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

May 21, 2008

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

RE: **EM-VER-080-080305** – Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 651 Paddock Avenue, Meriden, Connecticut.

Dear Attorney Baldwin:

The Connecticut Siting Council (Council) hereby acknowledges 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 March 5, 2008, including the placement of all necessary equipment and shelters within the tower compound. The modifications are in compliance with the exception criteria in Section 16-50j-72 (b) of the Regulations of Connecticut State Agencies as changes to an existing facility site that would not increase tower height, extend the boundaries of the tower site, increase noise levels at the tower site boundary by six decibels, and increase the total radio frequencies electromagnetic radiation power density measured at the tower site boundary to or above the standard adopted by the State Department of Environmental Protection pursuant to General Statutes § 22a-162. This facility has also been carefully modeled to ensure that radio frequency emissions are conservatively below State and federal standards applicable to the frequencies now used on this tower.

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

Thank you for your attention and cooperation.

Very truly yours,

S. Derek Phelps
Executive Director

SDP/MP

c: Honorable Mark Benigni, Mayor, City of Meriden
Lawrence Kendzior, City Manager, City of Meriden
Deborah L. Moore, Associate City Attorney, City of Meriden
Dominick Caruso, City Planner, City of Meriden

ROBINSON & COLE LLP

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

April 14, 2008

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

Re: **EM-VER-080-080305 - Cellco Partnership d/b/a Verizon Wireless - Notice of Intent to Modify an Existing Telecommunications Facility Located at 651 Paddock Avenue, Meriden, Connecticut**

Dear Mr. Phelps:

I am in receipt of your April 7, 2008 letter regarding the notice filed by Cellco Partnership d/b/a Verizon Wireless ("Cellco") of its intent to modify the existing telecommunications facility at 651 Paddock Avenue in Meriden. I offer the following additional information in response to City Attorney Deborah Moore's questions.

Cellco's proposal to install flush-mounted antennas at the 107-foot level on the existing tower conforms to the requirements of the Siting Council's August 29, 2007 Decision and Order in Docket No. 329. Condition No. 2 of the Decision and Order states "all antennas installed by commercial wireless telecommunications providers shall be flush-mounted." Behind Tab 1 of Cellco's March 5, 2008 filing is a set of project plans. Included on Sheet SC-1 is an elevation drawing showing what the tower would look like with the additional flush-mounted antennas. This same tower elevation was included in the original Optasite application and the final D&M Plan. It is unclear from Attorney Moore's letter what the City may find "more aesthetically pleasing".

As the Council knows from numerous other filings, Cellco installs emergency back-up generators at each of its cell site locations for use when commercial power to a particular facility is interrupted. By doing this, Cellco can provide its customers, as well as local, state and federal emergency service providers, with uninterrupted service during severe weather events, natural disasters, or at other times when commercial power may not be available. Cellco will generally choose between either

a diesel-fueled generator or a propane-fueled generator for its cell sites, taking into consideration, for example, environmental conditions at a particular location.

As the Council is aware from the Docket No. 329 proceeding, the telecommunications facility approved at 651 Paddock Avenue is located relatively close to an existing wetland area. The Council has taken steps through its approval of the docket and D&M Plan to protect these wetland areas. To avoid any potential impact on these wetland areas, Cellco has decided to install a propane generator rather than a diesel generator at this site. While Cellco is confident that its standard diesel fuel tank leak prevention and detection systems are adequate, the only way to eliminate the potential for any diesel fuel leaks impacting this wetland would be to eliminate the fuel altogether. In this case, Cellco felt that the use of a propane generator was most appropriate. The propane tank will comply with all applicable NFPA and State Building Code requirements.

If you have any additional questions regarding Cellco's proposed modifications, please do not hesitate to contact me.

Sincerely,

Kenneth C. Baldwin

KCB/kmd
Copy to:
Deborah L. Moore, Esq.

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

April 7, 2008

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

RE: **EM-VER-080-080305** – Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 651 Paddock Avenue, Meriden, Connecticut.

Dear Attorney Baldwin:

I am in receipt of a letter dated March 24, 2008 from the City of Meriden (City). A copy of that letter is attached for your convenience. In that letter, the City expressed concerns regarding the proposed 1,000 gallon propane tank and the three flush-mounted antennas.

If you could please respond to these concerns in writing by April 21, 2008 with a copy sent to the City and myself, I would appreciate it.

Thank you for your cooperation.

Sincerely,

S. Derek Phelps
Executive Director

SDP/MP

Enclosure: City of Meriden Letter dated March 24, 2008

c: Deborah L. Moore, Associate City Attorney, City of Meriden

mp
sdp
dm
file

City of Meriden, Connecticut
DEPARTMENT OF LAW

142 EAST MAIN STREET
MERIDEN, CONNECTICUT 06450-8022
TELEPHONE (203) 630-4045
FAX (203) 630-7907

March 24, 2008

ORIGINAL

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

RE: **EM-VER-080-080305** Cellco Partnership d/b/a Verizon Wireless Notice of Intent to Modify an Existing Telecommunication Facility located at 651 Paddock Avenue, Meriden, CT

Dear Mr. Phelps:

Thank you very much for your correspondence dated March 7, 2008 to Mayor Benigni regarding the above referenced matter. Please be advised that the matter was forwarded to the Legal Department.

While the City of Meriden is very appreciative of the fact that the height of the cell tower will not increase, there are some concerns regarding the appearance of the proposed modifications to the existing cell tower with the addition of the 3 flush mounted antennae. There did not appear to be a depiction of what the cell tower would look like with the additional antennae, nor whether there were other options available that would be more aesthetically pleasing.

Furthermore, while it was not clearly indicated in the applicant's intent to modify, there appears to be a 1,000 gallon propane storage tank that the applicants propose to locate on the existing site. It had appeared in Cellco's original application to the Siting Council which was withdrawn, but the tank has reappeared in the drawing of the cell tower location, attached to the applicant's Notice of Intent to Modify. There doesn't appear to be any explanation for the need, nor was there an explanation as to why one was not proposed when the facility originally came before the Siting Council. The City has concerns regarding the placement of such a tank at the cell tower site absent further information.

Thank you in advance for your time and attention to this matter.

Very truly yours,

Deborah L. Moore
Associate City Attorney

STATE OF CONNECTICUT

CONNECTICUT SITING COUNCIL

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

Daniel F. Caruso
Chairman

March 7, 2008

The Honorable Mark Benigni
Mayor
City of Meriden
City Hall
142 East Main Street
Room 124
Meriden, CT 06450

RE: **EM-VER-080-080305** – Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunication facility located at 651 Paddock Avenue, Meriden, Connecticut.

Dear Mayor Benigni:

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.

If you have any questions or comments regarding this proposal, please call me or inform the Council by March 24, 2008.

Thank you for your cooperation and consideration.

Very truly yours,

S. Derek Phelps
Executive Director

SDP/jb

Enclosure: Notice of Intent

c: Dominick Caruso, City Planner, City of Meriden
Lawrence Kendzior

ROBINSON & COLE LLP

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

EM-VER-080-080305

ORIGINAL

March 5, 2008

RECEIVED
MAR 05 2008
CONNECTICUT
SITING COUNCIL

Via Hand Delivery

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

Re: **Notice of Exempt Modification**
651 Paddock Avenue
Meriden, Connecticut

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") intends to install antennas on the existing 120-foot self-supporting monopole tower owned by Optasite Towers LLC ("Optasite") at 651 Paddock Avenue in Meriden, Connecticut. 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 Mark Benigni, Mayor of the City of Meriden. Pursuant to a Council directive, a copy of this letter is being sent to the First Assembly of God Church of Meriden, the owner of the property on which the tower is located.

The facility consists of a 120-foot self-supporting monopole tower capable of supporting multiple carriers within a fenced compound at 651 Paddock Avenue in Meriden. The tower will be shared by T-Mobile with antennas located at the 117-foot level on the tower. Cellco intends to install three (3) CSS-DUO4-7878-02 flush-mounted antennas at the 107-foot level on the tower. Equipment associated with the antennas will be located within a 12' x 30' shelter located on the ground adjacent to the tower. Attached behind Tab 1 are Project Plans for the proposed Cellco facility.

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

1. The proposed modification will not increase the overall height of the existing tower. Cellco's antennas will be mounted with their centerline at the 107-foot level on the 120-foot tower.

2. The proposed installation of associated equipment within a new shelter will not require an extension of the fenced compound or leased area.

3. The proposed installation 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. The worst-case RF power density calculations for approved and Cellco antennas would be 18.71% of the FCC standard. A cumulative power density calculations table is included behind Tab 2.

Included behind Tab 3, is a Structural Analysis Report confirming that the tower can support the existing and Cellco antennas and associated equipment.

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

Sincerely,

Kenneth C. Baldwin

Attachments
Copy to:
Mark Benigni, Meriden Mayor
First Assembly of God Church of Meriden
Sandy M. Carter
Michelle Kababik

CELLCO PARTNERSHIP
DBA
verizon wireless

MERIDEN - SE

651 PADDOCK AVENUE
MERIDEN, CONNECTICUT

GENERAL NOTES

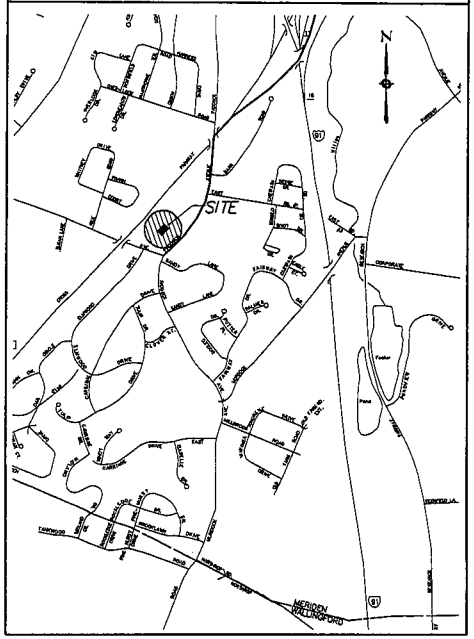
1. THE TYPE, DIMENSIONS, MOUNTING HARDWARE, AND POSITIONS OF ALL PROJECT OWNER'S EQUIPMENT ARE SHOWN IN ILLUSTRATIVE FASHION. THESE DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION. ACTUAL HARDWARE DETAILS AND FINAL LOCATIONS MAY DIFFER SLIGHTLY FROM WHAT IS SHOWN.

