Robinson+Cole

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Also admitted in Massachusetts

June 8, 2015

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

Re: **Notice of Exempt Modification – Antenna Swap**
21-35 East Main Street (a/k/a 1 Central Square), Plainville, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) wireless telecommunications antennas at the top of the existing 85-foot tower at 21-35 East Main Street (a/k/a 1 Central Square) in Plainville, Connecticut (the "Property"). The tower and underlying property are owned by the Town of Plainville. The Council approved Cellco's shared use of this tower in 2004. Cellco now intends to replace six (6) of its existing antennas with three (3) model LNX-6514DS-VTM, 700 MHz antennas and three (3) model HBXX-6517DS-VTM, 2100 MHz antennas, all at the same level on the tower. Cellco also intends to replace three (3) existing remote radio heads ("RRHs") with three newer model RRHs, one (1) each behind it 700 MHz antennas and install three (3) new RRHs, one (1) each behind its 2100 MHz antennas. Included in Attachment 1 are specifications for Cellco's replacement antennas and RRHs.

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 Katherine M. Pugliese, Chairwoman of the Plainville Town Council and Robert E. Lee, Plainville Town Manager for the Town of Plainville.

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 located on Cellco's existing platform at the top level of the tower.

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

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

4. The operation of the modified facility will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. Far Field Approximation tables for each of Cellco's operating frequencies are included behind Attachment 2. The Far Field calculations demonstrate that Cellco's modified facility will operate well within the RF emissions limits established by the FCC.

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

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

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

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Robert E. Lee, Town Manager
Katherine M. Pugliese, Chairwoman, Town Council
Tim Parks

ATTACHMENT 1

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

Electrical Specifications, BASTA*

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

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

General Specifications

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

Product Specifications

LNX-6514DS-VTM

Operating Frequency Band	698 – 896 MHz
Performance Note	Outdoor usage

Mechanical Specifications

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

Dimensions

Depth	180.5 mm | 7.1 in
Length	1851.0 mm | 72.9 in
Width	301.0 mm | 11.9 in
Net Weight	14.2 kg | 31.3 lb

Remote Electrical Tilt (RET) Information

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

Regulatory Compliance/Certifications

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

Included Products

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

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

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

Product Specifications

COMMSCOPE®

POWERED BY ANDREW.

HBXX-6517DS-VTM

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

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

Electrical Specifications

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

Electrical Specifications, BASTA*

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

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

General Specifications

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

Product Specifications

HBXX-6517DS-VTM

Performance Note	Outdoor usage

Mechanical Specifications

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

Dimensions

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

Remote Electrical Tilt (RET) Information

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

Regulatory Compliance/Certifications

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

Included Products

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

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

Alcatel-Lucent RRH2x40-07-U

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-07-U is a high-power, small form-factor Remote Radio Head (RRH) operating in the North American Digital Dividend / 700MHz frequency band (3GPP Band 13). The Alcatel-Lucent RRH2x40-07-U is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

A distributed eNodeB expands 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 an eNodeB to be installed separately, within the same site or several kilometres apart.

The Alcatel-Lucent RRH2x40-07-U 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. The Alcatel-Lucent RRH2x40-07-U has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to two-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 10 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-07-U is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-07-U installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-07-U is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-07-U is compact and weights less than 23 kg (50 lb), 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 — a fraction of the time required for a traditional BTS.

Excellent RF performance

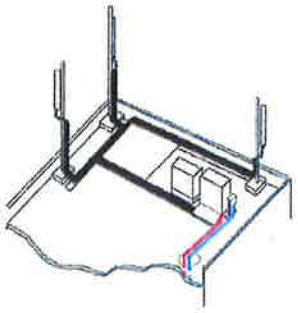
Because of its small size and weight, the Alcatel-Lucent RRH2x40-07-U can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-07-U where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-07-U provides more RF power while at the same time consuming less electricity.

Features

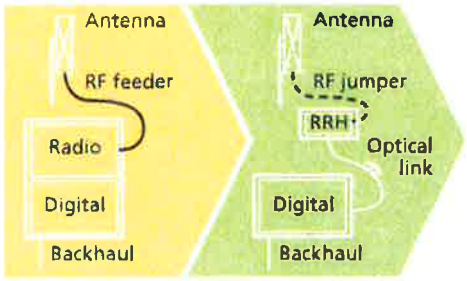
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless), noise-free, and heaterless unit
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

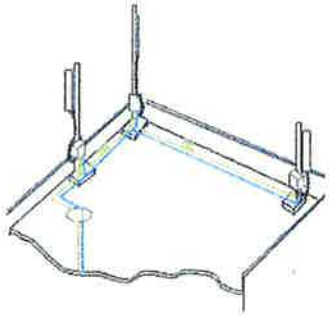
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility to network planning



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 390 mm (15.4 in.)
- Width: 380 mm (15 in.)
- Depth: 210 mm (8.2 in.)
- Weight (without mounting kit): less than 23 kg (50 lb)

Power

- Power supply: -48V

Operating environment

- Outdoor temperature range:
  - ¬ With solar load: -40°C to +50°C (-40°F to +122°F)
  - ¬ Without solar load: -40°C to +55°C (-40°F to +131°F)
- Passive convection cooling (no fans)
- Enclosure protection
  - ¬ IP65 (International Protection rating)

RF characteristics

- Frequency band: 700 MHz; 3GPP Band 13
- Bandwidth: up to 10 MHz
- RF output power at antenna port:
  - ¬ 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way
- Noise figure: below 2.5 dB typical
- ALD features
  - ¬ TMA
  - ¬ Remote electrical tilt (RET) support (AISG v2.0)

Optical characteristics

Type/number of fibers

- Up to 3.12 Gb/s line bit rate
- Single-mode variant
  - ¬ One SM fiber (9/125 µm) per RRH2x, carrying UL and DL using CWDM (at 1550/1310 nm)
- Multi-mode variant
  - ¬ Two MM fibers (50/125 µm) per RRH2x: one carrying UL, the other carrying DL (at 850 nm)

Optical fiber length

- Up to 500 m (0.31 mi), using MM fiber
- Up to 20 km (12.43 mi), using SM fiber

Alarms and ports

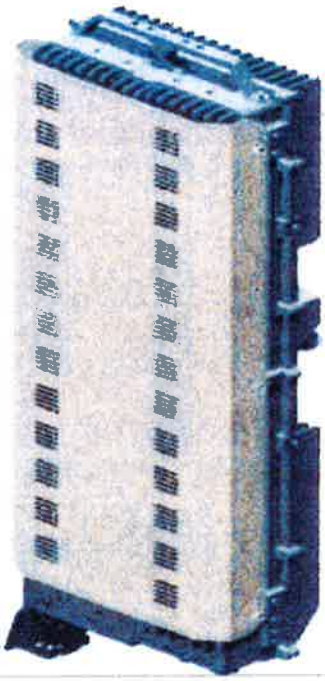
- Six external alarms
- Two optical ports to support daisy-chaining

Alcatel·Lucent

ALCATEL-LUCENT WIRELESS PRODUCT DATASHEET

RRH2x60-AWS 4T BAND 4 ANTENNA

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.

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.

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).

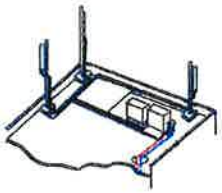
The Alcatel-Lucent RRH2x60-AWS is a very cost-effective solution to deploy LTE MIMO.

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.

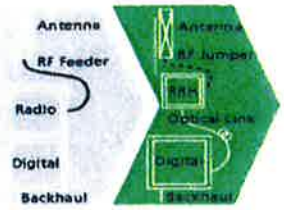
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

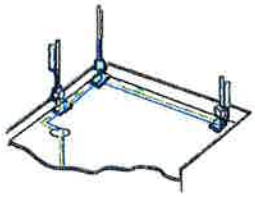
Installation can easily be done by a single person as the Alcatel-Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



Macro



RRH for space-constrained cell sites



Distributed

- 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
- 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.

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™

ATTACHMENT 2

Far Field Approximation
with downtilt variation

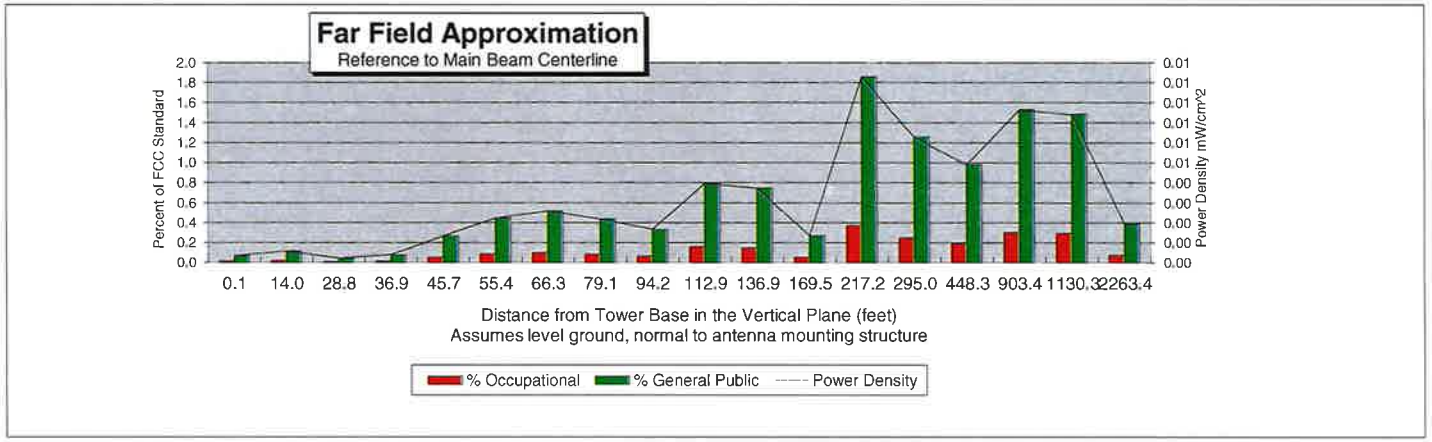
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Plainville 3, CT
Site #:	8-0009
Date:	01/22/14
Name:	Mark Brauer
File Name:	Plainville 3, CT - FF Power

Operating Freq. (MHz)	**746.0**
Antenna Height (ft):	**82.0**
Antenna Gain (dBi):	**16.4**
Antenna Size (in.):	**82.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
ERP (w):	**1050.0**
Number of Channels	**1**



Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	79.0	80.2	84.1	87.2	91.2	96.5	103.2	111.8	123.0	137.8	158.1	187.0	231.1	305.4	455.2	906.9	1133.1	2264.8	
Distance from Antenna Structure Base in Horizontal plane	0.1	14.0	28.8	36.9	45.7	55.4	66.3	79.1	94.2	112.9	136.9	169.5	217.2	295.0	448.3	903.4	1130.3	2263.4	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.4	0.3	0.2	0.3	0.3	0.1	
Percent of General Population Standard	0.1	0.1	0.0	0.1	0.3	0.4	0.5	0.4	0.3	0.8	0.7	0.3	1.9	1.3	1.0	1.5	1.5	0.4	

Antenna Type APX75-866514
Max% 1.86%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

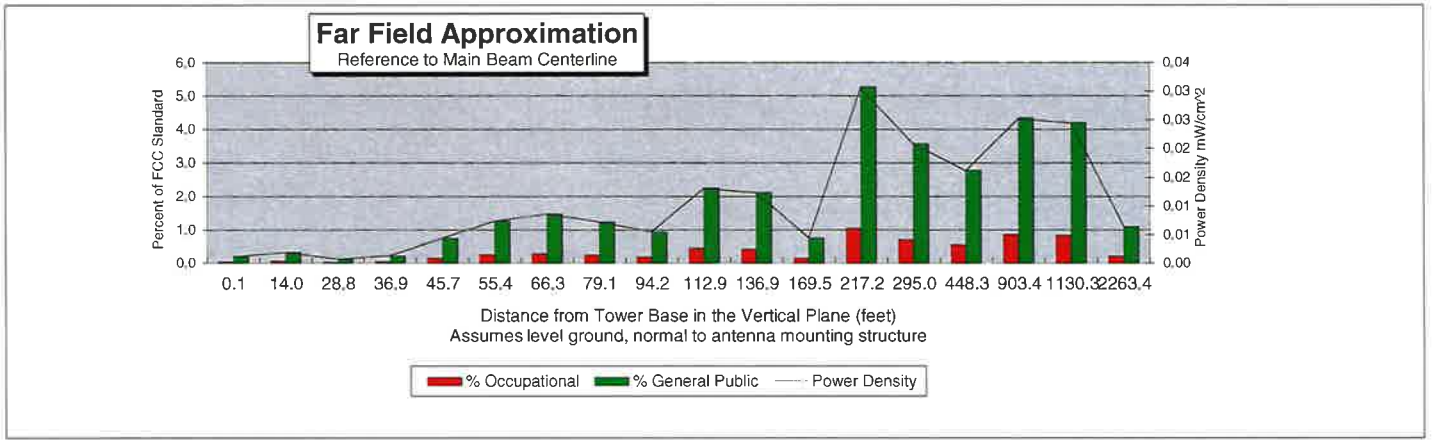
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Plainville 3, CT
Site #:	8-0009
Date:	01/22/14
Name:	Mark Brauer
File Name:	Plainville 3, CT - FF Power

Operating Freq. (MHz)	**869.0**
Antenna Height (ft):	**82.0**
Antenna Gain (dBi):	**15.9**
Antenna Size (in.):	**43.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
ERP (w):	**3841.0**
Number of Channels	**11**



Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0	
Solve for r, dx to antenna	79.0	80.2	84.1	87.2	91.2	96.5	103.2	111.8	123.0	137.8	158.1	187.0	231.1	305.4	455.2	906.9	1133.1	2264.8	
Distance from Antenna Structure Base in Horizontal plane	0.1	14.0	28.8	36.9	45.7	55.4	66.3	79.1	94.2	112.9	136.9	169.5	217.2	295.0	448.3	903.4	1130.3	2263.4	
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2	
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0	
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.03	0.02	0.02	0.03	0.02	0.01	
Percent of Occupational Standard	0.0	0.1	0.0	0.0	0.2	0.3	0.3	0.2	0.2	0.5	0.4	0.2	1.1	0.7	0.6	0.9	0.8	0.2	
Percent of General Population Standard	0.2	0.3	0.1	0.2	0.8	1.3	1.5	1.2	0.9	2.3	2.1	0.8	5.3	3.6	2.8	4.3	4.2	1.1	

Antenna Type SC-E 6014 REV2
Max% 5.27%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

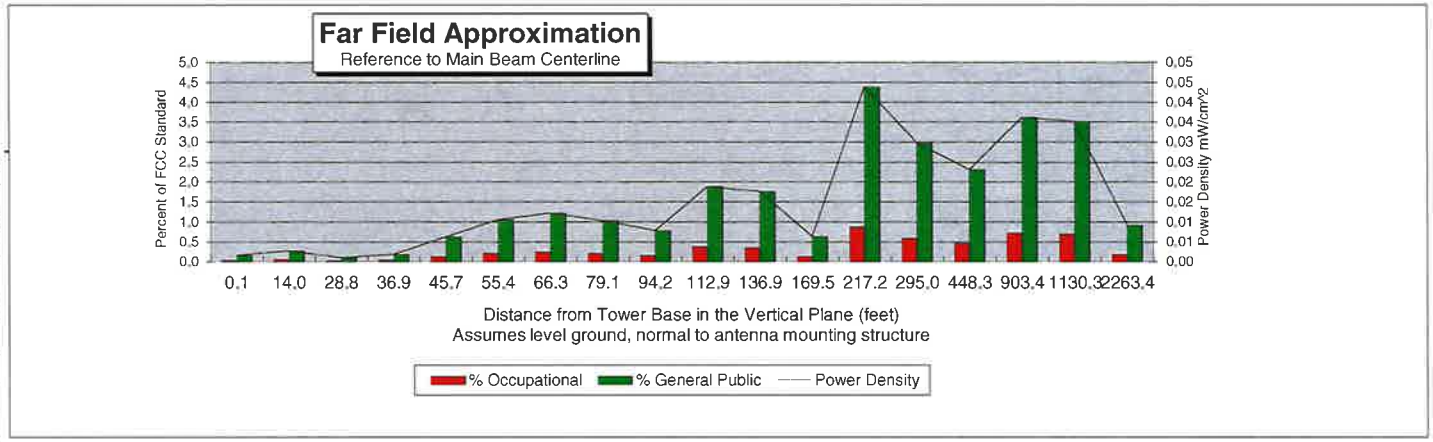
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Plainville 3, CT
Site #:	8-0009
Date:	01/22/14
Name:	Mark Brauer
File Name:	East Haven Cosey Beach, CT

Operating Freq. (MHz)	**1970.0**
Antenna Height (ft):	**82.0**
Antenna Gain (dBi):	**16.1**
Antenna Size (in.):	**48.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
ERP (w):	**5271.0**
Number of Channels	**11**



Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0
Solve for r, dx to antenna	79.0	80.2	84.1	87.2	91.2	96.5	103.2	111.8	123.0	137.8	158.1	187.0	231.1	305.4	455.2	906.9	1133.1	2264.8
Distance from Antenna Structure Base in Horizontal plane	0.1	14.0	28.8	36.9	45.7	55.4	66.3	79.1	94.2	112.9	136.9	169.5	217.2	295.0	448.3	903.4	1130.3	2263.4
Angle from Main Beam (reference to horizontal plane)	90	80	70	65	60	55	50	45	40	35	30	25	20	15	10	5	4	2
dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.04	0.03	0.02	0.04	0.04	0.01
Percent of Occupational Standard	0.0	0.1	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.4	0.4	0.1	0.9	0.6	0.5	0.7	0.7	0.2
Percent of General Population Standard	0.2	0.3	0.1	0.2	0.6	1.1	1.2	1.0	0.8	1.9	1.8	0.6	4.4	3.0	2.3	3.6	3.5	0.9

Antenna Type BXA-171063-8BF
Max% 4.39%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

Far Field Approximation
with downtilt variation

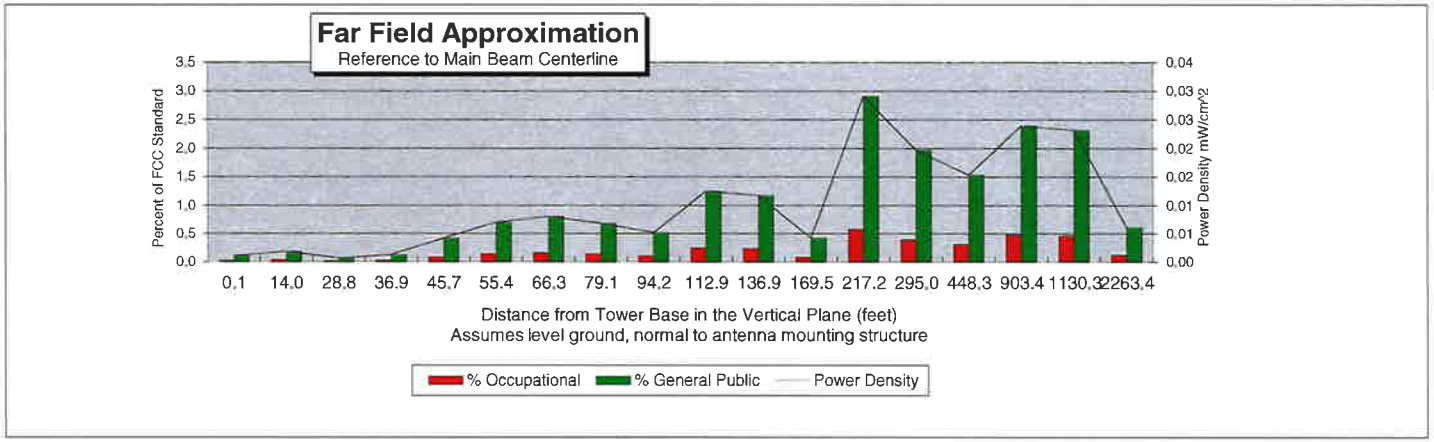
Estimated Radiated Emission

Single Emitter Far Field Model

Dipole / Wire/ Yagi Antenna Types

Location:	Plainville 3, CT
Site #:	8-0009
Date:	01/22/14
Name:	Mark Brauer
File Name:	Plainville 3, CT - FF Power

Operating Freq. (MHz)	**2145.0**
Antenna Height (ft):	**82.0**
Antenna Gain (dBi):	**19.1**
Antenna Size (in.):	**72.0**
Downtilt (degrees):	**0.0**
Feedline Loss (dB):	**0.0**
ERP (w):	**1750.0**
Number of Channels	**1**



Calc Angle	90.0	80.0	70.0	65.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	4.0	2.0
Solve for r, dx to antenna	79.0	80.2	84.1	87.2	91.2	96.5	103.2	111.8	123.0	137.8	158.1	187.0	231.1	305.4	455.2	906.9	1133.1	2264.8
Distance from Antenna Structure Base in Horizontal plane	0.1	14.0	28.8	36.9	45.7	55.4	66.3	79.1	94.2	112.9	136.9	169.5	217.2	295.0	448.3	903.4	1130.3	2263.4
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dB down from centerline (referenced to centerline)	36.76	34.35	38.52	35.34	29.54	26.8	25.59	25.63	25.99	21.21	20.29	23.24	13.03	12.3	9.92	2	0.2	0
Reflection Coefficient (1 to 4, 2.56 typical)	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56
Power Density (mW/cm^2)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.03	0.02	0.02	0.02	0.02	0.01
Percent of Occupational Standard	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.6	0.4	0.3	0.5	0.5	0.1
Percent of General Population Standard	0.1	0.2	0.1	0.1	0.4	0.7	0.8	0.7	0.5	1.2	1.2	0.4	2.9	2.0	1.5	2.4	2.3	0.6

Antenna Type BXA-171063-12CF
Max% 2.91%

Instructions:

1) Fill in Site Location, Site number, Date, Name of Person Responsible for Date, and enter File Name to ba saved as.
2) References to J4 refer to a point where the transmission line exits the equipment shelter and proceeds to the antenna(s). There is typically a connector located here where power measurements are made.
3) Enter Antenna Height (in feet to bottom of antenna), Antenna Gain (expressed as dBi, add 2.17 to dBd to obtain dBi), Antenna Size (vertical size in inches), Downtilt (in Degrees, enter zero if none), Feedline loss from J4 to Antenna, and J4 Po
4) From manufacturer's plots, or data sheet, input Angle from mainbeam and dB below mainbeam centerline.
5) Enter Reflection coefficient (2.56 would be typical, 1 for free space)
6) Spreadsheet calculates actual power density, then relates as Occupational or General Population percentage of FCC Standard.
7) An odd distance may be entered in the rightmost column of the lower table.

