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@po.state.ct.us
Web Site: www.state.ct.us/csc/index.htm

February 20, 2004

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

RE: **EM-VER-023-040202** - 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 February 18, 2004, 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 2, 2004. 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. 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,

Pamela B. Katz, P.E.
Chairman

PBK/laf

c: Honorable Mary B. Tomolonius, First Selectman, Town of Canton
Sarajane S. Pickett, Town Planner, Town of Canton
Canton Volunteer Fire Department
Christopher B. Fisher, Esq., Cuddy & Feder LLP
Michele G. Briggs, Southwestern Bell Mobile Systems
Thomas F. Flynn III, Nextel Communications, Inc.
Stephen J. Humes, Esq., LeBoeuf, Lamb, Greene & MacRae LLP
Thomas J. Regan, Esq., Brown Rudnick Berlack Israels LLP

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STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

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Phone: (860) 827-2935 Fax: (860) 827-2950
E-Mail: siting.council@po.state.ct.us
Web Site: www.ct.gov/csc

February 3, 2004

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

RE: **EM-VER-023-040202** - Cellco Partnership d/b/a Verizon Wireless notice of intent to modify existing telecommunications facilities 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 February 18, 2004, at 1:30 p.m. in Hearing Room One, Ten Franklin Square, New Britain, Connecticut.

Please call me or inform the Council if you have any questions or comments regarding this proposal.

Thank you for your cooperation and consideration.

Very truly yours,

S. Derek Phelps
Executive Director

SDP/cm

Enclosure: Notice of Intent

c: Sarajane S. Pickett, Town Planner, Town of Canton

ROBINSON & COLE LLP

EM-VER-023-040202

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

February 2, 2004

Via Hand Delivery

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

Re: **Notice of Exempt Modification**
Canton Volunteer Fire Department
14 Canton Springs Road
Canton, CT

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains a wireless telecommunications facility on the existing tower at the Canton Volunteer Fire Department, 14 Canton Springs Road in Canton, Connecticut, consisting of twelve (12) panel-type cellular antennas mounted to the existing tower and an associated equipment shelter at the base of the tower within a fenced compound. Cellco now intends to replace the existing cellular antennas with a combination of cellular and Personal Communications Service ("PCS") 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 the Canton First Selectman, Mary Tomolonius.

The existing facility consists of a 140-foot self-supporting monopole tower, capable of supporting multiple carriers within a fenced site compound. The tower is owned by the Canton Volunteer Fire Department ("CVFD"). The tower currently supports CVFD antennas extending above the tower at the 150-foot level; Cingular antennas at the 130-foot and 112-foot levels; Cellco antennas at the 120-foot level; Nextel antennas at the 110-foot level; T-Mobile antennas at the 100-foot level; Sprint antennas at the 90-foot level; and AT&T antennas at the 80-foot level.

Cellco proposes to modify its existing antenna configuration by replacing twelve (12) panel-type cellular antennas with eight (8) DB950F65E-M PCS antennas

and four (4) new DB844H90EXY cellular antennas. No changes to ground-mounted equipment are planned as part of this antenna replacement filing. Therefore, project plans are not provided as part of this filing.

The planned modifications to the Canton facility fall squarely within those activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed replacement will not increase the overall height of the existing tower. Cellco's antennas will be mounted with their centerline at the 120-foot level on the 140-foot tower.

2. The proposed replacement of twelve (12) panel-type antennas will not require an extension of the fenced compound.

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

4. The operation of the 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. Cellco's RF power density calculation for the replacement antenna would increase by 2.14%, for a total of 10.06% of the FCC standard (See Attachment 1).

Also included as Attachment 2 is a detailed structural analysis of the tower prepared by URS Corporation ("URS"). According to this analysis, the tower is capable of accommodating existing and Cellco replacement antennas.

For the foregoing reasons, Cellco respectfully submits that the proposed antenna replacement at the Canton facility tower constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Attachments
cc: Mary Tomolonius, Canton First Selectman
Sandy M. Carter

General Power Density

Site Name: Canton, CT
Tower Height: 120 Ft. rad center

Operator	Operating Frequency	Number of Trans.	ERP Per Trans.	Total ERP	Distance to Target	Calculated Power Density	Maximum Permissable Exposure*	Fraction of MPE
	(MHz)		(watts)	(watts)	(feet)	(mW/cm^2)	(mW/cm^2)	(%)
Verizon	880	9	200	1800	120	0.0450	0.56733	7.92%
Verizon	1900	3	285	855	120	0.0214	1	2.14%
Total Percentage of Maximum Permissible Exposure								10.06%

*Guidelines adopted by the FCC on August 1, 1996, 47 CFR Part 1 based on NCRP Report 86, 1986 and generally on ANSI/IEEE C95.1-1992

MHz = Megahertz
mW/cm^2 = milliwatts per square centimeter
ERP = Effective Radiated Power

Absolute worst case scenario, maximum values used.

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

Canton Fire Department
14 Canton Springs Road
Canton, Connecticut

prepared for

Verizon Wireless
99 East River Drive
East Hartford, Connecticut 06108

prepared by

URS CORPORATION
795 BROOK STREET, BUILDING 5
ROCKY HILL, CT 06067
TEL. 860-529-8882

36921458.00000
VZ1-060

January 14, 2004

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 140' monopole for Verizon Wireless at 14 Canton Springs Road in Canton, Connecticut. The analysis was conducted in accordance with the TIA/EIA-222-F standard for wind velocity of 80 mph and 80 mph concurrent with ½" ice with reduction. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined on the following page of this report.

The results of the analysis indicate the structure to be in compliance with the loading conditions and the material and member sizes for the monopole and foundation. **The monopole is considered structurally feasible with the TIA/EIA-222-F wind load classification specified above and all the existing and proposed antenna loading.** The proposed Verizon modification consists of:

Remove existing (12) ALP9212 antennas and add (8) DB950F65E-M and (4) DB844H90EXY panel antennas on existing standard platform with existing (12) 1 5/8" coax cable inside the monopole	Verizon (proposed)	@ 120' elevation

This analysis is based on:

1) The tower structure's theoretical capacity not including any assessment its condition.

2) Tower structure and foundation design prepared by Engineered Endeavors, Inc. job no. 4960 dated May 13, 1999 and May 21, 1999.

3) Soils report prepared by Dr. Clarence Welti, P.E., P.C. dated November 23, 1998.

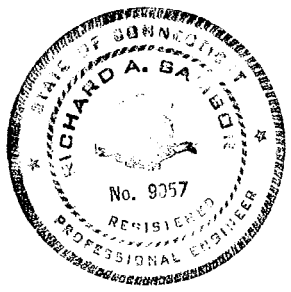
4) Antenna inventory as specified on the following page of this report.

5) TIA/EIA-222-F wind load classification.

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 assumptions of antenna and mount configurations. Notify the engineer in writing immediately if any of the assumptions found in this report are other than specified.

If you should have any questions, please call.

Sincerely,
URS Corporation AES



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

RAS/ddm

cc: Mark Gauger – Verizon Wireless
Doug Roberts, AIA – URS
I.A., A.A. - URS
CF/Book

2. INTRODUCTION

A structural analysis of this existing 140' communications monopole was performed by URS Corporation AES (URS) for Verizon Wireless. The monopole is located at 14 Canton Springs Road in Canton, Connecticut.

The structure is self-supporting and was designed by Engineered Endeavors, Inc. job no. 4960 dated May 13, 1999 and May 21, 1999.

This analysis was conducted to evaluate twist (rotation), sway (deflection), and stress on the monopole. The analysis was also used to find the effect of the forces to the foundation resulting from the antenna arrangement listed below:

Antenna and Mount Configuration:

ANTENNA & MOUNT DESCRIPTION	CARRIER	CENTERLINE ELEVATION
(1) Omnidirectional antenna with 4' side arm and (1) 7/8" coax cable within the monopole	Town (existing)	@ 150'
(9) DUO4-8670 antennas and (6) amplifiers with standard platform and (9) 7/8" coax cables within the monopole	Cingular (existing)	@ 130'
(8) DB950F65E-M and (4) DB844H90EXY antennas with existing standard platform and existing (12) 1 5/8" coax cable inside the monopole	**Verizon (proposed)**	**@ 120'**
(1) LMU GSM RX antenna with (1) 1/2" coax cable within the monopole	Cingular (existing)	@ 112'
(12) 7130.16 antennas with standard platform with (12) 1 5/8" coax cable within the monopole	Nextel (existing)	@ 110'
(6) RR90-17-02DP antennas on low profile platform with (12) 1 5/8" coax cable within the monopole	T-Mobile (existing)	@ 100'
(12) DB980F65 antennas on low profile platform and (12) 1 5/8" coax cable within the monopole	Sprint (existing)	@ 90'
(6) 7250.03 antennas on (3) T-arm mounts and (12) 1 5/8" coax cable within the monopole	AT&T (proposed)	@ 80'
(1) GPS antenna with (1) 7/8" coax cable	Sprint (existing)	@ 50'

Note:
1. **This analysis is based on the assumption that all carrier antenna cables are to be placed within the monopole unless otherwise noted. Porthole may be required. Installation of porthole shall be done per manufacturer suggestion.**
2. **Physical verification may be required to ensure that adequate space is available inside the monopole.**

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

Methodology:

The structural analysis was done in accordance with TIA/EIA-222-F June 1996, Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, the American Institute of Steel Construction (AISC) and the Manual of Steel Construction; Allowable Stress Design (ASD).

The analysis was conducted using ERI Tower 2.0. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA. The two load combinations were investigated in ERI Tower 2.0 to determine the stress, sway and rotation.

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

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

4. FINDINGS AND EVALUATION

Combined axial and bending stresses on the monopole structure were evaluated to compare with allowable stresses in accordance with AISC. In all cases, calculated stresses under the proposed loading were less than allowable stresses. Additionally, the monopole structure foundation was found to be adequate.

5. CONCLUSIONS

Our analysis concludes that the monopole and foundation will support the proposed new antenna arrangements under the analysis criteria outlined on the previous page.

Our analysis for the proposed new antenna arrangement and load condition is provided in Appendix A.

Limitations/Assumptions

1. This report is based on the following:
2. Tower inventory as listed in this report.
3. Tower is properly installed and maintained.
4. All members were as specified in the original design documents and are in good condition.
5. All required members are in place.
6. All bolts are in place and are properly tightened.
7. Tower is in plumb condition.
8. Protective coatings are in good condition
9. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
10. Foundations were properly constructed to support original design loads as specified in the original design documents.
11. All co-axial cable is installed within the monopole.

