVE IN WRITING OF DISCREPANCIES BEFORE PROCEEDING WITH THE WORK OR BE RESPONSIBLE FOR SAME.

72 HOURS

CALL
BEFORE YOU DIG
CALL TOLL FREE 1-800-922-4455
OR CALL 811

UNDERGROUND SERVICE ALERT

Hudson Design Group LLC
1600 OSGOOD STREET
BUILDING 20 NORTH, SUITE 3090
N. ANDOVER, MA 01845
TEL: (978) 557-5553
FAX: (978) 336-5586

SAI
27 NORTHWESTERN DR.
SALEM, NH 03079

SITE NUMBER: CT2283
SITE NAME: LEDYARD - VINEGAR HILL ROAD
136 VINEGAR HILL ROAD
GALES FERRY, CT 06335
NEW LONDON COUNTY

at&t
500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067

NO.	DATE	REVISIONS	BY	CHK	APP'D
1	09/23/16	ISSUED FOR CONSTRUCTION	SG	AT	DJC
A	07/15/16	ISSUED FOR REVIEW	EB	AT	DJC

SCALE: AS SHOWN
DESIGNED BY: AT
DRAWN BY: EB

DEREK J. CREASER

AT&T
TITLE SHEET
(LTE 1C&2C)

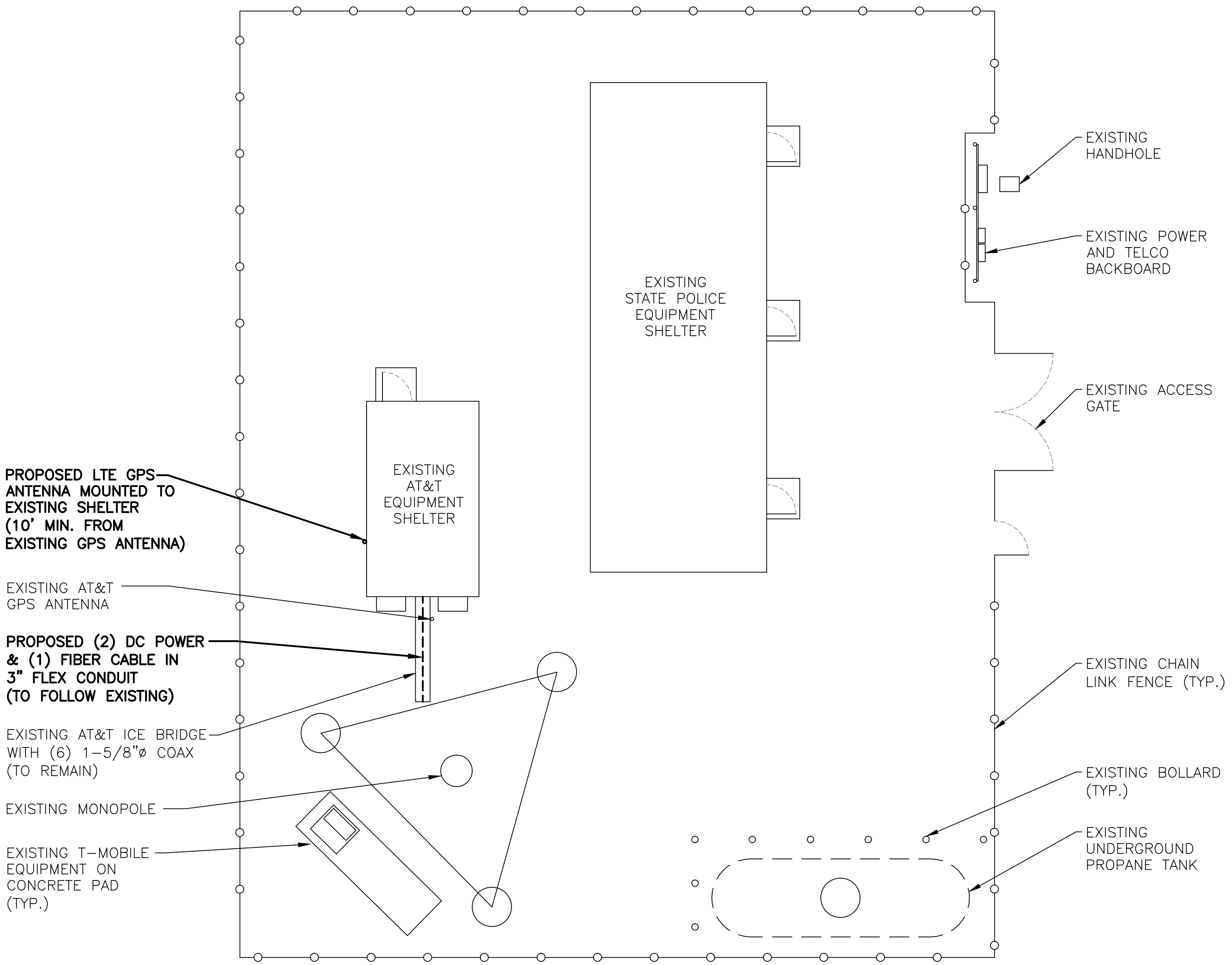
SITE NUMBER	DRAWING NUMBER	REV
CT2283	T-1	1

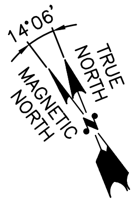
NOTE:

REFER TO STRUCTURAL ANALYSIS BY: AECOM DATED: AUGUST 1, 2016, FOR THE CAPACITY OF THE EXISTING STRUCTURES TO SUPPORT THE PROPOSED EQUIPMENT.

NOTE:

REFER TO THE FINAL RF DATA SHEET FOR FINAL ANTENNA SETTINGS.

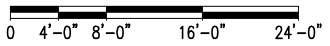


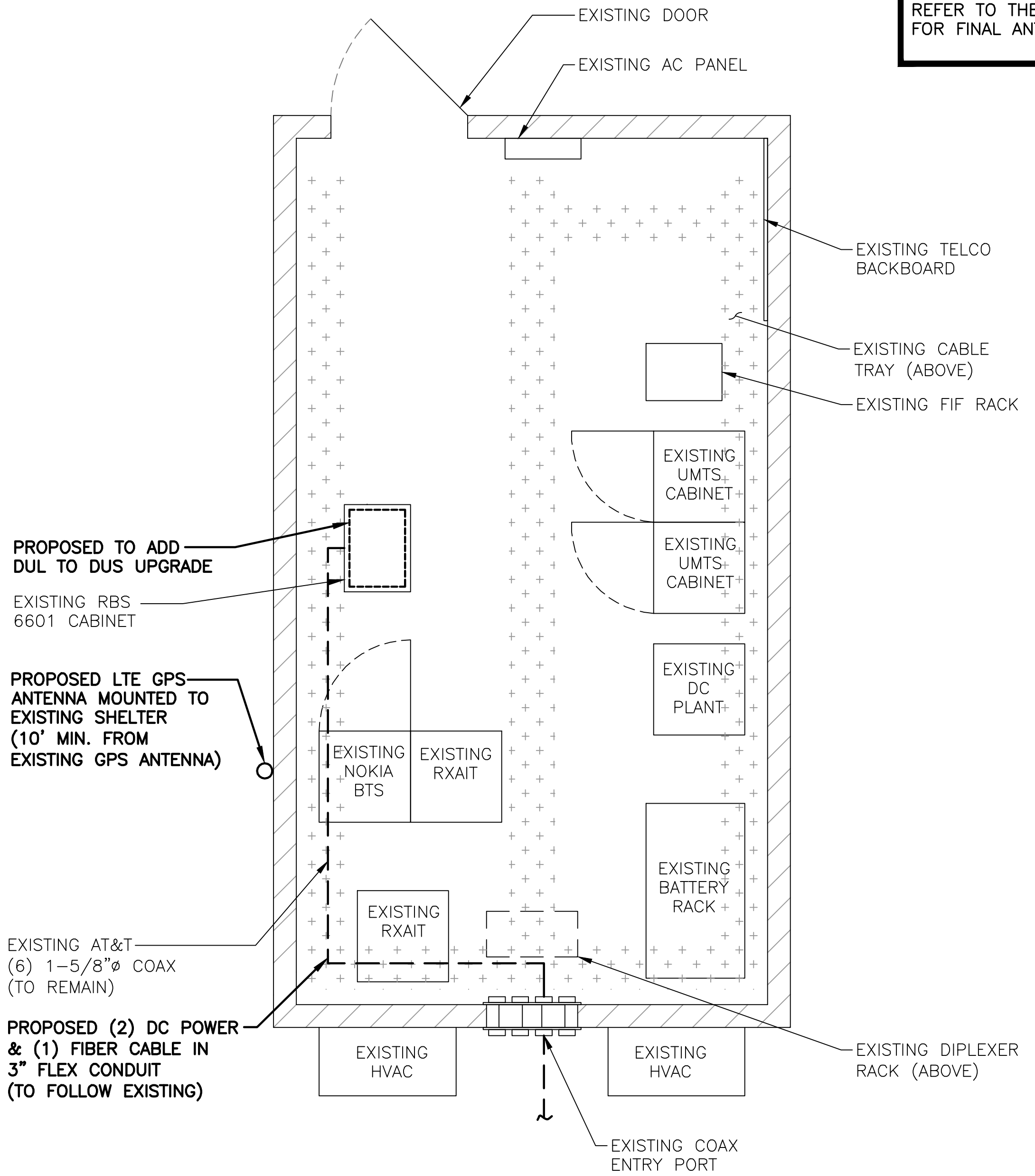


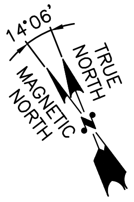
COMPOUND PLAN

22x34 SCALE: 1/8"=1'-0"
11x17 SCALE: 1/16"=1'-0"

1
A-1







EQUIPMENT PLAN

22x34 SCALE: 1/2"=1'-0"
11x17 SCALE: 1/4"=1'-0"

2
A-1

Hudson Design Group LLC
1600 OSGOOD STREET
BUILDING 20 NORTH, SUITE 3090
N. ANDOVER, MA 01845
TEL: (978) 557-5553
FAX: (978) 336-5586

SAI
27 NORTHWESTERN DR.
SALEM, NH 03079

SITE NUMBER: CT2283
SITE NAME: LEDYARD - VINEGAR HILL ROAD
136 VINEGAR HILL ROAD
GALES FERRY, CT 06335
NEW LONDON COUNTY

at&t
500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067

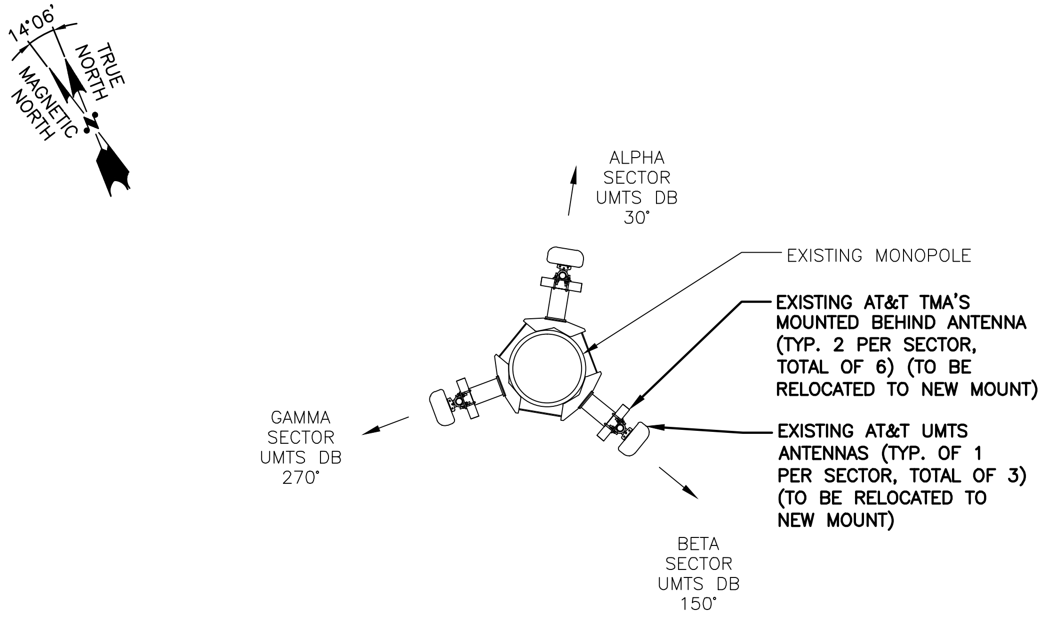
NO.	DATE	REVISIONS	BY	CHK	APP'D
1	09/23/16	ISSUED FOR CONSTRUCTION	SG	AT	DJC
A	07/15/16	ISSUED FOR REVIEW	EB	AT	DJC

SCALE: AS SHOWN
DESIGNED BY: AT
DRAWN BY: EB

DEREK J. CREASER
No. 28551

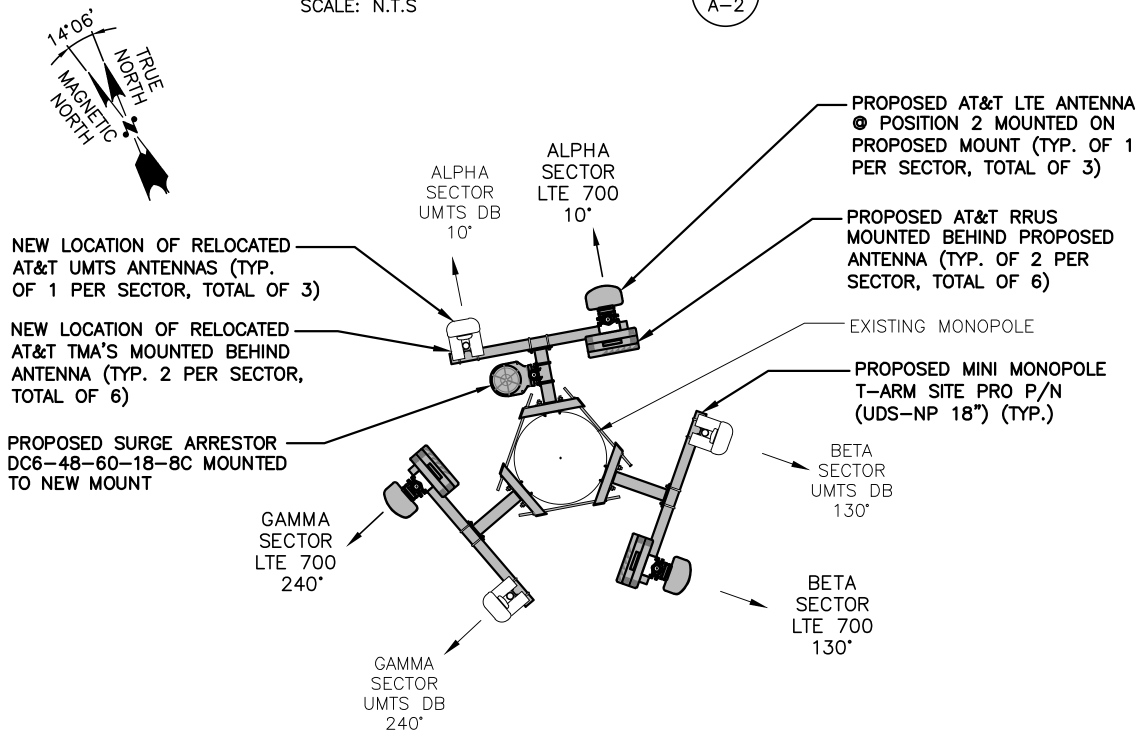
AT&T
COMPOUND & EQUIPMENT PLAN
(LTE 1C&2C)

SITE NUMBER	DRAWING NUMBER	REV
CT2283	A-1	1



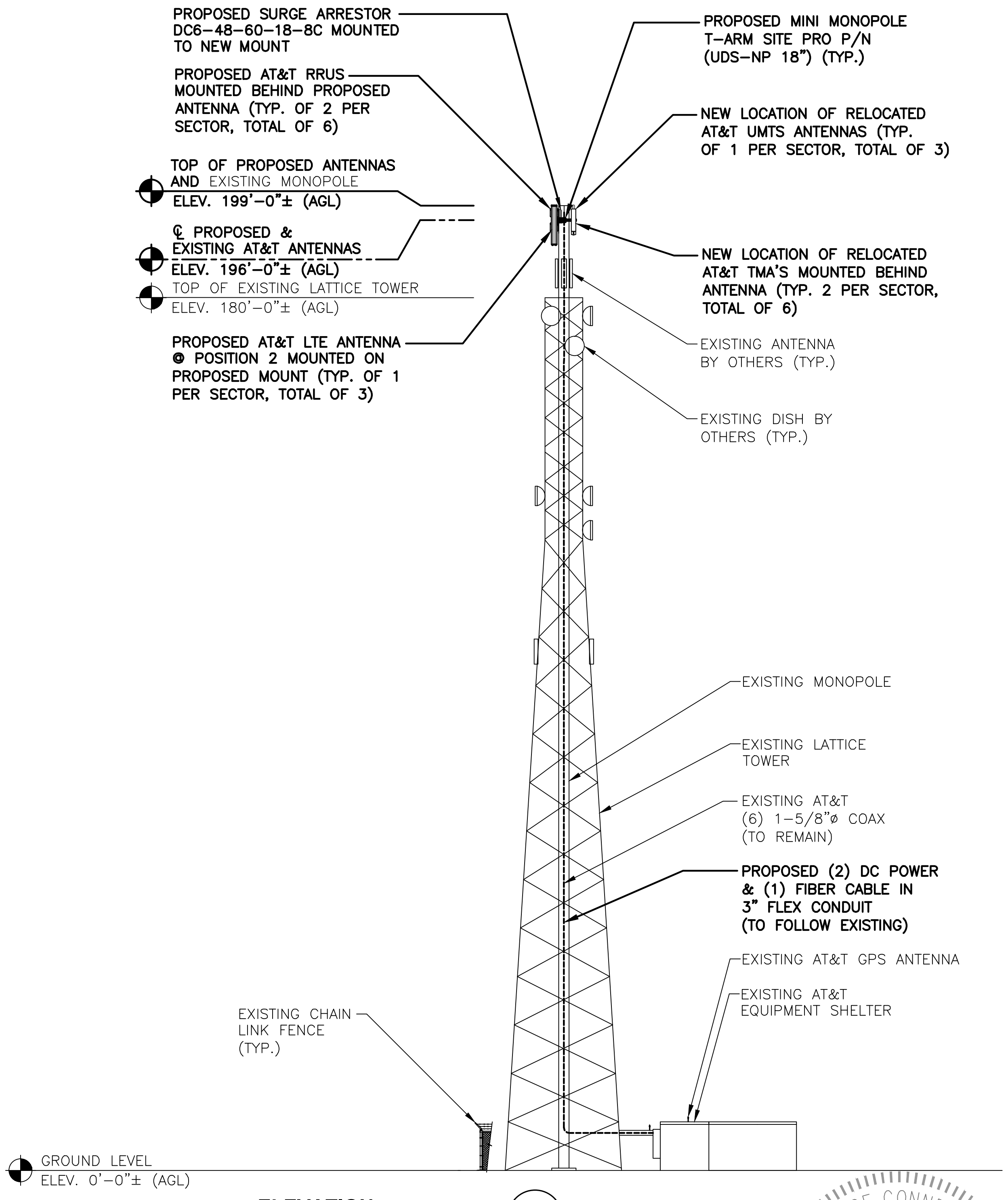
EXISTING ANTENNA LAYOUT 1/A–2

SCALE: N.T.S



PROPOSED ANTENNA LAYOUT 2/A–2

SCALE: N.T.S



ELEVATION 3/A–2

22x34 SCALE: 1/16"=1'–0"
11x17 SCALE: 1/32"=1'–0"

0 8'–0" 16'–0" 32'–0" 48'–0"

NOTE:

REFER TO STRUCTURAL ANALYSIS BY: AECOM DATED: AUGUST 1, 2016, FOR THE CAPACITY OF THE EXISTING STRUCTURES TO SUPPORT THE PROPOSED EQUIPMENT.

NOTE:

REFER TO THE FINAL RF DATA SHEET FOR FINAL ANTENNA SETTINGS.

Hudson Design Group LLC

1600 OSGOOD STREET
BUILDING 20 NORTH, SUITE 3090
N. ANDOVER, MA 01845

TEL: (978) 557-5553
FAX: (978) 336-5586

SAI

27 NORTHWESTERN DR.
SALEM, NH 03079

SITE NUMBER: CT2283
SITE NAME: LEDYARD - VINEGAR HILL ROAD
136 VINEGAR HILL ROAD
GALES FERRY, CT 06335
NEW LONDON COUNTY

at&t

500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067

NO.	DATE	REVISIONS	BY	CHK	APP'D
1	09/23/16	ISSUED FOR CONSTRUCTION	SG	AT	DJC
A	07/15/16	ISSUED FOR REVIEW	EB	AT	DJC

SCALE: AS SHOWN
DESIGNED BY: AT
DRAWN BY: EB

DEREK J. CREASER

AT&T

ANTENNA LAYOUTS & ELEVATION
(LTE 1C&2C)

SITE NUMBER	DRAWING NUMBER	REV
CT2283	A–2	1

AECOM

Submitted to
AT&T
500 Enterprise Drive
Suite 3A
Rocky Hill, CT 06067

Submitted by
AECOM
500 Enterprise Drive,
Suite 3B
Rocky Hill, CT 06067
August 1, 2016

DETAILED STRUCTURAL ANALYSIS AND MODIFICATION OF AN EXISTING 180' LATTICE TOWER WITH AN EXISTING 199' POWERMOUNT FOR PROPOSED ANTENNA ARRANGEMENT

at&t

AT&T Site I.D. #:	CT2283
CSP Site # :	Connecticut State Police Tower #54
Site Address:	136 Vinegar Hill Road Ledyard, CT

60492554
SAI-088

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis and reinforcement of the existing outer 180' self-supporting lattice tower and the existing inner 199' Powermount located at 136 Vinegar Hill Road in Ledyard, Connecticut. The analysis was conducted in accordance with the 2009 amendment to the 2005 Connecticut State Building Code, the TIA/EIA-222-F standard, and the Connecticut State Police Requirements for a wind velocity of 95 mph (fastest mile) and 90 mph (fastest mile) concurrent with ½" ice. The loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report. The proposed AT&T modification is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Remove: **(1) Valmont Flush Mount (P/N 840502)**	**AT&T (Existing)**	**@ 198'-0"**
Relocate to Proposed Antenna Mount: **(3) Powerwave 7770.00 antennas and** **(6) Powerwave LGP21401 TMA's**	**AT&T (Existing)**	**@ 198'-0"**
Install: **(1) SitePro 1 UDS-NP Triple T-Arm Mount** **(1) Valmont LWRM Universal Ring Mount** **(1) SBNH-1D6565C panel antenna (Alpha Sector)** **(2) AM-X-CD-17-65-00T-RET panel antennas (Beta and Gamma Sectors)** **(3) Ericsson RRUS-11 RRU units** **(3) Ericsson RRUS-12 RRU units** **(1) Surge Arrestor** **(2) DC Cables** **(1) Optic Fiber Line**	**AT&T (Proposed)**	**@ 198'-0"**

Note: All AT&T antennas and appurtenances shall be located on the existing Powermount.

The results of an initial analysis indicated that the existing outer tower did NOT have sufficient capacity to support the proposed loading conditions without modification. The required modifications are shown in SK-1 through SK-4. **Once the modifications are performed, the outer tower and foundation are considered structurally adequate for the wind load classifications specified above.** The tower anchor bolts and foundation are considered structurally adequate for the proposed antenna loading with the wind classification specified above without modification. The existing interior Powermount has the capacity to support the proposed loading without modification.

The tower deflection (sway) is 0.6057 degrees, and the tower rotation (twist) is 0.1155 degrees. These figures are within the Connecticut State Police specification of 0.75 degrees for combined deflection (sway) and rotation (twist).

1. EXECUTIVE SUMMARY *(continued)*

This analysis is based on:

1) The tower structures' theoretical capacity, not including any assessment of the condition of the tower.
2) Tower geometry, member sizes, and foundation taken from original construction drawings prepared by Stainless, Inc., (project number 358814) signed and sealed November 9, 1995.
3) Powermount (Pipe Riser) geometry and dimensions taken from Structural Report prepared by FWT, Inc., (job number J060324002) signed and sealed June 12, 2006.
4) Geotechnical information taken from Geotechnical Study performed by Dr. Clarence Welti, P.E., P.C. dated June 27, 2006.
5) Previous structural analysis performed by URS Corporation on behalf of T-Mobile and Cingular, project number VS1-038 / 36922158, signed and sealed July 24, 2006.
6) Proposed AT&T installation taken from Construction Drawings prepared by Hudson Design Group, job number 2283.01, Revision 0, dated August 29, 2012.
7) Proposed AT&T antennas taken from RFDS, revision V0.1, dated March 28, 2013.
8) Tower Mapping and Inventory performed by D&K Nationwide Communications, Inc., dated April 10, 2016.
9) Connecticut State Police updates to existing antenna inventory obtained vie e-mails dated May 12, 2016 and June 21, 2016.
10) Antenna and mount configuration as specified in Section 2 and 6 of this report.
11) Coax cable orientation as specified in Section 6 of this report.

This report is only valid as per the assumptions and data utilized in this report for antenna inventory, mounts and associated cables. The user of this report shall field verify the antenna, cabling and mount configuration used as well as the physical condition of the tower members, connections and foundation. Notify the engineer in writing immediately if any of the information in this report is found to be other than specified.

If you should have any questions, please call.

Sincerely,

AECOM, *contracting as URS Corporation AES,*

Richard A. Sambor, P.E.
Senior Structural Engineer

RICHARD A. SAMBOR
No. 2057

RAS/mcd

cc: ICA – URS
CF/Book

2. INTRODUCTION

The subject tower is located at 136 Vinegar Hill Road in Ledyard, Connecticut. The structure is a 180' self-supporting three-legged steel tapered lattice tower with a 199' Powermount. The tower is designed and manufactured by Stainless, Inc and the Powermount is designed and manufactured by FWT, Inc.

The inventory on the existing Powermount is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(1) SBNH-1D6565C panel antenna (Alpha Sector) **(2) AM-X-CD-17-65-00T-RET panel antennas (Beta and Gamma Sectors)** **(3) Ericsson RRUS-11 RRU units** **(3) Ericsson RRUS-12 RRU units** **(1) Surge Arrestor**	**AT&T (proposed)**	**(1) SitePro 1 UDS-NP Triple T-Arm Mount** **(1) Valmont LWRM Universal Ring Mount**	**198'-0"**	**(2) DC Cables** **(1) Fiber Line**
(3) Powerwave 7770.00 antennas (6) Powerwave LGP21401 TMA's	AT&T (existing)	*Antennas Relocated to Above Mount*	198'-0"	(6) 1 5/8" coax cables (within Powermount)
(3) RFS APX16PV-16PVL-E antennas, (6) Remec G20057A1 TMA's	T-Mobile (existing)	(1) Valmont Flush Mount (P/N 840502)	187'-3"	(6) 1 5/8" coax cables

The inventory on the existing lattice tower is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(1) Lightning Rod	Tower (existing)	Top of Tower Flange	180'	N/A
(1) Scala OGT9-806 Whip Antenna	#24 CSP-18 (existing)	*Shared Mount with Antenna # 23 (below)*	180'	(1) LDF7-50A
(1) Telewave VHF-150 2 Bay Dipole Antenna	#29 CSP-1 (existing)	2' Stand-off	180'	(1) LDF5-50A
(3) (windload) 6' Dish Antennas	CSP-60,61,62 (existing)	(3) Pipe Leg Mounted (windload)	180'	(3) WEP65 (windload)
(1) Decibel DB-809 Whip Antenna	#25 CSP-17 (existing)	(2) 6' Stand-off Mounts @ 170'	180'	(1) LDF7-50A
(1) 4' Grid Dish Antenna	#22 (existing)	Pipe Leg Mounted	175'	(1) LDF5-50A

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) 4' Grid Dish Antenna	#22 (existing)	Pipe Leg Mounted	175'	(1) LDF5-50A
(1) RFS 6' PA6-65 Dish w/ Radome	CSP-16 (existing)	Pipe Leg Mounted	170'	(1) WEP65
(1) (inverted) Decibel DB-809 Whip Antenna	#23 CSP-19 (existing)	(2) 6' Stand-off Mounts @ 170'	168'	(1) LDF7-50A
(1) RFS 6' PA6-65 Dish w/ Radome	#19 CSP-13 (existing)	Pipe Leg Mount	162.5'	(1) WEP65
(2) (inverted) Sinclair SC479-HF1LDF (DO2I-E5765) (1) Sinclair SC479-HF1LDF (DO2-E5765) (1) Sinclair 432-831-01T TTA Unit	#26, 27, 28 CSP-55,56,58,59 (existing)	(2) 6' Stand-off Mounts @ 160'	160'	(3) AVA7-50A (1) LDF4-50A
(1) Celwave PD-458 Omni Antenna	#17 CTT-9 (existing)	(2) 6' Stand-off Mounts @ 150'	160'	(1) LDF5-50A
(1) RFS 8' PA8-65 Dish w/ Radome	#16 CSP-15 (existing)	Pipe Leg Mount	158'	(1) WEP65
(1) Telewave VHF-150 21' 4 Dipole Array Antenna	#15 CSP-2 (existing)	(2) 4' Stand-off Mounts	158'	(1) LDF5-50A
(1) (inverted) Sinclair SC479-HF1LDF Whip Antenna	#18 CSP-54 (existing)	*Shared Mount with Antenna # 17 (above)*	153'	(1) LDF7-50A
(1) RFS 6' PA6-65 Dish w/ Radome w/ Ice Shield mounted above	#14 CSP-14 (existing)	Pipe Leg Mount	150'	(1) WEP65
(1) Celwave PD-320 12' Dipole Antenna	#13 DEP-21 (existing)	3' Stand-off	146'	(1) LDF5-50A
(1) RFS 6' PA6-65 Dish w/ Radome w/ Ice Shield mounted above	#12 CSP-23 (existing)	Pipe Leg Mount	135'	(1) WEP65
(1) Decibel DB-212 Dipole Antenna	#11 CSP-8 (existing)	3' Stand-off	133'	(1) LDF5-50A
(1) Decibel DB-222 Dual Dipole Antenna	#10 FBI-22 (existing)	*Shared with below Mount*	135'	(1) LDF5-50A
(1) Decibel DB-432 Yagi Antenna	FBI-24 (existing)	*Shared with below Mount*	125'	(1) LDF4-50A
(1) Comprod 531-70 10' Dipole Antenna	#9 DOT-52 (existing)	(2) 4' Stand-off Mounts	115'	(1) LDF5-50A
(1) Dish Antenna Ice Shield	#8 (existing)	Pipe Leg Mount	113'	N/A

Antenna Type	Carrier	Mount	Antenna Centerline Elevation	Cable
(1) Decibel PD-220 Omni Antenna	#6 DHS-3 (existing)	*Shared with below Mount*	113'	(1) LDF5-50A
(1) Decibel DB-264 22'-4 Dipole Array Antenna	#5 FBI-11 (existing)	2' Stand-off	92'	(1) LDF5-50A
(1) Decibel 12' - 4 Dipole Array Antenna	#4 FBI-53 (existing)	3' Stand-off	87.5'	(1) LDF5-50A
(1) Celwave PD-156S Yagi Antenna	#3 NEC-4 (existing)	2' Stand-off	62.5'	(1) LDF5-50A
(1) Decibel DB803-XT Omni Antenna	#2 CSP-25 (existing)	*Shared with below Mount*	53'	(1) LDF4-50A
(1) Sinclair SY-203 Yagi Antenna	#1 DEHMS-26 (existing)	3' Stand-off	48'	(1) LDF4-50A

Notes: Antenna elevations and ID numbering obtained from Tower Mapping and Existing Inventory via tower climb, performed by D&K Nationwide Communications, Inc. on April 10, 2016.

This structural analysis of the communications tower was performed by AECOM on behalf of AT&T. The purpose of this analysis was to investigate the structural integrity of the modified tower and Powermount with their existing and proposed antenna loads. This analysis was conducted to evaluate stress on the towers and the effect of forces to the foundation of the towers resulting from existing and proposed antenna arrangements.

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

The structural analysis was done in accordance with the 2009 amendment to the 2005 Connecticut State Building Code, TIA/EIA-222-F—Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, the Connecticut State Police Requirements, and the American Institute of Steel Construction (AISC) Manual of Steel Construction—Allowable Stress Design (ASD).

The analysis of the Powermount was conducted using STAAD Pro V8i. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 95 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 90 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

The support reactions from the STAAD analysis were applied to the lattice tower using TNX-Tower as "User Forces". Note: the Powermount is designed to support the vertical reactions of the antenna and coaxial cable loading and transfer the lateral loading to the lattice tower.

The analysis of the lattice tower was conducted using TNX-Tower 7.0.5.1. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 95 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 90 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

The TIA/EIA standard permits a one-third increase in allowable stresses for towers and monopoles less than 700 feet tall. For the purposes of this analysis, in computing the load capacity the allowable stresses of the tower members were increased by one-third.

4. FINDINGS AND EVALUATION

Stresses on the modified tower structure were evaluated to compare with the allowable stress in accordance with AISC. The results of an initial analysis indicated that the existing tower structure did not have enough capacity to support the proposed loading conditions. The tower structure require modifications shown on SK-1 through SK-4. Once the modifications indicated on sheets SK-1 through SK-4 are performed, the modified structure and existing foundation are considered structurally adequate with the wind load classification specified with the existing and proposed antenna loading noted herein.

See the below tower capacity and the tower deflection (sway) and rotation (twist) figures:

TABLE 1: Tower Deflection (Sway) and Twist at the top of the tower (in degrees):

Description	Current	Allowable
Tower Sway (degrees)	0.6057	N/A
Tower Twist (degrees)	0.1155	
Total (degrees)	0.7212	0.750

TABLE 2: Tower Base Reactions:

Base Reactions	Proposed Tower Reactions
Axial Load (kips)	48
Shear per Leg (kips)	49
Total Shear (kips)	87
Uplift per Leg (kips)	386
Comp.per Leg (kips)	456
O.T. Moment (ft-kips)	9520

For detailed proposed tower reactions, see drawing no. E-1 in section 6 of this report.

TABLE 3: Tower Component Stress vs. Capacity Summary:

Component/ (Section No.)	Existing Component Size	Controlling Component/Elevation	Stress (% capacity)	Pass/Fail
Powermount	18" Dia x 0.375" Pipe	Bending / 187'-3"	55.5 %	**Pass**
Tower Leg (T10)	HSS6.875x0.5 w/ ½ HSS 7.5x0.3125	Compression/0' – 25'	87.4 %	**Pass**
Diagonal (T5)	2L2 1/2x2 1/2x1/4	Compression/125' – 150'	88.4 %	**Pass**
Horizontal (T6)	L3x3x1/4	Compression/100' – 125'	91.2 %	**Pass**
Top Girt (T1)	L3x3x1/4	Compression/175'-180'	77.8 %	**Pass**
Red. Horizontal Bracing (T10)	L2 1/2x2 1/2x3/16	Compression/0-25'	77.4 %	**Pass**
Red. Diagonal Bracing (T10)	L3x3x1/4	Compression/0-25'	47.9 %	**Pass**
Inner Bracing (T9)	L2 1/2x2 1/2x3/16	Compression/25'-50'	0.8 %	**Pass**
Bolt Checks	(1) ¾" A325X Diagonal	Compression / 180'	99.2 %	**Pass**
Anchor Bolts	1 3/4" dia.	Tension & Shear	74 %	**Pass**
Existing Foundation	Pad & Pier	Overturning Moment Factor of Safety (2.0 min)	2.07 / 96.5 %	**Pass**

5. CONCLUSIONS

The results of an initial analysis indicated that the existing outer tower did NOT have sufficient capacity to support the proposed loading conditions without modification. The required modifications are shown in SK-1 through SK-4. **Once the modifications are performed, the outer tower and foundation are considered structurally adequate for the wind load classifications specified herein.** The tower anchor bolts and foundation are considered structurally adequate for the proposed antenna loading with the wind classification specified above without modification. The existing interior Powermount has the capacity to support the proposed loading without modification.

The tower deflection (sway) is 0.6057 degrees, and the tower rotation (twist) is 0.1155 degrees. These figures are within the Connecticut State Police specification of 0.75 degrees for combined deflection (sway) and rotation (twist).

Limitations/Assumptions:

This report is based on the following:

1. Tower inventory as listed in this report.
2. Tower is properly installed and maintained.
3. All members and their geometry are as specified in the original design documents and are in good condition.
4. All required members are in place.
5. All bolts are in place and are properly tightened.
6. Tower is in plumb condition.
7. All member protective coatings are in good condition.
8. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
9. Foundations are in good condition without defect and were properly constructed to support original design loads as specified in the original design documents.

AECOM is not responsible for any modifications completed prior to or hereafter in which AECOM is not or was not directly involved. Modifications include but are not limited to:

A. Adding antennas
B. Removing/replacing antennas
C. Adding coaxial cables

AECOM hereby states that this document represents the entire report and that it assumes no liability for any factual changes that may occur after the date of this report. All representations, recommendations, and conclusions are based upon information contained and set forth herein. If you are aware of any information which conflicts with that which is contained herein, or you are aware of any defects arising from original design, material, fabrication, or erection deficiencies, you should disregard this report and immediately contact AECOM. AECOM disclaims all liability for any representation, recommendation, or conclusion not expressly stated herein.

Ongoing and Periodic Inspection and Maintenance:

After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire tower structural system be performed at least yearly and more frequently as conditions warrant. According to TIA/EIA-222-F section 14.1, Note 1: It is recommended that the structure be inspected after severe wind and/or ice storms or other extreme loading conditions.

REINFORCEMENT DRAWINGS SK-1 THROUGH SK-4

GENERAL CONSTRUCTION NOTES

1. ALL WORK SHALL COMPLY WITH THE CONNECTICUT STATE BUILDING AND LIFE SAFETY CODES, SUPPLEMENTS AND AMENDMENTS.

2. CONTRACTOR IS TO REVIEW ALL DRAWINGS AND NOTES IN THE CONTRACT DOCUMENT SET. CONTRACTOR SHALL COORDINATE ALL WORK SHOWN IN THE SET OF DRAWINGS. THE CONTRACTOR SHALL PROVIDE A COMPLETE SET OF DRAWINGS TO ALL SUB-CONTRACTORS AND ALL RELATED PARTIES. THE SUB-CONTRACTORS SHALL EXAMINE ALL THE DRAWINGS AND SPECIFICATIONS FOR THE INFORMATION THAT AFFECTS THEIR WORK.

3. CONTRACTOR SHALL PROVIDE A COMPLETE BUILD-OUT WITH ALL FINISHES, STRUCTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS AND PROVIDE ALL ITEMS AS SHOWN OR INDICATED ON DRAWINGS OR WRITTEN IN SPECIFICATIONS.

4. CONTRACTOR SHALL FURNISH ALL MATERIAL, LABOR AND EQUIPMENT TO COMPLETE THE WORK AND FURNISH A COMPLETED JOB ALL IN ACCORDANCE WITH LOCAL AND STATE GOVERNING AUTHORITIES AND OTHER AUTHORITIES HAVING LAWFUL JURISDICTION OVER THE WORK.

5. CONTRACTOR SHALL SECURE AND PAY FOR ALL PERMITS AND ALL INSPECTIONS REQUIRED AND SHALL ALSO PAY FEES REQUIRED FOR THE GENERAL CONSTRUCTION AND ELECTRICAL SUB-CONTRACTORS SHALL PAY FOR THEIR PERMITS.

6. CONTRACTOR SHALL MAINTAIN A CURRENT SET OF DRAWINGS ON SITE AT ALL TIMES AND ENSURE THE DISTRIBUTION OF NEW DRAWINGS TO SUB-CONTRACTORS AND OTHER RELEVANT PARTIES AS SOON AS THEY ARE MADE AVAILABLE. ALL OLD DRAWINGS SHALL BE MARKED VOID AND REMOVED FROM THE CONTRACT AREA. CONTRACTOR SHALL FURNISH 'AS-BUILT' SET OF DRAWINGS TO OWNER UPON COMPLETION OF PROJECT.

7. INSTALLATION OF THIS WIRELESS COMMUNICATIONS EQUIPMENT SITE REQUIRES WORK IN THE IMMEDIATE VICINITY OF EXISTING OPERATING TELECOMMUNICATION SYSTEMS. THE CONTRACTOR SHALL PROVIDE AND COORDINATE THE METHODS OF PROTECTION WITH THE VARIOUS TELECOMMUNICATION CARRIERS AND THE TOWER OWNER. THERE SHALL BE NO INTERRUPTION OF OPERATION WITHOUT TIMELY COORDINATION WITH AND APPROVAL BY THE VARIOUS COMMUNICATIONS OPERATORS INCLUDING THE CONNECTICUT STATE POLICE.

8. THE REINFORCEMENT OF PORTIONS OF THIS TOWER STRUCTURE WILL AFFECT CRITICAL CONNECTICUT STATE POLICE ANTENNAS. NO MOVEMENT, ALTERATION, OR DISCONNECTION OF CONNECTICUT STATE POLICE ANTENNAS MAY OCCUR WITHOUT THE NOTIFICATION AND APPROVAL OF THE CONNECTICUT STATE POLICE. CONTACT THE NETWORK CONTROL CENTER AT 860-865-8008.

9. TOWER REINFORCING WORK AFFECTING CRITICAL CONNECTICUT STATE POLICE ANTENNAS MAY BE REQUIRED TO BE CONDUCTED AT TIMES AS DETERMINED BY THE REQUIREMENTS OF THE CONNECTICUT STATE POLICE.

11. ALL EQUIPMENT AND PRODUCTS PURCHASED ARE TO BE REVIEWED BY CONTRACTOR AND ALL APPLICABLE SUB-CONTRACTORS FOR ANY CONDITION PER MFR'S RECOMMENDATIONS. CONTRACTOR TO SUPPLY THESE ITEMS AT NO COST TO OWNER OR ARCHITECT.

12. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ON-SITE SAFETY FROM THE TIME THE JOB IS AWARDED UNTIL ALL WORK IS COMPLETE AND ACCEPTED BY THE OWNER.

13. SHOP DRAWINGS ARE REQUIRED. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS, ELEVATIONS, ANGLES, AND EXISTING CONDITIONS ON THE TOWER AND INCLUDE THE GATHERED INFORMATION ON THE SHOP DRAWINGS. INCLUDE ANY DISCREPANCIES ENCOUNTERED WITH THE SHOP DRAWINGS. NO FABRICATION OF STEEL SHALL OCCUR PRIOR TO THE RECEIPT OF APPROVED SHOP DRAWINGS.

14. CONTRACTOR TO REVIEW ALL SHOP DRAWINGS AND SUBMIT COPY TO ARCHITECT FOR REVIEW. DRAWINGS MUST BEAR THE CHECKER'S INITIALS BEFORE SUBMITTAL TO THE ARCHITECT FOR REVIEW.

15. THE CONTRACTOR IS SOLELY RESPONSIBLE TO DETERMINE CONSTRUCTION PROCEDURE AND SEQUENCE, AND TO ENSURE THE SAFETY OF THE EXISTING STRUCTURE AND ITS COMPONENT PARTS DURING CONSTRUCTION. THIS INCLUDES THE ADDITION OF WHATEVER SHORING, BRACING, UNDERPINNING, ETC. THAT MAY BE NECESSARY.

16. CONTRACTOR TO CONTACT "CALL BEFORE YOU DIG" AT 1-800-922-4455 TO VERIFY AND IDENTIFY THE EXACT LOCATIONS OF ALL UNDERGROUND UTILITIES AND OBSTRUCTIONS IDENTIFIED PRIOR TO COMMENCING WORK IN THE CONTRACT AREA.

17. CONTRACTOR SHALL COMPLY WITH OWNER ENVIRONMENTAL ENGINEER ON ALL METHODS AND PROVISIONS FOR ALL EXCAVATION ACTIVITIES INCLUDING SOIL DISPOSAL. ALL BACKFILL MATERIALS TO BE PROVIDED BY THE CONTRACTOR.

18. DIMENSIONS OF EXISTING TOWER ARE BASED ON MANUFACTURER'S DRAWINGS PREPARED BY STAINLESS INC. DATED JUNE 1994, AND ARE NOT GUARANTEED. CONTRACTOR SHALL TAKE FIELD DIMENSIONS AS NECESSARY TO ASSURE PROPER FIT OF ALL FINISHED WORK AND SHALL ASSUME FULL RESPONSIBILITY FOR THEIR ACCURACY. WHEN SHOP DRAWINGS BASED ON FIELD MEASUREMENT ARE SUBMITTED FOR REVIEW, DIMENSIONS ARE PROVIDED FOR THE ENGINEER'S REFERENCE ONLY.

19. TOWER INVENTORY IS BASED ON INFORMATION OBTAINED BY CONNECTICUT STATE POLICE DATED MAY 12, 2016. TOWER MAPPING AND EXISTING INVENTORY OBTAINED FROM D&K NATIONWIDE COMMUNICATIONS, INC. DATED APRIL 10, 2016.

20. CONTRACTOR TO VERIFY REQUIRED CLEARANCES INCLUDING BUT NOT LIMITED TO EXISTING BUILDINGS, EQUIPMENT PADS AND SHELTERS PRIOR TO COMMENCING WORK.

21. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION. NO MEMBER OF THE TOWER SHALL BE LEFT DISCONNECTED FOR THE NEXT WORKING DAY. THE CONTRACTOR SHALL BE AWARE OF WEATHER AND WIND CONDITIONS AND NOT PERFORM MEMBER REPLACEMENT IN A WIND.

STRUCTURAL NOTES

STRUCTURAL STEEL MATERIAL:

PIPE/TUBE LEG, HSS5x0.375 AND LARGER ....ASTM A572-60
1/2, 1/3 HSS MATERIAL & PIPE TUB LEG HSS5x0.25 ....ASTM A572-50
PLATES & ANGLES A36
BOLTS ....A325X & A490N

STRUCTURAL STEEL SHALL CONFORM TO ALL THE REQUIREMENTS OF THE ASTM SPECIFICATION, AS REFERENCED IN THE CODE.

UNLESS OTHERWISE NOTED, ALL STEEL WILL BE GALVANIZED IN ACCORDANCE WITH ASTM 123 AFTER FABRICATION. TOUCH UP ALL DAMAGED GALVANIZED STEEL WITH APPROVED COLD ZINC, "GALVANOX", "DRY GALV", "ZINC-IT", OR APPROVED EQUIVALENT, IN ACCORDANCE WITH MANUFACTURERS GUIDELINES. TOUCH-UP DAMAGED NON GALVANIZED STEEL WITH SAME PAINT APPLIED IN SHOP OR FIELD.

SHOP AND ERECTION DRAWINGS SHALL BE SUBMITTED FOR ALL STRUCTURAL STEEL WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. SUBMIT 2 SETS OF PRINTS FOR THE ENGINEER REVIEW.

MILL BEARING ENDS OF COLUMNS, STIFFENERS, AND OTHER BEARING SURFACES TO TRANSFER LOAD OVER ENTIRE CROSS SECTION.

THE OMISSION OF ANY MATERIAL THAT WAS SHOWN ON THE CONTRACT DRAWINGS SHALL NOT RELIEVE THE CONTRACTOR OF PROVIDING THE SAME.

CONNECTIONS / FIELD ASSEMBLY:

BOLTED CONNECTIONS: UNLESS OTHERWISE NOTED, ALL JOINTS ARE SLIP CRITICAL TYPE, REQUIRING 5/8", 3/4" & 1" DIA. A325X & A490-N BOLTS, A563 NUTS AND F436 WASHERS, ALL GALVANIZED. BEVELED WASHERS SHALL BE USED ON BEAM FLANGES HAVING A SLOPE GREATER THAN 1:20.

STRUCTURE IS DESIGNED TO BE LEVEL AND PLUMB, SELF-SUPPORTING AND STABLE AFTER WORK IS COMPLETED.

COMMENCEMENT OF WORK WITHOUT NOTIFYING THE ENGINEER OF ANY DISCREPANCIES WILL BE CONSIDERED ACCEPTANCE OF PRECEDING WORK.

INSPECTIONS:

SPECIAL INSPECTIONS ARE REQUIRED PER THE CODE FOR STRUCTURAL STEEL WORK.

OWNER WILL SUPPLY THE SERVICES OF A SPECIAL INSPECTOR AND TESTING AGENTS AS REQUIRED. CONTRACTOR SHALL COORDINATE INSPECTIONS OF FABRICATOR'S AND ERECTOR'S WORK AND MATERIALS TO MEET THE REQUIREMENTS OF THE STATEMENT OF SPECIAL INSPECTIONS FOR THIS PROJECT.

COPIES OF TESTING AND INSPECTION REPORTS WILL BE PROVIDED TO THE OWNER, BUILDING OFFICIAL, ENGINEER OF RECORD AND CONTRACTOR.

