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

July 25, 2008

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

RE: **EM-VER-111-080612** – Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 42 South Street, Plymouth, 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, with the condition that all remaining antenna mounts at 169-foot level of the tower be removed within one year of the date of this letter unless they can be utilized by another carrier within that time period.

The proposed modifications are to be implemented as specified here and in your notice dated June 12, 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/cm

c: The Honorable Vincent Festa, Jr., Mayor, Town of Plymouth
William Kuehn, Town Planner, Town of Plymouth

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

ORIGINAL

EM-VER-111-080612

June 12, 2008

Via Hand Delivery

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

Re: **Notice of Exempt Modification – Antenna Swap**
42 South Street, Plymouth, Connecticut

Dear Mr. Phelps:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains a wireless telecommunications facility at the above-referenced address. The Council approved Cellco's shared use of this facility in Petition No. 655. Cellco currently maintains six PCS antennas at the 169-foot level on the 180-foot tower. Alltel Communications ("Alltel") maintains twelve antennas and three tower mounted amplifiers ("TMAs") at the 179-foot level on the tower.

On May 30, 2008, Cellco acquired Alltel's CT-1 RSA cellular license for Litchfield County Connecticut. Cellco now intends to remove its twelve antennas and Alltel's twelve antennas and three TMAs and install four (4) LPA-80080/4CF cellular antennas; two (2) LPA-80063/4CF cellular antennas; four (4) LPA-185080/8CF PCS antennas; and two (2) LPA-185060/8CF PCS antennas all at the 179-foot level on the tower. The tower is owned by Cellco. Attached behind Tab 1 are the specifications for the proposed replacement antennas.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Vincent Festa, Jr., Mayor of the Town of Plymouth. Pursuant to a Council directive, a copy of this letter is also being sent to Walter T. and Susan A. MacDonald, the owners of the property on which the tower is located.

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

1. The proposed modifications will not result in the increase in the overall height of the existing structure. Cellco's replacement antennas will be located at the 179-foot level of the 180-foot tower.

2. The proposed antenna modifications will not require the extension of the site boundaries. Alltel's ground-mounted equipment will be removed from the existing site compound.

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

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

Also attached is a Structural Analysis Report confirming that the tower can support the proposed modifications. (See Tab 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Vincent Festa, Jr., Plymouth Mayor
Walter T. and Susan A. MacDonald
Sandy M. Carter

Vertically Polarized, Log Periodic 80° / 12.5 dBd

LPA-80080/4CF ___

When ordering replace "___" with connector type.

Mechanical specifications

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

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

Mounting and Downtilting

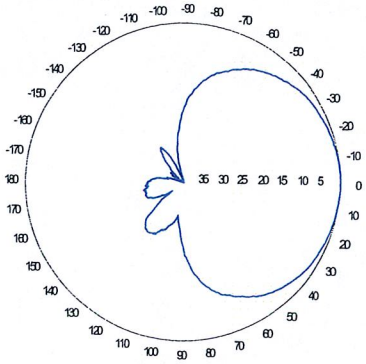
Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in). If the lock-down brace is used, the maximum diameter is Ø88.9 mm (3.5 in).

Mounting Bracket & Downtilt Bracket Kit #21699999

Electrical specifications

Frequency Range	806-960 MHz
Impedance	50Ω
[3] Connector(s)	NE or E-DIN 1 port / center
[1] VSWR	≤ 1.4:1
Polarization	Vertical
[1] Gain	12.5 dBd
[2] Power Rating	500 W
[1] Half Power Angle	
H-Plane	80°
E-Plane	15°
[1] Electrical Downtilt	0°
[1] Null Fill	15%
Lightning Protection	Direct Ground

Radiation pattern[1]



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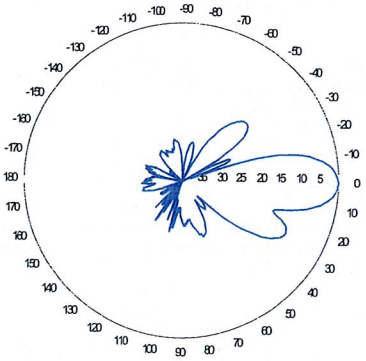
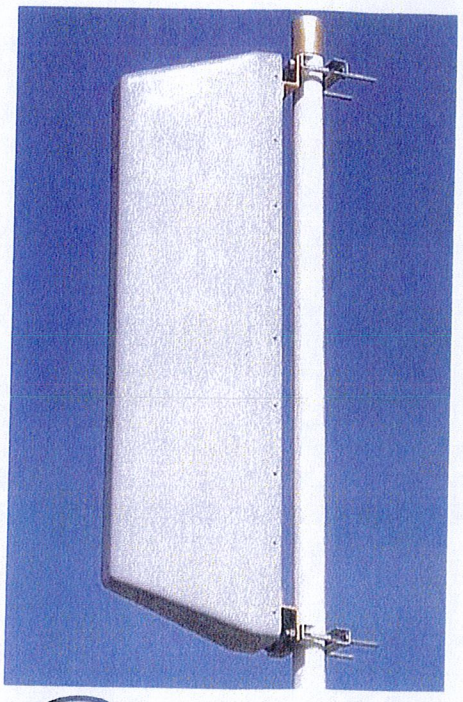


Vertical

Featuring upper side lobe suppression.

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

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



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

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

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

Antenna available with center-fed connector only.

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

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

CF Denotes a Center-Fed Connector.

806-960 MHz

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

Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/5/07

Vertically Polarized, Log Periodic 63° / 13 dBd

LPA-80063/4CF ___

When ordering replace "___" with connector type.

Mechanical specifications

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

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

Mounting and Downtilting

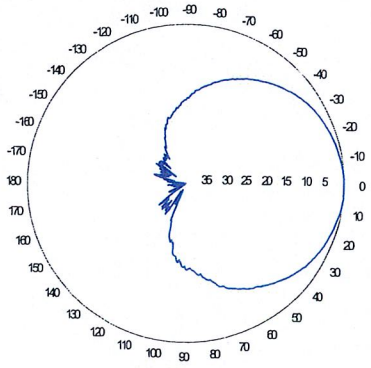
Mounting brackets attach to a pipe diameter of Ø50-102 mm (2.0-4.0 in). If the lock-down brace is used, the maximum diameter is Ø88.9 mm (3.5 in)

Mounting Bracket and Downtilt Bracket Kit #21699999

Electrical specifications

Frequency Range	806-960 MHz
Impedance	50Ω
3) Connector(s)	NE or E-DIN 1 port / center
1) VSWR	≤ 1.4:1
Polarization	Vertical
1) Gain	13 dBd
2) Power Rating	500 W
1) Half Power Angle	
H-Plane	63°
E-Plane	15°
1) Electrical Downtilt	0°
1) Null Fill	10%
Lightning Protection	Direct Ground

Radiation pattern[1)]