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

1. Adding or relocating antennas and platform

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.

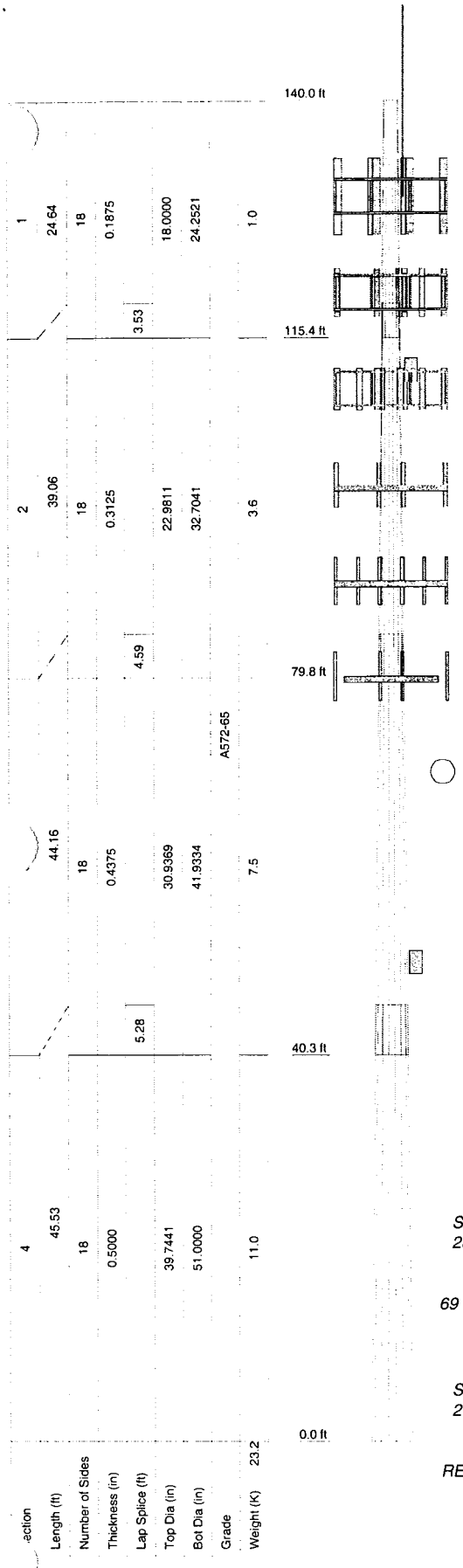
Ongoing and Periodic Inspection and Maintenance:

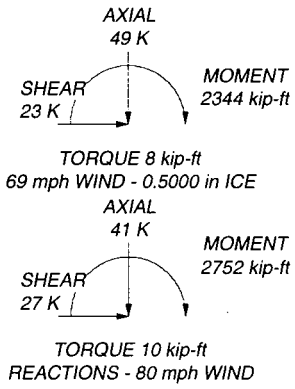
1. After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

2. The owner shall refer to TIA/EIA-222-F, Section 14 and Annex E 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 is 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

ERI TOWER INPUT / OUTPUT





APPURTENANCES

TYPE	ELEVATION	TYPE	ELEVATION
DB616-AB (20' Omni) (Town)	140	PiROD 15' Platform w/handrails (Monopole) (Nextel)	110
(3) DU08-8670 (Cingular)	130	(2) RR90-17-02DP (T-Mobile)	100
(2) NOKIA MHA (Cingular)	130	(2) RR90-17-02DP (T-Mobile)	100
(3) DU08-8670 (Cingular)	130	(2) RR90-17-02DP (T-Mobile)	100
(2) NOKIA MHA (Cingular)	130	PiROD 15' Low Profile Platform (Monopole) (T-Mobile)	100
(3) DU08-8670 (Cingular)	130	(4) DB980F65E-M (Sprint)	90
(2) NOKIA MHA (Cingular)	130	(4) DB980F65E-M (Sprint)	90
PiROD 15' Platform w/handrails (Monopole) (Cingular)	130	(4) DB980F65E-M (Sprint)	90
(2) DB844H90E-XY (Verizon)	120	PiROD 15' Low Profile Platform (Monopole) (Sprint)	90
(2) DB950F65E-M (Verizon)	120	(2) 7250.03 (ATT)	80
(4) DB950F65E-M (Verizon)	120	(2) 7250.03 (ATT)	80
(2) DB844H90E-XY (Verizon)	120	(2) 7250.03 (ATT)	80
(2) DB950F65E-M (Verizon)	120	Generic T-Arm Mount (ATT)	80
PiROD 15' Platform w/handrails (Monopole) (Verizon)	120	Generic T-Arm Mount (ATT)	80
GPS Antenna (Cingular)	112	Generic T-Arm Mount (ATT)	80
(4) 7130.16.05.00 (Nextel)	110	GPS Antenna (Sprint)	50
(4) 7130.16.05.00 (Nextel)	110		
(4) 7130.16.05.00 (Nextel)	110		

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: 68.5%

URS Corp. AES
795 Brook Street
Rocky Hill, CT 06067
Phone: (860) 529-8882
FAX: (860) 529-5566

Job: 140' Monopole			
Project: Canton Fire Department			
Client: Verizon	Drawn by: Daniel D. McClure	App'd:	
Code: TIA/EIA-222-F	Date: 01/13/04	Scale: NTS	
Path: P:\F12\ER\ Tower\140' Monopole - Canton.en		Dwg No. E-	

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 and feedline supports 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)		Use Top Mounted Sockets

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	140.00-115.36	24.64	3.53	18	18.0000	24.2521	0.1875	0.7500	A572-65 (65 ksi)
L2	115.36-79.83	39.06	4.59	18	22.9811	32.7041	0.3125	1.2500	A572-65 (65 ksi)
L3	79.83-40.26	44.16	5.28	18	30.9369	41.9334	0.4375	1.7500	A572-65 (65 ksi)
L4	40.26-0.00	45.53		18	39.7441	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
	24.6262	14.3214	1047.8077	8.5429	12.3201	85.0489	2096.9941	7.1621	3.9384	21.005
L2	24.2282	22.4844	1459.7185	8.0474	11.6744	125.0358	2921.3578	11.2444	3.4947	11.183
	33.2086	32.1284	4258.8427	11.4990	16.6137	256.3455	8523.2892	16.0673	5.2059	16.659
L3	32.5743	42.3522	4977.3272	10.8273	15.7159	316.7056	9961.2036	21.1801	4.6749	10.685
	42.5803	57.6222	12535.3942	14.7310	21.3022	588.4563	25087.2828	28.8166	6.6103	15.109
L4	41.6822	62.2805	12118.2198	13.9317	20.1900	600.2083	24252.3851	31.1461	6.1150	12.23
	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 140.00-115.36				1	1	1		
L2 115.36-79.83				1	1	1		
L3 79.83-40.26				1	1	1		
L4 40.26-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
7/8	C	No	Inside Pole	140.00 - 0.00	1	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54
						1" Ice	0.00	0.54
						2" Ice	0.00	0.54
						4" Ice	0.00	0.54
7/8	C	No	Inside Pole	130.00 - 0.00	9	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54
						1" Ice	0.00	0.54
						2" Ice	0.00	0.54
						4" Ice	0.00	0.54
1 5/8	C	No	Inside Pole	120.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
						1" Ice	0.00	1.04
						2" Ice	0.00	1.04
						4" Ice	0.00	1.04
1/2	C	No	Inside Pole	112.00 - 0.00	1	No Ice	0.00	0.25
						1/2" Ice	0.00	0.25
						1" Ice	0.00	0.25
						2" Ice	0.00	0.25
						4" Ice	0.00	0.25
1 5/8	C	No	Inside Pole	110.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
						1" Ice	0.00	1.04
						2" Ice	0.00	1.04
						4" Ice	0.00	1.04
1 5/8	C	No	Inside Pole	100.00 - 0.00	6	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
						1" Ice	0.00	1.04

Description	Face	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight plf
						2" Ice	0.00	1.04
						4" Ice	0.00	1.04
1 5/8	C	No	Inside Pole	90.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
						1" Ice	0.00	1.04
						2" Ice	0.00	1.04
						4" Ice	0.00	1.04
1 5/8	C	No	Inside Pole	80.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
						1" Ice	0.00	1.04
						2" Ice	0.00	1.04
						4" Ice	0.00	1.04
7/8	C	No	Inside Pole	50.00 - 0.00	1	No Ice	0.00	0.54
						1/2" Ice	0.00	0.54
						1" Ice	0.00	0.54
						2" Ice	0.00	0.54
						4" Ice	0.00	0.54

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.00-115.36	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	0.14
		D	0.000	0.000	0.000	0.000	0.00
L2	115.36-79.83	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	1.27
		D	0.000	0.000	0.000	0.000	0.00
L3	79.83-40.26	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	2.45
		D	0.000	0.000	0.000	0.000	0.00
L4	40.26-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	2.51
		D	0.000	0.000	0.000	0.000	0.00

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
L1	140.00-115.36	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	0.14
		D		0.000	0.000	0.000	0.000	0.00
L2	115.36-79.83	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	1.27
		D		0.000	0.000	0.000	0.000	0.00
L3	79.83-40.26	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00

Tower Section	Tower Elevation ft	Face	Ice Thickness in	A_R ft²	A_F ft²	C_AA_A In Face ft²	C_AA_A Out Face ft²	Weight K
		C		0.000	0.000	0.000	0.000	2.45
		D		0.000	0.000	0.000	0.000	0.00
L4	40.26-0.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	2.51
		D		0.000	0.000	0.000	0.000	0.00

