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

November 15, 2007

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

RE: **EM-VER-023-071025** - Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 14 Canton Springs Road, Canton, Connecticut.

Dear Attorney Baldwin:

At a public meeting held on November 5, 2007, 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 October 25, 2007, 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

Daniel F. Caruso
Chairman

DFC/MP/cm

c: The Honorable Mary B. Tomolonius, First Selectman, Town of Canton
Neil Pade, Town Planner, Town of Canton
Canton Fire Department

G:\EM\BAM-VERIZON\CANTON\dcl 10507.DOC

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Phone: (860) 827-2935 Fax: (860) 827-2950
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Daniel F. Caruso
Chairman

October 29, 2007

The Honorable Mary B. Tomolonius
First Selectman
Town of Canton
4 Market Street
P. O. Box 168
Collinsville, CT 06022-0168

RE: **EM-VER-023-071025** - Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 14 Canton Springs Road, Canton, Connecticut.

Dear Ms. Tomolonius:

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 November 5, 2007, at 1:30 p.m. in Hearing Room Two, Ten Franklin Square, New Britain, Connecticut.

If you have any questions or comments regarding this proposal, please call me or inform the Council by noon on November 5, 2007.

Thank you for your cooperation and consideration.

Very truly yours,

S. Derek Phelps
Executive Director

SDP/cm

Enclosure: Notice of Intent

c: Neil Pade, Town Planner, Town of Canton

ROBINSON & COL

EM-VER-023-071025

KENNETH C. BALDWIN

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

October 25, 2007

Via Hand Delivery

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

Re: **Notice of Exempt Modification – Antenna Swap**
14 Canton Springs Road, Canton, Connecticut

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains a wireless telecommunications facility at the above referenced location. In its continuing effort to improve the quality and reliability of its wireless service, Cellco intends to replace and upgrade its antenna system at this existing facility.

The Council originally approved Cellco's shared use of this facility on October 8, 1999. On February 18, 2004, the Council approved Cello's request to replace its existing antennas with eight (8) PCS and four (4) cellular antennas. Cellco intends to modify its installation further by replacing four (4) cellular antennas and two (2) PCS antennas with six (6) newer model cellular antennas at the same level on the 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 Mary B. Tomolonius, First Selectman of the Town of Canton. Pursuant to a Council directive, a copy of this letter is also being sent to Canton Volunteer Fire Department, 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 same height and location as the existing antennas.

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

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

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

Also attached is a Detailed Structural Analysis 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:
Mary B. Tomolonius, Canton First Selectman
Canton Volunteer Fire Department
Sandy M. Carter

Vertically Polarized, Log Periodic 63° / 13 dBd

LPA-80063/4CF ___

When ordering replace "___" with connector type.

Mechanical specifications

Length	1205 mm	47.4 in
Width	386 mm	15.2 in
Depth	335 mm	13.2 in
Depth with z-bracket	375 mm	14.8 in
[4] Weight	9.1 kg	20.0 lbs
Wind Area		
Fore/Aft	0.47 m^2	5.0 ft^2
Side	0.40 m^2	4.4 ft^2
Rated Wind Velocity (Safety factor 2.0)	>351 km/hr	>218 mph
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	665 N	149.5 lbs
Side	577 N	129.6 lbs

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

Mounting and Downtilting

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

Mounting Bracket and Downtilt Bracket Kit #21699999

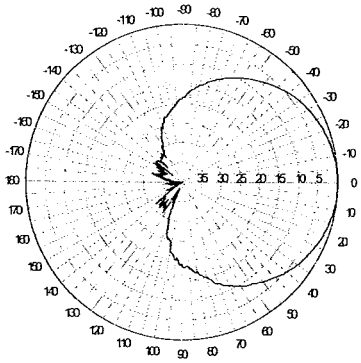
Electrical specifications

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	13 dBd
[2] Power Rating	500 W
[1] Half Power Angle	
H-Plane	63°
E-Plane	15°
[1] Electrical Downtilt	0°
[1] Null Fill	10%
Lightning Protection	Direct Ground

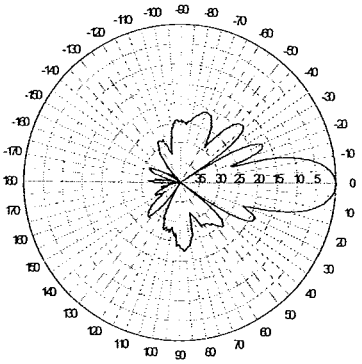
[1] Typical values.
[2] Power rating limited by connector only.
[3] NE indicates an elongated N connector.
E-DIN indicates an elongated DIN connector.
[4] The antenna weight listed above does not include the bracket weight.

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

Radiation pattern[1]



Horizontal



Vertical

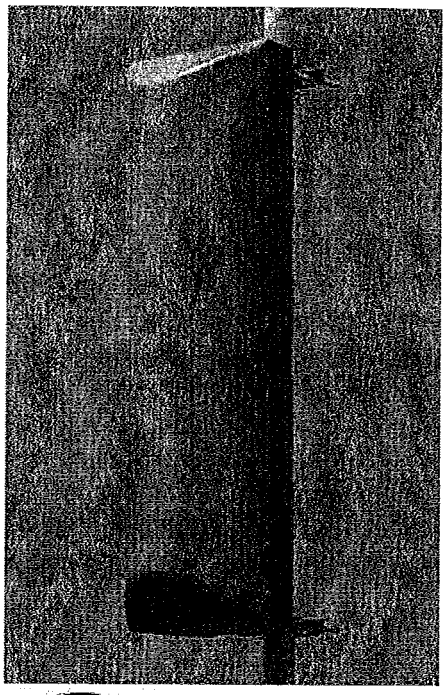
Featuring upper side lobe suppression.

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

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

CF Denotes a Center-Fed Connector.

806-960 MHz



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

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

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

Antenna available with center-fed connector only.

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

Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/5/07

Vertically Polarized, Log Periodic 80° / 12.5 dBd

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.
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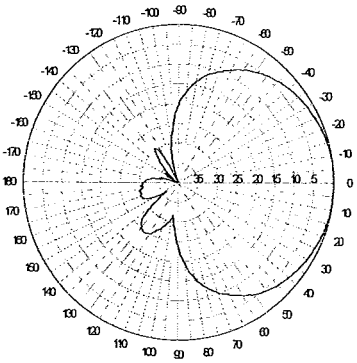
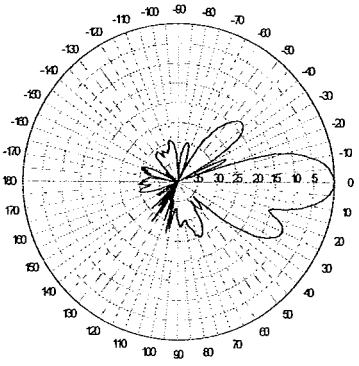


Horizontal



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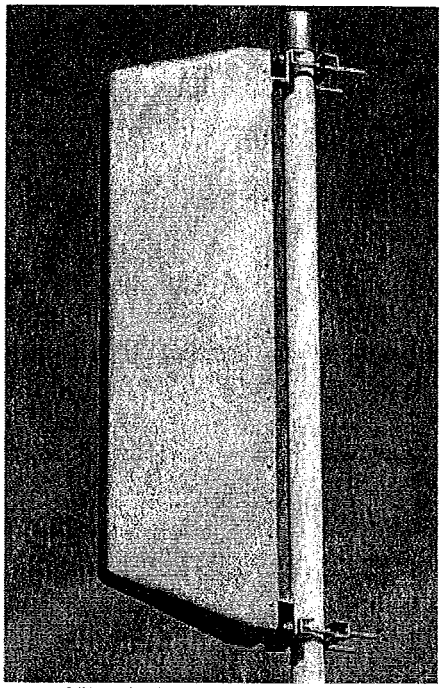

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Amphenol Antel, Inc.
The Antenna Technology Company

Revision Date: 7/5/07

	General	Power	Density					
Site Name: Canton								
Tower Height: Verizon @ 120 Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Cingular UMTS	1	500	154	0.0076	880	0.5867	1.29%	
*Cingular GSM	2	296	154	0.0090	880	0.5867	1.53%	
*Cingular GSM	1	427	154	0.0065	1900	1.0000	0.65%	
*Sprint	11	844.54	90	0.0004	1962.5	1.0000	0.04%	
*Canton FD	1	71	140	0.0013	300	0.2	0.65%	
*Nextel	9	100	110	0.0267	851	0.5673	4.71%	
*T-Mobile	8	121	100	0.0348	1935	1.0000	3.48%	
Verizon	**9**	**200**	**120**	**0.0449**	**875**	**0.5830**	**7.71%**	
Verizon PCS	**3**	**485**	**120**	**0.0363**	**1970**	**1.0000**	**3.63%**	
								23.70%
* Source: Siting Council								

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF EXISTING 140' MONOPOLE TOWER FOR NEW ANTENNA ARRANGEMENT

Site Name:
Canton FD – Canton Springs Road
14 Canton Springs Road
Canton, Connecticut

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

36931094.00000
VZ4-018

September 26, 2007

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 140' steel monopole structure, located at 14 Canton Springs Road, Canton, 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 antenna modification is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
On the existing Verizon platform:		
Remove:		
(4) Decibel DB844H90E-XY antennas	**Verizon**	
(2) Decibel DB950F65E-M antennas	**(existing)**	
Install:		**@ 120'**
(4) Antel LPA 80080/4CF and	**Verizon**	
(2) Antel LPA 80063/4CF antennas	**(proposed)**	

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.**

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 taken from original construction drawings and structural calculations prepared by Engineered Endeavors, Incorporated (EEI), on behalf of Bell Atlantic Mobile (Verizon Wireless), job number 4960, dated May 21, 1999.

