Robinson+Cole

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Also admitted in Massachusetts

March 27, 2015

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

Re: **Notice of Exempt Modification – Facility Modification**
60 Industrial Park Road, Vernon, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the 158.5-foot level on an existing 175-foot tower at 60 Industrial Park Road in Vernon (the "Property"). The tower and Property are owned by Millenicom. Cellco's use of the tower was approved by the Council in 2000. Cellco now intends to modify its facility by replacing nine (9) of its existing antennas with three (3) model LNX-6514DS-VTM, 850 MHz antennas; three (3) model HBXX-6517DS-VTM, 1900 MHz antennas; and three (3) model HBXX-6517DS-VTM, 2100 MHz antennas, all at the same 158.5-foot level on the tower. Cellco also intends to install six (6) remote radio heads ("RRHs") behind its 1900 MHz and 2100 MHz antennas and one (1) HYBRIFLEX™ antenna cable inside the tower. Included in Attachment 1 are specifications for Cellco's replacement antennas, RRHs and HYBRIFLEX™ cable.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Daniel A. Champagne, Mayor of the Town of Vernon and Millenicom, the owner of the Property.

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

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antennas and RRHs will be installed on its existing antenna platform at the 158.5-foot level on the tower.

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.

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

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative General Power Density table with Cellco's modified facility is included in Attachment 2.

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

6. The tower and its foundation, with certain modifications, can support Cellco's proposed modifications. (*See* Rigorous Structural Analysis and associated Reinforcement Design included in Attachment 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Daniel A. Champagne, Vernon Mayor
Millenicom
Tim Parks

ATTACHMENT 1

Product Specifications

LNX-6514DS-VTM

Andrew® Antenna, 698–896 MHz, 65° horizontal beamwidth, RET compatible

- Great solution to maximize network coverage and capacity
- Excellent gain, VSWR, front-to-back ratio, and PIM specifications for robust network performance
- Ideal choice for site collocations and tough zoning restrictions
- Excellent solution for site sharing and maximizing capacity
- Fully compatible with Andrew remote electrical tilt system for greater OpEx savings
- The RF connectors are designed for IP67 rating and the radome for IP56 rating

Electrical Specifications

Frequency Band, MHz	**698–806**	**806–896**
Gain, dBi	15.8	15.9
Beamwidth, Horizontal, degrees	65	64
Beamwidth, Vertical, degrees	12.4	11.2
Beam Tilt, degrees	0–10	0–10
USLS, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	23	23
CPR at Sector, dB	12	10
Isolation, dB	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153
Input Power per Port, maximum, watts	400	400
Polarization	±45°	±45°
Impedance	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**698–806**	**806–896**
Gain by all Beam Tilts, average, dBi	15.6	15.7
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.5
Gain by Beam Tilt, average, dBi	0 ° | 15.7 5 ° | 15.7 10 ° | 15.3	0 ° | 15.9 5 ° | 15.8 10 ° | 15.3
Beamwidth, Horizontal Tolerance, degrees	±0.9	±1.4
Beamwidth, Vertical Tolerance, degrees	±0.8	±0.6
USLS, dB	18	20
Front-to-Back Total Power at 180° ± 30°, dB	25	23
CPR at Boresight, dB	25	24
CPR at Sector, dB	15	12

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®

LNX-6514DS-VTM

Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	2
Wind Loading, maximum	617.7 N @ 150 km/h 138.9 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	14.2 kg | 31.3 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	LNX-6514DS-A1M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	**Classification**
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

DB380 — Pipe Mounting Kit for 2.4"-4.5" (60-115mm) OD round members on wide panel antennas. Includes 2 clamp sets and double nuts.

DB5083 — Downtilt Mounting Kit for 2.4"-4.5" (60 - 115 mm) OD round members. Includes a heavy-duty, galvanized steel downtilt mounting bracket assembly and associated hardware. This kit is compatible with the DB380 pipe mount kit for panel antennas that are equipped with two mounting brackets.

Product Specifications

POWERED BY ANDREW

HBXX-6517DS-VTM

Andrew® Quad Port Antenna, 1710–2180 MHz, 65° horizontal beamwidth, RET compatible

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression

Electrical Specifications

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain, dBi	19.0	19.1	19.2
Beamwidth, Horizontal, degrees	67	66	65
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beam Tilt, degrees	0–6	0–6	0–6
USLS, dB	18	18	18
Front-to-Back Ratio at 180°, dB	30	30	30
CPR at Boresight, dB	21	22	21
CPR at Sector, dB	10	11	9
Isolation, dB	30	30	30
VSWR | Return Loss, dB	1.4 | 15.6	1.4 | 15.6	1.4 | 15.6
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153
Input Power per Port, maximum, watts	350	350	350
Polarization	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	**1710–1880**	**1850–1990**	**1920–2180**
Gain by all Beam Tilts, average, dBi	18.5	18.6	18.8
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.3	±0.4
Gain by Beam Tilt, average, dBi	0 ° | 18.4 3 ° | 18.7 6 ° | 18.4	0 ° | 18.4 3 ° | 18.7 6 ° | 18.5	0 ° | 18.7 3 ° | 18.9 6 ° | 18.6
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
USLS, dB	18	19	19
Front-to-Back Total Power at 180° ± 30°, dB	25	26	26
CPR at Boresight, dB	22	23	22
CPR at Sector, dB	10	10	9

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz

Mechanical Specifications

Color	Light gray
Lightning Protection	dc Ground
Radiator Material	Low loss circuit board
Radome Material	PVC, UV resistant
RF Connector Interface	7-16 DIN Female
RF Connector Location	Bottom
RF Connector Quantity, total	4
Wind Loading, maximum	668.0 N @ 150 km/h 150.2 lbf @ 150 km/h
Wind Speed, maximum	241.0 km/h | 149.8 mph

Dimensions

Depth	166.0 mm | 6.5 in
Length	1903.0 mm | 74.9 in
Width	305.0 mm | 12.0 in
Net Weight	19.5 kg | 43.0 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 2.0 Actuator	HBXX-6517DS-A2M
RET System	Teletilt®

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

Included Products

600899A-2 — Downtilt Mounting Kit for 2.4 - 4.5 in (60 - 115 mm) OD round members. Kit contains one scissor top bracket set and one bottom bracket set.

PCS RF MODULES

RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

	RRH2x60
RF Output Power	2x60W
Instantaneous Bandwidth	20MHz
Transmitter	2 TX
Receiver 1900 HW version	2 Branch RX – LA6.0.1
1900A HW version	4 Branch RX – LR13.3
Features	AISG 2.0 for RET/TMA
	Internal Smart Bias-T
Power	-48VDC
CPRI Ports	2 CPRI Rate 3 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (top mounted)

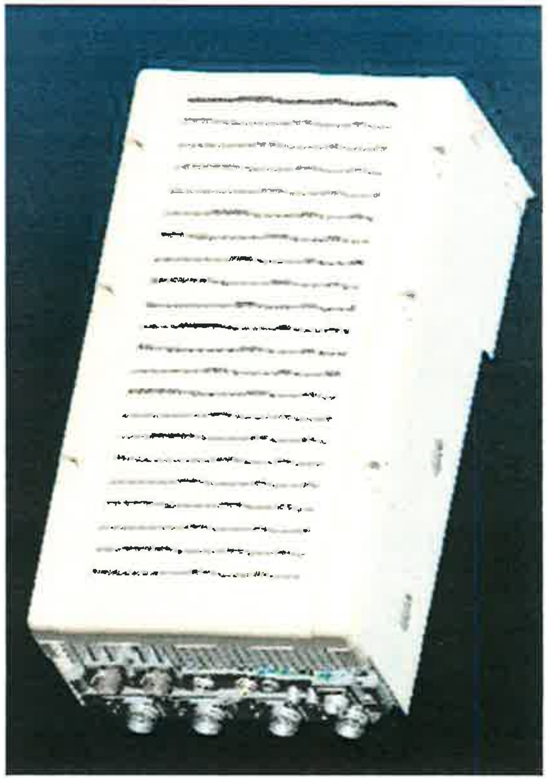
** Not a Verizon Wireless deployed product

NEW PCS RF MODULES FOR VZW

RRH2X60 - HW CHARACTERISTICS

LR14.3

	RRH2x60
RF Output Power	2x60W (4x30W HW Ready)
Instantaneous Bandwidth	60MHz
Target Reliability (Annual Return Rate)	<2%
Receiver	4 Branch Rx
Features	AISG 2.0 for RET/TMA
Power	-48VDC
	Internal Smart Bias-T
CPRI Ports	2 CPRI Rate 5 Ports
External Alarms	4 External User Alarms
Monitor Ports	TX, RX
Environmental	GR487 Compliance
RF Connectors	7/16 DIN (downward facing)
Dimensions	22"(h) x 12"(w)x 9.4" (d)**
Weight	55lb**



**- Includes solar shield but not mounting brackets (8 lbs.)

ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

RRH2X60-AWS FOR BAND 4 APPLICATIONS

The Alcatel-Lucent RRH2x60-AWS is a high power, small form factor Remote Radio Head operating in the AWS frequency band (3GPP Band 4) for LTE technology. It is designed with an eco-efficient approach, providing operators with the means to achieve high quality and high capacity coverage with minimum site requirements and efficient operation.

A distributed Node B expands the deployment options by using two components, a Base Band Unit (BBU) containing the digital assets and a separate RRH containing the radio-frequency (RF) elements. This modular design optimizes available space and allows the main components of a Node B to be installed separately, within the same site or several kilometers apart.

The Alcatel-Lucent RRH2x60-AWS is linked to the BBU by an optical-fiber connection carrying downlink and uplink digital radio signals along with operations, administration and maintenance (OA&M) information.

SUPERIOR RF PERFORMANCE

The Alcatel-Lucent RRH2x60-AWS integrates all the latest technologies. This allows to offer best-in-class characteristics.

It delivers an outstanding 120 watts of total RF power thanks to its two transmit RF paths of 60 W each.

It is ideally suited to support multiple-input multiple-output (MIMO) 2x2 operation.

It includes four RF receivers to natively support 4-way uplink reception diversity. This improves the radio uplink coverage and this can be used to extend the cell radius commensurate with 2x2MIMO 2x60 W for the downlink.

It supports multiple discontinuous LTE carriers within an instantaneous bandwidth of 45 MHz corresponding to the entire AWS B4 spectrum.

The latest generation power amplifiers (PA) used in this product achieve high efficiency (>40%), resulting in improved power consumption figures.

OPTIMIZED TCO

The Alcatel-Lucent RRH2x60-AWS is designed to make available all the benefits of a distributed Node B, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX).

The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

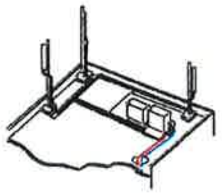
EASY INSTALLATION

The RRH2x60-AWS includes a reversible mounting bracket which allows for ease of installation behind an antenna, or on a rooftop knee wall while providing easy access to the mid body RF connectors.

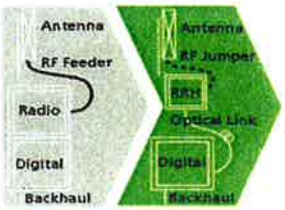
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

The Alcatel-Lucent RRH2x60-AWS is a zero-footprint solution and is convection cooled without fans for silent operation, simplifying negotiations with site property owners and minimizing environmental impacts.

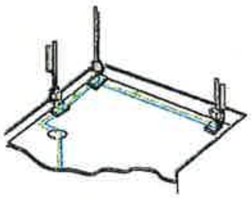
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

FEATURES

- RRH2x60-AWS integrates two power amplifiers of 60W rating (at each antenna connector)
- Support multiple carriers over the entire 3GPP band 4
- RRH2x60-AWS is optimized for LTE operation
- RRH2x60-AWS is a very compact and lightweight product
- Advanced power management techniques are embedded to provide power savings, such as PA bias control

BENEFITS

- MIMO LTE operation with only one single unit per sector
- Improved uplink coverage with built-in 4-way receive diversity capability
- RRH can be mounted close to the antenna, eliminating nearly all losses in RF cables and thus reducing power consumption by 50% compared to conventional solutions
- Distributed configurations provide easily deployable and cost-effective solutions, near zero footprint and silent solutions, with minimum impact on the neighborhood, which ease the deployment
- RETA and TMA support without additional hardware thanks to the AISG v2.0 port and the integrated Bias-Tees. Bias-Tees support AISG DC supply and signaling.

TECHNICAL SPECIFICATIONS

Specifications listed are hardware capabilities. Some capabilities depend on support in a specific software release or future release.

Dimensions and weights

- HxWxD : 510x285x186mm (27 l with solar shield)
- Weight : 20 kg (44 lbs)

Electrical Data

- Power Supply : -48V DC (-40.5 to -57V)
- Power Consumption (ETSI average traffic load reference) : 250W @2x60W

RF Characteristics

- Frequency band: 1710-1755, UL / 2110-2155 MHz, DL (3GPP band 4)
- Output power: 2x60W at antenna connectors
- Technology supported: LTE
- Instantaneous bandwidth: 45 MHz
- Rx diversity: 2-way and 4-way uplink reception
- Typical sensitivity without Rx diversity: -105 dBm for LTE

Connectivity

- Two CPRI optical ports for daisychaining and up to six RRHs per fiber
- Type of optical fiber: Single-Mode (SM) and Multi-Mode (MM) SFPs
- Optical fiber length: up to 500m using MM fiber, up to 20km using SM fiber
- TMA/RETA : AISG 2.0 (RS485 connector and internal Bias-Tee)
- Six external alarms
- Surge protection for all external ports (DC and RF)

Environmental specifications

- Operating temperature: -40°C to 55°C including solar load
- Operating relative humidity: 8% to 100%
- Environmental Conditions : ETS 300 019-1-4 class 4.1E
- Ingress Protection : IEC 60529 IP65
- Acoustic Noise : Noiseless (natural convection cooling)

Safety and Regulatory Data

- EMC : 3GPP 25113, EN 301 489-1, EN 301 489-23, GR 1089, GR 3108, OET-65
- Safety : IEC60950-1, EN 60825-1, UL, ANSI/NFPA 70, CAN/CSA-C22.2
- Regulatory : FCC Part 15 Class B, CE Mark – European Directive : 2002/95/EC (ROHS); 2002/96/EC (WEEE); 1999/5/EC (R&TTE)
- Health : EN 50385

Alcatel·Lucent

AT THE SPEED OF IDEAS™

Product Data Sheet HB158-1-08U8-S8J18

HYBRIFLEX™ RRH Hybrid Feeder Cabling Solution, 1-5/8", Single-Mode Fiber

Product Description

RFS' HYBRIFLEX Remote Radio Head (RRH) hybrid feeder cabling solution combines optical fiber and DC power for RRHs in a single lightweight aluminum corrugated cable, making it the world's most innovative solution for RRH deployments.

It was developed to reduce installation complexity and costs at Cellular sites. HYBRIFLEX allows mobile operators deploying an RRH architecture to standardize the RRH installation process and eliminate the need for and cost of cable grounding. HYBRIFLEX combines optical fiber (multi-mode or single-mode) and power in a single corrugated cable. It eliminates the need for junction boxes and can connect multiple RRHs with a single feeder. Standard RFS CELLFLEX® accessories can be used with HYBRIFLEX cable. Both pre-connectorized and on-site options are available.

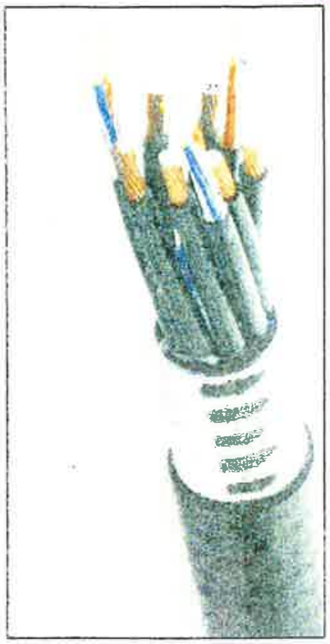


Figure 1: HYBRIFLEX Series

Features/Benefits

- Aluminum corrugated armor with outstanding bending characteristics – minimizes installation time and enables mechanical protection and shielding
- Same accessories as 1 5/8" coaxial cable
- Outer conductor grounding – Eliminates typical grounding requirements and saves on installation costs
- Lightweight solution and compact design – Decreases tower loading
- Robust cabling – Eliminates need for expensive cable trays and ducts
- Installation of tight bundled fiber optic cable pairs directly to the RRH – Reduces CAPEX and wind load by eliminating need for interconnection
- Optical fiber and power cables housed in single corrugated cable – Saves CAPEX by standardizing RRH cable installation and reducing installation requirements
- Outdoor polyethylene jacket – Ensures long-lasting cable protection

Technical Specifications

Structure			
Outer Conductor Armor	Corrugated Aluminum	[mm (in)]	46.5 (1.83)
Jacket	Polyethylene, PE	[mm (in)]	50.3 (1.98)
UV-Protection	Individual and External Jacket		Yes
Mechanical Properties			
Weight, Approximate		[kg/m (lb/ft)]	1.9 (1.30)
Minimum Bending Radius, Single Bending		[mm (in)]	200 (8)
Minimum Bending Radius, Repeated Bending		[mm (in)]	500 (20)
Recommended/Maximum Clamp Spacing		[m (ft)]	1.0 / 1.2 (3.25 / 4.0)
Electrical Properties			
DC-Resistance Outer Conductor Armor		[Ω/km (Ω/1000ft)]	068 (0.205)
DC-Resistance Power Cable, 8.4mm² (8AWG)		[Ω/km (Ω/1000ft)]	2.1 (0.307)
Fiber Optic Properties			
Version			Single-mode OM3
Quantity, Fiber Count			16 (8 pairs)
Core/Clad		[µm]	50/125
Primary Coating (Acrylate)		[µm]	245
Buffer Diameter, Nominal		[µm]	900
Secondary Protection, Jacket, Nominal		[mm (in)]	2.0 (0.08)
Minimum Bending Radius		[mm (in)]	104 (4.1)
Insertion Loss @ wavelength 850nm		dB/km	3.0
Insertion Loss @ wavelength 1310nm		dB/km	1.0
Standards (Meets or exceeds)			UL94-V0, UL1666 RoHS Compliant
DC Power Cable Properties			
Size (Power)		[mm (AWG)]	8.4 (8)
Quantity, Wire Count (Power)			16 (8 pairs)
Size (Alarm)		[mm (AWG)]	0.8 (18)
Quantity, Wire Count (Alarm)			4 (2 pairs)
Type			UV protected
Strands			19
Primary Jacket Diameter, Nominal		[mm (in)]	6.8 (0.27)
Standards (Meets or exceeds)			NFPA 130, ICEA S-95-658 UL Type XHHW-2, UL 44 UL-LS Limited Smoke, UL VW-1 IEEE-383 (1974), IEEE1202/FT4 RoHS Compliant
Environment			
Installation Temperature		[°C (°F)]	-40 to +65 (-40 to149)
Operation Temperature		[°C (°F)]	-40 to +65 (-40 to149)

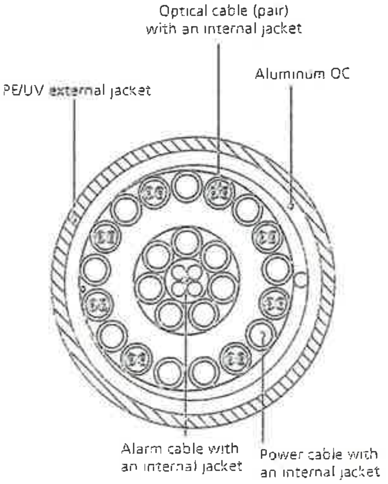


Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: Vernon 2								
Tower Height: 175Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	167.5	0.0145	880	0.5867	2.47%	
*AT&T UMTS	2	1077	167.5	0.0276	1900	1.0000	2.76%	
*AT&T GSM	1	283	167.5	0.0036	880	0.5867	0.62%	
*AT&T GSM	4	646	167.5	0.0331	1900	1.0000	3.31%	
*AT&T LTE	1	1313	167.5	0.0168	734	0.4893	3.44%	
*Nextel	9	100	145	0.0154	851	0.5673	2.71%	
*T-Mobile GSM	8	123	173	0.0118	1945	1.0000	1.18%	
*T-Mobile UMTS	2	692	173	0.0166	2100	1.0000	1.66%	
*Town Antennas	no RF information given							
Verizon PCS	**11**	**400**	**158.5**	**0.0630**	**1970**	**1.0000**	**6.30%**	
Verizon Cellular	**9**	**381**	**158.5**	**0.0491**	**869**	**0.5793**	**8.47%**	
Verizon AWS	**1**	**1750**	**158.5**	**0.0250**	**2145**	**1.0000**	**2.50%**	
Verizon 700	**1**	**1050**	**158.5**	**0.0150**	**746**	**0.4973**	**3.02%**	
								38.45%
* Source: Siting Council								

ATTACHMENT 3

PASS
(Shaft/Flange, **100%** capacity)

November 25, 2014

Mr. Michael J. Egan III, AIA
URS Corporation
500 Enterprise Drive, Suite 3B
Rocky Hill, CT 06067-3913
(860) 990-6737

Vertical Solutions, Inc.
PO Box 579
Holly Springs, NC 27540
(888) 321-6167
operations@verticalsolutions-inc.com

Subject	**Rigorous Structural Analysis**
Carrier Designation	**Verizon, Reconfiguration** **Site Number: Vernon_2** **Site Name: VZ5-177**
URS Designation	**Site Number: 36917426.00000** **Site Name: Vernon 2, CT**
Engineering Firm Designation	**Vertical Solutions Project: 141374.01, Revision 0**
Site Data	**60 Industrial Park Road, Vernon, Tolland County, CT 06066** **Latitude: N41° 50' 08.3"±, Longitude: W072° 27' 17.6"±** **Elevation: 381-ft±** **175-ft Self-Supporting Pole Structure (Monopole)**

Dear Mr. Egan,

To your request, we present our rigorous structural analysis. Our work indicates that with the proposed appurtenance configuration, the tower and foundation **will** satisfy the structural strength requirements of TIA/EIA-222-F-1996, *Structural Standards for Steel Antenna Towers and Antenna Supporting Structures* (industry standard) and the *2005 Connecticut State Building Code* (local building code) for:

- 85-mph fastest mile basic wind speed
- 74-mph fastest mile basic wind speed with 1/2-in radial ice

All equipment and modifications proposed in this report shall be installed in accordance with the attached drawings for the determined available structural capacity to be effective.

We trust you find our work satisfactory. Please do not hesitate to call should you have any questions.

Sincerely,

Matthew

Matthew E. Reeves, P.E., C.W.I.
Structural Engineer, Certified Welding Inspector

Reviewed by: AVF

No. 25064
11/26/2014

Michael L. Lassiter

Michael L. Lassiter, S.E., P.E.
Structural Engineer, Civil Engineer, & President

CT PE License No.: 25064

Table 1: Existing, Proposed and Reserved Appurtenance Configuration

Elevation (AGL, ft)	Carrier	Mount	Equipment	Coax[1]
178.25	T-Mobile	Low Profile Platform	(6) EMS RR90-17-02DP (3) APX16DWV-16DWS (9) TMAs[3]	(18) 1 5/8
167.67	AT&T	(1) Universal Ring Mount (3) Dual Standoff Arms	(3) 800-10121 (6) TMAs[3] (3) RETs (3) KMW AM-X-CD-16-65 (6) RRU (1) Surge Suppressor	(6) 1 5/8 (2) 3" Flex Conduit
158.50	Verizon [Existing][2]	Low Profile Platform	(2) BXA-70063-6CF-2 (1) BXA-70063-4CF-4 (6) Diplexers[3]	(12) 1 5/8
	Verizon [Proposed]		***(6) HBXX-6517DS-A2M*** ***(1) DB-T1-6Z-8AB-0Z Distribution Box*** ***(6) RH_2x60 RRH's*** ***(2) LNX-6514DS-VTM_04*** ***(1) LNX-6514DS-VTM_07***	***(1) 1 5/8 Fiber***
136.25	MetroPCS	Flush Mount	(3) RFS APXV18-206517	(6) 1 5/8 (outside)

1. See sheet QP-P for coax layout.
2. Verizon to remove (4) LPA-80063-4CF-EDIN- 4, (2) LPA-80063/6CF 5 & (3) BXA-171063-8BF-EDIN-2 prior to installation of proposed equipment.
3. Considered shielded.

Table 2: Structure Results, Percent Capacity Utilized[1, 2]

Elevation (ft)	Shaft	Result	Connection	Result
175 to 160	20	O. K.	25	O. K.
160 to 140	56	O. K.	69	O. K.
140 to 120	78	O. K.	97	O. K.
120 to 100	89	O. K.	95	O. K.
100 to 80	99	O. K.	**100**	**O. K.**
80 to 60	**100**	**O. K.**	96	O. K.
60 to 40	96	O. K.	99	O. K.
40 to 20	**100**	**O. K.**	**100**	**O. K.**
20 to 0	94	O. K.	86	O. K.

1. Utilization of 100% or less considered acceptable.
2. See tnxTower output and additional calculations for detailed results.

Table 3: Foundation Results, Percent Capacity Utilized[1]

Component	Percent Utilized	Result[2]
Soil	79	O. K.
Structure	90	O. K.

1. Percent capacity utilization of 100% of less considered acceptable.
2. See foundation calculations for detailed results.

ASSUMPTIONS

This rigorous structural analysis is based on the theoretical capacity of the members and is not a condition assessment of the tower. This analysis is from information supplied, and therefore, its results are based on and are as accurate as that supplied data. Vertical Solutions, Inc. ("VSI") has made no independent determination, nor is it required to, of its accuracy. The following assumptions were made for this structural analysis.

1. The tower member sizes and shapes are considered accurate as supplied. The material grade is as per data supplied and/or as assumed based on industry standards.
2. The antenna configuration is as supplied and/or as modeled in the analysis. It is assumed to be complete and accurate. All antennas, mounts, coax and waveguides are assumed to be properly installed and supported as per manufacturer requirements.
3. Some assumptions are made regarding antennas and mount sizes and their projected areas based on best interpretation of data supplied and of best knowledge of antenna type and industry practice.
4. All mounts, if applicable, are considered adequate to support the loading. No actual analysis of the mount(s) is performed. This analysis is limited to analyzing the tower only.
5. The soil parameters are as per data supplied or as assumed and stated in the calculations.
6. Foundations are properly designed and constructed to resist the original design loads indicated in the documents provided.
7. The tower and structures have been properly maintained in accordance with TIA Standards and/or with manufacturer's specifications.
8. All welds and connections are assumed to develop at least the member capacity unless determined otherwise and explicitly stated in this report.
9. All prior structural modifications are assumed to be as per data supplied/available and to have been properly installed.
10. Loading interpreted from photos is accurate to ±5' AGL, antenna size accurate to ±3.3 sf, and coax equal to the number of existing antennas without reserve.
11. Documents reviewed and used in this structural analysis were provided by CLIENT.
12. The proposed coax shall be installed per the attached coax layout plan, Sheet QP-P.
13. Leg A is determined per best industry practice.

If any of these assumptions are not valid or have been made in error, this analysis may be affected, and VSI should be allowed to review any new information to determine its effect on the structural integrity of the tower.

DISCLAIMER OF WARRANTIES

Vertical Solutions, Inc. ("VSI") has not performed a detailed site visit to the tower to verify the member sizes or antenna/coax loading. If the existing conditions are not as represented on the tower elevation contained in this report, we should be contacted immediately to evaluate the significance of the discrepancy. This is not a condition assessment of the tower or foundation. This report does not replace a full tower inspection. The tower and foundations are assumed to have been properly fabricated, erected, maintained, in good condition, twist free, and plumb.

The engineering services rendered by VSI in connection with this Rigorous Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. All tower components have been assumed to only resist dead loads when no other loads are applied. No allowance was made for any damaged, bent, missing, loose, or rusted members (above and below ground). No allowance was made for loose bolts or cracked welds.

VSI does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information needed to perform a thorough analysis of every structural sub-component and connection of an existing tower. VSI provides a limited scope of service in that we cannot verify the adequacy of every weld, plate connection detail, etc. The purpose of this report is to assess the feasibility of adding appurtenances usually accompanied by transmission lines to the structure.

It is the owner's responsibility to determine the amount of ice accumulation in excess of the specified code recommended amount, if any, that should be considered in the structural analysis.

The attached sketches are a schematic representation of the analyzed tower. If any material is fabricated from these sketches, the contractor shall be responsible for field verifying the existing conditions, proper fit, and clearance in the field. Any mentions of structural modifications are reasonable estimates and should not be used as a precise construction document. Precise modification drawings are obtainable from VSI, but are beyond the scope of this report.

Miscellaneous items such as antenna mounts, etc., have not been designed or detailed as a part of our work. We recommend that material of adequate size and strength be purchased from a reputable tower manufacturer.

VSI makes no warranties, expressed and/or implied, in connection with this report and disclaim any liability arising from material, fabrication, and erection of this tower. VSI will not be responsible whatsoever for, or on account of, consequential or incidental damages sustained by any person, firm, or organization as a result of any data or conclusions contained in this report. The maximum liability of VSI pursuant to this report will be limited to the total fee received for preparation of this report.

Attachments:

- Project History
- Sheet QP-P, Coax configuration plan
- Fill ratio calculations
- Program input and output – wind
- Tower improvement calculations
- Flange plate and flange bolt calculations
- Base plate and anchor rod calculations
- Foundation analysis
- Tower Improvement Drawings [For Construction]

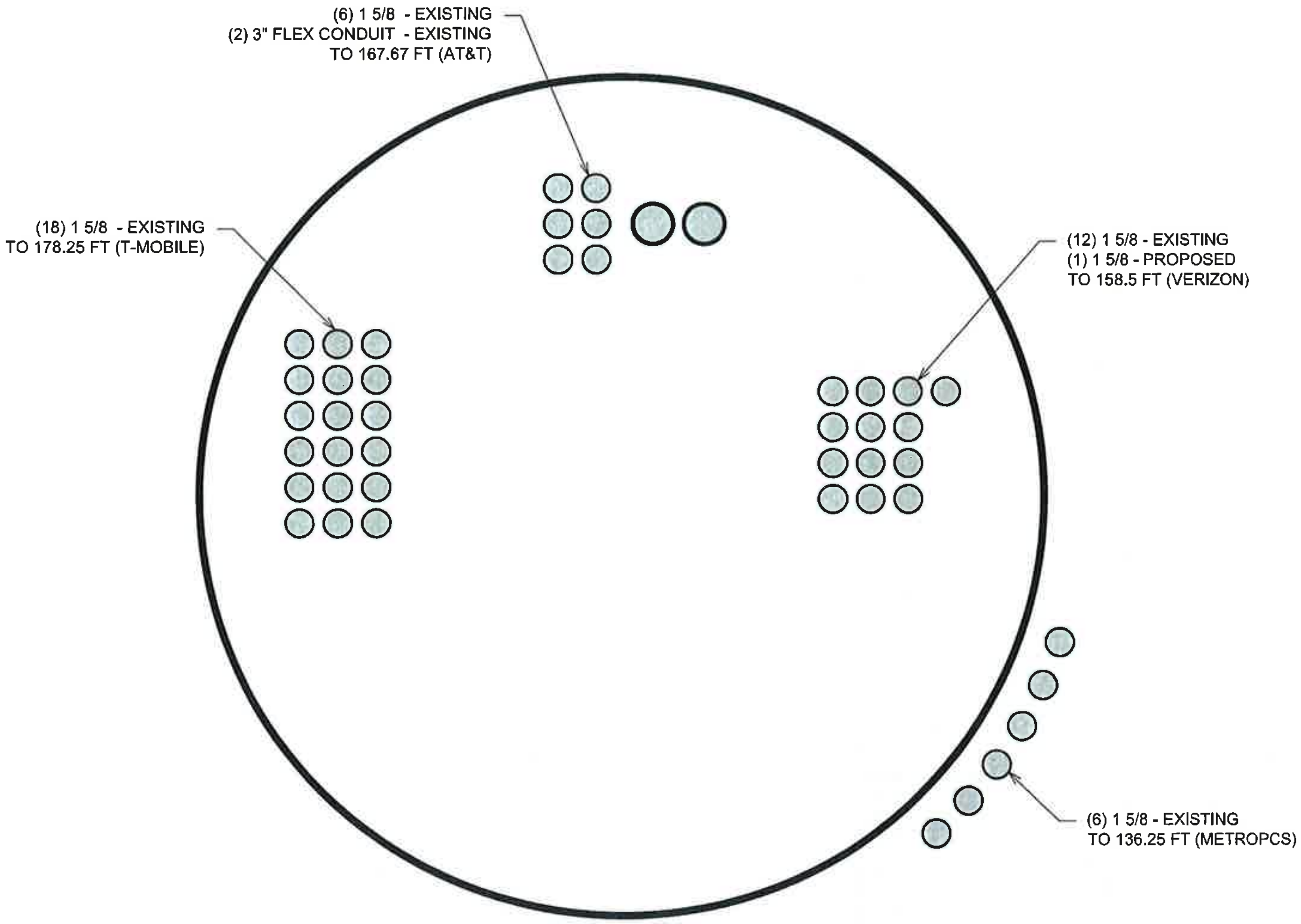
Project History

VSi Project #: 141374, Revision 0
URS Site Number: 36917426.00000 / VZ5-177
URS Site Name: Vernon 2, CT

Issued Date	Document ID	Issued By	Issued To	Description
11/23/1999	VZ5-177 Geotech.pdf	French Parrello & Associates, P.A.	Arcnet Architects Inc.	Geotechnical Report
01/28/2000	VZ5-177 Pirod.pdf	Pirod Inc.	Omnipoint	Tower & Foundation Design Drawings
12/28/2011	VZ5-177 NE Mapping.pdf	Northeast Towers, Inc	Mountain Top Services	Appurtenance Mapping
03/12/2014	VZ5-177 plan.pdf	URS Corporation	Verizon Wireless	Compound Plan
06/26/2014	VZ5-177_R2 Analysis Report.pdf	URS Corporation	Verizon Wireless	Structural Analysis Report

Table Note:

Files name format YYYYMMDD-XXX-ZZZZZZ.pdf
Where:
YYYYMMDD = Year, Month, Day published/issued
XXX=file describer
ZZZZZZ=COG Site ID



COAX CONFIGURATION PLAN

SCALE: 1" = 1'–0"

PROJECT INFORMATION:

VERNON 2, CT
VZ5-177

60 INDUSTRIAL PARK ROAD
VERNON, CT 06066
(TOLLAND COUNTY)

0	11-11-14	PSAR
REV	DATE:	Issued For:

DRAWN BY: MER CHECKED BY: AVF

SHEET NUMBER: **QP-P**

REVISION: 0

VSI #: 141374

PLANS PREPARED FOR:
URS
500 Enterprise Drive
Suite 3B
Rocky Hill, CT 06067
Office: (860) 990-6737

PLANS PREPARED BY:
vertical solutions
"execute & deliver"
113 Edinburgh South Dr.
Suite 130
Cary, NC 27511
Office: (888) 321-6167

FILL RATIO TOOL

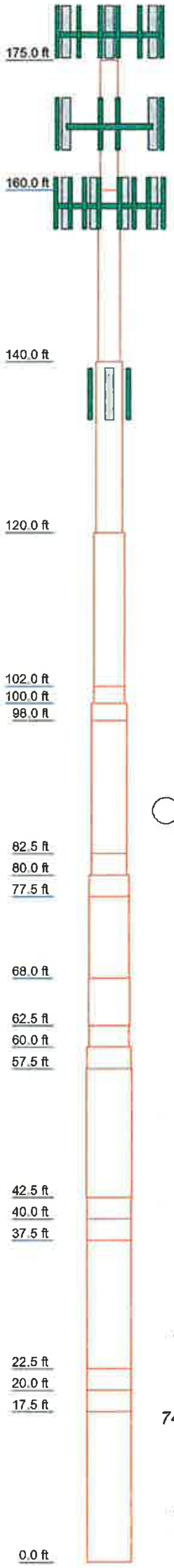
SELF-SUPPORTING POLE STRUCTURE

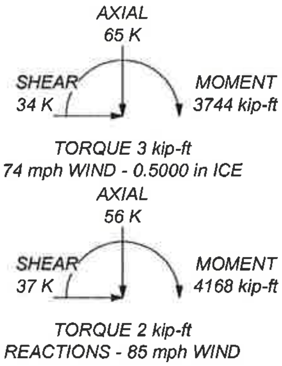
VSi Job #: 141374
Date: 11/25/2014
Calc'd by: MER
Reviewed by: AVF

Fill Ratio

Section Letter	Elevation (ft)	Section #	Group 1			Group 2			Group 3			Group 4			Group 5			A_P	A_{LA}	Fill Ratio	Result
			#	Nominal Diameter (in)	Area (in^2)	#	Nominal Diameter (in)	Area (in^2)	#	Nominal Diameter (in)	Area (in^2)	#	Nominal Diameter (in)	Area (in^2)	#	Nominal Diameter (in)	Area (in^2)	(in2)	(in2)		
E	175.00	1	18	1-5/8	55.42			0.00			0.00			0.00			0.00	424.56	55.42	**13.1%**	O.K.
D	167.67	1	18	1-5/8	55.42	6	1-5/8	18.47	2	3-in Conduit	14.14			0.00			0.00	424.56	88.03	**20.7%**	O.K.
C	158.50	2	18	1-5/8	55.42	6	1-5/8	18.47	2	3-in Conduit	14.14	13	1-5/8	40.03			0.00	671.96	128.06	**19.1%**	O.K.
B	136.25	3	18	1-5/8	55.42	6	1-5/8	18.47	2	3-in Conduit	14.14	13	1-5/8	40.03	6	1-5/8	0.00	975.91	128.06	**13.1%**	O.K.
A	0.00	9	18	1-5/8	55.42	6	1-5/8	18.47	2	3-in Conduit	14.14	13	1-5/8	40.03	6	1-5/8	0.00	2710.85	128.06	**4.7%**	O.K.