2. THE PROJECT OWNER'S PCS FACILITY IS AN UNMANNED PRIVATE AND SECURED EQUIPMENT INSTALLATION. IT IS ONLY ACCESSED BY TRAINED TECHNICIANS FOR PERIODIC ROUTINE MAINTENANCE AND THEREFORE DOES NOT REQUIRE ANY WATER OR SANITARY SEWER SERVICE. THE FACILITY IS NOT GOVERNED BY REGULATIONS REQUIRING PUBLIC ACCESS PER ADA REQUIREMENTS.

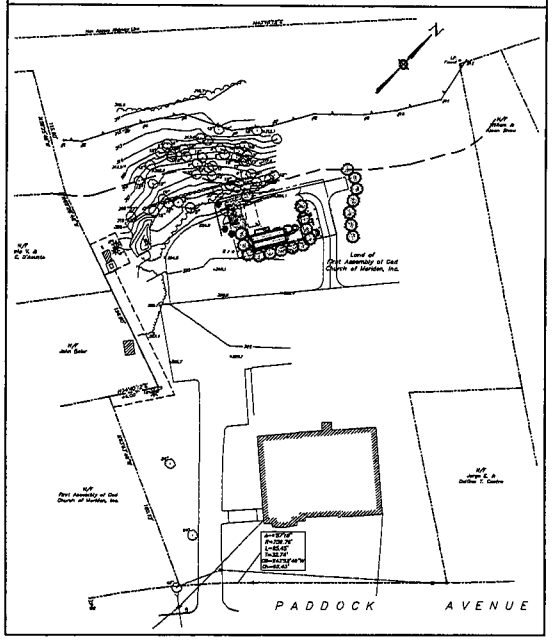
3. THE DESIGN OF THE TOWER, FOUNDATION AND ANTENNA MOUNTING HARDWARE WILL MEET THE ANSI/EIA/TIA-222-F STANDARDS FOR STRUCTURAL STEEL ANTENNA SUPPORTING STRUCTURES AND STATE BUILDING CODE REQUIREMENTS. DETAILED CONSTRUCTION DRAWINGS AND STRUCTURAL CALCULATIONS WILL BE PREPARED BY A REGISTERED PROFESSIONAL ENGINEER AND SUBMITTED WITH A BUILDING PERMIT APPLICATION FOR REVIEW AND APPROVAL BY THE LOCAL BUILDING CODE ENFORCEMENT OFFICIAL.

4. ONCE THE FACILITY BECOMES FULLY OPERATIONAL, NORMAL AND ROUTINE MAINTENANCE BY PROJECT OWNER'S TECHNICIANS WILL BE PERFORMED ON A MONTHLY BASIS. THEREFORE, THE ESTIMATED VEHICLE TRIP GENERATION RATE IS 2 TRIPS PER MONTH. THE AVERAGE DAILY TRIP GENERATION RATE (ADT) IS 0.07.

VICINITY MAP SCALE: 1"=50'-0"



PLOT PLAN SCALE: 1"=50'-0"



PROJECT SUMMARY

SITE NAME:	MERIDEN - SE
SITE ADDRESS:	651 PADDOCK AVENUE MERIDEN, CONNECTICUT
CONTACT PERSON	CELLCO PARTNERSHIP DBA VERIZON WIRELESS SANDY CARTER (860) 803-8219
TOWER OWNER:	OPTASITE TOWERS LLC
JURISDICTION:	CONNECTICUT SITING COUNCIL
ARCHITECT:	URS CORPORATION A.E.S. 500 ENTERPRISE DRIVE, SUITE 3B ROCKY HILL, CT 06067
M/E/P ENGINEER:	URS CORPORATION A.E.S. 500 ENTERPRISE DRIVE, SUITE 3B ROCKY HILL, CT 06067
LATITUDE:	41° 30' 46" NAD 83
LONGITUDE:	72° 46' 07" NAD 83

LEGEND

SYMBOL	DESCRIPTION
	SECTION OR DETAIL NUMBER SHEET WHERE DETAIL/SECTION OCCURS
	ELEVATION NUMBER SHEET WHERE ELEVATION OCCURS

ABBREVIATIONS

MIN.	MINIMUM
V.I.F.	VERIFY IN FIELD
O.C.	ON CENTER
PSF	POUND/SQUARE FOOT
TYP.	TYPICAL
TOC	TOP OF CONCRETE
TOW	TOP OF WALL
FT.	FEET
SQ.FT.	SQUARE FEET
N/A	NOT APPLICABLE

SHEET INDEX

SHT. NO.	DESCRIPTION
T-1	TITLE SHEET - PROJECT SUMMARY AND LEGENDS
SC-1	COMPOUND PLAN AND MONOPOLE ELEVATION

CELLCO PARTNERSHIP
DBA
verizon wireless

A&E FIRM
URS CORPORATION AES
500 ENTERPRISE DRIVE
SUITE 3B
ROCKY HILL, CONNECTICUT
1-(860)-529-8882

A&E SEAL

PROJECT NO: 36931087

JOB NO: VZ4-011

DRAWN BY: RRH/KAP

CHECKED BY:

ISSUED FOR

0	08-07-07	REVIEW
1	10-26-07	REVIEW
2	01-09-08	FINAL
3	03-04-08	FINAL REVISED

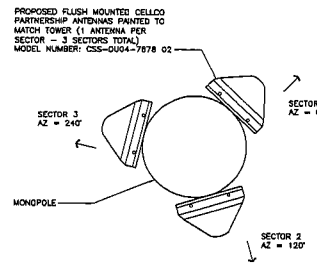
MERIDEN - SE

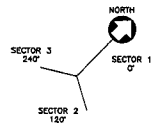
651 PADDOCK AVENUE
MERIDEN, CONNECTICUT

SCALE: AS NOTED

TITLE SHEET - PROJECT SUMMARY AND LEGENDS

T-1



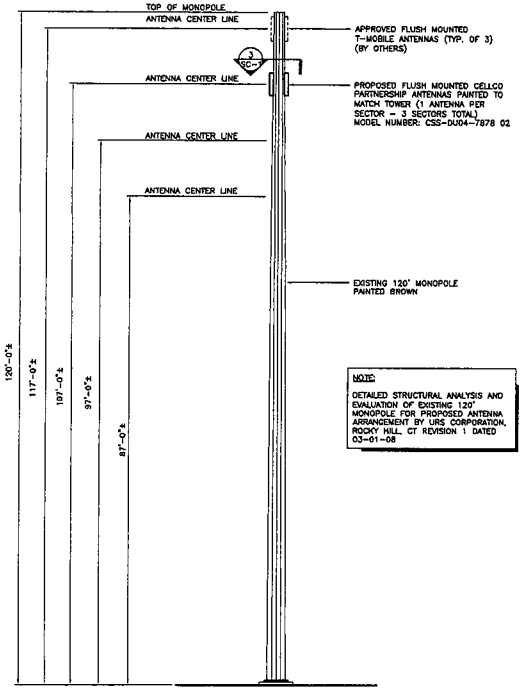


ANTENNA ORIENTATION KEY

LEGEND		
DESCRIPTION	EXISTING	PROPOSED
PROPERTY LINE		
LEASE LINE		
CHAIN LINK FENCE		
CONTOUR LINES	123	
UNDERGROUND UTILITIES		E/T
UTILITY POLE		
TREE LINE		
SEDIMENTATION FENCE		
SPOT ELEVATION	×124.5	
WOOD FENCE		