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	140.00-115.36	0.0000	0.0000	0.0000	0.0000
L2	115.36-79.83	0.0000	0.0000	0.0000	0.0000
L3	79.83-40.26	0.0000	0.0000	0.0000	0.0000
L4	40.26-0.00	0.0000	0.0000	0.0000	0.0000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment deg	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
DB616-AB (20' Omni)	C	From Leg	1.00 / 0.00	0.0000	140.00	No Ice	3.06	3.06	0.05
(Town)			0.00			1/2" Ice	5.13	5.13	0.08
						1" Ice	7.20	7.20	0.11
						2" Ice	11.41	11.41	0.23
						4" Ice	20.03	20.03	0.62
(3) DU08-8670	A	From Leg	2.00 / 0.00	0.0000	130.00	No Ice	13.07	9.13	0.07
(Cingular)			0.00			1/2" Ice	13.78	9.73	0.15
						1" Ice	14.51	10.34	0.23
						2" Ice	15.99	11.58	0.43
						4" Ice	19.05	14.14	0.94
(2) NOKIA MHA	A	None		0.0000	130.00	No Ice	1.23	0.34	0.02
(Cingular)						1/2" Ice	1.38	0.45	0.02
						1" Ice	1.54	0.57	0.03
						2" Ice	1.89	0.84	0.06
						4" Ice	2.69	1.47	0.13
(3) DU08-8670	B	From Leg	2.00 / 0.00	0.0000	130.00	No Ice	13.07	9.13	0.07
(Cingular)			0.00			1/2" Ice	13.78	9.73	0.15
						1" Ice	14.51	10.34	0.23
						2" Ice	15.99	11.58	0.43
						4" Ice	19.05	14.14	0.94
(2) NOKIA MHA	B	None		0.0000	130.00	No Ice	1.23	0.34	0.02
(Cingular)						1/2" Ice	1.38	0.45	0.02
						1" Ice	1.54	0.57	0.03
						2" Ice	1.89	0.84	0.06
						4" Ice	2.69	1.47	0.13
(3) DU08-8670	C	From Leg	2.00	0.0000	130.00	No Ice	13.07	9.13	0.07

ERITower	Job: 140' Monopole	Page: 5 of 20
URS Corp. AES 795 Brook Street Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-5566	Project: Canton Fire Department	Date: 08:56:02 01/13/04
	Client: Verizon	Designed by: Daniel D. McClure

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft	Offsets: Vert ft	Azimuth Adjustment deg	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(Cingular)			0.00				1/2" Ice	13.78	9.73	0.15
			0.00				1" Ice	14.51	10.34	0.23
							2" Ice	15.99	11.58	0.43
							4" Ice	19.05	14.14	0.94
(2) NOKIA MHA	C	None			0.0000	130.00	No Ice	1.23	0.34	0.02
(Cingular)							1/2" Ice	1.38	0.45	0.02
							1" Ice	1.54	0.57	0.03
							2" Ice	1.89	0.84	0.06
							4" Ice	2.69	1.47	0.13
PiROD 15' Platform	C	None			0.0000	130.00	No Ice	33.80	33.80	2.04
w/handrails (Monopole)							1/2" Ice	43.60	43.60	2.75
(Cingular)							1" Ice	53.40	53.40	3.45
							2" Ice	73.00	73.00	4.86
							4" Ice	112.20	112.20	7.68
(2) DB844H90E-XY	A	From Leg	2.00		0.0000	120.00	No Ice	2.87	3.73	0.01
(Verizon)			0.00				1/2" Ice	3.18	4.10	0.04
			0.00				1" Ice	3.52	4.48	0.06
							2" Ice	4.27	5.25	0.14
							4" Ice	5.88	6.91	0.34
(2) DB950F65E-M	A	From Leg	2.00		0.0000	120.00	No Ice	6.13	4.24	0.02
(Verizon)			0.00				1/2" Ice	6.59	4.62	0.05
			0.00				1" Ice	7.06	5.01	0.10
							2" Ice	8.02	5.89	0.20
							4" Ice	10.06	7.83	0.48
(4) DB950F65E-M	B	From Leg	2.00		0.0000	120.00	No Ice	6.13	4.24	0.02
(Verizon)			0.00				1/2" Ice	6.59	4.62	0.05
			0.00				1" Ice	7.06	5.01	0.10
							2" Ice	8.02	5.89	0.20
							4" Ice	10.06	7.83	0.48
(2) DB844H90E-XY	C	From Leg	2.00		0.0000	120.00	No Ice	2.87	3.73	0.01
(Verizon)			0.00				1/2" Ice	3.18	4.10	0.04
			0.00				1" Ice	3.52	4.48	0.06
							2" Ice	4.27	5.25	0.14
							4" Ice	5.88	6.91	0.34
(2) DB950F65E-M	C	From Leg	2.00		0.0000	120.00	No Ice	6.13	4.24	0.02
(Verizon)			0.00				1/2" Ice	6.59	4.62	0.05
			0.00				1" Ice	7.06	5.01	0.10
							2" Ice	8.02	5.89	0.20
							4" Ice	10.06	7.83	0.48
PiROD 15' Platform	C	None			0.0000	120.00	No Ice	33.80	33.80	2.04
w/handrails (Monopole)							1/2" Ice	43.60	43.60	2.75
(Verizon)							1" Ice	53.40	53.40	3.45
							2" Ice	73.00	73.00	4.86
							4" Ice	112.20	112.20	7.68
GPS Antenna	C	From Leg	2.00		0.0000	112.00	No Ice	4.00	4.00	0.09
(Cingular)			0.00				1/2" Ice	4.31	4.31	0.14
			0.00				1" Ice	4.62	4.62	0.20
							2" Ice	5.29	5.29	0.33
							4" Ice	6.76	6.76	0.64
(4) 7130.16.05.00	A	From Leg	2.00		0.0000	110.00	No Ice	5.76	5.76	0.02
(Nextel)			0.00				1/2" Ice	6.18	6.18	0.06
			0.00				1" Ice	6.60	6.60	0.11
							2" Ice	7.48	7.48	0.23
							4" Ice	9.33	9.33	0.53
(4) 7130.16.05.00	B	From Leg	2.00		0.0000	110.00	No Ice	5.76	5.76	0.02
(Nextel)			0.00				1/2" Ice	6.18	6.18	0.06
			0.00				1" Ice	6.60	6.60	0.11

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment deg	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
						2" Ice	7.48	7.48	0.23
						4" Ice	9.33	9.33	0.53
(4) 7130.16.05.00 (Nextel)	C	From Leg	2.00 0.00 0.00	0.0000	110.00	No Ice	5.76	5.76	0.02
						1/2" Ice	6.18	6.18	0.06
						1" Ice	6.60	6.60	0.11
						2" Ice	7.48	7.48	0.23
						4" Ice	9.33	9.33	0.53
PiROD 15' Platform w/handrails (Monopole) (Nextel)	C	None		0.0000	110.00	No Ice	33.80	33.80	2.04
						1/2" Ice	43.60	43.60	2.75
						1" Ice	53.40	53.40	3.45
						2" Ice	73.00	73.00	4.86
						4" Ice	112.20	112.20	7.68
(2) RR90-17-02DP (T-Mobile)	A	From Leg	2.00 0.00 0.00	0.0000	100.00	No Ice	4.36	1.97	0.02
						1/2" Ice	4.77	2.31	0.04
						1" Ice	5.20	2.66	0.07
						2" Ice	6.08	3.37	0.14
						4" Ice	7.95	4.89	0.33
(2) RR90-17-02DP (T-Mobile)	B	From Leg	2.00 0.00 0.00	0.0000	100.00	No Ice	4.36	1.97	0.02
						1/2" Ice	4.77	2.31	0.04
						1" Ice	5.20	2.66	0.07
						2" Ice	6.08	3.37	0.14
						4" Ice	7.95	4.89	0.33
(2) RR90-17-02DP (T-Mobile)	C	From Leg	2.00 0.00 0.00	0.0000	100.00	No Ice	4.36	1.97	0.02
						1/2" Ice	4.77	2.31	0.04
						1" Ice	5.20	2.66	0.07
						2" Ice	6.08	3.37	0.14
						4" Ice	7.95	4.89	0.33
PiROD 15' Low Profile Platform (Monopole) (T-Mobile)	C	None		0.0000	100.00	No Ice	17.30	17.30	1.50
						1/2" Ice	22.10	22.10	2.03
						1" Ice	26.90	26.90	2.56
						2" Ice	36.50	36.50	3.62
						4" Ice	55.70	55.70	5.74
(4) DB980F65E-M (Sprint)	A	From Leg	2.00 0.00 0.00	0.0000	90.00	No Ice	3.90	2.29	0.01
						1/2" Ice	4.28	2.65	0.03
						1" Ice	4.66	3.02	0.06
						2" Ice	5.46	3.79	0.12
						4" Ice	7.39	5.40	0.32
(4) DB980F65E-M (Sprint)	B	From Leg	2.00 0.00 0.00	0.0000	90.00	No Ice	3.90	2.29	0.01
						1/2" Ice	4.28	2.65	0.03
						1" Ice	4.66	3.02	0.06
						2" Ice	5.46	3.79	0.12
						4" Ice	7.39	5.40	0.32
(4) DB980F65E-M (Sprint)	C	From Leg	2.00 0.00 0.00	0.0000	90.00	No Ice	3.90	2.29	0.01
						1/2" Ice	4.28	2.65	0.03
						1" Ice	4.66	3.02	0.06
						2" Ice	5.46	3.79	0.12
						4" Ice	7.39	5.40	0.32
PiROD 15' Low Profile Platform (Monopole) (Sprint)	C	None		0.0000	90.00	No Ice	17.30	17.30	1.50
						1/2" Ice	22.10	22.10	2.03
						1" Ice	26.90	26.90	2.56
						2" Ice	36.50	36.50	3.62
						4" Ice	55.70	55.70	5.74
(2) 7250.03 (AT&T)	A	From Leg	2.00 0.00 0.00	0.0000	80.00	No Ice	4.00	1.87	0.02
						1/2" Ice	4.39	2.33	0.04
						1" Ice	4.78	2.70	0.06
						2" Ice	5.59	3.47	0.12
						4" Ice	7.54	5.09	0.32

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment deg	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(2) 7250.03 (AT&T)	B	From Leg	2.00 0.00 0.00	0.0000	80.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	4.00 4.39 4.78 5.59 7.54	1.87 2.33 2.70 3.47 5.09	0.02 0.04 0.06 0.12 0.32
(2) 7250.03 (AT&T)	C	From Leg	2.00 0.00 0.00	0.0000	80.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	4.00 4.39 4.78 5.59 7.54	1.87 2.33 2.70 3.47 5.09	0.02 0.04 0.06 0.12 0.32
Generic T-Arm Mount (AT&T)	A	None		0.0000	80.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	5.50 6.90 8.30 11.10 16.70	5.50 6.90 8.30 11.10 16.70	0.13 0.17 0.21 0.29 0.46
Generic T-Arm Mount (AT&T)	B	None		0.0000	80.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	5.50 6.90 8.30 11.10 16.70	5.50 6.90 8.30 11.10 16.70	0.13 0.17 0.21 0.29 0.46
Generic T-Arm Mount (AT&T)	C	None		0.0000	80.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	5.50 6.90 8.30 11.10 16.70	5.50 6.90 8.30 11.10 16.70	0.13 0.17 0.21 0.29 0.46
GPS Antenna (Sprint)	C	From Leg	2.00 0.00 0.00	0.0000	50.00	No Ice 1/2" Ice 1" Ice 2" Ice 4" Ice	4.00 4.31 4.62 5.29 6.76	4.00 4.31 4.62 5.29 6.76	0.09 0.14 0.20 0.33 0.64

