



STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

Ten Franklin Square, New Britain, CT 06051

Phone: (860) 827-2935 Fax: (860) 827-2950

E-Mail: siting.council@ct.gov

Internet: ct.gov/csc

Daniel F. Caruso
Chairman

March 17, 2008

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103-3597

RE: **EM-VER-096-080204** – Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 33 Boardman Road a/k/a 86 Boardman Road, New Milford, Connecticut.

Dear Attorney Baldwin:

At a public meeting held on February 28, 2008, the Connecticut Siting Council (Council) acknowledged your notice to modify this existing telecommunications facility, pursuant to Section 16-50j-73 of the Regulations of Connecticut State Agencies.

The proposed modifications are to be implemented as specified here and in your notice dated February 4, 2008, including the placement of all necessary equipment and shelters within the tower compound. The modifications are in compliance with the exception criteria in Section 16-50j-72 (b) of the Regulations of Connecticut State Agencies as changes to an existing facility site that would not increase tower height, extend the boundaries of the tower site, increase noise levels at the tower site boundary by six decibels, and increase the total radio frequencies electromagnetic radiation power density measured at the tower site boundary to or above the standard adopted by the State Department of Environmental Protection pursuant to General Statutes § 22a-162. This facility has also been carefully modeled to ensure that radio frequency emissions are conservatively below State and federal standards applicable to the frequencies now used on this tower.

This decision is under the exclusive jurisdiction of the Council. Please be advised that the validity of this action shall expire one year from the date of this letter. Any additional change to this facility will require explicit notice to this agency pursuant to Regulations of Connecticut State Agencies Section 16-50j-73. Such notice shall include all relevant information regarding the proposed change with cumulative worst-case modeling of radio frequency exposure at the closest point of uncontrolled access to the tower base, consistent with Federal Communications Commission, Office of Engineering and Technology, Bulletin 65. Any deviation from this format may result in the Council implementing enforcement proceedings pursuant to General Statutes § 16-50u including, without limitation, imposition of expenses resulting from such failure and of civil penalties in an amount not less than one thousand dollars per day for each day of construction or operation in material violation.

Thank you for your attention and cooperation.

Very truly yours,

Daniel F. Caruso
Chairman

DFC/MP

c: Honorable Patricia A. Murphy, Mayor, Town of New Milford
Thomas J. Regan, Esq., Brown Rudnick Berlack Israels LLP



Daniel F. Caruso
Chairman

STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

Ten Franklin Square, New Britain, CT 06051
Phone: (860) 827-2935 Fax: (860) 827-2950
E-Mail: siting.council@ct.gov
Internet: ct.gov/csc

February 6, 2008

The Honorable Patricia A. Murphy
Mayor
Town of New Milford
Town Hall
10 Main Street
New Milford, CT 06776

RE: **EM-VER-096-080204** – Celco Partnership d/b/a Verizon Wireless notice of intent to modify existing telecommunications facilities located at 33 Boardman Road a/k/a 86 Boardman Road, New Milford, Connecticut.

Dear Mayor Murphy:

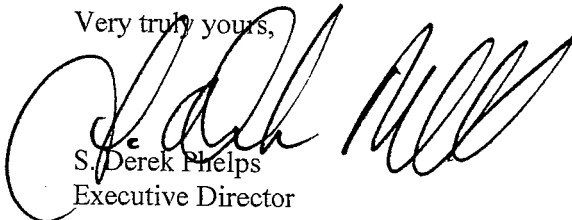
The Connecticut Siting Council (Council) received this request to modify an existing telecommunications facility, pursuant to Regulations of Connecticut State Agencies Section 16-50j-72.

The Council will consider this item at the next meeting scheduled for February 28, 2008, at 1:30 p.m. in Hearing Room One, Ten Franklin Square, New Britain, Connecticut.

If you have any questions or comments regarding this proposal, please call me or inform the Council by February 27, 2008.

Thank you for your cooperation and consideration.

Very truly yours,



S. Derek Phelps
Executive Director

SDP/jb

Enclosure: Notice of Intent

EM-VER-096-080204

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

ORIGINAL

February 4, 2008

Via Hand Delivery

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

RECEIVED
FEB 4 - 2008
CONNECTICUT
SITING COUNCIL

Re: **Notice of Exempt Modification – Antenna Swap**
33 Boardman Road (a/k/a 86 Boardman Road), New Milford,
Connecticut

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains a wireless telecommunications facility at the above-referenced address. The Council approved Cellco's installation of antennas at the 130-foot level on the existing 153-foot monopole tower on January 25, 2006. Cellco now intends to modify its facility by replacing six (6) DB950F65E-M antenna with six (6) LPA-80080/4CF antennas at the 130-foot level on the existing tower. 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 Patricia Murphy, Mayor of the Town of New Milford. Pursuant to a Council directive, a copy of this letter is also being sent to Quarry Stone & Gravel, LLC, c/o O&G Industries, the owner of the property on which the facility is located.

The planned modifications to the facility falls 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 130-foot level on the existing 153-foot tower.



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HART1-1446601-1

S. Derek Phelps
February 4, 2008
Page 2

2. The proposed modifications will not involve any modifications to 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 modified facility is included behind Tab 2.

Also attached is a Detailed Structural Analysis Report 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:

Patricia Murphy, New Milford Mayor
Quarry Stone & Gravel, LLC, c/o O&G Industries
Sandy M. Carter



LPA-80080/4CF

When ordering replace " " with connector type.

Mechanical specifications

Length	1200 mm	47.2 in
Width	140 mm	5.5 in
Depth	335 mm	13.2 in
Depth with z-bracket	375 mm	14.8 in
4) Weight	5.4 kg	12.0 lbs
Wind Area		
Fore/Aft	0.17 m ²	1.8 ft ²
Side	0.40 m ²	4.3 ft ²
Rated Wind Velocity (Safety factor 2.0)		
	>369 km/hr	>229 mph
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	254 N	57.1 lbs
Side	574 N	129.0 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

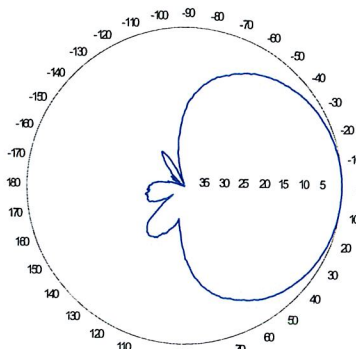
Electrical specifications

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	12.5 dBd
2) Power Rating	500 W
1) Half Power Angle	
H-Plane	80°
E-Plane	15°
1) Electrical Downtilt	0°
1) Null Fill	15%
Lightning Protection	Direct Ground

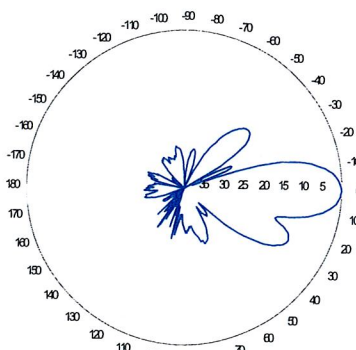
- 1) Typical values.
2) Power rating limited by connector only.
3) NE indicates an elongated N connector.
E-DIN indicates an elongated DIN connector.
4) The antenna weight listed above does not include the bracket weight.

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

Radiation pattern¹⁾



Horizontal

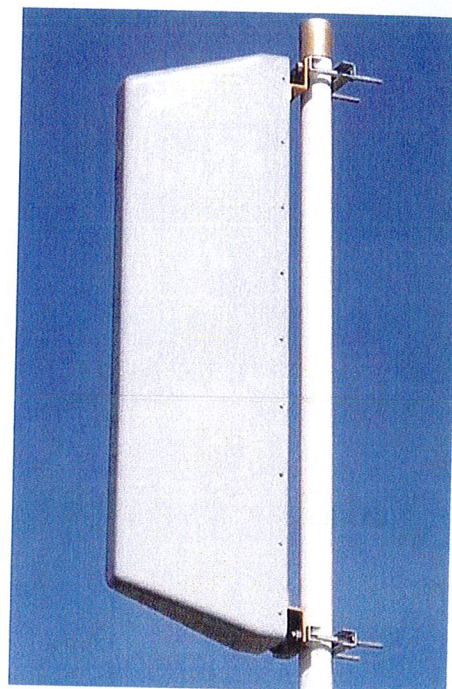


Vertical

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.



**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 bandwidth 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.

CF Denotes a Center-Fed Connector.

806-960 MHz

**Amphenol
Antel, Inc.**
The Antenna Technology Company

Revision Date: 7/5/07

General		Power	Density						
Site Name: New Milford West									
Tower Height: Verizon @ 130Ft.									
CARRIER	# OF CHAN.	WATTS ERP	HEIGHT	CALC. POWER DENS	FREQ.	MAX. PERMISS. EXP.	FRACTION MPE	Total	
*Sprint	11	286.5	150	0.0504	1962.5	1.0000	5.04%		
*Cingular	6	296	120	0.0443	880	0.5867	7.56%		
*Cingular	3	427	120	0.0320	1930	1.0000	3.20%		
*T-Mobile	8	110	140	0.0161	1945	1.0000	1.61%		
Verizon	9	485	130	0.0929	1970	1.0000	9.29%		
Verizon	9	200	130	0.0383	875	0.5830	6.57%		
								33.27%	
* Source: Siting Council									

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 153' MONOPOLE (TREEPOLE) FOR PROPOSED ANTENNA ARRANGEMENT

Site I.D: New Milford West
Address: 86 Boardman Road
New Milford, CT 06776

prepared for



Verizon Wireless
99 East River Drive
East Hartford, Connecticut 06108

prepared by



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

36931124.00000
VZ4-048

January 28, 2008

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 - **RISA TOWER INPUT / OUTPUT SUMMARY**
 - **RISA TOWER DETAILED OUTPUT**
 - **ANCHOR BOLT AND BASE PLATE ANALYSIS**
 - **FOUNDATION ANALYSIS**

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 153' steel tapered monopole (tree-pole) structure, located at 86 Boardman Road, Litchfield, 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
<u>On the existing Verizon platform</u> <u>Remove:</u> (6) existing PCS antennas (2 per sector, outboard) <u>Install:</u> <u>Alpha Sector</u> (2) Antel LPA-80080/4CF antennas <u>Beta Sector</u> (2) Antel LPA-80080/4CF antennas <u>Gamma Sector</u> (2) Antel LPA-80080/4CF antennas	 Verizon (existing to be removed) Verizon (Proposed)	 @ 130' @ 130'

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:

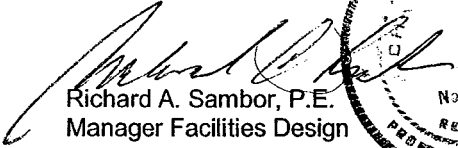
- 1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
- 2) Tower geometry and structural member sizes utilized in the preparation of this report obtained from manufacturers original design documents prepared by Engineered Endeavors, Incorporated, (EEI); Job No. 13200, signed and sealed March 02, 2005.
- 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.