3) Geotechnical testing report prepared by Dr. Clarence Welti, P.E., PC., on behalf of dated November 23, 1998.

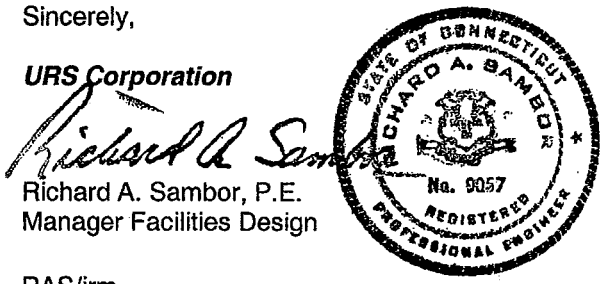
4) Antenna and mount configuration as specified on the following page of this report.

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 14 Canton Springs Road, Canton, CT. The structure is an existing 140' steel monopole designed and manufactured by Engineered Endeavors, Incorporated (EEI), Inc.

The inventory is summarized in the table below:

Antenna Type	***Carrier***	***Mount***	***Antenna Centerline Elevation***	***Cable***
(1) Omni whip antenna	Municipal (existing)	4' Stand off arm	148'	(1) 7/8" coax cable (within monopole)
(9) CSS DUO4-8670 antennas and (6) TMA's	AT&T (existing)	Platform with handrails	130'	(9) 7/8" coax cables (within monopole)
(4) Antel LPA 80080/4CF, (2) Antel LPA 80063/4CF antennas	**Verizon (proposed)**	Platform with rails	**120'**	(12) 1 5/8" coax cables (existing to remain within monopole)
(6) Decibel DB950F65E-M antennas	Verizon (existing)	Platform with rails (same as above)	120'	
(1) LMU GSM RX GPS antenna	AT&T (existing)	GPS mount	112'	(1) 1/2" coax cable (within monopole)
(12) Allgon 7130.16.05 antennas	Sprint/Nextel (existing)	Platform with rails	110'	(12) 1 5/8" coax cables (within monopole)
(6) RR90-17-02DP antennas	T-Mobile (existing)	15' Low Profile Platform	100'	(12) 1 5/8" coax cables (within monopole)
(12) Decibel DB980F65E-M antennas	Sprint/Nextel (existing)	15' Low Profile Platform	90'	(12) 1 5/8" coax cables (within monopole)
(1) GPS antenna	Sprint/Nextel (existing)	GPS mount	50'	(1) 7/8" coax cable (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 arrangements.

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. 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. 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 structurally adequate.

5. CONCLUSIONS

The results of the analysis indicate that the tower structure is in compliance with the proposed loading conditions. **The tower and its foundation are considered structurally adequate with the wind load classification specified above and all the existing and 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:

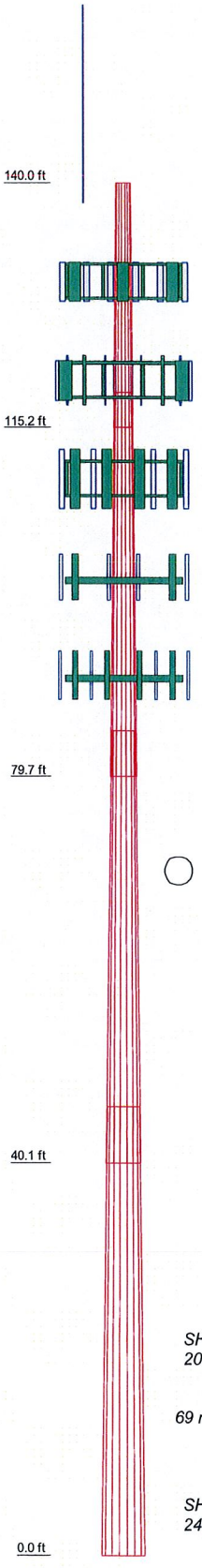
After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

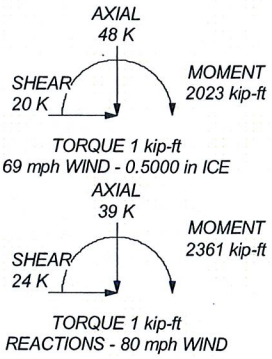
The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire 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	1	2	3	4
Length (ft)	24.79	39.13	44.21	45.87
Number of Sides	18	18	18	18
Thickness (in)	0.1875	0.3125	0.4375	0.5000
Lap Splice (ft)	3.58	4.67	5.75	
Top Dia (in)	18.0000	22.9630	30.9049	39.5950
Bot Dia (in)	24.2400	32.6900	41.9000	51.0000
Grade	A572-65			
Weight (K)	1.1	3.6	7.5	11.1





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
DB616-AB (Municipal)	148	DB950F85E-M (Verizon)	120
4' Arm	138	Platform w/ rails (Verizon)	120
(3) DU04-8670 (ATI)	130	LMU GSM RX - GPS (ATI)	112
(3) DU04-8670 (ATI)	130	2' GPS Mount (ATI)	112
(3) DU04-8670 (ATI)	130	(4) 7130.16.05 (Sprint/NEXTEL)	110
(2) TMA 15.4"x14"x3.1" (ATI)	130	(4) 7130.16.05 (Sprint/NEXTEL)	110
(2) TMA 15.4"x14"x3.1" (ATI)	130	(4) 7130.16.05 (Sprint/NEXTEL)	110
(2) TMA 15.4"x14"x3.1" (ATI)	130	Platform w/ rails (Sprint/NEXTEL)	110
Platform w/ rails (ATI)	130	(2) RR90-17-02DP (T-Mobile)	100
LPA-80080/4CF (Verizon - proposed)	120	(2) RR90-17-02DP (T-Mobile)	100
LPA-80080/4CF (Verizon - proposed)	120	(2) RR90-17-02DP (T-Mobile)	100
LPA-80080/4CF (Verizon - proposed)	120	15' Low Profile Platform (T-Mobile)	100
LPA-80080/4CF (Verizon - proposed)	120	(4) DB980F65E-M (Sprint/NEXTEL)	90
LPA-80063/4CFx5 (Verizon - proposed)	120	(4) DB980F65E-M (Sprint/NEXTEL)	90
LPA-80063/4CFx5 (Verizon - proposed)	120	(4) DB980F65E-M (Sprint/NEXTEL)	90
DB950F85E-M (Verizon)	120	15' Low Profile Platform (Sprint/NEXTEL)	90
DB950F85E-M (Verizon)	120		
DB950F85E-M (Verizon)	120	2' GPS Mount (Sprint/NEXTEL)	50
DB950F85E-M (Verizon)	120	GPS (Sprint/NEXTEL)	0
DB950F85E-M (Verizon)	120		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Hartford County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 56.8%

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

Job:	***140' EEI Monopole***
Project:	***14 Canton Springs Road, Canton, CT***
Client: Verizon Wireless	Drawn by: Staff / App'd:
Code: TIA/EIA-222-F	Date: 09/26/07 / Scale: NTS
Path: P:\08\ERI Files\VZ4-018 36931094.eri	Dwg No. E-1

RISA TOWER DETAILED OUTPUT

Tower Input Data

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

Tower is located in Hartford County, Connecticut.
Basic wind speed of 80 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
Temperature drop of 50 °F.
Deflections calculated using a wind speed of 50 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.333.
Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	140.00-115.21	24.79	3.58	18	18.0000	24.2400	0.1875	0.7500	A572-65 (65 ksi)
L2	115.21-79.66	39.13	4.67	18	22.9630	32.6900	0.3125	1.2500	A572-65 (65 ksi)
L3	79.66-40.12	44.21	5.75	18	30.9049	41.9000	0.4375	1.7500	A572-65 (65 ksi)
L4	40.12-0.00	45.87		18	39.5950	51.0000	0.5000	2.0000	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	18.2777	10.6007	424.9328	6.3234	9.1440	46.4712	850.4248	5.3013	2.8380	15.136
	24.6139	14.3142	1046.2279	8.5386	12.3139	84.9630	2093.8325	7.1585	3.9362	20.993
L2	24.2218	22.4665	1456.2288	8.0409	11.6652	124.8351	2914.3737	11.2354	3.4915	11.173
	33.1943	32.1144	4253.2835	11.4940	16.6065	256.1213	8512.1636	16.0603	5.2034	16.651
L3	32.5602	42.3079	4961.7019	10.8159	15.6997	316.0377	9929.9325	21.1580	4.6693	10.673
	42.5464	57.5759	12505.1494	14.7192	21.2852	587.5044	25026.7533	28.7934	6.6044	15.096
L4	41.6575	62.0437	11980.5594	13.8787	20.1142	595.6256	23976.8831	31.0278	6.0887	12.177
	51.7868	80.1435	25821.9188	17.9275	25.9080	996.6774	51677.8148	40.0794	8.0960	16.192

