ROBINSON & COLE LLP

KENNETH C. BALDWIN

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EM-VER-055-080131

anuary 31, 2008

Via Hand Delivery

ORIGINAL

S. Derek Phelps
Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Antenna Swap**
113 Brush Hill Road, Goshen, Connecticut

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains a wireless telecommunications facility at the above referenced location. The Council approved Cellco's use of this facility on February 2, 2005. Cellco intends to modify its installation by replacing six (6) LPA-185080/12CF antennas with six (6) LPA-80080/6CF antennas at the same 185-foot height. Attached behind Tab 1 are the specifications for the proposed replacement antennas.

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 Robert P. Valentine, First Selectman of the Town of Goshen. Pursuant to Council directive a copy of this letter is being sent to Woodridge Sewer District, the owner of the property on which the facility is located.

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 any increase in the overall height of the existing structures. Cellco's replacement antennas will be located at the same height and location as the existing antennas.

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

3. The proposed modifications will not increase noise levels at the facility by six decibels or more.

4. The operation of the replacement antennas will not increase radio frequency (RF) power density levels at the facility to a level at or above the Federal Communications Commission (FCC) adopted safety standard. A cumulative power density table for the facility is included behind Tab 2.

Also attached is a Detailed Structural Analysis and Evaluation confirming that the tower can support the proposed modifications. (See Tab 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 P. Valentine, Goshen First Selectman
Woodridge Sewer District
Sandy M. Carter

Vertically Polarized, Log Periodic 80° / 17.5 dBi

LPA-185080/12CF ___

When ordering replace "___" with connector type.

Mechanical specifications

Length	1806 mm	71.1 in
Width	104 mm	4.1 in
Depth	150 mm	5.9 in
Depth with t-bracket	178 mm	7.0 in
[4] Weight	4.8 kg	10.5 lbs
Wind Area		
Fore/Aft	0.19 m^2	2.0 ft^2
Side	0.27 m^2	2.9 ft^2
Rated Wind Velocity (Safety factor 2.0)	>270 km/hr	>168 mph
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	325 N	73.1 lbs
Side	440 N	98.9 lbs

Antenna consisting of aluminum alloy with brass feedlines covered by a UV safe fiberglass radome.

Mounting and Downtilting

Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in).

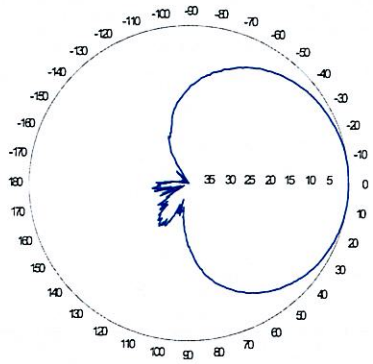
Mounting bracket kit #26799997
Downtilt bracket kit #26799999

The downtil bracket kit includes the mounting bracket kit.

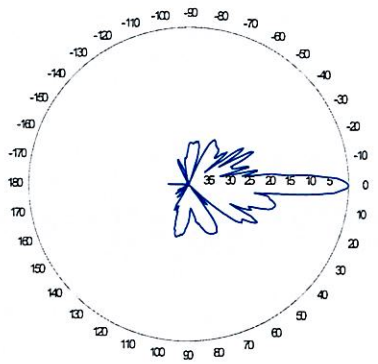
Electrical specifications

	Frequency Range	1850-1990 MHz
	Impedance	50Ω
[3]	Connector(s)	NE or E-DIN 1 port / center
[1]	VSWR	≤ 1.4:1
	Polarization	Vertical
[1]	Gain	17.5 dBi
[2]	Power Rating	250 W
[1]	Half Power Angle	
	H-Plane	80°
	E-Plane	5°
[1]	Electrical Downtilt	0°
[1]	Null Fill	10%
	Lightning Protection	Direct Ground

Radiation pattern[1]



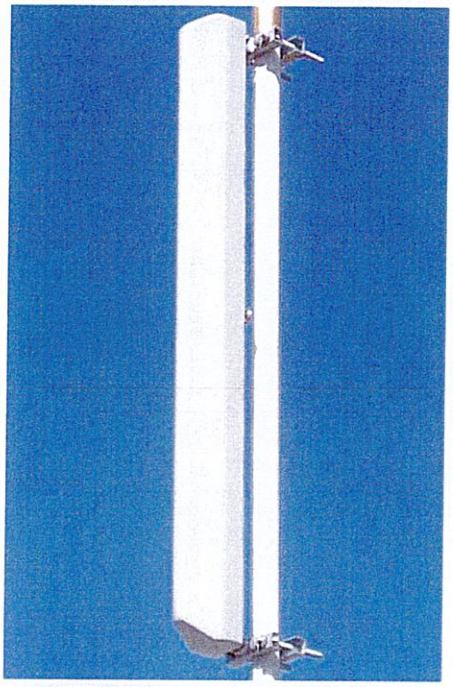
Horizontal



Vertical

Radiation patterns for all antennas are measured with the antenna mounted on a fiberglass pole.

Mounting on a metal pole will typically improve the Front-to-Back ratio.



Amphenol Antel's Exclusive 3T (True Transmission Line Technology) Antenna Design:

- True log-periodic design allows for superior front-to-side characteristics to minimize sector overlap.
- Unique feedline design eliminates the need for conventional solder joints in the signal path.
- A non-collinear system with access to every radiating element for broad band-width and superior performance.
- Air as insulation for virtually no internal signal loss.

This Amphenol Antel antenna is under a five-year limited warranty for repair or replacement.

Antenna available with center-fed connector only.

[1] Typical values.
[2] Power rating limited by connector only.
[3] NE indicates an elongated N connector.
E-DIN indicates an elongated DIN connector.
[4] The antenna weight listed above does not include the bracket weight.

Improvements to mechanical and/or electrical performance of the antenna may be made without notice.

CF Denotes a Center-Fed Connector.

1850-1990 MHz

Amphenol Antel, Inc. 1300 Capital Drive Rockford, Illinois 61109 USA Tel. (815) 399-0001
Toll-Free (888) 417-9562 Fax. (815) 399-0156 antel@antelinc.com www.antelinc.com

Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/12/07

Vertically Polarized, Log Periodic 80° / 14 dBd

LPA-80080/6CF ___

When ordering replace "___" with connector type.

Mechanical specifications

Length	1800	mm	70.9	in
Width	140	mm	5.5	in
Depth	335	mm	13.2	in
Depth with z-bracket	375	mm	14.8	in
[4] Weight	9.5	kg	21.0	lbs
Wind Area				
Fore/Aft	0.25	m^2	2.7	ft^2
Side	0.60	m^2	6.5	ft^2
Rated Wind Velocity (Safety factor 2.0)	>295	km/hr	>183	mph
Wind Load @ 100 mph (161 km/hr)				
Fore/Aft	415	N	93.3	lbs
Side	870	N	195.6	lbs

Antenna consisting of aluminum alloy with brass feedlines covered by a UV safe fiberglass radome.

Mounting and Downtilting

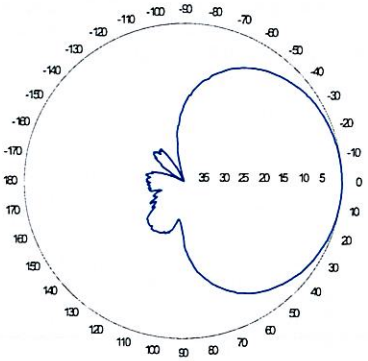
Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in). If the lock-down brace is used, the maximum diameter is Ø88.9 mm (3.5 in)

Mounting Bracket & Downtilt Bracket Kit #21699999

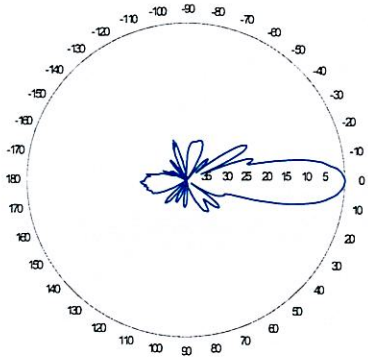
Electrical specifications

	Frequency Range	806-960 MHz
	Impedance	50Ω
[3]	Connector(s)	NE or E-DIN 1 port / center
[1]	VSWR	≤ 1.4:1
	Polarization	Vertical
[1]	Gain	14 dBd
[2]	Power Rating	500 W
[1]	Half Power Angle	
	H-Plane	80°
	E-Plane	10°
[1]	Electrical Downtilt	0°
[1]	Null Fill	10%
	Lightning Protection	Direct Ground

Radiation pattern[1]



Horizontal

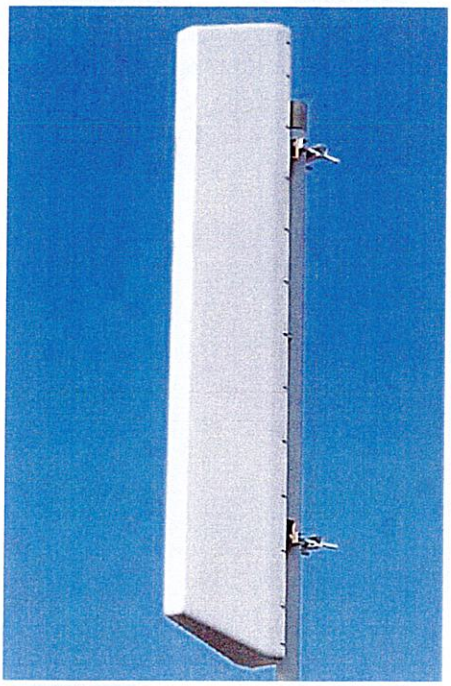


Vertical

Featuring upper side lobe suppression.

Radiation patterns for all antennas are measured with the antenna mounted on a fiberglass pole.

Mounting on a metal pole will typically improve the Front-to-Back ratio.



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Antenna available with center-fed connector only.

1) Typical values.
2) Power rating limited by connector only.
3) NE indicates an elongated N connector. E-DIN indicates an elongated DIN connector.
4) The antenna weight listed above does not include the bracket weight.

Improvements to mechanical and/or electrical performance of the antenna may be made without notice.