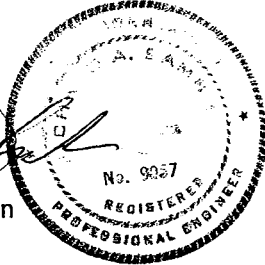
This report is only valid as per the assumptions and data utilized in this report for antenna inventory, mounts and associated cables. The user of this report shall field verify the assumption of the antenna and mount configuration as well as the physical condition of the tower. Notify the engineer in 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 86 Boardman Road, Litchfield, CT. The structure is an existing 153' steel tapered monopole (tree-pole) 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
(12) 5' Panel antennas	Sprint/Nextel (existing)	(3) T-Arms (same as above)	150'	(15) 1-5/8" coax cables (within monopole)
(6) 5' Panel antennas	T-Mobile (existing)	(3) T-Arms	140'	(6) 1-5/8" coax cables (within monopole)
(6) Antel LPA-185090/8CF_2 panel antennas	Verizon (existing)	(3) T-Arms	130'	(12) 1-5/8" coax cables (within monopole)
(6) Antel LPA-80080/4CF panel antennas	Verizon (proposed)	(3) T-Arms (same as above)	130'	(re-use existing listed above)
(6) Powerwave 7770.00 panel antennas and (6) TMA's	AT&T (existing)	(3) T-Arms	120'	(12) 1 5/8" coax cables (within monopole)

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)	51.2	59
Shear (kips)	58.68	61
O.T. Moment (ft-kips)	6547.5	6511

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 (L4)	1'-44.54'	94.6%	Pass	
Anchor Bolts	Compression	85%	Pass	
Base Plate	Bending	49%	Pass	

Foundation Summary

Foundation	Component	Stress (% capacity/FOS)	Pass/Fail	Comments:
Reinf. Concrete Pad and Pier	OTM	89.7%/2.23	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

Section	Length (ft)	Number of Sides	Thickness (in)	Lap Splice (ft)	Top Dia (in)	Bot Dia (in)	Grade	Weight (K)
1	19.17	18	0.1875	4.33	25.2500	30.0300		1.1
2	50.00	18	0.3125	5.67	28.5753	40.9100	A572-65	5.8
3	50.29	18	0.5000	6.92	38.8862	51.2800		12.1
4	50.46	18	0.5625	48.5746	61.0000			16.6
								35.6

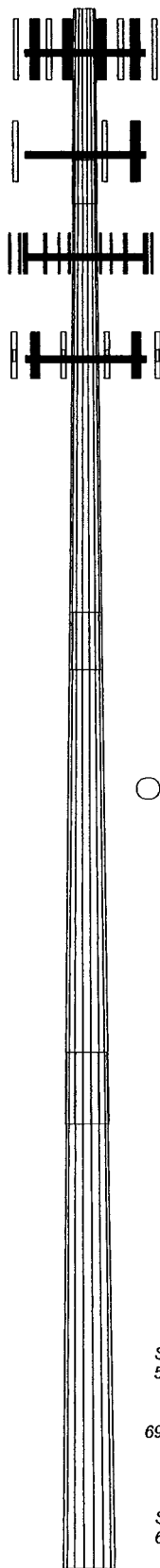
154.0 ft

134.8 ft

89.2 ft

44.5 ft

1.0 ft



DESIGNED APPURTENANCE LOADING

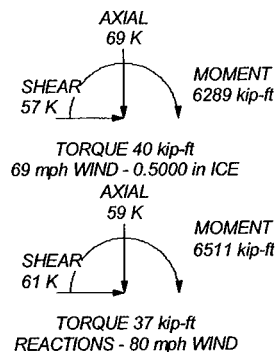
TYPE	ELEVATION	TYPE	ELEVATION
EEI Pine Branches	150	LPA-185090-8CF_2 (Verizon - existing)	130
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	150	LPA-185090-8CF_2 (Verizon - existing)	130
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	150	LPA-185090-8CF_2 (Verizon - existing)	130
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	150	LPA-185090-8CF_2 (Verizon - existing)	130
(4) 5' Decibel Antenna (Sprint/Nextel)	150	LPA-185090-8CF_2 (Verizon - existing)	130
(4) 5' Decibel Antenna (Sprint/Nextel)	150	LPA-185090-8CF_2 (Verizon - existing)	130
(4) 5' Decibel Antenna (Sprint/Nextel)	150	12' T-Frame Sector Mount (1) (Verizon - existing)	130
EEI Pine Branches	140	12' T-Frame Sector Mount (1) (Verizon - existing)	130
5' Panel Antenna (T-Mobile)	140	12' T-Frame Sector Mount (1) (Verizon - existing)	130
5' Panel Antenna (T-Mobile)	140	12' T-Frame Sector Mount (1) (Verizon - existing)	130
5' Panel Antenna (T-Mobile)	140	EEI Pine Branches	120
(2) TMA 10"x8"x3" (T-Mobile)	140	(2) 7770.00 (ATI/Cingular)	120
(2) TMA 10"x8"x3" (T-Mobile)	140	(2) 7770.00 (ATI/Cingular)	120
(2) TMA 10"x8"x3" (T-Mobile)	140	(2) 7770.00 (ATI/Cingular)	120
EEI 10' Universal T-Arms x (1) (T-Mobile)	140	(2) LPG 21401 TMA (ATI/Cingular)	120
EEI 10' Universal T-Arms x (1) (T-Mobile)	140	(2) LPG 21401 TMA (ATI/Cingular)	120
EEI 10' Universal T-Arms x (1) (T-Mobile)	140	(2) LPG 21401 TMA (ATI/Cingular)	120
EEI Pine Branches	130	EEI 10' Universal T-Arms x (1) (ATI/Cingular)	120
LPA-80080/4CF (Verizon - proposed)	130	EEI 10' Universal T-Arms x (1) (ATI/Cingular)	120
LPA-80080/4CF (Verizon - proposed)	130	EEI 10' Universal T-Arms x (1) (ATI/Cingular)	120
LPA-80080/4CF (Verizon - proposed)	130	EEI Pine Branches	110
LPA-80080/4CF (Verizon - proposed)	130	EEI Pine Branches	100
LPA-80080/4CF (Verizon - proposed)	130	EEI Pine Branches	90
LPA-80080/4CF (Verizon - proposed)	130	EEI Pine Branches	80

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 RATING: 94.6%



URS Corporation		Job: 153' EEI Monopole w/ Branches	
500 Enterprise Drive, Suite 3B		Project: 86 Boardman Road, New Milford, CT	
Rocky Hill, CT 06067		Client: Verizon Wireless - New Milford West	Drawn by: Staff
Phone: (860) 529-8882		Code: TIA/EIA-222-F	Date: 01/28/08
FAX: (860) 529-3991		Path: P:\08ERI Files\150 EEI Tree Pole New Milford CT.dwg	Scale: NTS
		Dwg No. E-1	

RISA TOWER DETAILED OUTPUT

RISATower URS Corporation 500 Enterprise Drive, Suite 3B Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-3991	Job	153' EEI Monopole w/ Branches	Page	1 of 20
	Project	86 Boardman Road, New Milford, CT	Date	11:36:49 01/28/08
	Client	Verizon Wireless - New Milford West	Designed by	Staff

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.

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	Section Length	Splice Length	Number of Sides	Top Diameter	Bottom Diameter	Wall Thickness	Bend Radius	Pole Grade
	ft	ft	ft		in	in	in	in	
L1	154.00-134.83	19.17	4.33	18	25.2500	30.0300	0.1875	0.7500	A572-65 (65 ksi)
L2	134.83-89.16	50.00	5.67	18	28.5753	40.9100	0.3125	1.2500	A572-65 (65 ksi)
L3	89.16-44.54	50.29	6.92	18	38.8862	51.2800	0.5000	2.0000	A572-65 (65 ksi)
L4	44.54-1.00	50.46		18	48.5746	61.0000	0.5625	2.2500	A572-65 (65 ksi)

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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 ³	w in	w/t
L1	25.6395	14.9153	1183.6378	8.8972	12.8270	92.2771	2368.8330	7.4591	4.1140	21.941
	30.4933	17.7600	1998.2566	10.5941	15.2552	130.9882	3999.1425	8.8817	4.9553	26.428
L2	30.1008	28.0332	2829.0525	10.0333	14.5163	194.8885	5661.8276	14.0193	4.4793	14.334
	41.5411	40.2676	8384.7915	14.4121	20.7823	403.4587	16780.6158	20.1376	6.6502	21.281
L3	40.9050	60.9190	11340.7394	13.6271	19.7542	574.0922	22696.4013	30.4653	5.9640	11.928
	52.0711	80.5879	26253.8178	18.0269	26.0502	1007.8148	52542.1810	40.3016	8.1453	16.291
L4	51.0542	85.7196	24964.2715	17.0443	24.6759	1011.6866	49961.3916	42.8679	7.5591	13.438
	61.9410	107.9036	49795.0730	21.4553	30.9880	1606.9147	99655.6677	53.9621	9.7460	17.326

Tower Elevation	Gusset Area (per face)	Gusset Thickness	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
ft	ft ²	in						
L1 154.00-134.83				1	1	1		
L2 134.83-89.16				1	1	1		
L3 89.16-44.54				1	1	1		
L4 44.54-1.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C _A A _A ft ² /ft	Weight plf
1 5/8 (Sprint/Nextel)	C	No	Inside Pole	150.00 - 4.00	15	No Ice	0.00	1.04
1 5/8 (T-Mobile)	C	No	Inside Pole	140.00 - 4.00	6	1/2" Ice	0.00	1.04
1 5/8 (Verizon - proposed)	C	No	Inside Pole	130.00 - 4.00	12	No Ice	0.00	1.04
1 5/8 (AT&T/Cingular)	C	No	Inside Pole	120.00 - 4.00	12	1/2" Ice	0.00	1.04
						No Ice	0.00	1.04
						1/2" Ice	0.00	1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A _R ft ²	A _F ft ²	C _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
L1	154.00-134.83	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	0.27
L2	134.83-89.16	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	1.89
L3	89.16-44.54	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	2.09
L4	44.54-1.00	A	0.000	0.000	0.000	0.000	0.00

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Tower Section	Tower Elevation ft	Face	A _R ft ²	A _F ft ²	C _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	1.90

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 _A A _A In Face ft ²	C _A A _A Out Face ft ²	Weight K
L1	154.00-134.83	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.27
L2	134.83-89.16	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	1.89
L3	89.16-44.54	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	2.09
L4	44.54-1.00	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	1.90

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft	C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
EEI Pine Branches	A	From Face	0.00	0.0000	150.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	140.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	130.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	120.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	110.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	100.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	90.00	No Ice	90.00	1.50
			0.00			1/2" Ice	130.00	1.90
			0.00					
EEI Pine Branches	A	From Face	0.00	0.0000	80.00	No Ice	45.00	0.75
			0.00			1/2" Ice	65.00	0.95
			0.00					