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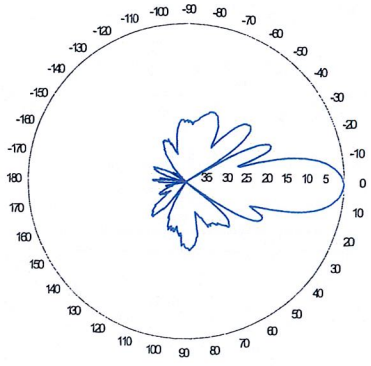
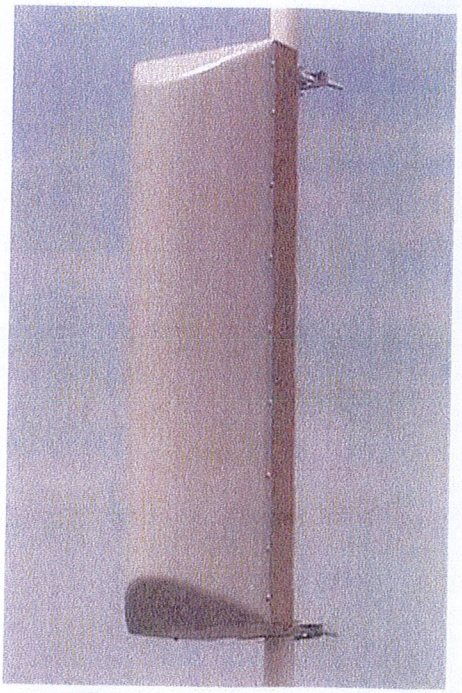


Vertical

Featuring upper side lobe suppression.

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

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



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

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

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

Antenna available with center-fed connector only.

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

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

CF Denotes a Center-Fed Connector.

806-960 MHz

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Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/5/07

Vertically Polarized, Log Periodic 80° / 16.5 dBi

LPA-185080/8CF ___

When ordering replace "___" with connector type.

Mechanical specifications

Length	1204 mm	47.4 in
Width	104 mm	4.1 in
Depth	150 mm	5.9 in
Depth with t-bracket	178 mm	7.0 in
[4] Weight	3.2 kg	7.0 lbs
Wind Area		
Fore/Aft	0.13 m^2	1.4 ft^2
Side	0.14 m^2	1.6 ft^2
Rated Wind Velocity (Safety factor 2.0)	>658 km/hr	>409 mph
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	202 N	45.0 lbs
Side	270 N	60.8 lbs

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

Mounting and Downtilting

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

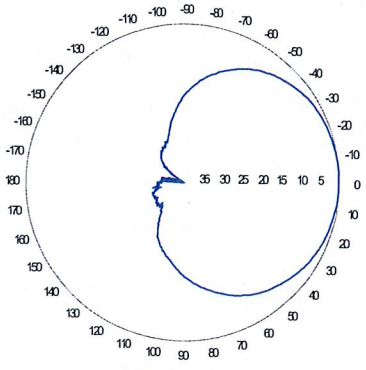
Mounting bracket kit #26799997
Downtilt bracket kit #26799999

The downtil bracket kit includes the mounting bracket kit.

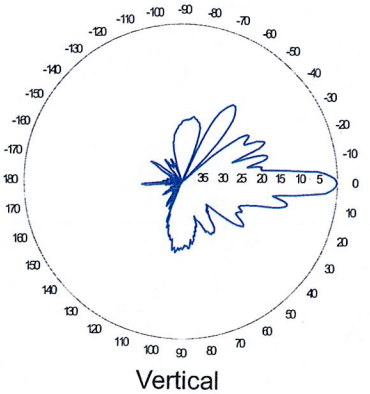
Electrical specifications

	Frequency Range	1850-1990 MHz
	Impedance	50Ω
[3]	Connector(s)	NE or E-DIN 1 port / center
[1]	VSWR	≤ 1.4:1
	Polarization	Vertical
[1]	Gain	16.5 dBi
[2]	Power Rating	250 W
[1]	Half Power Angle	
	H-Plane	80°
	E-Plane	8°
[1]	Electrical Downtilt	0°
[1]	Null Fill	10%
	Lightning Protection	Direct Ground

Radiation pattern[1]



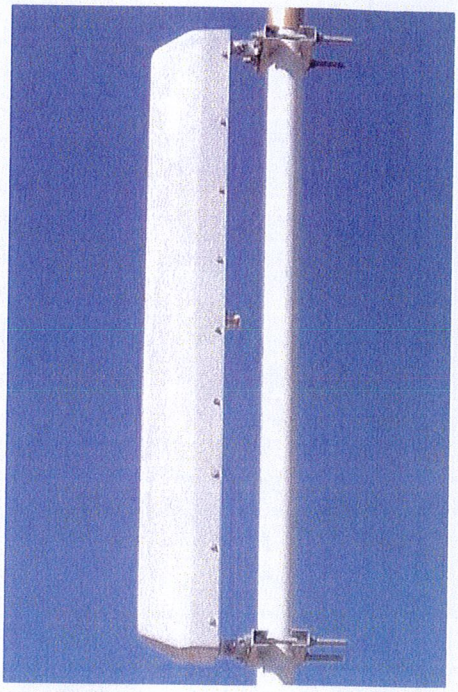
Horizontal



Vertical

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

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



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

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

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

Antenna available with center-fed connector only.

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

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

CF Denotes a Center-Fed Connector.

1850-1990 MHz

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Toll-Free (888) 417-9562 Fax. (815) 399-0156 antel@antelinc.com www.antelinc.com

Amphenol Antel, Inc. The Antenna Technology Company

Revision Date: 7/12/07

Vertically Polarized, Log Periodic 63° / 18 dBi

LPA-185063/8CF ___

When ordering replace "___" with connector type.

Mechanical specifications

Length	1200 mm	47.2 in
Width	167 mm	6.6 in
Depth	148 mm	5.8 in
Depth with t-bracket	176 mm	6.9 in
[4] Weight	4.1 kg	9.0 lbs
Wind Area		
Fore/Aft	0.20 m^2	2.2 ft^2
Side	0.18 m^2	1.9 ft^2
Rated Wind Velocity (Safety factor 2.0)	>548 km/hr	>341 mph
Wind Load @ 100 mph (161 km/hr)		
Fore/Aft	299 N	67.2 lbs
Side	267 N	60.0 lbs

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

Mounting and Downtilting

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

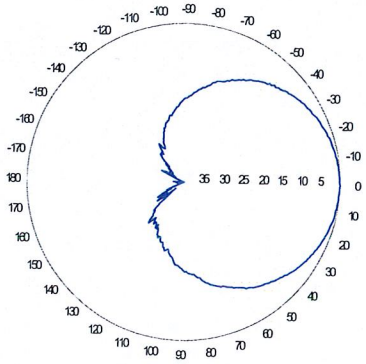
Mounting bracket kit #26799997
Downtilt bracket kit #26799999

The downtil bracket kit includes the mounting bracket kit.