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806-960 MHz

Amphenol Antel, Inc. 1300 Capital Drive Rockford, Illinois 61109 USA Tel. (815) 399-0001
Toll-Free (888) 417-9562 Fax. (815) 399-0156 antel@antelinc.com www.antelinc.com

Revision Date: 7/5/07

	General	Power	Density					
Site Name: Goshen South								
Tower Height: Verizon @ 185Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
Sprint	11	213	195	0.0222	1962.5	1.0000	2.22%	
Verizon	**9**	**485**	**185**	**0.0459**	**1970**	**1.0000**	4.59%	
Verizon	**9**	**200**	**185**	**0.0189**	**875**	**0.5830**	3.24%	
								10.05%
* Source: Siting Council								

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 195' MONOPOLE FOR PROPOSED ANTENNA ARRANGEMENT

Site I.D: Goshen South
Address: 113 Brush Hill Road
Goshen, CT

prepared for

verizonwireless

Verizon Wireless
99 East River Drive
East Hartford, Connecticut 06108

prepared by

URS

URS CORPORATION
500 ENTERPRISE DRIVE, SUITE 3B
ROCKY HILL, CT 06067
TEL. 860-529-8882

36931116.00000
VZ4-040

Rev 1 January 25, 2008

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 195' steel tapered monopole structure, located at 113 Brush Hill Road, Goshen, CT. The analysis was conducted in accordance with the 2005 Connecticut State Building Code and the TIA/EIA-222-F standard for a wind velocity of 80 mph (fastest mile) and 69 mph (fastest mile) concurrent with ½" ice. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report. The proposed Verizon Wireless installation is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
On the existing Verizon platform **Remove:** (6) existing PCS antennas (2 per sector, outboard) **Install:** **Alpha Sector** **(2) Antel LPA-80080/6CF antennas** **Beta Sector** **(2) Antel LPA-80080/6CF antennas** **Gamma Sector** **(2) Antel LPA-80080/6CF antennas**	Verizon (existing to be removed) **Verizon (Proposed)**	@ 185' **@ 185'**

The results of the analysis indicate that the tower structure does have the capacity to support the proposed loading conditions. **The tower and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

1. EXECUTIVE SUMMARY - *continued*

This analysis is based on:

1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
2) Tower geometry and structural member sizes utilized in the preparation of this report obtained from manufacturers original design documents prepared by Engineered Endeavors, Incorporated, (EEI); Job No. 12782, signed and sealed July 28, 2004.
3) Site documentation and visual verification of existing appurtenances conducted from the existing grade by URS during December 2007.
4) Antenna and mount configuration as specified within Section 2 and 6 of this report.

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

If you should have any questions, please call.

Sincerely,

URS Corporation

Richard A. Sambor, P.E.
Manager Facilities Design

RAS/jrm
cc: AA, DR, ICA – URS, CF/Book

2. INTRODUCTION

The subject tower is located at 113 Brush Hill Road, Goshen, CT. The structure is an existing 195' steel tapered monopole structure, designed and manufactured by Engineered Endeavors, Incorporated, (EEI).

The inventory is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
7' Lightning Rod	N/A	5' Pipe Mount Extension	202.5'	N/A
(12) Dapa 48000 panel antennas **see note below**	Sprint/Nextel (existing)	Low Profile Platform	195'	(12) 1-5/8" coax cables (within monopole)
(6) Antel LPA-185080/12CF panel antennas	Verizon (existing)	Low profile Platform (existing to remain)	185'	(12) 1-5/8" coax cables (within monopole)
(6) Antel LPA-80080/6CF panel antennas	**Verizon (proposed)**	Low profile Platform (same as above)	**185'**	(re-use existing listed above)
(1) GPS antenna	Sprint/Nextel (existing)	GPS mount	50'	(1) 7/8" coax cable (within monopole)

Notes:

Sprint/Nextel inventory based on original design documents.

This structural analysis of the communications tower was performed by URS Corporation (URS) for Verizon Wireless. The purpose of this analysis was to investigate the structural integrity of the existing tower with its existing and proposed antenna loads. This analysis was conducted to evaluate stress on the tower and the effect of forces to the foundation of the tower resulting from existing and proposed antenna arrangement.

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

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

The analysis was conducted using RISA Tower 5.0.2. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 80 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 69 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

Please note that wind pressure is a function of velocity squared. Under Load Condition 2, a 25 percent reduction in wind pressure is allowed by code to account for the unlikelihood of the full wind pressure and ice load occurring at the same time. The same results may be achieved by utilizing a lower wind pressure without taking the 25 percent reduction, as shown above.

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

4. FINDINGS AND EVALUATION

Combined axial and bending stresses on the monopole structure were evaluated to compare with allowable stresses in accordance with AISC. The calculated stresses under the proposed loading were below the allowable stresses (see table below). Detailed analysis and calculations for the proposed load condition are provided in section 6 of this report. Additionally, the anchor bolts, base plate and foundation were found to be within the allowable limits.

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

Proposed Tower Base Reactions vs. Original Design Reactions

Base Reactions	Original Design Reactions[1]	Proposed Reactions
Axial Load (kips)	51.1	47
Shear (kips)	33.6	24
O.T. Moment (ft-kips)	4719	3227

Notes:

1) Original Design reactions based on TIA-EIA 222F with 85mph Basic Wind Speed (fastest mile).

Tower Component Stress vs. Capacity Summary

Component (Section No.)	Controlling Component / Elevation	Stress Ratio (% capacity)	Pass/Fail	Notes:
Pole Shaft (L3)	48.2'-95.7	62.1%	Pass	
Anchor Bolts	Compression	51%	Pass	
Base Plate	Bending	63%	Pass	

Foundation Summary

Foundation	Component	Stress (% capacity/FOS)	Pass/Fail	Comments:
Reinf. Concrete Pad and Pier	OTM	58.7%/3.41	Pass	Min. F.O.S of 2.0 req'd per IBC 2003 Section 3108.4.2

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

Limitations/Assumptions:

This report is based on the following:

1. Tower inventory as listed in this report.
2. Tower is properly installed and maintained.
3. All members are as specified in the original design documents and are in good condition.
4. All required members are in place.
5. All bolts are in place and are properly tightened.
6. Tower is in plumb condition.
7. All member protective coatings are in good condition.
8. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
9. Foundations were properly constructed to support original design loads as specified in the original design documents.
10. All coaxial cable is installed within the monopole unless specified otherwise.

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

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

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

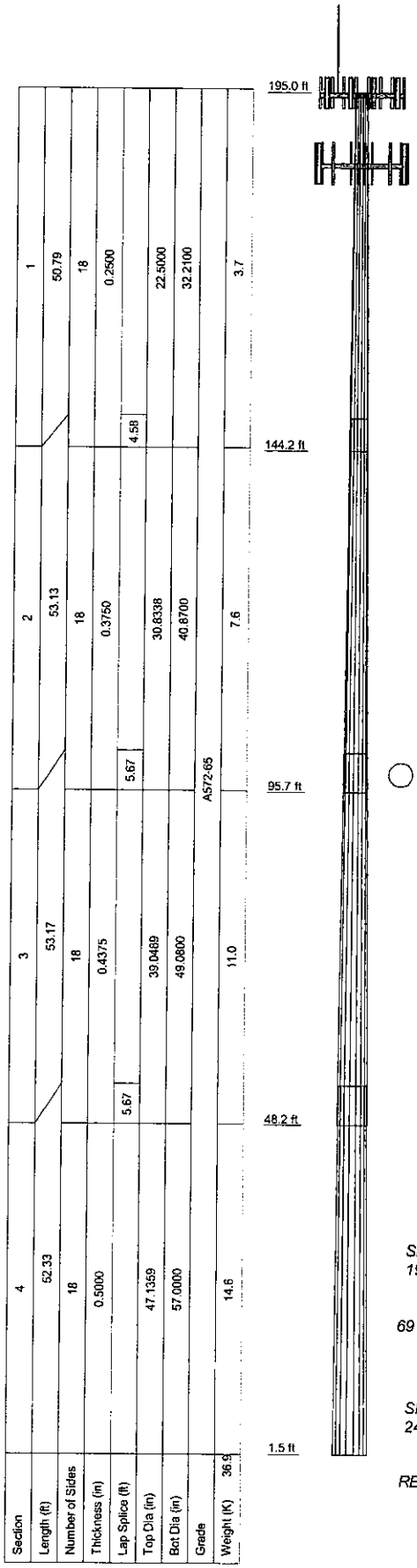
Ongoing and Periodic Inspection and Maintenance:

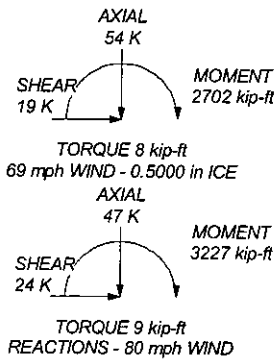
After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

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

6. DRAWINGS AND DATA

RISA TOWER INPUT/OUTPUT SUMMARY





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 1"x7' (None)	202.5	LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185
5'0"x3" Pipe Mount (None)	197.5	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
(4) 48000 w/Mount Pipe (Sprint/Nextel)	195	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
(4) 48000 w/Mount Pipe (Sprint/Nextel)	195	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
(4) 48000 w/Mount Pipe (Sprint/Nextel)	195	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
EEI Channel (Old) Low Profile Platform (Sprint/Nextel)	195	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185	LPA-185080/12CF w/ Mount Pipe (Verizon - existing)	185
LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185	EEI Tube (New) Low Profile Platform (Verizon)	185
LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185	GPS Antenna (Sprint/Nextel)	50
LPA-80080/6CF w/ Mount Pipe (Verizon - proposed)	185	Generic Stand-Off Mount (Sprint/Nextel)	50

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. Connections use galvanized A325 bolts, nuts and locking devices.
6. Installation per TIA/EIA-222-F and AISC Specifications.
7. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
8. Top of foundation taken as 1.5 ft above finished grade.
9. TOWER RATING: 62.1%

URS Corporation
500 Enterprise Drive, Suite 3B
Rocky Hill, CT 06067
Phone: (860) 529-8882
FAX: (860) 529-3991