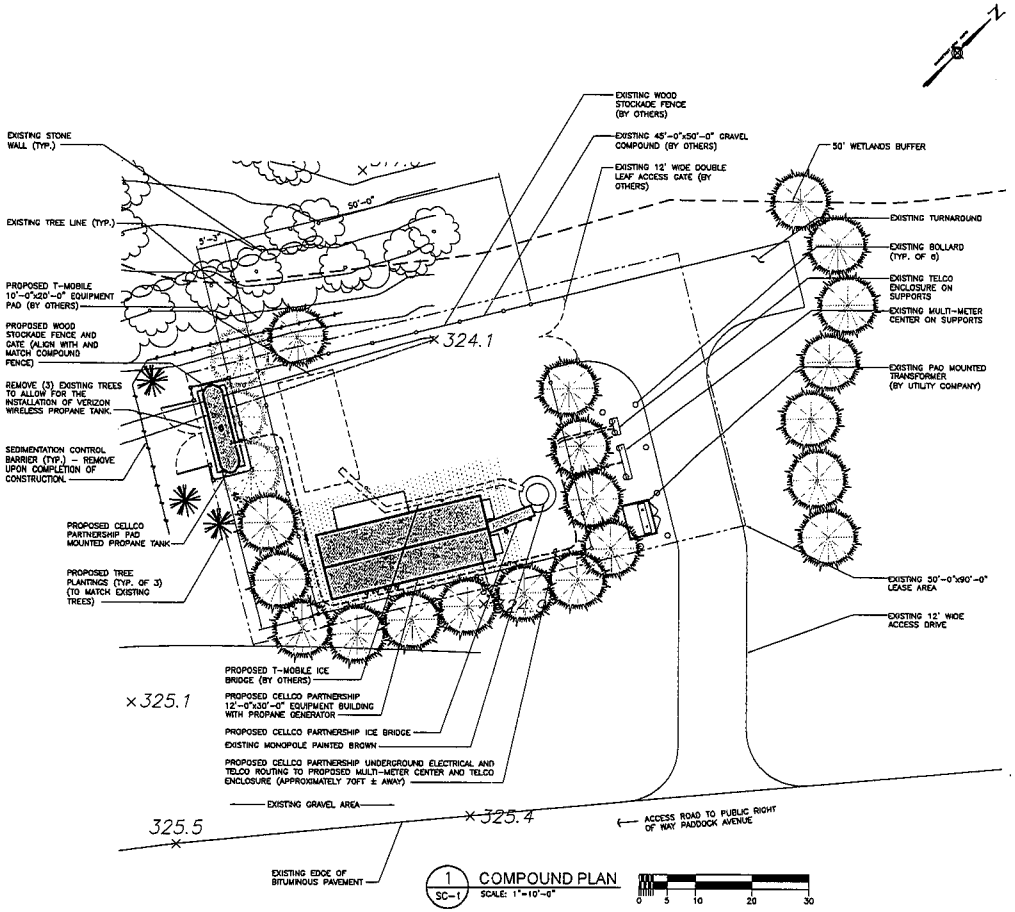
3 SC-1 ANTENNA ORIENTATION PLAN
SCALE: 1" = 1'-0"

0 .5 1 2 3



2 SC-1 MONOPOLE ELEVATION
SCALE: 1"=10'-0"

0 5 10 20 30



1 SC-1 COMPOUND PLAN
SCALE: 1"=10'-0"

0 5 10 20 30

CELLCO PARTNERSHIP
DBA
verizon wireless

A&E FIRM
URS CORPORATION AES
500 ENTERPRISE DRIVE
SUITE 3B
ROCKY HILL, CONNECTICUT
1-(860)-529-6882

A&E SEAL

PROJECT NO: 36931087

JOB NO: VZ4-011

DRAWN BY: RRH/KAP

CHECKED BY:

ISSUED FOR		
0	08-07-07	REVIEW
1	10-26-07	REVIEW
2	01-09-08	FINAL
3	03-04-08	FINAL REVISED

MERIDEN - SE

651 PADDOCK AVENUE
MERIDEN, CONNECTICUT

SCALE: AS NOTED

COMPOUND PLAN AND MONOPOLE ELEVATION

SC-1

	General	Power	Density					
Site Name: Meriden SE								
Tower Height: Verizon @ 107Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*T-Mobile	8	161	117	0.0338	1945	1.0000	3.38%	
VZW	**9**	**200**	**107**	0.0565	**880**	**0.5673**	**9.96%**	
VZW	**6**	**285**	**107**	0.0537	**1900**	**1.0000**	**5.37%**	
								18.71%
* Source: Siting Council								

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 120' MONOPOLE AND ITS FOUNDATION FOR PROPOSED ANTENNA ARRANGEMENT

Site I.D: Meriden SE
Address: 651 Paddock Road
Meriden, CT 06450

prepared for

verizonwireless

Verizon Wireless
99 East River Drive
East Hartford, Connecticut 06108

prepared by

URS

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

36931087.00000
VZ4-011

Revision 1 March 01, 2008

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 120' steel tapered monopole structure, located at 651 Paddock Road, Meriden, CT. The analysis was conducted in accordance with the 2005 Connecticut State Building Code and the TIA/EIÅ-222-F standard for a wind velocity of 85 mph (fastest mile) and 74 mph (fastest mile) concurrent with 0.5" ice. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report.
The proposed Verizon Wireless installation is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Install: **(3) CSS DUO4-7878 02 panel antennas (flush mounted)** **(12) 1 5/8" coaxial cables (all Verizon coax feed lines shall be located within existing monopole)**	**Verizon (Proposed)**	**@ 107'**

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 utilized in the preparation of this report obtained from manufacturers original design documents prepared by Sabre Communications Corporation, job no. 08-10201, signed and sealed November 8, 2007.
3) Antenna and mount configuration as specified within Section 2 and 6 of this report.

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

If you should have any questions, please call.

Sincerely,

URS Corporation

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

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

2. INTRODUCTION

The subject tower is located at 651 Paddock Road, Meriden, CT. The structure is an existing 120' steel tapered monopole structure, designed and manufactured by Sabre Communications Corporation.

The inventory is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(3) RFS APX16PV-16PVL panel antennas (see note below)	T-Mobile (reserved)	Flush mount	117'	(9) 1 5/8" coax cables (within monopole - see note below
(3) CSS DUO4-7878 02 panel antennas	**Verizon (proposed)**	**Flush Mount**	**107'**	**(12) 1 5/8" coax cables (within monopole)**

Note:

I. **T-Mobile antenna and coax feed line inventory based on original design documents.**

This structural analysis of the communications tower was performed by URS Corporation (URS) for Verizon Wireless. The purpose of this analysis was to investigate the structural integrity of the existing tower with its existing and proposed antenna loads. This analysis was conducted to evaluate stress on the tower and the effect of forces to the foundation of the tower resulting from existing and proposed antenna 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 5.1.1. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 85 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 74 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

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

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

4. FINDINGS AND EVALUATION

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

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

Tower Component Stress vs. Capacity Summary

Component (Section No.)	Controlling Component / Elevation	Stress Ratio (% capacity)	Pass/Fail	Notes:
Pole Shaft (L4)	1'-49.75'	44.1%	Pass	
Anchor Bolts	Compression	40%	Pass	
Base Plate	Bending	38%	Pass	

Foundation Summary

Foundation	Component	Stress (% capacity/FOS)	Pass/Fail	Comments:
Reinf. Concrete Pad and Pier	OTM	59%/3.39	Pass	Min. F.O.S of 2.0 req'd per IBC 2003 Section 3108.4.2

5. CONCLUSIONS AND RECOMMENDATIONS

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

Limitations/Assumptions:

This report is based on the following:

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

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

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

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

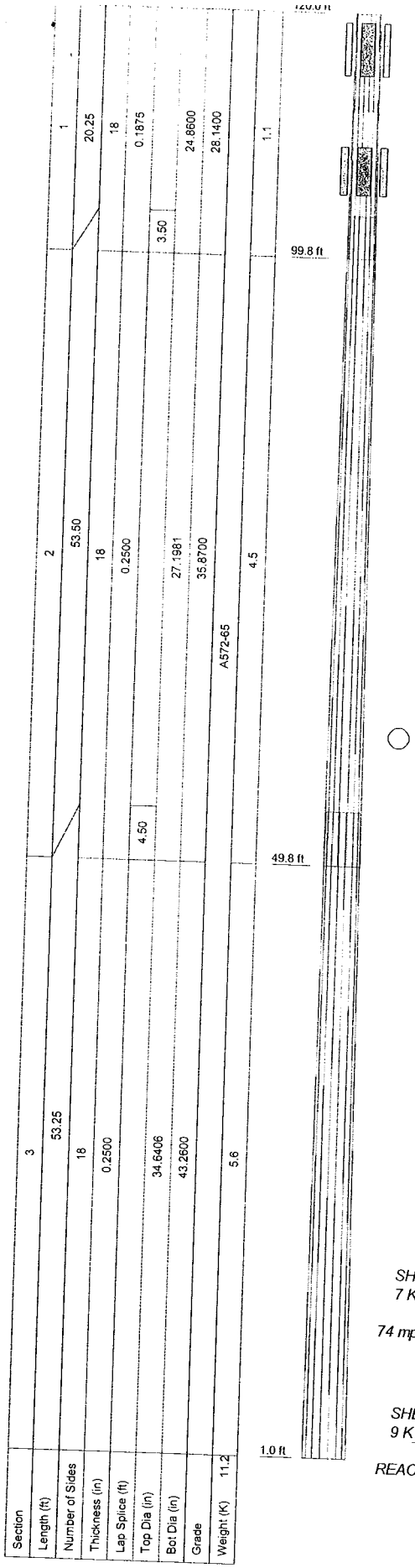
Ongoing and Periodic Inspection and Maintenance:

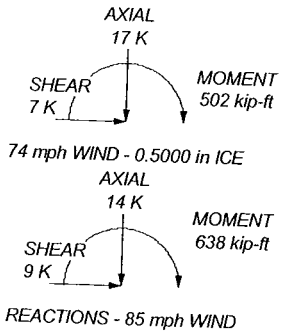
After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

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

6. DRAWINGS AND DATA

RISA TOWER INPUT/OUTPUT SUMMARY





DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
APX16PV-16PVL-X (T-Mobile)	117	DUO4-7878 (Verizon - proposed)	107
APX16PV-16PVL-X (T-Mobile)	117	DUO4-7878 (Verizon - proposed)	107
APX16PV-16PVL-X (T-Mobile)	117	Valmont Uni-Tri Bracket (Verizon - proposed)	107
Valmont Uni-Tri Bracket (T-Mobile - reserved)	117	DUO4-7878 (Verizon - proposed)	107

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 74 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. TOWER RATING: 44.1%

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

Job:	*120' Sabre Monopole - Rev 1*
Project:	*651 Paddock Avenue, Meriden, CT*
Client:	Verizon Wireless - Meriden SE
Drawn by:	Staff
App'd:	
Code:	TIA/EIA-222-F
Date:	03/01/08
Scale:	N
Path:	P:\06\Rev 1 03-01-08\ERI Files\1150 Sabre Monopole Meriden CT 10' ext.eri
Dwg No.	