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_{Ice} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 140.00-115.36	127.07	1.47	24	43.380	A	0.000	43.380	43.380	100.00	0.000	0.000
					B	0.000	43.380		100.00		
					C	0.000	43.380		100.00		
					D	0.000	43.380		100.00		
L2 115.36-79.83	96.90	1.36	22	83.735	A	0.000	83.735	83.735	100.00	0.000	0.000
					B	0.000	83.735		100.00		
					C	0.000	83.735		100.00		
					D	0.000	83.735		100.00		
L3 79.83-40.26	59.63	1.184	19	122.046	A	0.000	122.046	122.046	100.00	0.000	0.000
					B	0.000	122.046		100.00		
					C	0.000	122.046		100.00		

ERITower	Job	Page
	140' Monopole	8 of 20
URS Corp. AES 795 Brook Street Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-5566	Project Canton Fire Department	Date 08:56:02 01/13/04
	Client Verizon	Designed by Daniel D. McClure

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{Ice} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
					D	0.000	122.046		100.00		
L4 40.26-0.00	19.40	1	16	154.394	A	0.000	154.394	154.394	100.00	0.000	0.000
					B	0.000	154.394		100.00		
					C	0.000	154.394		100.00		
					D	0.000	154.394		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_{Ice} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 140.00-115.36	127.07	1.47	18	0.5000	45.433	A	0.000	45.433	45.433	100.00	0.000	0.000
						B	0.000	45.433		100.00		
						C	0.000	45.433		100.00		
						D	0.000	45.433		100.00		
L2 115.36-79.83	96.90	1.36	17	0.5000	86.696	A	0.000	86.696	86.696	100.00	0.000	0.000
						B	0.000	86.696		100.00		
						C	0.000	86.696		100.00		
						D	0.000	86.696		100.00		
L3 79.83-40.26	59.63	1.184	14	0.5000	125.344	A	0.000	125.344	125.344	100.00	0.000	0.000
						B	0.000	125.344		100.00		
						C	0.000	125.344		100.00		
						D	0.000	125.344		100.00		
L4 40.26-0.00	19.40	1	12	0.5000	157.748	A	0.000	157.748	157.748	100.00	0.000	0.000
						B	0.000	157.748		100.00		
						C	0.000	157.748		100.00		
						D	0.000	157.748		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_{Ice} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 140.00-115.36	127.07	1.47	9	43.380	A	0.000	43.380	43.380	100.00	0.000	0.000
					B	0.000	43.380		100.00		
					C	0.000	43.380		100.00		
					D	0.000	43.380		100.00		
L2 115.36-79.83	96.90	1.36	9	83.735	A	0.000	83.735	83.735	100.00	0.000	0.000
					B	0.000	83.735		100.00		
					C	0.000	83.735		100.00		
					D	0.000	83.735		100.00		
L3 79.83-40.26	59.63	1.184	8	122.046	A	0.000	122.046	122.046	100.00	0.000	0.000
					B	0.000	122.046		100.00		
					C	0.000	122.046		100.00		
					D	0.000	122.046		100.00		
L4 40.26-0.00	19.40	1	6	154.394	A	0.000	154.394	154.394	100.00	0.000	0.000

ERITower	Job: 140' Monopole	Page: 9 of 20
URS Corp. AES 795 Brook Street Rocky Hill, CT 06067 Phone: (860) 529-8882 FAX: (860) 529-5566	Project: Canton Fire Department	Date: 08:56:02 01/13/04
	Client: Verizon	Designed by: Daniel D. McClure

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
					B	0.000	154.394		100.00		
					C	0.000	154.394		100.00		
					D	0.000	154.394		100.00		

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.14	1.04	A	1	0.65	1	1	1	43.380	1.15	46.58	D
			B	1	0.65	1	1	1	43.380			
			C	1	0.65	1	1	1	43.380			
			D	1	0.65	1	1	1	43.380			
L2 115.36-79.83	1.27	3.63	A	1	0.65	1	1	1	83.735	2.05	57.62	D
			B	1	0.65	1	1	1	83.735			
			C	1	0.65	1	1	1	83.735			
			D	1	0.65	1	1	1	83.735			
L3 79.83-40.26	2.45	7.51	A	1	0.65	1	1	1	122.046	2.59	65.39	D
			B	1	0.65	1	1	1	122.046			
			C	1	0.65	1	1	1	122.046			
			D	1	0.65	1	1	1	122.046			
L4 40.26-0.00	2.51	11.03	A	1	0.65	1	1	1	154.394	2.78	69.03	D
			B	1	0.65	1	1	1	154.394			
			C	1	0.65	1	1	1	154.394			
			D	1	0.65	1	1	1	154.394			
Sum Weight:	6.38	23.22						OTM	552.43 kip-ft	8.56		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_L ft²	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.14	1.04	A	1	0.65	1	1	1	43.380	1.15	46.58	D
			B	1	0.65	1	1	1	43.380			
			C	1	0.65	1	1	1	43.380			
			D	1	0.65	1	1	1	43.380			
L2 115.36-79.83	1.27	3.63	A	1	0.65	1	1	1	83.735	2.05	57.62	D
			B	1	0.65	1	1	1	83.735			
			C	1	0.65	1	1	1	83.735			
			D	1	0.65	1	1	1	83.735			
L3 79.83-40.26	2.45	7.51	A	1	0.65	1	1	1	122.046	2.59	65.39	D
			B	1	0.65	1	1	1	122.046			
			C	1	0.65	1	1	1	122.046			
			D	1	0.65	1	1	1	122.046			
L4 40.26-0.00	2.51	11.03	A	1	0.65	1	1	1	154.394	2.78	69.03	D
			B	1	0.65	1	1	1	154.394			
			C	1	0.65	1	1	1	154.394			
			D	1	0.65	1	1	1	154.394			
Sum Weight:	6.38	23.22						OTM	552.43 kip-ft	8.56		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.14	1.37	A	1	0.65	1	1	1	45.433	0.90	36.58	D
			B	1	0.65	1	1	1	45.433			
			C	1	0.65	1	1	1	45.433			
			D	1	0.65	1	1	1	45.433			
L2 115.36-79.83	1.27	4.26	A	1	0.65	1	1	1	86.696	1.59	44.74	D
			B	1	0.65	1	1	1	86.696			
			C	1	0.65	1	1	1	86.696			
			D	1	0.65	1	1	1	86.696			
L3 79.83-40.26	2.45	8.43	A	1	0.65	1	1	1	125.344	1.99	50.37	D
			B	1	0.65	1	1	1	125.344			
			C	1	0.65	1	1	1	125.344			
			D	1	0.65	1	1	1	125.344			
L4 40.26-0.00	2.51	12.19	A	1	0.65	1	1	1	157.748	2.13	52.90	D
			B	1	0.65	1	1	1	157.748			
			C	1	0.65	1	1	1	157.748			
			D	1	0.65	1	1	1	157.748			
Sum Weight:	6.38	26.25						OTM	428.77 kip-ft	6.61		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 140.00-115.36	0.14	1.37	A	1	0.65	1	1	1	45.433	0.90	36.58	D
			B	1	0.65	1	1	1	45.433			
			C	1	0.65	1	1	1	45.433			
			D	1	0.65	1	1	1	45.433			
L2 115.36-79.83	1.27	4.26	A	1	0.65	1	1	1	86.696	1.59	44.74	D
			B	1	0.65	1	1	1	86.696			
			C	1	0.65	1	1	1	86.696			
			D	1	0.65	1	1	1	86.696			
L3 79.83-40.26	2.45	8.43	A	1	0.65	1	1	1	125.344	1.99	50.37	D
			B	1	0.65	1	1	1	125.344			
			C	1	0.65	1	1	1	125.344			
			D	1	0.65	1	1	1	125.344			
L4 40.26-0.00	2.51	12.19	A	1	0.65	1	1	1	157.748	2.13	52.90	D
			B	1	0.65	1	1	1	157.748			
			C	1	0.65	1	1	1	157.748			
			D	1	0.65	1	1	1	157.748			
Sum Weight:	6.38	26.25						OTM	428.77 kip-ft	6.61		

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 140.00-115.36	0.14	1.04	A	1	0.65	1	1	1	43.380	0.45	18.19	D
			B	1	0.65	1	1	1	43.380			
			C	1	0.65	1	1	1	43.380			
			D	1	0.65	1	1	1	43.380			
L2 115.36-79.83	1.27	3.63	A	1	0.65	1	1	1	83.735	0.80	22.51	D
			B	1	0.65	1	1	1	83.735			
			C	1	0.65	1	1	1	83.735			
			D	1	0.65	1	1	1	83.735			
L3 79.83-40.26	2.45	7.51	A	1	0.65	1	1	1	122.046	1.01	25.54	D
			B	1	0.65	1	1	1	122.046			
			C	1	0.65	1	1	1	122.046			
			D	1	0.65	1	1	1	122.046			
L4 40.26-0.00	2.51	11.03	A	1	0.65	1	1	1	154.394	1.09	26.96	D
			B	1	0.65	1	1	1	154.394			
			C	1	0.65	1	1	1	154.394			
			D	1	0.65	1	1	1	154.394			
Sum Weight:	6.38	23.22						OTM	215.79 kip-ft	3.34		

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 140.00-115.36	0.14	1.04	A	1	0.65	1	1	1	43.380	0.45	18.19	D
			B	1	0.65	1	1	1	43.380			
			C	1	0.65	1	1	1	43.380			
			D	1	0.65	1	1	1	43.380			
L2 115.36-79.83	1.27	3.63	A	1	0.65	1	1	1	83.735	0.80	22.51	D
			B	1	0.65	1	1	1	83.735			
			C	1	0.65	1	1	1	83.735			
			D	1	0.65	1	1	1	83.735			
L3 79.83-40.26	2.45	7.51	A	1	0.65	1	1	1	122.046	1.01	25.54	D
			B	1	0.65	1	1	1	122.046			
			C	1	0.65	1	1	1	122.046			
			D	1	0.65	1	1	1	122.046			
L4 40.26-0.00	2.51	11.03	A	1	0.65	1	1	1	154.394	1.09	26.96	D
			B	1	0.65	1	1	1	154.394			
			C	1	0.65	1	1	1	154.394			
			D	1	0.65	1	1	1	154.394			
Sum Weight:	6.38	23.22						OTM	215.79 kip-ft	3.34		