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 140.00-115.21				1	1	1		
L2 115.21-79.66				1	1	1		
L3 79.66-40.12				1	1	1		
L4 40.12-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
7/8 (Municipal)	C	No	Inside Pole	140.00 - 3.00	1	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54
7/8 (AT&T)	C	No	Inside Pole	130.00 - 3.00	9	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54
1 5/8 (Verizon)	C	No	Inside Pole	120.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1/2 (AT&T)	C	No	Inside Pole	112.00 - 3.00	1	No Ice	0.00	0.25
						1/2" Ice	0.00	0.25
1 5/8 (Sprint/NEXTEL)	C	No	Inside Pole	110.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (T-Mobile)	C	No	Inside Pole	100.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8 (Sprint/NEXTEL)	C	No	Inside Pole	90.00 - 3.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
7/8 (Sprint/NEXTEL)	C	No	Inside Pole	50.00 - 3.00	1	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	140.00-115.21	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
		C	0.000	0.000	0.000	0.000	0.145
L2	115.21-79.66	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.405
L3	79.66-40.12	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	2.203
L4	40.12-0.00	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	2.083

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	140.00-115.21	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.145
L2	115.21-79.66	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.405
L3	79.66-40.12	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	2.203
L4	40.12-0.00	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	2.083

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
DB616-AB	A	From Face	4.00	0.0000	148.00	No Ice	5.10	5.10	0.051
(Municipal)			0.00			1/2" Ice	7.17	7.17	0.089
			0.00						
4' Arm	A	From Face	2.00	0.0000	138.00	No Ice	5.00	5.00	0.070
			0.00			1/2" Ice	6.00	6.00	0.095
			0.00						
(3) DU08-8670	A	From Face	3.50	0.0000	130.00	No Ice	13.07	9.13	0.067
(AT&T)			0.00			1/2" Ice	13.78	9.73	0.146
			0.00						
(3) DU08-8670	B	From Face	3.50	0.0000	130.00	No Ice	13.07	9.13	0.067
(AT&T)			0.00			1/2" Ice	13.78	9.73	0.146
			0.00						
(3) DU08-8670	C	From Face	3.50	0.0000	130.00	No Ice	13.07	9.13	0.067
(AT&T)			0.00			1/2" Ice	13.78	9.73	0.146
			0.00						
(2) TMA 15.4"x14"x3.1"	A	From Face	3.50	0.0000	130.00	No Ice	2.10	0.46	0.031

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(AT&T)			0.00 0.00			1/2" Ice	2.29	0.59	0.042
(2) TMA 15.4"x14"x3.1"	B	From Face	3.50	0.0000	130.00	No Ice	2.10	0.46	0.031
(AT&T)			0.00 0.00			1/2" Ice	2.29	0.59	0.042
(2) TMA 15.4"x14"x3.1"	C	From Face	3.50	0.0000	130.00	No Ice	2.10	0.46	0.031
(AT&T)			0.00 0.00			1/2" Ice	2.29	0.59	0.042
Platform w/ rails	C	None		0.0000	130.00	No Ice	33.75	33.75	2.000
(AT&T)						1/2" Ice	42.20	42.20	3.000
LPA-80080/4CF	A	From Face	3.50	0.0000	120.00	No Ice	2.62	6.06	0.012
(Verizon - proposed)			6.00 0.00			1/2" Ice	2.92	6.45	0.045
LPA-80080/4CF	A	From Face	3.50	0.0000	120.00	No Ice	2.62	6.06	0.012
(Verizon - proposed)			-6.00 0.00			1/2" Ice	2.92	6.45	0.045
LPA-80080/4CF	B	From Face	3.50	0.0000	120.00	No Ice	2.62	6.06	0.012
(Verizon - proposed)			6.00 0.00			1/2" Ice	2.92	6.45	0.045
LPA-80080/4CF	B	From Face	3.50	0.0000	120.00	No Ice	2.62	6.06	0.012
(Verizon - proposed)			-6.00 0.00			1/2" Ice	2.92	6.45	0.045
LPA-80063/4CFx5	C	From Face	3.50	0.0000	120.00	No Ice	7.01	6.08	0.020
(Verizon - proposed)			6.00 0.00			1/2" Ice	7.42	6.48	0.073
LPA-80063/4CFx5	C	From Face	3.50	0.0000	120.00	No Ice	7.01	6.08	0.020
(Verizon - proposed)			-6.00 0.00			1/2" Ice	7.42	6.48	0.073
DB950F85E-M	A	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			4.00 0.00			1/2" Ice	2.90	4.57	0.034
DB950F85E-M	A	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			-4.00 0.00			1/2" Ice	2.90	4.57	0.034
DB950F85E-M	B	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			4.00 0.00			1/2" Ice	2.90	4.57	0.034
DB950F85E-M	B	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			-4.00 0.00			1/2" Ice	2.90	4.57	0.034
DB950F85E-M	C	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			4.00 0.00			1/2" Ice	2.90	4.57	0.034
DB950F85E-M	C	From Face	3.50	0.0000	120.00	No Ice	2.53	4.19	0.011
(Verizon)			-4.00 0.00			1/2" Ice	2.90	4.57	0.034
Platform w/ rails	C	None		0.0000	120.00	No Ice	33.75	33.75	2.000
(Verizon)						1/2" Ice	42.20	42.20	3.000
LMU GSM RX - GPS	C	From Face	2.00	0.0000	112.00	No Ice	4.00	4.00	0.090
(AT&T)			0.00 0.00			1/2" Ice	4.31	4.31	0.140
2' GPS Mount	C	From Face	1.00	0.0000	112.00	No Ice	0.78	0.68	0.025
(AT&T)			0.00 0.00			1/2" Ice	1.10	1.10	0.033
(4) 7130.16.05	A	From Face	3.50	0.0000	110.00	No Ice	5.77	5.77	0.018
(Sprint/NEXTEL)			0.00 0.00			1/2" Ice	6.39	6.39	0.063

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(4) 7130.16.05 (Sprint/NEXTEL)	B	From Face	3.50 0.00 0.00	0.0000	110.00	No Ice 1/2" Ice	5.77 6.39	5.77 6.39	0.018 0.063
(4) 7130.16.05 (Sprint/NEXTEL)	C	From Face	3.50 0.00 0.00	0.0000	110.00	No Ice 1/2" Ice	5.77 6.39	5.77 6.39	0.018 0.063
Platform w/ rails (Sprint/NEXTEL)	C	None		0.0000	110.00	No Ice 1/2" Ice	33.75 42.20	33.75 42.20	2.000 3.000
(2) RR90-17-02DP (T-Mobile)	A	From Face	3.50 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.36 4.77	1.97 2.31	0.018 0.040
(2) RR90-17-02DP (T-Mobile)	B	From Face	3.50 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.36 4.77	1.97 2.31	0.018 0.040
(2) RR90-17-02DP (T-Mobile)	C	From Face	3.50 0.00 0.00	0.0000	100.00	No Ice 1/2" Ice	4.36 4.77	1.97 2.31	0.018 0.040
Valmont 15' Low Profile Platform (T-Mobile)	C	None		0.0000	100.00	No Ice 1/2" Ice	17.30 22.10	17.30 22.10	1.500 2.030
(4) DB980F65E-M (Sprint/NEXTEL)	A	From Face	3.50 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.009 0.029
(4) DB980F65E-M (Sprint/NEXTEL)	B	From Face	3.50 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.009 0.029
(4) DB980F65E-M (Sprint/NEXTEL)	C	From Face	3.50 0.00 0.00	0.0000	90.00	No Ice 1/2" Ice	3.90 4.28	2.29 2.65	0.009 0.029
Valmont 15' Low Profile Platform (Sprint/NEXTEL)	C	None		0.0000	90.00	No Ice 1/2" Ice	17.30 22.10	17.30 22.10	1.500 2.030
GPS (Sprint/NEXTEL)	C	From Face	2.00 0.00 0.00	0.0000	0.00	No Ice 1/2" Ice	1.00 1.50	1.00 1.50	0.010 0.015
2' GPS Mount (Sprint/NEXTEL)	C	From Face	1.00 0.00 0.00	0.0000	50.00	No Ice 1/2" Ice	0.78 1.10	0.68 1.10	0.025 0.033

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.00-115.21	126.99	1.47	24.1	43.630	A B C	0.000 0.000 0.000	43.630 43.630 43.630	43.630	100.00 100.00 100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L2 115.21-79.66	96.74	1.36	22.2	83.748	A	0.000	83.748	83.748	100.00	0.000	0.000
					B	0.000	83.748		100.00		
					C	0.000	83.748		100.00		
L3 79.66-40.12	59.49	1.183	19.3	121.868	A	0.000	121.868	121.868	100.00	0.000	0.000
					B	0.000	121.868		100.00		
					C	0.000	121.868		100.00		
L4 40.12-0.00	19.34	1	16.4	153.835	A	0.000	153.835	153.835	100.00	0.000	0.000
					B	0.000	153.835		100.00		
					C	0.000	153.835		100.00		

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 140.00-115.21	126.99	1.47	18.1	0.5000	45.696	A	0.000	45.696	45.696	100.00	0.000	0.000
						B	0.000	45.696		100.00		
						C	0.000	45.696		100.00		
L2 115.21-79.66	96.74	1.36	16.7	0.5000	86.710	A	0.000	86.710	86.710	100.00	0.000	0.000
						B	0.000	86.710		100.00		
						C	0.000	86.710		100.00		
L3 79.66-40.12	59.49	1.183	14.5	0.5000	125.164	A	0.000	125.164	125.164	100.00	0.000	0.000
						B	0.000	125.164		100.00		
						C	0.000	125.164		100.00		
L4 40.12-0.00	19.34	1	12.3	0.5000	157.178	A	0.000	157.178	157.178	100.00	0.000	0.000
						B	0.000	157.178		100.00		
						C	0.000	157.178		100.00		