ATTACHMENT 3

CENTEK engineering

Centered on Solutions℠

Structural Analysis Report and Reinforcement Design

81-ft Existing EEI Monopole

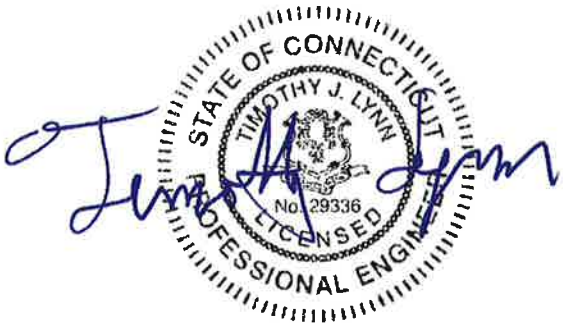
Proposed Verizon Wireless
Antenna Upgrade

Verizon Site Ref: Plainville 3

1 Central Square
Plainville, CT

CENTEK Project No. 15001.021

Date: April 6, 2015



Prepared for:

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

Table of Contents

SECTION 4 – REINFORCEMENT DRAWINGS

SECTION 5 – REFERENCE MATERIAL

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 Plainville, Connecticut.

The host tower is a 81-ft tall, two-section, eighteen sided, tapered monopole, originally designed and manufactured by Engineered Endeavors Incorporated (EEI); project no. 11122 dated October 4, 2002. The manufacturer's drawings were not available for use in this report. The tower geometry, structure member sizes and foundation system information were obtained a previous structural analysis report prepared by URS job no. 36917397.00000 VZ5-149 dated November 20, 2013.

Antenna and appurtenance information were obtained the aforementioned URS structural analysis report, visual verification conducted from grade by Centek personnel on February 18, 2015 and a Verizon RF data sheet.

The tower is made up of two (2) tapered vertical sections consisting of A572-65 pole sections. The vertical tower sections are slip joint connected. The diameter of the pole (flat-flat) is 13.0-in at the top and 24.0-in at the base.

Verizon proposes the removal of nine (9) panel antennas and three (3) remote radio heads and the installation of nine (9) panel antennas and six (6) remote radio heads mounted to 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:

- TOWN (EXISTING):
  Antennas: One (1) 20-ft dipole antenna, one (1) 10-ft Omni-directional whip antenna and two (2) 4-ft Omni-directional whip antennas mounted on low profile platform with an elevation of 62.5-ft above grade level.
  Coax Cables: Four (4) 7/8" ∅ coax cables running on the inside of the existing tower.

- TOWN (EXISTING):
  Antennas: Three (3) 10-ft dipole antennas, one (1) 10-ft Omni-directional whip antenna and two (2) yagi antennas mounted on low profile platform with an elevation of 42.5-ft above grade level.
  Coax Cables: Six (6) 7/8" ∅ coax cables running on the inside of the existing tower.

- VERIZON (EXISTING TO REMAIN):
  Antennas: Three (3) Antel BXA-70063-4CF panel antennas and one (1) Raycap RC2DC-4750-PF-48 main distribution box mounted on a low profile platform with a RAD center elevation of 81-ft above grade level.
  Coax Cables: Twelve (12) 1-1/4" ∅ coax cables and one (1) 1-5/8" ∅ fiber cable running on the inside of the existing tower.
- VERIZON (EXISTING TO REMOVE):
  Antennas: Three (3) RFS APX75-866514 panel antennas, three (3) Antel BXA-171063-8BF panel antennas, three (3) Antel BXA-171063-12CF panel antennas and three (3) Alcatel-Lucent RRH-2x40-AWS remote radio heads mounted on a low profile platform with a RAD center elevation of 81-ft above grade level.
- **VERIZON (PROPOSED):**
  Antennas: Three (3) Andrew LNX-6514DS panel antennas, six (6) Andrew HBXX-6517DS panel antennas, three (3) Alcatel-Lucent RRH2x40-07-U Remote Radio Heads and three (3) Alcatel-Lucent RRH-2x60-AWS remote radio heads mounted on a low profile platform with a RAD center elevation of 81-ft above grade level.

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 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:	Hartford; v = 80 mph (fastest mile)	*[Section 16 of TIA/EIA-222-F-96]*
	Plainville; v = 95 mph (3 second gust) equivalent to v = 77.5 mph (fastest mile)	*[Appendix K of the 2005 CT Building Code Supplement]*
	TIA/EIA wind speed controls.	
Load Cases:	Load Case 1; 80 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; 69 mph wind speed w/ ½" radial ice plus gravity load – used in calculation of tower stresses. The 69 mph wind speed velocity represents 75% of the wind pressure generated by the 80 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 **with the reinforcements outlined in drawings T-1, N-1, N-2, MI-1, S-1 and S-2 dated April 6, 2015, located within Section 4 of this report were found** to be within allowable limits.

Tower Section	Elevation	Stress Ratio (percentage of capacity)	Result
Pole Shaft (L1)	47.54'-81.00'	89.6%	**PASS**
Pole Shaft (L2)	37.54'-47.54'	78.2%	**PASS**
Pole Shaft (L3)	25.00'-37.54'	94.2%	**PASS**
Pole Shaft (L4)	0.00'-25.00'	94.0%	**PASS**

Foundation and Anchors

The existing foundation consists of a 5.0 ∅ x 21.0-ft long reinforced concrete caisson. The sub-grade conditions used in the analysis of the existing foundation were obtained from the aforementioned URS structural report. The base of the tower is connected to the foundation by means of (4) 2.25"∅, ASTM A615-75 anchor bolts embedded 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	8 kips
	Compression	11 kips
	Moment	516 kip-ft

- The foundation was found to be within allowable limits.

Foundation	Design Limit	Proposed Loading	Result
Reinforced Concrete Caisson	Moment Capacity	33.3%	**PASS**
	Lateral Deflection	0.69 in.(1)	**PASS**

(1) Lateral deflection typically limited to 1.0 in. for monopole tower structures.

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

Tower Component	Design Limit	Stress Ratio (percentage of capacity)	Result
Anchor Bolts	Tension	97.9%	**PASS**
Base Plate	Bending	96.8%	**PASS**

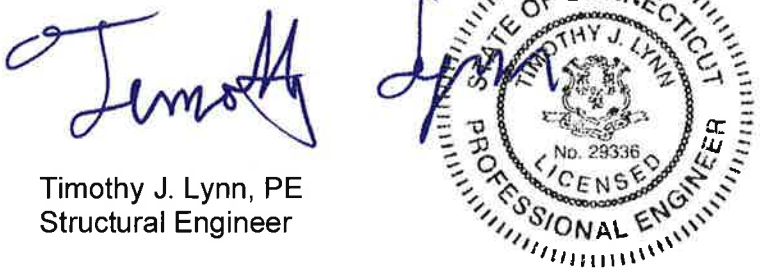
Conclusion

This analysis shows that **with the reinforcements outlined in drawings T-1, N-1, N-2, MI-1, S-1 and S-2 dated April 6, 2015, located within Section 4 of this report, the subject tower is adequate** to support the proposed Verizon antenna configuration.

The analysis is based, in part, on the information provided to this office by Verizon. 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:

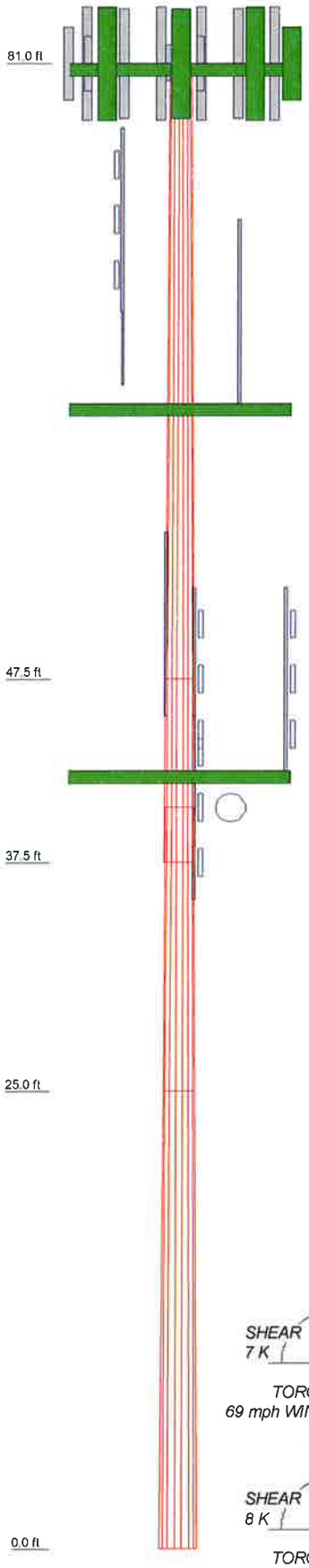
- Information supplied by the client regarding the structure itself, its foundations, the soil conditions, the antenna and feed line loading on the structure and its components, or other relevant information.
- Information from the field and/or drawings in the possession of Centek Engineering, Inc. or generated by field inspections or measurements of the structure.
- It is the responsibility of the client to ensure that the information provided 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
Length (ft)	33.46	10.00	15.46	25.00
Number of Sides	18	18	18	18
Thickness (in)	0.1875	0.2500	0.2500	0.3000
Socket Length (ft)		2.92		
Top Dia (in)	13.0000	17.7500	18.2554	20.9100
Bot Dia (in)	17.7500	19.1700	20.9100	24.0000
Grade	A572-65			
Weight (K)	1.0	0.5	0.8	1.8

AXIAL
13 K
SHEAR
7 K
MOMENT
451 kip-ft
TORQUE 3 kip-ft
69 mph WIND - 0.5000 in ICE

AXIAL
11 K
SHEAR
8 K
MOMENT
516 kip-ft
TORQUE 3 kip-ft
REACTIONS - 80 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
BXA-70063/4CF (Verizon Existing)	81	RC2DC-4750-PF-48 (Verizon Proposed)	81
HBXX-6517DS (Verizon Proposed)	81	EEI 12-ft Low Profile Platform (Verizon Proposed)	81
LNX-6514DS-VTM (Verizon Proposed)	81	20' 4-Bay Dipole (Town)	62.5
HBXX-6517DS (Verizon Proposed)	81	4' x 2" Dia Omni (Town)	62.5
BXA-70063/4CF (Verizon Existing)	81	4' x 2" Dia Omni (Town)	62.5
HBXX-6517DS (Verizon Proposed)	81	10' x 3" Dia Omni (Town)	62.5
LNX-6514DS-VTM (Verizon Proposed)	81	EEI 12-ft Low Profile Platform (Verizon Proposed)	62.5
HBXX-6517DS (Verizon Proposed)	81	10' Dipole (Town)	42.5
BXA-70063/4CF (Verizon Existing)	81	10' Dipole (Town)	42.5
HBXX-6517DS (Verizon Proposed)	81	10' Dipole (Town)	42.5
LNX-6514DS-VTM (Verizon Proposed)	81	3' Yagi (Town)	42.5
HBXX-6517DS (Verizon Proposed)	81	10' x 3" Dia Omni (Town)	42.5
RRH2x60-AWS (Verizon Proposed)	81	3' Yagi (Town)	42.5
RRH2x60-AWS (Verizon Proposed)	81	EEI 12-ft Low Profile Platform (Verizon Proposed)	42.5
RRH2x60-AWS (Verizon Proposed)	81		
RRH2x40-07-U (Verizon Proposed)	81		
RRH2x40-07-U (Verizon Proposed)	81		
RRH2x40-07-U (Verizon Proposed)	81		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
5. Welds are fabricated with ER-70S-6 electrodes.
6. TOWER RATING: 94.2%

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

Job:	*15001.021 - Plainville 3*		
Project:	*81' EEI Monopole - 1 Central Square Plainville, CT*		
Client: Verizon Wireless	Drawn by: TJL	App'd:	
Code: TIA/EIA-222-F	Date: 04/06/15	Scale: N	
Path:		Dwg No.	

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 80 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
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	81.00-47.54	33.46	0.00	18	13.0000	17.7500	0.1875	0.7500	A572-65 (65 ksi)
L2	47.54-37.54	10.00	2.92	18	17.7500	19.1700	0.2500	1.0000	A572-65 (65 ksi)
L3	37.54-25.00	15.46	0.00	18	18.2554	20.9100	0.2500	1.0000	A572-65 (65 ksi)
L4	25.00-0.00	25.00		18	20.9100	24.0000	0.3000	1.2000	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	13.2005	7.6250	158.1420	4.5484	6.6040	23.9464	316.4921	3.8132	1.9580	10.443
	18.0238	10.4519	407.2909	6.2347	9.0170	45.1692	815.1176	5.2269	2.7940	14.901
L2	18.0238	13.8863	537.2773	6.2125	9.0170	59.5849	1075.2617	6.9444	2.6840	10.736
	19.4657	15.0130	678.9656	6.7166	9.7384	69.7207	1358.8246	7.5079	2.9339	11.736
L3	19.0461	14.2873	585.1805	6.3919	9.2737	63.1009	1171.1309	7.1450	2.7729	11.092
	21.2326	16.3937	884.0470	7.3343	10.6223	83.2257	1769.2572	8.1984	3.2402	12.961
L4	21.2326	19.6248	1053.1727	7.3165	10.6223	99.1475	2107.7312	9.8143	3.1522	10.507
	24.3702	22.5671	1601.4400	8.4135	12.1920	131.3517	3204.9872	11.2857	3.6960	12.32

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 81.00-47.54				1	1	1		
L2 47.54-37.54				1	1	1		
L3 37.54-25.00				1	1	1		
L4 25.00-0.00				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 plf
1 1/4	C	No	Inside Pole	80.00 - 0.00	12	No Ice	0.00	0.66
(Verizon Existing)						1/2" Ice	0.00	0.66
HYBRIFLEX 1-5/8"	C	No	Inside Pole	80.00 - 0.00	1	No Ice	0.00	1.90
(Verizon Existing)						1/2" Ice	0.00	1.90
7/8	C	No	Inside Pole	62.00 - 0.00	4	No Ice	0.00	0.54
(Town)						1/2" Ice	0.00	0.54
7/8	C	No	Inside Pole	42.00 - 0.00	6	No Ice	0.00	0.54
(Town)						1/2" Ice	0.00	0.54

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	81.00-47.54	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.35
L2	47.54-37.54	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.13
L3	37.54-25.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.19
L4	25.00-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
		C	0.000	0.000	0.000	0.000	0.38

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	81.00-47.54	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.35
L2	47.54-37.54	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.13
L3	37.54-25.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.19
L4	25.00-0.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.38

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	81.00-47.54	0.0000	0.0000	0.0000	0.0000
L2	47.54-37.54	0.0000	0.0000	0.0000	0.0000
L3	37.54-25.00	0.0000	0.0000	0.0000	0.0000
L4	25.00-0.00	0.0000	0.0000	0.0000	0.0000

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
BXA-70063/4CF	A	From Face	3.00	0.0000	81.00	No Ice	5.16	2.44	0.01
(Verizon Existing)			-6.00			1/2" Ice	5.55	2.74	0.04
			0.00						
HBXX-6517DS	A	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05
(Verizon Proposed)			-4.00			1/2" Ice	9.31	5.71	0.10
			0.00						
LNX-6514DS-VTM	A	From Face	3.00	0.0000	81.00	No Ice	8.41	5.41	0.04
(Verizon Proposed)			0.00			1/2" Ice	8.96	5.86	0.09
			0.00						
HBXX-6517DS	A	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Verizon Proposed)			4.00 0.00			1/2" Ice	9.31	5.71	0.10
BXA-70063/4CF	B	From Face	3.00	0.0000	81.00	No Ice	5.16	2.44	0.01
(Verizon Existing)			-6.00 0.00			1/2" Ice	5.55	2.74	0.04
HBXX-6517DS	B	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05
(Verizon Proposed)			-4.00 0.00			1/2" Ice	9.31	5.71	0.10
LNX-6514DS-VTM	B	From Face	3.00	0.0000	81.00	No Ice	8.41	5.41	0.04
(Verizon Proposed)			0.00 0.00			1/2" Ice	8.96	5.86	0.09
HBXX-6517DS	B	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05
(Verizon Proposed)			4.00 0.00			1/2" Ice	9.31	5.71	0.10
BXA-70063/4CF	C	From Face	3.00	0.0000	81.00	No Ice	5.16	2.44	0.01
(Verizon Existing)			-6.00 0.00			1/2" Ice	5.55	2.74	0.04
HBXX-6517DS	C	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05
(Verizon Proposed)			-4.00 0.00			1/2" Ice	9.31	5.71	0.10
LNX-6514DS-VTM	C	From Face	3.00	0.0000	81.00	No Ice	8.41	5.41	0.04
(Verizon Proposed)			0.00 0.00			1/2" Ice	8.96	5.86	0.09
HBXX-6517DS	C	From Face	3.00	0.0000	81.00	No Ice	8.74	5.24	0.05
(Verizon Proposed)			4.00 0.00			1/2" Ice	9.31	5.71	0.10
RRH2x60-AWS	A	From Face	3.00	0.0000	81.00	No Ice	3.78	2.07	0.06
(Verizon Proposed)			-4.00 0.00			1/2" Ice	4.09	2.35	0.08
RRH2x60-AWS	B	From Face	3.00	0.0000	81.00	No Ice	3.78	2.07	0.06
(Verizon Proposed)			-4.00 0.00			1/2" Ice	4.09	2.35	0.08
RRH2x60-AWS	C	From Face	3.00	0.0000	81.00	No Ice	3.78	2.07	0.06
(Verizon Proposed)			-4.00 0.00			1/2" Ice	4.09	2.35	0.08
RRH2x40-07-U	A	From Face	3.00	0.0000	81.00	No Ice	0.00	1.23	0.05
(Verizon Proposed)			0.00 0.00			1/2" Ice	0.00	1.39	0.07
RRH2x40-07-U	B	From Face	3.00	0.0000	81.00	No Ice	0.00	1.23	0.05
(Verizon Proposed)			0.00 0.00			1/2" Ice	0.00	1.39	0.07
RRH2x40-07-U	C	From Face	3.00	0.0000	81.00	No Ice	0.00	1.23	0.05
(Verizon Proposed)			0.00 0.00			1/2" Ice	0.00	1.39	0.07
RC2DC-4750-PF-48	A	From Face	0.00	0.0000	81.00	No Ice	3.52	2.29	0.03
(Verizon Proposed)			0.00 0.00			1/2" Ice	3.77	2.51	0.05
EEI 12-ft Low Profile Platform	C	None		0.0000	81.00	No Ice	15.00	15.00	1.50
(Verizon Proposed)						1/2" Ice	18.40	18.40	1.75
20' 4-Bay Dipole	A	From Face	3.00	0.0000	62.50	No Ice	4.00	4.00	0.06
(Town)			0.00 10.00			1/2" Ice	6.00	6.00	0.10
4' x 2" Dia Omni	A	From Face	3.00	0.0000	62.50	No Ice	0.79	0.79	0.02
(Town)			0.00 3.00			1/2" Ice	1.03	1.03	0.03
4' x 2" Dia Omni	A	From Face	3.00	0.0000	62.50	No Ice	0.79	0.79	0.02

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Town)			0.00 3.00			1/2" Ice	1.03	1.03	0.03
10' x 3" Dia Omni	B	From Face	3.00	0.0000	62.50	No Ice	3.00	3.00	0.03
(Town)			0.00 5.00			1/2" Ice	4.03	4.03	0.05
EEI 12-ft Low Profile Platform (Verizon Proposed)	C	None		0.0000	62.50	No Ice 1/2" Ice	15.00 18.40	15.00 18.40	1.50 1.75
10' Dipole	B	From Face	3.00	0.0000	42.50	No Ice	4.00	4.00	0.05
(Town)			5.00 5.00			1/2" Ice	6.00	6.00	0.07
10' Dipole	B	From Face	3.00	0.0000	42.50	No Ice	4.00	4.00	0.05
(Town)			-5.00 5.00			1/2" Ice	6.00	6.00	0.07
10' Dipole	B	From Face	3.00	0.0000	42.50	No Ice	4.00	4.00	0.05
(Town)			-5.00 -2.00			1/2" Ice	6.00	6.00	0.07
3' Yagi	B	From Face	3.00	0.0000	42.50	No Ice	2.08	2.08	0.03
(Town)			0.00 4.00			1/2" Ice	3.79	3.79	0.05
10' x 3" Dia Omni	A	From Face	3.00	0.0000	42.50	No Ice	3.00	3.00	0.03
(Town)			5.00 8.00			1/2" Ice	4.03	4.03	0.05
3' Yagi	A	From Face	3.00	0.0000	42.50	No Ice	2.08	2.08	0.03
(Town)			0.00 4.00			1/2" Ice	3.79	3.79	0.05
EEI 12-ft Low Profile Platform (Verizon Proposed)	C	None		0.0000	42.50	No Ice 1/2" Ice	15.00 18.40	15.00 18.40	1.50 1.75

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg % %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 81.00-47.54	63.72	1.207	20	42.871	A	0.000	42.871	42.871	100.00	0.000	0.000
					B	0.000	42.871		100.00	0.000	0.000
					C	0.000	42.871		100.00	0.000	0.000
L2 47.54-37.54	42.48	1.075	18	15.383	A	0.000	15.383	15.383	100.00	0.000	0.000
					B	0.000	15.383		100.00	0.000	0.000
					C	0.000	15.383		100.00	0.000	0.000
L3 37.54-25.00	31.16	1	16	20.726	A	0.000	20.726	20.726	100.00	0.000	0.000
					B	0.000	20.726		100.00	0.000	0.000
					C	0.000	20.726		100.00	0.000	0.000
L4 25.00-0.00	12.21	1	16	46.781	A	0.000	46.781	46.781	100.00	0.000	0.000
					B	0.000	46.781		100.00	0.000	0.000
					C	0.000	46.781		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	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 81.00-47.54	63.72	1.207	15	0.5000	45.659	A	0.000	45.659	45.659	100.00	0.000	0.000
						B	0.000	45.659		100.00	0.000	0.000
						C	0.000	45.659		100.00	0.000	0.000
L2 47.54-37.54	42.48	1.075	13	0.5000	16.217	A	0.000	16.217	16.217	100.00	0.000	0.000
						B	0.000	16.217		100.00	0.000	0.000
						C	0.000	16.217		100.00	0.000	0.000
L3 37.54-25.00	31.16	1	12	0.5000	21.771	A	0.000	21.771	21.771	100.00	0.000	0.000
						B	0.000	21.771		100.00	0.000	0.000
						C	0.000	21.771		100.00	0.000	0.000
L4 25.00-0.00	12.21	1	12	0.5000	48.865	A	0.000	48.865	48.865	100.00	0.000	0.000
						B	0.000	48.865		100.00	0.000	0.000
						C	0.000	48.865		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 81.00-47.54	63.72	1.207	8	42.871	A	0.000	42.871	42.871	100.00	0.000	0.000
					B	0.000	42.871		100.00	0.000	0.000
					C	0.000	42.871		100.00	0.000	0.000
L2 47.54-37.54	42.48	1.075	7	15.383	A	0.000	15.383	15.383	100.00	0.000	0.000
					B	0.000	15.383		100.00	0.000	0.000
					C	0.000	15.383		100.00	0.000	0.000
L3 37.54-25.00	31.16	1	6	20.726	A	0.000	20.726	20.726	100.00	0.000	0.000
					B	0.000	20.726		100.00	0.000	0.000
					C	0.000	20.726		100.00	0.000	0.000
L4 25.00-0.00	12.21	1	6	46.781	A	0.000	46.781	46.781	100.00	0.000	0.000
					B	0.000	46.781		100.00	0.000	0.000
					C	0.000	46.781		100.00	0.000	0.000