RICHARD A. SAMBOR
No. 9057

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

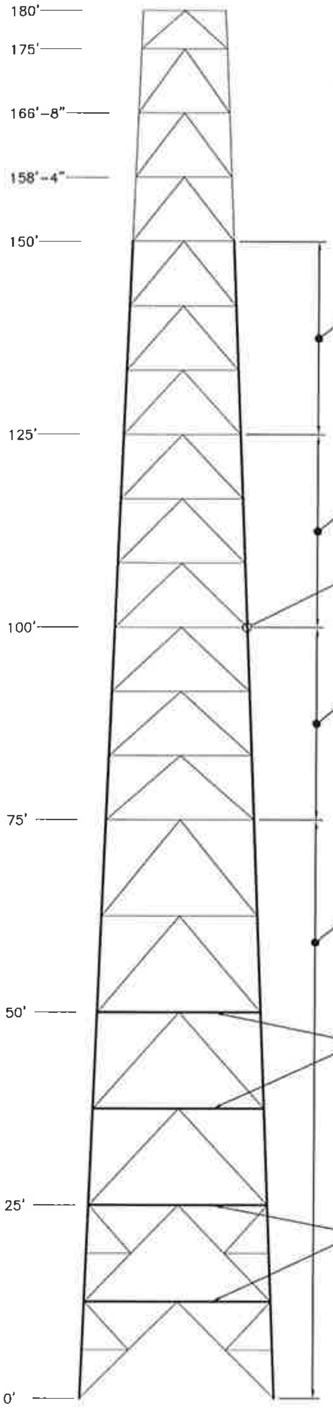
REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

Dwg. No.
SK-1
Dwg. 1 of 4

STRUCTURAL NOTES

SEE SHEET SK-2 FOR STRUCTURAL NOTES



INSTALL 1/3 HSS 5.5x0.258 TUBE TO EXISTING TOWER LEG (HSS 5x0.250) (EL. 125'-150') (SEE SK-3 FOR DETAILS)

INSTALL 1/3 HSS 5.5625x0.375 TUBE TO EXISTING TOWER LEG (HSS 5x0.375) (EL. 100'-125') (SEE SK-3 FOR DETAILS)

REPLACE (6) EXISTING 3/4" A325X BOLTS WITH (6) 3/4" A490N BOLTS AT TOWER FLANGE (EL 100)

INSTALL 1/2 HSS 6.0x0.50 TUBE TO EXISTING TOWER LEG (HSS 5x0.5) (EL. 75'-100') (SEE SK-3 FOR DETAILS)

INSTALL 1/2 HSS 7.5x0.3125 TUBE TO EXISTING TOWER LEG (HSS 6.8750x0.50) (EL. 0'-75') (SEE SK-3 FOR DETAILS)

REPLACE EXISTING HORIZONTAL ∠4x4x1/4 W/ ∠4x4x5/16 (EL 25'-50')

REPLACE EXISTING HORIZONTAL ∠4x4x5/16 W/ ∠4x4x3/8 (EL 0'-25')

1
SK-2
TOWER ELEVATION
SCALE: 1" = 30'-0"

STATE OF CONNECTICUT
RICHARD A. SAMBOR
NO. 9057
LICENSED
PROFESSIONAL ENGINEER

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

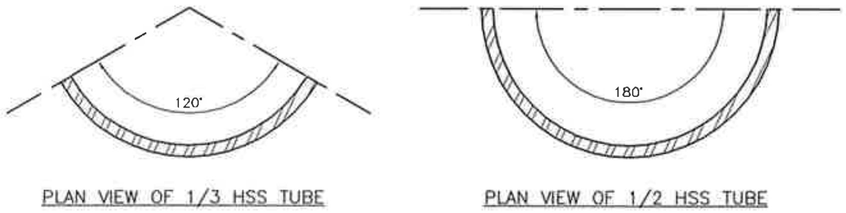
Dwg. No.
SK-2

Dwg. 2 of 4

ELEVATION	HSS TUBE EXISTING LEG SIZE (IN)	HSS TUBE REINFORCING DIMENSIONS (IN)	MINIMUM # U-BOLTS AT ENDS OF 25' SECTION SPACED @ 3" C-TO-C	MINIMUM U-BOLTS REMAIN PER LEG	MAXIMUM SPACING REMAINING U-BOLTS C-TO-C (IN)	INSTALLING PRETENSION FORCE ON BOLT (KIPS)
150' – 125'	5x0.250	1/3–5.5x0.258	13	21	10	2.7
125' – 100'	5x0.3750	1/3–5.5625x0.375	10	23	10	4.25
100' – 75'	5x0.50	1/2–6.0x0.50	23	13	12	4.25
75' – 50'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25
50' – 25'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25
25' – 0'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25

NOTES:

- U–BOLTS SHALL BE ASTM A449. BASIS OF DESIGN IS PORTLAND BOLT OF PORTLAND, OREGON, USA. ALTERNATIVE SUPPLIER SHALL MATCH OR EXCEED QUALITY OF PORTLAND BOLT
- CONTRACTOR SHALL TAKE SPECIFIC CARE WHEN INSTALLING U–BOLTS AND NOT ALLOW ANY VISUAL DEFORMATION OF THE EXISTING TOWER LEGS.
- 1/3 (ONE THIRD) AND 1/2 (ONE HALF) OF HSS TUBE REFER TO THE REQUIRED PORTION OF HSS TUBING TO BE INSTALLED FOR REINFORCING.
- SPACING DIMENSIONS FOR U–BOLTS ARE MAXIMUM ALLOWABLE DISTANCE. ADDITIONAL U–BOLTS MAY BE REQUIRED DUE TO INTERRUPTION CAUSED BY EXISTING TOWER COMPONENTS. SHOP DRAWINGS SHALL ILLUSTRATE ACTUAL BOLT SPACING REQUIRED BASED ON VERIFIED FIELD CONDITIONS.
- TOWER LEGS HAVE STEP BOLTS. 1/2 HSS TUBE REINFORCING SHALL BE NOTCHED TO ALLOW THE REINFORCING TO FIT AROUND STEP BOLTS. SHOP DRAWINGS SHALL ILLUSTRATE VERIFIED STEP BOLT LOCATIONS AND NOTCHES.
- 1/3 AND 1/2 HSS TUBES SHALL BE CONTINUOUS, SINGLE PIECE MEMBERS APPROXIMATELY 25' LONG.



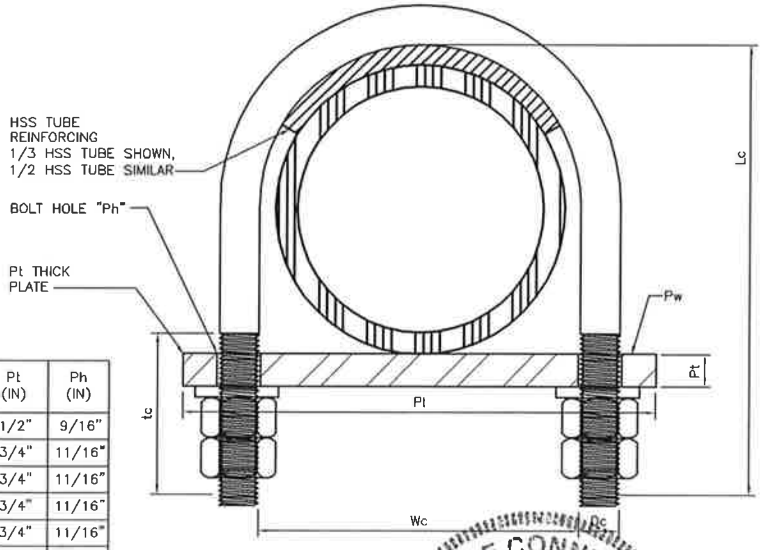
PLAN VIEW OF 1/3 HSS TUBE

PLAN VIEW OF 1/2 HSS TUBE

2 HSS TUBE DETAILS

SK-3

SCALE: N.T.S.



TOWER LEG DIAMETER (IN)	HSS REINFORCED O.D. (IN)	ELEVATION	Dc (IN)	Lc (IN)	Wc (IN)	tc (IN)	Pl (IN)	Pw (IN)	Pt (IN)	Ph (IN)
5x0.250	5.5	150'–125'	1/2"	7 $\frac{1}{2}$"	5 $\frac{1}{2}$"	3"	8"	2"	1/2"	9/16"
5x0.3750	5.5625	125'–100'	5/8"	8"	5 $\frac{9}{16}$"	3"	8 $\frac{1}{4}$"	2 $\frac{1}{2}$"	3/4"	11/16"
5x0.50	6	100'–75'	5/8"	8 $\frac{1}{4}$"	6"	3"	8 $\frac{3}{4}$"	2 $\frac{1}{2}$"	3/4"	11/16"
6.875x0.50	7.5	75'–50'	5/8"	9 $\frac{3}{4}$"	7 $\frac{1}{2}$"	3"	10 $\frac{1}{4}$"	2 $\frac{1}{2}$"	3/4"	11/16"
6.875x0.50	7.5	50'–25'	5/8"	9 $\frac{3}{4}$"	7 $\frac{1}{2}$"	3"	10 $\frac{1}{4}$"	2 $\frac{1}{2}$"	3/4"	11/16"
6.875x0.50	7.5	25'–0'	5/8"	9 $\frac{3}{4}$"	7 $\frac{1}{2}$"	3"	10 $\frac{1}{4}$"	2 $\frac{1}{2}$"	3/4"	11/16"

NOTE: U–BOLT ATTACHMENT PLATE MATERIAL SHALL BE MINIMUM 50 KSI. COORDINATE WITH ABOVE U–BOLT TABLE FOR QUANTITIES AND SPACING OF U–BOLT FOR ASSEMBLY.

1 U-BOLT FOR LEG REINFORCEMENT

SK-3

SCALE: 4" = 1'-0"

No. 9057

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

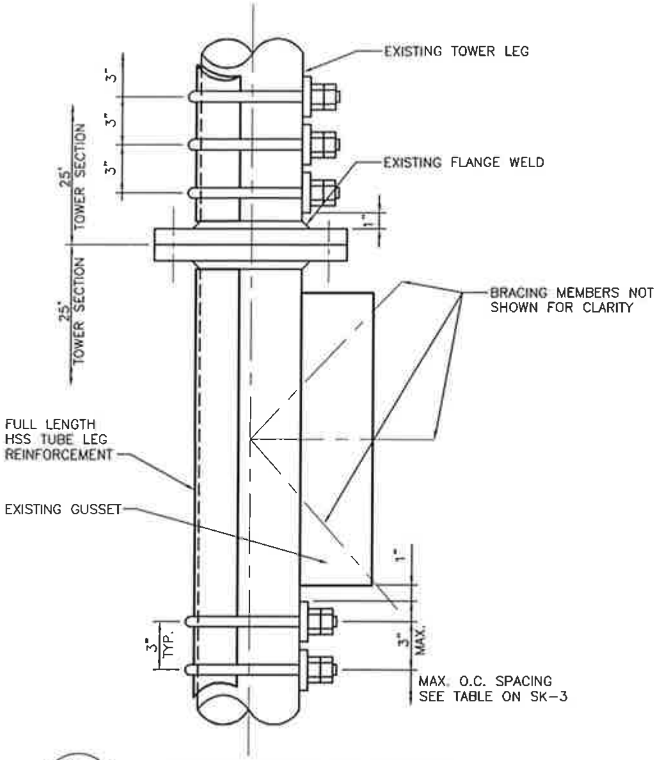
SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI–088
File No.

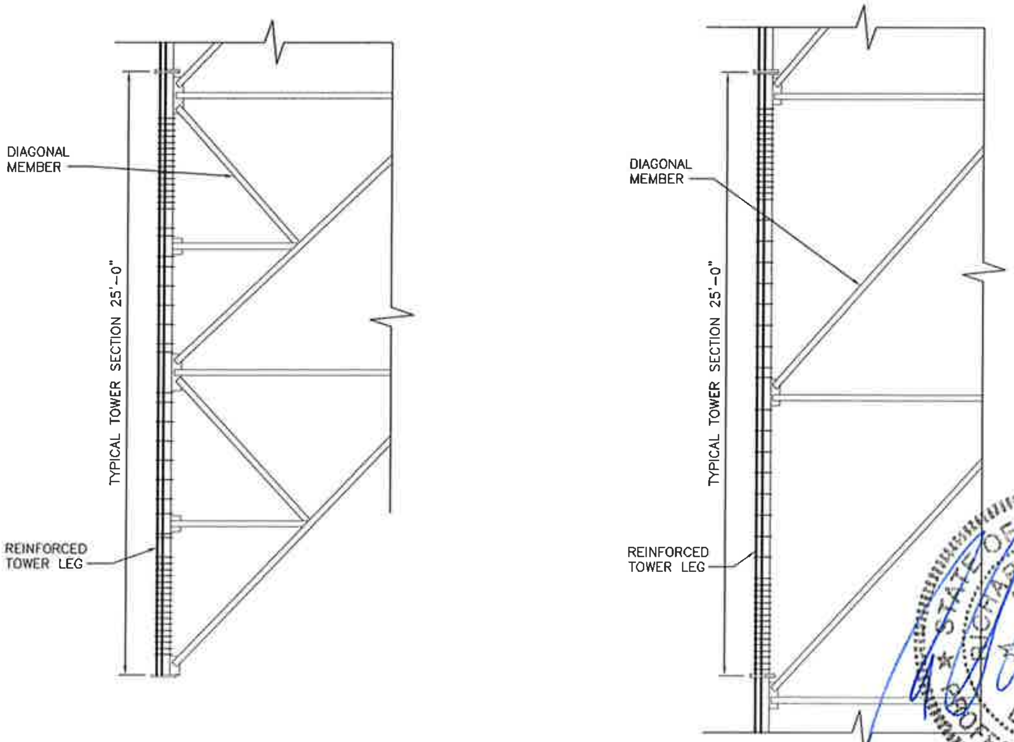
Dwg. No.
SK–3

Dwg. 3 of 4



2 SK-4 REINFORCEMENT DETAIL

SCALE: 1" = 1'-0"



1 SK-4 DIAGRAMATIC U-BOLT LAYOUT AT TOWER SECTIONS

SCALE: 1/8" = 1'-0"

RICHARD A. SAMSON
No. 9057

PROJECT NO.	
Designed by:	MCD
Drawn by:	KAP
Checked by:	KAB
Approved by:	RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

Dwg. No.
SK-4

Dwg. 3 of 4

Centek Engineering, Inc.
3-2 North Branford Road
Branford, Connecticut 06405
Phone: (203) 488-0580
Fax: (203) 488-8587

Steven L. Levine
Real Estate Consultant

September 27, 2016

Mayor Michael Finkelstein
Town of Ledyard
Town Hall 741 Colonel Ledyard Hwy
Ledyard, CT 06339

Re: Existing Telecommunications Facility – 136 Vinegar Hill Road, Ledyard

Dear Mayor Finkelstein:

In order to accommodate technological changes, implement Uniform Mobile Telecommunications System ("UMTS") and Long Term Evolution ("LTE") capabilities, and enhance system performance in the State of Connecticut, New Cingular Wireless PCS, LLC ("AT&T") will be changing its equipment configuration at certain cell sites.

As required by Regulations of Connecticut State Agencies ("R.C.S.A.") Section 16-50j-73, the Connecticut Siting Council has been notified of the changes and will review AT&T's proposal. Please accept this letter as notification under Section 16-50j-73 of construction which constitutes an exempt modification pursuant to R.C.S.A. Section 16-50j-72(b)(2).

The enclosed Notice fully sets forth the AT&T proposal. However, if you have any questions or require any further information on the plans for the site or the Siting Council's procedures, please contact the undersigned at 860-830-0380 or Ms. Melanie Bachman, Acting Executive Director, Connecticut Siting Council at (860) 827-2935.

Sincerely,

Steven L. Levine
Real Estate Consultant

Enclosure

AECOM

Submitted to
AT&T
500 Enterprise Drive
Suite 3A
Rocky Hill, CT 06067

Submitted by
AECOM
500 Enterprise Drive,
Suite 3B
Rocky Hill, CT 06067
August 1, 2016

DETAILED STRUCTURAL ANALYSIS AND MODIFICATION OF AN EXISTING 180' LATTICE TOWER WITH AN EXISTING 199' POWERMOUNT FOR PROPOSED ANTENNA ARRANGEMENT

at&t

AT&T Site I.D. #:	CT2283
CSP Site # :	Connecticut State Police Tower #54
Site Address:	136 Vinegar Hill Road Ledyard, CT

60492554
SAI-088

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis and reinforcement of the existing outer 180' self-supporting lattice tower and the existing inner 199' Powermount located at 136 Vinegar Hill Road in Ledyard, Connecticut. The analysis was conducted in accordance with the 2009 amendment to the 2005 Connecticut State Building Code, the TIA/EIA-222-F standard, and the Connecticut State Police Requirements for a wind velocity of 95 mph (fastest mile) and 90 mph (fastest mile) concurrent with ½" ice. The loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report. The proposed AT&T modification is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Remove: **(1) Valmont Flush Mount (P/N 840502)**	**AT&T (Existing)**	**@ 198'-0"**
Relocate to Proposed Antenna Mount: **(3) Powerwave 7770.00 antennas and** **(6) Powerwave LGP21401 TMA's**	**AT&T (Existing)**	**@ 198'-0"**
Install: **(1) SitePro 1 UDS-NP Triple T-Arm Mount** **(1) Valmont LWRM Universal Ring Mount** **(1) SBNH-1D6565C panel antenna (Alpha Sector)** **(2) AM-X-CD-17-65-00T-RET panel antennas (Beta and Gamma Sectors)** **(3) Ericsson RRUS-11 RRU units** **(3) Ericsson RRUS-12 RRU units** **(1) Surge Arrestor** **(2) DC Cables** **(1) Optic Fiber Line**	**AT&T (Proposed)**	**@ 198'-0"**

Note: All AT&T antennas and appurtenances shall be located on the existing Powermount.

The results of an initial analysis indicated that the existing outer tower did NOT have sufficient capacity to support the proposed loading conditions without modification. The required modifications are shown in SK-1 through SK-4. **Once the modifications are performed, the outer tower and foundation are considered structurally adequate for the wind load classifications specified above.** The tower anchor bolts and foundation are considered structurally adequate for the proposed antenna loading with the wind classification specified above without modification. The existing interior Powermount has the capacity to support the proposed loading without modification.

The tower deflection (sway) is 0.6057 degrees, and the tower rotation (twist) is 0.1155 degrees. These figures are within the Connecticut State Police specification of 0.75 degrees for combined deflection (sway) and rotation (twist).

1. EXECUTIVE SUMMARY *(continued)*

This analysis is based on:

1) The tower structures' theoretical capacity, not including any assessment of the condition of the tower.
2) Tower geometry, member sizes, and foundation taken from original construction drawings prepared by Stainless, Inc., (project number 358814) signed and sealed November 9, 1995.
3) Powermount (Pipe Riser) geometry and dimensions taken from Structural Report prepared by FWT, Inc., (job number J060324002) signed and sealed June 12, 2006.
4) Geotechnical information taken from Geotechnical Study performed by Dr. Clarence Welti, P.E., P.C. dated June 27, 2006.
5) Previous structural analysis performed by URS Corporation on behalf of T-Mobile and Cingular, project number VS1-038 / 36922158, signed and sealed July 24, 2006.
6) Proposed AT&T installation taken from Construction Drawings prepared by Hudson Design Group, job number 2283.01, Revision 0, dated August 29, 2012.
7) Proposed AT&T antennas taken from RFDS, revision V0.1, dated March 28, 2013.
8) Tower Mapping and Inventory performed by D&K Nationwide Communications, Inc., dated April 10, 2016.
9) Connecticut State Police updates to existing antenna inventory obtained vie e-mails dated May 12, 2016 and June 21, 2016.
10) Antenna and mount configuration as specified in Section 2 and 6 of this report.
11) Coax cable orientation as specified in Section 6 of this report.

This report is only valid as per the assumptions and data utilized in this report for antenna inventory, mounts and associated cables. The user of this report shall field verify the antenna, cabling and mount configuration used as well as the physical condition of the tower members, connections and foundation. Notify the engineer in writing immediately if any of the information in this report is found to be other than specified.

If you should have any questions, please call.

Sincerely,

AECOM, *contracting as URS Corporation AES,*

No. 2057

Richard A. Sambor, P.E.
Senior Structural Engineer

RAS/mcd

cc: ICA – URS
CF/Book

2. INTRODUCTION

The subject tower is located at 136 Vinegar Hill Road in Ledyard, Connecticut. The structure is a 180' self-supporting three-legged steel tapered lattice tower with a 199' Powermount. The tower is designed and manufactured by Stainless, Inc and the Powermount is designed and manufactured by FWT, Inc.

The inventory on the existing Powermount is summarized in the table below:

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) SBNH-1D6565C panel antenna (Alpha Sector) (2) AM-X-CD-17-65-00T-RET panel antennas (Beta and Gamma Sectors) (3) Ericsson RRUS-11 RRU units (3) Ericsson RRUS-12 RRU units (1) Surge Arrestor	**AT&T (proposed)**	**(1) SitePro 1 UDS-NP Triple T-Arm Mount (1) Valmont LWRM Universal Ring Mount**	**198'-0"**	**(2) DC Cables (1) Fiber Line**
(3) Powerwave 7770.00 antennas (6) Powerwave LGP21401 TMA's	AT&T (existing)	*Antennas Relocated to Above Mount*	198'-0"	(6) 1 5/8" coax cables (within Powermount)
(3) RFS APX16PV-16PVL-E antennas, (6) Remec G20057A1 TMA's	T-Mobile (existing)	(1) Valmont Flush Mount (P/N 840502)	187'-3"	(6) 1 5/8" coax cables

The inventory on the existing lattice tower is summarized in the table below:

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) Lightning Rod	Tower (existing)	Top of Tower Flange	180'	N/A
(1) Scala OGT9-806 Whip Antenna	#24 CSP-18 (existing)	*Shared Mount with Antenna # 23 (below)*	180'	(1) LDF7-50A
(1) Telewave VHF-150 2 Bay Dipole Antenna	#29 CSP-1 (existing)	2' Stand-off	180'	(1) LDF5-50A
(3) (windload) 6' Dish Antennas	CSP-60,61,62 (existing)	(3) Pipe Leg Mounted (windload)	180'	(3) WEP65 (windload)
(1) Decibel DB-809 Whip Antenna	#25 CSP-17 (existing)	(2) 6' Stand-off Mounts @ 170'	180'	(1) LDF7-50A
(1) 4' Grid Dish Antenna	#22 (existing)	Pipe Leg Mounted	175'	(1) LDF5-50A

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) 4' Grid Dish Antenna	#22 (existing)	Pipe Leg Mounted	175'	(1) LDF5-50A
(1) RFS 6' PA6-65 Dish w/ Radome	CSP-16 (existing)	Pipe Leg Mounted	170'	(1) WEP65
(1) (inverted) Decibel DB-809 Whip Antenna	#23 CSP-19 (existing)	(2) 6' Stand-off Mounts @ 170'	168'	(1) LDF7-50A
(1) RFS 6' PA6-65 Dish w/ Radome	#19 CSP-13 (existing)	Pipe Leg Mount	162.5'	(1) WEP65
(2) (inverted) Sinclair SC479-HF1LDF (DO2I-E5765) (1) Sinclair SC479-HF1LDF (DO2-E5765) (1) Sinclair 432-831-01T TTA Unit	#26, 27, 28 CSP-55,56,58,59 (existing)	(2) 6' Stand-off Mounts @ 160'	160'	(3) AVA7-50A (1) LDF4-50A
(1) Celwave PD-458 Omni Antenna	#17 CTT-9 (existing)	(2) 6' Stand-off Mounts @ 150'	160'	(1) LDF5-50A
(1) RFS 8' PA8-65 Dish w/ Radome	#16 CSP-15 (existing)	Pipe Leg Mount	158'	(1) WEP65
(1) Telewave VHF-150 21' 4 Dipole Array Antenna	#15 CSP-2 (existing)	(2) 4' Stand-off Mounts	158'	(1) LDF5-50A
(1) (inverted) Sinclair SC479-HF1LDF Whip Antenna	#18 CSP-54 (existing)	*Shared Mount with Antenna # 17 (above)*	153'	(1) LDF7-50A
(1) RFS 6' PA6-65 Dish w/ Radome w/ Ice Shield mounted above	#14 CSP-14 (existing)	Pipe Leg Mount	150'	(1) WEP65
(1) Celwave PD-320 12' Dipole Antenna	#13 DEP-21 (existing)	3' Stand-off	146'	(1) LDF5-50A
(1) RFS 6' PA6-65 Dish w/ Radome w/ Ice Shield mounted above	#12 CSP-23 (existing)	Pipe Leg Mount	135'	(1) WEP65
(1) Decibel DB-212 Dipole Antenna	#11 CSP-8 (existing)	3' Stand-off	133'	(1) LDF5-50A
(1) Decibel DB-222 Dual Dipole Antenna	#10 FBI-22 (existing)	*Shared with below Mount*	135'	(1) LDF5-50A
(1) Decibel DB-432 Yagi Antenna	FBI-24 (existing)	*Shared with below Mount*	125'	(1) LDF4-50A
(1) Comprod 531-70 10' Dipole Antenna	#9 DOT-52 (existing)	(2) 4' Stand-off Mounts	115'	(1) LDF5-50A
(1) Dish Antenna Ice Shield	#8 (existing)	Pipe Leg Mount	113'	N/A

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) Decibel PD-220 Omni Antenna	#6 DHS-3 (existing)	*Shared with below Mount*	113'	(1) LDF5-50A
(1) Decibel DB-264 22'-4 Dipole Array Antenna	#5 FBI-11 (existing)	2' Stand-off	92'	(1) LDF5-50A
(1) Decibel 12' - 4 Dipole Array Antenna	#4 FBI-53 (existing)	3' Stand-off	87.5'	(1) LDF5-50A
(1) Celwave PD-156S Yagi Antenna	#3 NEC-4 (existing)	2' Stand-off	62.5'	(1) LDF5-50A
(1) Decibel DB803-XT Omni Antenna	#2 CSP-25 (existing)	*Shared with below Mount*	53'	(1) LDF4-50A
(1) Sinclair SY-203 Yagi Antenna	#1 DEHMS-26 (existing)	3' Stand-off	48'	(1) LDF4-50A

Notes: Antenna elevations and ID numbering obtained from Tower Mapping and Existing Inventory via tower climb, performed by D&K Nationwide Communications, Inc. on April 10, 2016.

This structural analysis of the communications tower was performed by AECOM on behalf of AT&T. The purpose of this analysis was to investigate the structural integrity of the modified tower and Powermount with their existing and proposed antenna loads. This analysis was conducted to evaluate stress on the towers and the effect of forces to the foundation of the towers resulting from existing and proposed antenna arrangements.

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

The structural analysis was done in accordance with the 2009 amendment to the 2005 Connecticut State Building Code, TIA/EIA-222-F—Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, the Connecticut State Police Requirements, and the American Institute of Steel Construction (AISC) Manual of Steel Construction—Allowable Stress Design (ASD).

The analysis of the Powermount was conducted using STAAD Pro V8i. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 95 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 90 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

The support reactions from the STAAD analysis were applied to the lattice tower using TNX-Tower as "User Forces". Note: the Powermount is designed to support the vertical reactions of the antenna and coaxial cable loading and transfer the lateral loading to the lattice tower.

The analysis of the lattice tower was conducted using TNX-Tower 7.0.5.1. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 95 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 90 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

The TIA/EIA standard permits a one-third increase in allowable stresses for towers and monopoles less than 700 feet tall. For the purposes of this analysis, in computing the load capacity the allowable stresses of the tower members were increased by one-third.

4. FINDINGS AND EVALUATION

Stresses on the modified tower structure were evaluated to compare with the allowable stress in accordance with AISC. The results of an initial analysis indicated that the existing tower structure did not have enough capacity to support the proposed loading conditions. The tower structure require modifications shown on SK-1 through SK-4. Once the modifications indicated on sheets SK-1 through SK-4 are performed, the modified structure and existing foundation are considered structurally adequate with the wind load classification specified with the existing and proposed antenna loading noted herein.

See the below tower capacity and the tower deflection (sway) and rotation (twist) figures:

TABLE 1: Tower Deflection (Sway) and Twist at the top of the tower (in degrees):

Description	Current	Allowable
Tower Sway (degrees)	0.6057	N/A
Tower Twist (degrees)	0.1155	
Total (degrees)	0.7212	0.750

TABLE 2: Tower Base Reactions:

Base Reactions	Proposed Tower Reactions
Axial Load (kips)	48
Shear per Leg (kips)	49
Total Shear (kips)	87
Uplift per Leg (kips)	386
Comp.per Leg (kips)	456
O.T. Moment (ft-kips)	9520

For detailed proposed tower reactions, see drawing no. E-1 in section 6 of this report.

TABLE 3: Tower Component Stress vs. Capacity Summary:

Component/ (Section No.)	Existing Component Size	Controlling Component/Elevation	Stress (% capacity)	Pass/Fail
Powermount	18" Dia x 0.375" Pipe	Bending / 187'-3"	55.5 %	**Pass**
Tower Leg (T10)	HSS6.875x0.5 w/ ½ HSS 7.5x0.3125	Compression/0' – 25'	87.4 %	**Pass**
Diagonal (T5)	2L2 1/2x2 1/2x1/4	Compression/125' – 150'	88.4 %	**Pass**
Horizontal (T6)	L3x3x1/4	Compression/100' – 125'	91.2 %	**Pass**
Top Girt (T1)	L3x3x1/4	Compression/175'-180'	77.8 %	**Pass**
Red. Horizontal Bracing (T10)	L2 1/2x2 1/2x3/16	Compression/0-25'	77.4 %	**Pass**
Red. Diagonal Bracing (T10)	L3x3x1/4	Compression/0-25'	47.9 %	**Pass**
Inner Bracing (T9)	L2 1/2x2 1/2x3/16	Compression/25'-50'	0.8 %	**Pass**
Bolt Checks	(1) ¾" A325X Diagonal	Compression / 180'	99.2 %	**Pass**
Anchor Bolts	1 3/4" dia.	Tension & Shear	74 %	**Pass**
Existing Foundation	Pad & Pier	Overturning Moment Factor of Safety (2.0 min)	2.07 / 96.5 %	**Pass**

5. CONCLUSIONS

The results of an initial analysis indicated that the existing outer tower did NOT have sufficient capacity to support the proposed loading conditions without modification. The required modifications are shown in SK-1 through SK-4. **Once the modifications are performed, the outer tower and foundation are considered structurally adequate for the wind load classifications specified herein.** The tower anchor bolts and foundation are considered structurally adequate for the proposed antenna loading with the wind classification specified above without modification. The existing interior Powermount has the capacity to support the proposed loading without modification.

The tower deflection (sway) is 0.6057 degrees, and the tower rotation (twist) is 0.1155 degrees. These figures are within the Connecticut State Police specification of 0.75 degrees for combined deflection (sway) and rotation (twist).

Limitations/Assumptions:

This report is based on the following:

1. Tower inventory as listed in this report.
2. Tower is properly installed and maintained.
3. All members and their geometry are as specified in the original design documents and are in good condition.
4. All required members are in place.
5. All bolts are in place and are properly tightened.
6. Tower is in plumb condition.
7. All member protective coatings are in good condition.
8. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
9. Foundations are in good condition without defect and were properly constructed to support original design loads as specified in the original design documents.

AECOM is not responsible for any modifications completed prior to or hereafter in which AECOM is not or was not directly involved. Modifications include but are not limited to:

A. Adding antennas
B. Removing/replacing antennas
C. Adding coaxial cables

AECOM hereby states that this document represents the entire report and that it assumes no liability for any factual changes that may occur after the date of this report. All representations, recommendations, and conclusions are based upon information contained and set forth herein. If you are aware of any information which conflicts with that which is contained herein, or you are aware of any defects arising from original design, material, fabrication, or erection deficiencies, you should disregard this report and immediately contact AECOM. AECOM disclaims all liability for any representation, recommendation, or conclusion not expressly stated herein.

Ongoing and Periodic Inspection and Maintenance:

After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire tower structural system be performed at least yearly and more frequently as conditions warrant. According to TIA/EIA-222-F section 14.1, Note 1: It is recommended that the structure be inspected after severe wind and/or ice storms or other extreme loading conditions.

6. DRAWINGS AND DATA

REINFORCEMENT DRAWINGS SK-1 THROUGH SK-4

GENERAL CONSTRUCTION NOTES

1. ALL WORK SHALL COMPLY WITH THE CONNECTICUT STATE BUILDING AND LIFE SAFETY CODES, SUPPLEMENTS AND AMENDMENTS.
2. CONTRACTOR IS TO REVIEW ALL DRAWINGS AND NOTES IN THE CONTRACT DOCUMENT SET. CONTRACTOR SHALL COORDINATE ALL WORK SHOWN IN THE SET OF DRAWINGS. THE CONTRACTOR SHALL PROVIDE A COMPLETE SET OF DRAWINGS TO ALL SUB-CONTRACTORS AND ALL RELATED PARTIES. THE SUB-CONTRACTORS SHALL EXAMINE ALL THE DRAWINGS AND SPECIFICATIONS FOR THE INFORMATION THAT AFFECTS THEIR WORK.
3. CONTRACTOR SHALL PROVIDE A COMPLETE BUILD-OUT WITH ALL FINISHES, STRUCTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS AND PROVIDE ALL ITEMS AS SHOWN OR INDICATED ON DRAWINGS OR WRITTEN IN SPECIFICATIONS.
4. CONTRACTOR SHALL FURNISH ALL MATERIAL, LABOR AND EQUIPMENT TO COMPLETE THE WORK AND FURNISH A COMPLETED JOB ALL IN ACCORDANCE WITH LOCAL AND STATE GOVERNING AUTHORITIES AND OTHER AUTHORITIES HAVING LAWFUL JURISDICTION OVER THE WORK.
5. CONTRACTOR SHALL SECURE AND PAY FOR ALL PERMITS AND ALL INSPECTIONS REQUIRED AND SHALL ALSO PAY FEES REQUIRED FOR THE GENERAL CONSTRUCTION AND ELECTRICAL SUB-CONTRACTORS SHALL PAY FOR THEIR PERMITS.
6. CONTRACTOR SHALL MAINTAIN A CURRENT SET OF DRAWINGS ON SITE AT ALL TIMES AND ENSURE THE DISTRIBUTION OF NEW DRAWINGS TO SUB-CONTRACTORS AND OTHER RELEVANT PARTIES AS SOON AS THEY ARE MADE AVAILABLE. ALL OLD DRAWINGS SHALL BE MARKED VOID AND REMOVED FROM THE CONTRACT AREA. CONTRACTOR SHALL FURNISH 'AS-BUILT' SET OF DRAWINGS TO OWNER UPON COMPLETION OF PROJECT.
7. INSTALLATION OF THIS WIRELESS COMMUNICATIONS EQUIPMENT SITE REQUIRES WORK IN THE IMMEDIATE VICINITY OF EXISTING OPERATING TELECOMMUNICATION SYSTEMS. THE CONTRACTOR SHALL PROVIDE AND COORDINATE THE METHODS OF PROTECTION WITH THE VARIOUS TELECOMMUNICATION CARRIERS AND THE TOWER OWNER. THERE SHALL BE NO INTERRUPTION OF OPERATION WITHOUT TIMELY COORDINATION WITH AND APPROVAL BY THE VARIOUS COMMUNICATIONS OPERATORS INCLUDING THE CONNECTICUT STATE POLICE.
8. THE REINFORCEMENT OF PORTIONS OF THIS TOWER STRUCTURE WILL AFFECT CRITICAL CONNECTICUT STATE POLICE ANTENNAS. NO MOVEMENT, ALTERATION, OR DISCONNECTION OF CONNECTICUT STATE POLICE ANTENNAS MAY OCCUR WITHOUT THE NOTIFICATION AND APPROVAL OF THE CONNECTICUT STATE POLICE. CONTACT THE NETWORK CONTROL CENTER AT 860-865-8008.
9. TOWER REINFORCING WORK AFFECTING CRITICAL CONNECTICUT STATE POLICE ANTENNAS MAY BE REQUIRED TO BE CONDUCTED AT TIMES AS DETERMINED BY THE REQUIREMENTS OF THE CONNECTICUT STATE POLICE.
10. ALL EQUIPMENT AND PRODUCTS PURCHASED ARE TO BE REVIEWED BY CONTRACTOR AND ALL APPLICABLE SUB-CONTRACTORS FOR ANY CONDITION PER MFR'S RECOMMENDATIONS. CONTRACTOR TO SUPPLY THESE ITEMS AT NO COST TO OWNER OR ARCHITECT.
11. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ON-SITE SAFETY FROM THE TIME THE JOB IS AWARDED UNTIL ALL WORK IS COMPLETE AND ACCEPTED BY THE OWNER.
12. SHOP DRAWINGS ARE REQUIRED. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS, ELEVATIONS, ANGLES, AND EXISTING CONDITIONS ON THE TOWER AND INCLUDE THE GATHERED INFORMATION ON THE SHOP DRAWINGS. INCLUDE ANY DISCREPANCIES ENCOUNTERED WITH THE SHOP DRAWINGS. NO FABRICATION OF STEEL SHALL OCCUR PRIOR TO THE RECEIPT OF APPROVED SHOP DRAWINGS.
13. CONTRACTOR TO REVIEW ALL SHOP DRAWINGS AND SUBMIT COPY TO ARCHITECT FOR REVIEW. DRAWINGS MUST BEAR THE CHECKER'S INITIALS BEFORE SUBMITTAL TO THE ARCHITECT FOR REVIEW.
14. THE CONTRACTOR IS SOLELY RESPONSIBLE TO DETERMINE CONSTRUCTION PROCEDURE AND SEQUENCE, AND TO ENSURE THE SAFETY OF THE EXISTING STRUCTURE AND ITS COMPONENT PARTS DURING CONSTRUCTION. THIS INCLUDES THE ADDITION OF WHATEVER SHORING, BRACING, UNDERPINNING, ETC. THAT MAY BE NECESSARY.
15. CONTRACTOR TO CONTACT "CALL BEFORE YOU DIG" AT 1-800-922-4455 TO VERIFY AND IDENTIFY THE EXACT LOCATIONS OF ALL UNDERGROUND UTILITIES AND OBSTRUCTIONS IDENTIFIED PRIOR TO COMMENCING WORK IN THE CONTRACT AREA.
16. CONTRACTOR SHALL COMPLY WITH OWNER ENVIRONMENTAL ENGINEER ON ALL METHODS AND PROVISIONS FOR ALL EXCAVATION ACTIVITIES INCLUDING SOIL DISPOSAL. ALL BACKFILL MATERIALS TO BE PROVIDED BY THE CONTRACTOR.
17. DIMENSIONS OF EXISTING TOWER ARE BASED ON MANUFACTURER'S DRAWINGS PREPARED BY STAINLESS INC. DATED JUNE 1994, AND ARE NOT GUARANTEED. CONTRACTOR SHALL TAKE FIELD DIMENSIONS AS NECESSARY TO ASSURE PROPER FIT OF ALL FINISHED WORK AND SHALL ASSUME FULL RESPONSIBILITY FOR THEIR ACCURACY. WHEN SHOP DRAWINGS BASED ON FIELD MEASUREMENT ARE SUBMITTED FOR REVIEW, DIMENSIONS ARE PROVIDED FOR THE ENGINEER'S REFERENCE ONLY.
18. TOWER INVENTORY IS BASED ON INFORMATION OBTAINED BY CONNECTICUT STATE POLICE DATED MAY 12, 2016. TOWER MAPPING AND EXISTING INVENTORY OBTAINED FROM D&K NATIONWIDE COMMUNICATIONS, INC. DATED APRIL 10, 2016.
19. CONTRACTOR TO VERIFY REQUIRED CLEARANCES INCLUDING BUT NOT LIMITED TO EXISTING BUILDINGS, EQUIPMENT PADS AND SHELTERS PRIOR TO COMMENCING WORK.
20. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION. NO MEMBER OF THE TOWER SHALL BE LEFT DISCONNECTED FOR THE NEXT WORKING DAY. THE CONTRACTOR SHALL BE AWARE OF WEATHER AND WIND CONDITIONS AND NOT PERFORM MEMBER REPLACEMENT IN A WIND.

STRUCTURAL NOTES

STRUCTURAL STEEL MATERIAL:

PIPE/TUBE LEG, HSS5x0.375 AND LARGER	ASTM A572-60
1/2, 1/3 HSS MATERIAL & PIPE TUB LEG HSS5x0.25	ASTM A572-50
PLATES & ANGLES	A36
BOLTS	A325X & A490N

STRUCTURAL STEEL SHALL CONFORM TO ALL THE REQUIREMENTS OF THE ASTM SPECIFICATION, AS REFERENCED IN THE CODE.

UNLESS OTHERWISE NOTED, ALL STEEL WILL BE GALVANIZED IN ACCORDANCE WITH ASTM 123 AFTER FABRICATION. TOUCH UP ALL DAMAGED GALVANIZED STEEL WITH APPROVED COLD ZINC, "GALVANOX", "DRY GALV", "ZINC-IT", OR APPROVED EQUIVALENT, IN ACCORDANCE WITH MANUFACTURERS GUIDELINES. TOUCH-UP DAMAGED NON GALVANIZED STEEL WITH SAME PAINT APPLIED IN SHOP OR FIELD.

SHOP AND ERECTION DRAWINGS SHALL BE SUBMITTED FOR ALL STRUCTURAL STEEL WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. SUBMIT 2 SETS OF PRINTS FOR THE ENGINEER REVIEW.

MILL BEARING ENDS OF COLUMNS, STIFFENERS, AND OTHER BEARING SURFACES TO TRANSFER LOAD OVER ENTIRE CROSS SECTION.

THE OMISSION OF ANY MATERIAL THAT WAS SHOWN ON THE CONTRACT DRAWINGS SHALL NOT RELIEVE THE CONTRACTOR OF PROVIDING THE SAME.

CONNECTIONS / FIELD ASSEMBLY:

BOLTED CONNECTIONS: UNLESS OTHERWISE NOTED, ALL JOINTS ARE SLIP CRITICAL TYPE, REQUIRING 5/8", 3/4" & 1" DIA. A325X & A490-N BOLTS, A563 NUTS AND F436 WASHERS, ALL GALVANIZED. BEVELED WASHERS SHALL BE USED ON BEAM FLANGES HAVING A SLOPE GREATER THAN 1:20.

STRUCTURE IS DESIGNED TO BE LEVEL AND PLUMB, SELF-SUPPORTING AND STABLE AFTER WORK IS COMPLETED.

COMMENCEMENT OF WORK WITHOUT NOTIFYING THE ENGINEER OF ANY DISCREPANCIES WILL BE CONSIDERED ACCEPTANCE OF PRECEDING WORK.

INSPECTIONS:

SPECIAL INSPECTIONS ARE REQUIRED PER THE CODE FOR STRUCTURAL STEEL WORK.

OWNER WILL SUPPLY THE SERVICES OF A SPECIAL INSPECTOR AND TESTING AGENTS AS REQUIRED. CONTRACTOR SHALL COORDINATE INSPECTIONS OF FABRICATOR'S AND ERECTOR'S WORK AND MATERIALS TO MEET THE REQUIREMENTS OF THE STATEMENT OF SPECIAL INSPECTIONS FOR THIS PROJECT.

COPIES OF TESTING AND INSPECTION REPORTS WILL BE PROVIDED TO THE OWNER, BUILDING OFFICIAL, ENGINEER OF RECORD AND CONTRACTOR.

RICHARD A. SAMBOR
No. 9057

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

REV.	DATE:	DESCRIPTION

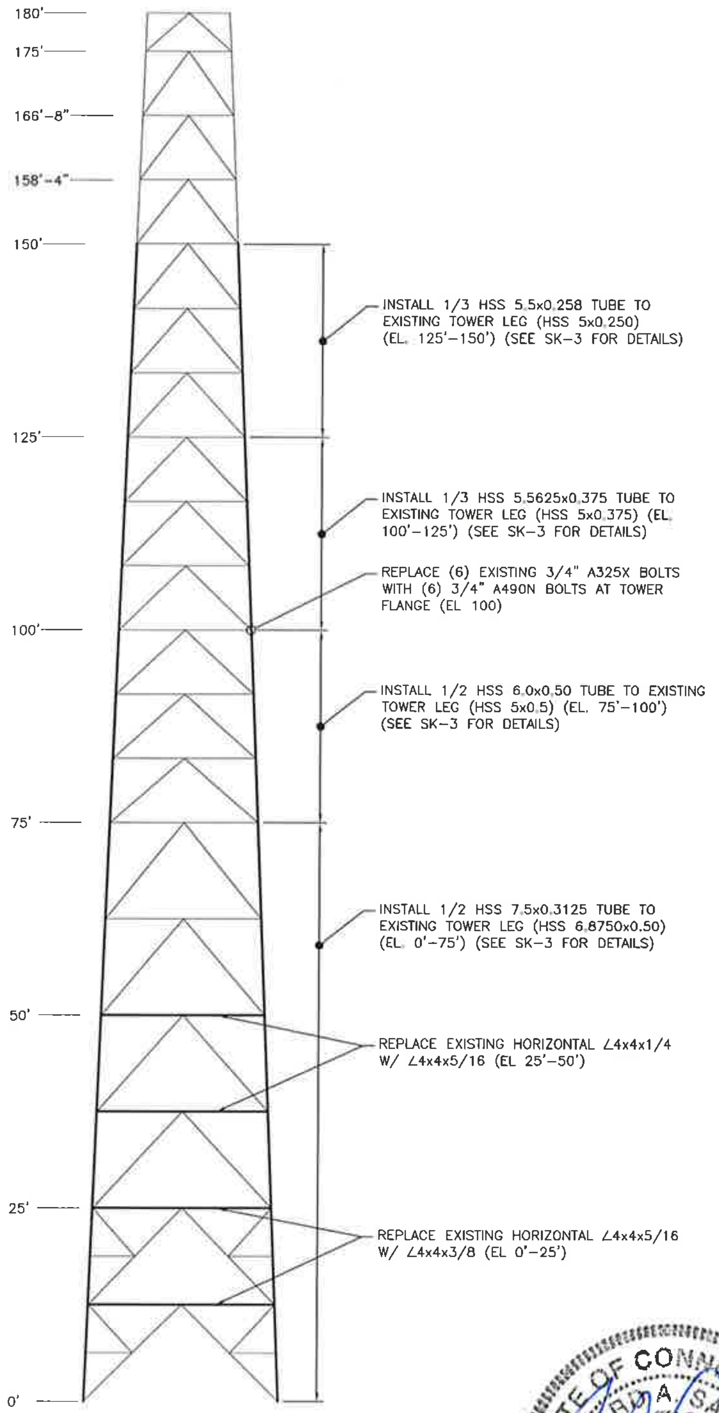
Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

Dwg. No.
SK-1

Dwg. 1 of 4

STRUCTURAL NOTES

SEE SHEET SK-2 FOR STRUCTURAL NOTES



INSTALL 1/3 HSS 5.5x0.258 TUBE TO EXISTING TOWER LEG (HSS 5x0.250) (EL. 125'-150') (SEE SK-3 FOR DETAILS)

INSTALL 1/3 HSS 5.5625x0.375 TUBE TO EXISTING TOWER LEG (HSS 5x0.375) (EL. 100'-125') (SEE SK-3 FOR DETAILS)

REPLACE (6) EXISTING 3/4" A325X BOLTS WITH (6) 3/4" A490N BOLTS AT TOWER FLANGE (EL 100)

INSTALL 1/2 HSS 6.0x0.50 TUBE TO EXISTING TOWER LEG (HSS 5x0.5) (EL. 75'-100') (SEE SK-3 FOR DETAILS)

INSTALL 1/2 HSS 7.5x0.3125 TUBE TO EXISTING TOWER LEG (HSS 6.8750x0.50) (EL. 0'-75') (SEE SK-3 FOR DETAILS)

REPLACE EXISTING HORIZONTAL ∠4x4x1/4 W/ ∠4x4x5/16 (EL 25'-50')

REPLACE EXISTING HORIZONTAL ∠4x4x5/16 W/ ∠4x4x3/8 (EL 0'-25')

1
SK-2

TOWER ELEVATION

SCALE: 1" = 30'-0"

STATE OF CONNECTICUT
RICHARD A. SAMBOR
No. 9057
LICENSED PROFESSIONAL ENGINEER

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

REV.	DATE:	DESCRIPTION

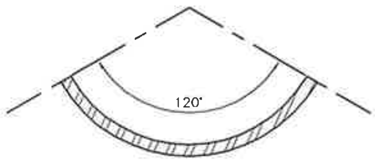
Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

Dwg. No.
SK-2
Dwg. 2 of 4

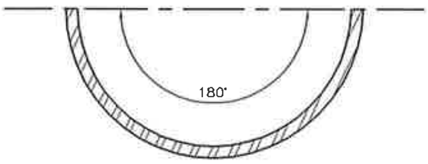
ELEVATION	HSS TUBE EXISTING LEG SIZE (IN)	HSS TUBE REINFORCING DIMENSIONS (IN)	MINIMUM # U-BOLTS AT ENDS OF 25' SECTION SPACED @ 3" C-TO-C	MINIMUM U-BOLTS REMAIN PER LEG	MAXIMUM SPACING REMAINING U-BOLTS C-TO-C (IN)	INSTALLING PRETENSION FORCE ON BOLT (KIPS)
150' – 125'	5x0.250	1/3–5.5x0.258	13	21	10	2.7
125' – 100'	5x0.3750	1/3–5.5625x0.375	10	23	10	4.25
100' – 75'	5x0.50	1/2–6.0x0.50	23	13	12	4.25
75' – 50'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25
50' – 25'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25
25' – 0'	6.875x0.50	1/2–7.5x0.3125	17	17	11	4.25

NOTES:

- U–BOLTS SHALL BE ASTM A449. BASIS OF DESIGN IS PORTLAND BOLT OF PORTLAND, OREGON, USA. ALTERNATIVE SUPPLIER SHALL MATCH OR EXCEED QUALITY OF PORTLAND BOLT
- CONTRACTOR SHALL TAKE SPECIFIC CARE WHEN INSTALLING U–BOLTS AND NOT ALLOW ANY VISUAL DEFORMATION OF THE EXISTING TOWER LEGS.
- 1/3 (ONE THIRD) AND 1/2 (ONE HALF) OF HSS TUBE REFER TO THE REQUIRED PORTION OF HSS TUBING TO BE INSTALLED FOR REINFORCING.
- SPACING DIMENSIONS FOR U–BOLTS ARE MAXIMUM ALLOWABLE DISTANCE. ADDITIONAL U–BOLTS MAY BE REQUIRED DUE TO INTERRUPTION CAUSED BY EXISTING TOWER COMPONENTS. SHOP DRAWINGS SHALL ILLUSTRATE ACTUAL BOLT SPACING REQUIRED BASED ON VERIFIED FIELD CONDITIONS.
- TOWER LEGS HAVE STEP BOLTS. 1/2 HSS TUBE REINFORCING SHALL BE NOTCHED TO ALLOW THE REINFORCING TO FIT AROUND STEP BOLTS. SHOP DRAWINGS SHALL ILLUSTRATE VERIFIED STEP BOLT LOCATIONS AND NOTCHES.
- 1/3 AND 1/2 HSS TUBES SHALL BE CONTINUOUS, SINGLE PIECE MEMBERS APPROXIMATELY 25' LONG.



