Robinson+Cole

KENNETH C. BALDWIN

280 Trumbull Street
Hartford, CT 06103-3597
Main (860) 275-8200
Fax (860) 275-8299
kbaldwin@rc.com
Direct (860) 275-8345

Also admitted in Massachusetts

December 23, 2014

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

Re: **Notice of Exempt Modification – Facility Modification**
812 Middletown Road, Colchester, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the top of the existing 180-foot tower at 812 Middletown Road in Colchester (the "Property"). The tower is owned by Cellco. The Council approved Cellco's use of the tower in 2002 (Docket No. 218). 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 level on the tower. Cellco also intends to install six (6) remote radio heads ("RRHs") behind its 1900 MHz and 2100 MHz antennas and two (2) HYBRIFLEX™ antenna cables, attached to the outside of the monopole tower. Included in Attachment 1 are specifications for the replacement antennas, RRHs and HYBRIFLEX™ cables.

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 Stanley Soby, First Selectman of the Town of Colchester. A copy of this letter is also being sent to Lorraine Leone, 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. The replacement antennas and RRHs will be installed on Cellco's existing antenna platform at the 180-foot level.

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 for 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 can support Cellco's proposed modifications. (*See* Structural Analysis Report 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:
Stanley Soby, Colchester First Selectman
Lorraine Leone
Sandy M. Carter

ATTACHMENT 1

Product Specifications

COMMSCOPE®

LNX-6514DS-VTM

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

POWERED BY ANDREW.

Electrical Specifications

Frequency Band, MHz	698–806	806–896
Gain, dBi	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	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°

Electrical Specifications, BASTA*

Frequency Band, MHz	698–806	806–896
Beamwidth, Horizontal Tolerance, degrees	±3	±3

* 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.

Mechanical Specifications

Color | Radome Material	Light gray | Fiberglass, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 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
Antenna Dimensions, L x W x D	1847.0 mm x 301.0 mm x 181.0 mm | 72.7 in x 11.9 in x 7.1 in
Net Weight	14.2 kg | 31.3 lb
Model with factory installed AISG 2.0 RET	LNX-6514DS-A1M

Product Specifications

COMMSCOPE®

HBXX-6517DS-VTM

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

POWERED BY ANDREW

Electrical Specifications

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, degrees	67	66	65
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
Beam Tilt, degrees	0–6	0–6	0–6
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
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°

**Values calculated using NGMN Alliance N-P-BASTA v9.6*

Mechanical Specifications

Color | Radome Material	Light gray | PVC, UV resistant
Connector Interface | Location | Quantity	7-16 DIN Female | Bottom | 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
Antenna Dimensions, L x W x D	1903.0 mm x 305.0 mm x 166.0 mm | 74.9 in x 12.0 in x 6.5 in
Net Weight	19.5 kg | 43.0 lb
Model with factory installed AISG 2.0 RET	HBXX-6517DS-A2M

PCS RF MODULES

RRH1900 2X60 - HW CHARACTERISTICS

LA6.0.1/13.3

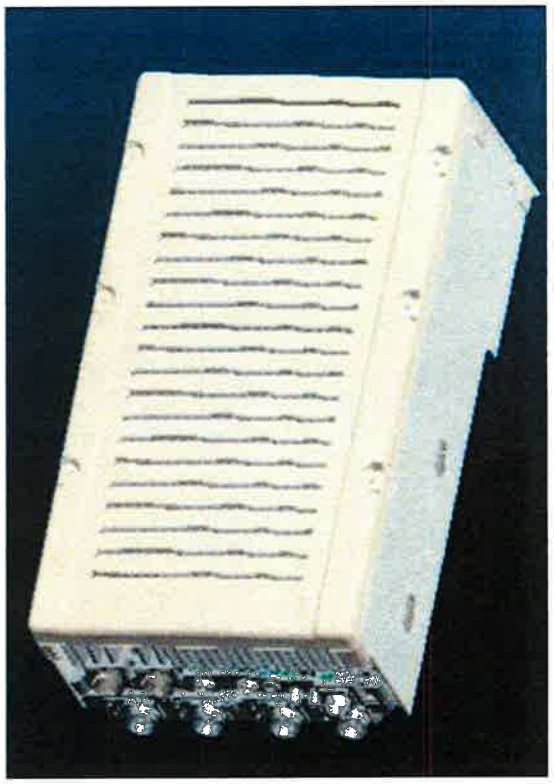
		RRH2x60
RF Output Power		2x60W
Instantaneous Bandwidth		20MHz
Transmitter		2 TX
Receiver	1900 HW version	2 Branch RX – LA6.0.1
	1900A HW version	4 Branch RX – LR13.3
Features		AISG 2.0 for RET/TMA
		Internal Smart Bias-T
Power		-48VDC
CPRI Ports		2 CPRI Rate 3 Ports
External Alarms		4 External User Alarms
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

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.

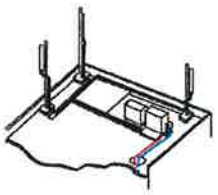
EASY INSTALLATION

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.

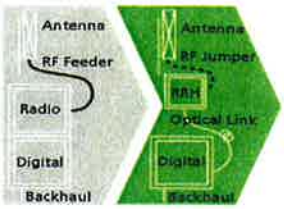
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

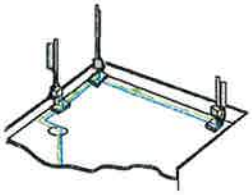
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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.

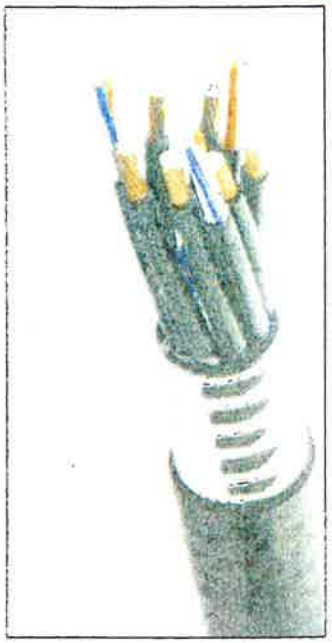


Figure 1: HYBRIFLEX Series

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

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
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)
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)
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
Size (Power)		[mm² (AWG)]	8.4 (8)
Quantity, Wire Count (Power)			16 (8 pairs)
Size (Alarm)		[mm² (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-93-638 UL Type XHHW-2, UL 44 UL-LS Limited Smoke, UL VW-1 IEEE-383 (1974), IEEE1202/FT4 RoHS Compliant
Installation Temperature		[°C (°F)]	-40 to +65 (-40 to149)
Operation Temperature		[°C (°F)]	-40 to +65 (-40 to149)

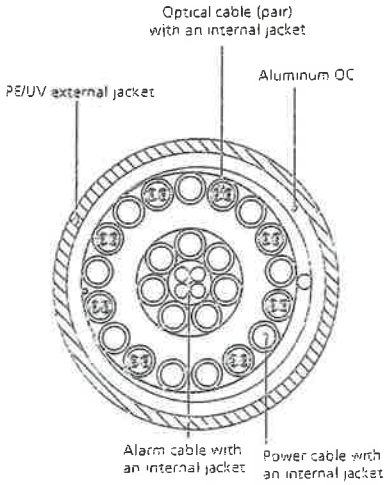


Figure 2: Construction Detail

* This data is provisional and subject to change

ATTACHMENT 2

	General	Power	Density					
Site Name: Colchester S								
Tower Height: 180ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*AT&T UMTS	2	565	160	0.0159	880	0.5867	2.71%	
*AT&T UMTS	2	875	160	0.0246	1900	1.0000	2.46%	
*AT&T GSM	1	283	160	0.0040	880	0.5867	0.68%	
*AT&T GSM	4	525	160	0.0295	1900	1.0000	2.95%	
*AT&T LTE	1	1615	160	0.0227	734	0.4893	4.64%	
Verizon PCS	**1**	**1494**	**180**	**0.0166**	**1970**	**1.0000**	**1.66%**	
Verizon Cellular	**9**	**236**	**180**	**0.0236**	**869**	**0.5793**	**4.07%**	
Verizon AWS	**1**	**2686**	**180**	**0.0298**	**2145**	**1.0000**	**2.98%**	
Verizon 700	**1**	**640**	**180**	**0.0071**	**746**	**0.4973**	**1.43%**	
								23.56%
* Source: Siting Council								

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report

180-ft Existing EEI Monopole

Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Colchester South

856 Middletown Road
Colchester, CT

CENTEK Project No. 14001.056

Date: November 21, 2014

Prepared for:

Verizon Wireless
99 East River Road, 9th Floor
East Hartford, CT 06108

63-2 North Branford Road, Branford, CT 06405 203.488.0580 Fax 203.488.8587 www.CentekEng.com

Table of Contents

Introduction

The purpose of this report is to summarize the results of the non-linear, P-Δ structural analysis of the antenna upgrade proposed by Verizon Wireless on the existing monopole (tower) located in Colchester, CT.

The host tower is a 180-ft tall, five-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Incorporated (EEI job no; 11294-E01), dated November 16, 2002. The tower geometry, structure member sizes and foundation system information were obtained from the aforementioned EEI design documents.

Antenna and appurtenance information were obtained from a previous structural analysis report prepared by Centek job no. 12044.CO14 dated September 28, 2012, visual verification conducted from grade by Centek personnel on November 19, 2014 and a Verizon RF data sheet.

The tower is made up of five (5) tapered vertical sections consisting of A572-65 pole sections. The bottom four (4) vertical tower sections are slip joint connected and the top vertical tower section is flange connected. The diameter of the pole (flat-flat) is 14.5-in at the top and 60.5-in at the base.

Verizon Wireless proposes the removal of nine (9) panel antennas and the installation of nine (9) panel antennas, six (6) remote radio heads and two (2) main distribution boxes mounted on the existing low profile platform. Refer to the Antenna and Appurtenance Summary below for a detailed description of the proposed antenna and appurtenance configuration.

Antenna and Appurtenance Summary

The existing, proposed and future loads considered in this analysis consist of the following:

- AT&T (EXISTING):
  Antennas: Six (6) Powerwave 7770 panel antennas, one (1) KMW AM-X-CD-14-65-00T-RET panel antenna, two (2) KMW AM-X-CD-17-65-00T-RET panel antennas, six (6) Powerwave LGP21401 TMA's, six (6) Powerwave LGP21901 diplexers and three (3) Bias-T mounted on a 13-ft low profile platform with a RAD center elevation of 160-ft above existing grade.
  Coax Cables: Twelve (12) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- AT&T (RESERVED):
  Antennas: Three (3) Powerwave 7770 panel antennas on a 13-ft low profile platform with a RAD center elevation of 160-ft above existing grade.
- AT&T (EXISTING):
  Antennas: Six (6) Ericsson RRUS-11 and one (1) Raycap DC6-48-60-18-8F surge arrestor mounted to one (1) universal ring mount with a RAD center elevation of 159-ft above grade level.
  Coax Cables: One (1) fiber cable and two (2) dc control cables running inside of the existing tower.

- VERIZON (EXISTING TO REMAIN):
  Antennas: Six (6) Antel LPA-80080-4CF panel antennas mounted on a low profile platform with a RAD center elevation of 180-ft above existing grade.
  Coax Cables: Eighteen (18) 1-5/8" ∅ coax cables running on the inside of the existing tower.
- VERIZON (EXISTING TO REMOVE):
  Antennas: Three (3) Antel BXA-70063-6CF and six (6) Antel LPA-171080-8CF panel antennas mounted on a low profile platform with a RAD center elevation of 180-ft above existing grade.
- **VERIZON (PROPOSED):**
  Antennas: Six (6) Andrew HBXX-6517DS panel antennas, three (3) Andrew LNX-6514DS panel antennas, three (3) Alcatel-Lucent RRH-2x60-PCS remote radio heads, three (3) Alcatel-Lucent RRH-2x60-AWS remote radio heads and two (2) RFD DB-T1-6Z-8AB-0Z main distribution boxes mounted on a low profile platform with a RAD center elevation of 180-ft above existing grade.
  Coax Cables: Two (2) 1-5/8" ∅ fiber cables banded to the exterior of the existing tower.

Primary Assumptions Used in the Analysis

- The tower structure's theoretical capacity not including any assessment of the condition of the tower.
- The tower carries the horizontal and vertical loads due to the weight of antennas, ice load and wind.
- Tower is properly installed and maintained.
- Tower is in plumb condition.
- Tower loading for antennas and mounts as listed in this report.
- All bolts are appropriately tightened providing the necessary connection continuity.
- All welds are fabricated with ER-70S-6 electrodes.
- All members are assumed to be as specified in the original tower design documents or reinforcement drawings.
- All members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
- All member protective coatings are in good condition.
- All tower members were properly designed, detailed, fabricated, installed and have been properly maintained since erection.
- Any deviation from the analyzed antenna loading will require a new analysis for verification of structural adequacy.
- All existing coax cables to be installed as indicated in this report.

Analysis

The existing tower was analyzed using a comprehensive computer program entitled tnxTower. The program analyzes the tower, considering the worst case loading condition. The tower is considered as loaded by concentric forces along the tower shaft, and the model assumes that the shaft members are subjected to bending, axial, and shear forces.

The existing tower was analyzed for the controlling basic wind speed (fastest mile) with no ice and a 75% reduction of wind force with ½ inch accumulative ice to determine stresses in members as per guidelines of TIA/EIA-222-F-96 entitled "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures", the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

The controlling wind speed is determined by evaluating the local available wind speed data as provided in Appendix K of the CSBC[1] and the wind speed data available in the TIA/EIA-222-F-96 Standard. The higher of the two wind speeds is utilized in preparation on the tower analysis.

Tower Loading

Tower loading was determined by the basic wind speed as applied to projected surface areas with modification factors per TIA/EIA-222-F, gravity loads of the tower structure and its components, and the application of ½" radial ice on the tower structure and its components.

Basic Wind Speed:	New London; v = 85 mph (fastest mile) Colchester; v = 105 mph (3 second gust) equivalent to v = 85 mph (fastest mile) *TIA-EIA-222-F and Appendix-K wind speeds are equal.*	*[Section 16 of TIA/EIA-222-F-96]* *[Appendix K of the 2005 CT Building Code Supplement]*
Load Cases:	Load Case 1; 85 mph wind speed w/ no ice plus gravity load – used in calculation of tower stresses and rotation.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 2; 74 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 74 mph wind speed velocity represents 75% of the wind pressure generated by the 85 mph wind speed.	*[Section 2.3.16 of TIA/EIA-222-F-96]*
	Load Case 3; Seismic – not checked	*[Section 1614.5 of State Bldg. Code 2005] does not control in the design of this structure type*

[1] The 2005 Connecticut State Building Code as amended by the 2009 CT State Supplement. (CSBC)

Tower Capacity

Tower stresses were calculated utilizing the structural analysis software tnxTower. Allowable stresses were determined based on Table 5 of the TIA/EIA code with a 1/3 increase per Section 3.1.1.1 of the same code.

- Calculated stresses were found to be within allowable limits. In Load Case 1, per tnxTower "Section Capacity Table", this tower was found to be at **90.2%** of its total capacity.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	151.00'-179.00'	87.6%	**PASS**
Pole Shaft (L2)	125.92'-151.00'	90.2%	**PASS**
Pole Shaft (L3)	85.80'-125.92'	71.8%	**PASS**
Pole Shaft (L4)	42.13'-85.80'	75.5%	**PASS**
Pole Shaft (L5)	0.00'-42.13'	66.7%	**PASS**

Foundation and Anchors

The existing foundation consists of a 8.0-ft ∅ x 28.0-ft long reinforced concrete caisson. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned EEI design report; project no. 11294-E01 dated November 16, 2002. The base of the tower is connected to the foundation by means of (16) 2.25"∅, ASTM A615-75 anchor bolts embedded approximately 7-ft into the concrete foundation structure.