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Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C _{AA} Front ft ²	C _{AA} Side ft ²	Weight K
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	A	From Face	2.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	B	From Face	2.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
EEI 10' Universal T-Arms x (1) (Sprint/Nextel)	C	From Face	2.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
(4) 5' Decibel Antenna (Sprint/Nextel)	A	From Face	4.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	2.78 3.15	4.24 4.62	0.01 0.04
(4) 5' Decibel Antenna (Sprint/Nextel)	B	From Face	4.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	2.78 3.15	4.24 4.62	0.01 0.04
(4) 5' Decibel Antenna (Sprint/Nextel)	C	From Face	4.00 0.00 0.00	0.0000	150.00	No Ice 1/2" Ice	2.78 3.15	4.24 4.62	0.01 0.04
5' Panel Antenna (T-Mobile)	A	From Face	4.00 -5.00 0.00	0.0000	140.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.01 0.03
5' Panel Antenna (T-Mobile)	B	From Face	4.00 -5.00 0.00	0.0000	140.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.01 0.03
5' Panel Antenna (T-Mobile)	C	From Face	4.00 -5.00 0.00	0.0000	140.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.01 0.03
(2) TMA 10"x8"x3" (T-Mobile)	A	From Face	4.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	0.78 0.90	0.29 0.38	0.02 0.02
(2) TMA 10"x8"x3" (T-Mobile)	B	From Face	4.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	0.78 0.90	0.29 0.38	0.02 0.02
(2) TMA 10"x8"x3" (T-Mobile)	C	From Face	4.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	0.78 0.90	0.29 0.38	0.02 0.02
EEI 10' Universal T-Arms x (1) (T-Mobile)	A	From Face	2.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
EEI 10' Universal T-Arms x (1) (T-Mobile)	B	From Face	2.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
EEI 10' Universal T-Arms x (1) (T-Mobile)	C	From Face	2.00 0.00 0.00	0.0000	140.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
LPA-80080/4CF (Verizon - proposed)	A	From Face	4.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05
LPA-80080/4CF (Verizon - proposed)	A	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05
LPA-80080/4CF (Verizon - proposed)	B	From Face	4.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05
LPA-80080/4CF (Verizon - proposed)	B	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05

<i>RISATower</i> <i>URS Corporation</i> 500 Enterprise Drive, Suite 3B Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-3991	Job	153' EEI Monopole w/ Branches	Page	5 of 20
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<i>Description</i>	<i>Face or Leg</i>	<i>Offset Type</i>	<i>Offsets: Horz Lateral Vert ft ft ft</i>	<i>Azimuth Adjustment °</i>	<i>Placement ft</i>	<i>CAA Front ft²</i>	<i>CAA Side ft²</i>	<i>Weight K</i>	
LPA-80080/4CF (Verizon - proposed)	C	From Face	4.00 6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05
LPA-80080/4CF (Verizon - proposed)	C	From Face	4.00 -6.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.62 2.92	6.06 6.45	0.01 0.05
LPA-185090-8CF_2 (Verizon - existing)	A	From Face	4.00 4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
LPA-185090-8CF_2 (Verizon - existing)	A	From Face	4.00 -4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
LPA-185090-8CF_2 (Verizon - existing)	B	From Face	4.00 4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
LPA-185090-8CF_2 (Verizon - existing)	B	From Face	4.00 -4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
LPA-185090-8CF_2 (Verizon - existing)	C	From Face	4.00 4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
LPA-185090-8CF_2 (Verizon - existing)	C	From Face	4.00 -4.00 0.00	0.0000	130.00	No Ice 1/2" Ice	2.09 2.39	2.79 3.09	0.01 0.03
12' T-Frame Sector Mount (1) (Verizon - existing)	A	From Face	2.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	13.60 18.40	13.60 18.40	0.47 0.60
12' T-Frame Sector Mount (1) (Verizon - existing)	B	From Face	2.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	13.60 18.40	13.60 18.40	0.47 0.60
12' T-Frame Sector Mount (1) (Verizon - existing)	C	From Face	2.00 0.00 0.00	0.0000	130.00	No Ice 1/2" Ice	13.60 18.40	13.60 18.40	0.47 0.60
(2) 7770.00 (AT&T/Cingular)	A	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	5.88 6.31	2.93 3.27	0.04 0.07
(2) 7770.00 (AT&T/Cingular)	B	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	5.88 6.31	2.93 3.27	0.04 0.07
(2) 7770.00 (AT&T/Cingular)	C	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	5.88 6.31	2.93 3.27	0.04 0.07
(2) LPG 21401 TMA (AT&T/Cingular)	A	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	0.95 1.09	0.37 0.48	0.02 0.02
(2) LPG 21401 TMA (AT&T/Cingular)	B	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	0.95 1.09	0.37 0.48	0.02 0.02
(2) LPG 21401 TMA (AT&T/Cingular)	C	From Face	4.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	0.95 1.09	0.37 0.48	0.02 0.02
EEI 10' Universal T-Arms x (1) (AT&T/Cingular)	A	From Face	2.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60
EEI 10' Universal T-Arms x (1) (AT&T/Cingular)	B	From Face	2.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60

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Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C _A A _A Front ft ²	C _A A _A Side ft ²	Weight K
EEI 10' Universal T-Arms x (1) (AT&T/Cingular)	C	From Face	2.00 0.00 0.00	0.0000	120.00	No Ice 1/2" Ice	13.34 16.80	13.34 16.80	0.45 0.60

Tower Pressures - No Ice

$$G_H = 1.690$$

Section Elevation ft	z ft	K _Z	q _z psf	A _G ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 154.00- 134.83	144.14	1.524	25	44.155	A	0.000	44.155	44.155	100.00	0.000	0.000
					B	0.000	44.155		100.00		
					C	0.000	44.155		100.00		
L2 134.83- 89.16	111.11	1.415	23	134.257	A	0.000	134.257	134.257	100.00	0.000	0.000
					B	0.000	134.257		100.00		
					C	0.000	134.257		100.00		
L3 89.16-44.54	66.49	1.222	20	170.232	A	0.000	170.232	170.232	100.00	0.000	0.000
					B	0.000	170.232		100.00		
					C	0.000	170.232		100.00		
L4 44.54-1.00	22.09	1	16	201.878	A	0.000	201.878	201.878	100.00	0.000	0.000
					B	0.000	201.878		100.00		
					C	0.000	201.878		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 ft ²	F a c e	A _F ft ²	A _R ft ²	A _{leg} ft ²	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
L1 154.00- 134.83	144.14	1.524	19	0.5000	45.752	A	0.000	45.752	45.752	100.00	0.000	0.000
						B	0.000	45.752		100.00		
						C	0.000	45.752		100.00		
L2 134.83-89.16	111.11	1.415	17	0.5000	138.063	A	0.000	138.063	138.063	100.00	0.000	0.000
						B	0.000	138.063		100.00		
						C	0.000	138.063		100.00		
L3 89.16-44.54	66.49	1.222	15	0.5000	173.950	A	0.000	173.950	173.950	100.00	0.000	0.000
						B	0.000	173.950		100.00		
						C	0.000	173.950		100.00		
L4 44.54-1.00	22.09	1	12	0.5000	205.506	A	0.000	205.506	205.506	100.00	0.000	0.000
						B	0.000	205.506		100.00		
						C	0.000	205.506		100.00		

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Tower Pressure - Service

$$G_H = 1.690$$

Section Elevation	z	K _z	q _z	A _G	F a c e	A _F	A _R	A _{leg}	Leg %	C _A A _A In Face ft ²	C _A A _A Out Face ft ²
ft	ft		psf	ft ²		ft ²	ft ²	ft ²			
L1 154.00- 134.83	144.14	1.524	10	44.155	A	0.000	44.155	44.155	100.00	0.000	0.000
					B	0.000	44.155		100.00		
					C	0.000	44.155		100.00		
L2 134.83- 89.16	111.11	1.415	9	134.257	A	0.000	134.257	134.257	100.00	0.000	0.000
					B	0.000	134.257		100.00		
					C	0.000	134.257		100.00		
L3 89.16-44.54	66.49	1.222	8	170.232	A	0.000	170.232	170.232	100.00	0.000	0.000
					B	0.000	170.232		100.00		
					C	0.000	170.232		100.00		
L4 44.54-1.00	22.09	1	6	201.878	A	0.000	201.878	201.878	100.00	0.000	0.000
					B	0.000	201.878		100.00		
					C	0.000	201.878		100.00		

Tower Forces - No Ice - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00- 134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	2.24	116.62	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83- 89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	6.30	137.91	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16- 44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	6.87	154.05	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	6.72	154.36	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	1605.48 kip-ft	22.13		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00- 134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	2.24	116.62	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83- 89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	6.30	137.91	C
			B	1	1.2	1	1	1	134.257			

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Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L3 89.16-44.54	2.09	12.11	C	1	1.2	1	1	1	134.257			
			A	1	1.2	1	1	1	170.232	6.87	154.05	C
			B	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	C	1	1.2	1	1	1	170.232			
			A	1	1.2	1	1	1	201.878	6.72	154.36	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	1605.48 kip-ft	22.13		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	2.24	116.62	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83-89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	6.30	137.91	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	6.87	154.05	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	6.72	154.36	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	1605.48 kip-ft	22.13		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	2.24	116.62	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83-89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	6.30	137.91	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	6.87	154.05	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	6.72	154.36	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	1605.48 kip-ft	22.13		

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Tower Forces - With Ice - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00- 134.83	0.27	1.40	A	1	1.2	1	1	1	45.752	1.74	90.63	C
			B	1	1.2	1	1	1	45.752			
			C	1	1.2	1	1	1	45.752			
L2 134.83- 89.16	1.89	6.82	A	1	1.2	1	1	1	138.063	4.86	106.37	C
			B	1	1.2	1	1	1	138.063			
			C	1	1.2	1	1	1	138.063			
L3 89.16- 44.54	2.09	13.38	A	1	1.2	1	1	1	173.950	5.27	118.06	C
			B	1	1.2	1	1	1	173.950			
			C	1	1.2	1	1	1	173.950			
L4 44.54-1.00	1.90	18.13	A	1	1.2	1	1	1	205.506	5.13	117.85	C
			B	1	1.2	1	1	1	205.506			
			C	1	1.2	1	1	1	205.506			
Sum Weight:	6.15	39.73						OTM	1236.82 kip-ft	16.99		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00- 134.83	0.27	1.40	A	1	1.2	1	1	1	45.752	1.74	90.63	C
			B	1	1.2	1	1	1	45.752			
			C	1	1.2	1	1	1	45.752			
L2 134.83- 89.16	1.89	6.82	A	1	1.2	1	1	1	138.063	4.86	106.37	C
			B	1	1.2	1	1	1	138.063			
			C	1	1.2	1	1	1	138.063			
L3 89.16- 44.54	2.09	13.38	A	1	1.2	1	1	1	173.950	5.27	118.06	C
			B	1	1.2	1	1	1	173.950			
			C	1	1.2	1	1	1	173.950			
L4 44.54-1.00	1.90	18.13	A	1	1.2	1	1	1	205.506	5.13	117.85	C
			B	1	1.2	1	1	1	205.506			
			C	1	1.2	1	1	1	205.506			
Sum Weight:	6.15	39.73						OTM	1236.82 kip-ft	16.99		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00- 134.83	0.27	1.40	A	1	1.2	1	1	1	45.752	1.74	90.63	C
			B	1	1.2	1	1	1	45.752			
			C	1	1.2	1	1	1	45.752			