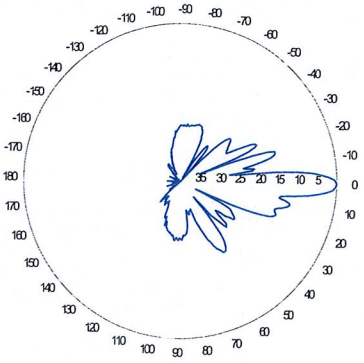
Electrical specifications

Frequency Range	1850-1990 MHz
Impedance	50Ω
[3] Connector(s)	NE or E-DIN 1 port / center
[1] VSWR	≤ 1.4:1
Polarization	Vertical
[1] Gain	18 dBi
[2] Power Rating	250 W
[1] Half Power Angle	
H-Plane	63°
E-Plane	8°
[1] Electrical Downtilt	0°
[1] Null Fill	10-20%
Lightning Protection	Direct Ground

Radiation pattern[1]



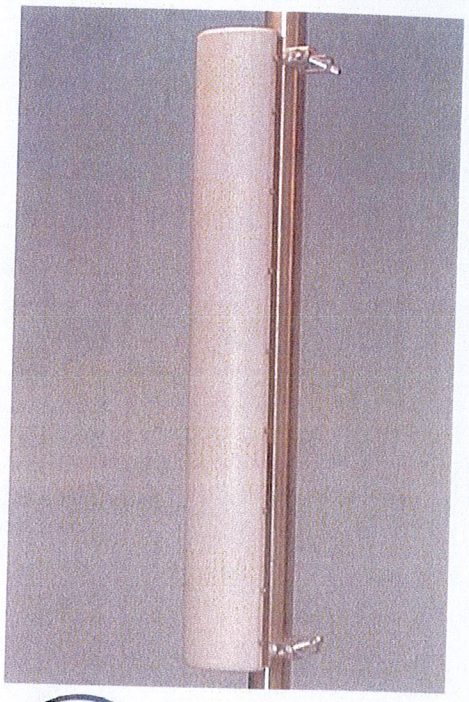
Horizontal



Vertical

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

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



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

- True log-periodic design allows for superior front-to-side characteristics to minimize sector overlap.
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- A non-collinear system with access to every radiating element for broad band-width and superior performance.
- Air as insulation for virtually no internal signal loss.

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

Antenna available with center-fed connector only.

1) Typical values.
2) Power rating limited by connector only.
3) NE indicates an elongated N connector.
   E-DIN indicates an elongated DIN connector.
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1850-1990 MHz

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Amphenol Antel, Inc.
The Antenna Technology Company

Revision Date: 7/12/07

	General	Power	Density					
Site Name: Plymouth West								
Tower Height: Verizon @ 179Ft.								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Existing Antennas							3.65%	
*Verizon	3	200	169	0.0076	1900	1.0000	0.76%	
*Alltel	3	250	178	0.0085	1900	1.0000	0.85%	
*Alltel	15	250	178	0.0426	850	0.5667	7.51%	
*Cingular	6	296	159	0.0253	880	0.5867	4.31%	
*Cingular	3	427	159	0.0182	1930	1.0000	1.82%	
Verizon	**9**	**485**	**179**	**0.0490**	**1970**	**1.0000**	**4.90%**	
Verizon	**9**	**200**	**179**	**0.0202**	**875**	**0.5830**	**3.46%**	
								27.26%
* Source: Siting Council								

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 180' MONOPOLE FOR NEW ANTENNA ARRANGEMENT

Site I.D: Plymouth West
Address: 42 South Street
Plymouth, CT 06782

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

36931110.00000
VZ4-034

January 16, 2008

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 180' steel tapered monopole structure, located at 42 South Street, Plymouth, CT. The analysis was conducted in accordance with the 2005 Connecticut State Building Code and the TIA/EIA-222-F standard for a wind velocity of 80 mph (fastest mile) and 69 mph (fastest mile) concurrent with ½" ice. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report. The proposed Verizon Wireless installation is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Remove: Alltel: All existing antennas and TMA's, (14) 7/8" + (1) 1/2" coaxial cable (within monopole) (3) T-Arms	Alltel (existing to be removed)	@ 179'
Verizon : (6) existing panel antennas (6) 1 5/8" coaxial cables (3) T- Frames	Verizon (existing to be removed)	@ 169'
Install: **Alpha Sector** **(2) Antel LPA 80080/4CF antennas** **(2) Antel LPA 185080/8CF antennas** **Beta Sector** **(2) Antel LPA 80080/4CF antennas** **(2) Antel LPA 185080/8CF antennas** **Gamma Sector** **(2) Antel LPA 80063/4CF antennas** **(2) Antel LPA 185063/8CF antennas** **(12) 1 5/8" coaxial cables** **(all new Verizon coax feed lines shall be located within existing monopole)** **(3) Verizon T-Arms** **(re-located from 169' to 179')**	**Verizon (Proposed)**	**@ 179'**

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

1. EXECUTIVE SUMMARY - *continued*

This analysis is based on:

1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
2) Tower geometry and structural member sizes utilized in the preparation of this report obtained from manufacturers original design documents prepared by Valmont Industries, Inc., order no. 11610-94, dated August 15, 1994.
3) Geotechnical report prepared by Heller and Johnson, Geotechnical Engineering Consultants, File No. 5701, dated April 11, 1994.
4) Site documentation and visual verification of existing appurtenances conducted from the existing grade by URS during December 2007.
5) 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 42 South Street, Plymouth, CT. The structure is an existing 180' steel tapered monopole structure, designed and manufactured by Valmont Industries, Inc.

The inventory is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(4) Antel LPA 80080/4CF, (2) Antel LPA 80063/4CF, (4) Antel LPA 185080/8CF and (2) Antel LPA 185063/8CF panel antennas	**Verizon (proposed)**	**(3) T-Arms (relocated – see note below)**	**179'**	**(12) 1-5/8" coax cables (within monopole)**

Note: Existing Verizon T-Arms to be removed and relocated to the 179' elevation.

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

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

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

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

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

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

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

4. FINDINGS AND EVALUATION

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

Tower Component Stress vs. Capacity Summary

Component (Section No.)	Controlling Component / Elevation	Stress Ratio (% capacity)	Pass/Fail	Notes:
Pole Shaft (L4)	0'-42.3'	86.1%	**Pass**	
Anchor Bolts	Compression	82%	**Pass**	
Base Plate	Bending	74%	**Pass**	

Foundation	Component	Stress (% capacity/FOS)	Pass/Fail	Comments:
Reinf. Concrete Caisson	Moment Capacity	66%/2.0	**Pass**	

5. CONCLUSIONS AND RECOMMENDATIONS

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

Limitations/Assumptions:

This report is based on the following:

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

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

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

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

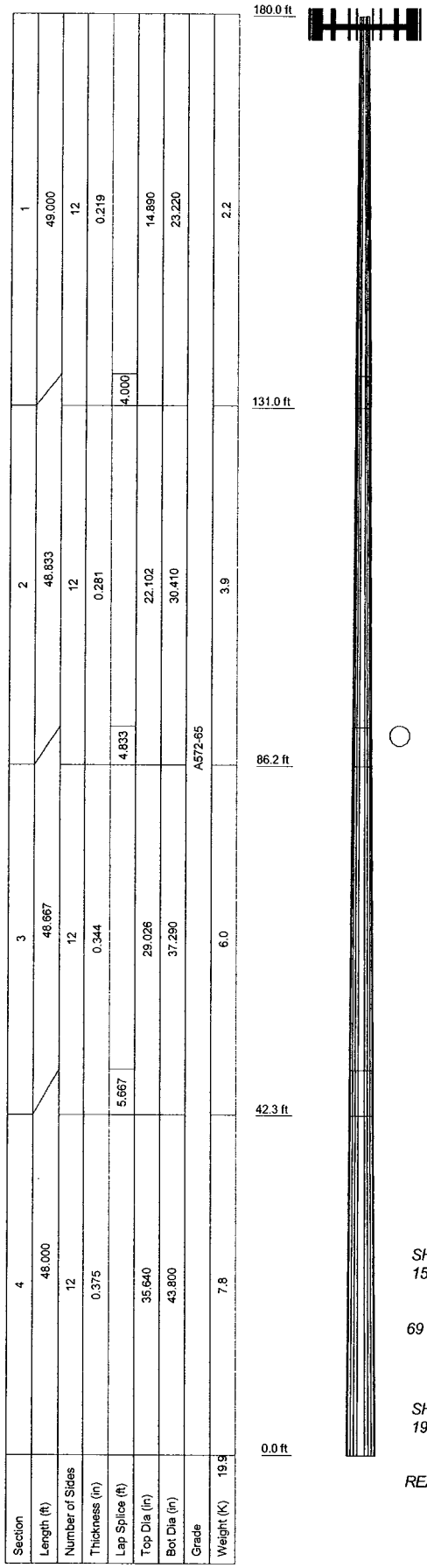
Ongoing and Periodic Inspection and Maintenance:

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

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

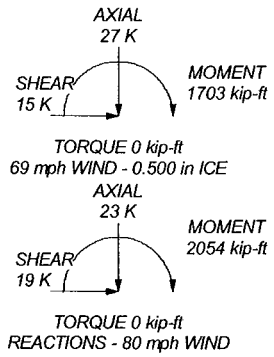
6. DRAWINGS AND DATA

RISA TOWER INPUT/OUTPUT SUMMARY



Section	1	2	3	4
Length (ft)	49.000	48.833	48.667	48.000
Number of Sides	12	12	12	12
Thickness (in)	0.219	0.281	0.344	0.375
Lap Splice (ft)	4.000	4.833	5.667	
Top Dia (in)	14.890	22.102	29.026	35.640
Bot Dia (in)	23.220	30.410	37.290	43.800
Grade	A572-65			
Weight (K)	2.2	3.9	6.0	7.8

19.9



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
LPA-80080/4CF (Verizon - proposed)	179	LPA-185080/8CF_2 (Verizon - proposed)	179
LPA-80080/4CF (Verizon - proposed)	179	LPA-185080/8CF_2 (Verizon - proposed)	179
LPA-80080/4CF (Verizon - proposed)	179	LPA-185063/8CFx2 (Verizon - proposed)	179
LPA-80080/4CF (Verizon - proposed)	179	LPA-185063/8CFx2 (Verizon - proposed)	179
LPA-80063/4CF (Verizon - proposed)	179	Valmont T-Arm (1) (Verizon - proposed)	179
LPA-80063/4CF (Verizon - proposed)	179	Valmont T-Arm (1) (Verizon - proposed)	179
LPA-185080/8CF_2 (Verizon - proposed)	179	Valmont T-Arm (1) (Verizon - proposed)	179
LPA-185080/8CF_2 (Verizon - proposed)	179		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
2. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
3. Deflections are based upon a 50 mph wind.
4. TOWER RATING: 86.1%

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

Job:	***180' Valmont Monopole***		
Project:	***42 South Street, Plymouth, CT***		
Client: Verizon Wireless	Drawn by: Staff	App'd:	
Code: TIA/EIA-222-F	Date: 01/16/08	Scale: NTS	
Path: P:\08\ERI Files\180' Monopole Plymouth CT.eri		Dwg No. E-1	

RISA TOWER DETAILED OUTPUT

Tower Input Data

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

Basic wind speed of 80 mph.
Nominal ice thickness of 0.500 in.
Ice density of 56 pcf.
A wind speed of 69 mph is used in combination with ice.
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	180.000-131.000	49.000	4.000	12	14.890	23.220	0.219	0.876	A572-65 (65 ksi)
L2	131.000-86.167	48.833	4.833	12	22.102	30.410	0.281	1.124	A572-65 (65 ksi)
L3	86.167-42.333	48.667	5.667	12	29.026	37.290	0.344	1.376	A572-65 (65 ksi)
L4	42.333-0.000	48.000		12	35.640	43.800	0.375	1.500	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^3	w in	w/t
L1	15.415	10.346	284.227	5.252	7.713	36.850	575.921	5.092	3.404	15.542
	24.039	16.220	1095.282	8.234	12.028	91.061	2219.339	7.983	5.636	25.735
L2	23.586	19.744	1199.975	7.812	11.449	104.812	2431.474	9.717	5.170	18.399
	31.483	27.261	3158.656	10.786	15.752	200.519	6400.293	13.417	7.397	26.323
L3	30.899	31.770	3335.935	10.268	15.035	221.873	6759.509	15.636	6.857	19.933
	38.605	40.924	7130.214	13.227	19.316	369.131	14447.746	20.142	9.072	26.372
L4	37.894	42.582	6759.160	12.625	18.461	366.125	13695.891	20.958	8.546	22.79
	45.345	52.436	12620.965	15.546	22.688	556.274	25573.497	25.807	10.733	28.622

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 180.000-131.000				1	1	1		
L2 131.000-86.167				1	1	1		
L3 86.167-42.333				1	1	1		
L4 42.333-0.000				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 klf
1 5/8 (Verizon)	C	No	Inside Pole	177.000 - 5.000	12	No Ice	0.000	0.001
						1/2" Ice	0.000	0.001

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	180.000-131.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.574
L2	131.000-86.167	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.560
L3	86.167-42.333	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.547
L4	42.333-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.466

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	180.000-131.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.574
L2	131.000-86.167	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.560
L3	86.167-42.333	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.547
L4	42.333-0.000	A	0.500	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.466