Job:	***195' EEI Monopole - REV 1***		
Project:	***113 Brush Hill Road, Goshen, CT***		
Client: Verizon Wireless - Goshen South	Drawn by: Staff	App'd:	
Code: TIA/EIA-222-F	Date: 01/25/08	Scale: NTS	
Path: P:\08\Rev_1\ERI Files\195' EEI Monopole_Goshen_CT.eri		Dwg No. E-1	

RISA TOWER DETAILED OUTPUT

Tower Input Data

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

Tower is located in Litchfield County, Connecticut.
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.
Connections use galvanized A325 bolts, nuts and locking devices..
Installation per TIA/EIA-222-F and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Top of foundation taken as 1.5 ft above finished grade..
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	195.00-144.21	50.79	4.58	18	22.5000	32.2100	0.2500	1.0000	A572-65 (65 ksi)
L2	144.21-95.66	53.13	5.67	18	30.8338	40.8700	0.3750	1.5000	A572-65 (65 ksi)
L3	95.66-48.16	53.17	5.67	18	39.0489	49.0800	0.4375	1.7500	A572-65

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L4	48.16-1.50	52.33		18	47.1359	57.0000	0.5000	2.0000	(65 ksi) A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in²	I in⁴	r in	C in	I/C in³	J in⁴	It/Q in²	w in	w/t
L1	22.8471	17.6554	1104.2678	7.8987	11.4300	96.6114	2209.9887	8.8294	3.5200	14.08
	32.7069	25.3603	3272.6887	11.3458	16.3627	200.0093	6549.6836	12.6825	5.2290	20.916
L2	32.1886	36.2536	4249.2773	10.8129	15.6636	271.2839	8504.1460	18.1303	4.7668	12.711
	41.5005	48.1992	9985.7307	14.3757	20.7620	480.9628	19984.6009	24.1042	6.5331	17.422
L3	40.7375	53.6168	10098.8199	13.7071	19.8369	509.0936	20210.9282	26.8135	6.1026	13.949
	49.8371	67.5462	20191.5702	17.2681	24.9326	809.8449	40409.7089	33.7795	7.8681	17.984
L4	48.9477	74.0111	20336.4179	16.5557	23.9450	849.2964	40699.5950	37.0126	7.4159	14.832
	57.8793	89.6655	36162.6061	20.0575	28.9560	1248.8813	72372.7958	44.8413	9.1520	18.304

Tower Elevation ft	Gusset Area (per face) ft²	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 195.00-144.21				1	1	1		
L2 144.21-95.66				1	1	1		
L3 95.66-48.16				1	1	1		
L4 48.16-1.50				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 ft²/ft	Weight plf
1 5/8 (Sprint/Nextel)	C	No	Inside Pole	195.00 - 6.50	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (Verizon)	C	No	Inside Pole	185.00 - 6.50	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
7/8 (Sprint/Nextel)	C	No	Inside Pole	50.00 - 6.50	1	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	195.00-144.21	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	1.14

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L2	144.21-95.66	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	1.21
L3	95.66-48.16	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	1.19
L4	48.16-1.50	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	1.06

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	195.00-144.21	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	1.14
L2	144.21-95.66	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	1.21
L3	95.66-48.16	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	1.19
L4	48.16-1.50	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	1.06

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
Lightning Rod 1"x7'	A	From Face	3.00	0.0000	202.50	No Ice	0.70	0.70	0.02
(None)			0.00			1/2" Ice	1.42	1.42	0.03
			0.00						
5'0"x3" Pipe Mount	A	From Face	3.00	0.0000	197.50	No Ice	1.36	1.36	0.03
(None)			0.00			1/2" Ice	1.67	1.67	0.04
			0.00						
(4) 48000 w/Mount Pipe	A	From Face	3.00	0.0000	195.00	No Ice	5.12	3.49	0.04
(Sprint/Nextel)			0.00			1/2" Ice	5.79	4.54	0.08
			0.00						
(4) 48000 w/Mount Pipe	B	From Face	3.00	0.0000	195.00	No Ice	5.12	3.49	0.04
(Sprint/Nextel)			0.00			1/2" Ice	5.79	4.54	0.08
			0.00						
(4) 48000 w/Mount Pipe	C	From Face	3.00	0.0000	195.00	No Ice	5.12	3.49	0.04
(Sprint/Nextel)			0.00			1/2" Ice	5.79	4.54	0.08
			0.00						
EEI Channel (Old) Low	A	From Face	3.00	0.0000	195.00	No Ice	22.50	22.50	1.50
Profile Platform			0.00			1/2" Ice	28.40	28.40	2.25

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Sprint/Nextel)			0.00						
LPA-80080/6CF w/ Mount Pipe	A	From Face	3.00 6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-80080/6CF w/ Mount Pipe	A	From Face	3.00 -6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-80080/6CF w/ Mount Pipe	B	From Face	3.00 6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-80080/6CF w/ Mount Pipe	B	From Face	3.00 -6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-80080/6CF w/ Mount Pipe	C	From Face	3.00 6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-80080/6CF w/ Mount Pipe	C	From Face	3.00 -6.00	0.0000	185.00	No Ice 1/2" Ice	4.35 4.79	10.51 11.56	0.04 0.10
(Verizon - proposed)			0.00						
LPA-185080/12CF w/ Mount Pipe	A	From Face	3.00 4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
LPA-185080/12CF w/ Mount Pipe	A	From Face	3.00 -4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
LPA-185080/12CF w/ Mount Pipe	B	From Face	3.00 4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
LPA-185080/12CF w/ Mount Pipe	B	From Face	3.00 -4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
LPA-185080/12CF w/ Mount Pipe	C	From Face	3.00 4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
LPA-185080/12CF w/ Mount Pipe	C	From Face	3.00 -4.00	0.0000	185.00	No Ice 1/2" Ice	3.55 3.99	5.99 6.94	0.03 0.07
(Verizon - existing)			0.00						
EEI Tube (New) Low Profile Platform	A	From Face	3.00 0.00	0.0000	185.00	No Ice 1/2" Ice	15.00 18.00	15.00 18.00	2.60 3.50
(Verizon)			0.00						
GPS Antenna (Sprint/Nextel)	A	From Face	2.00 0.00	0.0000	50.00	No Ice 1/2" Ice	4.00 4.31	4.00 4.31	0.09 0.14
			0.00						
Generic Stand-Off Mount (Sprint/Nextel)	A	From Face	2.00 0.00	0.0000	50.00	No Ice 1/2" Ice	1.00 1.40	1.00 1.40	0.04 0.08
			0.00						

Tower Pressures - No Ice

$G_H = 1.690$

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 195.00-144.21	168.37	1.593	26	115.780	A	0.000	115.780	115.780	100.00	0.000	0.000
					B	0.000	115.780		100.00		
					C	0.000	115.780		100.00		
L2 144.21-95.66	119.27	1.444	24	146.793	A	0.000	146.793	146.793	100.00	0.000	0.000
					B	0.000	146.793		100.00		
					C	0.000	146.793		100.00		
L3 95.66-48.16	71.68	1.248	20	176.539	A	0.000	176.539	176.539	100.00	0.000	0.000
					B	0.000	176.539		100.00		
					C	0.000	176.539		100.00		
L4 48.16-1.50	24.34	1	17	204.547	A	0.000	204.547	204.547	100.00	0.000	0.000
					B	0.000	204.547		100.00		
					C	0.000	204.547		100.00		

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 195.00-144.21	168.37	1.593	20	0.5000	120.013	A	0.000	120.013	120.013	100.00	0.000	0.000
						B	0.000	120.013		100.00		
						C	0.000	120.013		100.00		
L2 144.21-95.66	119.27	1.444	18	0.5000	150.839	A	0.000	150.839	150.839	100.00	0.000	0.000
						B	0.000	150.839		100.00		
						C	0.000	150.839		100.00		
L3 95.66-48.16	71.68	1.248	15	0.5000	180.497	A	0.000	180.497	180.497	100.00	0.000	0.000
						B	0.000	180.497		100.00		
						C	0.000	180.497		100.00		
L4 48.16-1.50	24.34	1	12	0.5000	208.436	A	0.000	208.436	208.436	100.00	0.000	0.000
						B	0.000	208.436		100.00		
						C	0.000	208.436		100.00		

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 195.00-144.21	168.37	1.593	10	115.780	A	0.000	115.780	115.780	100.00	0.000	0.000
					B	0.000	115.780		100.00		
					C	0.000	115.780		100.00		
L2 144.21-95.66	119.27	1.444	9	146.793	A	0.000	146.793	146.793	100.00	0.000	0.000
					B	0.000	146.793		100.00		
					C	0.000	146.793		100.00		
L3 95.66-48.16	71.68	1.248	8	176.539	A	0.000	176.539	176.539	100.00	0.000	0.000
					B	0.000	176.539		100.00		
					C	0.000	176.539		100.00		
L4 48.16-1.50	24.34	1	6	204.547	A	0.000	204.547	204.547	100.00	0.000	0.000

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
					B	0.000	204.547		100.00		
					C	0.000	204.547		100.00		

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 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	3.32	65.29	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	3.81	78.41	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	3.95	83.06	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	3.73	79.95	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	1363.75 kip-ft	14.80		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	3.32	65.29	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	3.81	78.41	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	3.95	83.06	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	3.73	79.95	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	1363.75 kip-ft	14.80		

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 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	3.32	65.29	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	3.81	78.41	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	3.95	83.06	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	3.73	79.95	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	1363.75 kip-ft	14.80		

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 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	3.32	65.29	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	3.81	78.41	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	3.95	83.06	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	3.73	79.95	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	1363.75 kip-ft	14.80		

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 ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	4.59	A	1	0.65	1	1	1	120.013	2.58	50.76	C
			B	1	0.65	1	1	1	120.013			
			C	1	0.65	1	1	1	120.013			
L2 144.21-95.66	1.21	8.74	A	1	0.65	1	1	1	150.839	2.93	60.43	C
			B	1	0.65	1	1	1	150.839			
			C	1	0.65	1	1	1	150.839			
L3 95.66-48.16	1.19	12.28	A	1	0.65	1	1	1	180.497	3.03	63.69	C
			B	1	0.65	1	1	1	180.497			
			C	1	0.65	1	1	1	180.497			