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:

Basic wind speed of 85 mph.
Nominal ice thickness of 0.5000 in.
Ice density of 56 pcf.
A wind speed of 74 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	120.00-99.75	20.25	3.50	18	24.8600	28.1400	0.1875	0.7500	A572-65 (65 ksi)
L2	99.75-49.75	53.50	4.50	18	27.1981	35.8700	0.2500	1.0000	A572-65 (65 ksi)
L3	49.75-1.00	53.25		18	34.6406	43.2600	0.2500	1.0000	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	25.2435	14.6832	1129.2370	8.7587	12.6289	89.4170	2259.9600	7.3430	4.0454	21.575
	28.5741	16.6352	1642.1303	9.9231	14.2951	114.8735	3286.4213	8.3192	4.6226	24.654
L2	28.1937	21.3833	1961.8607	9.5666	13.8166	141.9927	3926.3029	10.6937	4.3469	17.387
	36.4234	28.2645	4530.7086	12.6451	18.2220	248.6400	9067.3787	14.1349	5.8731	23.492
L3	35.9146	27.2889	4077.5861	12.2087	17.5974	231.7150	8160.5375	13.6471	5.6567	22.627
	43.9274	34.1284	7976.1389	15.2685	21.9761	362.9464	15962.7730	17.0675	7.1738	28.695

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 120.00-99.75				1	1	1		
L2 99.75-49.75				1	1	1		
L3 49.75-1.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
1 5/8	C	No	Inside Pole	107.00 - 4.00	12	No Ice	0.00	1.04
(Verizon - proposed)						1/2" Ice	0.00	1.04
1 5/8	C	No	Inside Pole	117.00 - 4.00	9	No Ice	0.00	1.04
(T-Mobile - reserved)						1/2" Ice	0.00	1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	120.00-99.75	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	0.25
L2	99.75-49.75	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	1.09
L3	49.75-1.00	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	1.00

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	120.00-99.75	A	0.500	0.000	0.000	0.000	0.000	0.00

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
L2	99.75-49.75	B	0.500	0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.25
		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	1.09
L3	49.75-1.00	A	0.500	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	1.00

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
DUO4-7878 (Verizon - proposed)	A	From Face	0.75	0.00	0.0000	107.00	No Ice	6.82	4.24	0.03
				0.00			1/2" Ice	7.24	4.61	0.07
DUO4-7878 (Verizon - proposed)	B	From Face	0.75	0.00	0.0000	107.00	No Ice	6.82	4.24	0.03
				0.00			1/2" Ice	7.24	4.61	0.07
DUO4-7878 (Verizon - proposed)	C	From Face	0.75	0.00	0.0000	107.00	No Ice	6.82	4.24	0.03
				0.00			1/2" Ice	7.24	4.61	0.07
APX16PV-16PVL-X (T-Mobile)	A	From Face	0.75	0.00	0.0000	117.00	No Ice	6.70	2.00	0.04
				0.00			1/2" Ice	7.13	2.33	0.07
APX16PV-16PVL-X (T-Mobile)	B	From Face	0.75	0.00	0.0000	117.00	No Ice	6.70	2.00	0.04
				0.00			1/2" Ice	7.13	2.33	0.07
APX16PV-16PVL-X (T-Mobile)	C	From Face	0.75	0.00	0.0000	117.00	No Ice	6.70	2.00	0.04
				0.00			1/2" Ice	7.13	2.33	0.07
Valmont Uni-Tri Bracket (Verizon - proposed)	C	None			0.0000	107.00	No Ice	1.75	1.75	0.29
							1/2" Ice	1.94	1.94	0.31
Valmont Uni-Tri Bracket (T-Mobile - reserved)	C	None			0.0000	117.00	No Ice	1.75	1.75	0.29
							1/2" Ice	1.94	1.94	0.31

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 120.00-	109.67	1.409	26	44.719	A	0.000	44.719	44.719	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
99.75					B	0.000	44.719		100.00	0.000	0.000
					C	0.000	44.719		100.00	0.000	0.000
L2 99.75-49.75	74.29	1.261	23	132.574	A	0.000	132.574	132.574	100.00	0.000	0.000
					B	0.000	132.574		100.00	0.000	0.000
					C	0.000	132.574		100.00	0.000	0.000
L3 49.75-1.00	24.77	1	19	159.715	A	0.000	159.715	159.715	100.00	0.000	0.000
					B	0.000	159.715		100.00	0.000	0.000
					C	0.000	159.715		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-99.75	109.67	1.409	20	0.5000	46.406	A	0.000	46.406	46.406	100.00	0.000	0.000
						B	0.000	46.406		100.00	0.000	0.000
						C	0.000	46.406		100.00	0.000	0.000
L2 99.75-49.75	74.29	1.261	17	0.5000	136.740	A	0.000	136.740	136.740	100.00	0.000	0.000
						B	0.000	136.740		100.00	0.000	0.000
						C	0.000	136.740		100.00	0.000	0.000
L3 49.75-1.00	24.77	1	14	0.5000	163.778	A	0.000	163.778	163.778	100.00	0.000	0.000
						B	0.000	163.778		100.00	0.000	0.000
						C	0.000	163.778		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 120.00-99.75	109.67	1.409	9	44.719	A	0.000	44.719	44.719	100.00	0.000	0.000
					B	0.000	44.719		100.00	0.000	0.000
					C	0.000	44.719		100.00	0.000	0.000
L2 99.75-49.75	74.29	1.261	8	132.574	A	0.000	132.574	132.574	100.00	0.000	0.000
					B	0.000	132.574		100.00	0.000	0.000
					C	0.000	132.574		100.00	0.000	0.000
L3 49.75-1.00	24.77	1	7	159.715	A	0.000	159.715	159.715	100.00	0.000	0.000
					B	0.000	159.715		100.00	0.000	0.000
					C	0.000	159.715		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e		C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	1.28	63.24	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	3.38	67.57	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	3.30	67.70	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	465.25 kip-ft	7.96		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e		C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	1.28	63.24	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	3.38	67.57	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	3.30	67.70	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	465.25 kip-ft	7.96		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e		C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	1.28	63.24	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	3.38	67.57	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	3.30	67.70	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	465.25 kip-ft	7.96		

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 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	1.28	63.24	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	3.38	67.57	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	3.30	67.70	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	465.25 kip-ft	7.96		

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 120.00-99.75	0.25	1.42	A	1	0.65	1	1	1	46.406	1.00	49.22	C
			B	1	0.65	1	1	1	46.406			
			C	1	0.65	1	1	1	46.406			
L2 99.75-49.75	1.09	5.52	A	1	0.65	1	1	1	136.740	2.61	52.27	C
			B	1	0.65	1	1	1	136.740			
			C	1	0.65	1	1	1	136.740			
L3 49.75-1.00	1.00	6.76	A	1	0.65	1	1	1	163.778	2.54	52.07	C
			B	1	0.65	1	1	1	163.778			
			C	1	0.65	1	1	1	163.778			
Sum Weight:	2.34	13.70						OTM	360.21 kip-ft	6.15		

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 120.00-99.75	0.25	1.42	A	1	0.65	1	1	1	46.406	1.00	49.22	C
			B	1	0.65	1	1	1	46.406			
			C	1	0.65	1	1	1	46.406			
L2 99.75-49.75	1.09	5.52	A	1	0.65	1	1	1	136.740	2.61	52.27	C
			B	1	0.65	1	1	1	136.740			
			C	1	0.65	1	1	1	136.740			
L3 49.75-1.00	1.00	6.76	A	1	0.65	1	1	1	163.778	2.54	52.07	C
			B	1	0.65	1	1	1	163.778			
			C	1	0.65	1	1	1	163.778			
Sum Weight:	2.34	13.70						OTM	360.21 kip-ft	6.15		

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 120.00-99.75	0.25	1.42	A	1	0.65	1	1	1	46.406	1.00	49.22	C
			B	1	0.65	1	1	1	46.406			
			C	1	0.65	1	1	1	46.406			
L2 99.75-49.75	1.09	5.52	A	1	0.65	1	1	1	136.740	2.61	52.27	C
			B	1	0.65	1	1	1	136.740			
			C	1	0.65	1	1	1	136.740			
L3 49.75-1.00	1.00	6.76	A	1	0.65	1	1	1	163.778	2.54	52.07	C
			B	1	0.65	1	1	1	163.778			
			C	1	0.65	1	1	1	163.778			
Sum Weight:	2.34	13.70						OTM	360.21 kip-ft	6.15		

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 120.00-99.75	0.25	1.42	A	1	0.65	1	1	1	46.406	1.00	49.22	C
			B	1	0.65	1	1	1	46.406			
			C	1	0.65	1	1	1	46.406			
L2 99.75-49.75	1.09	5.52	A	1	0.65	1	1	1	136.740	2.61	52.27	C
			B	1	0.65	1	1	1	136.740			
			C	1	0.65	1	1	1	136.740			
L3 49.75-1.00	1.00	6.76	A	1	0.65	1	1	1	163.778	2.54	52.07	C
			B	1	0.65	1	1	1	163.778			
			C	1	0.65	1	1	1	163.778			
Sum Weight:	2.34	13.70						OTM	360.21 kip-ft	6.15		

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 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	0.44	21.88	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	1.17	23.38	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	1.14	23.43	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	160.98	2.75		

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 - 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 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	0.44	21.88	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	1.17	23.38	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	1.14	23.43	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	160.98 kip-ft	2.75		

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 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	0.44	21.88	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	1.17	23.38	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	1.14	23.43	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	160.98 kip-ft	2.75		

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 120.00-99.75	0.25	1.08	A	1	0.65	1	1	1	44.719	0.44	21.88	C
			B	1	0.65	1	1	1	44.719			
			C	1	0.65	1	1	1	44.719			