- The tower base reactions developed from the governing Load Case 1 were used in the verification of the foundation and its anchors:

Location	Vector	Proposed Reactions
Base	Shear	28 kips
	Compression	41 kips
	Moment	3429 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	Proposed Loading	Result
Reinforced Concrete Caisson	Moment Capacity	52.0%	**PASS**
	Lateral Deflection	0.72in.	**PASS**

Note 1: Lateral deflection typically limited to 1.0 in. for monopole tower structures. Caisson installed in rock.

- The flange bolts, flange plate, anchor bolts and base plate were found to be within allowable limits.

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Flange Bolts	Tension	48.5%	**PASS**
Flange Plate	Bending	66.1%	**PASS**
Anchor Bolts	Combined Compression and Bending	76.8%	**PASS**
Base Plate	Bending	87.7%	**PASS**

Conclusion

This analysis shows that the subject tower **is adequate** to support the proposed modified antenna configuration.

The analysis is based, in part, on the information provided to this office by Verizon Wireless. If the existing conditions are different than the information in this report, Centek Engineering, Inc. must be contacted for resolution of any potential issues.

Please feel free to call with any questions or comments.

Respectfully Submitted by:

Timothy J. Lynn, PE
Structural Engineer

Standard Conditions for Furnishing of Professional Engineering Services on Existing Structures

All engineering services are performed on the basis that the information used is current and correct. This information may consist of, but is not necessarily limited to:

- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of CENTEK engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information provide to CENTEK engineering, Inc. and used in the performance of our engineering services is correct and complete. In the absence of information to the contrary, we assume that all structures were constructed in accordance with the drawings and specifications and are in an un-corroded condition and have not deteriorated. It is therefore assumed that its capacity has not significantly changed from the "as new" condition.
- All services will be performed to the codes specified by the client, and we do not imply to meet any other codes or requirements unless explicitly agreed in writing. If wind and ice loads or other relevant parameters are to be different from the minimum values recommended by the codes, the client shall specify the exact requirement. In the absence of information to the contrary, all work will be performed in accordance with the latest revision of ANSI/ASCE10 & ANSI/EIA-222
- All services performed, results obtained, and recommendations made are in accordance with generally accepted engineering principles and practices. CENTEK engineering, Inc. is not responsible for the conclusions, opinions and recommendations made by others based on the information we supply.

General Description of Structural Analysis Program

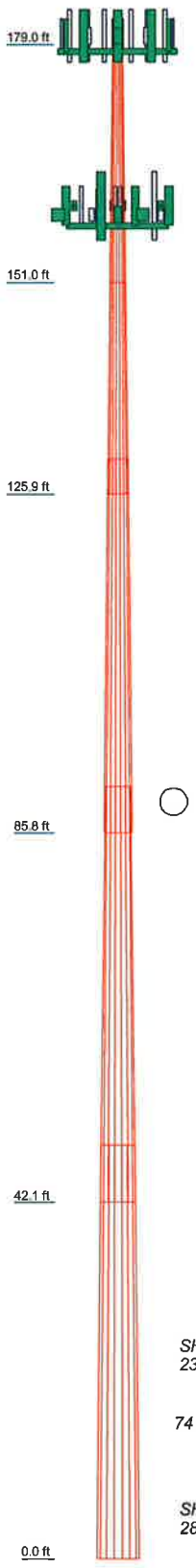
tnxTower, is an integrated structural analysis and design software package for Designed specifically for the telecommunications industry, tnxTower, formerly ERITower, automates much of the tower analysis and design required by the TIA/EIA 222 Standard.

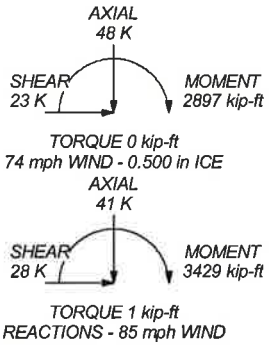
tnxTower Features:

- tnxTower can analyze and design 3- and 4-sided guyed towers, 3- and 4-sided self-supporting towers and either round or tapered ground mounted poles with or without guys.
- The program analyzes towers using the TIA-222-G (2005) standard or any of the previous TIA/EIA standards back to RS-222 (1959). Steel design is checked using the AISC ASD 9th Edition or the AISC LRFD specifications.
- Linear and non-linear (P-delta) analyses can be used in determining displacements and forces in the structure. Wind pressures and forces are automatically calculated.
- Extensive graphics plots include material take-off, shear-moment, leg compression, displacement, twist, feed line, guy anchor and stress plots.
- tnxTower contains unique features such as True Cable behavior, hog rod take-up, foundation stiffness and much more.

Section	1	2	3	4	5
Length (ft)	28.000	25.080	44.290	49.080	48.882
Number of Sides	18	18	18	18	18
Thickness (in)	0.188	0.250	0.375	0.375	0.438
Socket Length (ft)		4.166	5.416	6.750	
Top Dia (in)	14.500	22.070	27.224	36.863	47.435
Bot Dia (in)	22.070	28.850	39.060	49.990	60.500
Grade	A572-65				
Weight (K)	1.0	1.7	5.9	8.6	12.4

29.5





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080-4CF (Verizon - Existing)	180	7770.00 (ATI - Existing)	160
LPA-80080-4CF (Verizon - Existing)	180	7770.00 (ATI - Existing)	160
LPA-80080-4CF (Verizon - Existing)	180	7770.00 (ATI - Existing)	160
LPA-80080-4CF (Verizon - Existing)	180	7770.00 (ATI - Existing)	160
LPA-80080-4CF (Verizon - Existing)	180	7770.00 (ATI - Existing)	160
LPA-80080-4CF (Verizon - Existing)	180	(2) LGP21401 TMA (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180	(2) LGP21401 TMA (ATI - Existing)	160
LNX-6514DS-VTM (Verizon - Proposed)	180	(2) LGP21401 TMA (ATI - Existing)	160
		(2) LGP21901 Diplexer (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180	(2) LGP21901 Diplexer (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180	(2) LGP21901 Diplexer (ATI - Existing)	160
LNX-6514DS-VTM (Verizon - Proposed)	180	Smart Bias T (ATI - Existing)	160
		Smart Bias T (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180	Smart Bias T (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180	AM-X-CD-14-65-00T-RET (ATI - Existing)	160
LNX-6514DS-VTM (Verizon - Proposed)	180		
		AM-X-CD-17-65-00T-RET (ATI - Existing)	160
HBXX-6517DS (Verizon - Proposed)	180		
RRH2x60-AWS (Verizon - Proposed)	180	AM-X-CD-17-65-00T-RET (ATI - Existing)	160
RRH2x60-AWS (Verizon - Proposed)	180		
RRH2x60-AWS (Verizon - Proposed)	180	7770.00 (ATI - Reserved)	160
RRH2x60-PCS (Verizon - Proposed)	180	7770.00 (ATI - Reserved)	160
RRH2x60-PCS (Verizon - Proposed)	180	7770.00 (ATI - Reserved)	160
RRH2x60-PCS (Verizon - Proposed)	180	(2) RRUS-11 (ATI - Existing)	159
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	180	(2) RRUS-11 (ATI - Existing)	159
		(2) RRUS-11 (ATI - Existing)	159
DB-T1-6Z-8AB-0Z (Verizon - Proposed)	180	DC6-48-60-18-8F Surge Arrestor (ATI - Existing)	159
EEI 14-ft Low Profile Platform (Verizon - Existing)	178.5	13' Low Profile Platform (ATI - Existing)	158
7770.00 (ATI - Existing)	160	Valmont Uni-Tri Bracket (ATI - Existing)	156

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
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. Weld together tower sections have flange connections.
5. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
6. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
7. Welds are fabricated with ER-70S-6 electrodes.
8. TOWER RATING: 90.2%

Centek Engineering Inc.
63-2 North Branford Rd.
Branford, CT 06405
Phone: (203) 488-0580
FAX: (203) 488-8587

Job: *14001.056 - Colchester South*			
Project: *180-ft EEI Monopole - 856 Middletown Rd., Colchester, CT*			
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 11/21/14	Scale: NTS	
Path:		Dwg No. E-1	

tnxTower	Job	Page
	14001.056 - Colchester South	1 of 22
Centek Engineering Inc. 63-2 North Branford Rd. Branford, CT 06405 Phone: (203) 488-0580 FAX: (203) 488-8587	Project 180-ft EEI Monopole - 856 Middletown Rd., Colchester, CT	Date 09:11:13 11/21/14
	Client Verizon Wireless	Designed by TJL

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 0.500 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.
Weld together tower sections have flange connections..
Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Welds are fabricated with ER-70S-6 electrodes..
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, feedline supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Treat Feedline Bundles As Cylinder
	Consider Moments - Horizontals		Assume Legs Pinned		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Calculate Redundant Bracing Forces
	Use Moment Magnification		Use Clear Spans For Wind Area		Ignore Redundant Members in FEA
√	Use Code Stress Ratios		Use Clear Spans For KL/r		SR Leg Bolts Resist Compression
	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		All Leg Panels Have Same Allowable
	Escalate Ice	√	Bypass Mast Stability Checks		Offset Girt At Foundation
	Always Use Max Kz		Use Azimuth Dish Coefficients		Consider Feedline Torque
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Include Angle Block Shear Check
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Poles
	Leg Bolts Are At Top Of Section		SR Members Have Cut Ends	√	Include Shear-Torsion Interaction
	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Always Use Sub-Critical Flow
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Use Top Mounted Sockets
	Add IBC .6D+W Combination				

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	179.000-151.000	28.000	0.000	18	14.500	22.070	0.188	0.750	A572-65 (65 ksi)
L2	151.000-125.920	25.080	4.166	18	22.070	28.850	0.250	1.000	A572-65 (65 ksi)
L3	125.920-85.796	44.290	5.416	18	27.224	39.060	0.375	1.500	A572-65 (65 ksi)

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	85.796-42.132	49.080	6.750	18	36.863	49.990	0.375	1.500	A572-65 (65 ksi)
L5	42.132-0.000	48.882		18	47.435	60.500	0.438	1.750	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	14.724	8.518	220.441	5.081	7.366	29.927	441.172	4.260	2.222	11.851
	22.410	13.023	787.837	7.768	11.212	70.270	1576.711	6.513	3.554	18.956
L2	22.410	17.314	1041.474	7.746	11.212	92.893	2084.319	8.659	3.444	13.777
	29.295	22.694	2345.214	10.153	14.656	160.020	4693.514	11.349	4.638	18.55
L3	28.774	31.957	2910.379	9.531	13.830	210.444	5824.588	15.981	4.131	11.017
	39.663	46.045	8705.695	13.733	19.842	438.740	17422.845	23.027	6.215	16.572
L4	38.902	43.429	7304.859	12.953	18.726	390.088	14619.331	21.719	5.828	15.541
	50.761	59.054	18366.002	17.613	25.395	723.216	36756.170	29.533	8.138	21.702
L5	49.998	65.261	18211.055	16.684	24.097	755.747	36446.073	32.637	7.578	17.322
	61.433	83.404	38013.044	21.322	30.734	1236.840	76076.106	41.710	9.878	22.578

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
L1 179.000-151.000				1	1	1		
L2 151.000-125.920				1	1	1		
L3 125.920-85.796				1	1	1		
L4 85.796-42.132				1	1	1		
L5 42.132-0.000				1	1	1		

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 klf
1 5/8	C	No	Inside Pole	178.000 - 3.000	18	No Ice	0.000	0.001
(Verizon - Existing)						1/2" Ice	0.000	0.001
1 5/8	C	No	Inside Pole	160.000 - 3.000	12	No Ice	0.000	0.001
(AT&T - Existing)						1/2" Ice	0.000	0.001
RG6-Fiber	C	No	Inside Pole	160.000 - 3.000	1	No Ice	0.000	0.001
(AT&T - Existing)						1/2" Ice	0.000	0.001
#8 AWG Copper WIre	C	No	Inside Pole	160.000 - 3.000	2	No Ice	0.000	0.000
(AT&T - Existing)						1/2" Ice	0.000	0.000

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
HYBRIFLEX 1-5/8" (Verizon - Proposed)	C	No	CaAa (Out Of Face)	178.000 - 3.000	2	No Ice	0.198	0.002
						1/2" Ice	0.298	0.003

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	179.000-151.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	10.692	0.730
L2	151.000-125.920	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	9.932	0.905
L3	125.920-85.796	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	15.889	1.448
L4	85.796-42.132	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	17.291	1.576
L5	42.132-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	15.496	1.413

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	179.000-151.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	16.092	0.812
L2	151.000-125.920	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	14.947	0.981
L3	125.920-85.796	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	23.914	1.570
L4	85.796-42.132	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	26.023	1.709
L5	42.132-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	23.322	1.531

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
LPA-80080-4CF (Verizon - Existing)	A	From Face	3.500 6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80080-4CF (Verizon - Existing)	A	From Face	3.500 -6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80080-4CF (Verizon - Existing)	B	From Face	3.500 6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80080-4CF (Verizon - Existing)	B	From Face	3.500 -6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80080-4CF (Verizon - Existing)	C	From Face	3.500 6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
LPA-80080-4CF (Verizon - Existing)	C	From Face	3.500 -6.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.619 2.922	6.057 6.453	0.012 0.045
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.500 4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-6514DS-VTM (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090
HBXX-6517DS (Verizon - Proposed)	A	From Face	3.500 -4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.500 4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-6514DS-VTM (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090
HBXX-6517DS (Verizon - Proposed)	B	From Face	3.500 -4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.500 4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
LNX-6514DS-VTM (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.411 8.964	5.405 5.863	0.039 0.090
HBXX-6517DS (Verizon - Proposed)	C	From Face	3.500 -4.000 0.000	0.000	180.000	No Ice 1/2" Ice	8.738 9.306	5.243 5.709	0.050 0.100
RRH2x60-AWS (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
RRH2x60-AWS (Verizon - Proposed)	B	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
RRH2x60-AWS (Verizon - Proposed)	C	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.193 2.400	1.430 1.612	0.050 0.066
RRH2x60-PCS (Verizon - Proposed)	A	From Face	3.500 0.000 0.000	0.000	180.000	No Ice 1/2" Ice	2.578 2.804	2.030 2.239	0.063 0.083

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
RRH2x60-PCS	B	From Face	3.500	0.000	180.000	No Ice	2.578	2.030	0.063
(Verizon - Proposed)			0.000			1/2" Ice	2.804	2.239	0.083
			0.000						
RRH2x60-PCS	C	From Face	3.500	0.000	180.000	No Ice	2.578	2.030	0.063
(Verizon - Proposed)			0.000			1/2" Ice	2.804	2.239	0.083
			0.000						
DB-T1-6Z-8AB-0Z	A	From Face	3.500	0.000	180.000	No Ice	5.600	2.333	0.044
(Verizon - Proposed)			0.000			1/2" Ice	5.915	2.558	0.080
			0.000						
DB-T1-6Z-8AB-0Z	B	From Face	3.500	0.000	180.000	No Ice	5.600	2.333	0.044
(Verizon - Proposed)			0.000			1/2" Ice	5.915	2.558	0.080
			0.000						
EEI 14-ft Low Profile Platform	C	None		0.000	178.500	No Ice	16.500	16.500	1.550
(Verizon - Existing)						1/2" Ice	20.000	20.000	1.800
7770.00	A	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			-6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	A	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	B	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			-6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	B	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	C	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			-6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	C	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Existing)			6.000			1/2" Ice	6.314	3.273	0.068
			0.000						
(2) LGP21401 TMA	A	From Face	3.000	0.000	160.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
(2) LGP21401 TMA	B	From Face	3.000	0.000	160.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
(2) LGP21401 TMA	C	From Face	3.000	0.000	160.000	No Ice	0.953	0.367	0.018
(AT&T - Existing)			0.000			1/2" Ice	1.093	0.480	0.023
			0.000						
(2) LGP21901 Diplexer	A	From Face	3.000	0.000	160.000	No Ice	0.233	0.117	0.006
(AT&T - Existing)			0.000			1/2" Ice	0.302	0.166	0.008
			0.000						
(2) LGP21901 Diplexer	B	From Face	3.000	0.000	160.000	No Ice	0.233	0.117	0.006
(AT&T - Existing)			0.000			1/2" Ice	0.302	0.166	0.008
			0.000						
(2) LGP21901 Diplexer	C	From Face	3.000	0.000	160.000	No Ice	0.233	0.117	0.006
(AT&T - Existing)			0.000			1/2" Ice	0.302	0.166	0.008
			0.000						
Smart Bias T	A	From Face	3.000	0.000	160.000	No Ice	0.156	0.078	0.002
(AT&T - Existing)			-2.000			1/2" Ice	0.212	0.121	0.003
			0.000						
Smart Bias T	B	From Face	3.000	0.000	160.000	No Ice	0.156	0.078	0.002
(AT&T - Existing)			-2.000			1/2" Ice	0.212	0.121	0.003
			0.000						