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Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L2 134.83-89.16	1.89	6.82	A	1	1.2	1	1	1	138.063	4.86	106.37	C
			B	1	1.2	1	1	1	138.063			
			C	1	1.2	1	1	1	138.063			
L3 89.16-44.54	2.09	13.38	A	1	1.2	1	1	1	173.950	5.27	118.06	C
			B	1	1.2	1	1	1	173.950			
			C	1	1.2	1	1	1	173.950			
L4 44.54-1.00	1.90	18.13	A	1	1.2	1	1	1	205.506	5.13	117.85	C
			B	1	1.2	1	1	1	205.506			
			C	1	1.2	1	1	1	205.506			
Sum Weight:	6.15	39.73						OTM	1236.82 kip-ft	16.99		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.40	A	1	1.2	1	1	1	45.752	1.74	90.63	C
			B	1	1.2	1	1	1	45.752			
			C	1	1.2	1	1	1	45.752			
L2 134.83-89.16	1.89	6.82	A	1	1.2	1	1	1	138.063	4.86	106.37	C
			B	1	1.2	1	1	1	138.063			
			C	1	1.2	1	1	1	138.063			
L3 89.16-44.54	2.09	13.38	A	1	1.2	1	1	1	173.950	5.27	118.06	C
			B	1	1.2	1	1	1	173.950			
			C	1	1.2	1	1	1	173.950			
L4 44.54-1.00	1.90	18.13	A	1	1.2	1	1	1	205.506	5.13	117.85	C
			B	1	1.2	1	1	1	205.506			
			C	1	1.2	1	1	1	205.506			
Sum Weight:	6.15	39.73						OTM	1236.82 kip-ft	16.99		

Tower Forces - Service - Wind Normal To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	0.87	45.56	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83-89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	2.46	53.87	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	2.69	60.18	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	2.63	60.30	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			

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Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
Sum Weight:	6.15	35.61						OTM	627.14 kip-ft	8.64		

Tower Forces - Service - Wind 45 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	0.87	45.56	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83-89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	2.46	53.87	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	2.69	60.18	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	2.63	60.30	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	627.14 kip-ft	8.64		

Tower Forces - Service - Wind 60 To Face

Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	0.87	45.56	C
			B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L2 134.83-89.16	1.89	5.81	A	1	1.2	1	1	1	134.257	2.46	53.87	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	170.232	2.69	60.18	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	201.878	2.63	60.30	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
Sum Weight:	6.15	35.61						OTM	627.14 kip-ft	8.64		

Tower Forces - Service - Wind 90 To Face

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Section Elevation	Add Weight	Self Weight	F a c e	e	C _F	R _R	D _F	D _R	A _E	F	w	Ctrl. Face
ft	K	K							ft ²	K	plf	
L1 154.00-134.83	0.27	1.07	A	1	1.2	1	1	1	44.155	0.87	45.56	C
L2 134.83-89.16	1.89	5.81	B	1	1.2	1	1	1	44.155			
			C	1	1.2	1	1	1	44.155			
L3 89.16-44.54	2.09	12.11	A	1	1.2	1	1	1	134.257	2.46	53.87	C
			B	1	1.2	1	1	1	134.257			
			C	1	1.2	1	1	1	134.257			
L4 44.54-1.00	1.90	16.62	A	1	1.2	1	1	1	170.232	2.69	60.18	C
			B	1	1.2	1	1	1	170.232			
			C	1	1.2	1	1	1	170.232			
Sum Weight:	6.15	35.61	A	1	1.2	1	1	1	201.878	2.63	60.30	C
			B	1	1.2	1	1	1	201.878			
			C	1	1.2	1	1	1	201.878			
								OTM	627.14	8.64		
									kip-ft			

Force Totals

Load Case	Vertical Forces	Sum of Forces X	Sum of Forces Z	Sum of Overturning Moments, M _x	Sum of Overturning Moments, M _z	Sum of Torques
	K	K	K	kip-ft	kip-ft	kip-ft
Leg Weight	35.61					
Bracing Weight	0.00					
Total Member Self-Weight	35.61					
Total Weight	59.18					
Wind 0 deg - No Ice				-7.97	13.81	
Wind 30 deg - No Ice		0.00	-60.74	-7.97	13.81	
Wind 45 deg - No Ice		30.37	-52.61	-6351.16	13.81	-32.57
Wind 60 deg - No Ice		42.95	-42.95	-5501.34	-3157.79	-37.61
Wind 90 deg - No Ice		52.61	-30.37	-4493.29	-4471.51	-36.33
Wind 120 deg - No Ice		60.74	0.00	-3179.57	-5479.56	-32.57
Wind 135 deg - No Ice		52.61	30.37	-7.97	-6329.38	-18.81
Wind 150 deg - No Ice		42.95	42.95	3163.62	-5479.56	0.00
Wind 180 deg - No Ice		30.37	52.61	4477.34	-4471.51	9.73
Wind 210 deg - No Ice		0.00	60.74	5485.39	-3157.79	18.81
Wind 225 deg - No Ice		-30.37	52.61	6335.22	13.81	32.57
Wind 240 deg - No Ice		-42.95	42.95	5485.39	3185.40	37.61
Wind 270 deg - No Ice		-52.61	30.37	4477.34	4499.12	36.33
Wind 300 deg - No Ice		-60.74	0.00	3163.62	5507.17	32.57
Wind 315 deg - No Ice		-52.61	-30.37	-7.97	6357.00	18.81
Wind 330 deg - No Ice		-42.95	-42.95	-3179.57	5507.17	0.00
Member Ice		-30.37	-52.61	-4493.29	4499.12	-9.73
Total Weight Ice	4.12			-5501.34	3185.40	-18.81
Wind 0 deg - Ice	68.94					
Wind 30 deg - Ice		0.00	-56.70	-10.10	17.49	
Wind 45 deg - Ice		28.35	-49.10	-6092.85	17.49	-35.29
Wind 60 deg - Ice		40.09	-40.09	-5277.92	-3023.89	-40.74
Wind 90 deg - Ice		49.10	-28.35	-4311.25	-4283.66	-39.36
Wind 120 deg - Ice		56.70	0.00	-3051.47	-5250.33	-35.29
Wind 135 deg - Ice		49.10	28.35	-10.10	-6065.26	-20.37
Wind 150 deg - Ice		40.09	40.09	3031.28	-5250.33	0.00
Wind 180 deg - Ice		28.35	49.10	4291.06	-4283.66	10.55
Wind 210 deg - Ice		0.00	56.70	5257.72	-3023.89	20.37
Wind 225 deg - Ice		-28.35	49.10	6072.65	17.49	35.29
Wind 240 deg - Ice		-40.09	40.09	5257.72	3058.87	40.74
Wind 270 deg - Ice		-49.10	28.35	4291.06	4318.64	39.36
		-56.70	0.00	3031.28	5285.31	35.29
				-10.10	6100.24	20.37

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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 300 deg - Ice		-49.10	-28.35	-3051.47	5285.31	0.00
Wind 315 deg - Ice		-40.09	-40.09	-4311.25	4318.64	-10.55
Wind 330 deg - Ice		-28.35	-49.10	-5277.92	3058.87	-20.37
Total Weight	59.18			-7.97	13.81	
Wind 0 deg - Service		0.00	-23.73	-2485.78	13.81	-12.72
Wind 30 deg - Service		11.86	-20.55	-2153.82	-1225.10	-14.69
Wind 45 deg - Service		16.78	-16.78	-1760.05	-1738.27	-14.19
Wind 60 deg - Service		20.55	-11.86	-1246.88	-2132.04	-12.72
Wind 90 deg - Service		23.73	0.00	-7.97	-2464.00	-7.35
Wind 120 deg - Service		20.55	11.86	1230.93	-2132.04	0.00
Wind 135 deg - Service		16.78	16.78	1744.10	-1738.27	3.80
Wind 150 deg - Service		11.86	20.55	2137.87	-1225.10	7.35
Wind 180 deg - Service		0.00	23.73	2469.84	13.81	12.72
Wind 210 deg - Service		-11.86	20.55	2137.87	1252.71	14.69
Wind 225 deg - Service		-16.78	16.78	1744.10	1765.88	14.19
Wind 240 deg - Service		-20.55	11.86	1230.93	2159.65	12.72
Wind 270 deg - Service		-23.73	0.00	-7.97	2491.62	7.35
Wind 300 deg - Service		-20.55	-11.86	-1246.88	2159.65	0.00
Wind 315 deg - Service		-16.78	-16.78	-1760.05	1765.88	-3.80
Wind 330 deg - Service		-11.86	-20.55	-2153.82	1252.71	-7.35

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

RISATower

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Job

153' EEI Monopole w/ Branches

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Project

86 Boardman Road, New Milford, CT

Date

11:36:49 01/28/08

Client

Verizon Wireless - New Milford West

Designed by
Staff

Comb. No.	Description
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	154 - 134.83	Pole	Max Tension	47	0.00	-0.00	-0.00
			Max. Compression	18	-9.31	3.81	2.20
			Max. Mx	14	-5.63	103.26	1.44
			Max. My	2	-5.64	2.49	102.00
			Max. Vy	14	-15.56	103.26	1.44
			Max. Vx	2	-15.56	2.49	102.00
			Max. Torque	28			-9.39
L2	134.83 - 89.16	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-29.45	13.71	7.91
			Max. Mx	14	-20.56	1430.86	5.87
			Max. My	2	-20.56	10.16	1426.35
			Max. Vy	14	-42.74	1430.86	5.87
			Max. Vx	2	-42.74	10.16	1426.35
			Max. Torque	28			-31.34
L3	89.16 - 44.54	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-46.50	18.32	10.58
			Max. Mx	14	-36.69	3606.15	8.13
			Max. My	2	-36.69	14.08	3600.14
			Max. Vy	14	-54.16	3606.15	8.13
			Max. Vx	2	-54.16	14.08	3600.14
			Max. Torque	28			-40.47
L4	44.54 - 1	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-68.94	18.39	10.62
			Max. Mx	14	-59.13	6508.91	8.22
			Max. My	2	-59.13	14.24	6502.86
			Max. Vy	14	-60.79	6508.91	8.22
			Max. Vx	2	-60.79	14.24	6502.86
			Max. Torque	28			-40.40