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
L2 99.75-49.75	1.09	4.52	A	1	0.65	1	1	1	132.574	1.17	23.38	C
			B	1	0.65	1	1	1	132.574			
			C	1	0.65	1	1	1	132.574			
L3 49.75-1.00	1.00	5.56	A	1	0.65	1	1	1	159.715	1.14	23.43	C
			B	1	0.65	1	1	1	159.715			
			C	1	0.65	1	1	1	159.715			
Sum Weight:	2.34	11.16						OTM	160.98 kip-ft	2.75		

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	11.16					
Bracing Weight	0.00					
Total Member Self-Weight	11.16			0.00	0.00	
Total Weight	14.30			0.00	0.00	
Wind 0 deg - No Ice		0.00	-9.43	-627.33	0.00	0.00
Wind 30 deg - No Ice		4.71	-8.16	-543.28	-313.66	0.00
Wind 45 deg - No Ice		6.67	-6.67	-443.59	-443.59	0.00
Wind 60 deg - No Ice		8.16	-4.71	-313.66	-543.28	0.00
Wind 90 deg - No Ice		9.43	0.00	0.00	-627.33	0.00
Wind 120 deg - No Ice		8.16	4.71	313.66	-543.28	0.00
Wind 135 deg - No Ice		6.67	6.67	443.59	-443.59	0.00
Wind 150 deg - No Ice		4.71	8.16	543.28	-313.66	0.00
Wind 180 deg - No Ice		0.00	9.43	627.33	0.00	0.00
Wind 210 deg - No Ice		-4.71	8.16	543.28	313.66	0.00
Wind 225 deg - No Ice		-6.67	6.67	443.59	443.59	0.00
Wind 240 deg - No Ice		-8.16	4.71	313.66	543.28	0.00
Wind 270 deg - No Ice		-9.43	0.00	0.00	627.33	0.00
Wind 300 deg - No Ice		-8.16	-4.71	-313.66	543.28	0.00
Wind 315 deg - No Ice		-6.67	-6.67	-443.59	443.59	0.00
Wind 330 deg - No Ice		-4.71	-8.16	-543.28	313.66	0.00
Member Ice	2.53					
Total Weight Ice	17.08			0.00	0.00	
Wind 0 deg - Ice		0.00	-7.34	-491.71	0.00	0.00
Wind 30 deg - Ice		3.67	-6.35	-425.83	-245.85	0.00
Wind 45 deg - Ice		5.19	-5.19	-347.69	-347.69	0.00
Wind 60 deg - Ice		6.35	-3.67	-245.85	-425.83	0.00
Wind 90 deg - Ice		7.34	0.00	0.00	-491.71	0.00
Wind 120 deg - Ice		6.35	3.67	245.85	-425.83	0.00
Wind 135 deg - Ice		5.19	5.19	347.69	-347.69	0.00
Wind 150 deg - Ice		3.67	6.35	425.83	-245.85	0.00
Wind 180 deg - Ice		0.00	7.34	491.71	0.00	0.00
Wind 210 deg - Ice		-3.67	6.35	425.83	245.85	0.00
Wind 225 deg - Ice		-5.19	5.19	347.69	347.69	0.00
Wind 240 deg - Ice		-6.35	3.67	245.85	425.83	0.00
Wind 270 deg - Ice		-7.34	0.00	0.00	491.71	0.00
Wind 300 deg - Ice		-6.35	-3.67	-245.85	425.83	0.00
Wind 315 deg - Ice		-5.19	-5.19	-347.69	347.69	0.00
Wind 330 deg - Ice		-3.67	-6.35	-425.83	245.85	0.00
Total Weight	14.30			0.00	0.00	
Wind 0 deg - Service		0.00	-3.26	-217.07	0.00	0.00
Wind 30 deg - Service		1.63	-2.82	-187.99	-108.53	0.00

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 45 deg - Service		2.31	-2.31	-153.49	-153.49	0.00
Wind 60 deg - Service		2.82	-1.63	-108.53	-187.99	0.00
Wind 90 deg - Service		3.26	0.00	0.00	-217.07	0.00
Wind 120 deg - Service		2.82	1.63	108.53	-187.99	0.00
Wind 135 deg - Service		2.31	2.31	153.49	-153.49	0.00
Wind 150 deg - Service		1.63	2.82	187.99	-108.53	0.00
Wind 180 deg - Service		0.00	3.26	217.07	0.00	0.00
Wind 210 deg - Service		-1.63	2.82	187.99	108.53	0.00
Wind 225 deg - Service		-2.31	2.31	153.49	153.49	0.00
Wind 240 deg - Service		-2.82	1.63	108.53	187.99	0.00
Wind 270 deg - Service		-3.26	0.00	0.00	217.07	0.00
Wind 300 deg - Service		-2.82	-1.63	-108.53	187.99	0.00
Wind 315 deg - Service		-2.31	-2.31	-153.49	153.49	0.00
Wind 330 deg - Service		-1.63	-2.82	-187.99	108.53	0.00

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

Comb. No.	Description
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	120 - 99.75	Pole	Max Tension	19	0.00	0.00	-0.00
			Max. Compression	18	-2.41	0.00	0.00
			Max. Mx	6	-1.82	-21.18	0.00
			Max. My	2	-1.82	0.00	21.18
			Max. Vy	6	2.56	-21.18	0.00
			Max. Vx	2	-2.56	0.00	21.18
			Max. Torque	3			-0.00
L2	99.75 - 49.75	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-8.69	0.00	0.00
			Max. Mx	6	-7.10	-228.64	0.00
			Max. My	2	-7.10	0.00	228.64
			Max. Vy	6	5.94	-228.64	0.00
			Max. Vx	2	-5.94	0.00	228.64
			Max. Torque	3			-0.00
L3	49.75 - 1	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	18	-17.08	0.00	0.00
			Max. Mx	6	-14.29	-637.62	0.00
			Max. My	10	-14.29	0.00	-637.62
			Max. Vy	6	9.43	-637.62	0.00
			Max. Vx	10	9.43	0.00	-637.62
			Max. Torque	5			0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	19	17.08	0.00	7.34
	Max. H_x	14	14.30	9.43	0.00
	Max. H_z	2	14.30	0.00	9.43
	Max. M_x	2	637.62	0.00	9.43
	Max. M_z	6	637.62	-9.43	0.00
	Max. Torsion	5	0.00	-8.16	4.71
	Min. Vert	1	14.30	0.00	0.00
	Min. H_x	6	14.30	-9.43	0.00
	Min. H_z	10	14.30	0.00	-9.43

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
	Min. M_x	10	-637.62	0.00	-9.43
	Min. M_z	14	-637.62	9.43	0.00
	Min. Torsion	15	-0.00	8.16	4.71

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	14.30	0.00	0.00	0.00	0.00	0.00
Dead+Wind 0 deg - No Ice	14.30	0.00	-9.43	-637.62	0.00	0.00
Dead+Wind 30 deg - No Ice	14.30	4.71	-8.16	-552.19	-318.81	0.00
Dead+Wind 45 deg - No Ice	14.30	6.67	-6.67	-450.86	-450.86	0.00
Dead+Wind 60 deg - No Ice	14.30	8.16	-4.71	-318.81	-552.19	-0.00
Dead+Wind 90 deg - No Ice	14.30	9.43	0.00	0.00	-637.62	0.00
Dead+Wind 120 deg - No Ice	14.30	8.16	4.71	318.81	-552.19	0.00
Dead+Wind 135 deg - No Ice	14.30	6.67	6.67	450.86	-450.86	0.00
Dead+Wind 150 deg - No Ice	14.30	4.71	8.16	552.19	-318.81	-0.00
Dead+Wind 180 deg - No Ice	14.30	0.00	9.43	637.62	0.00	0.00
Dead+Wind 210 deg - No Ice	14.30	-4.71	8.16	552.19	318.81	0.00
Dead+Wind 225 deg - No Ice	14.30	-6.67	6.67	450.86	450.86	0.00
Dead+Wind 240 deg - No Ice	14.30	-8.16	4.71	318.81	552.19	-0.00
Dead+Wind 270 deg - No Ice	14.30	-9.43	0.00	0.00	637.62	0.00
Dead+Wind 300 deg - No Ice	14.30	-8.16	-4.71	-318.81	552.19	0.00
Dead+Wind 315 deg - No Ice	14.30	-6.67	-6.67	-450.86	450.86	0.00
Dead+Wind 330 deg - No Ice	14.30	-4.71	-8.16	-552.19	318.81	-0.00
Dead+Ice+Temp	17.08	0.00	0.00	0.00	0.00	0.00
Dead+Wind 0 deg+Ice+Temp	17.08	0.00	-7.34	-501.57	0.00	0.00
Dead+Wind 30 deg+Ice+Temp	17.08	3.67	-6.35	-434.37	-250.79	0.00
Dead+Wind 45 deg+Ice+Temp	17.08	5.19	-5.19	-354.66	-354.66	0.00
Dead+Wind 60 deg+Ice+Temp	17.08	6.35	-3.67	-250.79	-434.37	-0.00
Dead+Wind 90 deg+Ice+Temp	17.08	7.34	0.00	0.00	-501.57	0.00
Dead+Wind 120 deg+Ice+Temp	17.08	6.35	3.67	250.79	-434.37	0.00
Dead+Wind 135 deg+Ice+Temp	17.08	5.19	5.19	354.66	-354.66	0.00
Dead+Wind 150 deg+Ice+Temp	17.08	3.67	6.35	434.37	-250.79	-0.00
Dead+Wind 180 deg+Ice+Temp	17.08	0.00	7.34	501.57	0.00	0.00
Dead+Wind 210 deg+Ice+Temp	17.08	-3.67	6.35	434.37	250.79	0.00
Dead+Wind 225 deg+Ice+Temp	17.08	-5.19	5.19	354.66	354.66	0.00
Dead+Wind 240 deg+Ice+Temp	17.08	-6.35	3.67	250.79	434.37	-0.00
Dead+Wind 270 deg+Ice+Temp	17.08	-7.34	0.00	0.00	501.57	0.00
Dead+Wind 300 deg+Ice+Temp	17.08	-6.35	-3.67	-250.79	434.37	0.00
Dead+Wind 315 deg+Ice+Temp	17.08	-5.19	-5.19	-354.66	354.66	0.00
Dead+Wind 330 deg+Ice+Temp	17.08	-3.67	-6.35	-434.37	250.79	-0.00
Dead+Wind 0 deg - Service	14.30	0.00	-3.26	-220.65	0.00	0.00
Dead+Wind 30 deg - Service	14.30	1.63	-2.82	-191.09	-110.33	0.00
Dead+Wind 45 deg - Service	14.30	2.31	-2.31	-156.03	-156.03	0.00
Dead+Wind 60 deg - Service	14.30	2.82	-1.63	-110.33	-191.09	-0.00
Dead+Wind 90 deg - Service	14.30	3.26	0.00	0.00	-220.65	0.00
Dead+Wind 120 deg - Service	14.30	2.82	1.63	110.33	-191.09	0.00
Dead+Wind 135 deg - Service	14.30	2.31	2.31	156.03	-156.03	0.00
Dead+Wind 150 deg - Service	14.30	1.63	2.82	191.09	-110.33	-0.00
Dead+Wind 180 deg - Service	14.30	0.00	3.26	220.65	0.00	0.00
Dead+Wind 210 deg - Service	14.30	-1.63	2.82	191.09	110.33	0.00
Dead+Wind 225 deg - Service	14.30	-2.31	2.31	156.03	156.03	0.00
Dead+Wind 240 deg - Service	14.30	-2.82	1.63	110.33	191.09	-0.00
Dead+Wind 270 deg - Service	14.30	-3.26	0.00	0.00	220.65	0.00
Dead+Wind 300 deg - Service	14.30	-2.82	-1.63	-110.33	191.09	0.00