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
Smart Bias T	C	From Face	3.000	0.000	160.000	No Ice	0.156	0.078	0.002
(AT&T - Existing)			-2.000			1/2" Ice	0.212	0.121	0.003
			0.000						
AM-X-CD-14-65-00T-RET	A	From Face	3.000	0.000	160.000	No Ice	5.507	2.828	0.037
(AT&T - Existing)			2.000			1/2" Ice	5.899	3.137	0.069
			0.000						
AM-X-CD-17-65-00T-RET	B	From Face	3.000	0.000	160.000	No Ice	11.311	6.800	0.060
(AT&T - Existing)			2.000			1/2" Ice	11.927	7.384	0.121
			0.000						
AM-X-CD-17-65-00T-RET	C	From Face	3.000	0.000	160.000	No Ice	11.311	6.800	0.060
(AT&T - Existing)			2.000			1/2" Ice	11.927	7.384	0.121
			0.000						
7770.00	A	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	B	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
7770.00	C	From Face	3.000	0.000	160.000	No Ice	5.882	2.928	0.035
(AT&T - Reserved)			-2.000			1/2" Ice	6.314	3.273	0.068
			0.000						
13' Low Profile Platform	C	None		0.000	158.000	No Ice	15.700	15.700	1.300
(AT&T - Existing)						1/2" Ice	20.100	20.100	1.765
(2) RRUS-11	A	From Face	1.000	0.000	159.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	B	From Face	1.000	0.000	159.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
(2) RRUS-11	C	From Face	1.000	0.000	159.000	No Ice	2.994	1.246	0.050
(AT&T - Existing)			2.000			1/2" Ice	3.226	1.412	0.070
			0.000						
DC6-48-60-18-8F Surge	C	From Face	0.500	0.000	159.000	No Ice	2.228	2.228	0.020
Arrestor			0.000			1/2" Ice	2.447	2.447	0.039
(AT&T - Existing)			0.000						
Valmont Uni-Tri Bracket	C	None		0.000	156.000	No Ice	1.750	1.750	0.290
(AT&T - Existing)						1/2" Ice	1.940	1.940	0.306

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	164.034	1.581	0.029	42.665	A	0.000	42.665	42.665	100.00	0.000	0.000
179.000-151.0					B	0.000	42.665		100.00	0.000	0.000
00					C	0.000	42.665		100.00	0.000	10.692
L2	137.903	1.505	0.028	53.211	A	0.000	53.211	53.211	100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
151.000-125.9					B	0.000	53.211		100.00	0.000	0.000
20					C	0.000	53.211		100.00	0.000	9.932
L3	105.065	1.392	0.026	112.677	A	0.000	112.677	112.677	100.00	0.000	0.000
125.920-85.79					B	0.000	112.677		100.00	0.000	0.000
6					C	0.000	112.677		100.00	0.000	15.889
L4	63.538	1.206	0.022	160.649	A	0.000	160.649	160.649	100.00	0.000	0.000
85.796-42.132					B	0.000	160.649		100.00	0.000	0.000
					C	0.000	160.649		100.00	0.000	17.291
L5	20.345	1	0.018	192.646	A	0.000	192.646	192.646	100.00	0.000	0.000
42.132-0.000					B	0.000	192.646		100.00	0.000	0.000
					C	0.000	192.646		100.00	0.000	15.496

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	164.034	1.581	0.022	0.500	44.998	A	0.000	44.998	44.998	100.00	0.000	0.000
179.000-151.000						B	0.000	44.998		100.00	0.000	0.000
						C	0.000	44.998		100.00	0.000	16.092
L2	137.903	1.505	0.021	0.500	55.301	A	0.000	55.301	55.301	100.00	0.000	0.000
151.000-125.920						B	0.000	55.301		100.00	0.000	0.000
						C	0.000	55.301		100.00	0.000	14.947
L3	105.065	1.392	0.019	0.500	116.020	A	0.000	116.020	116.020	100.00	0.000	0.000
125.920-85.796						B	0.000	116.020		100.00	0.000	0.000
						C	0.000	116.020		100.00	0.000	23.914
L4	63.538	1.206	0.017	0.500	164.288	A	0.000	164.288	164.288	100.00	0.000	0.000
85.796-42.132						B	0.000	164.288		100.00	0.000	0.000
						C	0.000	164.288		100.00	0.000	26.023
L5 42.132-0.000	20.345	1	0.014	0.500	196.157	A	0.000	196.157	196.157	100.00	0.000	0.000
						B	0.000	196.157		100.00	0.000	0.000
						C	0.000	196.157		100.00	0.000	23.322

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	164.034	1.581	0.010	42.665	A	0.000	42.665	42.665	100.00	0.000	0.000
179.000-151.0					B	0.000	42.665		100.00	0.000	0.000
00					C	0.000	42.665		100.00	0.000	10.692
L2	137.903	1.505	0.010	53.211	A	0.000	53.211	53.211	100.00	0.000	0.000
151.000-125.9					B	0.000	53.211		100.00	0.000	0.000
20					C	0.000	53.211		100.00	0.000	9.932
L3	105.065	1.392	0.009	112.677	A	0.000	112.677	112.677	100.00	0.000	0.000
125.920-85.79					B	0.000	112.677		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
6					C	0.000	112.677		100.00	0.000	15.889
L4	63.538	1.206	0.008	160.649	A	0.000	160.649	160.649	100.00	0.000	0.000
85.796-42.132					B	0.000	160.649		100.00	0.000	0.000
					C	0.000	160.649		100.00	0.000	17.291
L5	20.345	1	0.006	192.646	A	0.000	192.646	192.646	100.00	0.000	0.000
42.132-0.000					B	0.000	192.646		100.00	0.000	0.000
					C	0.000	192.646		100.00	0.000	15.496

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	1.899	0.068	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	2.094	0.083	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	3.872	0.097	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	4.563	0.104	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	4.399	0.104	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	1386.504 kip-ft	16.826		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	1.899	0.068	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	2.094	0.083	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	3.872	0.097	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	4.563	0.104	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	4.399	0.104	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
Sum Weight:	6.073	29.533						OTM	1386.504 kip-ft	16.826		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	1.899	0.068	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	2.094	0.083	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	3.872	0.097	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	4.563	0.104	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	4.399	0.104	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	1386.504 kip-ft	16.826		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	1.899	0.068	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	2.094	0.083	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	3.872	0.097	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	4.563	0.104	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	4.399	0.104	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	1386.504 kip-ft	16.826		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.812	1.351	A	1	0.65	1	1	1	44.998	1.681	0.060	C
179.000-151.0			B	1	0.65	1	1	1	44.998			
00			C	1	0.65	1	1	1	44.998			
L2	0.981	2.109	A	1	0.65	1	1	1	55.301	1.795	0.072	C
151.000-125.9			B	1	0.65	1	1	1	55.301			
20			C	1	0.65	1	1	1	55.301			
L3	1.570	6.725	A	1	0.65	1	1	1	116.020	3.236	0.081	C
125.920-85.79			B	1	0.65	1	1	1	116.020			
6			C	1	0.65	1	1	1	116.020			
L4	1.709	9.761	A	1	0.65	1	1	1	164.288	3.734	0.086	C
85.796-42.132			B	1	0.65	1	1	1	164.288			
			C	1	0.65	1	1	1	164.288			
L5	1.531	13.804	A	1	0.65	1	1	1	196.157	3.536	0.084	C
42.132-0.000			B	1	0.65	1	1	1	196.157			
			C	1	0.65	1	1	1	196.157			
Sum Weight:	6.603	33.749						OTM	1172.501 kip-ft	13.982		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.812	1.351	A	1	0.65	1	1	1	44.998	1.681	0.060	C
179.000-151.0			B	1	0.65	1	1	1	44.998			
00			C	1	0.65	1	1	1	44.998			
L2	0.981	2.109	A	1	0.65	1	1	1	55.301	1.795	0.072	C
151.000-125.9			B	1	0.65	1	1	1	55.301			
20			C	1	0.65	1	1	1	55.301			
L3	1.570	6.725	A	1	0.65	1	1	1	116.020	3.236	0.081	C
125.920-85.79			B	1	0.65	1	1	1	116.020			
6			C	1	0.65	1	1	1	116.020			
L4	1.709	9.761	A	1	0.65	1	1	1	164.288	3.734	0.086	C
85.796-42.132			B	1	0.65	1	1	1	164.288			
			C	1	0.65	1	1	1	164.288			
L5	1.531	13.804	A	1	0.65	1	1	1	196.157	3.536	0.084	C
42.132-0.000			B	1	0.65	1	1	1	196.157			
			C	1	0.65	1	1	1	196.157			
Sum Weight:	6.603	33.749						OTM	1172.501 kip-ft	13.982		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.812	1.351	A	1	0.65	1	1	1	44.998	1.681	0.060	C
179.000-151.0			B	1	0.65	1	1	1	44.998			
00			C	1	0.65	1	1	1	44.998			
L2	0.981	2.109	A	1	0.65	1	1	1	55.301	1.795	0.072	C
151.000-125.9			B	1	0.65	1	1	1	55.301			
20			C	1	0.65	1	1	1	55.301			
L3	1.570	6.725	A	1	0.65	1	1	1	116.020	3.236	0.081	C
125.920-85.79			B	1	0.65	1	1	1	116.020			
6			C	1	0.65	1	1	1	116.020			
L4	1.709	9.761	A	1	0.65	1	1	1	164.288	3.734	0.086	C
85.796-42.132			B	1	0.65	1	1	1	164.288			
			C	1	0.65	1	1	1	164.288			
L5	1.531	13.804	A	1	0.65	1	1	1	196.157	3.536	0.084	C
42.132-0.000			B	1	0.65	1	1	1	196.157			
			C	1	0.65	1	1	1	196.157			
Sum Weight:	6.603	33.749						OTM	1172.501 kip-ft	13.982		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.812	1.351	A	1	0.65	1	1	1	44.998	1.681	0.060	C
179.000-151.0			B	1	0.65	1	1	1	44.998			
00			C	1	0.65	1	1	1	44.998			
L2	0.981	2.109	A	1	0.65	1	1	1	55.301	1.795	0.072	C
151.000-125.9			B	1	0.65	1	1	1	55.301			
20			C	1	0.65	1	1	1	55.301			
L3	1.570	6.725	A	1	0.65	1	1	1	116.020	3.236	0.081	C
125.920-85.79			B	1	0.65	1	1	1	116.020			
6			C	1	0.65	1	1	1	116.020			
L4	1.709	9.761	A	1	0.65	1	1	1	164.288	3.734	0.086	C
85.796-42.132			B	1	0.65	1	1	1	164.288			
			C	1	0.65	1	1	1	164.288			
L5	1.531	13.804	A	1	0.65	1	1	1	196.157	3.536	0.084	C
42.132-0.000			B	1	0.65	1	1	1	196.157			
			C	1	0.65	1	1	1	196.157			
Sum Weight:	6.603	33.749						OTM	1172.501 kip-ft	13.982		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	0.657	0.023	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	0.725	0.029	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	1.340	0.033	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	1.579	0.036	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	1.522	0.036	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	479.759 kip-ft	5.822		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	0.657	0.023	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	0.725	0.029	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	1.340	0.033	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	1.579	0.036	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	1.522	0.036	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	479.759 kip-ft	5.822		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	0.657	0.023	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	0.725	0.029	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	1.340	0.033	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	1.579	0.036	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	1.522	0.036	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	479.759 kip-ft	5.822		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.730	1.026	A	1	0.65	1	1	1	42.665	0.657	0.023	C
179.000-151.0			B	1	0.65	1	1	1	42.665			
00			C	1	0.65	1	1	1	42.665			
L2	0.905	1.707	A	1	0.65	1	1	1	53.211	0.725	0.029	C
151.000-125.9			B	1	0.65	1	1	1	53.211			
20			C	1	0.65	1	1	1	53.211			
L3	1.448	5.878	A	1	0.65	1	1	1	112.677	1.340	0.033	C
125.920-85.79			B	1	0.65	1	1	1	112.677			
6			C	1	0.65	1	1	1	112.677			
L4	1.576	8.558	A	1	0.65	1	1	1	160.649	1.579	0.036	C
85.796-42.132			B	1	0.65	1	1	1	160.649			
			C	1	0.65	1	1	1	160.649			
L5	1.413	12.364	A	1	0.65	1	1	1	192.646	1.522	0.036	C
42.132-0.000			B	1	0.65	1	1	1	192.646			
			C	1	0.65	1	1	1	192.646			
Sum Weight:	6.073	29.533						OTM	479.759 kip-ft	5.822		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	29.533					
Bracing Weight	0.000					
Total Member Self-Weight	29.533			-0.070	-0.053	
Total Weight	40.604			-0.070	-0.053	
Wind 0 deg - No Ice		0.039	-28.020	-3299.293	-6.283	0.360
Wind 30 deg - No Ice		14.104	-24.285	-2860.396	-1666.384	0.574
Wind 45 deg - No Ice		19.926	-19.840	-2337.378	-2353.377	0.625
Wind 60 deg - No Ice		24.390	-14.044	-1655.076	-2879.994	0.634
Wind 90 deg - No Ice		28.140	-0.039	-6.300	-3321.926	0.525