Maximum Reactions

RISATower URS Corporation 500 Enterprise Drive, Suite 3B Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-3991	Job	153' EEI Monopole w/ Branches	Page	15 of 20
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Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	31	68.94	56.70	-0.00
	Max. H _x	14	59.18	60.74	0.00
	Max. H _z	2	59.18	0.00	60.74
	Max. M _x	2	6502.86	0.00	60.74
	Max. M _z	6	6480.28	-60.74	0.00
	Max. Torsion	20	40.36	-28.35	49.10
	Min. Vert	1	59.18	0.00	0.00
	Min. H _x	6	59.18	-60.74	0.00
	Min. H _z	10	59.18	0.00	-60.74
	Min. M _x	10	-6486.33	0.00	-60.74
	Min. M _z	14	-6508.91	60.74	0.00
	Min. Torsion	28	-40.36	28.35	-49.10

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	59.18	-0.00	-0.00	-8.28	14.34	0.00
Dead+Wind 0 deg - No Ice	59.18	-0.00	-60.74	-6502.86	14.23	-32.26
Dead+Wind 30 deg - No Ice	59.18	30.37	-52.61	-5632.70	-3233.06	-37.25
Dead+Wind 45 deg - No Ice	59.18	42.95	-42.95	-4600.57	-4578.12	-35.98
Dead+Wind 60 deg - No Ice	59.18	52.61	-30.37	-3255.49	-5610.21	-32.26
Dead+Wind 90 deg - No Ice	59.18	60.74	-0.00	-8.22	-6480.28	-18.63
Dead+Wind 120 deg - No Ice	59.18	52.61	30.37	3239.03	-5610.17	0.00
Dead+Wind 135 deg - No Ice	59.18	42.95	42.95	4584.09	-4578.07	9.64
Dead+Wind 150 deg - No Ice	59.18	30.37	52.61	5616.19	-3233.02	18.63
Dead+Wind 180 deg - No Ice	59.18	-0.00	60.74	6486.33	14.23	32.26
Dead+Wind 210 deg - No Ice	59.18	-30.37	52.61	5616.27	3261.53	37.25
Dead+Wind 225 deg - No Ice	59.18	-42.95	42.95	4584.17	4606.62	35.98
Dead+Wind 240 deg - No Ice	59.18	-52.61	30.37	3239.10	5638.76	32.26
Dead+Wind 270 deg - No Ice	59.18	-60.74	-0.00	-8.22	6508.91	18.62
Dead+Wind 300 deg - No Ice	59.18	-52.61	-30.37	-3255.56	5638.80	0.00
Dead+Wind 315 deg - No Ice	59.18	-42.95	-42.95	-4600.65	4606.67	-9.64
Dead+Wind 330 deg - No Ice	59.18	-30.37	-52.61	-5632.77	3261.57	-18.62
Dead+Ice+Temp	68.94	-0.00	-0.00	-10.62	18.39	0.00
Dead+Wind 0 deg+Ice+Temp	68.94	0.00	-56.70	-6278.88	18.22	-34.95
Dead+Wind 30 deg+Ice+Temp	68.94	28.35	-49.10	-5439.02	-3115.92	-40.36
Dead+Wind 45 deg+Ice+Temp	68.94	40.09	-40.09	-4442.85	-4414.10	-38.98
Dead+Wind 60 deg+Ice+Temp	68.94	49.10	-28.35	-3144.63	-5410.21	-34.95
Dead+Wind 90 deg+Ice+Temp	68.94	56.70	0.00	-10.52	-6249.94	-20.18
Dead+Wind 120 deg+Ice+Temp	68.94	49.10	28.35	3123.55	-5410.15	0.00
Dead+Wind 135 deg+Ice+Temp	68.94	40.09	40.09	4421.73	-4414.03	10.45
Dead+Wind 150 deg+Ice+Temp	68.94	28.35	49.10	5417.87	-3115.86	20.18
Dead+Wind 180 deg+Ice+Temp	68.94	0.00	56.70	6257.70	18.23	34.95
Dead+Wind 210 deg+Ice+Temp	68.94	-28.35	49.10	5417.98	3152.37	40.36
Dead+Wind 225 deg+Ice+Temp	68.94	-40.09	40.09	4421.86	4450.60	38.98
Dead+Wind 240 deg+Ice+Temp	68.94	-49.10	28.35	3123.66	5446.78	34.95
Dead+Wind 270 deg+Ice+Temp	68.94	-56.70	0.00	-10.52	6286.64	20.18
Dead+Wind 300 deg+Ice+Temp	68.94	-49.10	-28.35	-3144.74	5446.84	0.00
Dead+Wind 315 deg+Ice+Temp	68.94	-40.09	-40.09	-4442.97	4450.67	-10.44
Dead+Wind 330 deg+Ice+Temp	68.94	-28.35	-49.10	-5439.13	3152.43	-20.18
Dead+Wind 0 deg - Service	59.18	0.00	-23.73	-2547.72	14.39	-12.69
Dead+Wind 30 deg - Service	59.18	11.86	-20.55	-2207.50	-1255.31	-14.65
Dead+Wind 45 deg - Service	59.18	16.78	-16.78	-1803.93	-1781.23	-14.15
Dead+Wind 60 deg - Service	59.18	20.55	-11.86	-1278.01	-2184.78	-12.69

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Project

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Date

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Client

Verizon Wireless - New Milford West

Designed by
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Load Combination	Vertical K	Shear _x K	Shear _y K	Overturning Moment, M _x kip-ft	Overturning Moment, M _y kip-ft	Torque kip-ft
Dead+Wind 90 deg - Service	59.18	23.73	-0.00	-8.31	-2524.99	-7.33
Dead+Wind 120 deg - Service	59.18	20.55	11.86	1261.38	-2184.78	0.00
Dead+Wind 135 deg - Service	59.18	16.78	16.78	1787.31	-1781.22	3.79
Dead+Wind 150 deg - Service	59.18	11.86	20.55	2190.86	-1255.30	7.33
Dead+Wind 180 deg - Service	59.18	0.00	23.73	2531.08	14.39	12.69
Dead+Wind 210 deg - Service	59.18	-11.86	20.55	2190.87	1284.09	14.65
Dead+Wind 225 deg - Service	59.18	-16.78	16.78	1787.32	1810.02	14.15
Dead+Wind 240 deg - Service	59.18	-20.55	11.86	1261.39	2213.59	12.69
Dead+Wind 270 deg - Service	59.18	-23.73	-0.00	-8.31	2553.80	7.33
Dead+Wind 300 deg - Service	59.18	-20.55	-11.86	-1278.02	2213.59	0.00
Dead+Wind 315 deg - Service	59.18	-16.78	-16.78	-1803.95	1810.03	-3.79
Dead+Wind 330 deg - Service	59.18	-11.86	-20.55	-2207.51	1284.10	-7.33

Solution Summary

Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
1	0.00	-59.18	0.00	0.00	59.18	0.00	0.000%
2	0.00	-59.18	-60.74	0.00	59.18	60.74	0.000%
3	30.37	-59.18	-52.61	-30.37	59.18	52.61	0.000%
4	42.95	-59.18	-42.95	-42.95	59.18	42.95	0.000%
5	52.61	-59.18	-30.37	-52.61	59.18	30.37	0.000%
6	60.74	-59.18	0.00	-60.74	59.18	0.00	0.000%
7	52.61	-59.18	30.37	-52.61	59.18	-30.37	0.000%
8	42.95	-59.18	42.95	-42.95	59.18	-42.95	0.000%
9	30.37	-59.18	52.61	-30.37	59.18	-52.61	0.000%
10	0.00	-59.18	60.74	0.00	59.18	-60.74	0.000%
11	-30.37	-59.18	52.61	30.37	59.18	-52.61	0.000%
12	-42.95	-59.18	42.95	42.95	59.18	-42.95	0.000%
13	-52.61	-59.18	30.37	52.61	59.18	-30.37	0.000%
14	-60.74	-59.18	0.00	60.74	59.18	0.00	0.000%
15	-52.61	-59.18	-30.37	52.61	59.18	30.37	0.000%
16	-42.95	-59.18	-42.95	42.95	59.18	42.95	0.000%
17	-30.37	-59.18	-52.61	30.37	59.18	52.61	0.000%
18	0.00	-68.94	0.00	0.00	68.94	0.00	0.000%
19	0.00	-68.94	-56.70	-0.00	68.94	56.70	0.000%
20	28.35	-68.94	-49.10	-28.35	68.94	49.10	0.000%
21	40.09	-68.94	-40.09	-40.09	68.94	40.09	0.000%
22	49.10	-68.94	-28.35	-49.10	68.94	28.35	0.000%
23	56.70	-68.94	0.00	-56.70	68.94	-0.00	0.000%
24	49.10	-68.94	28.35	-49.10	68.94	-28.35	0.000%
25	40.09	-68.94	40.09	-40.09	68.94	-40.09	0.000%
26	28.35	-68.94	49.10	-28.35	68.94	-49.10	0.000%
27	0.00	-68.94	56.70	0.00	68.94	-56.70	0.000%
28	-28.35	-68.94	49.10	28.35	68.94	-49.10	0.000%
29	-40.09	-68.94	40.09	40.09	68.94	-40.09	0.000%
30	-49.10	-68.94	28.35	49.10	68.94	-28.35	0.000%
31	-56.70	-68.94	0.00	56.70	68.94	-0.00	0.000%
32	-49.10	-68.94	-28.35	49.10	68.94	28.35	0.000%
33	-40.09	-68.94	-40.09	40.09	68.94	40.09	0.000%
34	-28.35	-68.94	-49.10	28.35	68.94	49.10	0.000%
35	0.00	-59.18	-23.73	0.00	59.18	23.73	0.000%
36	11.86	-59.18	-20.55	-11.86	59.18	20.55	0.000%
37	16.78	-59.18	-16.78	-16.78	59.18	16.78	0.000%
38	20.55	-59.18	-11.86	-20.55	59.18	11.86	0.000%
39	23.73	-59.18	0.00	-23.73	59.18	0.00	0.000%
40	20.55	-59.18	11.86	-20.55	59.18	-11.86	0.000%