Section	Size	Length (ft)	Grade	Weight (K)
1	P24x3/8	15.00	A53-B-42	1.4
2	P30x3/8	20.00		2.4
3	P36x3/8	20.00		2.9
4	P42x3/8	18.00		3.0
5	[illegible]	2.00	A572-65	0.8
6	[illegible]	2.00		0.6
7	P48x3/8	15.50	A53-B-42	3.0
8	[illegible]	2.50	A572-65	1.2
9	[illegible]	2.50		1.0
10	[illegible]	9.50	A53-B-42	2.0
11	[illegible]	5.50	A572-65	1.4
12	[illegible]	2.50		1.3
13	[illegible]	2.50		1.0
14	[illegible]	15.00		4.1
15	[illegible]	2.50		1.3
16	[illegible]	2.50		1.3
17	P60x1/2	15.00	A53-B-42	4.8
18	[illegible]	2.50	A572-65	2.1
19	[illegible]	2.50		2.1
20	P60x5/8	17.50	A53-B-42	6.9
				44.6





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	178.25
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	178.25
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	178.25
RFS APX16DWV-16DWVS-C (T-Mobile)	178.25
RFS APX16DWV-16DWVS-C (T-Mobile)	178.25
RFS APX16DWV-16DWVS-C (T-Mobile)	178.25
(3) TMA (14.5" x 7" x 2.5") - Shielded (T-Mobile)	178.25
(3) TMA (14.5" x 7" x 2.5") - Shielded (T-Mobile)	178.25
(3) TMA (14.5" x 7" x 2.5") - Shielded (T-Mobile)	178.25
PiROD 13' Low Profile Platform (T-Mobile)	178.25
Kathrein 800 10121 w Mount Pipe (ATI)	167.667
Kathrein 800 10121 w Mount Pipe (ATI)	167.667
Kathrein 800 10121 w Mount Pipe (ATI)	167.667
(2) TMA (14.5" x 7" x 2.5") - Shielded (ATI)	167.667
(2) TMA (14.5" x 7" x 2.5") - Shielded (ATI)	167.667
(2) TMA (14.5" x 7" x 2.5") - Shielded (ATI)	167.667
KMW AM-X-CD-16-65-00T-RET (54") w/ 60" MP (ATI)	167.667
KMW AM-X-CD-16-65-00T-RET (54") w/ 60" MP (ATI)	167.667
KMW AM-X-CD-16-65-00T-RET (54") w/ 60" MP (ATI)	167.667
(2) RRU 17.6" x 16.6" x 5.2" (ATI)	167.667
(2) RRU 17.6" x 16.6" x 5.2" (ATI)	167.667
(2) RRU 17.6" x 16.6" x 5.2" (ATI)	167.667
Raycap DC2-48-60-0-9E (ATI)	167.667
Chain Mount (ATI)	167.667
Valmont Dual Standoff [DSM2] (ATI)	167.667
Valmont Dual Standoff [DSM2] (ATI)	167.667
Valmont Dual Standoff [DSM2] (ATI)	167.667
(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	158.5
(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	158.5
(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	158.5
DB-T1-6Z-8AB-0Z Distribution Box (Verizon)	158.5
(2) ALU RRH2x60 (Verizon)	158.5
(2) ALU RRH2x60 (Verizon)	158.5
(2) ALU RRH2x60 (Verizon)	158.5
Andrew LNX-6514DS-VTM w/ MP (Verizon)	158.5
Andrew LNX-6514DS-VTM w/ MP (Verizon)	158.5
Andrew LNX-6514DS-VTM w/ MP (Verizon)	158.5
BXA-70063/6CF with MP (Verizon)	158.5
BXA-70063/6CF with MP (Verizon)	158.5
BXA-70063/4CF w Mount Pipe (Verizon)	158.5
(2) Diplexer (Verizon)	158.5
(2) Diplexer (Verizon)	158.5
(2) Diplexer (Verizon)	158.5
PiROD 13' Low Profile Platform (Verizon)	158.5
RFS APXV18-206517 w/MP (MetroPCS)	136.25
RFS APXV18-206517 w/MP (MetroPCS)	136.25
RFS APXV18-206517 w/MP (MetroPCS)	136.25
100-ft Jump Kit (--)	100
80-ft Jump Kit (--)	80
60-ft Jump Kit (--)	60
40-ft Jump Kit (--)	40
20-ft Jump Kit (--)	20

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A53-B-42	42 ksi	63 ksi	A572-65	65 ksi	80 ksi

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. TOWER RATING: 100%

Vertical Solutions, Inc
113 Edinburgh South Drive, Suite 130
Cary, NC 27511
Phone: (888) 321-3167
FAX: (888) 321-1768

Job: Vernon 2, CT (VZ5-177)		
Project: 141374.01, Revision 0		
Client: URS	Drawn by: MER	App'd:
Code: TIA/EIA-222-F	Date: 11/13/14	Scale: NTS
Path: [illegible]		Dwg No. E-1

Tower Input Data

There is a pole section.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

Basic wind speed of 85 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 74 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole 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)
Add IBC .6D+W Combination

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
SR Members Have Cut Ends
Sort Capacity Reports By Component
Triangulate Diamond Inner Bracing

Treat Feedline 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 Feedline Torque
Include Angle Block Shear Check

Poles

Include Shear-Torsion Interaction
Always Use Sub-Critical Flow
Use Top Mounted Sockets

Pole Section Geometry

Section	*Elevation* *ft*	*Section Length* *ft*	*Pole Size*	*Pole Grade*	*Socket Length* *ft*
L1	175.00-160.00	15.00	P24x3/8	A53-B-42 (42 ksi)	
L2	160.00-140.00	20.00	P30x3/8	A53-B-42 (42 ksi)	
L3	140.00-120.00	20.00	P36x3/8	A53-B-42 (42 ksi)	
L4	120.00-102.00	18.00	P42x3/8	A53-B-42 (42 ksi)	
L5	102.00-100.00	2.00	HSS 42 x 0.9549	A572-65 (65 ksi)	
L6	100.00-98.00	2.00	HSS 48 x 0.6211	A572-65 (65 ksi)	
L7	98.00-82.50	15.50	P48x3/8	A53-B-42	

Section	*Elevation* *ft*	*Section Length* *ft*	*Pole Size*	*Pole Grade*	*Socket Length* *ft*
				(42 ksi)	
L8	82.50-80.00	2.50	HSS 48 x 0.9854	A572-65 (65 ksi)	
L9	80.00-77.50	2.50	HSS 54 x 0.6755	A572-65 (65 ksi)	
L10	77.50-68.00	9.50	P54x3/8	A53-B-42 (42 ksi)	
L11	68.00-62.50	5.50	HSS 55.25 x 0.4227	A572-65 (65 ksi)	
L12	62.50-60.00	2.50	HSS 54 x 0.8874	A572-65 (65 ksi)	
L13	60.00-57.50	2.50	HSS 60 x 0.6354	A572-65 (65 ksi)	
L14	57.50-42.50	15.00	HSS 61.25 x 0.4228	A572-65 (65 ksi)	
L15	42.50-40.00	2.50	HSS 60 x 0.7918	A572-65 (65 ksi)	
L16	40.00-37.50	2.50	HSS 60 x 0.7918	A572-65 (65 ksi)	
L17	37.50-22.50	15.00	P60x1/2	A53-B-42 (42 ksi)	
L18	22.50-20.00	2.50	HSS 60 x 1.3638	A572-65 (65 ksi)	
L19	20.00-17.50	2.50	HSS 60 x 1.3638	A572-65 (65 ksi)	
L20	17.50-0.00	17.50	P60x5/8	A53-B-42 (42 ksi)	

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*
L1 175.00-160.00				1	1	1		
L2 160.00-140.00				1	1	1		
L3 140.00-120.00				1	1	1		
L4 120.00-102.00				1	1	1		
L5 102.00-100.00				1	1	1		
L6 100.00-98.00				1	1	1		
L7 98.00-82.50				1	1	1		
L8 82.50-80.00				1	1	1		
L9 80.00-77.50				1	1	1		
L10 77.50-68.00				1	1	1		
L11 68.00-62.50				1	1	1		
L12 62.50-60.00				1	1	1		
L13 60.00-57.50				1	1	1		
L14 57.50-42.50				1	1	1		

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*
L15 42.50-40.00				1	1	1		
L16 40.00-37.50				1	1	1		
L17 37.50-22.50				1	1	1		
L18 22.50-20.00				1	1	1		
L19 20.00-17.50				1	1	1		
L20 17.50-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	*Sector*	*Component Type*	*Placement* *ft*	*Total Number*	*Number Per Row*	*Start/End Position*	*Width or Diameter* *in*	*Perimeter* *in*	*Weight* *plf*
*****									
LDF7-50A (1-5/8 FOAM) (MetroPCS)	C	Surface Ar (CaAa)	136.25 - 0.00	6	6	0.000 0.000	1.9800		0.82

Feed Line/Linear Appurtenances - Entered As Area

Description	*Face or Leg*	*Allow Shield*	*Component Type*	*Placement* *ft*	*Total Number*		*C_AA_A* *ft^2/ft*	*Weight* *plf*
LDF7-50A (1-5/8 FOAM) (T-Mobile)	C	No	Inside Pole	175.00 - 0.00	18	No Ice 1/2" Ice	0.00 0.00	0.82 0.82
*****								
LDF7-50A (1-5/8 FOAM) (AT&T)	C	No	Inside Pole	167.67 - 0.00	6	No Ice 1/2" Ice	0.00 0.00	0.82 0.82
3" Conduit (AT&T)	C	No	Inside Pole	167.67 - 0.00	2	No Ice 1/2" Ice	0.00 0.00	1.00 1.00
*****								
LDF7-50A (1-5/8 FOAM) (Verizon)	C	No	Inside Pole	158.50 - 0.00	12	No Ice 1/2" Ice	0.00 0.00	0.82 0.82
LDF7-50A (1-5/8 FOAM) (Verizon)	C	No	Inside Pole	158.50 - 0.00	1	No Ice 1/2" Ice	0.00 0.00	0.82 0.82

Feed Line/Linear Appurtenances Section Areas

Tower Section	*Tower Elevation* *ft*	*Face*	*A_R* *ft^2*	*A_F* *ft^2*	*C_AA_A In Face* *ft^2*	*C_AA_A Out Face* *ft^2*	*Weight* *K*
L1	175.00-160.00	A	0.000	0.000	0.000	0.000	0.00

Tower Section	*Tower Elevation ft*	*Face*	A_R ft^2	A_F ft^2	C_AA_A *In Face* ft^2	C_AA_A *Out Face* ft^2	*Weight K*
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.27
L2	160.00-140.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.63
L3	140.00-120.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	19.305	0.000	0.73
L4	120.00-102.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	21.384	0.000	0.67
L5	102.00-100.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.376	0.000	0.07
L6	100.00-98.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.376	0.000	0.07
L7	98.00-82.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	18.414	0.000	0.58
L8	82.50-80.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L9	80.00-77.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L10	77.50-68.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	11.286	0.000	0.35
L11	68.00-62.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	6.534	0.000	0.20
L12	62.50-60.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L13	60.00-57.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L14	57.50-42.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	17.820	0.000	0.56
L15	42.50-40.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L16	40.00-37.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L17	37.50-22.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	17.820	0.000	0.56
L18	22.50-20.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L19	20.00-17.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	2.970	0.000	0.09
L20	17.50-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	20.790	0.000	0.65

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	175.00-160.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.27
L2	160.00-140.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.63
L3	140.00-120.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	39.726	0.000	0.84
L4	120.00-102.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	44.004	0.000	0.80
L5	102.00-100.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	4.889	0.000	0.09
L6	100.00-98.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	4.889	0.000	0.09
L7	98.00-82.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	37.892	0.000	0.69
L8	82.50-80.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L9	80.00-77.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L10	77.50-68.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	23.224	0.000	0.42
L11	68.00-62.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	13.446	0.000	0.24
L12	62.50-60.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L13	60.00-57.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L14	57.50-42.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	36.670	0.000	0.66
L15	42.50-40.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L16	40.00-37.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L17	37.50-22.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	36.670	0.000	0.66
L18	22.50-20.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	6.112	0.000	0.11
L19	20.00-17.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00

Tower Section	*Tower Elevation* *ft*	*Face or Leg*	*Ice Thickness* *in*	A_R *ft²*	A_F *ft²*	C_AA_A *In Face* *ft²*	C_AA_A *Out Face* *ft²*	*Weight* *K*
		C		0.000	0.000	6.112	0.000	0.11
L20	17.50-0.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	42.782	0.000	0.77

Feed Line Center of Pressure

Section	*Elevation* *ft*	CP_X *in*	CP_Z *in*	CP_X *Ice* *in*	CP_Z *Ice* *in*
L1	175.00-160.00	0.0000	0.0000	0.0000	0.0000
L2	160.00-140.00	0.0000	0.0000	0.0000	0.0000
L3	140.00-120.00	0.0000	1.1557	0.0000	1.6333
L4	120.00-102.00	0.0000	1.3931	0.0000	1.9577
L5	102.00-100.00	0.0000	1.3931	0.0000	1.9577
L6	100.00-98.00	0.0000	1.4306	0.0000	2.0544
L7	98.00-82.50	0.0000	1.4306	0.0000	2.0544
L8	82.50-80.00	0.0000	1.4306	0.0000	2.0544
L9	80.00-77.50	0.0000	1.4615	0.0000	2.1374
L10	77.50-68.00	0.0000	1.4615	0.0000	2.1374
L11	68.00-62.50	0.0000	1.4673	0.0000	2.1532
L12	62.50-60.00	0.0000	1.4615	0.0000	2.1374
L13	60.00-57.50	0.0000	1.4874	0.0000	2.2093
L14	57.50-42.50	0.0000	1.4923	0.0000	2.2231
L15	42.50-40.00	0.0000	1.4874	0.0000	2.2093
L16	40.00-37.50	0.0000	1.4874	0.0000	2.2093
L17	37.50-22.50	0.0000	1.4874	0.0000	2.2093
L18	22.50-20.00	0.0000	1.4874	0.0000	2.2093
L19	20.00-17.50	0.0000	1.4874	0.0000	2.2093
L20	17.50-0.00	0.0000	1.4874	0.0000	2.2093

Discrete Tower Loads

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft* *ft* *ft*	*Azimuth Adjustment* *°*	*Placement* *ft*		C_AA_A *Front* *ft²*	C_AA_A *Side* *ft²*	*Weight* *K*
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	A	From Leg	3.00 0.00 0.00	0.0000	178.25	No Ice 1/2" Ice	4.91 5.57	3.64 4.70	0.04 0.08
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	B	From Leg	3.00 0.00 0.00	0.0000	178.25	No Ice 1/2" Ice	4.91 5.57	3.64 4.70	0.04 0.08
(2) RR90-17-02DP w/Mount Pipe (T-Mobile)	C	From Leg	3.00 0.00 0.00	0.0000	178.25	No Ice 1/2" Ice	4.91 5.57	3.64 4.70	0.04 0.08
RFS APX16DWV-16DWVS-C (T-Mobile)	A	From Leg	3.00 0.00 0.00	0.0000	178.25	No Ice 1/2" Ice	7.19 7.64	2.16 2.49	0.02 0.05

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft* *ft* *ft*	*Azimuth Adjustment* *°*	*Placement* *ft*		*C_AA_A Front* *ft^2*	*C_AA_A Side* *ft^2*	*Weight* *K*
RFS	B	From Leg	3.00	0.0000	178.25	No Ice	7.19	2.16	0.02
APX16DWV-16DWVS-C			0.00			1/2" Ice	7.64	2.49	0.05
(T-Mobile)			0.00						
RFS	C	From Leg	3.00	0.0000	178.25	No Ice	7.19	2.16	0.02
APX16DWV-16DWVS-C			0.00			1/2" Ice	7.64	2.49	0.05
(T-Mobile)			0.00						
(3) TMA (14.5" x 7" x 2.5") -	A	From Leg	3.00	0.0000	178.25	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(T-Mobile)			0.00						
(3) TMA (14.5" x 7" x 2.5") -	B	From Leg	3.00	0.0000	178.25	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(T-Mobile)			0.00						
(3) TMA (14.5" x 7" x 2.5") -	C	From Leg	3.00	0.0000	178.25	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(T-Mobile)			0.00						
PiROD 13' Low Profile	C	None		0.0000	178.25	No Ice	15.70	15.70	1.30
Platform						1/2" Ice	20.10	20.10	1.76
(T-Mobile)									
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Kathrein 800 10121 w Mount	A	From Leg	3.00	0.0000	167.67	No Ice	5.80	4.71	0.07
Pipe			0.00			1/2" Ice	6.34	5.56	0.12
(AT&T)			0.00						
Kathrein 800 10121 w Mount	B	From Leg	3.00	0.0000	167.67	No Ice	5.80	4.71	0.07
Pipe			0.00			1/2" Ice	6.34	5.56	0.12
(AT&T)			0.00						
Kathrein 800 10121 w Mount	C	From Leg	3.00	0.0000	167.67	No Ice	5.80	4.71	0.07
Pipe			0.00			1/2" Ice	6.34	5.56	0.12
(AT&T)			0.00						
(2) TMA (14.5" x 7" x 2.5") -	A	From Leg	3.00	0.0000	167.67	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(AT&T)			0.00						
(2) TMA (14.5" x 7" x 2.5") -	B	From Leg	3.00	0.0000	167.67	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(AT&T)			0.00						
(2) TMA (14.5" x 7" x 2.5") -	C	From Leg	3.00	0.0000	167.67	No Ice	0.00	0.35	0.01
Shielded			0.00			1/2" Ice	0.00	0.47	0.02
(AT&T)			0.00						
KMW	A	From Leg	3.00	0.0000	167.67	No Ice	6.73	5.32	0.05
AM-X-CD-16-65-00T-RET			0.00			1/2" Ice	7.20	6.03	0.11
(54") w/ 60" MP			0.00						
(AT&T)									
KMW	B	From Leg	3.00	0.0000	167.67	No Ice	6.73	5.32	0.05
AM-X-CD-16-65-00T-RET			0.00			1/2" Ice	7.20	6.03	0.11
(54") w/ 60" MP			0.00						
(AT&T)									
KMW	C	From Leg	3.00	0.0000	167.67	No Ice	6.73	5.32	0.05
AM-X-CD-16-65-00T-RET			0.00			1/2" Ice	7.20	6.03	0.11
(54") w/ 60" MP			0.00						
(AT&T)									
(2) RRU 17.6" x 16.6" x 5.2"	A	From Leg	3.00	0.0000	167.67	No Ice	2.84	0.89	0.02
(AT&T)			0.00			1/2" Ice	3.07	1.04	0.03
			0.00						
(2) RRU 17.6" x 16.6" x 5.2"	B	From Leg	3.00	0.0000	167.67	No Ice	2.84	0.89	0.02
(AT&T)			0.00			1/2" Ice	3.07	1.04	0.03
			0.00						
(2) RRU 17.6" x 16.6" x 5.2"	C	From Leg	3.00	0.0000	167.67	No Ice	2.84	0.89	0.02
(AT&T)			0.00			1/2" Ice	3.07	1.04	0.03

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert ft ft ft*	*Azimuth Adjustment °*	*Placement ft*		*C_AA_A Front ft^2*	*C_AA_A Side ft^2*	*Weight K*
			0.00						
Raycap DC2-48-60-0-9E (AT&T)	C	From Leg	0.00 0.00 0.00	0.0000	167.67	No Ice 1/2" Ice	1.02 1.16	0.62 0.73	0.02 0.02
Chain Mount (AT&T)	A	None		0.0000	167.67	No Ice 1/2" Ice	0.50 0.50	0.50 0.50	0.05 0.10
Valmont Dual Standoff [DSM2] (AT&T)	A	None		0.0000	167.67	No Ice 1/2" Ice	1.00 1.00	1.00 1.00	0.20 0.26
Valmont Dual Standoff [DSM2] (AT&T)	B	None		0.0000	167.67	No Ice 1/2" Ice	1.00 1.00	1.00 1.00	0.20 0.26
Valmont Dual Standoff [DSM2] (AT&T)	C	None		0.0000	167.67	No Ice 1/2" Ice	1.00 1.00	1.00 1.00	0.20 0.26
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(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	A	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.92 9.56	6.91 8.10	0.07 0.14
(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	B	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.92 9.56	6.91 8.10	0.07 0.14
(2) Andrew HBXX-6517DS-A2M with Mount Pipe (Verizon)	C	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.92 9.56	6.91 8.10	0.07 0.14
DB-T1-6Z-8AB-0Z Distribution Box (Verizon)	C	None		0.0000	158.50	No Ice 1/2" Ice	5.35 5.75	2.40 2.72	0.04 0.07
(2) ALU RRH2x60 (Verizon)	A	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	2.19 2.40	1.49 1.67	0.04 0.06
(2) ALU RRH2x60 (Verizon)	B	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	2.19 2.40	1.49 1.67	0.04 0.06
(2) ALU RRH2x60 (Verizon)	C	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	2.19 2.40	1.49 1.67	0.04 0.06
Andrew LNX-6514DS-VTM w/ MP (Verizon)	A	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.41 8.96	7.13 7.95	0.07 0.14
Andrew LNX-6514DS-VTM w/ MP (Verizon)	B	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.41 8.96	7.13 7.95	0.07 0.14
Andrew LNX-6514DS-VTM w/ MP (Verizon)	C	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	8.41 8.96	7.13 7.95	0.07 0.14
BXA-70063/6CF with MP (Verizon)	A	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	7.75 8.29	5.18 6.11	0.04 0.10
BXA-70063/6CF with MP (Verizon)	B	From Leg	3.00 0.00 0.00	0.0000	158.50	No Ice 1/2" Ice	7.75 8.29	5.18 6.11	0.04 0.10
BXA-70063/4CF w Mount Pipe	C	From Leg	3.00 0.00	0.0000	158.50	No Ice 1/2" Ice	5.41 5.86	3.63 4.24	0.03 0.07

Description	*Face or Leg*	*Offset Type*	*Offsets: Horz Lateral Vert* *ft* *ft* *ft*	*Azimuth Adjustment* °	*Placement* *ft*		C_AA_A *Front* ft^2	C_AA_A *Side* ft^2	*Weight* *K*
(Verizon)			0.00						
(2) Diplexer	A	From Leg	3.00	0.0000	158.50	No Ice	0.00	0.00	0.02
(Verizon)			0.00			1/2" Ice	0.00	0.00	0.02
			0.00						
(2) Diplexer	B	From Leg	3.00	0.0000	158.50	No Ice	0.00	0.00	0.02
(Verizon)			0.00			1/2" Ice	0.00	0.00	0.02
			0.00						
(2) Diplexer	C	From Leg	3.00	0.0000	158.50	No Ice	0.00	0.00	0.02
(Verizon)			0.00			1/2" Ice	0.00	0.00	0.02
			0.00						
PiROD 13' Low Profile Platform	C	None		0.0000	158.50	No Ice	15.70	15.70	1.30
(Verizon)						1/2" Ice	20.10	20.10	1.76
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RFS APXV18-206517 w/MP	A	From Leg	1.00	0.0000	136.25	No Ice	5.32	4.70	0.06
(MetroPCS)			0.00			1/2" Ice	5.87	5.86	0.10
			0.00						
RFS APXV18-206517 w/MP	B	From Leg	1.00	0.0000	136.25	No Ice	5.32	4.70	0.06
(MetroPCS)			0.00			1/2" Ice	5.87	5.86	0.10
			0.00						
RFS APXV18-206517 w/MP	C	From Leg	1.00	0.0000	136.25	No Ice	5.32	4.70	0.06
(MetroPCS)			0.00			1/2" Ice	5.87	5.86	0.10
			0.00						
***************									
20-ft Jump Kit	C	None		0.0000	20.00	No Ice	12.22	12.22	0.00
(--)						1/2" Ice	14.06	14.06	0.00
40-ft Jump Kit	C	None		0.0000	40.00	No Ice	6.11	6.11	0.00
(--)						1/2" Ice	7.03	7.03	0.00
60-ft Jump Kit	C	None		0.0000	60.00	No Ice	6.63	6.63	0.00
(--)						1/2" Ice	7.63	7.63	0.00
80-ft Jump Kit	C	None		0.0000	80.00	No Ice	6.63	6.63	0.00
(--)						1/2" Ice	7.63	7.63	0.00
100-ft Jump Kit	C	None		0.0000	100.00	No Ice	4.51	4.51	0.00
(--)						1/2" Ice	5.19	5.19	0.00

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 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice

Comb. No.	*Description*
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
L1	175 - 160	Pole	Max Tension	14	0.00	0.00	0.00
			Max. Compression	14	-6.41	0.02	-0.01
			Max. Mx	11	-4.16	97.13	-0.01
			Max. My	8	-4.16	0.01	-97.13
			Max. Vy	5	7.71	-97.10	-0.01
			Max. Vx	8	7.71	0.01	-97.13
			Max. Torque	13			0.05
L2	160 - 140	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-13.62	-0.07	0.04
			Max. Mx	5	-9.24	-390.44	-0.01
			Max. My	2	-9.24	-0.01	390.43
			Max. Vy	5	15.93	-390.44	-0.01
			Max. Vx	8	15.93	-0.01	-390.41
			Max. Torque	13			-0.43
L3	140 - 120	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-18.07	-0.07	-0.27
			Max. Mx	5	-13.00	-747.41	-0.14
			Max. My	8	-13.00	-0.01	-747.51
			Max. Vy	5	19.28	-747.41	-0.14
			Max. Vx	8	19.28	-0.01	-747.51
			Max. Torque	13			-0.43
L4	120 - 102	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-22.34	-0.07	-0.66
			Max. Mx	5	-16.73	-1118.11	-0.30
			Max. My	8	-16.73	-0.01	-1118.37
			Max. Vy	5	21.90	-1118.11	-0.30
			Max. Vx	8	21.90	-0.01	-1118.37

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. Torque	17			-0.69
L5	102 - 100	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-23.31	-0.07	-0.70
			Max. Mx	5	-17.64	-1162.19	-0.32
			Max. My	8	-17.64	-0.02	-1162.48
			Max. Vy	5	22.20	-1162.19	-0.32
			Max. Vx	8	22.20	-0.02	-1162.48
			Max. Torque	17			-0.74
L6	100 - 98	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-24.09	-0.07	-0.75
			Max. Mx	5	-18.34	-1207.29	-0.34
			Max. My	8	-18.34	-0.02	-1207.59
			Max. Vy	5	22.71	-1207.29	-0.34
			Max. Vx	8	22.71	-0.02	-1207.59
			Max. Torque	17			-0.78
L7	98 - 82.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-28.20	-0.07	-1.14
			Max. Mx	5	-21.96	-1576.88	-0.50
			Max. My	8	-21.96	-0.02	-1577.35
			Max. Vy	5	24.97	-1576.88	-0.50
			Max. Vx	8	24.97	-0.02	-1577.35
			Max. Torque	18			-1.14
L8	82.5 - 80	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-29.62	-0.07	-1.20
			Max. Mx	5	-23.30	-1639.78	-0.52
			Max. My	8	-23.30	-0.02	-1640.28
			Max. Vy	5	25.35	-1639.78	-0.52
			Max. Vx	8	25.35	-0.02	-1640.28
			Max. Torque	18			-1.20
L9	80 - 77.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-30.77	-0.07	-1.27
			Max. Mx	5	-24.35	-1704.33	-0.55
			Max. My	8	-24.35	-0.02	-1704.85
			Max. Vy	5	26.02	-1704.33	-0.55
			Max. Vx	8	26.02	-0.02	-1704.85
			Max. Torque	18			-1.27
L10	77.5 - 68	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-33.55	-0.07	-1.53
			Max. Mx	5	-26.81	-1958.13	-0.66
			Max. My	8	-26.81	-0.02	-1958.76
			Max. Vy	5	27.41	-1958.13	-0.66
			Max. Vx	8	27.41	-0.02	-1958.76
			Max. Torque	18			-1.53
L11	68 - 62.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-35.35	-0.07	-1.69
			Max. Mx	5	-28.42	-2111.06	-0.73
			Max. My	8	-28.42	-0.02	-2111.76
			Max. Vy	5	28.21	-2111.06	-0.73
			Max. Vx	8	28.21	-0.02	-2111.76
			Max. Torque	18			-1.67
L12	62.5 - 60	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-36.80	-0.07	-1.76
			Max. Mx	5	-29.78	-2182.02	-0.76
			Max. My	8	-29.78	-0.02	-2182.75
			Max. Vy	5	28.57	-2182.02	-0.76
			Max. Vx	8	28.57	-0.02	-2182.75
			Max. Torque	18			-1.74
L13	60 - 57.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-38.01	-0.07	-1.84
			Max. Mx	5	-30.89	-2254.55	-0.79
			Max. My	8	-30.89	-0.02	-2255.31

Section No.	*Elevation ft*	*Component Type*	*Condition*	*Gov. Load Comb.*	*Force K*	*Major Axis Moment kip-ft*	*Minor Axis Moment kip-ft*
			Max. Vy	5	29.21	-2254.55	-0.79
			Max. Vx	8	29.21	-0.02	-2255.31
			Max. Torque	18			-1.80
L14	57.5 - 42.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-43.37	-0.07	-2.31
			Max. Mx	5	-35.68	-2708.65	-0.98
			Max. My	8	-35.68	-0.02	-2709.61
			Max. Vy	5	31.34	-2708.65	-0.98
			Max. Vx	8	31.34	-0.02	-2709.61
			Max. Torque	18			-2.21
L15	42.5 - 40	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-44.82	-0.07	-2.38
			Max. Mx	5	-37.04	-2787.41	-1.02
			Max. My	8	-37.04	-0.02	-2788.41
			Max. Vy	5	31.68	-2787.41	-1.02
			Max. Vx	8	31.68	-0.02	-2788.41
			Max. Torque	18			-2.27
L16	40 - 37.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-46.28	-0.07	-2.46
			Max. Mx	5	-38.39	-2867.53	-1.05
			Max. My	8	-38.39	-0.02	-2868.55
			Max. Vy	5	32.22	-2867.53	-1.05
			Max. Vx	8	32.22	-0.02	-2868.55
			Max. Torque	18			-2.33
L17	37.5 - 22.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-52.27	-0.07	-2.92
			Max. Mx	5	-43.89	-3364.08	-1.24
			Max. My	8	-43.89	-0.02	-3365.30
			Max. Vy	5	33.99	-3364.08	-1.24
			Max. Vx	8	33.99	-0.02	-3365.30
			Max. Torque	18			-2.68
L18	22.5 - 20	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-54.61	-0.07	-3.00
			Max. Mx	5	-46.13	-3449.43	-1.27
			Max. My	8	-46.13	-0.02	-3450.67
			Max. Vy	5	34.30	-3449.43	-1.27
			Max. Vx	8	34.30	-0.02	-3450.67
			Max. Torque	18			-2.74
L19	20 - 17.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-56.95	-0.07	-3.08
			Max. Mx	5	-48.37	-3536.53	-1.30
			Max. My	8	-48.37	-0.02	-3537.81
			Max. Vy	5	35.00	-3536.53	-1.30
			Max. Vx	8	35.01	-0.02	-3537.81
			Max. Torque	18			-2.80
L20	17.5 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-65.31	-0.07	-3.61
			Max. Mx	5	-56.19	-4166.30	-1.52
			Max. My	8	-56.19	-0.02	-4167.80
			Max. Vy	5	36.96	-4166.30	-1.52
			Max. Vx	8	36.96	-0.02	-4167.80
			Max. Torque	18			-3.21

Maximum Reactions

Location	*Condition*	*Gov. Load Comb.*	*Vertical K*	*Horizontal, X K*	*Horizontal, Z K*
Pole	Max. Vert	21	65.31	0.00	-34.16
	Max. H_x	11	56.20	36.95	-0.00
	Max. H_z	2	56.20	0.00	36.95
	Max. M_x	2	4164.75	0.00	36.95
	Max. M_z	5	4166.30	-36.95	-0.00
	Max. Torsion	24	3.21	34.16	0.00
	Min. Vert	33	56.20	0.00	-12.78
	Min. H_x	5	56.20	-36.95	-0.00
	Min. H_z	8	56.20	0.00	-36.95
	Min. M_x	8	-4167.80	0.00	-36.95
	Min. M_z	11	-4166.26	36.95	-0.00
	Min. Torsion	18	-3.21	-34.16	0.00

Tower Mast Reaction Summary

Load Combination	*Vertical* K	*Shear$_x$* K	*Shear$_z$* K	*Overturning Moment, M_x* kip-ft	*Overturning Moment, M_z* kip-ft	*Torque* kip-ft
Dead Only	56.20	0.00	0.00	1.50	-0.02	0.00
Dead+Wind 0 deg - No Ice	56.20	0.00	-36.95	-4164.75	-0.02	0.38
Dead+Wind 30 deg - No Ice	56.20	18.47	-32.00	-3606.58	-2083.16	1.37
Dead+Wind 60 deg - No Ice	56.20	32.00	-18.47	-2081.62	-3608.12	1.99
Dead+Wind 90 deg - No Ice	56.20	36.95	0.00	1.52	-4166.30	2.08
Dead+Wind 120 deg - No Ice	56.20	32.00	18.47	2084.66	-3608.12	1.62
Dead+Wind 150 deg - No Ice	56.20	18.47	32.00	3609.63	-2083.16	0.72
Dead+Wind 180 deg - No Ice	56.20	0.00	36.95	4167.80	-0.02	-0.38
Dead+Wind 210 deg - No Ice	56.20	-18.47	32.00	3609.63	2083.12	-1.37
Dead+Wind 240 deg - No Ice	56.20	-32.00	18.47	2084.66	3608.08	-1.99
Dead+Wind 270 deg - No Ice	56.20	-36.95	0.00	1.52	4166.26	-2.08
Dead+Wind 300 deg - No Ice	56.20	-32.00	-18.47	-2081.62	3608.08	-1.62
Dead+Wind 330 deg - No Ice	56.20	-18.47	-32.00	-3606.58	2083.12	-0.72
Dead+Ice+Temp	65.31	0.00	0.00	3.61	-0.07	0.00
Dead+Wind 0 deg+Ice+Temp	65.31	0.00	-34.16	-3736.74	-0.07	0.29
Dead+Wind 30 deg+Ice+Temp	65.31	17.08	-29.58	-3235.62	-1870.29	1.86
Dead+Wind 60 deg+Ice+Temp	65.31	29.58	-17.08	-1866.52	-3239.39	2.93
Dead+Wind 90 deg+Ice+Temp	65.31	34.16	0.00	3.69	-3740.51	3.21
Dead+Wind 120 deg+Ice+Temp	65.31	29.58	17.08	1873.91	-3239.39	2.64
Dead+Wind 150 deg+Ice+Temp	65.31	17.08	29.58	3243.01	-1870.29	1.36
Dead+Wind 180 deg+Ice+Temp	65.31	0.00	34.16	3744.13	-0.07	-0.29
Dead+Wind 210 deg+Ice+Temp	65.31	-17.08	29.58	3243.01	1870.15	-1.86
Dead+Wind 240 deg+Ice+Temp	65.31	-29.58	17.08	1873.91	3239.24	-2.93
Dead+Wind 270 deg+Ice+Temp	65.31	-34.16	0.00	3.69	3740.36	-3.21
Dead+Wind 300 deg+Ice+Temp	65.31	-29.58	-17.08	-1866.52	3239.24	-2.64
Dead+Wind 330 deg+Ice+Temp	65.31	-17.08	-29.58	-3235.62	1870.14	-1.36
Dead+Wind 0 deg - Service	56.20	0.00	-12.78	-1440.63	-0.02	0.13
Dead+Wind 30 deg - Service	56.20	6.39	-11.07	-1247.42	-721.10	0.47
Dead+Wind 60 deg - Service	56.20	11.07	-6.39	-719.55	-1248.96	0.69
Dead+Wind 90 deg - Service	56.20	12.78	0.00	1.53	-1442.18	0.72
Dead+Wind 120 deg - Service	56.20	11.07	6.39	722.60	-1248.96	0.56
Dead+Wind 150 deg - Service	56.20	6.39	11.07	1250.47	-721.10	0.25
Dead+Wind 180 deg - Service	56.20	0.00	12.78	1443.68	-0.02	-0.13
Dead+Wind 210 deg - Service	56.20	-6.39	11.07	1250.47	721.06	-0.47
Dead+Wind 240 deg - Service	56.20	-11.07	6.39	722.60	1248.92	-0.69
Dead+Wind 270 deg - Service	56.20	-12.78	0.00	1.53	1442.14	-0.72
Dead+Wind 300 deg - Service	56.20	-11.07	-6.39	-719.55	1248.92	-0.56
Dead+Wind 330 deg - Service	56.20	-6.39	-11.07	-1247.42	721.06	-0.25

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-56.20	0.00	0.00	56.20	0.00	0.000%
2	0.00	-56.20	-36.95	0.00	56.20	36.95	0.000%
3	18.47	-56.20	-32.00	-18.47	56.20	32.00	0.000%
4	32.00	-56.20	-18.47	-32.00	56.20	18.47	0.000%
5	36.95	-56.20	0.00	-36.95	56.20	-0.00	0.000%
6	32.00	-56.20	18.47	-32.00	56.20	-18.47	0.000%
7	18.47	-56.20	32.00	-18.47	56.20	-32.00	0.000%
8	0.00	-56.20	36.95	0.00	56.20	-36.95	0.000%
9	-18.47	-56.20	32.00	18.47	56.20	-32.00	0.000%
10	-32.00	-56.20	18.47	32.00	56.20	-18.47	0.000%
11	-36.95	-56.20	0.00	36.95	56.20	-0.00	0.000%
12	-32.00	-56.20	-18.47	32.00	56.20	18.47	0.000%
13	-18.47	-56.20	-32.00	18.47	56.20	32.00	0.000%
14	0.00	-65.31	0.00	0.00	65.31	0.00	0.000%
15	0.00	-65.31	-34.16	0.00	65.31	34.16	0.000%
16	17.08	-65.31	-29.58	-17.08	65.31	29.58	0.000%
17	29.58	-65.31	-17.08	-29.58	65.31	17.08	0.000%
18	34.16	-65.31	0.00	-34.16	65.31	0.00	0.000%
19	29.58	-65.31	17.08	-29.58	65.31	-17.08	0.000%
20	17.08	-65.31	29.58	-17.08	65.31	-29.58	0.000%
21	0.00	-65.31	34.16	0.00	65.31	-34.16	0.000%
22	-17.08	-65.31	29.58	17.08	65.31	-29.58	0.000%
23	-29.58	-65.31	17.08	29.58	65.31	-17.08	0.000%
24	-34.16	-65.31	0.00	34.16	65.31	0.00	0.000%
25	-29.58	-65.31	-17.08	29.58	65.31	17.08	0.000%
26	-17.08	-65.31	-29.58	17.08	65.31	29.58	0.000%
27	0.00	-56.20	-12.78	0.00	56.20	12.78	0.000%
28	6.39	-56.20	-11.07	-6.39	56.20	11.07	0.000%
29	11.07	-56.20	-6.39	-11.07	56.20	6.39	0.000%
30	12.78	-56.20	0.00	-12.78	56.20	0.00	0.000%
31	11.07	-56.20	6.39	-11.07	56.20	-6.39	0.000%
32	6.39	-56.20	11.07	-6.39	56.20	-11.07	0.000%
33	0.00	-56.20	12.78	0.00	56.20	-12.78	0.000%
34	-6.39	-56.20	11.07	6.39	56.20	-11.07	0.000%
35	-11.07	-56.20	6.39	11.07	56.20	-6.39	0.000%
36	-12.78	-56.20	0.00	12.78	56.20	0.00	0.000%
37	-11.07	-56.20	-6.39	11.07	56.20	6.39	0.000%
38	-6.39	-56.20	-11.07	6.39	56.20	11.07	0.000%

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	0.00022315
3	Yes	5	0.00000001	0.00019350
4	Yes	5	0.00000001	0.00018697
5	Yes	4	0.00000001	0.00031348
6	Yes	5	0.00000001	0.00019232
7	Yes	5	0.00000001	0.00019065
8	Yes	4	0.00000001	0.00021670

9	Yes	5	0.00000001	0.00018759
10	Yes	5	0.00000001	0.00019419
11	Yes	4	0.00000001	0.00031348
12	Yes	5	0.00000001	0.00018869
13	Yes	5	0.00000001	0.00019029
14	Yes	4	0.00000001	0.00000001
15	Yes	5	0.00000001	0.00023616
16	Yes	5	0.00000001	0.00046490
17	Yes	5	0.00000001	0.00045572
18	Yes	5	0.00000001	0.00023716
19	Yes	5	0.00000001	0.00046604
20	Yes	5	0.00000001	0.00046044
21	Yes	5	0.00000001	0.00023652
22	Yes	5	0.00000001	0.00045802
23	Yes	5	0.00000001	0.00046759
24	Yes	5	0.00000001	0.00023714
25	Yes	5	0.00000001	0.00045695
26	Yes	5	0.00000001	0.00046217
27	Yes	4	0.00000001	0.00008159
28	Yes	4	0.00000001	0.00051494
29	Yes	4	0.00000001	0.00047874
30	Yes	4	0.00000001	0.00008939
31	Yes	4	0.00000001	0.00050853
32	Yes	4	0.00000001	0.00049888
33	Yes	4	0.00000001	0.00008173
34	Yes	4	0.00000001	0.00048233
35	Yes	4	0.00000001	0.00051963
36	Yes	4	0.00000001	0.00008939
37	Yes	4	0.00000001	0.00048768
38	Yes	4	0.00000001	0.00049627

Maximum Tower Deflections - Service Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	175 - 160	22.151	33	1.1632	0.0007
L2	160 - 140	18.536	33	1.1272	0.0007
L3	140 - 120	14.016	33	1.0054	0.0006
L4	120 - 102	10.117	33	0.8386	0.0005
L5	102 - 100	7.228	33	0.6834	0.0004
L6	100 - 98	6.944	33	0.6747	0.0004
L7	98 - 82.5	6.663	33	0.6657	0.0004
L8	82.5 - 80	4.709	33	0.5322	0.0003
L9	80 - 77.5	4.433	33	0.5224	0.0003
L10	77.5 - 68	4.162	33	0.5121	0.0003
L11	68 - 62.5	3.217	33	0.4366	0.0003
L12	62.5 - 60	2.737	33	0.3963	0.0003
L13	60 - 57.5	2.532	33	0.3862	0.0003
L14	57.5 - 42.5	2.332	33	0.3757	0.0002
L15	42.5 - 40	1.302	33	0.2776	0.0002
L16	40 - 37.5	1.159	33	0.2671	0.0002
L17	37.5 - 22.5	1.022	33	0.2563	0.0002
L18	22.5 - 20	0.387	33	0.1450	0.0001
L19	20 - 17.5	0.313	33	0.1372	0.0001
L20	17.5 - 0	0.243	33	0.1292	0.0001

Critical Deflections and Radius of Curvature - Service Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
178.25	(2) RR90-17-02DP w/Mount Pipe	33	22.151	1.1632	0.0007	44755
167.67	Kathrein 800 10121 w Mount Pipe	33	20.372	1.1498	0.0007	30514
158.50	(2) Andrew HBXX-6517DS-A2M with Mount Pipe	33	18.182	1.1210	0.0007	13853
136.25	RFS APXV18-206517 w/MP	33	13.232	0.9772	0.0005	7057
100.00	100-ft Jump Kit	33	6.944	0.6747	0.0004	9118
80.00	80-ft Jump Kit	33	4.433	0.5224	0.0003	10378
60.00	60-ft Jump Kit	33	2.532	0.3862	0.0003	11719
40.00	40-ft Jump Kit	33	1.159	0.2671	0.0002	11000
20.00	20-ft Jump Kit	33	0.313	0.1372	0.0001	11037