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 plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.93	27.74	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.30	29.76	C

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 plf	Ctrl. Face
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.37	29.75	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.84	33.68	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	93.69 kip-ft	2.44		

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 plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.93	27.74	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.30	29.76	C
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.37	29.75	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.84	33.68	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	93.69 kip-ft	2.44		

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 plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.93	27.74	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.30	29.76	C
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.37	29.75	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.84	33.68	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	93.69	2.44		

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 plf	Ctrl. Face
									kip-ft			

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 plf	Ctrl. Face
L1	0.35	1.36	A	1	0.65	1	1	1	45.659	0.74	22.16	C
81.00-47.54			B	1	0.65	1	1	1	45.659			
			C	1	0.65	1	1	1	45.659			
L2	0.13	0.61	A	1	0.65	1	1	1	16.217	0.24	23.53	C
47.54-37.54			B	1	0.65	1	1	1	16.217			
			C	1	0.65	1	1	1	16.217			
L3	0.19	0.96	A	1	0.65	1	1	1	21.771	0.29	23.43	C
37.54-25.00			B	1	0.65	1	1	1	21.771			
			C	1	0.65	1	1	1	21.771			
L4 25.00-0.00	0.38	2.15	A	1	0.65	1	1	1	48.865	0.66	26.38	C
			B	1	0.65	1	1	1	48.865			
			C	1	0.65	1	1	1	48.865			
Sum Weight:	1.06	5.08						OTM	74.45 kip-ft	1.93		

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 ft^2	F K	w plf	Ctrl. Face
L1	0.35	1.36	A	1	0.65	1	1	1	45.659	0.74	22.16	C
81.00-47.54			B	1	0.65	1	1	1	45.659			
			C	1	0.65	1	1	1	45.659			
L2	0.13	0.61	A	1	0.65	1	1	1	16.217	0.24	23.53	C
47.54-37.54			B	1	0.65	1	1	1	16.217			
			C	1	0.65	1	1	1	16.217			
L3	0.19	0.96	A	1	0.65	1	1	1	21.771	0.29	23.43	C
37.54-25.00			B	1	0.65	1	1	1	21.771			
			C	1	0.65	1	1	1	21.771			
L4 25.00-0.00	0.38	2.15	A	1	0.65	1	1	1	48.865	0.66	26.38	C
			B	1	0.65	1	1	1	48.865			
			C	1	0.65	1	1	1	48.865			
Sum Weight:	1.06	5.08						OTM	74.45 kip-ft	1.93		

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 plf	Ctrl. Face
L1	0.35	1.36	A	1	0.65	1	1	1	45.659	0.74	22.16	C
81.00-47.54			B	1	0.65	1	1	1	45.659			
			C	1	0.65	1	1	1	45.659			
L2	0.13	0.61	A	1	0.65	1	1	1	16.217	0.24	23.53	C
47.54-37.54			B	1	0.65	1	1	1	16.217			
			C	1	0.65	1	1	1	16.217			
L3	0.19	0.96	A	1	0.65	1	1	1	21.771	0.29	23.43	C
37.54-25.00			B	1	0.65	1	1	1	21.771			
			C	1	0.65	1	1	1	21.771			
L4 25.00-0.00	0.38	2.15	A	1	0.65	1	1	1	48.865	0.66	26.38	C
			B	1	0.65	1	1	1	48.865			
			C	1	0.65	1	1	1	48.865			
Sum Weight:	1.06	5.08						OTM	74.45 kip-ft	1.93		

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 plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.36	10.84	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.12	11.62	C
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.15	11.62	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.33	13.16	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	36.60 kip-ft	0.95		

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 ft²	F K	w plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.36	10.84	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.12	11.62	C
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.15	11.62	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			

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 plf	Ctrl. Face
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.33	13.16	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	36.60 kip-ft	0.95		

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 ft^2	F K	w plf	Ctrl. Face
L1	0.35	1.03	A	1	0.65	1	1	1	42.871	0.36	10.84	C
81.00-47.54			B	1	0.65	1	1	1	42.871			
			C	1	0.65	1	1	1	42.871			
L2	0.13	0.49	A	1	0.65	1	1	1	15.383	0.12	11.62	C
47.54-37.54			B	1	0.65	1	1	1	15.383			
			C	1	0.65	1	1	1	15.383			
L3	0.19	0.81	A	1	0.65	1	1	1	20.726	0.15	11.62	C
37.54-25.00			B	1	0.65	1	1	1	20.726			
			C	1	0.65	1	1	1	20.726			
L4 25.00-0.00	0.38	1.79	A	1	0.65	1	1	1	46.781	0.33	13.16	C
			B	1	0.65	1	1	1	46.781			
			C	1	0.65	1	1	1	46.781			
Sum Weight:	1.06	4.12						OTM	36.60 kip-ft	0.95		

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	4.12					
Bracing Weight	0.00					
Total Member Self-Weight	4.12			-1.04	-0.12	
Total Weight	10.85			-1.04	-0.12	
Wind 0 deg - No Ice		-0.02	-7.92	-488.85	1.42	0.50
Wind 30 deg - No Ice		3.96	-6.85	-422.72	-243.58	-0.86
Wind 60 deg - No Ice		6.87	-3.95	-243.61	-423.35	-1.98
Wind 90 deg - No Ice		7.95	0.02	0.50	-489.71	-2.57
Wind 120 deg - No Ice		6.89	3.98	244.20	-424.89	-2.48
Wind 150 deg - No Ice		3.99	6.87	422.19	-246.25	-1.72
Wind 180 deg - No Ice		0.02	7.92	486.78	-1.66	-0.50
Wind 210 deg - No Ice		-3.96	6.85	420.65	243.34	0.86
Wind 240 deg - No Ice		-6.87	3.95	241.54	423.10	1.98
Wind 270 deg - No Ice		-7.95	-0.02	-2.57	489.47	2.57
Wind 300 deg - No Ice		-6.89	-3.98	-246.27	424.64	2.48
Wind 330 deg - No Ice		-3.99	-6.87	-424.26	246.00	1.72
Member Ice	0.96					
Total Weight Ice	13.43			-1.62	-0.14	

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 0 deg - Ice		-0.01	-6.81	-420.15	1.05	0.57
Wind 30 deg - Ice		3.40	-5.89	-363.49	-209.06	-0.93
Wind 60 deg - Ice		5.91	-3.39	-209.86	-363.19	-2.18
Wind 90 deg - Ice		6.83	0.01	-0.43	-420.04	-2.84
Wind 120 deg - Ice		5.92	3.42	208.67	-364.38	-2.75
Wind 150 deg - Ice		3.43	5.91	361.43	-211.12	-1.91
Wind 180 deg - Ice		0.01	6.81	416.91	-1.33	-0.57
Wind 210 deg - Ice		-3.40	5.89	360.25	208.78	0.93
Wind 240 deg - Ice		-5.91	3.39	206.62	362.91	2.18
Wind 270 deg - Ice		-6.83	-0.01	-2.81	419.76	2.84
Wind 300 deg - Ice		-5.92	-3.42	-211.91	364.10	2.75
Wind 330 deg - Ice		-3.43	-5.91	-364.67	210.84	1.91
Total Weight	10.85			-1.04	-0.12	
Wind 0 deg - Service		-0.01	-3.10	-191.59	0.48	0.19
Wind 30 deg - Service		1.55	-2.68	-165.76	-95.22	-0.33
Wind 60 deg - Service		2.68	-1.54	-95.79	-165.45	-0.77
Wind 90 deg - Service		3.10	0.01	-0.43	-191.37	-1.01
Wind 120 deg - Service		2.69	1.55	94.76	-166.05	-0.97
Wind 150 deg - Service		1.56	2.68	164.29	-96.27	-0.67
Wind 180 deg - Service		0.01	3.10	189.52	-0.72	-0.19
Wind 210 deg - Service		-1.55	2.68	163.69	94.98	0.33
Wind 240 deg - Service		-2.68	1.54	93.72	165.20	0.77
Wind 270 deg - Service		-3.10	-0.01	-1.64	191.12	1.01
Wind 300 deg - Service		-2.69	-1.55	-96.83	165.80	0.97
Wind 330 deg - Service		-1.56	-2.68	-166.36	96.02	0.67

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp

Comb. No.	Description
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	81 - 47.54	Pole	Max Tension	14	0.00	-0.00	-0.00
			Max. Compression	14	-6.89	0.35	0.46
			Max. Mx	11	-4.88	163.71	1.01
			Max. My	2	-4.88	0.86	162.98
			Max. Vy	5	5.80	-163.27	-0.35
			Max. Vx	2	-5.78	0.86	162.98
			Max. Torque	17			0.72
L2	47.54 - 37.54	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-9.53	-0.14	1.71
			Max. Mx	5	-7.04	-209.84	0.21
			Max. My	2	-7.04	0.71	209.85
			Max. Vy	5	7.12	-209.84	0.21
			Max. Vx	2	-7.10	0.71	209.85
			Max. Torque	18			2.92
L3	37.54 - 25	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-10.90	-0.14	1.75
			Max. Mx	5	-8.38	-322.56	-0.06
			Max. My	2	-8.39	1.02	322.22
			Max. Vy	5	7.45	-322.56	-0.06
			Max. Vx	2	-7.43	1.02	322.22
			Max. Torque	18			2.92
L4	25 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-13.43	-0.14	1.77
			Max. Mx	5	-10.85	-515.05	-0.54
			Max. My	2	-10.85	1.51	514.16
			Max. Vy	5	7.96	-515.05	-0.54
			Max. Vx	2	-7.93	1.51	514.16
			Max. Torque	18			2.91

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	15	13.43	0.01	6.81
	Max. H_x	11	10.85	7.95	0.02
	Max. H_z	2	10.85	0.02	7.92

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Max. M_x	2	514.16	0.02	7.92
	Max. M_z	5	515.05	-7.95	-0.02
	Max. Torsion	18	2.91	-6.83	-0.01
	Min. Vert	1	10.85	0.00	0.00
	Min. H_x	5	10.85	-7.95	-0.02
	Min. H_z	8	10.85	-0.02	-7.92
	Min. M_x	8	-511.95	-0.02	-7.92
	Min. M_z	11	-514.80	7.95	0.02
	Min. Torsion	24	-2.91	6.83	0.01

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	10.85	0.00	-0.00	-1.10	-0.12	0.00
Dead+Wind 0 deg - No Ice	10.85	-0.02	-7.92	-514.16	1.51	0.50
Dead+Wind 30 deg - No Ice	10.85	3.96	-6.85	-444.61	-256.19	-0.87
Dead+Wind 60 deg - No Ice	10.85	6.87	-3.95	-256.21	-445.26	-2.01
Dead+Wind 90 deg - No Ice	10.85	7.95	0.02	0.54	-515.05	-2.61
Dead+Wind 120 deg - No Ice	10.85	6.89	3.98	256.84	-446.86	-2.51
Dead+Wind 150 deg - No Ice	10.85	3.99	6.87	444.03	-258.99	-1.74
Dead+Wind 180 deg - No Ice	10.85	0.02	7.92	511.95	-1.75	-0.50
Dead+Wind 210 deg - No Ice	10.85	-3.96	6.85	442.41	255.93	0.87
Dead+Wind 240 deg - No Ice	10.85	-6.87	3.95	254.03	445.00	2.01
Dead+Wind 270 deg - No Ice	10.85	-7.95	-0.02	-2.71	514.80	2.61
Dead+Wind 300 deg - No Ice	10.85	-6.89	-3.98	-259.02	446.63	2.51
Dead+Wind 330 deg - No Ice	10.85	-3.99	-6.87	-446.22	258.76	1.74
Dead+Ice+Temp	13.43	-0.00	-0.00	-1.77	-0.14	0.00
Dead+Wind 0 deg+Ice+Temp	13.43	-0.01	-6.81	-449.32	1.14	0.57
Dead+Wind 30 deg+Ice+Temp	13.43	3.40	-5.89	-388.72	-223.55	-0.96
Dead+Wind 60 deg+Ice+Temp	13.43	5.91	-3.39	-224.42	-388.38	-2.23
Dead+Wind 90 deg+Ice+Temp	13.43	6.83	0.01	-0.46	-449.16	-2.91
Dead+Wind 120 deg+Ice+Temp	13.43	5.92	3.42	223.13	-389.63	-2.80
Dead+Wind 150 deg+Ice+Temp	13.43	3.43	5.91	386.46	-225.75	-1.95
Dead+Wind 180 deg+Ice+Temp	13.43	0.01	6.81	445.78	-1.42	-0.57
Dead+Wind 210 deg+Ice+Temp	13.43	-3.40	5.89	385.19	223.26	0.96
Dead+Wind 240 deg+Ice+Temp	13.43	-5.91	3.39	220.91	388.08	2.23
Dead+Wind 270 deg+Ice+Temp	13.43	-6.83	-0.01	-3.03	448.88	2.91
Dead+Wind 300 deg+Ice+Temp	13.43	-5.92	-3.42	-226.63	389.37	2.80
Dead+Wind 330 deg+Ice+Temp	13.43	-3.43	-5.91	-389.98	225.49	1.95
Dead+Wind 0 deg - Service	10.85	-0.01	-3.10	-201.91	0.51	0.20
Dead+Wind 30 deg - Service	10.85	1.55	-2.68	-174.69	-100.34	-0.34
Dead+Wind 60 deg - Service	10.85	2.68	-1.54	-100.96	-174.34	-0.79
Dead+Wind 90 deg - Service	10.85	3.10	0.01	-0.47	-201.66	-1.03
Dead+Wind 120 deg - Service	10.85	2.69	1.55	99.84	-174.98	-0.99
Dead+Wind 150 deg - Service	10.85	1.56	2.68	173.11	-101.44	-0.68
Dead+Wind 180 deg - Service	10.85	0.01	3.10	199.69	-0.76	-0.20
Dead+Wind 210 deg - Service	10.85	-1.55	2.68	172.47	100.09	0.34
Dead+Wind 240 deg - Service	10.85	-2.68	1.54	98.74	174.09	0.79
Dead+Wind 270 deg - Service	10.85	-3.10	-0.01	-1.74	201.41	1.03
Dead+Wind 300 deg - Service	10.85	-2.69	-1.55	-102.06	174.73	0.99
Dead+Wind 330 deg - Service	10.85	-1.56	-2.68	-175.32	101.20	0.68

Solution Summary

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
1	0.00	-10.85	0.00	0.00	10.85	0.00	0.000%
2	-0.02	-10.85	-7.92	0.02	10.85	7.92	0.000%
3	3.96	-10.85	-6.85	-3.96	10.85	6.85	0.000%
4	6.87	-10.85	-3.95	-6.87	10.85	3.95	0.000%
5	7.95	-10.85	0.02	-7.95	10.85	-0.02	0.000%
6	6.89	-10.85	3.98	-6.89	10.85	-3.98	0.000%
7	3.99	-10.85	6.87	-3.99	10.85	-6.87	0.000%
8	0.02	-10.85	7.92	-0.02	10.85	-7.92	0.000%
9	-3.96	-10.85	6.85	3.96	10.85	-6.85	0.000%
10	-6.87	-10.85	3.95	6.87	10.85	-3.95	0.000%
11	-7.95	-10.85	-0.02	7.95	10.85	0.02	0.000%
12	-6.89	-10.85	-3.98	6.89	10.85	3.98	0.000%
13	-3.99	-10.85	-6.87	3.99	10.85	6.87	0.000%
14	0.00	-13.43	0.00	0.00	13.43	0.00	0.000%
15	-0.01	-13.43	-6.81	0.01	13.43	6.81	0.000%
16	3.40	-13.43	-5.89	-3.40	13.43	5.89	0.000%
17	5.91	-13.43	-3.39	-5.91	13.43	3.39	0.000%
18	6.83	-13.43	0.01	-6.83	13.43	-0.01	0.000%
19	5.92	-13.43	3.42	-5.92	13.43	-3.42	0.000%
20	3.43	-13.43	5.91	-3.43	13.43	-5.91	0.000%
21	0.01	-13.43	6.81	-0.01	13.43	-6.81	0.000%
22	-3.40	-13.43	5.89	3.40	13.43	-5.89	0.000%
23	-5.91	-13.43	3.39	5.91	13.43	-3.39	0.000%
24	-6.83	-13.43	-0.01	6.83	13.43	0.01	0.000%
25	-5.92	-13.43	-3.42	5.92	13.43	3.42	0.000%
26	-3.43	-13.43	-5.91	3.43	13.43	5.91	0.000%
27	-0.01	-10.85	-3.10	0.01	10.85	3.10	0.000%
28	1.55	-10.85	-2.68	-1.55	10.85	2.68	0.000%
29	2.68	-10.85	-1.54	-2.68	10.85	1.54	0.000%
30	3.10	-10.85	0.01	-3.10	10.85	-0.01	0.000%
31	2.69	-10.85	1.55	-2.69	10.85	-1.55	0.000%
32	1.56	-10.85	2.68	-1.56	10.85	-2.68	0.000%
33	0.01	-10.85	3.10	-0.01	10.85	-3.10	0.000%
34	-1.55	-10.85	2.68	1.55	10.85	-2.68	0.000%
35	-2.68	-10.85	1.54	2.68	10.85	-1.54	0.000%
36	-3.10	-10.85	-0.01	3.10	10.85	0.01	0.000%
37	-2.69	-10.85	-1.55	2.69	10.85	1.55	0.000%
38	-1.56	-10.85	-2.68	1.56	10.85	2.68	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	5	0.00000001	0.00009750
3	Yes	6	0.00000001	0.00009866
4	Yes	6	0.00000001	0.00012463
5	Yes	5	0.00000001	0.00062319
6	Yes	6	0.00000001	0.00009232
7	Yes	6	0.00000001	0.00012023
8	Yes	5	0.00000001	0.00012303
9	Yes	6	0.00000001	0.00011242
10	Yes	6	0.00000001	0.00009201

11	Yes	5	0.00000001	0.00065363
12	Yes	6	0.00000001	0.00012990
13	Yes	6	0.00000001	0.00009643
14	Yes	4	0.00000001	0.00005685
15	Yes	5	0.00000001	0.00071916
16	Yes	6	0.00000001	0.00024421
17	Yes	6	0.00000001	0.00030414
18	Yes	6	0.00000001	0.00011904
19	Yes	6	0.00000001	0.00023444
20	Yes	6	0.00000001	0.00029185
21	Yes	5	0.00000001	0.00072287
22	Yes	6	0.00000001	0.00027182
23	Yes	6	0.00000001	0.00023110
24	Yes	6	0.00000001	0.00012178
25	Yes	6	0.00000001	0.00031860
26	Yes	6	0.00000001	0.00024199
27	Yes	4	0.00000001	0.00047188
28	Yes	5	0.00000001	0.00016923
29	Yes	5	0.00000001	0.00026422
30	Yes	5	0.00000001	0.00014708
31	Yes	5	0.00000001	0.00017176
32	Yes	5	0.00000001	0.00024397
33	Yes	4	0.00000001	0.00049212
34	Yes	5	0.00000001	0.00021279
35	Yes	5	0.00000001	0.00016129
36	Yes	5	0.00000001	0.00014987
37	Yes	5	0.00000001	0.00028609
38	Yes	5	0.00000001	0.00017101

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	81 - 47.54	24.707	38	2.6495	0.0205
L2	47.54 - 37.54	8.584	38	1.7124	0.0165
L3	40.46 - 25	6.229	38	1.4611	0.0145
L4	25 - 0	2.342	38	0.8883	0.0073

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
81.00	BXA-70063/4CF	38	24.707	2.6495	0.0206	7607
62.50	20' 4-Bay Dipole	38	15.036	2.1699	0.0190	2055
42.50	10' Dipole	38	6.868	1.5352	0.0152	1681

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	81 - 47.54	62.751	12	6.7410	0.0570
L2	47.54 - 37.54	21.838	12	4.3566	0.0464
L3	40.46 - 25	15.854	12	3.7174	0.0409
L4	25 - 0	5.968	12	2.2627	0.0206

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
81.00	BXA-70063/4CF	12	62.751	6.7410	0.0574	3062
62.50	20' 4-Bay Dipole	12	38.216	5.5209	0.0532	825
42.50	10' Dipole	12	17.478	3.9058	0.0429	669

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	81 - 79.327	TP17.75x13x0.1875	33.46	81.00	209.8	3.392	7.7664	-2.97	26.35	0.113
	79.327 - 77.654					3.517	7.9077	-3.04	27.81	0.109
	77.654 - 75.981					3.644	8.0491	-3.12	29.33	0.106
	75.981 - 74.308					3.773	8.1904	-2.10	30.90	0.068
	74.308 - 72.635					3.904	8.3317	-2.16	32.53	0.066
	72.635 - 70.962					4.038	8.4731	-2.23	34.21	0.065
	70.962 - 69.289					4.174	8.6144	-2.29	35.95	0.064
	69.289 - 67.616					4.312	8.7558	-2.36	37.75	0.063
	67.616 - 65.943					4.452	8.8971	-2.43	39.61	0.061
	65.943 - 64.27					4.595	9.0385	-2.51	41.53	0.060
	64.27 - 62.597					4.739	9.1798	-2.58	43.51	0.059
	62.597 - 60.924					4.886	9.3211	-4.19	45.55	0.092
	60.924 - 59.251					5.036	9.4625	-4.27	47.65	0.090
	59.251 - 57.578					5.187	9.6038	-4.35	49.82	0.087
	57.578 - 55.905					5.341	9.7452	-4.44	52.05	0.085
	55.905 - 54.232					5.497	9.8865	-4.52	54.35	0.083
	54.232 - 52.559					5.656	10.0279	-4.61	56.71	0.081
	52.559 - 50.886					5.816	10.1692	-4.70	59.15	0.079
	50.886 - 49.213					5.979	10.3105	-4.79	61.65	0.078
	49.213 - 47.54					6.144	10.4519	-4.88	64.22	0.076
L2	47.54 - 46.5286	TP19.17x17.75x0.25	10.00	81.00	155.2	6.201	14.0002	-4.95	86.81	0.057
	46.5286 - 45.5171					6.302	14.1142	-5.02	88.95	0.056
	45.5171 - 44.5057					6.404	14.2281	-5.09	91.12	0.056
	44.5057 - 43.4943					6.507	14.3421	-5.16	93.33	0.055
	43.4943 - 42.4829					6.611	14.4561	-6.89	95.57	0.072