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Load Comb.	Sum of Applied Forces			Sum of Reactions			% Error
	PX K	PY K	PZ K	PX K	PY K	PZ K	
41	16.78	-59.18	16.78	-16.78	59.18	-16.78	0.000%
42	11.86	-59.18	20.55	-11.86	59.18	-20.55	0.000%
43	0.00	-59.18	23.73	0.00	59.18	-23.73	0.000%
44	-11.86	-59.18	20.55	11.86	59.18	-20.55	0.000%
45	-16.78	-59.18	16.78	16.78	59.18	-16.78	0.000%
46	-20.55	-59.18	11.86	20.55	59.18	-11.86	0.000%
47	-23.73	-59.18	0.00	23.73	59.18	0.00	0.000%
48	-20.55	-59.18	-11.86	20.55	59.18	11.86	0.000%
49	-16.78	-59.18	-16.78	16.78	59.18	16.78	0.000%
50	-11.86	-59.18	-20.55	11.86	59.18	20.55	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	0.00012711
3	Yes	5	0.00000001	0.00019273
4	Yes	5	0.00000001	0.00028739
5	Yes	5	0.00000001	0.00031623
6	Yes	5	0.00000001	0.00007336
7	Yes	5	0.00000001	0.00021721
8	Yes	5	0.00000001	0.00023950
9	Yes	5	0.00000001	0.00018773
10	Yes	5	0.00000001	0.00012705
11	Yes	5	0.00000001	0.00033527
12	Yes	5	0.00000001	0.00028853
13	Yes	5	0.00000001	0.00018931
14	Yes	5	0.00000001	0.00007343
15	Yes	5	0.00000001	0.00022220
16	Yes	5	0.00000001	0.00024413
17	Yes	5	0.00000001	0.00027397
18	Yes	4	0.00000001	0.00002683
19	Yes	5	0.00000001	0.00028625
20	Yes	5	0.00000001	0.00045021
21	Yes	5	0.00000001	0.00063170
22	Yes	5	0.00000001	0.00066515
23	Yes	5	0.00000001	0.00017903
24	Yes	5	0.00000001	0.00047674
25	Yes	5	0.00000001	0.00053776
26	Yes	5	0.00000001	0.00042964
27	Yes	5	0.00000001	0.00028556
28	Yes	5	0.00000001	0.00070418
29	Yes	5	0.00000001	0.00063545
30	Yes	5	0.00000001	0.00044258
31	Yes	5	0.00000001	0.00017981
32	Yes	5	0.00000001	0.00049135
33	Yes	5	0.00000001	0.00055250
34	Yes	5	0.00000001	0.00058688
35	Yes	5	0.00000001	0.00003658
36	Yes	5	0.00000001	0.00003668
37	Yes	5	0.00000001	0.00005126
38	Yes	5	0.00000001	0.00005525
39	Yes	4	0.00000001	0.00065420
40	Yes	4	0.00000001	0.00085934
41	Yes	5	0.00000001	0.00003290

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42	Yes	4	0.00000001	0.00077664
43	Yes	5	0.00000001	0.00003615
44	Yes	5	0.00000001	0.00006102
45	Yes	5	0.00000001	0.00005191
46	Yes	5	0.00000001	0.00003307
47	Yes	4	0.00000001	0.00066880
48	Yes	4	0.00000001	0.00093955
49	Yes	5	0.00000001	0.00003556
50	Yes	5	0.00000001	0.00004396

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	154 - 134.83	36.657	48	2.0379	0.0455
L2	139.16 - 89.16	30.357	48	1.9992	0.0410
L3	94.83 - 44.54	13.932	48	1.4013	0.0198
L4	51.46 - 1	4.032	48	0.7298	0.0071

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
150.00	EEI Pine Branches	48	34.946	2.0323	0.0444	25285
140.00	EEI Pine Branches	48	30.708	2.0034	0.0413	9186
130.00	EEI Pine Branches	48	26.598	1.9305	0.0373	6494
120.00	EEI Pine Branches	48	22.673	1.8144	0.0325	5156
110.00	EEI Pine Branches	48	18.981	1.6657	0.0273	4275
100.00	EEI Pine Branches	48	15.569	1.4948	0.0222	3650
90.00	EEI Pine Branches	48	12.487	1.3126	0.0176	3353
80.00	EEI Pine Branches	48	9.761	1.1306	0.0138	3271

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	154 - 134.83	92.788	15	5.1466	0.1253
L2	139.16 - 89.16	76.904	15	5.0534	0.1130
L3	94.83 - 44.54	35.387	15	3.5548	0.0545
L4	51.46 - 1	10.260	15	1.8563	0.0195

Critical Deflections and Radius of Curvature - Design Wind

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Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
150.00	EEI Pine Branches	15	88.475	5.1345	0.1223	10422
140.00	EEI Pine Branches	15	77.790	5.0641	0.1138	3782
130.00	EEI Pine Branches	15	67.417	4.8769	0.1027	2648
120.00	EEI Pine Branches	15	57.502	4.5787	0.0893	2088
110.00	EEI Pine Branches	15	48.167	4.2021	0.0750	1722
100.00	EEI Pine Branches	15	39.535	3.7801	0.0611	1465
90.00	EEI Pine Branches	15	31.725	3.3449	0.0488	1340
80.00	EEI Pine Branches	15	24.813	2.9190	0.0386	1302

Compression Checks

Pole Design Data

Section No.	Elevation	Size	L	L _u	Kl/r	F _a	A	Actual P	Allow. P _a	Ratio P
	ft		ft	ft		ksi	in ²	K	K	P _a
L1	154 - 134.83 (1)	TP30.03x25.25x0.1875	19.17	0.00	0.0	38.627	17.1175	-8.01	661.20	0.012
L2	134.83 - 89.16 (2)	TP40.91x28.5753x0.3125	50.00	0.00	0.0	39.000	38.8803	-20.56	1516.33	0.014
L3	89.16 - 44.54 (3)	TP51.28x38.8862x0.5	50.29	0.00	0.0	39.000	77.8814	-36.69	3037.37	0.012
L4	44.54 - 1 (4)	TP61x48.5746x0.5625	50.46	0.00	0.0	39.000	107.9040	-59.13	4208.24	0.014

Pole Bending Design Data

Section No.	Elevation	Size	Actual M _x	Actual f _{bx}	Allow. F _{bx}	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M _y	Actual f _{by}	Allow. F _{by}	Ratio $\frac{f_{by}}{F_{by}}$
	ft		kip-ft	ksi	ksi		kip-ft	ksi	ksi	
L1	154 - 134.83 (1)	TP30.03x25.25x0.1875	102.44	10.105	38.627	0.262	0.00	0.000	38.627	0.000
L2	134.83 - 89.16 (2)	TP40.91x28.5753x0.3125	1432.09	45.701	39.000	1.172	0.00	0.000	39.000	0.000
L3	89.16 - 44.54 (3)	TP51.28x38.8862x0.5	3608.35	46.018	39.000	1.180	0.00	0.000	39.000	0.000
L4	44.54 - 1 (4)	TP61x48.5746x0.5625	6511.12	48.623	39.000	1.247	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation	Size	Actual V	Actual f _v	Allow. F _v	Ratio $\frac{f_v}{F_v}$	Actual T	Actual f _{vt}	Allow. F _{vt}	Ratio $\frac{f_{vt}}{F_{vt}}$
	ft		K	ksi	ksi		kip-ft	ksi	ksi	
L1	154 - 134.83 (1)	TP30.03x25.25x0.1875	15.44	0.902	26.000	0.069	0.00	0.000	26.000	0.000
L2	134.83 - 89.16 (2)	TP40.91x28.5753x0.3125	42.74	1.099	26.000	0.085	7.48	0.117	26.000	0.004
L3	89.16 - 44.54 (3)	TP51.28x38.8862x0.5	54.16	0.695	26.000	0.053	0.00	0.000	26.000	0.000

RISATower URS Corporation 500 Enterprise Drive, Suite 3B Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-3991	Job	153' EEI Monopole w/ Branches	Page	20 of 20
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	Client	Verizon Wireless - New Milford West	Designed by	Staff

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 $\frac{f_{vt}}{F_{vt}}$
L4	44.54 - 1 (4)	TP61x48.5746x0.5625	60.79	0.563	26.000	0.043	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio P P_a	Ratio f_{bx} F_{bx}	Ratio f_{by} F_{by}	Ratio f_v F_v	Ratio f_{vt} F_{vt}	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	154 - 134.83 (1)	0.012	0.262	0.000	0.069	0.000	0.275 ✓	1.333	H1-3+VT ✓
L2	134.83 - 89.16 (2)	0.014	1.172	0.000	0.085	0.004	1.188 ✓	1.333	H1-3+VT ✓
L3	89.16 - 44.54 (3)	0.012	1.180	0.000	0.053	0.000	1.193 ✓	1.333	H1-3+VT ✓
L4	44.54 - 1 (4)	0.014	1.247	0.000	0.043	0.000	1.261 ✓	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	154 - 134.83	Pole	TP30.03x25.25x0.1875	1	-8.01	881.38	20.6	Pass
L2	134.83 - 89.16	Pole	TP40.91x28.5753x0.3125	2	-20.56	2021.27	89.1	Pass
L3	89.16 - 44.54	Pole	TP51.28x38.8862x0.5	3	-36.69	4048.81	89.5	Pass
L4	44.54 - 1	Pole	TP61x48.5746x0.5625	4	-59.13	5609.58	94.6	Pass
							Summary	
							Pole (L4)	94.6 Pass
							RATING =	94.6 Pass

ANCHOR BOLT AND BASE PLATE ANALYSIS

ANCHOR BOLT AND BASE PLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	OM := 6511·ft·kips	user input
Shear Force:	Shear := 61·kips	user input
Axial Force:	Axial := 59·kips	user input

Anchor Bolt Data:

Use ASTM A615 Grade 75	user input
Number of Anchor Bolts = N	$N_{\text{wb}} := 28$ user input
Diameter of Bolt Circle:	$D_{\text{bc}} := 68\text{in}$ user input
Bolt "Column" Distance:	$L_{\text{w}} := 3.25\text{in}$ user input
Bolt Ultimate Strength:	$F_u := 100\text{·ksi}$ user input
Bolt Yield Strength:	$F_y := 75\text{·ksi}$ user input
Bolt Modulus:	$E := 29000\text{·ksi}$ user input
Anchor Bolt Diameter	$D := 2.25\text{in}$ user input
Threads per Inch:	$n := 4.5$ user input

Base Plate Data:

Use ASTM A572 Grade 60	user input
Plate Yield Strength:	$F_{y_{\text{bp}}} := 60\text{·ksi}$ user input
Base Plate Thickness:	PlateThickness := 3.00·in user input
Base Plate Diameter:	$D_{\text{bp}} := 74\text{·in}$ user input
Outer Pole Diameter:	$D_{\text{pole}} := 61.00\text{in}$ 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: $i := 1..N$

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

$d_1 = 7.57 \cdot \text{in}$	$d_7 = 34.00 \cdot \text{in}$
$d_2 = 14.75 \cdot \text{in}$	$d_8 = 33.15 \cdot \text{in}$
$d_3 = 21.20 \cdot \text{in}$	$d_9 = 30.63 \cdot \text{in}$
$d_4 = 26.58 \cdot \text{in}$	$d_{10} = 26.58 \cdot \text{in}$
$d_5 = 30.63 \cdot \text{in}$	$d_{11} = 21.20 \cdot \text{in}$
$d_6 = 33.15 \cdot \text{in}$	etc.