Maximum Tower Deflections - Design Wind

Section No.	*Elevation* *ft*	*Horz. Deflection* *in*	*Gov. Load Comb.*	*Tilt* °	*Twist* °
L1	175 - 160	63.916	8	3.3572	0.0024
L2	160 - 140	53.488	8	3.2534	0.0024
L3	140 - 120	40.447	8	2.9019	0.0023
L4	120 - 102	29.198	8	2.4204	0.0022
L5	102 - 100	20.863	8	1.9724	0.0019
L6	100 - 98	20.042	8	1.9474	0.0019
L7	98 - 82.5	19.232	8	1.9214	0.0019
L8	82.5 - 80	13.593	8	1.5363	0.0016
L9	80 - 77.5	12.796	8	1.5078	0.0015
L10	77.5 - 68	12.015	8	1.4782	0.0015
L11	68 - 62.5	9.285	8	1.2604	0.0013
L12	62.5 - 60	7.900	8	1.1440	0.0012
L13	60 - 57.5	7.309	8	1.1147	0.0012
L14	57.5 - 42.5	6.733	8	1.0845	0.0011
L15	42.5 - 40	3.757	8	0.8013	0.0008
L16	40 - 37.5	3.345	8	0.7710	0.0008
L17	37.5 - 22.5	2.950	8	0.7399	0.0008
L18	22.5 - 20	1.117	8	0.4185	0.0004
L19	20 - 17.5	0.904	8	0.3961	0.0004
L20	17.5 - 0	0.702	8	0.3731	0.0004

Critical Deflections and Radius of Curvature - Design Wind

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
178.25	(2) RR90-17-02DP w/Mount Pipe	8	63.916	3.3572	0.0024	15601
167.67	Kathrein 800 10121 w Mount Pipe	8	58.785	3.3186	0.0024	10636
158.50	(2) Andrew HBXX-6517DS-A2M with Mount Pipe	8	52.466	3.2355	0.0024	4827
136.25	RFS APXV18-206517 w/MP	8	38.185	2.8204	0.0023	2456
100.00	100-ft Jump Kit	8	20.042	1.9474	0.0019	3166
80.00	80-ft Jump Kit	8	12.796	1.5078	0.0015	3601

Elevation *ft*	*Appurtenance*	*Gov. Load Comb.*	*Deflection* *in*	*Tilt* °	*Twist* °	*Radius of Curvature* *ft*
60.00	60-ft Jump Kit	8	7.309	1.1147	0.0012	4063
40.00	40-ft Jump Kit	8	3.345	0.7710	0.0008	3812
20.00	20-ft Jump Kit	8	0.904	0.3961	0.0004	3824

Compression Checks

Pole Design Data

Section No.	*Elevation* *ft*	*Size*	*L* *ft*	L_u *ft*	*Kl/r*	F_a *ksi*	*A* in^2	*Actual P* *K*	*Allow.* P_a *K*	*Ratio* $\frac{P}{P_a}$
L1	175 - 160 (1)	P24x3/8	15.00	0.00	0.0	25.200	27.8325	-4.16	701.38	0.006
L2	160 - 140 (2)	P30x3/8	20.00	0.00	0.0	25.075	34.9011	-9.24	875.15	0.011
L3	140 - 120 (3)	P36x3/8	20.00	0.00	0.0	23.696	41.9697	-13.00	994.51	0.013
L4	120 - 102 (4)	P42x3/8	18.00	0.00	0.0	22.711	49.0383	-16.73	1113.69	0.015
L5	102 - 100 (5)	HSS 42 x 0.9549	2.00	0.00	0.0	39.000	123.1310	-17.64	4802.13	0.004
L6	100 - 98 (6)	HSS 48 x 0.6211	2.00	0.00	0.0	34.566	92.4478	-18.34	3195.55	0.006
L7	98 - 82.5 (7)	P48x3/8	15.50	0.00	0.0	21.972	56.1069	-21.96	1232.77	0.018
L8	82.5 - 80 (8)	HSS 48 x 0.9854	2.50	0.00	0.0	39.000	145.5440	-23.30	5676.23	0.004
L9	80 - 77.5 (9)	HSS 54 x 0.6755	2.50	0.00	0.0	34.281	113.1620	-24.35	3879.33	0.006
L10	77.5 - 68 (10)	P54x3/8	9.50	0.00	0.0	21.397	63.1755	-26.81	1351.78	0.020
L11	68 - 62.5 (11)	HSS 55.25 x 0.4227	5.50	0.00	0.0	31.065	72.8080	-28.42	2261.76	0.013
L12	62.5 - 60 (12)	HSS 54 x 0.8874	2.50	0.00	0.0	36.879	148.0700	-29.78	5460.65	0.005
L13	60 - 57.5 (13)	HSS 60 x 0.6354	2.50	0.00	0.0	33.011	118.5020	-30.89	3911.81	0.008
L14	57.5 - 42.5 (14)	HSS 61.25 x 0.4228	15.00	0.00	0.0	30.570	80.7947	-35.68	2469.87	0.014
L15	42.5 - 40 (15)	HSS 60 x 0.7918	2.50	0.00	0.0	34.736	147.2810	-37.04	5115.99	0.007
L16	40 - 37.5 (16)	HSS 60 x 0.7918	2.50	0.00	0.0	34.736	147.2810	-38.39	5115.99	0.008
L17	37.5 - 22.5 (17)	P60x1/2 H1-3 (1.33 CR) - 17	15.00	0.00	0.0	22.317	93.4624	-43.89	2085.77	0.021
L18	22.5 - 20 (18)	HSS 60 x 1.3638	2.50	0.00	0.0	39.000	251.2270	-46.13	9797.85	0.005
L19	20 - 17.5 (19)	HSS 60 x 1.3638	2.50	0.00	0.0	39.000	251.2270	-48.37	9797.85	0.005
L20	17.5 - 0 (20)	P60x5/8	17.50	0.00	0.0	23.696	116.5830	-56.19	2762.52	0.020

Pole Bending Design Data

Section No.	*Elevation* *ft*	*Size*	*Actual* M_x *kip-ft*	*Actual* f_{bx} *ksi*	*Allow.* F_{bx} *ksi*	*Ratio* $\frac{f_{bx}}{F_{bx}}$	*Actual* M_y *kip-ft*	*Actual* f_{by} *ksi*	*Allow.* F_{by} *ksi*	*Ratio* $\frac{f_{by}}{F_{by}}$
L1	175 - 160 (1)	P24x3/8	97.14	-7.202	27.720	0.260	0.00	0.000	27.720	0.000
L2	160 - 140 (2)	P30x3/8	390.44	-18.352	25.075	0.732	0.00	0.000	25.075	0.000
L3	140 - 120 (3)	P36x3/8	747.51	-24.248	23.696	1.023	0.00	0.000	23.696	0.000
L4	120 - 102 (4)	P42x3/8	1118.38	-26.534	22.711	1.168	0.00	0.000	22.711	0.000
L5	102 - 100 (5)	HSS 42 x 0.9549	1162.47	-11.291	42.900	0.263	0.00	0.000	42.900	0.000
L6	100 - 98 (6)	HSS 48 x 0.6211	1207.59	-13.405	34.566	0.388	0.00	0.000	34.566	0.000
L7	98 - 82.5 (7)	P48x3/8	1577.35	-28.556	21.972	1.300	0.00	0.000	21.972	0.000
L8	82.5 - 80 (8)	HSS 48 x 0.9854	1640.28	-11.742	42.900	0.274	0.00	0.000	42.900	0.000
L9	80 - 77.5 (9)	HSS 54 x 0.6755	1704.85	-13.731	34.281	0.401	0.00	0.000	34.281	0.000
L10	77.5 - 68 (10)	P54x3/8	1958.77	-27.945	21.397	1.306	0.00	0.000	21.397	0.000
L11	68 - 62.5 (11)	HSS 55.25 x 0.4227	2111.76	-25.587	31.065	0.824	0.00	0.000	31.065	0.000
L12	62.5 - 60 (12)	HSS 54 x 0.8874	2182.75	-13.541	36.879	0.367	0.00	0.000	36.879	0.000

Section No.	*Elevation* *ft*	*Size*	*Actual* M_x *kip-ft*	*Actual* f_{bx} *ksi*	*Allow.* F_{bx} *ksi*	*Ratio* $\frac{f_{bx}}{F_{bx}}$	*Actual* M_y *kip-ft*	*Actual* f_{by} *ksi*	*Allow.* F_{by} *ksi*	*Ratio* $\frac{f_{by}}{F_{by}}$
L13	60 - 57.5 (13)	HSS 60 x 0.6354	2255.31	-15.551	33.011	0.471	0.00	0.000	33.011	0.000
L14	57.5 - 42.5 (14)	HSS 61.25 x 0.4228	2709.62	-26.647	30.570	0.872	0.00	0.000	30.570	0.000
L15	42.5 - 40 (15)	HSS 60 x 0.7918	2788.41	-15.551	34.736	0.448	0.00	0.000	34.736	0.000
L16	40 - 37.5 (16)	HSS 60 x 0.7918	2868.55	-15.998	34.736	0.461	0.00	0.000	34.736	0.000
L17	37.5 - 22.5 (17)	P60x1/2	3365.30	-29.290	22.317	1.312	0.00	0.000	22.317	0.000
L18	22.5 - 20 (18)	HSS 60 x 1.3638	3450.68	-11.499	42.900	0.268	0.00	0.000	42.900	0.000
L19	20 - 17.5 (19)	HSS 60 x 1.3638	3537.81	-11.790	42.900	0.275	0.00	0.000	42.900	0.000
L20	17.5 - 0 (20)	P60x5/8	4167.80	-29.202	23.696	1.232	0.00	0.000	23.696	0.000

Pole Interaction Design Data

Section No.	*Elevation* *ft*	*Size*	*Ratio* $\frac{P}{P_a}$	*Ratio* $\frac{f_{bx}}{F_{bx}}$	*Ratio* $\frac{f_{by}}{F_{by}}$	*Comb. Stress Ratio*	*Allow. Stress Ratio*	*Criteria*
L1	175 - 160 (1)	P24x3/8	0.006	0.260	0.000	0.266	1.333	H1-3
L2	160 - 140 (2)	P30x3/8	0.011	0.732	0.000	0.742	1.333	H1-3
L3	140 - 120 (3)	P36x3/8	0.013	1.023	0.000	1.036	1.333	H1-3
L4	120 - 102 (4)	P42x3/8	0.015	1.168	0.000	1.183	1.333	H1-3
L5	102 - 100 (5)	HSS 42 x 0.9549	0.004	0.263	0.000	0.267	1.333	H1-3
L6	100 - 98 (6)	HSS 48 x 0.6211	0.006	0.388	0.000	0.394	1.333	H1-3
L7	98 - 82.5 (7)	P48x3/8	0.018	1.300	0.000	1.317	1.333	H1-3
L8	82.5 - 80 (8)	HSS 48 x 0.9854	0.004	0.274	0.000	0.278	1.333	H1-3
L9	80 - 77.5 (9)	HSS 54 x 0.6755	0.006	0.401	0.000	0.407	1.333	H1-3
L10	77.5 - 68 (10)	P54x3/8	0.020	1.306	0.000	1.326	1.333	H1-3
L11	68 - 62.5 (11)	HSS 55.25 x 0.4227	0.013	0.824	0.000	0.836	1.333	H1-3
L12	62.5 - 60 (12)	HSS 54 x 0.8874	0.005	0.367	0.000	0.373	1.333	H1-3
L13	60 - 57.5 (13)	HSS 60 x 0.6354	0.008	0.471	0.000	0.479	1.333	H1-3
L14	57.5 - 42.5 (14)	HSS 61.25 x 0.4228	0.014	0.872	0.000	0.886	1.333	H1-3
L15	42.5 - 40 (15)	HSS 60 x 0.7918	0.007	0.448	0.000	0.455	1.333	H1-3
L16	40 - 37.5 (16)	HSS 60 x 0.7918	0.008	0.461	0.000	0.468	1.333	H1-3
L17	37.5 - 22.5 (17)	P60x1/2	0.021	1.312	0.000	**1.334**	1.333	H1-3
L18	22.5 - 20 (18)	HSS 60 x 1.3638	0.005	0.268	0.000	0.273	1.333	H1-3
L19	20 - 17.5 (19)	HSS 60 x 1.3638	0.005	0.275	0.000	0.280	1.333	H1-3
L20	17.5 - 0 (20)	P60x5/8	0.020	1.232	0.000	1.253	1.333	H1-3

Section Capacity Table

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	$SF*P_{allow}$ *K*	*% Capacity*	*Pass Fail*
L1	175 - 160	Pole	P24x3/8	1	-4.16	934.94	19.9	Pass
L2	160 - 140	Pole	P30x3/8	2	-9.24	1166.57	55.7	Pass
L3	140 - 120	Pole	P36x3/8	3	-13.00	1325.68	77.7	Pass
L4	120 - 102	Pole	P42x3/8	4	-16.73	1484.55	88.8	Pass
L5	102 - 100	Pole	HSS 42 x 0.9549	5				
L6	100 - 98	Pole	HSS 48 x 0.6211	6				
L7	98 - 82.5	Pole	P48x3/8	7	-21.96	1643.28	98.8	Pass
L8	82.5 - 80	Pole	HSS 48 x 0.9854	8				
L9	80 - 77.5	Pole	HSS 54 x 0.6755	9				
L10	77.5 - 68	Pole	P54x3/8	10	-26.81	1801.92	99.5	Pass
L11	68 - 62.5	Pole	HSS 55.25 x 0.4227	11				
L12	62.5 - 60	Pole	HSS 54 x 0.8874	12				
L13	60 - 57.5	Pole	HSS 60 x 0.6354	13				

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*$SF*P_{allow}$ K*	*% Capacity*	*Pass Fail*
L14	57.5 - 42.5	Pole	HSS 61.25 x 0.4228	14				
L15	42.5 - 40	Pole	HSS 60 x 0.7918	15				
L16	40 - 37.5	Pole	HSS 60 x 0.7918	16				
L17	37.5 - 22.5	Pole	P60x1/2	17	-43.89	2780.33	100.0	Pass
L18	22.5 - 20	Pole	HSS 60 x 1.3638	18				
L19	20 - 17.5	Pole	HSS 60 x 1.3638	19				
L20	17.5 - 0	Pole	P60x5/8	20	-56.19	3682.44	94.0	Pass
							Summary	
						Pole (L17)	100.0	Pass
						RATING =	**100.0**	**Pass**

SEE ADDITIONAL CALCULATIONS FOR RESULT DETAILS.

SELF-SUPPORTING POLE STRUCTURE REINFORCEMENT DESIGN, TIA-222-F

Design	**0**

	Initials	Date
Produced By:	MER	11/13/2014
Checked By:	MRD	11/13/2014

SELF-SUPPORTING POLE STRUCTURE REINFORCEMENT DESIGN, TIA-222-F

VSi Job #	141374	
Client Site Name:	Vernon 2, CT	
Client Site Number:	VZ5-177	
Hole Size Allowance:	0.0625	inches
Allowable Stress Increase	133%	
Design Percentage	100%	
	133%	

SELF-SUPPORTING POLE STRUCTURE REINFORCEMENT DESIGN, TIA-222-F

Pole Geometry									VZ5-177	141374
Section #	Sides # (12,16,18,0)	Elevation (ft)	(ft)	Dia Across Flats (in)	(in)	Splice (ft)	Thickness (in)	Material Specification	Taper (in/ft)	Length (ft)
		TOP	BOTTOM	TOP	BOTTOM					
1	0	175.0	160.0	24.00	24.00	0.00	0.3750	A53E-B-42	0.000	15.00
2	0	160.0	140.0	30.00	30.00	0.00	0.3750	A53E-B-42	0.000	20.00
3	0	140.0	120.0	36.00	36.00	0.00	0.3750	A53E-B-42	0.000	20.00
4	0	120.0	100.0	42.00	42.00	0.00	0.3750	A53E-B-42	0.000	20.00
5	0	100.0	80.0	48.00	48.00	0.00	0.3750	A53E-B-42	0.000	20.00
6	0	80.0	60.0	54.00	54.00	0.00	0.3750	A53E-B-42	0.000	20.00
7	0	60.0	40.0	60.00	60.00	0.00	0.3750	A53E-B-42	0.000	20.00
8	0	40.0	20.0	60.00	60.00	0.00	0.5000	A53E-B-42	0.000	20.00
9	0	20.0	0.0	60.00	60.00	0.00	0.6250	A53E-B-42	0.000	20.00

SELF-SUPPORTING POLE STRUCTURE REINFORCEMENT DESIGN, TIA-222-F

Bar Reinforcement VZS-177 141374

Section Letter	Elevation (ft)	Moment (kip-ft)	Section #	Bar # (3,4)	Bar Width (in)	Bar Thickness (in)	Bar Length (in)	TB Type (in)	TB Size (in)	TB Grade	TB Number	Bar K (0.80<K<1.00)	Bar Matertial Specification	TB Vall (kip)	r_{max}	r_b Pole	r_c	r_t Gross	rt Net	r_{BS}	r_p Bar	r_p Pole	r_v	t Model (in)	F_y Model (ksi)	D_o Model (in)	t_A Model (in)
D	68.0	1959	6	3	**3.25**	1.25	24	**AJAX**	**M20**	**N/A**	**4**	1.00	A572-65	20.9	**86%**	81%	81%	46%	73%	29%	13%	59%	86%	0.42	65	**55.25**	**0.4227**
C	60.0	2183	6	3	**3.25**	1.25	24	**AJAX**	**M20**	**N/A**	**6**	1.00	A572-65	20.9	**91%**	91%	91%	51%	82%	23%	10%	44%	64%	0.42	65	**55.25**	**0.4227**
B	60.0	2183	7	3	**3.50**	1.25	24	**AJAX**	**M20**	**N/A**	**6**	1.00	A572-65	20.9	**75%**	75%	75%	41%	63%	20%	9%	38%	56%	0.42	65	**61.25**	**0.4228**
A	40.0	2788	7	3	**3.50**	1.25	24	**HSB**	**1 1/8**	**A325-X**	**6**	1.00	A572-65	29.8	**96%**	96%	96%	53%	82%	26%	11%	49%	50%	0.42	65	**61.25**	**0.4228**

ANCHOR ROD / FLANGE BOLT
& BASE / FLANGE PLATE DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

160-ft (+)

Input

- Reactions:

$M := 97.13 \cdot kip \cdot ft$ = moment at top of base / flange plate

$P_t := 4.16 \cdot kip$ = axial load at top of base / flange plate

$V_t := 7.71 \cdot kip$ = shear load at top of base / flange plate

- Shaft:

$D_{o\_shaft} := 24 \cdot in$ = outside diameter of shaft

$t_{shaft} := 0.375 \cdot in$ = thickness of shaft

$t_{w\_O} := 0.3125 \cdot in$ [✓ Fillet] PJP = outer shaft weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$ [✓ Fillet] PJP = inner shaft weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode

- Base / Flange Plate:

$t := 1.25 \cdot in$ = thickness of base / flange plate

$D_{PL} := 30.375 \cdot in$ = diameter of base / flange plate

$F_y := 36 \cdot ksi$ = yield stress of base / flange plate

- Anchor Rods / Flange Bolts: ☐ ***Check if Upset Rod***

$BC := 27 \cdot in$ = fastener bolt circle diameter

$n_b := 20$ = total number of fasteners

$d_b := 1.0 \cdot in$ = diameter of fasteners

[✓ A325] [✓ N] = grade of fastener & thread condition
A490 X
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

- Constants:

$ASI \equiv \frac{4}{3}$ = allowable stress increase

Output - Anchor Rods / Flange Bolts:

- Properties:

$F_{yb} = 92 \cdot ksi$

$F_{ub} = 120 \cdot ksi$

$$A_b := \frac{\pi \cdot d_b^2}{4} \qquad A_b = 0.785 \cdot in^2$$

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

$$A_{stiff} := A_b \qquad A_{stiff} = 0.785 \cdot in^2$$

$$A_{stress} := \left| \begin{array}{ll} A_b & \text{if Upset} = 0 \\ A_n & \text{otherwise} \end{array} \right. \qquad A_{stress} = 0.785 \cdot in^2$$

- Forces:

$$i := 0 .. (n_b - 1)$$

$$\theta_i := 2 \cdot \pi \cdot \left(\frac{i}{n_b} \right)$$

$$d' := \frac{BC}{2} \cdot \cos(\theta)$$

$$d_i := \left| d'_i \right|$$

$$P := \frac{M \cdot d}{\sum \overrightarrow{(d^2)}} + \frac{P_t}{n_b}$$

$$f_t := \overrightarrow{\left(\frac{P}{A_{stress}} \right)}$$

$$f_{t\_max} := \max(f_t) \qquad f_{t\_max} = 11.3 \cdot ksi$$

$$V := \frac{V_t}{n_b} \qquad V = 0.39 \cdot kip$$

$$f_v := \frac{V}{A_b} \qquad f_v = 0.49 \cdot ksi$$

ALLOWABLE STRESS CALCS.

- Allowable Tensile Stress [J3.4AISC]:

$F_t = 44.0 \cdot ksi$

$F'_t = 58.7 \cdot ksi$

- Allowable Shear Stress [J3.4, AISC]:

$F_v = 21.0 \cdot ksi$

$F'_v = 28.0 \cdot ksi$

- Allowable Combined Tension & Shear Stress [J3.5, AISC]:

$F_{t\_v} = 44.0 \cdot ksi$

$F'_{t\_v} = 58.7 \cdot ksi$

- Results:

$r_t := \overrightarrow{\left(\frac{f_t}{F'_t}\right)}$

$r_{t\_max} := \max(r_t)$ $r_{t\_max} = 19 \cdot \%$

$r_v := \frac{f_v}{F'_v}$ $r_v = 2 \cdot \%$

$r_{t\_v} := \overrightarrow{\left(\frac{f_t}{F'_{t\_v}}\right)}$

$r_{t\_v\_max} := \max(r_{t\_v})$ $r_{t\_v\_max} = 19 \cdot \%$

$r_{fasteners} := \max(r_{t\_max}, r_v, r_{t\_v\_max})$ $r_{fasteners} = 19 \cdot \%$

Output - Base / Flange Plate:

- Plate Flexure:

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

$M_{PL} := \sum \overrightarrow{(P \cdot m)}$ $M_{PL} = 27.39 \cdot kip \cdot in$

$b_{eff} = 11.701 \cdot in$

$S_{PL} := \frac{b_{eff} \cdot t^2}{6}$ $S_{PL} = 3.05 \cdot in^3$

$f_b := \frac{M_{PL}}{S_{PL}}$ $f_b = 9.0 \cdot ksi$

- Allowable Bending Stress [F2.1, AISC]:

$F_b := 0.75 \cdot F_y$ $F_b = 27.0 \cdot ksi$

$F'_b := ASI \cdot F_b$ $F'_b = 36.0 \cdot ksi$

- Result:

$r_b := \frac{f_b}{F'_b}$ $r_b = 25 \cdot \%$

Output - Shaft to Base / Flange Plate Weld:

- Properties:

$$R_{w\_O} := \frac{D_{o\_shaft} + \frac{t_{w\_O}}{3}}{2} \qquad R_{w\_O} = 12.052 \cdot in$$

$$R_{w\_I} := \frac{D_{o\_shaft} - \left(t_{shaft} + \frac{t_{w\_I}}{3}\right)}{2} \qquad R_{w\_I} = 11.760 \cdot in$$

$$L_{w\_O} := 2 \cdot \pi \cdot R_{w\_O} \qquad L_{w\_O} = 75.7 \cdot in$$

$$L_{w\_I} := 2 \cdot \pi \cdot R_{w\_I} \qquad L_{w\_I} = 73.9 \cdot in$$

$$L_{w} := L_{w\_O} + L_{w\_I} \qquad L_{w} = 149.6 \cdot in$$

$$A_{w\_O} := \left| \begin{array}{l} (0.707 \cdot t_{w\_O}) \cdot L_{w\_O} \ \text{ if Weld\_Outer = "Fillet"} \\ t_{w\_O} \cdot L_{w\_O} \ \text{ if Weld\_Outer = "PJP"} \end{array} \right. \qquad A_{w\_O} = 16.7 \cdot in^{2}$$

$$A_{w\_I} := \left| \begin{array}{l} (0.707 \cdot t_{w\_I}) \cdot L_{w\_I} \ \text{ if Weld\_Inner = "Fillet"} \\ t_{w\_I} \cdot L_{w\_I} \ \text{ if Weld\_Inner = "PJP"} \end{array} \right. \qquad A_{w\_I} = 16.3 \cdot in^{2}$$

$$A_{w} := A_{w\_O} + A_{w\_I} \qquad A_{w} = 33.1 \cdot in^{2}$$

$$I_{w\_O} := \pi \cdot R_{w\_O}^{\ 3} \qquad I_{w\_O} = 5500 \cdot in^{3}$$

$$I_{w\_I} := \pi \cdot R_{w\_I}^{\ 3} \qquad I_{w\_I} = 5110 \cdot in^{3}$$

$$I_{w} := I_{w\_O} + I_{w\_I} \qquad I_{w} = 10610 \cdot in^{3}$$

- Tension Force per Unit Length:

$$T_{w\_IN} := -\frac{P_{t}}{L_{w}} + \frac{M \cdot R_{w\_O}}{I_{w}} \qquad T_{w\_IN} = 1.296 \cdot \frac{kip}{in}$$

$$T_{w} := T_{w\_IN} \cdot L_{w} \qquad T_{w} = 193.9 \cdot kip$$

- Allowable Tension Weld Force & Result:

$$\theta_{t} := 90 \cdot deg$$

$$F_{w\_t} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_{t})^{1.5}\right) \qquad F_{w\_t} = 31.5 \cdot ksi$$

$$T_{all\_w} := F_{w\_t} \cdot A_{w} \qquad T_{all\_w} = 1041.3 \cdot kip$$

$$T'_{all\_w} := T_{all\_w} \cdot ASI \qquad T'_{all\_w} = 1388.4 \cdot kip$$

$$r_{w\_T} := \frac{T_{w}}{T'_{all\_w}} \qquad r_{w\_T} = 14 \cdot \%$$

- Allowable Shear Weld Force & Result:

$\theta_v \equiv 0 \cdot deg$

$F_{w\_v} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin\left(\theta_v\right)^{1.5}\right)$ $F_{w\_v} = 21.0 \cdot ksi$

$V_{all\_w} := F_{w\_v} \cdot A_w$ $V_{all\_w} = 694.2 \cdot kip$

$V'_{all\_w} := V_{all\_w} \cdot ASI$ $V'_{all\_w} = 925.6 \cdot kip$

$r_{w\_V} := \dfrac{V_t}{V'_{all\_w}}$ $r_{w\_V} = 1 \cdot \%$

- Combined Result:

$r_w := \sqrt{\left(\dfrac{T_w}{T'_{all\_w}}\right)^2 + \left(\dfrac{V_t}{V'_{all\_w}}\right)^2}$ $r_w = 14 \cdot \%$

vertical solutions
"execute & deliver"

ANCHOR ROD / FLANGE BOLT & BASE / FLANGE PLATE DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

140-ft (+)

VSi Job No.: 141374
Date: 11/14/2014
Calculated by: MER

Input

- Reactions:

$M := 390.44 \cdot kip \cdot ft$ = moment at top of base / flange plate

$P_t := 9.24 \cdot kip$ = axial load at top of base / flange plate

$V_t := 15.93 \cdot kip$ = shear load at top of base / flange plate

- Shaft:

$D_{o\_shaft} := 30 \cdot in$ = outside diameter of shaft

$t_{shaft} := 0.375 \cdot in$ = thickness of shaft

$t_{w\_O} := 0.3125 \cdot in$
Fillet
PJP
= outer shaft weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$
Fillet
PJP
= inner shaft weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode

- Base / Flange Plate:

$t := 1.25 \cdot in$ = thickness of base / flange plate

$D_{PL} := 36.375 \cdot in$ = diameter of base / flange plate

$F_y := 36 \cdot ksi$ = yield stress of base / flange plate

- Anchor Rods / Flange Bolts: ☐ ***Check if Upset Rod***

$BC := 33 \cdot in$ = fastener bolt circle diameter

$n_b := 24$ = total number of fasteners

$d_b := 1.0 \cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of fastener & thread condition

- Constants:

$ASI \equiv \frac{4}{3}$ = allowable stress increase

Output - Anchor Rods / Flange Bolts:

- Properties:

$F_{yb} = 92 \cdot \mathrm{ksi}$

$F_{ub} = 120 \cdot \mathrm{ksi}$

$A_b := \dfrac{\pi \cdot {d_b}^2}{4}$ $\qquad A_b = 0.785 \cdot \mathrm{in}^2$

$A_n := \dfrac{\pi}{4} \cdot \left(d_b - \dfrac{0.9743 \cdot \mathrm{in}}{n} \right)^2$ $\qquad A_n = 0.606 \cdot \mathrm{in}^2$

$A_{stiff} := A_b$ $\qquad A_{stiff} = 0.785 \cdot \mathrm{in}^2$

$A_{stress} := \left| \begin{array}{ll} A_b & \text{if Upset} = 0 \\ A_n & \text{otherwise} \end{array} \right.$ $\qquad A_{stress} = 0.785 \cdot \mathrm{in}^2$

- Forces:

$i := 0 .. (n_b - 1)$

$\theta_i := 2 \cdot \pi \cdot \left(\dfrac{i}{n_b} \right)$

$d' := \dfrac{BC}{2} \cdot \cos(\theta)$

$d_i := \left| d'_i \right|$

$P := \dfrac{M \cdot d}{\sum \overrightarrow{\left(d^2\right)}} + \dfrac{P_t}{n_b}$

$f_t := \overrightarrow{\left(\dfrac{P}{A_{stress}} \right)}$

$f_{t\_max} := \max(f_t)$ $\qquad f_{t\_max} = 30.6 \cdot \mathrm{ksi}$

$V := \dfrac{V_t}{n_b}$ $\qquad V = 0.66 \cdot \mathrm{kip}$

$f_v := \dfrac{V}{A_b}$ $\qquad f_v = 0.85 \cdot \mathrm{ksi}$

ALLOWABLE STRESS CALCS.

- Allowable Tensile Stress [J3.4AISC]:

$F_t = 44.0 \cdot \mathrm{ksi}$

$F'_t = 58.7 \cdot \mathrm{ksi}$

- Allowable Shear Stress [J3.4, AISC]:

$F_v = 21.0 \cdot \mathrm{ksi}$

$F'_v = 28.0 \cdot \mathrm{ksi}$

- Allowable Combined Tension & Shear Stress [J3.5, AISC]:

$$F_{t\_v} = 44.0\cdot\text{ksi}$$

$$F'_{t\_v} = 58.6\cdot\text{ksi}$$

- Results:

$$r_t := \overrightarrow{\left(\frac{f_t}{F'_t}\right)}$$

$$r_{t\_max} := \max(r_t) \qquad r_{t\_max} = 52\cdot\%$$

$$r_v := \frac{f_v}{F'_v} \qquad r_v = 3\cdot\%$$

$$r_{t\_v} := \overrightarrow{\left(\frac{f_t}{F'_{t\_v}}\right)}$$

$$r_{t\_v\_max} := \max(r_{t\_v}) \qquad r_{t\_v\_max} = 52\cdot\%$$

$$r_{fasteners} := \max(r_{t\_max}, r_v, r_{t\_v\_max}) \qquad r_{fasteners} = 52\cdot\%$$

Output - Base / Flange Plate:

- Plate Flexure:

MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

$$M_{PL} := \sum \overrightarrow{(P\cdot m)} \qquad M_{PL} = 79.66\cdot\text{kip}\cdot\text{in}$$

$$b_{eff} = 12.292\cdot\text{in}$$

$$S_{PL} := \frac{b_{eff}\cdot t^2}{6} \qquad S_{PL} = 3.20\cdot\text{in}^3$$

$$f_b := \frac{M_{PL}}{S_{PL}} \qquad f_b = 24.9\cdot\text{ksi}$$

- Allowable Bending Stress [F2.1, AISC]:

$$F_b := 0.75\cdot F_y \qquad F_b = 27.0\cdot\text{ksi}$$

$$F'_b := ASI\cdot F_b \qquad F'_b = 36.0\cdot\text{ksi}$$

- Result:

$$r_b := \frac{f_b}{F'_b} \qquad r_b = 69\cdot\%$$

Output - Shaft to Base / Flange Plate Weld:

- Properties:

$$R_{w\_O} := \frac{D_{o\_shaft} + \frac{t_{w\_O}}{3}}{2} \qquad R_{w\_O} = 15.052\cdot in$$

$$R_{w\_I} := \frac{D_{o\_shaft} - \left(t_{shaft} + \frac{t_{w\_I}}{3}\right)}{2} \qquad R_{w\_I} = 14.760\cdot in$$

$$L_{w\_O} := 2\cdot\pi\cdot R_{w\_O} \qquad L_{w\_O} = 94.6\cdot in$$

$$L_{w\_I} := 2\cdot\pi\cdot R_{w\_I} \qquad L_{w\_I} = 92.7\cdot in$$

$$L_w := L_{w\_O} + L_{w\_I} \qquad L_w = 187.3\cdot in$$

$$A_{w\_O} := \left| \begin{array}{l} \left(0.707\cdot t_{w\_O}\right)\cdot L_{w\_O} \ \text{ if } \ Weld\_Outer = \text{"Fillet"} \\ t_{w\_O}\cdot L_{w\_O} \ \text{ if } \ Weld\_Outer = \text{"PJP"} \end{array} \right. \qquad A_{w\_O} = 20.9\cdot in^2$$

$$A_{w\_I} := \left| \begin{array}{l} \left(0.707\cdot t_{w\_I}\right)\cdot L_{w\_I} \ \text{ if } \ Weld\_Inner = \text{"Fillet"} \\ t_{w\_I}\cdot L_{w\_I} \ \text{ if } \ Weld\_Inner = \text{"PJP"} \end{array} \right. \qquad A_{w\_I} = 20.5\cdot in^2$$

$$A_w := A_{w\_O} + A_{w\_I} \qquad A_w = 41.4\cdot in^2$$

$$I_{w\_O} := \pi\cdot R_{w\_O}^{\ 3} \qquad I_{w\_O} = 10714\cdot in^3$$

$$I_{w\_I} := \pi\cdot R_{w\_I}^{\ 3} \qquad I_{w\_I} = 10103\cdot in^3$$

$$I_w := I_{w\_O} + I_{w\_I} \qquad I_w = 20817\cdot in^3$$

- Tension Force per Unit Length:

$$T_{w\_IN} := \frac{P_t}{L_w} + \frac{M\cdot R_{w\_O}}{I_w} \qquad T_{w\_IN} = 3.339\cdot\frac{kip}{in}$$

$$T_w := T_{w\_IN}\cdot L_w \qquad T_w = 625.4\cdot kip$$

- Allowable Tension Weld Force & Result:

$$\theta_t := 90\cdot deg$$

$$F_{w\_t} := 0.30\cdot F_{EXX}\cdot\left(1.0 + 0.50\cdot\sin\left(\theta_t\right)^{1.5}\right) \qquad F_{w\_t} = 31.5\cdot ksi$$

$$T_{all\_w} := F_{w\_t}\cdot A_w \qquad T_{all\_w} = 1303.6\cdot kip$$

$$T'_{all\_w} := T_{all\_w}\cdot ASI \qquad T'_{all\_w} = 1738.2\cdot kip$$

$$r_{w\_T} := \frac{T_w}{T'_{all\_w}} \qquad r_{w\_T} = 36\cdot\%$$

- Allowable Shear Weld Force & Result:

$\theta_V \equiv 0 \cdot deg$

$F_{w\_v} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_V)^{1.5}\right)$ $F_{w\_v} = 21.0 \cdot ksi$

$V_{all\_w} := F_{w\_v} \cdot A_w$ $V_{all\_w} = 869.1 \cdot kip$

$V'_{all\_w} := V_{all\_w} \cdot ASI$ $V'_{all\_w} = 1158.8 \cdot kip$

$r_{w\_V} := \frac{V_t}{V'_{all\_w}}$ $r_{w\_V} = 1 \cdot \%$

- Combined Result:

$r_w := \sqrt{\left(\frac{T_w}{T'_{all\_w}}\right)^2 + \left(\frac{V_t}{V'_{all\_w}}\right)^2}$ $r_w = 36 \cdot \%$

vertical solutions
'execute & deliver'

ANCHOR ROD / FLANGE BOLT & BASE / FLANGE PLATE DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

120-ft (+)

VSi Job No.: 141374
Date: 11/14/2014
Calculated by: MER

Input

- Reactions:

$M := 747.51 \cdot kip \cdot ft$ = moment at top of base / flange plate

$P_t := 13.00 \cdot kip$ = axial load at top of base / flange plate

$V_t := 19.28 \cdot kip$ = shear load at top of base / flange plate

- Shaft:

$D_{o\_shaft} := 36 \cdot in$ = outside diameter of shaft

$t_{shaft} := 0.375 \cdot in$ = thickness of shaft

$t_{w\_O} := 0.3125 \cdot in$ [✓ Fillet] PJP = outer shaft weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$ [✓ Fillet] PJP = inner shaft weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode

- Base / Flange Plate:

$t := 1.25 \cdot in$ = thickness of base / flange plate

$D_{PL} := 42.375 \cdot in$ = diameter of base / flange plate

$F_y := 36 \cdot ksi$ = yield stress of base / flange plate

- Anchor Rods / Flange Bolts: ☐ ***Check if Upset Rod***

$BC := 39 \cdot in$ = fastener bolt circle diameter

$n_b := 28$ = total number of fasteners

$d_b := 1.0 \cdot in$ = diameter of fasteners

[✓ A325] [✓ N] = grade of fastener & thread condition
A490 X
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

- Constants:

$ASI \equiv \frac{4}{3}$ = allowable stress increase

Output - Anchor Rods / Flange Bolts:

- Properties:

$F_{yb} = 92 \cdot ksi$

$F_{ub} = 120 \cdot ksi$

$$A_b := \frac{\pi \cdot {d_b}^2}{4}$$

$A_b = 0.785 \cdot in^2$

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

$A_n = 0.606 \cdot in^2$

$$A_{stiff} := A_b$$

$A_{stiff} = 0.785 \cdot in^2$

$$A_{stress} := \left| \begin{array}{ll} A_b & \text{if Upset} = 0 \\ A_n & \text{otherwise} \end{array} \right.$$

$A_{stress} = 0.785 \cdot in^2$

- Forces:

$$i := 0 .. \left(n_b - 1 \right)$$

$$\theta_i := 2 \cdot \pi \cdot \left(\frac{i}{n_b} \right)$$

$$d' := \frac{BC}{2} \cdot \cos(\theta)$$

$$d_i := \left| d'_i \right|$$

$$P := \frac{M \cdot d}{\sum \overrightarrow{\left(d^2 \right)}} + \frac{P_t}{n_b}$$

$$f_t := \overrightarrow{\left(\frac{P}{A_{stress}} \right)}$$

$$f_{t\_max} := \max\left(f_t \right)$$

$f_{t\_max} = 42.4 \cdot ksi$

$$V := \frac{V_t}{n_b}$$

$V = 0.69 \cdot kip$

$$f_v := \frac{V}{A_b}$$

$f_v = 0.88 \cdot ksi$

▶ ALLOWABLE STRESS CALCS.