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 $\frac{P}{P_a}$
	42.4829 - 41.4714					6.716	14.5700	-6.97	97.85	0.071
	41.4714 - 40.46					6.821	14.6840	-7.04	100.17	0.070
	40.46 - 37.54					7.130	15.0130	-3.74	107.05	0.035
L3	40.46 - 37.54	TP20.91x18.2554x0.25	15.46	81.00	147.9	6.822	14.6851	-3.64	100.19	0.036
	37.54 - 36.495					6.955	14.8275	-7.46	103.13	0.072
	36.495 - 35.45					7.090	14.9699	-7.54	106.13	0.071
	35.45 - 34.405					7.225	15.1123	-7.62	109.19	0.070
	34.405 - 33.36					7.362	15.2546	-7.71	112.30	0.069
	33.36 - 32.315					7.500	15.3970	-7.79	115.48	0.067
	32.315 - 31.27					7.639	15.5394	-7.87	118.71	0.066
	31.27 - 30.225					7.780	15.6818	-7.96	122.00	0.065
	30.225 - 29.18					7.922	15.8242	-8.04	125.36	0.064
	29.18 - 28.135					8.065	15.9666	-8.12	128.77	0.063
	28.135 - 27.09					8.209	16.1089	-8.21	132.25	0.062
	27.09 - 26.045					8.355	16.2513	-8.30	135.78	0.061
	26.045 - 25					8.502	16.3937	-8.38	139.38	0.060
L4	25 - 23.75	TP24x20.91x0.3	25.00	81.00	131.9	8.589	19.7720	-8.50	169.81	0.050
	23.75 - 22.5					8.717	19.9191	-8.61	173.63	0.050
	22.5 - 21.25					8.846	20.0662	-8.73	177.51	0.049
	21.25 - 20					8.976	20.2133	-8.85	181.44	0.049
	20 - 18.75					9.107	20.3604	-8.97	185.43	0.048
	18.75 - 17.5					9.239	20.5075	-9.09	189.48	0.048
	17.5 - 16.25					9.372	20.6546	-9.21	193.59	0.048
	16.25 - 15					9.506	20.8018	-9.33	197.75	0.047
	15 - 13.75					9.641	20.9489	-9.45	201.98	0.047
	13.75 - 12.5					9.777	21.0960	-9.57	206.26	0.046
	12.5 - 11.25					9.914	21.2431	-9.70	210.61	0.046
	11.25 - 10					10.052	21.3902	-9.82	215.01	0.046
	10 - 8.75					10.191	21.5373	-9.95	219.48	0.045
	8.75 - 7.5					10.330	21.6845	-10.07	224.01	0.045
	7.5 - 6.25					10.471	21.8316	-10.20	228.60	0.045
	6.25 - 5					10.613	21.9787	-10.33	233.25	0.044
	5 - 3.75					10.755	22.1258	-10.46	237.97	0.044
	3.75 - 2.5					10.899	22.2729	-10.58	242.75	0.044
	2.5 - 1.25					11.043	22.4200	-10.71	247.59	0.043
	1.25 - 0					11.188	22.5671	-10.85	252.49	0.043

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	81 - 79.327	TP17.75x13x0.1875	5.69	-2.747	39.000	0.070	0.00	0.000	39.000	0.000
	79.327 - 77.654		11.42	-5.316	39.000	0.136	0.00	0.000	39.000	0.000
	77.654 - 75.981		17.21	-7.734	39.000	0.198	0.00	0.000	39.000	0.000
	75.981 - 74.308		27.03	-11.727	39.000	0.301	0.00	0.000	39.000	0.000
	74.308 - 72.635		33.98	-14.245	39.000	0.365	0.00	0.000	39.000	0.000
	72.635 - 70.962		41.02	-16.622	39.000	0.426	0.00	0.000	39.000	0.000
	70.962 - 69.289		48.13	-18.867	39.000	0.484	0.00	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	69.289 - 67.616		55.33	-20.989	39.000	0.538	0.00	0.000	39.000	0.000
	67.616 - 65.943		62.61	-22.997	39.000	0.590	0.00	0.000	39.000	0.000
	65.943 - 64.27		69.97	-24.897	39.000	0.638	0.00	0.000	39.000	0.000
	64.27 - 62.597		77.40	-26.697	39.000	0.685	0.00	0.000	39.000	0.000
	62.597 - 60.924		88.77	-29.689	39.000	0.761	0.00	0.000	39.000	0.000
	60.924 - 59.251		97.95	-31.783	39.000	0.815	0.00	0.000	39.000	0.000
	59.251 - 57.578		107.20	-33.764	39.000	0.866	0.00	0.000	39.000	0.000
	57.578 - 55.905		116.53	-35.638	39.000	0.914	0.00	0.000	39.000	0.000
	55.905 - 54.232		125.93	-37.413	39.000	0.959	0.00	0.000	39.000	0.000
	54.232 - 52.559		135.39	-39.093	39.000	1.002	0.00	0.000	39.000	0.000
	52.559 - 50.886		144.93	-40.685	39.000	1.043	0.00	0.000	39.000	0.000
	50.886 - 49.213		154.53	-42.194	39.000	1.082	0.00	0.000	39.000	0.000
	49.213 - 47.54		164.21	-43.624	39.000	1.119	0.00	0.000	39.000	0.000
L2	47.54 - 46.5286	TP19.17x17.75x0.25	170.09	-33.695	39.000	0.864	0.00	0.000	39.000	0.000
	46.5286 - 45.5171		176.00	-34.301	39.000	0.880	0.00	0.000	39.000	0.000
	45.5171 - 44.5057		181.93	-34.888	39.000	0.895	0.00	0.000	39.000	0.000
	44.5057 - 43.4943		187.89	-35.456	39.000	0.909	0.00	0.000	39.000	0.000
	43.4943 - 42.4829		196.25	-36.449	39.000	0.935	0.00	0.000	39.000	0.000
	42.4829 - 41.4714		203.42	-37.188	39.000	0.954	0.00	0.000	39.000	0.000
	41.4714 - 40.46		210.62	-37.904	39.000	0.972	0.00	0.000	39.000	0.000
	40.46 - 37.54		120.07	-20.665	39.000	0.530	0.00	0.000	39.000	0.000
L3	40.46 - 37.54	TP20.91x18.2554x0.25	111.49	-20.062	39.000	0.514	0.00	0.000	39.000	0.000
	37.54 - 36.495		239.11	-42.197	39.000	1.082	0.00	0.000	39.000	0.000
	36.495 - 35.45		246.68	-42.704	39.000	1.095	0.00	0.000	39.000	0.000
	35.45 - 34.405		254.27	-43.188	39.000	1.107	0.00	0.000	39.000	0.000
	34.405 - 33.36		261.88	-43.649	39.000	1.119	0.00	0.000	39.000	0.000
	33.36 - 32.315		269.52	-44.089	39.000	1.130	0.00	0.000	39.000	0.000
	32.315 - 31.27		277.17	-44.509	39.000	1.141	0.00	0.000	39.000	0.000
	31.27 - 30.225		284.85	-44.909	39.000	1.152	0.00	0.000	39.000	0.000
	30.225 - 29.18		292.54	-45.291	39.000	1.161	0.00	0.000	39.000	0.000
	29.18 - 28.135		300.26	-45.655	39.000	1.171	0.00	0.000	39.000	0.000
	28.135 - 27.09		307.99	-46.002	39.000	1.180	0.00	0.000	39.000	0.000
	27.09 - 26.045		315.75	-46.333	39.000	1.188	0.00	0.000	39.000	0.000
	26.045 - 25		323.53	-46.648	39.000	1.196	0.00	0.000	39.000	0.000
L4	25 - 23.75	TP24x20.91x0.3	332.86	-39.685	39.000	1.018	0.00	0.000	39.000	0.000
	23.75 - 22.5		342.22	-40.197	39.000	1.031	0.00	0.000	39.000	0.000
	22.5 - 21.25		351.62	-40.693	39.000	1.043	0.00	0.000	39.000	0.000
	21.25 - 20		361.06	-41.175	39.000	1.056	0.00	0.000	39.000	0.000
	20 - 18.75		370.52	-41.642	39.000	1.068	0.00	0.000	39.000	0.000
	18.75 - 17.5		380.02	-42.094	39.000	1.079	0.00	0.000	39.000	0.000
	17.5 - 16.25		389.55	-42.533	39.000	1.091	0.00	0.000	39.000	0.000
	16.25 - 15		399.12	-42.959	39.000	1.102	0.00	0.000	39.000	0.000
	15 - 13.75		408.71	-43.372	39.000	1.112	0.00	0.000	39.000	0.000

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
	13.75 - 12.5		418.34	-43.773	39.000	1.122	0.00	0.000	39.000	0.000
	12.5 - 11.25		428.00	-44.161	39.000	1.132	0.00	0.000	39.000	0.000
	11.25 - 10		437.69	-44.538	39.000	1.142	0.00	0.000	39.000	0.000
	10 - 8.75		447.41	-44.903	39.000	1.151	0.00	0.000	39.000	0.000
	8.75 - 7.5		457.16	-45.257	39.000	1.160	0.00	0.000	39.000	0.000
	7.5 - 6.25		466.94	-45.601	39.000	1.169	0.00	0.000	39.000	0.000
	6.25 - 5		476.75	-45.934	39.000	1.178	0.00	0.000	39.000	0.000
	5 - 3.75		486.60	-46.257	39.000	1.186	0.00	0.000	39.000	0.000
	3.75 - 2.5		496.47	-46.570	39.000	1.194	0.00	0.000	39.000	0.000
	2.5 - 1.25		506.37	-46.874	39.000	1.202	0.00	0.000	39.000	0.000
	1.25 - 0		516.30	-47.168	39.000	1.209	0.00	0.000	39.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	81 - 79.327	TP17.75x13x0.1875	0.113	0.070	0.000	0.183 ✔	1.333	H1-3 ✔
	79.327 - 77.654		0.109	0.136	0.000	0.246 ✔	1.333	H1-3 ✔
	77.654 - 75.981		0.106	0.198	0.000	0.305 ✔	1.333	H1-3 ✔
	75.981 - 74.308		0.068	0.301	0.000	0.369 ✔	1.333	H1-3 ✔
	74.308 - 72.635		0.066	0.365	0.000	0.432 ✔	1.333	H1-3 ✔
	72.635 - 70.962		0.065	0.426	0.000	0.491 ✔	1.333	H1-3 ✔
	70.962 - 69.289		0.064	0.484	0.000	0.548 ✔	1.333	H1-3 ✔
	69.289 - 67.616		0.063	0.538	0.000	0.601 ✔	1.333	H1-3 ✔
	67.616 - 65.943		0.061	0.590	0.000	0.651 ✔	1.333	H1-3 ✔
	65.943 - 64.27		0.060	0.638	0.000	0.699 ✔	1.333	H1-3 ✔
	64.27 - 62.597		0.059	0.685	0.000	0.744 ✔	1.333	H1-3 ✔
	62.597 - 60.924		0.092	0.761	0.000	0.853 ✔	1.333	H1-3 ✔
	60.924 - 59.251		0.090	0.815	0.000	0.905 ✔	1.333	H1-3 ✔
	59.251 - 57.578		0.087	0.866	0.000	0.953 ✔	1.333	H1-3 ✔
	57.578 - 55.905		0.085	0.914	0.000	0.999 ✔	1.333	H1-3 ✔
	55.905 - 54.232		0.083	0.959	0.000	1.043 ✔	1.333	H1-3 ✔
	54.232 - 52.559		0.081	1.002	0.000	1.084 ✔	1.333	H1-3 ✔

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	52.559 - 50.886		0.079	1.043	0.000	1.123 ✔	1.333	H1-3 ✔
	50.886 - 49.213		0.078	1.082	0.000	1.160 ✔	1.333	H1-3 ✔
	49.213 - 47.54		0.076	1.119	0.000	1.195 ✔	1.333	H1-3 ✔
L2	47.54 - 46.5286	TP19.17x17.75x0.25	0.057	0.864	0.000	0.921 ✔	1.333	H1-3 ✔
	46.5286 - 45.5171		0.056	0.880	0.000	0.936 ✔	1.333	H1-3 ✔
	45.5171 - 44.5057		0.056	0.895	0.000	0.950 ✔	1.333	H1-3 ✔
	44.5057 - 43.4943		0.055	0.909	0.000	0.964 ✔	1.333	H1-3 ✔
	43.4943 - 42.4829		0.072	0.935	0.000	1.007 ✔	1.333	H1-3 ✔
	42.4829 - 41.4714		0.071	0.954	0.000	1.025 ✔	1.333	H1-3 ✔
	41.4714 - 40.46		0.070	0.972	0.000	1.042 ✔	1.333	H1-3 ✔
	40.46 - 37.54		0.035	0.530	0.000	0.565 ✔	1.333	H1-3 ✔
L3	40.46 - 37.54	TP20.91x18.2554x0.25	0.036	0.514	0.000	0.551 ✔	1.333	H1-3 ✔
	37.54 - 36.495		0.072	1.082	0.000	1.154 ✔	1.333	H1-3 ✔
	36.495 - 35.45		0.071	1.095	0.000	1.166 ✔	1.333	H1-3 ✔
	35.45 - 34.405		0.070	1.107	0.000	1.177 ✔	1.333	H1-3 ✔
	34.405 - 33.36		0.069	1.119	0.000	1.188 ✔	1.333	H1-3 ✔
	33.36 - 32.315		0.067	1.130	0.000	1.198 ✔	1.333	H1-3 ✔
	32.315 - 31.27		0.066	1.141	0.000	1.208 ✔	1.333	H1-3 ✔
	31.27 - 30.225		0.065	1.152	0.000	1.217 ✔	1.333	H1-3 ✔
	30.225 - 29.18		0.064	1.161	0.000	1.225 ✔	1.333	H1-3 ✔
	29.18 - 28.135		0.063	1.171	0.000	1.234 ✔	1.333	H1-3 ✔
	28.135 - 27.09		0.062	1.180	0.000	1.242 ✔	1.333	H1-3 ✔
	27.09 - 26.045		0.061	1.188	0.000	1.249 ✔	1.333	H1-3 ✔
	26.045 - 25		0.060	1.196	0.000	1.256 ✔	1.333	H1-3 ✔
L4	25 - 23.75	TP24x20.91x0.3	0.050	1.018	0.000	1.068 ✔	1.333	H1-3 ✔
	23.75 - 22.5		0.050	1.031	0.000	1.080 ✔	1.333	H1-3 ✔

Section No.	Elevation ft	Size	Ratio P / P_a	Ratio f_{bx} / F_{bx}	Ratio f_{by} / F_{by}	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
	22.5 - 21.25		0.049	1.043	0.000	1.093 ✔	1.333	H1-3 ✔
	21.25 - 20		0.049	1.056	0.000	1.105 ✔	1.333	H1-3 ✔
	20 - 18.75		0.048	1.068	0.000	1.116 ✔	1.333	H1-3 ✔
	18.75 - 17.5		0.048	1.079	0.000	1.127 ✔	1.333	H1-3 ✔
	17.5 - 16.25		0.048	1.091	0.000	1.138 ✔	1.333	H1-3 ✔
	16.25 - 15		0.047	1.102	0.000	1.149 ✔	1.333	H1-3 ✔
	15 - 13.75		0.047	1.112	0.000	1.159 ✔	1.333	H1-3 ✔
	13.75 - 12.5		0.046	1.122	0.000	1.169 ✔	1.333	H1-3 ✔
	12.5 - 11.25		0.046	1.132	0.000	1.178 ✔	1.333	H1-3 ✔
	11.25 - 10		0.046	1.142	0.000	1.188 ✔	1.333	H1-3 ✔
	10 - 8.75		0.045	1.151	0.000	1.197 ✔	1.333	H1-3 ✔
	8.75 - 7.5		0.045	1.160	0.000	1.205 ✔	1.333	H1-3 ✔
	7.5 - 6.25		0.045	1.169	0.000	1.214 ✔	1.333	H1-3 ✔
	6.25 - 5		0.044	1.178	0.000	1.222 ✔	1.333	H1-3 ✔
	5 - 3.75		0.044	1.186	0.000	1.230 ✔	1.333	H1-3 ✔
	3.75 - 2.5		0.044	1.194	0.000	1.238 ✔	1.333	H1-3 ✔
	2.5 - 1.25		0.043	1.202	0.000	1.245 ✔	1.333	H1-3 ✔
	1.25 - 0		0.043	1.209	0.000	1.252 ✔	1.333	H1-3 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF*P_{allow} K	% Capacity	Pass Fail
L1	81 - 47.54	Pole	TP17.75x13x0.1875	1	-4.88	85.60	89.6	Pass
L2	47.54 - 37.54	Pole	TP19.17x17.75x0.25	2	-7.04	133.52	78.2	Pass
L3	37.54 - 25	Pole	TP20.91x18.2554x0.25	3	-8.38	185.80	94.2	Pass
L4	25 - 0	Pole	TP24x20.91x0.3	4	-10.85	336.57	94.0	Pass
							Summary	
						Pole (L3)	94.2	Pass
						RATING =	**94.2**	**Pass**

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Subject:		Monopole Reinforcement
Location:		Plainville, CT
Rev. 0: 4/6/15		Designed by: T.J.L. Checked by: C.F.C. Job No. 15001.021

MONOPOLE REINFORCEMENT DESIGN

Note: Existing monopole is a 18 sided polygon. Proposed reinforcements shall comprise of flat bar stock attached to the exterior of the pole.

Design Forces:

Moment =	$M_{act} := 530 \cdot ft \cdot kips$	(User Input)
Axial =	$P := 11 \cdot kips$	(User Input)
Shear =	$V := 8 \cdot kips$	(User Input)

Existing Monopole data:

Youngs Modulus of Elasticity for Steel =	$E := 29000ksi$	(User Input)
Pole Yield Strength =	$Fy := 65 \cdot ksi$	(User Input)
Pole Section Diameter =	$D_{o.pole} := 24in$	(User Input)
Pole Section Wall Thickness =	$t := 0.25in$	(User Input)
Pole Cross-Sectional Area =	$A_{pole} := 18.84in^2$	(User Input)
Pole Section Moment of Inertia =	$I_{pole} := 1342in^4$	(User Input)

Stiffener Reinforcement Data:

Stiffener Yield Strength =	$Fy_{stiff} := 50 \cdot ksi$	(User Input)	
Stiffener Width =	$b := 3in$	(User Input)	
Stiffener Depth =	$d := 0.625in$	(User Input)	
Unbraced Length of Stiffener =	$l := 12in$	(User Input)	(Equal to Bolt Spacing. Assumed pin-pin Between Bolts)
Effective Length K Factor =	$K := 1.0$	(User Input)	
Number of Stiffeners =	$n_{stiff} := 3$	(User Input)	
Distance to Stiffener Centroid =	$d_1 := 12.375in$	(User Input)	
	$d_2 := 6.25in$	(User Input)	

AJAX Bolt Data:

Bolt Grade =	AS1252 PC 8.8	(User Input)	NOTE: AJAX bdts conform to AS 1252 Property Class 8.8 similar to A325 Fu = 120ksi
Number of Bolts per Stiffener =	$n_b := 4$	(User Input)	
Bolt Diameter =	$d_b := 0.75in$	(User Input)	
Allowable Shear Stress =	$Fv_{bolt} := 27 \cdot ksi$	(User Input)	
Number of Shear Planes =	$n_{plane} := 1$	(User Input)	

Calculated Properties:

Distance from Centroid to Extreme Fiber (Pole)

$c := D_{o.pole} \cdot 0.5 = 12 \cdot in$

Pole Allowable Axial Stress =

$Fa := 0.6 \cdot 1.33Fy = 51.87 \cdot ksi$

Note: 1.333 increase allowed per TIA/EIA

Pole Allowable Bending Stress =

$Fb := 0.6 \cdot 1.33Fy = 51.87 \cdot ksi$

Stiffener Area =

$A_{stiff} := b \cdot d = 1.875 \cdot in^2$

Distance from Centroid to Extreme Fiber =

$c_{total} := c + d = 12.625 \cdot in$

Stiffener Allowable Bending Stress =

$Fb_{stiff} := 0.60 \cdot 1.33Fy_{stiff} = 39.9 \cdot ksi$

Note: 1.33 increase allowed per TIA/EIA

Stiffener Moment of Inertia =

$I_{stiff} := \left(\frac{bd^3}{12}\right) = 0.061 \cdot in^4$

Stiffener Moment Area =

$Q_{stiff} := A_{stiff} d_1 = 23.203 \cdot in^3$

Total Stiffener Moment of Inertia =

$I_{stifftotal} := I_{stiff} n_{stiff} + A_{stiff}\left[(d_1)^2 \cdot 1 + (d_2)^2 \cdot 2\right] = 433.81 \cdot in^4$

Total Moment of Inertia =

$I_{total} := I_{stifftotal} + I_{pole} = 1775.8 \cdot in^4$

Stiffener Radius of Gyration =

$r := \sqrt{\frac{I_{stiff}}{A_{stiff}}} = 0.18 \cdot in$

Stiffener Slenderness Ratio =

$SRatio := \left(\frac{K \cdot l}{r}\right) = 66.511$

Stiffener Compression Index =

$C_c := \pi \cdot \sqrt{\frac{2 \cdot E}{Fy_{stiff}}} = 107$

Stiffener Allowable Compressive Force =

$$Fa_{stiff} := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right] \cdot Fy_{stiff}}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} = 21.575 \cdot ksi$$

Check Existing Monopole:

Moment Capacity of Existing Section = $Mn_{pole} := \left(\frac{Fb \cdot I_{pole}}{c}\right) = 483 \cdot kip \cdot ft$

$PoleShaft := if\left(Mn_{pole} > M_{act}, "Okay", "Reinforcement\_Reqd"\right)$

$\frac{M_{act}}{Mn_{pole}} = 1.096$ PoleShaft = "Reinforcement_Reqd"

Design Moment of Stiffeners:

Moment Capacity (Moment of Inertia) = $Mn_{stiff1} := \frac{Fb_{stiff} \cdot I_{stifftotal}}{c_{total}} = 114.25 ft \cdot kips$

Allowable compressive strength of stiffener = $Pa_{stiff} := 1.333 Fa_{stiff} A_{stiff} = 53.925 \cdot kips$

Moment Capacity (Compression) = $Mn_{stiff2} := Pa_{stiff}\left(d_1 + d_2\right) = 83.696 ft \cdot kips$

Stiffener Design Moment = $Mn_{stiff} := \begin{cases} Mn_{stiff1} & \text{if } Mn_{stiff1} \le Mn_{stiff2} \\ Mn_{stiff2} & \text{otherwise} \end{cases} = 83.696 \cdot ft \cdot kips$

Check Reinforced Monopole:

Moment Capacity Reinforced Section = $Mn_{reinf} := \left(Mn_{pole} + Mn_{stiff}\right) = 567 \cdot kip \cdot ft$

Compression Force on Pole Section = $P_{pole} := P = 11 \cdot kips$

Allowable Compression = $Pa_{pole} := Fa \cdot A_{pole} = 977.231 \cdot kips$

$Reinforced\_PoleShaft := if\left(\frac{P_{pole}}{Pa_{pole}} + \frac{M_{act}}{Mn_{reinf}} \le 1.00, "OK", "Overstressed"\right)$

$\frac{P_{pole}}{Pa_{pole}} + \frac{M_{act}}{Mn_{reinf}} = 0.95$ Reinforced_PoleShaft = "OK"

Calculate Equivalent Pole Thickness for RISA Input:

Equivalent Moment of Inertia = $Eq_I := \left(\frac{Mn_{reinf} \cdot c}{Fb}\right) = 1574.4 \cdot in^4$

Equivalent Pole Inside Diameter = $Eq_{Idpole} := \sqrt[4]{\left(D_{o.pole}^4 - \frac{Eq_I \cdot 64}{\pi}\right)}$

Equivalent Pole Thickness = $Eq_{polethk} := \frac{\left(D_{o.pole} - Eq_{Idpole}\right)}{2} = 0.301 \cdot in$

Design AJAX Bolts:

Bolt Area =

$$a_b := \frac{1}{4}\cdot\pi\cdot d_b^{\,2} = 0.442\cdot in^2$$

Bolt Spacing =

$$s_b := l = 1\,ft$$

Total Force at Stiffener Ends =

$$F := \frac{Mn_{stiff}\,Q_{stiff}}{I_{stifftotal}} = 53.72\cdot kips$$

Number of Bolts Required at Ends =

$$NB_{req} := \frac{F}{Fv_{bolt}\cdot a_b\cdot 1.33} = 3.386$$

$NB_{req} = 3$

$$Boltcheck := if\left(NB_{req} \le n_b, \text{"OK"}, \text{"Increase number of bolts"}\right)$$

Boltcheck = "OK"

Equivalent Shear Force =

$$V_{eq} := V\cdot\left(\frac{Mn_{reinf}}{M_{act}}\right) = 8.56\cdot kips$$

Shear Flow =

$$q := \frac{V_{eq}\cdot Q_{stiff}}{I_{total}} = 1.342\cdot klf$$

Shear per Bolt =

$$V_{bolt} := q\cdot s_b = 1.342\cdot kips$$

Bolt Shear Stress =

$$fv_{bolt} := \frac{V_{bolt}}{a_b} = 3.038\cdot ksi$$

Note: 1.333 increase allowed per AISC 9th edition for transient loading

$$Boltcheck := if\left(\frac{fv_{bolt}}{Fv_{bolt}} \le 1.33, \text{"OK"}, \text{"Increase number of bolts"}\right)$$

Boltcheck = "OK"

$$\frac{fv_{bolt}}{Fv_{bolt}} = 0.11$$

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Subject:	Monopole Reinforcement
Location:	Plainville, CT
Rev. 0: 4/6/15	Designed by: T.J.L. Checked by: C.F.C. Job No. 15001.021

MONOPOLE REINFORCEMENT DESIGN

Note: Existing monopole is a 18 sided polygon. Proposed reinforcements shall comprise of flat bar stock attached to the exterior of the pole.