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
LPA-80080/4CF	A	From Face	4.000	0.000	179.000	No Ice	2.619	6.057	0.012
(Verizon - proposed)			6.000			1/2" Ice	2.922	6.453	0.045
			0.000						
LPA-80080/4CF	A	From Face	4.000	0.000	179.000	No Ice	2.619	6.057	0.012
(Verizon - proposed)			-6.000			1/2" Ice	2.922	6.453	0.045
			0.000						
LPA-80080/4CF	B	From Face	4.000	0.000	179.000	No Ice	2.619	6.057	0.012
(Verizon - proposed)			6.000			1/2" Ice	2.922	6.453	0.045
			0.000						
LPA-80080/4CF	B	From Face	4.000	0.000	179.000	No Ice	2.619	6.057	0.012
(Verizon - proposed)			-6.000			1/2" Ice	2.922	6.453	0.045
			0.000						
LPA-80063/4CF	C	From Face	4.000	0.000	179.000	No Ice	7.011	6.084	0.020
(Verizon - proposed)			6.000			1/2" Ice	7.421	6.481	0.073
			0.000						
LPA-80063/4CF	C	From Face	4.000	0.000	179.000	No Ice	7.011	6.084	0.020
(Verizon - proposed)			-6.000			1/2" Ice	7.421	6.481	0.073
			0.000						
LPA-185080/8CF_2	A	From Face	4.000	0.000	179.000	No Ice	2.095	2.786	0.007
(Verizon - proposed)			4.000			1/2" Ice	2.391	3.092	0.025
			0.000						
LPA-185080/8CF_2	A	From Face	4.000	0.000	179.000	No Ice	2.095	2.786	0.007
(Verizon - proposed)			-4.000			1/2" Ice	2.391	3.092	0.025
			0.000						
LPA-185080/8CF_2	B	From Face	4.000	0.000	179.000	No Ice	2.095	2.786	0.007
(Verizon - proposed)			4.000			1/2" Ice	2.391	3.092	0.025
			0.000						
LPA-185080/8CF_2	B	From Face	4.000	0.000	179.000	No Ice	2.095	2.786	0.007
(Verizon - proposed)			-4.000			1/2" Ice	2.391	3.092	0.025
			0.000						
LPA-185063/8CFx2	C	From Face	4.000	0.000	179.000	No Ice	3.040	2.734	0.009
(Verizon - proposed)			4.000			1/2" Ice	3.382	3.038	0.031

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.000						
LPA-185063/8CFx2	C	From Face	4.000	0.000	179.000	No Ice	3.040	2.734	0.009
(Verizon - proposed)			-4.000			1/2" Ice	3.382	3.038	0.031
			0.000						
Valmont T-Arm (1)	A	From Face	2.000	0.000	179.000	No Ice	10.540	10.540	0.336
(Verizon - proposed)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	B	From Face	2.000	0.000	179.000	No Ice	10.540	10.540	0.336
(Verizon - proposed)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						
Valmont T-Arm (1)	C	From Face	2.000	0.000	179.000	No Ice	10.540	10.540	0.336
(Verizon - proposed)			0.000			1/2" Ice	14.450	14.450	0.412
			0.000						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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 180.000-131.000	153.987	1.553	0.025	77.808	A	0.000	77.808	77.808	100.00	0.000	0.000
					B	0.000	77.808		100.00		
					C	0.000	77.808		100.00		
L2 131.000-86.167	107.842	1.403	0.023	99.366	A	0.000	99.366	99.366	100.00	0.000	0.000
					B	0.000	99.366		100.00		
					C	0.000	99.366		100.00		
L3 86.167-42.333	63.979	1.208	0.020	122.619	A	0.000	122.619	122.619	100.00	0.000	0.000
					B	0.000	122.619		100.00		
					C	0.000	122.619		100.00		
L4 42.333-0.000	20.535	1	0.016	141.821	A	0.000	141.821	141.821	100.00	0.000	0.000
					B	0.000	141.821		100.00		
					C	0.000	141.821		100.00		

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	t_Z in	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 180.000-131.000	153.987	1.553	0.019	0.500	81.891	A	0.000	81.891	81.891	100.00	0.000	0.000
						B	0.000	81.891		100.00		
						C	0.000	81.891		100.00		
L2 131.000-	107.842	1.403	0.017	0.500	103.102	A	0.000	103.102	103.102	100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z ksf	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
86.167						B	0.000	103.102		100.00		
						C	0.000	103.102		100.00		
L3 86.167-42.333	63.979	1.208	0.015	0.500	126.272	A	0.000	126.272	126.272	100.00	0.000	0.000
						B	0.000	126.272		100.00		
						C	0.000	126.272		100.00		
L4 42.333-0.000	20.535	1	0.012	0.500	145.349	A	0.000	145.349	145.349	100.00	0.000	0.000
						B	0.000	145.349		100.00		
						C	0.000	145.349		100.00		

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z ksf	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 180.000-131.000	153.987	1.553	0.010	77.808	A	0.000	77.808	77.808	100.00	0.000	0.000
					B	0.000	77.808		100.00		
					C	0.000	77.808		100.00		
L2 131.000-86.167	107.842	1.403	0.009	99.366	A	0.000	99.366	99.366	100.00	0.000	0.000
					B	0.000	99.366		100.00		
					C	0.000	99.366		100.00		
L3 86.167-42.333	63.979	1.208	0.008	122.619	A	0.000	122.619	122.619	100.00	0.000	0.000
					B	0.000	122.619		100.00		
					C	0.000	122.619		100.00		
L4 42.333-0.000	20.535	1	0.006	141.821	A	0.000	141.821	141.821	100.00	0.000	0.000
					B	0.000	141.821		100.00		
					C	0.000	141.821		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 klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	3.442	0.070	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	3.967	0.088	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	4.202	0.096	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	4.045	0.096	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	1309.746 kip-ft	15.656		

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	3.442	0.070	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	3.967	0.088	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	4.202	0.096	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	4.045	0.096	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	1309.746 kip-ft	15.656		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	3.442	0.070	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	3.967	0.088	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	4.202	0.096	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	4.045	0.096	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	1309.746 kip-ft	15.656		

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 klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	3.442	0.070	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	3.967	0.088	C
			B	1	1.03	1	1	1	99.366			

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 klf	Ctrl. Face
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	4.202	0.096	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	4.045	0.096	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	1309.746 kip-ft	15.656		

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 klf	Ctrl. Face
L1 180.000-131.000	0.574	2.815	A	1	1.03	1	1	1	81.891	2.717	0.055	C
			B	1	1.03	1	1	1	81.891			
			C	1	1.03	1	1	1	81.891			
L2 131.000-86.167	0.560	4.666	A	1	1.03	1	1	1	103.102	3.087	0.069	C
			B	1	1.03	1	1	1	103.102			
			C	1	1.03	1	1	1	103.102			
L3 86.167-42.333	0.547	6.954	A	1	1.03	1	1	1	126.272	3.246	0.074	C
			B	1	1.03	1	1	1	126.272			
			C	1	1.03	1	1	1	126.272			
L4 42.333-0.000	0.466	8.839	A	1	1.03	1	1	1	145.349	3.109	0.073	C
			B	1	1.03	1	1	1	145.349			
			C	1	1.03	1	1	1	145.349			
Sum Weight:	2.147	23.273						OTM	1022.790 kip-ft	12.159		

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 klf	Ctrl. Face
L1 180.000-131.000	0.574	2.815	A	1	1.03	1	1	1	81.891	2.717	0.055	C
			B	1	1.03	1	1	1	81.891			
			C	1	1.03	1	1	1	81.891			
L2 131.000-86.167	0.560	4.666	A	1	1.03	1	1	1	103.102	3.087	0.069	C
			B	1	1.03	1	1	1	103.102			
			C	1	1.03	1	1	1	103.102			
L3 86.167-42.333	0.547	6.954	A	1	1.03	1	1	1	126.272	3.246	0.074	C
			B	1	1.03	1	1	1	126.272			
			C	1	1.03	1	1	1	126.272			
L4 42.333-0.000	0.466	8.839	A	1	1.03	1	1	1	145.349	3.109	0.073	C
			B	1	1.03	1	1	1	145.349			
			C	1	1.03	1	1	1	145.349			
Sum Weight:	2.147	23.273						OTM	1022.790 kip-ft	12.159		