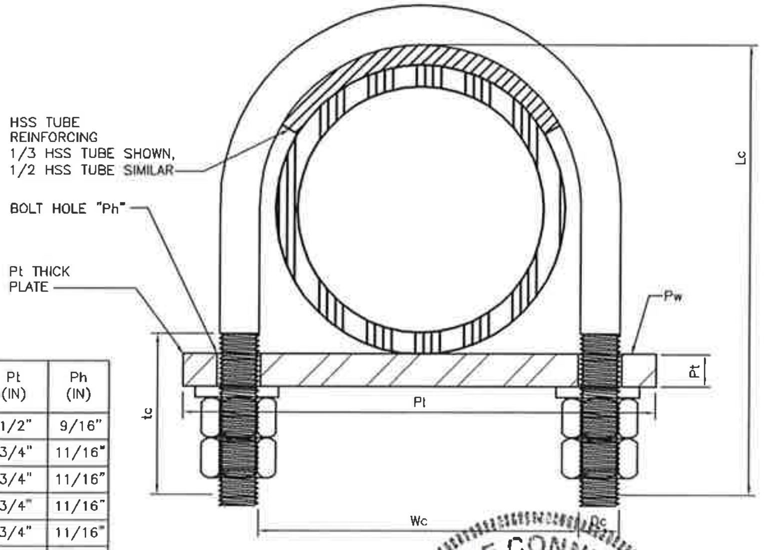
PLAN VIEW OF 1/3 HSS TUBE



PLAN VIEW OF 1/2 HSS TUBE

2 SK-3 HSS TUBE DETAILS

SCALE: N.T.S.



TOWER LEG DIAMETER (IN)	HSS REINFORCED O.D. (IN)	ELEVATION	Dc (IN)	Lc (IN)	Wc (IN)	tc (IN)	Pl (IN)	Pw (IN)	Pt (IN)	Ph (IN)
5x0.250	5.5	150'–125'	1/2"	7 ½"	5 ½"	3"	8"	2"	1/2"	9/16"
5x0.3750	5.5625	125'–100'	5/8"	8"	5 9/16"	3"	8 ¼"	2 ½"	3/4"	11/16"
5x0.50	6	100'–75'	5/8"	8 ¼"	6"	3"	8 ¾"	2 ½"	3/4"	11/16"
6.875x0.50	7.5	75'–50'	5/8"	9 ¾"	7 ½"	3"	10 ¼"	2 ½"	3/4"	11/16"
6.875x0.50	7.5	50'–25'	5/8"	9 ¾"	7 ½"	3"	10 ¼"	2 ½"	3/4"	11/16"
6.875x0.50	7.5	25'–0'	5/8"	9 ¾"	7 ½"	3"	10 ¼"	2 ½"	3/4"	11/16"

NOTE: U–BOLT ATTACHMENT PLATE MATERIAL SHALL BE MINIMUM 50 KSI. COORDINATE WITH ABOVE U–BOLT TABLE FOR QUANTITIES AND SPACING OF U–BOLT FOR ASSEMBLY.

1 SK-3 U-BOLT FOR LEG REINFORCEMENT

SCALE: 4" = 1'-0"

No. 9057

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

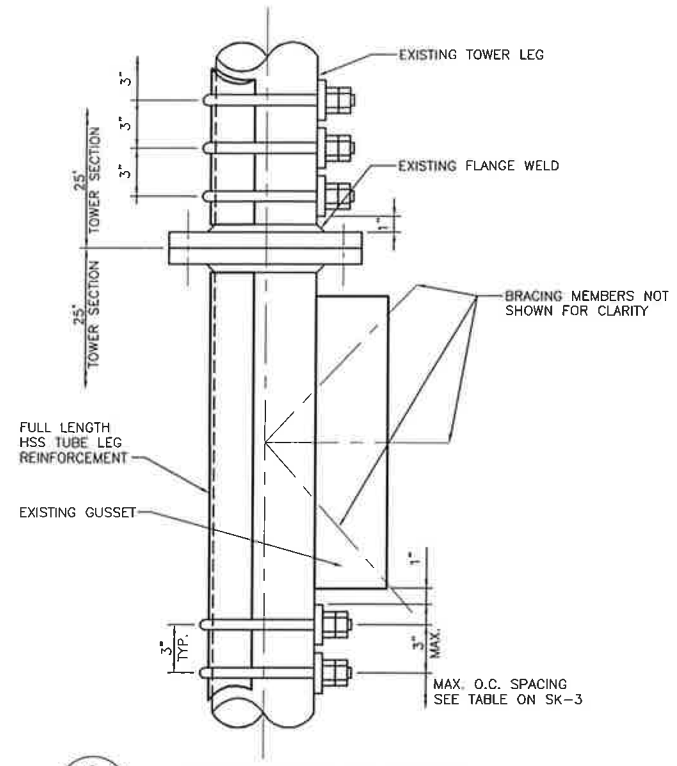
AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

SITE ADDRESS:
136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

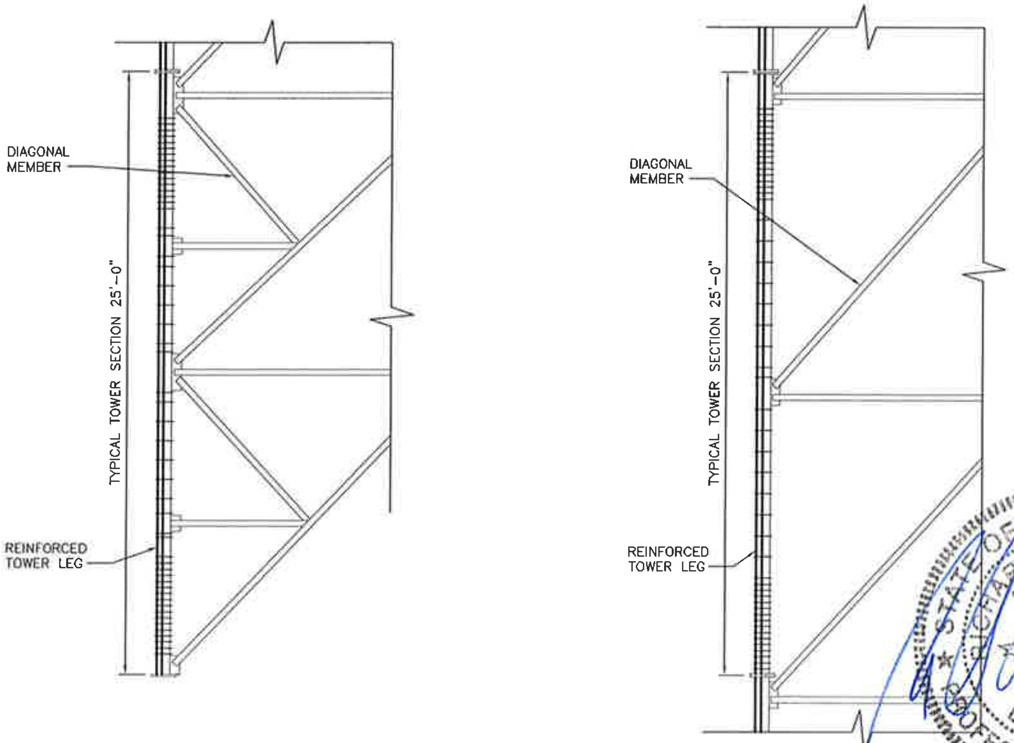
REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI–088
File No.
Dwg. No. SK–3
Dwg. 3 of 4



2 SK-4 REINFORCEMENT DETAIL

SCALE: 1" = 1'-0"



RICHARD A. SAMSON
No. 9057

1 SK-4 DIAGRAMATIC U-BOLT LAYOUT AT TOWER SECTIONS

SCALE: 1/8" = 1'-0"

PROJECT NO.
Designed by: MCD
Drawn by: KAP
Checked by: KAB
Approved by: RAS

AECOM
500 ENTERPRISE DRIVE
ROCKY HILL, CONNECTICUT
(860)-529-8882

AT&T SITE: CT 2283 CSP SITE #54

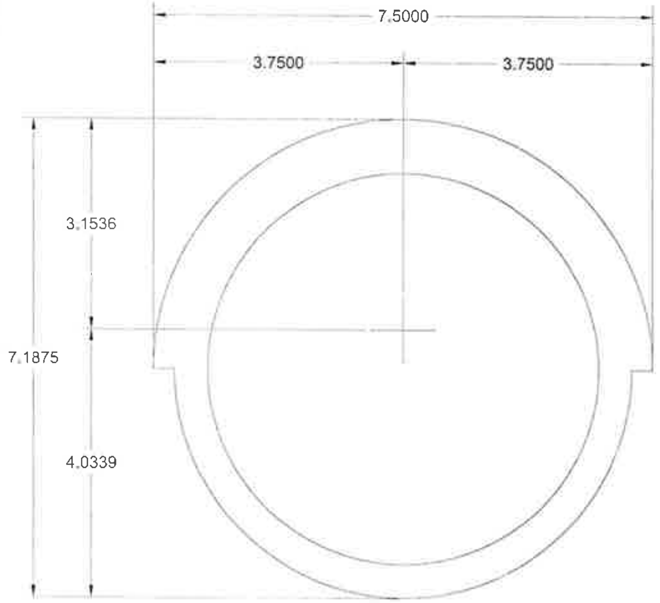
SITE ADDRESS: 136 VINEGAR HILL ROAD
LEDYARD, CONNECTICUT 06335

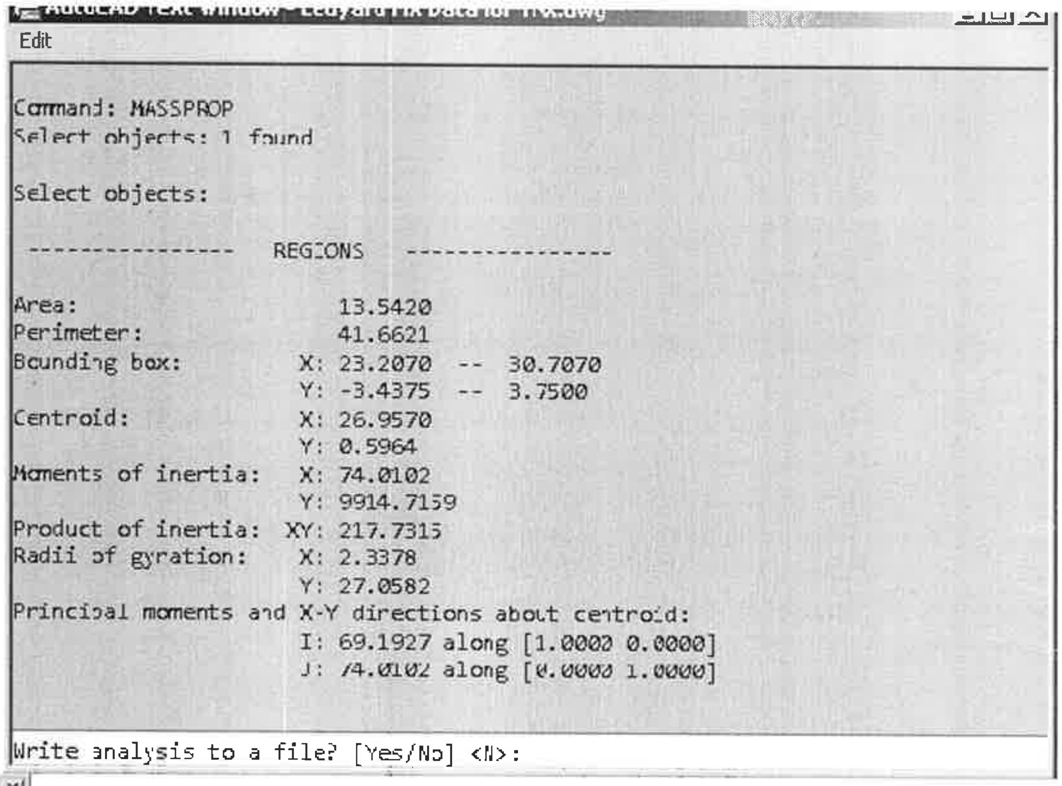
REV.	DATE:	DESCRIPTION

Scale: AS NOTED
Date: 06/29/16
Job No. SAI-088
File No.

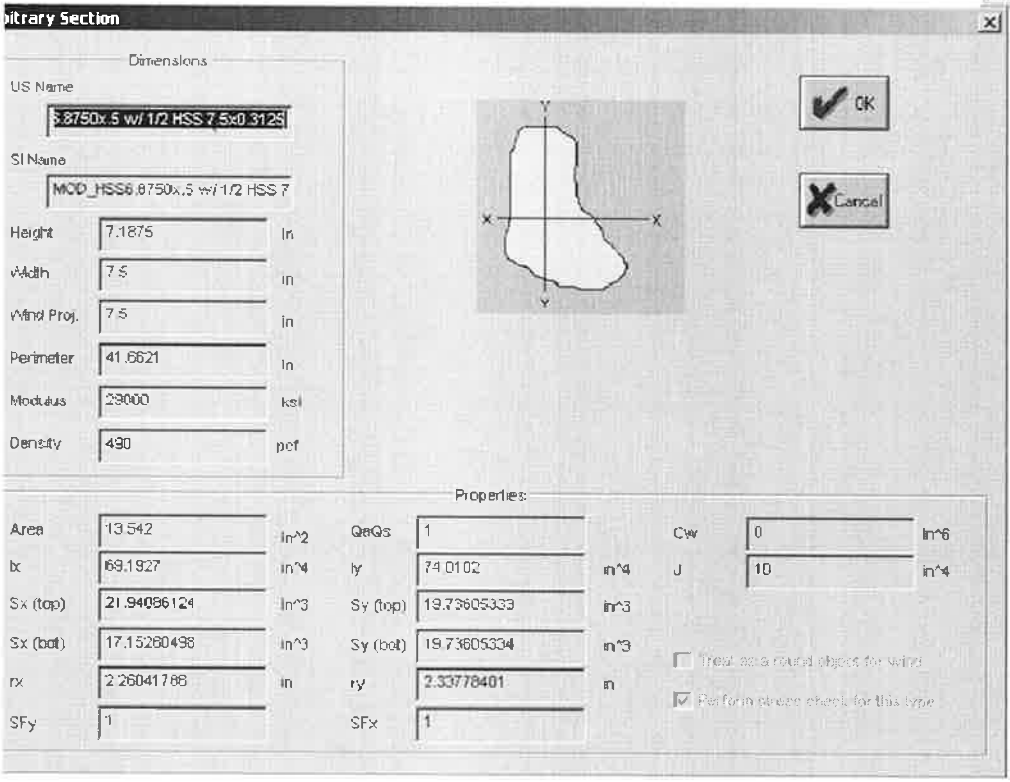
Dwg. No. SK-4
Dwg. 3 of 4

ISS 6.8750x0.50 (ASTM A572-60 (60KSI MIN))
REINFORCED WITH 1/2 HSS 7.5x0.3125 ASTM A572-50
50KSI MIN)





```
Command: MASSPROP
Select objects: 1 found

Select objects:

 ----------------    REGIONS    ----------------

Area:                     13.5420
Perimeter:                41.6621
Bounding box:          X: 23.2070  --  30.7070
                       Y: -3.4375  --  3.7500
Centroid:              X: 26.9570
                       Y: 0.5964
Moments of inertia:    X: 74.0102
                       Y: 9914.7159
Product of inertia:   XY: 217.7315
Radii of gyration:     X: 2.3378
                       Y: 27.0582
Principal moments and X-Y directions about centroid:
                       I: 69.1927 along [1.0000 0.0000]
                       J: 74.0102 along [0.0000 1.0000]

Write analysis to a file? [Yes/No] <N>:
```



US Name: 6.8750x.5 w/ 1/2 HSS 7.5x0.3125

SI Name: MOD_HSS6.8750x.5 w/ 1/2 HSS 7

Height: 7.1875 in

Width: 7.5 in

Wind Proj.: 7.5 in

Perimeter: 41.6621 in

Modulus: 29000 ksi

Density: 490 pcf

Area: 13.542 in^2

Ix: 69.1927 in^4

Sx (top): 21.94086124 in^3

Sx (bot): 17.15280498 in^3

rx: 2.26041786 in

SFy: 1

QaQs: 1

Iy: 74.0102 in^4

Sy (top): 19.73605333 in^3

Sy (bot): 19.73605334 in^3

ry: 2.33778401 in

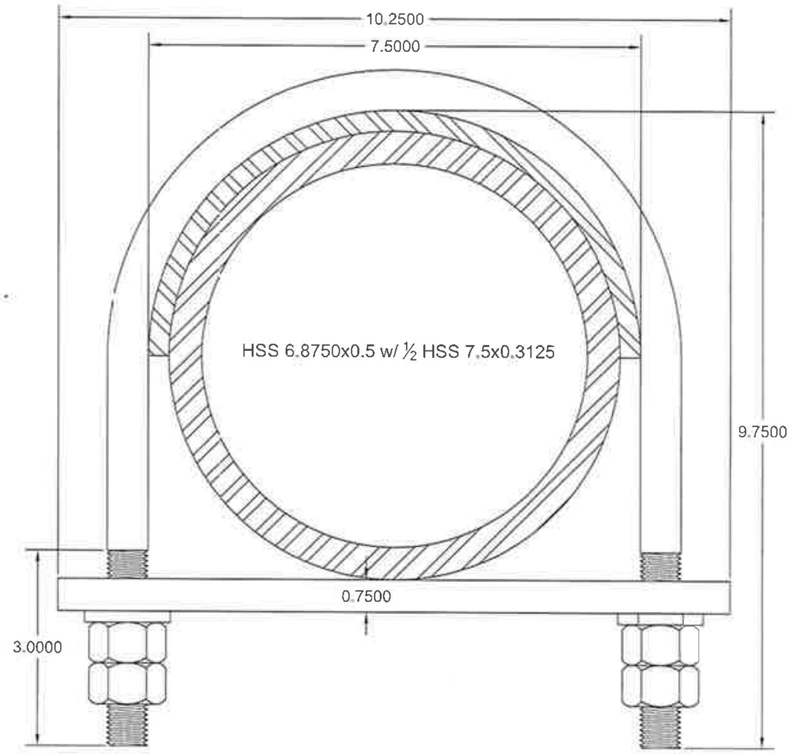
SFx: 1

Cw: 0 in^6

J: 10 in^4

☐ Treat as a round object for wind

☑ Perform stress check for this type



Job Ledyard, Ct. 150 tower

Description Elevations 0'-25', 25'-50', 50'-75'

HSS 6.8750x0.5 w/ 1/2 HSS 7.5x0.3125

Project No. ______

Computed by MCD

Checked by ______

Page ______ of ______

Sheet ______ of ______

Date ______

Date ______

Reference

Calculations to determine maximum # of clamps required for development of reinforcing Pipe (using Bolts of type ASTM A 449) → AISC "Group A Bolt"

$L_{b\,maximum} = 25ft/4bays$

$= 6.25ft = 75in$

(cons) $k = 1$

$r_{exist} = 2.27in$

$A_{exist} = 9.36in^2$

- Because existing leg is 60ksi, use AISC CHAPTER E (14th Ed.)

• Check if member is Slender – Table 4.1a

$0.11\frac{E}{F_y} = 0.11\left(\frac{29000}{60}\right) = 53.16 \quad \frac{D}{t} = \frac{6.875}{.5} = 13.75$

NOT-Slender ∴ Apply Section [E-3]

AISC [EQ 3-2]

$\frac{KL}{r} = \frac{1 \times 75}{2.27} = 33 \leq 4.71 \times \sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000}{60}} = 103.5 \rightarrow F_{cr} = \left[0.658^{(F_y/Fe)}\right]F_y$

$Fe = \frac{\pi^2 29000}{\left(\frac{KL}{r}\right)^2} = 262$

$F_{cr} = 54.519ksi$

$P_{Allow} = \frac{F_{cr} \times A_g}{\Omega = 1.67} = \frac{54.52 \times 9.36}{1.67} = \underline{305,572\,lbs} = \underline{305.6\,kip}$

$r_{reinforced} = 2.3377in\ (r_y)$

$A_{reinforced} = 13.5420in^2$

- Due to reinforcing being 50ksi, reinforced section is assumed to behave as 50ksi.

$\frac{KL}{r} = \frac{(1)(75)}{2.3377} = 32 \xrightarrow{} 27.8ksi \times 13.5420 = \underline{376,467\,lbs} = \underline{376.5\,kip}$

table 4-22 (ASD)

$\Delta(P_{reinf} - P_{exist}) = 376\,467 - 305\,572 = \frac{70895}{lbs} = \underline{70,895\,kip}$

• Consider use of U-Bolt of 5/8" diameter – (Ref. Supplied by Portland Bolt)

AISC [J3-1]

$\frac{F_n \cdot A_b}{\Omega = 2} = \frac{\overset{(T)}{90ksi}\left(\frac{\pi}{4} \times \frac{5}{8}\right)^2}{2} = 13.8\ kip/Bolt$

Reference

AISC [J3-4] $R_A = \frac{\mu D_u h_f T_b n_s}{\Omega} = \frac{(0.3)(1.13)(1.0)(19)(1)}{1.50} = 4.294$ kip/Bolt.
$= \underline{4294 \text{ lbs/Bolt.}}$

$\frac{70895}{4294} = 16.5 \rightarrow$ Say 17 Bolts @ ends to develop connection against slip failure.

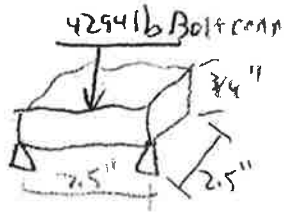
- Check existing Leg capacity for Pipe crush capacity

[AISC K1-2] $R_A = \frac{5.5 \times F_y \times t^2 \times \left(1 + 0.25 \frac{l_b}{D}\right) Q_f}{\Omega = 1.67}$, where F_y = Leg Steel = 60 ksi
t = Leg thickness
$l_b = 0$ (conservative approach)
D = O.D. Leg - existing
$Q_f = 1 - 0.3(U)(1+U)$ - Assume $U=1$
Leg @ full cap.
$Q_f = 0.4$

$R_A = \frac{5.5 \times 60 \times 0.5^2 \times 1 \times 0.4}{1.67} = \underline{19.76 \text{ kip}}$

- The value above is indicating the maximum point load allowable that can be applied to leg.

- Check U-Bolt connection plate



- Assume plate to go "Plastic" $Z = \frac{bd^2}{4}$
- Plate material to be 50 ksi

$M_{applied} = \frac{PL}{4} = \frac{4294^{\#} \times 7.5}{4} = 8051.25$ lbs·in

$\frac{8051.25 \text{ lb·in}}{0.28125 \text{ in}^3} = 28,626$ psi

$Z = \frac{bd^2}{4} = \frac{2'' \times 3/4''^2}{4} = 0.28125$ in.³

$\frac{50,000 \text{ psi}}{\Omega = 1.67} = 30,000$ psi $> 28,626$ psi

∴ $\boxed{OK}$

Clamp Spacing (per 25' Section)

Calculate effective distance of clamps for Reinforced Leg after developed Section.

- for the region 0'-75'

  - Use 1/2 HSS 7.5 x 0.3125"

    Material 50ksi (min)

    Area = 3.5282 in^2

    I_x = 4.3356 → $r_x = \sqrt{I_x/A}$ = 1.1085 in ← (Governs)

    I_y = 22.8262 → $r_y = \sqrt{I_y/A}$ = 2.5435 in

Consider Leg effective Length → 25 Ft / 4 ft bay = 6.25 Ft = 75 in

- Compare Property of existing Leg against reinforcing material

K = 1.0

L = 75 in

r = 2.26 in

$\frac{KL}{r} = \frac{1 \times 75}{2.26} = 33.2$

65.37

Consider weaker radius of gyration for Analysis

#clamps : $\frac{KL/(\#clamp-1)}{r_{weak}} < \frac{KL}{r_{exist}}$

33.2

try 4 clamps → $\frac{1 \times 75 in (4-1)}{1.1085}$ = 22.553 < 33.2 → OK, determine max spacing Allowed.

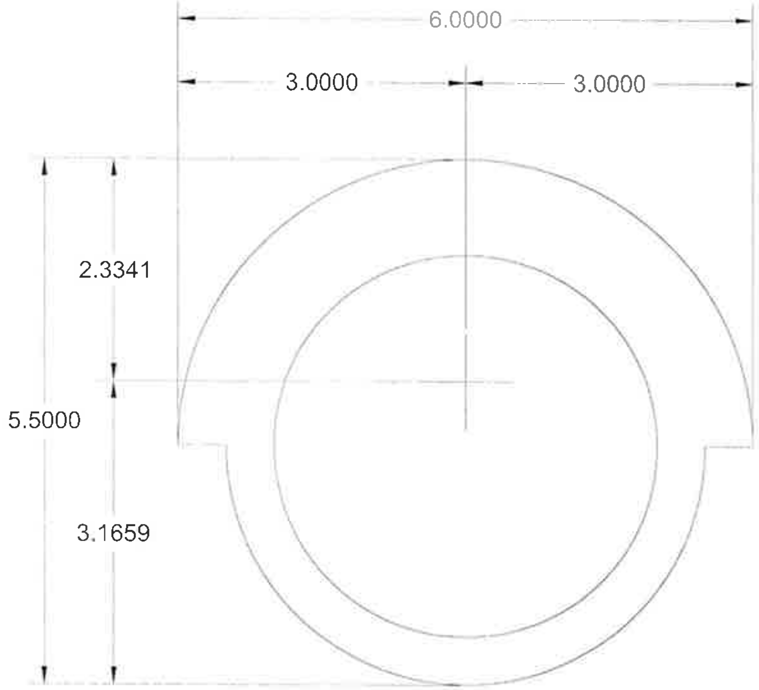
4 clamps per 6.25 Ft bay = $\frac{6.25 \times 12}{4}$ ÷ 1.67=2 → ≅11.2

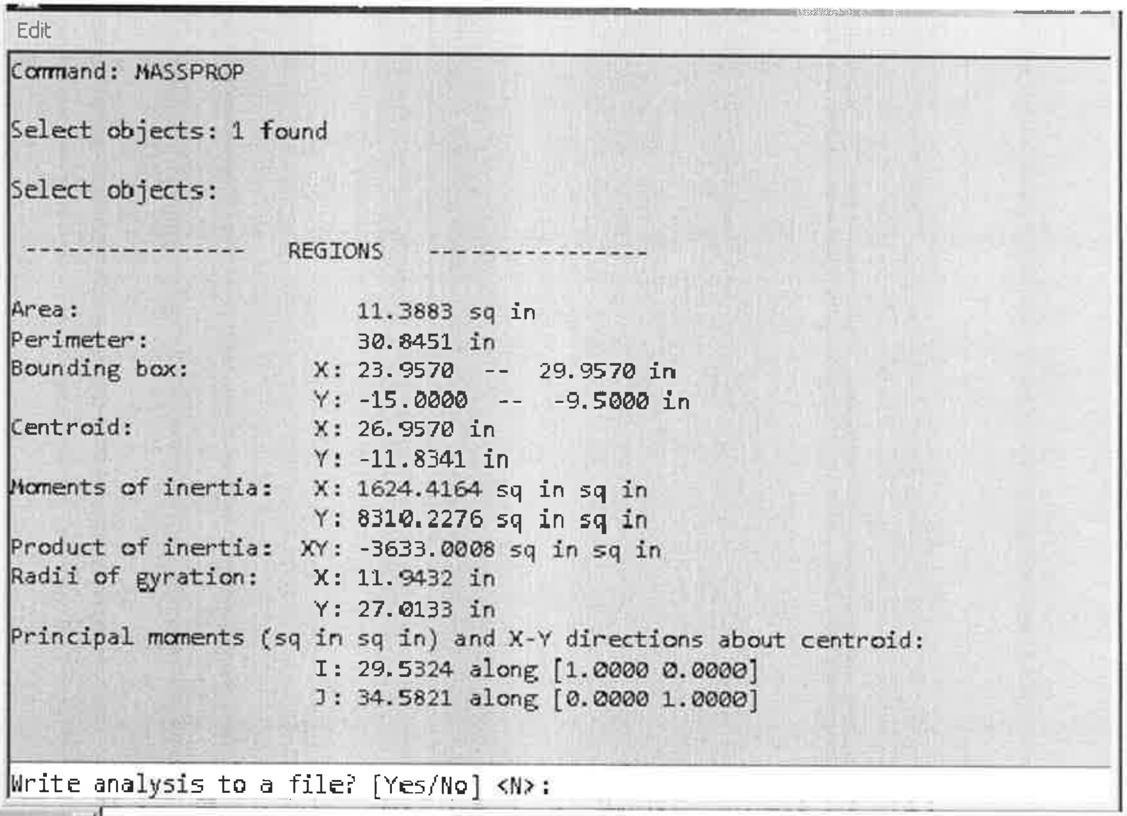
Say max spacing 11 in Between Bays

Qty per Leg = 25' x 12 = 300" − 2" end − 2" end − 16 x 3" x 2 = 200"

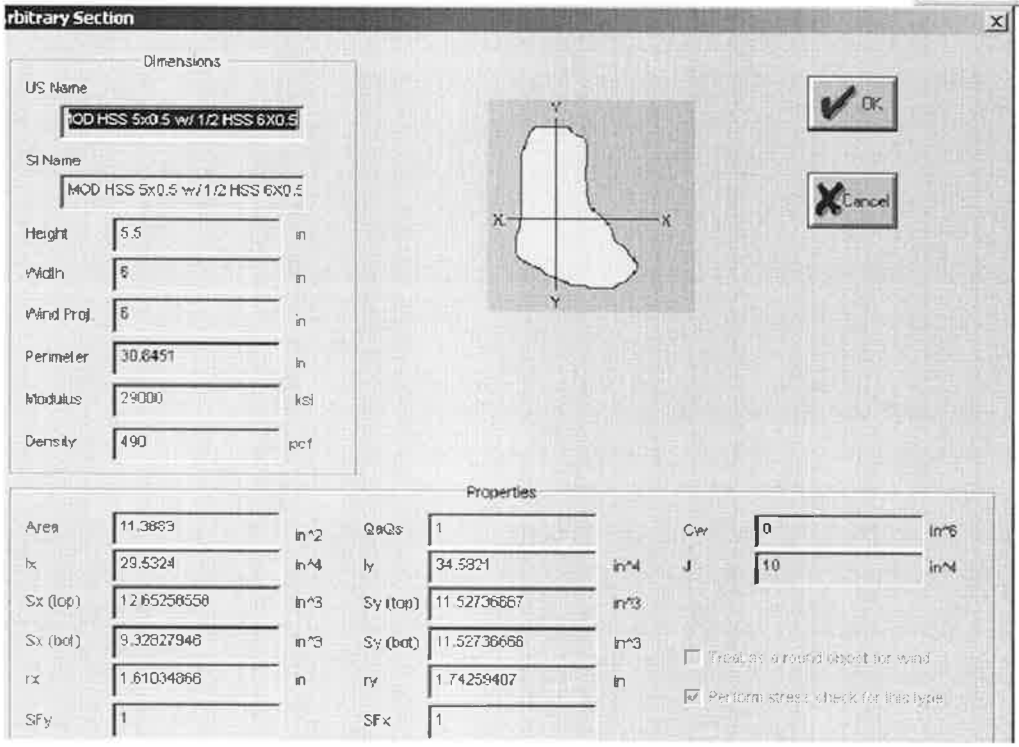
$\frac{200''}{11''/Blt}$ = 18 Bays → 17 Bolts Additional per Leg

EINFORCED WITH 1/2 HSS 6x0.5 ASTM A572-50
0 KSI)





```
Command: MASSPROP

Select objects: 1 found

Select objects:

 ----------------   REGIONS   ----------------

Area:                         11.3883 sq in
Perimeter:                    30.8451 in
Bounding box:              X: 23.9570  --   29.9570 in
                           Y: -15.0000  --   -9.5000 in
Centroid:                  X: 26.9570 in
                           Y: -11.8341 in
Moments of inertia:        X: 1624.4164 sq in sq in
                           Y: 8310.2276 sq in sq in
Product of inertia:       XY: -3633.0008 sq in sq in
Radii of gyration:         X: 11.9432 in
                           Y: 27.0133 in
Principal moments (sq in sq in) and X-Y directions about centroid:
                           I: 29.5324 along [1.0000 0.0000]
                           J: 34.5821 along [0.0000 1.0000]

Write analysis to a file? [Yes/No] <N>:
```



US Name: OD HSS 5x0.5 w/ 1/2 HSS 6X0.5

SI Name: MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5

Height: 5.5 in

Width: 6 in

Wind Proj: 6 in

Perimeter: 30.8451 in

Modulus: 29000 ksi

Density: 490 pcf

Area: 11.3883 in^2

QaQs: 1

Cw: 0 in^6

Ix: 29.5324 in^4

Iy: 34.5821 in^4

J: 10 in^4

Sx (top): 12.65258558 in^3

Sy (top): 11.52736667 in^3

Sx (bot): 9.32827948 in^3

Sy (bot): 11.52736666 in^3

rx: 1.61034866 in

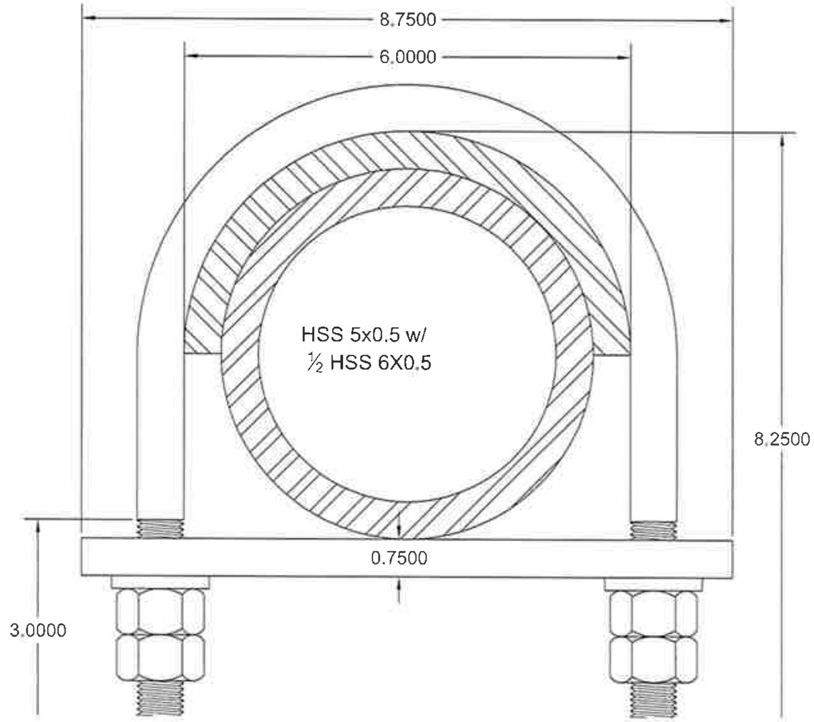
ry: 1.74259407 in

SFy: 1

SFx: 1

☐ Treat as a round object for wind

☑ Perform stress check for this type



Job Ledyard, Ct 150 Tower

Description Elevation 75'-100'

HSS 5x0.5 w/ 1/2 HSS 6x0.5

Project No.

Computed by MCD

Checked by

Page of

Sheet of

Date

Date

Reference

Calculations to determine maximum # clamps required for development of reinforcing pipe (using bolts of type ASTM A449) → AISC "Group A Bolt"

L_b maximum = 25 ft / 3 bays

= 8.33 ft = 100 in

$K = 1$

$r_{exist} = 1.61$ in

$A_{exist} = 6.62$ in^2

- Because existing leg is 60 ksi, use AISC CHAPTER-E (14th-Ed.)

- Check if member is slender - Table 4.1.a

$0.11 \frac{E}{F_y} = 0.11 \left(\frac{29000}{60}\right) = 53.16 \quad \frac{D}{t} = \frac{5}{.5} = 10$

Non-Slender ∴ Apply Section [E-3]

AISC
[Eq 3-2]

$$\frac{KL}{r} = \frac{1 \times 100}{1.61} = 62.1 \leq 4.71 \times \sqrt{\frac{E}{F_y}} = 4.71 \sqrt{\frac{29000}{60}} = 103.5 \rightarrow F_{cr} = \left[0.658^{F_y/F_e}\right] F_y$$

$$F_e = \frac{\pi^2 29000}{\left(\frac{KL}{r}\right)^2} = 74.19$$

$F_{cr} = 42.77$ ksi

$$P_{Allow} = \frac{F_{cr} A_g}{\Omega = 1.67} = \frac{42.77 \times 6.62}{1.67} = 169{,}546 \text{ lbf} = \underline{169.5 \text{ kip}}$$

$r_{reinforced} = 1.7426$ in

$A_{reinforced} = 11.3883$ in^2

Due to reinforcing being 50 ksi, reinforced section is assumed to behave as 50 ksi.

$$\frac{KL}{r} = \frac{(1)(100)}{1.7426} = 57.4 \rightarrow \overset{\text{table 4-22 (ASD)}}{23.5} \text{ ksi (ASD)} \times 11.3883 \text{ in} = 267{,}625 \text{ lbf} = 267.625 \text{ kip}$$

$$\Delta(P_{reinf} - P_{exist}) = 267{,}625 - 169{,}546 = 98{,}079 \text{ lbf} = 98 \text{ kip}$$

- Consider use of U-Bolt of 5/8" diameter - (Ref. supplied by Portland Bolt)

AISC
[J3-1]

$$\frac{F_n \cdot A_b}{\Omega = 2} = \frac{90 \text{ ksi} \left(\frac{\pi}{4} \times \frac{5}{8}\right)^2}{2} = 13.8 \text{ kip/Bolt}$$

AECOM

Job ______ Project No. ______ Page ______ of ______

Description ______ Sheet ______ of ______

Computed by MCD Date ______

Checked by ______ Date ______

Reference

AFSC [J3-4] $R_A = \frac{\mu D_u h_f T_b n_s}{\Omega} = \frac{(0.3)(1.13)(1.0)(19)(1)}{1.50} = 4.294$ kip/Bolt $= \underline{4294\text{ lbf/Bolt}}$

$\frac{98,079}{4294} = 22.8 \rightarrow$ Say 23 Bolt @ ends to Develop connection Against slip failure.

- Check existing Leg capacity for Pipe crush capacity

[AFSC K1-2] $R_A = \frac{5.5 \times F_y \times t^2 \times \left(1 + 0.25 \frac{l_b}{D}\right) Q_f}{\Omega = 1.67}$, where F_y = Leg Steel = 60 ksi

t = Leg thickness

$l_b = 0$ (conservative Approach)

D = O.D. Leg - existing

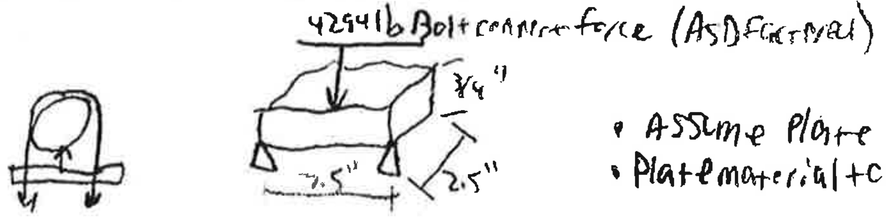
$Q_f = 1 - 0.3(U)(1+U)$ – Assume $U=1$ Leg @ full cap.

$Q_f = 0.4$

$RA = \frac{5.5 \times 60 \times 0.5^2 \times 1 \times 0.4}{1.67} = \underline{19.76\text{ kip}}$

- The value above is indicating the maximum point load allowable that can be applied to leg.

- Check U-Bolt connection plate



- Assume plate to be "Plastic" $Z = \frac{bd^2}{4}$
- Plate material to be 50 ksi

$M_{applied} = \frac{PL}{4} = \frac{4294^{\#} \times 7.5}{4} = 8051.25$ lbf·in

$Z = \frac{bd^2}{4} = \frac{2" \times 3/4"^2}{4} = 0.28125\text{ in}^3$

$\frac{8051.25\text{ lb·in}}{0.28125\text{ in}^3} = 28,626$ psi

$\frac{50,000\text{ psi}}{\Omega = 1.67} = 30,000$ psi $> 28,626$ psi

$\therefore \boxed{O.K}$

Clamp Per 25' Section

Calculate effective distance of Clamps for reinforced Leg After developed Section

- for the region 75'-100'

  - use ½ HSS 6 x 0.5"
    material props. (min)
    Area = 4.5197
    $I_x = 3.1561 \rightarrow r_x = \sqrt{I_x/A} = 0.8547 \text{ in}$ ← (governs)
    $I_y = 16.4688 \rightarrow r_y = \sqrt{I_y/A} = 1.9528 \text{ in}$

Consider Leg effective Length → 25 ft / 3 bay = 8.33 ft = 100 in
- compare property of existing Leg against reinf. material
  K = 1
  L = 100 in
  r = 1.61 in

$$\frac{KL}{r} = \frac{100}{1.61} = 62.1$$

Consider weaker radius of gyration for Analysis

$$\#\text{clamps} : \frac{KL/(\#\text{clamp}-1)}{r_{weak}} \leq \frac{KL}{r_{exist}} \quad (62.1)$$

$$\text{try } \underline{3} \text{ Clamps} \rightarrow \frac{1 \times 100/(3-1)}{0.8547} \; 58.5 < 62.1 \rightarrow \text{Ok}$$

, determine max spacing Allowed.

$$3 \text{ clamps per } 8.33 \text{ ft bay} = \frac{8.33 \times 12}{3} \div 1.67 \Rightarrow 2 \approx 19.94 \text{ in}$$

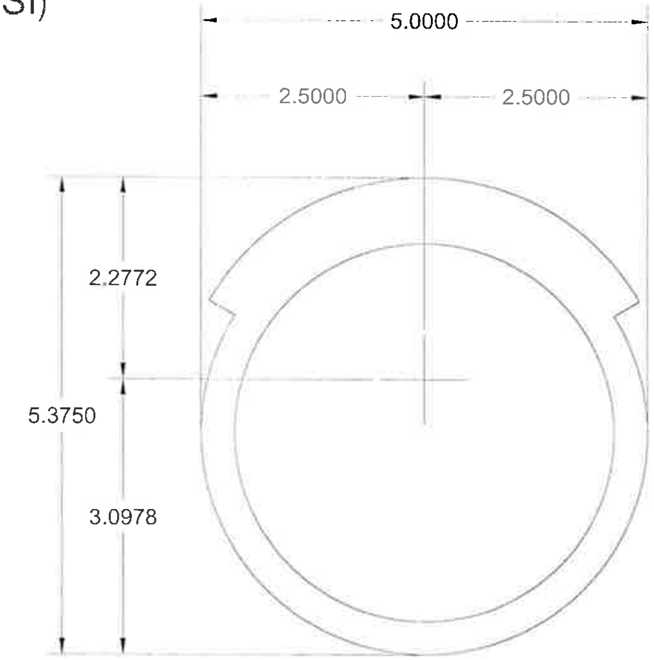
(Not Reasonable distance

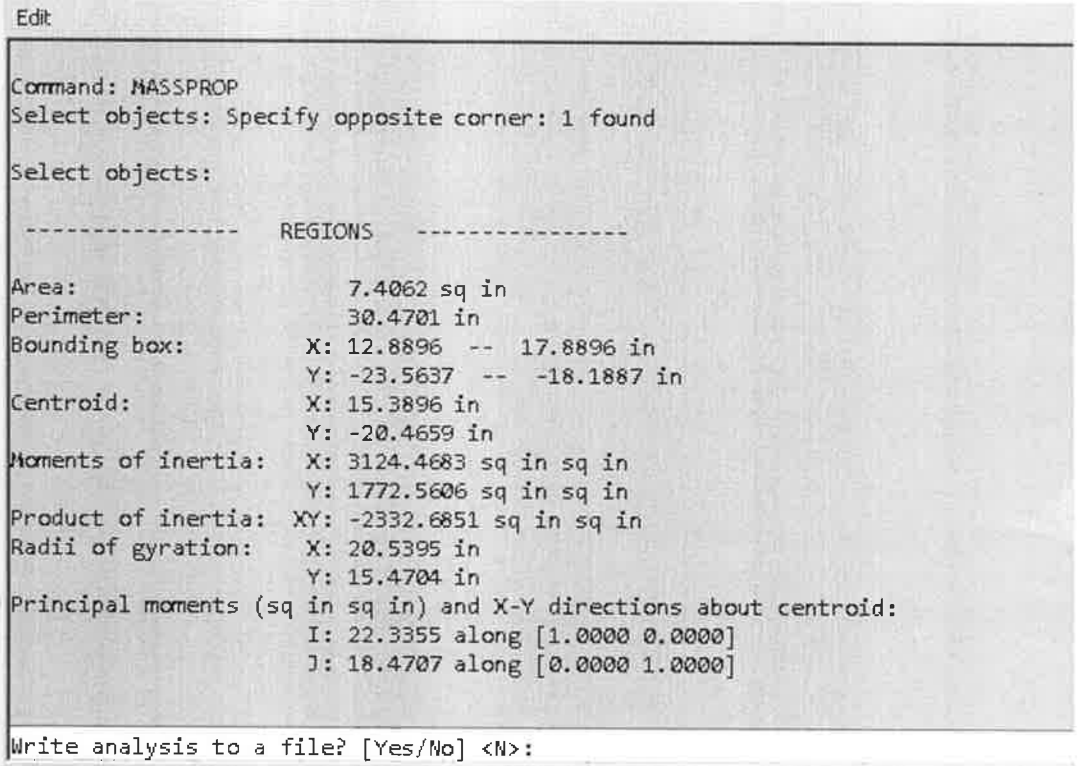
Say $\underline{12\text{" max Spacing}}$

Qty per Leg = 25 X 12 = 300" - 2" end - 2" end - 22 x 3" x 2
= 164 in

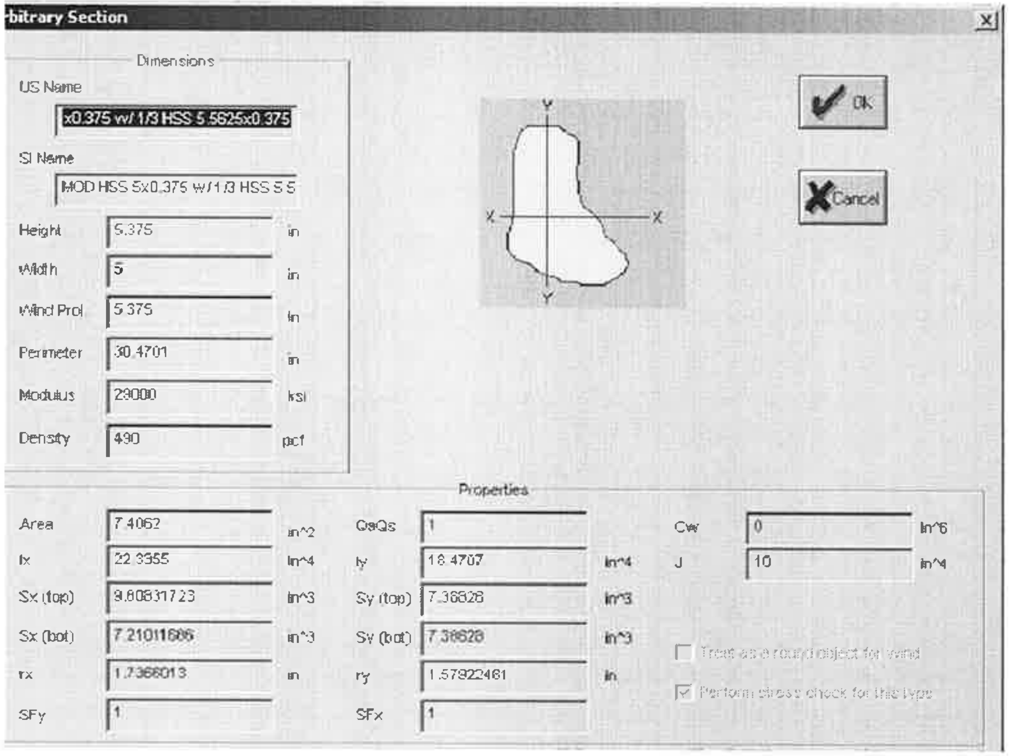
$$\frac{164 \text{ in}}{12 \text{ in/Bolt}} = 14 \text{ bays} \rightarrow \underline{13} \text{ Additional Bolts per Leg}$$

REINFORCED WITH 1/3 HSS 5.5625x0.375 ASTM
572-50 (50 KSI)





```
Command: MASSPROP
Select objects: Specify opposite corner: 1 found

Select objects:

 ----------------   REGIONS   ----------------

Area:                    7.4062 sq in
Perimeter:               30.4701 in
Bounding box:         X: 12.8896  --  17.8896 in
                      Y: -23.5637  --  -18.1887 in
Centroid:             X: 15.3896 in
                      Y: -20.4659 in
Moments of inertia:   X: 3124.4683 sq in sq in
                      Y: 1772.5606 sq in sq in
Product of inertia:  XY: -2332.6851 sq in sq in
Radii of gyration:    X: 20.5395 in
                      Y: 15.4704 in
Principal moments (sq in sq in) and X-Y directions about centroid:
                      I: 22.3355 along [1.0000 0.0000]
                      J: 18.4707 along [0.0000 1.0000]

Write analysis to a file? [Yes/No] <N>:
```



Dimensions

US Name: x0.375 w/ 1/3 HSS 5.5625x0.375

SI Name: MOD HSS 5x0.375 w/ 1/3 HSS 5.5

Height 5.375 in

Width 5 in

Wind Proj 5.375 in

Perimeter 30.4701 in

Modulus 29000 ksi

Density 490 pcf

Properties

Area 7.4062 in^2

Ix 22.3355 in^4

Sx (top) 9.80831723 in^3

Sx (bot) 7.21011686 in^3

rx 1.7366013 in

SFy 1

QsQs 1

Iy 18.4707 in^4

Sy (top) 7.38828 in^3

Sy (bot) 7.38828 in^3

ry 1.57922461 in

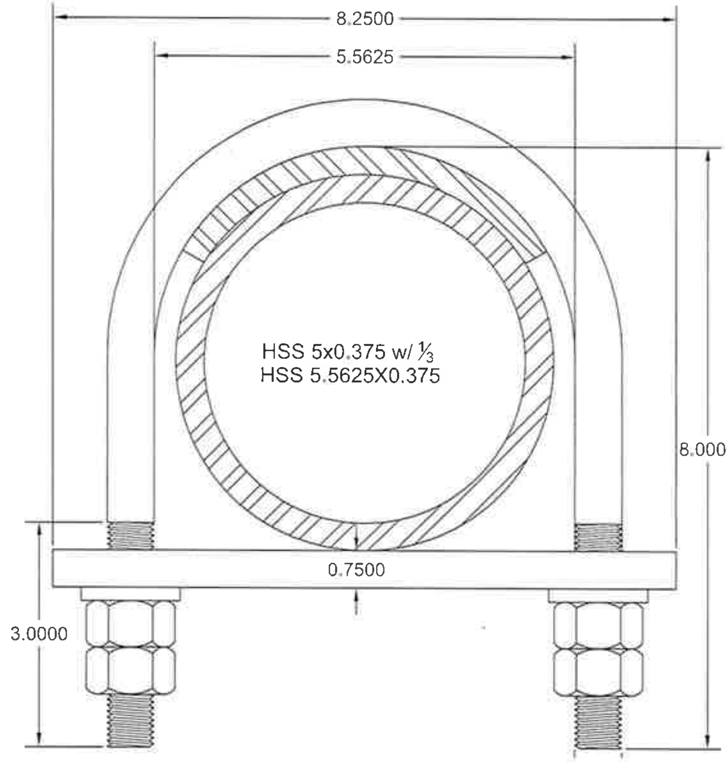
SFx 1

Cw 0 in^6

J 10 in^4

☐ Treat as a round object for wind

☑ Perform stress check for this type



Job Ledyard CT CSP Tower
Description Elevation 100'-125'
HSS 5x0.375 w/ 1/3 5.5625x0.375
Project No. ______
Computed by McD
Checked by ______
Page ____ of ____
Sheet ____ of ____
Date ______
Date ______

Reference

Calculations to determinal maximum # clamps reQuired for development of Reinforcing Pipe (using bolts of type ASTM A449) ≥ AISC "Group A Bolt"

$L_{b\,maximum} = 25\,ft / 3\,bays$
$= 8.33\,ft = 100\,in$
$K = 1$
$r_{exist} = 1.65\,in$
$A_{exist} = 5.10\,in^2$

- Because existing leg is 60 ksi, use AISC CHAPTER-E (14th ED.)