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

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	23.22					
Bracing Weight	0.00					
Total Member Self-Weight	23.22			-0.55	-1.53	
Total Weight	40.89			-0.55	-1.53	
Wind 0 deg - No Ice		-0.46	-26.92	-2629.14	47.33	7.88
Wind 30 deg - No Ice		13.06	-23.08	-2252.55	-1273.51	3.70
Wind 45 deg - No Ice		18.71	-18.71	-1824.69	-1825.67	1.15
Wind 60 deg - No Ice		23.08	-13.06	-1272.53	-2253.52	-1.47
Wind 90 deg - No Ice		26.92	0.46	48.31	-2630.11	-6.24
Wind 120 deg - No Ice		23.54	13.85	1356.05	-2302.38	-9.34
Wind 135 deg - No Ice		19.36	19.36	1892.69	-1894.77	-9.98
Wind 150 deg - No Ice		13.85	23.54	2300.30	-1358.13	-9.94
Wind 180 deg - No Ice		0.46	26.92	2628.03	-50.39	-7.88
Wind 210 deg - No Ice		-13.06	23.08	2251.44	1270.45	-3.70
Wind 225 deg - No Ice		-18.71	18.71	1823.59	1822.61	-1.15
Wind 240 deg - No Ice		-23.08	13.06	1271.42	2250.46	1.47
Wind 270 deg - No Ice		-26.92	-0.46	-49.41	2627.06	6.24
Wind 300 deg - No Ice		-23.54	-13.85	-1357.16	2299.32	9.34
Wind 315 deg - No Ice		-19.36	-19.36	-1893.79	1891.71	9.98
Wind 330 deg - No Ice		-13.85	-23.54	-2301.40	1355.08	9.94
Member Ice	3.03					
Total Weight Ice	49.39			-1.72	-3.26	
Wind 0 deg - Ice		-0.35	-22.48	-2222.15	33.85	6.53
Wind 30 deg - Ice		10.94	-19.29	-1906.12	-1081.34	3.12
Wind 45 deg - Ice		15.65	-15.65	-1545.56	-1547.10	1.03
Wind 60 deg - Ice		19.29	-10.94	-1079.80	-1907.66	-1.13
Wind 90 deg - Ice		22.48	0.35	35.39	-2223.69	-5.07
Wind 120 deg - Ice		19.64	11.54	1140.63	-1944.77	-7.66
Wind 135 deg - Ice		16.14	16.14	1594.60	-1599.58	-8.20
Wind 150 deg - Ice		11.54	19.64	1939.78	-1145.61	-8.19
Wind 180 deg - Ice		0.35	22.48	2218.71	-40.37	-6.53
Wind 210 deg - Ice		-10.94	19.29	1902.67	1074.82	-3.12
Wind 225 deg - Ice		-15.65	15.65	1542.12	1540.58	-1.03
Wind 240 deg - Ice		-19.29	10.94	1076.36	1901.13	1.13
Wind 270 deg - Ice		-22.48	-0.35	-38.83	2217.17	5.07
Wind 300 deg - Ice		-19.64	-11.54	-1144.07	1938.24	7.66
Wind 315 deg - Ice		-16.14	-16.14	-1598.04	1593.06	8.20
Wind 330 deg - Ice		-11.54	-19.64	-1943.22	1139.09	8.19
Total Weight	40.89			-0.55	-1.53	
Wind 0 deg - Service		-0.18	-10.51	-1027.34	17.56	3.08
Wind 30 deg - Service		5.10	-9.02	-880.24	-498.39	1.45
Wind 45 deg - Service		7.31	-7.31	-713.11	-714.08	0.45
Wind 60 deg - Service		9.02	-5.10	-497.42	-881.21	-0.57
Wind 90 deg - Service		10.51	0.18	18.53	-1028.32	-2.44
Wind 120 deg - Service		9.19	5.41	529.37	-900.30	-3.65
Wind 135 deg - Service		7.56	7.56	738.99	-741.07	-3.90
Wind 150 deg - Service		5.41	9.19	898.22	-531.45	-3.88
Wind 180 deg - Service		0.18	10.51	1026.24	-20.61	-3.08
Wind 210 deg - Service		-5.10	9.02	879.13	495.34	-1.45
Wind 225 deg - Service		-7.31	7.31	712.00	711.03	-0.45
Wind 240 deg - Service		-9.02	5.10	496.31	878.16	0.57
Wind 270 deg - Service		-10.51	-0.18	-19.64	1025.26	2.44
Wind 300 deg - Service		-9.19	-5.41	-530.48	897.24	3.65
Wind 315 deg - Service		-7.56	-7.56	-740.10	738.02	3.90
Wind 330 deg - Service		-5.41	-9.19	-899.32	528.40	3.88

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

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	140 - 115.359	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-8.87	-1.44	1.25
			Max. Mx	6	-5.34	-84.19	-2.32
			Max. My	2	-5.34	2.21	84.07
			Max. Vy	6	10.81	-84.19	-2.32
			Max. Vx	2	-10.81	2.21	84.07
			Max. Torque	8			5.26
L2	115.359 - 79.8307	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-22.19	-2.80	1.97
			Max. Mx	6	-15.11	-637.47	-10.50
			Max. My	2	-15.11	9.99	636.95
			Max. Vy	6	20.70	-637.47	-10.50
			Max. Vx	2	-20.70	9.99	636.95
			Max. Torque	16			-9.57
L3	79.8307 - 40.2552	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-33.20	-3.32	1.76
			Max. Mx	6	-25.40	-1532.60	-28.52
			Max. My	2	-25.40	27.52	1531.60
			Max. Vy	6	24.42	-1532.60	-28.52
			Max. Vx	2	-24.42	27.52	1531.60
			Max. Torque	16			-10.02
L4	40.2552 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-49.39	-3.27	1.73
			Max. Mx	6	-40.88	-2702.37	-49.65
			Max. My	2	-40.88	48.64	2701.36
			Max. Vy	6	26.94	-2702.37	-49.65
			Max. Vx	2	-26.94	48.64	2701.36
			Max. Torque	16			-10.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	18	49.39	0.00	-0.00
	Max. H_x	14	40.89	26.91	0.46
	Max. H_z	2	40.89	0.46	26.91
	Max. M_x	2	2701.36	0.46	26.91
	Max. M_z	6	2702.37	-26.91	-0.46
	Max. Torsion	8	10.00	-19.36	-19.36
	Min. Vert	40	40.89	-9.19	-5.41
	Min. H_x	6	40.89	-26.91	-0.46
	Min. H_z	10	40.89	-0.46	-26.91
	Min. M_x	10	-2700.19	-0.46	-26.91
	Min. M_z	14	-2699.18	26.91	0.46
	Min. Torsion	16	-10.00	19.36	19.36

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	40.89	-0.00	0.00	-0.55	-1.52	-0.00
Dead+Wind 0 deg - No Ice	40.89	-0.46	-26.91	-2701.36	48.65	7.89
Dead+Wind 30 deg - No Ice	40.89	13.06	-23.08	-2314.51	-1308.54	3.71
Dead+Wind 45 deg - No Ice	40.89	18.71	-18.71	-1874.89	-1875.90	1.17
Dead+Wind 60 deg - No Ice	40.89	23.08	-13.06	-1307.53	-2315.52	-1.46
Dead+Wind 90 deg - No Ice	40.89	26.91	0.46	49.65	-2702.37	-6.24
Dead+Wind 120 deg - No Ice	40.89	23.54	13.85	1393.30	-2365.59	-9.35
Dead+Wind 135 deg - No Ice	40.89	19.36	19.36	1944.66	-1946.79	-10.00
Dead+Wind 150 deg - No Ice	40.89	13.85	23.54	2363.46	-1395.43	-9.96
Dead+Wind 180 deg - No Ice	40.89	0.46	26.91	2700.19	-51.78	-7.90
Dead+Wind 210 deg - No Ice	40.89	-13.06	23.08	2313.32	1305.36	-3.72
Dead+Wind 225 deg - No Ice	40.89	-18.71	18.71	1873.72	1872.71	-1.17
Dead+Wind 240 deg - No Ice	40.89	-23.08	13.06	1306.37	2312.32	1.46
Dead+Wind 270 deg - No Ice	40.89	-26.91	-0.46	-50.77	2699.18	6.25
Dead+Wind 300 deg - No Ice	40.89	-23.54	-13.85	-1394.42	2362.45	9.36
Dead+Wind 315 deg - No Ice	40.89	-19.36	-19.36	-1945.78	1943.65	10.00
Dead+Wind 330 deg - No Ice	40.89	-13.85	-23.54	-2364.58	1392.29	9.96
Dead+Ice+Temp	49.39	-0.00	0.00	-1.73	-3.27	0.00
Dead+Wind 0 deg+Ice+Temp	49.39	-0.35	-22.48	-2305.91	35.06	6.62
Dead+Wind 30 deg+Ice+Temp	49.39	10.94	-19.29	-1978.04	-1122.18	3.17
Dead+Wind 45 deg+Ice+Temp	49.39	15.65	-15.65	-1603.90	-1605.52	1.05
Dead+Wind 60 deg+Ice+Temp	49.39	19.29	-10.94	-1120.56	-1979.66	-1.14
Dead+Wind 90 deg+Ice+Temp	49.39	22.48	0.35	36.68	-2307.53	-5.14
Dead+Wind 120 deg+Ice+Temp	49.39	19.64	11.54	1183.56	-2018.09	-7.76
Dead+Wind 135 deg+Ice+Temp	49.39	16.14	16.14	1654.63	-1659.91	-8.32
Dead+Wind 150 deg+Ice+Temp	49.39	11.54	19.64	2012.81	-1188.84	-8.30
Dead+Wind 180 deg+Ice+Temp	49.39	0.35	22.48	2302.19	-41.97	-6.63
Dead+Wind 210 deg+Ice+Temp	49.39	-10.94	19.29	1974.32	1115.24	-3.17
Dead+Wind 225 deg+Ice+Temp	49.39	-15.65	15.65	1600.18	1598.56	-1.05
Dead+Wind 240 deg+Ice+Temp	49.39	-19.29	10.94	1116.86	1972.70	1.14
Dead+Wind 270 deg+Ice+Temp	49.39	-22.48	-0.35	-40.35	2300.57	5.14
Dead+Wind 300 deg+Ice+Temp	49.39	-19.64	-11.54	-1187.22	2011.18	7.76
Dead+Wind 315 deg+Ice+Temp	49.39	-16.14	-16.14	-1658.29	1653.00	8.32
Dead+Wind 330 deg+Ice+Temp	49.39	-11.54	-19.64	-2016.47	1181.93	8.30
Dead+Wind 0 deg - Service	40.89	-0.18	-10.51	-1056.13	18.03	3.10
Dead+Wind 30 deg - Service	40.89	5.10	-9.01	-904.91	-512.38	1.46
Dead+Wind 45 deg - Service	40.89	7.31	-7.31	-733.10	-734.11	0.46
Dead+Wind 60 deg - Service	40.89	9.01	-5.10	-511.37	-905.92	-0.57
Dead+Wind 90 deg - Service	40.89	10.51	0.18	19.04	-1057.15	-2.45
Dead+Wind 120 deg - Service	40.89	9.19	5.41	544.18	-925.54	-3.67
Dead+Wind 135 deg - Service	40.89	7.56	7.56	759.73	-761.92	-3.93
Dead+Wind 150 deg - Service	40.89	5.41	9.19	923.43	-546.41	-3.91
Dead+Wind 180 deg - Service	40.89	0.18	10.51	1054.95	-21.22	-3.10
Dead+Wind 210 deg - Service	40.89	-5.10	9.01	903.73	509.18	-1.46
Dead+Wind 225 deg - Service	40.89	-7.31	7.31	731.92	730.91	-0.46
Dead+Wind 240 deg - Service	40.89	-9.01	5.10	510.19	902.72	0.57
Dead+Wind 270 deg - Service	40.89	-10.51	-0.18	-20.21	1053.94	2.45
Dead+Wind 300 deg - Service	40.89	-9.19	-5.41	-545.39	922.41	3.67
Dead+Wind 315 deg - Service	40.89	-7.56	-7.56	-760.90	758.72	3.93
Dead+Wind 330 deg - Service	40.89	-5.41	-9.19	-924.52	543.17	3.91