Design Forces:

Moment =	$M_{act} := 218 \cdot ft \cdot kips$	(User Input)
Axial =	$P := 9.5 \cdot kips$	(User Input)
Shear =	$V := 7.5 \cdot kips$	(User Input)

Existing Monopole data:

Youngs Modulus of Elasticity for Steel =	$E := 29000ksi$	(User Input)
Pole Yield Strength =	$Fy := 65 \cdot ksi$	(User Input)
Pole Section Diameter =	$D_{o.pole} := 19.17in$	(User Input)
Pole Section Wall Thickness =	$t := 0.1875in$	(User Input)
Pole Cross-Sectional Area =	$A_{pole} := 11.29in^2$	(User Input)
Pole Section Moment of Inertia =	$I_{pole} := 514in^4$	(User Input)

Stiffener Reinforcement Data:

Stiffener Yield Strength =	$Fy_{stiff} := 50 \cdot ksi$	(User Input)	
Stiffener Width =	$b := 3in$	(User Input)	
Stiffener Depth =	$d := 0.625in$	(User Input)	
Unbraced Length of Stiffener =	$l := 12in$	(User Input)	(Equal to Bolt Spacing. Assumed pin-pin Between Bolts)
Effective Length K Factor =	$K := 1.0$	(User Input)	
Number of Stiffeners =	$n_{stiff} := 3$	(User Input)	
Distance to Stiffener Centroid =	$d_1 := 9.875in$	(User Input)	
	$d_2 := 5.125in$	(User Input)	

AJAX Bolt Data:

Bolt Grade =	AS1252 PC 8.8	(User Input)	NOTE: AJAX bdts conform to AS 1252 Property Class 8.8 similar to A325 Fu =120ksi
Number of Bolts per Stiffener =	$n_b := 4$	(User Input)	
Bolt Diameter =	$d_b := 0.75in$	(User Input)	
Allowable Shear Stress =	$Fv_{bolt} := 27 \cdot ksi$	(User Input)	
Number of Shear Planes =	$n_{plane} := 1$	(User Input)	

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Calculated Properties:

Distance from Centroid to Extreme Fiber (Pole)

$c := D_{o.pole} \cdot 0.5 = 9.585 \cdot in$

Pole Allowable Axial Stress =

$Fa := 0.6 \cdot 1.33Fy = 51.87 \cdot ksi$

Note: 1.333 increase allowed per TIA/EIA

Pole Allowable Bending Stress =

$Fb := 0.6 \cdot 1.33Fy = 51.87 \cdot ksi$

Stiffener Area =

$A_{stiff} := b \cdot d = 1.875 \cdot in^2$

Distance from Centroid to Extreme Fiber =

$c_{total} := c + d = 10.21 \cdot in$

Stiffener Allowable Bending Stress =

$Fb_{stiff} := 0.60 \cdot 1.33Fy_{stiff} = 39.9 \cdot ksi$

Note: 1.33 increase allowed per TIA/EIA

Stiffener Moment of Inertia =

$I_{stiff} := \left(\frac{bd^3}{12}\right) = 0.061 \cdot in^4$

Stiffener Moment Area =

$Q_{stiff} := A_{stiff} d_1 = 18.516 \cdot in^3$

Total Stiffener Moment of Inertia =

$I_{stifftotal} := I_{stiff} n_{stiff} + A_{stiff}\left[\left(d_1\right)^2 \cdot 1 + \left(d_2\right)^2 \cdot 2\right] = 281.52 \cdot in^4$

Total Moment of Inertia =

$I_{total} := I_{stifftotal} + I_{pole} = 795.5 \cdot in^4$

Stiffener Radius of Gyration =

$r := \sqrt{\frac{I_{stiff}}{A_{stiff}}} = 0.18 \cdot in$

Stiffener Slenderness Ratio =

$SRatio := \left(\frac{K \cdot l}{r}\right) = 66.511$

Stiffener Compression Index =

$C_c := \pi \cdot \sqrt{\frac{2 \cdot E}{Fy_{stiff}}} = 107$

Stiffener Allowable Compressive Force =

$$Fa_{stiff} := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right] \cdot Fy_{stiff}}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} = 21.575 \cdot ksi$$

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Check Existing Monopole:

Moment Capacity of Existing Section =

$$Mn_{pole} := \left(\frac{Fb \cdot I_{pole}}{c}\right) = 232 \cdot kip \cdot ft$$

$$PoleShaft := if\left(Mn_{pole} > M_{act}, "Okay", "Reinforcement\_Reqd"\right)$$

$$\frac{M_{act}}{Mn_{pole}} = 0.94 \qquad PoleShaft = "Okay"$$

Design Moment of Stiffeners:

Moment Capacity (Moment of Inertia) =

$$Mn_{stiff1} := \frac{Fb_{stiff} \cdot I_{stifftotal}}{c_{total}} = 91.68\,ft \cdot kips$$

Allowable compressive strength of stiffener =

$$Pa_{stiff} := 1.333 Fa_{stiff} \cdot A_{stiff} = 53.925 \cdot kips$$

Moment Capacity (Compression) =

$$Mn_{stiff2} := Pa_{stiff}\left(d_1 + d_2\right) = 67.406\,ft \cdot kips$$

Stiffener Design Moment =

$$Mn_{stiff} := \begin{cases} Mn_{stiff1} & \text{if } Mn_{stiff1} \le Mn_{stiff2} \\ Mn_{stiff2} & \text{otherwise} \end{cases} = 67.406 \cdot ft \cdot kips$$

Check Reinforced Monopole:

Moment Capacity Reinforced Section =

$$Mn_{reinf} := \left(Mn_{pole} + Mn_{stiff}\right) = 299 \cdot kip \cdot ft$$

Compression Force on Pole Section =

$$P_{pole} := P = 9.5 \cdot kips$$

Allowable Compression =

$$Pa_{pole} := Fa \cdot A_{pole} = 585.612 \cdot kips$$

$$Reinforced\_PoleShaft := if\left(\frac{P_{pole}}{Pa_{pole}} + \frac{M_{act}}{Mn_{reinf}} \le 1.00, "OK", "Overstressed"\right)$$

$$\frac{P_{pole}}{Pa_{pole}} + \frac{M_{act}}{Mn_{reinf}} = 0.74 \qquad Reinforced\_PoleShaft = "OK"$$

Calculate Equivalent Pole Thickness for RISA Input:

Equivalent Moment of Inertia =

$$Eq_I := \left(\frac{Mn_{reinf} \cdot c}{Fb}\right) = 663.5 \cdot in^4$$

Equivalent Pole Inside Diameter =

$$Eq_{Idpole} := \sqrt[4]{\left(D_{o.pole}^4 - \frac{Eq_I \cdot 64}{\pi}\right)}$$

Equivalent Pole Thickness =

$$Eq_{polethk} := \frac{\left(D_{o.pole} - Eq_{Idpole}\right)}{2} = 0.249 \cdot in$$

Design AJAX Bolts:

Bolt Area =

$$a_b := \frac{1}{4}\cdot\pi\cdot d_b^{\,2} = 0.442\cdot in^2$$

Bolt Spacing =

$$s_b := l = 1\,ft$$

Total Force at Stiffener Ends =

$$F := \frac{Mn_{stiff}\,Q_{stiff}}{I_{stifftotal}} = 53.199\cdot kips$$

Number of Bolts Required at Ends =

$$NB_{req} := \frac{F}{Fv_{bolt}\cdot a_b\cdot 1.33} = 3.353$$

$NB_{req} = 3$

$$Boltcheck := if\left(NB_{req} \le n_b, "OK", "Increase number of bolts"\right)$$

Boltcheck = "OK"

Equivalent Shear Force =

$$V_{eq} := V\cdot\left(\frac{Mn_{reinf}}{M_{act}}\right) = 10.294\cdot kips$$

Shear Flow =

$$q := \frac{V_{eq}\cdot Q_{stiff}}{I_{total}} = 2.875\cdot klf$$

Shear per Bolt =

$$V_{bolt} := q\cdot s_b = 2.875\cdot kips$$

Bolt Shear Stress =

$$fv_{bolt} := \frac{V_{bolt}}{a_b} = 6.508\cdot ksi$$

Note: 1.333 increase allowed per AISC 9th edition for transient loading

$$Boltcheck := if\left(\frac{fv_{bolt}}{Fv_{bolt}} \le 1.33, "OK", "Increase number of bolts"\right)$$

Boltcheck = "OK"

$$\frac{fv_{bolt}}{Fv_{bolt}} = 0.24$$

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F: (203) 488-8587

Subject:		Anchor Bolt and Baseplate Analysis
Location:		81-ft EEI Monopole Plainville, CT
Rev. 0: 4/6/15		Prepared by: T.J.L. Checked by: C.F.C. Job No. 15001.021

Anchor Bolt and Base Plate Analysis:

Input Data:

Tower Reactions:

Overturning Moment =	OM := 516·ft·kips	(Input From tnxTower)
Shear Force =	Shear := 8·kips	(Input From tnxTower)
Axial Force =	Axial := 11·kips	(Input From tnxTower)

Anchor Bolt Data:

ASTM A615 Grade 75

Number of Anchor Bolts =	N := 4	(User Input)
Bolt "Column" Distance =	l := 3.0·in	(User Input)
Bolt Ultimate Strength =	F_u := 100·ksi	(User Input)
Bolt Yield Strength =	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 60

Plate Yield Strength =	Fy_{bp} := 60·ksi	(User Input)
Base Plate Thickness =	t_{bp} := 1.75·in	(User Input)
Base Plate Diameter =	D_{bp} := 38·in	(User Input)
Outer Pole Diameter =	D_{pole} := 24·in	(User Input)

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Subject:	Anchor Bolt and Baseplate Analysis
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Geometric Layout Data:

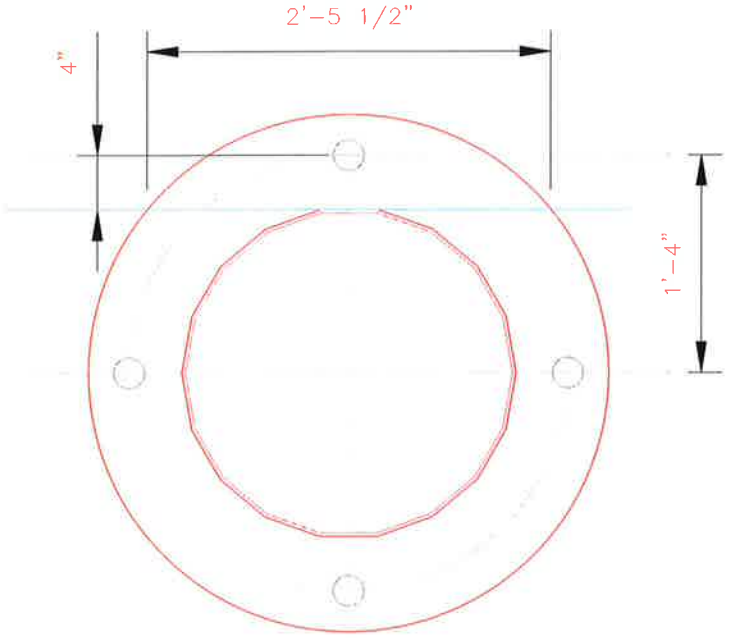
Distance from Bolts to Centroid of Pole:

$d_1 := 16in$ (User Input)

Critical Distances For Bending in Plate:

$ma_1 := 4in$ (User Input)

Effective Width of Baseplate for Bending = $B_{eff} := 0.9 \cdot 29.5 \cdot in = 26.6 \cdot in$ (User Input)



Anchor Bolt Analysis:

Calculated Anchor Bolt Properties:

Polar Moment of Inertia = $I_p := \left[\left(d_1\right)^2 \cdot 2\right] = 512 \cdot in^2$

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 = $T_{Max} := OM \cdot \frac{d_1}{I_p} - \frac{Axial}{N} = 190.8 \cdot kips$

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 = $\frac{T_{Max}}{T_{ALL.Net}} = 97.9 \cdot \%$ 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"

Base Plate Analysis:

Force from Bolts =

$$C_1 := OM \cdot \frac{d_1}{I_p} + \frac{Axial}{N} = 196.3 \cdot kips$$

Maximum Bending Stress in Plate =

$$f_{bp} := \frac{6 \cdot (C_1 \cdot ma_1)}{(B_{eff} \cdot t_{bp}^{\ 2})} = 57.9 \cdot ksi$$

Allowable Bending Stress in Plate =

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

Plate Bending Stress % of Capacity =

$$\frac{f_{bp}}{F_{bp}} = 96.8 \cdot \%$$

Condition3 =

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

Condition3 = "Ok"

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Subject: CAISSON FOUNDATION

Location: 81-ft EEI Monopole
Plainville, CT

Rev. 0: 4/6/15

Prepared by: TJL Checked by: C.F.C.
Job No. 15001.021

Caisson Foundation:

Input Data:

Shear Force =	$S := 8k$	*USER INPUT-FROM tnxTower*
Overturning Moment =	$M := 516ft \cdot k$	*USER INPUT-FROM tnxTower*
Applied Axial Load =	$A1 := 11k$	*USER INPUT-FROM tnxTower*
Bending Moment =	$Mu := 561ft \cdot k$	*USER INPUT–FROM LPILE*
Moment Capacity =	$Mn := 2161ft \cdot k$	*USER INPUT–FROM LPILE*
Foundation Diameter =	$d := 5.0ft$	*USER INPUT*
Overall Length of Caisson =	$L_c := 21.0ft$	*USER INPUT*
Depth From Top of Caisson to Grade =	$L_{pag} := 1.0ft$	*USER INPUT*
Number of Rebar =	$n := 12$	*USER INPUT*
Area of Rebar =	$Ar := 1.560in^2$	*USER INPUT*
Rebar Yield Strength =	$fy := 60ksi$	*USER INPUT*
Concrete Comp Strength =	$f'c := 4ksi$	*USER INPUT*

Check Moment Capacity:

Factor of Safety = $FS := \frac{Mn}{Mu} = 3.9$

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\1500100.WI\021 - Plainville 3 CT\Backup Documentation\Calcs\Foundation\
Name of input data file: Plainville 3 Caisson Analysis.lpd
Name of output file: Plainville 3 Caisson Analysis.lpo
Name of plot output file: Plainville 3 Caisson Analysis.lpp
Name of runtime file: Plainville 3 Caisson Analysis.lpr

Time and Date of Analysis

Date: April 6, 2015 Time: 11:05:49

Problem Title

15001.021 - Plainville 3

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 = 252.00 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	60.00000000	636172.5000	2827.4300	3605000.
2	252.0000	60.00000000	636172.5000	2827.4300	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 3 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 = 60.000 in
p-y subgrade modulus k for top of soil layer = 1.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 1.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 22.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 22.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 252.000 in
p-y subgrade modulus k for top of soil layer = 45.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 45.000 lbs/in**3

(Depth of lowest layer extends 0.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	12.00	0.05800
2	60.00	0.05800
3	60.00	0.06900
4	120.00	0.06900
5	120.00	0.03500
6	252.00	0.03500

Shear Strength of Soils

Shear strength parameters with depth defined using 6 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	25.00	------	------
2	60.000	0.00000	25.00	------	------
3	60.000	0.00000	34.00	------	------
4	120.000	0.00000	34.00	------	------
5	120.000	0.00000	34.00	------	------
6	252.000	0.00000	34.00	------	------

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 = 8000.000 lbs
Bending moment at pile head = 6192000.000 in-lbs
Axial load at pile head = 11000.000 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 = 60.0000 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 = 12
Area of Single Bar = 1.56000 in**2
Number of Rows of Reinforcing Bars = 7
Area of Steel = 18.720 in**2
Area of Shaft = 2827.433 in**2
Percentage of Steel Reinforcement = 0.662 percent
Cover Thickness (edge to bar center) = 4.000 in

Unfactored Axial Squash Load Capacity = 10672.83 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.560	26.000
2	3.120	22.517
3	3.120	13.000
4	3.120	0.000
5	3.120	-13.000
6	3.120	-22.517
7	1.560	-26.000

Axial Thrust Force = 15000.00 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
2077098.	2.492518E+12	8.333333E-07	0.00002649	31.79107368	94.16689871	671.61761
4136618.	2.481971E+12	0.00000167	0.00005160	30.96055448	182.11612	1303.09347
6178528.	2.471411E+12	0.00000250	0.00007669	30.67671597	268.81854	1934.06191
8202867.	2.460860E+12	0.00000333	0.00010178	30.53472698	354.33610	2565.02361
10209636.	2.450313E+12	0.00000417	0.00012687	30.44948280	438.66891	3195.97917
10209636.	2.041927E+12	0.00000500	0.00007396	14.79249537	254.91575	5975.08817
10209636.	1.750223E+12	0.00000583	0.00008525	14.61496174	292.83684	7000.96897
10209636.	1.531445E+12	0.00000667	0.00009656	14.48349774	330.56676	8026.52377
10209636.	1.361285E+12	0.00000750	0.00010787	14.38275397	368.10500	9051.75101
10209636.	1.225156E+12	0.00000833	0.00011920	14.30352867	405.45124	10076.64724
10209636.	1.113778E+12	0.00000917	0.00013053	14.23995316	442.60475	11101.21245
10209636.	1.020964E+12	0.00001000	0.00014188	14.18812215	479.56506	12125.44458
10209636.	9.424279E+11	0.00001083	0.00015324	14.14533198	516.33165	13149.34154