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 ft^2	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.815	A	1	1.03	1	1	1	81.891	2.717	0.055	C
			B	1	1.03	1	1	1	81.891			
			C	1	1.03	1	1	1	81.891			
L2 131.000-86.167	0.560	4.666	A	1	1.03	1	1	1	103.102	3.087	0.069	C
			B	1	1.03	1	1	1	103.102			
			C	1	1.03	1	1	1	103.102			
L3 86.167-42.333	0.547	6.954	A	1	1.03	1	1	1	126.272	3.246	0.074	C
			B	1	1.03	1	1	1	126.272			
			C	1	1.03	1	1	1	126.272			
L4 42.333-0.000	0.466	8.839	A	1	1.03	1	1	1	145.349	3.109	0.073	C
			B	1	1.03	1	1	1	145.349			
			C	1	1.03	1	1	1	145.349			
Sum Weight:	2.147	23.273						OTM	1022.790 kip-ft	12.159		

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 ft^2	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.815	A	1	1.03	1	1	1	81.891	2.717	0.055	C
			B	1	1.03	1	1	1	81.891			
			C	1	1.03	1	1	1	81.891			
L2 131.000-86.167	0.560	4.666	A	1	1.03	1	1	1	103.102	3.087	0.069	C
			B	1	1.03	1	1	1	103.102			
			C	1	1.03	1	1	1	103.102			
L3 86.167-42.333	0.547	6.954	A	1	1.03	1	1	1	126.272	3.246	0.074	C
			B	1	1.03	1	1	1	126.272			
			C	1	1.03	1	1	1	126.272			
L4 42.333-0.000	0.466	8.839	A	1	1.03	1	1	1	145.349	3.109	0.073	C
			B	1	1.03	1	1	1	145.349			
			C	1	1.03	1	1	1	145.349			
Sum Weight:	2.147	23.273						OTM	1022.790 kip-ft	12.159		

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 ft^2	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	1.345	0.027	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	1.550	0.035	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	1.642	0.037	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	1.580	0.037	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	511.619 kip-ft	6.116		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	1.345	0.027	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	1.550	0.035	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	1.642	0.037	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	1.580	0.037	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	511.619 kip-ft	6.116		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face e	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	1.345	0.027	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	1.550	0.035	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	1.642	0.037	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	1.580	0.037	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			

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 klf	Ctrl. Face
Sum Weight:	2.147	19.899						OTM	511.619 kip-ft	6.116		

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 klf	Ctrl. Face
L1 180.000-131.000	0.574	2.215	A	1	1.03	1	1	1	77.808	1.345	0.027	C
			B	1	1.03	1	1	1	77.808			
			C	1	1.03	1	1	1	77.808			
L2 131.000-86.167	0.560	3.905	A	1	1.03	1	1	1	99.366	1.550	0.035	C
			B	1	1.03	1	1	1	99.366			
			C	1	1.03	1	1	1	99.366			
L3 86.167-42.333	0.547	6.019	A	1	1.03	1	1	1	122.619	1.642	0.037	C
			B	1	1.03	1	1	1	122.619			
			C	1	1.03	1	1	1	122.619			
L4 42.333-0.000	0.466	7.760	A	1	1.03	1	1	1	141.821	1.580	0.037	C
			B	1	1.03	1	1	1	141.821			
			C	1	1.03	1	1	1	141.821			
Sum Weight:	2.147	19.899						OTM	511.619 kip-ft	6.116		

Discrete Appurtenance Pressures - No Ice $G_H = 1.690$

Description	Aiming Azimuth °	Weight K	$Offset_x$ ft	$Offset_z$ ft	z ft	K_z	q_z ksf	C_AA_C Front ft²	C_AA_C Side ft²
LPA-80080/4CF	300.000	0.012	-1.008	-7.510	179.000	1.621	0.027	2.619	6.057
LPA-80080/4CF	300.000	0.012	-7.008	2.882	179.000	1.621	0.027	2.619	6.057
LPA-80080/4CF	60.000	0.012	7.008	2.882	179.000	1.621	0.027	2.619	6.057
LPA-80080/4CF	60.000	0.012	1.008	-7.510	179.000	1.621	0.027	2.619	6.057
LPA-80063/4CF	180.000	0.020	-6.000	4.627	179.000	1.621	0.027	7.011	6.084
LPA-80063/4CF	180.000	0.020	6.000	4.627	179.000	1.621	0.027	7.011	6.084
LPA-185080/8CF_2	300.000	0.007	-2.008	-5.778	179.000	1.621	0.027	2.095	2.786
LPA-185080/8CF_2	300.000	0.007	-6.008	1.150	179.000	1.621	0.027	2.095	2.786
LPA-185080/8CF_2	60.000	0.007	6.008	1.150	179.000	1.621	0.027	2.095	2.786
LPA-185080/8CF_2	60.000	0.007	2.008	-5.778	179.000	1.621	0.027	2.095	2.786
LPA-185063/8CFx2	180.000	0.009	-4.000	4.627	179.000	1.621	0.027	3.040	2.734
LPA-185063/8CFx2	180.000	0.009	4.000	4.627	179.000	1.621	0.027	3.040	2.734
Valmont T-Arm (1)	300.000	0.336	-2.275	-1.314	179.000	1.621	0.027	10.540	10.540
Valmont T-Arm (1)	60.000	0.336	2.275	-1.314	179.000	1.621	0.027	10.540	10.540
Valmont T-Arm (1)	180.000	0.336	0.000	2.627	179.000	1.621	0.027	10.540	10.540
	Sum Weight:	1.142							

Discrete Appurtenance Pressures - With Ice $G_H = 1.690$

Description	Aiming Azimuth °	Weight K	$Offset_x$ ft	$Offset_z$ ft	z ft	K_z	q_z ksf	C_AA_C Front ft^2	C_AA_C Side ft^2	t_z in
LPA-80080/4CF	300.000	0.045	-1.008	-7.510	179.000	1.621	0.020	2.922	6.453	0.500
LPA-80080/4CF	300.000	0.045	-7.008	2.882	179.000	1.621	0.020	2.922	6.453	0.500
LPA-80080/4CF	60.000	0.045	7.008	2.882	179.000	1.621	0.020	2.922	6.453	0.500
LPA-80080/4CF	60.000	0.045	1.008	-7.510	179.000	1.621	0.020	2.922	6.453	0.500
LPA-80063/4CF	180.000	0.073	-6.000	4.627	179.000	1.621	0.020	7.421	6.481	0.500
LPA-80063/4CF	180.000	0.073	6.000	4.627	179.000	1.621	0.020	7.421	6.481	0.500
LPA-185080/8CF_2	300.000	0.025	-2.008	-5.778	179.000	1.621	0.020	2.391	3.092	0.500
LPA-185080/8CF_2	300.000	0.025	-6.008	1.150	179.000	1.621	0.020	2.391	3.092	0.500
LPA-185080/8CF_2	60.000	0.025	6.008	1.150	179.000	1.621	0.020	2.391	3.092	0.500
LPA-185080/8CF_2	60.000	0.025	2.008	-5.778	179.000	1.621	0.020	2.391	3.092	0.500
LPA-185063/8CFx2	180.000	0.031	-4.000	4.627	179.000	1.621	0.020	3.382	3.038	0.500
LPA-185063/8CFx2	180.000	0.031	4.000	4.627	179.000	1.621	0.020	3.382	3.038	0.500
Valmont T-Arm (1)	300.000	0.412	-2.275	-1.314	179.000	1.621	0.020	14.450	14.450	0.500
Valmont T-Arm (1)	60.000	0.412	2.275	-1.314	179.000	1.621	0.020	14.450	14.450	0.500
Valmont T-Arm (1)	180.000	0.412	0.000	2.627	179.000	1.621	0.020	14.450	14.450	0.500
	Sum Weight:	1.724								