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+Wind 315 deg - Service	14.30	-2.31	-2.31	-156.03	156.03	0.00
Dead+Wind 330 deg - Service	14.30	-1.63	-2.82	-191.09	110.33	-0.00

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	-14.30	0.00	0.00	14.30	0.00	0.000%
2	0.00	-14.30	-9.43	0.00	14.30	9.43	0.000%
3	4.71	-14.30	-8.16	-4.71	14.30	8.16	0.000%
4	6.67	-14.30	-6.67	-6.67	14.30	6.67	0.000%
5	8.16	-14.30	-4.71	-8.16	14.30	4.71	0.000%
6	9.43	-14.30	0.00	-9.43	14.30	0.00	0.000%
7	8.16	-14.30	4.71	-8.16	14.30	-4.71	0.000%
8	6.67	-14.30	6.67	-6.67	14.30	-6.67	0.000%
9	4.71	-14.30	8.16	-4.71	14.30	-8.16	0.000%
10	0.00	-14.30	9.43	0.00	14.30	-9.43	0.000%
11	-4.71	-14.30	8.16	4.71	14.30	-8.16	0.000%
12	-6.67	-14.30	6.67	6.67	14.30	-6.67	0.000%
13	-8.16	-14.30	4.71	8.16	14.30	-4.71	0.000%
14	-9.43	-14.30	0.00	9.43	14.30	0.00	0.000%
15	-8.16	-14.30	-4.71	8.16	14.30	4.71	0.000%
16	-6.67	-14.30	-6.67	6.67	14.30	6.67	0.000%
17	-4.71	-14.30	-8.16	4.71	14.30	8.16	0.000%
18	0.00	-17.08	0.00	0.00	17.08	0.00	0.000%
19	0.00	-17.08	-7.34	0.00	17.08	7.34	0.000%
20	3.67	-17.08	-6.35	-3.67	17.08	6.35	0.000%
21	5.19	-17.08	-5.19	-5.19	17.08	5.19	0.000%
22	6.35	-17.08	-3.67	-6.35	17.08	3.67	0.000%
23	7.34	-17.08	0.00	-7.34	17.08	0.00	0.000%
24	6.35	-17.08	3.67	-6.35	17.08	-3.67	0.000%
25	5.19	-17.08	5.19	-5.19	17.08	-5.19	0.000%
26	3.67	-17.08	6.35	-3.67	17.08	-6.35	0.000%
27	0.00	-17.08	7.34	0.00	17.08	-7.34	0.000%
28	-3.67	-17.08	6.35	3.67	17.08	-6.35	0.000%
29	-5.19	-17.08	5.19	5.19	17.08	-5.19	0.000%
30	-6.35	-17.08	3.67	6.35	17.08	-3.67	0.000%
31	-7.34	-17.08	0.00	7.34	17.08	0.00	0.000%
32	-6.35	-17.08	-3.67	6.35	17.08	3.67	0.000%
33	-5.19	-17.08	-5.19	5.19	17.08	5.19	0.000%
34	-3.67	-17.08	-6.35	3.67	17.08	6.35	0.000%
35	0.00	-14.30	-3.26	0.00	14.30	3.26	0.000%
36	1.63	-14.30	-2.82	-1.63	14.30	2.82	0.000%
37	2.31	-14.30	-2.31	-2.31	14.30	2.31	0.000%
38	2.82	-14.30	-1.63	-2.82	14.30	1.63	0.000%
39	3.26	-14.30	0.00	-3.26	14.30	0.00	0.000%
40	2.82	-14.30	1.63	-2.82	14.30	-1.63	0.000%
41	2.31	-14.30	2.31	-2.31	14.30	-2.31	0.000%
42	1.63	-14.30	2.82	-1.63	14.30	-2.82	0.000%
43	0.00	-14.30	3.26	0.00	14.30	-3.26	0.000%
44	-1.63	-14.30	2.82	1.63	14.30	-2.82	0.000%
45	-2.31	-14.30	2.31	2.31	14.30	-2.31	0.000%
46	-2.82	-14.30	1.63	2.82	14.30	-1.63	0.000%
47	-3.26	-14.30	0.00	3.26	14.30	0.00	0.000%
48	-2.82	-14.30	-1.63	2.82	14.30	1.63	0.000%
49	-2.31	-14.30	-2.31	2.31	14.30	2.31	0.000%
50	-1.63	-14.30	-2.82	1.63	14.30	2.82	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	0.00000001
3	Yes	4	0.00000001	0.00058817
4	Yes	4	0.00000001	0.00067584
5	Yes	4	0.00000001	0.00058817
6	Yes	4	0.00000001	0.00000001
7	Yes	4	0.00000001	0.00058817
8	Yes	4	0.00000001	0.00067584
9	Yes	4	0.00000001	0.00058817
10	Yes	4	0.00000001	0.00000001
11	Yes	4	0.00000001	0.00058817
12	Yes	4	0.00000001	0.00067584
13	Yes	4	0.00000001	0.00058817
14	Yes	4	0.00000001	0.00000001
15	Yes	4	0.00000001	0.00058817
16	Yes	4	0.00000001	0.00067584
17	Yes	4	0.00000001	0.00058817
18	Yes	4	0.00000001	0.00000001
19	Yes	4	0.00000001	0.00073206
20	Yes	5	0.00000001	0.00002640
21	Yes	5	0.00000001	0.00002866
22	Yes	5	0.00000001	0.00002640
23	Yes	4	0.00000001	0.00073206
24	Yes	5	0.00000001	0.00002640
25	Yes	5	0.00000001	0.00002866
26	Yes	5	0.00000001	0.00002640
27	Yes	4	0.00000001	0.00073206
28	Yes	5	0.00000001	0.00002640
29	Yes	5	0.00000001	0.00002866
30	Yes	5	0.00000001	0.00002640
31	Yes	4	0.00000001	0.00073206
32	Yes	5	0.00000001	0.00002640
33	Yes	5	0.00000001	0.00002866
34	Yes	5	0.00000001	0.00002640
35	Yes	4	0.00000001	0.00000001
36	Yes	4	0.00000001	0.00003163
37	Yes	4	0.00000001	0.00003648
38	Yes	4	0.00000001	0.00003163
39	Yes	4	0.00000001	0.00000001
40	Yes	4	0.00000001	0.00003163
41	Yes	4	0.00000001	0.00003648
42	Yes	4	0.00000001	0.00003163
43	Yes	4	0.00000001	0.00000001
44	Yes	4	0.00000001	0.00003163
45	Yes	4	0.00000001	0.00003648
46	Yes	4	0.00000001	0.00003163
47	Yes	4	0.00000001	0.00000001
48	Yes	4	0.00000001	0.00003163
49	Yes	4	0.00000001	0.00003648
50	Yes	4	0.00000001	0.00003163

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 99.75	8.619	39	0.5239	0.0000
L2	103.25 - 49.75	6.789	39	0.5157	0.0000
L3	54.25 - 1	2.148	39	0.3526	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	APX16PV-16PVL-X	39	8.291	0.5239	0.0000	530963
107.00	DUO4-7878	39	7.198	0.5202	0.0000	203041

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	120 - 99.75	24.904	6	1.5137	0.0000
L2	103.25 - 49.75	19.616	6	1.4901	0.0000
L3	54.25 - 1	6.206	6	1.0187	0.0000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
117.00	APX16PV-16PVL-X	6	23.955	1.5126	0.0000	184310
107.00	DUO4-7878	6	20.797	1.5008	0.0000	70479