10209636.	8.751116E+11	0.00001167	0.00016461	14.10965145	552.90405	14172.90126
10209636.	8.167709E+11	0.00001250	0.00017600	14.07966435	589.28173	15196.12167
10209636.	7.657227E+11	0.00001333	0.00018739	14.05430853	625.46418	16219.00070
10209636.	7.206802E+11	0.00001417	0.00019880	14.03276503	661.45058	17241.53903
10209636.	6.806424E+11	0.00001500	0.00021022	14.01441157	697.24081	18263.73097
10209636.	6.448191E+11	0.00001583	0.00022167	13.99999917	732.89808	19285.00038
10209636.	6.125781E+11	0.00001667	0.00023333	13.99999917	769.01021	20300.00040
10209636.	5.834078E+11	0.00001750	0.00024500	13.99999917	804.87620	21315.00042
10209636.	5.568892E+11	0.00001833	0.00025667	13.99999917	840.49603	22330.00044
10209636.	5.326766E+11	0.00001917	0.00026827	13.99650872	875.66010	23346.94057
10209636.	5.104818E+11	0.00002000	0.00027978	13.98904145	910.31533	24366.35596
10209636.	4.900625E+11	0.00002083	0.00029131	13.98282588	944.77315	25385.37603
10209636.	4.712140E+11	0.00002167	0.00030285	13.97771537	979.03255	26404.00217
10209636.	4.537616E+11	0.00002250	0.00031441	13.97359550	1013.09320	27422.22894
10209636.	4.375558E+11	0.00002333	0.00032598	13.97036254	1046.95439	28440.05468
10209636.	4.224677E+11	0.00002417	0.00033756	13.96792710	1080.61538	29457.47776
10491638.	4.196655E+11	0.00002500	0.00034916	13.96621406	1114.07563	30474.49481
10828070.	4.191511E+11	0.00002583	0.00036077	13.96515906	1147.33462	31491.10167
11164175.	4.186566E+11	0.00002667	0.00037239	13.96469772	1180.39124	32507.30043
11499960.	4.181804E+11	0.00002750	0.00038403	13.96478713	1213.24546	33523.08227
11835417.	4.177206E+11	0.00002833	0.00039569	13.96537721	1245.89619	34538.44839
12170549.	4.172760E+11	0.00002917	0.00040735	13.96643221	1278.34312	35553.39275
12505347.	4.168449E+11	0.00003000	0.00041904	13.96790922	1310.58492	36567.91898
12839819.	4.164265E+11	0.00003083	0.00043074	13.96978676	1342.62176	37582.01567
13173955.	4.160196E+11	0.00003167	0.00044245	13.97202909	1374.45229	38595.68662
13507758.	4.156233E+11	0.00003250	0.00045417	13.97461474	1406.07616	39608.92561
14174347.	4.148589E+11	0.00003417	0.00047767	13.98071945	1468.70030	41634.10381
14839581.	4.141278E+11	0.00003583	0.00050124	13.98795426	1530.48934	43657.51753
15503436.	4.134250E+11	0.00003750	0.00052486	13.99618328	1591.43667	45679.15069
16159367.	4.125796E+11	0.00003917	0.00054833	13.99999917	1650.99473	47705.00095
16807544.	4.116133E+11	0.00004083	0.00057167	13.99999917	1709.18870	49735.00099
17452500.	4.106471E+11	0.00004250	0.00059500	13.99999917	1766.39809	51765.00103
18094236.	4.096808E+11	0.00004417	0.00061833	13.99999917	1822.62290	53795.00107
18803482.	4.102578E+11	0.00004583	0.00064173	14.00146186	1878.02624	55823.05694
19459066.	4.096645E+11	0.00004750	0.00066560	14.01268780	1933.55858	57837.52255
20113183.	4.090817E+11	0.00004917	0.00068953	14.02438581	1988.20097	59850.22990
20641300.	4.060584E+11	0.00005083	0.00071208	14.00815308	2038.63028	60000.00000
21094593.	4.018018E+11	0.00005250	0.00073500	13.99999917	2088.97820	60000.00000
21599312.	3.987565E+11	0.00005417	0.00075833	13.99999917	2139.29552	60000.00000
21886992.	3.920058E+11	0.00005583	0.00077802	13.93466055	2180.69649	60000.00000
22157704.	3.853514E+11	0.00005750	0.00079724	13.86497676	2220.40478	60000.00000
22427802.	3.790614E+11	0.00005917	0.00081649	13.79979193	2259.52717	60000.00000
22697280.	3.731060E+11	0.00006083	0.00083577	13.73874128	2298.06063	60000.00000
22966128.	3.674581E+11	0.00006250	0.00085509	13.68149579	2336.00171	60000.00000
23234352.	3.620938E+11	0.00006417	0.00087445	13.62776935	2373.34804	60000.00000
23501949.	3.569916E+11	0.00006583	0.00089384	13.57730091	2410.09664	60000.00000
23768899.	3.521318E+11	0.00006750	0.00091326	13.52984726	2446.24343	60000.00000
24035210.	3.474970E+11	0.00006917	0.00093273	13.48520100	2481.78597	60000.00000
24226262.	3.420178E+11	0.00007083	0.00095081	13.42326343	2514.10558	60000.00000
24333596.	3.356358E+11	0.00007250	0.00096736	13.34282935	2543.02321	60000.00000
24440579.	3.295359E+11	0.00007417	0.00098392	13.26631486	2571.50156	60000.00000
24547216.	3.236995E+11	0.00007583	0.00100050	13.19346607	2599.53916	60000.00000
24653511.	3.181098E+11	0.00007750	0.00101711	13.12405050	2627.13445	60000.00000
24759444.	3.127509E+11	0.00007917	0.00103375	13.05784643	2654.28463	60000.00000
24878757.	3.077784E+11	0.00008083	0.00105083	13.00000012	2681.70993	60000.00000
24990213.	3.029117E+11	0.00008250	0.00107162	12.98933208	2714.67474	60000.00000
25092689.	2.981310E+11	0.00008417	0.00108781	12.92451560	2739.52388	60000.00000
25194838.	2.935321E+11	0.00008583	0.00110403	12.86248505	2763.95044	60000.00000
25296660.	2.891047E+11	0.00008750	0.00112027	12.80308306	2787.95262	60000.00000
25398159.	2.848392E+11	0.00008917	0.00113653	12.74616659	2811.52889	60000.00000
25499322.	2.807265E+11	0.00009083	0.00115282	12.69159615	2834.67679	60000.00000
25600154.	2.767584E+11	0.00009250	0.00116913	12.63925016	2857.39491	60000.00000
25700660.	2.729274E+11	0.00009417	0.00118547	12.58901417	2879.68157	60000.00000
25800821.	2.692260E+11	0.00009583	0.00120182	12.54077375	2901.53402	60000.00000
25900646.	2.656477E+11	0.00009750	0.00121821	12.49443233	2922.95085	60000.00000
26000135.	2.621862E+11	0.00009917	0.00123461	12.44989693	2943.93024	60000.00000
26198074.	2.555910E+11	0.00010250	0.00126750	12.36589015	2984.56750	60000.00000
26394626.	2.493980E+11	0.00010583	0.00130049	12.28812039	3023.42993	60000.00000
26589785.	2.435705E+11	0.00010917	0.00133358	12.21603334	3060.50140	60000.00000
26783514.	2.380757E+11	0.00011250	0.00136678	12.14913189	3095.76420	60000.00000
26964090.	2.327835E+11	0.00011583	0.00139964	12.08319604	3128.75078	60000.00000
27074356.	2.271974E+11	0.00011917	0.00143000	12.00000107	3157.42629	60000.00000
27113259.	2.213327E+11	0.00012250	0.00146439	11.95417821	3188.16815	60000.00000
27165542.	2.158851E+11	0.00012583	0.00149148	11.85284078	3210.62185	60000.00000
27217124.	2.107132E+11	0.00012917	0.00151865	11.75726116	3231.87304	60000.00000
27268010.	2.057963E+11	0.00013250	0.00154588	11.66701376	3251.91250	60000.00000
27318176.	2.011154E+11	0.00013583	0.00157318	11.58170521	3270.72981	60000.00000
27367634.	1.966537E+11	0.00013917	0.00160055	11.50099218	3288.31566	60000.00000
27416375.	1.923956E+11	0.00014250	0.00162800	11.42455637	3304.65981	60000.00000
27464373.	1.883271E+11	0.00014583	0.00165552	11.35210454	3319.75152	60000.00000
27511625.	1.844355E+11	0.00014917	0.00168310	11.28337562	3333.58047	60000.00000
27558132.	1.807091E+11	0.00015250	0.00171077	11.21813357	3346.13629	60000.00000
27603889.	1.771373E+11	0.00015583	0.00173850	11.15616024	3357.40818	60000.00000
27648874.	1.737102E+11	0.00015917	0.00176631	11.09725177	3367.38489	60000.00000
27693083.	1.704190E+11	0.00016250	0.00179420	11.04122579	3376.05536	60000.00000
27693083.	1.669935E+11	0.00016583	0.00182417	10.99999845	3383.91343	60000.00000
27740812.	1.639851E+11	0.00016917	0.00186083	10.99999845	3391.47728	60000.00000
27848157.	1.614386E+11	0.00017250	0.00189145	10.96494734	3395.93381	60000.00000

27886040.	1.585936E+11	0.00017583	0.00191840	10.91034472	3398.49184	60000.00000
27923198.	1.558504E+11	0.00017917	0.00194543	10.85820973	3399.80888	60000.00000
27958719.	1.531985E+11	0.00018250	0.00197254	10.80842078	3396.98315	60000.00000
27992653.	1.506331E+11	0.00018583	0.00199973	10.76085269	3390.23955	60000.00000
28026249.	1.481564E+11	0.00018917	0.00202700	10.71539462	3384.40878	60000.00000
28059513.	1.457637E+11	0.00019250	0.00205435	10.67194641	3389.42787	60000.00000
28092438.	1.434507E+11	0.00019583	0.00208179	10.63041151	3393.48864	60000.00000
28125006.	1.412134E+11	0.00019917	0.00210931	10.59069693	3396.58002	60000.00000
28157216.	1.390480E+11	0.00020250	0.00213693	10.55272043	3398.69087	60000.00000
28189082.	1.369510E+11	0.00020583	0.00216463	10.51641047	3399.80975	60000.00000
28220277.	1.349177E+11	0.00020917	0.00219247	10.48194587	3397.66041	60000.00000
28250718.	1.329446E+11	0.00021250	0.00222048	10.44932663	3391.58093	60000.00000
28280901.	1.310312E+11	0.00021583	0.00224856	10.41803777	3385.48303	60000.00000
28310845.	1.291750E+11	0.00021917	0.00227671	10.38802922	3380.64657	60000.00000
28340529.	1.273732E+11	0.00022250	0.00230493	10.35924375	3385.71880	60000.00000
28369947.	1.256234E+11	0.00022583	0.00233323	10.33163130	3390.03609	60000.00000
28399096.	1.239233E+11	0.00022917	0.00236160	10.30514538	3393.59013	60000.00000
28427988.	1.222709E+11	0.00023250	0.00239004	10.27974665	3396.37250	60000.00000
28484946.	1.191008E+11	0.00023917	0.00244716	10.23203909	3399.58653	60000.00000
28540029.	1.160950E+11	0.00024583	0.00250476	10.18886268	3394.63363	60000.00000
28593539.	1.132417E+11	0.00025250	0.00256278	10.14962375	3383.70736	60000.00000
28646341.	1.105325E+11	0.00025917	0.00262103	10.11330664	3376.35941	60000.00000
28698413.	1.079564E+11	0.00026583	0.00267952	10.07971466	3385.81896	60000.00000
28749734.	1.055036E+11	0.00027250	0.00273826	10.04867256	3392.91545	60000.00000
28800296.	1.031652E+11	0.00027917	0.00279726	10.02002656	3397.59865	60000.00000
28800296.	1.007591E+11	0.00028583	0.00285833	9.99999940	3399.86118	60000.00000
28800296.	9.846255E+10	0.00029250	0.00292500	9.99999940	3391.70831	60000.00000
28800296.	9.626840E+10	0.00029917	0.00299167	9.99999940	3380.25831	60000.00000
28896053.	9.448301E+10	0.00030583	0.00305833	9.99999940	3368.80831	60000.00000
28951779.	9.264569E+10	0.00031250	0.00311257	9.96023834	3373.99092	60000.00000
28951779.	9.071054E+10	0.00031917	0.00316094	9.90371525	3379.50325	60000.00000
28951779.	8.885457E+10	0.00032583	0.00320939	9.84978139	3384.38208	60000.00000
28951779.	8.707302E+10	0.00033250	0.00325793	9.79829013	3388.61838	60000.00000
28951779.	8.536151E+10	0.00033917	0.00330657	9.74909484	3392.20191	60000.00000
28951779.	8.371599E+10	0.00034583	0.00335530	9.70207036	3395.12302	60000.00000
28951779.	8.213271E+10	0.00035250	0.00340412	9.65709150	3397.37128	60000.00000
28951779.	8.060820E+10	0.00035917	0.00345305	9.61405456	3398.93658	60000.00000
28951779.	7.913926E+10	0.00036583	0.00350207	9.57284868	3399.80810	60000.00000
28951779.	7.772290E+10	0.00037250	0.00355129	9.53366697	3398.63350	60000.00000
28951779.	7.635634E+10	0.00037917	0.00360286	9.50204551	3392.93458	60000.00000
28951779.	7.503701E+10	0.00038583	0.00365549	9.47428286	3386.95366	60000.00000
28951779.	7.376250E+10	0.00039250	0.00370820	9.44765389	3380.95297	60000.00000
28951779.	7.253055E+10	0.00039917	0.00376099	9.42210138	3374.93257	60000.00000
28951779.	7.133909E+10	0.00040583	0.00381385	9.39757168	3368.89251	60000.00000

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 28812.26624 in-kip

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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 = 8000.000 lbs
Specified moment at pile head = 6192000.000 in-lbs
Specified axial load at pile head = 11000.000 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	0.691407	6.19E+06	8000.000	-0.003919	295.887	2.47E+12	0.000	0.000
20.160	0.612915	6.35E+06	7978.905	-0.003868	303.530	2.47E+12	-5.001	20.563
40.320	0.535468	6.51E+06	7770.501	-0.003815	311.074	2.47E+12	-15.164	71.366
60.480	0.459094	6.67E+06	6939.773	-0.003761	318.331	2.47E+12	-378.207	2076.005
80.640	0.383816	6.72E+06	-1884.199	-0.003707	320.951	2.47E+12	-486.422	3193.675
100.800	0.309642	6.58E+06	-12233.	-0.003652	314.350	2.47E+12	-529.752	4311.345
120.960	0.236550	6.23E+06	-23463.	-0.003600	297.695	2.47E+12	-1024.338	10912.
141.120	0.164477	5.56E+06	-42680.	-0.003551	266.024	2.47E+12	-861.455	13199.
161.280	0.093313	4.54E+06	-57349.	-0.003510	218.039	2.48E+12	-573.385	15485.
181.440	0.022891	3.29E+06	-64960.	-0.003478	159.258	2.48E+12	-161.425	17771.
201.600	-0.046994	1.99E+06	-63021.	-0.003457	97.577	2.49E+12	374.028	20057.
221.760	-0.116552	8.35E+05	-49040.	-0.003445	43.260	2.49E+12	1033.386	22343.
241.920	-0.185968	1.07E+05	-20510.	-0.003442	8.944	2.49E+12	1817.565	24629.

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	=	0.69140730 in
Computed slope at pile head	=	-0.00391893
Maximum bending moment	=	6726681. lbs-in
Maximum shear force	=	-65485.75343 lbs
Depth of maximum bending moment	=	75.60000000 in
Depth of maximum shear force	=	189.00000 in
Number of iterations	=	5
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= 8000.000	M= 6.19E+06	11000.0000	0.6914073	6726681.	-65485.7534

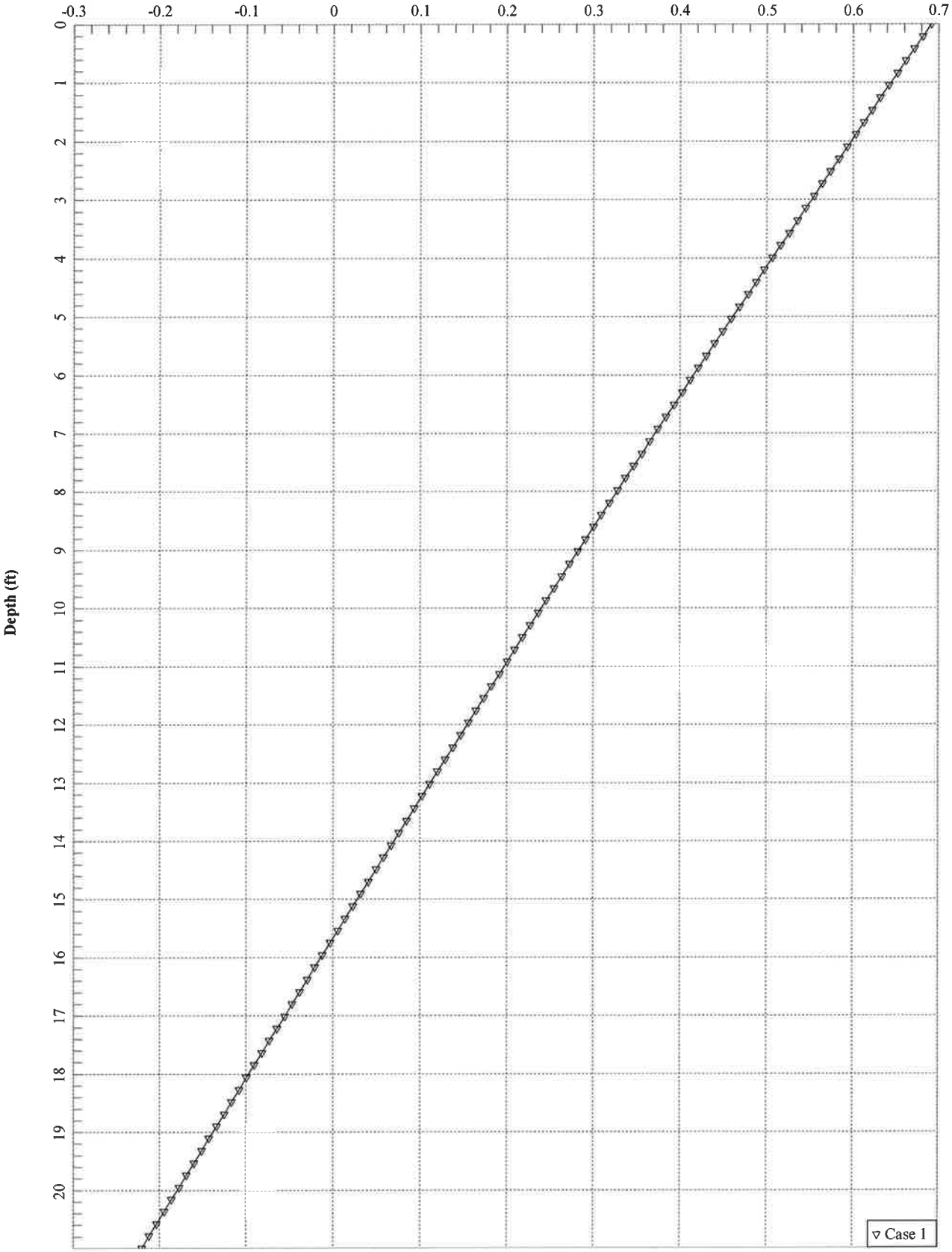
Computed Pile-head Stiffness Matrix Members
K22, K23, K32, K33 for Superstructure

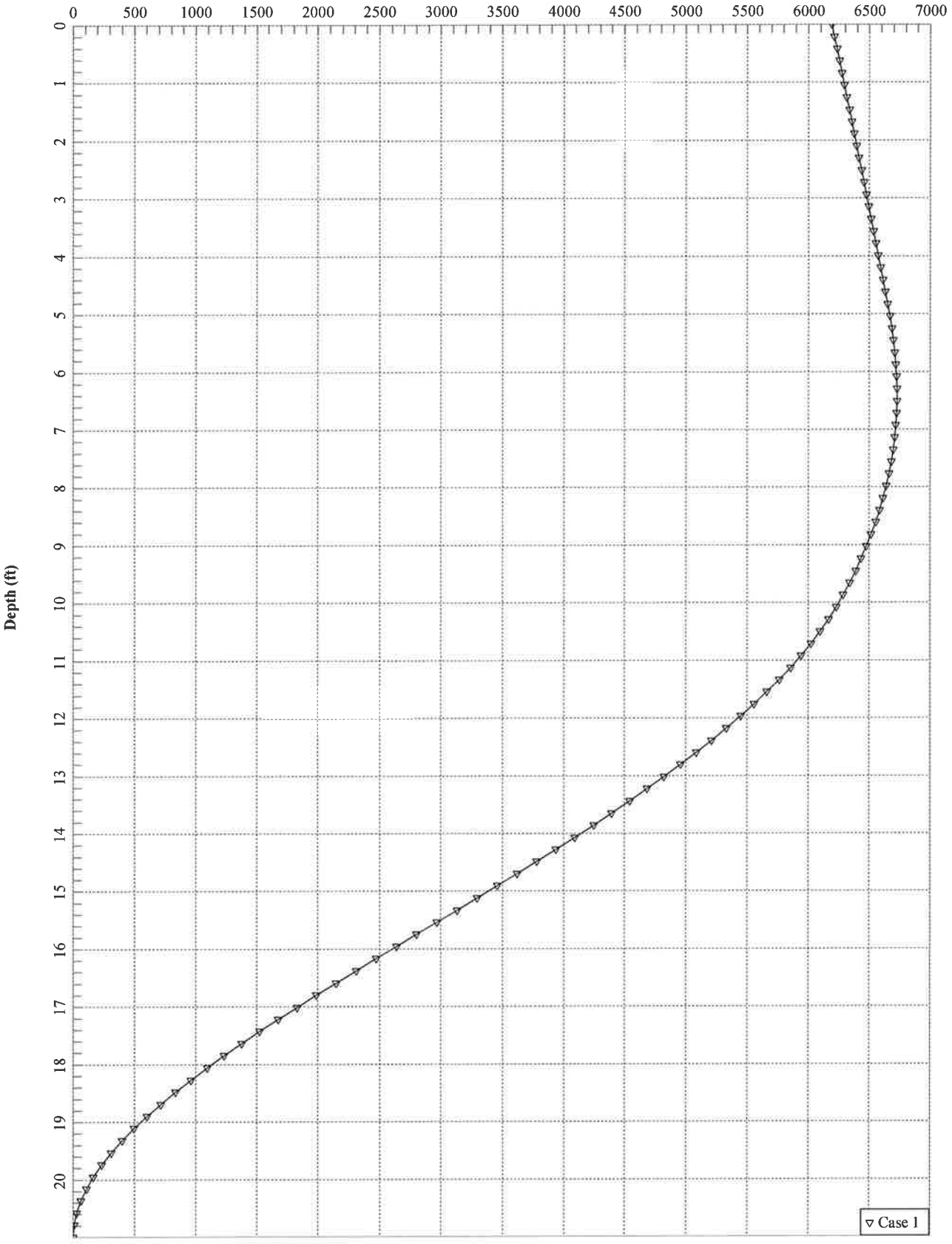
Top y in	Shear React. lbs	Mom. React. in-lbs	K22 lbs/in	K32 in-lbs/in
0.00139508	800.00001	138368.72492	573445.44834	99183643.
0.00419960	2408.23997	416531.36040	573445.44834	99183643.
0.00665620	3816.97004	660186.58662	573445.44834	99183643.
0.00839919	4816.47993	833062.72081	573445.44834	99183643.
0.00975116	5591.76003	967155.86814	573445.44834	99183643.
0.01085580	6225.21000	1076718.	573445.44834	99183643.
0.01178976	6760.78432	1169351.	573445.44834	99183643.
0.01259879	7224.71990	1249594.	573445.44834	99183643.
0.01331241	7633.94008	1320373.	573445.44834	99183643.
0.01395076	8000.00000	1383687.	573445.44834	99183643.

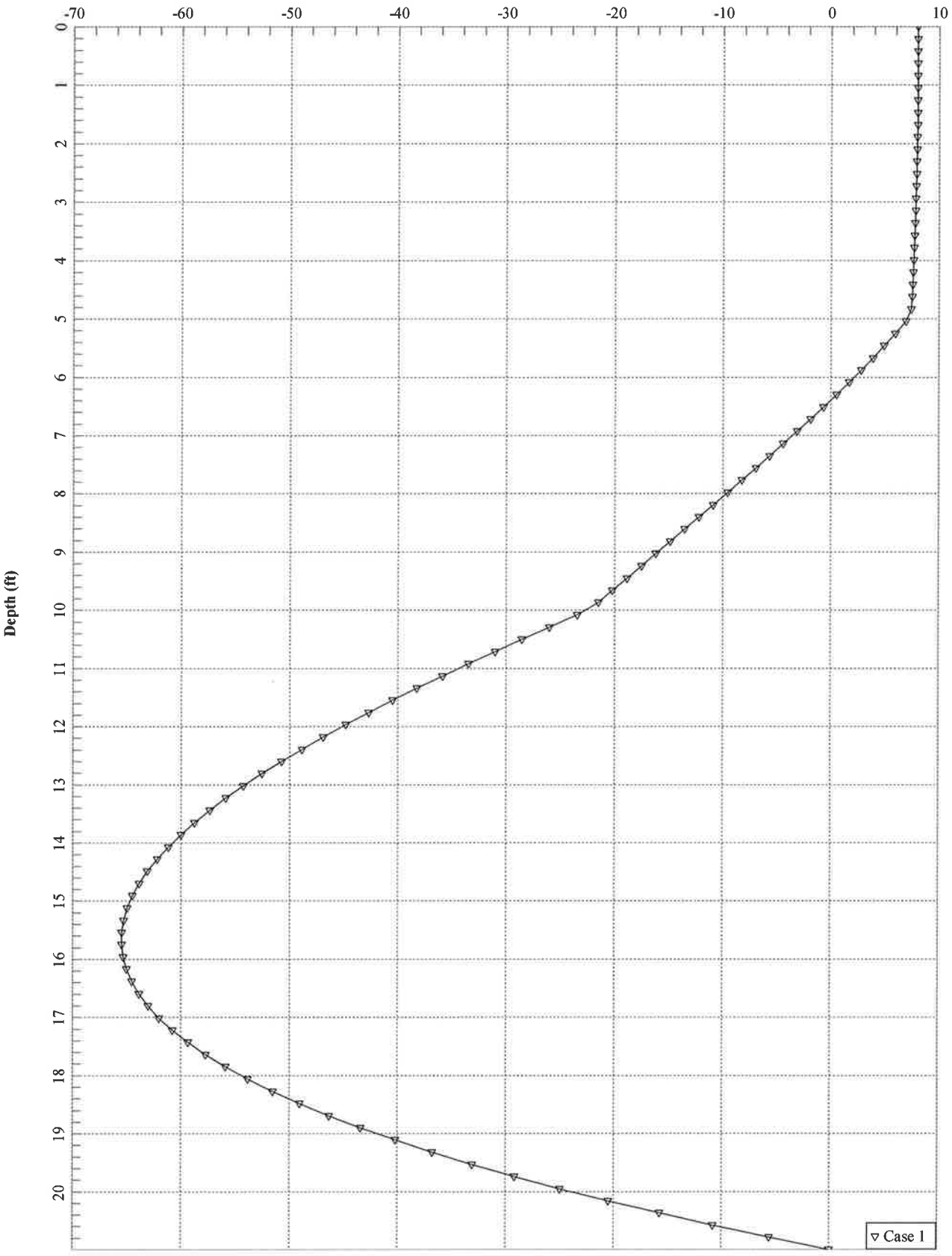
Top Rota. rad	Shear React. lbs	Mom. React. in-lbs	K23 lbs/rad	K33 in-lbs/rad
0.00003244	3217.14786	619200.00923	99183643.	1.908974E+10
0.00009764	9684.57992	1863978.	99183643.	1.908974E+10
0.00015484	15349.79110	2954335.	99134608.	1.908018E+10
0.00019549	19369.55678	3727955.	99081361.	1.906966E+10
0.00022704	22487.64213	4328022.	99046035.	1.906262E+10
0.00025285	25035.37167	4818313.	99012053.	1.905588E+10
0.00027469	27189.50313	5232847.	98981537.	1.904982E+10
0.00029362	29055.53893	5591933.	98955463.	1.904464E+10
0.00031033	30701.53002	5908670.	98933303.	1.904023E+10
0.00032527	32173.94265	6192000.	98914308.	1.903644E+10

K22 = abs(Shear Reaction/Top y)
K23 = abs(Shear Reaction/Top Rotation)
K32 = abs(Moment Reaction/Top y)
K33 = abs(Moment Reaction/Top Rotation)

The analysis ended normally.