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 140.00-115.21	126.99	1.47	9.4	43.630	A	0.000	43.630	43.630	100.00	0.000	0.000
					B	0.000	43.630		100.00		
					C	0.000	43.630		100.00		
L2 115.21-79.66	96.74	1.36	8.7	83.748	A	0.000	83.748	83.748	100.00	0.000	0.000
					B	0.000	83.748		100.00		
					C	0.000	83.748		100.00		
L3 79.66-40.12	59.49	1.183	7.5	121.868	A	0.000	121.868	121.868	100.00	0.000	0.000
					B	0.000	121.868		100.00		
					C	0.000	121.868		100.00		
L4 40.12-0.00	19.34	1	6.4	153.835	A	0.000	153.835	153.835	100.00	0.000	0.000
					B	0.000	153.835		100.00		
					C	0.000	153.835		100.00		

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	1.154	46.55	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	2.046	57.57	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	2.582	65.30	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	2.769	69.01	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	551.67 kip-ft	8.551		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	1.154	46.55	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	2.046	57.57	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	2.582	65.30	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	2.769	69.01	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	551.67 kip-ft	8.551		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	1.154	46.55	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-	1.405	3.634	A	1	0.65	1	1	1	83.748	2.046	57.57	C

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
79.66			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	2.582	65.30	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	2.769	69.01	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	551.67 kip-ft	8.551		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	1.154	46.55	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	2.046	57.57	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	2.582	65.30	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	2.769	69.01	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	551.67 kip-ft	8.551		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.382	A	1	0.65	1	1	1	45.696	0.907	36.57	C
			B	1	0.65	1	1	1	45.696			
			C	1	0.65	1	1	1	45.696			
L2 115.21-79.66	1.405	4.265	A	1	0.65	1	1	1	86.710	1.589	44.70	C
			B	1	0.65	1	1	1	86.710			
			C	1	0.65	1	1	1	86.710			
L3 79.66-40.12	2.203	8.428	A	1	0.65	1	1	1	125.164	1.989	50.30	C
			B	1	0.65	1	1	1	125.164			
			C	1	0.65	1	1	1	125.164			
L4 40.12-0.00	2.083	12.248	A	1	0.65	1	1	1	157.178	2.122	52.88	C
			B	1	0.65	1	1	1	157.178			
			C	1	0.65	1	1	1	157.178			
Sum Weight:	5.836	26.323						OTM	428.20	6.606		

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
									kip-ft			

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.382	A	1	0.65	1	1	1	45.696	0.907	36.57	C
			B	1	0.65	1	1	1	45.696			
			C	1	0.65	1	1	1	45.696			
L2 115.21-79.66	1.405	4.265	A	1	0.65	1	1	1	86.710	1.589	44.70	C
			B	1	0.65	1	1	1	86.710			
			C	1	0.65	1	1	1	86.710			
L3 79.66-40.12	2.203	8.428	A	1	0.65	1	1	1	125.164	1.989	50.30	C
			B	1	0.65	1	1	1	125.164			
			C	1	0.65	1	1	1	125.164			
L4 40.12-0.00	2.083	12.248	A	1	0.65	1	1	1	157.178	2.122	52.88	C
			B	1	0.65	1	1	1	157.178			
			C	1	0.65	1	1	1	157.178			
Sum Weight:	5.836	26.323						OTM	428.20 kip-ft	6.606		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.382	A	1	0.65	1	1	1	45.696	0.907	36.57	C
			B	1	0.65	1	1	1	45.696			
			C	1	0.65	1	1	1	45.696			
L2 115.21-79.66	1.405	4.265	A	1	0.65	1	1	1	86.710	1.589	44.70	C
			B	1	0.65	1	1	1	86.710			
			C	1	0.65	1	1	1	86.710			
L3 79.66-40.12	2.203	8.428	A	1	0.65	1	1	1	125.164	1.989	50.30	C
			B	1	0.65	1	1	1	125.164			
			C	1	0.65	1	1	1	125.164			
L4 40.12-0.00	2.083	12.248	A	1	0.65	1	1	1	157.178	2.122	52.88	C
			B	1	0.65	1	1	1	157.178			
			C	1	0.65	1	1	1	157.178			
Sum Weight:	5.836	26.323						OTM	428.20 kip-ft	6.606		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.382	A	1	0.65	1	1	1	45.696	0.907	36.57	C
			B	1	0.65	1	1	1	45.696			
			C	1	0.65	1	1	1	45.696			
L2 115.21-79.66	1.405	4.265	A	1	0.65	1	1	1	86.710	1.589	44.70	C
			B	1	0.65	1	1	1	86.710			
			C	1	0.65	1	1	1	86.710			
L3 79.66-40.12	2.203	8.428	A	1	0.65	1	1	1	125.164	1.989	50.30	C
			B	1	0.65	1	1	1	125.164			
			C	1	0.65	1	1	1	125.164			
L4 40.12-0.00	2.083	12.248	A	1	0.65	1	1	1	157.178	2.122	52.88	C
			B	1	0.65	1	1	1	157.178			
			C	1	0.65	1	1	1	157.178			
Sum Weight:	5.836	26.323						OTM	428.20 kip-ft	6.606		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	0.451	18.18	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	0.799	22.49	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	1.009	25.51	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	1.082	26.96	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	215.50 kip-ft	3.340		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	0.451	18.18	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	0.799	22.49	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	1.009	25.51	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	1.082	26.96	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	215.50 kip-ft	3.340		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	0.451	18.18	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	0.799	22.49	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	1.009	25.51	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	1.082	26.96	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	215.50 kip-ft	3.340		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.21	0.145	1.051	A	1	0.65	1	1	1	43.630	0.451	18.18	C
			B	1	0.65	1	1	1	43.630			
			C	1	0.65	1	1	1	43.630			
L2 115.21-79.66	1.405	3.634	A	1	0.65	1	1	1	83.748	0.799	22.49	C
			B	1	0.65	1	1	1	83.748			
			C	1	0.65	1	1	1	83.748			
L3 79.66-40.12	2.203	7.513	A	1	0.65	1	1	1	121.868	1.009	25.51	C
			B	1	0.65	1	1	1	121.868			
			C	1	0.65	1	1	1	121.868			
L4 40.12-0.00	2.083	11.097	A	1	0.65	1	1	1	153.835	1.082	26.96	C
			B	1	0.65	1	1	1	153.835			
			C	1	0.65	1	1	1	153.835			
Sum Weight:	5.836	23.294						OTM	215.50 kip-ft	3.340		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	23.294					
Bracing Weight	0.000					
Total Member Self-Weight	23.294			0.28	0.38	
Total Weight	39.776			0.28	0.38	
Wind 0 deg - No Ice		0.000	-25.968	-2574.51	0.38	-1.39
Wind 30 deg - No Ice		12.806	-22.489	-2229.56	-1265.75	-1.25
Wind 45 deg - No Ice		18.110	-18.362	-1820.37	-1790.20	-1.05
Wind 60 deg - No Ice		22.180	-12.984	-1287.12	-2192.62	-0.78
Wind 90 deg - No Ice		25.611	0.000	0.28	-2531.87	-0.09
Wind 120 deg - No Ice		22.180	12.984	1287.68	-2192.62	0.61
Wind 135 deg - No Ice		18.110	18.362	1820.94	-1790.20	0.92
Wind 150 deg - No Ice		12.806	22.489	2230.12	-1265.75	1.16
Wind 180 deg - No Ice		0.000	25.968	2575.08	0.38	1.39
Wind 210 deg - No Ice		-12.806	22.489	2230.12	1266.50	1.25
Wind 225 deg - No Ice		-18.110	18.362	1820.94	1790.95	1.05
Wind 240 deg - No Ice		-22.180	12.984	1287.68	2193.37	0.78
Wind 270 deg - No Ice		-25.611	0.000	0.28	2532.63	0.09
Wind 300 deg - No Ice		-22.180	-12.984	-1287.12	2193.37	-0.61
Wind 315 deg - No Ice		-18.110	-18.362	-1820.37	1790.95	-0.92
Wind 330 deg - No Ice		-12.806	-22.489	-2229.56	1266.50	-1.16
Member Ice	3.028					
Total Weight Ice	49.069			0.54	0.59	
Wind 0 deg - Ice		0.000	-21.587	-2164.07	0.59	-1.39
Wind 30 deg - Ice		10.659	-18.695	-1874.07	-1065.60	-1.28
Wind 45 deg - Ice		15.075	-15.264	-1530.07	-1507.23	-1.09
Wind 60 deg - Ice		18.462	-10.794	-1081.76	-1846.11	-0.82
Wind 90 deg - Ice		21.319	0.000	0.54	-2131.79	-0.15
Wind 120 deg - Ice		18.462	10.794	1082.85	-1846.11	0.57
Wind 135 deg - Ice		15.075	15.264	1531.15	-1507.23	0.88
Wind 150 deg - Ice		10.659	18.695	1875.15	-1065.60	1.13
Wind 180 deg - Ice		0.000	21.587	2165.15	0.59	1.39
Wind 210 deg - Ice		-10.659	18.695	1875.15	1066.78	1.28
Wind 225 deg - Ice		-15.075	15.264	1531.15	1508.42	1.09
Wind 240 deg - Ice		-18.462	10.794	1082.85	1847.29	0.82
Wind 270 deg - Ice		-21.319	0.000	0.54	2132.98	0.15
Wind 300 deg - Ice		-18.462	-10.794	-1081.76	1847.29	-0.57
Wind 315 deg - Ice		-15.075	-15.264	-1530.07	1508.42	-0.88
Wind 330 deg - Ice		-10.659	-18.695	-1874.07	1066.78	-1.13
Total Weight	39.776			0.28	0.38	
Wind 0 deg - Service		0.000	-10.144	-1005.50	0.38	-0.54
Wind 30 deg - Service		5.002	-8.785	-870.75	-494.20	-0.49
Wind 45 deg - Service		7.074	-7.173	-710.91	-699.06	-0.41
Wind 60 deg - Service		8.664	-5.072	-502.61	-856.26	-0.30
Wind 90 deg - Service		10.004	0.000	0.28	-988.78	-0.04
Wind 120 deg - Service		8.664	5.072	503.17	-856.26	0.24
Wind 135 deg - Service		7.074	7.173	711.48	-699.06	0.36
Wind 150 deg - Service		5.002	8.785	871.32	-494.20	0.45
Wind 180 deg - Service		0.000	10.144	1006.06	0.38	0.54
Wind 210 deg - Service		-5.002	8.785	871.32	494.96	0.49
Wind 225 deg - Service		-7.074	7.173	711.48	699.82	0.41
Wind 240 deg - Service		-8.664	5.072	503.17	857.02	0.30
Wind 270 deg - Service		-10.004	0.000	0.28	989.54	0.04
Wind 300 deg - Service		-8.664	-5.072	-502.61	857.02	-0.24
Wind 315 deg - Service		-7.074	-7.173	-710.91	699.82	-0.36
Wind 330 deg - Service		-5.002	-8.785	-870.75	494.96	-0.45