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 120 deg - No Ice		24.351	13.976	1644.146	-2873.764	0.274
Wind 135 deg - No Ice		19.871	19.785	2328.427	-2344.567	0.117
Wind 150 deg - No Ice		14.037	24.246	2854.026	-1655.594	-0.049
Wind 180 deg - No Ice		-0.039	28.020	3299.152	6.176	-0.360
Wind 210 deg - No Ice		-14.104	24.285	2860.255	1666.278	-0.574
Wind 225 deg - No Ice		-19.926	19.840	2337.237	2353.270	-0.625
Wind 240 deg - No Ice		-24.390	14.044	1654.936	2879.888	-0.634
Wind 270 deg - No Ice		-28.140	0.039	6.159	3321.819	-0.525
Wind 300 deg - No Ice		-24.351	-13.976	-1644.287	2873.658	-0.274
Wind 315 deg - No Ice		-19.871	-19.785	-2328.568	2344.461	-0.117
Wind 330 deg - No Ice		-14.037	-24.246	-2854.166	1655.488	0.049
Member Ice	4.216					
Total Weight Ice	47.552			-0.086	-0.121	
Wind 0 deg - Ice		0.028	-23.284	-2760.631	-4.663	0.295
Wind 30 deg - Ice		11.714	-20.178	-2393.059	-1393.207	0.457
Wind 45 deg - Ice		16.551	-16.484	-1955.298	-1967.891	0.493
Wind 60 deg - Ice		20.261	-11.666	-1384.292	-2408.475	0.496
Wind 90 deg - Ice		23.379	-0.028	-4.628	-2778.426	0.403
Wind 120 deg - Ice		20.232	11.617	1376.254	-2403.932	0.201
Wind 135 deg - Ice		16.511	16.444	1948.703	-1961.467	0.076
Wind 150 deg - Ice		11.665	20.150	2388.346	-1385.340	-0.054
Wind 180 deg - Ice		-0.028	23.284	2760.460	4.421	-0.295
Wind 210 deg - Ice		-11.714	20.178	2392.888	1392.965	-0.457
Wind 225 deg - Ice		-16.551	16.484	1955.127	1967.649	-0.493
Wind 240 deg - Ice		-20.261	11.666	1384.121	2408.233	-0.496
Wind 270 deg - Ice		-23.379	0.028	4.457	2778.184	-0.403
Wind 300 deg - Ice		-20.232	-11.617	-1376.425	2403.691	-0.201
Wind 315 deg - Ice		-16.511	-16.444	-1948.874	1961.225	-0.076
Wind 330 deg - Ice		-11.665	-20.150	-2388.517	1385.098	0.054
Total Weight	40.604			-0.070	-0.053	
Wind 0 deg - Service		0.013	-9.695	-1141.670	-2.209	0.124
Wind 30 deg - Service		4.880	-8.403	-989.802	-576.638	0.199
Wind 45 deg - Service		6.895	-6.865	-808.827	-814.352	0.216
Wind 60 deg - Service		8.439	-4.859	-572.737	-996.572	0.219
Wind 90 deg - Service		9.737	-0.013	-2.226	-1149.490	0.182
Wind 120 deg - Service		8.426	4.836	568.863	-994.417	0.095
Wind 135 deg - Service		6.876	6.846	805.638	-811.303	0.040
Wind 150 deg - Service		4.857	8.390	987.506	-572.905	-0.017
Wind 180 deg - Service		-0.013	9.695	1141.529	2.102	-0.124
Wind 210 deg - Service		-4.880	8.403	989.662	576.532	-0.199
Wind 225 deg - Service		-6.895	6.865	808.687	814.246	-0.216
Wind 240 deg - Service		-8.439	4.859	572.596	996.466	-0.219
Wind 270 deg - Service		-9.737	0.013	2.085	1149.384	-0.182
Wind 300 deg - Service		-8.426	-4.836	-569.003	994.311	-0.095
Wind 315 deg - Service		-6.876	-6.846	-805.779	811.197	-0.040
Wind 330 deg - Service		-4.857	-8.390	-987.647	572.799	0.017

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice

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

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	179 - 151	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-9.362	-0.121	0.086
			Max. Mx	6	-5.194	-263.891	0.483
			Max. My	2	-5.224	-0.403	259.429
			Max. Vy	6	13.901	-263.891	0.483
			Max. Vx	2	-13.775	-0.403	259.429
			Max. Torque	5			-0.608
L2	151 - 125.92	Pole	Max Tension	1	0.000	0.000	0.000

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Compression	18	-11.900	-0.121	0.086
			Max. Mx	6	-7.581	-572.110	1.316
			Max. My	2	-7.604	-1.259	565.005
			Max. Vy	6	15.633	-572.110	1.316
			Max. Vx	2	-15.507	-1.259	565.005
			Max. Torque	5			-0.607
L3	125.92 - 85.796	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-19.572	-0.121	0.086
			Max. Mx	6	-14.652	-1252.315	2.884
			Max. My	2	-14.667	-2.847	1240.272
			Max. Vy	6	19.411	-1252.315	2.884
			Max. Vx	2	-19.284	-2.847	1240.272
			Max. Torque	5			-0.605
L4	85.796 - 42.132	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-30.414	-0.121	0.086
			Max. Mx	6	-24.694	-2163.759	4.593
			Max. My	2	-24.701	-4.564	2146.362
			Max. Vy	6	23.600	-2163.759	4.593
			Max. Vx	2	-23.474	-4.564	2146.362
			Max. Torque	5			-0.603
L5	42.132 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-47.552	-0.121	0.086
			Max. Mx	6	-40.590	-3429.022	6.532
			Max. My	2	-40.590	-6.501	3405.592
			Max. Vy	6	28.161	-3429.022	6.532
			Max. Vx	2	-28.040	-6.501	3405.592
			Max. Torque	5			-0.601

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	47.552	23.379	-0.028
	Max. H_x	14	40.604	28.140	-0.039
	Max. H_z	2	40.604	-0.039	28.020
	Max. M_x	2	3405.592	-0.039	28.020
	Max. M_z	6	3429.022	-28.140	0.039
	Max. Torsion	13	0.587	24.390	-14.044
	Min. Vert	1	40.604	0.000	0.000
	Min. H_x	6	40.604	-28.140	0.039
	Min. H_z	10	40.604	0.039	-28.020
	Min. M_x	10	-3405.437	0.039	-28.020
	Min. M_z	14	-3428.910	28.140	-0.039
	Min. Torsion	5	-0.601	-24.390	14.044

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead Only	40.604	0.000	0.000	-0.070	-0.053	0.000
Dead+Wind 0 deg - No Ice	40.604	0.039	-28.020	-3405.592	-6.501	0.348
Dead+Wind 30 deg - No Ice	40.604	14.104	-24.285	-2952.526	-1720.158	0.551
Dead+Wind 45 deg - No Ice	40.604	19.926	-19.840	-2412.646	-2429.287	0.597
Dead+Wind 60 deg - No Ice	40.604	24.390	-14.044	-1708.370	-2972.862	0.601
Dead+Wind 90 deg - No Ice	40.604	28.140	-0.039	-6.532	-3429.022	0.486
Dead+Wind 120 deg - No Ice	40.604	24.351	13.976	1697.059	-2966.457	0.239
Dead+Wind 135 deg - No Ice	40.604	19.871	19.785	2403.402	-2420.210	0.088
Dead+Wind 150 deg - No Ice	40.604	14.037	24.246	2945.958	-1709.016	-0.067
Dead+Wind 180 deg - No Ice	40.604	-0.039	28.020	3405.437	6.396	-0.350
Dead+Wind 210 deg - No Ice	40.604	-14.104	24.285	2952.366	1720.057	-0.539
Dead+Wind 225 deg - No Ice	40.604	-19.926	19.840	2412.483	2429.185	-0.582
Dead+Wind 240 deg - No Ice	40.604	-24.390	14.044	1708.204	2972.757	-0.587
Dead+Wind 270 deg - No Ice	40.604	-28.140	0.039	6.365	3428.910	-0.483
Dead+Wind 300 deg - No Ice	40.604	-24.351	-13.976	-1697.220	2966.342	-0.251
Dead+Wind 315 deg - No Ice	40.604	-19.871	-19.785	-2403.559	2420.095	-0.103
Dead+Wind 330 deg - No Ice	40.604	-14.037	-24.246	-2946.112	1708.904	0.053
Dead+Ice+Temp	47.552	0.000	0.000	-0.086	-0.121	0.000
Dead+Wind 0 deg+Ice+Temp	47.552	0.028	-23.284	-2878.740	-4.883	0.284
Dead+Wind 30 deg+Ice+Temp	47.552	11.714	-20.178	-2495.430	-1452.920	0.424
Dead+Wind 45 deg+Ice+Temp	47.552	16.551	-16.484	-2038.936	-2052.212	0.451
Dead+Wind 60 deg+Ice+Temp	47.552	20.261	-11.666	-1443.509	-2511.654	0.447
Dead+Wind 90 deg+Ice+Temp	47.552	23.379	-0.028	-4.858	-2897.439	0.348
Dead+Wind 120 deg+Ice+Temp	47.552	20.232	11.617	1435.081	-2506.925	0.155
Dead+Wind 135 deg+Ice+Temp	47.552	16.511	16.444	2032.029	-2045.513	0.040
Dead+Wind 150 deg+Ice+Temp	47.552	11.665	20.150	2490.496	-1444.703	-0.077
Dead+Wind 180 deg+Ice+Temp	47.552	-0.028	23.284	2878.543	4.625	-0.285
Dead+Wind 210 deg+Ice+Temp	47.552	-11.714	20.178	2495.227	1452.666	-0.416
Dead+Wind 225 deg+Ice+Temp	47.552	-16.551	16.484	2038.731	2051.957	-0.442
Dead+Wind 240 deg+Ice+Temp	47.552	-20.261	11.666	1443.301	2511.397	-0.438
Dead+Wind 270 deg+Ice+Temp	47.552	-23.379	0.028	4.650	2897.175	-0.347
Dead+Wind 300 deg+Ice+Temp	47.552	-20.232	-11.617	-1435.284	2506.659	-0.162
Dead+Wind 315 deg+Ice+Temp	47.552	-16.511	-16.444	-2032.230	2045.248	-0.049
Dead+Wind 330 deg+Ice+Temp	47.552	-11.665	-20.150	-2490.693	1444.439	0.068
Dead+Wind 0 deg - Service	40.604	0.013	-9.695	-1180.329	-2.292	0.123
Dead+Wind 30 deg - Service	40.604	4.880	-8.403	-1023.324	-596.209	0.192
Dead+Wind 45 deg - Service	40.604	6.895	-6.865	-836.222	-841.985	0.208
Dead+Wind 60 deg - Service	40.604	8.439	-4.859	-592.139	-1030.385	0.210
Dead+Wind 90 deg - Service	40.604	9.737	-0.013	-2.313	-1188.484	0.170
Dead+Wind 120 deg - Service	40.604	8.426	4.836	588.113	-1028.152	0.085
Dead+Wind 135 deg - Service	40.604	6.876	6.846	832.908	-838.826	0.033
Dead+Wind 150 deg - Service	40.604	4.857	8.390	1020.936	-592.339	-0.022
Dead+Wind 180 deg - Service	40.604	-0.013	9.695	1180.175	2.178	-0.123
Dead+Wind 210 deg - Service	40.604	-4.880	8.403	1023.170	596.096	-0.191
Dead+Wind 225 deg - Service	40.604	-6.895	6.865	836.067	841.872	-0.207
Dead+Wind 240 deg - Service	40.604	-8.439	4.859	591.983	1030.272	-0.208
Dead+Wind 270 deg - Service	40.604	-9.737	0.013	2.157	1188.370	-0.170
Dead+Wind 300 deg - Service	40.604	-8.426	-4.836	-588.268	1028.038	-0.087
Dead+Wind 315 deg - Service	40.604	-6.876	-6.846	-833.062	838.712	-0.034
Dead+Wind 330 deg - Service	40.604	-4.857	-8.390	-1021.090	592.225	0.021

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.000	-40.604	0.000	0.000	40.604	0.000	0.000%
2	0.039	-40.604	-28.020	-0.039	40.604	28.020	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
3	14.104	-40.604	-24.285	-14.104	40.604	24.285	0.000%
4	19.926	-40.604	-19.840	-19.926	40.604	19.840	0.000%
5	24.390	-40.604	-14.044	-24.390	40.604	14.044	0.000%
6	28.140	-40.604	-0.039	-28.140	40.604	0.039	0.000%
7	24.351	-40.604	13.976	-24.351	40.604	-13.976	0.000%
8	19.871	-40.604	19.785	-19.871	40.604	-19.785	0.000%
9	14.037	-40.604	24.246	-14.037	40.604	-24.246	0.000%
10	-0.039	-40.604	28.020	0.039	40.604	-28.020	0.000%
11	-14.104	-40.604	24.285	14.104	40.604	-24.285	0.000%
12	-19.926	-40.604	19.840	19.926	40.604	-19.840	0.000%
13	-24.390	-40.604	14.044	24.390	40.604	-14.044	0.000%
14	-28.140	-40.604	0.039	28.140	40.604	-0.039	0.000%
15	-24.351	-40.604	-13.976	24.351	40.604	13.976	0.000%
16	-19.871	-40.604	-19.785	19.871	40.604	19.785	0.000%
17	-14.037	-40.604	-24.246	14.037	40.604	24.246	0.000%
18	0.000	-47.552	0.000	0.000	47.552	0.000	0.000%
19	0.028	-47.552	-23.284	-0.028	47.552	23.284	0.000%
20	11.714	-47.552	-20.178	-11.714	47.552	20.178	0.000%
21	16.551	-47.552	-16.484	-16.551	47.552	16.484	0.000%
22	20.261	-47.552	-11.666	-20.261	47.552	11.666	0.000%
23	23.379	-47.552	-0.028	-23.379	47.552	0.028	0.000%
24	20.232	-47.552	11.617	-20.232	47.552	-11.617	0.000%
25	16.511	-47.552	16.444	-16.511	47.552	-16.444	0.000%
26	11.665	-47.552	20.150	-11.665	47.552	-20.150	0.000%
27	-0.028	-47.552	23.284	0.028	47.552	-23.284	0.000%
28	-11.714	-47.552	20.178	11.714	47.552	-20.178	0.000%
29	-16.551	-47.552	16.484	16.551	47.552	-16.484	0.000%
30	-20.261	-47.552	11.666	20.261	47.552	-11.666	0.000%
31	-23.379	-47.552	0.028	23.379	47.552	-0.028	0.000%
32	-20.232	-47.552	-11.617	20.232	47.552	11.617	0.000%
33	-16.511	-47.552	-16.444	16.511	47.552	16.444	0.000%
34	-11.665	-47.552	-20.150	11.665	47.552	20.150	0.000%
35	0.013	-40.604	-9.695	-0.013	40.604	9.695	0.000%
36	4.880	-40.604	-8.403	-4.880	40.604	8.403	0.000%
37	6.895	-40.604	-6.865	-6.895	40.604	6.865	0.000%
38	8.439	-40.604	-4.859	-8.439	40.604	4.859	0.000%
39	9.737	-40.604	-0.013	-9.737	40.604	0.013	0.000%
40	8.426	-40.604	4.836	-8.426	40.604	-4.836	0.000%
41	6.876	-40.604	6.846	-6.876	40.604	-6.846	0.000%
42	4.857	-40.604	8.390	-4.857	40.604	-8.390	0.000%
43	-0.013	-40.604	9.695	0.013	40.604	-9.695	0.000%
44	-4.880	-40.604	8.403	4.880	40.604	-8.403	0.000%
45	-6.895	-40.604	6.865	6.895	40.604	-6.865	0.000%
46	-8.439	-40.604	4.859	8.439	40.604	-4.859	0.000%
47	-9.737	-40.604	0.013	9.737	40.604	-0.013	0.000%
48	-8.426	-40.604	-4.836	8.426	40.604	4.836	0.000%
49	-6.876	-40.604	-6.846	6.876	40.604	6.846	0.000%
50	-4.857	-40.604	-8.390	4.857	40.604	8.390	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	0.00063963
3	Yes	6	0.00000001	0.00004685