Lateral Deflection (in)
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
▽ Case 1


Bending Moment (in-kips)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Case 1


Shear Force (kips)
-70
-60
-50
-40
-30
-20
-10
0
10
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
▽ Case 1

TOWER REINFORCEMENT DESIGN

PLAINVILLE 3
1 CENTRAL SQUARE
PLAINVILLE, CT 06062

VICINITY MAP

NORTH

PROJECT SUMMARY

SITE ADDRESS:	1 CENTRAL SQUARE PLAINVILLE, CT 06062
PROJECT COORDINATES:	LAT: 41°-40'-18.70N LON: 72°-52'-01.90W ELEV: ±186' AMSL
VERIZON SITE REF.:	PLAINVILLE 3
VERIZON CONTACT:	HOLLIS REDDING 860.966.0989
ENGINEER OF RECORD:	CENTEK ENGINEERING, INC. 63-2 NORTH BRANFORD ROAD BRANFORD, CT 06405
CENTEK CONTACT:	CARLO F. CENTORE, PE 203.488.0580 ext. 122

SHEET INDEX

SHT. NO.	DESCRIPTION	REV.
T-1	TITLE SHEET	0
N-1	DESIGN BASIS & GENERAL NOTES	0
N-2	STRUCTURAL STEEL NOTES	0
MI-1	MODIFICATION INSPECTION REQUIREMENTS	0
S-1	TOWER REINFORCEMENT ELEVATIONS	0
S-2	TOWER REINFORCEMENT DETAILS	0

REV.	DATE	ISSUED BY/COMM'S ANY DESCRIPTION
0	4/6/15	CFC ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER SEAL

CENTEK engineering
Centered on Solutions℠
www.CentekEng.com
[203] 488-0580
[203] 488-8587 Fax
63-2 North Branford Road, Branford, CT 06405

VERIZON WIRELESS

PLAINVILLE 3

DATE: 4/6/15
SCALE: AS SHOWN
JOB NO. 15001.021

TITLE SHEET

SHEET NO.
T-1
Sheet No. 1 of 5

DESIGN BASIS

1. GOVERNING CODE: 2003 INTERNATIONAL BUILDING CODE AS MODIFIED BY THE 2005 CT STATE BUILDING CODE AND 2009 AMENDMENTS.

2. TIA/EIA-222-F-1996 "STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND ANTENNA SUPPORTING STRUCTURES".

3. DESIGN CRITERIA

   WIND LOAD: (TIA/EIA-222-F-1996)
   BASIC WIND SPEED (V) = 80 MPH (FASTEST MILE)

   WIND LOAD: (2005 CT STATE BUILDING CODE APPENDIX K)
   BASIC WIND SPEED (V) = 95 MPH (3-SECOND GUST)
   EQUIVALENT TO (V) = 77.5 MPH (FASTEST MILE)

   TIA/EIA-222-F-1996 WIND SPEED CONTROLS

GENERAL NOTES

1. REFER TO STRUCTURAL ANALYSIS AND REINFORCEMENT DESIGN PREPARED BY CENTEK ENGINEERING, INC., FOR VERIZON, DATED 4/6/15.

2. TOWER GEOMETRY AND STRUCTURE MEMBER SIZES WERE OBTAINED FROM A PREVIOUS STRUCTURAL ANALYSIS REPORT PREAPRED BY URS PROJECT #VZ5-149, DATED NOVEMBER 20, 2013.

3. PROVIDE TEMPORARY ANCHORS, GUYING AND/OR BRACING AS REQUIRED TO SAFELY CONDUCT THE WORK.

4. ALL WORK SHALL BE IN ACCORDANCE WITH TIA/EIA-222 REVISION "F" "STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND SUPPORTING STRUCTURES".

5. THE TOWER STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER REINFORCEMENTS ARE COMPLETE. IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE AND TO INSURE THE SAFETY OF THE TOWER STRUCTURE AND ITS COMPONENT PARTS DURING ERECTION. THIS INCLUDES THE ADDITION OF WHATEVER SHORING, TEMPORARY BRACING, GUYS OR TIE-DOWNS, WHICH MIGHT BE NECESSARY.

5. THE CONTRACTOR IS SOLELY RESPONSIBLE TO DETERMINE CONSTRUCTION PROCEDURE AND SEQUENCE, AND TO ENSURE THE SAFETY OF THE EXISTING STRUCTURES AND ITS COMPONENT PARTS DURING CONSTRUCTION. THIS INCLUDES THE ADDITION OF WHATEVER SHORING, BRACING, UNDERPINNING, ETC. THAT MAY BE NECESSARY. MAINTAIN EXISTING SITE OPERATIONS, COORDINATE WORK WITH TOWER OWNER.

6. DRAWINGS INDICATE THE MINIMUM STANDARDS, BUT IF ANY WORK SHOULD BE INDICATED TO BE SUBSTANDARD TO ANY ORDINANCES, LAWS, CODES, RULES, OR REGULATIONS BEARING ON THE WORK, THE CONTRACTOR SHALL INCLUDE IN HIS SCOPE OF WORK AND SHALL EXECUTE THE WORK CORRECTLY IN ACCORDANCE WITH SUCH ORDINANCES, LAWS, CODES, RULES OR REGULATIONS WITH NO INCREASE IN COSTS.

7. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS, ELEVATIONS, ANGLES, AND EXISTING CONDITIONS AT THE SITE, PRIOR TO FABRICATION AND/OR INSTALLATION OF ANY WORK IN THE CONTRACT AREA.

8. ALL DAMAGE CAUSED TO ANY EXISTING STRUCTURE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR WILL BE HELD LIABLE FOR ALL REPAIRS REQUIRED FOR EXISTING STRUCTURES IF DAMAGED DURING CONSTRUCTION ACTIVITIES.

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

10. CONTRACTOR SHALL TAKE FIELD MEASUREMENTS NECESSARY TO ASSURE PROPER FIT OF ALL FINISHED WORK.

11. TOWER REINFORCING SHALL BE CONDUCTED BY FIELD CREWS EXPERIENCED IN THE ASSEMBLY AND ERECTION OF RADIO ANTENNAS AND SUPPORT STRUCTURES. ALL SAFETY PROCEDURES, RIGGING AND ERECTION METHODS SHALL BE STANDARD TO THE INDUSTRY AND IN COMPLIANCE WITH OSHA.

12. EXISTING COAXIAL CABLES AND ALL ACCESSORIES SHALL BE RELOCATED AS NECESSARY AND REINSTALLED BY THE CONTRACTOR WITHOUT INTERRUPTION IN SERVICE WHERE THEY ARE IN CONFLICT WITH TOWER REINFORCEMENT.

13. IF ANY FIELD CONDITIONS EXIST WHICH PRECLUDE COMPLIANCE WITH THE DRAWINGS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER AND SHALL PROCEED WITH AFFECTED WORK AFTER CONFLICT IS SATISFACTORILY RESOLVED.

REV	DATE	BRIEF DESCRIPTION
0	4/6/15	ISSUED FOR CONSTRUCTION

PROFESSIONAL ENGINEER SEAL

CENTEK engineering
Centered on Solutions℠
www.CentekEng.com
[203] 488-0580
[203] 488-8587 Fax
63-2 North Branford Road, Branford, CT 06405

VERIZON WIRELESS

PLAINVILLE 3

DATE: 4/6/15
SCALE: AS SHOWN
JOB NO. 15001.021

DESIGN BASIS & GENERAL NOTES

SHEET NO.
N-1
Sheet No. 2 of 2

STRUCTURAL STEEL

1. ALL STRUCTURAL STEEL IS DESIGNED BY ALLOWABLE STRESS DESIGN (ASD).

2. MATERIAL SPECIFICATIONS

   A. STRUCTURAL STEEL (W SHAPES)---ASTM A992 (FY = 50 KSI)
   B. STRUCTURAL STEEL (OTHER SHAPES)---ASTM A36 (FY = 36 KSI).
   C. STRUCTURAL STEEL (TOWER REINF. PLATES---ASTM A572_GR50 (50 KSI)
   D. STRUCTURAL HSS (RECTANGULAR SHAPES)---ASTM A500 GRADE B, (FY = 46 KSI)
   E. STRUCTURAL HSS (ROUND SHAPES)---ASTM A500 GRADE B, (FY = 42 KSI)
   F. PIPE---ASTM A53 GRADE B (FY = 35 KSI)

3. FASTENER SPECIFICATIONS

   A. CONNECTION BOLTS---ASTM A325-N, UNLESS OTHERWISE SCHEDULED.
   B. U-BOLTS---ASTM A307
   C. ANCHOR RODS---ASTM F1554
   D. WELDING ELECTRODES---ASTM E70XX FOR A36 & A572_GR50 STEELS, ASTM E80XX FOR A572_GR65 STEEL.
   E. BLIND BOLTS---AS1252 PROPERTY CLASS 8.8 (FU=120 KSI).

4. CONTRACTOR TO REVIEW ALL SHOP DRAWINGS AND SUBMIT COPY TO ENGINEER FOR APPROVAL. DRAWINGS MUST BEAR THE CHECKER'S INITIALS BEFORE SUBMITTING TO THE ENGINEER FOR REVIEW. SHOP DRAWINGS SHALL INCLUDE THE FOLLOWING: SECTION PROFILES, SIZES, CONNECTION ATTACHMENTS, REINFORCING, ANCHORAGE, SIZE AND TYPE OF FASTENERS AND ACCESSORIES. INCLUDE ERECTION DRAWINGS, ELEVATIONS AND DETAILS.

5. STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE LATEST PROVISIONS OF AISC MANUAL OF STEEL CONSTRUCTION.

6. PROVIDE ALL PLATES, CLIP ANGLES, CLOSURE PIECES, STRAP ANCHORS, MISCELLANEOUS PIECES AND HOLES REQUIRED TO COMPLETE THE STRUCTURE.

7. FIT AND SHOP ASSEMBLE FABRICATIONS IN THE LARGEST PRACTICAL SECTIONS FOR DELIVERY TO SITE.

8. INSTALL FABRICATIONS PLUMB AND LEVEL, ACCURATELY FITTED, AND FREE FROM DISTORTIONS OR DEFECTS.

9. AFTER ERECTION OF STRUCTURES, TOUCHUP ALL WELDS, ABRASIONS AND NON-GALVANIZED SURFACES WITH A 95% ORGANIC ZINC RICH PAINT IN ACCORDANCE WITH ASTM 780.

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

11. ALL BOLTS, ANCHORS AND MISCELLANEOUS HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153 "ZINC COATING (HOT-DIP) ON IRON AND STEEL HARDWARE".

12. CONTRACTOR SHALL COMPLY WITH AWS CODE FOR PROCEDURES APPEARANCE AND QUALITY OF WELDS, AND WELDING PROCESSES SHALL BE QUALIFIED IN ACCORDANCE WITH AWS "STANDARD QUALIFICATION PROCEDURES". ALL WELDING SHALL BE DONE USING THE SCHEDULED ELECTRODES AND WELDING SHALL CONFORM TO AISC AND D1.1 WHERE FILLET WELD SIZES ARE NOT SHOWN, PROVIDE THE MINIMUM SIZE PER TABLET J2.4 IN THE AISC "MANUAL OF STEEL CONSTRUCTION" 9TH EDITION. AT THE COMPLETION OF WELDING, ALL DAMAGE TO GALVANIZED COATING SHALL BE REPAIRED.

13. THE ENGINEER SHALL BE NOTIFIED OF ANY INCORRECTLY FABRICATED, DAMAGED OR OTHERWISE MISFITTING OR NON CONFORMING MATERIALS OR CONDITIONS TO REMEDIAL OR CORRECTIVE ACTION. ANY SUCH ACTION SHALL REQUIRE ENGINEER REVIEW.

14. CONNECTION ANGLES SHALL HAVE A MINIMUM THICKNESS OF 1/4 INCHES.

15. STRUCTURAL CONNECTION BOLTS SHALL CONFORM TO ASTM A325. ALL BOLTS SHALL BE 3/4" DIAMETER MINIMUM AND SHALL HAVE A MINIMUM OF TWO BOLTS, UNLESS OTHERWISE ON THE DRAWINGS.

16. LOCK WASHER ARE NOT PERMITTED FOR A325 BOLTED STEEL ASSEMBLIES.

17. SHOP CONNECTIONS SHALL BE WELDED OR HIGH STRENGTH BOLTED.

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

19. FABRICATE BEAMS WITH MILL CAMBER UP.

20. LEVEL AND PLUMB INDIVIDUAL MEMBERS OF THE STRUCTURE TO AN ACCURACY OF 1:500, BUT NOT TO EXCEED 1/4" IN THE FULL HEIGHT OF THE COLUMN.

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

REV	DATE	DRAWN BY	CHK'D BY	DESCRIPTION
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VERIZON WIRELESS

PLAINVILLE 3

DATE: 4/6/15
SCALE: AS SHOWN
JOB NO. 15001.021

STRUCTURAL STEEL NOTES

SHEET NO.
N-2

MODIFICATION INSPECTION REPORT REQUIREMENTS

PRE-CONSTUCTION		DURING CONSTRUCTION		POST-CONSTRUCTION	
SCHEDULED ITEM	REPORT ITEM	SCHEDULED ITEM	REPORT ITEM	SCHEDULED ITEM	REPORT ITEM
X	EOR MODIFICATION INSPECTION DRAWING	–	FOUNDATIONS	X	MODIFICATION INSPECTOR RECORD REDLINE DRAWING
X	EOR APPROVED SHOP DRAWINGS	–	EARTHWORK: BACKFILL MATERIAL & COMPACTION	–	POST–INSTALLED ANCHOR ROD PULL–OUT TEST
–	EOR APPROVED POST–INSTALLED ANCHOR MPII	–	CONCRETE TESTING	X	PHOTOGRAPHS
–	FABRICATION INSPECTION	X	STEEL INSPECTION		
–	FABRICATOR CERTIFIED WELDER INSPECTION	–	POST INSTALLED ANCHOR ROD VERIFICATION		
X	MATERIAL CERTIFICATIONS	–	BASE PLATE GROUT VERIFICATION		
		X	CONTRACTOR'S CERTIFIED WELD INSPECTION		
		X	ON–SITE COLD GALVANIZING VERIFICATION		
		–	GUY WIRE TENSION REPORT		
		X	CONTRACTOR AS–BUILT REDLINE DRAWINGS		

NOTES:
1. REFER TO MODIFICATION INSPECTION NOTES FOR ADDITIONAL REQUIREMENTS
2. "X" DENOTES DOCUMENT REQUIRED FOR INCLUSION IN MODIFICATION INSPECTION FINAL REPORT.
3. "–" DENOTES DOCUMENT NOT REQUIRED FOR INCLUSION IN MODIFICATION INSPECTION FINAL REPORT.
4. EOR – ENGINEER OF RECORD
4. MPII – "MANUFACTURER'S PRINTED INSTALLATION GUIDELINES"

GENERAL

1. THE MODIFICATION INSPECTION IS A VISUAL INSPECTION OF STRUCTURAL MODIFICATIONS, TO INCLUDE A REVIEW AND COMPILATION OF SPECIFIED SUBMITTALS AND CONSTRUCTION INSPECTIONS, AS AN ASSURANCE OF COMPLIANCE WITH THE CONSTRUCTION DOCUMENTS PREPARED UNDER THE DIRECTION OF THE ENGINEER OF RECORD (EOR).
2. THE MODIFICATION INSPECTION IS TO CONFIRM INSTALLATION CONFIGURATION AND GENERAL WORKMANSHIP AND IS NOT A REVIEW OF THE MODIFICATION DESIGN. OWNERSHIP OF THE MODIFICATION DESIGN EFFECTIVENESS AND INTENT RESIDES WITH THE ENGINEER OF RECORD.
3. TO ENSURE COMPLIANCE WITH THE MODIFICATION INSPECTION REQUIREMENTS THE GENERAL CONTRACTOR (GC) AND THE MODIFICATION INSPECTOR (MI) COMMENCE COMMUNICATION UPON AUTHORIZATION TO PROCEED BY THE CLIENT. EACH PARTY SHALL BE PROACTIVE IN CONTACTING THE OTHER. THE EOR SHALL BE CONTACTED IF SPECIFIC GC/MI CONTACT INFORMATION IS NOT MADE AVAILABLE.
4. THE GC SHALL PROVIDE THE MI WITH A MINIMUM OF 5 BUSINESS DAYS NOTICE OF IMPENDING INSPECTIONS.
5. WHEN POSSIBLE, THE GC AND MI SHALL BE ON SITE DURING THE MODIFICATION INSPECTION TO HAVE ANY NOTED DEFICIENCIES ADDRESSED DURING THE INITIAL MODIFICATION INSPECTION.

MODIFICATION INSPECTOR (MI)

1. THE MI SHALL CONTACT THE GC UPON AUTHORIZATION BY THE CLIENT TO:

   – REVIEW THE MODIFICATION INSPECTION REPORT REQUIREMENTS.
   – WORK WITH THE GC IN DEVELOPMENT OF A SCHEDULE FOR ON–SITE INSPECTIONS.
   – DISCUSS CRITICAL INSPECTIONS AND PROJECT CONCERNS.
2. THE MI IS RESPONSIBLE FOR COLLECTION OF ALL INSPECTION AND TEST REPORTS, REVIEWING REPORTS FOR ADHERENCE TO THE CONTRACT DOCUMENTS, CONDUCTING ON–SITE INSPECTIONS AND COMPILATION & SUBMISSION OF THE MODIFICATION INSPECTION REPORT TO THE CLIENT AND THE EOR.

GENERAL CONTRACTOR (GC)

1. THE GC IS REQUIRED TO CONTACT THE GC UPON AUTHORIZATION TO PROCEED WITH CONSTRUCTION BY THE CLIENT TO:

   – REVIEW THE MODIFICATION INSPECTION REPORT REQUIREMENTS.
   – WORK WITH THE MI IN DEVELOPMENT OF A SCHEDULE FOR ON–SITE INSPECTIONS.
   – DISCUSS CRITICAL INSPECTIONS AND PROJECT CONCERNS.
2. THE GC IS RESPONSIBLE FOR COORDINATING AND SCHEDULING IN ADVANCE ALL REQUIRED INSPECTIONS AND TESTS WITH THE MI.

CORRECTION OF FAILING MODIFICATION INSPECTION

1. SHOULD THE STRUCTURAL MODIFICATION NOT COMPLY WITH THE REQUIREMENTS OF THE CONSTRUCTION DOCUMENTS, THE GC SHALL WORK WITH THE MODIFICATION INSPECTOR IN A VIABLE REMEDIATION PLAN AS FOLLOWS:

   – CORRECT ALL DEFICIENCIES TO COMPLY WITH THE CONTRACT DOCUMENTS AND COORDINATE WITH THE MI FOR A FOLLOW UP INSPECTION.
   – WITH CLIENT AUTHORIZATION, THE GC MAY WORK WITH THE EOR TO REANALYZE THE MODIFICATION USING THE AS–BUILT CONDITION.