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	0.00	-40.89	0.00	0.00	40.89	-0.00	0.000%
2	-0.46	-40.89	-26.92	0.46	40.89	26.91	0.001%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
3	13.06	-40.89	-23.08	-13.06	40.89	23.08	0.000%
4	18.71	-40.89	-18.71	-18.71	40.89	18.71	0.000%
5	23.08	-40.89	-13.06	-23.08	40.89	13.06	0.000%
6	26.92	-40.89	0.46	-26.91	40.89	-0.46	0.001%
7	23.54	-40.89	13.85	-23.54	40.89	-13.85	0.000%
8	19.36	-40.89	19.36	-19.36	40.89	-19.36	0.000%
9	13.85	-40.89	23.54	-13.85	40.89	-23.54	0.000%
10	0.46	-40.89	26.92	-0.46	40.89	-26.91	0.001%
11	-13.06	-40.89	23.08	13.06	40.89	-23.08	0.000%
12	-18.71	-40.89	18.71	18.71	40.89	-18.71	0.000%
13	-23.08	-40.89	13.06	23.08	40.89	-13.06	0.000%
14	-26.92	-40.89	-0.46	26.91	40.89	0.46	0.001%
15	-23.54	-40.89	-13.85	23.54	40.89	13.85	0.000%
16	-19.36	-40.89	-19.36	19.36	40.89	19.36	0.000%
17	-13.85	-40.89	-23.54	13.85	40.89	23.54	0.000%
18	0.00	-49.39	0.00	0.00	49.39	-0.00	0.003%
19	-0.35	-49.39	-22.48	0.35	49.39	22.48	0.001%
20	10.94	-49.39	-19.29	-10.94	49.39	19.29	0.000%
21	15.65	-49.39	-15.65	-15.65	49.39	15.65	0.000%
22	19.29	-49.39	-10.94	-19.29	49.39	10.94	0.000%
23	22.48	-49.39	0.35	-22.48	49.39	-0.35	0.001%
24	19.64	-49.39	11.54	-19.64	49.39	-11.54	0.000%
25	16.14	-49.39	16.14	-16.14	49.39	-16.14	0.000%
26	11.54	-49.39	19.64	-11.54	49.39	-19.64	0.000%
27	0.35	-49.39	22.48	-0.35	49.39	-22.48	0.001%
28	-10.94	-49.39	19.29	10.94	49.39	-19.29	0.000%
29	-15.65	-49.39	15.65	15.65	49.39	-15.65	0.000%
30	-19.29	-49.39	10.94	19.29	49.39	-10.94	0.000%
31	-22.48	-49.39	-0.35	22.48	49.39	0.35	0.001%
32	-19.64	-49.39	-11.54	19.64	49.39	11.54	0.000%
33	-16.14	-49.39	-16.14	16.14	49.39	16.14	0.000%
34	-11.54	-49.39	-19.64	11.54	49.39	19.64	0.000%
35	-0.18	-40.89	-10.51	0.18	40.89	10.51	0.003%
36	5.10	-40.89	-9.02	-5.10	40.89	9.01	0.003%
37	7.31	-40.89	-7.31	-7.31	40.89	7.31	0.003%
38	9.02	-40.89	-5.10	-9.01	40.89	5.10	0.003%
39	10.51	-40.89	0.18	-10.51	40.89	-0.18	0.003%
40	9.19	-40.89	5.41	-9.19	40.89	-5.41	0.003%
41	7.56	-40.89	7.56	-7.56	40.89	-7.56	0.001%
42	5.41	-40.89	9.19	-5.41	40.89	-9.19	0.001%
43	0.18	-40.89	10.51	-0.18	40.89	-10.51	0.003%
44	-5.10	-40.89	9.02	5.10	40.89	-9.01	0.003%
45	-7.31	-40.89	7.31	7.31	40.89	-7.31	0.003%
46	-9.02	-40.89	5.10	9.01	40.89	-5.10	0.003%
47	-10.51	-40.89	-0.18	10.51	40.89	0.18	0.003%
48	-9.19	-40.89	-5.41	9.19	40.89	5.41	0.001%
49	-7.56	-40.89	-7.56	7.56	40.89	7.56	0.001%
50	-5.41	-40.89	-9.19	5.41	40.89	9.19	0.003%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	15	0.00000001	0.00011026
3	Yes	16	0.00000001	0.00012336

4	Yes	16	0.00000001	0.00012671
5	Yes	16	0.00000001	0.00011646
6	Yes	15	0.00000001	0.00009105
7	Yes	16	0.00000001	0.00010644
8	Yes	17	0.00000001	0.00006149
9	Yes	17	0.00000001	0.00006547
10	Yes	15	0.00000001	0.00013519
11	Yes	16	0.00000001	0.00009895
12	Yes	16	0.00000001	0.00012550
13	Yes	16	0.00000001	0.00010331
14	Yes	15	0.00000001	0.00011575
15	Yes	17	0.00000001	0.00006440
16	Yes	17	0.00000001	0.00006134
17	Yes	16	0.00000001	0.00010631
18	Yes	6	0.00000001	0.00002521
19	Yes	15	0.00000001	0.00013148
20	Yes	16	0.00000001	0.00013556
21	Yes	16	0.00000001	0.00014308
22	Yes	16	0.00000001	0.00012911
23	Yes	15	0.00000001	0.00011359
24	Yes	16	0.00000001	0.00012392
25	Yes	17	0.00000001	0.00006759
26	Yes	17	0.00000001	0.00006912
27	Yes	15	0.00000001	0.00014753
28	Yes	16	0.00000001	0.00011434
29	Yes	16	0.00000001	0.00013990
30	Yes	16	0.00000001	0.00011800
31	Yes	15	0.00000001	0.00012835
32	Yes	17	0.00000001	0.00006790
33	Yes	17	0.00000001	0.00006731
34	Yes	16	0.00000001	0.00012364
35	Yes	13	0.00008952	0.00013036
36	Yes	13	0.00008933	0.00013289
37	Yes	13	0.00008926	0.00010363
38	Yes	13	0.00008933	0.00011226
39	Yes	13	0.00008952	0.00011298
40	Yes	13	0.00008927	0.00012605
41	Yes	14	0.00000001	0.00009108
42	Yes	14	0.00000001	0.00010725
43	Yes	13	0.00008952	0.00013900
44	Yes	13	0.00008933	0.00007211
45	Yes	13	0.00008926	0.00010076
46	Yes	13	0.00008933	0.00007744
47	Yes	13	0.00008952	0.00012101
48	Yes	14	0.00000001	0.00010378
49	Yes	14	0.00000001	0.00009070
50	Yes	13	0.00008927	0.00013100

Maximum Tower Deflections - Service Wind

Section No.	*Elevation*	*Horz. Deflection*	*Gov. Load Comb.*	*Tilt*	*Twist*
	ft	*in*		*deg*	*deg*
L1	140 - 115.359	27.217	41	1.6683	0.0323
L2	118.891 - 79.8307	19.908	41	1.6003	0.0252
L3	84.4193 - 40.2552	9.760	41	1.1314	0.0104
L4	45.5335 - 0	2.742	41	0.5620	0.0035

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt deg	Twist deg	Radius of Curvature ft
140.00	DB616-AB (20' Omni)	41	27.217	1.6683	0.0323	28598
130.00	(3) DU08-8670	41	23.706	1.6509	0.0292	14299
120.00	(2) DB844H90E-XY	41	20.280	1.6078	0.0256	7215
112.00	GPS Antenna	41	17.653	1.5397	0.0223	5773
110.00	(4) 7130.16.05.00	41	17.016	1.5179	0.0214	5536
100.00	(2) RR90-17-02DP	41	13.969	1.3863	0.0169	4592
90.00	(4) DB980F65E-M	41	11.184	1.2271	0.0125	3921
80.00	(2) 7250.03	41	8.705	1.0543	0.0090	3600
50.00	GPS Antenna	41	3.284	0.6032	0.0038	3442

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt deg	Twist deg
L1	140 - 115.359	69.477	8	4.2602	0.0823
L2	118.891 - 79.8307	50.840	8	4.0878	0.0643
L3	84.4193 - 40.2552	24.941	8	2.8917	0.0265
L4	45.5335 - 0	7.011	8	1.4367	0.0088