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
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	140 - 115.21	Pole	Max Tension	14	0.000	-0.00	-0.00
			Max. Compression	18	-9.560	0.59	0.10
			Max. Mx	14	-5.328	92.37	0.10
			Max. My	2	-5.290	0.30	92.61
			Max. Vy	14	-10.782	92.37	0.10
			Max. Vx	10	11.138	0.30	-92.32
			Max. Torque	28			-1.63
L2	115.21 - 79.6633	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-23.281	0.59	-0.39
			Max. Mx	14	-15.162	645.23	-0.19
			Max. My	10	-15.126	0.36	-658.01
			Max. Vy	14	-20.685	645.23	-0.19
			Max. Vx	10	21.052	0.36	-658.01
			Max. Torque	28			-1.62
L3	79.6633 - 40.12	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-33.148	0.59	-0.48
			Max. Mx	14	-24.601	1486.24	-0.25
			Max. My	10	-24.582	0.39	-1513.17
			Max. Vy	14	-23.031	1486.24	-0.25
			Max. Vx	10	23.398	0.39	-1513.17
			Max. Torque	27			-1.41
L4	40.12 - 0	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-49.069	0.59	-0.54
			Max. Mx	14	-39.762	2602.13	-0.30
			Max. My	10	-39.762	0.39	-2645.75
			Max. Vy	14	-25.632	2602.13	-0.30
			Max. Vx	10	25.989	0.39	-2645.75
			Max. Torque	27			-1.41

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	27	49.069	-0.000	-21.587
	Max. H_x	14	39.776	25.611	0.000
	Max. H_z	2	39.776	0.000	25.968
	Max. M_x	2	2645.16	0.000	25.968
	Max. M_z	6	2601.33	-25.611	0.000
	Max. Torsion	19	1.41	-0.000	21.587
	Min. Vert	1	39.776	0.000	0.000
	Min. H_x	6	39.776	-25.611	0.000
	Min. H_z	10	39.776	0.000	-25.968
	Min. M_x	10	-2645.75	0.000	-25.968
	Min. M_z	14	-2602.13	25.611	0.000
	Min. Torsion	27	-1.41	-0.000	-21.587

Tower Mast Reaction Summary

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead Only	39.776	0.000	0.000	0.28	0.38	0.00
Dead+Wind 0 deg - No Ice	39.776	-0.000	-25.968	-2645.16	0.39	-1.40
Dead+Wind 30 deg - No Ice	39.776	12.806	-22.489	-2290.75	-1300.45	-1.26
Dead+Wind 45 deg - No Ice	39.776	18.110	-18.362	-1870.35	-1839.28	-1.05
Dead+Wind 60 deg - No Ice	39.776	22.180	-12.984	-1322.46	-2252.75	-0.78
Dead+Wind 90 deg - No Ice	39.776	25.611	0.000	0.30	-2601.33	-0.09
Dead+Wind 120 deg - No Ice	39.776	22.180	12.984	1323.05	-2252.75	0.62
Dead+Wind 135 deg - No Ice	39.776	18.110	18.362	1870.94	-1839.28	0.92
Dead+Wind 150 deg - No Ice	39.776	12.806	22.489	2291.34	-1300.44	1.16
Dead+Wind 180 deg - No Ice	39.776	-0.000	25.968	2645.75	0.39	1.40
Dead+Wind 210 deg - No Ice	39.776	-12.806	22.489	2291.34	1301.23	1.26
Dead+Wind 225 deg - No Ice	39.776	-18.110	18.362	1870.94	1840.07	1.05
Dead+Wind 240 deg - No Ice	39.776	-22.180	12.984	1323.05	2253.55	0.78
Dead+Wind 270 deg - No Ice	39.776	-25.611	0.000	0.30	2602.13	0.09
Dead+Wind 300 deg - No Ice	39.776	-22.180	-12.984	-1322.46	2253.55	-0.62
Dead+Wind 315 deg - No Ice	39.776	-18.110	-18.362	-1870.35	1840.07	-0.92
Dead+Wind 330 deg - No Ice	39.776	-12.806	-22.489	-2290.76	1301.23	-1.17
Dead+Ice+Temp	49.069	0.000	0.000	0.54	0.59	-0.00
Dead+Wind 0 deg+Ice+Temp	49.069	0.000	-21.587	-2249.66	0.63	-1.41
Dead+Wind 30 deg+Ice+Temp	49.069	10.659	-18.695	-1948.19	-1107.69	-1.29
Dead+Wind 45 deg+Ice+Temp	49.069	15.075	-15.264	-1590.59	-1566.78	-1.10
Dead+Wind 60 deg+Ice+Temp	49.069	18.462	-10.794	-1124.55	-1919.05	-0.83
Dead+Wind 90 deg+Ice+Temp	49.069	21.319	0.000	0.58	-2216.04	-0.14
Dead+Wind 120 deg+Ice+Temp	49.069	18.462	10.794	1125.70	-1919.05	0.58
Dead+Wind 135 deg+Ice+Temp	49.069	15.075	15.264	1591.74	-1566.77	0.89
Dead+Wind 150 deg+Ice+Temp	49.069	10.659	18.695	1949.33	-1107.69	1.15
Dead+Wind 180 deg+Ice+Temp	49.069	0.000	21.587	2250.80	0.63	1.41
Dead+Wind 210 deg+Ice+Temp	49.069	-10.659	18.695	1949.34	1108.96	1.29
Dead+Wind 225 deg+Ice+Temp	49.069	-15.075	15.264	1591.74	1568.05	1.10
Dead+Wind 240 deg+Ice+Temp	49.069	-18.462	10.794	1125.71	1920.33	0.83
Dead+Wind 270 deg+Ice+Temp	49.069	-21.319	0.000	0.58	2217.32	0.14
Dead+Wind 300 deg+Ice+Temp	49.069	-18.462	-10.794	-1124.56	1920.33	-0.58
Dead+Wind 315 deg+Ice+Temp	49.069	-15.075	-15.264	-1590.60	1568.05	-0.89
Dead+Wind 330 deg+Ice+Temp	49.069	-10.659	-18.695	-1948.19	1108.96	-1.15
Dead+Wind 0 deg - Service	39.776	-0.000	-10.144	-1033.77	0.40	-0.55
Dead+Wind 30 deg - Service	39.776	5.002	-8.785	-895.23	-508.07	-0.49
Dead+Wind 45 deg - Service	39.776	7.074	-7.173	-730.90	-718.69	-0.41
Dead+Wind 60 deg - Service	39.776	8.664	-5.072	-516.74	-880.30	-0.31
Dead+Wind 90 deg - Service	39.776	10.004	0.000	0.29	-1016.55	-0.04
Dead+Wind 120 deg - Service	39.776	8.664	5.072	517.33	-880.30	0.24
Dead+Wind 135 deg - Service	39.776	7.074	7.173	731.49	-718.69	0.36
Dead+Wind 150 deg - Service	39.776	5.002	8.785	895.82	-508.07	0.46
Dead+Wind 180 deg - Service	39.776	-0.000	10.144	1034.36	0.40	0.55
Dead+Wind 210 deg - Service	39.776	-5.002	8.785	895.82	508.87	0.49
Dead+Wind 225 deg - Service	39.776	-7.074	7.173	731.49	719.49	0.41
Dead+Wind 240 deg - Service	39.776	-8.664	5.072	517.33	881.10	0.31
Dead+Wind 270 deg - Service	39.776	-10.004	0.000	0.29	1017.35	0.04
Dead+Wind 300 deg - Service	39.776	-8.664	-5.072	-516.74	881.10	-0.24
Dead+Wind 315 deg - Service	39.776	-7.074	-7.173	-730.90	719.49	-0.36
Dead+Wind 330 deg - Service	39.776	-5.002	-8.785	-895.23	508.87	-0.46