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
L4 48.16-1.50	1.06	16.10	A	1	0.65	1	1	1	208.436	2.85	61.10	C
			B	1	0.65	1	1	1	208.436			
			C	1	0.65	1	1	1	208.436			
Sum Weight:	4.60	41.71						OTM	1053.12 kip-ft	11.39		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	4.59	A	1	0.65	1	1	1	120.013	2.58	50.76	C
			B	1	0.65	1	1	1	120.013			
			C	1	0.65	1	1	1	120.013			
L2 144.21-95.66	1.21	8.74	A	1	0.65	1	1	1	150.839	2.93	60.43	C
			B	1	0.65	1	1	1	150.839			
			C	1	0.65	1	1	1	150.839			
L3 95.66-48.16	1.19	12.28	A	1	0.65	1	1	1	180.497	3.03	63.69	C
			B	1	0.65	1	1	1	180.497			
			C	1	0.65	1	1	1	180.497			
L4 48.16-1.50	1.06	16.10	A	1	0.65	1	1	1	208.436	2.85	61.10	C
			B	1	0.65	1	1	1	208.436			
			C	1	0.65	1	1	1	208.436			
Sum Weight:	4.60	41.71						OTM	1053.12 kip-ft	11.39		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	4.59	A	1	0.65	1	1	1	120.013	2.58	50.76	C
			B	1	0.65	1	1	1	120.013			
			C	1	0.65	1	1	1	120.013			
L2 144.21-95.66	1.21	8.74	A	1	0.65	1	1	1	150.839	2.93	60.43	C
			B	1	0.65	1	1	1	150.839			
			C	1	0.65	1	1	1	150.839			
L3 95.66-48.16	1.19	12.28	A	1	0.65	1	1	1	180.497	3.03	63.69	C
			B	1	0.65	1	1	1	180.497			
			C	1	0.65	1	1	1	180.497			
L4 48.16-1.50	1.06	16.10	A	1	0.65	1	1	1	208.436	2.85	61.10	C
			B	1	0.65	1	1	1	208.436			
			C	1	0.65	1	1	1	208.436			
Sum Weight:	4.60	41.71						OTM	1053.12 kip-ft	11.39		

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 195.00-144.21	1.14	4.59	A	1	0.65	1	1	1	120.013	2.58	50.76	C
			B	1	0.65	1	1	1	120.013			
			C	1	0.65	1	1	1	120.013			
L2 144.21-95.66	1.21	8.74	A	1	0.65	1	1	1	150.839	2.93	60.43	C
			B	1	0.65	1	1	1	150.839			
			C	1	0.65	1	1	1	150.839			
L3 95.66-48.16	1.19	12.28	A	1	0.65	1	1	1	180.497	3.03	63.69	C
			B	1	0.65	1	1	1	180.497			
			C	1	0.65	1	1	1	180.497			
L4 48.16-1.50	1.06	16.10	A	1	0.65	1	1	1	208.436	2.85	61.10	C
			B	1	0.65	1	1	1	208.436			
			C	1	0.65	1	1	1	208.436			
Sum Weight:	4.60	41.71						OTM	1053.12 kip-ft	11.39		

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 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	1.30	25.50	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	1.49	30.63	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	1.54	32.45	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	1.46	31.23	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	532.72 kip-ft	5.78		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	1.30	25.50	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	1.49	30.63	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			

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
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	1.54	32.45	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	1.46	31.23	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	532.72 kip-ft	5.78		

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 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	1.30	25.50	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	1.49	30.63	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	1.54	32.45	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	1.46	31.23	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	532.72 kip-ft	5.78		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 195.00-144.21	1.14	3.72	A	1	0.65	1	1	1	115.780	1.30	25.50	C
			B	1	0.65	1	1	1	115.780			
			C	1	0.65	1	1	1	115.780			
L2 144.21-95.66	1.21	7.63	A	1	0.65	1	1	1	146.793	1.49	30.63	C
			B	1	0.65	1	1	1	146.793			
			C	1	0.65	1	1	1	146.793			
L3 95.66-48.16	1.19	10.96	A	1	0.65	1	1	1	176.539	1.54	32.45	C
			B	1	0.65	1	1	1	176.539			
			C	1	0.65	1	1	1	176.539			
L4 48.16-1.50	1.06	14.57	A	1	0.65	1	1	1	204.547	1.46	31.23	C
			B	1	0.65	1	1	1	204.547			
			C	1	0.65	1	1	1	204.547			
Sum Weight:	4.60	36.88						OTM	532.72 kip-ft	5.78		

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	36.88					
Bracing Weight	0.00					
Total Member Self-Weight	36.88			-8.54	14.78	
Total Weight	46.67			-8.54	14.78	
Wind 0 deg - No Ice		0.00	-24.08	-3093.61	14.78	-6.76
Wind 30 deg - No Ice		12.04	-20.85	-2680.29	-1527.75	-7.81
Wind 45 deg - No Ice		17.02	-17.02	-2190.01	-2166.69	-7.54
Wind 60 deg - No Ice		20.85	-12.04	-1551.07	-2656.97	-6.76
Wind 90 deg - No Ice		24.08	0.00	-8.54	-3070.29	-3.90
Wind 120 deg - No Ice		20.85	12.04	1534.00	-2656.97	0.00
Wind 135 deg - No Ice		17.02	17.02	2172.94	-2166.69	2.02
Wind 150 deg - No Ice		12.04	20.85	2663.22	-1527.75	3.90
Wind 180 deg - No Ice		0.00	24.08	3076.54	14.78	6.76
Wind 210 deg - No Ice		-12.04	20.85	2663.22	1557.32	7.81
Wind 225 deg - No Ice		-17.02	17.02	2172.94	2196.26	7.54
Wind 240 deg - No Ice		-20.85	12.04	1534.00	2686.54	6.76
Wind 270 deg - No Ice		-24.08	0.00	-8.54	3099.86	3.90
Wind 300 deg - No Ice		-20.85	-12.04	-1551.07	2686.54	0.00
Wind 315 deg - No Ice		-17.02	-17.02	-2190.01	2196.26	-2.02
Wind 330 deg - No Ice		-12.04	-20.85	-2680.29	1557.32	-3.90
Member Ice	4.83					
Total Weight Ice	54.40			-12.04	20.86	
Wind 0 deg - Ice		0.00	-19.39	-2550.48	20.86	-6.30
Wind 30 deg - Ice		9.69	-16.79	-2210.39	-1248.36	-7.27
Wind 45 deg - Ice		13.71	-13.71	-1806.99	-1774.09	-7.03
Wind 60 deg - Ice		16.79	-9.69	-1281.26	-2177.49	-6.30
Wind 90 deg - Ice		19.39	0.00	-12.04	-2517.58	-3.64
Wind 120 deg - Ice		16.79	9.69	1257.18	-2177.49	0.00
Wind 135 deg - Ice		13.71	13.71	1782.90	-1774.09	1.88
Wind 150 deg - Ice		9.69	16.79	2186.31	-1248.36	3.64
Wind 180 deg - Ice		0.00	19.39	2526.39	20.86	6.30
Wind 210 deg - Ice		-9.69	16.79	2186.31	1290.07	7.27
Wind 225 deg - Ice		-13.71	13.71	1782.90	1815.80	7.03
Wind 240 deg - Ice		-16.79	9.69	1257.18	2219.21	6.30
Wind 270 deg - Ice		-19.39	0.00	-12.04	2559.29	3.64
Wind 300 deg - Ice		-16.79	-9.69	-1281.26	2219.21	0.00
Wind 315 deg - Ice		-13.71	-13.71	-1806.99	1815.80	-1.88
Wind 330 deg - Ice		-9.69	-16.79	-2210.39	1290.07	-3.64
Total Weight	46.67			-8.54	14.78	
Wind 0 deg - Service		0.00	-9.40	-1213.64	14.78	-2.64
Wind 30 deg - Service		4.70	-8.14	-1052.19	-587.77	-3.05
Wind 45 deg - Service		6.65	-6.65	-860.67	-837.35	-2.95
Wind 60 deg - Service		8.14	-4.70	-611.09	-1028.87	-2.64
Wind 90 deg - Service		9.40	0.00	-8.54	-1190.32	-1.53
Wind 120 deg - Service		8.14	4.70	594.02	-1028.87	0.00
Wind 135 deg - Service		6.65	6.65	843.60	-837.35	0.79
Wind 150 deg - Service		4.70	8.14	1035.12	-587.77	1.53
Wind 180 deg - Service		0.00	9.40	1196.57	14.78	2.64
Wind 210 deg - Service		-4.70	8.14	1035.12	617.34	3.05
Wind 225 deg - Service		-6.65	6.65	843.60	866.92	2.95
Wind 240 deg - Service		-8.14	4.70	594.02	1058.44	2.64
Wind 270 deg - Service		-9.40	0.00	-8.54	1219.89	1.53
Wind 300 deg - Service		-8.14	-4.70	-611.09	1058.44	0.00
Wind 315 deg - Service		-6.65	-6.65	-860.67	866.92	-0.79

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 330 deg - Service		-4.70	-8.14	-1052.19	617.34	-1.53

Load Combinations

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

Comb. No.	Description
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	195 - 144.21	Pole	Max Tension	18	0.00	-0.00	-0.00
			Max. Compression	18	-13.02	21.01	12.13
			Max. Mx	14	-8.45	474.94	8.35
			Max. My	2	-8.46	14.47	468.73
			Max. Vy	14	-12.79	474.94	8.35
			Max. Vx	2	-12.79	14.47	468.73
			Max. Torque	11			-8.13
L2	144.21 - 95.663	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-22.35	21.75	12.56
			Max. Mx	14	-16.90	1172.57	8.68
			Max. My	2	-16.90	15.03	1166.21
			Max. Vy	14	-16.62	1172.57	8.68
			Max. Vx	2	-16.62	15.03	1166.21
			Max. Torque	11			-8.12
L3	95.663 - 48.163	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-35.42	22.25	12.85
			Max. Mx	14	-28.99	2054.20	8.88
			Max. My	2	-28.99	15.38	2047.72
			Max. Vy	14	-20.41	2054.20	8.88
			Max. Vx	2	-20.41	15.38	2047.72
			Max. Torque	11			-8.09
L4	48.163 - 1.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-54.40	23.20	13.39
			Max. Mx	14	-46.66	3224.99	9.21
			Max. My	2	-46.66	15.95	3218.27
			Max. Vy	14	-24.10	3224.99	9.21
			Max. Vx	2	-24.10	15.95	3218.27
			Max. Torque	11			-8.71