- Allowable Tensile Stress [J3.4AISC]:

$F_t = 44.0 \cdot ksi$

$F'_t = 58.7 \cdot ksi$

- Allowable Shear Stress [J3.4, AISC]:

$F_v = 21.0 \cdot ksi$

$F'_v = 28.0 \cdot ksi$

- Allowable Combined Tension & Shear Stress [J3.5, AISC]:

$F_{t\_v} = 44.0 \cdot ksi$

$F'_{t\_v} = 58.6 \cdot ksi$

- Results:

$r_t := \overrightarrow{\left(\frac{f_t}{F'_t}\right)}$

$r_{t\_max} := \max(r_t)$ $\qquad r_{t\_max} = 72 \cdot \%$

$r_v := \frac{f_v}{F'_v}$ $\qquad r_v = 3 \cdot \%$

$r_{t\_v} := \overrightarrow{\left(\frac{f_t}{F'_{t\_v}}\right)}$

$r_{t\_v\_max} := \max(r_{t\_v})$ $\qquad r_{t\_v\_max} = 72 \cdot \%$

$r_{fasteners} := \max(r_{t\_max}, r_v, r_{t\_v\_max})$ $\qquad r_{fasteners} = 72 \cdot \%$

Output - Base / Flange Plate:

- Plate Flexure:

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

$M_{PL} := \sum \overrightarrow{(P \cdot m)}$ $\qquad M_{PL} = 115.70 \cdot kip \cdot in$

$b_{eff} = 12.723 \cdot in$

$S_{PL} := \frac{b_{eff} \cdot t^2}{6}$ $\qquad S_{PL} = 3.31 \cdot in^3$

$f_b := \frac{M_{PL}}{S_{PL}}$ $\qquad f_b = 34.9 \cdot ksi$

- Allowable Bending Stress [F2.1, AISC]:

$F_b := 0.75 \cdot F_y$ $\qquad F_b = 27.0 \cdot ksi$

$F'_b := ASI \cdot F_b$ $\qquad F'_b = 36.0 \cdot ksi$

- Result:

$r_b := \frac{f_b}{F'_b}$ $\qquad r_b = 97 \cdot \%$

Output - Shaft to Base / Flange Plate Weld:

- Properties:

$R_{w\_O} := \dfrac{D_{o\_shaft} + \dfrac{t_{w\_O}}{3}}{2}$ $\qquad R_{w\_O} = 18.052 \cdot in$

$R_{w\_I} := \dfrac{D_{o\_shaft} - \left(t_{shaft} + \dfrac{t_{w\_I}}{3}\right)}{2}$ $\qquad R_{w\_I} = 17.760 \cdot in$

$L_{w\_O} := 2 \cdot \pi \cdot R_{w\_O}$ $\qquad L_{w\_O} = 113.4 \cdot in$

$L_{w\_I} := 2 \cdot \pi \cdot R_{w\_I}$ $\qquad L_{w\_I} = 111.6 \cdot in$

$L_w := L_{w\_O} + L_{w\_I}$ $\qquad L_w = 225.0 \cdot in$

$A_{w\_O} := \left| \begin{array}{l} (0.707 \cdot t_{w\_O}) \cdot L_{w\_O} \text{ if Weld\_Outer = "Fillet"} \\ t_{w\_O} \cdot L_{w\_O} \text{ if Weld\_Outer = "PJP"} \end{array} \right.$ $\qquad A_{w\_O} = 25.1 \cdot in^2$

$A_{w\_I} := \left| \begin{array}{l} (0.707 \cdot t_{w\_I}) \cdot L_{w\_I} \text{ if Weld\_Inner = "Fillet"} \\ t_{w\_I} \cdot L_{w\_I} \text{ if Weld\_Inner = "PJP"} \end{array} \right.$ $\qquad A_{w\_I} = 24.7 \cdot in^2$

$A_w := A_{w\_O} + A_{w\_I}$ $\qquad A_w = 49.7 \cdot in^2$

$I_{w\_O} := \pi \cdot R_{w\_O}{}^3$ $\qquad I_{w\_O} = 18481 \cdot in^3$

$I_{w\_I} := \pi \cdot R_{w\_I}{}^3$ $\qquad I_{w\_I} = 17600 \cdot in^3$

$I_w := I_{w\_O} + I_{w\_I}$ $\qquad I_w = 36081 \cdot in^3$

- Tension Force per Unit Length:

$T_{w\_IN} := -\dfrac{P_t}{L_w} + \dfrac{M \cdot R_{w\_O}}{I_w}$ $\qquad T_{w\_IN} = 4.430 \cdot \dfrac{kip}{in}$

$T_w := T_{w\_IN} \cdot L_w$ $\qquad T_w = 996.9 \cdot kip$

- Allowable Tension Weld Force & Result:

$\theta_t := 90 \cdot deg$

$F_{w\_t} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_t)^{1.5}\right)$ $\qquad F_{w\_t} = 31.5 \cdot ksi$

$T_{all\_w} := F_{w\_t} \cdot A_w$ $\qquad T_{all\_w} = 1566.0 \cdot kip$

$T'_{all\_w} := T_{all\_w} \cdot ASI$ $\qquad T'_{all\_w} = 2088.0 \cdot kip$

$r_{w\_T} := \dfrac{T_w}{T'_{all\_w}}$ $\qquad r_{w\_T} = 48 \cdot \%$

- Allowable Shear Weld Force & Result:

$\theta_v \equiv 0 \cdot deg$

$F_{w\_v} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_v)^{1.5}\right)$ $F_{w\_v} = 21.0 \cdot ksi$

$V_{all\_w} := F_{w\_v} \cdot A_w$ $V_{all\_w} = 1044.0 \cdot kip$

$V'_{all\_w} := V_{all\_w} \cdot ASI$ $V'_{all\_w} = 1392.0 \cdot kip$

$r_{w\_V} := \frac{V_t}{V'_{all\_w}}$ $r_{w\_V} = 1 \cdot \%$

- Combined Result:

$r_w := \sqrt{\left(\frac{T_w}{T'_{all\_w}}\right)^2 + \left(\frac{V_t}{V'_{all\_w}}\right)^2}$ $r_w = 48 \cdot \%$

FLANGE BOLT & FLANGE PLATE w/ JUMP KIT DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

100-ft

Input

$z := 100 \cdot ft$ = centerline elevation of flange connection

- Wind Speed & Reactions:

$V_{fm} := 85 \cdot mph$ = design wind speed

$M := 1162.48 \cdot kip \cdot ft$ = moment reaction at top of flange plate

$P_t := 17.64 \cdot kip$ = axial reaction at top of flange plate

$V_t := 22.20 \cdot kip$ = shear reaction at top of flange plate

- Shaft:

$D_{o\_shaft\_ab} := 42 \cdot in$ = outside diameter of shaft section above

$t_{shaft\_ab} := 0.375 \cdot in$ = thickness of shaft section above

$D_{o\_shaft\_bl} := 48 \cdot in$ = outside diameter of shaft section below

$t_{shaft\_bl} := 0.375 \cdot in$ = thickness of shaft section below

$t_{w\_O} := 0.3125 \cdot in$ Fillet / PJP = outer shaft (above) weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$ Fillet / PJP = inner shaft (above) weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode

$F_{y\_shaft} := 42 \cdot ksi$ = specified minimum yield stress of shaft material

$F_{u\_shaft} := 60 \cdot ksi$ = specified minimum ultimate stress of shaft material

- Flange Connection:

- Bolts: ☐ ***Check if Upset Rod***

$BC_1 := 45 \cdot in$ = outer bolt circle diameter (or if singe BC, input here)

$n_{b\_1} := 32$ = total number of bolts on BC_1

$BC_2 := 0 \cdot in$ = inner fastener bolt circle diameter (or if singe BC, set to 0)

$n_{b\_2} := 0$ = total number of bolts on BC_2

$d_b := 1.0 \cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of bolts & thread condition

- Flange Plate:

$t := 1.25 \cdot in$ = thickness of flange plate

$D_{PL} := 48.375 \cdot in$ = diameter of flange plate

$F_y := 36 \cdot ksi$ = specified minimum yield stress of flange plate

- Stiffener Plates (ASSUMED - FIELD VERIFY): ☐ ***Check if Stiffener Plates***

$b_{SP} := 0 \cdot in$ = width of stiffener plate
$t_{SP} := 0 \cdot in$ = thickness of stiffener plate
$L_{SP} := 0 \cdot in$ = length of stiffener plate

$clip := 0 \cdot in$ = length of clip

$t_{VW} := 0 \cdot in$ = thickness of vertical weld to shaft
$t_{HW} := 0 \cdot in$ = thickness of horizontal weld to flange plate

$F_{y\_SP} := 0 \cdot ksi$ = specified minimum yield stress of SP material

- Jump Kits:

$n_{JK} := 3$ = number of jump kits and/or reinforcing bars (3, 4 or 6)

- Reinforcing Bars:

$b_{bar} := 0 \cdot in$ = width of reinforcing bar above flange (if applicable; set to 0 if no RB)
$t_{bar} := 0 \cdot in$ = thickness of reinforcing bar above flange (if applicable; set to 0 if no RB)

- Termination Bolts: ☐ ***Check if Upset Rod***

$n_{b\_TB} := 4$ = number of termination bolts
$d_{b\_TB} := 20 \cdot mm$ = diameter of termination bolt

AJAX ONESIDE (PC 8.8) N = grade of termination bolts / thread condition
AJAX ONESIDE (PC 10.9) X
A325
A490
A36
A193 Gr. B7
A307 Gr. A

$d_{hole\_TB} := 31 \cdot mm$ = diameter of termination bolt hole
$s_{TB} := 3.0 \cdot in$ = spacing of termination bolts

- Plate Properties:

$L := 24 \cdot in$ = length between bottom/top termination bolts

$t_{VP} := 1.25 \cdot in$ = thickness of vertical plate
$b_{VP} := 7.0 \cdot in$ = width of vertical plate

$t_{GP} := 1.25 \cdot in$ = thickness of gusset plate
$b_{GP} := 2.625 \cdot in$ = width of gusset plate

$t_{FP} := 3.25 \cdot in$ = thickness of filler plate (total thickness if multiple filler plates)

$t_{w\_GP} := 0.3125 \cdot in$ = thickness of gusset plate to vertical plate weld
$F_{EXX\_GP} := 80 \cdot ksi$ = gusset plate to vertical plate weld electrode

$F_{y\_bar} := 65 \cdot ksi$ = specified minimum yield stress of JK bar material
$F_{u\_bar} := 80 \cdot ksi$ = specified minimum ultimate stress of JK bar material

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$ASI \equiv \frac{4}{3}$ = allowable stress increase

$C_{mx} \equiv 0.85$ = coefficient for restrained compression member in plane of bending

$K \equiv 0.8$ = stiffener plate effective length factor

$K_{JK} \equiv 0.6$ = jump kit effective length factor

▶ JK WIND AREA

▶ BUILT-UP MEMBER PROPERTIES

▶ FLANGE BOLT / TB PROPERTIES

▶ FLANGE FASTENERS & TB FORCES - #1

$d_1 := 1.784 \cdot in$ ***** adjust until d_1 is the same (Eq 1 = Eq 2)**

▶ FLANGE FASTENERS & TB FORCES - #2

$Find(d_1) = 1.784 \cdot in$ ***

$Eq1 := \Sigma A_{b\_TB} \cdot y'_{TB}$ $Eq1 = 11.1 \cdot in^3$

$Eq2 := b_{eff\_VP} \cdot d_1 \cdot \frac{d_1}{2}$ $Eq2 = 11.1 \cdot in^3$

▶ FLANGE FASTENERS & TB FORCES - #3

▶ FASTENER ALLOWABLE STRESS CALCS. & RESULTS

▶ TB BEARING - SHAFT

▶ BUILT-UP MEMBER CAPACITY

▶ SHAFT

▶ SHAFT TO FLANGE PLATE WELD

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

▶ BASE / FLANGE PLATE w/ STIFFENER PLATES

▶ STIFFENER PLATES

▶ EQUIVALENT SHAFT THICKNESS

Output - Results Summary:

- Flange Connection:

$$\text{result}_{Flange\_Bolts} := \begin{pmatrix} r_{t\_max} \\ r_{v} \\ r_{t\_v\_max} \end{pmatrix}$$

$$\text{result}_{Flange\_Bolts} = \begin{pmatrix} 70 \\ 3 \\ 70 \end{pmatrix} \cdot \%$$

$$\text{result}_{Flange\_Plate} := \begin{vmatrix} r_b \ \text{ if } \ SPL = 0 \\ \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_{b\_xy} \end{pmatrix} \ \text{otherwise} \end{vmatrix}$$

$$\text{result}_{Flange\_Plate} = 95 \cdot \%$$

$$\text{result}_{Stiffener\_Plates} := \begin{vmatrix} \text{"N/A"} \ \text{ if } \ SPL = 0 \\ \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_{V} \\ r_{v\_H} \\ r_{t\_H} \\ r_{H} \end{pmatrix} \ \text{otherwise} \end{vmatrix}$$

$$\text{result}_{Stiffener\_Plates} = \text{"N/A"} \cdot \%$$

$$\text{result}_{SP\_weld} := \begin{vmatrix} \text{"N/A"} \ \text{ if } \ SPL = 0 \\ \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} \ \text{otherwise} \end{vmatrix}$$

$$\text{result}_{SP\_weld} = \text{"N/A"} \cdot \%$$

$$\text{result}_{SP\_shaft} := \begin{vmatrix} \text{"N/A"} \ \text{ if } \ SPL = 0 \\ r_{v\_PS} \ \text{ otherwise} \end{vmatrix}$$

$$\text{result}_{SP\_shaft} = \text{"N/A"} \cdot \%$$

- Shaft:

$$\text{result}_{Bearing\_Shaft} := r_{p\_shaft}$$

$$\text{result}_{Bearing\_Shaft} = 45 \cdot \%$$

$$\text{result}_{Shaft} := \begin{pmatrix} r_{b\_shaft\_ab} \\ r_{a\_shaft\_ab} \\ r_{ab\_shaft\_H1\text{-}3} \end{pmatrix}$$

$$\text{result}_{Shaft} = \begin{pmatrix} 76 \\ 1 \\ 77 \end{pmatrix} \cdot \%$$

$$\text{result}_{Weld\_Shaft} := \begin{pmatrix} r_{w\_T} \\ r_{w\_V} \\ r_{w} \end{pmatrix}$$

$$\text{result}_{Weld\_Shaft} = \begin{pmatrix} 54 \\ 1 \\ 54 \end{pmatrix} \cdot \%$$

- Jump Kits:

$$result_{Termination\_Bolts} := \begin{pmatrix} r_{t\_TB} \\ r_{v\_max\_TB} \\ r_{t\_v\_max\_TB} \end{pmatrix}$$

$$result_{Termination\_Bolts} = \begin{pmatrix} 62 \\ 68 \\ 85 \end{pmatrix} \cdot \%$$

$$result_{JK} := \begin{pmatrix} r_{a\_JK} \\ r_{bx\_JK} \\ r_{t\_gross\_JK} \\ r_{t\_net\_JK} \\ r_{ab\_x\_JK\_H1-1} \\ r_{ab\_x\_JK\_H1-2} \\ r_{tb\_x\_JK\_H2-1} \end{pmatrix}$$

$$result_{JK} = \begin{pmatrix} 10 \\ 78 \\ 9 \\ 10 \\ 77 \\ 95 \\ 88 \end{pmatrix} \cdot \%$$

$$result_{JK\_weld} := \begin{pmatrix} r_{v\_w\_GP} \\ r_{t\_w\_GP} \\ r_{w\_GP} \end{pmatrix}$$

$$result_{JK\_weld} = \begin{pmatrix} 22 \\ 8 \\ 23 \end{pmatrix} \cdot \%$$

$Max\_Utilization = 95 \cdot \%$

$b_{min\_VP} = 6.875 \cdot in$

$t_{shaft\_ab\_MOD} = 0.9549 \cdot in$

$t_{shaft\_bl\_MOD} = 0.6211 \cdot in$

$CaAa_{JK} = 4.512 \cdot ft^2$

$M_{shaft} = 966.69 \cdot kip \cdot ft$

vertical solutions
"execute & deliver"

FLANGE BOLT & FLANGE PLATE w/ JUMP KIT DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

80-ft

VSi Job No.: 141374
Date: 11/13/2014
Calculated by: MER

Input

$z := 80 \cdot ft$ = centerline elevation of flange connection

- Wind Speed & Reactions:

$V_{fm} := 85 \cdot mph$ = design wind speed
$M := 1640.28 \cdot kip \cdot ft$ = moment reaction at top of flange plate
$P_t := 23.30 \cdot kip$ = axial reaction at top of flange plate
$V_t := 25.35 \cdot kip$ = shear reaction at top of flange plate

- Shaft:

$D_{o\_shaft\_ab} := 48 \cdot in$ = outside diameter of shaft section above
$t_{shaft\_ab} := 0.375 \cdot in$ = thickness of shaft section above

$D_{o\_shaft\_bl} := 54 \cdot in$ = outside diameter of shaft section below
$t_{shaft\_bl} := 0.375 \cdot in$ = thickness of shaft section below

$t_{w\_O} := 0.3125 \cdot in$ Fillet / PJP = outer shaft (above) weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$ Fillet / PJP = inner shaft (above) weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode
$F_{y\_shaft} := 42 \cdot ksi$ = specified minimum yield stress of shaft material
$F_{u\_shaft} := 60 \cdot ksi$ = specified minimum ultimate stress of shaft material

- Flange Connection:

- Bolts: ☐ ***Check if Upset Rod***

$BC_1 := 51 \cdot in$ = outer bolt circle diameter (or if singe BC, input here)
$n_{b\_1} := 36$ = total number of bolts on BC_1

$BC_2 := 0 \cdot in$ = inner fastener bolt circle diameter (or if singe BC, set to 0)
$n_{b\_2} := 0$ = total number of bolts on BC_2

$d_b := 1.0 \cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of bolts & thread condition

- Flange Plate:

$t := 1.25 \cdot in$ = thickness of flange plate
$D_{PL} := 54.375 \cdot in$ = diameter of flange plate
$F_y := 36 \cdot ksi$ = specified minimum yield stress of flange plate

- Stiffener Plates (ASSUMED - FIELD VERIFY):

$b_{SP} := 0 \cdot in$ = width of stiffener plate

$t_{SP} := 0 \cdot in$ = thickness of stiffener plate

$L_{SP} := 0 \cdot in$ = length of stiffener plate

$clip := 0 \cdot in$ = length of clip

$t_{VW} := 0 \cdot in$ = thickness of vertical weld to shaft

$t_{HW} := 0 \cdot in$ = thickness of horizontal weld to flange plate

$F_{y\_SP} := 0 \cdot ksi$ = specified minimum yield stress of SP material

- Jump Kits:

$n_{JK} := 3$ = number of jump kits and/or reinforcing bars (3, 4 or 6)

- Reinforcing Bars:

$b_{bar} := 0 \cdot in$ = width of reinforcing bar above flange (if applicable; set to 0 if no RB)

$t_{bar} := 0 \cdot in$ = thickness of reinforcing bar above flange (if applicable; set to 0 if no RB)

- Termination Bolts:

$n_{b\_TB} := 6$ = number of termination bolts

$d_{b\_TB} := 20 \cdot mm$ = diameter of termination bolt

= grade of termination bolts / thread condition

$d_{hole\_TB} := 31 \cdot mm$ = diameter of termination bolt hole

$s_{TB} := 3.0 \cdot in$ = spacing of termination bolts

- Plate Properties:

$L := 24 \cdot in$ = length between bottom/top termination bolts

$t_{VP} := 1.25 \cdot in$ = thickness of vertical plate

$b_{VP} := 7.0 \cdot in$ = width of vertical plate

$t_{GP} := 1.25 \cdot in$ = thickness of gusset plate

$b_{GP} := 4.0 \cdot in$ = width of gusset plate

$t_{FP} := 3.25 \cdot in$ = thickness of filler plate (total thickness if multiple filler plates)

$t_{w\_GP} := 0.3125 \cdot in$ = thickness of gusset plate to vertical plate weld

$F_{EXX\_GP} := 80 \cdot ksi$ = gusset plate to vertical plate weld electrode

$F_{y\_bar} := 65 \cdot ksi$ = specified minimum yield stress of JK bar material

$F_{u\_bar} := 80 \cdot ksi$ = specified minimum ultimate stress of JK bar material

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$K \equiv 0.8$ = stiffener plate effective length factor

$ASI \equiv \frac{4}{3}$ = allowable stress increase

$K_{JK} \equiv 0.6$ = jump kit effective length factor

$C_{mx} \equiv 0.85$ = coefficient for restrained compression member in plane of bending

▶ JK WIND AREA

▶ BUILT-UP MEMBER PROPERTIES

▶ FLANGE BOLT / TB PROPERTIES

▶ FLANGE FASTENERS & TB FORCES - #1

$d_1 := 2.573 \cdot in$ ***** adjust until d_1 is the same (Eq 1 = Eq 2)**

▶ FLANGE FASTENERS & TB FORCES - #2

$Find(d_1) = 2.572 \cdot in$ ***

$Eq1 := \Sigma A_{b\_TB} \cdot y'_{TB}$ $Eq1 = 23.2 \cdot in^3$

$Eq2 := b_{eff\_VP} \cdot d_1 \cdot \frac{d_1}{2}$ $Eq2 = 23.2 \cdot in^3$

▶ FLANGE FASTENERS & TB FORCES - #3

▶ FASTENER ALLOWABLE STRESS CALCS. & RESULTS

▶ TB BEARING - SHAFT

▶ BUILT-UP MEMBER CAPACITY

▶ SHAFT

▶ SHAFT TO FLANGE PLATE WELD

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

▶ FLANGE PLATE w/ STIFFENER PLATES

▶ STIFFENER PLATES

▶ EQUIVALENT SHAFT THICKNESS

Output - Results Summary:

- Flange Connection:

$$\mathrm{result}_{\mathrm{Flange\_Bolts}} := \begin{pmatrix} r_{t\_max} \\ r_{v} \\ r_{t\_v\_max} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Flange\_Bolts}} = \begin{pmatrix} 73 \\ 3 \\ 73 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{Flange\_Plate}} := \left| \begin{array}{ll} r_{b} & \text{if } SPL = 0 \\ \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_{b\_xy} \end{pmatrix} & \text{otherwise} \end{array} \right. \qquad \mathrm{result}_{\mathrm{Flange\_Plate}} = 100 \cdot \%$$

$$\mathrm{result}_{\mathrm{Stiffener\_Plates}} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_{V} \\ r_{v\_H} \\ r_{t\_H} \\ r_{H} \end{pmatrix} & \text{otherwise} \end{array} \right. \qquad \mathrm{result}_{\mathrm{Stiffener\_Plates}} = \text{"N/A"} \cdot \%$$

$$\mathrm{result}_{\mathrm{SP\_weld}} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} & \text{otherwise} \end{array} \right. \qquad \mathrm{result}_{\mathrm{SP\_weld}} = \text{"N/A"} \cdot \%$$

$$\mathrm{result}_{\mathrm{SP\_shaft}} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ r_{v\_PS} & \text{otherwise} \end{array} \right. \qquad \mathrm{result}_{\mathrm{SP\_shaft}} = \text{"N/A"} \cdot \%$$

- Shaft:

$$\mathrm{result}_{\mathrm{Bearing\_Shaft}} := r_{p\_shaft} \qquad \mathrm{result}_{\mathrm{Bearing\_Shaft}} = 48 \cdot \%$$

$$\mathrm{result}_{\mathrm{Shaft}} := \begin{pmatrix} r_{b\_shaft\_ab} \\ r_{a\_shaft\_ab} \\ r_{ab\_shaft\_H1\text{-}3} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Shaft}} = \begin{pmatrix} 80 \\ 1 \\ 81 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{Weld\_Shaft}} := \begin{pmatrix} r_{w\_T} \\ r_{w\_V} \\ r_{w} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Weld\_Shaft}} = \begin{pmatrix} 59 \\ 1 \\ 59 \end{pmatrix} \cdot \%$$

- Jump Kits:

$$result_{Termination\_Bolts} := \begin{pmatrix} r_{t\_TB} \\ r_{v\_max\_TB} \\ r_{t\_v\_max\_TB} \end{pmatrix}$$

$$result_{Termination\_Bolts} = \begin{pmatrix} 54 \\ 72 \\ 78 \end{pmatrix} \cdot \%$$

$$result_{JK} := \begin{pmatrix} r_{a\_JK} \\ r_{bx\_JK} \\ r_{t\_gross\_JK} \\ r_{t\_net\_JK} \\ r_{ab\_x\_JK\_H1\text{-}1} \\ r_{ab\_x\_JK\_H1\text{-}2} \\ r_{tb\_x\_JK\_H2\text{-}1} \end{pmatrix}$$

$$result_{JK} = \begin{pmatrix} 13 \\ 75 \\ 12 \\ 13 \\ 77 \\ 97 \\ 88 \end{pmatrix} \cdot \%$$

$$result_{JK\_weld} := \begin{pmatrix} r_{v\_w\_GP} \\ r_{t\_w\_GP} \\ r_{w\_GP} \end{pmatrix}$$

$$result_{JK\_weld} = \begin{pmatrix} 23 \\ 6 \\ 24 \end{pmatrix} \cdot \%$$

$Max\_Utilization = 100 \cdot \%$

$b_{min\_VP} = 6.875 \cdot in$

$t_{shaft\_ab\_MOD} = 0.9854 \cdot in$

$t_{shaft\_bl\_MOD} = 0.6755 \cdot in$

$CaAa_{JK} = 6.631 \cdot ft^2$

$M_{shaft} = 1286.90 \cdot kip \cdot ft$

vertical solutions
"execute & deliver"

FLANGE BOLT & FLANGE PLATE w/ JUMP KIT DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

VSi Job No.: 141374
Date: 11/13/2014
Calculated by: MER

60-ft

Input

$z := 60 \cdot ft$ = centerline elevation of flange connection

- Wind Speed & Reactions:

$V_{fm} := 85 \cdot mph$ = design wind speed
$M := 2182.75 \cdot kip \cdot ft$ = moment reaction at top of flange plate
$P_t := 29.78 \cdot kip$ = axial reaction at top of flange plate
$V_t := 28.57 \cdot kip$ = shear reaction at top of flange plate

- Shaft:

$D_{o\_shaft\_ab} := 54 \cdot in$ = outside diameter of shaft section above
$t_{shaft\_ab} := 0.375 \cdot in$ = thickness of shaft section above

$D_{o\_shaft\_bl} := 60 \cdot in$ = outside diameter of shaft section below
$t_{shaft\_bl} := 0.375 \cdot in$ = thickness of shaft section below

$t_{w\_O} := 0.3125 \cdot in$ Fillet / PJP = outer shaft (above) weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$ Fillet / PJP = inner shaft (above) weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode
$F_{y\_shaft} := 42 \cdot ksi$ = specified minimum yield stress of shaft material
$F_{u\_shaft} := 60 \cdot ksi$ = specified minimum ultimate stress of shaft material

- Flange Connection:

- Bolts: ☐ ***Check if Upset Rod***

$BC_1 := 57 \cdot in$ = outer bolt circle diameter (or if singe BC, input here)
$n_{b\_1} := 48$ = total number of bolts on BC_1

$BC_2 := 0 \cdot in$ = inner fastener bolt circle diameter (or if singe BC, set to 0)
$n_{b\_2} := 0$ = total number of bolts on BC_2

$d_b := 1.0 \cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of bolts & thread condition

- Flange Plate:

$t := 1.25 \cdot in$ = thickness of flange plate
$D_{PL} := 60.375 \cdot in$ = diameter of flange plate
$F_y := 36 \cdot ksi$ = specified minimum yield stress of flange plate

- Stiffener Plates (ASSUMED - FIELD VERIFY): ☑ ***Check if Stiffener Plates***

$b_{SP} := 3.0 \cdot in$ = width of stiffener plate
$t_{SP} := 0.5 \cdot in$ = thickness of stiffener plate
$L_{SP} := 4.0 \cdot in$ = length of stiffener plate

$clip := 0.5 \cdot in$ = length of clip

$t_{VW} := 0.375 \cdot in$ = thickness of vertical weld to shaft
$t_{HW} := 0.375 \cdot in$ = thickness of horizontal weld to flange plate

$F_{y\_SP} := 36 \cdot ksi$ = specified minimum yield stress of SP material

- Jump Kits:

$n_{JK} := 3$ = number of jump kits and/or reinforcing bars (3, 4 or 6)

- Reinforcing Bars:

$b_{bar} := 3.25 \cdot in$ = width of reinforcing bar above flange (if applicable; set to 0 if no RB)
$t_{bar} := 1.25 \cdot in$ = thickness of reinforcing bar above flange (if applicable; set to 0 if no RB)

- Termination Bolts: ☐ ***Check if Upset Rod***

$n_{b\_TB} := 6$ = number of termination bolts
$d_{b\_TB} := 20 \cdot mm$ = diameter of termination bolt

AJAX ONESIDE (PC 8.8)
AJAX ONESIDE (PC 10.9)
A325
A490
A36
A193 Gr. B7
A307 Gr. A

N
X

= grade of termination bolts / thread condition

$d_{hole\_TB} := 31 \cdot mm$ = diameter of termination bolt hole
$s_{TB} := 3.0 \cdot in$ = spacing of termination bolts

- Plate Properties:

$L := 24 \cdot in$ = length between bottom/top termination bolts

$t_{VP} := 1.25 \cdot in$ = thickness of vertical plate
$b_{VP} := 7.0 \cdot in$ = width of vertical plate

$t_{GP} := 1.25 \cdot in$ = thickness of gusset plate
$b_{GP} := 4.0 \cdot in$ = width of gusset plate

$t_{FP} := 2.0 \cdot in$ = thickness of filler plate (total thickness if multiple filler plates)

$t_{w\_GP} := 0.3125 \cdot in$ = thickness of gusset plate to vertical plate weld
$F_{EXX\_GP} := 80 \cdot ksi$ = gusset plate to vertical plate weld electrode

$F_{y\_bar} := 65 \cdot ksi$ = specified minimum yield stress of JK bar material
$F_{u\_bar} := 80 \cdot ksi$ = specified minimum ultimate stress of JK bar material

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$ASI \equiv \frac{4}{3}$ = allowable stress increase

$C_{mx} \equiv 0.85$ = coefficient for restrained compression member in plane of bending

$K \equiv 0.8$ = stiffener plate effective length factor

$K_{JK} \equiv 0.6$ = jump kit effective length factor

▶ JK WIND AREA

▶ BUILT-UP MEMBER PROPERTIES

▶ FLANGE BOLT / TB PROPERTIES

▶ FLANGE FASTENERS & TB FORCES - #1

$d_1 := 2.573 \cdot in$ ***** adjust until d_1 is the same (Eq 1 = Eq 2)**

▶ FLANGE FASTENERS & TB FORCES - #2

$Find(d_1) = 2.572 \cdot in$ ***

$Eq1 := \Sigma A_{b\_TB} \cdot y'_{TB}$ $Eq1 = 23.2 \cdot in^3$

$Eq2 := b_{eff\_VP} \cdot d_1 \cdot \frac{d_1}{2}$ $Eq2 = 23.2 \cdot in^3$

▶ FLANGE FASTENERS & TB FORCES - #3

▶ FASTENER ALLOWABLE STRESS CALCS. & RESULTS

▶ TB BEARING - SHAFT

▶ BUILT-UP MEMBER CAPACITY

▶ SHAFT

▶ SHAFT TO FLANGE PLATE WELD

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

▶ FLANGE PLATE w/ STIFFENER PLATES

▶ STIFFENER PLATES

▶ EQUIVALENT SHAFT THICKNESS

Output - Results Summary:

- Flange Connection:

$$result_{Flange\_Bolts} := \begin{pmatrix} r_{t\_max} \\ r_{v} \\ r_{t\_v\_max} \end{pmatrix}$$

$$result_{Flange\_Bolts} = \begin{pmatrix} 69 \\ 3 \\ 69 \end{pmatrix} \cdot \%$$

$$result_{Flange\_Plate} := \left| \begin{array}{l} r_{b} \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_{b\_xy} \end{pmatrix} \ \text{ otherwise} \end{array} \right.$$

$$result_{Flange\_Plate} = \begin{pmatrix} 31 \\ 40 \\ 51 \end{pmatrix} \cdot \%$$

$$result_{Stiffener\_Plates} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_{V} \\ r_{v\_H} \\ r_{t\_H} \\ r_{H} \end{pmatrix} \ \text{ otherwise} \end{array} \right.$$

$$result_{Stiffener\_Plates} = \begin{pmatrix} 77 \\ 73 \\ 32 \\ 79 \\ 68 \\ 68 \\ 96 \end{pmatrix} \cdot \%$$

$$result_{SP\_weld} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} \ \text{ otherwise} \end{array} \right.$$

$$result_{SP\_weld} = \begin{pmatrix} 47 \\ 21 \\ 51 \\ 62 \end{pmatrix} \cdot \%$$

$$result_{SP\_shaft} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ r_{v\_PS} \ \text{ otherwise} \end{array} \right.$$

$$result_{SP\_shaft} = 28 \cdot \%$$

- Shaft:

$$result_{Bearing\_Shaft} := r_{p\_shaft}$$

$$result_{Bearing\_Shaft} = 45 \cdot \%$$

$$result_{Shaft} := \begin{pmatrix} r_{b\_shaft\_ab} \\ r_{a\_shaft\_ab} \\ r_{ab\_shaft\_H1\text{-}3} \end{pmatrix}$$

$$result_{Shaft} = \begin{pmatrix} 90 \\ 2 \\ 92 \end{pmatrix} \cdot \%$$

$$result_{Weld\_Shaft} := \begin{pmatrix} r_{w\_T} \\ r_{w\_V} \\ r_{w} \end{pmatrix}$$

$$result_{Weld\_Shaft} = \begin{pmatrix} 61 \\ 1 \\ 61 \end{pmatrix} \cdot \%$$

- Jump Kits:

$$\text{result}_{\text{Termination\_Bolts}} := \begin{pmatrix} r_{\text{t\_TB}} \\ r_{\text{v\_max\_TB}} \\ r_{\text{t\_v\_max\_TB}} \end{pmatrix}$$

$$\text{result}_{\text{Termination\_Bolts}} = \begin{pmatrix} 52 \\ 68 \\ 71 \end{pmatrix} \cdot \%$$

$$\text{result}_{\text{JK}} := \begin{pmatrix} r_{\text{a\_JK}} \\ r_{\text{bx\_JK}} \\ r_{\text{t\_gross\_JK}} \\ r_{\text{t\_net\_JK}} \\ r_{\text{ab\_x\_JK\_H1-1}} \\ r_{\text{ab\_x\_JK\_H1-2}} \\ r_{\text{tb\_x\_JK\_H2-1}} \end{pmatrix}$$

$$\text{result}_{\text{JK}} = \begin{pmatrix} 12 \\ 71 \\ 11 \\ 12 \\ 73 \\ 92 \\ 83 \end{pmatrix} \cdot \%$$

$$\text{result}_{\text{JK\_weld}} := \begin{pmatrix} r_{\text{v\_w\_GP}} \\ r_{\text{t\_w\_GP}} \\ r_{\text{w\_GP}} \end{pmatrix}$$

$$\text{result}_{\text{JK\_weld}} = \begin{pmatrix} 22 \\ 6 \\ 23 \end{pmatrix} \cdot \%$$

$b_{\text{min\_VP}} = 6.875 \cdot \text{in}$

$t_{\text{shaft\_ab\_MOD}} = 0.8874 \cdot \text{in}$

$t_{\text{shaft\_bl\_MOD}} = 0.6356 \cdot \text{in}$

$\text{CaAa}_{\text{JK}} = 6.631 \cdot \text{ft}^2$

$M_{\text{shaft}} = 1805.91 \cdot \text{kip} \cdot \text{ft}$

$\text{Max\_Utilization} = 96 \cdot \%$

FLANGE BOLT & FLANGE PLATE w/ JUMP KIT DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

40-ft

VSi Job No.: 141374
Date: 11/13/2014
Calculated by: MER

Input

$z := 40 \cdot ft$ = centerline elevation of flange connection

- Wind Speed & Reactions:

$V_{fm} := 85 \cdot mph$ = design wind speed

$M := 2788.41 \cdot kip \cdot ft$ = moment reaction at top of flange plate

$P_t := 37.04 \cdot kip$ = axial reaction at top of flange plate

$V_t := 31.68 \cdot kip$ = shear reaction at top of flange plate

- Shaft:

$D_{o\_shaft\_ab} := 60 \cdot in$ = outside diameter of shaft section above

$t_{shaft\_ab} := 0.375 \cdot in$ = thickness of shaft section above

$D_{o\_shaft\_bl} := 60 \cdot in$ = outside diameter of shaft section below

$t_{shaft\_bl} := 0.5 \cdot in$ = thickness of shaft section below

$t_{w\_O} := 0.3125 \cdot in$

Fillet
PJP

= outer shaft (above) weld type & size / effective throat

$t_{w\_I} := 0.3125 \cdot in$

Fillet
PJP

= inner shaft (above) weld type & size / effective throat

$F_{EXX} := 70 \cdot ksi$ = weld electrode

$F_{y\_shaft} := 42 \cdot ksi$ = specified minimum yield stress of shaft material

$F_{u\_shaft} := 60 \cdot ksi$ = specified minimum ultimate stress of shaft material

- Flange Connection:

- Bolts: ☐ ***Check if Upset Rod***

$BC_1 := 53 \cdot in$ = outer bolt circle diameter (or if singe BC, input here)

$n_{b\_1} := 32$ = total number of bolts on BC_1

$BC_2 := 47 \cdot in$ = inner fastener bolt circle diameter (or if singe BC, set to 0)

$n_{b\_2} := 32$ = total number of bolts on BC_2

$d_b := 1.25 \cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of bolts & thread condition

- Flange Plate:

$t := 1.25 \cdot in$ = thickness of flange plate

$D_{PL} := 60.375 \cdot in$ = diameter of flange plate

$F_y := 36 \cdot ksi$ = specified minimum yield stress of flange plate

- Stiffener Plates (ASSUMED - FIELD VERIFY): ☑ ***Check if Stiffener Plates***

$b_{SP} := 7.0 \cdot in$ = width of stiffener plate

$t_{SP} := 0.5 \cdot in$ = thickness of stiffener plate

$L_{SP} := 9.0 \cdot in$ = length of stiffener plate

$clip := 0.5 \cdot in$ = length of clip

$t_{VW} := 0.375 \cdot in$ = thickness of vertical weld to shaft

$t_{HW} := 0.375 \cdot in$ = thickness of horizontal weld to flange plate

$F_{y\_SP} := 36 \cdot ksi$ = specified minimum yield stress of SP material

- Jump Kits:

$n_{JK} := 3$ = number of jump kits and/or reinforcing bars (3, 4 or 6)

- Reinforcing Bars:

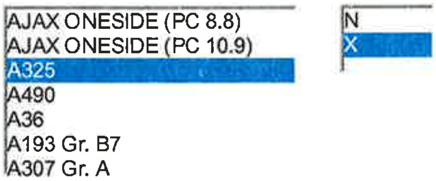
$b_{bar} := 3.5 \cdot in$ = width of reinforcing bar above flange (if applicable; set to 0 if no RB)

$t_{bar} := 1.25 \cdot in$ = thickness of reinforcing bar above flange (if applicable; set to 0 if no RB)

- Termination Bolts: ☐ ***Check if Upset Rod***

$n_{b\_TB} := 6$ = number of termination bolts

$d_{b\_TB} := 1.125 \cdot in$ = diameter of termination bolt



AJAX ONESIDE (PC 8.8)
AJAX ONESIDE (PC 10.9)
A325
A490
A36
A193 Gr. B7
A307 Gr. A

N
X

= grade of termination bolts / thread condition

$d_{hole\_TB} := 31 \cdot mm$ = diameter of termination bolt hole

$s_{TB} := 3.0 \cdot in$ = spacing of termination bolts

- Plate Properties:

$L := 24 \cdot in$ = length between bottom/top termination bolts

$t_{VP} := 1.25 \cdot in$ = thickness of vertical plate

$b_{VP} := 8.0 \cdot in$ = width of vertical plate

$t_{GP} := 1.25 \cdot in$ = thickness of gusset plate

$b_{GP} := 4.0 \cdot in$ = width of gusset plate

$t_{FP} := 0 \cdot in$ = thickness of filler plate (total thickness if multiple filler plates)

$t_{w\_GP} := 0.3125 \cdot in$ = thickness of gusset plate to vertical plate weld

$F_{EXX\_GP} := 80 \cdot ksi$ = gusset plate to vertical plate weld electrode

$F_{y\_bar} := 65 \cdot ksi$ = specified minimum yield stress of JK bar material

$F_{u\_bar} := 80 \cdot ksi$ = specified minimum ultimate stress of JK bar material

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$ASI \equiv \frac{4}{3}$ = allowable stress increase

$C_{mx} \equiv 0.85$ = coefficient for restrained compression member in plane of bending

$K \equiv 0.8$ = stiffener plate effective length factor

$K_{JK} \equiv 0.6$ = jump kit effective length factor

▶ JK WIND AREA

▶ BUILT-UP MEMBER PROPERTIES

▶ FLANGE BOLT / TB PROPERTIES

▶ FLANGE FASTENERS & TB FORCES - #1

$d_1 := 3.290 \cdot in$ ***** adjust until d_1 is the same (Eq 1 = Eq 2)**

▶ FLANGE FASTENERS & TB FORCES - #2

$Find(d_1) = 3.290 \cdot in$ ***

$Eq1 := \Sigma A_{b\_TB} \cdot y'_{TB}$ $Eq1 = 43.3 \cdot in^3$

$Eq2 := b_{eff\_VP} \cdot d_1 \cdot \frac{d_1}{2}$ $Eq2 = 43.3 \cdot in^3$

▶ FLANGE FASTENERS & TB FORCES - #3

▶ FASTENER ALLOWABLE STRESS CALCS. & RESULTS

▶ TB BEARING - SHAFT

▶ BUILT-UP MEMBER CAPACITY

▶ SHAFT

▶ SHAFT TO FLANGE PLATE WELD

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

▶ FLANGE PLATE w/ STIFFENER PLATES

▶ STIFFENER PLATES

▶ EQUIVALENT SHAFT THICKNESS

Output - Results Summary:

- Flange Connection:

$$result_{Flange\_Bolts} := \begin{pmatrix} r_{t\_max} \\ r_v \\ r_{t\_v\_max} \end{pmatrix}$$

$$result_{Flange\_Bolts} = \begin{pmatrix} 46 \\ 1 \\ 46 \end{pmatrix} \cdot \%$$

$$result_{Flange\_Plate} := \left| \begin{array}{ll} r_b & \text{if } SPL = 0 \\ \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_{b\_xy} \end{pmatrix} & \text{otherwise} \end{array} \right.$$

$$result_{Flange\_Plate} = \begin{pmatrix} 4 \\ 62 \\ 62 \end{pmatrix} \cdot \%$$

$$result_{Stiffener\_Plates} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_V \\ r_{v\_H} \\ r_{t\_H} \\ r_H \end{pmatrix} & \text{otherwise} \end{array} \right.$$

$$result_{Stiffener\_Plates} = \begin{pmatrix} 92 \\ 76 \\ 38 \\ 85 \\ 74 \\ 67 \\ 99 \end{pmatrix} \cdot \%$$

$$result_{SP\_weld} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} & \text{otherwise} \end{array} \right.$$

$$result_{SP\_weld} = \begin{pmatrix} 49 \\ 24 \\ 55 \\ 64 \end{pmatrix} \cdot \%$$

$$result_{SP\_shaft} := \left| \begin{array}{ll} \text{"N/A"} & \text{if } SPL = 0 \\ r_{v\_PS} & \text{otherwise} \end{array} \right.$$

$$result_{SP\_shaft} = 32 \cdot \%$$

- Shaft:

$$result_{Bearing\_Shaft} := r_{p\_shaft}$$

$$result_{Bearing\_Shaft} = 75 \cdot \%$$

$$result_{Shaft} := \begin{pmatrix} r_{b\_shaft\_ab} \\ r_{a\_shaft\_ab} \\ r_{ab\_shaft\_H1\text{-}3} \end{pmatrix}$$

$$result_{Shaft} = \begin{pmatrix} 87 \\ 2 \\ 89 \end{pmatrix} \cdot \%$$

$$result_{Weld\_Shaft} := \begin{pmatrix} r_{w\_T} \\ r_{w\_V} \\ r_w \end{pmatrix}$$

$$result_{Weld\_Shaft} = \begin{pmatrix} 63 \\ 1 \\ 63 \end{pmatrix} \cdot \%$$

- Jump Kits:

$$result_{Termination\_Bolts} := \begin{pmatrix} r_{t\_TB} \\ r_{v\_max\_TB} \\ r_{t\_v\_max\_TB} \end{pmatrix}$$

$$result_{Termination\_Bolts} = \begin{pmatrix} 26 \\ 77 \\ 41 \end{pmatrix} \cdot \%$$

$$result_{JK} := \begin{pmatrix} r_{a\_JK} \\ r_{bx\_JK} \\ r_{t\_gross\_JK} \\ r_{t\_net\_JK} \\ r_{ab\_x\_JK\_H1\text{-}1} \\ r_{ab\_x\_JK\_H1\text{-}2} \\ r_{tb\_x\_JK\_H2\text{-}1} \end{pmatrix}$$

$$result_{JK} = \begin{pmatrix} 18 \\ 69 \\ 18 \\ 19 \\ 78 \\ 98 \\ 88 \end{pmatrix} \cdot \%$$

$$result_{JK\_weld} := \begin{pmatrix} r_{v\_w\_GP} \\ r_{t\_w\_GP} \\ r_{w\_GP} \end{pmatrix}$$

$$result_{JK\_weld} = \begin{pmatrix} 36 \\ 6 \\ 36 \end{pmatrix} \cdot \%$$

$b_{min\_VP} = 6.875 \cdot in$

Max_Utilization = 99·%

$t_{shaft\_ab\_MOD} = 0.7918 \cdot in$

$t_{shaft\_bl\_MOD} = 0.7918 \cdot in$

$CaAa_{JK} = 6.112 \cdot ft^2$

$M_{shaft} = 2101.49 \cdot kip \cdot ft$

vertical solutions
"execute & deliver"

FLANGE BOLT & FLANGE PLATE w/ JUMP KIT DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

20-ft

VSi Job No.: 141374
Date: 11/13/2014
Calculated by: MER

Input

$z := 20\cdot ft$ = centerline elevation of flange connection

- Wind Speed & Reactions:

$V_{fm} := 85\cdot mph$ = design wind speed

$M := 3450.67\cdot kip\cdot ft$ = moment reaction at top of flange plate

$P_t := 46.13\cdot kip$ = axial reaction at top of flange plate

$V_t := 34.30\cdot kip$ = shear reaction at top of flange plate

- Shaft:

$D_{o\_shaft\_ab} := 60\cdot in$ = outside diameter of shaft section above

$t_{shaft\_ab} := 0.5\cdot in$ = thickness of shaft section above

$D_{o\_shaft\_bl} := 60\cdot in$ = outside diameter of shaft section below

$t_{shaft\_bl} := 0.625\cdot in$ = thickness of shaft section below

$t_{w\_O} := 0.3125\cdot in$
Fillet
PJP
= outer shaft (above) weld type & size / effective throat

$t_{w\_I} := 0.3125\cdot in$
Fillet
PJP
= inner shaft (above) weld type & size / effective throat

$F_{EXX} := 70\cdot ksi$ = weld electrode

$F_{y\_shaft} := 42\cdot ksi$ = specified minimum yield stress of shaft material

$F_{u\_shaft} := 60\cdot ksi$ = specified minimum ultimate stress of shaft material

- Flange Connection:

- Bolts: ☐ ***Check if Upset Rod***

$BC_1 := 53\cdot in$ = outer bolt circle diameter (or if singe BC, input here)

$n_{b\_1} := 32$ = total number of bolts on BC_1

$BC_2 := 47\cdot in$ = inner fastener bolt circle diameter (or if singe BC, set to 0)

$n_{b\_2} := 32$ = total number of bolts on BC_2

$d_b := 1.25\cdot in$ = diameter of fasteners

A325
A490
A36
A193 Gr. B7
A307 Gr. A
A307 Gr. C
A354 Gr. BD

N
X

= grade of bolts & thread condition

- Flange Plate:

$t := 1.25\cdot in$ = thickness of flange plate

$D_{PL} := 60.375\cdot in$ = diameter of flange plate

$F_y := 36\cdot ksi$ = specified minimum yield stress of flange plate

- Stiffener Plates (ASSUMED - FIELD VERIFY): ☑ ***Check if Stiffener Plates***

$b_{SP} := 7.0\cdot in$ = width of stiffener plate

$t_{SP} := 0.5\cdot in$ = thickness of stiffener plate

$L_{SP} := 9.0\cdot in$ = length of stiffener plate

$clip := 0.5\cdot in$ = length of clip

$t_{VW} := 0.375\cdot in$ = thickness of vertical weld to shaft

$t_{HW} := 0.375\cdot in$ = thickness of horizontal weld to flange plate

$F_{y\_SP} := 36\cdot ksi$ = specified minimum yield stress of SP material

- Jump Kits:

$n_{JK} := 6$ = number of jump kits and/or reinforcing bars (3, 4 or 6)

- Reinforcing Bars:

$b_{bar} := 0\cdot in$ = width of reinforcing bar above flange (if applicable; set to 0 if no RB)

$t_{bar} := 0\cdot in$ = thickness of reinforcing bar above flange (if applicable; set to 0 if no RB)

- Termination Bolts: ☐ ***Check if Upset Rod***

$n_{b\_TB} := 6$ = number of termination bolts

$d_{b\_TB} := 1.125\cdot in$ = diameter of termination bolt

AJAX ONESIDE (PC 8.8)
AJAX ONESIDE (PC 10.9)
A325
A490
A36
A193 Gr. B7
A307 Gr. A

N
X

= grade of termination bolts / thread condition

$d_{hole\_TB} := 31\cdot mm$ = diameter of termination bolt hole

$s_{TB} := 3.0\cdot in$ = spacing of termination bolts

- Plate Properties:

$L := 24\cdot in$ = length between bottom/top termination bolts

$t_{VP} := 1.25\cdot in$ = thickness of vertical plate

$b_{VP} := 8.0\cdot in$ = width of vertical plate

$t_{GP} := 1.25\cdot in$ = thickness of gusset plate

$b_{GP} := 4.0\cdot in$ = width of gusset plate

$t_{FP} := 1.25\cdot in$ = thickness of filler plate (total thickness if multiple filler plates)

$t_{w\_GP} := 0.3125\cdot in$ = thickness of gusset plate to vertical plate weld

$F_{EXX\_GP} := 80\cdot ksi$ = gusset plate to vertical plate weld electrode

$F_{y\_bar} := 65\cdot ksi$ = specified minimum yield stress of JK bar material

$F_{u\_bar} := 80\cdot ksi$ = specified minimum ultimate stress of JK bar material

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$ASI \equiv \frac{4}{3}$ = allowable stress increase

$C_{mx} \equiv 0.85$ = coefficient for restrained compression member in plane of bending

$K \equiv 0.8$ = stiffener plate effective length factor

$K_{JK} \equiv 0.6$ = jump kit effective length factor

▶ JK WIND AREA

▶ BUILT-UP MEMBER PROPERTIES

▶ FLANGE BOLT / TB PROPERTIES

▶ FLANGE FASTENERS & TB FORCES - #1

$d_1 := 3.290 \cdot in$ ***** adjust until d_1 is the same (Eq 1 = Eq 2)**

▶ FLANGE FASTENERS & TB FORCES - #2

$\text{Find}(d_1) = 3.290 \cdot in$ ***

$Eq1 := \Sigma A_{b\_TB} \cdot y'_{TB}$ $Eq1 = 43.3 \cdot in^3$

$Eq2 := b_{eff\_VP} \cdot d_1 \cdot \frac{d_1}{2}$ $Eq2 = 43.3 \cdot in^3$

▶ FLANGE FASTENERS & TB FORCES - #3

▶ FASTENER ALLOWABLE STRESS CALCS. & RESULTS

▶ TB BEARING - SHAFT

▶ BUILT-UP MEMBER CAPACITY

▶ SHAFT

▶ SHAFT TO FLANGE PLATE WELD

▶ MOMENT ARM & EFFECTIVE BENDING WIDTH CALCS.

▶ FLANGE PLATE w/ STIFFENER PLATES

▶ STIFFENER PLATES

▶ EQUIVALENT SHAFT THICKNESS

Output - Results Summary:

- Flange Connection:

$$\mathrm{result}_{Flange\_Bolts} := \begin{pmatrix} r_{t\_max} \\ r_v \\ r_{t\_v\_max} \end{pmatrix} \qquad \mathrm{result}_{Flange\_Bolts} = \begin{pmatrix} 46 \\ 2 \\ 46 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{Flange\_Plate} := \left| \begin{array}{l} r_b \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_{b\_xy} \end{pmatrix} \ \text{ otherwise} \end{array} \right. \qquad \mathrm{result}_{Flange\_Plate} = \begin{pmatrix} 4 \\ 61 \\ 61 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{Stiffener\_Plates} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_V \\ r_{v\_H} \\ r_{t\_H} \\ r_H \end{pmatrix} \ \text{ otherwise} \end{array} \right. \qquad \mathrm{result}_{Stiffener\_Plates} = \begin{pmatrix} 92 \\ 76 \\ 37 \\ 85 \\ 73 \\ 66 \\ 99 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{SP\_weld} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} \ \text{ otherwise} \end{array} \right. \qquad \mathrm{result}_{SP\_weld} = \begin{pmatrix} 49 \\ 24 \\ 55 \\ 64 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{SP\_shaft} := \left| \begin{array}{l} \text{"N/A"} \ \text{ if } SPL = 0 \\ r_{v\_PS} \ \text{ otherwise} \end{array} \right. \qquad \mathrm{result}_{SP\_shaft} = 24 \cdot \%$$

- Shaft:

$$\mathrm{result}_{Bearing\_Shaft} := r_{p\_shaft} \qquad \mathrm{result}_{Bearing\_Shaft} = 56 \cdot \%$$

$$\mathrm{result}_{Shaft} := \begin{pmatrix} r_{b\_shaft\_ab} \\ r_{a\_shaft\_ab} \\ r_{ab\_shaft\_H1\text{-}3} \end{pmatrix} \qquad \mathrm{result}_{Shaft} = \begin{pmatrix} 61 \\ 2 \\ 63 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{Weld\_Shaft} := \begin{pmatrix} r_{w\_T} \\ r_{w\_V} \\ r_w \end{pmatrix} \qquad \mathrm{result}_{Weld\_Shaft} = \begin{pmatrix} 79 \\ 1 \\ 79 \end{pmatrix} \cdot \%$$

- Jump Kits:

$$result_{Termination\_Bolts} := \begin{pmatrix} r_{t\_TB} \\ r_{v\_max\_TB} \\ r_{t\_v\_max\_TB} \end{pmatrix}$$

$$result_{Termination\_Bolts} = \begin{pmatrix} 26 \\ 76 \\ 40 \end{pmatrix} \cdot \%$$

$$result_{JK} := \begin{pmatrix} r_{a\_JK} \\ r_{bx\_JK} \\ r_{t\_gross\_JK} \\ r_{t\_net\_JK} \\ r_{ab\_x\_JK\_H1-1} \\ r_{ab\_x\_JK\_H1-2} \\ r_{tb\_x\_JK\_H2-1} \end{pmatrix}$$

$$result_{JK} = \begin{pmatrix} 18 \\ 68 \\ 17 \\ 19 \\ 77 \\ 100 \\ 87 \end{pmatrix} \cdot \%$$

$$result_{JK\_weld} := \begin{pmatrix} r_{v\_w\_GP} \\ r_{t\_w\_GP} \\ r_{w\_GP} \end{pmatrix}$$

$$result_{JK\_weld} = \begin{pmatrix} 36 \\ 6 \\ 36 \end{pmatrix} \cdot \%$$

$Max\_Utilization = 100 \cdot \%$

$b_{min\_VP} = 6.875 \cdot in$

$t_{shaft\_ab\_MOD} = 1.3638 \cdot in$

$t_{shaft\_bl\_MOD} = 1.3638 \cdot in$

$CaAa_{JK} = 12.223 \cdot ft^2$

$M_{shaft} = 2086.58 \cdot kip \cdot ft$

ANCHOR ROD / FLANGE BOLT & BASE / FLANGE PLATE
w/ STIFFENER PLATES DESIGN
DEFORMATION METHOD
TIA/EIA-222-F & AISC 9th Ed.

0-ft (+)

VSi Job No.: 141374
Date: 11/14/2014
Calculated by: MER

Input

Design
[✓ Analysis]

- Reactions:

$M := 4168 \cdot kip \cdot ft$ = max moment reaction at top of base plate

$P_t := 56 \cdot kip$ = max axial reaction at top of base plate

$V_t := 37 \cdot kip$ = shear load at top of base / flange plate

- Shaft:

$D_{o\_shaft} := 60 \cdot in$ = thickness of shaft

$t_{shaft} := 0.625 \cdot in$ = thickness of shaft

$F_{y\_shaft} := 35 \cdot ksi$ = specified minimum yield stress of shaft

$t_{w\_O} := 0.5 \cdot in$ [✓ Fillet] PJP = outer shaft weld type & size / effective throat

$t_{w\_I} := 0.375 \cdot in$ [✓ Fillet] PJP = inner shaft weld type & size / effective throat

- Base Plate:

$t := 1.25 \cdot in$ = thickness of base plate

$F_y := 36 \cdot ksi$ = specified minimum yield stress of shaft

- Anchor Rods / Flange Bolts: ☐ ***Check if Upset Rod***

$D_{bc} := 67 \cdot in$ = fastener bolt circle diameter

$n_b := 52$ = total number of fasteners

$d_b := 1.25 \cdot in$ = diameter of fasteners

A572 Gr. 50
A572 Gr. 55
A572 Gr. 60
A572 Gr. 65
A588
[✓ A687]
F1554 Gr. 36

[✓ N]
X

= grade of fastener & thread condition

- Stiffener Plates (single SP spaced evenly between fasteners) (ASSUMED - FIELD VERIFY):

$b_{SP} := 4.75 \cdot in$ = width of stiffener plate

$t_{SP} := (0.5 \cdot in) + 2 \cdot (0.25 \cdot in)$ = thickness of stiffener plate

$L_{SP} := 6.5 \cdot in$ = length of stiffener plate

$clip := 0.5 \cdot in$ = length of clip

$t_{VW} := 0.375 \cdot in$ = thickness of vertical weld

$t_{HW} := 0.375 \cdot in$ = thickness of vertical weld

$F_{y\_SP} := 36 \cdot ksi$ = specified minimum yield stress of SP material

$F_{EXX} := 70 \cdot ksi$ = specified minimum ultimate stress of weld electrode

- Constants:

$E \equiv 29000 \cdot ksi$ = steel modulus of elasticity

$K \equiv 0.8$ = stiffener plate effective length factor

$ASI \equiv \frac{4}{3}$ = allowable stress increase

Output - Anchor Rods / Flange Bolts:

$F_{yb} = 105 \cdot ksi$

$F_{ub} = 150 \cdot ksi$

- Properties:

$$A_b := \frac{\pi \cdot d_b^{\,2}}{4} \qquad A_b = 1.227 \cdot in^2$$

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

$$A_{stiff} := A_b \qquad A_{stiff} = 1.227 \cdot in^2$$

$$A_{stress} := \left| \begin{array}{ll} A_b & \text{if } Upset = 0 \\ A_n & \text{otherwise} \end{array} \right. \qquad A_{stress} = 1.227 \cdot in^2$$

- Forces:

$$i := 0 .. \left(n_b - 1\right)$$

$$\theta_i := 2 \cdot \pi \cdot \left(\frac{i}{n_b}\right)$$

$$d' := \frac{D_{bc}}{2} \cdot \cos(\theta)$$

$$d_i := \left| d'_i \right|$$

$$P := \frac{M \cdot d}{\sum \overrightarrow{\left(d^2\right)}} + \frac{P_t}{n_b}$$

$$f_t := \overrightarrow{\left(\frac{P}{A_{stress}}\right)}$$

$$f_{t\_max} := \max\left(f_t\right) \qquad f_{t\_max} = 47.7 \cdot ksi$$

$$V := \frac{V_t}{n_b} \qquad V = 0.71 \cdot kip$$

$$f_v := \frac{V}{A_b} \qquad f_v = 0.58 \cdot ksi$$

▶ ALLOWABLE STRESS CALCS.

- Allowable Tensile Stress [J3.4AISC]:

$F_t = 49.5 \cdot ksi$

$F'_t = 66.0 \cdot ksi$

- Allowable Shear Stress [J3.4, AISC]:

$F_v = 25.5 \cdot ksi$

$F'_v = 34.0 \cdot ksi$

- Allowable Combined Tension & Shear Stress [J3.5, AISC]:

$F_{t\_v} = 49.5 \cdot ksi$

$F'_{t\_v} = 66.0 \cdot ksi$

- Results:

$$r_t := \overrightarrow{\left(\frac{f_t}{F'_t}\right)}$$

$r_{t\_max} := \max(r_t)$ $\qquad$ $r_{t\_max} = 72 \cdot \%$

$r_v := \dfrac{f_v}{F'_v}$ $\qquad$ $r_v = 2 \cdot \%$

$$r_{t\_v} := \overrightarrow{\left(\frac{f_t}{F'_{t\_v}}\right)}$$

$r_{t\_v\_max} := \max(r_{t\_v})$ $\qquad$ $r_{t\_v\_max} = 72 \cdot \%$

Output - Base / Flange Plate:

- Max Fastener Force:

$$P_{max} := \left| \begin{array}{l} \max\left[1.054449 \cdot \overrightarrow{\left(F_t \cdot A_{stress}\right)} \cdot ASI\right] \;\; \text{if } Case = \text{"Design"} \\ \max(P) \;\; \text{if } Case = \text{"Analysis"} \end{array} \right.$$

$P_{max} = 58.5 \cdot kip$

- Plate Properties:

$s_{SP} := \left(\dfrac{D_{bc}}{2}\right) \cdot \left(\dfrac{360 \cdot deg}{n_b}\right)$ $\qquad$ $s_{SP} = 4.048 \cdot in$

$a := \dfrac{s_{SP}}{2}$ $\qquad$ $a = 2.024 \cdot in$

$b := a$ $\qquad$ $b = 2.024 \cdot in$

$$m_i := \left| \begin{array}{l} d'_i - \dfrac{D_{o\_shaft}}{2} \;\; \text{if } d'_i > \dfrac{D_{o\_shaft}}{2} \\ 0 \;\; \text{otherwise} \end{array} \right.$$

$y := \max(m)$ $\qquad$ $y = 3.50 \cdot in$

$k := b_{SP} - y$ $\qquad$ $k = 1.250 \cdot in$

$I_x := \frac{s_{SP} \cdot t^3}{12}$ $I_x = 0.66 \cdot in^4$

$k_x := \frac{3 \cdot I_x}{y^3}$ $k_x = 0.05 \cdot in$

$S_x := \frac{I_x}{\left(\frac{t}{2}\right)}$ $S_x = 1.05 \cdot in^3$

$I_y := \frac{(y + k) \cdot t^3}{12}$ $I_y = 0.77 \cdot in^4$

$k_y := \frac{3 \cdot I_y \cdot (3 \cdot a + b)^2}{2 \cdot a^3 \cdot b^2}$ $k_y = 2.24 \cdot in$

$S_y := \frac{I_y}{\left(\frac{t}{2}\right)}$ $S_y = 1.24 \cdot in^3$

- Max Plate Flexural Stresses:

$M_{x\_max} := \left(\frac{k_x}{k_x + k_y}\right) \cdot \left(P_{max} \cdot y\right)$ $M_{x\_max} = 4.1 \cdot kip \cdot in$

$f_{b\_x} := \frac{M_{x\_max}}{S_x}$ $f_{b\_x} = 3.9 \cdot ksi$

$M_{y\_max} := \frac{k_y}{k_x + k_y} \cdot \left[\frac{P_{max} \cdot a \cdot b^2}{(a + b)^2}\right]$ $M_{y\_max} = 29.0 \cdot kip \cdot in$

$f_{b\_y} := \frac{M_{y\_max}}{S_y}$ $f_{b\_y} = 23.4 \cdot ksi$

- Allowable Bending Stress [F2.1, AISC]:

$F_b := 0.75 \cdot F_y$ $F_b = 27.0 \cdot ksi$

$F'_b := ASI \cdot F_b$ $F'_b = 36.0 \cdot ksi$

- Result:

$r_{b\_x} := \frac{f_{b\_x}}{F'_b}$ $r_{b\_x} = 11 \cdot \%$

$r_{b\_y} := \frac{f_{b\_y}}{F'_b}$ $r_{b\_y} = 65 \cdot \%$

$r_b := \sqrt{{r_{b\_x}}^2 + {r_{b\_y}}^2}$ $r_b = 66 \cdot \%$

Output - Calculate Forces in SP's:

$$P_{max\_shaft} := \left(\frac{k_x}{k_x + k_y}\right) \cdot P_{max}$$ $$P_{max\_shaft} = 1.2 \cdot kip$$

$$P_{max\_SP} := \left(\frac{k_y}{k_x + k_y}\right) \cdot P_{max}$$ $$P_{max\_SP} = 57.3 \cdot kip$$

Output - Calculate SP Section Properties:

$$L_{VW} := L_{SP} - clip$$ $$L_{VW} = 6.00 \cdot in$$

$$L_{HW} := b_{SP} - clip$$ $$L_{HW} = 4.25 \cdot in$$

$$\theta := atan\left(\frac{b_{SP}}{L_{SP}}\right)$$ $$\theta = 36.16 \cdot deg$$

$$B := L_{SP} \cdot \sin(\theta)$$ $$B = 3.84 \cdot in$$

$$N_B := \frac{clip}{(\sin(\theta) + \cos(\theta))}$$ $$N_B = 0.358 \cdot in$$

$$N := \frac{N_B}{B}$$ $$N = 0.093$$

$$L := \sqrt{L_{SP}^2 + b_{SP}^2}$$ $$L = 8.05 \cdot in$$

$$r := \frac{t_{SP}}{\sqrt{12}}$$ $$r = 0.289 \cdot in$$

$$x := \frac{b_{SP}}{2}$$ $$x = 2.38 \cdot in$$

Output - Calculate Compressive Strength of SP:

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_{y\_SP}}}$$ $$C_c = 126.1$$

$$KLr := \frac{K \cdot L}{r}$$ $$KLr = 22.3$$

$$F_{cr\_B} := \left\| \begin{array}{l} \left[\dfrac{\left[1 - \dfrac{(KLr)^2}{2 \cdot C_c^{\,2}}\right] \cdot F_{y\_SP}}{\dfrac{5}{3} + \dfrac{3}{8} \cdot \left(\dfrac{KLr}{C_c}\right) - \dfrac{(KLr)^3}{8 \cdot C_c^{\,3}}}\right] \text{ if } KLr < C_c \\ \left[\dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot (KLr)^2}\right] \text{ if } KLr \ge C_c \end{array} \right.$$ $$F_{cr\_B} = 20.5 \cdot ksi$$

$$\Delta F_{cr} := F_{y\_SP} - F_{cr\_B}$$ $$\Delta F_{cr} = 15.5 \cdot ksi$$

$$P'_{all\_SP} := \left[\frac{t_{SP} \cdot B^2}{6 \cdot x} \cdot \left[3 \cdot F_{y\_SP} \cdot \left(1 - N^2\right) - 2 \cdot \left(\Delta F_{cr}\right) \cdot \left(1 - N^3\right)\right]\right] \cdot ASI$$ $$P'_{all\_SP} = 104.6 \cdot kip$$

$$r_{cSP} := \frac{P_{max\_SP}}{P'_{all\_SP}}$$ $$r_{cSP} = 55 \cdot \%$$

Output - Calculate Shear and Tensile Strength of SP:

- Calculate Forces in SP:

$h_V := \text{clip} + \frac{L_{VW}}{2}$ $h_V = 3.50 \cdot \text{in}$

$V_{max\_V} := P_{max\_SP}$ = shear on Vertical leg $V_{max\_V} = 57.3 \cdot \text{kip}$

$T_{max\_V} := \frac{P_{max\_SP} \cdot x}{h_V}$ = max tension on Vertical leg $T_{max\_V} = 38.9 \cdot \text{kip}$

$V_{max\_H} := \frac{P_{max\_SP} \cdot x}{h_V}$ = shear on Horizontal leg $V_{max\_H} = 38.9 \cdot \text{kip}$

$T_{max\_H} := P_{max\_SP}$ = tension on Horizontal leg $T_{max\_H} = 57.3 \cdot \text{kip}$

- Shear Strength of *Vertical* Leg of SP:

$V'_{all\_V} := \left[\left(0.4 \cdot F_{y\_SP}\right) \cdot \left(L_{VW} \cdot t_{SP}\right)\right] \cdot ASI$ $V'_{all\_V} = 115.2 \cdot \text{kip}$

$r_{v\_V} := \frac{V_{max\_V}}{V'_{all\_V}}$ $r_{v\_V} = 50 \cdot \%$

- Tensile Strength of *Vertical* Leg of SP:

$T_{all\_V} := \left[\left(0.6 \cdot F_{y\_SP}\right) \cdot \left(L_{VW} \cdot t_{SP}\right)\right] \cdot ASI$ $T_{all\_V} = 172.8 \cdot \text{kip}$

$r_{t\_V} := \frac{T_{max\_V}}{T_{all\_V}}$ $r_{t\_V} = 23 \cdot \%$

- Combined Tension & Shear Strength of *Vertical* Leg of SP:

$r_V := \sqrt{\left(\frac{T_{max\_V}}{T_{all\_V}}\right)^2 + \left(\frac{V_{max\_V}}{V'_{all\_V}}\right)^2}$ $r_V = 55 \cdot \%$

- Shear Strength of *Horizontal* Leg of SP:

$V'_{all\_H} := \left[\left(0.4 \cdot F_{y\_SP}\right) \cdot \left(L_{HW} \cdot t_{SP}\right)\right] \cdot ASI$ $V'_{all\_H} = 81.6 \cdot \text{kip}$

$r_{v\_H} := \frac{V_{max\_H}}{V'_{all\_H}}$ $r_{v\_H} = 48 \cdot \%$

- Tensile Strength of *Horizontal* Leg of SP:

$T'_{all\_H} := \left[\left(0.6 \cdot F_{y\_SP}\right) \cdot \left(L_{HW} \cdot t_{SP}\right)\right] \cdot ASI$ T'_{all_H}

$r_{t\_H} := \frac{T_{max\_H}}{T'_{all\_H}}$ $r_{t\_H} = 47 \cdot \%$

- Combined Tension & Shear Strength of *Horizontal* Leg of SP:

$r_H := \sqrt{\left(\frac{T_{max\_H}}{T'_{all\_H}}\right)^2 + \left(\frac{V_{max\_H}}{V'_{all\_H}}\right)^2}$ $r_H = 67 \cdot \%$

Output - Check Shear and Tensile Strength of SP Welds:

$\theta_v \equiv 0 \cdot deg$

$F_{w\_v} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_v)^{1.5}\right)$ $F_{w\_v} = 21.0 \cdot ksi$

$\theta_t \equiv 90 \cdot deg$

$F_{w\_t} := 0.30 \cdot F_{EXX} \cdot \left(1.0 + 0.50 \cdot \sin(\theta_t)^{1.5}\right)$ $F_{w\_t} = 31.5 \cdot ksi$

- Shear Strength of *Vertical Weld*:

$A_{w\_V} := (0.707 \cdot t_{VW}) \cdot L_{VW}$ $A_{w\_V} = 1.59 \cdot in^2$

$V'_{all\_Vw} := \left[2 \cdot \left(F_{w\_v} \cdot A_{w\_V}\right)\right] \cdot ASI$ $V'_{all\_Vw} = 89 \cdot kip$

$r_{v\_Vw} := \dfrac{V_{max\_V}}{V'_{all\_Vw}}$ $r_{v\_Vw} = 64 \cdot \%$

- Tensile Strength of *Vertical Weld*:

$T'_{all\_Vw} := \left[2 \cdot \left(F_{w\_t} \cdot A_{w\_V}\right)\right] \cdot ASI$ $T'_{all\_Vw} = 134 \cdot kip$

$r_{t\_Vw} := \dfrac{T_{max\_V}}{T'_{all\_Vw}}$ $r_{t\_Vw} = 29 \cdot \%$

- Combined Tension & Shear Strength of *Vertical Weld*:

$r_{Vw} := \sqrt{\left(\dfrac{T_{max\_V}}{T'_{all\_Vw}}\right)^2 + \left(\dfrac{V_{max\_V}}{V'_{all\_Vw}}\right)^2}$ $r_{Vw} = 71 \cdot \%$

- Shear Strength of *Horizontal Weld*:

$A_{w\_H} := (0.707 \cdot t_{HW}) \cdot L_{HW}$ $A_{w\_H} = 1.13 \cdot in^2$

$V'_{all\_Hw} := \left[2 \cdot \left(F_{w\_v} \cdot A_{w\_H}\right)\right] \cdot ASI$ $V'_{all\_Hw} = 63 \cdot kip$

$r_{v\_Hw} := \dfrac{V_{max\_H}}{V'_{all\_Hw}}$ $r_{v\_Hw} = 62 \cdot \%$

- Tensile Strength of *Horizontal Weld*:

$T'_{all\_Hw} := \left[2 \cdot \left(F_{w\_t} \cdot A_{w\_H}\right)\right] \cdot ASI$ $T'_{all\_Hw} = 95 \cdot kip$

$r_{t\_Hw} := \dfrac{T_{max\_H}}{T'_{all\_Hw}}$ $r_{t\_Hw} = 61 \cdot \%$

- Combined Tension & Shear Strength of *Horizontal Weld*:

$r_{Hw} := \sqrt{\left(\dfrac{T_{max\_H}}{T'_{all\_Hw}}\right)^2 + \left(\dfrac{V_{max\_H}}{V'_{all\_Hw}}\right)^2}$ $r_{Hw} = 86 \cdot \%$

Output - Check Design Shaft Punching Shear:

$V_{max\_PS} := T_{max\_V}$ $\qquad V_{max\_PS} = 38.9 \cdot kip$

$V'_{all} := 2 \cdot \left[\left(0.4 \cdot F_{y\_shaft}\right) \cdot \left(t_{shaft} \cdot L_{VW}\right)\right] \cdot ASI$ $\qquad V'_{all} = 140.0 \cdot kip$

$r_{v\_PS} := \frac{V_{max\_PS}}{V'_{all}}$ $\qquad r_{v\_PS} = 28 \cdot \%$

Output - Shaft to Base / Flange Plate Weld:

- Properties:

$R_{w\_O} := \frac{D_{o\_shaft} + \frac{t_{w\_O}}{3}}{2}$ $\qquad R_{w\_O} = 30.083 \cdot in$

$R_{w\_I} := \frac{D_{o\_shaft} - \left(t_{shaft} + \frac{t_{w\_I}}{3}\right)}{2}$ $\qquad R_{w\_I} = 29.625 \cdot in$

$L_{w\_O} := 2 \cdot \pi \cdot R_{w\_O}$ $\qquad L_{w\_O} = 189.0 \cdot in$

$L_{w\_I} := 2 \cdot \pi \cdot R_{w\_I}$ $\qquad L_{w\_I} = 186.1 \cdot in$

$L_w := L_{w\_O} + L_{w\_I}$ $\qquad L_w = 375.2 \cdot in$

$A_{w\_O} := \left| \begin{array}{l} \left(0.707 \cdot t_{w\_O}\right) \cdot L_{w\_O} \text{ if Weld\_Outer = "Fillet"} \\ t_{w\_O} \cdot L_{w\_O} \text{ if Weld\_Outer = "PJP"} \end{array} \right.$ $\qquad A_{w\_O} = 66.8 \cdot in^2$

$A_{w\_I} := \left| \begin{array}{l} \left(0.707 \cdot t_{w\_I}\right) \cdot L_{w\_I} \text{ if Weld\_Inner = "Fillet"} \\ t_{w\_I} \cdot L_{w\_I} \text{ if Weld\_Inner = "PJP"} \end{array} \right.$ $\qquad A_{w\_I} = 49.4 \cdot in^2$

$A_w := A_{w\_O} + A_{w\_I}$ $\qquad A_w = 116.2 \cdot in^2$

$I_{w\_O} := \pi \cdot R_{w\_O}^{\ 3}$ $\qquad I_{w\_O} = 85532 \cdot in^3$

$I_{w\_I} := \pi \cdot R_{w\_I}^{\ 3}$ $\qquad I_{w\_I} = 81682 \cdot in^3$

$I_w := I_{w\_O} + I_{w\_I}$ $\qquad I_w = 167214 \cdot in^3$

- Tension Force per Unit Length:

$T_{w\_IN} := -\frac{P_t}{L_w} + \frac{M \cdot R_{w\_O}}{I_w}$ $\qquad T_{w\_IN} = 8.849 \cdot \frac{kip}{in}$

$T_w := T_{w\_IN} \cdot L_w$ $\qquad T_w = 3319.8 \cdot kip$

- Allowable Tension Weld Force & Result:

$T_{all\_w} := F_{w\_t} \cdot A_w$ $\qquad T_{all\_w} = 3659.3 \cdot kip$

$T'_{all\_w} := T_{all\_w} \cdot ASI$ $\qquad T'_{all\_w} = 4879.1 \cdot kip$

$r_{w\_T} := \frac{T_w}{T'_{all\_w}}$ $\qquad r_{w\_T} = 68 \cdot \%$

- Allowable Shear Weld Force & Result:

$$V_{all\_w} := F_{w\_v} \cdot A_w \qquad V_{all\_w} = 2439.5 \cdot kip$$

$$V'_{all\_w} := V_{all\_w} \cdot ASI \qquad V'_{all\_w} = 3252.7 \cdot kip$$

$$r_{w\_V} := \frac{V_t}{V'_{all\_w}} \qquad r_{w\_V} = 1 \cdot \%$$

- Combined Result:

$$r_w := \sqrt{\left(\frac{T_w}{T'_{all\_w}}\right)^2 + \left(\frac{V_t}{V'_{all\_w}}\right)^2} \qquad r_w = 68 \cdot \%$$

Output - Results Summary:

- Anchor Rods & Base Plate:

$$result_{Fastener} := \begin{pmatrix} r_{t\_max} \\ r_v \\ r_{t\_v\_max} \end{pmatrix} \qquad result_{Fastener} = \begin{pmatrix} 72 \\ 2 \\ 72 \end{pmatrix} \cdot \%$$

$$result_{PL} := \begin{pmatrix} r_{b\_x} \\ r_{b\_y} \\ r_b \end{pmatrix} \qquad result_{PL} = \begin{pmatrix} 11 \\ 65 \\ 66 \end{pmatrix} \cdot \%$$

$$Max\_Utilization_{Fastener\_PL} := \max\left(result_{Fastener}, result_{PL}\right) \qquad Max\_Utilization_{Fastener\_PL} = 72 \cdot \%$$

- Stiffener Plate:

$$result_{SP} := \begin{pmatrix} r_{cSP} \\ r_{v\_V} \\ r_{t\_V} \\ r_V \\ r_{v\_H} \\ r_{t\_H} \\ r_H \end{pmatrix} \qquad result_{SP} = \begin{pmatrix} 55 \\ 50 \\ 23 \\ 55 \\ 48 \\ 47 \\ 67 \end{pmatrix} \cdot \%$$

$$result_{SP\_weld} := \begin{pmatrix} r_{v\_Vw} \\ r_{t\_Vw} \\ r_{Vw} \\ r_{Hw} \end{pmatrix} \qquad result_{SP\_weld} = \begin{pmatrix} 64 \\ 29 \\ 71 \\ 86 \end{pmatrix} \cdot \%$$

$$Max\_Utilization_{SP} := \max\left(result_{SP}, result_{SP\_weld}\right) \qquad Max\_Utilization_{SP} = 86 \cdot \%$$

- Shaft:

$\text{result}_{\text{shaft}} := r_{\text{v\_PS}}$ $\text{result}_{\text{shaft}} = 28 \cdot \%$

$\text{result}_{\text{shaft\_weld}} := \begin{pmatrix} r_{\text{w\_T}} \\ r_{\text{w\_V}} \\ r_{\text{w}} \end{pmatrix}$ $\text{result}_{\text{shaft\_weld}} = \begin{pmatrix} 68 \\ 1 \\ 68 \end{pmatrix} \cdot \%$

$\text{Max\_Utilization}_{\text{Shaft}} := \max\left(\text{result}_{\text{shaft}}, \text{result}_{\text{shaft\_weld}}\right)$ $\text{Max\_Utilization}_{\text{Shaft}} = 68 \cdot \%$