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.000	-39.776	0.000	0.000	39.776	0.000	0.000%
2	0.000	-39.776	-25.968	0.000	39.776	25.968	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
3	12.806	-39.776	-22.489	-12.806	39.776	22.489	0.000%
4	18.110	-39.776	-18.362	-18.110	39.776	18.362	0.000%
5	22.180	-39.776	-12.984	-22.180	39.776	12.984	0.000%
6	25.611	-39.776	0.000	-25.611	39.776	0.000	0.000%
7	22.180	-39.776	12.984	-22.180	39.776	-12.984	0.000%
8	18.110	-39.776	18.362	-18.110	39.776	-18.362	0.000%
9	12.806	-39.776	22.489	-12.806	39.776	-22.489	0.000%
10	0.000	-39.776	25.968	0.000	39.776	-25.968	0.000%
11	-12.806	-39.776	22.489	12.806	39.776	-22.489	0.000%
12	-18.110	-39.776	18.362	18.110	39.776	-18.362	0.000%
13	-22.180	-39.776	12.984	22.180	39.776	-12.984	0.000%
14	-25.611	-39.776	0.000	25.611	39.776	0.000	0.000%
15	-22.180	-39.776	-12.984	22.180	39.776	12.984	0.000%
16	-18.110	-39.776	-18.362	18.110	39.776	18.362	0.000%
17	-12.806	-39.776	-22.489	12.806	39.776	22.489	0.000%
18	0.000	-49.069	0.000	0.000	49.069	0.000	0.000%
19	0.000	-49.069	-21.587	-0.000	49.069	21.587	0.000%
20	10.659	-49.069	-18.695	-10.659	49.069	18.695	0.000%
21	15.075	-49.069	-15.264	-15.075	49.069	15.264	0.000%
22	18.462	-49.069	-10.794	-18.462	49.069	10.794	0.000%
23	21.319	-49.069	0.000	-21.319	49.069	-0.000	0.000%
24	18.462	-49.069	10.794	-18.462	49.069	-10.794	0.000%
25	15.075	-49.069	15.264	-15.075	49.069	-15.264	0.000%
26	10.659	-49.069	18.695	-10.659	49.069	-18.695	0.000%
27	0.000	-49.069	21.587	-0.000	49.069	-21.587	0.000%
28	-10.659	-49.069	18.695	10.659	49.069	-18.695	0.000%
29	-15.075	-49.069	15.264	15.075	49.069	-15.264	0.000%
30	-18.462	-49.069	10.794	18.462	49.069	-10.794	0.000%
31	-21.319	-49.069	0.000	21.319	49.069	-0.000	0.000%
32	-18.462	-49.069	-10.794	18.462	49.069	10.794	0.000%
33	-15.075	-49.069	-15.264	15.075	49.069	15.264	0.000%
34	-10.659	-49.069	-18.695	10.659	49.069	18.695	0.000%
35	0.000	-39.776	-10.144	0.000	39.776	10.144	0.000%
36	5.002	-39.776	-8.785	-5.002	39.776	8.785	0.000%
37	7.074	-39.776	-7.173	-7.074	39.776	7.173	0.000%
38	8.664	-39.776	-5.072	-8.664	39.776	5.072	0.000%
39	10.004	-39.776	0.000	-10.004	39.776	0.000	0.000%
40	8.664	-39.776	5.072	-8.664	39.776	-5.072	0.000%
41	7.074	-39.776	7.173	-7.074	39.776	-7.173	0.000%
42	5.002	-39.776	8.785	-5.002	39.776	-8.785	0.000%
43	0.000	-39.776	10.144	0.000	39.776	-10.144	0.000%
44	-5.002	-39.776	8.785	5.002	39.776	-8.785	0.000%
45	-7.074	-39.776	7.173	7.074	39.776	-7.173	0.000%
46	-8.664	-39.776	5.072	8.664	39.776	-5.072	0.000%
47	-10.004	-39.776	0.000	10.004	39.776	0.000	0.000%
48	-8.664	-39.776	-5.072	8.664	39.776	5.072	0.000%
49	-7.074	-39.776	-7.173	7.074	39.776	7.173	0.000%
50	-5.002	-39.776	-8.785	5.002	39.776	8.785	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00065141
3	Yes	5	0.00000001	0.00017443

4	Yes	5	0.00000001	0.00020644
5	Yes	5	0.00000001	0.00019208
6	Yes	4	0.00000001	0.00022298
7	Yes	5	0.00000001	0.00018634
8	Yes	5	0.00000001	0.00020590
9	Yes	5	0.00000001	0.00017709
10	Yes	4	0.00000001	0.00065159
11	Yes	5	0.00000001	0.00019698
12	Yes	5	0.00000001	0.00020763
13	Yes	5	0.00000001	0.00017691
14	Yes	4	0.00000001	0.00022309
15	Yes	5	0.00000001	0.00018146
16	Yes	5	0.00000001	0.00020659
17	Yes	5	0.00000001	0.00019316
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00014069
20	Yes	5	0.00000001	0.00042114
21	Yes	5	0.00000001	0.00049727
22	Yes	5	0.00000001	0.00045355
23	Yes	5	0.00000001	0.00013068
24	Yes	5	0.00000001	0.00044177
25	Yes	5	0.00000001	0.00049611
26	Yes	5	0.00000001	0.00042634
27	Yes	5	0.00000001	0.00014078
28	Yes	5	0.00000001	0.00046357
29	Yes	5	0.00000001	0.00050060
30	Yes	5	0.00000001	0.00042627
31	Yes	5	0.00000001	0.00013084
32	Yes	5	0.00000001	0.00043454
33	Yes	5	0.00000001	0.00049759
34	Yes	5	0.00000001	0.00045481
35	Yes	4	0.00000001	0.00013850
36	Yes	4	0.00000001	0.00046067
37	Yes	4	0.00000001	0.00059404
38	Yes	4	0.00000001	0.00055668
39	Yes	4	0.00000001	0.00005231
40	Yes	4	0.00000001	0.00051988
41	Yes	4	0.00000001	0.00058565
42	Yes	4	0.00000001	0.00047037
43	Yes	4	0.00000001	0.00013862
44	Yes	4	0.00000001	0.00058849
45	Yes	4	0.00000001	0.00060202
46	Yes	4	0.00000001	0.00047248
47	Yes	4	0.00000001	0.00005240
48	Yes	4	0.00000001	0.00049278
49	Yes	4	0.00000001	0.00059029
50	Yes	4	0.00000001	0.00056233

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	140 - 115.21	26.770	43	1.6703	0.0116
L2	118.793 - 79.6633	19.451	43	1.5880	0.0042
L3	84.33 - 40.12	9.443	43	1.1052	0.0015
L4	45.87 - 0	2.686	43	0.5457	0.0005

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
148.00	DB616-AB	43	26.770	1.6703	0.0117	26389
138.00	4' Arm	43	26.066	1.6661	0.0108	26389
130.00	(3) DU08-8670	43	23.266	1.6452	0.0077	13194
120.00	LPA-80080/4CF	43	19.853	1.5967	0.0045	6663
112.00	LMU GSM RX - GPS	43	17.244	1.5246	0.0030	5436
110.00	(4) 7130.16.05	43	16.613	1.5019	0.0028	5241
100.00	(2) RR90-17-02DP	43	13.602	1.3658	0.0019	4434
90.00	(4) DB980F65E-M	43	10.861	1.2034	0.0016	3834
50.00	2' GPS Mount	43	3.171	0.5831	0.0006	3536
0.00	GPS	0	0.000	0.5457	0.0005	32403

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	140 - 115.21	68.405	10	4.2684	0.0301
L2	118.793 - 79.6633	49.709	10	4.0584	0.0110
L3	84.33 - 40.12	24.142	10	2.8256	0.0037
L4	45.87 - 0	6.869	10	1.3954	0.0012

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
148.00	DB616-AB	10	68.405	4.2684	0.0301	10496
138.00	4' Arm	10	66.608	4.2584	0.0281	10496
130.00	(3) DU08-8670	10	59.455	4.2077	0.0201	5247
120.00	LPA-80080/4CF	10	50.735	4.0814	0.0118	2648
112.00	LMU GSM RX - GPS	10	44.072	3.8922	0.0077	2150
110.00	(4) 7130.16.05	10	42.460	3.8327	0.0071	2071
100.00	(2) RR90-17-02DP	10	34.767	3.4800	0.0049	1747
90.00	(4) DB980F65E-M	10	27.764	3.0682	0.0040	1509
50.00	2' GPS Mount	10	8.110	1.5175	0.0015	1384
0.00	GPS	0	0.000	0.5457	0.0005	12672

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	140 - 115.21 (1)	TP24.24x18x0.1875	24.79	0.00	0.0	39.000	13.7775	-5.300	537.321	0.010
L2	115.21 - 79.6633 (2)	TP32.69x22.963x0.3125	39.13	0.00	0.0	39.000	30.9638	-15.126	1207.590	0.013
L3	79.6633 - 40.12 (3)	TP41.9x30.9049x0.4375	44.21	0.00	0.0	39.000	55.5901	-24.582	2168.010	0.011
L4	40.12 - 0 (4)	TP51x39.595x0.5	45.87	0.00	0.0	39.000	79.3103	-39.070	3093.100	0.013