• Check if member is slender

$$0.11\frac{E}{F_y} = 0.11\left(\frac{29{,}000}{60}\right) = 53.16 \qquad \frac{D}{t} = \frac{5}{0.375} = 13.3$$

non-slender ∴ Apply section [E-3]

AISC [EQ 3-2]

$$\frac{KL}{r} = \frac{1\times100}{1.65} = 60.60 \le 4.71\sqrt{\frac{E}{F_y}},\ 4.71\sqrt{\frac{29{,}000}{60}} = 103.5 \rightarrow F_{cr} = \left[0.658^{F_y/F_e}\right]F_y$$

$$F_e = \frac{\pi^2\,29{,}000}{\left(\frac{KL}{r}\right)^2} = 77.922$$

$F_{cr} = 43.469\,ksi$

$$P_{allow} = \frac{F_{cr}A_g}{\Omega = 1.67} = \frac{43.469\times5.10}{1.67} = 132{,}751.8\,lbf = \underline{132.8}\,kip$$

$r_{reinforced} = 1.7366\ (r_x)$
$A_{reinforced} = 7.4062\,in^2$

- Due to reinforcing being 50 ksi, reinforced section is assumed to behave as 50 ksi.

$$\frac{KL}{r} = \frac{(1)(100)}{1.7366\,in} = 57.58 \rightarrow \overset{\text{Table 4-22(ASD)}}{23.5\,ksi} \times 7.4062\,in^2 = 174{,}045.7\,lbf = 174\,kip.$$

$$\Delta(P_{reinf} - P_{exist}) = 174{,}045.7 - 132{,}751.8 = \underline{41{,}293.9\,lbf} = \underline{41.3\,kip}$$

• Consider use of U-Bolt of 5/8" diameter (Ref. Supplied by Portland Bolt)

AISC [J3-1]

$$\frac{F_n A_b}{\Omega = 2} = \frac{90\,ksi\left(\frac{\pi}{4}\times\frac{5}{8}^2\right)}{2} = 13.8\,kip/Bolt.$$

AECOM

Page ______ of ______

Job ______ Project No. ______ Sheet ______ of ______

Description ______ Computed by MCD Date ______

Checked by ______ Date ______

Reference

AFSC [J3-4] $R_A = \frac{\mu D_u h_f T_b n_s}{\Omega} = \frac{(0.3)(1.13)(1.0)(19)(1)}{1.50} = 4.294$ kip/Bolt

$= \underline{4294 \text{ lbf/Bolt}}$

$\frac{41293.9}{4294} = 9.6$ → Say 10 Bolt @ ends to Develop connection Against slip failure,

- Check existing Leg capacity for Pipe crush capacity

[AISC K1-2] $RA = 5.5 \times F_y \times t^2 \times (1 + 0.25 \frac{l_b}{D}) Q_f$, where F_y = Leg steel = 60ksi

t = Leg thickness

$l_b = 0$ (conservative)

D = O.D. Leg existing

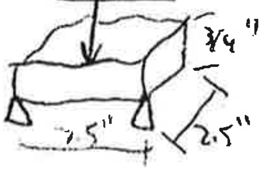
$Q_f = 1 - 0.3(U)(1+U)$ - Assume $U = 1$

$RA = \frac{5.5 \times 60 \times (0.375)^2 \times 1 \times 0.4}{1.67} = \underline{11.11 \text{ kip}}$

$Q_f = 0.4$

- The value above is indicating the maximum point load allowable that can be aplied to leg.

- Check U-Bolt connection plate



- Assume Plate to go "Plastic" $Z = \frac{bd^2}{4}$
- Plate material to be 50ksi

$M_{applied} = \frac{PL}{4} = \frac{4294^{\#} \times 7.5}{4} = 8051.25 \text{ lbf} \times \text{in}$

$\frac{8051.25 \text{ lb.in}}{0.28125 \text{ in}^3} = 28,626 \text{ psi}$

$Z = \frac{bd^2}{4} = \frac{2" \times 3/4"^2}{4} = 0.28125 \text{ in}^3$

$\frac{50,000 \text{ psi}}{\Omega 1.67} = 30,000 \text{ psi} > 28,626 \text{ psi}$

∴ $\boxed{O.K}$

Clamp Per 25' Section

Calculate effective distance of clamps for Reinforced Leg After developed Section

- for the region 100'-125'

  - Use 1/3 HSS 5.5625x0.375"
    Material: 50ksi (min)
    Area = 2.0371 in^2
    $Ix = 0.3308 in^4 \rightarrow r_x = \sqrt{Ix/A} = 0.40297$ in ← governs
    $Iy = 4.0400 in^4 \rightarrow r_y = \sqrt{Iy/A} = 1.40826$ in

Consider Leg effective Length → 25 ft / 3 bay = 8.33 ft = 100 in
- Compare property of existing Leg against reinf. Material

K = 1
L = 100 in
r = 1.65 in

$$\frac{KL}{r} = \frac{100}{1.65} = 60.6$$

Consider weaker radius of gyration for Analysis

$$\#clamps = \frac{KL/(\#clamp-1)}{r_{weak}} < \frac{KL}{r_{exist}} \quad (60.6)$$

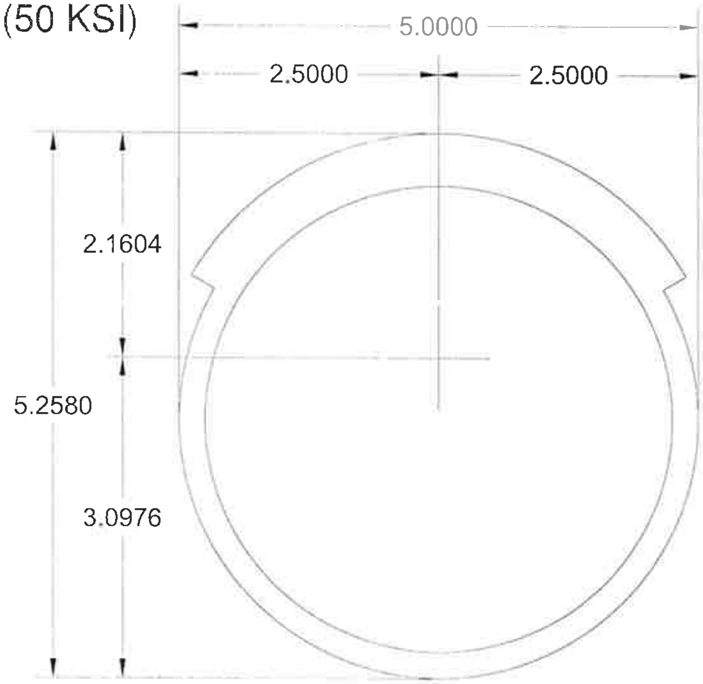
try $\underline{6}$ clamps → $\frac{1 \times 100/(6-1)}{0.40297} = 49.6 < 60.6 \rightarrow$ OK, determine Max Spacing Allowed

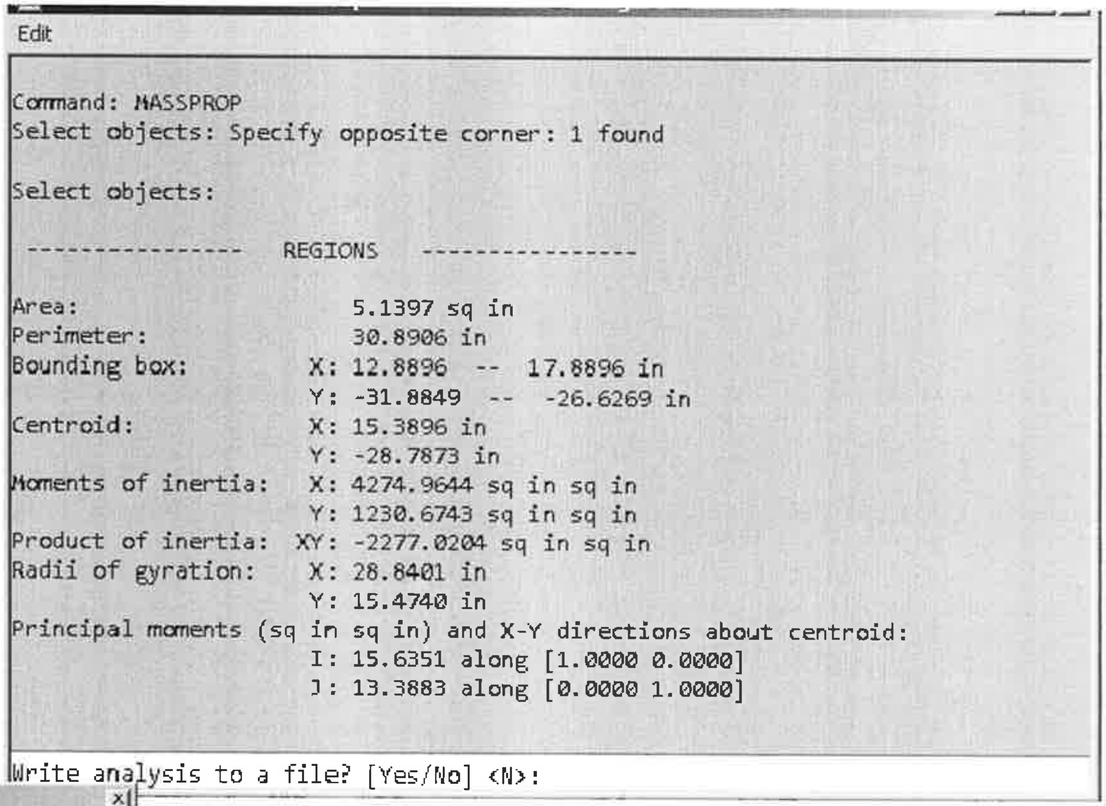
6 clamps per 8.33 ft bay = $\frac{8.33 \times 12}{6}$ ÷ 1.6 > ≈ 10 in max spacing

Qty Per Leg = 25' x 12 = 300" - 2" end - 2" end - 9 x 3" x 2
= 242"

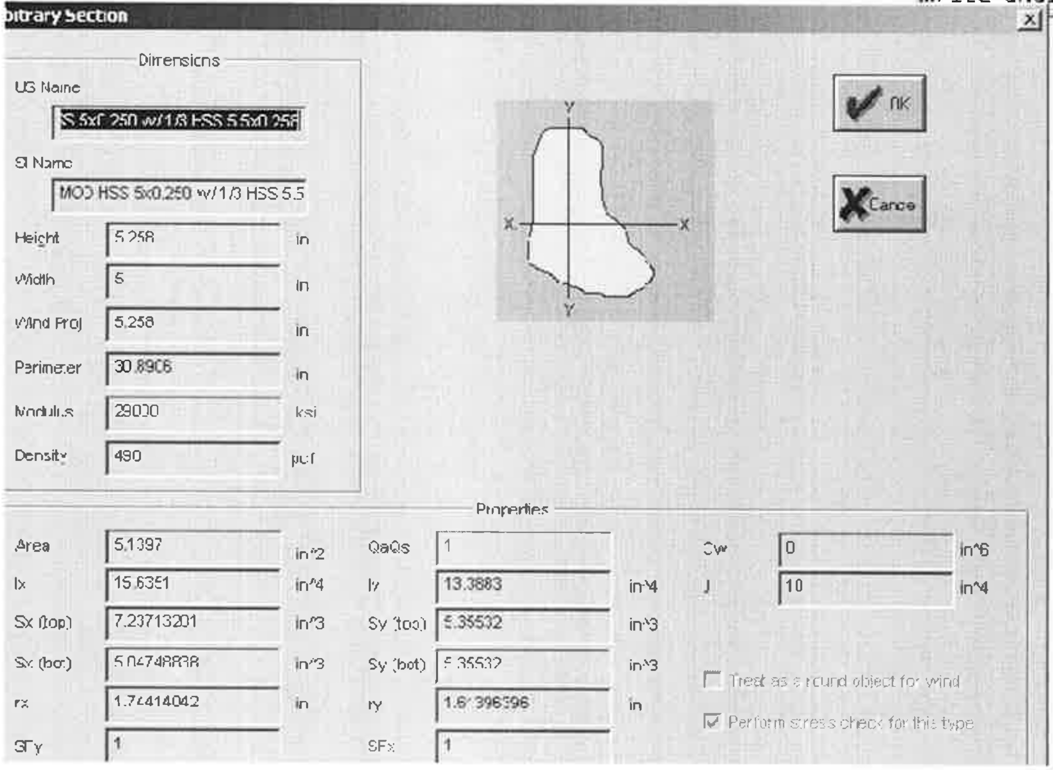
$\frac{242"}{10"/Bolt} \approx$ 24 bays → $\underline{23}$ Additional Bolts Per Leg.

EINFORCED WITH 1/3 HSS 5.5x0.258 ASTM
572-50 (50 KSI)





```
Command: MASSPROP
Select objects: Specify opposite corner: 1 found

Select objects:

 ----------------   REGIONS   ----------------

Area:                    5.1397 sq in
Perimeter:               30.8906 in
Bounding box:         X: 12.8896  --  17.8896 in
                      Y: -31.8849  --  -26.6269 in
Centroid:             X: 15.3896 in
                      Y: -28.7873 in
Moments of inertia:   X: 4274.9644 sq in sq in
                      Y: 1230.6743 sq in sq in
Product of inertia:  XY: -2277.0204 sq in sq in
Radii of gyration:    X: 28.8401 in
                      Y: 15.4740 in
Principal moments (sq in sq in) and X-Y directions about centroid:
                      I: 15.6351 along [1.0000 0.0000]
                      J: 13.3883 along [0.0000 1.0000]

Write analysis to a file? [Yes/No] <N>:
```



bitrary Section

Dimensions

US Name
S 5x0.250 w/1/3 HSS 5.5x0.258

SI Name
MOD HSS 5x0.250 w/1/3 HSS 5.5

Height 5.258 in
Width 5 in
Wind Proj 5.258 in
Perimeter 30.8906 in
Modulus 29000 ksi
Density 490 pcf

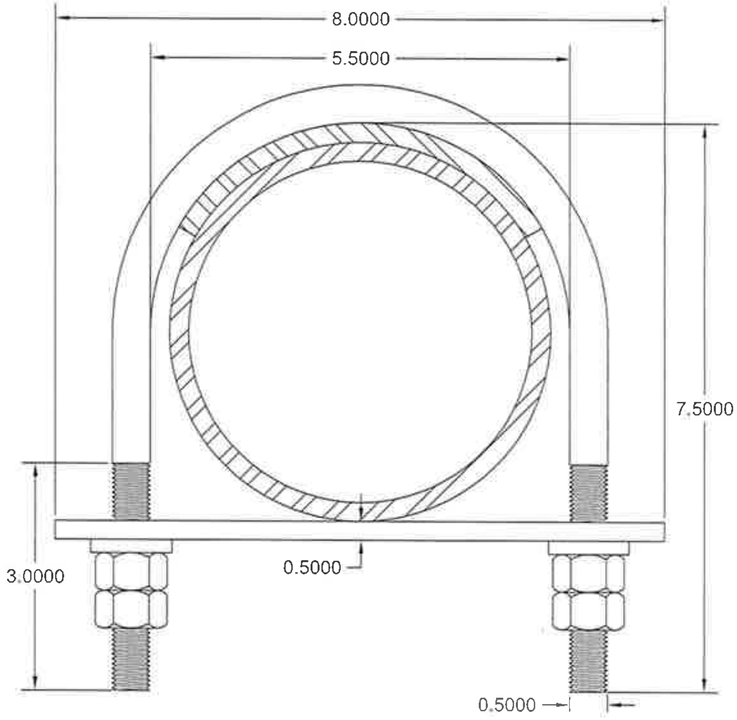
Properties

Area 5.1397 in^2
Ix 15.6351 in^4
Sx (top) 7.23713201 in^3
Sx (bot) 5.04748838 in^3
rx 1.74414042 in
SFy 1

QaQs 1
Iy 13.3883 in^4
Sy (top) 5.35532 in^3
Sy (bot) 5.35532 in^3
ry 1.61396396 in
SFx 1

Cw 0 in^6
J 10 in^4

☐ Treat as a round object for wind
☑ Perform stress check for this type



Job Ledyard, CT CSP tower
Description Elevation 125'-150'
HSS 5x0.250 w/ HSS 5.5x0.258

Page ____ of ____
Project No. ____
Sheet ____ of ____
Computed by ____
Date ____
Checked by ____
Date ____

Reference

Calculations to determine maximum # clamps required for development of reinforcing Pipe (using bolts of type ASTM A449) → AISC "Group A Bolt"

Lb maximum = 25 ft / 3 bays
= 8.33 ft = 100 in
k = 1
r exist = 1.69 in
A exist = 3.59 in²

$\frac{KL}{r} = \frac{100 \text{ in}}{1.69 \text{ in}} = 59.2 \rightarrow 23.2 \text{ ksi} \times 3.59 \text{ in}^2$ (ASD)
= 83.288 kip
= 83,288 lbf

r reinforced = 1.614 in
A reinforced = 5.1397 in²

$\frac{KL}{r} = \frac{100}{1.614} = 62 \rightarrow 22.6 \text{ ksi} \times 5.1397$ (ASD)
= 116.157 kip
= 116157 lbf

$\Delta(P_{reinf} - P_{exist}) = 116157 \text{ lbs} - 83{,}288 \text{ lbs} = \underline{32{,}869 \text{ lbs}} = \underline{32.869 \text{ kip}}$

- consider use of ½" dia. U-Bolt (Ref. supplied by Portland Bolt)

AISC [J3-1] $\frac{F_n A_b}{\Omega = 2} = \frac{90 \text{ ksi} (\frac{\pi}{4} \times \frac{1}{2}^2)}{2} = 8.835$ kip/Bolt.

AISC [J3-4] $R_A = \frac{\mu D_u h_f T_b n_s}{\Omega = 1.50} = \frac{(0.3)(1.13)(1.0)(12)(1)}{1.5} = 2.712$ kip/Bolt
$= \underline{2712 \text{ lbs/Bolt}}$

$\frac{32869}{2712} = 12.11 \rightarrow$ Say 13 Bolt @ ends to develop connection against slip failure

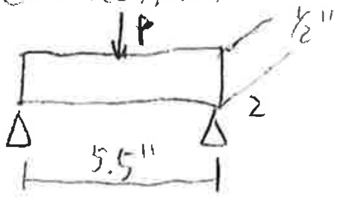
- Check existing Leg capacity for Pipe crush capacity

[AISC K1-2] $R_A = \frac{5.5 F_y t^2 (1 + 0.25 B/D) \times Q_f}{\Omega = 1.67}$, where F_y = Leg Steel = 50 ksi
t = Leg thickness
lb = 0 (cons.)
D = O.D. leg
$Q_f = 1 - 0.3(U)(1+U)$ — Assume U = 1, ∴ Q_f = 0.4

$R_A = \frac{5.5 \times 50 \times 0.25^2 \times 1 \times .4}{1.67} = \underline{4.116 \text{ kip}}$

- The calculated value is indicating the maximum point load allowable that can be applied to the leg.

- Check U-Bolt connection plate



P = 2712 lbs/Bolt

Applied.

$\frac{PL}{4} = \frac{2712 \times 5.5}{4} = 3729\text{ lb}\cdot\text{in}$

$Z = \frac{bd^2}{4} = \frac{2 \times \frac{1}{2}''^{2}}{4} = 0.125\text{ in}^3$

$\frac{3729\text{ lb}\cdot\text{in}}{0.125\text{ in}^3} = 29{,}832\text{ Psi}$

$\frac{50{,}000\text{psi}}{1.67} = 30{,}000\text{Psi} > 29{,}832 \therefore \boxed{OK}$

Determine Clamp distance on Leg After developed section

- For the region 125'-150'

Use ⅓ HSS 5.5×0.258
Material 50ksi min
Area = 1.4163 in²
$I_y = 0.2280\text{ in}^4 \rightarrow r_y = 0.40122$ ← governs
$I_y = 2.8800\text{ in}^4 \rightarrow r_y = 1.4263$

Consider Leg effective Length → 25ft / 3bay = 8.33 = 100 in
- compare property of existing Legs against reinf. Material

k = 1
L = 100 in
r : 1.69 in

$\frac{kL}{r} = \frac{100}{1.69} = 59.2$

Page ______ of ______

Job ______ Project No. ______ Sheet ______ of ______

Description ______ Computed by ______ Date ______

Checked by ______ Date ______

Reference

Consider weaker radius of Gyration for Analysis

$$\# \text{Clamps} = \frac{KL/\# - 1}{r_{weak}} < \frac{KL}{r} \ (59.2)$$

try $\underline{6}$ Clamps $\rightarrow \frac{1\times100/(6-1)}{0.40122} = 49.8 < 59.2 \rightarrow \boxed{OK}$, determine max spacing Allowed.

6 clamps per 8.33 ft bay $= \frac{8.33\times12}{6} \doteq 16.67 = 10$ in max spacing

Qty per Leg $= 25'\times12 = 300$ in $- 2''$ end $- 2''$ end $- 12\times3''\times2$
$= 224$ in

$\frac{224''}{10''/\text{Bolt}} \approx 22$ bays $\rightarrow \underline{21}$ Additional Bolts per Leg.

POWERMOUNT LOADING CALCULATIONS

AECOM

Antenna and Appurtenances

Computed by MCD Date 6/25/2016

Checked by ______ Date ______

AT&T - Per Antenna

Description	Manufacturer	Model	Appurtenance			Area	Area w/ Ice	Weight	Weight w/ Ice	Quantity
			Height (in)	Width (in)	Depth (in)	(SF)	(SF)	(lb)	(lb)	
Antenna	Andrew	SNBH-1D6565C	96.4	11.9	7.1	11.445	12.064	60.8	126.67	1
RRU	Ericsson	RRUS-11	17.8	17	7.2	2.942	3.172	55.0	74.32	6
Antenna	KMW	P65-17-XLH-RR	96	12	6	11.311	11.927	62.0	124.00	2
Antenna	Powerwave	7770	55	11	5	5.882	6.314	35.0	67.63	3
RET	Powerwave	7070	1.732	19	8.15	0.320	0.459	5.0	12.51	3
TMA	Powerwave	LGP21401	6	8	2	0.467	0.562	5.5	8.51	6

AT&T Total

Description	Manufacturer	Model	Area	Area w/ Ice	Weight	Weight w/ Ice
			(SF)	(SF)	(lb)	(lb)
Antenna	Andrew	SNBH-1D6565C	11.445	12.064	60.800	126.668
RRU	Ericsson	RRUS-11	17.652	19.031	330.000	445.920
Antenna	KMW	P65-17-XLH-RR	22.622	23.853	124.000	248.000
Antenna	Powerwave	7770	17.646	18.942	105.000	202.903
RET	Powerwave	7070	0.960	1.376	15.000	37.532
TMA	Powerwave	LGP21401	2.800	3.370	33.000	51.083
		TOTAL	73.125	78.636	667.800	1112.106

T-Mobile - Per Antenna

Description	Manufacturer	Model	Area	Area w/ Ice	Weight	Weight w/ Ice	Quantity
			(SF)	(SF)	(lb)	(lb)	
Antenna	RFS	APX16PV-16PVL-E	6.65	7.08	40	71	3
TMA	Unknown	Unknown	0.77	0.9	15	21	3

T-Mobile Total

Description	Manufacturer	Model	Area	Area w/ Ice	Weight	Weight w/ Ice
			(SF)	(SF)	(lb)	(lb)
Antenna	RFS	APX16PV-16PVL-E	19.95	21.24	120	213
TMA	Unknown	Unknown	2.31	2.7	45	63
		TOTAL	22.26	23.94	165	276

AECOM

				Page	of
Job	Ledyard CSP#54 - 136 Vinegar Hill Road	Project No.	SAI-088	Sheet 1	of 5
Description	TIA/EIA-222-F Loading for STAAD Analysis	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

AT&T PANEL ANTENNA & MOUNT LOADING

Antenna Information - AT&T @ 198' A.G.L.

Antenna RAD Centerline $Ant\_RAD\_CL\_ATT := 198ft$

Antenna CaAa $CaAa_{antenna.ATT} := 73.125ft^2$

Antenna Weight $Wt_{Ant.ATT} := 667.800lb$

Antenna CaAa & Ice $CaAa_{antenna.ice.ATT} := 78.636ft^2$

Antenna Weight & Ice $Wt_{Ant.Ice.ATT} := 1112.106lb$

Antenna Mount Information

Mount Area $Area_{Platform.ATT} := 8.8ft^2$

Mount Weight $Wt_{Platform.ATT} := 1613lb$

Mount Area w/ Ice $Area_{Platform.ice.ATT} := 11.3ft^2$

Mount Weight w/ Ice $Wt_{Platform.ice.ATT} := 2000lb$

Note: Antenna mount consists of Valmont (SitePro Part # RMV5-296) T-Arm assembly with Universal Ring, Valmont Part # LWRM

Wind Pressure

Wind Velocity $V_{full} := 95mph$

2005 Connecticut State Building Code converted to 3-Second Gust

Height Factor $kz_{ATT} := \left(\frac{Ant\_RAD\_CL\_ATT}{33}\right)^{\left(\frac{2}{7}\right)} = 1.67$ TIA/EIA-222 F Section 2.3.3

Gust Response Factor $G_H := 1.69$ TIA/EIA-222 F Section 2.3.4.2

Extreme Wind Pressure $q_{z.full.ATT} := 0.00256\frac{psf}{mph^2}\cdot V_{full}{}^2\cdot kz_{ATT}\,G_H = 65\cdot\frac{lb}{ft^2}$

Wind Pressure with Ice $q_{z.ice.ATT} := 0.75\cdot q_{z.full.ATT} = 49\cdot\frac{lb}{ft^2}$ TIA/EIA-222 F Section 2.3.3

Structural Loads - No Ice

Horizontal Load $P_{Ant\_Hor\_ATT} := q_{z.full.ATT}\cdot\left(CaAa_{antenna.ATT} + Area_{Platform.ATT}\right)\cdot 0.9 = 4804\cdot lb$

Use 90% to account for projection TIA/EIA-222 F Section 2.3.2

Vertical Load $P_{Ant\_Vert\_ATT} := Wt_{Ant.ATT} + Wt_{Platform.ATT} = 2281\cdot lb$

Structural Loads - With Ice

Horizontal Load $P_{Ant\_Hor\_ATT.ice} := q_{z.ice.ATT}\cdot\left(CaAa_{antenna.ice.ATT} + Area_{Platform.ice.ATT}\right)\cdot 0.9 = 3955\cdot lb$

Use 90% to account for projection TIA/EIA-222 F Section 2.3.2

Vertical Load $P_{Ant\_Vert\_ATT.ice} := Wt_{Ant.Ice.ATT} + Wt_{Platform.ice.ATT} = 3112\cdot lb$

COAXIAL CABLE STRUCTURAL LOADING

(6) 1-5/8" Coax, (2) DC Cables & (1) Fiber Line

Cable Weight (no ice) $Wt_{cable.ATT} := 6 \cdot 1.04 \frac{lb}{ft} + 2 \cdot 0.4 \frac{lb}{ft} + 0.4 \frac{lb}{ft}$

Number of Supports $N_{support} := 1$

Length of Cable $L_{cable.ATT} := Ant\_RAD\_CL\_ATT = 198 \cdot ft$

$$P_{cable.vert.ATT.pole} := \frac{L_{cable.ATT} \cdot Wt_{cable.ATT}}{N_{support}} = 1473 \cdot lb$$

Coaxial cable to be located within pole --> No horizontal loads from coax

T-MOBILE PANEL ANTENNA & MOUNT LOADING

Antenna Information - T-Mobile @ 187'-3" A.G.L.

Antenna RAD Centerline $Ant\_RAD\_CL\_TM := 187.25ft$

Antenna CaAa $CaAa_{antenna.TM} := 22.26ft^2$

Antenna Weight $Wt_{Ant.TM} := 165lb$

Antenna CaAa & Ice $CaAa_{antenna.ice.TM} := 23.94ft^2$

Antenna Weight & Ice $Wt_{Ant.Ice.TM} := 276lb$

Antenna Mount Information - Cluster Mount

Mount Area $Area_{Platform.TM} := 0.5ft^2$

Mount Weight $Wt_{Platform.TM} := 50lb$

Mount Area w/ Ice $Area_{Platform.ice.TM} := 1ft^2$

Mount Weight w/ Ice $Wt_{Platform.ice.TM} := 75lb$

AECOM

				Page	of
Job	Ledyard CSP#54 - 136 Vinegar Hill Road	Project No.	SAI-088	Sheet 3	of 5
Description	TIA/EIA-222-F Loading for STAAD Analysis	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

Wind Pressure

Height Factor $$kz_{TM} := \left(\frac{Ant\_RAD\_CL\_TM}{33}\right)^{\left(\frac{2}{7}\right)} = 1.64$$ TIA/EIA-222 F Section 2.3.3

Extreme Wind Pressure $$q_{z.full.TM} := 0.00256\frac{psf}{mph^2}\cdot V_{full}{}^{2}\cdot kz_{TM}\cdot G_H = 64\cdot\frac{lb}{ft^2}$$

Wind Pressure with Ice $$q_{z.ice.TM} := 0.75\cdot q_{z.full.TM} = 48\cdot\frac{lb}{ft^2}$$ TIA/EIA-222 F Section 2.3.3

Structural Loads - No Ice

Horizontal Load $$P_{Ant\_Hor\_TM} := q_{z.full.TM}\cdot\left(CaAa_{antenna.TM} + Area_{Platform.TM}\right)\cdot 0.9 = 1313\cdot lb$$

Use 90% to account for projection TIA/EIA-222 F Section 2.3.2

Vertical Load $$P_{Ant\_Vert\_TM} := Wt_{Ant.TM} + Wt_{Platform.TM} = 215\cdot lb$$

Structural Loads - With Ice

Horizontal Load $$P_{Ant\_Hor\_TM.ice} := q_{z.ice.TM}\cdot\left(CaAa_{antenna.ice.TM} + Area_{Platform.ice.TM}\right)\cdot 0.9 = 1079\cdot lb$$

Use 90% to account for projection TIA/EIA-222 F Section 2.3.2

Vertical Load $$P_{Ant\_Vert\_TM.ice} := Wt_{Ant.Ice.TM} + Wt_{Platform.ice.TM} = 351\cdot lb$$

COAXIAL CABLE STRUCTURAL LOADING

(6) 1-5/8" Coax

Cable Weight (no ice) $$Wt_{cable.TM} := 6\cdot 1.04\frac{lb}{ft}$$

Length of Cable $$L_{cable.TM} := Ant\_RAD\_CL\_TM = 187\cdot ft$$

$$P_{cable.vert.TM.pole} := \frac{L_{cable.TM}\cdot Wt_{cable.TM}}{N_{support}} = 1168\cdot lb$$

Coaxial cable to be located within pole --> No horizontal loads from coax

AECOM

					Page	of
Job	Ledyard CSP#54 - 136 Vinegar Hill Road	Project No.	SAI-088	Sheet	4	of 5
Description	TIA/EIA-222-F Loading for STAAD Analysis	Computed by	MCD	Date	06/29/16	
	Tower MODification - Analysis	Checked by		Date		

POWERMOUNT STRUCTURAL LOADING

Shape Factor $C_{d.Powermount} := 1.2$ TIA/EIA-222 F Section 2.3.7

Powermount Diameter $Dia_{Powermount} := 18in = 1.5 \cdot ft$

PCS Mast Area per Foot

$$Area_{Mast} := \frac{(Dia_{Powermount} \cdot 1ft \cdot C_{d.Powermount})}{1ft} = 1.8 \cdot \frac{ft^2}{ft}$$

TIA/EIA-222 F Section 2.3.8

$$Area_{Mast.ice} := \frac{[(Dia_{Powermount} + 1in) \cdot 1ft \cdot C_{d.Powermount}]}{1ft} = 1.9 \cdot \frac{ft^2}{ft}$$

Powermount Section Center Elevations

$$Elevation_{CL.Mast} := \begin{pmatrix} 187.5ft \\ 162.5ft \\ 137.5ft \\ 112.5ft \\ 87.5ft \\ 62.5ft \\ 37.5ft \\ 12.5ft \end{pmatrix}$$

Height Factor

$$kz_{Mast} := \left(\frac{Elevation_{CL.Mast}}{33}\right)^{\left(\frac{2}{7}\right)}$$

TIA/EIA-222 F Section 2.3.3

Extreme Wind Pressure

$$q_{z.full.PM} := 0.00256 \frac{psf}{mph^2} \cdot V_{full}^{\ 2} \cdot kz_{Mast} \cdot G_H$$

Wind Pressure with Ice $q_{z.ice} := 0.75 \cdot q_{z.full.PM}$

Powermount Wind Force per Foot

$$P_{horizontal.powermount.full} := Area_{Mast} \cdot q_{z.full.PM}$$

$$P_{horizontal.powermount.ice} := Area_{Mast.ice} \cdot q_{z.ice}$$

Additional Area from Ice (1/2" Each Side)

$$Area_{ice} := \frac{\pi \cdot \left[(Dia_{Powermount} + 1in)^2 - Dia_{Powermount}^{\ 2}\right]}{4} = 29.1 \cdot in^2$$

Unit Weight of Ice

$$\gamma_{ice} := 56 \frac{lb}{ft^3}$$

Additional Weight from Ice

$$Wt_{addl.ice} := Area_{ice} \cdot \gamma_{ice} = 11 \cdot \frac{lb}{ft}$$

AECOM

				Page	of
Job	Ledyard CSP#54 - 136 Vinegar Hill Road	Project No.	SAI-088	Sheet 5	of 5
Description	TIA/EIA-222-F Loading for STAAD Analysis	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

SUMMARY OF LOADING FOR STAAD ANALYSIS

	AT&T - EL 198'	T-Mobile - EL 187'-3"
Antenna Loads - No Ice		
Horizontal Load	$P_{Ant\_Hor\_ATT} = 4804\ lbf$	$P_{Ant\_Hor\_TM} = 1313\ lbf$
Vertical Load	$P_{Ant\_Vert\_ATT} = 2281\ lbf$	$P_{Ant\_Vert\_TM} = 215\ lbf$
Antenna Loads - With Ice		
Horizontal Load	$P_{Ant\_Hor\_ATT.ice} = 3955\ lbf$	$P_{Ant\_Hor\_TM.ice} = 1079\ lbf$
Vertical Load	$P_{Ant\_Vert\_ATT.ice} = 3112\ lbf$	$P_{Ant\_Vert\_TM.ice} = 351\ lbf$
Coaxial Cable Loads		
Vertical Load	$P_{cable.vert.ATT.pole} = 1473\ lbf$	$P_{cable.vert.TM.pole} = 1168\ lbf$

Wind Loading on Powermount by Section CL Elevation

$$Elevation_{CL.Mast} = \begin{pmatrix} 187.5 \\ 162.5 \\ 137.5 \\ 112.5 \\ 87.5 \\ 62.5 \\ 37.5 \\ 12.5 \end{pmatrix} \cdot ft \qquad P_{horizontal.powermount.full} = \begin{pmatrix} 115 \\ 111 \\ 106 \\ 100 \\ 93 \\ 84 \\ 73 \\ 53 \end{pmatrix} \cdot \frac{lb}{ft} \qquad P_{horizontal.powermount.ice} = \begin{pmatrix} 91 \\ 88 \\ 84 \\ 79 \\ 74 \\ 67 \\ 58 \\ 42 \end{pmatrix} \cdot \frac{lb}{ft}$$

Additional Weight on Powermount from Ice

$$Wt_{addl.ice} = 11 \cdot \frac{lb}{ft}$$

STAAD ANALYSIS OF POWERMOUNT

```
     ****************************************************
     *                                                  *
     *           STAAD.Pro V8i SELECTseries3            *
     *           Version  20.07.08.22                   *
     *           Proprietary Program of                 *
     *           Bentley Systems, Inc.                  *
     *           Date=    JUN 25, 2016                  *
     *           Time=    13: 9: 9                      *
     *                                                  *
     *      USER ID: URS Corporation                    *
     ****************************************************
```

```
     1. STAAD SPACE 199' POWERMOUNT
INPUT FILE: 9-22-13 Update - 199' Powermount.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 08/14/13
     4. ENGINEER NAME MCD
     5. END JOB INFORMATION
     6. INPUT WIDTH 79
     7. UNIT FEET KIP
     8. JOINT COORDINATES
     9. 1 0 199 0; 2 0 198 0; 3 0 187.25 0; 4 0 180 0; 5 0 175 0; 6 0 150 0; 7 0 125 0
    10. 8 0 100 0; 9 0 75 0; 10 0 50 0; 11 0 25 0; 12 0 0 0
    11. MEMBER INCIDENCES
    12. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 7 8; 8 8 9; 9 9 10; 10 10 11
    13. 11 11 12
    14. DEFINE MATERIAL START
    15. ISOTROPIC STEEL
    16. E 4.176E+006
    17. POISSON 0.3
    18. DENSITY 0.489024
    19. ALPHA 6.5E-006
    20. DAMP 0.03
    21. END DEFINE MATERIAL
    22. MEMBER PROPERTY AMERICAN
    23. 1 TO 11 TABLE ST HSSP18X0.375
    24. CONSTANTS
    25. MATERIAL STEEL ALL
    26. SUPPORTS
    27. 12 PINNED
    28. 4 TO 11 FIXED BUT FY MX MY MZ
    29. ******************************************************************************
    30. LOAD 1 LOADTYPE DEAD  TITLE SELF
    31. SELFWEIGHT Y -1
    32. LOAD 2 LOADTYPE LIVE  TITLE ICE ON POWERMOUNT
    33. MEMBER LOAD
    34. 1 TO 11 UNI GY -0.011
    35. LOAD 3 LOADTYPE WIND  TITLE FULL WIND ON POWERMOUNT
    36. MEMBER LOAD
    37. 1 TO 4 UNI GZ 0.115
    38. 5 UNI GZ 0.111
    39. 6 UNI GZ 0.106
    40. 7 UNI GZ 0.1
```

```
   41. 8 UNI GZ 0.093
   42. 9 UNI GZ 0.084
   43. 10 UNI GZ 0.073
   44. 11 UNI GZ 0.053
   45. LOAD 4 LOADTYPE WIND  TITLE WIND WITH ICE ON POWERMOUNT
   46. MEMBER LOAD
   47. 1 TO 4 UNI GZ 0.091
   48. 5 UNI GZ 0.088
   49. 6 UNI GZ 0.084
   50. 7 UNI GZ 0.079
   51. 8 UNI GZ 0.074
   52. 9 UNI GZ 0.067
   53. 10 UNI GZ 0.058
   54. 11 UNI GZ 0.042
   55. LOAD 5 LOADTYPE WIND  TITLE FULL WIND ON ANTENNAS
   56. JOINT LOAD
   57. 2 FY -2.281 FZ 4.804
   58. 3 FY -0.215 FZ 1.313
   59. LOAD 6 LOADTYPE WIND  TITLE WIND WITH ICE ON ANTENNAS
   60. JOINT LOAD
   61. 2 FY -3.112 FZ 3.955
   62. 3 FY -0.351 FZ 1.079
   63. LOAD 7 LOADTYPE LIVE  TITLE COAX WEIGHT
   64. JOINT LOAD
   65. 2 FY -1.473
   66. 3 FY -1.168
   67. LOAD COMB 8 COMBINATION FULL WIND
   68. 1 1.0 3 1.0 5 1.0 7 1.0
   69. LOAD COMB 9 COMBINATION WIND WITH ICE
   70. 1 1.0 2 1.0 4 1.0 6 1.0 7 1.0
   71. ******************************************************************************
   72. PERFORM ANALYSIS


          P R O B L E M   S T A T I S T I C S
          -----------------------------------

    NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     12/    11/     9

          SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

    ORIGINAL/FINAL BAND-WIDTH=     1/     1/     12 DOF
    TOTAL PRIMARY LOAD CASES =     7, TOTAL DEGREES OF FREEDOM =     53
    SIZE OF STIFFNESS MATRIX =        1 DOUBLE  KILO-WORDS
    REQRD/AVAIL. DISK SPACE  =     12.0/********* MB


 ***WARNING -  INSTABILITY AT JOINT    12   DIRECTION = MY
  PROBABLE CAUSE SINGULAR-ADDING WEAK SPRING
  K-MATRIX DIAG=  5.6066664E+04 L-MATRIX DIAG= -2.1827873E-11 EQN NO      52
  ***NOTE - VERY WEAK SPRING ADDED FOR STABILITY
```

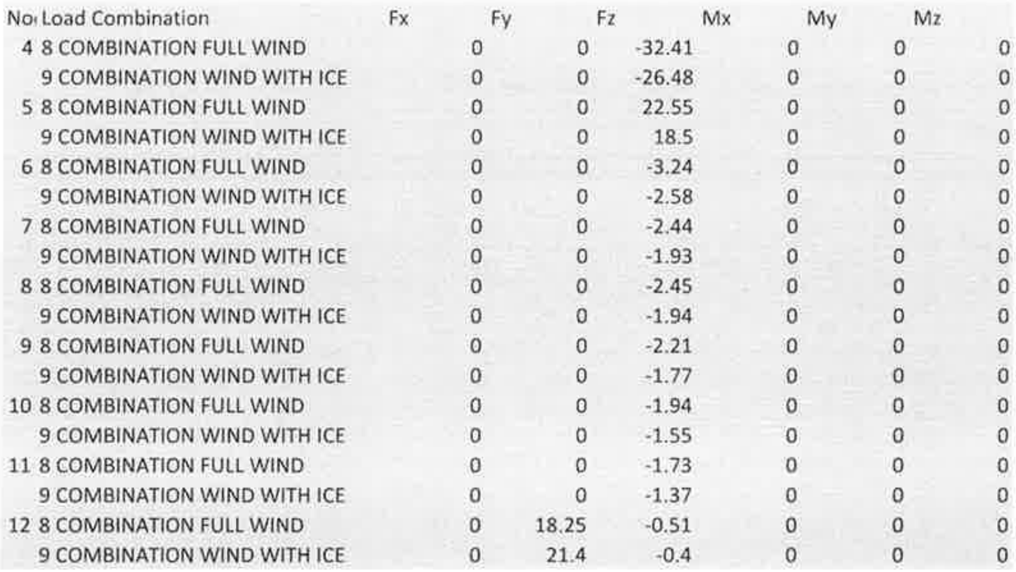
```
**NOTE** STAAD DETECTS INSTABILITIES AS EXCESSIVE LOSS OF SIGNIFICANT DIGITS
         DURING DECOMPOSITION. WHEN A DECOMPOSED DIAGONAL IS LESS THAN THE
         BUILT-IN REDUCTION FACTOR TIMES THE ORIGINAL STIFFNESS MATRIX DIAGONAL,
         STAAD PRINTS A SINGULARITY NOTICE. THE BUILT-IN REDUCTION FACTOR
         IS   1.000E-09

         THE ABOVE CONDITIONS COULD ALSO BE CAUSED BY VERY STIFF OR VERY WEAK
         ELEMENTS AS WELL AS TRUE SINGULARITIES.



73. LOAD LIST 8 9
74. UNIT INCHES KIP
75. PARAMETER 1
76. CODE AISC
77. * 35KSI STEEL WITH 1/3 INCREASE IN STRENGTH PER TIA
78. FYLD 46.655 ALL
79. CHECK CODE ALL
```

```
                    STAAD.Pro CODE CHECKING - (AISC 9TH EDITION)   v1.0
                    ************************



ALL UNITS ARE - KIP  INCH (UNLESS OTHERWISE NOTED)

MEMBER     TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                          FX            MY             MZ       LOCATION
=======================================================================


     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   1  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     SHEAR   -Z         0.001         8
                       0.07 C          0.69            0.00       12.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   2  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.286         8
                       4.53 C        714.98            0.00      129.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   3  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.555         8
                       6.39 C       1400.98            0.00       87.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   4  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.555         8
                       6.39 C       1400.98            0.00        0.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   5  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.055         8
                       8.37 C         93.77            0.00      300.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   6  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.055         8
                       8.37 C         93.77            0.00        0.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   7  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.050         8
                      11.66 C         62.15            0.00      300.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   8  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.052         9
                      15.64 C         44.21            0.00      300.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
   9  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.054         9
                      17.56 C         38.26            0.00      300.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
  10  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.058         9
                      19.48 C         37.19            0.00      300.00
     ***NOTE: DESIGN IN ACCORDANCE WITH ASD PROVISIONS FOR PIPES***
  11  ST   HSSP18X0.375             (AISC SECTIONS)
                           PASS     AISC- H1-3         0.058         9
                      19.48 C         37.19            0.00        0.00

  80. PRINT MEMBER FORCES ALL
```

```
 MEMBER END FORCES    STRUCTURE TYPE = SPACE
 -----------------
 ALL UNITS ARE -- KIP  INCH     (LOCAL )

MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y       MOM-Z


     1    8     1      0.00      0.00     0.00      0.00       0.00        0.00
                2     -0.07      0.00    -0.12      0.00      -0.69        0.00
          9     1      0.00      0.00     0.00      0.00       0.00        0.00
                2     -0.08      0.00    -0.09      0.00      -0.55        0.00

     2    8     2      3.82      0.00     4.92      0.00       0.69        0.00
                3     -4.53      0.00    -6.16      0.00    -714.98        0.00
          9     2      4.66      0.00     4.05      0.00       0.55        0.00
                3     -5.49      0.00    -5.02      0.00    -585.58        0.00

     3    8     3      5.91      0.00     7.47      0.00     714.98        0.00
                4     -6.39      0.00    -8.30      0.00   -1400.98        0.00
          9     3      7.01      0.00     6.10      0.00     585.58        0.00
                4     -7.56      0.00    -6.76      0.00   -1145.26        0.00

     4    8     4      6.39      0.00   -24.10      0.00    1400.98        0.00
                5     -6.72      0.00    23.53      0.00      28.03        0.00
          9     4      7.56      0.00   -19.72      0.00    1145.26        0.00
                5     -7.95      0.00    19.27      0.00      24.31        0.00

     5    8     5      6.72      0.00    -0.98      0.00     -28.03        0.00
                6     -8.37      0.00    -1.79      0.00     -93.77        0.00
          9     5      7.95      0.00    -0.77      0.00     -24.31        0.00
                6     -9.87      0.00    -1.43      0.00     -74.90        0.00

     6    8     6      8.37      0.00    -1.45      0.00      93.77        0.00
                7    -10.01      0.00    -1.20      0.00     -57.72        0.00
          9     6      9.87      0.00    -1.15      0.00      74.90        0.00
                7    -11.79      0.00    -0.95      0.00     -45.47        0.00

     7    8     7     10.01      0.00    -1.24      0.00      57.72        0.00
                8    -11.66      0.00    -1.26      0.00     -62.15        0.00
          9     7     11.79      0.00    -0.97      0.00      45.47        0.00
                8    -13.72      0.00    -1.00      0.00     -49.27        0.00

     8    8     8     11.66      0.00    -1.18      0.00      62.15        0.00
                9    -13.31      0.00    -1.14      0.00     -55.42        0.00
          9     8     13.72      0.00    -0.94      0.00      49.27        0.00
                9    -15.64      0.00    -0.91      0.00     -44.21        0.00

     9    8     9     13.31      0.00    -1.07      0.00      55.42        0.00
               10    -14.95      0.00    -1.03      0.00     -48.03        0.00
          9     9     15.64      0.00    -0.86      0.00      44.21        0.00
               10    -17.56      0.00    -0.82      0.00     -38.26        0.00
```

```
 MEMBER END FORCES    STRUCTURE TYPE = SPACE
 -----------------
 ALL UNITS ARE -- KIP  INCH     (LOCAL )

MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z



   10     8   10     14.95      0.00    -0.92      0.00     48.03       0.00
              11    -16.60      0.00    -0.91      0.00    -46.90       0.00
          9   10     17.56      0.00    -0.73      0.00     38.26       0.00
              11    -19.48      0.00    -0.72      0.00    -37.19       0.00

   11     8   11     16.60      0.00    -0.82      0.00     46.90       0.00
              12    -18.25      0.00    -0.51      0.00      0.00       0.00
          9   11     19.48      0.00    -0.65      0.00     37.19       0.00
              12    -21.40      0.00    -0.40      0.00      0.00       0.00

 ************** END OF LATEST ANALYSIS RESULT **************


  81. UNIT FEET KIP
  82. PRINT SUPPORT REACTION ALL
```

```
   SUPPORT REACTIONS -UNIT KIP  FEET    STRUCTURE TYPE = SPACE
   -----------------

 JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z


    12    8       0.00     18.25     -0.51      0.00      0.00      0.00
          9       0.00     21.40     -0.40      0.00      0.00      0.00
     4    8       0.00      0.00    -32.41      0.00      0.00      0.00
          9       0.00      0.00    -26.48      0.00      0.00      0.00
     5    8       0.00      0.00     22.55      0.00      0.00      0.00
          9       0.00      0.00     18.50      0.00      0.00      0.00
     6    8       0.00      0.00     -3.24      0.00      0.00      0.00
          9       0.00      0.00     -2.58      0.00      0.00      0.00
     7    8       0.00      0.00     -2.44      0.00      0.00      0.00
          9       0.00      0.00     -1.93      0.00      0.00      0.00
     8    8       0.00      0.00     -2.45      0.00      0.00      0.00
          9       0.00      0.00     -1.94      0.00      0.00      0.00
     9    8       0.00      0.00     -2.21      0.00      0.00      0.00
          9       0.00      0.00     -1.77      0.00      0.00      0.00
    10    8       0.00      0.00     -1.94      0.00      0.00      0.00
          9       0.00      0.00     -1.55      0.00      0.00      0.00
    11    8       0.00      0.00     -1.73      0.00      0.00      0.00
          9       0.00      0.00     -1.37      0.00      0.00      0.00

   ************** END OF LATEST ANALYSIS RESULT **************


    83. PERFORM DIRECT ANALYSIS ASD

 **ERROR-NO DEFINE DIRECT DATA ENTERED.


            *********** END OF THE STAAD.Pro RUN ***********

              **** DATE= JUN 25,2016   TIME= 13: 9:10 ****
```