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	120 - 99.75 (1)	TP28.14x24.86x0.1875	20.25	0.00	0.0	39.000	16.2978	-1.82	635.62	0.003
L2	99.75 - 49.75 (2)	TP35.87x27.1981x0.25	53.50	0.00	0.0	39.000	27.6857	-7.10	1079.74	0.007
L3	49.75 - 1 (3)	TP43.26x34.6406x0.25	53.25	0.00	0.0	36.541	34.1284	-14.29	1247.07	0.011

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 $\frac{P}{P_a}$

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	120 - 99.75 (1)	TP28.14x24.86x0.1875	21.18	2.305	39.000	0.059	0.00	0.000	39.000	0.000
L2	99.75 - 49.75 (2)	TP35.87x27.1981x0.25	228.64	11.503	39.000	0.295	0.00	0.000	39.000	0.000
L3	49.75 - 1 (3)	TP43.26x34.6406x0.25	637.62	21.081	36.541	0.577	0.00	0.000	36.541	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	120 - 99.75 (1)	TP28.14x24.86x0.1875	2.56	0.157	26.000	0.012	0.00	0.000	26.000	0.000
L2	99.75 - 49.75 (2)	TP35.87x27.1981x0.25	5.94	0.214	26.000	0.016	0.00	0.000	26.000	0.000
L3	49.75 - 1 (3)	TP43.26x34.6406x0.25	9.43	0.276	26.000	0.021	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	120 - 99.75 (1)	0.003	0.059	0.000	0.012	0.000	0.062 ✔	1.333	H1-3+VT ✔
L2	99.75 - 49.75 (2)	0.007	0.295	0.000	0.016	0.000	0.302 ✔	1.333	H1-3+VT ✔
L3	49.75 - 1 (3)	0.011	0.577	0.000	0.021	0.000	0.589 ✔	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	120 - 99.75	Pole	TP28.14x24.86x0.1875	1	-1.82	847.28	4.7	Pass
L2	99.75 - 49.75	Pole	TP35.87x27.1981x0.25	2	-7.10	1439.29	22.6	Pass
L3	49.75 - 1	Pole	TP43.26x34.6406x0.25	3	-14.29	1662.34	44.1	Pass
							Summary	
						Pole (L3)	44.1	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
						RATING =	44.1	Pass

Program Version 5.1.1.4 - 2/24/2008 File:P:/08/Rev_1_03-01-08/ERI Files/150_Sabre_Monopole_Meriden_CT_10'_ext.eri

ANCHOR BOLT AND
BASE PLATE ANALYSIS

ANCHOR BOLT AND BASEPLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 638 \cdot kips \cdot ft$	*user input*
Shear Force:	$Shear := 9.0 \cdot kips$	*user input*
Axial Force:	$Axial := 14.0 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts = N	$N := 8$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot ksi$	*user input*
Bolt Allowable Strength:	$Fy := 75 \cdot ksi$	*user input*
Diameter Of Anchor Bolts	$D := 2.25in$	*user input*
Threaded length per inch	$n := 4.5$	*user input*
Bolt "Column" Distance:	$l := 3in$	*user input*
Bolt Modulus:	$E := 29000 \cdot ksi$	*user input*

Base Plate Data:

Use ASTM A572 Grade 60

Plate Yield Strength:	$Fy_{bp} := 60 \cdot ksi$	*user input*
Base Plate Thickness:	$PlateThicknessProvide := 2.25 \cdot in$	*user input*

Geometric Layout Data:

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

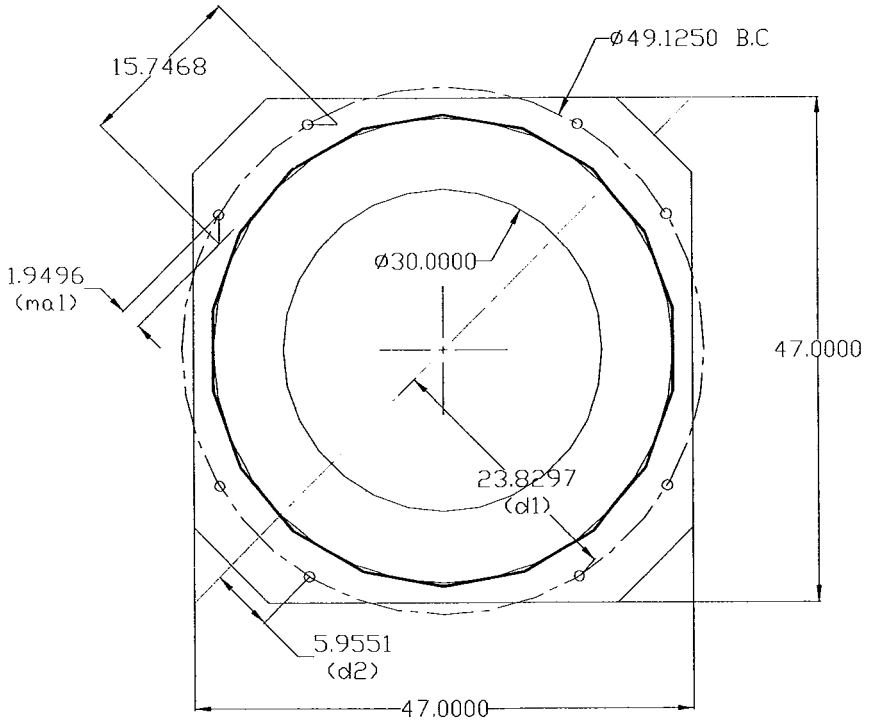
Distances for loading condition (see detail):

$d_1 := 23.8297 \cdot in$ *user input*

$d_2 := 5.9551 \cdot in$ *user input*

$MomentArm_1 := 1.9496 \cdot in$ *user input*

$EffectiveWidth := 15.7468 \cdot in$ *user input*



DETAIL - ANCHOR BOLT AND PLATE

Anchor Bolt Section Properties:

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

$$\Sigma d := \left[\left(d_1\right)^2 \cdot 4 + \left(d_2\right)^2 \cdot 4\right] \qquad \Sigma d = 2.41 \times 10^3 \cdot in^2$$

Gross Area of Bolt:

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

Net Area of Bolt:

$$A_{net} := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 \qquad A_{net} = 3.25 \cdot in^2$$

Net Diameter:

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

Radius of Gyration of Bolt:

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

Section Modulus of Bolt:

$$S_x := \frac{\pi \cdot D_n^{\ 3}}{32} \qquad S_x = 0.83 \cdot in^3$$

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left(\frac{Shear}{N}\right) \cdot l \qquad M_x = 0.28 \cdot kips \cdot ft$$

$$f_{bx} := \frac{M_x}{S_x} \qquad f_{bx} = 4.09 \cdot ksi$$

Allowable Bending

$$F_{bx} := 1.333 \cdot 0.60 \cdot Fy \qquad F_{bx} = 59.98 \cdot ksi$$

Note: 1.333 increase allowed per TIA/EIA

Anchor Bolt Tensile Stress Check:

Maximum Tensile Force (Gross Area):

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

Note: 1.333 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$F_{net.area} := 1.333 \cdot (0.60 \cdot A_{net} \cdot Fy)$ $F_{net.area} = 194.81 \cdot kips$

Note: 1.333 increase allowed per TIA/EIA

Maximum Applied Tension:

$$MaxTension := \frac{OM \cdot d_1}{\Sigma d} - \frac{Axial}{N} \qquad MaxTension = 73.85 \cdot kips$$

Check Stresses:

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

$AnchorBoltStress := if(F_{net.area} > MaxTension, "Not Overstressed", "Overstressed")$

$AnchorBoltStress = "Not Overstressed"$

$$PercentStressed := 100 \cdot \frac{MaxTension}{F_{net.area}}$$

$PercentStressed = 37.9$

Note: Shear Stress is negligible

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 if a combined stress analysis is not required and set the bending stress to zero:

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0.0\,in & \text{otherwise} \end{cases} \qquad l = 0$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0.0\,ksi & \text{otherwise} \end{cases} \qquad f_{bx} = 0 \cdot ksi$$

Allowable Compressive Force:

$$K := 0.65$$

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

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right] \cdot Fy}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} \qquad F_a = 45 \cdot ksi$$

$$F_a := 1.333 \cdot F_a \quad \text{Note: 1.333 increase allowed per TIA/EIA} \qquad F_a = 59.98 \cdot ksi$$

Applied Compressive Force:

$$MaxCompression := \frac{OM \cdot d_l}{\Sigma d} + \frac{Axial}{N} \qquad MaxCompression = 77.35 \cdot kips$$

$$f_a := \frac{MaxCompression}{A_{net}} \qquad f_a = 23.82 \cdot ksi$$

Check Combined Stresses:

$$StressRatio := \frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \qquad StressRatio = 0.4$$

Condition := if(StressRatio ≤ 1.0, "Not Overstressed", "Overstressed")

Condition = "Not Overstressed"

Base Plate Analysis:

Force From Bolt(s):

$$C_1 := \frac{OM \cdot d_1}{\Sigma d} + \frac{Axial}{N} \qquad C_1 = 77.35 \cdot kips$$

Bending Stress In Plate:

$$f_{bp} := \frac{6 \cdot (2C_1 \cdot MomentArm_1)}{EffectiveWidth \cdot PlateThicknessProvide^2} \qquad f_{bp} = 22.7 \cdot ksi$$

Check Stresses:

$$BasePlateRatio := \frac{f_{bp}}{1.333 \cdot 0.75 Fy_{bp}} \quad BasePlateRatio = 0.38$$

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

BasePlateStress = "Not Over Stress"