$\text{Max}_{\text{Utilization}} := \max\left(\text{Max\_Utilization}_{\text{Fastener\_PL}}, \text{Max\_Utilization}_{\text{SP}}, \text{Max\_Utilization}_{\text{Shaft}}\right)$ $\text{Max}_{\text{Utilization}} = 86 \cdot \%$

```
================================================================================
                  LPile Plus for Windows, Version 2013-07.007

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        L:\2014\1374_Vernon 2_CT\Task 1\Models\LPile\
Name of input data file:       PIER.lp7d
Name of output report file:    PIER.lp7o
Name of plot output file:      PIER.lp7p
Name of runtime messeage file: PIER.lp7r


--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  November 14, 2014     Time:   9:28:20


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: Vernon 2, CT (VZ5-177)


Job Number: 141374.01, Revision 0


Client: URS


Engineer: MER


Description: PIER



--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute nonlinear bending properties of pile only
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected
```

```
Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


--------------------------------------------------------------------------------
                   Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Total number of pile sections                              =          1

Total length of pile                                       =       7.50 ft

Depth of ground surface below top of pile                  =       0.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth             Pile
                X             Diameter
               ft                in
-----       ---------        -----------
  1          0.00000         84.0000000
  2         7.500000         84.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                            = Drilled Shaft (Bored Pile)
   Section Length                                          =      7.50000 ft
   Section Diameter                                        =     84.00000 in


--------------------------------------------------------------------------------
    Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:
-------------------

Dimensions and Properties of Drilled Shaft (Bored Pile):
--------------------------------------------------------

Length of Section                                          =      7.50000 ft
Shaft Diameter                                             =     84.00000 in
Concrete Cover Thickness                                   =      3.50000 in
Number of Reinforcing Bars                                 =           34 bars
Yield Stress of Reinforcing Bars                           =       60000. psi
Modulus of Elasticity of Reinforcing Bars                  =    29000000. psi
Gross Area of Shaft                                        =   5541.76944 sq. in.
Total Area of Reinforcing Steel                            =     34.00000 sq. in.
Area Ratio of Steel Reinforcement                          =         0.61 percent
Edge-to-Edge Bar Spacing                                   =      5.87258 in
Maximum Concrete Aggregate Size                            =      0.75000 in
Ratio of Bar Spacing to Aggregate Size                     =         7.83
Offset of Center of Rebar Cage from Center of Pile         =       0.0000 in

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As        =    16084.812 kips
Tensile Load for Cracking of Concrete                      =    -2108.269 kips
Nominal Axial Tensile Capacity                             =    -2040.000 kips


Reinforcing Bar Dimensions and Positions Used in Computations:

     Bar          Bar Diam.      Bar Area         X              Y
    Number         inches        sq. in.        inches         inches
  ----------    ----------    ----------    ----------    ----------
      1            1.12800       1.00000      37.93600       0.00000
      2            1.12800       1.00000      37.29007       6.97072
      3            1.12800       1.00000      35.37427      13.70406
      4            1.12800       1.00000      32.25384      19.97073
      5            1.12800       1.00000      28.03504      25.55732
      6            1.12800       1.00000      22.86155      30.27358
```

```
      7           1.12800        1.00000       16.90953       33.95891
      8           1.12800        1.00000       10.38168       36.48782
      9           1.12800        1.00000        3.50029       37.77417
     10           1.12800        1.00000       -3.50029       37.77417
     11           1.12800        1.00000      -10.38168       36.48782
     12           1.12800        1.00000      -16.90953       33.95891
     13           1.12800        1.00000      -22.86155       30.27358
     14           1.12800        1.00000      -28.03504       25.55732
     15           1.12800        1.00000      -32.25384       19.97073
     16           1.12800        1.00000      -35.37427       13.70406
     17           1.12800        1.00000      -37.29007        6.97072
     18           1.12800        1.00000      -37.93600        0.00000
     19           1.12800        1.00000      -37.29007       -6.97072
     20           1.12800        1.00000      -35.37427      -13.70406
     21           1.12800        1.00000      -32.25384      -19.97073
     22           1.12800        1.00000      -28.03504      -25.55732
     23           1.12800        1.00000      -22.86155      -30.27358
     24           1.12800        1.00000      -16.90953      -33.95891
     25           1.12800        1.00000      -10.38168      -36.48782
     26           1.12800        1.00000       -3.50029      -37.77417
     27           1.12800        1.00000        3.50029      -37.77417
     28           1.12800        1.00000       10.38168      -36.48782
     29           1.12800        1.00000       16.90953      -33.95891
     30           1.12800        1.00000       22.86155      -30.27358
     31           1.12800        1.00000       28.03504      -25.55732
     32           1.12800        1.00000       32.25384      -19.97073
     33           1.12800        1.00000       35.37427      -13.70406
     34           1.12800        1.00000       37.29007       -6.97072

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero =      5.87258 inches between Bars 32 and 33

Spacing to aggregate size ratio =      7.83011


Concrete Properties:
--------------------

Compressive Strength of Concrete                          =   3000.00000 psi
Modulus of Elasticity of Concrete                         =     3122019. psi
Modulus of Rupture of Concrete                            =   -410.79191 psi
Compression Strain at Peak Stress                         =      0.00163
Tensile Strain at Fracture of Concrete                    =   -0.0001160
Maximum Coarse Aggregate Size                             =      0.75000 in


Input Axial Thrust Forces:
--------------------------

Number of Axial Thrust Force Values Determined from Input Data = 1

   Number    Axial Thrust Force
                   kips
   ------    ------------------
      1            56.000


Definitions of Run Messages and Notes:
--------------------------------------

   C = concrete in section has cracked in tension.
   Y = stress in reinforcing steel has reached yield stress.
   T = ACI 318-08 criteria for tension-controlled section met, tensile strain in
       reinforcement exceeds 0.005 while simultaneously compressive strain in
       concrete more than 0.003. See ACI 318-08, Section 10.3.4.
   Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.


Axial Thrust Force =     56.000 kips

    Bending       Bending        Bending        Depth to      Max Comp      Max Tens     Max Concrete   Max Steel    Run
   Curvature      Moment        Stiffness        N Axis        Strain        Strain        Stress        Stress     Msg
    rad/in.       in-kip         kip-in2           in           in/in         in/in          ksi           ksi
 ------------- ------------- ------------- ------------- ------------- ------------- ------------- ------------- ---
   0.000000313 2990.7060557   9570259378.    50.4745874     0.0000158    -0.0000105     0.0571776     0.4536197
   0.000000625 5967.0310529   9547249685.    46.2509958     0.0000289    -0.0000236     0.1042873     0.8306868
   0.000000938 8928.2255557   9523440593.    44.8432543     0.0000420    -0.0000367     0.1510172     1.2077572
   0.000001250        11874.   9499428409.    44.1394408     0.0000552    -0.0000498     0.1973673     1.5848297
   0.000001563        14805.   9475334682.    43.7171935     0.0000683    -0.0000629     0.2433375     1.9619041
   0.000001875        17721.   9451200100.    43.4357278     0.0000814    -0.0000761     0.2889277     2.3389802
   0.000002188        20622.   9427042170.    43.2347089     0.0000946    -0.0000892     0.3341380     2.7160581
```

```
0.000002500      23507.  9402869633.  43.0839690  0.0001077  -0.0001023  0.3789684    3.0931377
0.000002813      26378.  9378687351.  42.9667484  0.0001208  -0.0001154  0.4234189    3.4702191
0.000003125      26378.  8440818616.  22.0358821  0.0000689  -0.0001936  0.2429775   -5.5774357  C
0.000003438      26378.  7673471469.  21.7239480  0.0000747  -0.0002141  0.2629504   -6.1662752  C
0.000003750      26378.  7034015513.  21.4648622  0.0000805  -0.0002345  0.2828620   -6.7550212  C
0.000004063      26378.  6492937397.  21.2384077  0.0000863  -0.0002550  0.3025986   -7.3446188  C
0.000004375      26378.  6029156154.  21.0432807  0.0000921  -0.0002754  0.3222477   -7.9343463  C
0.000004688      26378.  5627212411.  20.8748746  0.0000979  -0.0002959  0.3418364   -8.5239780  C
0.000005000      26378.  5275511635.  20.7281811  0.0001036  -0.0003164  0.3613646   -9.1135137  C
0.000005313      26378.  4965187421.  20.5993704  0.0001094  -0.0003368  0.3808322   -9.7029532  C
0.000005625      26378.  4689343676.  20.4808778  0.0001152  -0.0003573  0.4001509  -10.2930443  C
0.000005938      26378.  4442536114.  20.3745953  0.0001210  -0.0003778  0.4193928  -10.8831806  C
0.000006250      26378.  4220409308.  20.2794908  0.0001267  -0.0003983  0.4385748  -11.4732173  C
0.000006563      26378.  4019437436.  20.1939691  0.0001325  -0.0004187  0.4576970  -12.0631540  C
0.000006875      26378.  3836735735.  20.1167248  0.0001383  -0.0004392  0.4767591  -12.6529905  C
0.000007188      26378.  3669921137.  20.0466799  0.0001441  -0.0004597  0.4957612  -13.2427264  C
0.000007500      26378.  3517007757.  19.9829358  0.0001499  -0.0004801  0.5147030  -13.8323614  C
0.000007813      26378.  3376327446.  19.9247378  0.0001557  -0.0005006  0.5335846  -14.4218953  C
0.000008125      26378.  3246468699.  19.8714473  0.0001615  -0.0005210  0.5524058  -15.0113277  C
0.000008438      26378.  3126229117.  19.8225203  0.0001673  -0.0005415  0.5711665  -15.6006583  C
0.000008750      26378.  3014578077.  19.7774905  0.0001731  -0.0005619  0.5898666  -16.1898868  C
0.000009063      26378.  2910627109.  19.7357505  0.0001789  -0.0005824  0.6084999  -16.7790668  C
0.000009375      26378.  2813606205.  19.6954096  0.0001846  -0.0006029  0.6270185  -17.3686230  C
0.000009688      26378.  2722844715.  19.6580524  0.0001904  -0.0006233  0.6454772  -17.9580721  C
  0.0000100      26378.  2637755818.  19.6234003  0.0001962  -0.0006438  0.6638758  -18.5474139  C
  0.0000103      26378.  2557823823.  19.5912086  0.0002020  -0.0006642  0.6822142  -19.1366479  C
  0.0000106      26378.  2482593711.  19.5612614  0.0002078  -0.0006847  0.7004924  -19.7257738  C
  0.0000109      26378.  2411662462.  19.5333675  0.0002136  -0.0007051  0.7187102  -20.3147912  C
  0.0000113      26378.  2344671838.  19.5073567  0.0002195  -0.0007255  0.7368675  -20.9036998  C
  0.0000116      26378.  2281302329.  19.4830776  0.0002253  -0.0007460  0.7549642  -21.4924992  C
  0.0000119      26378.  2221268057.  19.4603945  0.0002311  -0.0007664  0.7730002  -22.0811891  C
  0.0000122      26378.  2164312466.  19.4391857  0.0002369  -0.0007868  0.7909754  -22.6697690  C
  0.0000128      26378.  2058736248.  19.4007634  0.0002486  -0.0008277  0.8267431  -23.8465976  C
  0.0000134      26378.  1962981074.  19.3670551  0.0002602  -0.0008685  0.8622663  -25.0229819  C
  0.0000141      26378.  1875737470.  19.3374399  0.0002719  -0.0009093  0.8975442  -26.1989190  C
  0.0000147      26378.  1795918855.  19.3114025  0.0002836  -0.0009501  0.9325760  -27.3744057  C
  0.0000153      26378.  1722616044.  19.2885117  0.0002954  -0.0009909  0.9673607  -28.5494390  C
  0.0000159      26378.  1655062474.  19.2684042  0.0003071  -0.0010317  1.0018975  -29.7240156  C
  0.0000166      26378.  1592607286.  19.2507716  0.0003188  -0.0010724  1.0361855  -30.8981325  C
  0.0000172      27108.  1577194636.  19.2353504  0.0003306  -0.0011131  1.0702238  -32.0717862  C
  0.0000178      28034.  1573820994.  19.2219142  0.0003424  -0.0011539  1.1040114  -33.2449741  C
  0.0000184      28958.  1570629525.  19.2102673  0.0003542  -0.0011946  1.1375475  -34.4176917  C
  0.0000191      29882.  1567601941.  19.2002399  0.0003660  -0.0012352  1.1708312  -35.5899364  C
  0.0000197      30805.  1564722362.  19.1916836  0.0003778  -0.0012759  1.2038615  -36.7617046  C
  0.0000203      31728.  1561976857.  19.1844685  0.0003897  -0.0013166  1.2366374  -37.9329929  C
  0.0000209      32649.  1559353159.  19.1784804  0.0004015  -0.0013572  1.2691580  -39.1037978  C
  0.0000216      33569.  1556840417.  19.1736181  0.0004134  -0.0013978  1.3014224  -40.2741157  C
  0.0000222      34489.  1554429000.  19.1697922  0.0004253  -0.0014384  1.3334295  -41.4439431  C
  0.0000228      35408.  1552110331.  19.1669230  0.0004372  -0.0014790  1.3651784  -42.6132763  C
  0.0000234      36325.  1549876743.  19.1649393  0.0004492  -0.0015196  1.3966680  -43.7821115  C
  0.0000241      37242.  1547721364.  19.1637776  0.0004611  -0.0015601  1.4278974  -44.9504452  C
  0.0000247      38158.  1545638013.  19.1633807  0.0004731  -0.0016007  1.4588656  -46.1182733  C
  0.0000253      39073.  1543621119.  19.1636972  0.0004851  -0.0016412  1.4895715  -47.2855922  C
  0.0000259      39987.  1541665642.  19.1646807  0.0004971  -0.0016817  1.5200140  -48.4523979  C
  0.0000266      40900.  1539767017.  19.1662894  0.0005091  -0.0017221  1.5501922  -49.6186864  C
  0.0000272      41812.  1537921093.  19.1684851  0.0005211  -0.0017626  1.5801049  -50.7844537  C
  0.0000278      42723.  1536124091.  19.1712333  0.0005332  -0.0018031  1.6097511  -51.9496958  C
  0.0000284      43634.  1534372559.  19.1745027  0.0005453  -0.0018435  1.6391297  -53.1144085  C
  0.0000291      44543.  1532663341.  19.1782645  0.0005574  -0.0018839  1.6682396  -54.2785877  C
  0.0000297      45451.  1530993544.  19.1824926  0.0005695  -0.0019243  1.6970796  -55.4422290  C
  0.0000303      46359.  1529360509.  19.1871631  0.0005816  -0.0019646  1.7256487  -56.6053282  C
  0.0000309      47265.  1527761792.  19.1922540  0.0005938  -0.0020050  1.7539457  -57.7678809  C
  0.0000316      48171.  1526195135.  19.1977452  0.0006059  -0.0020453  1.7819695  -58.9298827  C
  0.0000322      49075.  1524658458.  19.2036182  0.0006181  -0.0020856  1.8097189  -60.0000000  CY
  0.0000328      49978.  1523149832.  19.2098560  0.0006303  -0.0021259  1.8371927  -60.0000000  CY
  0.0000334      50881.  1521667472.  19.2164429  0.0006425  -0.0021662  1.8643896  -60.0000000  CY
  0.0000341      51768.  1519782206.  19.2215639  0.0006547  -0.0022065  1.8911717  -60.0000000  CY
  0.0000347      52569.  1515510789.  19.2167556  0.0006666  -0.0022472  1.9168883  -60.0000000  CY
  0.0000353      53253.  1508042390.  19.1982151  0.0006779  -0.0022883  1.9412323  -60.0000000  CY
  0.0000359      53888.  1499491988.  19.1749599  0.0006891  -0.0023296  1.9648840  -60.0000000  CY
  0.0000366      54488.  1490270789.  19.1486032  0.0007001  -0.0023711  1.9879646  -60.0000000  CY
  0.0000372      55006.  1479143114.  19.1134350  0.0007108  -0.0024130  2.0100243  -60.0000000  CY
  0.0000397      56887.  1433367940.  18.9645415  0.0007527  -0.0025811  2.0942872  -60.0000000  CY
  0.0000422      58456.  1385630478.  18.7961700  0.0007930  -0.0027508  2.1717830  -60.0000000  CY
  0.0000447      59671.  1335287439.  18.6020700  0.0008313  -0.0029225  2.2421414  -60.0000000  CY
  0.0000472      60828.  1289064834.  18.4254105  0.0008694  -0.0030943  2.3091171  -60.0000000  CY
  0.0000497      61719.  1242143383.  18.2352180  0.0009061  -0.0032677  2.3703798  -60.0000000  CY
  0.0000522      62557.  1198702443.  18.0598469  0.0009425  -0.0034413  2.4285143  -60.0000000  CY
  0.0000547      63370.  1158771587.  17.8896989  0.0009783  -0.0036154  2.4829323  -60.0000000  CY
  0.0000572      63962.  1118456942.  17.7055029  0.0010125  -0.0037912  2.5322322  -60.0000000  CY
  0.0000597      64530.  1081136804.  17.5361529  0.0010467  -0.0039671  2.5790147  -60.0000000  CY
  0.0000622      65096.  1046765361.  17.3825368  0.0010810  -0.0041428  2.6235043  -60.0000000  CY
  0.0000647      65658.  1014999805.  17.2428637  0.0011154  -0.0043184  2.6656742  -60.0000000  CY
  0.0000672      66063.   983261355.  17.0833206  0.0011478  -0.0044960  2.7029948  -60.0000000  CY
  0.0000697      66427.   953212616.  16.9293562  0.0011798  -0.0046740  2.7376633  -60.0000000  CY
  0.0000722      66789.   925212054.  16.7877139  0.0012119  -0.0048519  2.7703026  -60.0000000  CY
  0.0000747      67148.   899053404.  16.6571805  0.0012441  -0.0050297  2.8008894  -60.0000000  CY
  0.0000772      67505.   874557109.  16.5367010  0.0012764  -0.0052073  2.8293997  -60.0000000  CY
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    0.0000797         67857.     851539233.     16.4249848     0.0013089     -0.0053849      2.8557854    -60.0000000   CY
    0.0000822         68134.     829004868.     16.3039028     0.0013400     -0.0055638      2.8789778    -60.0000000   CY
    0.0000847         68350.     807089537.     16.1775710     0.0013700     -0.0057437      2.8994335    -60.0000000   CY
    0.0000872         68565.     786410303.     16.0597715     0.0014002     -0.0059235      2.9180649    -60.0000000   CY
    0.0000897         68778.     766863423.     15.9498090     0.0014305     -0.0061033      2.9348510    -60.0000000   CY
    0.0000922         68989.     748356399.     15.8470642     0.0014609     -0.0062828      2.9497700    -60.0000000   CY
    0.0000947         69198.     730806492.     15.7509841     0.0014914     -0.0064623      2.9627998    -60.0000000   CY
    0.0000972         69405.     714139468.     15.6610730     0.0015221     -0.0066417      2.9739176    -60.0000000   CY
    0.0000997         69611.     698288528.     15.5768860     0.0015528     -0.0068209      2.9831003    -60.0000000   CY
    0.0001022         69811.     683163842.     15.4936275     0.0015833     -0.0070005      2.9902301    -60.0000000   CY
    0.0001047         69989.     668554898.     15.4082431     0.0016131     -0.0071807      2.9953263    -60.0000000   CY
    0.0001072         70139.     654357237.     15.3221177     0.0016423     -0.0073614      2.9985237    -60.0000000   CY
    0.0001097         70253.     640480741.     15.2337412     0.0016710     -0.0075428      2.9999154    -60.0000000   CY
    0.0001122         70365.     627206476.     15.1504739     0.0016997     -0.0077241      2.9960500    -60.0000000   CY
    0.0001147         70475.     614497839.     15.0718479     0.0017286     -0.0079052      2.9972440    -60.0000000   CY
    0.0001172         70584.     602320086.     14.9974973     0.0017575     -0.0080862      2.9993688    -60.0000000   CY
    0.0001197         70692.     590639056.     14.9272046     0.0017866     -0.0082672      2.9995358    -60.0000000   CY
    0.0001222         70798.     579418781.     14.8610173     0.0018158     -0.0084479      2.9941184    -60.0000000   CY
    0.0001247         70902.     568639265.     14.7982778     0.0018452     -0.0086286      2.9971622    -60.0000000   CY
    0.0001272         71006.     558274352.     14.7387942     0.0018746     -0.0088092      2.9992364    -60.0000000   CY
    0.0001297         71106.     548288678.     14.6801652     0.0019038     -0.0089899      2.9999952    -60.0000000   CY
    0.0001322         71202.     538642649.     14.6202683     0.0019326     -0.0091711      2.9955415    -60.0000000   CY
    0.0001347         71297.     529347976.     14.5632831     0.0019615     -0.0093523      2.9947943    -60.0000000   CY
    0.0001372         71390.     520386012.     14.5090153     0.0019905     -0.0095333      2.9975760    -60.0000000   CY
    0.0001522         71858.     472168455.     14.2146595     0.0021633     -0.0106205      2.9976691     60.0000000   CY
    0.0001672         72130.     431433043.     13.9485493     0.0023320     -0.0117117      2.9938535     60.0000000   CY
    0.0001822         72374.     397251993.     13.7191525     0.0024995     -0.0128043      2.9949747     60.0000000   CY
    0.0001972         72599.     368172986.     13.5230538     0.0026666     -0.0138972      2.9978604     60.0000000   CY
    0.0002122         72815.     343163522.     13.3632053     0.0028355     -0.0149882      2.9909846     60.0000000   CY
    0.0002272         73007.     321352008.     13.2400872     0.0030080     -0.0160758      2.9963656     60.0000000   CYT
    0.0002422         73122.     301923185.     13.1187137     0.0031772     -0.0171666      2.9962926     60.0000000   CYT
    0.0002572         73187.     284566275.     13.0196874     0.0033485     -0.0182552      2.9834377     60.0000000   CYT
    0.0002722         73228.     269035169.     12.9103084     0.0035140     -0.0193497      2.9955446     60.0000000   CYT
    0.0002872         73254.     255074086.     12.8267344     0.0036837     -0.0204401      2.9999998     60.0000000   CYT
    0.0003022         73263.     242443074.     12.7675408     0.0038582     -0.0215256      2.9860803     60.0000000   CYT
```

```
---------------------------------------------------------------------------------
   Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---------------------------------------------------------------------------------

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

 Load          Axial Thrust         Nominal Mom. Cap.       Max. Comp.
  No.              kips                  in-kip               Strain
 ----        ----------------     ------------------      ------------
   1              56.000              72998.266            0.00300000

Note note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318-08, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318-08, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

 Axial     Resistance          Nominal          Ultimate (Factored)    Ultimate (Factored)     Bending Stiffness
 Load        Factor        Moment Capacity         Axial Thrust          Moment Capacity       at Ult. Mom. Cap.
  No.      for Moment          in-kip                  kips                  in-kip                kip-in^2
 -----     ----------     -------------------   -------------------    -------------------    -------------------
   1          0.65            72998.266                36.400              47448.871           1527443857.139

   1          0.70            72998.266                39.200              51098.786           1521203971.662

   1          0.75            72998.266                42.000              54748.700           1484666755.510


The analysis ended normally.
```

vertical solutions
"execute & deliver"

PAD AND PIER FOUNDATION DESIGN
SELF-SUPPORTING POLE STRUCTURE
ANSI/TIA/EIA-222-F-1996 & ACI 318-05

VSi Job No.: 141374
Date: 11/14/2014
Calculated by: MER

Inputs

- Reactions:

$M := 4168 \cdot kip \cdot ft$ = overturning moment at top of pier, factored

$P := 56 \cdot kip$ = axial load at top of pier

$V := 37 \cdot kip$ = shear load at top of pier

- Concrete:

$B_{pad} := (20 + 2 \cdot 1.5) \cdot ft$ = pad width (and length) $B_{pad} = 23.0 \cdot ft$

$B_{pier} := 7.0 \cdot ft$ = pier diameter

Pier_Shape := [✓ Circular] Square

$H := 6.0 \cdot in$ = distance from top of pier to top of grade

$z_{pad} := 10.0 \cdot ft$ = pad depth

$t_{pad} := 3.0 \cdot ft$ = pad thickness

$\gamma_c := 150 \cdot pcf$ = density of concrete

$f'_{c\_design} := 3000 \cdot psi$ = design compressive strength of beam concrete

$f'_{c\_spec} := 4000 \cdot psi$ = specified compressive strength of beam concrete

- Rebar:

$f_y := 60 \cdot ksi$ = specified minimum yield strength of rebar

Tie := "#4" = size of tie rebar in pier

$s_{tie} := 12 \cdot in$ = spacing of tie rebar in pier

Vert := "#9" = size of vertical rebar in pier

$n_{vert} := 34$ = number of vertical rebar in pier

$L_{vert\_ext} := 19.3125 \cdot in$ = length of vertical rebar exension in pad

$cover_{top} := 3.0 \cdot in$ = cover from top edge of vertical to top of concrete in pier

$cover_{side} := 3.0 \cdot in$ = cover from outside edge of tie to edge of concrete in pier

Top_Horiz := #5 #6 #7 [✓ #8] #9

$s_{h\_top} := 10.5 \cdot in$ = size / max spacing of horizontal rebar in top of pad

Bot_Horiz := #5 #6 #7 [✓ #8] #9

$s_{h\_bot} := 10.5 \cdot in$ = size / max spacing of horizontal rebar in bottom of pad

$cover_{tb\_pad} := 3.0 \cdot in$ = cover from outside edge of outside top/bottom horizontal to edge of concrete in pad

$cover_{end\_pad} := 3.0 \cdot in$ = cover from outside end of horizontal to edge of concrete in pad

- Anchor Rods (ASSUMED):

$d_{AR} := 1.25 \cdot in$ = diameter of anchor rod

$BC := 67 \cdot in$ = bolt-circle diameter for anchor rods

$d_{template} := 6.0 \cdot in$ = anchor rod template width

$L_{AR} := 72.0 \cdot in$ = total length of anchor rod

$proj_{AR} := 1.0 \cdot ft$ = projection of anchor rod above top of concrete

- Pier Strength:

$\phi M_{n\_pier} := 0.9 \cdot (72998.266 \cdot kip \cdot in)$ = design flexural strength of pier (w/ applied axial comp. rxn) [Pier.lpd]

$\phi M_{n\_pier} = 5475 \cdot kip \cdot ft$

- Soil:

$\gamma_s := 120 \cdot pcf$ = density of soil

$q'_{all} := 6000 \cdot psf$ = net allowable bearing pressure

$\psi_{input} := 0.30$ = coefficient of friction per GEO (-or- for clay: assumed per TBL 8.3; for sand: = 0 if to be calc'd

$\phi := 0 \cdot deg$ = friction angle of soil (= 0 if $\psi$is input or if soil is clay)

$GW := \infty \cdot ft$ = ground water depth

- Constants:

$\gamma_w \equiv 62.4 \cdot pcf$ = unit weight of water

$E \equiv 29000 \cdot ksi$ = modulus of elasticity of rebar steel

$\varepsilon_{cu} \equiv 0.003 \cdot \frac{in}{in}$ = maximum usable strain at extreme concrete compression fiber

$\phi_s \equiv 0.75$ = resistance factor for soil strength

$\phi_v \equiv 0.75$ = strength reduction factor for shear

$\phi_t \equiv 0.90$ = strength reduction factor for tension

GEOMETRY, DEAD LOADS & REBAR

Output - Pad & Pier Geometry:

$$A_{g\_pier} := \left| \begin{array}{l} \left(\frac{\pi \cdot B_{pier}^{\ 2}}{4}\right) \text{ if Pier\_Shape = "Circular"} \\ \left(B_{pier}^{\ 2}\right) \text{ if Pier\_Shape = "Square"} \end{array} \right.$$

$A_{g\_pier} = 38.5 \cdot ft^2$

$L_{pier} := z_{pad} - t_{pad} + H$

$L_{pier} = 7.50\,ft$

$V_{pier} := A_{g\_pier} \cdot L_{pier}$

$V_{pier} = 288.6 \cdot ft^3$

$A_{g\_pad} := B_{pad}^{\ 2}$

$A_{g\_pad} = 529.0 \cdot ft^2$

$V_{pad} := A_{g\_pad} \cdot t_{pad}$

$V_{pad} = 1587.0 \cdot ft^3$

$Vol_{conc} := V_{pier} + V_{pad}$

$Vol_{conc} = 69.5 \cdot yd^3$

$$V_{soil} := A_{g\_pad} \cdot \left(z_{pad} - t_{pad}\right) - V_{pier} \cdot \left(\frac{L_{pier} - H}{L_{pier}}\right)$$

$V_{soil} = 3433.6 \cdot ft^3$

Output - Dead Loads:

$$\gamma'_{c\_pier} := \left| \begin{array}{l} \gamma_c \;\; \text{if } GW \ge (z_{pad} - t_{pad}) \\ \gamma_c \cdot \left(\dfrac{GW}{L_{pier}} \right) + (\gamma_c - \gamma_w) \cdot \left[\dfrac{(z_{pad} - t_{pad}) - GW}{L_{pier} - H} \right] \;\; \text{if } (0 \cdot ft) \le GW < (z_{pad} - t_{pad}) \end{array} \right.$$

$\gamma'_{c\_pier} = 150.0 \cdot pcf$

$D_{pier} := V_{pier} \cdot \gamma'_{c\_pier}$

$D_{pier} = 43.3 \cdot kip$

$$\gamma'_{c\_pad} := \left| \begin{array}{l} \gamma_c \;\; \text{if } GW \ge z_{pad} \\ (\gamma_c - \gamma_w) \;\; \text{if } GW \le (z_{pad} - t_{pad}) \\ \gamma_c \cdot \left[\dfrac{t_{pad} - (z_{pad} - GW)}{t_{pad}} \right] + (\gamma_c - \gamma_w) \cdot \left(\dfrac{z_{pad} - GW}{t_{pad}} \right) \;\; \text{if } (z_{pad} - t_{pad}) < GW < z_{pad} \end{array} \right.$$

$\gamma'_{c\_pad} = 150.0 \cdot pcf$

$D_{pad} := V_{pad} \cdot \gamma'_{c\_pad}$

$D_{pad} = 238.1 \cdot kip$

$$\gamma'_s := \left| \begin{array}{l} \gamma_s \;\; \text{if } GW \ge (z_{pad} - t_{pad}) \\ \gamma_s \cdot \left[\dfrac{GW}{(z_{pad} - t_{pad})} \right] + (\gamma_s - \gamma_w) \cdot \left[\dfrac{(z_{pad} - t_{pad}) - GW}{(z_{pad} - t_{pad})} \right] \;\; \text{if } 0 \cdot ft \le GW < (z_{pad} - t_{pad}) \end{array} \right.$$

$\gamma'_s = 120.0 \cdot pcf$

$D_{soil} := V_{soil} \cdot \gamma'_s$

$D_{soil} = 412.0 \cdot kip$

Output - Rebar Properties:

▶ CALCS.

- Pier:

$d_{vert} = 1.128 \cdot in$ $\quad A_{vert} = 1.00 \cdot in^2$

$d_{tie} = 0.500 \cdot in$ $\quad A_{tr} = 0.20 \cdot in^2$

- Pad Top:

$d_{h\_top} = 1.000 \cdot in$ $\quad A_{b\_top} = 0.79 \cdot in^2$ $\quad d_{top\_v} = 32.50 \cdot in$ $\quad d_{top\_f} = 31.50 \cdot in$

- Pad Bottom:

$d_{h\_bot} = 1.000 \cdot in$ $\quad A_{b\_bot} = 0.79 \cdot in^2$ $\quad d_{bot\_v} = 32.50 \cdot in$ $\quad d_{bot\_f} = 31.50 \cdot in$

SOIL RESISTANCE

Output - Unfactored Reactions:

$M_u := 1.3 \cdot M$

$M_u = 5418.4 \cdot kip \cdot ft$

$P_u := 1.3 \cdot P$

$P_u = 72.8 \cdot kip$

$V_u := 1.3 \cdot V$

$V_u = 48.1 \cdot kip$

Output - Eccentricity:

$P_{total} := D_{pier} + D_{pad} + D_{soil} + P$ $\quad P_{total} = 749.4 \cdot kip$

$M_{total} := M + V \cdot (H + z_{pad})$ $\quad M_{total} = 4557 \cdot kip \cdot ft$

$ecc := \dfrac{M_{total}}{P_{total}}$ $\quad ecc = 6.08\ ft$

$limit := \dfrac{B_{pad}}{6}$ $\quad limit = 3.83\ ft$

$X := 3 \cdot \left(\dfrac{B_{pad}}{2} - ecc\right)$ $\quad X = 16.26\ ft$

Output - Bearing Pressure, Unfactored (bottom):

$$q_{max} := \begin{cases} \dfrac{P_{total}}{B_{pad}^{\ 2}} + \dfrac{M_{total}}{\left(\dfrac{B_{pad}}{6}\right)^3} & \text{if } ecc \le \dfrac{B_{pad}}{6} \\ \dfrac{2 \cdot P_{total}}{3 \cdot B_{pad}^{\ 2} \cdot \left(0.5 - \dfrac{ecc}{B_{pad}}\right)} & \text{if } ecc > \dfrac{B_{pad}}{6} \end{cases} \qquad q_{max} = 4008 \cdot psf$$

$q'_{max} := q_{max} - \gamma'_s \cdot z_{pad}$ $\quad q'_{max} = 2808 \cdot psf$

$r_{q'} := \dfrac{q'_{max}}{q'_{all}}$ $\quad r_{q'} = 47 \cdot \%$

Output - Overturning Stability (Limit States):

$OTM_t := M + V \cdot (H + z_{pad})$ $\quad OTM_t = 4557 \cdot kip \cdot ft$

$OTM_r := (D_{pier} + D_{pad} + D_{soil} + P) \cdot \dfrac{B_{pad}}{2}$ $\quad OTM_r = 8618 \cdot kip \cdot ft$

$r_{OTM} := \dfrac{OTM_t}{\left(\dfrac{OTM_r}{1.5}\right)}$ $\quad r_{OTM} = 79 \cdot \%$

Output - Sliding Stability (Limit States):

$H_t := V$ $\quad H_t = 37.0 \cdot kip$

$\psi_{calc} := \tan(0.7 \cdot \phi)$ $\quad \psi_{calc} = 0.00$

$$\psi := \begin{cases} \psi_{input} & \text{if } \psi_{input} \ne 0 \\ \psi_{calc} & \text{otherwise} \end{cases} \qquad \psi = 0.30$$

$H_r := (D_{pier} + D_{pad} + P) \cdot \psi$ $\quad H_r = 101.2 \cdot kip$

$r_H := \dfrac{H_t}{\left(\dfrac{H_r}{2.0}\right)}$ $\quad r_H = 73 \cdot \%$

SOIL RESISTANCE - ABOUT DIAGONAL

Output - Bearing Pressure, Unfactored (bottom) - About Diagonal Axis:

$A_F := B_{pad}^{\;2}$ $\qquad A_F = 529\,ft^2$

$q_p := \dfrac{P_{total}}{A_F}$ $\qquad q_p = 1416.6\cdot psf$

$ratio := \dfrac{ecc}{\sqrt{2}\cdot B_{pad}}$ $\qquad ratio = 0.187$

$C_1 = 0.64 \qquad C_2 = 3.78$

$X_{diag} := \left| \begin{array}{l} C_1\cdot\left(B_{pad}\cdot\sqrt{2}\right) \text{ if } C_1 \neq \text{"-"} \\ \left(\sqrt{2}\cdot B_{pad}\right) \text{ if } C_1 = \text{"-"} \end{array} \right.$ $\qquad X_{diag} = 20.69\,ft$

$q_{max\_diag} := C_2\cdot q_p$ $\qquad q_{max\_diag} = 5350\cdot psf$

$q'_{max\_diag} := q_{max\_diag} - \gamma'_s\cdot z_{pad}$ $\qquad q'_{max\_diag} = 4150\cdot psf$

$r_{q'\_diag} := \dfrac{q'_{max\_diag}}{q'_{all}}$ $\qquad r_{q'\_diag} = 69\cdot\%$

Output - Overturning Stability (Limit States):

$OTM_{r\_diag} := \left(D_{pier} + D_{pad} + D_{soil} + P\right)\cdot\dfrac{\left(\sqrt{2}\cdot B_{pad}\right)}{2}$ $\qquad OTM_{r\_diag} = 12187\cdot kip\cdot ft$

$r_{OTM\_diag} := \dfrac{OTM_t}{\left(\dfrac{OTM_{r\_diag}}{1.5}\right)}$ $\qquad r_{OTM\_diag} = 56\cdot\%$

PAD STRUCTURE FORCES

PAD FLEXURAL STRENGTH - *DESIGN*

Output - Calculate Req'd Flexureal Area of Steel:

- Top:

$n_{h\_top} := ceil\left[\dfrac{B_{pad} - \left(2\cdot cover_{end\_pad} + d_{h\_top}\right)}{s_{h\_top}} + 1\right]$ $\qquad n_{h\_top} = 27$

$d_{top} := t_{pad} - cover_{tb\_pad} - 1.5\cdot d_{h\_top}$ $\qquad d_{top} = 31.50\cdot in$

$A_{top} := -\left(\dfrac{f_y^{\;2}}{1.7\cdot B_{pad}\cdot f_{c\_design}}\right) \qquad B_{top} := f_y\cdot d_{top} \qquad C_{top} := -\left(\dfrac{M_{u\_top}}{0.90}\right)$

(assumes tension controlled section, i.e. ϕ = 0.90)

$A_{s\_top\_REQD\_flexure} := \dfrac{-B_{top} + \sqrt{B_{top}^{\;2} - 4\cdot A_{top}\cdot C_{top}}}{2\cdot A_{top}}$ $\qquad A_{s\_top\_REQD\_flexure} = 8.81\cdot in^2$

$A_{s\_top} := n_{h\_top}\cdot A_{b\_top}$ $\qquad A_{s\_top} = 21.33\cdot in^2$

spacing req'd for current bar size = $s_{h\_top\_req'd} = 26.59\cdot in$

size of rebar req'd for current #/spacing = Top_Horiz_Req'd = "#6"

- Bottom:

$$n_{h\_bot} := ceil\left[\frac{B_{pad} - (2\cdot cover_{end\_pad} + d_{h\_bot})}{s_{h\_bot}} + 1\right]$$ $n_{h\_bot} = 27$

$d_{bot} := t_{pad} - cover_{tb\_pad} - 1.5\cdot d_{h\_bot}$ $d_{bot} = 31.50\cdot in$

$$A_{bot} := -\left(\frac{f_y^{\,2}}{1.7\cdot B_{pad}\cdot f'_{c\_design}}\right) \qquad B_{bot} := f_y\cdot d_{bot} \qquad C_{bot} := -\left(\frac{M_{u\_bot}}{0.90}\right)$$

(assumes tension controlled section, i.e. ϕ = 0.90)

$$A_{s\_bot\_REQD\_flexure} := \frac{-B_{bot} + \sqrt{B_{bot}^{\,2} - 4\cdot A_{bot}\cdot C_{bot}}}{2\cdot A_{bot}}$$ $A_{s\_bot\_REQD\_flexure} = 19.19\cdot in^2$

$A_{s\_bot} := n_{h\_bot}\cdot A_{b\_bot}$ $A_{s\_bot} = 21.33\cdot in^2$

spacing req'd for current bar size = $s_{h\_bot\_req'd} = 11.59\cdot in$

size of rebar req'd for current #/spacing = Bot_Horiz_Req'd = "#8"

PAD FLEXURAL STRENGTH - ANALYSIS

PAD SHEAR STRENGTH

PIER STRUCTURE STRENGTH

PAD & PIER STRUCTURE DETAILING

RESULTS

- Soil:

$$\mathrm{result}_{\mathrm{Soil}} := \begin{pmatrix} r_{q'} \\ r_{\mathrm{OTM}} \\ r_{\mathrm{H}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Soil}} = \begin{pmatrix} 47 \\ 79 \\ 73 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{Soil\_About\_Diag}} := \begin{pmatrix} r_{q'\_\mathrm{diag}} \\ r_{\mathrm{OTM\_diag}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Soil\_About\_Diag}} = \begin{pmatrix} 69 \\ 56 \end{pmatrix} \cdot \%$$

- Structure - Pad:

$$\mathrm{result}_{\mathrm{Pad\_Top\_Str}} := \begin{pmatrix} r_{\mathrm{f\_top}} \\ r_{\mathrm{v\_top}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Pad\_Top\_Str}} = \begin{pmatrix} 42 \\ 28 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{As\_Max\_Top}} := \mathrm{Check}_{\mathrm{As\_max\_top}} \qquad \mathrm{result}_{\mathrm{As\_Max\_Top}} = \text{"OK"}$$

$$\mathrm{result}_{\mathrm{Pad\_Bot\_Str}} := \begin{pmatrix} r_{\mathrm{f\_bot}} \\ r_{\mathrm{v\_bot\_br}} \\ r_{\mathrm{v\_bot\_1way}} \\ r_{\mathrm{v\_bot\_2way}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Pad\_Bot\_Str}} = \begin{pmatrix} 90 \\ 60 \\ 54 \\ 29 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{As\_Max\_Bot}} := \mathrm{Check}_{\mathrm{As\_max\_bot}} \qquad \mathrm{result}_{\mathrm{As\_Max\_Bot}} = \text{"OK"}$$

$$\mathrm{result}_{\mathrm{As\_min\_pad}} := \mathrm{Check}_{\mathrm{As\_min\_pad}} \qquad \mathrm{result}_{\mathrm{As\_min\_pad}} = \text{"OK"}$$

- Structure - Pier:

$$\mathrm{result}_{\mathrm{Pier\_Str\_Strength}} := \begin{pmatrix} r_{\mathrm{f\_pier}} \\ r_{\mathrm{v\_pier}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Pier\_Str\_Strength}} = \begin{pmatrix} 83 \\ 8 \end{pmatrix} \cdot \%$$

$$\mathrm{result}_{\mathrm{As\_Min\_Pier}} := r_{\mathrm{As\_pier}} \qquad \mathrm{result}_{\mathrm{As\_Min\_Pier}} = \text{"OK"}$$

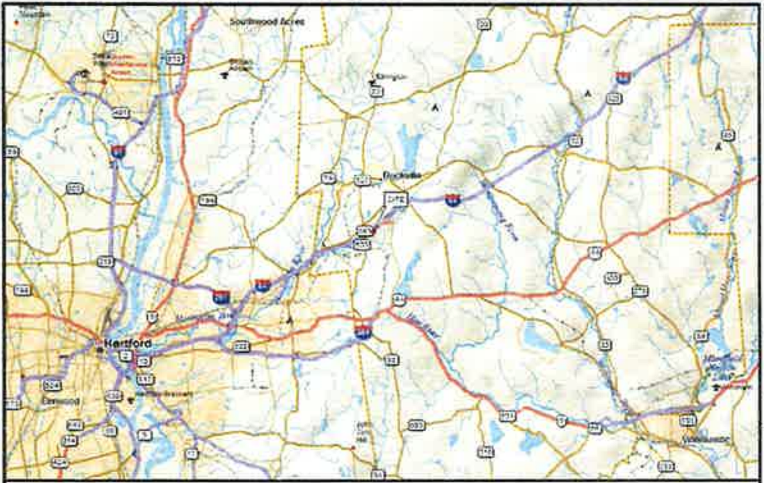
- Detailing - Pad & Pier:

$$\mathrm{result}_{\mathrm{Detailing\_AR\_PullOut}} := \left| \begin{array}{l} \begin{pmatrix} \mathrm{result}_{\mathrm{ld\_AR}} \\ \mathrm{result}_{\mathrm{ldh\_AR}} \end{pmatrix} \ \text{if } \mathrm{Shear}_{\mathrm{Plane\_45}} = \text{"In Pier"} \\ \mathrm{result}_{\mathrm{ld\_horiz\_AR}} \ \text{if } \mathrm{Shear}_{\mathrm{Plane\_45}} = \text{"In Pad"} \end{array} \right. \qquad \mathrm{result}_{\mathrm{Detailing\_AR\_PullOut}} = \begin{pmatrix} \text{"OK"} \\ \text{"OK"} \end{pmatrix}$$

$$\mathrm{result}_{\mathrm{Horiz\_ld}} := \begin{pmatrix} \mathrm{result}_{\mathrm{ld\_horiz\_top}} \\ \mathrm{result}_{\mathrm{ld\_horiz\_bot}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Horiz\_ld}} = \begin{pmatrix} \text{"OK"} \\ \text{"OK"} \end{pmatrix}$$

$$\mathrm{result}_{\mathrm{Vert}} := \begin{pmatrix} \mathrm{result}_{\mathrm{Lvert\_ext}} \\ \mathrm{result}_{\mathrm{ldh}} \end{pmatrix} \qquad \mathrm{result}_{\mathrm{Vert}} = \begin{pmatrix} \text{"OK"} \\ \text{"OK"} \end{pmatrix}$$

$$\mathrm{Max\_Utilization\_Soil} = 79 \cdot \% \qquad \mathrm{Max\_Utilization\_Structure} = 90 \cdot \% \qquad \mathrm{Detailing}_{\mathrm{Checks}} = \text{"OK"}$$



PROXIMITY MAP

LOCATION MAP

START AT BRADLEY INTERNATIONAL AIRPORT. GO STRAIGHT (E) ON SCHOEPHOESTER RD. IN 0.04 MI TURN RIGHT (SSW) ON TO ELLA GRASSO TPKE (SR 75). IN 0.68 MI KEEP LEFT (S) ON TO SR 75 (POQUONOCK AVE). IN 3.08 MI GO STRAIGHT (SSE) ON TO I-91 S RAMP. IN 0.16 MI KEEP RIGHT (S) ON I-91 S RAMP. IN 3.82 MI GO STRAIGHT (W) ON TO I-291 E RAMP 35B. IN 0.34 MI KEEP LEFT (ESE) ON I-291 E RAMP. IN 5.83 MI KEEP LEFT (E) ON TO I-84 E (WILBUR CROSS HWY). IN 0.38 MI KEEP LEFT (ENE) ON I-84 E (WILBUR CROSS HWY). IN 6.05 MI KEEP RIGHT (E) ON TO SR 541 (S FRONTAGE RD) RAMP 66. IN 0.19 MI KEEP LEFT (SE) ON SR 541 (S FRONTAGE RD) RAMP. IN 0.04 MI TURN LEFT (NE) ON TO SR 541 (S FRONTAGE RD). IN 0.17 MI TURN RIGHT (SE) ON TO BOLTON RD. IN 0.10 MI TURN LEFT (N) ON TO CLARK RD. IN 0.07 MI TURN RIGHT (ENE) ON TO INDUSTRIAL PARK RD. IN 0.14 MI FINISH AT SITE.