4	Yes	6	0.00000001	0.00004702
5	Yes	6	0.00000001	0.00004561
6	Yes	4	0.00000001	0.00041669
7	Yes	6	0.00000001	0.00004635
8	Yes	6	0.00000001	0.00004689
9	Yes	6	0.00000001	0.00004608
10	Yes	4	0.00000001	0.00030609
11	Yes	6	0.00000001	0.00004557
12	Yes	6	0.00000001	0.00004704
13	Yes	6	0.00000001	0.00004698
14	Yes	4	0.00000001	0.00076788
15	Yes	6	0.00000001	0.00004583
16	Yes	6	0.00000001	0.00004691
17	Yes	6	0.00000001	0.00004593
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00034065
20	Yes	6	0.00000001	0.00013234
21	Yes	6	0.00000001	0.00014429
22	Yes	6	0.00000001	0.00013013
23	Yes	5	0.00000001	0.00034010
24	Yes	6	0.00000001	0.00013080
25	Yes	6	0.00000001	0.00014339
26	Yes	6	0.00000001	0.00013042
27	Yes	5	0.00000001	0.00033875
28	Yes	6	0.00000001	0.00012989
29	Yes	6	0.00000001	0.00014421
30	Yes	6	0.00000001	0.00013249
31	Yes	5	0.00000001	0.00034199
32	Yes	6	0.00000001	0.00013003
33	Yes	6	0.00000001	0.00014346
34	Yes	6	0.00000001	0.00013003
35	Yes	4	0.00000001	0.00012043
36	Yes	5	0.00000001	0.00012204
37	Yes	5	0.00000001	0.00013711
38	Yes	5	0.00000001	0.00011701
39	Yes	4	0.00000001	0.00012171
40	Yes	5	0.00000001	0.00011949
41	Yes	5	0.00000001	0.00013535
42	Yes	5	0.00000001	0.00011805
43	Yes	4	0.00000001	0.00010271
44	Yes	5	0.00000001	0.00011648
45	Yes	5	0.00000001	0.00013701
46	Yes	5	0.00000001	0.00012278
47	Yes	4	0.00000001	0.00014158
48	Yes	5	0.00000001	0.00011720
49	Yes	5	0.00000001	0.00013540
50	Yes	5	0.00000001	0.00011738

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	179 - 151	44.509	39	2.878	0.002
L2	151 - 125.92	29.062	39	2.267	0.002
L3	130.086 - 85.796	20.354	39	1.703	0.001
L4	91.212 - 42.132	9.144	39	1.044	0.000
L5	48.882 - 0	2.411	39	0.462	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180.000	LPA-80080-4CF	39	44.509	2.878	0.002	9096
178.500	EEI 14-ft Low Profile Platform	39	44.216	2.868	0.002	9096
160.000	7770.00	39	33.672	2.484	0.002	2392
159.000	(2) RRUS-11	39	33.136	2.462	0.002	2273
158.000	13' Low Profile Platform	39	32.606	2.438	0.002	2164
156.000	Valmont Uni-Tri Bracket	39	31.562	2.391	0.002	1976

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	179 - 151	127.973	6	8.275	0.007
L2	151 - 125.92	83.663	6	6.523	0.006
L3	130.086 - 85.796	58.634	6	4.905	0.003
L4	91.212 - 42.132	26.361	6	3.009	0.001
L5	48.882 - 0	6.953	6	1.332	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
180.000	LPA-80080-4CF	6	127.973	8.275	0.007	3274
178.500	EEI 14-ft Low Profile Platform	6	127.133	8.247	0.007	3274
160.000	7770.00	6	96.895	7.147	0.006	858
159.000	(2) RRUS-11	6	95.357	7.081	0.006	815
158.000	13' Low Profile Platform	6	93.835	7.015	0.006	776
156.000	Valmont Uni-Tri Bracket	6	90.838	6.880	0.007	707

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	179 - 151 (1)	TP22.07x14.5x0.188	28.000	0.000	0.0	39.000	13.023	-5.194	507.890	0.010
L2	151 - 125.92 (2)	TP28.85x22.07x0.25	25.080	0.000	0.0	39.000	21.800	-7.581	850.218	0.009
L3	125.92 - 85.796	TP39.06x27.224x0.375	44.290	0.000	0.0	39.000	44.322	-14.652	1728.560	0.008

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 $\frac{P}{P_a}$
L4	85.796 - 42.132 (3)	TP49.99x36.863x0.375	49.080	0.000	0.0	39.000	51.029	-20.441	1990.150	0.010
L5	42.132 - 0 (4)	TP60.5x47.435x0.438	48.882	0.000	0.0	39.000	67.767	-27.860	2642.900	0.011

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	179 - 151 (1)	TP22.07x14.5x0.188	263.892	45.065	39.000	1.156	0.000	0.000	39.000	0.000
L2	151 - 125.92 (2)	TP28.85x22.07x0.25	572.112	46.509	39.000	1.193	0.000	0.000	39.000	0.000
L3	125.92 - 85.796 (3)	TP39.06x27.224x0.375	1252.317	36.980	39.000	0.948	0.000	0.000	39.000	0.000
L4	85.796 - 42.132 (4)	TP49.99x36.863x0.375	1745.067	38.824	39.000	0.995	0.000	0.000	39.000	0.000
L5	42.132 - 0 (5)	TP60.5x47.435x0.438	2325.500	34.234	39.000	0.878	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	179 - 151 (1)	TP22.07x14.5x0.188	13.901	1.067	26.000	0.082	0.491	0.041	26.000	0.002
L2	151 - 125.92 (2)	TP28.85x22.07x0.25	15.633	0.717	26.000	0.055	0.489	0.019	26.000	0.001
L3	125.92 - 85.796 (3)	TP39.06x27.224x0.375	19.411	0.438	26.000	0.034	0.487	0.007	26.000	0.000
L4	85.796 - 42.132 (4)	TP49.99x36.863x0.375	22.006	0.431	26.000	0.033	0.486	0.005	26.000	0.000
L5	42.132 - 0 (5)	TP60.5x47.435x0.438	24.542	0.362	26.000	0.028	0.486	0.003	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	179 - 151 (1)	0.010	1.156	0.000	0.082	0.002	1.168 ✔	1.333	H1-3+VT ✔
L2	151 - 125.92 (2)	0.009	1.193	0.000	0.055	0.001	1.202 ✔	1.333	H1-3+VT ✔
L3	125.92 - 85.796 (3)	0.008	0.948	0.000	0.034	0.000	0.957 ✔	1.333	H1-3+VT ✔

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L4	85.796 - 42.132 (4)	0.010	0.995	0.000	0.033	0.000	1.006 ✔	1.333	H1-3+VT ✔
L5	42.132 - 0 (5)	0.011	0.878	0.000	0.028	0.000	0.889 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	179 - 151	Pole	TP22.07x14.5x0.188	1	-5.194	677.017	87.6	Pass
L2	151 - 125.92	Pole	TP28.85x22.07x0.25	2	-7.581	1133.341	90.2	Pass
L3	125.92 - 85.796	Pole	TP39.06x27.224x0.375	3	-14.652	2304.170	71.8	Pass
L4	85.796 - 42.132	Pole	TP49.99x36.863x0.375	4	-20.441	2652.870	75.5	Pass
L5	42.132 - 0	Pole	TP60.5x47.435x0.438	5	-27.860	3522.986	66.7	Pass
							Summary	
						Pole (L2)	90.2	Pass
						RATING =	**90.2**	**Pass**

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Subject:		Flange Bolts and Flangeplate Analysis
Location:		180-ft EEI Monopole Colchester, CT
Rev. 0: 11/21/14		Prepared by: T.J.L. Checked by: C.F.C. Job No. 14001.056

Flange Bolt and Flange Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 264·ft·kips	(Input From tnxTower)
Shear Force =	Shear := 14·kips	(Input From tnxTower)
Axial Force =	Axial := 9.4·kips	(Input From tnxTower)

Flange Bolt Data:

Use ASTM A325

Number of Flange Bolts =	N := 24	(User Input)
Diameter of Bolt Circle =	D_{bc} := 25.75·in	(User Input)
Bolt Ultimate Strength =	F_u := 120·ksi	(User Input)
Bolt Yield Strength =	F_y := 92·ksi	(User Input)
Bolt Modulus =	E := 29000·ksi	(User Input)
Diameter of Flange Bolts =	D := 1.0·in	(User Input)
Threads per Inch =	n := 8	(User Input)

Flange Plate Data:

Use ASTM A572 GR. 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Flange Plate Thickness =	t_{bp} := 1.0·in	(User Input)
Flange Plate Diameter =	D_{bp} := 29.0·in	(User Input)
Outer Pole Diameter =	D_{pole} := 22.07·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 12.875 \cdot in$

Distance to Bolts = $i := 1 .. N$

$$d_i := \left| \begin{array}{l} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{array} \right.$$

$d_1 = 3.33 \cdot in$ $d_7 = 12.44 \cdot in$

$d_2 = 6.44 \cdot in$ $d_8 = 11.15 \cdot in$

$d_3 = 9.10 \cdot in$ $d_9 = 9.10 \cdot in$

$d_4 = 11.15 \cdot in$ $d_{10} = 6.44 \cdot in$

$d_5 = 12.44 \cdot in$ $d_{11} = 3.33 \cdot in$

$d_6 = 12.88 \cdot in$ $d_{12} = 0.00 \cdot in$

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 11 \cdot in$

Moment Arms of Bolts about Neutral Axis = $MA_i := if\left(d_i \geq R_{pole}, d_i - R_{pole}, 0in\right)$

$MA_1 = 0.00 \cdot in$ $MA_7 = 1.40 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.12 \cdot in$

$MA_3 = 0.00 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 0.12 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 1.40 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 1.84 \cdot in$ $MA_{12} = 0.00 \cdot in$

Effective Width of Flangeplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 15.1 \cdot in$

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Subject:	Flange Bolts and Flangeplate Analysis
Location:	180-ft EEI Monopole Colchester, CT
Rev. 0: 11/21/14	Prepared by: T.J.L. Checked by: C.F.C. Job No. 14001.056

Flange Bolt Analysis:

Calculated Flange Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 1.989 \times 10^3 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 0.785 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 0.606 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 0.878 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.22 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^3}{32} = 0.066 \cdot in^3$

Check Flange Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 20.1 \cdot kips$

Allowable Tensile Force = $T_{ALL.Gross} := 1.333 \cdot \left(0.33 \cdot A_g \cdot F_u\right) = 41.5 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Gross}} = 48.5\,\%$

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Gross}} \le 1.00, "OK", "Overstressed"\right)$

Condition1 = "OK"

Flange Plate Analysis:

Force from Bolts =

$$C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$$

$C_1 = 5.7 \cdot kips$
$C_2 = 10.6 \cdot kips$
$C_3 = 14.9 \cdot kips$
$C_4 = 18.1 \cdot kips$
$C_5 = 20.2 \cdot kips$
$C_6 = 20.9 \cdot kips$
$C_7 = 20.2 \cdot kips$
$C_8 = 18.1 \cdot kips$
$C_9 = 14.9 \cdot kips$
$C_{10} = 10.6 \cdot kips$
$C_{11} = 5.7 \cdot kips$
$C_{12} = 0.4 \cdot kips$

Maximum Bending Stress in Plate =

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 39.6 \cdot ksi$$

Allowable Bending Stress in Plate =

$$F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$$

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} = 66.1 \cdot \%$$

Condition3 =

$$Condition2 := if\left(\frac{f_{bp}}{F_{bp}} < 1.00, "Ok", "Overstressed"\right)$$

Condition2 = "Ok"

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Subject:		Anchor Bolt and Baseplate Analysis
Location:		180-ft EEI Monopole Colchester, CT
Rev. 0: 11/21/14		Prepared by: T.J.L. Checked by: C.F.C. Job No. 14001.056

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 3429·ft·kips	(Input From RisaTower)
Shear Force =	Shear := 28·kips	(Input From RisaTower)
Axial Force =	Axial := 41·kips	(Input From RisaTower)

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts =	N := 16	(User Input)
Diameter of Bolt Circle =	D_{bc} := 70.0·in	(User Input)
Bolt "Column" Distance =	l := 3.0·in	(User Input)
Bolt Ultimate Strenght =	F_u := 100·ksi	(User Input)
Bolt Yeild Strenght =	F_y := 75·ksi	(User Input)
Bolt Modulus =	E := 29000·ksi	(User Input)
Diameter of Anchor Bolts =	D := 2.25·in	(User Input)
Threads per Inch =	n := 4.5	(User Input)

Base Plate Data:

Use ASTM A572 GR 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 2.0·in	(User Input)
Base Plate Diameter =	D_{bp} := 76.0·in	(User Input)
Outer Pole Diameter =	D_{pole} := 60.5·in	(User Input)

Geometric Layout Data:

Distance from Bolts to Centroid of Pole:

Radius of Bolt Circle =: $R_{bc} := \frac{D_{bc}}{2} = 35 \cdot in$

Distance to Bolts = $i := 1 .. N$

$$d_i := \left| \begin{array}{l} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{array} \right.$$

$d_1 = 13.39 \cdot in$ $d_7 = 13.39 \cdot in$

$d_2 = 24.75 \cdot in$ $d_8 = 0.00 \cdot in$

$d_3 = 32.34 \cdot in$ $d_9 = -13.39 \cdot in$

$d_4 = 35.00 \cdot in$ $d_{10} = -24.75 \cdot in$

$d_5 = 32.34 \cdot in$ $d_{11} = -32.34 \cdot in$

$d_6 = 24.75 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius = $R_{pole} := \frac{D_{pole}}{2} = 30.3 \cdot in$

Moment Arms of Bolts about Neutral Axis = $MA_i := if\left(d_i \geq R_{pole}, d_i - R_{pole}, 0in\right)$

$MA_1 = 0.00 \cdot in$ $MA_7 = 0.00 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 2.09 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 4.75 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 2.09 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 0.00 \cdot in$ etc

Effective Width of Baseplate for Bending = $B_{eff} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2} = 36.8 \cdot in$

Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \sum_i \left(d_i\right)^2 = 9.8 \times 10^3 \cdot in^2$

Gross Area of Bolt = $A_g := \frac{\pi}{4} \cdot D^2 = 3.976 \cdot in^2$

Net Area of Bolt = $A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 = 3.248 \cdot in^2$

Net Diameter = $D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} = 2.033 \cdot in$

Radius of Gyration of Bolt = $r := \frac{D_n}{4} = 0.508 \cdot in$

Section Modulus of Bolt = $S_x := \frac{\pi \cdot D_n^3}{32} = 0.826 \cdot in^3$

Check Anchor Bolt Tension Force:

Maximum Tensile Force = $T_{Max} := OM \cdot \frac{R_{bc}}{I_p} - \frac{Axial}{N} = 144.4 \cdot kips$

Allowable Tensile Force = $T_{ALL.Gross} := 1.333 \cdot \left(0.33 \cdot A_g \cdot F_u\right) = 174.9 \cdot kips$ (1.333 increase allowed per TIA/EIA)

$T_{ALL.Net} := 1.333 \cdot \left(0.60 \cdot A_n \cdot F_y\right) = 194.812 \cdot kips$ (1.333 increase allowed per TIA/EIA)

Bolt Tension % of Capacity = $\frac{T_{Max}}{T_{ALL.Net}} = 74.1 \cdot \%$ Bolts are "upset bolts". Use net area per AISC

Condition1 = $Condition1 := if\left(\frac{T_{Max}}{T_{ALL.Net}} \le 1.00, "OK", "Overstressed"\right)$

Condition1 = "OK"

Check Anchor Bolt Bending Stress:

Maximum Bending Moment = $M_x := \left(\frac{Shear}{N}\right) \cdot l = 0.437 \cdot ft \cdot kips$

Maximum Bending Stress = $f_{bx} := \frac{M_x}{S_x} = 6.4 \cdot ksi$

Allowable Bending Stress = $F_{bx} := 1.333 \cdot 0.6 \cdot F_y = 60 \cdot ksi$ (1.333 increase allowed per TIA/EIA)

Check Combined Stress Requirement:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required.