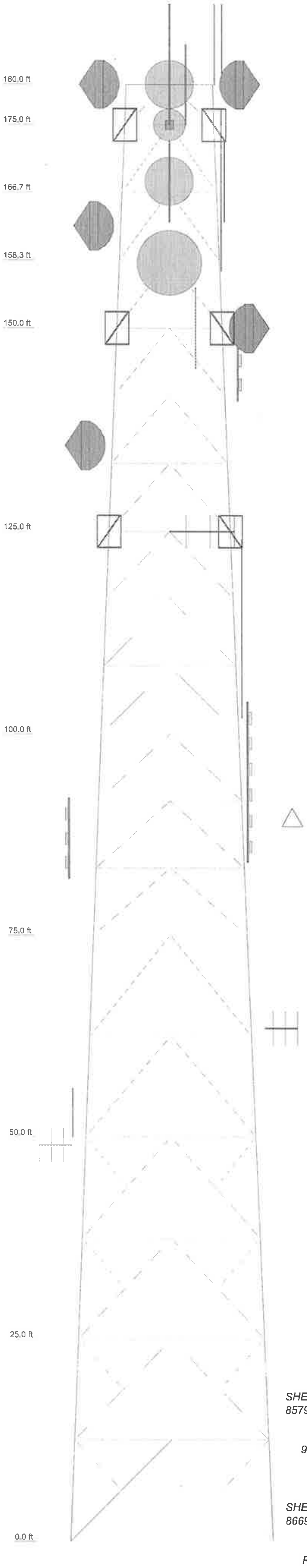
No	Load Combination	Fx	Fy	Fz	Mx	My	Mz
4	8 COMBINATION FULL WIND	0	0	-32.41	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-26.48	0	0	0
5	8 COMBINATION FULL WIND	0	0	22.55	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	18.5	0	0	0
6	8 COMBINATION FULL WIND	0	0	-3.24	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-2.58	0	0	0
7	8 COMBINATION FULL WIND	0	0	-2.44	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-1.93	0	0	0
8	8 COMBINATION FULL WIND	0	0	-2.45	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-1.94	0	0	0
9	8 COMBINATION FULL WIND	0	0	-2.21	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-1.77	0	0	0
10	8 COMBINATION FULL WIND	0	0	-1.94	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-1.55	0	0	0
11	8 COMBINATION FULL WIND	0	0	-1.73	0	0	0
	9 COMBINATION WIND WITH ICE	0	0	-1.37	0	0	0
12	8 COMBINATION FULL WIND	0	18.25	-0.51	0	0	0
	9 COMBINATION WIND WITH ICE	0	21.4	-0.4	0	0	0

From STAAD output

	No Ice Shear	Ice Shear
180ft A.G.L.	32410	26480
175	-22550	-18500
150	3240	2580
125	2440	1930
100	2450	1940
75	2210	1770
50	1940	1550
25	1730	1370
0	510	400

TNX-TOWER INPUT / OUTPUT SUMMARY

Section	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1
Legs	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125			MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5	MOD HSS 5x0.375 w/ 1/3 HSS 5.5625x0.375	MOD HSS 5x0.250 w/ 1/3 HSS 5.5x0.258	HSS5x 25			
Leg Grade	A572-50									
Diagonals	2L3 1/2x3 1/2x1/4		2L3 1/2x3 1/2x5/16	2L3x2 1/2x1/4		2L2 1/2x2 1/2x1/4		2L2 1/2x2x3/16		
Diagonal Grade	A36									
Top Girts	N.A.									L3x3x1/4
Horizontals	L4x4x3/8	L4x4x5/16	L4x4x1/4		L3x3x1/4		L2 1/2x2 1/2x1/4	L2 1/2x2 1/2x3/16		N.A.
Red. Horizontals	L2 1/2x2 1/2x3/16		N.A.							
Red. Diagonals	L3x3x1/4		N.A.							
Inner Bracing	L3x3x1/4	L2 1/2x2 1/2x3/16					N.A.			
Face Width (ft)	25	23	21	19	17	15	13	12.3333	11.6667	11 10.599
# Panels @ (ft)	6 @ 12.5			12 @ 8.33333						1 @ 5
Weight (lb) 40626.8	8304.3	7706.0	7171.4	6199.2	4679.5	3707.3	796.6	747.5	734.9	580.0



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Ground Rod w/Extension	185	Ice Shield (DNK-14 / CSP-14)	150
VHF-150 10' Dipole (DNK-29 / CSP-1)	185	6 FT DISH (DNK-14 / CSP-14)	150
OGT9-840 (DNK-24 / CSP-18)	185	(joined) 6' Side Mount Standoff (DNK-17,18 / CTT-9,CSP-54)	150
Dish Mount (CSP-62)	180	(joined) 6' Side Mount Standoff (DNK-17,18 / CTT-9,CSP-54)	150
Dish Mount (CSP-60)	180	(inverted) SC479-HF1LDF (DNK-18 / CSP-54)	150
DB809T3-Y (DNK-25 / CSP-17)	180	Powermount Reaction at 150	150
SC479-HF1LDF (D02-E5765) (DNK-28 / CSP-55)	180	2' Side Mount Standoff (DNK-13 / DEP-21)	146
Dish Mount (CSP-61)	180	PD320 (DNK-13 / DEP-21)	146
6 FT DISH (CSP Windload - CSP-60)	180	Ice Shield (DNK-12 / CSP-23)	138
6 FT DISH (CSP Windload - CSP-61)	180	Dish Mount (DNK-12 / CSP-23)	138
6 FT DISH (CSP Windload - CSP-62)	180	6 FT DISH (DNK-12 / CSP-22)	135.5
Powermount Reaction at 180	180	DB264-A (DNK-10/ FBI-22)	135
(joined) 6' Side Mount Standoff (DNK-25 / CSP-17)	175	2' Side Mount Standoff (DNK-11 / CSP-8)	133
TMA 432-83H-01T (DNK-27 / CSP-59)	175	DB212-1 (DNK-11 / CSP-8)	133
(joined) 6' Side Mount Standoff (DNK-26,27,28 / CSP 55,56,58,59)	175	DB432-A (FBI-24)	125
(joined) 6' Side Mount Standoff (DNK-23,24 / CSP-19,18)	175	(joined) 6' Side Mount Standoff (DNK-9,10 / DOT-52, FBI-22,24)	125
(joined) 6' Side Mount Standoff (DNK-25 / CSP-17)	175	(joined) 6' Side Mount Standoff (DNK-9,10 / DOT-52, FBI-22,24)	125
(joined) 6' Side Mount Standoff (DNK-23,24 / CSP-19,18)	175	Powermount Reaction at 125	125
(joined) 6' Side Mount Standoff (DNK-23,24 / CSP-19,18)	175	531-70 Dipole (DNK-9 / DOT-52)	115
Dish Mount (DNK-22 / CSP-5B)	175	Dish Mount (DNK-8)	113
Dish Mount (DNK-21 / CSP-5A)	175	PD220 (DNK-6 / DHS-3)	113
Dish Mount (DNK-20 / CSP-7)	175	Ice Shield (DNK-8)	113
4 FT DISH (DNK-22 / CSP-5B)	175	Dish Mount (DNK-7 / CSP-6)	100
Powermount Reaction at 175	175	Ice Shield (DNK-7 / CSP-6)	100
Dish Mount (CSP-16)	171	Powermount Reaction at 100	100
(inverted) DB809T3-Y (DNK-23 / CSP-19)	168	DB264-A (DNK-5 / FBI-11)	94
SC479-HF1LDF (D02I-E5765) (DNK-26 / CSP-56)	168	2' Side Mount Standoff (DNK-4 / FBI-53)	87
SC479-HF1LDF (D02I-E5765) (CSP-58)	168	DB212-1 (DNK-4 / FBI-53)	87
6 FT DISH (CSP-16)	168	2' Side Mount Standoff (DNK-56 / FBI-11, DHS-3)	87
PD458-1 (DNK-17 / CTT-9)	167	Powermount Reaction at 75	75
6 FT DISH (DNK-19 / CSP-13)	162.5	PD156S (DNK-3 / NEC-4)	63.5
Dish Mount (DNK-19 / CSP-13)	162.5	Side Arm Mount (DNK-3 / NEC-4)	63.5
VHF-150-6 (DNK-15 / CSP-2)	158	DB803Q-XT (DNK-2 / CSP-25)	53
8 FT DISH (DNK-16 / CSP-15)	158	2' Side Mount Standoff (DNK-12 / DEHMS-26,CSP-25)	50
Dish Mount (DNK-16 / CSP-15)	158	Powermount Reaction at 50	50
Dish Mount (DNK-14 / CSP-14)	150	SY203(C) - YAGI Antenna (DNK-1 / DEHMS-26)	49
(joined) 6' Side Mount Standoff (DNK-15 / CSP-2)	150	Powermount Reaction at 25	25
(joined) 6' Side Mount Standoff (DNK-15 / CSP-2)	150		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in New London County, Connecticut.
2. Tower designed for a 95 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 90 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 90 mph wind.
5. TOWER RATING: 99.2%

MAX. CORNER REACTIONS AT BASE:
DOWN: 455619 lb
SHEAR: 49078 lb

UPLIFT: -386516 lb
SHEAR: 42492 lb

AXIAL
68919 lb
SHEAR 85797 lb
MOMENT 9296 kip-ft
TORQUE 89 kip-ft
90 mph WIND - 0.5000 in ICE

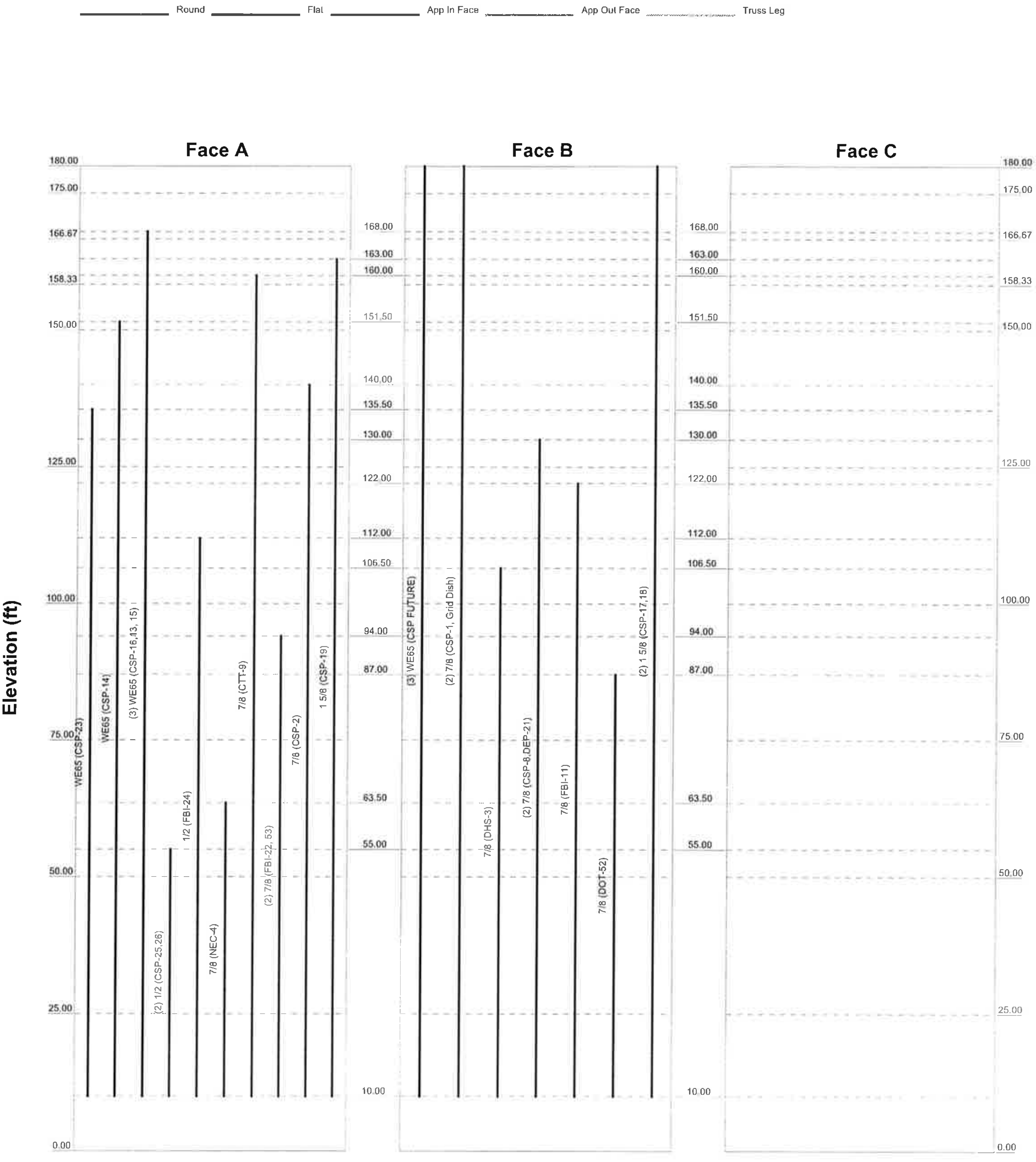
AXIAL
47799 lb
SHEAR 86693 lb
MOMENT 9520 kip-ft
TORQUE 73 kip-ft
REACTIONS - 95 mph WIND

AECOM 500 Enterprise Drive, Suite 3B Rocky Hill, CT Phone: 860-529-8882 FAX: 860-529-3991	Job: **180' Stainless Lattice, Ledyard, CT** Project: **AT&T Site CT2283** Client: MODification - Ledyard, CT Tower / AT&T Code: TIA/EIA-222-F Path:	Drawn by: MCD App'd: Date: 06/29/16 Scale: NTS Dwg No. E-1

TNX-TOWER FEEDLINE DISTRIBUTION CHART

Feed Line Distribution Chart

0' - 180'



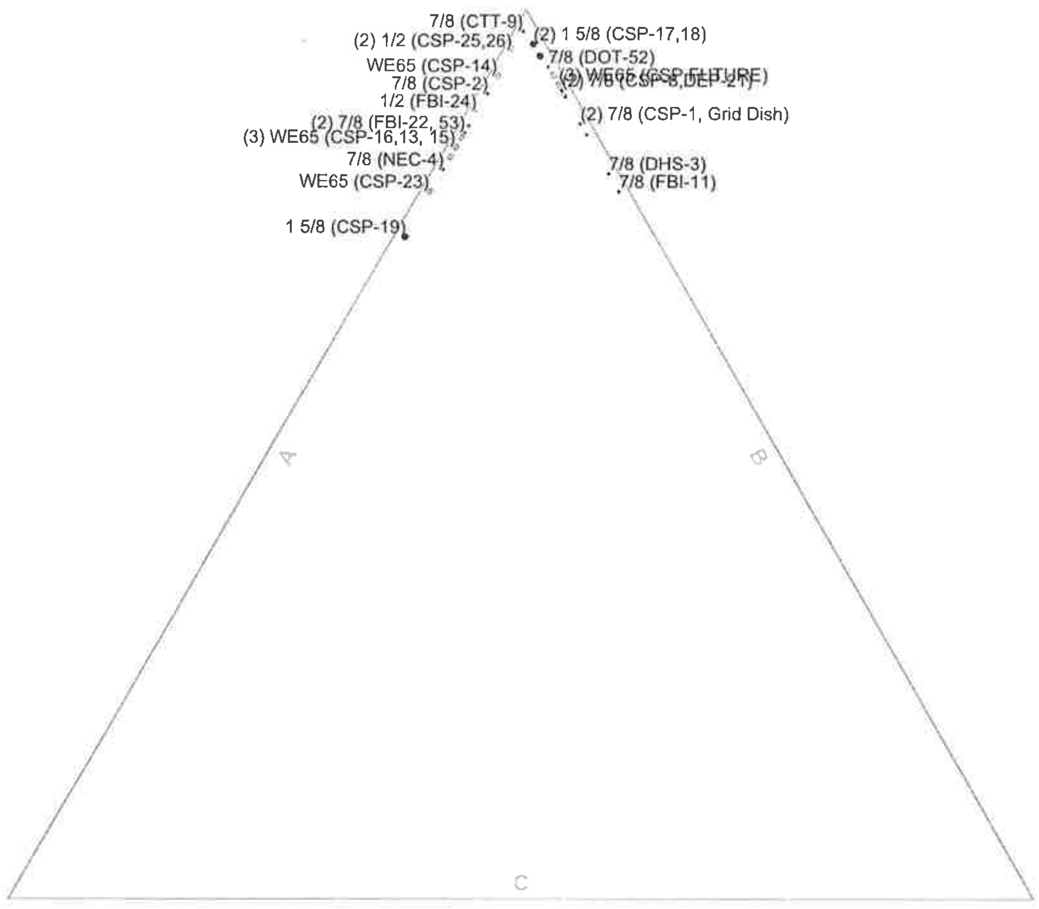
AECOM
500 Enterprise Drive, Suite 3B
Rocky Hill, CT
Phone: 860-529-8882
FAX: 860-529-3991

Job: ***180' Stainless Lattice, Ledyard, CT***
Project: ***AT&T Site CT2283***
Client: MODification - Ledyard, CT Tower / AT&T
Drawn by: MCD
App'd:
Code: TIA/EIA-222-F
Date: 06/29/16
Scale: NTS
Path:
Dwg No. E-7

TNX TOWER FEEDLINE PLAN

Feed Line Plan

Round Flat App In Face App Out Face

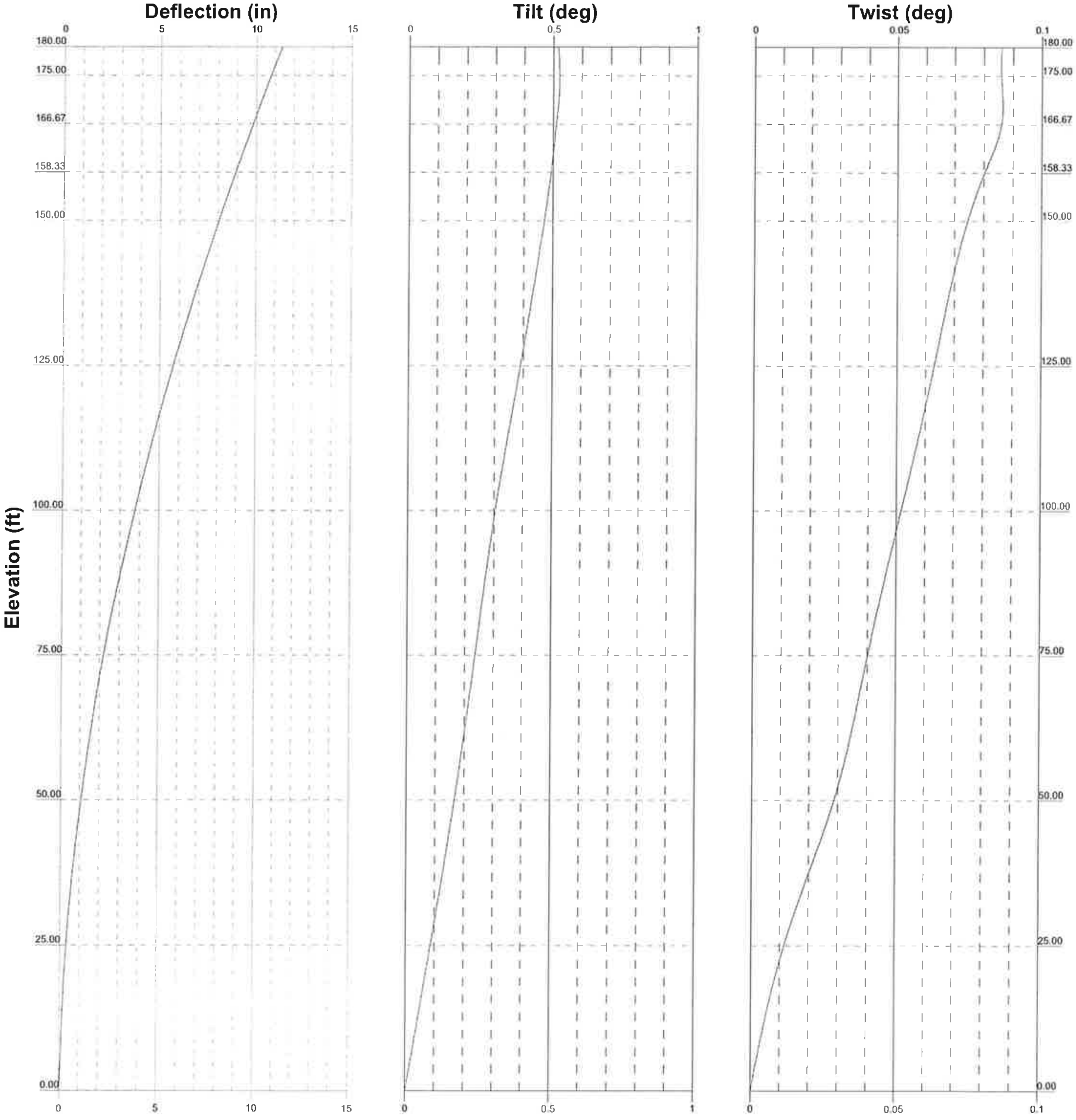


AECOM
500 Enterprise Drive, Suite 3B
Rocky Hill, CT
Phone: 860-529-8882
FAX: 860-529-3991

Job: ***180' Stainless Lattice, Ledyard, CT***
Project: ***AT&T Site CT2283***
Client: MODification - Ledyard, CT Tower / AT&T
Drawn by: MCD
App'd:
Code: TIA/EIA-222-F
Date: 06/29/16
Scale: NTS
Path:
Dwg No. E-7

TIA/EIA-222-F - Service - 90 mph

Maximum Values



AECOM
500 Enterprise Drive, Suite 3B
Rocky Hill, CT
Phone: 860-529-8882
FAX: 860-529-3991

Job: ***180' Stainless Lattice, Ledyard, CT***
Project: ***AT&T Site CT2283***
Client: MODification - Ledyard, CT Tower / AT&T
Drawn by: MCD
App'd:
Code: TIA/EIA-222-F
Date: 06/29/16
Scale: NTS
Path:
Dwg No. E-5

TNX-TOWER DETAILED OUTPUT

Tower Input Data

The main tower is a 3x free standing tower with an overall height of 180.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 10.60 ft at the top and 25.00 ft at the base.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

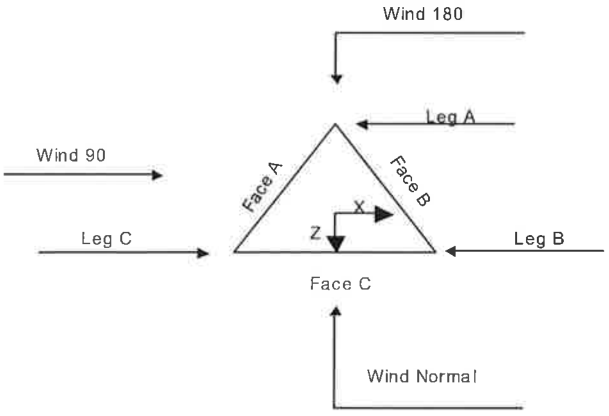
Tower is located in New London County, Connecticut.
Basic wind speed of 95 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 90 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 90 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.333.
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

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-G Bracing Resist. Exemption
Use TIA-222-G Tension Splice Exemption
Poles
Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets



Triangular Tower

Tower Section Geometry

Tower Section	*Tower Elevation* *ft*	*Assembly Database*	*Description*	*Section Width* *ft*	*Number of Sections*	*Section Length* *ft*
T1	180.00-175.00			10.60	1	5.00
T2	175.00-166.67			11.00	1	8.33
T3	166.67-158.33			11.67	1	8.33
T4	158.33-150.00			12.33	1	8.33
T5	150.00-125.00			13.00	1	25.00
T6	125.00-100.00			15.00	1	25.00
T7	100.00-75.00			17.00	1	25.00
T8	75.00-50.00			19.00	1	25.00
T9	50.00-25.00			21.00	1	25.00
T10	25.00-0.00			23.00	1	25.00

Tower Section Geometry *(cont'd)*

Tower Section	*Tower Elevation* *ft*	*Diagonal Spacing* *ft*	*Bracing Type*	*Has K Brace End Panels*	*Has Horizontals*	*Top Girt Offset* *in*	*Bottom Girt Offset* *in*
T1	180.00-175.00	5.00	K Brace Down	No	Yes	0.0000	0.0000
T2	175.00-166.67	8.33	K Brace Down	No	Yes	0.0000	0.0000
T3	166.67-158.33	8.33	K Brace Down	No	Yes	0.0000	0.0000
T4	158.33-150.00	8.33	K Brace Down	No	Yes	0.0000	0.0000
T5	150.00-125.00	8.33	K Brace Down	No	Yes	0.0000	0.0000

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
T6	125.00-100.00	8.33	K Brace Down	No	Yes	0.0000	0.0000
T7	100.00-75.00	8.33	K Brace Down	No	Yes	0.0000	0.0000
T8	75.00-50.00	12.50	K Brace Down	No	Yes	0.0000	0.0000
T9	50.00-25.00	12.50	K1 Down	No	Yes	0.0000	0.0000
T10	25.00-0.00	12.50	K1 Down	No	Yes	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 180.00-175.00	Pipe	HSS5x.25	A572-50 (50 ksi)	Double Angle	2L2 1/2x2x3/16	A36 (36 ksi)
T2 175.00-166.67	Pipe	HSS5x.25	A572-50 (50 ksi)	Double Angle	2L2 1/2x2x3/16	A36 (36 ksi)
T3 166.67-158.33	Pipe	HSS5x.25	A572-50 (50 ksi)	Double Angle	2L2 1/2x2x3/16	A36 (36 ksi)
T4 158.33-150.00	Pipe	HSS5x.25	A572-50 (50 ksi)	Double Angle	2L2 1/2x2x3/16	A36 (36 ksi)
T5 150.00-125.00	Arbitrary Shape	MOD HSS 5x0.250 w/ 1/3 HSS 5.5x0.258	A572-50 (50 ksi)	Double Angle	2L2 1/2x2 1/2x1/4	A36 (36 ksi)
T6 125.00-100.00	Arbitrary Shape	MOD HSS 5x0.375 w/ 1/3 HSS 5.5625x0.375	A572-50 (50 ksi)	Double Angle	2L3x2 1/2x1/4	A36 (36 ksi)
T7 100.00-75.00	Arbitrary Shape	MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5	A572-50 (50 ksi)	Double Angle	2L3x2 1/2x1/4	A36 (36 ksi)
T8 75.00-50.00	Arbitrary Shape	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	A572-50 (50 ksi)	Double Angle	2L3 1/2x3 1/2x5/16	A36 (36 ksi)
T9 50.00-25.00	Arbitrary Shape	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	A572-50 (50 ksi)	Double Angle	2L3 1/2x3 1/2x1/4	A36 (36 ksi)
T10 25.00-0.00	Arbitrary Shape	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	A572-50 (50 ksi)	Double Angle	2L3 1/2x3 1/2x1/4	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	No. of Mid Girts	Mid Girt Type	Mid Girt Size	Mid Girt Grade	Horizontal Type	Horizontal Size	Horizontal Grade
T1 180.00-175.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L3x3x1/4	A36 (36 ksi)
T2 175.00-166.67	None	Flat Bar		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T3 166.67-158.33	None	Flat Bar		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T4 158.33-150.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)
T5 150.00-125.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L3x3x1/4	A36 (36 ksi)
T6 125.00-100.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L3x3x1/4	A36 (36 ksi)
T7 100.00-75.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L4x4x1/4	A36 (36 ksi)

Tower Elevation *ft*	*No. of Mid Girts*	*Mid Girt Type*	*Mid Girt Size*	*Mid Girt Grade*	*Horizontal Type*	*Horizontal Size*	*Horizontal Grade*
T8 75.00-50.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L4x4x1/4	A36 (36 ksi)
T9 50.00-25.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L4x4x5/16	A36 (36 ksi)
T10 25.00-0.00	None	Flat Bar		A36 (36 ksi)	Equal Angle	L4x4x3/8	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Secondary Horizontal Type*	*Secondary Horizontal Size*	*Secondary Horizontal Grade*	*Inner Bracing Type*	*Inner Bracing Size*	*Inner Bracing Grade*
T5 150.00-125.00	Equal Angle		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T6 125.00-100.00	Equal Angle		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T7 100.00-75.00	Equal Angle		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T8 75.00-50.00	Equal Angle		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T9 50.00-25.00	Equal Angle		A36 (36 ksi)	Equal Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T10 25.00-0.00	Equal Angle		A36 (36 ksi)	Equal Angle	L3x3x1/4	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation *ft*	*Redundant Bracing Grade*		*Redundant Type*	*Redundant Size*	*K Factor*
T9	A36	Horizontal (1)	Equal Angle	L2 1/2x2 1/2x3/16	1
50.00-25.00	(36 ksi)	Diagonal (1)	Equal Angle	L3x3x1/4	1
T10	A36	Horizontal (1)	Equal Angle	L2 1/2x2 1/2x3/16	1
25.00-0.00	(36 ksi)	Diagonal (1)	Equal Angle	L3x3x1/4	1

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 180.00-175.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T2 175.00-166.67	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000

Tower Elevation *ft*	*Gusset Area (per face)* *ft^2*	*Gusset Thickness* *in*	*Gusset Grade*	*Adjust. Factor* *A_f*	*Adjust. Factor* *A_r*	*Weight Mult.*	*Double Angle Stitch Bolt Spacing Diagonals* *in*	*Double Angle Stitch Bolt Spacing Horizontals* *in*	*Double Angle Stitch Bolt Spacing Redundants* *in*
T3 166.67-158.33	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T4 158.33-150.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T5 150.00-125.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T6 125.00-100.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T7 100.00-75.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T8 75.00-50.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T9 50.00-25.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T10 25.00-0.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000

Tower Section Geometry *(cont'd)*

			K Factors[1]							
Tower Elevation *ft*	*Calc K Single Angles*	*Calc K Solid Rounds*	*Legs*	*X Brace Diags* *X* *Y*	*K Brace Diags* *X* *Y*	*Single Diags* *X* *Y*	*Girts* *X* *Y*	*Horiz.* *X* *Y*	*Sec. Horiz.* *X* *Y*	*Inner Brace* *X* *Y*
T1	Yes	No	1	1	1	1	1	1	1	1
180.00-175.00				1	1	1	1	1	1	1
T2	Yes	No	1	1	1	1	1	1	1	1
175.00-166.67				1	1	1	1	1	1	1
T3	Yes	No	1	1	1	1	1	1	1	1
166.67-158.33				1	1	1	1	1	1	1
T4	Yes	No	1	1	1	1	1	1	1	1
158.33-150.00				1	1	1	1	1	1	1
T5	Yes	No	1	1	1	1	1	1	1	1
150.00-125.00				1	1	1	1	1	1	1
T6	Yes	No	1	1	1	1	1	1	1	1
125.00-100.00				1	1	1	1	1	1	1
T7	Yes	No	1	1	1	1	1	1	1	1
100.00-75.00				1	1	1	1	1	1	1
T8	Yes	No	1	1	1	1	1	1	1	1
75.00-50.00				1	1	1	1	1	1	1
T9	Yes	No	1	1	1	1	1	1	1	1
50.00-25.00				1	1	1	1	1	1	1
T10	Yes	No	1	1	1	1	1	1	1	1
25.00-0.00				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 180.00-175.00	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
T2 175.00-166.67	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T3 166.67-158.33	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 158.33-150.00	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 150.00-125.00	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 125.00-100.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T7 100.00-75.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T8 75.00-50.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T9 50.00-25.00	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
T10 25.00-0.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	*Leg Connection Type*	*Leg*		*Diagonal*		*Top Girt*		*Bottom Girt*		*Mid Girt*		*Long Horizontal*		*Short Horizontal*	
		Bolt Size in	*No.*	*Bolt Size* in	*No.*	*Bolt Size* in	*No.*	*Bolt Size* in	*No.*	*Bolt Size* in	*No.*	*Bolt Size* in	*No.*	*Bolt Size* in	*No.*
T1 180.00-175.00	Flange	0.7500 A325X	6	0.7500 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T2 175.00-166.67	Flange	0.7500 A325X	6	0.7500 A325X	1	0.6250 A325N	0	0.0000 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T3 166.67-158.33	Flange	0.7500 A325X	0	0.7500 A325X	1	0.6250 A325X	2	0.0000 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T4 158.33-150.00	Flange	0.7500 A325X	0	0.7500 A325X	1	0.6250 A325X	2	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T5 150.00-125.00	Flange	0.7500 A325X	6	0.7500 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T6 125.00-100.00	Flange	0.7500 A325X	6	0.7500 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T7 100.00-75.00	Flange	0.7500 A490N	6	0.7500 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T8 75.00-50.00	Flange	1.0000 A325X	8	1.0000 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T9 50.00-25.00	Flange	1.0000 A325X	8	1.0000 A325X	1	0.6250 A325N	0	0.0000 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0
T10 25.00-0.00	Flange	1.0000 A325X	8	1.0000 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325X	2	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement ft*	*Face Offset in*	*Lateral Offset (Frac FW)*	*#*	*# Per Row*	*Clear Spacing in*	*Width or Diameter in*	*Perimeter in*	*Weight plf*
WE65 (CSP FUTURE)	B	Yes	Af (CfAe)	180.00 - 10.00	-2.0000	-0.42	3	3	1.5836	1.5836	5.1284	0.53
WE65 (CSP-23)	A	Yes	Af (CfAe)	135.50 - 10.00	-2.0000	0.3	1	1	1.5836	1.5836	5.1284	0.53
WE65 (CSP-14)	A	Yes	Af (CfAe)	151.50 - 10.00	-2.0000	0.43	1	1	1.5836	1.5836	5.1284	0.53
WE65 (CSP-16,13, 15)	A	Yes	Af (CfAe)	168.00 - 10.00	-2.0000	0.35	3	3	1.5836	1.5836	5.1284	0.53
1/2 (CSP-25,26)	A	Yes	Ar (CfAe)	55.00 - 10.00	-2.0000	0.46	2	2	0.5800	0.5800		0.25
1/2 (FBI-24)	A	Yes	Ar (CfAe)	112.00 - 10.00	-2.0000	0.39	1	1	0.5800	0.5800		0.25
7/8 (CSP-1, Grid Dish)	B	Yes	Ar (CfAe)	180.00 - 10.00	-2.0000	-0.37	2	2	2.5000 1.1100	1.1100		0.54
7/8 (DHS-3)	B	Yes	Ar (CfAe)	106.50 - 10.00	-2.0000	-0.32	1	1	2.5000 1.1100	1.1100		0.54
7/8 (CSP-8,DEP-21)	B	Yes	Ar (CfAe)	130.00 - 10.00	-2.0000	-0.41	2	2	1.1100	1.1100		0.54
7/8 (NEC-4)	A	Yes	Ar (CfAe)	63.50 - 10.00	-2.0000	0.325	1	1	1.1100	1.1100		0.54
7/8 (CTT-9)	A	Yes	Ar (CfAe)	160.00 - 10.00	-2.0000	0.48	1	1	1.1100	1.1100		0.54
7/8 (FBI-22, 53)	A	Yes	Ar (CfAe)	94.00 - 10.00	-2.0000	0.37	2	2	1.1100	1.1100		0.54
7/8 (FBI-11)	B	Yes	Ar (CfAe)	122.00 - 10.00	-2.0000	-0.3	1	1	2.5000 1.1100	1.1100		0.54
7/8 (DOT-52)	B	Yes	Ar (CfAe)	87.00 - 10.00	-2.0000	-0.44	1	1	1.1100	1.1100		0.54
7/8 (CSP-2)	A	Yes	Ar (CfAe)	140.00 - 10.00	-2.0000	0.41	1	1	1.1100	1.1100		0.54
1 5/8 (CSP-19)	A	Yes	Ar (CfAe)	163.00 - 10.00	-2.0000	0.25	1	1	1.9800	1.9800		1.04
1 5/8 (CSP-17,18)	B	Yes	Ar (CfAe)	180.00 - 10.00	-2.0000	-0.46	2	2	1.9800	1.9800		1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	*Tower Elevation ft*	*Face*	A_R ft^2	A_F ft^2	C_AA_A *In Face* ft^2	C_AA_A *Out Face* ft^2	*Weight lb*
T1	180.00-175.00	A	0.000	0.000	0.000	0.000	0.00
		B	2.575	1.979	0.000	0.000	23.75
		C	0.000	0.000	0.000	0.000	0.00
T2	175.00-166.67	A	0.000	0.528	0.000	0.000	2.12
		B	4.292	3.299	0.000	0.000	39.58
		C	0.000	0.000	0.000	0.000	0.00
T3	166.67-158.33	A	0.924	3.299	0.000	0.000	19.00
		B	4.292	3.299	0.000	0.000	39.58
		C	0.000	0.000	0.000	0.000	0.00
T4	158.33-150.00	A	2.146	3.497	0.000	0.000	27.21
		B	4.292	3.299	0.000	0.000	39.58
		C	0.000	0.000	0.000	0.000	0.00
T5	150.00-125.00	A	7.825	14.582	0.000	0.000	106.17

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 lb
		B	13.800	9.897	0.000	0.000	124.15
		C	0.000	0.000	0.000	0.000	0.00
T6	125.00-100.00	A	9.330	16.496	0.000	0.000	122.25
		B	20.136	9.897	0.000	0.000	161.14
		C	0.000	0.000	0.000	0.000	0.00
T7	100.00-75.00	A	13.473	16.496	0.000	0.000	146.02
		B	23.235	9.897	0.000	0.000	179.23
		C	0.000	0.000	0.000	0.000	0.00
T8	75.00-50.00	A	16.315	16.496	0.000	0.000	162.29
		B	24.438	9.897	0.000	0.000	186.25
		C	0.000	0.000	0.000	0.000	0.00
T9	50.00-25.00	A	19.313	16.496	0.000	0.000	178.50
		B	24.438	9.897	0.000	0.000	186.25
		C	0.000	0.000	0.000	0.000	0.00
T10	25.00-0.00	A	11.588	9.897	0.000	0.000	107.10
		B	14.663	5.938	0.000	0.000	111.75
		C	0.000	0.000	0.000	0.000	0.00

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight lb
T1	180.00-175.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		4.242	2.813	0.000	0.000	69.21
		C		0.000	0.000	0.000	0.000	0.00
T2	175.00-166.67	A	0.500	0.000	0.750	0.000	0.000	7.58
		B		7.069	4.688	0.000	0.000	115.35
		C		0.000	0.000	0.000	0.000	0.00
T3	166.67-158.33	A	0.500	1.452	4.688	0.000	0.000	61.84
		B		7.069	4.688	0.000	0.000	115.35
		C		0.000	0.000	0.000	0.000	0.00
T4	158.33-150.00	A	0.500	3.535	4.969	0.000	0.000	84.21
		B		7.069	4.688	0.000	0.000	115.35
		C		0.000	0.000	0.000	0.000	0.00
T5	150.00-125.00	A	0.500	13.242	20.721	0.000	0.000	334.24
		B		22.967	14.064	0.000	0.000	361.30
		C		0.000	0.000	0.000	0.000	0.00
T6	125.00-100.00	A	0.500	16.580	23.440	0.000	0.000	387.87
		B		35.011	14.064	0.000	0.000	465.66
		C		0.000	0.000	0.000	0.000	0.00
T7	100.00-75.00	A	0.500	24.973	23.440	0.000	0.000	457.59
		B		40.902	14.064	0.000	0.000	516.69
		C		0.000	0.000	0.000	0.000	0.00
T8	75.00-50.00	A	0.500	30.115	23.923	0.000	0.000	505.28
		B		43.188	14.064	0.000	0.000	536.50
		C		0.000	0.000	0.000	0.000	0.00
T9	50.00-25.00	A	0.500	34.771	25.857	0.000	0.000	558.20
		B		43.188	14.064	0.000	0.000	536.50
		C		0.000	0.000	0.000	0.000	0.00
T10	25.00-0.00	A	0.500	20.863	15.514	0.000	0.000	334.92
		B		25.913	8.438	0.000	0.000	321.90
		C		0.000	0.000	0.000	0.000	0.00

Feed Line Shielding

Section	*Elevation* *ft*	*Face*	A_R ft^2	A_R *Ice* ft^2	A_F ft^2	A_F *Ice* ft^2
T1	180.00-175.00	A	0.000	0.000	0.000	0.000
		B	0.000	0.293	0.484	0.794
		C	0.000	0.000	0.000	0.000
T2	175.00-166.67	A	0.000	0.024	0.036	0.059
		B	0.000	0.342	0.521	0.854
		C	0.000	0.000	0.000	0.000
T3	166.67-158.33	A	0.000	0.183	0.283	0.458
		B	0.000	0.334	0.509	0.834
		C	0.000	0.000	0.000	0.000
T4	158.33-150.00	A	0.000	0.243	0.370	0.606
		B	0.000	0.327	0.498	0.817
		C	0.000	0.000	0.000	0.000
T5	150.00-125.00	A	0.000	0.939	1.532	2.532
		B	0.000	0.991	1.620	2.674
		C	0.000	0.000	0.000	0.000
T6	125.00-100.00	A	0.000	1.057	1.882	3.170
		B	0.000	1.243	2.189	3.729
		C	0.000	0.000	0.000	0.000
T7	100.00-75.00	A	0.000	1.220	2.414	4.180
		B	0.000	1.342	2.669	4.596
		C	0.000	0.000	0.000	0.000
T8	75.00-50.00	A	0.000	0.988	2.083	3.650
		B	0.000	1.020	2.179	3.766
		C	0.000	0.000	0.000	0.000
T9	50.00-25.00	A	0.000	2.168	3.931	7.036
		B	0.000	2.006	3.769	6.513
		C	0.000	0.000	0.000	0.000
T10	25.00-0.00	A	0.000	1.262	2.290	4.099
		B	0.000	1.169	2.196	3.794
		C	0.000	0.000	0.000	0.000

Feed Line Center of Pressure

Section	*Elevation* *ft*	CP_X *in*	CP_Z *in*	CP_X *Ice* *in*	CP_Z *Ice* *in*
T1	180.00-175.00	0.3164	-7.9767	0.3761	-8.8364
T2	175.00-166.67	0.3354	-10.8403	0.4180	-12.0992
T3	166.67-158.33	-0.3035	-14.6861	-0.2516	-16.0926
T4	158.33-150.00	-0.4749	-16.6788	-0.4322	-18.4196
T5	150.00-125.00	-0.6374	-19.2756	-0.6152	-21.9409
T6	125.00-100.00	-0.5146	-22.9508	-0.4019	-26.9176
T7	100.00-75.00	-0.5218	-24.7179	-0.4428	-30.0243
T8	75.00-50.00	-0.6890	-28.5416	-0.6665	-35.5882
T9	50.00-25.00	-0.7017	-26.8224	-0.6779	-32.0724
T10	25.00-0.00	-0.4798	-18.3525	-0.4742	-22.4653

User Defined Loads

Description	*Elevation* *ft*	*Offset From Centroid* *ft*	*Azimuth Angle* °		*Weight* *lb*	F_x *lb*	F_z *lb*	*Wind Force* *lb*	C_AA_C *ft²*
Powermount Reaction at 180	180.00	0.00	0.0000	No Ice	0.00	0.00	0.00	32410.00	**770.79**
				Ice	0.00	0.00	0.00	26480.00	**701.67**
				Service	0.00	0.00	0.00	26480.00	**701.67**
Powermount Reaction at 175	175.00	0.00	0.0000	No Ice	0.00	0.00	0.00	-22550.00	**540.63**
				Ice	0.00	0.00	0.00	-18500.00	**494.18**
				Service	0.00	0.00	0.00	-18500.00	**494.18**
Powermount Reaction at 150	150.00	0.00	0.0000	No Ice	0.00	0.00	0.00	3240.00	**81.18**
				Ice	0.00	0.00	0.00	2580.00	**72.02**
				Service	0.00	0.00	0.00	2578.00	**71.97**
Powermount Reaction at 125	125.00	0.00	0.0000	No Ice	0.00	0.00	0.00	2440.00	**64.40**
				Ice	0.00	0.00	0.00	1930.00	**56.76**
				Service	0.00	0.00	0.00	1930.00	**56.76**
Powermount Reaction at 100	100.00	0.00	0.0000	No Ice	0.00	0.00	0.00	2450.00	**68.92**
				Ice	0.00	0.00	0.00	1940.00	**60.81**
				Service	0.00	0.00	0.00	1940.00	**60.81**
Powermount Reaction at 75	75.00	0.00	0.0000	No Ice	0.00	0.00	0.00	2210.00	**67.50**
				Ice	0.00	0.00	0.00	1770.00	**60.23**
				Service	0.00	0.00	0.00	1770.00	**60.23**
Powermount Reaction at 50	50.00	0.00	0.0000	No Ice	0.00	0.00	0.00	1940.00	**66.53**
				Ice	0.00	0.00	0.00	1550.00	**59.22**
				Service	0.00	0.00	0.00	1550.00	**59.22**
Powermount Reaction at 25	25.00	0.00	0.0000	No Ice	0.00	0.00	0.00	1730.00	**66.80**
				Ice	0.00	0.00	0.00	1370.00	**58.94**
				Service	0.00	0.00	0.00	1370.00	**58.94**