DRIVING DIRECTIONS

PROJECT INFORMATION:

PROJECT NAME:

VERNON 2

SITE NUMBER:

VZ5-177

PROJECT LOCATION:

60 INDUSTRIAL PARK ROAD
VERNON, CT 06066
(TOLLAND COUNTY)

LATITUDE	N41° 10' 36.86"
LONGITUDE	W073° 08' 46.50"
GROUND ELEVATION	24'±

2-C CERTIFICATION

SITE CONSTRUCTON MANAGER:	
NAME	URS COOPERATION
ADDRESS	500 ENTERPRISE DR, STE 3B
CITY, STATE, ZIP	ROCKY HILL, CT 06067
CONTACT	MICHAEL J. EGAN III
PHONE	(860) 990-6737
SITE APPLICANT:	
NAME	VERIZON
ADDRESS	99 EAST RIVER DRIVE
CITY, STATE, ZIP	EAST HARTFORD, CT 06108
CONTACT	-
PHONE	-
SURVEYOR:	
NAME	N/A
ADDRESS	N/A
CITY, STATE, ZIP	N/A
CONTACT	N/A
PHONE	N/A
CIVIL ENGINEER:	
NAME	VERTICAL SOLUTIONS
ADDRESS	113 EDINBURGH SOUTH DRIVE SUITE 130
CITY, STATE, ZIP	CARY, NC 27511
CONTACT	MATT REEVES
PHONE	(888) 321-6167
ELECTRICAL ENGINEER:	
NAME	N/A
ADDRESS	N/A
CITY, STATE, ZIP	N/A
CONTACT	N/A
PHONE	N/A
PROPERTY INFORMATION:	
NAME	VERNON 2
ADDRESS	60 INDUSTRIAL PARK ROAD
CITY, STATE, ZIP	VERNON, CT 06066
CONTACT	MICHAEL J. EGAN III
PHONE	(860) 990-6737
UTILITIES:	
POWER COMPANY	N/A
CONTACT	N/A
PHONE	N/A
TELEPHONE COMPANY	N/A
CONTACT	N/A
PHONE	N/A
PHONE # NEAR SITE	N/A

CONTACT INFORMATION

PROJECT DESCRIPTION:
STRUCTURAL UPGRADE

TOWER TYPE:
175' SELF SUPPORTING POLE STRUCTURE

AREA OF CONSTRUCTION:
-

PROJECT INFORMATION

CALL before you DIG
FOR CT 1-800-922-4455

CONNECTICUT ONE CALL
CALL BEFORE YOU DIG
1-800-922-4455

ONE CALL

SHEET	DESCRIPTION	REV
T-1	TITLE SHEET	0
N-1	PROJECT NOTES	0
N-2	PROJECT NOTES	0
N-3	PROJECT NOTES	0
B-1	BILL OF MATERIALS	0
S-1	TOWER ELEVATION AND MODIFICATION SCHEDULE	0
S-2	CONSTRUCTION DETAILS	0
S-3	CONSTRUCTION DETAILS	0
S-4	CONSTRUCTION DETAILS	0
S-5	CONSTRUCTION DETAILS	0
S-6	CONSTRUCTION DETAILS	0
S-7	FABRICATION DETAILS	0
S-8	FABRICATION DETAILS	0
S-9	FABRICATION DETAILS	0

INDEX OF SHEETS

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
execute & deliver

113 EDINBURGH SOUTH DRIVE SUITE 130
CARY, NC 27511
OFFICE: (888) 321-6167
www.verticalsolutions-inc.com

REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA | CHECKED BY: MER

SHEET TITLE:

TITLE SHEET

SHEET NUMBER:	REVISION:
T-1	0
	VSI #: 141374

SEAL:

No. 25064

November 25, 2014

GENERAL NOTES:

1. ALL REFERENCES TO TOWER OWNER IN THESE DOCUMENTS SHALL BE CONSIDERED AS URS OR ITS DESIGNATED REPRESENTATIVE.

2. ALL WORK PRESENTED ON THESE DRAWINGS MUST BE COMPLETED BY THE CONTRACTOR UNLESS NOTED OTHERWISE. THE CONTRACTOR MUST HAVE CONSIDERABLE EXPERIENCE IN PERFORMANCE OF WORK SIMILAR TO THAT DESCRIBED HEREIN. BY ACCEPTANCE OF THIS ASSIGNMENT, THE CONTRACTOR IS ATTESTING THAT HE DOES HAVE SUFFICENT EXPERIENCE AND ABILITY, THAT HE IS KNOWLEDGEABLE OF THE WORK TO BE PERFORMED AND THAT HE IS PROPERLY LICENSED AND PROPERLY REGISTERED TO DO THIS WORK IN THE STATE OF CONNECTICUT.

3. THE STRUCTURE IS DESIGNED IN ACCORDANCE WITH TIA/EIA-222-F-1996, FOR A 85 MPH FASTEST MILE BASIC WIND SPEED. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH THE CONNECTICUT STATE BUILDING CODE, 2005 EDITION.

4. UNLESS SHOWN OR NOTED OTHERWISE ON THE CONTRACT DRAWINGS, OR IN THE SPECIFICATIONS, THE FOLLOWING NOTES SHALL APPLY TO THE MATERIALS LISTED HEREIN, AND TO THE PROCEDURES TO BE USED ON THIS PROJECT.

5. ALL PRODUCT MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED EXACTLY AND SHALL SUPERCEDE ANY CONFLICTING NOTES ENCLOSED HEREIN.

6. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE MODIFICATION PROCEDURE AND SEQUENCE TO INSURE THE SAFETY OF THE STRUCTURE AND IT'S COMPONENT PARTS DURING ERECTION AND/OR FIELD MODIFICATIONS. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF TEMPORARY BRACING, GUYS OR TIE-DOWNS THAT MAY BE NECESSARY, SUCH MATERIAL SHALL BE REMOVED AND SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AFTER THE COMPLETION OF THE PROJECT.

7. ALL DIMENSIONS, ELEVATIONS, AND EXISTING CONDITIONS SHOWN ON THE DRAWINGS SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO BEGINNING ANY MATERIALS ORDERING, FABRICATION OR CONSTRUCTION WORK ON THIS PROJECT. CONTRACTOR SHALL NOT SCALE CONTRACT DRAWINGS IN LIEU OF FIELD VERIFICATION. ANY DISCREPANCIES SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE OWNER AND THE OWNER'S ENGINEER. THE DISCREPANCIES MUST BE RESOLVED BEFORE THE CONTRACTOR IS TO PROCEED WITH THE WORK. THE CONTRACT DOCUMENTS DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK AND SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES. OBSERVATION VISITS TO THE SITE BY THE OWNER AND/OR THE ENGINEER SHALL NOT INCLUDE INSPECTION OF THE PROTECTIVE MEASURES AND PROCEDURES.

8. ALL MATERIALS AND EQUIPMENT FURNISHED SHALL BE NEW AND OF GOOD QUALITY, FREE FROM FAULTS AND DEFECTS AND IN COMFORMANCE WITH THE CONTRACT DOCUMENTS. ANY AND ALL SUBSTITUTIONS MUST BE PROPERLY APPROVED AND AUTHORIZED IN WRITING BY THE OWNER AND ENGINEER PRIOR TO INSTALLATION. THE CONTRACTOR SHALL FURNISH SATISFACTORY EVIDENCE AS TO THE KIND AND QUALITY OF THE MATERIALS AND EQUIPMENT BEING SUBSTITUTED.

9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR INSURING THAT THIS PROJECT AND RELATED WORK COMPLIES WITH ALL APPLICABLE AND LOCAL, STATE, AND FEDERAL SAFETY CODES AND REGULATIONS GOVERNING THIS WORK.

10. ACCESS TO THE PROPOSED WORK SITE MAY BE RESTRICTED. THE CONTRACTOR SHALL COORDINATE INTENDED CONSTRUCTION ACTIVITY, INCLUDING WORK SCHEDULE AND MATERIALS ACCESS, WITH THE RESIDENT LEASING AGENT FOR APPROVAL.

11. BILL OF MATERIALS AND PART NUMBERS LISTED ON THE CONSTRUCTION DRAWINGS ARE INTENDED TO AID THE CONTRACTOR/OWNER. CONTRACTOR/OWNER SHALL VERIFY PARTS AND QUANTITIES WITH THE MANUFACTURER PRIOR TO BIDDING AND/OR ORDERING MATERIALS.

12. CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS FOR THIS PROJECT FROM ALL APPLICABLE GOVERNING AGENCIES.

13. ALL PERMITS THAT MUST BE OBTAINED ARE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE RESPONSIBLE FOR ABIDING BY ALL CONDITIONS AND REQUIREMENTS OF THE PERMITS.

14. 24 HOURS BEFORE THE BEGINNING OF ANY CONSTRUCTION, THE CONTRACTOR MUST NOTIFY THE APPLICABLE JURISDICTIONAL (STATE, COUNTY OR CITY) ENGINEER.

15. THE CONTRACTOR SHALL REWORK (DRY, SCARIFY, ETC.) ALL MATERIAL NOT SUITABLE FOR SUBGRADE IN ITS PRESENT STATE. IF THE MATERIAL REMAINS UNSUITABLE AFTER REWORKING, THE CONTRACTOR SHALL UNDERCUT THIS MATERIAL AND REPLACE IT WITH APPROVED MATERIAL. IF PAVING IS TO BE DONE, ALL SUBGRADES SHALL BE PROOFROLLED WITH A FULLY LOADED TANDEM AXLE DUMP TRUCK PRIOR TO PAVING. ANY SOFT MATERIAL SHALL BE REWORKED OR REPLACED.

16. THE CONTRACTOR IS REQUIRED TO MAINTAIN ALL PIPES, DITCHES, AND OTHER DRAINAGE STRUCTURES FREE FROM OBSTRUCTION UNTIL WORK IS ACCEPTED BY THE OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES CAUSED BY FAILURE TO MAINTAIN DRAINAGE STRUCTURE IN OPERABLE CONDITION.

17. ALL MATERIALS AND WORKMANSHIP SHALL BE WARRANTED FOR ONE YEAR FROM ACCEPTANCE DATE.

18. ALL DIMENSIONS SHALL BE VERIFIED WITH THE PLANS (LATEST REVISION) PRIOR TO COMMENCING CONSTRUCTION. THE OWNER SHALL HAVE A SET OF APPROVED PLANS AVAILABLE AT THE SITE AT ALL TIMES WHILE WORK IS BEING PERFORMED. A DESIGNATED RESPONSIBLE EMPLOYEE SHALL BE AVAILABLE FOR CONTACT BY GOVERNING AGENCY INSPECTORS.

STRUCTURAL STEEL NOTES:

1. THE FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE AISC SPECIFICATION FOR THE MANUAL OF STEEL CONSTRUCTION, ALLOWABLE STRESS DESIGN, 9TH EDITION.

2. UNLESS OTHERWISE NOTED, ALL STRUCTURAL ELEMENTS SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
   - A. ALL SHAPES SHALL BE ASTM A572-50, PLATES A572-65, TUBES A500-C, PIPES A500-C
   - B. ALL BOLTS SHALL BE GALVANIZED A325 HIGH STRENGTH BOLTS.
   - C. ALL NUTS SHALL BE CARBON AND ALLOY STEEL NUTS.
   - D. ALL WASHERS SHALL BE ASTM F436 HARDENED STEEL WASHERS.

3. ALL CONNECTIONS NOT FULLY DETAILED ON THESE PLANS SHALL BE DETAILED BY THE FABRICATOR IN ACCORDANCE WITH AISC SPECIFICATION FOR MANUAL OF STEEL CONSTRUCTION, ALLOWABLE STRESS DESIGN, 9TH EDITION.

4. HOLES SHALL NOT BE FLAME CUT THRU STEEL UNLESS APPROVED BY THE ENGINEER.

5. HOT-DIP GALVANIZE ALL ITEMS UNLESS OTHERWISE NOTED, AFTER FABRICATION WHERE PRACTICABLE. GALVANIZING: ASTM A123, ASTM A153/153M OR ASTM A653/653M, G90, AS APPLICABLE.

6. REPAIR DAMAGED SURFACES WITH GALVANIZING REPAIR METHOD AND PAINT CONFORMING TO ASTM OR BY APPLICATION OF STICK OR THICK PASTE MATERIAL SPECIFICALLY DESIGNED FOR REPAIR OF GALVANIZING. CLEAN AREAS TO BE REPAIRED AND REMOVE SLAG FROM WELDS. HEAT SURFACES TO WHICH STICK OR PASTE MATERIAL IS APPLIED, WITH A TORCH, TO A TEMPERATURE SUFFICIENT TO MELT THE METALLICS IN STICK OR PASTE; SPREAD MOLTEN MATERIAL UNIFORMLY OVER SURFACES TO BE COATED AND WIPE OFF EXCESS MATERIAL.

7. A NUT LOCKING DEVICE SHALL BE INSTALLED ON ALL PROPOSED AND/OR REPLACED BOLTS.

8. ALL PROPOSED AND/OR REPLACED BOLTS SHALL BE OF SUFFICIENT LENGTH TO EXCLUDE THE THREADS FROM THE SHEAR PLANE.

9. ALL PROPOSED AND/OR REPLACED BOLTS SHALL BE OF SUFFICIENT LENGTH SUCH THAT THE END OF THE BOLT BE AT LEAST FLUSH WITH THE FACE OF THE NUT. IT IS NOT PERMITTED FOR THE BOLT END TO BE BELOW THE FACE OF THE NUT AFTER TIGHTENING IS COMPLETED.

10. DO NOT OVER TORQUE ASSEMBLY BOLTS. GALVANIZING ON BOLT NUTS AND STEEL PARTS MAY ACT AS A LUBRICANT, THUS OVER TIGHTENING MAY OCCUR AND MAY CAUSE BOLTS TO CRACK AND SNAP OFF.

BOLT TIGHTENING PROCEDURE:

1. TIGHTEN FLANGE BOLTS BY AISC- "TURN OF THE NUT" METHOD, USING THE CHART BELOW:

BOLT LENGTHS UP TO AND INCLUDING FOUR DIA.

3/4"	BOLTS UP TO AND INCLUDING 4.0 LENGTH	+1/3 TURN BEYOND SNUG TIGHT
7/8"	BOLTS UP TO AND INCLUDING 3.5 LENGTH	+1/3 TURN BEYOND SNUG TIGHT
1"	BOLTS UP TO AND INCLUDING 4.0 LENGTH	+1/3 TURN BEYOND SNUG TIGHT
1-1/8"	BOLTS UP TO AND INCLUDING 4.5 LENGTH	+1/3 TURN BEYOND SNUG TIGHT
1-1/4"	BOLTS UP TO AND INCLUDING 5.0 LENGTH	+1/3 TURN BEYOND SNUG TIGHT
1-1/2"	BOLTS UP TO AND INCLUDING 6.0 LENGTH	+1/3 TURN BEYOND SNUG TIGHT

BOLT LENGTH OVER FOUR DIA. BUT NOT EXCEEDING 8 DIA.

3/4"	BOLTS 4.25 TO 6.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT
7/8"	BOLTS 3.75 TO 7.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT
1"	BOLTS 4.25 TO 8.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT
1-1/8"	BOLTS 4.75 TO 9.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT
1-1/4"	BOLTS 5.25 TO 10.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT
1-1/2"	BOLTS 6.25 TO 12.0 INCH LENGTH	+1/2 TURN BEYOND SNUG TIGHT

2. SPLICE BOLTS SUBJECT TO DIRECT TENSION SHALL BE INSTALLED AND TIGHTENED AS PER SECTION 8(d)(1) OF THE AISC MANUAL OF STEEL CONSTRUCTION. THE INSTALLATION PROCEDURE IS PARAPHRASED AS FOLLOWS:

"FASTENERS SHALL BE INSTALLED IN PROPERLY ALIGNED HOLES AND BE TIGHTENED BY ONE OF THE METHODS DESCRIBED IN SUBSECTION 8(d)(1) THROUGH 8(d)(4).

8(d)(1) TURN-OF-THE-NUT TIGHTENING.
BOLTS SHALL BE INSTALLED IN ALL HOLES OF THE CONNECTION AND BROUGHT TO A SNUG TIGHT CONDITION. SNUG TIGHT IS DEFINED AS THE TIGHTNESS THAT EXISTS WHEN THE PLIES OF A JOINT ARE IN FIRM CONTACT. THIS MAY BE OBTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH. SNUG TIGHTENING SHALL PROGRESS SYSTEMATICALLY...UNTIL ALL THE BOLTS ARE SIMULTANEOUSLY SNUG TIGHT AND THE CONNECTION IS FULLY COMPACTED. FOLLOWING THIS INITIAL OPERATION ALL BOLTS IN THE CONNECTION SHALL BE TIGHTENED FURTHER BY THE APPLICABLE AMOUNT OF ROTATION SPECIFIED ABOVE. DURING THE TIGHTENING OPERATION THERE SHALL BE NO ROTATION OF THE PART NOT TURNED BY THE WRENCH. TIGHTENING SHALL PROGRESS SYSTEMATICALLY.

BEFORE 1/3 TURN

AFTER 1/3 TURN

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR. STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
"execute & deliver"

113 EDINBURGH SOUTH DRIVE SUITE 130
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0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:

PROJECT NOTES

SHEET NUMBER:

N-1

REVISION:

0

VSI #: 141374

SEAL:

No. 2506

November 25, 2014

APPLICABLE CODES AND STANDARDS

1. ANSI/TIA/EIA STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND ANTENNA SUPPORTING STRUCTURES, 222-F-1996.
2. 2005 CONNECTICUT STATE BUILDING CODE.
3. ACI 318: AMERICAN CONCRETE INSTITUTE, BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, 318-89.
4. CRSI: CONCRETE REINFORCING STEEL INSTITUTE, MANUAL OF STANDARD PRACTICE, LATEST EDITION.
5. AISC: AMERICAN INSTITUTE OF STEEL CONSTRUCTION, MANUAL OF STEEL CONSTRUCTION, 9TH EDITION.
6. AWS: AMERICAN WELDING SOCIETY D1.1, STRUCTURAL WELDING CODE, LATEST EDITION.

STRUCTURAL STEEL

1. ALL DETAILING, FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE AISC SPECIFICATIONS, LATEST EDITION.
2. ALL EXPOSED STRUCTURAL STEEL MEMBERS SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION PER ASTM A123. EXPOSED STEEL HARDWARE AND ANCHOR BOLTS SHALL BE GALVANIZED PER ASTM A153 OR B695.
3. ALL U-BOLTS SHALL BE ASTM A307 OR EQUIVALENT, WITH LOCKING DEVICE, UNLESS NOTED OTHERWISE.

WELDING

1. ALL WELDING SHALL BE PERFORMED BY WELDERS CURRENTLY STATE OR AWS CERTIFIED TO THE AWS D1.1 STRUCTURAL WELDING CODE, LATEST EDITION.
2. ALL FIELD WELDING SHALL UTILIZE LOW HYDROGEN ELECTRODES.
3. PRIOR TO FIELD WELDING, GRIND OFF GALVANIZING TO 1/2" BEYOND ALL FIELD WELD SURFACES.
4. ALL FIELD CUT, FIELD WELDED, OR DAMAGED GALVANIZING SURFACES SHALL BE REPAIRED WITH ZINC RICH PAINT (95% ZINC CONTENT) PER ASTM A780.
5. PRIOR TO FIELD WELDING, CONTRACTOR SHALL CLEAR THE INTERIOR OF MONOPOLE OF FLAMMABLE DEBRIS. COAXIAL CABLE SHALL BE SHIFTED AWAY FROM PROXIMITY OF THE WELD AND/OR COVERED WITH A HEAT RESISTANT BLANKET.

PAINT

1. CLEAN AND PAINT PROPOSED STEEL ACCORDING TO FAA ADVISORY CIRCULAR AC 70/7460-1K.

REINFORCEMENT STEEL

1. ALL REINFORCEMENT BARS ARE ASTM A572 GRADE 65, Fy = 65 ksi, Fu = 80 ksi.

FIELD WELDS

1. ALL FIELD WELDS SHALL BE MADE WITH E70XX WELD RODS.
2. ALL SHOP WELDS SHALL BE MADE WITH E80XX WELD RODS.

GENERAL NOTES:

1. ALL METHODS, MATERIAL AND WORKMANSHIP SHALL FOLLOW THE DICTATES OF GOOD CONSTRUCTION PRACTICES.
2. ALL WORK INDICATED ON THESE DRAWINGS SHALL BE PERFORMED BY QUALIFIED CONTRACTORS EXPERIENCED IN TOWER AND FOUNDATION CONSTRUCTION.
3. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF RECORD IMMEDIATELY OF ANY INSTALLATION INTERFERENCES. ALL NEW WORK SHALL ACCOMMODATE EXISTING CONDITIONS. DETAILS NOT SPECIFICALLY SHOWN ON THE DRAWINGS SHALL FOLLOW SIMILAR DETAILS FOR THIS JOB.
4. ANY SUBSTITUTIONS MUST CONFORM TO THE REQUIREMENTS OF THE NOTES AND SPECIFICATIONS AND SHOULD BE SIMILAR TO THOSE SHOWN. ALL SUBSTITUTIONS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR REVIEW AND APPROVAL PRIOR TO FABRICATION.
5. ANY MANUFACTURED DESIGN ELEMENTS MUST CONFORM TO THE REQUIREMENTS OF THESE NOTES AND SPECIFICATIONS AND SHOULD BE SIMILAR TO THOSE SHOWN. THESE DESIGN ELEMENTS MUST BE STAMPED BY AN ENGINEER PROFESSIONALLY REGISTERED IN THE STATE OF THE PROJECT, AND SUBMITTED TO THE ENGINEER OF RECORD FOR APPROVAL PRIOR TO FABRICATION.
6. ALL WORK SHALL BE DONE IN ACCORDANCE WITH LOCAL CODES AND OSHA SAFETY REGULATIONS.
7. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND EXECUTION OF ALL MISCELLANEOUS SHORING, BRACING, TEMPORARY SUPPORTS, ETC. NECESSARY TO PROVIDE A COMPLETE AND STABLE STRUCTURE AS SHOWN ON THESE DRAWINGS.
8. ANY STEEL WHICH HAS BEEN FIELD CUT OR WELDED SHALL BE COLD GALVANIZED WITH 95% ZINC RICH PAINT PER ASTM A780.
9. CONTRACTOR'S PROPOSED INSTALLATION SHALL NOT INTERFERE, NOR DENY ACCESS TO, ANY EXISTING OPERATIONAL AND SAFETY EQUIPMENT.

SPECIAL INSPECTION

1. A QUALIFIED INDEPENDENT TESTING LABORATORY, EMPLOYED BY THE OWNER, SHALL PERFORM INSPECTION AND TESTING IN ACCORDANCE WITH IBC 2003, SECTION 1704 AS REQUIRED BY PROJECT SPECIFICATIONS FOR THE FOLLOWING CONSTRUCTION WORK:
    a) STRUCTURAL WELDING
    b) HIGH STRENGTH BOLTS
2. THE INSPECTION AGENCY SHALL SUBMIT INSPECTION AND TEST REPORTS TO THE BUILDING DEPARTMENT, THE ENGINEER OF RECORD, AND THE OWNER IN ACCORDANCE WITH IBC 2003, SECTION 1704. UNLESS THE FABRICATOR IS APPROVED BY THE BUILDING OFFICIAL TO PERFORM SUCH WORK WITHOUT THE SPECIAL INSPECTIONS.

FIELD BOLTS

1. ALL STITCH, SPLICE & TERMINATION BOLTS ARE 20 mm ONESIDE BOLTS BY AJAX.
    a) BOLTS SHALL MEET AS 1252, PROPERTRY CLASS 8.8 (SIMILAR TO ASTM A325M)
    b) Fu = 120 ksi
2. EACH BOLT SHALL INCLUDE A 30 mm O.D. BY 20 mm I.D. SLEEVE (Fu=120 ksi)
3. BOLT HOLES SHALL BE 31 mm MAXIMUM.

FOUNDATION NOTES

1. CONCRETE SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
2. REBAR SHALL CONFORM TO ASTM SPECIFICATION A615.
3. ALL REBAR SHALL HAVE 3 INCHES MINIMUM COVER.
4. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 1 INCH.
5. SEE GEOTECHNICAL REPORT FOR INSTALLATION REQUIREMENTS.
6. REINFORCEMENT SHALL BE 3 INCHES CLEAR FROM EDGES OF CONCRETE.

PHOTO CHECKLIST

1. CONTRACTOR SHALL SUBMIT THE FOLLOWING PHOTOS TO VERTICAL SOLUTIONS. IF PHOTOS DON'T MEET THE SATISFACTION OF OWNER OR ENGINEER OF RECORD, CONTRACTOR SHALL RETURN TO SITE AT HIS OWN EXPENSE TO OBTAIN ADDITIONAL PHOTOS. AS AN ALTERNATE, CONTRACTOR MAY RETAIN VERTICAL SOLUTIONS TO EXECUTE AN INSPECTION FOR A FEE. TOWERCO MAY ALSO ELECT TO RETAIN VERTICAL SOLUTIONS IF CONTRACTOR SCHEDULE DOES NOT MEET PROJECT TIMELINES. CONTACT inspection@verticalsolutions-inc.com FOR FEE AMOUNT AND / OR SCHEDULE.

PERIMETER POUR - SELF SUPPORTING POLE STRUCTURE

COMPLETE (Y/N)	PHOTOGRAPH(S) DESCRIPTION
	EACH AREA OF EXCAVATION PRIOR TO LAYING OUT THE REBAR/ DOWELS.
	ALL CORINGS IN THE EXISTING FOUNDATION.
	EACH AREA OF EXCAVATION AFTER LAYING OUT THE REBAR/ DOWELS.
	EACH AREA OF THE FOUNDATION AFTER THE CONCRETE IS POURED..

PLANS PREPARED FOR:

URS
500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2
VZ5-177
60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
"execute & deliver"
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www.verticalsolutions-inc.com

0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:
PROJECT NOTES

SHEET NUMBER: N-2
REVISION: 0
VSI #: 141374

SEAL:

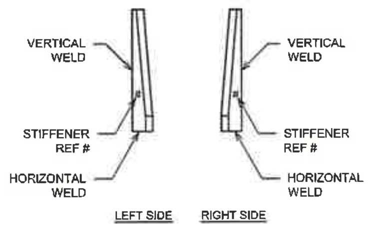
November 25, 2014

PHOTO CHECKLIST

1. CONTRACTOR SHALL SUBMIT THE FOLLOWING PHOTOS TO VERTICAL SOLUTIONS. IF PHOTOS DON'T MEET THE SATISFACTION OF OWNER OR ENGINEER OF RECORD, CONTRACTOR SHALL RETURN TO SITE AT HIS OWN EXPENSE TO OBTAIN ADDITIONAL PHOTOS. AS AN ALTERNATE, CONTRACTOR MAY RETAIN VERTICAL SOLUTIONS TO EXECUTE AN INSPECTION FOR A FEE. TOWERCO MAY ALSO ELECT TO RETAIN VERTICAL SOLUTIONS IF CONTRACTOR SCHEDULE DOES NOT MEET PROJECT TIMELINES. CONTACT inspection@verticalsolutions-inc.com FOR FEE AMOUNT AND / OR SCHEDULE.

STIFFENER PLATES - SELF SUPPORTING POLE STRUCTURE

COMPLETE (Y/N)	PHOTOGRAPH(S) DESCRIPTION
	LABEL AND PHOTO EACH STIFFENER PLATE EACH SIDE AFTER WELDING AND PRIOR TO COLD GALVANIZING.
	LABEL AND PHOTO EACH STIFFNER PLATE EACH SIDE AFTER COLD GALVANIZING.



BAR REINFORCEMENT - SELF SUPPORTING POLE STRUCTURE

COMPLETE (Y/N)	PHOTOGRAPH(S) DESCRIPTION
	BOTTOM OF B#1 TO B#6, INCLUDING ALL TERMINATIONBOLTS. MAKE SURE RB'S ARE LABELED PER FIGURE BELOW.
	FULL ELEVATION OF B#1 TO B#6, INCLUDING FULL LENGTH OF BAR.
	TOP OF B#1 TO B#6 INCLUDING ALL TERMINATION BOLTS.

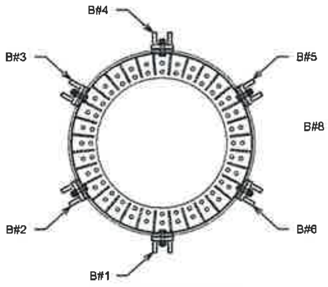


FIGURE 1 - 20' ELEVATION

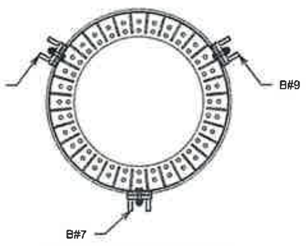


FIGURE 2 - 40' TO 100' ELEVATION

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
"execute & deliver"

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REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA | CHECKED BY: MER

SHEET TITLE:

PROJECT NOTES

SHEET NUMBER: **N-3**

REVISION: **0**

VSI #: 141374

SEAL:

No. 25084

November 25, 2014

BILL OF MATERIAL - MONOPOLE REINFORCEMENT

MARK NO.	DESCRIPTION	SIZE	QTY
RB-01	REINFORCING BAR - 01	A572-65 ℙ 1 1/4"x7"x5'-0"	15
RB-02	REINFORCING BAR - 02	A572-65 ℙ 1 1/4"x3 1/2"x14'-3 1/4"	3
RB-03	REINFORCING BAR - 03	A572-65 ℙ 1 1/4"x3 1/4"x5'-1 5/16"	3
RB-04	REINFORCING BAR - 04	A572-65 ℙ 1 1/4"x7"x4'-0"	3
RB-01-GP	REINFORCING BAR GUSSET PLATE - 01	A572-65 ℙ 1 1/4"x4"x5'-0"	6
RB-04-GP	REINFORCING BAR GUSSET PLATE - 04	A572-65 ℙ 1 1/4"x2 5/8"x4'-0"	6
FPL-01	FILLER PLATE - 01	A36 ℙ 1 1/4"x7"x1'-9"	18
FPL-02	FILLER PLATE - 02	A36 ℙ 1 3/4"x7"x1'-9"	6
FPL-03	FILLER PLATE - 03	A36 ℙ 1/4"x7"x1'-9"	3
FPL-04	FILLER PLATE - 04	A36 ℙ 1 1/2"x7"x1'-9"	3
FPL-05	FILLER PLATE - 05	A36 ℙ 1/4"x7"x1'-3"	3
FPL-06	FILLER PLATE - 06	A36 ℙ 1 1/2"x7"x1'-3"	3
FPL-07	FILLER PLATE - 07	A36 ℙ 1 3/4"x7"x1'-3"	3
SP-01	STIFFENER PLATE - 01	A36 ℙ 1/4"	52
SP-02	STIFFENER PLATE - 02	A36 ℙ 1/4"	52
SB-01	HIGH STRENGTH BOLT W/ ASTM F436 WASHER	ASTM A325 1 1/8"Ø X 5" (1) FLAT WASHER (1) SPLIT WASHER	126
SB-02	STITCH BOLT (AJAX)	20-mmØ - 165mm ONESIDE W/ 30-mmØ SLEEVE	30
SB-03	HIGH STRENGTH BOLT W/ ASTM F436 WASHER	ASTM A325 1 1/8"Ø X 7 3/4" (1) FLAT WASHER (1) SPLIT WASHER	18
SB-04	STITCH BOLT (AJAX)	20-mmØ - 95mm ONESIDE W/ 30-mmØ SLEEVE	69
-	WELD ELECTRODE	E70XX	TBD
-	WELD ELECTRODE	E80XX	TBD

NOTES:
1. LABEL BARS WITH BAR #.
2. BARS ARE TO BE ASTM A572 GRADE 65 STEEL
   & HOT-DIP GALVANIZED.
3. HOLES IN BARS ARE 31mmØ & DIMENSIONED TO CENTERS.
4. BOTTOM OF BARS ON LEFT AS SHOWN.

BILL OF MATERIAL - FOUNDATION REINFORCEMENT

MARK NO.	DESCRIPTION	SIZE	QTY
HORIZ	HORIZONTAL BAR	#8 ASTM A615-60 x 22'-6"	16
DOWEL	HOOKED DOWEL	#5 ASTM A615-60 x 2'-1"	160
CONC	4000-PSI MIX	14.4 CY	1
EPOXY	HILTI EPOXY	HIT-RE-500	TBD

BILL OF MATERIAL - AJAX SLEEVE

SLEEVE SIZE	QTY
30-mmØ x 1.5"	39
30-mmØ x 1.75"	30
30-mmØ x 4 3/4"	30

NOTE:
1. 23'-6"± TOTAL NEEDED.

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
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PLANS PREPARED BY:

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REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:

BILL OF MATERIALS

SHEET NUMBER: **B-1**

REVISION: **0**

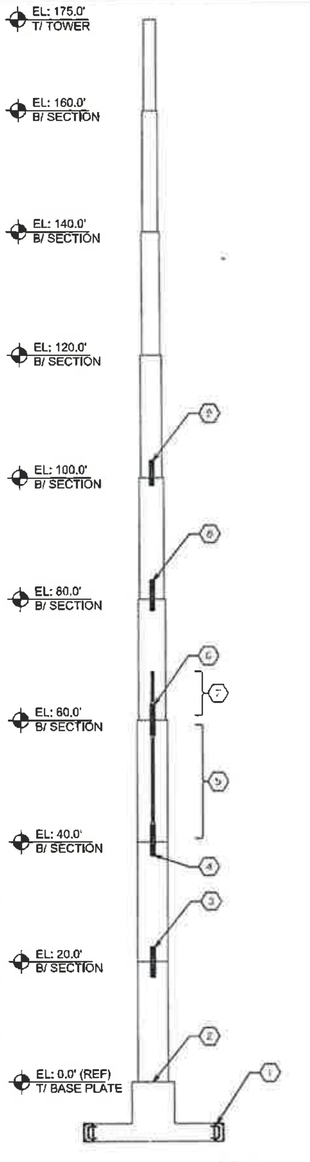
VSI #: 141374

SEAL:

STATE OF CONNECTICUT
No. 25064
LICENSED PROFESSIONAL ENGINEER

November 25, 2014

STRUCTURE									
SECTION	01	02	03	04	05	06	07	08	09
LENGTH	20'								15
# SIDES	ROUND								
THICK. (IN.)	0.625	0.500	0.375						
TOP DIA. (IN)	60			54.0	48.0	42.0	36.0	30.0	24.0
BOT DIA. (IN)	60			54.0	48.0	42.0	36.0	30.0	24.0
SHAFT GRADE	A53-B-42								
ANCHOR BOLT	(10) 2.25" x 6'-0" A615 GR 75								
BASE PLATE	1.75" x 54.0"Ø								



TOWER ELEVATION ⑩

SCALE: 1" = 20'-0"

MODIFICATION DESIGN PROVISIONS

THIS MODIFICATION DESIGN IS BASED ON VERTICAL SOLUTIONS STRUCTURAL ANALYSIS REPORT, VSI JOB # 141374 DATED NOVEMBER 25, 2014. THIS REPORT IS BASED ON A SPECIFIC ANTENNA AND COAX CONFIGURATION. SEE THE REPORT FOR ANTENNA AND COAX LOADING. ANY OTHER ANTENNA CONFIGURATION REQUIRES REVIEW BY VERTICAL SOLUTIONS.

CONSTRUCTION INTERFERENCES

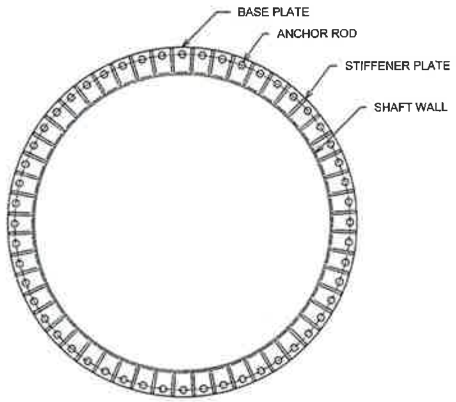
EXISTING AND PROPOSED ANTENNAS, MOUNTS, COAX, AND HAND-HOLE RIMS ARE NOT SHOWN FOR CLARITY. CONTRACTOR SHALL COORDINATE WITH THE TOWER OWNER WITH RESPECT TO INTERFERENCES TO REINFORCEMENT. CONTRACTOR SHALL FIELD VERIFY TOWER DIMENSION PRIOR TO FABRICATION.