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot in$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0 & \text{otherwise} \end{cases} = 0 \cdot ksi$$

Check Anchor Bolt Compression/Combined Stress:

Maximum Compressive Force =

$$C_{Max} := OM \cdot \frac{R_{bc}}{I_p} + \frac{Axial}{N} = 149.5 \cdot kips$$

Maximum Compressive Stress =

$$f_a := \frac{C_{Max}}{A_n} = 46 \cdot ksi$$

$$K := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_y}} = 87.364$$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^2}\right] \cdot F_y}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^3}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} = 45 \cdot ksi$$

Allowable Compressive Stress =

$$F_a := 1.333 \cdot F_a = 60 \cdot ksi$$

(1.333 increase allowed per TIA/EIA)

Combined Stress % of Capacity =

$$\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}}\right) = 76.8 \cdot \%$$

Condition 2 =

$$Condition2 := if\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right)$$

Condition2 = "OK"

Base Plate Analysis:

Force from Bolts = $C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$

$C_1 = 58.8 \cdot kips$ $C_7 = 58.8 \cdot kips$

$C_2 = 106.5 \cdot kips$ $C_8 = 2.6 \cdot kips$

$C_3 = 138.3 \cdot kips$ $C_9 = -53.7 \cdot kips$

$C_4 = 149.5 \cdot kips$ $C_{10} = -101.4 \cdot kips$

$C_5 = 138.3 \cdot kips$ $C_{11} = -133.2 \cdot kips$

$C_6 = 106.5 \cdot kips$ etc.

Maximum Bending Stress in Plate = $f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{\left(B_{eff} \cdot t_{bp}^2\right)} = 52.5 \cdot ksi$

Allowable Bending Stress in Plate = $F_{bp} := 1.33 \cdot 0.75 \cdot Fy_{bp} = 59.9 \cdot ksi$

Plate Bending Stress % of Capacity = $\frac{f_{bp}}{F_{bp}} = 87.7 \cdot \%$

Condition3 = $Condition3 := if\left(\frac{f_{bp}}{F_{bp}} < 1.00, "Ok", "Overstressed"\right)$

Condition3 = "Ok"

CENTEK engineering
Centered on Solutions
63-2 North Branford Road
Branford, CT 06405
www.centekeng.com
P: (203) 488-0580
F: (203) 488-8587

Subject:		CAISSON FOUNDATION
Location:		180-ft EEI Monopole Colchester, CT
Rev. 0: 11/21/14		Prepared by: TJL Checked by: C.F.C. Job No. 14001.056

Caisson Foundation:

Input Data:

Shear Force =	S := 28k	*USER INPUT-FROM tnxTower*
Overturning Moment =	M := 3429ft·k	*USER INPUT-FROM tnxTower*
Applied Axial Load =	A1 := 41k	*USER INPUT-FROM tnxTower*
Bending Moment =	Mu := 3574ft·k	*USER INPUT–FROM LPILE*
Moment Capacity =	Mn := 8989ft·k	*USER INPUT–FROM LPILE*
Foundation Diameter =	d := 8ft	*USER INPUT*
Overall Length of Caisson =	$L_c := 28.0ft$	*USER INPUT*
Depth From Top of Caisson to Grade =	$L_{pag} := 1.0ft$	*USER INPUT*
Number of Rebar =	n := 27	*USER INPUT*
Area of Rebar =	$Ar := 1.56in^2$	*USER INPUT*
Rebar Yield Strength =	fy := 60ksi	*USER INPUT*
Concrete Comp Strength =	f'c := 4ksi	*USER INPUT*

Check Moment Capacity:

Factor of Safety = $FS := \frac{Mn}{Mu} = 2.5$

Factor of Safety Required = $FS_{reqd} := 1.3$

$FOSCheck := if(FS \geq FS_{reqd}, "OK", "NO GOOD")$

FOSCheck = "OK"

LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This program is licensed to:

TJL
Centek Engineering

Files Used for Analysis

Path to file locations: J:\Jobs\1400100.WI\056 - Colchester S CT\Backup Documentation\MathCad\Foundation\
Name of input data file: Colchester South Caisson Analysis.lpd
Name of output file: Colchester South Caisson Analysis.lpo
Name of plot output file: Colchester South Caisson Analysis.lpp
Name of runtime file: Colchester South Caisson Analysis.lpr

Time and Date of Analysis

Date: November 21, 2014 Time: 9:28:41

Problem Title

14001.056 - Colchester South

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- Analysis includes computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-04 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 8

Pile Structural Properties and Geometry

Pile Length = 336.00 in

Depth of ground surface below top of pile = 12.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	96.00000000	4169220.	7238.2300	3605000.
2	336.0000	96.00000000	4169220.	7238.2300	3605000.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 36.000 in
p-y subgrade modulus k for top of soil layer = 0.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 0.000 lbs/in**3

NOTE: Internal default values for p-y subgrade modulus will be computed for the above soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 36.000 in
Distance from top of pile to bottom of layer = 156.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 156.000 in
Distance from top of pile to bottom of layer = 228.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 228.000 in
Distance from top of pile to bottom of layer = 372.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

(Depth of lowest layer extends 36.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05200
2	36.00	0.05200
3	36.00	0.07200
4	156.00	0.07200
5	156.00	0.07500
6	228.00	0.07500
7	228.00	0.08100
8	372.00	0.08100

Shear Strength of Soils

Shear strength parameters with depth defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	12.000	0.00000	1.00	------	------
2	36.000	0.00000	1.00	------	------
3	36.000	0.00000	33.00	------	------
4	156.000	0.00000	33.00	------	------
5	156.000	0.00000	35.00	------	------
6	228.000	0.00000	35.00	------	------
7	228.000	0.00000	35.00	------	------
8	372.000	0.00000	35.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 28000.000 lbs
Bending moment at pile head = 41148000.000 in-lbs
Axial load at pile head = 41000.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 96.0000 in

Material Properties:

Compressive Strength of Concrete	=	4.000 kip/in**2
Yield Stress of Reinforcement	=	60. kip/in**2
Modulus of Elasticity of Reinforcement	=	29000. kip/in**2
Number of Reinforcing Bars	=	27
Area of Single Bar	=	1.56000 in**2
Number of Rows of Reinforcing Bars	=	27
Area of Steel	=	42.120 in**2
Area of Shaft	=	7238.229 in**2
Percentage of Steel Reinforcement	=	0.582 percent
Cover Thickness (edge to bar center)	=	4.000 in

Unfactored Axial Squash Load Capacity = 26993.97 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.560	43.926
2	1.560	43.332
3	1.560	42.152
4	1.560	40.402
5	1.560	38.105
6	1.560	35.293
7	1.560	32.004
8	1.560	28.283
9	1.560	24.178
10	1.560	19.747
11	1.560	15.049
12	1.560	10.147
13	1.560	5.108
14	1.560	0.000
15	1.560	-5.108

16	1.560	-10.147
17	1.560	-15.049
18	1.560	-19.747
19	1.560	-24.178
20	1.560	-28.283
21	1.560	-32.004
22	1.560	-35.293
23	1.560	-38.105
24	1.560	-40.402
25	1.560	-42.152
26	1.560	-43.332
27	1.560	-43.926

Axial Thrust Force = 41000.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
10187897.	1.630064E+13	6.250000E-07	0.00003161	50.58256388	112.20875	842.95973
20272497.	1.621800E+13	0.00000125	0.00006175	49.39649820	217.32042	1642.92457
30253115.	1.613499E+13	0.00000188	0.00009186	48.98983812	320.65110	2442.27472
40130095.	1.605204E+13	0.00000250	0.00012197	48.78638792	422.27556	3241.61615
40130095.	1.284163E+13	0.00000313	0.00007218	23.09759188	248.67812	6237.53452
40130095.	1.070136E+13	0.00000375	0.00008524	22.73130655	292.50699	7524.87495
40130095.	9.172593E+12	0.00000438	0.00009832	22.47301912	336.07945	8811.79099
40130095.	8.026019E+12	0.00000500	0.00011172	22.34313440	380.43815	10089.45156
40130095.	7.134239E+12	0.00000563	0.00012479	22.18449354	423.37067	11376.51130
40130095.	6.420815E+12	0.00000625	0.00013788	22.06015062	466.05004	12663.10526
40130095.	5.837105E+12	0.00000688	0.00015098	21.96077013	508.47551	13949.22977
40130095.	5.350679E+12	0.00000750	0.00016410	21.88012362	550.64621	15234.88219
40130095.	4.939089E+12	0.00000813	0.00017724	21.81390238	592.56131	16520.05908
40130095.	4.586297E+12	0.00000875	0.00019039	21.75903082	634.22006	17804.75652
40130095.	4.280543E+12	0.00000938	0.00020356	21.71324587	675.62144	19088.97262
40130095.	4.013009E+12	0.00001000	0.00021675	21.67485952	716.76474	20372.70284
40130095.	3.776950E+12	0.00001063	0.00022995	21.64257288	757.64895	21655.94509
40130095.	3.567120E+12	0.00001125	0.00024317	21.61538458	798.27335	22938.69439
40130095.	3.379376E+12	0.00001188	0.00025641	21.59249640	838.63696	24220.94842
40130095.	3.210408E+12	0.00001250	0.00026967	21.57327318	878.73888	25502.70360
40130095.	3.057531E+12	0.00001313	0.00028294	21.55719995	918.57818	26783.95665
40130095.	2.918552E+12	0.00001375	0.00029623	21.54385614	958.15396	28064.70400
40130095.	2.791659E+12	0.00001438	0.00030954	21.53289843	997.46546	29344.94036
40130095.	2.675340E+12	0.00001500	0.00032286	21.52402925	1036.51141	30624.66542
40881748.	2.616432E+12	0.00001563	0.00033620	21.51701403	1075.29124	31903.87192
42450890.	2.612362E+12	0.00001625	0.00034956	21.51164103	1113.80372	33182.55883
44018431.	2.608500E+12	0.00001688	0.00036294	21.50773859	1152.04803	34460.72085
45584363.	2.604821E+12	0.00001750	0.00037634	21.50515795	1190.02328	35738.35352
47148664.	2.601306E+12	0.00001813	0.00038976	21.50376463	1227.72820	37015.45565
48711339.	2.597938E+12	0.00001875	0.00040319	21.50345278	1265.16212	38292.02024
50272373.	2.594703E+12	0.00001938	0.00041664	21.50412226	1302.32389	39568.04475
51831745.	2.591587E+12	0.00002000	0.00043011	21.50568438	1339.21228	40843.52726
53389470.	2.588580E+12	0.00002063	0.00044360	21.50807333	1375.82677	42118.45859
54945514.	2.585671E+12	0.00002125	0.00045711	21.51121473	1412.16583	43392.83963
56499877.	2.582852E+12	0.00002188	0.00047064	21.51505423	1448.22864	44666.66394
58052558.	2.580114E+12	0.00002250	0.00048419	21.51954317	1484.01433	45939.92530
59603531.	2.577450E+12	0.00002313	0.00049776	21.52463007	1519.52147	47212.62294
61152788.	2.574854E+12	0.00002375	0.00051134	21.53027487	1554.74906	48484.75192
62700326.	2.572321E+12	0.00002438	0.00052495	21.53644323	1589.69614	49756.30618
65790201.	2.567422E+12	0.00002563	0.00055222	21.55022192	1658.74437	52297.67234
68873052.	2.562718E+12	0.00002688	0.00057958	21.56573439	1726.65683	54836.68828
71948787.	2.558179E+12	0.00002813	0.00060702	21.58279467	1793.42422	57373.31713
75017326.	2.553781E+12	0.00002938	0.00063454	21.60125399	1859.03737	59907.51730
77492617.	2.530371E+12	0.00003063	0.00066037	21.56306219	1919.23237	60000.00000
79508365.	2.494380E+12	0.00003188	0.00068485	21.48558855	1975.05729	60000.00000
81222333.	2.451995E+12	0.00003313	0.00070842	21.38636255	2027.69820	60000.00000
82718623.	2.406360E+12	0.00003438	0.00073131	21.27449369	2077.80067	60000.00000
84079533.	2.360127E+12	0.00003563	0.00075377	21.15856504	2126.02710	60000.00000
85294246.	2.313064E+12	0.00003688	0.00077576	21.03750086	2172.31065	60000.00000
86393347.	2.266055E+12	0.00003813	0.00079734	20.91392756	2216.88350	60000.00000
87056334.	2.210955E+12	0.00003938	0.00081900	20.79999876	2260.78127	60000.00000
88408707.	2.176214E+12	0.00004063	0.00084298	20.75016832	2308.63276	60000.00000
89228638.	2.130833E+12	0.00004188	0.00086308	20.61088514	2347.64152	60000.00000
90046415.	2.088033E+12	0.00004313	0.00088322	20.48049402	2386.01043	60000.00000
90780794.	2.045764E+12	0.00004438	0.00090298	20.34881830	2422.92035	60000.00000
91440011.	2.004165E+12	0.00004563	0.00092239	20.21681070	2458.48715	60000.00000
92097315.	1.964743E+12	0.00004688	0.00094184	20.09252501	2493.45455	60000.00000
92744015.	1.927148E+12	0.00004813	0.00096126	19.97433615	2527.72839	60000.00000
93266892.	1.888950E+12	0.00004938	0.00098003	19.84863997	2560.13821	60000.00000
93788077.	1.852604E+12	0.00005063	0.00099882	19.72973013	2591.98644	60000.00000
94307596.	1.817978E+12	0.00005188	0.00101764	19.61712599	2623.27095	60000.00000
94825406.	1.784949E+12	0.00005313	0.00103649	19.51038122	2653.98853	60000.00000
95266687.	1.752031E+12	0.00005438	0.00105489	19.40022326	2683.33115	60000.00000
95673666.	1.719976E+12	0.00005563	0.00107310	19.29171896	2711.78503	60000.00000
96156989.	1.690672E+12	0.00005688	0.00109200	19.20000029	2740.75740	60000.00000
96569941.	1.661418E+12	0.00005813	0.00111534	19.18857908	2776.03981	60000.00000
96961792.	1.633041E+12	0.00005938	0.00113298	19.08183432	2801.70567	60000.00000
97352182.	1.605809E+12	0.00006063	0.00115066	18.97992754	2826.87201	60000.00000