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	140 - 115.21 (1)	TP24.24x18x0.1875	92.66	14.131	39.000	0.362	0.00	0.000	39.000	0.000
L2	115.21 - 79.6633 (2)	TP32.69x22.963x0.3125	658.01	33.175	39.000	0.851	0.00	0.000	39.000	0.000
L3	79.6633 - 40.12 (3)	TP41.9x30.9049x0.4375	1513.17	33.167	39.000	0.850	0.00	0.000	39.000	0.000
L4	40.12 - 0 (4)	TP51x39.595x0.5	2591.06	31.858	39.000	0.817	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	140 - 115.21 (1)	TP24.24x18x0.1875	11.050	0.802	26.000	0.062	0.82	0.061	26.000	0.002
L2	115.21 - 79.6633 (2)	TP32.69x22.963x0.3125	21.052	0.680	26.000	0.052	1.40	0.034	26.000	0.001
L3	79.6633 - 40.12 (3)	TP41.9x30.9049x0.4375	23.398	0.421	26.000	0.032	1.40	0.015	26.000	0.001
L4	40.12 - 0 (4)	TP51x39.595x0.5	25.962	0.327	26.000	0.025	1.40	0.008	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	140 - 115.21 (1)	0.010	0.362	0.000	0.062	0.002	0.373 ✔	1.333	H1-3+VT ✔
L2	115.21 - 79.6633 (2)	0.013	0.851	0.000	0.052	0.001	0.864 ✔	1.333	H1-3+VT ✔
L3	79.6633 - 40.12 (3)	0.011	0.850	0.000	0.032	0.001	0.862 ✔	1.333	H1-3+VT ✔
L4	40.12 - 0 (4)	0.013	0.817	0.000	0.025	0.000	0.830 ✔	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	140 - 115.21	Pole	TP24.24x18x0.1875	1	-5.300	716.249	28.0	Pass
L2	115.21 - 79.6633	Pole	TP32.69x22.963x0.3125	2	-15.126	1609.717	64.8	Pass
L3	79.6633 - 40.12	Pole	TP41.9x30.9049x0.4375	3	-24.582	2889.957	64.7	Pass
L4	40.12 - 0	Pole	TP51x39.595x0.5	4	-39.070	4123.102	62.2	Pass
							Summary	
						Pole (L2)	64.8	Pass
						RATING =	**64.8**	**Pass**

ANCHOR BOLT AND BASE PLATE ANALYSIS

ANCHOR BOLT AND BASE PLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 2361 \cdot ft \cdot kips$	*user input*
Shear Force:	$Shear := 24 \cdot kips$	*user input*
Axial Force:	$Axial := 39 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75	*user input*	
Number of Anchor Bolts = N	$N := 20$	*user input*
Diameter of Bolt Circle:	$D_{bc} := 60in$	*user input*
Bolt "Column" Distance:	$l := 3.0in$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot ksi$	*user input*
Bolt Yield Strength:	$Fy := 75 \cdot ksi$	*user input*
Bolt Modulus:	$E := 29000 \cdot ksi$	*user input*
Anchor Bolt Diameter	$D := 2.25in$	*user input*
Threads per Inch:	$n := 4.5$	*user input*

Base Plate Data:

Use ASTM A871 Grade 60		*user input*
Plate Yield Strength:	$Fy_{bp} := 60 \cdot ksi$	*user input*
Base Plate Thickness:	$PlateThickness := 2.0 \cdot in$	*user input*
Base Plate Diameter:	$D_{bp} := 66 \cdot in$	*user input*
Outer Pole Diameter:	$D_{pole} := 51.0in$	*user input*

Geometric Layout Data:

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

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

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

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

$d_1 = 9.27 \cdot in$ $d_7 = 24.27 \cdot in$

$d_2 = 17.63 \cdot in$ $d_8 = 17.63 \cdot in$

$d_3 = 24.27 \cdot in$ $d_9 = 9.27 \cdot in$

$d_4 = 28.53 \cdot in$ $d_{10} = 0.00 \cdot in$

$d_5 = 30.00 \cdot in$ $d_{11} = -9.27 \cdot in$

$d_6 = 28.53 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius: $R_{pole} := \frac{D_{pole}}{2}$ $R_{pole} = 25.50 \cdot in$

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

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

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

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

$MA_4 = 3.03 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 4.50 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 3.03 \cdot in$ etc.

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

Anchor Bolt Analysis:

Polar Moment of Inertia I_p:

$$I_p := \sum_i \left(d_i\right)^2 \qquad I_p = 9.000 \times 10^3 \cdot in^2$$

Gross Area of Bolt:

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

Net Area of Bolt:

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

Net Diameter:

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

Radius of Gyration of Bolt:

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

Section Modulus of Bolt:

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

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left(\frac{Shear}{N}\right) \cdot 1 \qquad M_x = 0.300 \cdot ft \cdot kips$$

$$f_{bx} := \frac{M_x}{S_x} \qquad f_{bx} = 4.4 \cdot ksi$$

Allowable Bending

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

Note: 1.333 increase allowed per TIA/EIA

Check Tensile Forces:

Maximum Tensile Force (Gross Area):

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

Note: 1.333 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

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

Note: 1.333 increase allowed per TIA/EIA

Applied Tension:

$$MaxTension := \frac{OM \cdot R_{bc}}{I_p} - \frac{Axial}{N} \qquad MaxTension = 92.5 \cdot kips$$

Check Stresses:

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

$$\frac{MaxTension}{F_{net.area}} = 0.47$$

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

Condition = "OK"

Check Compression & Combined Stresses (if required):

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

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

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

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

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

Allowable Compressive Force:

$$K := 0.65$$

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

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

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

Applied Compressive Force:

$$MaxCompression := \frac{OM \cdot R_{bc}}{I_p} + \frac{Axial}{N} \qquad MaxCompression = 96.4 \cdot kips$$

$$f_a := \frac{MaxCompression}{A_n} \qquad f_a = 29.7 \cdot ksi$$

Check Combined Stresses:

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} = 0.49$$

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

Base Plate Analysis:

Force from Bolt(s):

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

$C_1 = 31.1 \cdot kips$ $C_7 = 78.4 \cdot kips$

$C_2 = 57.5 \cdot kips$ $C_8 = 57.5 \cdot kips$

$C_3 = 78.4 \cdot kips$ $C_9 = 31.1 \cdot kips$

$C_4 = 91.8 \cdot kips$ $C_{10} = 2.0 \cdot kips$

$C_5 = 96.4 \cdot kips$ $C_{11} = -27.2 \cdot kips$

$C_6 = 91.8 \cdot kips$ etc.

Bending Stress in Plate:

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{EffectiveWidth \cdot PlateThickness^2} \qquad f_{bp} = 44.3 \cdot ksi$$

Check Stresses:

$$\frac{f_{bp}}{1.333 \cdot 0.75 Fy_{bp}} = 0.74$$

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

Condition = "OK"

FOUNDATION ANALYSIS

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 2361 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 24.0kip$
Max Compressive Force	$C_t := 39.0 \cdot kip$
Height of Tower	$H_t := 140 \cdot ft$
Base Plate Bolt Circle	$MP := 60.0in$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 6.5ft$
Length of Pier	$L_p := 4.5 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 1.0 \cdot ft$
Diameter of Pier	$d_p := 6.5 \cdot ft$
Thickness of Footing	$T_f := 3 \cdot ft$
Width of Footing:	$W_f := 24ft$
Length of Anchor Bolts:	$L_{st} := 72in$
Projection of anchor bolts above pier	$A_{BP} := 12 \cdot in$

PROPERTIES:

Compressive Strength of Concrete	$f'c := 4000psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Yield Strength of Anchor Bolt	$fya := 75000 \cdot psi$
Internal Friction Angle of Soil	$\theta_s := 30 \cdot deg$
Allowable Bearing Capacity	$q_s := 4000 \cdot psf$
Unit Weight of Soil	$\pi_s := 125 \cdot pcf$
Unit Weight of Concrete	$\pi_c := 150 \cdot pcf$
Depth to Neglect	$n := 1ft$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c := 0 \cdot ksf$
Seismic Zone Factor: UBC Fig 23-2	$Z := 2$
Coefficient of Friction between Concrete:	$\mu := 0.45$
Clear Cover of Reinforcement Pier:	$Cvr_{pier} := 3 \cdot in$
Clear Cover of Reinforcement Pad:	$Cvr_{pad} := 3 \cdot in$
Anchor Bolt Diameter	$d_{anchor} := 2.25in$
Anchor bolt area	$A_{anchor} := 3.97 \cdot in^2$

PIER REINFORCEMENT:

Bar Size	$BSpier := 8$	Bar Diameter	$d_{bpier} := 1.000 \cdot in$
Number of Bars	$NBpier := 44$	Bar Area	$A_{bpier} := 0.790 \cdot in^2$

PAD REINFORCEMENT:

TOP:	Bar Size	$BS_{top} := 8$	Bar Diameter	$d_{btop} := 1.000 \cdot in$
	Number of Bars	$NB_{top} := 28$	Bar Area	$A_{btop} := 0.790 \cdot in^2$
BOTTOM:	Bar Size	$BS_{bot} := 8$	Bar Diameter	$d_{bbot} := 1.000 \cdot in$
	Number of Bars	$NB_{bot} := 40$	Bar Area	$A_{bot} := 0.790 \cdot in^2$

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

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

CHECK ANCHOR STEEL EMBEDMENT

Depth:

$D_{ab} := L_{st} - A_{BP}$ $D_{ab} = 5 \cdot ft$ $L_{anchor} := \frac{(0.11 \cdot fy) \cdot in}{\sqrt{fc \cdot psi}}$ $L_{anchor} = 8.6963 \cdot ft$

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

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

STABILITY OF FOOTING

Passive Pressure:

$P_{pn} := K_p \cdot \pi_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pn} = 0.375 \cdot ksf$

$P_{pt} := K_p \cdot \pi_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pt} = 1.3125 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}]$ $P_{top} = 1.3125 \cdot ksf$

$P_{bot} := K_p \cdot \pi_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 2.4375 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 1.875 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)]$ $T_p = 3 \cdot ft$