Discrete Appurtenance Pressures - Service $G_H = 1.690$

Description	Aiming Azimuth °	Weight K	$Offset_x$ ft	$Offset_z$ ft	z ft	K_z	q_z ksf	C_AA_C Front ft^2	C_AA_C Side ft^2
LPA-80080/4CF	300.000	0.012	-1.008	-7.510	179.000	1.621	0.010	2.619	6.057
LPA-80080/4CF	300.000	0.012	-7.008	2.882	179.000	1.621	0.010	2.619	6.057
LPA-80080/4CF	60.000	0.012	7.008	2.882	179.000	1.621	0.010	2.619	6.057
LPA-80080/4CF	60.000	0.012	1.008	-7.510	179.000	1.621	0.010	2.619	6.057
LPA-80063/4CF	180.000	0.020	-6.000	4.627	179.000	1.621	0.010	7.011	6.084
LPA-80063/4CF	180.000	0.020	6.000	4.627	179.000	1.621	0.010	7.011	6.084
LPA-185080/8CF_2	300.000	0.007	-2.008	-5.778	179.000	1.621	0.010	2.095	2.786
LPA-185080/8CF_2	300.000	0.007	-6.008	1.150	179.000	1.621	0.010	2.095	2.786
LPA-185080/8CF_2	60.000	0.007	6.008	1.150	179.000	1.621	0.010	2.095	2.786
LPA-185080/8CF_2	60.000	0.007	2.008	-5.778	179.000	1.621	0.010	2.095	2.786
LPA-185063/8CFx2	180.000	0.009	-4.000	4.627	179.000	1.621	0.010	3.040	2.734
LPA-185063/8CFx2	180.000	0.009	4.000	4.627	179.000	1.621	0.010	3.040	2.734
Valmont T-Arm (1)	300.000	0.336	-2.275	-1.314	179.000	1.621	0.010	10.540	10.540
Valmont T-Arm (1)	60.000	0.336	2.275	-1.314	179.000	1.621	0.010	10.540	10.540
Valmont T-Arm (1)	180.000	0.336	0.000	2.627	179.000	1.621	0.010	10.540	10.540
	Sum Weight:	1.142							

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	19.899					
Bracing Weight	0.000					
Total Member Self-Weight	19.899			0.093	0.000	
Total Weight	23.188			0.093	0.000	
Wind 0 deg - No Ice		0.000	-19.380	-1976.241	0.000	0.000
Wind 30 deg - No Ice		9.449	-16.783	-1711.463	-945.080	-0.005
Wind 45 deg - No Ice		13.363	-13.704	-1397.386	-1336.544	-0.008
Wind 60 deg - No Ice		16.367	-9.690	-988.074	-1636.926	-0.009

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 90 deg - No Ice		18.898	0.000	0.093	-1890.159	-0.011
Wind 120 deg - No Ice		16.367	9.690	988.259	-1636.926	-0.009
Wind 135 deg - No Ice		13.363	13.704	1397.571	-1336.544	-0.008
Wind 150 deg - No Ice		9.449	16.783	1711.648	-945.080	-0.005
Wind 180 deg - No Ice		0.000	19.380	1976.426	0.000	0.000
Wind 210 deg - No Ice		-9.449	16.783	1711.648	945.080	0.005
Wind 225 deg - No Ice		-13.363	13.704	1397.571	1336.544	0.008
Wind 240 deg - No Ice		-16.367	9.690	988.259	1636.926	0.009
Wind 270 deg - No Ice		-18.898	0.000	0.093	1890.159	0.011
Wind 300 deg - No Ice		-16.367	-9.690	-988.074	1636.926	0.009
Wind 315 deg - No Ice		-13.363	-13.704	-1397.386	1336.544	0.008
Wind 330 deg - No Ice		-9.449	-16.783	-1711.463	945.080	0.005
Member Ice	3.374					
Total Weight Ice	27.144			0.311	0.000	
Wind 0 deg - Ice		0.000	-15.488	-1618.476	0.000	0.000
Wind 30 deg - Ice		7.558	-13.413	-1401.600	-776.155	-0.004
Wind 45 deg - Ice		10.689	-10.952	-1144.344	-1097.649	-0.006
Wind 60 deg - Ice		13.092	-7.744	-809.082	-1344.340	-0.007
Wind 90 deg - Ice		15.117	0.000	0.311	-1552.311	-0.008
Wind 120 deg - Ice		13.092	7.744	809.705	-1344.340	-0.007
Wind 135 deg - Ice		10.689	10.952	1144.967	-1097.649	-0.006
Wind 150 deg - Ice		7.558	13.413	1402.223	-776.155	-0.004
Wind 180 deg - Ice		0.000	15.488	1619.099	0.000	0.000
Wind 210 deg - Ice		-7.558	13.413	1402.223	776.155	0.004
Wind 225 deg - Ice		-10.689	10.952	1144.967	1097.649	0.006
Wind 240 deg - Ice		-13.092	7.744	809.705	1344.340	0.007
Wind 270 deg - Ice		-15.117	0.000	0.311	1552.311	0.008
Wind 300 deg - Ice		-13.092	-7.744	-809.082	1344.340	0.007
Wind 315 deg - Ice		-10.689	-10.952	-1144.344	1097.649	0.006
Wind 330 deg - Ice		-7.558	-13.413	-1401.600	776.155	0.004
Total Weight	23.188			0.093	0.000	
Wind 0 deg - Service		0.000	-7.570	-771.913	0.000	0.000
Wind 30 deg - Service		3.691	-6.556	-668.484	-369.172	-0.002
Wind 45 deg - Service		5.220	-5.353	-545.798	-522.088	-0.003
Wind 60 deg - Service		6.393	-3.785	-385.910	-639.424	-0.004
Wind 90 deg - Service		7.382	0.000	0.093	-738.343	-0.004
Wind 120 deg - Service		6.393	3.785	386.095	-639.424	-0.004
Wind 135 deg - Service		5.220	5.353	545.983	-522.088	-0.003
Wind 150 deg - Service		3.691	6.556	668.669	-369.172	-0.002
Wind 180 deg - Service		0.000	7.570	772.098	0.000	0.000
Wind 210 deg - Service		-3.691	6.556	668.669	369.172	0.002
Wind 225 deg - Service		-5.220	5.353	545.983	522.088	0.003
Wind 240 deg - Service		-6.393	3.785	386.095	639.424	0.004
Wind 270 deg - Service		-7.382	0.000	0.093	738.343	0.004
Wind 300 deg - Service		-6.393	-3.785	-385.910	639.424	0.004
Wind 315 deg - Service		-5.220	-5.353	-545.798	522.088	0.003
Wind 330 deg - Service		-3.691	-6.556	-668.484	369.172	0.002