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	54.40	19.39	0.00
	Max. H_x	14	46.67	24.08	0.00
	Max. H_z	2	46.67	0.00	24.08
	Max. M_x	2	3218.27	0.00	24.08
	Max. M_z	6	3193.17	-24.08	0.00
	Max. Torsion	3	8.70	-12.04	20.85
	Min. Vert	1	46.67	0.00	0.00
	Min. H_x	6	46.67	-24.08	0.00
	Min. H_z	10	46.67	0.00	-24.08
	Min. M_x	10	-3199.90	0.00	-24.08
	Min. M_z	14	-3224.99	24.08	0.00
	Min. Torsion	11	-8.70	12.04	-20.85

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K

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	46.67	-0.00	-0.00	-9.23	15.99	0.00
Dead+Wind 0 deg - No Ice	46.67	-0.00	-24.08	-3218.27	15.95	-7.53
Dead+Wind 30 deg - No Ice	46.67	12.04	-20.85	-2788.36	-1588.59	-8.70
Dead+Wind 45 deg - No Ice	46.67	17.02	-17.02	-2278.38	-2253.22	-8.41
Dead+Wind 60 deg - No Ice	46.67	20.85	-12.04	-1613.76	-2763.22	-7.54
Dead+Wind 90 deg - No Ice	46.67	24.08	-0.00	-9.21	-3193.17	-4.35
Dead+Wind 120 deg - No Ice	46.67	20.85	12.04	1595.36	-2763.24	0.00
Dead+Wind 135 deg - No Ice	46.67	17.02	17.02	2259.99	-2253.25	2.25
Dead+Wind 150 deg - No Ice	46.67	12.04	20.85	2769.97	-1588.61	4.35
Dead+Wind 180 deg - No Ice	46.67	-0.00	24.08	3199.90	15.95	7.54
Dead+Wind 210 deg - No Ice	46.67	-12.04	20.85	2769.94	1620.49	8.70
Dead+Wind 225 deg - No Ice	46.67	-17.02	17.02	2259.95	2285.11	8.40
Dead+Wind 240 deg - No Ice	46.67	-20.85	12.04	1595.32	2795.08	7.53
Dead+Wind 270 deg - No Ice	46.67	-24.08	-0.00	-9.21	3224.99	4.35
Dead+Wind 300 deg - No Ice	46.67	-20.85	-12.04	-1613.73	2795.06	0.00
Dead+Wind 315 deg - No Ice	46.67	-17.02	-17.02	-2278.34	2285.08	-2.25
Dead+Wind 330 deg - No Ice	46.67	-12.04	-20.85	-2788.32	1620.47	-4.35
Dead+Ice+Temp	54.40	-0.00	-0.00	-13.39	23.20	0.00
Dead+Wind 0 deg+Ice+Temp	54.40	-0.00	-19.39	-2688.75	23.15	-7.29
Dead+Wind 30 deg+Ice+Temp	54.40	9.69	-16.79	-2330.34	-1314.55	-8.42
Dead+Wind 45 deg+Ice+Temp	54.40	13.71	-13.71	-1905.17	-1868.66	-8.13
Dead+Wind 60 deg+Ice+Temp	54.40	16.79	-9.69	-1351.08	-2293.84	-7.29
Dead+Wind 90 deg+Ice+Temp	54.40	19.39	-0.00	-13.37	-2652.29	-4.21
Dead+Wind 120 deg+Ice+Temp	54.40	16.79	9.69	1324.36	-2293.85	0.00
Dead+Wind 135 deg+Ice+Temp	54.40	13.71	13.71	1878.46	-1868.67	2.18
Dead+Wind 150 deg+Ice+Temp	54.40	9.69	16.79	2303.63	-1314.57	4.21
Dead+Wind 180 deg+Ice+Temp	54.40	-0.00	19.39	2662.06	23.15	7.29
Dead+Wind 210 deg+Ice+Temp	54.40	-9.69	16.79	2303.61	1360.85	8.42
Dead+Wind 225 deg+Ice+Temp	54.40	-13.71	13.71	1878.43	1914.94	8.13
Dead+Wind 240 deg+Ice+Temp	54.40	-16.79	9.69	1324.33	2340.10	7.29
Dead+Wind 270 deg+Ice+Temp	54.40	-19.39	-0.00	-13.36	2698.51	4.21
Dead+Wind 300 deg+Ice+Temp	54.40	-16.79	-9.69	-1351.04	2340.08	0.00
Dead+Wind 315 deg+Ice+Temp	54.40	-13.71	-13.71	-1905.13	1914.91	-2.18
Dead+Wind 330 deg+Ice+Temp	54.40	-9.69	-16.79	-2330.30	1360.83	-4.21
Dead+Wind 0 deg - Service	46.67	-0.00	-9.40	-1264.10	16.03	-2.97
Dead+Wind 30 deg - Service	46.67	4.70	-8.14	-1095.98	-611.40	-3.43
Dead+Wind 45 deg - Service	46.67	6.65	-6.65	-896.57	-871.29	-3.31
Dead+Wind 60 deg - Service	46.67	8.14	-4.70	-636.68	-1070.71	-2.97
Dead+Wind 90 deg - Service	46.67	9.40	-0.00	-9.25	-1238.83	-1.71
Dead+Wind 120 deg - Service	46.67	8.14	4.70	618.17	-1070.71	0.00
Dead+Wind 135 deg - Service	46.67	6.65	6.65	878.07	-871.29	0.89
Dead+Wind 150 deg - Service	46.67	4.70	8.14	1077.48	-611.40	1.71
Dead+Wind 180 deg - Service	46.67	-0.00	9.40	1245.60	16.03	2.97
Dead+Wind 210 deg - Service	46.67	-4.70	8.14	1077.48	643.45	3.43
Dead+Wind 225 deg - Service	46.67	-6.65	6.65	878.06	903.34	3.31
Dead+Wind 240 deg - Service	46.67	-8.14	4.70	618.17	1102.75	2.97
Dead+Wind 270 deg - Service	46.67	-9.40	-0.00	-9.25	1270.87	1.71
Dead+Wind 300 deg - Service	46.67	-8.14	-4.70	-636.68	1102.76	0.00
Dead+Wind 315 deg - Service	46.67	-6.65	-6.65	-896.56	903.34	-0.89
Dead+Wind 330 deg - Service	46.67	-4.70	-8.14	-1095.98	643.45	-1.71