97652841.	1.578228E+12	0.00006188	0.00116762	18.87064791	2850.45865	60000.00000
97952310.	1.551720E+12	0.00006313	0.00118461	18.76608610	2873.58493	60000.00000
98250606.	1.526223E+12	0.00006438	0.00120162	18.66597319	2896.24906	60000.00000
98547702.	1.501679E+12	0.00006563	0.00121866	18.57005453	2918.44868	60000.00000
98843617.	1.478035E+12	0.00006688	0.00123572	18.47810125	2940.18201	60000.00000
99138314.	1.455241E+12	0.00006813	0.00125281	18.38989305	2961.44650	60000.00000
99431784.	1.433251E+12	0.00006938	0.00126993	18.30522966	2982.23997	60000.00000
99669677.	1.411252E+12	0.00007063	0.00128653	18.21640062	3001.89922	60000.00000
99892266.	1.389805E+12	0.00007188	0.00130303	18.12905645	3020.94463	60000.00000
1.001138E+08	1.369077E+12	0.00007313	0.00131954	18.04502249	3039.55129	60000.00000
1.003342E+08	1.349032E+12	0.00007438	0.00133608	17.96413279	3057.71715	60000.00000
1.007719E+08	1.310854E+12	0.00007688	0.00136923	17.81117964	3092.71840	60000.00000
1.012051E+08	1.275025E+12	0.00007938	0.00140248	17.66908121	3125.93224	60000.00000
1.012966E+08	1.237210E+12	0.00008188	0.00144100	17.59999895	3162.33870	60000.00000
1.020541E+08	1.209530E+12	0.00008438	0.00147689	17.50392580	3193.80963	60000.00000
1.023516E+08	1.178148E+12	0.00008688	0.00150758	17.35339022	3218.69602	60000.00000
1.026457E+08	1.148484E+12	0.00008938	0.00153834	17.21224737	3242.05050	60000.00000
1.029364E+08	1.120397E+12	0.00009188	0.00156920	17.07974482	3263.85946	60000.00000
1.032236E+08	1.093760E+12	0.00009438	0.00160015	16.95520163	3284.10842	60000.00000
1.035073E+08	1.068462E+12	0.00009688	0.00163118	16.83801985	3302.78350	60000.00000
1.037513E+08	1.044039E+12	0.00009938	0.00166170	16.72152758	3319.52969	60000.00000
1.039528E+08	1.020396E+12	0.00010188	0.00169164	16.60508394	3334.40272	60000.00000
1.041512E+08	9.978556E+11	0.00010438	0.00172167	16.49503183	3347.79565	60000.00000
1.043463E+08	9.763396E+11	0.00010688	0.00175178	16.39093065	3359.69494	60000.00000
1.045382E+08	9.557776E+11	0.00010938	0.00178198	16.29238272	3370.08692	60000.00000
1.047268E+08	9.361051E+11	0.00011188	0.00181227	16.19902468	3378.95756	60000.00000
1.049120E+08	9.172635E+11	0.00011438	0.00184264	16.11052465	3386.29260	60000.00000
1.050939E+08	8.991991E+11	0.00011688	0.00187311	16.02657938	3392.07749	60000.00000
1.057681E+08	8.860156E+11	0.00011938	0.00191000	16.00000048	3397.01895	60000.00000
1.066627E+08	8.751810E+11	0.00012188	0.00195000	16.00000048	3399.70675	60000.00000
1.066627E+08	8.575894E+11	0.00012438	0.00198066	15.92490721	3397.01657	60000.00000
1.066627E+08	8.406911E+11	0.00012688	0.00200858	15.83118010	3390.16754	60000.00000
1.066627E+08	8.244459E+11	0.00012938	0.00203658	15.74171591	3383.29661	60000.00000
1.066627E+08	8.088166E+11	0.00013188	0.00206467	15.65628290	3385.59848	60000.00000
1.066627E+08	7.937688E+11	0.00013438	0.00209285	15.57466364	3390.36835	60000.00000
1.066627E+08	7.792707E+11	0.00013688	0.00212111	15.49665785	3394.19505	60000.00000
1.066627E+08	7.652928E+11	0.00013938	0.00214945	15.42207956	3397.06746	60000.00000
1.066627E+08	7.518075E+11	0.00014188	0.00217789	15.35075426	3398.97421	60000.00000
1.066627E+08	7.387891E+11	0.00014438	0.00220641	15.28252745	3399.90375	60000.00000
1.066627E+08	7.262140E+11	0.00014688	0.00223513	15.21788549	3396.62905	60000.00000
1.066627E+08	7.140598E+11	0.00014938	0.00226398	15.15637922	3390.58947	60000.00000
1.066780E+08	7.024064E+11	0.00015188	0.00229291	15.09733629	3384.53230	60000.00000
1.067624E+08	6.915783E+11	0.00015438	0.00232190	15.04063940	3378.45743	60000.00000
1.068368E+08	6.810317E+11	0.00015688	0.00235060	14.98391962	3379.05372	60000.00000
1.068884E+08	6.706720E+11	0.00015938	0.00237852	14.92404699	3383.85591	60000.00000
1.069394E+08	6.606292E+11	0.00016188	0.00240650	14.86640596	3388.04707	60000.00000
1.069899E+08	6.508888E+11	0.00016438	0.00243454	14.81090212	3391.62092	60000.00000
1.070398E+08	6.414372E+11	0.00016688	0.00246265	14.75744104	3394.57087	60000.00000
1.070893E+08	6.322614E+11	0.00016938	0.00249082	14.70593691	3396.89031	60000.00000
1.071382E+08	6.233493E+11	0.00017188	0.00251905	14.65630674	3398.57247	60000.00000
1.071865E+08	6.146897E+11	0.00017438	0.00254735	14.60847616	3399.61052	60000.00000
1.072796E+08	5.980744E+11	0.00017938	0.00260432	14.51888323	3395.51987	60000.00000
1.073689E+08	5.823398E+11	0.00018438	0.00266170	14.43632269	3385.64496	60000.00000
1.073689E+08	5.669645E+11	0.00018938	0.00272700	14.39999914	3373.67456	60000.00000
1.073689E+08	5.523802E+11	0.00019438	0.00279900	14.39999914	3375.30202	60000.00000
1.074675E+08	5.390220E+11	0.00019938	0.00287100	14.39999914	3387.05715	60000.00000
1.078011E+08	5.274673E+11	0.00020438	0.00293440	14.35792208	3393.78150	60000.00000
1.078626E+08	5.151648E+11	0.00020938	0.00299125	14.28657675	3397.45924	60000.00000
1.079230E+08	5.034309E+11	0.00021438	0.00304833	14.21960020	3399.52765	60000.00000
1.079493E+08	4.920767E+11	0.00021938	0.00310377	14.14822626	3398.57373	60000.00000
1.079599E+08	4.811583E+11	0.00022438	0.00316041	14.08537245	3391.00661	60000.00000
1.079701E+08	4.707142E+11	0.00022938	0.00321716	14.02577162	3383.40841	60000.00000
1.079799E+08	4.607141E+11	0.00023438	0.00327404	13.96922636	3375.77847	60000.00000
1.079892E+08	4.511300E+11	0.00023938	0.00333104	13.91555357	3368.11625	60000.00000
1.079982E+08	4.419364E+11	0.00024438	0.00338816	13.86459017	3360.42091	60000.00000
1.080067E+08	4.331097E+11	0.00024938	0.00344541	13.81618166	3352.95250	60000.00000
1.080148E+08	4.246283E+11	0.00025438	0.00350279	13.77018785	3361.65456	60000.00000
1.080225E+08	4.164721E+11	0.00025938	0.00356031	13.72648001	3369.51331	60000.00000
1.080288E+08	4.086197E+11	0.00026438	0.00361812	13.68556738	3376.56312	60000.00000
1.080288E+08	4.010351E+11	0.00026938	0.00367761	13.65237093	3383.11780	60000.00000
1.080288E+08	3.937270E+11	0.00027438	0.00373728	13.62105417	3388.63841	60000.00000
1.080288E+08	3.866804E+11	0.00027938	0.00379713	13.59153414	3393.10042	60000.00000
1.080288E+08	3.798816E+11	0.00028438	0.00385719	13.56374216	3396.47839	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 107871.87744 in-kip

---

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 28000.000 lbs
Specified moment at pile head = 41148000.000 in-lbs
Specified axial load at pile head = 41000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	0.717292	4.11E+07	28000.	-0.004568	479.399	2.62E+12	0.000	0.000
26.880	0.600219	4.19E+07	27935.	-0.004141	488.116	2.61E+12	-8.461	47.366
53.760	0.494729	4.26E+07	21857.	-0.003706	496.351	2.61E+12	-624.191	4239.248
80.640	0.401019	4.29E+07	-7683.053	-0.003266	499.270	2.61E+12	-1574.492	13192.
107.520	0.319145	4.20E+07	-59270.	-0.002828	489.321	2.61E+12	-2124.965	22372.
134.400	0.248215	3.96E+07	-1.19E+05	-0.002532	461.905	1.61E+13	-2253.175	30500.
161.280	0.181013	3.56E+07	-1.77E+05	-0.002469	415.974	1.61E+13	-1938.487	35982.
188.160	0.115408	3.02E+07	-2.24E+05	-0.002414	353.669	1.61E+13	-1515.102	44111.
215.040	0.051152	2.37E+07	-2.56E+05	-0.002369	278.962	1.62E+13	-795.277	52240.
241.920	-0.012047	1.67E+07	-2.64E+05	-0.002335	197.842	1.62E+13	213.375	59514.
268.800	-0.074501	9.82E+06	-2.42E+05	-0.002314	118.689	1.63E+13	1499.838	67643.
295.680	-0.136516	4.04E+06	-1.81E+05	-0.002302	52.211	1.63E+13	3078.569	75771.
322.560	-0.198344	5.11E+05	-73533.	-0.002299	11.543	1.63E+13	4952.676	83900.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.71729239 in
Computed slope at pile head	=	-0.00456816
Maximum bending moment	=	42890465. lbs-in
Maximum shear force	=	-264586.50214 lbs
Depth of maximum bending moment	=	73.92000000 in
Depth of maximum shear force	=	235.20000 in
Number of iterations	=	86
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

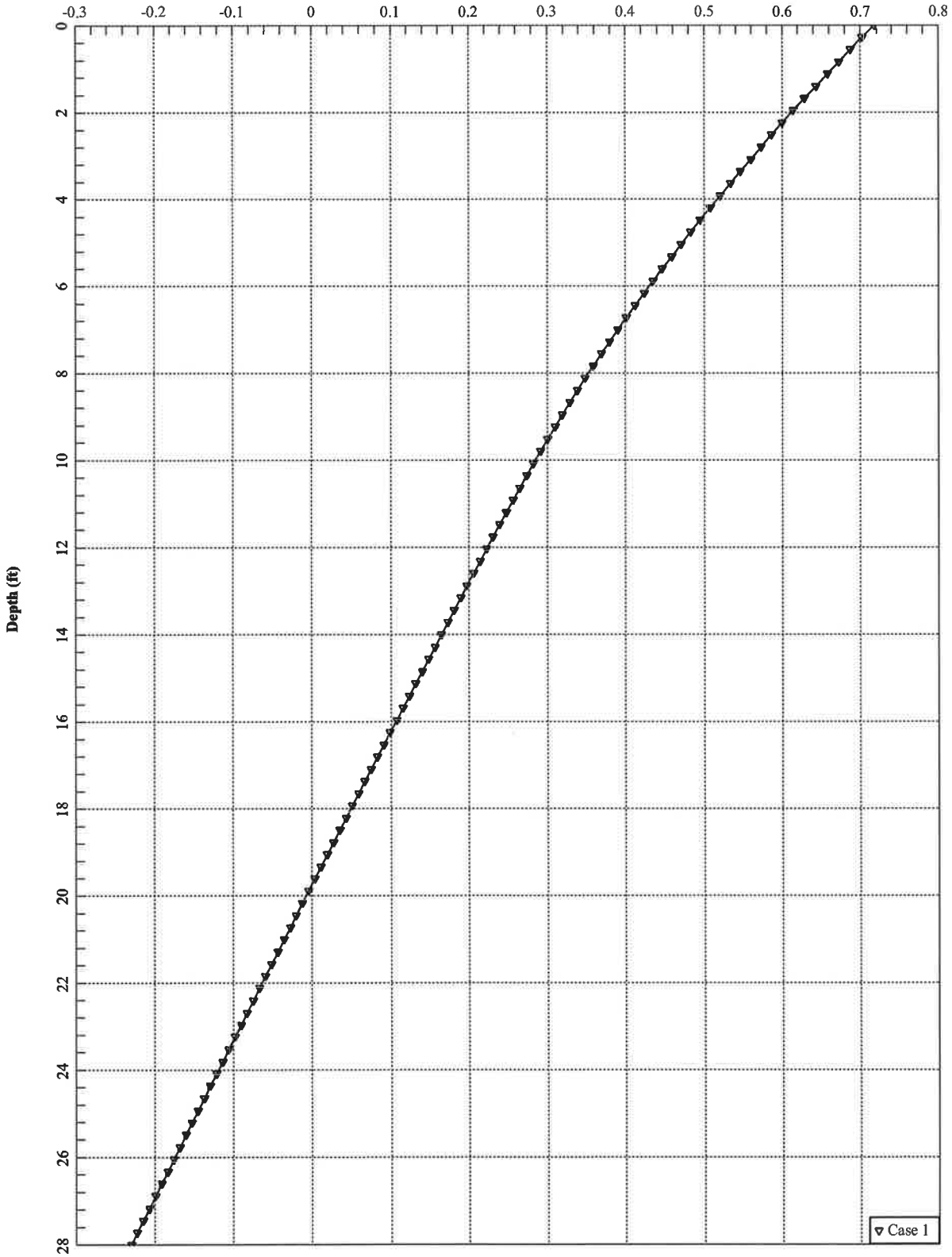
Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

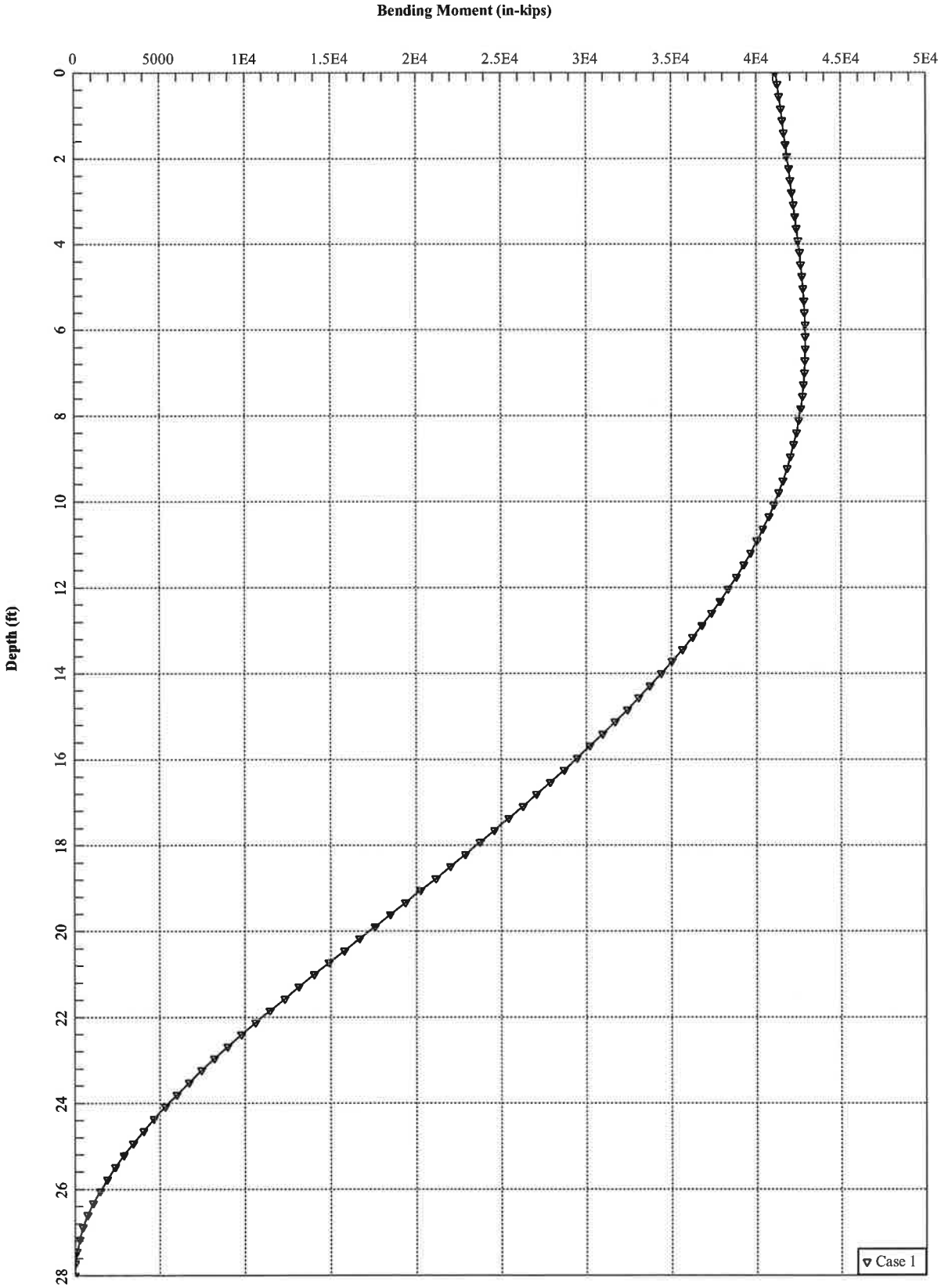
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 28000.	M= 4.11E+07	41000.0000	0.7172924	4.2890E+07	-264587.