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* *lb*
Ground Rod w/Extension	B	From Leg	0.50 0.00 0.00	0.0000	185.00	No Ice 1/2" Ice	3.00 4.03	3.00 4.03	80.00 107.00
Dish Mount (CSP-60)	A	None		0.0000	180.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
Dish Mount (CSP-61)	B	None		0.0000	180.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
Dish Mount (CSP-62)	C	None		0.0000	180.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
VHF-150 10' Dipole (DNK-29 / CSP-1)	A	None		0.0000	185.00	No Ice 1/2" Ice	5.28 5.74	2.73 3.77	55.74 95.99
DB809T3-Y (DNK-25 / CSP-17)	C	From Face	2.00 -2.00 0.00	0.0000	180.00	No Ice 1/2" Ice	2.53 3.83	2.53 3.83	25.00 44.57
(joined) 6' Side Mount Standoff (DNK-25 / CSP-17)	B	From Leg	0.00 0.00 0.00	45.0000	175.00	No Ice 1/2" Ice	4.97 6.12	4.97 6.12	70.00 130.00
(joined) 6' Side Mount Standoff (DNK-25 / CSP-17)	C	From Leg	0.00 0.00 0.00	-45.0000	175.00	No Ice 1/2" Ice	4.97 6.12	4.97 6.12	70.00 130.00
Dish Mount	A	None		0.0000	175.00	No Ice	2.40	2.40	90.00

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 lb*
(DNK-22 / CSP-5B)						1/2" Ice	3.04	3.04	107.00
Dish Mount	A	None		0.0000	175.00	No Ice	2.40	2.40	90.00
(DNK-21 / CSP-5A)						1/2" Ice	3.04	3.04	107.00
Dish Mount	C	None		0.0000	175.00	No Ice	2.40	2.40	90.00
(DNK-20 / CSP-7)						1/2" Ice	3.04	3.04	107.00
Dish Mount	A	None		0.0000	171.00	No Ice	2.40	2.40	90.00
(CSP-16)						1/2" Ice	3.04	3.04	107.00
SC479-HF1LDF	C	From Face	4.00	0.0000	180.00	No Ice	5.06	5.06	34.00
(D02-E5765)			0.00			1/2" Ice	6.54	6.54	69.82
(DNK-28 / CSP-55)			0.00						
SC479-HF1LDF	C	From Face	4.00	0.0000	168.00	No Ice	5.06	5.06	34.00
(D02I-E5765)			0.00			1/2" Ice	6.54	6.54	69.82
(DNK-26 / CSP-56)			0.00						
SC479-HF1LDF	C	From Face	2.00	0.0000	168.00	No Ice	5.06	5.06	34.00
(D02I-E5765)			0.00			1/2" Ice	6.54	6.54	69.82
(CSP-58)			0.00						
TMA 432-83H-01T	C	From Face	2.00	0.0000	175.00	No Ice	1.63	0.95	25.00
(DNK-27 / CSP-59)			0.00			1/2" Ice	1.81	1.09	37.44
			0.00						
(joined) 6' Side Mount	B	From Leg	0.00	45.0000	175.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-26,27,28 / CSP			0.00						
55,56,58,59)									
(joined) 6' Side Mount	C	From Leg	0.00	-45.0000	175.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-23,24 / CSP-19,18)			0.00						
OGT9-840	B	From Face	4.50	0.0000	185.00	No Ice	2.27	2.27	18.50
(DNK-24 / CSP-18)			0.00			1/2" Ice	3.44	3.44	36.09
			0.00						
(inverted) DB809T3-Y	B	From Face	4.50	0.0000	168.00	No Ice	2.53	2.53	25.00
(DNK-23 / CSP-19)			0.00			1/2" Ice	3.83	3.83	44.57
			0.00						
(joined) 6' Side Mount	A	From Leg	0.00	45.0000	175.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-23,24 / CSP-19,18)			0.00						
(joined) 6' Side Mount	B	From Leg	0.00	-45.0000	175.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-23,24 / CSP-19,18)			0.00						
Dish Mount	C	None		0.0000	138.00	No Ice	2.40	2.40	90.00
(DNK-12 / CSP-23)						1/2" Ice	3.04	3.04	107.00
Dish Mount	C	None		0.0000	162.50	No Ice	2.40	2.40	90.00
(DNK-19 / CSP-13)						1/2" Ice	3.04	3.04	107.00
Dish Mount	A	None		0.0000	158.00	No Ice	2.40	2.40	90.00
(DNK-16 / CSP-15)						1/2" Ice	3.04	3.04	107.00
VHF-150-6	C	From Face	4.00	0.0000	158.00	No Ice	3.16	3.16	36.00
(DNK-15 / CSP-2)			0.00			1/2" Ice	5.69	5.69	46.80
			0.00						
(joined) 6' Side Mount	B	From Leg	0.00	45.0000	150.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-15 / CSP-2)			0.00						
(joined) 6' Side Mount	C	From Leg	0.00	-45.0000	150.00	No Ice	4.97	4.97	70.00
Standoff			0.00			1/2" Ice	6.12	6.12	130.00
(DNK-15 / CSP-2)			0.00						
PD458-1	B	From Face	4.00	0.0000	167.00	No Ice	2.88	2.88	24.00
(DNK-17 / CTT-9)			0.00			1/2" Ice	4.34	4.34	46.22
			0.00						
(joined) 6' Side Mount	A	From Leg	0.00	45.0000	150.00	No Ice	4.97	4.97	70.00

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* *lb*
Standoff (DNK-17,18 / CTT-9,CSP-54)			0.00 0.00			1/2" Ice	6.12	6.12	130.00
(joined) 6' Side Mount Standoff (DNK-17,18 / CTT-9,CSP-54)	B	From Leg	0.00 0.00 0.00	-45.0000	150.00	No Ice 1/2" Ice	4.97 6.12	4.97 6.12	70.00 130.00
(inverted) SC479-HF1LDF (DNK-18 / CSP-54)	B	From Face	0.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	5.06 6.54	5.06 6.54	34.00 69.82
Dish Mount (DNK-14 / CSP-14)	B	None		0.0000	150.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
Ice Shield (DNK-14 / CSP-14)	B	None		0.0000	150.00	No Ice 1/2" Ice	4.00 5.07	4.00 5.07	200.00 250.00
PD320 (DNK-13 / DEP-21)	B	From Leg	2.00 0.00 0.00	0.0000	146.00	No Ice 1/2" Ice	2.03 4.58	2.03 4.58	15.00 34.00
2' Side Mount Standoff (DNK-13 / DEP-21)	B	None		0.0000	146.00	No Ice 1/2" Ice	2.72 4.91	2.72 4.91	50.00 89.00
Ice Shield (DNK-12 / CSP-23)	C	None		0.0000	138.00	No Ice 1/2" Ice	4.00 5.07	4.00 5.07	200.00 250.00
2' Side Mount Standoff (DNK-11 / CSP-8)	A	None		0.0000	133.00	No Ice 1/2" Ice	2.72 4.91	2.72 4.91	50.00 89.00
DB212-1 (DNK-11 / CSP-8)	A	From Leg	2.00 0.00 0.00	0.0000	133.00	No Ice 1/2" Ice	4.40 8.42	4.40 8.42	31.00 70.21
DB264-A (DNK-10/ FBI-22)	C	From Face	4.50 0.00 0.00	0.0000	135.00	No Ice 1/2" Ice	3.16 5.69	3.16 5.69	36.00 46.80
DB432-A (FBI-24)	C	From Face	4.50 0.00 0.00	0.0000	125.00	No Ice 1/2" Ice	0.30 0.54	0.30 0.54	5.00 6.50
531-70 Dipole (DNK-9 / DOT-52)	C	From Face	4.50 0.00 0.00	0.0000	115.00	No Ice 1/2" Ice	3.23 5.00	2.63 4.39	37.00 56.93
(joined) 6' Side Mount Standoff (DNK-9,10 / DOT-52, FBI-22,24)	B	From Leg	0.00 0.00 0.00	45.0000	125.00	No Ice 1/2" Ice	4.97 6.12	4.97 6.12	70.00 130.00
(joined) 6' Side Mount Standoff (DNK-9,10 / DOT-52, FBI-22,24)	C	From Leg	0.00 0.00 0.00	-45.0000	125.00	No Ice 1/2" Ice	4.97 6.12	4.97 6.12	70.00 130.00
Dish Mount (DNK-8)	A	None		0.0000	113.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
Ice Shield (DNK-8)	A	None		0.0000	113.00	No Ice 1/2" Ice	4.00 5.07	4.00 5.07	200.00 250.00
PD220 (DNK-6 / DHS-3)	B	From Leg	1.00 0.00 0.00	0.0000	113.00	No Ice 1/2" Ice	3.08 5.30	3.08 5.30	23.00 48.68
Dish Mount (DNK-7 / CSP-6)	C	None		0.0000	100.00	No Ice 1/2" Ice	2.40 3.04	2.40 3.04	90.00 107.00
Ice Shield (DNK-7 / CSP-6)	C	None		0.0000	100.00	No Ice 1/2" Ice	4.00 5.07	4.00 5.07	200.00 250.00
DB264-A (DNK-5 / FBI-11)	B	From Leg	1.00 0.00 0.00	0.0000	94.00	No Ice 1/2" Ice	3.16 5.69	3.16 5.69	36.00 46.80

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*Placement*		C_AA_A *Front*	C_AA_A *Side*	*Weight*
			ft *ft* *ft*	°	*ft*		*ft²*	*ft²*	*lb*
2' Side Mount Standoff	C	None		0.0000	87.00	No Ice	2.72	2.72	50.00
(DNK-5&6 / FBI-11, DHS-3)						1/2" Ice	4.91	4.91	89.00
DB212-1	C	From Leg	4.00	0.0000	87.00	No Ice	4.40	4.40	31.00
(DNK-4 / FBI-53)			0.00			1/2" Ice	8.42	8.42	70.21
			0.00						
2' Side Mount Standoff	C	None		0.0000	87.00	No Ice	2.72	2.72	50.00
(DNK-4 / FBI-53)						1/2" Ice	4.91	4.91	89.00
PD156S	B	From Leg	2.00	0.0000	63.50	No Ice	0.50	0.50	4.00
(DNK-3 / NEC-4)			0.00			1/2" Ice	1.51	1.51	11.00
			0.00						
Side Arm Mount	B	None		0.0000	63.50	No Ice	3.00	3.00	45.00
(DNK-3 / NEC-4)						1/2" Ice	4.50	4.50	60.00
DB803Q-XT	C	From Leg	2.00	0.0000	53.00	No Ice	2.05	2.05	27.00
(DNK-2 / CSP-25)			0.00			1/2" Ice	2.55	2.55	42.01
			0.00						
2' Side Mount Standoff	C	None		0.0000	50.00	No Ice	2.72	2.72	50.00
(DNK-1&2 / DEHMS-26,CSP-25)						1/2" Ice	4.91	4.91	89.00
SY203(C) - YAGI Antenna	C	From Leg	2.00	0.0000	49.00	No Ice	16.37	2.53	3.20
(DNK-1 / DEHMS-26)			0.00			1/2" Ice	16.91	2.84	77.98
			0.00						

Dishes

Description	*Face or Leg*	*Dish Type*	*Offset Type*	*Offsets: Horz Lateral Vert*	*Azimuth Adjustment*	*3 dB Beam Width*	*Elevation*	*Outside Diameter*		*Aperture Area*	*Weight*
				ft	°	°	*ft*	*ft*		*ft²*	*lb*
6 FT DISH	A	Paraboloid	From	1.00	0.0000		180.00	6.00	No Ice	28.27	143.00
(CSP Windload -		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
CSP-60)				0.00							
6 FT DISH	B	Paraboloid	From	1.00	0.0000		180.00	6.00	No Ice	28.27	143.00
(CSP Windload -		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
CSP-61)				0.00							
6 FT DISH	C	Paraboloid	From	1.00	0.0000		180.00	6.00	No Ice	28.27	143.00
(CSP Windload -		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
CSP-62)				0.00							
8 FT DISH	A	Paraboloid	From	1.00	0.0000		158.00	8.00	No Ice	50.30	251.00
(DNK-16 / CSP-15)		w/Radome	Leg	0.00					1/2" Ice	51.29	514.30
				0.00							
4 FT DISH	A	Grid	From	1.00	45.0000		175.00	4.00	No Ice	12.56	170.00
(DNK-22 / CSP-5B)			Leg	0.00					1/2" Ice	13.09	237.19
				0.00							
6 FT DISH	B	Paraboloid	From	1.00	0.0000		150.00	6.00	No Ice	28.27	143.00
(DNK-14 / CSP-14)		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
				0.00							
6 FT DISH	C	Paraboloid	From	1.00	0.0000		162.50	6.00	No Ice	28.27	143.00
(DNK-19 / CSP-13)		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
				0.00							
6 FT DISH	C	Paraboloid	From	1.00	0.0000		135.50	6.00	No Ice	28.27	143.00

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* *lb*
(DNK-12 / CSP-22)		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
				0.00							
6 FT DISH	A	Paraboloid	From	1.00	0.0000		168.00	6.00	No Ice	28.27	143.00
(CSP-16)		w/Radome	Leg	0.00					1/2" Ice	29.05	292.13
				0.00							

Tower Pressures - No Ice

$G_H = 1.121$

Section Elevation *ft*	*z* *ft*	K_Z	q_z *psf*	A_G *ft²*	*Face*	A_F *ft²*	A_R *ft²*	A_{leg} *ft²*	*Leg %*	C_AA_A *In Face* *ft²*	C_AA_A *Out Face* *ft²*
T1 180.00-175.00	177.50	1.617	37	56.082	A	5.526	4.171	4.171	43.02	0.000	0.000
					B	7.021	6.746		30.30	0.000	0.000
					C	5.526	4.171		43.02	0.000	0.000
T2 175.00-166.67	170.83	1.6	37	97.919	A	6.784	6.952	6.952	50.61	0.000	0.000
					B	9.071	11.244		34.22	0.000	0.000
					C	6.293	6.952		52.49	0.000	0.000
T3 166.67-158.33	162.50	1.577	36	103.475	A	9.534	7.876	6.952	39.93	0.000	0.000
					B	9.309	11.244		33.83	0.000	0.000
					C	6.518	6.952		51.61	0.000	0.000
T4 158.33-150.00	154.17	1.553	36	109.031	A	9.873	9.098	6.952	36.65	0.000	0.000
					B	9.547	11.244		33.44	0.000	0.000
					C	6.746	6.952		50.75	0.000	0.000
T5 150.00-125.00	137.50	1.503	35	359.009	A	58.263	7.825	21.932	33.19	0.000	0.000
					B	53.490	13.800		32.59	0.000	0.000
					C	45.213	0.000		48.51	0.000	0.000
T6 125.00-100.00	112.50	1.42	33	409.496	A	65.530	9.330	22.420	29.95	0.000	0.000
					B	58.625	20.136		28.47	0.000	0.000
					C	50.917	0.000		44.03	0.000	0.000
T7 100.00-75.00	87.50	1.321	31	459.733	A	74.382	13.473	25.027	28.49	0.000	0.000
					B	67.529	23.235		27.57	0.000	0.000
					C	60.301	0.000		41.50	0.000	0.000
T8 75.00-50.00	62.50	1.2	28	513.151	A	76.610	16.315	31.283	33.67	0.000	0.000
					B	69.915	24.438		33.16	0.000	0.000
					C	62.197	0.000		50.30	0.000	0.000
T9 50.00-25.00	37.50	1.037	24	563.151	A	88.654	19.313	31.283	28.97	0.000	0.000
					B	82.218	24.438		29.33	0.000	0.000
					C	76.089	0.000		41.11	0.000	0.000
T10 25.00-0.00	12.50	1	23	613.151	A	86.621	11.588	31.283	31.85	0.000	0.000
					B	82.756	14.663		32.11	0.000	0.000
					C	79.013	0.000		39.59	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.121$

Section Elevation *ft*	*z* *ft*	K_Z	q_z *psf*	t_Z *in*	A_G ft^2	*Face*	A_F ft^2	A_R ft^2	A_{leg} ft^2	*Leg %*	C_AA_A *In Face* ft^2	C_AA_A *Out Face* ft^2
T1 180.00-175.00	177.50	1.617	34	0.5000	56.499	A	5.526	7.046	5.005	39.81	0.000	0.000
						B	7.544	10.995		27.00	0.000	0.000
						C	5.526	7.046		39.81	0.000	0.000
T2 175.00-166.67	170.83	1.6	33	0.5000	98.614	A	6.984	10.836	8.342	46.82	0.000	0.000
						B	10.127	17.587		30.10	0.000	0.000
						C	6.293	10.859		48.64	0.000	0.000
T3 166.67-158.33	162.50	1.577	33	0.5000	104.170	A	10.748	12.218	8.342	36.32	0.000	0.000
						B	10.372	17.685		29.73	0.000	0.000
						C	6.518	10.949		47.76	0.000	0.000
T4 158.33-150.00	154.17	1.553	32	0.5000	109.726	A	11.109	14.333	8.342	32.79	0.000	0.000
						B	10.617	17.783		29.37	0.000	0.000
						C	6.746	11.041		46.90	0.000	0.000
T5 150.00-125.00	137.50	1.503	31	0.5000	361.094	A	66.183	20.953	24.712	28.36	0.000	0.000
						B	59.383	30.625		27.46	0.000	0.000
						C	47.994	8.650		43.63	0.000	0.000
T6 125.00-100.00	112.50	1.42	29	0.5000	411.581	A	73.968	25.022	25.200	25.46	0.000	0.000
						B	64.033	43.267		23.49	0.000	0.000
						C	53.698	9.499		39.88	0.000	0.000
T7 100.00-75.00	87.50	1.321	27	0.5000	461.818	A	82.342	34.078	27.807	23.89	0.000	0.000
						B	72.550	49.885		22.71	0.000	0.000
						C	63.082	10.325		37.88	0.000	0.000
T8 75.00-50.00	62.50	1.2	25	0.5000	515.236	A	85.251	37.509	34.064	27.75	0.000	0.000
						B	75.276	50.550		27.07	0.000	0.000
						C	64.978	8.382		46.43	0.000	0.000
T9 50.00-25.00	37.50	1.037	22	0.5000	565.236	A	97.691	45.751	34.064	23.75	0.000	0.000
						B	86.421	54.329		24.20	0.000	0.000
						C	78.870	13.148		37.02	0.000	0.000
T10 25.00-0.00	12.50	1	21	0.5000	615.236	A	93.209	33.601	34.064	26.86	0.000	0.000
						B	86.438	38.744		27.21	0.000	0.000
						C	81.794	14.001		35.56	0.000	0.000

Tower Pressure - Service

$G_H = 1.121$

Section Elevation *ft*	*z* *ft*	K_Z	q_z *psf*	A_G ft^2	*Face*	A_F ft^2	A_R ft^2	A_{leg} ft^2	*Leg %*	C_AA_A *In Face* ft^2	C_AA_A *Out Face* ft^2
T1 180.00-175.00	177.50	1.617	34	56.082	A	5.526	4.171	4.171	43.02	0.000	0.000
					B	7.021	6.746		30.30	0.000	0.000
					C	5.526	4.171		43.02	0.000	0.000
T2 175.00-166.67	170.83	1.6	33	97.919	A	6.784	6.952	6.952	50.61	0.000	0.000
					B	9.071	11.244		34.22	0.000	0.000
					C	6.293	6.952		52.49	0.000	0.000
T3 166.67-158.33	162.50	1.577	33	103.475	A	9.534	7.876	6.952	39.93	0.000	0.000
					B	9.309	11.244		33.83	0.000	0.000
					C	6.518	6.952		51.61	0.000	0.000
T4 158.33-150.00	154.17	1.553	32	109.031	A	9.873	9.098	6.952	36.65	0.000	0.000
					B	9.547	11.244		33.44	0.000	0.000
					C	6.746	6.952		50.75	0.000	0.000
T5 150.00-125.00	137.50	1.503	31	359.009	A	58.263	7.825	21.932	33.19	0.000	0.000
					B	53.490	13.800		32.59	0.000	0.000
					C	45.213	0.000		48.51	0.000	0.000
T6	112.50	1.42	29	409.496	A	65.530	9.330	22.420	29.95	0.000	0.000

Section Elevation *ft*	*z* *ft*	*K_Z*	*q_z* *psf*	*A_G* *ft^2*	*Face*	*A_F* *ft^2*	*A_R* *ft^2*	*A_{leg}* *ft^2*	*Leg %*	*C_AA_A In Face* *ft^2*	*C_AA_A Out Face* *ft^2*
125.00-100.00					B	58.625	20.136		28.47	0.000	0.000
					C	50.917	0.000		44.03	0.000	0.000
T7 100.00-75.00	87.50	1.321	27	459.733	A	74.382	13.473	25.027	28.49	0.000	0.000
					B	67.529	23.235		27.57	0.000	0.000
					C	60.301	0.000		41.50	0.000	0.000
T8 75.00-50.00	62.50	1.2	25	513.151	A	76.610	16.315	31.283	33.67	0.000	0.000
					B	69.915	24.438		33.16	0.000	0.000
					C	62.197	0.000		50.30	0.000	0.000
T9 50.00-25.00	37.50	1.037	22	563.151	A	88.654	19.313	31.283	28.97	0.000	0.000
					B	82.218	24.438		29.33	0.000	0.000
					C	76.089	0.000		41.11	0.000	0.000
T10 25.00-0.00	12.50	1	21	613.151	A	86.621	11.588	31.283	31.85	0.000	0.000
					B	82.756	14.663		32.11	0.000	0.000
					C	79.013	0.000		39.59	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	*C_F*	*R_R*	*D_F*	*D_R*	*A_E* *ft^2*	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1 180.00-175.00	23.75	579.98	A	0.173	2.689	0.585	1	1	7.967	1136.75	227.35	B
			B	0.245	2.451	0.601	1	1	11.074			
			C	0.173	2.689	0.585	1	1	7.967			
T2 175.00-166.67	41.70	734.95	A	0.14	2.808	0.58	1	1	10.817	1675.12	201.01	B
			B	0.207	2.571	0.592	1	1	15.727			
			C	0.135	2.826	0.579	1	1	10.320			
T3 166.67-158.33	58.59	747.53	A	0.168	2.705	0.584	1	1	14.137	1693.23	203.19	B
			B	0.199	2.601	0.59	1	1	15.944			
			C	0.13	2.846	0.579	1	1	10.541			
T4 158.33-150.00	66.80	796.60	A	0.174	2.685	0.585	1	1	15.199	1708.44	205.01	B
			B	0.191	2.627	0.589	1	1	16.164			
			C	0.126	2.863	0.578	1	1	10.764			
T5 150.00-125.00	230.32	3707.32	A	0.184	2.65	0.587	1	1	62.858	6485.41	259.42	A
			B	0.187	2.639	0.588	1	1	61.603			
			C	0.126	2.862	0.578	1	1	45.213			
T6 125.00-100.00	283.39	4679.49	A	0.183	2.654	0.587	1	1	71.007	6929.43	277.18	A
			B	0.192	2.622	0.589	1	1	70.483			
			C	0.124	2.868	0.578	1	1	50.917			
T7 100.00-75.00	325.25	6199.19	A	0.191	2.626	0.589	1	1	82.313	7396.08	295.84	A
			B	0.197	2.605	0.59	1	1	81.235			
			C	0.131	2.842	0.579	1	1	60.301			
T8 75.00-50.00	348.54	7171.40	A	0.181	2.66	0.587	1	1	86.183	7126.12	285.04	A
			B	0.184	2.651	0.587	1	1	84.266			
			C	0.121	2.88	0.577	1	1	62.197			
T9 50.00-25.00	364.75	7706.04	A	0.192	2.624	0.589	1	1	100.024	7049.46	281.98	A
			B	0.189	2.632	0.588	1	1	96.594			
			C	0.135	2.827	0.579	1	1	76.089			
T10 25.00-0.00	218.85	8304.28	A	0.16	2.734	0.583	1	1	93.377	6612.26	264.49	A
			B	0.159	2.739	0.583	1	1	91.303			
			C	0.129	2.851	0.578	1	1	79.013			
Sum Weight:	1961.93	40626.76						OTM	4137.33 kip-ft	47812.29		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	0.825	1	7.000	1010.62	202.12	B
180.00-175.00			B	0.245	2.451	0.601	0.825	1	9.845			
			C	0.173	2.689	0.585	0.825	1	7.000			
T2	41.70	734.95	A	0.14	2.808	0.58	0.825	1	9.629	1506.03	180.72	B
175.00-166.67			B	0.207	2.571	0.592	0.825	1	14.139			
			C	0.135	2.826	0.579	0.825	1	9.219			
T3	58.59	747.53	A	0.168	2.705	0.584	0.825	1	12.469	1520.23	182.43	B
166.67-158.33			B	0.199	2.601	0.59	0.825	1	14.315			
			C	0.13	2.846	0.579	0.825	1	9.400			
T4	66.80	796.60	A	0.174	2.685	0.585	0.825	1	13.471	1531.86	183.82	B
158.33-150.00			B	0.191	2.627	0.589	0.825	1	14.493			
			C	0.126	2.863	0.578	0.825	1	9.584			
T5	230.32	3707.32	A	0.184	2.65	0.587	0.825	1	52.662	5433.44	217.34	A
150.00-125.00			B	0.187	2.639	0.588	0.825	1	52.243			
			C	0.126	2.862	0.578	0.825	1	37.301			
T6	283.39	4679.49	A	0.183	2.654	0.587	0.825	1	59.540	5810.31	232.41	A
125.00-100.00			B	0.192	2.622	0.589	0.825	1	60.224			
			C	0.124	2.868	0.578	0.825	1	42.007			
T7	325.25	6199.19	A	0.191	2.626	0.589	0.825	1	69.296	6226.47	249.06	A
100.00-75.00			B	0.197	2.605	0.59	0.825	1	69.417			
			C	0.131	2.842	0.579	0.825	1	49.748			
T8	348.54	7171.40	A	0.181	2.66	0.587	0.825	1	72.776	6017.56	240.70	A
75.00-50.00			B	0.184	2.651	0.587	0.825	1	72.031			
			C	0.121	2.88	0.577	0.825	1	51.312			
T9	364.75	7706.04	A	0.192	2.624	0.589	0.825	1	84.510	5956.03	238.24	A
50.00-25.00			B	0.189	2.632	0.588	0.825	1	82.206			
			C	0.135	2.827	0.579	0.825	1	62.774			
T10	218.85	8304.28	A	0.16	2.734	0.583	0.825	1	78.219	5538.84	221.55	A
25.00-0.00			B	0.159	2.739	0.583	0.825	1	76.820			
			C	0.129	2.851	0.578	0.825	1	65.186			
Sum Weight:	1961.93	40626.76						OTM	3534.12 kip-ft	40551.41		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	0.8	1	6.862	992.61	198.52	B
180.00-175.00			B	0.245	2.451	0.601	0.8	1	9.669			
			C	0.173	2.689	0.585	0.8	1	6.862			
T2	41.70	734.95	A	0.14	2.808	0.58	0.8	1	9.460	1481.88	177.83	B
175.00-166.67			B	0.207	2.571	0.592	0.8	1	13.913			
			C	0.135	2.826	0.579	0.8	1	9.062			
T3	58.59	747.53	A	0.168	2.705	0.584	0.8	1	12.230	1495.51	179.46	B
166.67-158.33			B	0.199	2.601	0.59	0.8	1	14.082			
			C	0.13	2.846	0.579	0.8	1	9.237			
T4	66.80	796.60	A	0.174	2.685	0.585	0.8	1	13.224	1506.63	180.80	B
158.33-150.00			B	0.191	2.627	0.589	0.8	1	14.255			
			C	0.126	2.863	0.578	0.8	1	9.415			
T5	230.32	3707.32	A	0.184	2.65	0.587	0.8	1	51.206	5283.15	211.33	A
150.00-125.00			B	0.187	2.639	0.588	0.8	1	50.905			

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*F a c e*	*e*	*C_F*	*R_R*	*D_F*	*D_R*	*A_E* *ft²*	*F* *lb*	*w* *plf*	*Ctrl. Face*
			C	0.126	2.862	0.578	0.8	1	36.170			
T6	283.39	4679.49	A	0.183	2.654	0.587	0.8	1	57.901	5663.55	226.54	B
125.00-100.00			B	0.192	2.622	0.589	0.8	1	58.758			
			C	0.124	2.868	0.578	0.8	1	40.734			
T7	325.25	6199.19	A	0.191	2.626	0.589	0.8	1	67.436	6059.39	242.38	A
100.00-75.00			B	0.197	2.605	0.59	0.8	1	67.729			
			C	0.131	2.842	0.579	0.8	1	48.241			
T8	348.54	7171.40	A	0.181	2.66	0.587	0.8	1	70.861	5859.20	234.37	A
75.00-50.00			B	0.184	2.651	0.587	0.8	1	70.283			
			C	0.121	2.88	0.577	0.8	1	49.758			
T9	364.75	7706.04	A	0.192	2.624	0.589	0.8	1	82.293	5799.83	231.99	A
50.00-25.00			B	0.189	2.632	0.588	0.8	1	80.151			
			C	0.135	2.827	0.579	0.8	1	60.871			
T10	218.85	8304.28	A	0.16	2.734	0.583	0.8	1	76.053	5385.50	215.42	A
25.00-0.00			B	0.159	2.739	0.583	0.8	1	74.751			
			C	0.129	2.851	0.578	0.8	1	63.211			
Sum Weight:	1961.93	40626.76						OTM	3449.43 kip-ft	39527.25		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*F a c e*	*e*	*C_F*	*R_R*	*D_F*	*D_R*	*A_E* *ft²*	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	0.85	1	7.138	1028.64	205.73	B
180.00-175.00			B	0.245	2.451	0.601	0.85	1	10.021			
			C	0.173	2.689	0.585	0.85	1	7.138			
T2	41.70	734.95	A	0.14	2.808	0.58	0.85	1	9.799	1530.19	183.62	B
175.00-166.67			B	0.207	2.571	0.592	0.85	1	14.366			
			C	0.135	2.826	0.579	0.85	1	9.376			
T3	58.59	747.53	A	0.168	2.705	0.584	0.85	1	12.707	1544.94	185.39	B
166.67-158.33			B	0.199	2.601	0.59	0.85	1	14.547			
			C	0.13	2.846	0.579	0.85	1	9.563			
T4	66.80	796.60	A	0.174	2.685	0.585	0.85	1	13.718	1557.08	186.85	B
158.33-150.00			B	0.191	2.627	0.589	0.85	1	14.732			
			C	0.126	2.863	0.578	0.85	1	9.752			
T5	230.32	3707.32	A	0.184	2.65	0.587	0.85	1	54.119	5583.72	223.35	A
150.00-125.00			B	0.187	2.639	0.588	0.85	1	53.580			
			C	0.126	2.862	0.578	0.85	1	38.431			
T6	283.39	4679.49	A	0.183	2.654	0.587	0.85	1	61.178	5970.19	238.81	A
125.00-100.00			B	0.192	2.622	0.589	0.85	1	61.689			
			C	0.124	2.868	0.578	0.85	1	43.280			
T7	325.25	6199.19	A	0.191	2.626	0.589	0.85	1	71.156	6393.56	255.74	A
100.00-75.00			B	0.197	2.605	0.59	0.85	1	71.106			
			C	0.131	2.842	0.579	0.85	1	51.256			
T8	348.54	7171.40	A	0.181	2.66	0.587	0.85	1	74.691	6175.93	247.04	A
75.00-50.00			B	0.184	2.651	0.587	0.85	1	73.778			
			C	0.121	2.88	0.577	0.85	1	52.867			
T9	364.75	7706.04	A	0.192	2.624	0.589	0.85	1	86.726	6112.24	244.49	A
50.00-25.00			B	0.189	2.632	0.588	0.85	1	84.261			
			C	0.135	2.827	0.579	0.85	1	64.676			
T10	218.85	8304.28	A	0.16	2.734	0.583	0.85	1	80.384	5692.19	227.69	A
25.00-0.00			B	0.159	2.739	0.583	0.85	1	78.889			
			C	0.129	2.851	0.578	0.85	1	67.161			

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
Sum Weight:	1961.93	40626.76						OTM	3620.30 kip-ft	41588.68		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	69.21	849.94	A	0.223	2.523	0.595	1	1	9.720	1204.96	240.99	B
180.00-175.00			B	0.328	2.224	0.625	1	1	14.415			
			C	0.223	2.523	0.595	1	1	9.720			
T2	122.94	1078.07	A	0.181	2.662	0.587	1	1	13.340	1820.73	218.49	B
175.00-166.67			B	0.281	2.348	0.61	1	1	20.860			
			C	0.174	2.685	0.585	1	1	12.650			
T3	177.20	1098.79	A	0.22	2.529	0.595	1	1	18.015	1841.72	221.01	B
166.67-158.33			B	0.269	2.381	0.607	1	1	21.106			
			C	0.168	2.707	0.584	1	1	12.916			
T4	199.56	1156.12	A	0.232	2.493	0.597	1	1	19.671	1859.60	223.15	B
158.33-150.00			B	0.259	2.411	0.604	1	1	21.360			
			C	0.162	2.727	0.583	1	1	13.187			
T5	695.53	5303.21	A	0.241	2.464	0.6	1	1	78.748	6779.73	271.19	A
150.00-125.00			B	0.249	2.44	0.602	1	1	77.810			
			C	0.157	2.746	0.583	1	1	53.033			
T6	853.53	6420.98	A	0.241	2.466	0.6	1	1	88.969	7240.04	289.60	A
125.00-100.00			B	0.261	2.406	0.605	1	1	90.195			
			C	0.154	2.758	0.582	1	1	59.227			
T7	974.28	8185.90	A	0.252	2.431	0.602	1	1	102.871	7680.66	307.23	A
100.00-75.00			B	0.265	2.393	0.606	1	1	102.772			
			C	0.159	2.739	0.583	1	1	69.100			
T8	1041.78	9205.54	A	0.238	2.473	0.599	1	1	107.717	7431.35	297.25	A
75.00-50.00			B	0.244	2.455	0.6	1	1	105.626			
			C	0.142	2.8	0.58	1	1	69.842			
T9	1094.70	10245.01	A	0.254	2.426	0.603	1	1	125.272	7326.99	293.08	A
50.00-25.00			B	0.249	2.44	0.602	1	1	119.107			
			C	0.163	2.725	0.584	1	1	86.542			
T10	656.82	10988.42	A	0.206	2.576	0.592	1	1	113.090	6770.14	270.81	A
25.00-0.00			B	0.203	2.584	0.591	1	1	109.341			
			C	0.156	2.751	0.582	1	1	89.948			
Sum Weight:	5885.55	54531.98						OTM	4353.51 kip-ft	49955.92		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	69.21	849.94	A	0.223	2.523	0.595	0.825	1	8.753	1094.60	218.92	B
180.00-175.00			B	0.328	2.224	0.625	0.825	1	13.095			
			C	0.223	2.523	0.595	0.825	1	8.753			

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T2	122.94	1078.07	A	0.181	2.662	0.587	0.825	1	12.118	1666.05	199.93	B
175.00-166.67			B	0.281	2.348	0.61	0.825	1	19.088			
			C	0.174	2.685	0.585	0.825	1	11.549			
T3	177.20	1098.79	A	0.22	2.529	0.595	0.825	1	16.134	1683.34	202.00	B
166.67-158.33			B	0.269	2.381	0.607	0.825	1	19.291			
			C	0.168	2.707	0.584	0.825	1	11.776			
T4	199.56	1156.12	A	0.232	2.493	0.597	0.825	1	17.727	1697.85	203.74	B
158.33-150.00			B	0.259	2.411	0.604	0.825	1	19.503			
			C	0.162	2.727	0.583	0.825	1	12.006			
T5	695.53	5303.21	A	0.241	2.464	0.6	0.825	1	67.166	5782.60	231.30	A
150.00-125.00			B	0.249	2.44	0.602	0.825	1	67.418			
			C	0.157	2.746	0.583	0.825	1	44.634			
T6	853.53	6420.98	A	0.241	2.466	0.6	0.825	1	76.024	6270.29	250.81	B
125.00-100.00			B	0.261	2.406	0.605	0.825	1	78.990			
			C	0.154	2.758	0.582	0.825	1	49.829			
T7	974.28	8185.90	A	0.252	2.431	0.602	0.825	1	88.461	6619.40	264.78	B
100.00-75.00			B	0.265	2.393	0.606	0.825	1	90.076			
			C	0.159	2.739	0.583	0.825	1	58.061			
T8	1041.78	9205.54	A	0.238	2.473	0.599	0.825	1	92.798	6402.10	256.08	A
75.00-50.00			B	0.244	2.455	0.6	0.825	1	92.453			
			C	0.142	2.8	0.58	0.825	1	58.471			
T9	1094.70	10245.01	A	0.254	2.426	0.603	0.825	1	108.176	6327.08	253.08	A
50.00-25.00			B	0.249	2.44	0.602	0.825	1	103.983			
			C	0.163	2.725	0.584	0.825	1	72.740			
T10	656.82	10988.42	A	0.206	2.576	0.592	0.825	1	96.778	5793.64	231.75	A
25.00-0.00			B	0.203	2.584	0.591	0.825	1	94.214			
			C	0.156	2.751	0.582	0.825	1	75.634			
Sum Weight:	5885.55	54531.98						OTM	3803.73 kip-ft	43336.95		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	69.21	849.94	A	0.223	2.523	0.595	0.8	1	8.615	1078.84	215.77	B
180.00-175.00			B	0.328	2.224	0.625	0.8	1	12.906			
			C	0.223	2.523	0.595	0.8	1	8.615			
T2	122.94	1078.07	A	0.181	2.662	0.587	0.8	1	11.944	1643.95	197.27	B
175.00-166.67			B	0.281	2.348	0.61	0.8	1	18.834			
			C	0.174	2.685	0.585	0.8	1	11.391			
T3	177.20	1098.79	A	0.22	2.529	0.595	0.8	1	15.866	1660.71	199.29	B
166.67-158.33			B	0.269	2.381	0.607	0.8	1	19.032			
			C	0.168	2.707	0.584	0.8	1	11.613			
T4	199.56	1156.12	A	0.232	2.493	0.597	0.8	1	17.449	1674.75	200.97	B
158.33-150.00			B	0.259	2.411	0.604	0.8	1	19.237			
			C	0.162	2.727	0.583	0.8	1	11.838			
T5	695.53	5303.21	A	0.241	2.464	0.6	0.8	1	65.512	5640.15	225.61	A
150.00-125.00			B	0.249	2.44	0.602	0.8	1	65.934			
			C	0.157	2.746	0.583	0.8	1	43.434			
T6	853.53	6420.98	A	0.241	2.466	0.6	0.8	1	74.175	6143.21	245.73	B
125.00-100.00			B	0.261	2.406	0.605	0.8	1	77.389			
			C	0.154	2.758	0.582	0.8	1	48.487			
T7	974.28	8185.90	A	0.252	2.431	0.602	0.8	1	86.402	6486.12	259.44	B
100.00-75.00			B	0.265	2.393	0.606	0.8	1	88.263			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
			C	0.159	2.739	0.583	0.8	1	56.484			
T8	1041.78	9205.54	A	0.238	2.473	0.599	0.8	1	90.666	6255.06	250.20	A
75.00-50.00			B	0.244	2.455	0.6	0.8	1	90.571			
			C	0.142	2.8	0.58	0.8	1	56.846			
T9	1094.70	10245.01	A	0.254	2.426	0.603	0.8	1	105.733	6184.23	247.37	A
50.00-25.00			B	0.249	2.44	0.602	0.8	1	101.822			
			C	0.163	2.725	0.584	0.8	1	70.768			
T10	656.82	10988.42	A	0.206	2.576	0.592	0.8	1	94.448	5654.14	226.17	A
25.00-0.00			B	0.203	2.584	0.591	0.8	1	92.053			
			C	0.156	2.751	0.582	0.8	1	73.589			
Sum Weight:	5885.55	54531.98						OTM	3728.08	42421.16		
									kip-ft			

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
T1	69.21	849.94	A	0.223	2.523	0.595	0.85	1	8.891	1110.37	222.07	B
180.00-175.00			B	0.328	2.224	0.625	0.85	1	13.283			
			C	0.223	2.523	0.595	0.85	1	8.891			
T2	122.94	1078.07	A	0.181	2.662	0.587	0.85	1	12.293	1688.14	202.58	B
175.00-166.67			B	0.281	2.348	0.61	0.85	1	19.341			
			C	0.174	2.685	0.585	0.85	1	11.706			
T3	177.20	1098.79	A	0.22	2.529	0.595	0.85	1	16.403	1705.97	204.72	B
166.67-158.33			B	0.269	2.381	0.607	0.85	1	19.551			
			C	0.168	2.707	0.584	0.85	1	11.939			
T4	199.56	1156.12	A	0.232	2.493	0.597	0.85	1	18.005	1720.96	206.52	B
158.33-150.00			B	0.259	2.411	0.604	0.85	1	19.768			
			C	0.162	2.727	0.583	0.85	1	12.175			
T5	695.53	5303.21	A	0.241	2.464	0.6	0.85	1	68.821	5925.04	237.00	A
150.00-125.00			B	0.249	2.44	0.602	0.85	1	68.903			
			C	0.157	2.746	0.583	0.85	1	45.834			
T6	853.53	6420.98	A	0.241	2.466	0.6	0.85	1	77.874	6397.36	255.89	B
125.00-100.00			B	0.261	2.406	0.605	0.85	1	80.590			
			C	0.154	2.758	0.582	0.85	1	51.172			
T7	974.28	8185.90	A	0.252	2.431	0.602	0.85	1	90.520	6758.48	270.34	A
100.00-75.00			B	0.265	2.393	0.606	0.85	1	91.890			
			C	0.159	2.739	0.583	0.85	1	59.638			
T8	1041.78	9205.54	A	0.238	2.473	0.599	0.85	1	94.929	6549.14	261.97	A
75.00-50.00			B	0.244	2.455	0.6	0.85	1	94.335			
			C	0.142	2.8	0.58	0.85	1	60.095			
T9	1094.70	10245.01	A	0.254	2.426	0.603	0.85	1	110.618	6469.92	258.80	A
50.00-25.00			B	0.249	2.44	0.602	0.85	1	106.144			
			C	0.163	2.725	0.584	0.85	1	74.712			
T10	656.82	10988.42	A	0.206	2.576	0.592	0.85	1	99.108	5933.14	237.33	A
25.00-0.00			B	0.203	2.584	0.591	0.85	1	96.375			
			C	0.156	2.751	0.582	0.85	1	77.678			
Sum Weight:	5885.55	54531.98						OTM	3879.89	44258.52		
									kip-ft			

Tower Forces - Service - Wind Normal To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	1	1	7.967	1020.24	204.05	B
180.00-175.00			B	0.245	2.451	0.601	1	1	11.074			
			C	0.173	2.689	0.585	1	1	7.967			
T2	41.70	734.95	A	0.14	2.808	0.58	1	1	10.817	1503.43	180.41	B
175.00-166.67			B	0.207	2.571	0.592	1	1	15.727			
			C	0.135	2.826	0.579	1	1	10.320			
T3	58.59	747.53	A	0.168	2.705	0.584	1	1	14.137	1519.69	182.36	B
166.67-158.33			B	0.199	2.601	0.59	1	1	15.944			
			C	0.13	2.846	0.579	1	1	10.541			
T4	66.80	796.60	A	0.174	2.685	0.585	1	1	15.199	1533.33	184.00	B
158.33-150.00			B	0.191	2.627	0.589	1	1	16.164			
			C	0.126	2.863	0.578	1	1	10.764			
T5	230.32	3707.32	A	0.184	2.65	0.587	1	1	62.858	5820.70	232.83	A
150.00-125.00			B	0.187	2.639	0.588	1	1	61.603			
			C	0.126	2.862	0.578	1	1	45.213			
T6	283.39	4679.49	A	0.183	2.654	0.587	1	1	71.007	6219.21	248.77	A
125.00-100.00			B	0.192	2.622	0.589	1	1	70.483			
			C	0.124	2.868	0.578	1	1	50.917			
T7	325.25	6199.19	A	0.191	2.626	0.589	1	1	82.313	6638.03	265.52	A
100.00-75.00			B	0.197	2.605	0.59	1	1	81.235			
			C	0.131	2.842	0.579	1	1	60.301			
T8	348.54	7171.40	A	0.181	2.66	0.587	1	1	86.183	6395.74	255.83	A
75.00-50.00			B	0.184	2.651	0.587	1	1	84.266			
			C	0.121	2.88	0.577	1	1	62.197			
T9	364.75	7706.04	A	0.192	2.624	0.589	1	1	100.024	6326.93	253.08	A
50.00-25.00			B	0.189	2.632	0.588	1	1	96.594			
			C	0.135	2.827	0.579	1	1	76.089			
T10	218.85	8304.28	A	0.16	2.734	0.583	1	1	93.377	5934.55	237.38	A
25.00-0.00			B	0.159	2.739	0.583	1	1	91.303			
			C	0.129	2.851	0.578	1	1	79.013			
Sum Weight:	1961.93	40626.76						OTM	3713.28 kip-ft	42911.86		

Tower Forces - Service - Wind 45 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	0.825	1	7.000	907.04	181.41	B
180.00-175.00			B	0.245	2.451	0.601	0.825	1	9.845			
			C	0.173	2.689	0.585	0.825	1	7.000			
T2	41.70	734.95	A	0.14	2.808	0.58	0.825	1	9.629	1351.68	162.20	B
175.00-166.67			B	0.207	2.571	0.592	0.825	1	14.139			
			C	0.135	2.826	0.579	0.825	1	9.219			
T3	58.59	747.53	A	0.168	2.705	0.584	0.825	1	12.469	1364.41	163.73	B
166.67-158.33			B	0.199	2.601	0.59	0.825	1	14.315			
			C	0.13	2.846	0.579	0.825	1	9.400			
T4	66.80	796.60	A	0.174	2.685	0.585	0.825	1	13.471	1374.85	164.98	B
158.33-150.00			B	0.191	2.627	0.589	0.825	1	14.493			
			C	0.126	2.863	0.578	0.825	1	9.584			
T5	230.32	3707.32	A	0.184	2.65	0.587	0.825	1	52.662	4876.55	195.06	A
150.00-125.00			B	0.187	2.639	0.588	0.825	1	52.243			

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
			C	0.126	2.862	0.578	0.825	1	37.301			
T6	283.39	4679.49	A	0.183	2.654	0.587	0.825	1	59.540	5214.80	208.59	A
125.00-100.00			B	0.192	2.622	0.589	0.825	1	60.224			
			C	0.124	2.868	0.578	0.825	1	42.007			
T7	325.25	6199.19	A	0.191	2.626	0.589	0.825	1	69.296	5588.30	223.53	A
100.00-75.00			B	0.197	2.605	0.59	0.825	1	69.417			
			C	0.131	2.842	0.579	0.825	1	49.748			
T8	348.54	7171.40	A	0.181	2.66	0.587	0.825	1	72.776	5400.80	216.03	A
75.00-50.00			B	0.184	2.651	0.587	0.825	1	72.031			
			C	0.121	2.88	0.577	0.825	1	51.312			
T9	364.75	7706.04	A	0.192	2.624	0.589	0.825	1	84.510	5345.58	213.82	A
50.00-25.00			B	0.189	2.632	0.588	0.825	1	82.206			
			C	0.135	2.827	0.579	0.825	1	62.774			
T10	218.85	8304.28	A	0.16	2.734	0.583	0.825	1	78.219	4971.15	198.85	A
25.00-0.00			B	0.159	2.739	0.583	0.825	1	76.820			
			C	0.129	2.851	0.578	0.825	1	65.186			
Sum Weight:	1961.93	40626.76						OTM	3171.90 kip-ft	36395.17		

Tower Forces - Service - Wind 60 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E ft^2	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1	23.75	579.98	A	0.173	2.689	0.585	0.8	1	6.862	890.87	178.17	B
180.00-175.00			B	0.245	2.451	0.601	0.8	1	9.669			
			C	0.173	2.689	0.585	0.8	1	6.862			
T2	41.70	734.95	A	0.14	2.808	0.58	0.8	1	9.460	1330.00	159.60	B
175.00-166.67			B	0.207	2.571	0.592	0.8	1	13.913			
			C	0.135	2.826	0.579	0.8	1	9.062			
T3	58.59	747.53	A	0.168	2.705	0.584	0.8	1	12.230	1342.23	161.07	B
166.67-158.33			B	0.199	2.601	0.59	0.8	1	14.082			
			C	0.13	2.846	0.579	0.8	1	9.237			
T4	66.80	796.60	A	0.174	2.685	0.585	0.8	1	13.224	1352.21	162.27	B
158.33-150.00			B	0.191	2.627	0.589	0.8	1	14.255			
			C	0.126	2.863	0.578	0.8	1	9.415			
T5	230.32	3707.32	A	0.184	2.65	0.587	0.8	1	51.206	4741.67	189.67	A
150.00-125.00			B	0.187	2.639	0.588	0.8	1	50.905			
			C	0.126	2.862	0.578	0.8	1	36.170			
T6	283.39	4679.49	A	0.183	2.654	0.587	0.8	1	57.901	5083.07	203.32	B
125.00-100.00			B	0.192	2.622	0.589	0.8	1	58.758			
			C	0.124	2.868	0.578	0.8	1	40.734			
T7	325.25	6199.19	A	0.191	2.626	0.589	0.8	1	67.436	5438.34	217.53	A
100.00-75.00			B	0.197	2.605	0.59	0.8	1	67.729			
			C	0.131	2.842	0.579	0.8	1	48.241			
T8	348.54	7171.40	A	0.181	2.66	0.587	0.8	1	70.861	5258.67	210.35	A
75.00-50.00			B	0.184	2.651	0.587	0.8	1	70.283			
			C	0.121	2.88	0.577	0.8	1	49.758			
T9	364.75	7706.04	A	0.192	2.624	0.589	0.8	1	82.293	5205.39	208.22	A
50.00-25.00			B	0.189	2.632	0.588	0.8	1	80.151			
			C	0.135	2.827	0.579	0.8	1	60.871			
T10	218.85	8304.28	A	0.16	2.734	0.583	0.8	1	76.053	4833.52	193.34	A
25.00-0.00			B	0.159	2.739	0.583	0.8	1	74.751			
			C	0.129	2.851	0.578	0.8	1	63.211			