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	-46.67	0.00	0.00	46.67	0.00	0.000%
2	0.00	-46.67	-24.08	0.00	46.67	24.08	0.000%
3	12.04	-46.67	-20.85	-12.04	46.67	20.85	0.000%
4	17.02	-46.67	-17.02	-17.02	46.67	17.02	0.000%
5	20.85	-46.67	-12.04	-20.85	46.67	12.04	0.000%
6	24.08	-46.67	0.00	-24.08	46.67	0.00	0.000%
7	20.85	-46.67	12.04	-20.85	46.67	-12.04	0.000%
8	17.02	-46.67	17.02	-17.02	46.67	-17.02	0.000%
9	12.04	-46.67	20.85	-12.04	46.67	-20.85	0.000%
10	0.00	-46.67	24.08	0.00	46.67	-24.08	0.000%
11	-12.04	-46.67	20.85	12.04	46.67	-20.85	0.000%
12	-17.02	-46.67	17.02	17.02	46.67	-17.02	0.000%
13	-20.85	-46.67	12.04	20.85	46.67	-12.04	0.000%
14	-24.08	-46.67	0.00	24.08	46.67	0.00	0.000%
15	-20.85	-46.67	-12.04	20.85	46.67	12.04	0.000%
16	-17.02	-46.67	-17.02	17.02	46.67	17.02	0.000%
17	-12.04	-46.67	-20.85	12.04	46.67	20.85	0.000%
18	0.00	-54.40	0.00	0.00	54.40	0.00	0.000%
19	0.00	-54.40	-19.39	0.00	54.40	19.39	0.000%
20	9.69	-54.40	-16.79	-9.69	54.40	16.79	0.000%
21	13.71	-54.40	-13.71	-13.71	54.40	13.71	0.000%
22	16.79	-54.40	-9.69	-16.79	54.40	9.69	0.000%
23	19.39	-54.40	0.00	-19.39	54.40	0.00	0.000%
24	16.79	-54.40	9.69	-16.79	54.40	-9.69	0.000%
25	13.71	-54.40	13.71	-13.71	54.40	-13.71	0.000%
26	9.69	-54.40	16.79	-9.69	54.40	-16.79	0.000%
27	0.00	-54.40	19.39	0.00	54.40	-19.39	0.000%
28	-9.69	-54.40	16.79	9.69	54.40	-16.79	0.000%
29	-13.71	-54.40	13.71	13.71	54.40	-13.71	0.000%
30	-16.79	-54.40	9.69	16.79	54.40	-9.69	0.000%
31	-19.39	-54.40	0.00	19.39	54.40	0.00	0.000%
32	-16.79	-54.40	-9.69	16.79	54.40	9.69	0.000%
33	-13.71	-54.40	-13.71	13.71	54.40	13.71	0.000%
34	-9.69	-54.40	-16.79	9.69	54.40	16.79	0.000%
35	0.00	-46.67	-9.40	0.00	46.67	9.40	0.000%
36	4.70	-46.67	-8.14	-4.70	46.67	8.14	0.000%
37	6.65	-46.67	-6.65	-6.65	46.67	6.65	0.000%
38	8.14	-46.67	-4.70	-8.14	46.67	4.70	0.000%
39	9.40	-46.67	0.00	-9.40	46.67	0.00	0.000%
40	8.14	-46.67	4.70	-8.14	46.67	-4.70	0.000%
41	6.65	-46.67	6.65	-6.65	46.67	-6.65	0.000%
42	4.70	-46.67	8.14	-4.70	46.67	-8.14	0.000%
43	0.00	-46.67	9.40	0.00	46.67	-9.40	0.000%
44	-4.70	-46.67	8.14	4.70	46.67	-8.14	0.000%
45	-6.65	-46.67	6.65	6.65	46.67	-6.65	0.000%
46	-8.14	-46.67	4.70	8.14	46.67	-4.70	0.000%
47	-9.40	-46.67	0.00	9.40	46.67	0.00	0.000%
48	-8.14	-46.67	-4.70	8.14	46.67	4.70	0.000%
49	-6.65	-46.67	-6.65	6.65	46.67	6.65	0.000%
50	-4.70	-46.67	-8.14	4.70	46.67	8.14	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00001685
2	Yes	5	0.00000001	0.00018472
3	Yes	5	0.00000001	0.00054108
4	Yes	5	0.00000001	0.00071934
5	Yes	5	0.00000001	0.00072300
6	Yes	5	0.00000001	0.00010527
7	Yes	5	0.00000001	0.00060315
8	Yes	5	0.00000001	0.00067954
9	Yes	5	0.00000001	0.00055784
10	Yes	5	0.00000001	0.00018289
11	Yes	5	0.00000001	0.00075343
12	Yes	5	0.00000001	0.00073123
13	Yes	5	0.00000001	0.00055877
14	Yes	5	0.00000001	0.00010710
15	Yes	5	0.00000001	0.00064631
16	Yes	5	0.00000001	0.00072440
17	Yes	5	0.00000001	0.00070412
18	Yes	4	0.00000001	0.00013504
19	Yes	5	0.00000001	0.00048717
20	Yes	6	0.00000001	0.00006577
21	Yes	6	0.00000001	0.00008457
22	Yes	6	0.00000001	0.00008316
23	Yes	5	0.00000001	0.00037597
24	Yes	6	0.00000001	0.00006977
25	Yes	6	0.00000001	0.00007898
26	Yes	6	0.00000001	0.00006566
27	Yes	5	0.00000001	0.00047668
28	Yes	6	0.00000001	0.00008730
29	Yes	6	0.00000001	0.00008674
30	Yes	6	0.00000001	0.00006807
31	Yes	5	0.00000001	0.00038988
32	Yes	6	0.00000001	0.00007737
33	Yes	6	0.00000001	0.00008714
34	Yes	6	0.00000001	0.00008331
35	Yes	4	0.00000001	0.00077913
36	Yes	4	0.00000001	0.00091356
37	Yes	5	0.00000001	0.00007115
38	Yes	5	0.00000001	0.00007603
39	Yes	4	0.00000001	0.00042965
40	Yes	4	0.00000001	0.00098251
41	Yes	5	0.00000001	0.00005836
42	Yes	4	0.00000001	0.00084819
43	Yes	4	0.00000001	0.00074851
44	Yes	5	0.00000001	0.00008351
45	Yes	5	0.00000001	0.00007449
46	Yes	4	0.00000001	0.00095044
47	Yes	4	0.00000001	0.00046084
48	Yes	5	0.00000001	0.00006177
49	Yes	5	0.00000001	0.00007140
50	Yes	5	0.00000001	0.00007400

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	195 - 144.21	45.904	48	2.3038	0.0379
L2	148.793 - 95.663	25.595	48	1.7543	0.0140
L3	101.333 - 48.163	11.232	48	1.1035	0.0060
L4	53.83 - 1.5	2.989	48	0.5299	0.0023

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
202.50	Lightning Rod 1"x7'	48	45.904	2.3038	0.0379	29435
197.50	5'0"x3" Pipe Mount	48	45.904	2.3038	0.0379	29435
195.00	(4) 48000 w/Mount Pipe	48	45.904	2.3038	0.0379	29435
185.00	LPA-80080/6CF w/ Mount Pipe	48	41.232	2.1886	0.0319	14717
50.00	GPS Antenna	48	2.595	0.5078	0.0021	4426

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	195 - 144.21	114.488	15	5.6352	0.0964
L2	148.793 - 95.663	64.372	15	4.3866	0.0355
L3	101.333 - 48.163	28.359	15	2.7806	0.0151
L4	53.83 - 1.5	7.563	15	1.3399	0.0058

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
202.50	Lightning Rod 1"x7'	15	114.488	5.6352	0.0964	12640
197.50	5'0"x3" Pipe Mount	15	114.488	5.6352	0.0964	12640
195.00	(4) 48000 w/Mount Pipe	15	114.488	5.6352	0.0964	12640
185.00	LPA-80080/6CF w/ Mount Pipe	15	102.989	5.3821	0.0811	6319
50.00	GPS Antenna	15	6.570	1.2549	0.0053	1759

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	195 - 144.21 (1)	TP32.21x22.5x0.25	50.79	0.00	0.0	39.000	24.6650	-8.45	961.94	0.009
L2	144.21 - 95.663 (2)	TP40.87x30.8338x0.375	53.13	0.00	0.0	39.000	46.9244	-16.90	1830.05	0.009
L3	95.663 - 48.163 (3)	TP49.08x39.0489x0.4375	53.17	0.00	0.0	39.000	66.0616	-28.99	2576.40	0.011
L4	48.163 - 1.5 (4)	TP57x47.1359x0.5	52.33	0.00	0.0	39.000	89.6655	-46.66	3496.95	0.013

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	195 - 144.21 (1)	TP32.21x22.5x0.25	477.21	30.275	39.000	0.776	0.00	0.000	39.000	0.000
L2	144.21 - 95.663 (2)	TP40.87x30.8338x0.375	1174.90	30.936	39.000	0.793	0.00	0.000	39.000	0.000
L3	95.663 - 48.163 (3)	TP49.08x39.0489x0.4375	2056.57	31.865	39.000	0.817	0.00	0.000	39.000	0.000
L4	48.163 - 1.5 (4)	TP57x47.1359x0.5	3227.45	31.011	39.000	0.795	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	195 - 144.21 (1)	TP32.21x22.5x0.25	12.79	0.519	26.000	0.040	0.00	0.000	26.000	0.000
L2	144.21 - 95.663 (2)	TP40.87x30.8338x0.375	16.62	0.354	26.000	0.027	0.00	0.000	26.000	0.000
L3	95.663 - 48.163 (3)	TP49.08x39.0489x0.4375	20.41	0.309	26.000	0.024	0.00	0.000	26.000	0.000
L4	48.163 - 1.5 (4)	TP57x47.1359x0.5	24.10	0.269	26.000	0.021	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	195 - 144.21 (1)	0.009	0.776	0.000	0.040	0.000	0.785 ✓	1.333	H1-3+VT ✓
L2	144.21 - 95.663 (2)	0.009	0.793	0.000	0.027	0.000	0.803 ✓	1.333	H1-3+VT ✓
L3	95.663 - 48.163 (3)	0.011	0.817	0.000	0.024	0.000	0.828 ✓	1.333	H1-3+VT ✓
L4	48.163 - 1.5 (4)	0.013	0.795	0.000	0.021	0.000	0.809 ✓	1.333	H1-3+VT ✓

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	SF*P_{allow} K	% Capacity	Pass Fail
L1	195 - 144.21	Pole	TP32.21x22.5x0.25	1	-8.45	1282.26	58.9	Pass
L2	144.21 - 95.663	Pole	TP40.87x30.8338x0.375	2	-16.90	2439.46	60.2	Pass
L3	95.663 - 48.163	Pole	TP49.08x39.0489x0.4375	3	-28.99	3434.34	62.1	Pass
L4	48.163 - 1.5	Pole	TP57x47.1359x0.5	4	-46.66	4661.43	60.7	Pass
							Summary	
						Pole (L3)	62.1	Pass
						RATING =	**62.1**	**Pass**

ANCHOR BOLT AND
BASE PLATE ANALYSIS

ANCHOR BOLT AND BASE PLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 3227 \cdot ft \cdot kips$	*user input*
Shear Force:	$Shear := 24 \cdot kips$	*user input*
Axial Force:	$Axial := 47 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75	*user input*	
Number of Anchor Bolts = N	$N := 24$	*user input*
Diameter of Bolt Circle:	$D_{bc} := 66in$	*user input*
Bolt "Column" Distance:	$L := 3.0in$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot ksi$	*user input*
Bolt Yield Strength:	$Fy := 75 \cdot ksi$	*user input*
Bolt Modulus:	$E := 29000 \cdot ksi$	*user input*
Anchor Bolt Diameter	$D := 2.25in$	*user input*
Threads per Inch:	$n := 4.5$	*user input*

Base Plate Data:

Use ASTM A572 Grade 60		*user input*
Plate Yield Strength:	$Fy_{bp} := 60 \cdot ksi$	*user input*
Base Plate Thickness:	$PlateThickness := 2.25 \cdot in$	*user input*
Base Plate Diameter:	$D_{bp} := 72.0 \cdot in$	*user input*
Outer Pole Diameter:	$D_{pole} := 57.0in$	*user input*

Geometric Layout Data:

Distance from the center of gravity of the group to bolt in question = d(i)

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

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

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

$d_1 = 8.54 \cdot in$ $d_7 = 31.88 \cdot in$

$d_2 = 16.50 \cdot in$ $d_8 = 28.58 \cdot in$

$d_3 = 23.33 \cdot in$ $d_9 = 23.33 \cdot in$

$d_4 = 28.58 \cdot in$ $d_{10} = 16.50 \cdot in$

$d_5 = 31.88 \cdot in$ $d_{11} = 8.54 \cdot in$

$d_6 = 33.00 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius: $R_{pole} := \frac{D_{pole}}{2}$ $R_{pole} = 28.50 \cdot in$

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

$MA_1 = 0.00 \cdot in$ $MA_7 = 3.38 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.08 \cdot in$

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

$MA_4 = 0.08 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 3.38 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 4.50 \cdot in$ etc.