Critical Distances For Bending in Plate:

Outer Pole Radius: $R_{pole} := \frac{D_{pole}}{2}$ $R_{pole} = 30.50 \cdot \text{in}$

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

$MA_1 = 0.00 \cdot \text{in}$	$MA_7 = 3.50 \cdot \text{in}$
$MA_2 = 0.00 \cdot \text{in}$	$MA_8 = 2.65 \cdot \text{in}$
$MA_3 = 0.00 \cdot \text{in}$	$MA_9 = 0.13 \cdot \text{in}$
$MA_4 = 0.00 \cdot \text{in}$	$MA_{10} = 0.00 \cdot \text{in}$
$MA_5 = 0.13 \cdot \text{in}$	$MA_{11} = 0.00 \cdot \text{in}$
$MA_6 = 2.65 \cdot \text{in}$	etc.

Effective Width of Baseplate for Bending: $\text{EffectiveWidth} := .8 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2} \right)^2 - \left(\frac{D_{pole}}{2} \right)^2}$ $\text{EffectiveWidth} = 33.51 \cdot \text{in}$

Anchor Bolt Analysis:

Polar Moment of Inertia I_p :

$$I_p := \sum_i (d_i)^2 \quad I_p = 1.618 \times 10^4 \cdot \text{in}^2$$

Gross Area of Bolt:

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

Net Area of Bolt:

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

Net Diameter:

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

Radius of Gyration of Bolt:

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

Section Modulus of Bolt:

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

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left(\frac{\text{Shear}}{N} \right) \cdot l \quad M_x = 0.590 \cdot \text{ft} \cdot \text{kips}$$

$$f_{bx} := \frac{M_x}{S_x} \quad f_{bx} = 8.6 \cdot \text{ksi}$$

Allowable Bending

$$F_{bx} := 1.333 \cdot 0.60 \cdot F_y \quad F_{bx} = 60.0 \cdot \text{ksi}$$

Note: 1.333 increase allowed per TIA/EIA

Check Tensile Forces:

Maximum Tensile Force (Gross Area):

$$\text{AllowableTension} := 1.333 \cdot (0.33 \cdot A_g \cdot F_u) \quad \text{AllowableTension} = 174.9 \cdot \text{kips}$$

Note: 1.333 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

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

Note: 1.333 increase allowed per TIA/EIA

Applied Tension:

$$\text{MaxTension} := \frac{OM \cdot R_{bc}}{I_p} - \frac{\text{Axial}}{N} \quad \text{MaxTension} = 162.0 \cdot \text{kips}$$

Check Stresses:

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

$$\frac{\text{MaxTension}}{F_{\text{net.area}}} = 0.83$$

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

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:

$$l_w := \begin{cases} 1 & \text{if } l > 2 \cdot D_n \\ 0.00 \text{ in} & \text{otherwise} \end{cases} \quad l = 0.00 \text{ in} \quad f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0.0 \text{ ksi} & \text{otherwise} \end{cases} \quad f_{bx} = 0.0 \text{ ksi}$$

Allowable Compressive Force:

$$K_w := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{F_y}} \quad C_c = 87.36$$

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

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

Applied Compressive Force:

$$\text{MaxCompression} := \frac{OM \cdot R_{bc}}{I_p} + \frac{\text{Axial}}{N} \quad \text{MaxCompression} = 166.3 \text{ kips}$$

$$f_a := \frac{\text{MaxCompression}}{A_n} \quad f_a = 51.2 \text{ ksi}$$

Check Combined Stresses:

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} = 0.85$$

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

Condition = "OK"

Base Plate Analysis:

Force from Bolt(s):

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

$$C_1 = 38.6 \cdot \text{kips}$$

$$C_7 = 166.3 \cdot \text{kips}$$

$$C_2 = 73.3 \cdot \text{kips}$$

$$C_8 = 162.1 \cdot \text{kips}$$

$$C_3 = 104.4 \cdot \text{kips}$$

$$C_9 = 150.0 \cdot \text{kips}$$

$$C_4 = 130.4 \cdot \text{kips}$$

$$C_{10} = 130.4 \cdot \text{kips}$$

$$C_5 = 150.0 \cdot \text{kips}$$

$$C_{11} = 104.4 \cdot \text{kips}$$

$$C_6 = 162.1 \cdot \text{kips}$$

etc.

Bending Stress in Plate:

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

$$f_{bp} = 29.4 \cdot \text{ksi}$$

Check Stresses:

$$\frac{f_{bp}}{1.333 \cdot 0.75 F_{y_{bp}}} = 0.49$$

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

Condition = "OK"

FOUNDATION ANALYSIS

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 6511 \cdot \text{ft-kips}$
Shear at Base of Tower	$S_t := 61 \text{ kip}$
Max Compressive Force	$C_t := 59 \cdot \text{kip}$
Height of Tower	$H_t := 153.0 \cdot \text{ft}$
Base Plate Bolt Circle	$MP := 68.0 \text{ in}$

PROPERTIES:

Compressive Strength of Concrete	$f'_c := 3000 \text{ psi}$
Yield Strength of Steel Reinforcement	$f_y := 60000 \cdot \text{psi}$
Yield Strength of Anchor Bolt	$f_{ya} := 75000 \cdot \text{psi}$
Internal Friction Angle of Soil	$\theta_s := 10 \cdot \text{deg}$
Allowable Bearing Capacity	$q_s := 6000 \cdot \text{psf}$
Unit Weight of Soil	$\pi_s := 100 \cdot \text{pcf}$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 6.5 \text{ ft}$
Length of Pier	$L_p := 3.5 \cdot \text{ft}$
Extension of Pier Above Grade	$L_{pag} := 1.0 \cdot \text{ft}$
Diameter of Pier	$d_p := 7.5 \cdot \text{ft}$
Thickness of Footing	$T_f := 4.0 \cdot \text{ft}$
Width of Footing:	$W_f := 32.00 \text{ ft}$
Length of Anchor Bolts:	$L_{st} := 96 \text{ in}$
Projection of anchor bolts above pier	$A_{BP} := 12.0 \cdot \text{in}$

Unit Weight of Concrete	$\pi_c := 150 \cdot \text{pcf}$
Depth to Neglect	$n := 1.0 \text{ ft}$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c_{\text{max}} := 0 \cdot \text{ksf}$
Seismic Zone Factor: UBC Fig 23-2	$Z := 2$
Coefficient of Friction between Concrete:	$\mu := 0.45$
Clear Cover of Reinforcement Pier:	$C_{vr_pier} := 3 \cdot \text{in}$
Clear Cover of Reinforcement Pad:	$C_{vr_pad} := 3 \cdot \text{in}$
Anchor Bolt Diameter	$d_{\text{anchor}} := 2.25 \text{ in}$
Anchor bolt area	$A_{\text{anchor}} := 3.98 \cdot \text{in}^2$

PIER REINFORCEMENT:

Bar Size	$BS_{\text{pier}} := 11$	Bar Diameter	$d_{\text{bpier}} := 1.410 \cdot \text{in}$
Number of Bars	$NB_{\text{pier}} := 36$	Bar Area	$A_{\text{bpier}} := 1.560 \cdot \text{in}^2$

PAD REINFORCEMENT:

TOP:	Bar Size	$BS_{\text{top}} := 11$	Bar Diameter	$d_{\text{btop}} := 1.410 \cdot \text{in}$
	Number of Bars	$NB_{\text{top}} := 42$	Bar Area	$A_{\text{btop}} := 1.560 \cdot \text{in}^2$
BOTTOM:	Bar Size	$BS_{\text{bot}} := 11$	Bar Diameter	$d_{\text{bbot}} := 1.410 \cdot \text{in}$
	Number of Bars	$NB_{\text{bot}} := 42$	Bar Area	$A_{\text{bot}} := 1.560 \cdot \text{in}^2$

Coefficient of Lateral Soil Pressure: $K_p := \frac{1 + \sin(\theta_s)}{1 - \sin(\theta_s)} K_p = 1.4203$

Load Factor (EIA 3.1.1): $LF := \text{if } H_t \leq 700 \cdot \text{ft}, 1.333, \text{if } H_t \geq 1200, 1.7, 1.333 + \left(\frac{H_t - 700}{1200 - 700} \right) \cdot 0.4 \quad LF = 1.333$

CHECK ANCHOR STEEL EMBEDMENT

Depth: $D_{ab} := L_{st} - A_{BP}$ $D_{ab} = 7 \cdot \text{ft}$ $L_{anchor} := \frac{(0.11 \cdot f_y) \cdot \text{in}}{\sqrt{f_c \cdot \text{psi}}}$ $L_{anchor} = 12.552 \cdot \text{ft}$

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

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

STABILITY OF FOOTING

Passive Pressure: $P_{pn} := K_p \cdot \pi_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pn} = 0.142 \cdot \text{ksf}$

$P_{pt} := K_p \cdot \pi_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pt} = 0.3551 \cdot \text{ksf}$

$P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}]$ $P_{top} = 0.3551 \cdot \text{ksf}$

$P_{bot} := K_p \cdot \pi_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 0.9232 \cdot \text{ksf}$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 0.6391 \cdot \text{ksf}$

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

$A_p := W_f \cdot T_p$ $A_p = 128 \cdot \text{ft}^2$

Ultimate Shear: $S_u := P_{ave} \cdot A_p$ $S_u = 81.8079 \cdot \text{kip}$

Weight of Concrete Pad: $WT_c := \left[(W_f^2 \cdot T_f) + \frac{d_p^2 \cdot \pi}{4} L_p \right] \cdot \pi_c$ $WT_c = 637.5938 \cdot \text{kip}$

Weight of Soil above Footing: $WT_{s1} := \left[W_f^2 \cdot (|L_p - L_{pag}|) - \frac{d_p^2 \cdot \pi}{4} \cdot (|L_p - L_{pag}|) \right] \cdot \pi_s$ $WT_{s1} = 244.9553 \cdot \text{kip}$

Weight of Soil Wedge at back face: $WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\theta_s)}{2} \cdot W_f \right) \cdot \pi_s$ $WT_{s2} = 11.9197 \cdot \text{kip}$

Total Weight: $WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 941.5491 \cdot \text{kip}$

Resisting Moment: $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\theta_s)}{3} \right)$ $M_r = 15559.8476 \cdot \text{kip} \cdot \text{ft}$

Overturning Moment: $M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 6968.5 \cdot \text{kip} \cdot \text{ft}$

Factor of Safety: $FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 2.23$

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

SHEAR CAPACITY IN PIER $FS := 2$

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

$$S_p = 252.7525 \cdot \text{kips}$$

$$\text{ShearCheck} := \text{if}(S_p > S_t, \text{"Okay"}, \text{"No Good"})$$

$$\text{ShearCheck} = \text{"Okay"}$$

BEARING PRESSURE CAUSED BY FOOTING

$$A_{mat} := W_f^2$$

$$A_{mat} = 1024 \cdot \text{ft}^2$$

$$S := \frac{W_f^3}{6}$$

$$S = 5461.3333 \cdot \text{ft}^3$$

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

$$P_{max} = 2.1955 \cdot \text{ksf}$$

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

$$P_{min} = -0.3565 \cdot \text{ksf}$$

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

$$\text{MaxPressure} = \text{"Okay"}$$

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

$$\text{MinPressure} = \text{"No Good"}$$

Distance to Resultant of Pressure Distribution:

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

$$X_p = 9.1766 \cdot \text{ft}$$

Distance to Kern:

$$X_k := \frac{W_f}{6}$$

$$X_k = 5.3333 \cdot \text{ft}$$

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

Eccentricity:

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

$$e = 7.4011$$

Adjusted Soil Pressure:

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

$$P_a = 2.2812 \cdot \text{ksf}$$

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

$$q_{adj} = 2.2812 \cdot \text{ksf}$$

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

$$\text{PressureCheck} = \text{"Okay"}$$

CONCRETE BEARING CAPACITY (ACI 10.17)

$$\theta_c := 0.75 \quad (\text{ACI 9.3.2.2})$$

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

$$P_b = 12166.7993 \cdot \text{kip}$$

$$\text{BearingCheck} := \text{if}(P_b > L F \cdot C_t, \text{"Okay"}, \text{"No Good"})$$

$$\text{BearingCheck} = \text{"Okay"}$$

SHEAR STRENGTH OF CONCRETE

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

$$\theta_{\text{max}} := .85 \quad (\text{ACI 9.3.2.3})$$

$$d := T_f - C_{\text{vr}} \cdot \text{pad} - d_{\text{bbot}}$$

$$d = 43.59 \cdot \text{in}$$

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

$$d_1 = 12.25 \cdot \text{ft}$$

$$d_2 := d_1 - d$$

$$d_2 = 8.6175 \cdot \text{ft}$$

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

$$L = 25.7967 \cdot \text{ft}$$

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

$$\text{Slope} = 0.0884 \cdot \text{kcf}$$

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

$$V_{\text{req}} = 908.9769 \cdot \text{kip}$$

ACI 11.3.1.1

$$V_{\text{Avail}} := \theta_c \cdot 2 \cdot \sqrt{f_c \cdot \text{psi}} \cdot W_f \cdot d$$

$$V_{\text{Avail}} = 1558.5748 \cdot \text{kip}$$

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

$$\text{BeamShearCheck} = \text{"Okay"}$$

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

$$b_o := (d_p + d) \cdot \pi$$

$$b_o = 34.9738 \cdot \text{ft}$$

Area included inside bo:

$$A_{\text{bo}} := \frac{\pi \cdot (d_p + d)^2}{4}$$

$$A_{\text{bo}} = 97.3364 \cdot \text{ft}^2$$

Area outside of bo:

$$A_{\text{out}} := A_{\text{mat}} - A_{\text{bo}}$$

$$A_{\text{out}} = 926.6636 \cdot \text{ft}^2$$

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Guess Value: $v_u := 1 \text{ksf}$

(From "Foundation Analysis and design",
By Joseph Bowles, Eq. 8-9)

$$\text{Given} \quad d^2 + d_p \cdot d = \frac{W_{T_{\text{tot}}}}{\pi \cdot v_u}$$

$$W_{\text{av}} := \text{Find}(v_u)$$

$$v_u = 7.4113 \cdot \text{ksf}$$

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

$$V_u = 861.4903 \cdot \text{kips}$$

$$V_{\text{req}} := LF \cdot V_u$$

$$V_{\text{req}} = 1148.3666 \cdot \text{kips}$$

$$V_{\text{avail}} := \theta_c \cdot 4 \cdot \sqrt{f_c \cdot \text{psi}} \cdot b_o \cdot d$$

$$V_{\text{avail}} = 3406.8282 \cdot \text{kips}$$

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

$$\text{PunchingShearCheck} = \text{"Okay"}$$

STEEL REINFORCEMENT IN THE PAD

$$\theta_m := .90 \text{ ACI 9.3.2.2}$$

Take Maximum Bending at face of Pier:

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

$$q_b = 1.1979 \cdot \text{ksf}$$

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

$$M_n = 3842.7435 \cdot \text{kip} \cdot \text{ft}$$

ACI 10.2.7.3

$$\beta := \text{if} \left[f_c \leq 4000 \cdot \text{psi}, .85, \text{if} \left[f_c \geq 8000 \cdot \text{psi}, .65, .85 - \left(\frac{\frac{f_c}{\text{psi}} - 4000}{1000} \right) \cdot .05 \right] \right] \beta = 0.85$$

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

$$R_u = 10112 \text{ lbf}$$

$$\rho := \frac{0.85 \cdot f_c}{f_y} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f_c}} \right)$$

$$\rho = 0.0012$$

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

$$\rho_{\text{min}} = 0.00158$$

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

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $A_s := \max(\rho \rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $A_s = 30.1294 \cdot \text{in}^2$

$A_{s_{prov}} := A_{bot} \cdot NB_{bot}$ $A_{s_{prov}} = 65.52 \cdot \text{in}^2$

PadReinforcement := if($A_{s_{prov}} > A_s$, "Okay", "No Good") PadReinforcement = "Okay"

FOR TOP BARS: $A_s := \rho_{sh} \cdot (W_f \cdot d)$ $A_s = 30.1294 \cdot \text{in}^2$

$A_{s_{prov}} := A_{bot} \cdot NB_{top}$ $A_{s_{prov}} = 65.52 \cdot \text{in}^2$

PadReinforcement := if($A_{s_{prov}} > A_s$, "Okay", "No Good") PadReinforcement = "Okay"

TENSION (ACI 12.2.3) DEVELOPMENT LENGTH OF PAD REINFORCEMENT

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot C_{vr_{pad}} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 7.7751 \cdot \text{in}$

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: $c := \text{if}\left(C_{vr_{pad}} < \frac{B_{sPad}}{2}, C_{vr_{pad}}, \frac{B_{sPad}}{2}\right)$ $c = 3 \cdot \text{in}$

Transverse Reinforcement Index $k_{tr} := 0$

$L_{dbt} := \frac{3}{40} \cdot \frac{\bar{f}_y}{\sqrt{\bar{f}_c \cdot \text{psi}}} \cdot \frac{\alpha \cdot \beta \cdot \pi \cdot \lambda}{c + k_{tr}} \cdot d_{bbot}$ $L_{dbt} = 54.4464 \cdot \text{in}$

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

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

(ACI 12.2.1)

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - C_{vr_{pad}}$ $L_{Pad} = 144 \cdot \text{in}$

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

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REINFORCEMENT IN PIER

Pier Area: $A_p = \frac{\pi \cdot d_p^2}{4}$ $A_p = 6361.7251 \cdot \text{in}^2$

(ACI 10.8.4 and 10.9.1) $A_{smin} := 0.01 \cdot 0.05 \cdot A_p$ $A_{smin} = 3.1809 \cdot \text{in}^2$

$A_{sprov} := NB_{pier} \cdot A_{bpier}$ $A_{sprov} = 56.16 \cdot \text{in}^2$

SteelAreaCheck := if($A_{sprov} > A_{smin}$, "Okay", "No Good") 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: $B_{spier} := \frac{d_p \cdot \pi}{NB_{pier}} - d_{bpier}$ $B_{spier} = 6.444 \cdot \text{in}$

Diameter of Reinforcement Cage: $Diam_{cage} := d_p - 2 \cdot C_{vr_{pier}}$ $Diam_{cage} = 84 \cdot \text{in}$

Maximum Moment in Pier: $M_p := \left[M_t + S_t \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF$ $M_p = 108052.98 \cdot \text{in} \cdot \text{kips}$

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

(defined variables) $(f_c \ f_y \ c1 \ Spiral) = (3 \ 60 \ 3 \ 0)$

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: $(D \ N_{\text{bar}} \ P_u \ M_{xu}) := (90 \ 36 \ 11 \ 79 \ 108053)$

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: $(\theta P_n \ \theta M_{xn} \ f_{sp} \ \rho) = (81.5948 \ 111602.0566 \ -60 \ 0.0088)$

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") AxialLoadCheck = "Okay"

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

DEVELOPMENT LENGTH OF PIER REINFORCEMENT

TENSION (ACI 12.2.3)

Factors for development:

Reinforcement Location Factor	$\alpha_w := 1.0$
Coating Factor	$\beta_w := 1.0$
Concrete strength Factor	$\lambda_w := 1.0$
Reinforcement Size Factor	$\pi_w := 1.0$

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

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

$$L_{dbw} := \frac{3}{40} \cdot \frac{f_y}{\sqrt{f_c \cdot \text{psi}}} \cdot \frac{\alpha \cdot \beta \cdot \pi \cdot \lambda}{c + k_{tr}} \cdot d_{bpier} \quad L_{dbt} = 54.4464 \cdot \text{in}$$

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

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

$$L_{dh} := \frac{1200 \cdot d_{bpier}}{\sqrt{\frac{f_c}{\text{psi}}}} \cdot .7 \quad L_{dh} = 21.6241 \cdot \text{in}$$

$$L_{db} := \max(L_{dbt}, L_{dbmin}) \quad L_{db} = 54.4464 \cdot \text{in}$$

COMPRESSION: (ACI 12.3.2)

$$L_{dbc1} := \frac{.02 \cdot d_{bpier} \cdot f_y}{\sqrt{f_c \cdot \text{psi}}} \quad L_{dbc1} = 30.8916 \cdot \text{in}$$

$$L_{dbmin} := 0.0003 \cdot \frac{\text{in}^2}{\text{lb}} \cdot (d_{bpier} \cdot f_y) \quad L_{dbmin} = 25.38 \cdot \text{in}$$

$$L_{dbc} := \text{if}(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}) \quad L_{dbc} = 30.8916 \cdot \text{in}$$

Available Length in Foundation:

$$L_{pier} := L_p - C_{vr_pier} \quad L_{pier} = 39 \cdot \text{in}$$

$$L_{pad} := T_f - C_{vr_pad} \quad L_{pad} = 45 \cdot \text{in}$$

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

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

NOTE: Anchor bolts and plate provided, OK

TIE SIZE AND SPACING IN COLUMN

Minimum Tie Size:

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

$$Tie_{min} = 4$$

Used #4 Ties

$$d_{Tie} := 4$$

Seismic factor:
(ACI 21.10.5)

$$z := \text{if}(Z \leq 2, 1, 0.5)$$

$$z = 1$$

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

$$s_{lim1} = 22.56 \cdot \text{in}$$

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

$$s_{lim2} = 24 \cdot \text{in}$$

$$s_{lim3} := D_f \cdot z$$

$$s_{lim3} = 78 \cdot \text{in}$$

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

$$s_{lim4} = 18 \cdot \text{in}$$

Maximum Spacing:

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

$$s_{tie} = 18 \cdot \text{in}$$

Number of Ties Required:

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

$$n_{tie} = 3$$