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt deg	Twist deg	Radius of Curvature ft
140.00	DB616-AB (20' Omni)	8	69.477	4.2602	0.0823	11387
130.00	(3) DU08-8670	8	60.526	4.2182	0.0744	5693
120.00	(2) DB844H90E-XY	8	51.787	4.1073	0.0654	2871
112.00	GPS Antenna	8	45.086	3.9291	0.0569	2290
110.00	(4) 7130.16.05.00	8	43.462	3.8722	0.0546	2195
100.00	(2) RR90-17-02DP	8	35.687	3.5310	0.0429	1815
90.00	(4) DB980F65E-M	8	28.577	3.1276	0.0318	1546
80.00	(2) 7250.03	8	22.246	2.7054	0.0229	1417
50.00	GPS Antenna	8	8.396	1.5715	0.0097	1348

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 - 115.359 (1)	TP24.2521x18x0.1875	24.64	140.00	204.3	3.579	13.7882	-8.30	49.35	0.168
L2	115.359 - 79.8307 (2)	TP32.7041x22.9811x0.3125	39.06	140.00	151.4	6.511	30.9955	-15.07	201.82	0.075
L3	79.8307 - 40.2552 (3)	TP41.9334x30.9369x0.4375	44.16	140.00	117.8	10.766	55.7972	-25.37	600.70	0.042
L4	40.2552 - 0 (4)	TP51x39.7441x0.5	45.53	140.00	95.7	16.307	78.4811	-39.44	1279.77	0.031

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 - 115.359 (1)	TP24.2521x18x0.1875	74.59	-11.357	39.000	0.291	0.00	0.000	39.000	0.000
L2	115.359 - 79.8307 (2)	TP32.7041x22.9811x0.3125	647.66	-32.587	39.000	0.836	0.00	0.000	39.000	0.000
L3	79.8307 - 40.2552 (3)	TP41.9334x30.9369x0.4375	1560.76	-33.955	39.000	0.871	0.00	0.000	39.000	0.000
L4	40.2552 - 0 (4)	TP51x39.7441x0.5	2636.18	-33.105	39.000	0.849	0.00	0.000	39.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	140 - 115.359 (1)	TP24.2521x18x0.1875	0.168	0.291	0.000	0.459 ✔	1.333	H1-3 ✔
L2	115.359 - 79.8307 (2)	TP32.7041x22.9811x0.3125	0.075	0.836	0.000	0.910 ✔	1.333	H1-3 ✔
L3	79.8307 - 40.2552 (3)	TP41.9334x30.9369x0.4375	0.042	0.871	0.000	0.913 ✔	1.333	H1-3 ✔
L4	40.2552 - 0 (4)	TP51x39.7441x0.5	0.031	0.849	0.000	0.880 ✔	1.333	H1-3 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	140 - 115.359	Pole	TP24.2521x18x0.1875	1	-8.30	65.79	34.5	Pass
L2	115.359 - 79.8307	Pole	TP32.7041x22.9811x0.3125	2	-15.07	269.03	68.3	Pass
L3	79.8307 - 40.2552	Pole	TP41.9334x30.9369x0.4375	3	-25.37	800.73	68.5	Pass
L4	40.2552 - 0	Pole	TP51x39.7441x0.5	4	-39.44	1705.93	66.0	Pass
							Summary	
						Pole (L3)	68.5	Pass
						RATING =	**68.5**	**Pass**

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ANCHOR BOLT AND BASE PLATE ANALYSIS

URS

Job	140' Monopole - Canton, CT	Project No.	VZ1-060	Page	of
Description	Anchor Bolts and Base Plate Analysis	Computed by	DDM	Sheet 1	of 4
		Checked by		Date	01/13/04

ANCHOR BOLT AND BASEPLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 2752 \cdot kips \cdot ft$	*user input*
Shear Force:	$Shear := 27 \cdot kips$	*user input*
Axial Force:	$Axial := 41 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM 615 Grade 75

Number of Anchor Bolts = N	$N := 20$	*user input*
Diameter of Bolt Circle:	$D_{bc} := 60.0in$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot \frac{kips}{in^2}$	*user input*
Bolt Allowable Strength:	$Fy := 75 \cdot \left(1000 \cdot \frac{lb}{in^2} \right)$	*user input*
Thickness Of Anchor Bolts	$D := 2.25in$	*user input*

Base Plate Data:

Plate Yield Strength:	$Fy_{bp} := 60 \cdot 10^3 \cdot \frac{lb}{in^2}$	*user input*
Base Plate Thickness:	$PlateThicknessProvide := 2.25 \cdot in$	*user input*
Base Plate Diameter:	$D_{bp} := 66.0 \cdot in$	*user input*
Outer Pole Diameter:	$D_{pole} := 51.0in$	*user input*

Geometric Layout Data for Bolt Analysis:

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

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

Number of Spaces in Quadrant: $N_q := \frac{N}{4}$

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

$$d_i := \left| \begin{array}{l} \theta \leftarrow \frac{360}{N} \cdot \frac{\pi}{180} \\ \text{for } j \in i \\ \quad \left| \begin{array}{l} \theta \leftarrow \theta \cdot i \\ d \leftarrow R \cdot \sin(\theta) \end{array} \right. \end{array} \right. \qquad d = \begin{pmatrix} 9.27 \\ 17.63 \\ 24.27 \\ 28.53 \\ 30.00 \end{pmatrix} \text{in}$$

Critical Distances For Bending in Plate:

$MomentArm_1 := d_5 - \frac{D_{pole}}{2}$ $\qquad MomentArm_1 = 4.5\,\text{in}$

$MomentArm_2 := d_4 - \frac{D_{pole}}{2}$ $\qquad MomentArm_2 = 3.032\,\text{in}$

$EffectiveWidth := 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2}$ $\qquad EffectiveWidth = 41.89\,\text{in}$

Anchor Bolt Analysis:

Polar Moment of Inertia (J) divided by Area (A) = Σd

$$\Sigma d := \left(d_1\right)^2 \cdot 4 + \left(d_2\right)^2 \cdot 4 + \left(d_3\right)^2 \cdot 4 + \left(d_4\right)^2 \cdot 4 + \left(d_5\right)^2 \cdot 2 \qquad \Sigma d = 9 \times 10^3\ \text{in}^2$$

Gross Area of Bolt:

$$A_g := \frac{\pi}{4} \cdot D^2 \qquad A_g = 3.98\ \text{in}^2$$

Maximum Bolt Force:

$$\text{AllowableTension} := 1.33 \cdot \left(0.33 \cdot A_g \cdot F_u\right) \qquad \text{AllowableTension} = 174.51\ \text{kips}$$

Note: 1.33 increase allowed per TIA/EIA

$$\text{MaxTension} := \frac{OM \cdot d_5}{\Sigma d} + \frac{\text{Axial}}{N} \qquad \text{MaxTension} = 112.13\ \text{kips}$$

Check Stresses:

$$\text{AnchorBoltStress} := \text{if}\left(\text{AllowableTension} > \text{MaxTension}, \text{"Not Overstressed"}, \text{"Overstressed"}\right)$$

$$\text{AnchorBoltStress} = \text{"Not Overstressed"}$$

$$\text{PercentStressed} := 100 \cdot \frac{\text{MaxTension}}{\text{AllowableTension}}$$

$$\text{PercentStressed} = 64.25$$

Note: Shear Stress is negligible

Base Plate Analysis:

Force From Bolt(s):

$$C_1 := \frac{OM \cdot d_5}{\Sigma d} + \frac{Axial}{N} \qquad C_1 = 112.13 \times 10^3 \text{ lb}$$

$$C_2 := \frac{OM \cdot d_4}{\Sigma d} + \frac{Axial}{N} \qquad C_2 = 106.74 \times 10^3 \text{ lb}$$

Bending Stress In Plate:

$$f_{bp} := \frac{6 \cdot \left(C_1 \cdot MomentArm_1 + 2 \cdot C_2 \cdot MomentArm_2\right)}{EffectiveWidth \cdot PlateThicknessProvide^2} \qquad f_{bp} = 32.59 \text{ ksi}$$

Check Stresses:

$$BasePlateRatio := \frac{f_{bp}}{0.75 \cdot 1.33 Fy_{bp}} \qquad BasePlateRatio = 0.54$$

BasePlateStress := if(BasePlateRatio < 1, "Not Over Stress", "Is Over Stress")

BasePlateStress = "Not Over Stress"

PIER AND FOUNDATION ANALYSIS

URS

Job	140' Monopole - Canton, CT	Project No.	VZ1-060	Page	of
Description	Foundation and Pier Analysis	Computed by	DDM	Sheet 1	of 9
		Checked by		Date	01/13/04

140' MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 2752 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 27kip$
Max Compressive Force	$C_t := 41 \cdot kip$
Height of Tower	$H_t := 140 \cdot ft$
Base Plate Bolt Circle	$MP := 5.0ft$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 6.5ft$
Length of Pier	$L_p := 4.5 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 1 \cdot ft$
Diameter of Pier	$d_p := 6.5 \cdot ft$
Thickness of Footing	$T_f := 3.0 \cdot ft$
Width of Footing:	$W_f := 24.0ft$
Length of Anchor Bolts:	$L_{st} := 72in$
Projection of anchor bolts above pier	$A_{BP} := 12 \cdot in$
Anchor bolts area	$A_{anchor} := 3.97 \cdot in^2$

PROPERTIES:

Compressive Strength of Concrete	$f'c := 4000psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Internal Friction Angle of Soil	$\phi_s := 30 \cdot deg$
Allowable Bearing Capacity	$q_s := 4000 \cdot psf$
Unit Weight of Soil	$\gamma_s := 100 \cdot pcf$
Unit Weight of Concrete	$\gamma_c := 150 \cdot pcf$
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 soil and Concrete:	$\mu := 0.5$
Clear Cover of Reinforcement Pier:	$Cvr_{pier} := 3 \cdot in$
Clear Cover of Reinforcement Pier:	$Cvr_{pad} := 3 \cdot in$

PIER REINFORCEMENT:

Bar Size	$BSpier := 8$	Bar Diameter	$d_{bpier} := 0.79 \cdot in$
Number of Bars	$NBpier := 44$	Bar Area	$A_{bpier} := 1 \cdot in^2$

PAD REINFORCEMENT:

TOP:	Number of Bars	$BS_{top} := 8$	Bar Diameter	$d_{btop} := 0.79 \cdot in$
	Number of Bars	$NB_{top} := 28$	Bar Area	$A_{btop} := 1 \cdot in^2$
BOTTOM:	Bar Size	$BS_{bot} := 8$	Bar Diameter	$d_{bbot} := 0.79 \cdot in$
	Number of Bars	$NB_{bot} := 40$	Bar Area	$A_{bot} := 1 \cdot in^2$