Effective Width of Baseplate for Bending: $EffectiveWidth := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2}$ $EffectiveWidth = 35.19 \cdot in$

Anchor Bolt Analysis:

Polar Moment of Inertia I_p:

$$I_p := \sum_i \left(d_i\right)^2 \qquad I_p = 1.307 \times 10^4 \cdot in^2$$

Gross Area of Bolt:

$$A_g := \frac{\pi}{4} \cdot D^2 \qquad A_g = 3.976 \cdot in^2$$

Net Area of Bolt:

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

Net Diameter:

$$D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} \qquad D_n = 2.03 \cdot in$$

Radius of Gyration of Bolt:

$$r := \frac{D_n}{4} \qquad r = 0.51 \cdot in$$

Section Modulus of Bolt:

$$S_x := \frac{\pi \cdot D_n^{\,3}}{32} \qquad S_x = 0.826 \cdot in^3$$

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left(\frac{Shear}{N}\right) \cdot l \qquad M_x = 0.250 \cdot ft \cdot kips$$

$$f_{bx} := \frac{M_x}{S_x} \qquad f_{bx} = 3.6 \cdot ksi$$

Allowable Bending

$$F_{bx} := 1.333 \cdot 0.60 \cdot Fy \qquad F_{bx} = 60.0 \cdot ksi$$

Note: 1.333 increase allowed per TIA/EIA

Check Tensile Forces:

Maximum Tensile Force (Gross Area):

$AllowableTension := 1.333 \cdot (0.33 \cdot A_g \cdot F_u)$ $AllowableTension = 174.9 \cdot kips$

Note: 1.333 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$F_{net.area} := 1.333 \cdot (0.60 \cdot A_n \cdot Fy)$ $F_{net.area} = 194.8 \cdot kips$

Note: 1.333 increase allowed per TIA/EIA

Applied Tension:

$$MaxTension := \frac{OM \cdot R_{bc}}{I_p} - \frac{Axial}{N} \qquad MaxTension = 95.8 \cdot kips$$

Check Stresses:

Note: Bolts supplied are "upset bolts." Use net area for checking per AISC.

$$\frac{MaxTension}{F_{net.area}} = 0.49$$

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

Condition = "OK"

Check Compression & Combined Stresses (if required):

Check to see if a complete combined stress analysis is required:

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

Set the clear space between the plate and bolt to zero and remove bending stresses if a combined stress analysis is not required:

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0.00\,\text{in} & \text{otherwise} \end{cases} \qquad l = 0.00 \cdot \text{in}$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0.0\,\text{ksi} & \text{otherwise} \end{cases} \qquad f_{bx} = 0.0 \cdot \text{ksi}$$

Allowable Compressive Force:

$$K := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{Fy}} \qquad C_c = 87.36$$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right] \cdot Fy}{\frac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} \qquad F_a = 45.0 \cdot \text{ksi}$$

$$F_a := 1.333 \cdot F_a \quad \text{Note: 1.333 increase allowed per TIA/EIA} \qquad F_a = 60.0 \cdot \text{ksi}$$

Applied Compressive Force:

$$\text{MaxCompression} := \frac{OM \cdot R_{bc}}{I_p} + \frac{\text{Axial}}{N} \qquad \text{MaxCompression} = 99.7 \cdot \text{kips}$$

$$f_a := \frac{\text{MaxCompression}}{A_n} \qquad f_a = 30.7 \cdot \text{ksi}$$

Check Combined Stresses:

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} = 0.51$$

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

Base Plate Analysis:

Force from Bolt(s):

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

$C_1 = 27.3 \cdot kips$ $C_7 = 96.4 \cdot kips$

$C_2 = 50.9 \cdot kips$ $C_8 = 86.6 \cdot kips$

$C_3 = 71.1 \cdot kips$ $C_9 = 71.1 \cdot kips$

$C_4 = 86.6 \cdot kips$ $C_{10} = 50.9 \cdot kips$

$C_5 = 96.4 \cdot kips$ $C_{11} = 27.3 \cdot kips$

$C_6 = 99.7 \cdot kips$ etc.

Bending Stress in Plate:

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{EffectiveWidth \cdot PlateThickness^2} \qquad f_{bp} = 37.5 \cdot ksi$$

Check Stresses:

$$\frac{f_{bp}}{1.333 \cdot 0.75 Fy_{bp}} = 0.63$$

$$Condition := if\left(\frac{f_{bp}}{1.333 \cdot 0.75 Fy_{bp}} < 1.00, "OK", "Overstressed"\right)$$

Condition = "OK"

FOUNDATION ANALYSIS

URS

Job	195' EEI Monopole - Goshen, CT - REV 1	Project No.	VZ4-040	Page / Sheet	of / 1 of 9
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Date	01/25/08
		Checked by		Date	

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 3227 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 24kip$
Max Compressive Force	$C_t := 47 \cdot kip$
Height of Tower	$H_t := 193.5 \cdot ft$
Base Plate Bolt Circle	$MP := 66.0in$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 8.0ft$
Length of Pier	$L_p := 5.0 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 1.0 \cdot ft$
Diameter of Pier	$d_p := 9.0 \cdot ft$
Thickness of Footing	$T_f := 4.0 \cdot ft$
Width of Footing:	$W_f := 26.0ft$
Length of Anchor Bolts:	$L_{st} := 96in$
Projection of anchor bolts above pier	$A_{BP} := 12.0 \cdot in$

PROPERTIES:

Compressive Strength of Concrete	$fc := 4000psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Yield Strength of Anchor Bolt	$fya := 75000 \cdot psi$
Internal Friction Angle of Soil	$\theta_s := 30 \cdot deg$
Allowable Bearing Capacity	$q_s := 3200 \cdot psf$
Unit Weight of Soil	$\pi_s := 110 \cdot pcf$
Unit Weight of Concrete	$\pi_c := 150 \cdot pcf$
Depth to Neglect	$n := 1.0ft$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c := 0 \cdot ksf$
Seismic Zone Factor: UBC Fig 23-2	$Z := 2$
Coefficient of Friction between Concrete:	$\mu := 0.45$
Clear Cover of Reinforcement Pier:	$Cvr_{pier} := 3 \cdot in$
Clear Cover of Reinforcement Pad:	$Cvr_{pad} := 3 \cdot in$
Anchor Bolt Diameter	$d_{anchor} := 2.25in$
Anchor bolt area	$A_{anchor} := 3.98 \cdot in^2$

PIER REINFORCEMENT:

Bar Size	$BSpier := 8$	Bar Diameter	$d_{bpier} := 1.000 \cdot in$
Number of Bars	$NBpier := 48$	Bar Area	$A_{bpier} := 0.790 \cdot in^2$

PAD REINFORCEMENT:

TOP:	Bar Size	$BS_{top} := 8$	Bar Diameter	$d_{btop} := 1.000 \cdot in$
	Number of Bars	$NB_{top} := 31$	Bar Area	$A_{btop} := 0.790 \cdot in^2$
BOTTOM:	Bar Size	$BS_{bot} := 8$	Bar Diameter	$d_{bbot} := 1.000 \cdot in$
	Number of Bars	$NB_{bot} := 40$	Bar Area	$A_{bot} := 0.790 \cdot in^2$

Coefficient of Lateral Soil Pressure: $K_p := \frac{1 + \sin(\theta_s)}{1 - \sin(\theta_s)}$ $K_p = 3$

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

URS

Job	195' EEI Monopole - Goshen, CT - REV 1	Project No.	VZ4-040	Page / Sheet	of / 2 of 9
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Date	01/25/08
		Checked by		Date	

CHECK ANCHOR STEEL EMBEDMENT

Depth:

$D_{ab} := L_{st} - A_{BP}$ $D_{ab} = 7 \cdot ft$ $L_{anchor} := \frac{(0.11 \cdot fya) \cdot in}{\sqrt{fc \cdot psi}}$ $L_{anchor} = 10.8703 \cdot ft$

$DepthCheck := if(D_{ab} \geq L_{anchor}, "Okay", "No Good")$

$DepthCheck = "No Good"$ **Note:** anchor plate is provided

STABILITY OF FOOTING

Passive Pressure:

$P_{pn} := K_p \cdot \pi_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pn} = 0.33 \cdot ksf$

$P_{pt} := K_p \cdot \pi_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pt} = 1.32 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}]$ $P_{top} = 1.32 \cdot ksf$

$P_{bot} := K_p \cdot \pi_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 2.64 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 1.98 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)]$ $T_p = 4 \cdot ft$

$A_p := W_f \cdot T_p$ $A_p = 104 \cdot ft^2$

Ultimate Shear:

$S_u := P_{ave} \cdot A_p$ $S_u = 205.92 \cdot kip$

Weight of Concrete Pad:

$WT_c := \left[\left(W_f^2 \cdot T_f \right) + \frac{d_p^2 \cdot \pi}{4} L_p \right] \cdot \pi_c$ $WT_c = 453.3129 \cdot kip$

Weight of Soil: above Footing:

$WT_{s1} := \left[W_f^2 \cdot \left(|L_p - L_{pag}| \right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(|L_p - L_{pag}| \right) \right] \cdot \pi_s$ $WT_{s1} = 269.4484 \cdot kip$

Weight of Soil Wedge at back face:

$WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\theta_s)}{2} \cdot W_f \right) \cdot \pi_s$ $WT_{s2} = 52.8391 \cdot kip$

Total Weight:

$WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 769.7613 \cdot kip$

Resisting Moment:

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\theta_s)}{3} \right)$ $M_r = 11736.6251 \cdot kip \cdot ft$

Overturning Moment:

$M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 3443 \cdot kip \cdot ft$

Factor of Safety:

$FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 3.41$

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

SHEAR CAPACITY IN PIER

$FS := 2$

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS}$$

$S_p = 276.1563 \cdot kips$

$ShearCheck := if(S_p > S_t, "Okay", "No Good")$

$ShearCheck = "Okay"$

BEARING PRESSURE CAUSED BY FOOTING

$A_{mat} := W_f^2$ $\quad A_{mat} = 676 \cdot ft^2$

$S := \frac{W_f^3}{6}$ $\quad S = 2929.3333 \cdot ft^3$

$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S}$ $\quad P_{max} = 2.3141 \cdot ksf$