FIELD VERIFICATION

CONTRACTOR TO VERIFY EXISTING CONDITIONS PRIOR TO FABRICATION.

MODIFICATION SCHEDULE

NO.	MODIFICATION DESCRIPTION
1	INSTALL PERIMETER POUR, SEE SHEETS S-2 & S-3.
2	REINFORCE EXISTING STIFFENER PLATES, SEE SHEETS S-4.
3	INSTALL (6) JUMP KITS, SEE SHEETS S-4.
4	INSTALL (3) JUMP KITS, SEE SHEETS S-5.
5	INSTALL (3) REINFORCING BARS, SEE SHEETS S-5.
6	INSTALL (3) JUMP KITS, SEE SHEETS S-5.
7	INSTALL (3) REINFORCING BARS, SEE SHEETS S-5.
8	INSTALL (3) JUMP KITS, SEE SHEETS S-5.
9	INSTALL (3) JUMP KITS, SEE SHEETS S-6.
10	CONTRACTOR SHALL PROVIDE CONSTRUCTION PROGRESS PHOTOS, AS WELL AS PROJECT COMPLETION PHOTOS, ALONG WITH STEEL & CONCRETE CERTIFICATION FOR VERTICAL SOLUTIONS, INC. TO COMPLETE A POST MODIFICATION LETTER. SEE SHEET N-2 & N-3.



SECTION @ BASE

SCALE: 1/2" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR. STE 3B
ROCKY HILL, CT 06067
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0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:

TOWER ELEVATION AND MODIFICATION SCHEDULE

SHEET NUMBER: **S-1**

REVISION: **0**

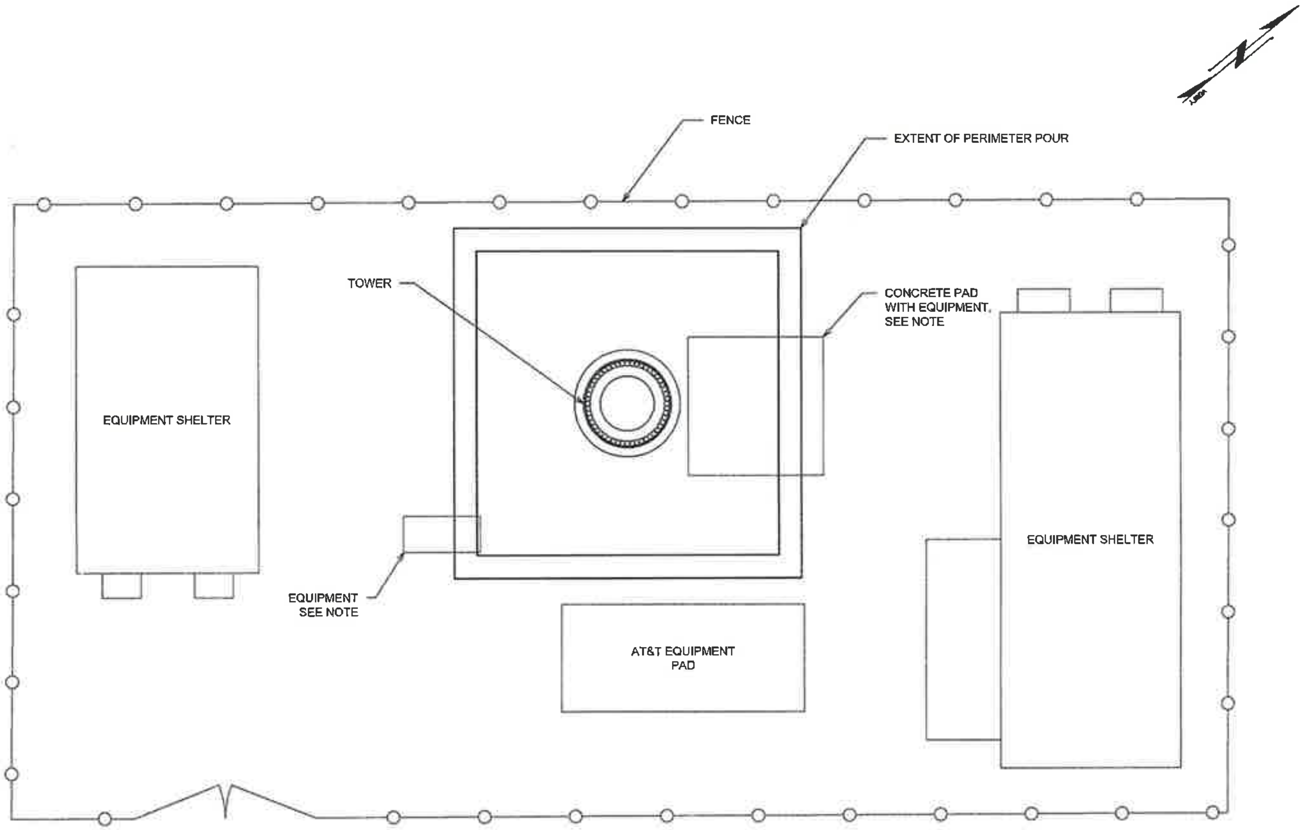
VSI # 141374

SEAL:

No. 25064

November 25, 2014

NOTE:
1. RELOCATE PAD AND EQUIPMENT AS NEEDED.



1 COMPOUND PLAN
S-2 SCALE: 1/8" = 1'-0"

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SHEET TITLE:

COMPOUND PLAN

SHEET NUMBER:
S-2

REVISION:
0

VSI #: 141374

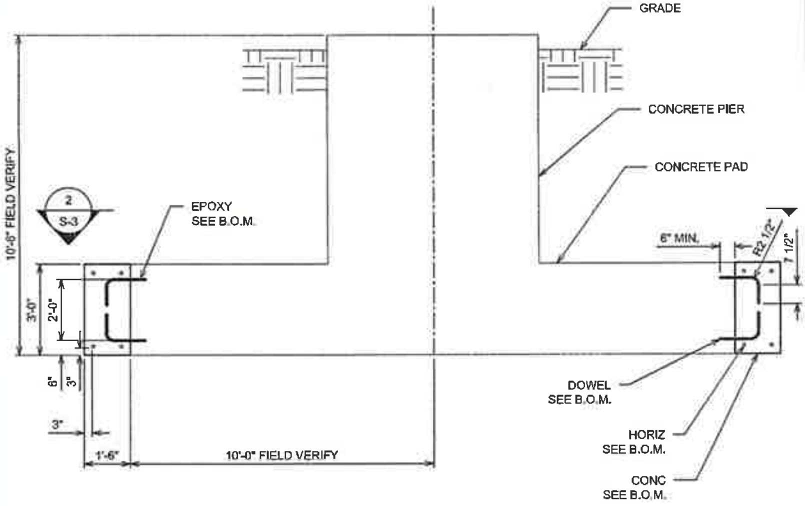
SEAL:

No. 25064

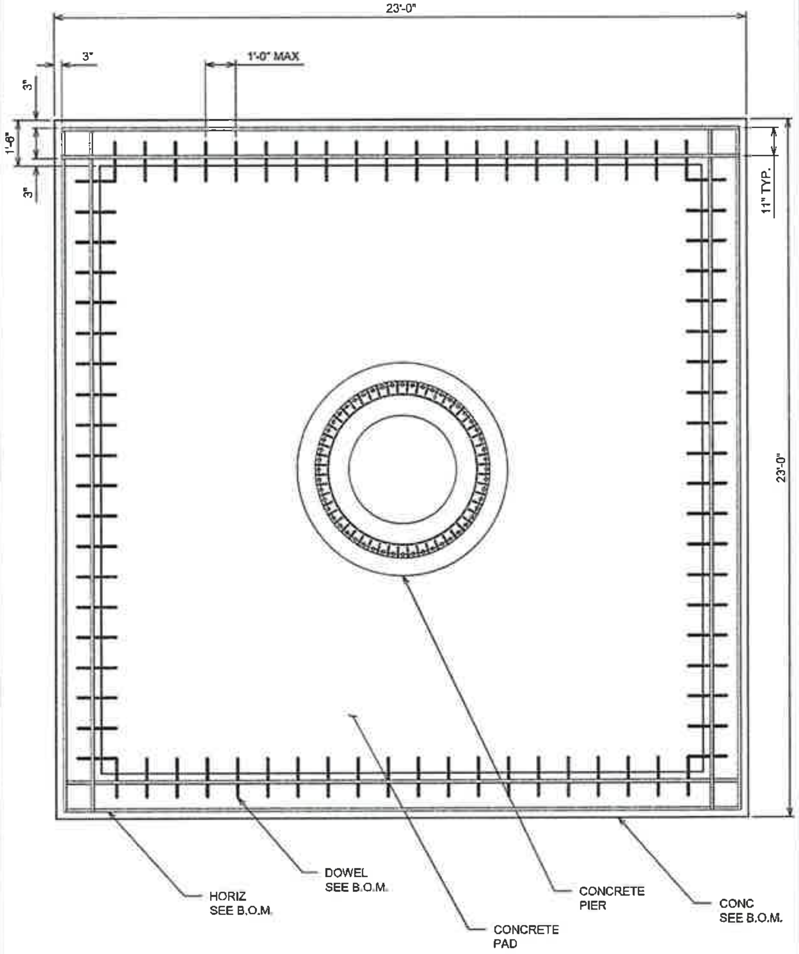
November 25, 2014

NOTE:

1. STAGGER ELEVATION OF DOWELS AND HORIZONTALS AT THE FOUNDATION CORNERS TO AVOID INTERFERENCE.
2. HOLES DRILLED INTO FOUNDATION TO BE 3/4"Ø, 6" MIN INTO EXISTING CONCRETE.
3. HOLES DRILLED INTO CONCRETE TO BE ROUGHENED AND CLEANED.
4. EPOXY TO BE HILTI HIT-RE-500 & INSTALLED IN ACCORDANCE WITH ACI 306R-88 (2002).



1 PERIMETER POUR ELEVATION
S-3 SCALE: 1/4" = 1'-0"



2 PERIMETER POUR PLAN
S-3 SCALE: 1/4" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
"execute & deliver"

113 EDINBURGH SOUTH DRIVE SUITE 130
CARY, NC 27511
OFFICE: (888) 321-6167
www.verticalsolutions-inc.com

REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:

CONSTRUCTION DETAILS

SHEET NUMBER:
S-3

REVISION:
0

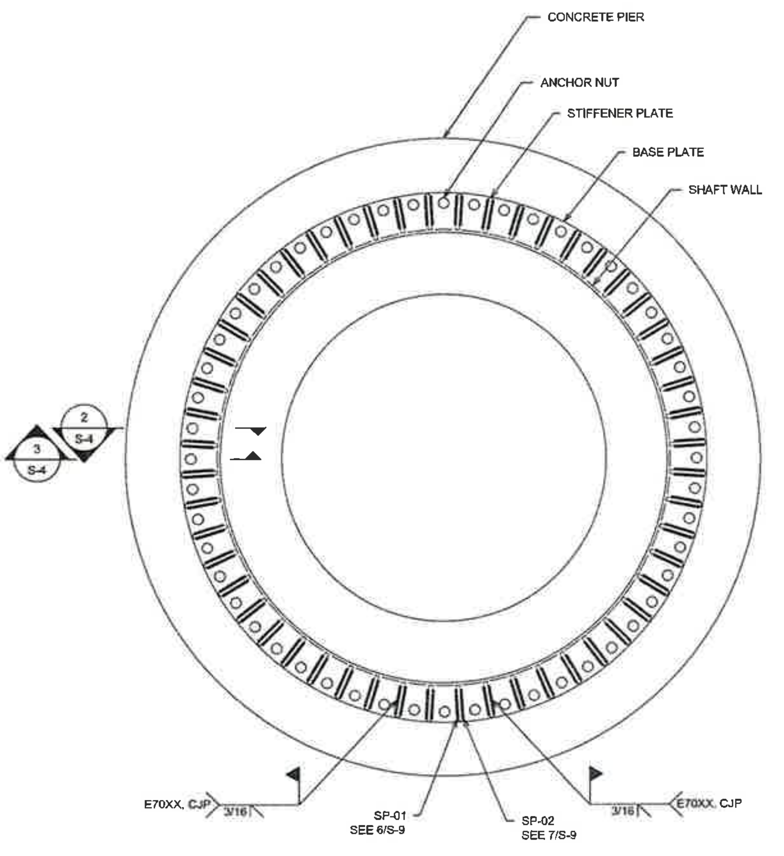
VSI #: 141374

SEAL:

No. 25064

November 25 2014

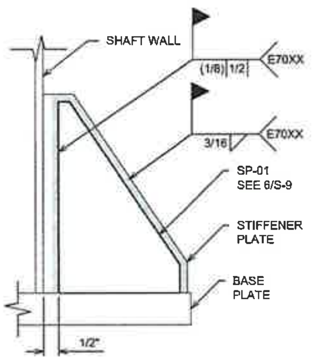
NOTES:
1. VERIFY EXISTING STIFFENER PLATE DIMENSIONS PRIOR TO FABRICATION OF SP-01 & SP-02.



1 S-4 BASE PLATE - PLAN

SCALE: 3/16" = 1'-0"

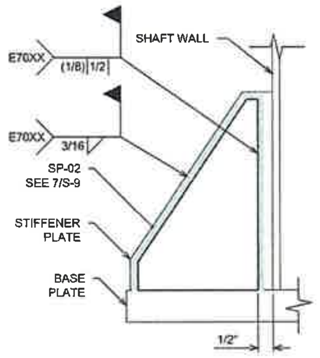
NOTES:
1. VERIFY EXISTING STIFFENER PLATE DIMENSIONS PRIOR TO FABRICATION OF SP-01.



2 S-4 SP-01 CONN. - ELEVATION

SCALE: 1" = 1'-0"

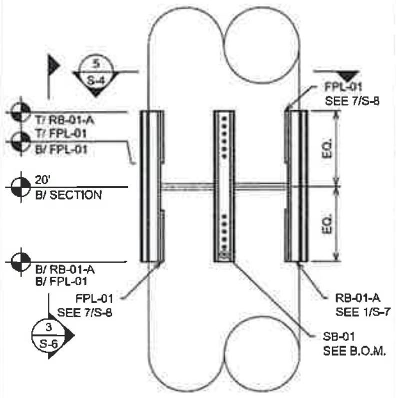
NOTES:
1. VERIFY EXISTING STIFFENER PLATE DIMENSIONS PRIOR TO FABRICATION OF SP-02.



3 S-4 SP-02 CONN. - ELEVATION

SCALE: 1" = 1'-0"

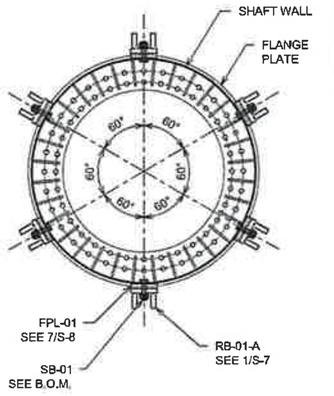
NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 60° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



4 S-4 20' FLANGE - ELEVATION

SCALE: 1/4" = 1'-0"

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 60° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



5 S-4 20' FLANGE - PLAN

SCALE: 3/8" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

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0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MBA CHECKED BY: MER

SHEET TITLE:

CONSTRUCTION DETAILS

SHEET NUMBER: **S-4**

REVISION: **0**

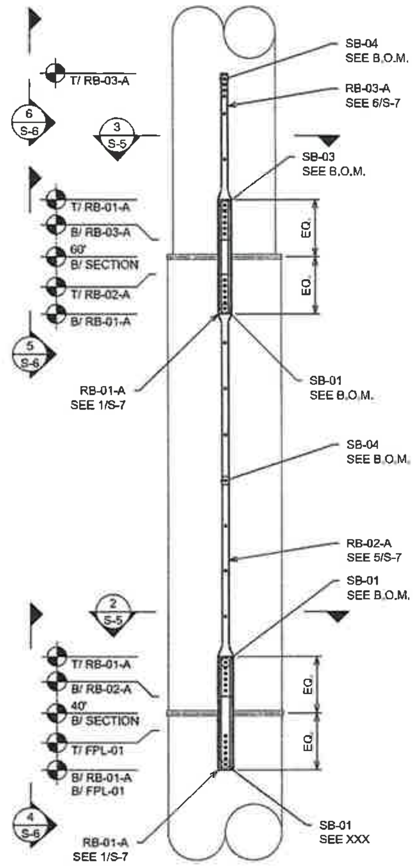
VSI #: 141374

SEAL:

No. 250

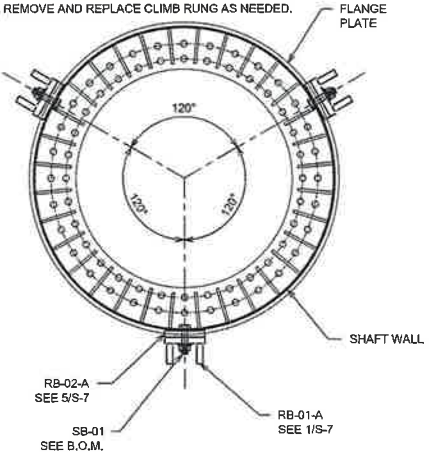
November 25, 2014

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



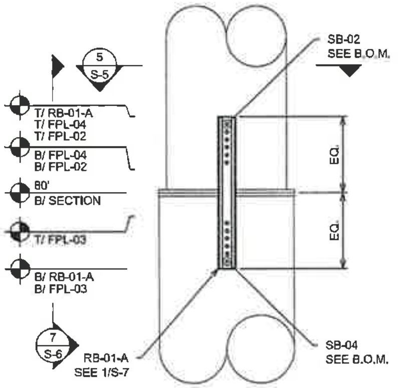
1 S-5 SECTION ELEVATION
SCALE: 3/16" = 1'-0"

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



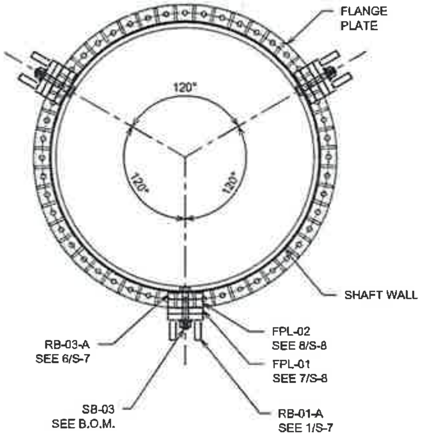
2 S-5 40' FLANGE - PLAN
SCALE: 1/2" = 1'-0"

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



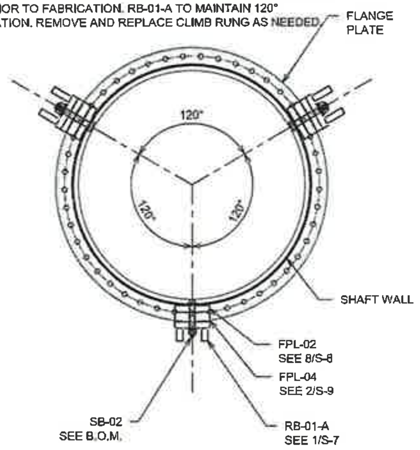
4 S-5 80' FLANGE - ELEVATION
SCALE: 1/4" = 1'-0"

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



3 S-5 60' FLANGE - PLAN
SCALE: 1/2" = 1'-0"

NOTE:
1. RB-01-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



5 S-5 80' FLANGE - PLAN
SCALE: 1/2" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR. STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

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CARY, NC 27511
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www.verticalsolutions-inc.com

0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MEA CHECKED BY: MER

SHEET TITLE:

CONSTRUCTION DETAILS

SHEET NUMBER: S-5

REVISION: 0

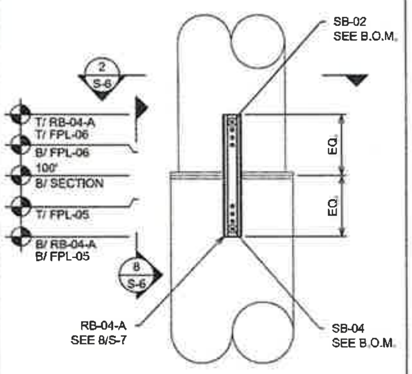
VSI #: 141374

SEAL:

No. 25064

November 25 2014

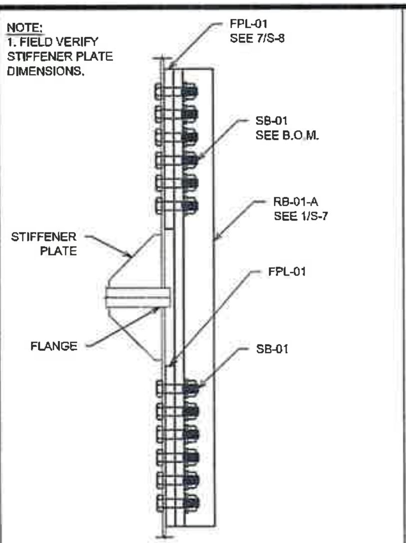
NOTE:
1. RB-04-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



1 100' FLANGE - ELEVATION

S-6 SCALE: 1/4" = 1'-0"

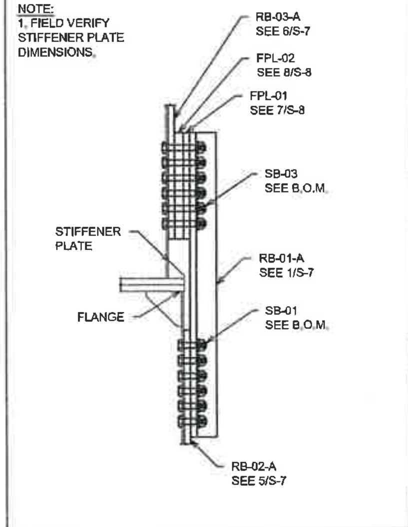
NOTE:
1. FIELD VERIFY STIFFENER PLATE DIMENSIONS.



3 20' JUMP KIT DETAIL

S-6 SCALE: 3/4" = 1'-0"

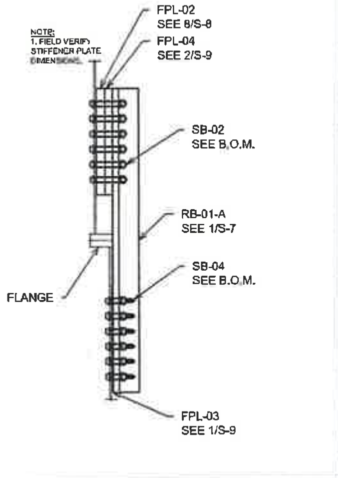
NOTE:
1. FIELD VERIFY STIFFENER PLATE DIMENSIONS.



5 60' JUMP KIT DETAIL

S-6 SCALE: 1/2" = 1'-0"

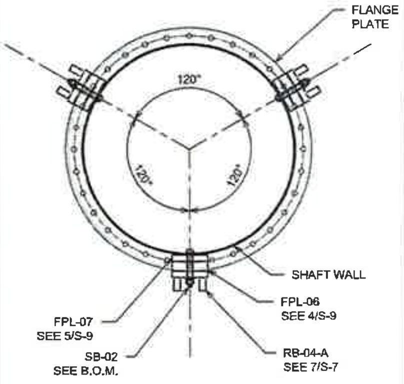
NOTE:
1. FIELD VERIFY STIFFENER PLATE DIMENSIONS.



7 80' JUMP KIT DETAIL

S-6 SCALE: 1/2" = 1'-0"

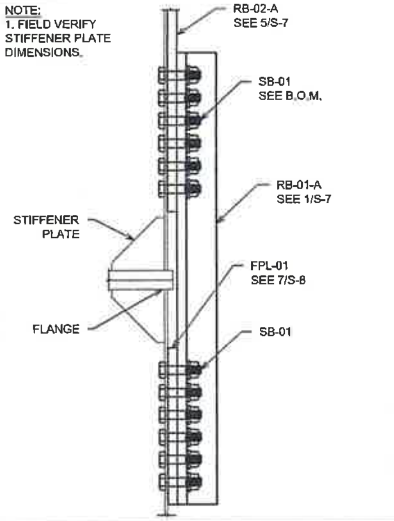
NOTE:
1. RB-04-A TO BE CENTERED AT CENTERLINE OF FLANGE.
2. CONTRACTOR TO VERIFY LOCATION OF CLIMB RUNGS AND/OR HHR PRIOR TO FABRICATION. RB-01-A TO MAINTAIN 120° SEPARATION. REMOVE AND REPLACE CLIMB RUNG AS NEEDED.



2 100' FLANGE - PLAN

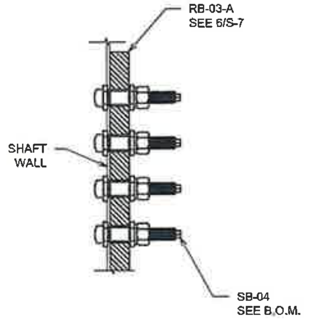
S-6 SCALE: 1/2" = 1'-0"

NOTE:
1. FIELD VERIFY STIFFENER PLATE DIMENSIONS.



4 40' JUMP KIT DETAIL

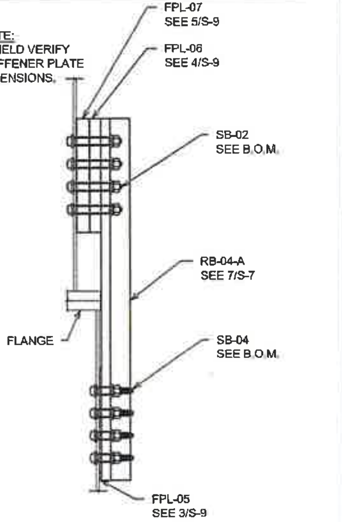
S-6 SCALE: 3/8" = 1'-0"



6 RB-03-A TOP TERMINATION

S-6 SCALE: 1 1/2" = 1'-0"

NOTE:
1. FIELD VERIFY STIFFENER PLATE DIMENSIONS.



8 100' JUMP KIT DETAIL

S-6 SCALE: 3/4 = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR. STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
VERNON, CT 06066
(TOLLAND COUNTY)

PLANS PREPARED BY:

vertical solutions
execute & deliver

113 EDINBURGH SOUTH DRIVE SUITE 130
CARY, NC 27511
OFFICE: (888) 321-6167
www.verticalsolutions-inc.com

0	11-25-14	CONSTRUCTION
REV	DATE	ISSUED FOR:

DRAWN BY: MEA CHECKED BY: MER

SHEET TITLE:

CONSTRUCTION DETAILS

SHEET NUMBER: **S-6**

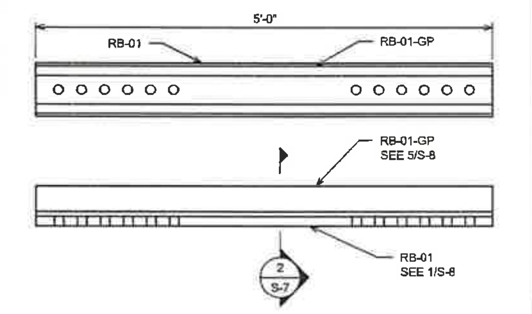
REVISION: **0**

VSI #: 141374

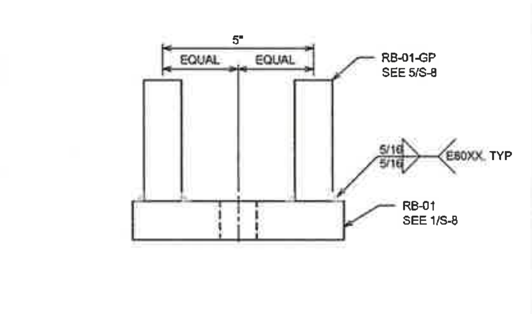
SEAL:

No. 25064

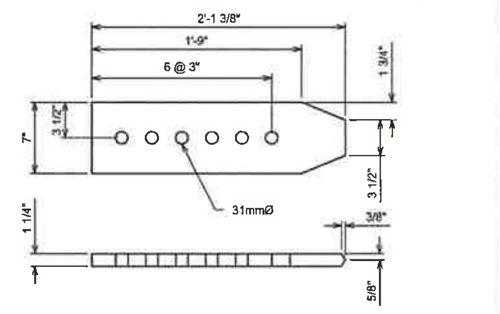
November 25 2014



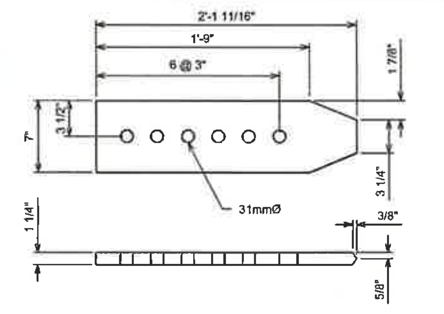
1
S-7
RB-01-A DETAIL
SCALE: 3/4" = 1'-0"



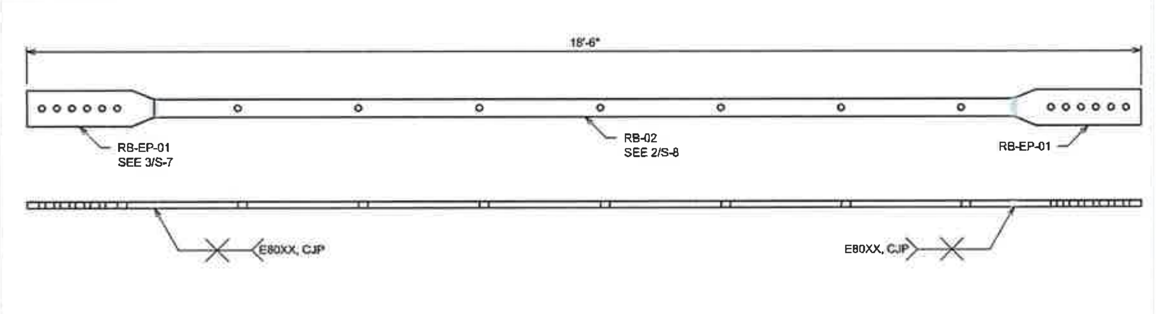
2
S-7
RB-01-A SECTION
SCALE: 3" = 1'-0"



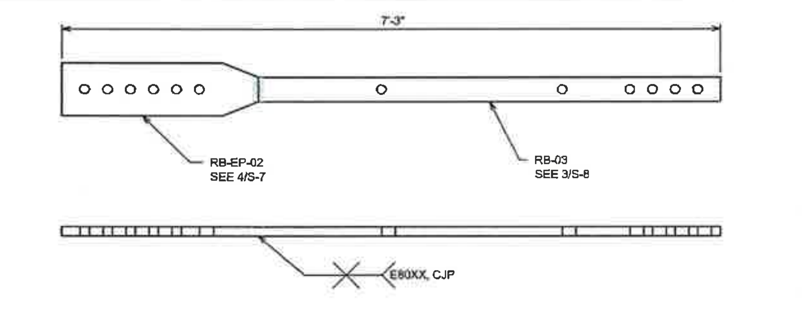
3
S-7
RB-EP-01 DETAIL
SCALE: 1" = 1'-0"



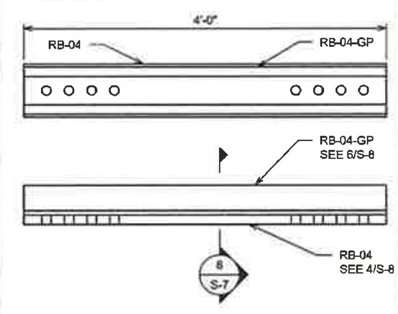
4
S-7
RB-EP-02 DETAIL
SCALE: 1" = 1'-0"



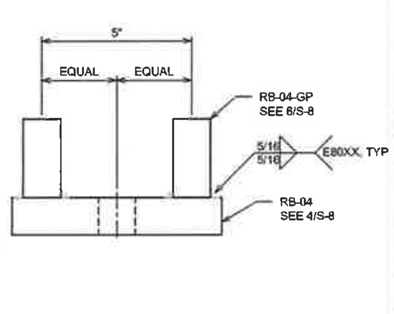
5
S-7
RB-02-A DETAIL
SCALE: 1/2" = 1'-0"



6
S-7
RB-03-A DETAIL
SCALE: 3/4" = 1'-0"



7
S-7
RB-04-A DETAIL
SCALE: 3/4" = 1'-0"



8
S-7
RB-04-A SECTION
SCALE: 3" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR, STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

60 INDUSTRIAL PARK RD
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(TOLLAND COUNTY)

PLANS PREPARED BY:

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CARY, NC 27511
OFFICE: (888) 321-5167
www.verticalsolutions-inc.com

REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA CHECKED BY: MER

SHEET TITLE:

FABRICATION DETAILS

SHEET NUMBER: **S-7**

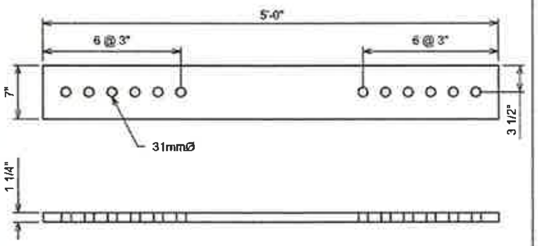
REVISION: 0

VSI #: 141374

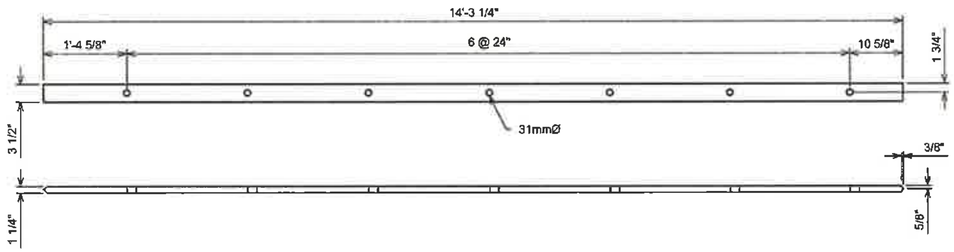
SEAL:

No. 25064

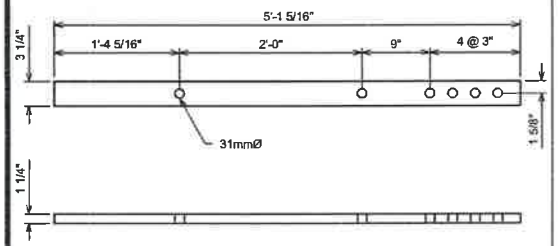
November 25, 2014



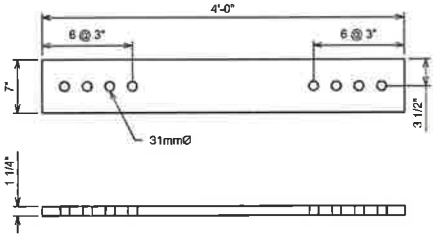
1
S-8
RB-01 DETAIL
SCALE: 3/4" = 1'-0"



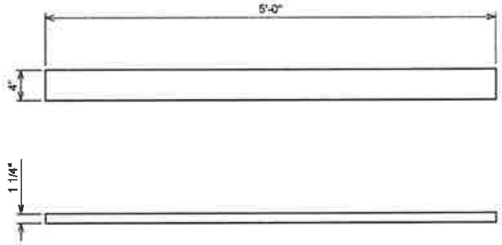
2
S-8
RB-02 DETAIL
SCALE: 1/2" = 1'-0"



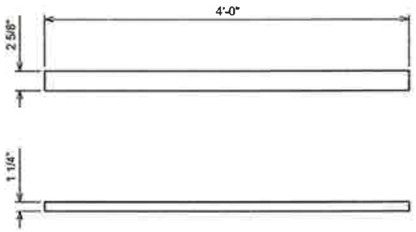
3
S-8
RB-03 DETAIL
SCALE: 3/4" = 1'-0"



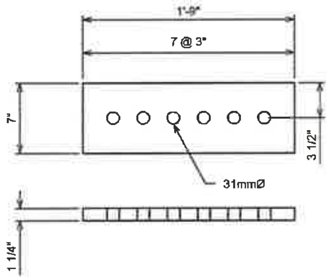
4
S-8
RB-04 DETAIL
SCALE: 3/4" = 1'-0"



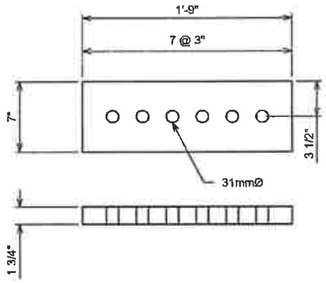
5
S-8
RB-01-GP DETAIL
SCALE: 3/4" = 1'-0"



6
S-8
RB-04-GP DETAIL
SCALE: 3/4" = 1'-0"



7
S-8
FPL-01 DETAIL
SCALE: 1" = 1'-0"



8
S-8
FPL-02 DETAIL
SCALE: 1" = 1'-0"

PLANS PREPARED FOR:

URS

500 ENTERPRISE DR STE 3B
ROCKY HILL, CT 06067
OFFICE: (860) 990-6737

PROJECT INFORMATION:

VERNON 2

VZ5-177

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REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA
CHECKED BY: MER

SHEET TITLE:

FABRICATION DETAILS

SHEET NUMBER: **S-8**

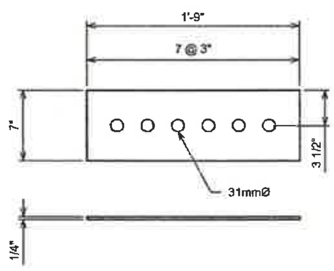
REVISION: **0**

VSI #: 141374

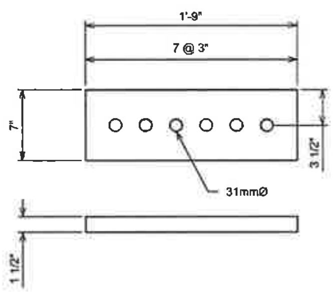
SEAL:

No. 25084

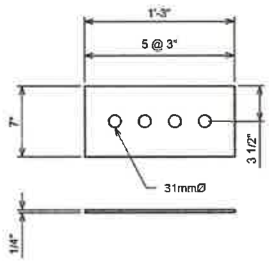
November 25, 2014



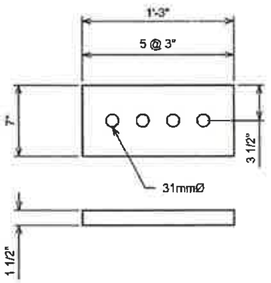
1 S-9 FPL-03 DETAIL
SCALE: 1" = 1'-0"



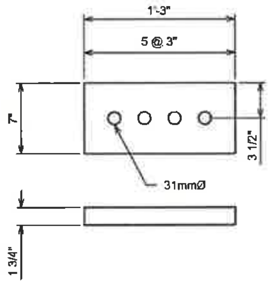
2 S-9 FPL-04 DETAIL
SCALE: 1" = 1'-0"



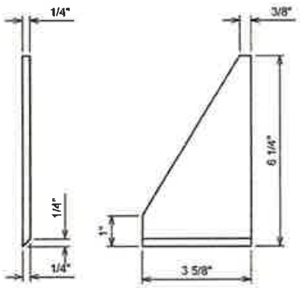
3 S-9 FPL-05 DETAIL
SCALE: 1" = 1'-0"



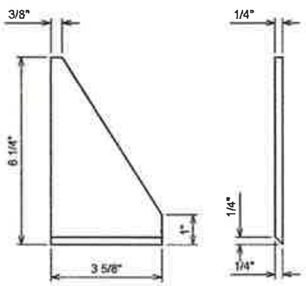
4 S-9 FPL-06 DETAIL
SCALE: 1" = 1'-0"



5 S-9 FPL-07 DETAIL
SCALE: 1" = 1'-0"



6 S-9 SP-01 DETAIL
SCALE: 3" = 1'-0"



7 S-9 SP-02 DETAIL
SCALE: 3" = 1'-0"

PLANS PREPARED FOR:

URS

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PROJECT INFORMATION:

VERNON 2

VZ5-177

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REV	DATE	ISSUED FOR:
0	11-25-14	CONSTRUCTION

DRAWN BY: MEA | CHECKED BY: MER

SHEET TITLE:

FABRICATION DETAILS

SHEET NUMBER: **S-9**

REVISION: **0**

VSI #: 141374

SEAL:

No. 25064

November 25 2014