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

Load Factor (EIA 3.1.1): $LF := if\left[H_t \le 700 \cdot ft, 1.3, if\left[H_t \ge 1200, 1.7, 1.3 + \left(\frac{H_t - 700}{1200 - 700} \right) \cdot 0.4 \right] \right]$ $LF = 1.3$

CHECK ANCHOR STEEL EMBEDMENT

$$L_{anchor} := \frac{(0.11 \cdot fy) \cdot in}{\sqrt{f'c\,psi}}$$

Depth:

$D_{ab} := L_{st} - A_{BP}$ $\quad D_{ab} = 5\,ft$

$DepthCheck := if\left(D_{ab} \geq L_{anchor}, "Okay", "No\ Good"\right)$ $\quad L_{anchor} = 8.6963\,ft$

$DepthCheck = "No\ Good"$ anchor plate is provided

STABILITY OF FOOTING

Passive Pressure:

$P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $\quad P_{pn} = 0.3\,ksf$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $\quad P_{pt} = 1.05\,ksf$

$P_{top} := if\left[n < (D_f - T_f), P_{pt}, P_{pn}\right]$ $\quad P_{top} = 1.05\,ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $\quad P_{bot} = 1.95\,ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $\quad P_{ave} = 1.5\,ksf$

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

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

Ultimate Shear:

$S_u := P_{ave} \cdot A_p$ $\quad S_u = 3474.7972 \frac{ft}{sec^2}\,kip$

Weight of Concrete Pad:

$WT_c := \left[\left(W_f^2 \cdot T_f\right) + \frac{d_p^2 \cdot \pi}{4} L_p\right] \cdot \gamma_c$ $\quad WT_c = 9060.1662 \frac{ft}{sec^2}\,kip$

Weight of Soil: above Footing:

$WT_{s1} := \left[W_f^2 \cdot \left(\left|L_p - L_{pag}\right|\right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(\left|L_p - L_{pag}\right|\right)\right] \cdot \gamma_s$ $\quad WT_{s1} = 189.9859\,kip$

Weight of Soil Wedge at back face:

$WT_{s2} := \left[\frac{(D_f)^2 \cdot \tan(\phi_s)}{2} \cdot W_f\right] \cdot \gamma_s$ $\quad WT_{s2} = 29.2717\,kip$

Total Weight:

$WT_{tot} := WT_c + WT_{s1} + C_t$ $\quad WT_{tot} = 512.5845\,kip$

Resisting Moment:

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\phi_s)}{3}\right)$ $\quad M_r = 6998.1505\,kip \cdot ft$

Overturning Moment:

$M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $\quad M_{ot} = 2954.5\,kip \cdot ft$

Factor of Safety:

$FS := \frac{M_r}{M_{ot}}$ $\quad FS_{req} := 1.5$ $\quad FS = 2.37$

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

SHEAR CAPACITY IN PIER

$FS := 2$

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

$S_p = 182.1461$ kips

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

ShearCheck = "Okay"

BEARING PRESSURE CAUSED BY FOOTING

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

$A_{mat} = 576\ ft^2$

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

$S = 2304\ ft^3$

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

$P_{max} = 2.1722$ ksf

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

$P_{min} = -0.3924$ ksf

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

MaxPressure = "Okay"

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

MinPressure = "No Good"

Distance to Resultant of Pressure Distribution:

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

$X_p = 6.7759$ ft

Distance to Kern:

$$X_k := \frac{W_f}{3}$$

$X_k = 8$ ft

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

Eccentricity:

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

$e = 5.7639$

Adjusted Soil Pressure:

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

$P_a = 2.2832$ ksf

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

$q_{adj} = 2.2832$ ksf

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

PressureCheck = "Okay"

CONCRETE BEARING CAPACITY (ACI 10.17)

$\phi_c := 0.75$ (ACI 9.3.2.2)

$P_b := \phi_c \cdot 0.85 \cdot f'c \frac{d_p^2 \cdot \pi}{4}$ $P_b = 12184.8242\,kip$

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

$\phi_c := .85$ (ACI 9.3.2.3)

$d := T_f - Cvr_{pier} - .5 \cdot in$ $d = 32.5\,in$

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

$d_2 := d_1 - d$ $d_2 = 6.0417\,ft$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$ $L = 18.7082\,ft$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$ $Slope = 0.122\,kcf$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$ $V_{req} = 477.5576\,kip$

ACI 11.3.1.1 $V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f'c\,psi} \cdot W_f \cdot d$ $V_{Avail} = 1006.3632\,kip$

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

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

$b_o := (d_p + d) \cdot \pi$ $b_o = 28.9288\,ft$

Area included inside bo: $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4}$ $A_{bo} = 66.5966\,ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo}$ $A_{out} = 509.4034\,ft^2$

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

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

$v_u := \text{Find}(v_u)$ $v_u = 6.5424\,ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 425.2538\,kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 552.8299\,kips$

$V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f'c\,psi} \cdot b_o \cdot d$ $V_{Avail} = 2426.0761\,kips$

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

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

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 1.2153\,ksf$

$M_n := \frac{LF}{\phi_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f$ $M_n = 2557.6575\,kip \cdot ft$

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

$A_s := \frac{M_n}{\phi_m \cdot fy \cdot d}$ $A_s = 17.4883\,in^2$

$a := \frac{A_s \cdot fy}{\beta \cdot f'c\,W_f}$ $a = 1.0716\,in$

$A_s := \frac{M_n}{fy \cdot \left(d - \frac{a}{2} \right)}$ $A_s = 16.0033\,in^2$

$\rho := \frac{A_s}{W_f \cdot d}$ $\rho = 0.0017$

$\rho_{min} := \frac{3 \cdot \sqrt{f'c\,psi}}{fy}$ $\rho_{min} = 0.0032$

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

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $As := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 29.5989\ in^2$

$As_{prov} := A_{bot} \cdot NB_{bot}$ $As_{prov} = 40\ in^2$

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

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 16.848\ in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 28\ in^2$

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

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

Bar Spacing: $B_{sPad} := \dfrac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 6.4205\ in$

Development Length Factors:

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

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

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

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c\,psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\left(\dfrac{c + k_{tr}}{d_{bbot}}\right)} \cdot d_{bbot}$$

$L_{dbt} = 14.8018\ in$

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

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

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

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

REINFORCEMENT IN PIER

Pier Area:

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

(ACI 10.8.4 and 10.9.1)

$$A_{smin} := 0.01 \cdot 0.05 \cdot A_p \qquad A_{smin} = 2.3892\ in^2$$

$$A_{sprov} := NBpier \cdot A_{bpier} \qquad A_{sprov} = 44\ in^2$$

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

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

Bar Spacing In Pier:

$$B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier} \qquad B_{sPier} = 4.7792\ in$$

Diamter of Reinforcement Cage:

$$Diam_{cage} := d_p - 2 \cdot Cvr_{pier} \qquad Diam_{cage} = 72\ in$$

Maximum Moment in Pier:

$$M_p := \left[M_t + S_t \cdot \left(L_p + \frac{A_{BP}}{2}\right)\right] \cdot LF \qquad M_p = 45037.2\ in \cdot kips$$

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

(defined variables)

$$\left(f'_c \;\; f_y \;\; cl \;\; Spiral\right) = (4 \;\; 60 \;\; 3 \;\; 0)$$

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:

$$\left(D \;\; N \;\; n \;\; P_u \;\; M_{xu}\right) := (78 \;\; 44 \;\; 8 \;\; 41 \;\; 45037.2)$$

Clears any previous output:

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

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

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

$$\left(\phi P_n \;\; \phi M_{xn} \;\; f_{sp} \;\; \rho\right) = (57.0103 \;\; 62623.9544 \;\; -60 \;\; 0.0073)$$

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

$$AxialLoadCheck := \text{if}\left(\phi P_n \geq P_u, \text{"Okay"}, \text{"No Good"}\right) \qquad AxialLoadCheck = \text{"Okay"}$$

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

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 $\gamma := 1.0$

Spacing or Cover Dimension: $c := \text{if}\left(Cvr_{pier} < \frac{B_{sPier}}{2}, Cvr_{pier}, \frac{B_{sPier}}{2}\right)$ $c = 2.3896\ \text{in}$

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

$$L_{dbt} := \frac{3}{40}\cdot\frac{fy}{\sqrt{f'c\,psi}}\cdot\frac{\alpha\cdot\beta\cdot\gamma\cdot\lambda}{\left(\frac{c + k_{tr}}{d_{bpier}}\right)}\cdot d_{bpier} \qquad L_{dbt} = 18.5829\ \text{in}$$

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

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

$$L_{dh} := \frac{1200\cdot d_{bpier}}{\sqrt{\frac{f'c}{psi}}}\cdot .7 \qquad L_{dh} = 10.4924\ \text{in}$$

$$L_{db} := \max\left(L_{dbt}, L_{dbmin}\right) \qquad L_{db} = 18.5829\ \text{in}$$

COMPRESSION: (ACI 12.3.2)

$$L_{dbc1} := \frac{.02\cdot d_{bpier}\cdot fy}{\sqrt{f'c\,psi}} \qquad L_{dbc1} = 14.9892\ \text{in}$$

$$L_{dbmin} := 0.0003\cdot\frac{in^2}{lb}\cdot\left(d_{bpier}\cdot fy\right) \qquad L_{dbmin} = 14.22\ \text{in}$$

$$L_{dbc} := \text{if}\left(L_{dbc1} \geq L_{dbmin}, L_{dbc1}, L_{dbmin}\right) \qquad L_{dbc} = 14.9892\ \text{in}$$

Available Length in Pier: $L_{pier} := L_p - 3\cdot\text{in}$ $L_{pier} = 51\ \text{in}$

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

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

Available Length in Pad: $L_{pad} := T_f - 3\cdot\text{in}$ $L_{pad} = 33\ \text{in}$

$L_{padtension} := \text{if}\left(L_{pad} > L_{dh}, \text{"Okay"}, \text{"No Good"}\right)$ $L_{padtension} = \text{"Okay"}$

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

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)

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

$s_{lim1} := 16 \cdot d_{bpier} \cdot z$ $\quad s_{lim1} = 12.64\,in$

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

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

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

Maximum Spacing:

$$s_{tie} := \min\left(\begin{pmatrix} s_{lim1} \\ s_{lim2} \\ s_{lim3} \\ s_{lim4} \end{pmatrix}\right) \quad s_{tie} = 12.64\,in$$

Number of Ties Required:

$$n_{tie} := \frac{L_{pier} - 3 \cdot in}{s_{tie}} + 1 \quad n_{tie} = 4.7975$$