$A_p := W_f \cdot T_p$ $A_p = 72 \cdot ft^2$

Ultimate Shear:

$S_u := P_{ave} \cdot A_p$ $S_u = 135 \cdot kip$

Weight of Concrete Pad:

$WT_c := \left[\left(W_f^2 \cdot T_f \right) + d_p^2 L_p \right] \cdot \pi_c$ $WT_c = 287.7188 \cdot kip$

Weight of Soil: above Footing:

$WT_{s1} := \left[W_f^2 \cdot \left(|L_p - L_{pag}| \right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(|L_p - L_{pag}| \right) \right] \cdot \pi_s$ $WT_{s1} = 237.4824 \cdot kip$

Weight of Soil Wedge at back face:

$WT_{s2} := \left(\frac{D_f \cdot \tan(\theta_s)}{2} \cdot W_f \right) \cdot \pi_s$ $WT_{s2} = 5.6292 \cdot kip$

Total Weight:

$WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 564.2012 \cdot kip$

Resisting Moment:

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\theta_s)}{3} \right)$ $M_r = 7047.5555 \cdot kip \cdot ft$

Overturning Moment:

$M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 2541 \cdot kip \cdot ft$

Factor of Safety:

$FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 2.77$

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

URS

Job	140' EEI Monopole - Canton, CT	Project No.	VZ4-018	Page	of
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Sheet 3	of 9
		Checked by		Date	09/26/07
				Date	

SHEAR CAPACITY IN PIER

$FS := 2$

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

$S_p = 194.4453 \cdot kips$

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

$ShearCheck = "Okay"$

BEARING PRESSURE CAUSED BY FOOTING

$A_{mat} := W_f^2$ $\quad A_{mat} = 576 \cdot ft^2$

$S := \frac{W_f^3}{6}$ $\quad S = 2304 \cdot ft^3$

$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S}$ $\quad P_{max} = 2.0824 \cdot ksf$

$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S}$ $\quad P_{min} = -0.1233 \cdot ksf$

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

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

Distance to Resultant of Pressure Distribution:

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

$X_p = 7.5526 \cdot ft$

Distance to Kern: $X_k := \frac{W_f}{6}$ $\quad X_k = 4 \cdot ft$

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

Eccentricity: $e := \frac{M_{ot}}{WT_{tot}}$ $\quad e = 4.5037$

Adjusted Soil Pressure: $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)}$ $\quad P_a = 2.0907 \cdot ksf$

$q_{adj} := if\left(P_{min} < 0, P_a, \frac{P_{max}}{ft^2}\right)$ $\quad q_{adj} = 2.0907 \cdot ksf$

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

CONCRETE BEARING CAPACITY (ACI 10.17)

$\theta_c := 0.75$ (ACI 9.3.2.2)

$P_b := \theta_c \cdot 0.85 \cdot fc \cdot \frac{d_p^2 \cdot \pi}{4}$ $P_b = 12184.8242 \cdot kip$

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

SHEAR STRENGTH OF CONCRETE

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

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

$d := T_f - Cvr_{pad} - d_{bbot}$ $d = 32 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$ $d_1 = 8.75 \cdot ft$

$d_2 := d_1 - d$ $d_2 = 6.0833 \cdot ft$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$ $L = 22.4889 \cdot ft$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$ $Slope = 0.093 \cdot kcf$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$ $V_{req} = 471.3877 \cdot kip$

ACI 11.3.1.1 $V_{Avail} := \theta_c \cdot 2 \cdot \sqrt{fc \cdot psi} \cdot W_f \cdot d$ $V_{Avail} = 990.8807 \cdot kip$

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

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

$b_o := \left(d_p + d\right) \cdot \pi$ $b_o = 28.7979 \cdot ft$

Area included inside bo: $A_{bo} := \frac{\pi \cdot \left(d_p + d\right)^2}{4}$ $A_{bo} = 65.9953 \cdot ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo}$ $A_{out} = 510.0047 \cdot ft^2$

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

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

$v_u := \text{Find}(v_u)$ $v_u = 7.3469 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 470.2014 \cdot kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 626.7784 \cdot kips$

$V_{Avail} := \theta_c \cdot 4 \cdot \sqrt{fc \cdot psi} \cdot b_o \cdot d$ $V_{Avail} = 2377.943 \cdot kips$

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

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

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 1.2772 \cdot ksf$

$M_n := \frac{LF}{\theta_m} \cdot \left[\left(q_{adj} - q_b \right) \cdot \frac{{d_1}^2}{3} + q_b \cdot \frac{{d_1}^2}{2} \right] \cdot W_f$ $M_n = 2475.9525 \cdot kip \cdot ft$

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

$R_u := \frac{M_n}{\theta_m \cdot W_f \cdot d^2}$ $R_u = 16119.5\ lbf$

$\rho := \frac{0.85 \cdot fc}{fy} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot fc}} \right)$ $\rho = 0.0019$

$\rho_{min} := 1.333 \cdot \rho$ $\rho_{min} = 0.00253$

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

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $As := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 23.31 \cdot in^2$

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

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

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 16.5888 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 22.12 \cdot in^2$

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

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

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 6.2051 \cdot in$

Development Length Factors:

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

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

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

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

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

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

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad}$ $L_{Pad} = 102 \cdot in$

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

REINFORCEMENT IN PIER

Pier Area: $A_p := \frac{\pi \cdot d_p^2}{4}$ $A_p = 4778.3624 \cdot in^2$

(ACI 10.8.4 and 10.9.1) $A_{smin} := 0.01 \cdot 0.05 \cdot A_p$ $A_{smin} = 2.3892 \cdot in^2$

$A_{sprov} := NBpier \cdot A_{bpier}$ $A_{sprov} = 34.76 \cdot in^2$

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

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: $B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier}$ $B_{sPier} = 4.5692 \cdot in$

Diamter of Reinforcement Cage: $Diam_{cage} := d_p - 2 \cdot Cvr_{pier}$ $Diam_{cage} = 72 \cdot in$

Maximum Moment in Pier: $M_p := \left[M_t + S_t \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF$ $M_p = 39686.076 \cdot in \cdot kips$

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

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

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

$(D \ N \ n \ P_u \ M_{xu}) := (78 \ 44 \ 8 \ 52 \ 39687)$

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:

$(\theta P_n \ \theta M_{xn} \ f_{sp} \ \rho) = (80.4373 \ 61390.6616 \ -60 \ 0.0073)$

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 $\alpha := 1.0$

Coating Factor $\beta := 1.0$

Concrete strength Factor $\lambda := 1.0$

Reinforcement Size Factor $\pi := 1.0$

Spacing or Cover Dimension: $c := if\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right)$ $c = 2.2846 \cdot in$

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

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{fc \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \pi \cdot \lambda}{\frac{c + k_{tr}}{d_{bpier}}} \cdot d_{bpier} \qquad L_{dbt} = 31.1439 \cdot in$$

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

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

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

$$L_{db} := \max\left(L_{dbt}, L_{dbmin}\right) \qquad L_{db} = 31.1439 \cdot in$$

COMPRESSION: (ACI 12.3.2)

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

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

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

Available Length in Foundation:

$$L_{pier} := L_p - Cvr_{pier} \qquad L_{pier} = 51 \cdot in$$

$$L_{pad} := T_f - Cvr_{pad} \qquad L_{pad} = 33 \cdot in$$

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

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

NOTE: Anchor bolts and plate provided, OK

TIE SIZE AND SPACING IN COLUMN

Minimum Tie Size:

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

Used #4 Ties

$d_{Tie} := 4$

Seismic factor:
(ACI 21.10.5)

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

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

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

$s_{lim3} := D_f \cdot z$ $\quad s_{lim3} = 78 \cdot in$

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

Maximum Spacing:

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

Number of Ties Required:

$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1$ $\quad n_{tie} = 4$

URS

FAA 1-A SURVEY CERTIFICATION

Applicant:	Verizon Wireless 20 Alexander Drive Wallingford, CT 06492		
Site Name:	Vernon 3		
Site Address:	777 Talcottville Road Vernon, Connecticut		
Source of Coordinates:		X GPS survey	☐ Ground survey
Vertical Datum:	NGVD 1929 (AMSL)	X GPS survey	☐ Ground survey
Structure Type:	☐ New Tower	X Existing Tower	☐ Roof Top
	☐ Water Tank	☐ Smoke Stack	☐ Other – _____
Latitude:	(NAD 83) 41° 51' 48.43"		(NAD 27) 41° 51' 48.08"
Longitude:	(NAD 83) 72° 28' 59.82"		(NAD 27) 72° 29' 01.51"
Ground Elevation:	236.1 AMSL Elevation (in feet)		
Tower Structure Height:	160.5 (in feet) AGL		
Height of Highest Appurtenance on Tower:	162.4 (in feet) AGL		

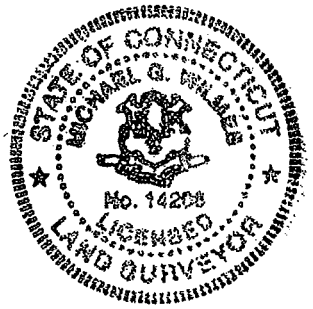
Certification: I certify that the latitude and longitude are accurate to within +/- 15 feet horizontally, and that the ground elevation is accurate to within +/- 3 feet vertically. The horizontal datum (coordinates) are expressed in degrees, minutes, seconds and tenths of seconds. The vertical datum (heights) is expressed in terms of feet.

Company: URS Corporation AES

Surveyor Signature/Seal: _____

Michael G. Wilmes L.S. 14206

Date: October 12, 2007



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