REQUIRED PHOTOGRAPHS

1. THE GC AND MI SHALL AT MINIMUM PHOTO DOCUMENT THE FOLLOWING FOR INCLUSION IN THE MODIFICATION INSPECTION REPORT:

   – PRE–CONSTRUCTION: GENERAL CONDITION OF THE SITE.
   – DURING CONSTRUCTION: RAW MATERIALS, CRITICAL DETAILS, WELD PREPARATION, BOLT INSTALLATION & TORQUE, FINAL INSTALLED CONDITION & SURFACE COATING REPAIRS.
   – POST–CONSTRUCTION: FINAL CONDITION OF THE SITE

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DATE: 4/6/15
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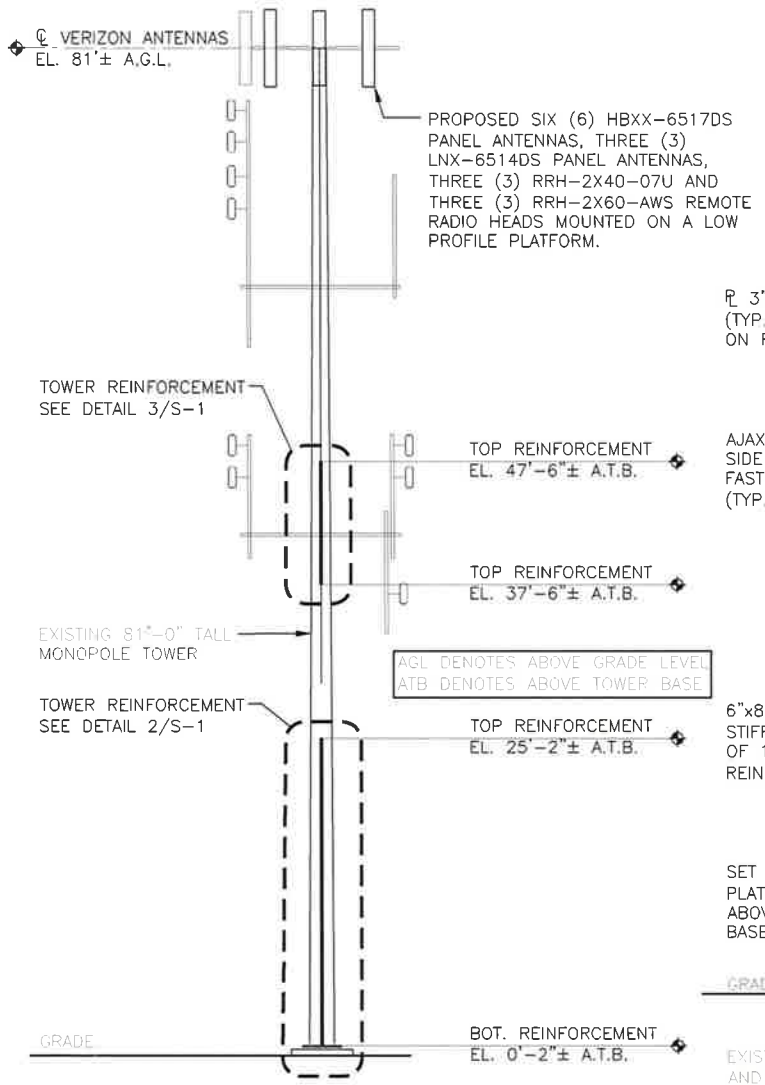
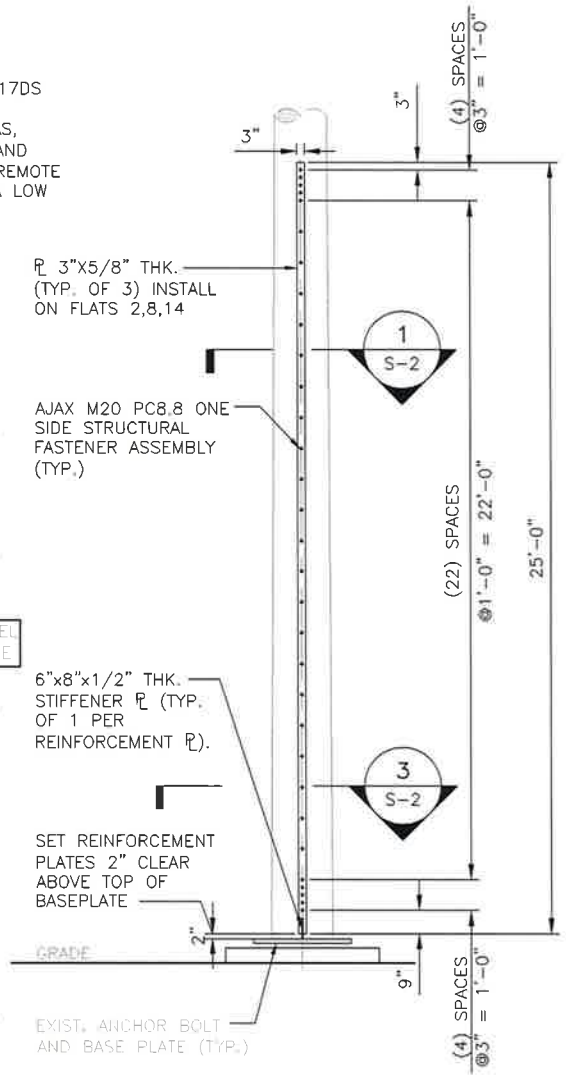
MODIFICATION INSPECTION REQUIREMENTS

SHEET NO.
MI-1



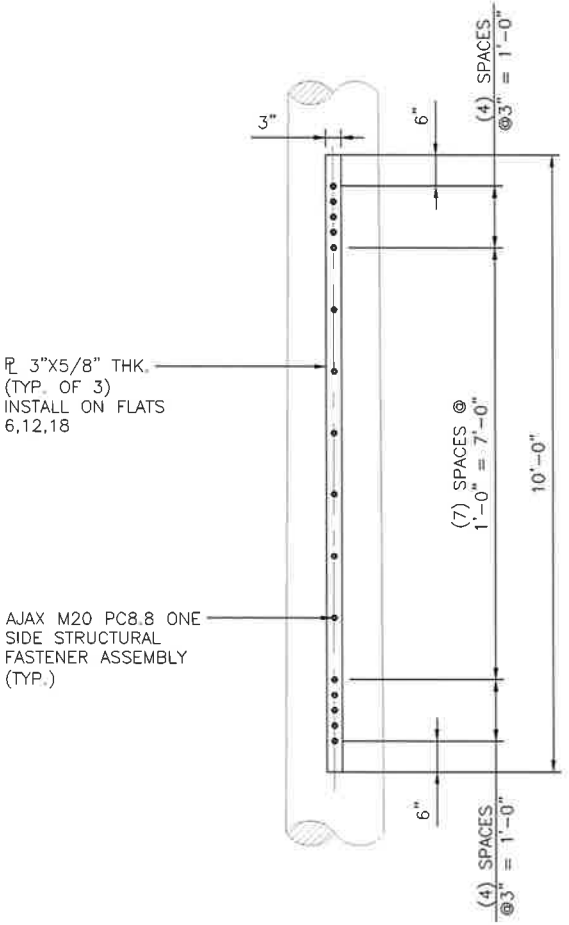
1/S-1 TOWER ELEVATION - PROPOSED

SCALE: NOT TO SCALE



2/S-1 REINFORCEMENT ELEVATION

SCALE: 1/4" = 1'-0"



3/S-1 REINFORCEMENT ELEVATION

SCALE: 1/2" = 1'-0"

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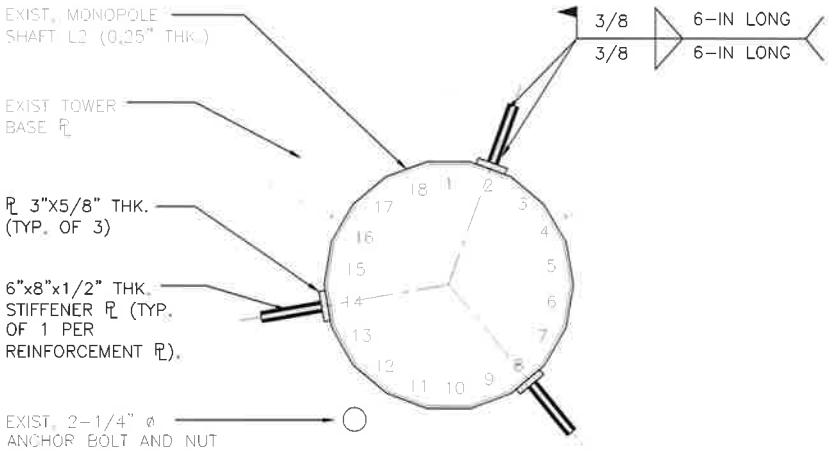
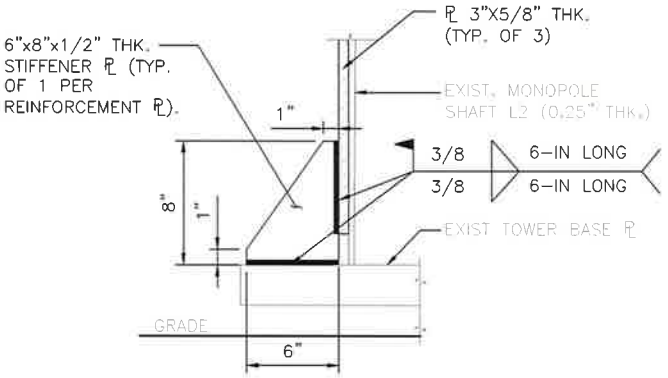
TOWER REINFORCEMENT ELEVATIONS

SHEET NO. S-1
Sheet No. 5 of 6



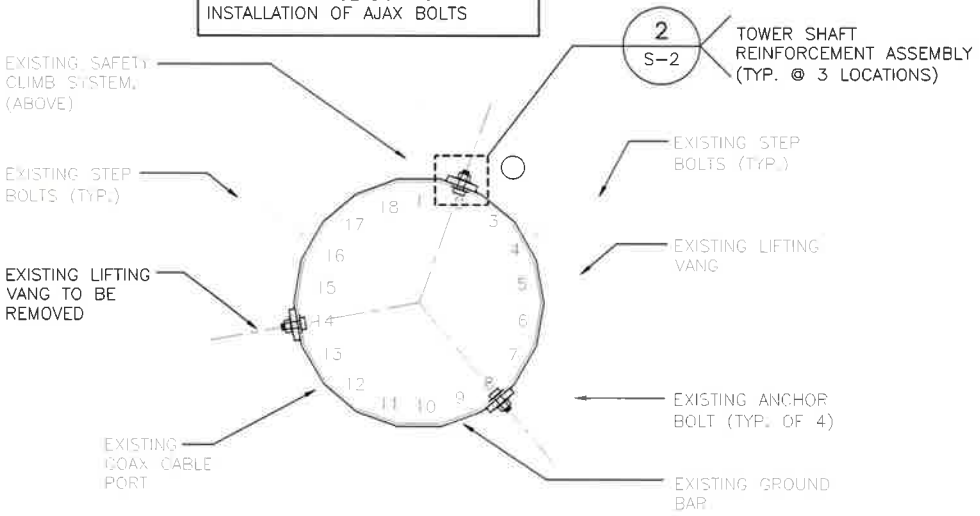
3 S-2 **STIFFENER PLAN**
SCALE: 1" = 1'-0"



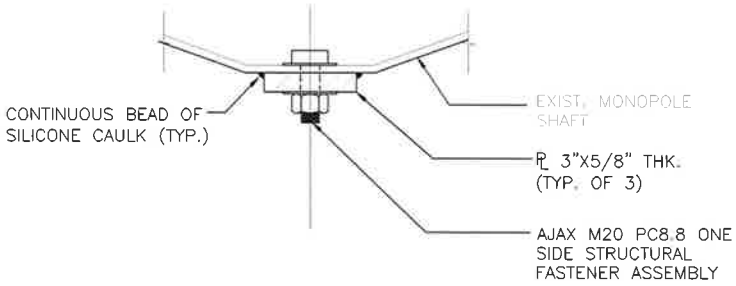
4 S-2 **STIFFENER DETAIL**
SCALE: 1-1/2" = 1'-0"

PRECAUTIONARY NOTE

CONTRACTOR TO V.I.F. PLACEMENT OF COAX CABLES WITHIN MONOPOLE SHAFT AND TAKE MEASURES TO PREVENT DAMAGE DURING INSTALLATION OF AJAX BOLTS



1 S-2 **REINFORCEMENT PLAN**
SCALE: 1" = 1'-0"



2 S-2 **REINFORCEMENT DETAIL**
SCALE: 3" = 1'-0"

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PLAINVILLE 3

DATE:	4/6/15
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TOWER REINFORCEMENT DETAILS

SHEET NO. S-2

SITE NAME	PLAINVILLE 3 CT	ECP & CELL #	8	0060
700 tilt change, RRH, plus RET antenna swap outs and 40W to 60W RRH upgrade on AWS.		LATITUDE	41-40-18.73 N	
		LONGITUDE	72-52-01.74 W	
		STRUCTURE TYPE	LATTICE	

700 LTE - CURRENT CONFIG	ALPHA	BETA	GAMMA
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	APX75-866514T0	APX75-866514T0	APX75-866514T0
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	280
DOWN TILT (ELECT)	0	2 mech	0
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL			
700 Mhz - LTE Future Config	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	700 eNodeB	700 eNodeB	700 eNodeB
ANTENNA TYPE	LNX-6514DS-A1M	LNX-6514DS-A1M	LNX-6514DS-A1M
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	280
DOWN TILT (ELECT)	4	3	6
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 x ALU RH_2X40-700U	1 x ALU RH_2X40-700U	1 x ALU RH_2X40-700U
850 CELLULAR - CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	BXA-70063-4CF	BXA-70063-4CF	BXA-70063-4CF
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	20	150	250
DOWN TILT (MECH/DEG)	2	2	6
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
850 CELLULAR - FUTURE CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	Cellular Mod 4.0B	Cellular Mod 4.0B	Cellular Mod 4.0B
ANTENNA TYPE	BXA-70063-4CF	BXA-70063-4CF	BXA-70063-4CF
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	20	150	250
DOWN TILT (MECH/DEG)	2	2	6
RAD CTR (FT AGL)	82	82	82
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
DIPLEX WITH LTE CABLE			
1900 PCS - CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 4.0B
ANTENNA TYPE	BXA-171063-8BF_2	BXA-171063-8BF_2	BXA-171063-8BF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	250
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
1900 PCS - FUTURE CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	PCS Mod 4.0B	PCS Mod 4.0B	PCS Mod 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	250
DOWN TILT (ELECT)	2	2	4
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEX WITH CELLULAR CABLE			
RRH - QTY/MODEL			
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX			
AWS - LTE CURRENT CONFIG	**ALPHA**	**BETA**	**GAMMA**
EQUIPMENT TYPE	2100 MHz BBU	2100 MHz BBU	2100 MHz BBU
ANTENNA TYPE	BXA-171063-12CF_2	BXA-171063-12CF_2	BXA-171063-12CF_2
QTY OF ANTENNAS PER FACE	1	1	1
ORIENTATION (DEG)	30	150	250
DOWN TILT (MECH/DEG)	0	0	0
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 x ALU RH_2X40-AWS	1 x ALU RH_2X40-AWS	1 x ALU RH_2X40-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1 x DB-T1-6Z-8AB-0Z		
AWS - LTE Future CONFIG	**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	250
DOWN TILT (ELECT)	2	2	4
RAD CTR (FT AGL)	80.6	80.6	80.6
TMA - QTY / MODEL			
DIPLEXER - QTY / MODEL			
RRH - QTY/MODEL	1 x ALU RH_2X60-AWS	1 x ALU RH_2X60-AWS	1 x ALU RH_2X60-AWS
SECTOR DISTRIBUTION BOX			
MAIN DISTRIBUTION BOX	1 x DB-T1-6Z-8AB-0Z		

NUMBER OF CABLES NEEDED					FIBER LINES MODEL NUMBER				
TOTAL # FIBER LINES	1	TOTAL # OF MAINLINES	12		FIBER LINE MODEL #			HB158-1-08U8-S8J18	
TOTAL # TOP JUMPERS	6	TOTAL # OF TOP JUMPERS	24		FIBER TOP JUMPER MODEL #			HB114-1-08U4-S4J18	
EQUIPMENT CABLE ORDERING		MAIN CABLE #	12		+		TOP JUMPER #	12 + 0	

TX / RX FREQUENCIES			TX POWER OUTPUT	
Cellular-A Band	PCS-F/AWS Band	700 MHz C-Block	Cellular (Watts)	20
TX: 869-880/890-891.5 MHz	TX: 1970-1975/2145-2155 MHz	TX: 746-757 MHz	PCS (Watts)	16
RX: 824-835/845-846.5 MHz	RX: 1890-1895/1745-1755 MHz	RX: 776-787 MHz	LTE/AWS (Watts)	40

ALPHA				BETA				GAMMA			
Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code	Ant.	Freq.	Func.	Color Code
A1-A	800	Tx1/Rx0	RED	A5-A	800	Tx2/Rx0	BLUE	A9-A	800	Tx3/Rx0	GREEN
A1-B	1900	Tx1/Rx0	RED/WHITE	A5-B	1900	Tx2/Rx0	BLUE/ WHITE	A9-B	1900	Tx3/Rx0	GREEN/WHITE
A2	700	Tx1/Rx0	RED/ORANGE	A6	700	Tx2/Rx0	BLUE/ ORANGE	A10	700	Tx3/Rx0	GREEN/ORANGE
A3	700	Tx4/Rx1	RED/RED/ORANGE	A7	700	Tx5/Rx1	BLUE/BLUE/ORANGE	A11	700	Tx6/Rx1	GREEN/GREEN/ORANGE
A4-B	1900	Tx4/Rx1	RED/RED/WHITE	A8-B	1900	Tx5/Rx1	BLUE/BLUE/WHITE	A12-B	1900	Tx6/Rx1	GREEN/GREEN/WHITE
A4-A	800	Tx4/Rx1	RED/RED	A8-A	800	Tx5/Rx1	BLUE/BLUE	A12-A	800	Tx6/Rx1	GREEN/GREEN
F1-A	1700	Tx/Rx	RED/BROWN	F1-B	1700	Tx/Rx	BLUE/BROWN	F1-C	1700	Tx/Rx	GREEN/BROWN
F1-D	1700	Tx/Rx	RED/RED/BROWN	F1-E	1700	Tx/Rx	BLUE/BLUE/BROWN	F1-F	1700	Tx/Rx	GREEN/GREEN/BROWN

RF ENGINEER	RF MANAGER	INITIALS	DATE
Prepared by: Mark Brauer	Robert Hesselbach	MB	2/5/2015

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.

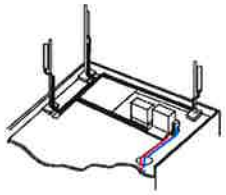
EASY INSTALLATION

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.

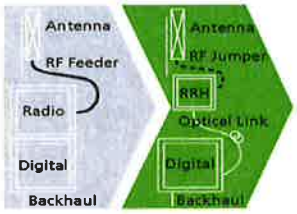
The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment. However, many of these sites can host an Alcatel-Lucent RRH2x60-AWS installation, providing more flexible site selection and improved network quality along with greatly reduced installation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

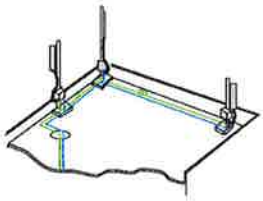
Installation can easily be done by a single person as the Alcatel–Lucent RRH2x60-AWS is compact and weighs about 20 kg, eliminating the need for a crane to hoist the BTS cabinet to the rooftop. A site can be in operation in less than one day.



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™

Alcatel-Lucent RRH2x40-07-U

REMOTE RADIO HEAD

The Alcatel-Lucent RRH2x40-07-U is a high-power, small form-factor Remote Radio Head (RRH) operating in the North American Digital Dividend / 700MHz frequency band (3GPP Band 13). The Alcatel-Lucent RRH2x40-07-U is designed with an eco-efficient approach, providing operators with the means to achieve high quality and capacity coverage with minimum site requirements.

A distributed eNodeB expands 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 an eNodeB to be installed separately, within the same site or several kilometres apart.

The Alcatel-Lucent RRH2x40-07-U 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. The Alcatel-Lucent RRH2x40-07-U has two transmit RF paths, 40 W RF output power per transmit path, and is designed to manage up to two-way receive diversity. The device is ideally suited to support macro coverage, with multiple-input multiple-output (MIMO) 2x2 operation in up to 10 MHz of bandwidth.

The Alcatel-Lucent RRH2x40-07-U is designed to make available all the benefits of a distributed eNodeB, with excellent RF characteristics, with low capital expenditures (CAPEX) and low operating expenditures (OPEX). The limited space available in some sites may prevent the installation of traditional single-cabinet BTS equipment or require costly cranes to be employed, leaving coverage holes. However, many of these sites can host an Alcatel-Lucent RRH2x40-07-U installation, providing more flexible site selection and improved network quality along with greatly reduced installation time and costs.

Fast, low-cost installation and deployment

The Alcatel-Lucent RRH2x40-07-U is a zero-footprint solution and operates noise-free, simplifying negotiations with site property owners and minimizing environmental impacts. Installation can easily be done by a single person because the Alcatel-Lucent RRH2x40-07-U is compact and weights less than 23 kg (50 lb), 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 — a fraction of the time required for a traditional BTS.

Excellent RF performance

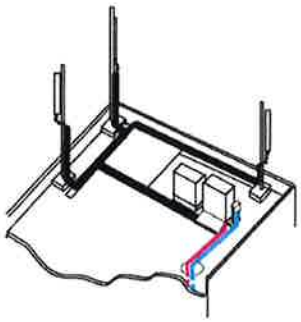
Because of its small size and weight, the Alcatel-Lucent RRH2x40-07-U can be installed close to the antenna. Operators can therefore locate the Alcatel-Lucent RRH2x40-07-U where RF engineering is deemed ideal, minimizing trade-offs between available sites and RF optimum sites. The RF feeder cost and installation costs are reduced or eliminated, and there is no need for a Tower Mounted Amplifier (TMA) because losses introduced by the RF feeder are greatly reduced. The Alcatel-Lucent RRH2x40-07-U provides more RF power while at the same time consuming less electricity.

Features

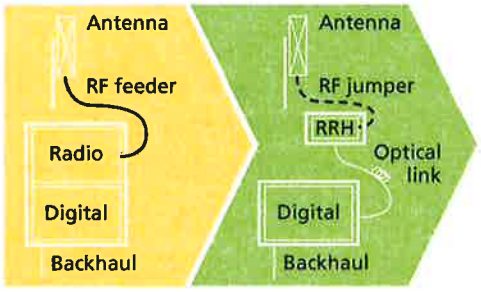
- Zero-footprint deployment
- Easy installation, with a lightweight unit can be carried and set up by one person
- Optimized RF power, with flexible site selection and elimination of a TMA
- Convection-cooled (fanless), noise-free, and heaterless unit
- Best-in-class power efficiency, with significantly reduced energy consumption

Benefits

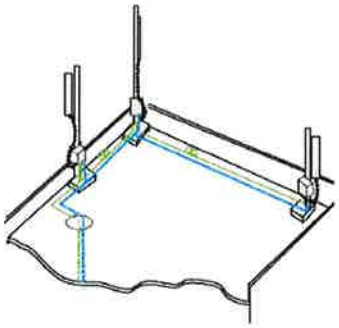
- Leverages existing real estate with lower site costs
- Reduces installation costs, with fewer installation materials and simplified logistics
- Decreases power costs and minimizes environmental impacts, with the potential for eco-sustainable power options
- Improves RF performance and adds flexibility to network planning



Macro



RRH for space-constrained cell sites



Distributed

Technical specifications

Physical dimensions

- Height: 390 mm (15.4 in.)
- Width: 380 mm (15 in.)
- Depth: 210 mm (8.2 in.)
- Weight (without mounting kit): less than 23 kg (50 lb)

Power

- Power supply: -48V

Operating environment

- Outdoor temperature range:
  - ¬ With solar load: -40°C to +50°C (-40°F to +122°F)
  - ¬ Without solar load: -40°C to +55°C (-40°F to +131°F)
- Passive convection cooling (no fans)
- Enclosure protection
  - ¬ IP65 (International Protection rating)

RF characteristics

- Frequency band: 700 MHz; 3GPP Band 13
- Bandwidth: up to 10 MHz
- RF output power at antenna port:
  - ¬ 40 W nominal RF power for each Tx port
- Rx diversity: 2-way or 4-way
- Noise figure: below 2.5 dB typical
- ALD features
  - ¬ TMA
  - ¬ Remote electrical tilt (RET) support (AISG v2.0)

Optical characteristics

Type/number of fibers

- Up to 3.12 Gb/s line bit rate
- Single-mode variant
  - ¬ One SM fiber (9/125 µm) per RRH2x, carrying UL and DL using CWDM (at 1550/1310 nm)
- Multi-mode variant
  - ¬ Two MM fibers (50/125 µm) per RRH2x: one carrying UL, the other carrying DL (at 850 nm)

Optical fiber length

- Up to 500 m (0.31 mi), using MM fiber
- Up to 20 km (12.43 mi), using SM fiber

Alarms and ports

- Six external alarms
- Two optical ports to support daisy-chaining

Alcatel·Lucent