FOUNDATION ANALYSIS

URS

Job	120' Sabre Monopole Meriden, CT - Rev 1	Project No.	VZ4-011	Page / Sheet	of / 1 of 9
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Date	03/01/08
		Checked by		Date	

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 638 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 9.0 kip$
Max Compressive Force	$C_t := 14.0 \cdot kip$
Height of Tower	$H_t := 119 \cdot ft$
Base Plate Bolt Circle	$MP := 49.125 in$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 5.5 ft$
Length of Pier	$L_p := 5.0 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 1.0 \cdot ft$
Diameter of Pier	$d_p := 6.0 \cdot ft$
Thickness of Footing	$T_f := 1.5 \cdot ft$
Width of Footing:	$W_f := 17.5 ft$
Length of Anchor Bolts:	$L_{st} := 84.0 in$
Projection of anchor bolts above pier	$A_{BP} := 12.0 \cdot in$

PROPERTIES:

Compressive Strength of Concrete	$f'c := 4000 psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Yield Strength of Anchor Bolt	$fya := 75000 \cdot psi$
Internal Friction Angle of Soil	$\phi_s := 30 \cdot deg$
Allowable Bearing Capacity	$q_s := 9000 \cdot psf$
Unit Weight of Soil	$\gamma_s := 110 \cdot pcf$
Unit Weight of Concrete	$\gamma_c := 150 \cdot pcf$
Depth to Neglect	$n := 1.0 ft$
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	$d_{anchor} := 2.25 in$
Anchor bolt area	$A_{anchor} := 3.98 \cdot in^2$

PIER REINFORCEMENT:

Bar Size	$BSpier := 8$	Bar Diameter	$d_{bpier} := 1.000 \cdot in$
Number of Bars	$NBpier := 26$	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	$NB_{top} := 18$	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	$NB_{bot} := 18$	Bar Area	$A_{bot} := 0.790 \cdot in^2$

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

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

URS

Job	120' Sabre Monopole Meriden, CT - Rev 1	Project No.	VZ4-011	Page / Sheet	of / 2 of 9
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Date	03/01/08
		Checked by		Date	

CHECK ANCHOR STEEL EMBEDMENT

Depth:

$D_{ab} := L_{st} - A_{BP}$ $D_{ab} = 6 \cdot ft$ $L_{anchor} := \frac{(0.11 \cdot fya) \cdot in}{\sqrt{f'c \cdot psi}}$ $L_{anchor} = 10.8703 \cdot ft$

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

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

STABILITY OF FOOTING

Passive Pressure:

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

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

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

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 1.815 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 1.5675 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)]$ $T_p = 1.5 \cdot ft$

$A_p := W_f \cdot T_p$ $A_p = 26.25 \cdot ft^2$

Ultimate Shear:

$S_u := P_{ave} \cdot A_p$ $S_u = 41.1469 \cdot kip$

Weight of Concrete Pad:

$WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 L_p\right] \cdot \gamma_c$ $WT_c = 95.9063 \cdot kip$

Weight of Soil: above Footing:

$WT_{s1} := \left[W_f^2 \cdot \left(\left|L_p - L_{pag}\right|\right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(\left|L_p - L_{pag}\right|\right)\right] \cdot \gamma_s$ $WT_{s1} = 122.3093 \cdot kip$

Weight of Soil Wedge at back face:

$WT_{s2} := \left(\frac{D_f^2 \cdot \tan(\phi_s)}{2} \cdot W_f\right) \cdot \gamma_s$ $WT_{s2} = 16.8099 \cdot kip$

Total Weight:

$WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 232.2155 \cdot kip$

Resisting Moment:

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\phi_s)}{3}\right)$ $M_r = 2364.4258 \cdot kip \cdot ft$

Overturning Moment:

$M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 696.5 \cdot kip \cdot ft$

Factor of Safety:

$FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 3.39$

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

SHEAR CAPACITY IN PIER

$FS := 2$

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

$S_p = 72.8219 \cdot kips$

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

$ShearCheck = "Okay"$

BEARING PRESSURE CAUSED BY FOOTING

$A_{mat} := W_f^2$ $\quad A_{mat} = 306.25 \cdot ft^2$

$S := \frac{W_f^3}{6}$ $\quad S = 893.2292 \cdot ft^3$

$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S}$ $\quad P_{max} = 1.538 \cdot ksf$

$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S}$ $\quad P_{min} = -0.0215 \cdot ksf$

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

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

Distance to Resultant of Pressure Distribution:

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

$X_p = 5.7529 \cdot ft$

Distance to Kern: $X_k := \frac{W_f}{6}$ $\quad X_k = 2.9167 \cdot ft$

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

Eccentricity: $e := \frac{M_{ot}}{WT_{tot}}$ $\quad e = 2.9994$

Adjusted Soil Pressure: $P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)}$ $\quad P_a = 1.5383 \cdot ksf$

$q_{adj} := if\left(P_{min} < 0, P_a, \frac{P_{max}}{ft^2}\right)$ $\quad q_{adj} = 1.5383 \cdot ksf$

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

CONCRETE BEARING CAPACITY (ACI 10.17)

$\phi_c := 0.75$ (ACI 9.3.2.2)

$P_b := \phi_c \cdot 0.85 \cdot f'c \cdot \frac{d_p^2 \cdot \pi}{4}$ $P_b = 10382.3354 \cdot kip$

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

SHEAR STRENGTH OF CONCRETE

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

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

$d := T_f - Cvr_{pad} - d_{bbot}$ $d = 14 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$ $d_1 = 5.75 \cdot ft$

$d_2 := d_1 - d$ $d_2 = 4.5833 \cdot ft$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$ $L = 17.2519 \cdot ft$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$ $Slope = 0.0892 \cdot kcf$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$ $V_{req} = 171.9534 \cdot kip$

ACI 11.3.1.1 $V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f'c \cdot psi} \cdot W_f \cdot d$ $V_{Avail} = 316.1013 \cdot kip$

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

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

$b_o := (d_p + d) \cdot \pi$ $b_o = 22.5147 \cdot ft$

Area included inside bo: $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4}$ $A_{bo} = 40.3389 \cdot ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo}$ $A_{out} = 265.9111 \cdot ft^2$

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

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

$v_u := \text{Find}(v_u)$ $v_u = 8.8405 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 180.4938 \cdot kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 240.5982 \cdot kips$

$V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f'c \cdot psi} \cdot b_o \cdot d$ $V_{Avail} = 813.3646 \cdot kips$

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

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

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 1.0256 \cdot ksf$

$M_n := \frac{1}{LF \cdot \phi_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f$ $M_n = 329.7395 \cdot kip \cdot ft$

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

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2}$ $R_u = 15381.4\,lbf$

$\rho := \frac{0.85 \cdot f'c}{fy} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f'c}} \right)$ $\rho = 0.0018$

$\rho_{min} := 1.333 \cdot \rho$ $\rho_{min} = 0.00241$

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: $As := \max(\rho\rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 7.09 \cdot in^2$

$As_{prov} := A_{bot} \cdot NB_{bot}$ $As_{prov} = 14.22 \cdot in^2$

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

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 5.292 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 14.22 \cdot in^2$

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

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

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 10.9412 \cdot in$

Development Length Factors:

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

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 $k_{tr} := 0$

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

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

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

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad}$ $L_{Pad} = 66 \cdot in$

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

REINFORCEMENT IN PIER

Pier Area: $A_{pv} := \frac{\pi \cdot d_p^2}{4}$ $A_p = 4071.5041 \cdot in^2$

(ACI 10.8.4 and 10.9.1) $A_{smin} := 0.01 \cdot 0.05 \cdot A_p$ $A_{smin} = 2.0358 \cdot in^2$

$A_{sprov} := NBpier \cdot A_{bpier}$ $A_{sprov} = 20.54 \cdot in^2$

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

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: $B_{sPier} := \frac{d_p \cdot \pi}{NBpier} - d_{bpier}$ $B_{sPier} = 7.6998 \cdot in$

Diamter of Reinforcement Cage: $Diam_{cage} := d_p - 2 \cdot Cvr_{pier}$ $Diam_{cage} = 66 \cdot in$

Maximum Moment in Pier: $M_p := \left[M_t + S_t \cdot \left(L_p + \frac{A_{BP}}{2} \right) \right] \cdot LF$ $M_p = 10997.25 \cdot in \cdot kips$

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: $(D \ N \ n \ P_u \ M_{xu}) := (72 \ 26 \ 8 \ 18.6 \ 10998)$

Clears any previous output: $(\phi P_n \ \phi M_{xn} \ f_{sp} \ \rho) := (0 \ 0 \ 0 \ 0)$

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

The Output is given as useable axial load in kips, moment capacity in kip inches, splicing stress in ksi, and reinforcement ratio: $(\phi P_n \ \phi M_{xn} \ f_{sp} \ \rho) = (58.8548 \ 34800.2868 \ -60 \ 0.005)$

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

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

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

URS

Job	120' Sabre Monopole Meriden, CT - Rev 1	Project No.	VZ4-011	Page / Sheet	of 8 of 9
Description	Spread Footing w/ Pier Analysis	Computed by	JRM	Date	03/01/08
		Checked by		Date	

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

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

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

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

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

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

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

COMPRESSION: (ACI 12.3.2)

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

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

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

Available Length in Foundation:

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

$$L_{pad} := T_f - Cvr_{pad} \qquad L_{pad} = 15 \cdot in$$

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

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

NOTE: Anchor bolts and plate provided, OK

TIE SIZE AND SPACING IN COLUMN

Minimum Tie Size:

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

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

Seismic factor:
(ACI 21.10.5)

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

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

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

$s_{lim3} := D_f \cdot z$ $\quad s_{lim3} = 66 \cdot in$

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

Maximum Spacing:

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

Number of Ties Required:

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