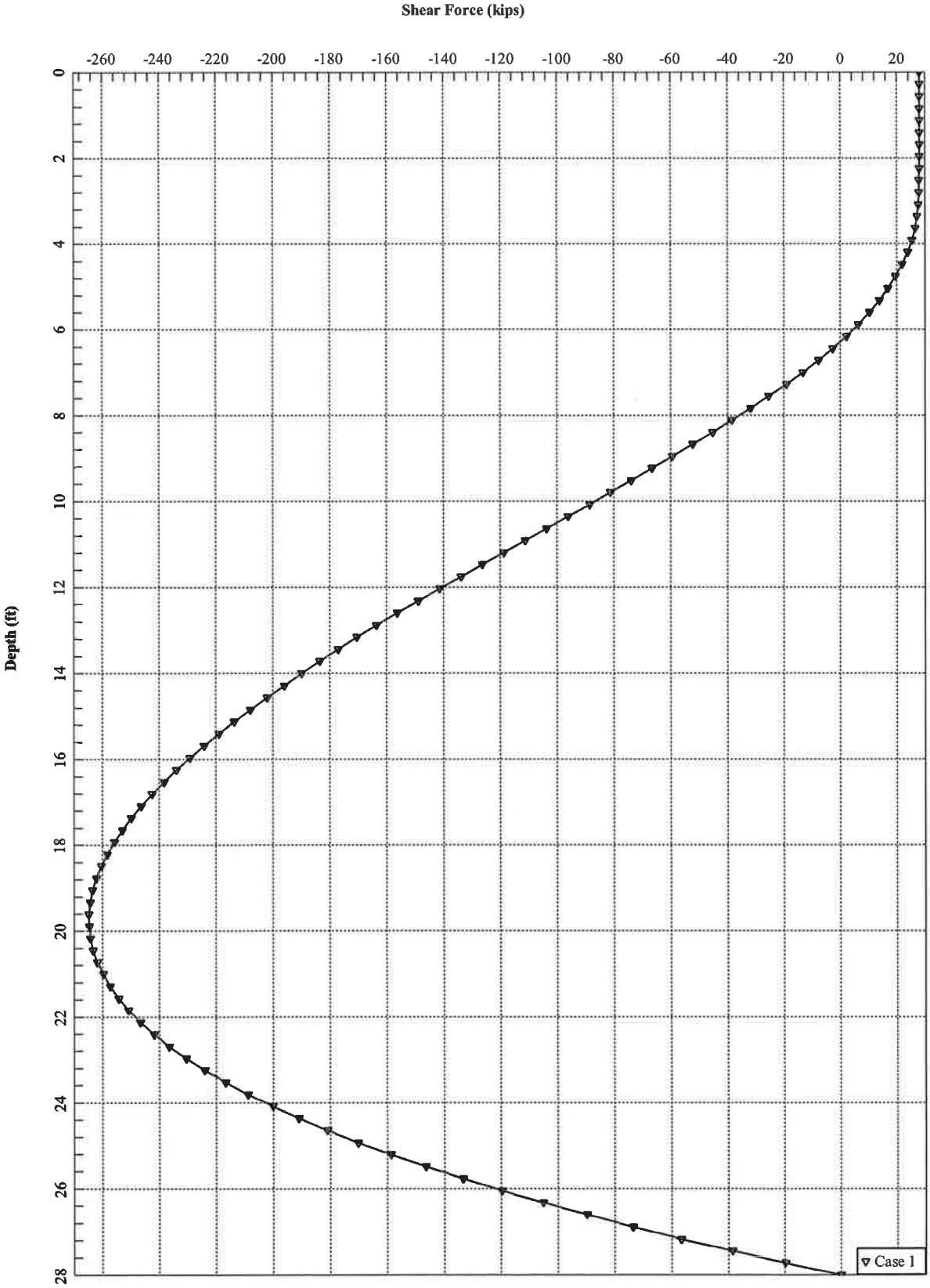
Computed Pile-head Stiffness Matrix Members K22, K23, K32, K33 for Superstructure

Top y in	Shear React. lbs	Mom. React. in-lbs	K22 lbs/in	K32 in-lbs/in
0.00134274	2800.00004	577374.90654	2085287.	4.299973E+08
0.00404205	8428.83988	1738072.	2085287.	4.299973E+08
0.00640650	13359.39513	2754778.	2085287.	4.299973E+08
0.00808663	16857.67976	3477093.	2084636.	4.299804E+08
0.00939109	19571.16012	4037839.	2084013.	4.299647E+08
0.01045699	21788.23501	4496029.	2083605.	4.299545E+08
0.01135823	23662.74512	4883438.	2083313.	4.299472E+08
0.01213894	25286.51964	5219036.	2083091.	4.299416E+08
0.01282760	26718.79026	5515061.	2082914.	4.299371E+08
0.01344364	28000.00000	5779870.	2082770.	4.299335E+08

Top Rota. rad	Shear React. lbs	Mom. React. in-lbs	K23 lbs/rad	K33 in-lbs/rad
0.00003898	16761.09045	4114800.	4.299973E+08	1.055631E+11
0.00011737	50456.05489	12386782.	4.298942E+08	1.055375E+11


Lateral Deflection (in)
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Case 1


Bending Moment (in-kips)
0
5000
1E4
1.5E4
2E4
2.5E4
3E4
3.5E4
4E4
4.5E4
5E4
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Case 1


Shear Force (kips)
-260
-240
-220
-200
-180
-160
-140
-120
-100
-80
-60
-40
-20
0
20
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Case 1

SITE NAME	COLCHESTER S CT	ECP - CELL #	2 34
LATITUDE	41-27-11.00 N	LONGITUDE	72-09-14.00 W
Additional Comments: 2015 AWS ADD.		SAVE BUTTON	
		STRUCTURE TYPE	Lattice

AWS - LTE ANTENNA ADD	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	2100 MHz BBU	2100 MHz BBU	2100 MHz BBU
ANTENNA TYPE	HBXX-6517DS-A2M	HBXX-6517DS-A2M	HBXX-6517DS-A2M
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/ELEC)	0M/3E	0M/2E	0M/3E
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 ALU RH_2X60-AWS	1 ALU RH_2X60-AWS	1 ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	2		DB-T1-6Z-8AB-0Z

700 Mhz - LTE Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	BXA-70063-6CF_2	BXA-70063-6CF_2	BXA-70063-6CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

700 Mhz - LTE Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	eNodeB	eNodeB	eNodeB
ANTENNA TYPE	LNX-6514DS-A1M	LNX-6514DS-A1M	LNX-6514DS-A1M
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0M/5E	0M/4E	0M/4E
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080-4CF	LPA-80080-4CF EDIN 4	LPA-80080-4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	6	4	4
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

850 Celluar - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	Cellular Modcell 4.0B	Cellular Modcell 4.0B	Cellular Modcell 4.0B
ANTENNA TYPE	LPA-80080-4CF	LPA-80080-4CF EDIN 4	LPA-80080-4CF
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/ELEC)	6	4	4
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			

1900 PCS - Current Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	PCS Modcell 4.0B	PCS Modcell 4.0B	PCS Modcell 4.0B
ANTENNA TYPE	LPA-171080-8CF-EDIN 2	LPA-171080-8CF-EDIN 2	LPA-171080-8CF-EDIN 2
QTY OF ANTENNAS PER FACE	2	2	2
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	180	180	180
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			

1900 PCS - Future Config	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	PCS Modcell 4.0B	PCS Modcell 4.0B	PCS Modcell 4.0B
ANTENNA TYPE	HBXX-6517DS-A2M	HBXX-6517DS-A2M	HBXX-6517DS-A2M
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	270
DOWN TILT (MECH/DEG)	0M/3E	0M/2E	0M/3E
RAD CTR (FT AGL)	180	180	180
RRH - QTY/MODEL	1 ALU RRH_2X60-PCS	1 ALU RRH_2X60-PCS	1 ALU RRH_2X60-PCS
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			

NUMBER OF CABLE'S NEEDED						ESTIMATED CABLE LENGTH			
MAINLINE SIZE	1 5/8"	TOTAL # OF MAINLINES			18	MAINLINE (FT)			
JUMPER SIZE	1/2 "	TOTAL # OF TOP JUMPERS			18	TOP JUMPER (FT)			12
Equipment Cable Ordering		MAIN CABLE #	18	+	0	TOP JUMPER #	18	+	0
FIBER LINE SIZE	1 5/8"	TOTAL # OF FIBER LINES			2	FIBER LINE MODEL #			HB158-1-08U8-S8J18
JUMPER SIZE	5/8"	TOTAL # OF TOP JUMPERS			3	TOP JUMPER MODEL #			HB058-1-08U1-S1J18
Fiber Cable Ordering		FIBER CABLE #	0	+	2	TOP JUMPER #	0	+	3

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular A-Band	PCS F / AWS-Band	700 Mhz C - B	Cellular (Watts)	20
TX - 869-880,890-891.5 MHz	TX - 1970-1975 / 2145-21	TX - 746-757	PCS (Watts)	16
RX - 824-835,845-846.5 MHz	RX - 1890-1895 / 1745-17	RX - 776-787	LTE (Watts)	60

ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1	800	Tx1/Rx0	RED	A7	800	Tx2/Rx0	BLUE	A13	800	Tx3/Rx0	GREEN
A2	1900	Tx1/Rx0	RED/ WHITE	A8	1900	Tx2/Rx0	BLUE/ WHITE	A14	1900	Tx3/Rx0	GREEN/WHITE
A3	700	Tx1/Rx0	RED/ ORANGE	A9	700	Tx2/Rx0	BLUE/ ORANGE	A15	700	Tx3/Rx0	GREEN/ORANGE
A4	700	Tx4/Rx1	RED/RED/ ORANGE	A10	700	Tx5/Rx1	BLUE/BLUE/ ORANGE	A16	700	Tx6/Rx1	GREEN/GREEN/ ORANGE
A5	1900	Tx4/Rx1	RED/RED/ WHITE	A11	1900	Tx5/Rx1	BLUE/BLUE/ WHITE	A17	1900	Tx6/Rx1	GREEN/GREEN/ WHITE
A6	800	Tx4/Rx1	RED/RED	A12	800	Tx5/Rx1	BLUE/BLUE	A18	800	Tx6/Rx1	GREEN/GREEN

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared By: Mark Brauer	Rob Hesselbach	MB	3/11/2014

Site Configuration

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

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

- Superior azimuth tracking and pattern symmetry with excellent passive intermodulation suppression
- The values presented on this datasheet have been calculated based on N-P-BASTA White Paper version 9.6 by the NGMN Alliance

Electrical Specifications

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, degrees	67	66	65
Beamwidth, Horizontal Tolerance, degrees	±2.4	±1.7	±2.9
Beamwidth, Vertical, degrees	5.0	4.7	4.4
Beamwidth, Vertical Tolerance, degrees	±0.3	±0.3	±0.3
Beam Tilt, degrees	0–6	0–6	0–6
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
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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol® single band, quad
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	1710 – 2180 MHz
Number of Ports, all types	4

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

Product Specifications

HBXX-6517DS-VTM

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 1.1 Actuator	HBXX-6517DS-R2M
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.

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

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	15.7	16.3
Beamwidth, Horizontal, degrees	65	65
Beamwidth, Horizontal Tolerance, degrees	±3	±3
Beamwidth, Vertical, degrees	12.5	11.2
Beam Tilt, degrees	0–10	0–10
USLS, typical, dB	17	18
Front-to-Back Ratio at 180°, dB	32	30
CPR at Boresight, dB	20	20
CPR at Sector, dB	10	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

General Specifications

Antenna Brand	Andrew®
Antenna Type	DualPol®
Band	Single band
Brand	DualPol® | Teletilt®
Operating Frequency Band	698 – 896 MHz

Mechanical Specifications

Color	Light gray
Connector Interface	7-16 DIN Female
Connector Location	Bottom
Connector Quantity, total	2
Lightning Protection	dc Ground
Radiator Material	Aluminum
Radome Material	Fiberglass, UV resistant
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

Product Specifications

LNX-6514DS-VTM

Dimensions

Depth	181.0 mm | 7.1 in
Length	1847.0 mm | 72.7 in
Width	301.0 mm | 11.9 in
Net Weight	17.6 kg | 38.8 lb

Remote Electrical Tilt (RET) Information

Model with Factory Installed AISG 1.1 Actuator	LNX-6514DS-R2M
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.

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.

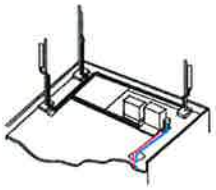
EASY INSTALLATION

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.

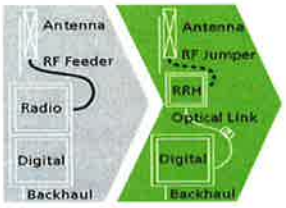
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

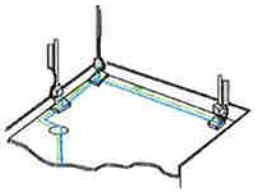
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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 DB-B1 and DB-T1 Series

DC and Fiber Management Distribution Boxes for HYBRIFLEX™ Cable

Product Description

The RFS Distribution Box design comes with the option for pluggable over voltage protection (OVP) for up to 6 remote radios and the connection for 6 pairs of optical fiber with LC optical fiber cable management. There is a hybrid cable input with a jumper configuration for power and optical fiber to the remote radio heads (RRHs). A custom wall, a 2-inch pole, and an H-Frame mounting bracket are included. Both the compact and standard design are available with lightening protection.

Features/Benefits

- Designed to accommodate varying diameters of HYBRIFLEX™ (combined power and fiber optic) cables – up to 2 inches
- Supports Single- and Multi-Mode Optical fiber
- NEMA 4x rated enclosure – allows **flexibility for indoor or outdoor installation** on a roof or tower top
- Weatherproof enclosure and ports – **improves system reliability**
- Modular design – makes replacement or addition of OVP easy without removal of other components within the box
- Strikesorb OVP technology – protects equipment from damaging surges up to 60 kA on an 8/20 waveform and up to 5 kA on a 10/350 waveform (certain models only)
- Low residual voltage and high impedance – **ideally suited for RRH technology** – won't shut down the RRH the way spark gap technology does (certain models only)

Technical Specifications

Mechanical Specifications

Model Number	DB-B1-6C-8AB-0Z	DB-T1-6Z-8AB-0Z
Enclosure Design	Standard, 6 OVP's	Standard without OVP
Dimensions - H x W x D, mm (in)	610 x 610 x 254 (24 x 24 x 10)	610 x 610 x 254 (24 x 24 x 10)
Weight, kg (lb)	20 (44)	20 (44)
Suppression Connection Method	Compression lug, #2-#14 AWG Copper, #2-#12 Aluminum	
Fiber Connection Method	LC-LC Single- or Multi-mode duplex	
Environmental Rating	NEMA 4x	
Operating Temperature, °C (°F)	-40 to +80 (-40 to +176)	
UV Protection	ISO 4892-2 Method A Xenon-Arc 2160 hrs	

Electrical Specifications

Nominal Operating Voltage		48 VDC
Nominal Discharge Current (I_n) per UL 1449 3rd Ed	20 kA 8/20 µs	N/A
Maximum Discharge Current (I_{max}) per NEMA LS-1	60 kA 8/20 µs	N/A
Maximum Impulse (Lightning) Current (I_{imp}) per IEC 61643-1	5 kA 10/350 µs	N/A
Maximum Continuous Operating Voltage (U_c)	75 VDC	N/A
Voltage Protection Rating per UL1449 3rd Ed	400 V	N/A
Protection Class as per IEC 61643-1	Class 1	N/A
Strikesorb OVP Compliance	ANSI/UL 1449-3rd Ed	N/A
	IEEE C62.41	N/A
	NEMA LS-1	N/A
	IEC 61643-1	N/A
	IEC 61643-12	N/A
	EN 61643-11	N/A

* This data is provisional and subject to change.