$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S}$ $\quad P_{min} = -0.0367 \cdot ksf$

$MaxPressure := if(P_{max} < q_s, "Okay", "No Good")$ $\quad MaxPressure = "Okay"$

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

Distance to Resultant of Pressure Distribution:

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

$X_p = 8.5315 \cdot ft$

Distance to Kern: $X_k := \frac{W_f}{6}$ $\quad X_k = 4.3333 \cdot ft$

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

Eccentricity: $e := \frac{M_{ot}}{WT_{tot}}$ $\quad e = 4.4728$

Adjusted Soil Pressure:

$$P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)}$$

$P_a = 2.3147 \cdot ksf$

$$q_{adj} := if\left(P_{min} < 0, P_a, \frac{P_{max}}{ft^2}\right)$$

$q_{adj} = 2.3147 \cdot ksf$

$PressureCheck := if(q_{adj} < q_s, "Okay", "No Good")$ $\quad PressureCheck = "Okay"$

CONCRETE BEARING CAPACITY (ACI 10.17)

$\theta_c := 0.75$ (ACI 9.3.2.2)

$P_b := \theta_c \cdot 0.85 \cdot fc \cdot \frac{d_p^2 \cdot \pi}{4}$ $P_b = 23360.2547 \cdot kip$

$BearingCheck := if(P_b > LF \cdot C_t, "Okay", "No Good")$ $BearingCheck = "Okay"$

SHEAR STRENGTH OF CONCRETE

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

$\theta_{vc} := .85$ (ACI 9.3.2.3)

$d := T_f - Cvr_{pad} - d_{bbot}$ $d = 44 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$ $d_1 = 8.5 \cdot ft$

$d_2 := d_1 - d$ $d_2 = 4.8333 \cdot ft$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$ $L = 25.5816 \cdot ft$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$ $Slope = 0.0905 \cdot kcf$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$ $V_{req} = 568.596 \cdot kip$

ACI 11.3.1.1 $V_{Avail} := \theta_c \cdot 2 \cdot \sqrt{fc \cdot psi} \cdot W_f \cdot d$ $V_{Avail} = 1475.9994 \cdot kip$

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

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

$b_o := \left(d_p + d\right) \cdot \pi$ $b_o = 39.7935 \cdot ft$

Area included inside bo: $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4}$ $A_{bo} = 126.0128 \cdot ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo}$ $A_{out} = 549.9872 \cdot ft^2$

Guess Value: $v_u := 1ksf$ (From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

Given $d^2 + d_p \cdot d = \frac{WT_{tot}}{\pi \cdot v_u}$

$v_u := \text{Find}(v_u)$ $v_u = 5.2756 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 502.9412 \cdot kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 670.4207 \cdot kips$

$V_{Avail} := \theta_c \cdot 4 \cdot \sqrt{fc \cdot psi} \cdot b_o \cdot d$ $V_{Avail} = 4518.0918 \cdot kips$

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

STEEL REINFORCEMENT IN THE PAD $\theta_m := .90$ ACI 9.3.2.2

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 1.5456 \cdot ksf$

$M_n := \frac{1}{LF \cdot \theta_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f$ $M_n = 1611.4427 \cdot kip \cdot ft$

ACI 10.2.7.3 $\beta := \text{if}\left[fc \le 4000 \cdot psi, .85, \text{if}\left[fc \ge 8000 \cdot psi, .65, .85 - \left(\frac{\frac{fc}{psi} - 4000}{1000} \right) \cdot .05 \right] \right]$ $\beta = 0.85$

$R_u := \frac{M_n}{\theta_m \cdot W_f \cdot d^2}$ $R_u = 5122.2\,lbf$

$\rho := \frac{0.85 \cdot fc}{fy} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot fc}} \right)$ $\rho = 0.0006$

$\rho_{min} := 1.333 \cdot \rho$ $\rho_{min} = 0.00079$

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

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $As := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 24.7104 \cdot in^2$

$As_{prov} := A_{bot} \cdot NB_{bot}$ $As_{prov} = 31.6 \cdot in^2$

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

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 24.7104 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 24.49 \cdot in^2$

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

TENSION (ACI 12.2.3) **DEVELOPMENT LENGTH OF PAD REINFORCEMENT**

Bar Spacing: $B_{sPad} := \dfrac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 6.8205 \cdot in$

Development Length Factors:

Reinforcement Location Factor	$\alpha := 1.0$	
Coating Factor	$\beta := 1.0$	
Concrete strength Factor	$\lambda := 1.0$	
Reinforcement Size Factor	$\pi := 1.0$	

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

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

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \pi \cdot \lambda}{\frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot}$$

$L_{dbt} = 23.7171 \cdot in$

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

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

Available Length in Pad: $L_{Pad} := \dfrac{W_f}{2} - \dfrac{d_p}{2} - Cvr_{pad}$ $L_{Pad} = 99 \cdot in$

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

REINFORCEMENT IN PIER

Pier Area:

$$A_{pv} := \frac{\pi \cdot d_p^{\,2}}{4} \qquad A_p = 9160.8842 \cdot in^2$$

(ACI 10.8.4 and 10.9.1)

$$A_{smin} := 0.01 \cdot 0.05 \cdot A_p \qquad A_{smin} = 4.5804 \cdot in^2$$

$$A_{sprov} := NBpier \cdot A_{bpier} \qquad A_{sprov} = 37.92 \cdot in^2$$

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

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

Bar Spacing In Pier:

$$B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier} \qquad B_{sPier} = 6.0686 \cdot in$$

Diamter of Reinforcement Cage:

$$Diam_{cage} := d_p - 2 \cdot Cvr_{pier} \qquad Diam_{cage} = 102 \cdot in$$

Maximum Moment in Pier:

$$M_p := \left[M_t + S_t \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF \qquad M_p = 53730.564 \cdot in \cdot kips$$

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

(defined variables)

$$(f_c \;\; f_y \;\; cl \;\; Spiral) = (3 \;\; 60 \;\; 3 \;\; 0)$$

The required input is column diameter in inches, number of reinforcing bars, bar size number, factored axial load in kips and moment in kip inches:

$$(D \;\; N \;\; n \;\; P_u \;\; M_{xu}) := (108 \;\; 48 \;\; 8 \;\; 63 \;\; 53731)$$

Clears any previous output:

$$(\theta P_n \;\; \theta M_{xn} \;\; f_{sp} \;\; \rho) := (0 \;\; 0 \;\; 0 \;\; 0)$$

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

The Output is given as useable axial load in kips, moment capacity in kip inches, splicing stress in ksi, and reinforcement ratio:

$$(\theta P_n \;\; \theta M_{xn} \;\; f_{sp} \;\; \rho) = (117.1507 \;\; 99914.7047 \;\; -60 \;\; 0.0041)$$

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

$$AxialLoadCheck := if(\theta P_n \geq P_u, "Okay", "No Good") \qquad AxialLoadCheck = "Okay"$$

$$BendingCheck := if(\theta M_{xn} \geq M_{xu}, "Okay", "No Good") \qquad BendingCheck = "Okay"$$

DEVELOPMENT LENGTH OF PIER REINFORCEMENT

TENSION (ACI 12.2.3)

Factors for development:

Reinforcement Location Factor $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\pi := 1.0$

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

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

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \pi \cdot \lambda}{\frac{c + k_{tr}}{d_{bpier}}} \cdot d_{bpier} \qquad L_{dbt} = 23.7171 \cdot in$$

Minimum Development Length: (ACI 12.2.1) $L_{dbmin} := 12 \cdot in$

Pier reinforcement bars are standard 90 degree hooks and therefore developement in the pad is computed as follows:

$$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f'c}{psi}}} \cdot .7 \qquad L_{dh} = 13.2816 \cdot in$$

$$L_{db} := \max\left(L_{dbt}, L_{dbmin}\right) \qquad L_{db} = 23.7171 \cdot in$$

COMPRESSION: (ACI 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot fy}{\sqrt{f'c \cdot psi}} \qquad L_{dbc1} = 18.9737 \cdot in$$

$$L_{dbmin} := 0.0003 \cdot \frac{in^2}{lb} \cdot \left(d_{bpier} \cdot fy\right) \qquad L_{dbmin} = 18 \cdot in$$

$$L_{dbc} := if\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) \qquad L_{dbc} = 18.9737 \cdot in$$

Available Length in Foundation:

$$L_{pier} := L_p - Cvr_{pier} \qquad L_{pier} = 57 \cdot in$$

$$L_{pad} := T_f - Cvr_{pad} \qquad L_{pad} = 45 \cdot in$$

$$L_{tension} := if\left(L_{pier} + L_{pad} > L_{dbt}, \text{"Okay"}, \text{"No Good"}\right) = \text{"Okay"} \qquad L_{tension} = \text{"Okay"}$$

$$L_{compression} := if\left(L_{pier} + L_{pad} > L_{dbc}, \text{"Okay"}, \text{"No Good"}\right) \qquad L_{compression} = \text{"Okay"}$$

NOTE: Anchor bolts and plate provided, OK

TIE SIZE AND SPACING IN COLUMN

Minimum Tie Size:

$Tie_{min} := if(BSpier \le 10, 3, 4)$ $\quad Tie_{min} = 3$

Used #4 Ties $\quad d_{Tie} := 4$

Seismic factor:
(ACI 21.10.5)

$z := if(Z \le 2, 1, 0.5)$ $\quad z = 1$

$s_{lim1} := 16 \cdot d_{bpier} \cdot z$ $\quad s_{lim1} = 16 \cdot in$

$s_{lim2} := \frac{48 \cdot d_{Tie} \cdot in}{8} \cdot z$ $\quad s_{lim2} = 24 \cdot in$

$s_{lim3} := D_f \cdot z$ $\quad s_{lim3} = 96 \cdot in$

$s_{lim4} := 18in$ $\quad s_{lim4} = 18 \cdot in$

Maximum Spacing:

$$s_{tie} := \min\left(\begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix}\right) \quad s_{tie} = 16 \cdot in$$

Number of Ties Required:

$$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 \quad n_{tie} = 4.375$$