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E *ft*^{2}	*F* *lb*	*w* *plf*	*Ctrl. Face*
Sum Weight:	1961.93	40626.76						OTM	3095.88 kip-ft	35475.98		

Tower Forces - Service - Wind 90 To Face

Section Elevation *ft*	*Add Weight* *lb*	*Self Weight* *lb*	*Face*	*e*	C_F	R_R	D_F	D_R	A_E *ft*^{2}	*F* *lb*	*w* *plf*	*Ctrl. Face*
T1 180.00-175.00	23.75	579.98	A	0.173	2.689	0.585	0.85	1	7.138	923.21	184.64	B
			B	0.245	2.451	0.601	0.85	1	10.021			
			C	0.173	2.689	0.585	0.85	1	7.138			
T2 175.00-166.67	41.70	734.95	A	0.14	2.808	0.58	0.85	1	9.799	1373.36	164.80	B
			B	0.207	2.571	0.592	0.85	1	14.366			
			C	0.135	2.826	0.579	0.85	1	9.376			
T3 166.67-158.33	58.59	747.53	A	0.168	2.705	0.584	0.85	1	12.707	1386.60	166.39	B
			B	0.199	2.601	0.59	0.85	1	14.547			
			C	0.13	2.846	0.579	0.85	1	9.563			
T4 158.33-150.00	66.80	796.60	A	0.174	2.685	0.585	0.85	1	13.718	1397.49	167.70	B
			B	0.191	2.627	0.589	0.85	1	14.732			
			C	0.126	2.863	0.578	0.85	1	9.752			
T5 150.00-125.00	230.32	3707.32	A	0.184	2.65	0.587	0.85	1	54.119	5011.43	200.46	A
			B	0.187	2.639	0.588	0.85	1	53.580			
			C	0.126	2.862	0.578	0.85	1	38.431			
T6 125.00-100.00	283.39	4679.49	A	0.183	2.654	0.587	0.85	1	61.178	5358.28	214.33	A
			B	0.192	2.622	0.589	0.85	1	61.689			
			C	0.124	2.868	0.578	0.85	1	43.280			
T7 100.00-75.00	325.25	6199.19	A	0.191	2.626	0.589	0.85	1	71.156	5738.26	229.53	A
			B	0.197	2.605	0.59	0.85	1	71.106			
			C	0.131	2.842	0.579	0.85	1	51.256			
T8 75.00-50.00	348.54	7171.40	A	0.181	2.66	0.587	0.85	1	74.691	5542.94	221.72	A
			B	0.184	2.651	0.587	0.85	1	73.778			
			C	0.121	2.88	0.577	0.85	1	52.867			
T9 50.00-25.00	364.75	7706.04	A	0.192	2.624	0.589	0.85	1	86.726	5485.78	219.43	A
			B	0.189	2.632	0.588	0.85	1	84.261			
			C	0.135	2.827	0.579	0.85	1	64.676			
T10 25.00-0.00	218.85	8304.28	A	0.16	2.734	0.583	0.85	1	80.384	5108.78	204.35	A
			B	0.159	2.739	0.583	0.85	1	78.889			
			C	0.129	2.851	0.578	0.85	1	67.161			
Sum Weight:	1961.93	40626.76						OTM	3249.24 kip-ft	37326.13		

Force Totals

Load Case	*Vertical Forces* *lb*	*Sum of Forces X* *lb*	*Sum of Forces Z* *lb*	*Sum of Overturning Moments,* M_x *kip-ft*	*Sum of Overturning Moments,* M_z *kip-ft*	*Sum of Torques* *kip-ft*
Leg Weight	17563.64					
Bracing Weight	23063.13					
Total Member Self-Weight	40626.76			-15.74	-0.47	

Load Case	*Vertical Forces* *lb*	*Sum of Forces X* *lb*	*Sum of Forces Z* *lb*	*Sum of Overturning Moments, M_x* *kip-ft*	*Sum of Overturning Moments, M_z* *kip-ft*	*Sum of Torques* *kip-ft*
Total Weight	47789.13			-15.74	-0.47	
Wind 0 deg - No Ice		344.98	-86426.82	-9669.85	-35.64	-1.59
Wind 30 deg - No Ice		39979.76	-69553.05	-7931.03	-4517.68	-40.31
Wind 45 deg - No Ice		55472.63	-55794.38	-6367.75	-6283.08	-51.72
Wind 60 deg - No Ice		66945.45	-38618.20	-4403.90	-7611.15	-59.95
Wind 90 deg - No Ice		79738.58	328.94	59.63	-9032.50	-69.15
Wind 120 deg - No Ice		74709.93	43036.41	4801.10	-8327.04	-71.45
Wind 135 deg - No Ice		56006.81	55642.81	6346.43	-6402.97	-52.23
Wind 150 deg - No Ice		40232.45	68947.98	7828.21	-4596.84	-37.59
Wind 180 deg - No Ice		-177.92	77415.09	8836.13	9.71	0.78
Wind 210 deg - No Ice		-40600.94	69473.72	7892.09	4622.62	39.41
Wind 225 deg - No Ice		-56334.25	56265.63	6417.90	6428.59	54.21
Wind 240 deg - No Ice		-74952.08	43565.78	4852.23	8346.98	73.36
Wind 270 deg - No Ice		-79435.19	816.37	99.71	8986.68	69.45
Wind 300 deg - No Ice		-66160.63	-37979.57	-4336.34	7507.51	58.51
Wind 315 deg - No Ice		-54617.39	-55109.89	-6287.54	6175.55	49.77
Wind 330 deg - No Ice		-39149.62	-68927.86	-7852.90	4420.21	37.90
Member Ice	13905.22					
Total Weight Ice	68919.03			-48.56	1.01	
Wind 0 deg - Ice		296.75	-85215.27	-9461.95	-27.90	1.33
Wind 30 deg - Ice		39667.44	-68996.93	-7800.71	-4425.47	-46.59
Wind 45 deg - Ice		55181.52	-55479.11	-6284.78	-6171.21	-62.52
Wind 60 deg - Ice		66648.05	-38446.22	-4359.23	-7475.50	-73.87
Wind 90 deg - Ice		79091.48	322.86	24.19	-8842.40	-86.90
Wind 120 deg - Ice		73701.67	42326.18	4627.86	-8125.10	-89.15
Wind 135 deg - Ice		55534.22	55225.13	6176.82	-6257.03	-65.60
Wind 150 deg - Ice		39530.66	68677.72	7679.44	-4433.41	-45.68
Wind 180 deg - Ice		-673.19	77242.10	8674.56	99.71	2.24
Wind 210 deg - Ice		-40575.72	69058.85	7720.42	4583.86	48.44
Wind 225 deg - Ice		-56165.23	56101.98	6295.96	6341.43	66.23
Wind 240 deg - Ice		-74076.65	43289.78	4758.58	8173.13	89.29
Wind 270 deg - Ice		-79045.95	1260.09	146.93	8844.02	88.50
Wind 300 deg - Ice		-66166.56	-37489.37	-4232.16	7424.99	76.65
Wind 315 deg - Ice		-54282.23	-54710.73	-6186.51	6055.27	63.53
Wind 330 deg - Ice		-38763.83	-68407.26	-7726.15	4313.94	47.84
Total Weight	47789.13			-15.74	-0.47	
Wind 0 deg - Service		309.63	-75263.18	-8360.09	-32.38	-1.43
Wind 30 deg - Service		34729.37	-60427.73	-6840.11	-3903.44	-36.18
Wind 45 deg - Service		48156.84	-48445.61	-5485.23	-5425.10	-46.41
Wind 60 deg - Service		58087.39	-33507.36	-3785.46	-6568.87	-53.81
Wind 90 deg - Service		69260.43	295.22	69.00	-7803.93	-62.06
Wind 120 deg - Service		65056.06	37472.73	4172.90	-7211.39	-64.12
Wind 135 deg - Service		48636.27	48309.58	5497.05	-5532.71	-46.87
Wind 150 deg - Service		34956.16	59884.68	6778.78	-3974.49	-33.73
Wind 180 deg - Service		-159.69	67175.09	7642.77	8.33	0.70
Wind 210 deg - Service		-35286.88	60356.54	6836.11	3996.85	35.37
Wind 225 deg - Service		-48930.15	48868.57	5561.19	5554.92	48.66
Wind 240 deg - Service		-65273.39	37947.85	4218.79	7228.51	65.84
Wind 270 deg - Service		-68988.14	732.70	104.97	7762.03	62.33
Wind 300 deg - Service		-57383.01	-32934.18	-3724.82	6475.08	52.51
Wind 315 deg - Service		-47389.26	-47831.28	-5413.24	5327.82	44.66
Wind 330 deg - Service		-33984.31	-59866.62	-6769.98	3815.19	34.02

Load Combinations

Comb. No.	*Description*
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force lb*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
T1	180 - 175	Leg	Max Tension	13	516.68	0.00	-0.00
			Max. Compression	24	-928.66	0.32	0.13
			Max. Mx	10	35.29	-0.41	0.04

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force lb*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. My	14	-213.87	-0.02	-0.94
			Max. Vy	13	11901.73	0.00	-0.00
			Max. Vx	3	-11861.20	0.00	0.00
		Diagonal	Max Tension	6	16176.04	0.00	0.00
			Max. Compression	6	-16273.07	0.00	0.00
			Max. Mx	28	13118.53	0.04	0.00
			Max. My	24	-118.66	0.00	0.00
			Max. Vy	28	-23.57	0.00	0.00
			Max. Vx	24	-0.92	0.00	0.00
		Top Girt	Max Tension	5	13664.72	0.03	0.02
			Max. Compression	13	-13833.06	0.01	0.02
			Max. Mx	24	5706.40	0.04	0.01
			Max. My	14	-12016.78	0.02	0.02
			Max. Vy	24	-28.03	0.04	0.01
			Max. Vx	14	4.93	0.00	0.00
T2	175 - 166.667	Leg	Max Tension	5	18144.91	-0.32	0.05
			Max. Compression	2	-20051.56	0.59	0.15
			Max. Mx	5	17972.44	-0.60	0.07
			Max. My	14	-644.81	-0.02	-0.94
			Max. Vy	27	631.07	-0.55	-0.10
			Max. Vx	24	-587.04	-0.29	0.33
		Diagonal	Max Tension	9	9146.59	0.00	0.00
			Max. Compression	9	-9240.56	0.00	0.00
			Max. Mx	28	8351.68	0.06	0.00
			Max. My	30	-207.06	0.00	-0.00
			Max. Vy	28	-25.13	0.00	0.00
			Max. Vx	30	1.34	0.00	0.00
		Horizontal	Max Tension	2	6415.53	0.00	0.00
			Max. Compression	10	-6234.68	0.01	0.00
			Max. Mx	22	2666.62	0.03	0.00
			Max. My	19	5.60	0.01	0.01
			Max. Vy	22	20.14	0.03	0.00
			Max. Vx	19	-3.01	0.00	0.00
T3	166.667 - 158.333	Leg	Max Tension	5	30139.37	-0.60	0.07
			Max. Compression	2	-33209.76	0.44	0.18
			Max. Mx	5	30139.37	-0.60	0.07
			Max. My	2	14721.71	-0.26	-0.59
			Max. Vy	5	-287.20	-0.60	0.07
			Max. Vx	2	-325.30	-0.26	0.59
		Diagonal	Max Tension	9	10198.64	0.00	0.00
			Max. Compression	9	-10299.14	0.00	0.00
			Max. Mx	28	9812.50	0.07	0.00
			Max. My	30	5.16	0.00	-0.00
			Max. Vy	28	-26.53	0.00	0.00
			Max. Vx	30	-1.35	0.00	0.00
		Horizontal	Max Tension	9	6080.64	0.01	0.01
			Max. Compression	9	-6082.36	0.01	0.01
			Max. Mx	27	277.48	0.04	0.00
			Max. My	32	-4506.12	0.02	0.01
			Max. Vy	27	21.92	0.04	0.00
			Max. Vx	32	-2.38	0.00	0.00
T4	158.333 - 150	Leg	Max Tension	10	43129.38	-0.38	-0.13
			Max. Compression	2	-47864.65	0.28	-0.06
			Max. Mx	5	43032.66	-0.49	0.07
			Max. My	2	21629.48	-0.26	0.59
			Max. Vy	10	-745.29	-0.38	-0.13
			Max. Vx	13	-882.15	-0.24	-0.53
		Diagonal	Max Tension	11	11859.17	0.00	0.00
			Max. Compression	11	-11976.61	0.00	0.00
			Max. Mx	28	11629.31	0.07	0.00

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force lb*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. My	24	693.93	0.00	0.00
			Max. Vy	28	-27.93	0.00	0.00
			Max. Vx	24	-1.35	0.00	0.00
		Horizontal	Max Tension	11	7322.60	0.00	0.00
			Max. Compression	12	-7376.95	0.03	0.01
			Max. Mx	22	385.92	0.05	0.01
			Max. My	32	-5297.70	0.02	0.01
			Max. Vy	22	28.15	0.05	0.01
			Max. Vx	32	-2.84	0.00	0.00
T5	150 - 125	Leg	Max Tension	10	92210.97	-0.57	-0.11
			Max. Compression	2	-102637.86	0.26	-0.03
			Max. Mx	5	73493.24	-0.67	0.06
			Max. My	2	37624.47	-0.36	0.65
			Max. Vy	22	427.92	-0.65	0.07
			Max. Vx	2	-468.15	-0.36	0.65
		Diagonal	Max Tension	11	14940.81	0.00	0.00
			Max. Compression	28	-15213.60	0.00	0.00
			Max. Mx	28	14885.01	0.12	0.00
			Max. My	30	636.36	0.00	-0.01
			Max. Vy	28	-43.37	0.00	0.00
			Max. Vx	30	-1.82	0.00	0.00
		Horizontal	Max Tension	28	10063.33	0.00	0.00
			Max. Compression	9	-10043.21	0.03	-0.00
			Max. Mx	27	888.50	0.09	0.02
			Max. My	2	1052.45	-0.00	-0.03
			Max. Vy	27	39.91	0.09	0.02
			Max. Vx	30	5.13	0.01	-0.03
		Inner Bracing	Max Tension	2	9.12	0.00	0.00
			Max. Compression	33	-14.42	0.00	0.00
			Max. Mx	18	-3.13	-0.03	0.00
			Max. My	19	7.11	0.00	-0.00
			Max. Vy	18	19.33	0.00	0.00
			Max. Vx	30	0.16	0.00	0.00
T6	125 - 100	Leg	Max Tension	10	146506.28	-0.56	0.02
			Max. Compression	2	-164990.30	0.35	-0.00
			Max. Mx	2	-143847.69	0.59	-0.02
			Max. My	6	-3074.08	-0.02	0.57
			Max. Vy	27	-219.13	-0.54	0.02
			Max. Vx	24	244.97	-0.30	0.53
		Diagonal	Max Tension	9	16522.72	0.00	0.00
			Max. Compression	26	-16851.51	0.00	0.00
			Max. Mx	28	16436.86	0.16	0.00
			Max. My	30	919.39	0.00	-0.01
			Max. Vy	28	-53.50	0.00	0.00
			Max. Vx	30	2.00	0.00	0.00
		Horizontal	Max Tension	26	11893.38	0.07	-0.00
			Max. Compression	9	-11860.79	0.04	-0.00
			Max. Mx	27	1422.15	0.10	0.02
			Max. My	13	1524.87	0.00	-0.03
			Max. Vy	27	43.20	0.10	0.02
			Max. Vx	30	4.78	0.03	-0.03
		Inner Bracing	Max Tension	2	7.64	0.00	0.00
			Max. Compression	21	-13.63	0.00	0.00
			Max. Mx	18	-3.60	-0.04	0.00
			Max. My	30	5.62	0.00	-0.00
			Max. Vy	18	22.03	0.00	0.00
			Max. Vx	30	0.15	0.00	0.00
T7	100 - 75	Leg	Max Tension	10	202088.99	-0.42	-0.04
			Max. Compression	2	-230724.17	0.96	-0.01
			Max. Mx	13	-229888.25	0.96	-0.19
			Max. My	31	-6590.32	-0.06	-1.31

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force lb*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. Vy	27	-200.98	-0.62	-0.03
			Max. Vx	31	276.32	-0.06	-1.31
		Diagonal	Max Tension	28	18162.18	0.00	0.00
			Max. Compression	28	-18665.79	0.00	0.00
			Max. Mx	28	18162.18	0.19	0.00
			Max. My	30	1288.46	0.00	-0.01
			Max. Vy	28	-59.69	0.00	0.00
			Max. Vx	30	2.04	0.00	0.00
		Horizontal	Max Tension	28	13871.80	0.00	0.00
			Max. Compression	28	-13719.19	0.11	-0.00
			Max. Mx	27	1982.61	0.17	0.04
			Max. My	13	1818.87	0.00	-0.05
			Max. Vy	27	64.69	0.17	0.04
			Max. Vx	30	7.65	0.04	-0.05
		Inner Bracing	Max Tension	2	12.82	0.00	0.00
			Max. Compression	21	-19.23	0.00	0.00
			Max. Mx	18	-4.27	-0.06	0.00
			Max. My	19	10.10	0.00	-0.00
			Max. Vy	18	24.73	0.00	0.00
			Max. Vx	19	0.14	0.00	0.00
T8	75 - 50	Leg	Max Tension	10	248679.57	-1.72	-0.01
			Max. Compression	2	-286984.17	-1.40	0.04
			Max. Mx	2	-252958.91	1.91	0.02
			Max. My	31	-9282.74	-0.22	-2.37
			Max. Vy	7	455.64	1.90	0.18
			Max. Vx	31	396.59	-0.22	-2.37
		Diagonal	Max Tension	28	23911.58	0.00	0.00
			Max. Compression	28	-24567.99	0.00	0.00
			Max. Mx	28	23911.58	0.40	0.00
			Max. My	30	2125.98	0.00	-0.02
			Max. Vy	28	-98.88	0.00	0.00
			Max. Vx	30	3.92	0.00	0.00
		Horizontal	Max Tension	28	15530.44	0.00	0.00
			Max. Compression	28	-15482.71	0.13	-0.00
			Max. Mx	27	2461.18	0.21	0.04
			Max. My	30	2451.27	0.04	-0.06
			Max. Vy	27	71.26	0.21	0.04
			Max. Vx	30	7.27	0.04	-0.06
		Inner Bracing	Max Tension	2	9.93	0.00	0.00
			Max. Compression	21	-21.10	0.00	0.00
			Max. Mx	18	-6.46	-0.07	0.00
			Max. My	19	8.60	0.00	-0.00
			Max. Vy	18	26.98	0.00	0.00
			Max. Vx	19	0.12	0.00	0.00
T9	50 - 25	Leg	Max Tension	10	301913.58	4.33	-0.01
			Max. Compression	2	-352673.97	-6.26	0.03
			Max. Mx	2	-352502.48	8.11	-0.02
			Max. My	31	-12529.09	-0.50	-4.73
			Max. Vy	2	2373.92	8.11	-0.02
			Max. Vx	31	1292.31	-0.50	-4.73
		Diagonal	Max Tension	28	25531.20	-0.16	-0.01
			Max. Compression	30	-27040.07	0.00	0.00
			Max. Mx	28	12165.61	-0.24	0.02
			Max. My	30	-25253.06	0.04	0.04
			Max. Vy	21	74.00	-0.24	-0.02
			Max. Vx	30	-5.90	0.00	0.00
		Horizontal	Max Tension	28	16946.25	0.00	0.00
			Max. Compression	30	-17410.19	0.23	0.02
			Max. Mx	27	3019.29	0.27	0.04
			Max. My	30	2766.05	0.07	-0.06
			Max. Vy	27	88.89	0.27	0.04

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force lb*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. Vx	30	7.06	0.07	-0.06
		Redund Horz 1 Bracing	Max Tension	2	6113.37	0.00	0.00
			Max. Compression	2	-6113.37	0.00	0.00
			Max. Mx	18	349.96	-0.02	0.00
			Max. My	30	6038.63	0.00	0.00
			Max. Vy	18	14.83	0.00	0.00
			Max. Vx	30	-0.34	0.00	0.00
		Redund Diag 1 Bracing	Max Tension	2	4660.84	0.00	0.00
			Max. Compression	2	-4660.84	0.00	0.00
			Max. Mx	29	4152.81	-0.04	0.00
			Max. My	30	2414.13	0.00	0.00
			Max. Vy	29	20.05	0.00	0.00
			Max. Vx	30	-0.78	0.00	0.00
		Inner Bracing	Max Tension	2	7.61	0.00	0.00
			Max. Compression	21	-20.46	0.00	0.00
			Max. Mx	18	-7.17	-0.08	0.00
			Max. My	19	5.91	0.00	-0.00
			Max. Vy	18	29.68	0.00	0.00
			Max. Vx	19	0.09	0.00	0.00
T10	25 - 0	Leg	Max Tension	10	357729.73	4.79	-0.01
			Max. Compression	2	-421754.93	-0.00	0.00
			Max. Mx	2	-386319.86	8.56	-0.02
			Max. My	31	-14257.67	0.73	-4.92
			Max. Vy	2	2489.96	8.56	-0.02
			Max. Vx	31	1310.32	0.73	-4.92
		Diagonal	Max Tension	28	26328.64	-0.18	-0.01
			Max. Compression	30	-27711.69	0.00	0.00
			Max. Mx	21	14214.01	-0.27	-0.02
			Max. My	30	-26969.13	0.06	0.04
			Max. Vy	21	80.59	-0.27	-0.02
			Max. Vx	30	6.47	0.00	0.00
		Horizontal	Max Tension	28	18109.73	0.00	0.00
			Max. Compression	30	-18625.73	0.23	0.02
			Max. Mx	27	3609.63	0.33	0.04
			Max. My	30	2952.47	0.12	-0.06
			Max. Vy	27	104.93	0.33	0.04
			Max. Vx	30	6.82	0.12	-0.06
		Redund Horz 1 Bracing	Max Tension	2	7310.85	0.00	0.00
			Max. Compression	2	-7310.85	0.00	0.00
			Max. Mx	27	3477.73	-0.02	0.00
			Max. My	24	-2225.28	0.00	0.00
			Max. Vy	27	-16.18	0.00	0.00
			Max. Vx	24	-0.37	0.00	0.00
		Redund Diag 1 Bracing	Max Tension	2	5293.48	0.00	0.00
			Max. Compression	2	-5293.48	0.00	0.00
			Max. Mx	30	5133.43	-0.05	0.00
			Max. My	30	1814.39	0.00	0.00
			Max. Vy	30	-21.92	0.00	0.00
			Max. Vx	30	-0.77	0.00	0.00
		Inner Bracing	Max Tension	2	4.60	0.00	0.00
			Max. Compression	30	-20.15	0.00	0.00
			Max. Mx	18	-8.17	-0.14	0.00
			Max. My	24	2.04	0.00	-0.00
			Max. Vy	18	-45.69	0.00	0.00
			Max. Vx	24	0.08	0.00	0.00

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical lb*	*Horizontal, X lb*	*Horizontal, Z lb*
Leg C	Max. Vert	13	454932.75	41771.68	-26051.71
	Max. H_x	13	454932.75	41771.68	-26051.71
	Max. H_z	4	-376824.94	-34312.95	23814.29
	Min. Vert	5	-384538.19	-36009.45	22416.05
	Min. H_x	5	-384538.19	-36009.45	22416.05
	Min. H_z	30	452143.68	41433.78	-26307.22
Leg B	Max. Vert	7	452946.78	-41585.83	-25855.99
	Max. H_x	15	-378827.17	35538.13	22078.43
	Max. H_z	16	-370665.81	33804.20	23445.06
	Min. Vert	15	-378827.17	35538.13	22078.43
	Min. H_x	7	452946.78	-41585.83	-25855.99
	Min. H_z	24	447192.68	-41063.19	-26029.94
Leg A	Max. Vert	2	455619.38	-71.93	49077.47
	Max. H_x	31	16177.90	10590.11	748.16
	Max. H_z	2	455619.38	-71.93	49077.47
	Min. Vert	10	-386515.74	42.76	-42491.91
	Min. H_x	23	21859.93	-10557.53	1289.19
	Min. H_z	10	-386515.74	42.76	-42491.91

Tower Mast Reaction Summary

Load Combination	*Vertical lb*	*Shear$_x$ lb*	*Shear$_z$ lb*	*Overturning Moment, M_x kip-ft*	*Overturning Moment, M_z kip-ft*	*Torque kip-ft*
Dead Only	47797.63	-0.00	0.00	-15.65	-0.41	0.00
Dead+Wind 0 deg - No Ice	47797.61	344.98	-86425.73	-9519.50	-35.64	-1.61
Dead+Wind 30 deg - No Ice	47797.62	39979.19	-69552.15	-7819.11	-4452.86	-40.35
Dead+Wind 45 deg - No Ice	47797.62	55471.89	-55793.68	-6278.79	-6193.88	-51.75
Dead+Wind 60 deg - No Ice	47797.62	66944.59	-38617.74	-4342.49	-7504.63	-59.99
Dead+Wind 90 deg - No Ice	47797.62	79737.54	328.88	59.70	-8903.07	-69.21
Dead+Wind 120 deg - No Ice	47797.61	74709.05	43035.76	4725.89	-8196.86	-71.54
Dead+Wind 135 deg - No Ice	47797.62	56006.11	55642.00	6257.49	-6314.13	-52.31
Dead+Wind 150 deg - No Ice	47797.62	40231.96	68947.04	7716.25	-4532.31	-37.64
Dead+Wind 180 deg - No Ice	47797.62	-177.91	77414.12	8713.26	9.79	0.79
Dead+Wind 210 deg - No Ice	47797.62	-40600.40	69472.80	7780.21	4558.22	39.45
Dead+Wind 225 deg - No Ice	47798.56	-56335.84	56264.89	6329.05	6339.91	54.27
Dead+Wind 240 deg - No Ice	47797.61	-74951.20	43565.14	4777.09	8216.95	73.39
Dead+Wind 270 deg - No Ice	47797.62	-79434.16	816.31	99.84	8857.28	69.51
Dead+Wind 300 deg - No Ice	47797.62	-66159.78	-37979.12	-4274.82	7400.93	58.59
Dead+Wind 315 deg - No Ice	47797.62	-54616.66	-55109.21	-6198.45	6086.28	49.84
Dead+Wind 330 deg - No Ice	47797.62	-39149.10	-68926.95	-7740.83	4355.35	37.95
Dead+Ice+Temp	68919.03	0.00	0.00	-48.55	1.01	0.00
Dead+Wind 0 deg+Ice+Temp	68919.00	296.76	-85213.67	-9296.30	-27.96	1.31
Dead+Wind 30 deg+Ice+Temp	68919.01	39666.55	-68995.60	-7674.69	-4352.46	-46.68
Dead+Wind 45 deg+Ice+Temp	68919.01	55180.35	-55478.06	-6184.01	-6070.05	-62.63
Dead+Wind 60 deg+Ice+Temp	68919.01	66646.69	-38445.50	-4289.58	-7354.50	-74.00
Dead+Wind 90 deg+Ice+Temp	68919.01	79089.93	322.83	24.10	-8696.51	-87.07
Dead+Wind 120 deg+Ice+Temp	68919.00	73700.40	42325.26	4544.66	-7981.63	-89.33
Dead+Wind 135 deg+Ice+Temp	68919.01	55533.23	55223.93	6075.66	-6156.26	-65.75
Dead+Wind 150 deg+Ice+Temp	68919.01	39529.98	68676.29	7553.12	-4360.59	-45.79
Dead+Wind 180 deg+Ice+Temp	68919.01	-673.17	77240.57	8535.02	99.95	2.25

Load Combination	*Vertical* *lb*	*Shear$_x$* *lb*	*Shear$_z$* *lb*	*Overturning Moment, M_x* *kip-ft*	*Overturning Moment, M_z* *kip-ft*	*Torque* *kip-ft*
Dead+Wind 210 deg+Ice+Temp	68919.01	-40575.02	69057.40	7594.17	4511.38	48.54
Dead+Wind 225 deg+Ice+Temp	68919.01	-56164.22	56100.76	6195.06	6240.84	66.35
Dead+Wind 240 deg+Ice+Temp	68919.00	-74075.38	43288.83	4675.69	8029.76	89.42
Dead+Wind 270 deg+Ice+Temp	68919.01	-79044.40	1260.03	147.12	8698.14	88.68
Dead+Wind 300 deg+Ice+Temp	68919.01	-66165.21	-37488.69	-4162.25	7303.87	76.82
Dead+Wind 315 deg+Ice+Temp	68919.01	-54281.09	-54709.70	-6085.52	5953.84	63.67
Dead+Wind 330 deg+Ice+Temp	68919.01	-38762.96	-68405.95	-7599.98	4240.66	47.94
Dead+Wind 0 deg - Service	47797.62	309.62	-75262.20	-8241.76	-32.03	-1.44
Dead+Wind 30 deg - Service	47797.62	34728.90	-60426.93	-6756.32	-3844.69	-36.21
Dead+Wind 45 deg - Service	47797.63	48156.22	-48444.99	-5422.13	-5344.36	-46.44
Dead+Wind 60 deg - Service	47797.63	58086.65	-33506.95	-3747.17	-6472.51	-53.84
Dead+Wind 90 deg - Service	47797.62	69259.53	295.17	51.99	-7686.93	-62.12
Dead+Wind 120 deg - Service	47797.62	65055.26	37472.18	4088.09	-7093.79	-64.20
Dead+Wind 135 deg - Service	47797.62	48635.63	48308.89	5399.81	-5452.28	-46.94
Dead+Wind 150 deg - Service	47797.62	34955.70	59883.87	6660.80	-3915.98	-33.78
Dead+Wind 180 deg - Service	47797.63	-159.68	67174.24	7514.98	8.74	0.70
Dead+Wind 210 deg - Service	47797.62	-35286.39	60355.74	6718.21	3939.15	35.41
Dead+Wind 225 deg - Service	47797.62	-48929.48	48867.89	5464.05	5475.34	48.68
Dead+Wind 240 deg - Service	47797.62	-65272.59	37947.30	4134.05	7111.74	65.87
Dead+Wind 270 deg - Service	47797.62	-68987.24	732.64	88.01	7645.75	62.39
Dead+Wind 300 deg - Service	47797.63	-57382.28	-32933.78	-3686.43	6379.35	52.58
Dead+Wind 315 deg - Service	47797.63	-47388.64	-47830.67	-5350.02	5247.71	44.72
Dead+Wind 330 deg - Service	47797.63	-33983.87	-59865.81	-6686.07	3757.08	34.06

Solution Summary

	Sum of Applied Forces			*Sum of Reactions*			
Load Comb.	*PX* *lb*	*PY* *lb*	*PZ* *lb*	*PX* *lb*	*PY* *lb*	*PZ* *lb*	*% Error*
1	-0.00	-47797.63	0.00	0.00	47797.63	-0.00	0.000%
2	344.98	-47797.63	-86426.82	-344.98	47797.61	86425.73	0.001%
3	39979.76	-47797.63	-69553.05	-39979.19	47797.62	69552.15	0.001%
4	55472.63	-47797.63	-55794.38	-55471.89	47797.62	55793.68	0.001%
5	66945.45	-47797.63	-38618.20	-66944.59	47797.62	38617.74	0.001%
6	79738.58	-47797.63	328.94	-79737.54	47797.62	-328.88	0.001%
7	74709.93	-47797.63	43036.41	-74709.05	47797.61	-43035.76	0.001%
8	56006.81	-47797.63	55642.81	-56006.11	47797.62	-55642.00	0.001%
9	40232.45	-47797.63	68947.98	-40231.96	47797.62	-68947.04	0.001%
10	-177.92	-47797.63	77415.09	177.91	47797.62	-77414.12	0.001%
11	-40600.94	-47797.63	69473.72	40600.40	47797.62	-69472.80	0.001%
12	-56334.25	-47797.63	56265.63	56335.84	47798.56	-56264.89	0.002%
13	-74952.08	-47797.63	43565.78	74951.20	47797.61	-43565.14	0.001%
14	-79435.19	-47797.63	816.37	79434.16	47797.62	-816.31	0.001%
15	-66160.63	-47797.63	-37979.57	66159.78	47797.62	37979.12	0.001%
16	-54617.39	-47797.63	-55109.89	54616.66	47797.62	55109.21	0.001%
17	-39149.62	-47797.63	-68927.86	39149.10	47797.62	68926.95	0.001%
18	0.00	-68919.03	0.00	-0.00	68919.03	-0.00	0.000%
19	296.75	-68919.03	-85215.27	-296.76	68919.00	85213.67	0.001%
20	39667.44	-68919.03	-68996.93	-39666.55	68919.01	68995.60	0.002%
21	55181.52	-68919.03	-55479.11	-55180.35	68919.01	55478.06	0.002%
22	66648.05	-68919.03	-38446.22	-66646.69	68919.01	38445.50	0.001%
23	79091.48	-68919.03	322.86	-79089.93	68919.01	-322.83	0.001%
24	73701.67	-68919.03	42326.18	-73700.40	68919.00	-42325.26	0.001%
25	55534.22	-68919.03	55225.13	-55533.23	68919.01	-55223.93	0.001%
26	39530.66	-68919.03	68677.72	-39529.98	68919.01	-68676.29	0.002%
27	-673.19	-68919.03	77242.10	673.17	68919.01	-77240.57	0.001%
28	-40575.72	-68919.03	69058.85	40575.02	68919.01	-69057.40	0.002%
29	-56165.23	-68919.03	56101.98	56164.22	68919.01	-56100.76	0.002%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
30	-74076.65	-68919.03	43289.78	74075.38	68919.00	-43288.83	0.001%
31	-79045.95	-68919.03	1260.09	79044.40	68919.01	-1260.03	0.001%
32	-66166.56	-68919.03	-37489.37	66165.21	68919.01	37488.69	0.001%
33	-54282.23	-68919.03	-54710.73	54281.09	68919.01	54709.70	0.001%
34	-38763.83	-68919.03	-68407.26	38762.96	68919.01	68405.95	0.002%
35	309.63	-47797.63	-75263.18	-309.62	47797.62	75262.20	0.001%
36	34729.37	-47797.63	-60427.73	-34728.90	47797.62	60426.93	0.001%
37	48156.84	-47797.63	-48445.61	-48156.22	47797.63	48444.99	0.001%
38	58087.39	-47797.63	-33507.36	-58086.65	47797.63	33506.95	0.001%
39	69260.43	-47797.63	295.22	-69259.53	47797.62	-295.17	0.001%
40	65056.06	-47797.63	37472.73	-65055.26	47797.62	-37472.18	0.001%
41	48636.27	-47797.63	48309.58	-48635.63	47797.62	-48308.89	0.001%
42	34956.16	-47797.63	59884.68	-34955.70	47797.62	-59883.87	0.001%
43	-159.69	-47797.63	67175.09	159.68	47797.63	-67174.24	0.001%
44	-35286.88	-47797.63	60356.54	35286.39	47797.62	-60355.74	0.001%
45	-48930.15	-47797.63	48868.56	48929.48	47797.62	-48867.89	0.001%
46	-65273.39	-47797.63	37947.85	65272.59	47797.62	-37947.30	0.001%
47	-68988.14	-47797.63	732.70	68987.24	47797.62	-732.64	0.001%
48	-57383.01	-47797.63	-32934.18	57382.28	47797.63	32933.78	0.001%
49	-47389.26	-47797.63	-47831.28	47388.64	47797.63	47830.67	0.001%
50	-33984.31	-47797.63	-59866.62	33983.87	47797.63	59865.81	0.001%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00007514
3	Yes	4	0.00000001	0.00006713
4	Yes	4	0.00000001	0.00006085
5	Yes	4	0.00000001	0.00005800
6	Yes	4	0.00000001	0.00006695
7	Yes	4	0.00000001	0.00007508
8	Yes	4	0.00000001	0.00007266
9	Yes	4	0.00000001	0.00006702
10	Yes	4	0.00000001	0.00005816
11	Yes	4	0.00000001	0.00006702
12	Yes	4	0.00000001	0.00007246
13	Yes	4	0.00000001	0.00007513
14	Yes	4	0.00000001	0.00006714
15	Yes	4	0.00000001	0.00005812
16	Yes	4	0.00000001	0.00006083
17	Yes	4	0.00000001	0.00006701
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00011032
20	Yes	4	0.00000001	0.00010230
21	Yes	4	0.00000001	0.00009608
22	Yes	4	0.00000001	0.00009330
23	Yes	4	0.00000001	0.00010201
24	Yes	4	0.00000001	0.00011031
25	Yes	4	0.00000001	0.00010808
26	Yes	4	0.00000001	0.00010204
27	Yes	4	0.00000001	0.00009328
28	Yes	4	0.00000001	0.00010241
29	Yes	4	0.00000001	0.00010816
30	Yes	4	0.00000001	0.00011046

31	Yes	4	0.00000001	0.00010249
32	Yes	4	0.00000001	0.00009336
33	Yes	4	0.00000001	0.00009609
34	Yes	4	0.00000001	0.00010234
35	Yes	4	0.00000001	0.00007422
36	Yes	4	0.00000001	0.00006731
37	Yes	4	0.00000001	0.00006197
38	Yes	4	0.00000001	0.00005958
39	Yes	4	0.00000001	0.00006716
40	Yes	4	0.00000001	0.00007417
41	Yes	4	0.00000001	0.00007213
42	Yes	4	0.00000001	0.00006725
43	Yes	4	0.00000001	0.00005956
44	Yes	4	0.00000001	0.00006725
45	Yes	4	0.00000001	0.00007211
46	Yes	4	0.00000001	0.00007421
47	Yes	4	0.00000001	0.00006729
48	Yes	4	0.00000001	0.00005968
49	Yes	4	0.00000001	0.00006200
50	Yes	4	0.00000001	0.00006726

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
T1	180 - 175	11.364	35	0.5176	0.0840
T2	175 - 166.667	10.762	35	0.5190	0.0845
T3	166.667 - 158.333	9.832	35	0.5091	0.0837
T4	158.333 - 150	8.921	35	0.4921	0.0815
T5	150 - 125	8.049	35	0.4680	0.0767
T6	125 - 100	5.696	35	0.3895	0.0639
T7	100 - 75	3.757	35	0.3060	0.0514
T8	75 - 50	2.200	35	0.2363	0.0381
T9	50 - 25	1.072	46	0.1665	0.0264
T10	25 - 0	0.315	46	0.0876	0.0129

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
185.00	Ground Rod w/Extension	35	11.364	0.5176	0.0840	7944
180.00	6 FT DISH	35	11.364	0.5176	0.0840	7944
175.00	4 FT DISH	35	10.762	0.5190	0.0845	7944
171.00	Dish Mount	35	10.308	0.5158	0.0843	12770
168.00	6 FT DISH	35	9.978	0.5114	0.0839	54654
167.00	PD458-1	35	9.869	0.5097	0.0837	152530
162.50	6 FT DISH	35	9.375	0.5014	0.0829	47794
158.00	8 FT DISH	35	8.886	0.4913	0.0814	17667
150.00	6 FT DISH	35	8.049	0.4680	0.0767	19613
146.00	PD320	35	7.646	0.4557	0.0743	19656
138.00	Dish Mount	35	6.869	0.4311	0.0700	18634
135.50	6 FT DISH	35	6.635	0.4233	0.0688	18280
135.00	DB264-A	35	6.589	0.4217	0.0686	18211
133.00	2' Side Mount Standoff	35	6.405	0.4154	0.0676	17940

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
125.00	DB432-A	35	5.696	0.3895	0.0639	17160
115.00	531-70 Dipole	35	4.873	0.3556	0.0591	18607
113.00	Dish Mount	35	4.716	0.3487	0.0582	18983
100.00	Dish Mount	35	3.757	0.3060	0.0514	21354
94.00	DB264-A	35	3.346	0.2880	0.0481	19897
87.00	2' Side Mount Standoff	35	2.896	0.2684	0.0442	18016
75.00	Powermount Reaction at 75	35	2.200	0.2363	0.0381	15871
63.50	PD156S	35	1.633	0.2050	0.0327	19061
53.00	DB803Q-XT	46	1.188	0.1753	0.0278	24030
50.00	2' Side Mount Standoff	46	1.072	0.1665	0.0264	24653
49.00	SY203(C) - YAGI Antenna	46	1.034	0.1635	0.0259	24328
25.00	Powermount Reaction at 25	46	0.315	0.0876	0.0129	13311

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
T1	180 - 175	13.190	2	0.6041	0.1151
T2	175 - 166.667	12.486	2	0.6057	0.1155
T3	166.667 - 158.333	11.401	2	0.5937	0.1138
T4	158.333 - 150	10.340	2	0.5733	0.1104
T5	150 - 125	9.326	2	0.5446	0.1045
T6	125 - 100	6.592	2	0.4522	0.0881
T7	100 - 75	4.343	2	0.3547	0.0710
T8	75 - 50	2.541	2	0.2736	0.0521
T9	50 - 25	1.237	13	0.1927	0.0358
T10	25 - 0	0.362	13	0.1013	0.0175

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
185.00	Ground Rod w/Extension	2	13.190	0.6041	0.1151	6445
180.00	6 FT DISH	2	13.190	0.6041	0.1151	6445
175.00	4 FT DISH	2	12.486	0.6057	0.1155	6445
171.00	Dish Mount	2	11.956	0.6018	0.1150	10323
168.00	6 FT DISH	2	11.571	0.5964	0.1142	43563
167.00	PD458-1	2	11.444	0.5944	0.1139	118663
162.50	6 FT DISH	2	10.868	0.5844	0.1124	39560
158.00	8 FT DISH	2	10.298	0.5723	0.1102	14648
150.00	6 FT DISH	2	9.326	0.5446	0.1045	16651
146.00	PD320	2	8.857	0.5301	0.1016	16758
138.00	Dish Mount	2	7.954	0.5010	0.0963	15881
135.50	6 FT DISH	2	7.682	0.4918	0.0947	15581
135.00	DB264-A	2	7.628	0.4900	0.0944	15522
133.00	2' Side Mount Standoff	2	7.415	0.4826	0.0931	15289
125.00	DB432-A	2	6.592	0.4522	0.0881	14623
115.00	531-70 Dipole	2	5.637	0.4126	0.0816	15892
113.00	Dish Mount	2	5.455	0.4046	0.0802	16222
100.00	Dish Mount	2	4.343	0.3547	0.0710	18324

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
94.00	DB264-A	2	3.868	0.3338	0.0664	17098
87.00	2' Side Mount Standoff	2	3.346	0.3110	0.0610	15501
75.00	Powermount Reaction at 75	2	2.541	0.2736	0.0521	13678
63.50	PD156S	2	1.885	0.2374	0.0445	16419
53.00	DB803Q-XT	13	1.371	0.2029	0.0378	20683
50.00	2' Side Mount Standoff	13	1.237	0.1927	0.0358	21221
49.00	SY203(C) - YAGI Antenna	13	1.193	0.1892	0.0351	20944
25.00	Powermount Reaction at 25	13	0.362	0.1013	0.0175	11504

Bolt Design Data

Section No.	*Elevation* *ft*	*Component Type*	*Bolt Grade*	*Bolt Size* *in*	*Number Of Bolts*	*Maximum Load per Bolt* *lb*	*Allowable Load* *lb*	*Ratio Load / Allowable*	*Allowable Ratio*	*Criteria*
T1	180	Leg	A325X	0.7500	6	86.11	18989.00	0.005 ✓	1.333	Bolt Tension
		Diagonal	A325X	0.7500	1	16176.00	12234.40	1.322 ✓	1.333	Member Bearing
T2	175	Leg	A325X	0.7500	6	3012.44	19437.90	0.155 ✓	1.333	Bolt Tension
		Diagonal	A325X	0.7500	1	9146.59	12234.40	0.748 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	3207.76	8156.25	0.393 ✓	1.333	Member Bearing
T3	166.667	Diagonal	A325X	0.7500	1	10198.60	12234.40	0.834 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	3041.18	8156.25	0.373 ✓	1.333	Member Bearing
T4	158.333	Diagonal	A325X	0.7500	1	11859.20	12234.40	0.969 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	3688.47	9203.88	0.401 ✓	1.333	Bolt Shear
T5	150	Leg	A325X	0.7500	6	9551.63	19438.50	0.491 ✓	1.333	Bolt Tension
		Diagonal	A325X	0.7500	1	14940.80	16312.50	0.916 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	5031.67	9203.88	0.547 ✓	1.333	Bolt Shear
T6	125	Leg	A325X	0.7500	6	18282.30	19438.60	0.941 ✓	1.333	Bolt Tension
		Diagonal	A325X	0.7500	1	16522.70	16312.50	1.013 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	5946.69	9203.88	0.646 ✓	1.333	Bolt Shear
T7	100	Leg	A490N	0.7500	6	27410.60	23856.40	1.149 ✓	1.333	Bolt Tension
		Diagonal	A325X	0.7500	1	18162.20	16312.50	1.113 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	6935.90	9203.88	0.754 ✓	1.333	Bolt Shear
T8	75	Leg	A325X	1.0000	8	27554.20	34557.40	0.797 ✓	1.333	Bolt Tension
		Diagonal	A325X	1.0000	1	23911.60	27187.50	0.880 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	7765.22	9203.88	0.844 ✓	1.333	Bolt Shear
T9	50	Leg	A325X	1.0000	8	34259.70	34556.30	0.991 ✓	1.333	Bolt Tension
		Diagonal	A325X	1.0000	1	25531.20	21750.00	1.174 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	8705.10	9203.88	0.946 ✓	1.333	Bolt Shear
T10	25	Leg	A325X	1.0000	8	41165.40	34554.00	1.191 ✓	1.333	Bolt Tension
		Diagonal	A325X	1.0000	1	26328.60	21750.00	1.211 ✓	1.333	Member Bearing
		Horizontal	A325X	0.6250	2	9312.87	9203.88	1.012 ✓	1.333	Bolt Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	180 - 175	HSS5x.25	5.01	5.01	35.6 K=1.00	26.434	3.4894	-745.14	92239.80	0.008* ✓
T2	175 - 166.667	HSS5x.25	8.34	8.34	59.3 K=1.00	22.832	3.4894	-20051.60	79670.80	0.252 ✓
T3	166.667 - 158.333	HSS5x.25	8.34	8.34	59.3 K=1.00	22.832	3.4894	-33209.80	79670.80	0.417 ✓
T4	158.333 - 150	HSS5x.25	8.34	8.34	59.3 K=1.00	22.832	3.4894	-47864.60	79670.80	0.601 ✓
T5	150 - 125	MOD HSS 5x0.250 w/ 1/3 HSS 5.5x0.258	25.03	8.34	62.0 K=1.00	22.369	5.1397	-102638.00	114969.00	0.893 ✓
T6	125 - 100	MOD HSS 5x0.375 w/ 1/3 HSS 5.5625x0.375	25.03	8.34	63.4 K=1.00	22.131	7.4062	-164990.00	163903.00	1.007 ✓
T7	100 - 75	MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5	25.03	8.34	62.2 K=1.00	22.345	11.3883	-230724.00	254467.00	0.907 ✓
T8	75 - 50	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	12.51	66.4 K=1.00	21.590	13.5420	-286984.00	292369.00	0.982 ✓
T9	50 - 25	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	6.26	33.2 K=1.00	26.746	13.5420	-352674.00	362200.00	0.974 ✓
T10	25 - 0	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	6.26	33.2 K=1.00	26.746	13.5420	-421755.00	362200.00	1.164 ✓

* DL controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	180 - 175	2L2 1/2x2x3/16	7.43	6.88	104.5 K=1.00	12.396	1.6200	-16273.10	20081.80	0.810 ✓
T2	175 - 166.667	2L2 1/2x2x3/16	10.17	9.54	144.9 K=1.00	7.111	1.6200	-9240.56	11520.30	0.802 ✓
T3	166.667 - 158.333	2L2 1/2x2x3/16	10.37	9.75	148.1 K=1.00	6.811	1.6200	-10299.10	11034.50	0.933 ✓
T4	158.333 - 150	2L2 1/2x2x3/16	10.57	9.96	151.3 K=1.00	6.523	1.6200	-11976.60	10567.40	1.133 ✓
T5	150 - 125	2L2 1/2x2 1/2x1/4	11.21	10.63	165.9 K=1.00	5.426	2.3800	-15213.60	12914.80	1.178 ✓
T6	125 - 100	2L3x2 1/2x1/4	11.91	11.34	144.0 K=1.00	7.198	2.6300	-16851.50	18931.60	0.890 ✓

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow.* P_a *lb*	*Ratio* $\frac{P}{P_a}$
T7	100 - 75	2L3x2 1/2x1/4	12.64	12.04	152.8 K=1.00	6.394	2.6300	-18665.80	16815.40	1.110 ✓
T8	75 - 50	2L3 1/2x3 1/2x5/16	16.33	15.51	172.3 K=1.00	5.029	4.1800	-24568.00	21022.50	1.169 ✓
T9	50 - 25	2L3 1/2x3 1/2x1/4	16.99	16.19	133.1 K=1.00	8.430	3.3800	-27040.10	28494.40	0.949 ✓
T10	25 - 0	2L3 1/2x3 1/2x1/4	17.68	16.90	138.9 K=1.00	7.735	3.3800	-27069.30	26145.10	1.035 ✓

Horizontal Design Data (Compression)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow.* P_a *lb*	*Ratio* $\frac{P}{P_a}$
T2	175 - 166.667	L2 1/2x2 1/2x3/16	11.00	10.19	142.8 K=0.91	7.319	0.9020	-6234.68	6601.99	0.944 ✓
T3	166.667 - 158.333	L2 1/2x2 1/2x3/16	11.67	10.85	149.2 K=0.89	6.712	0.9020	-6082.36	6054.06	1.005 ✓
T4	158.333 - 150	L2 1/2x2 1/2x1/4	12.33	11.52	156.8 K=0.87	6.077	1.1900	-7376.95	7231.11	1.020 ✓
T5	150 - 125	L3x3x1/4	14.33	6.76	133.0 K=0.97	8.439	1.4400	-10043.20	12152.70	0.826 ✓
T6	125 - 100	L3x3x1/4	16.33	7.76	148.5 K=0.94	6.775	1.4400	-11860.80	9755.60	1.216 ✓
T7	100 - 75	L4x4x1/4	18.33	8.72	128.9 K=0.98	8.990	1.9400	-13719.20	17440.90	0.787 ✓
T8	75 - 50	L4x4x1/4	20.00	9.49	137.7 K=0.96	7.870	1.9400	-15482.70	15268.00	1.014 ✓
T9	50 - 25	L4x4x5/16	22.00	10.49	149.9 K=0.94	6.649	2.4000	-17410.20	15958.40	1.091 ✓
T10	25 - 0	L4x4x3/8	24.00	11.49	161.9 K=0.93	5.695	2.8600	-18625.70	16288.60	1.143 ✓

Top Girt Design Data (Compression)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow.* P_a *lb*	*Ratio* $\frac{P}{P_a}$
T1	180 - 175	L3x3x1/4	10.60	10.18	127.0 K=0.97	9.258	1.4400	-13833.10	13332.00	1.038 ✓

Redundant Horizontal (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T9	50 - 25	L2 1/2x2 1/2x3/16	5.50	5.19	125.8 K=1.00	9.442	0.9020	-6113.37	8516.82	0.718 ✓
T10	25 - 0	L2 1/2x2 1/2x3/16	6.00	5.69	137.9 K=1.00	7.855	0.9020	-7310.85	7085.37	1.032 ✓

Redundant Diagonal (1) Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T9	50 - 25	L3x3x1/4	8.16	7.68	155.6 K=1.00	6.165	1.4400	-4537.06	8877.80	0.511 ✓
T10	25 - 0	L3x3x1/4	8.49	8.03	162.8 K=1.00	5.633	1.4400	-5174.78	8111.57	0.638 ✓

Inner Bracing Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T5	150 - 125	L2 1/2x2 1/2x3/16	7.17	7.17	173.7 K=1.00	4.947	0.9020	-13.06	4462.43	0.003 ✓
T6	125 - 100	L2 1/2x2 1/2x3/16	8.17	8.17	198.0 K=1.00	3.810	0.9020	-12.72	3436.50	0.004 ✓
T7	100 - 75	L2 1/2x2 1/2x3/16	9.17	9.17	222.2 K=1.00	3.024	0.9020	-17.76	2727.61	0.007 ✓
T8	75 - 50	L2 1/2x2 1/2x3/16	10.00	10.00	242.4 K=1.00	2.541	0.9020	-19.85	2291.95	0.009 ✓
T9	50 - 25	L2 1/2x2 1/2x3/16	11.00	11.00	266.7 K=1.00	2.100	0.9020	-19.86	1894.18	0.010 ✓
T10	25 - 0	KL/R > 250 (C) - 218 L3x3x1/4	12.00	12.00	243.2 K=1.00	2.524	1.4400	-19.88	3634.39	0.005 ✓

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	180 - 175	HSS5x.25	5.01	5.01	35.6	30.000	3.4894	516.68	104682.00	0.005 ✓

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T2	175 - 166.667	HSS5x.25	8.34	8.34	59.3	30.000	3.4894	18074.70	104682.00	0.173 ✓
T3	166.667 - 158.333	HSS5x.25	8.34	8.34	59.3	30.000	3.4894	30139.40	104682.00	0.288 ✓
T4	158.333 - 150	HSS5x.25	8.34	8.34	59.3	30.000	3.4894	43129.40	104682.00	0.412 ✓
T5	150 - 125	MOD HSS 5x0.250 w/ 1/3 HSS 5.5x0.258	25.03	8.34	62.0	30.000	5.1397	92211.00	154191.00	0.598 ✓
T6	125 - 100	MOD HSS 5x0.375 w/ 1/3 HSS 5.5625x0.375	25.03	8.34	63.4	30.000	7.4062	146506.00	222186.00	0.659 ✓
T7	100 - 75	MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5	25.03	8.34	62.2	30.000	11.3883	202089.00	341649.00	0.592 ✓
T8	75 - 50	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	12.51	66.4	30.000	13.5420	248680.00	406260.00	0.612 ✓
T9	50 - 25	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	6.26	33.2	30.000	13.5420	301914.00	406260.00	0.743 ✓
T10	25 - 0	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	25.03	6.26	33.2	30.000	13.5420	357730.00	406260.00	0.881 ✓

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
T1	180 - 175	2L2 1/2x2x3/16	7.43	6.88	108.6	29.000	0.9689	16176.00	28098.30	0.576 ✓
T2	175 - 166.667	2L2 1/2x2x3/16	10.17	9.54	149.0	29.000	0.9689	9146.59	28098.30	0.326 ✓
T3	166.667 - 158.333	2L2 1/2x2x3/16	10.37	9.75	152.2	29.000	0.9689	10198.60	28098.30	0.363 ✓
T4	158.333 - 150	2L2 1/2x2x3/16	10.57	9.96	155.4	29.000	0.9689	11859.20	28098.30	0.422 ✓
T5	150 - 125	2L2 1/2x2 1/2x1/4	11.21	10.63	170.1	29.000	1.4569	14940.80	42249.40	0.354 ✓
T6	125 - 100	2L3x2 1/2x1/4	11.91	11.34	147.5	29.000	1.6444	16522.70	47686.90	0.346 ✓
T7	100 - 75	2L3x2 1/2x1/4	12.64	12.04	156.3	29.000	1.6444	18162.20	47686.90	0.381 ✓
T8	75 - 50	2L3 1/2x3 1/2x5/16	16.33	15.51	176.0	29.000	2.6077	23911.60	75622.00	0.316 ✓
T9	50 - 25	2L3 1/2x3 1/2x1/4	16.99	16.19	135.8	29.000	2.1131	25531.20	61280.60	0.417 ✓
T10	25 - 0	2L3 1/2x3 1/2x1/4	17.33	16.55	138.8	29.000	2.1131	26328.60	61280.60	0.430 ✓

Horizontal Design Data (Tension)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* $\frac{P}{P_a}$
T2	175 - 166.667	L2 1/2x2 1/2x3/16	11.00	10.19	163.2	29.000	0.5710	6415.53	16559.90	0.387 ✓
T3	166.667 - 158.333	L2 1/2x2 1/2x3/16	11.67	10.85	173.5	29.000	0.5710	6080.64	16559.90	0.367 ✓
T4	158.333 - 150	L2 1/2x2 1/2x1/4	12.33	11.52	186.0	29.000	0.7519	7322.60	21804.40	0.336 ✓
T5	150 - 125	L3x3x1/4	14.33	6.76	89.8	29.000	0.9394	10063.30	27241.90	0.369 ✓
T6	125 - 100	L3x3x1/4	16.33	7.76	102.7	29.000	0.9394	11893.40	27241.90	0.437 ✓
T7	100 - 75	L4x4x1/4	18.33	8.72	85.6	29.000	1.3144	13871.80	38116.90	0.364 ✓
T8	75 - 50	L4x4x1/4	20.00	9.49	93.0	29.000	1.3144	15530.40	38116.90	0.407 ✓
T9	50 - 25	L4x4x5/16	22.00	10.49	103.4	29.000	1.6242	16946.30	47102.30	0.360 ✓
T10	25 - 0	L4x4x3/8	24.00	11.49	114.0	29.000	1.9341	18109.70	56087.80	0.323 ✓

Top Girt Design Data (Tension)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* $\frac{P}{P_a}$
T1	180 - 175	L3x3x1/4	10.60	10.18	131.4	21.600	1.4400	13664.70	31104.00	0.439 ✓

Redundant Horizontal (1) Design Data (Tension)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* $\frac{P}{P_a}$
T9	50 - 25	L2 1/2x2 1/2x3/16	5.50	5.19	80.0	21.600	0.9020	6113.37	19483.20	0.314 ✓
T10	25 - 0	L2 1/2x2 1/2x3/16	6.00	5.69	87.7	21.600	0.9020	7310.85	19483.20	0.375 ✓

Redundant Diagonal (1) Design Data (Tension)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* $\frac{P}{P_a}$
T9	50 - 25	L3x3x1/4	8.01	7.52	97.0	21.600	1.4400	4660.84	31104.00	0.150 ✓

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	*L_u* *ft*	*Kl/r*	*F_a* *ksi*	*A* *in^2*	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* *$\frac{P}{P_a}$*
T10	25 - 0	L3x3x1/4	8.33	7.87	101.5	21.600	1.4400	5293.48	31104.00	0.170 ✓

Inner Bracing Design Data (Tension)

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	*L_u* *ft*	*Kl/r*	*F_a* *ksi*	*A* *in^2*	*Actual P* *lb*	*Allow. P_a* *lb*	*Ratio* *$\frac{P}{P_a}$*
T5	150 - 125	L2 1/2x2 1/2x3/16	6.50	6.50	100.3	21.600	0.9020	9.12	19483.20	0.000 ✓
T6	125 - 100	L2 1/2x2 1/2x3/16	7.50	7.50	115.7	21.600	0.9020	7.64	19483.20	0.000 ✓
T7	100 - 75	L2 1/2x2 1/2x3/16	8.50	8.50	131.1	21.600	0.9020	12.82	19483.20	0.001 ✓
T8	75 - 50	L2 1/2x2 1/2x3/16	9.50	9.50	146.5	21.600	0.9020	9.93	19483.20	0.001 ✓
T9	50 - 25	L2 1/2x2 1/2x3/16	10.50	10.50	162.0	21.600	0.9020	7.61	19483.20	0.000 ✓
T10	25 - 0	L3x3x1/4	11.50	11.50	148.4	21.600	1.4400	4.60	31104.00	0.000 ✓

Section Capacity Table

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P* *lb*	*$SF*P_{allow}$* *lb*	*% Capacity*	*Pass Fail*
T1	180 - 175	Leg	HSS5x.25	2	-745.14	92239.80	34.3	Pass
T2	175 - 166.667	Leg	HSS5x.25	15	-20051.60	106201.17	18.9	Pass
T3	166.667 - 158.333	Leg	HSS5x.25	27	-33209.80	106201.17	31.3	Pass
T4	158.333 - 150	Leg	HSS5x.25	39	-47864.60	106201.17	45.1	Pass
T5	150 - 125	Leg	MOD HSS 5x0.250 w/ 1/3 HSS 5.5x0.258	51	-102638.00	153253.67	67.0	Pass
T6	125 - 100	Leg	MOD HSS 5x0.375 w/ 1/3 HSS 5.5625x0.375	90	-164990.00	218482.69	75.5	Pass
T7	100 - 75	Leg	MOD HSS 5x0.5 w/ 1/2 HSS 6X0.5	129	-230724.00	339204.50	68.0 86.2 (b)	Pass
T8	75 - 50	Leg	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	168	-286984.00	389727.86	73.6	Pass
T9	50 - 25	Leg	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	195	-352674.00	482812.58	73.0 74.4 (b)	Pass
T10	25 - 0	Leg	MOD_HSS6.8750x.5 w/ 1/2 HSS 7.5x0.3125	246	-421755.00	482812.58	87.4 89.4 (b)	Pass
T1	180 - 175	Diagonal	2L2 1/2x2x3/16	8	-16273.10	26769.04	60.8 99.2 (b)	Pass
T2	175 - 166.667	Diagonal	2L2 1/2x2x3/16	20	-9240.56	15356.56	60.2	Pass
T3	166.667 - 158.333	Diagonal	2L2 1/2x2x3/16	32	-10299.10	14708.99	70.0	Pass
T4	158.333 - 150	Diagonal	2L2 1/2x2x3/16	48	-11976.60	14086.34	85.0	Pass
T5	150 - 125	Diagonal	2L2 1/2x2 1/2x1/4	60	-15213.60	17215.43	88.4	Pass
T6	125 - 100	Diagonal	2L3x2 1/2x1/4	95	-16851.50	25235.82	66.8	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	SF*P_allow lb	% Capacity	Pass Fail
							76.0 (b)	
T7	100 - 75	Diagonal	2L3x2 1/2x1/4	138	-18665.80	22414.93	83.3	Pass
							83.5 (b)	
T8	75 - 50	Diagonal	2L3 1/2x3 1/2x5/16	177	-24568.00	28022.99	87.7	Pass
T9	50 - 25	Diagonal	2L3 1/2x3 1/2x1/4	214	-27040.10	37983.03	71.2	Pass
							88.1 (b)	
T10	25 - 0	Diagonal	2L3 1/2x3 1/2x1/4	265	-27069.30	34851.42	77.7	Pass
							90.8 (b)	
T2	175 - 166.667	Horizontal	L2 1/2x2 1/2x3/16	19	-6234.68	8800.45	70.8	Pass
T3	166.667 - 158.333	Horizontal	L2 1/2x2 1/2x3/16	31	-6082.36	8070.06	75.4	Pass
T4	158.333 - 150	Horizontal	L2 1/2x2 1/2x1/4	46	-7376.95	9639.07	76.5	Pass
T5	150 - 125	Horizontal	L3x3x1/4	55	-10043.20	16199.55	62.0	Pass
T6	125 - 100	Horizontal	L3x3x1/4	94	-11860.80	13004.21	91.2	Pass
T7	100 - 75	Horizontal	L4x4x1/4	136	-13719.20	23248.72	59.0	Pass
T8	75 - 50	Horizontal	L4x4x1/4	175	-15482.70	20352.24	76.1	Pass
T9	50 - 25	Horizontal	L4x4x5/16	210	-17410.20	21272.55	81.8	Pass
T10	25 - 0	Horizontal	L4x4x3/8	261	-18625.70	21712.70	85.8	Pass
T1	180 - 175	Top Girt	L3x3x1/4	4	-13833.10	17771.56	77.8	Pass
T9	50 - 25	Redund Horz 1 Bracing	L2 1/2x2 1/2x3/16	212	-6113.37	11352.92	53.8	Pass
T10	25 - 0	Redund Horz 1 Bracing	L2 1/2x2 1/2x3/16	263	-7310.85	9444.80	77.4	Pass
T9	50 - 25	Redund Diag 1 Bracing	L3x3x1/4	213	-4537.06	11834.11	38.3	Pass
T10	25 - 0	Redund Diag 1 Bracing	L3x3x1/4	264	-5174.78	10812.72	47.9	Pass
T5	150 - 125	Inner Bracing	L2 1/2x2 1/2x3/16	63	-13.06	5948.42	0.2	Pass
T6	125 - 100	Inner Bracing	L2 1/2x2 1/2x3/16	100	-12.72	4580.85	0.3	Pass
T7	100 - 75	Inner Bracing	L2 1/2x2 1/2x3/16	141	-17.76	3635.90	0.5	Pass
T8	75 - 50	Inner Bracing	L2 1/2x2 1/2x3/16	180	-19.85	3055.17	0.6	Pass
T9	50 - 25	Inner Bracing	L2 1/2x2 1/2x3/16	218	-19.86	2524.94	0.8	Pass
T10	25 - 0	Inner Bracing	L3x3x1/4	269	-19.88	4844.64	0.4	Pass
							Summary	
						Leg (T10)	89.4	Pass
						Diagonal (T1)	99.2	Pass
						Horizontal (T6)	91.2	Pass
						Top Girt (T1)	77.8	Pass
						Redund Horz 1 Bracing (T10)	77.4	Pass
						Redund Diag 1 Bracing (T10)	47.9	Pass
						Inner Bracing (T9)	0.8	Pass
						Bolt Checks	99.2	Pass
						RATING =	**99.2**	**Pass**

ANCHOR BOLT ANALYSIS

AECOM

				Page	of
Job	180' Stainless Lattice Tower - Ledyard, CT	Project No.		Sheet 1	of 3
Description	Anchor Bolt Analysis	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

ANCHOR BOLT ANALYSIS

Input Data

Max Pier Reactions:

Uplift:	$\mathrm{Uplift} := 386 \cdot \mathrm{kips}$	*user input*
Shear:	$\mathrm{Shear} := 49 \cdot \mathrm{kips}$	*user input*
Compression:	$\mathrm{Compression} := 456 \cdot \mathrm{kips}$	*user input*

Anchor Bolt Data:

Use ASTM A449

Number of Anchor Bolts = N	$N := 6$	*user input*	
Bolt Ultimate Strength:	$F_u := 90 \cdot \mathrm{ksi}$	*user input*	
Bolt Yield Strength:	$Fy := 58 \cdot \mathrm{ksi}$	*user input*	
Bolt Modulus:	$E := 29000 \cdot \mathrm{ksi}$	*user input*	
Thickness of Anchor Bolts	$D := 1.75\mathrm{in}$	*user input*	
Threads per Inch:	$n := 5$	*user input*	
Coefficient of Friction:	$\mu := 0.55$	*user input*	(for baseplate with grout ASCE 10-97)

AECOM

Page ___ of ___

Job 180' Stainless Lattice Tower - Ledyard, CT
Project No. ______
Sheet 1 of 3

Description Anchor Bolt Analysis
Computed by MCD
Date 06/29/16

Tower MODification - Analysis
Checked by ______
Date ______

Anchor Bolt Area:

Gross Area of Bolt:

$A_g := \frac{\pi}{4} \cdot D^2 \qquad A_g = 2.405 \cdot in^2$

Net Area of Bolt:

$A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 \qquad A_n = 1.899 \cdot in^2$

Check Tensile Forces:

Maximum Tensile Force (Gross Area):

$\text{AllowableTension} := 1.33 \cdot (0.33 \cdot A_g \cdot F_u) \qquad \text{AllowableTension} = 95.0 \cdot kips$

Note: 1.33 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$F_{net.area} := 1.33 \cdot (0.60 \cdot A_n \cdot Fy) \qquad F_{net.area} = 87.9 \cdot kips$

Note: 1.33 increase allowed per TIA/EIA

Applied Tension:

$\text{MaxTension} := \frac{\text{Uplift}}{N} \qquad \text{MaxTension} = 64.3 \cdot kips$

Check Stresses:

$\frac{\text{MaxTension}}{F_{net.area}} = 0.73$

$\text{Condition1} := \text{if}\left(\frac{\text{MaxTension}}{F_{net.area}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$

$\boxed{\text{Condition1} = \text{"OK"}}$

				Page	of
Job	180' Stainless Lattice Tower - Ledyard, CT	Project No.		Sheet 1	of 3
Description	Anchor Bolt Analysis	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

Check Anchor Bolt Area:

Based on the ASCE 10-97 Design of Latticed Steel Transmission Structures

Required Area:

$$A_{s1} := \frac{\text{Uplift}}{\text{Fy}} + \frac{\text{Shear}}{\mu \cdot 0.85 \cdot \text{Fy}} \qquad A_{s1} = 8.5 \cdot \text{in}^2$$

$$A_{s2} := \left| \frac{\text{Shear} - (0.3 \cdot \text{Compression})}{\mu \cdot 0.85 \cdot \text{Fy}} \right| \qquad A_{s2} = 3.2 \cdot \text{in}^2$$

Provided Area:

$$A_{\text{sprovided}} := A_n \cdot N \qquad A_{\text{sprovided}} = 11.4 \cdot \text{in}^2$$

$$\text{Condition2} := \text{if}\left(\frac{A_{s1}}{A_{\text{sprovided}}} \le 1.00, \text{"OK"}, \text{"Overstressed"} \right) \qquad \frac{A_{s1}}{A_{\text{sprovided}}} = 0.74$$

$$\boxed{\text{Condition2} = \text{"OK"}}$$

$$\text{Condition3} := \text{if}\left(\frac{A_{s2}}{A_{\text{sprovided}}} \le 1.00, \text{"OK"}, \text{"Overstressed"} \right) \qquad \frac{A_{s2}}{A_{\text{sprovided}}} = 0.28$$

$$\boxed{\text{Condition3} = \text{"OK"}}$$

FOUNDATION ANALYSIS

AECOM

				Page	of
Job	180' Stainless Lattice w/ Powermount - Ledyard, CT	Project No.		Sheet 1	of 10
Description	Foundation Analysis with Clipped Corner	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

PIER AND MAT W/ CLIPPED CORNER FOUNDATION ANALYSIS - 3 PIERS

TOWER FORCES:

Moment Caused by Tower	$M_t := 9520 \cdot \text{kip} \cdot \text{ft}$
Shear at Base of Tower	$S_t := 86.693 \cdot \text{kip}$
Max Compressive Force	$C_t := 455.619 \cdot \text{kip}$
Max Uplift	$U_t := 386.516 \cdot \text{kip}$
Height of Tower	$H_t := 180 \cdot \text{ft}$
Width of Tower at Base	$W_t := 25 \cdot \text{ft}$
Weight of Tower	$WT_t := 21.4 \cdot \text{kip}$

NOTE: Weight of Tower is incorporated into the other loads listed above and the weight of the Powermount is input above

FOOTING DIMENSIONS:

Width of Footing	$W_f := 36.25 \cdot \text{ft}$
Width of Clipped Corner	$W_{clip} := 6.75\text{ft}$
Length of Clipped Corner	$L_{clip} := 8.4166\text{ft}$
Overall Depth of Footing	$D_f := 6\text{ft}$
Length of Pier	$L_p := 4.5 \cdot \text{ft}$
Extension of Pier Above Grade	$L_{pag} := 0 \cdot \text{ft}$
Diameter of Pier	$d_p := 4 \cdot \text{ft}$
Thickness of Footing	$T_f := 2.5 \cdot \text{ft}$
Reinforcement Cover:	$Cvr := 3\text{in}$

$$A_{mat} := W_f^{\,2} - \frac{W_{clip} \cdot L_{clip}}{2} \qquad A_{mat} = 1286 \cdot \text{ft}^2$$

Unit Weight of Soil	$\gamma_{soil} := 120 \cdot \text{pcf}$
Unit Weight of Concrete	$\gamma_{conc} := 150 \cdot \text{pcf}$
Depth to Neglect	$n := 0 \cdot \text{ft}$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c := 0 \cdot \text{ksf}$

MATERIAL PROPERTIES:

Compressive Strength of Concrete	$f'c := 3000 \cdot \text{psi}$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot \text{psi}$
Internal Friction Angle of Soil	$\phi_s := 34 \cdot \text{deg}$
Allowable Bearing Capacity	$q_s := 6000 \cdot \text{psf}$

Coefficient of Lateral Soil Pressure:

$$K_p := \frac{1 + \sin(\phi_s)}{1 - \sin(\phi_s)} \qquad K_p = 3.5371$$

Is foundation subject to bouyancy (Yes=1/N=0): $\text{Bouyancy} := 0$

What is Position of Center of Tower with respect to Center of Pad?

1=Offset
2=Not Offset

$Pos_{tower} := 2$

Adjusted Unit Weights:

$$\gamma_c := \text{if}(\text{Bouyancy} = 1, \gamma_{conc} - 62.4\text{pcf}, \gamma_{conc}) \qquad \gamma_c = 150 \cdot \text{pcf}$$

$$\gamma_s := \text{if}(\text{Bouyancy} = 1, \gamma_{soil} - 62.4\text{pcf}, \gamma_{soil}) \qquad \gamma_s = 120 \cdot \text{pcf}$$

STEEL REINFORCING:

PIER REINFORCEMENT:

Bar Size	$BSpier := 9$	Bar Diameter	$d_{bpier} := 1.128 \cdot \text{in}$
Number of Bars	$NBpier := 12$	Bar Area	$A_{bpier} := 1.00 \cdot \text{in}^2$

PAD REINFORCEMENT:

Bar Size	$BS_{pad} := 9$	Bar Diameter	$d_{bpad} := 1.128 \cdot \text{in}$
Number of Bars	$NB_{pad} := 55$	Bar Area	$A_{bpad} := 1.000 \cdot \text{in}^2$

Note: Bar size varies. Equivalent area of reinforcement.

AECOM

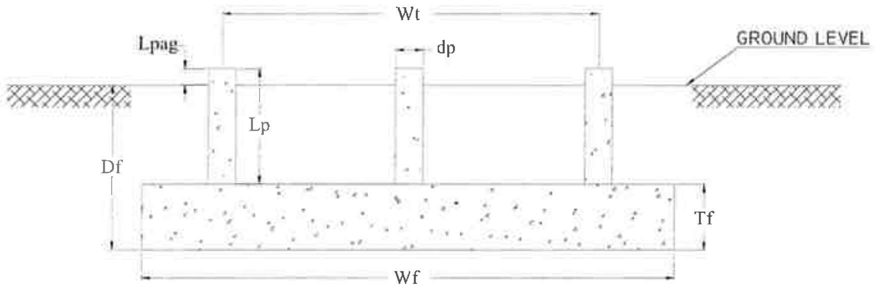
Page ___ of ___

Job 180' Stainless Lattice w/ Powermount - Ledyard, CT Project No. ________ Sheet 2 of 10

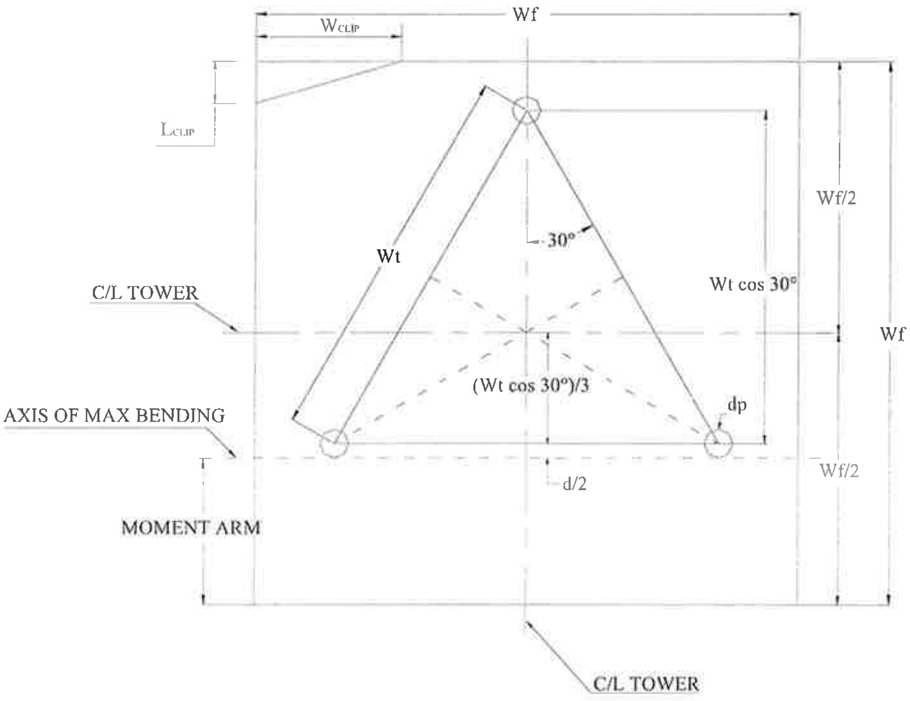
Description Foundation Analysis with Clipped Corner Computed by MCD Date 06/29/16

Tower MODification - Analysis Checked by ________ Date ________

FOUNDATION OVERVIEW



ELEVATION



PLAN

AECOM

Page ___ of ___

Job: 180' Stainless Lattice w/ Powermount - Ledyard, CT
Project No. ___
Sheet 3 of 10

Description: Foundation Analysis with Clipped Corner
Computed by: MCD
Date: 06/29/16

Tower MODification - Analysis
Checked by: ___
Date: ___

STABILITY OF FOOTING

Factor of Safety Req'd: $FS_{req} := 2.0$

Passive Pressure:

$$P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p} \qquad P_{pn} = 0 \cdot ksf$$

$$P_{pt} := K_p \cdot \gamma_s \cdot \left(D_f - T_f\right) + c \cdot 2 \cdot \sqrt{K_p} \qquad P_{pt} = 1.4856 \cdot ksf$$

$$P_{top} := if\left[n < \left(D_f - T_f\right), P_{pt}, P_{pn}\right] \qquad P_{top} = 1.4856 \cdot ksf$$

$$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p} \qquad P_{bot} = 2.5467 \cdot ksf$$

$$P_{ave} := \frac{P_{top} + P_{bot}}{2} \qquad P_{ave} = 2.0162 \cdot ksf$$

Shear:

$$T_{pp} := if\left[n < \left(D_f - T_f\right), T_f, \left(D_f - n\right)\right] \qquad T_{pp} = 2.5 \cdot ft$$

$$A_{pp} := W_f \cdot T_{pp} \qquad A_{pp} = 90.625 \cdot ft^2$$

Ultimate Shear:

$$S_u := P_{ave} \cdot A_{pp} \qquad S_u = 182.715 \cdot kip$$

Weight of Concrete Pad:

$$WT_c := \left(A_{mat} \cdot T_f\right) \cdot \gamma_c \qquad WT_c = 482.1212 \cdot kip$$

Weight of Soil: above Footing:

$$WT_{s1} := A_{mat}\left(\left|D_f - T_f - n\right|\right) \cdot \gamma_s \qquad WT_{s1} = 539.9757 \cdot kip$$

Weight of Soil Wedge at back face:

$$WT_{s2} := \left[\frac{\left(D_f - n\right)^2 \cdot \tan\left(\phi_s\right)}{2} \cdot W_f\right] \cdot \gamma_s \qquad WT_{s2} = 52.814 \cdot kip$$

Eccentricity of Foundation Due to Clipped Corner

$$Eccentricity_1 := \frac{W_f}{2} - \frac{W_f^{\,2} \cdot \frac{W_f}{2} - \frac{L_{clip} \cdot W_{clip}}{2} \cdot \left(W_f - \frac{W_{clip}}{3}\right)}{A_{mat}} \qquad Eccentricity_1 = 0.3508 \cdot ft$$

$$Eccentricity_2 := \frac{W_f}{2} - \frac{W_f^{\,2} \cdot \frac{W_f}{2} - \frac{L_{clip} \cdot W_{clip}}{2} \cdot \left(W_f - \frac{L_{clip}}{3}\right)}{A_{mat}} \qquad Eccentricity_2 = 0.3385 \cdot ft$$

Distance to center of Tower Leg from Edge of Footing:

$$X_{t1} := \frac{W_f}{2} - \frac{W_t \cdot \cos(30 \cdot deg)}{2} \qquad X_{t2} := \frac{W_f}{2} - \frac{W_t \cdot \cos(30 \cdot deg)}{3}$$

$$X_t := if\left(Pos_{tower} = 1, X_{t1}, X_{t2}\right) \qquad X_t = 10.9081 \cdot ft$$

Additional Offset of Footing:

$$X_{off1} := \frac{W_f}{2} - \left(\frac{W_t \cdot \cos(30 \cdot deg)}{3} + X_t\right) \qquad X_{off2} := 0$$

$$X_{off} := if\left(Pos_{tower} = 1, X_{off1}, X_{off2}\right) + \max\left(Eccentricity_1, Eccentricity_2\right) \qquad X_{off} = 0.3508 \cdot ft$$

Resisting Moment:

$$M_r := \left(WT_c + WT_{s1}\right) \cdot \frac{W_f}{2} + WT_t \cdot \left(\frac{W_f}{2} - X_{off}\right) + S_u \cdot \frac{T_{pp}}{3} + WT_{s2} \cdot \left(W_f + \frac{T_{pp} \cdot \tan\left(\phi_s\right)}{3}\right)$$

Overturning Moment:

$$M_{ot} := M_t + S_t \cdot \left(L_p + T_f\right) + WT_t \cdot X_{off} \qquad M_r = 21002.332 \cdot kip \cdot ft \qquad M_{ot} = 10134.3571 \cdot kip \cdot ft$$

Factor of Safety:

$$FS := \frac{M_r}{M_{ot}} \qquad FS = 2.07$$

$SafetyCheck := if\left(FS > FS_{req}, \text{"Okay"}, \text{"No Good"}\right)$ SafetyCheck = "Okay"

AECOM

Job 180' Stainless Lattice w/ Powermount - Ledyard, CT
Description Foundation Analysis with Clipped Corner
Tower MODification - Analysis

Project No.
Computed by MCD
Checked by

Page of
Sheet 4 of 10
Date 06/29/16
Date

BEARING PRESSURE CHECK:

Pressure Applied:

$$LOAD_{tot} := WT_c + WT_{s1} + WT_t \qquad LOAD_{tot} = 1043.4969 \cdot kip$$

$$I_1 := \frac{W_f^{\,4}}{12} + W_f^{\,2} \cdot Eccentricity_1^{\,2} - \frac{L_{clip} \cdot W_{clip}^{\,3}}{36} - L_{clip} \cdot W_{clip} \cdot \left(\frac{W_f}{2} - Eccentricity_1\right)$$

$$S_1 := \frac{I_1}{0.5 \cdot W_f + Eccentricity_1} \qquad I_1 = 142977 \cdot ft^4 \qquad S_1 = 7739 \cdot ft^3$$

$$I_2 := \frac{W_f^{\,4}}{12} + W_f^{\,2} \cdot Eccentricity_2^{\,2} - \frac{2W_{clip} \cdot L_{clip}^{\,3}}{36} - L_{clip} \cdot W_{clip} \cdot \left(\frac{W_f}{2} - Eccentricity_2\right)$$

$$S_2 := \frac{I_2}{0.5 \cdot W_f + Eccentricity_2} \qquad I_2 = 142813 \cdot ft^4 \qquad S_2 = 7735 \cdot ft^3$$

$$S := \min(S_1, S_2) \qquad S = 7735 \cdot ft^3$$

$$P_{max} := \frac{LOAD_{tot}}{A_{mat}} + \frac{M_{ot}}{S} \qquad P_{max} = 2.1219 \cdot ksf$$

$$P_{min} := \frac{LOAD_{tot}}{A_{mat}} - \frac{M_{ot}}{S} \qquad P_{min} = -0.4986 \cdot ksf$$

$$MaxPressure := if\left(P_{max} < q_s, \text{"Okay"}, \text{"No Good"}\right) \qquad MaxPressure = \text{"Okay"}$$

$$MinPressure := if\left[\left(P_{min} \geq 0\right) \cdot \left(P_{min} < q_s\right), \text{"Okay"}, \text{"No Good"}\right] \qquad MinPressure = \text{"No Good"}$$

Distance to Resultant of Pressure Distribution:

$$X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3} \qquad X_p = 9.7843 \cdot ft$$

Distance to Kern:

$$X_k := \frac{W_f}{3} \qquad X_k = 12.0833 \cdot ft$$

Since Resultant Force is Not in Kern, Area to which Pressure is Applied Must be Reduced.

Eccentricity:

$$e := \frac{M_{ot}}{LOAD_{tot}} \qquad e = 9.7119$$

Adjusted Soil Pressure:

$$q_a := \frac{2 \cdot LOAD_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)} \qquad q_a = 2.2811 \cdot ksf$$

Revised Maximum:

$$q_{max} := if\left(X_p < X_k, q_a, P_{max}\right) \qquad q_{max} = 2.2811 \cdot kip$$

$$PressureCheck := if\left(q_{max} < q_s, \text{"Okay"}, \text{"No Good"}\right) \qquad PressureCheck = \text{"Okay"}$$

AECOM

Page ___ of ___

Job 180' Stainless Lattice w/ Powermount - Ledyard, CT Project No. ______ Sheet 5 of 10

Description Foundation Analysis with Clipped Corner Computed by MCD Date 06/29/16

Tower MODification - Analysis Checked by ______ Date ______

CHECK PUNCHING AND BEAM SHEAR:

Load Factor: (EIA 3.1.1) $LF := if\left[H_t \le 700\cdot ft, 1.333, if\left[H_t \ge 1200, 1.7, 1.333 + \left(\frac{H_t - 700}{1200 - 700}\right)\cdot 0.4\right]\right]$ $LF = 1.333$

Beam Shear: (Critical section located at a distance d from the face of Pier) (ACI 11.3.1.1)

$\phi_c := .85$ (ACI 9.3.2.3)

$d := T_f - Cvr - .5\cdot in$ $d = 26.5\cdot in$

Factored load: $FL := LF\cdot\frac{C_t}{W_f^{\,2}}$ $FL = 0.4622\cdot ksf$

$V_{req} := \frac{FL\cdot\left(X_t - 0.5\cdot d_p - d\right)\cdot W_f}{\phi_c}$ $V_{req} = 132.0584\cdot kip$

ACI 11.3.1.1 $V_{Avail} := 2\cdot\sqrt{f'c\cdot psi}\cdot W_f\cdot d$ $V_{Avail} = 1262.7744\cdot kip$

$BeamShearCheck := if\left(V_{req} < V_{Avail}, \text{"Okay"}, \text{"No Good"}\right)$ $BeamShearCheck = \text{"Okay"}$

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.12.2.1)

$b_o := \left(d_p + d\right)\cdot\pi$ $b_o = 19.5041\cdot ft$

$V_{req} := FL\cdot\frac{W_f^{\,2} - \left(d_p + d\right)^2\cdot\frac{\pi}{4}}{\phi_c}$ $V_{req} = 698.0575\cdot kip$

$V_{Avail} := 4\cdot\sqrt{f'c\cdot psi}\cdot b_o\cdot d$ $V_{Avail} = 1358.8535\cdot kip$

$PunchingShearCheck := if\left(V_{req} < V_{Avail}, \text{"Okay"}, \text{"No Good"}\right)$ $PunchingShearCheck = \text{"Okay"}$

AECOM

				Page	of
Job	180' Stainless Lattice w/ Powermount - Ledyard, CT	Project No.		Sheet 6	of 10
Description	Foundation Analysis with Clipped Corner	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

TENSILE REINFORCEMENT IN PAD:

$\phi_m := .90$ per ACI 9.3.2.2

Applied Moments:

$$M_{nT} := LF\cdot\left[U_t\cdot\left(W_t\cdot\sin(60\cdot deg) - \frac{d_p}{2}\right) + S_t\cdot\left(D_f + L_{pag}\right)\right] - WT_t\cdot X_{off}$$

$$M_{nS} := -1\cdot\left[\frac{1}{2}\cdot\left(\frac{W_f}{2} + \frac{W_t}{3}\cdot\cos(30\cdot deg) - \frac{d_p}{2}\right)^2\cdot W_t\left[\gamma_s\cdot\left(T_{pp} - T_f\right)\right] + WT_{s2}\cdot\left[\frac{W_f}{2} + \frac{W_t}{3}\cdot\cos(30\cdot deg) - \frac{d_p}{2} + \left(D_f - n\right)\cdot\tan\left(\phi_s\right)\right]\right]$$

$$M_{nC} := -1\cdot\left[\frac{1}{2}\cdot\left(\frac{W_f}{2} + \frac{W_t}{3}\cdot\cos(30\cdot deg) - \frac{d_p}{2}\right)^2\cdot W_t\cdot\left(\gamma_c\cdot T_f\right)\right]$$

Design Moment: $M_n := \dfrac{M_{nT} + M_{nS} + M_{nC}}{\phi_m}$ $\quad M_n = 7566.5633\cdot kips\cdot ft$

Required Reinforcement:

ACI 10.2.7.3 $\quad \beta := if\left[f'c \le 4000\cdot psi, .85, if\left[f'c \ge 8000\cdot psi, .65, .85 - \left(\dfrac{\dfrac{f'c}{psi} - 4000}{1000}\right)\cdot .05\right]\right]$ $\quad \beta = 0.85$

Effective Width: $\quad b_{eff} := W_t\cdot\cos(30\cdot deg) + d_p$ $\quad b_{eff} = 307.8076\cdot in$

$A_s := \dfrac{M_n}{\phi_m\cdot fy\cdot d}$ $\quad A_s = 63.4513\cdot in^2$

$a := \dfrac{A_s\cdot fy}{\beta\cdot f'c\cdot b_{eff}}$ $\quad a = 4.8503\cdot in$

$A_s := \dfrac{M_n}{fy\cdot\left(d - \dfrac{a}{2}\right)}$ $\quad A_s = 62.8587\cdot in^2$

$\rho := \dfrac{A_s}{b_{eff}\cdot d}$ $\quad \rho = 0.0077$

AECOM

				Page	of
Job	180' Stainless Lattice w/ Powermount - Ledyard, CT	Project No.		Sheet 7	of 10
Description	Foundation Analysis with Clipped Corner	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

Temperature and Shrinkage: $\rho_{sh} := \text{if}(fy \geq 60000 \cdot psi, 0.0018, 0.0020)$ $\rho_{sh} = 0.0018$

(ACI 7.12.2.1b)

Area Required: $As := \text{if}\left(\rho \geq \rho_{sh}, A_s, \rho_{sh} \cdot \frac{b_{eff}}{2} \cdot d\right)$ $As = 62.8587 \cdot in^2$

Area Provided: $As_{prov} := A_{bpad} \cdot NB_{pad}$ $As_{prov} = 55 \cdot in^2$

$PadReinforcement := \text{if}\left(As_{prov} > As, \text{"Okay"}, \text{"No Good"}\right)$ $PadReinforcement = \text{"No Good"}$

DEVELOPMENT LENGTH OF PAD REINFORCEMENT:

TENSION (ACI 12.2.3)

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot Cvr - NB_{pad} \cdot d_{bpad}}{NB_{pad} - 1}$ $B_{sPad} = 6.7956 \cdot in$

Development Length Factors:

Reinforcement Location Factor $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\gamma := 1.0$

Spacing or Cover Dimension: $c := \text{if}\left(Cvr < \frac{B_{sPad}}{2}, Cvr, \frac{B_{sPad}}{2}\right)$ $c = 3 \cdot in$

Transverse Reinforcement Inde As allowed by ACI 12.2.4 $k_{tr} := 0$

Development Length: $L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\frac{c + k_{tr}}{d_{bpad}}} \cdot d_{bpad}$ $L_{dbt} = 34.8457 \cdot in$

$L_{dbmin} := 12 \cdot in$

Minimum Development Length: $L_{dbtCheck} := \text{if}\left(L_{dbt} \geq L_{dbmin}, \text{"Use L.dbt"}, \text{"Use L.dbmin"}\right)$ $L_{dbtCheck} = \text{"Use L.dbt"}$
(ACI 12.2.1)

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{W_t}{2} - Cvr$ $L_{Pad} = 64.5 \cdot in$

$LpadTension := \text{if}\left(L_{Pad} > L_{dbt}, \text{"Okay"}, \text{"No Good"}\right)$ $LpadTension = \text{"Okay"}$

AECOM

Page ___ of ___

Job: 180' Stainless Lattice w/ Powermount - Ledyard, CT
Project No.:
Sheet 8 of 10

Description: Foundation Analysis with Clipped Corner
Computed by: MCD
Date: 06/29/16

Tower MODification - Analysis
Checked by:
Date:

REINFORCEMENT IN PIER:

Pier Area: $A_p := \frac{\pi \cdot d_p^{\,2}}{4}$ $\quad A_p = 1809.5574 \cdot in^2$

(ACI 10.8.4 and 10.9.1) $A_{smin} := 0.01 \cdot 0.5 \cdot A_p$ $\quad A_{smin} = 9.0478 \cdot in^2$

$A_{sprov} := NBpier \cdot A_{bpier}$ $\quad A_{sprov} = 12 \cdot in^2$

$SteelAreaCheck := if\left(A_{sprov} > A_{smin}, "Okay", "No Good"\right)$ $\quad SteelAreaCheck = "Okay"$

NOTE: Anchor Bolts are not accounted for in reinforcement calculation and will provide additional reinforcement to satisfy minimum requirement of steel.

Bar Spacing In Pier: $B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier}$ $\quad B_{sPier} = 11.4384 \cdot in$

Diamter of Reinforcement Cage: $Diam_{cage} := d_p - 2 \cdot Cvr$ $\quad Diam_{cage} = 42 \cdot in$

Maximum Moment in Pier: $M_p := \left(S_t \cdot L_p\right) \cdot LF$ $\quad M_p = 6240.3355 \cdot kips \cdot in$

Pier Check evaluated from outside program and results are listed below;

(defined variables) $\left(f'_c \;\; f_y \;\; cl \;\; Spiral\right) = (3 \;\; 60 \;\; 4 \;\; 0)$

The required input is column diameter in inches, number of reinforcing bars, bar size number, factored axial load in kips and moment in kip inches: $\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) := (48 \;\; 12 \;\; 9 \;\; 553 \;\; 4698)$

Clears any previous output: $\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := (0 \;\; 0 \;\; 0 \;\; 0)$

$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) := \phi P'_n\left(D, N, n, P_u, M_{xu}\right)^T$

The Output is given as useable axial load in kips, moment capacity in kip inches, splicing stress in ksi, and reinforcement ratio: $\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = (2245.0134 \;\; 19072.4646 \;\; -36.9447 \;\; 0.0066)$

Column size and reinforcement may be changed to match capacity to the applied load.

$AxialLoadCheck := if\left(\phi P_n \ge P_u, "Okay", "No Good"\right)$ $\quad AxialLoadCheck = "Okay"$

$BendingCheck := if\left(\phi M_{xn} \ge M_{xu}, "Okay", "No Good"\right)$ $\quad BendingCheck = "Okay"$

AECOM

Page ___ of ___

Job 180' Stainless Lattice w/ Powermount - Ledyard, CT
Project No. ___
Sheet 9 of 10
Description Foundation Analysis with Clipped Corner
Computed by MCD
Date 06/29/16
Tower MODification - Analysis
Checked by ___
Date ___

DEVELOPMENT LENGTH OF PIER REINFORCEMENT:

TENSION (ACI 12.2.3)

Spacing and Cover: $Cvr = 3 \cdot in$ $\quad B_{sPier} = 11.4384 \cdot in$

Factors for development:

Reinforcement Location Factor $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\gamma := 1.0$

Spacing or Cover Dimension: $c := \text{if}\left(Cvr < \frac{B_{sPier}}{2}, Cvr, \frac{B_{sPier}}{2}\right)$ $\quad c = 3 \cdot in$

Transverse Reinforcement: As allowed by ACI 12.2.4 $\quad k_{tr} := 0$

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\frac{c+k_{tr}}{d_{bpier}}} \cdot d_{bpier} \qquad L_{dbt} = 34.8457 \cdot in$$

Minimum Development Length: (ACI 12.2.1) $\quad L_{dbmin} := 12 \cdot in$

$$L_{dbtCheck} := \text{if}\left(L_{dbt} \ge L_{dbmin}, \text{"Use L.dbt"}, \text{"Use L.dbmin"}\right) \qquad L_{dbtCheck} = \text{"Use L.dbt"}$$

COMPRESSION: (ACI 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot fy}{\sqrt{f'c \cdot psi}} \qquad L_{dbc1} = 24.7132 \cdot in$$

$$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot fy\right) \qquad L_{dbmin} = 20.304 \cdot in$$

$$L_{dbc} := \text{if}\left(L_{dbc1} \ge L_{dbmin}, L_{dbc1}, L_{dbmin}\right) \qquad L_{dbc} = 24.7132 \cdot in$$

AECOM

				Page	of
Job	180' Stainless Lattice w/ Powermount - Ledyard, CT	Project No.		Sheet 10	of 10
Description	Foundation Analysis with Clipped Corner	Computed by	MCD	Date	06/29/16
	Tower MODification - Analysis	Checked by		Date	

Available Length in Pier: $L_{pier} := L_p - 3 \cdot in$ $\quad L_{pier} = 51 \cdot in$

$L_{piertension} := \text{if}\left(L_{pier} > L_{dbt}, \text{"Okay"}, \text{"No Good"}\right)$ $\quad L_{piertension} = \text{"Okay"}$

$L_{piercompression} := \text{if}\left(L_{pier} > L_{dbc}, \text{"Okay"}, \text{"No Good"}\right)$ $\quad L_{piercompression} = \text{"Okay"}$

Available Length in Pad: $L_{pad} := T_f - 3 \cdot in$ $\quad L_{pad} = 27 \cdot in$

$L_{padtension} := \text{if}\left(L_{pad} > L_{dbt}, \text{"Okay"}, \text{"No Good"}\right)$ $\quad L_{padtension} = \text{"No Good"}$

$L_{padcompression} := \text{if}\left(L_{pad} > L_{dbc}, \text{"Okay"}, \text{"No Good"}\right)$ $\quad L_{padcompression} = \text{"Okay"}$

NOTE: Anchor bolts and plate provided, OK

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of $6 billion.

More information on AECOM and its services can be found at www.aecom.com.

500 Enterprise Drive, Suite 3B
Rocky Hill, CT 06067
860-529-8882
Fax: 860-529-3991