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

Comb. No.	Description
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
19	Dead+Wind 0 deg+Ice
20	Dead+Wind 30 deg+Ice
21	Dead+Wind 45 deg+Ice
22	Dead+Wind 60 deg+Ice
23	Dead+Wind 90 deg+Ice
24	Dead+Wind 120 deg+Ice
25	Dead+Wind 135 deg+Ice
26	Dead+Wind 150 deg+Ice
27	Dead+Wind 180 deg+Ice
28	Dead+Wind 210 deg+Ice
29	Dead+Wind 225 deg+Ice
30	Dead+Wind 240 deg+Ice
31	Dead+Wind 270 deg+Ice
32	Dead+Wind 300 deg+Ice
33	Dead+Wind 315 deg+Ice
34	Dead+Wind 330 deg+Ice
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	180 - 131	Pole	Max Tension	35	0.000	0.000	-0.000
			Max. Compression	18	-4.790	0.000	-0.319
			Max. Mx	6	-2.905	-220.463	-0.096
			Max. My	10	-2.793	0.000	-242.215
			Max. Vy	6	6.738	-220.463	-0.096
			Max. Vx	10	7.238	0.000	-242.215
			Max. Torque	23			0.026

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L2	131 - 86.167	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-9.744	0.000	-0.319
			Max. Mx	6	-7.119	-603.790	-0.098
			Max. My	10	-7.036	0.000	-647.868
			Max. Vy	6	10.741	-603.790	-0.098
			Max. Vx	10	11.252	0.000	-647.868
			Max. Torque	23			0.026
L3	86.167 - 42.333	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-16.858	0.000	-0.319
			Max. Mx	6	-13.566	-1154.282	-0.099
			Max. My	10	-13.519	0.000	-1220.325
			Max. Vy	6	14.812	-1154.282	-0.099
			Max. Vx	10	15.319	0.000	-1220.325
			Max. Torque	23			0.026
L4	42.333 - 0	Pole	Max Tension	1	0.000	0.000	0.000
			Max. Compression	18	-27.144	0.000	-0.319
			Max. Mx	6	-23.171	-1964.486	-0.100
			Max. My	10	-23.170	0.000	-2054.395
			Max. Vy	6	18.919	-1964.486	-0.100
			Max. Vx	10	19.401	0.000	-2054.395
			Max. Torque	23			0.026

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	19	27.144	0.000	15.488
	Max. H_x	14	23.188	18.898	0.000
	Max. H_z	2	23.188	0.000	19.380
	Max. M_x	2	2054.199	0.000	19.380
	Max. M_z	6	1964.486	-18.898	0.000
	Max. Torsion	23	0.026	-15.117	0.000
	Min. Vert	1	23.188	0.000	0.000
	Min. H_x	6	23.188	-18.898	0.000
	Min. H_z	10	23.188	0.000	-19.380
	Min. M_x	10	-2054.395	0.000	-19.380
	Min. M_z	14	-1964.486	18.898	0.000
	Min. Torsion	31	-0.026	15.117	0.000

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	23.188	0.000	0.000	0.093	0.000	0.000
Dead+Wind 0 deg - No Ice	23.188	0.000	-19.380	-2054.199	0.000	0.000
Dead+Wind 30 deg - No Ice	23.188	9.449	-16.783	-1779.134	-982.000	-0.011
Dead+Wind 45 deg - No Ice	23.188	13.363	-13.704	-1452.764	-1388.874	-0.015
Dead+Wind 60 deg - No Ice	23.188	16.367	-9.690	-1027.318	-1701.159	-0.017
Dead+Wind 90 deg - No Ice	23.188	18.898	0.000	0.100	-1964.486	-0.017
Dead+Wind 120 deg - No Ice	23.188	16.367	9.690	1027.517	-1701.157	-0.012

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 135 deg - No Ice	23.188	13.363	13.704	1452.962	-1388.872	-0.008
Dead+Wind 150 deg - No Ice	23.188	9.449	16.783	1779.331	-981.999	-0.005
Dead+Wind 180 deg - No Ice	23.188	0.000	19.380	2054.395	0.000	0.000
Dead+Wind 210 deg - No Ice	23.188	-9.449	16.783	1779.331	981.999	0.005
Dead+Wind 225 deg - No Ice	23.188	-13.363	13.704	1452.962	1388.872	0.008
Dead+Wind 240 deg - No Ice	23.188	-16.367	9.690	1027.517	1701.157	0.012
Dead+Wind 270 deg - No Ice	23.188	-18.898	0.000	0.100	1964.486	0.017
Dead+Wind 300 deg - No Ice	23.188	-16.367	-9.690	-1027.318	1701.159	0.017
Dead+Wind 315 deg - No Ice	23.188	-13.363	-13.704	-1452.764	1388.874	0.015
Dead+Wind 330 deg - No Ice	23.188	-9.449	-16.783	-1779.134	982.000	0.011
Dead+Ice	27.144	0.000	0.000	0.319	0.000	0.000
Dead+Wind 0 deg+Ice	27.144	0.000	-15.488	-1702.764	0.000	0.000
Dead+Wind 30 deg+Ice	27.144	7.558	-13.413	-1474.681	-816.177	-0.014
Dead+Wind 45 deg+Ice	27.144	10.689	-10.952	-1204.081	-1154.317	-0.020
Dead+Wind 60 deg+Ice	27.144	13.092	-7.744	-851.364	-1413.827	-0.023
Dead+Wind 90 deg+Ice	27.144	15.117	0.000	0.347	-1632.641	-0.026
Dead+Wind 120 deg+Ice	27.144	13.092	7.744	852.054	-1413.823	-0.021
Dead+Wind 135 deg+Ice	27.144	10.689	10.952	1204.769	-1154.312	-0.017
Dead+Wind 150 deg+Ice	27.144	7.558	13.413	1475.366	-816.173	-0.012
Dead+Wind 180 deg+Ice	27.144	0.000	15.488	1703.446	0.000	0.000
Dead+Wind 210 deg+Ice	27.144	-7.558	13.413	1475.366	816.173	0.012
Dead+Wind 225 deg+Ice	27.144	-10.689	10.952	1204.769	1154.312	0.017
Dead+Wind 240 deg+Ice	27.144	-13.092	7.744	852.054	1413.823	0.021
Dead+Wind 270 deg+Ice	27.144	-15.117	0.000	0.347	1632.641	0.026
Dead+Wind 300 deg+Ice	27.144	-13.092	-7.744	-851.364	1413.827	0.023
Dead+Wind 315 deg+Ice	27.144	-10.689	-10.952	-1204.081	1154.317	0.020
Dead+Wind 330 deg+Ice	27.144	-7.558	-13.413	-1474.681	816.177	0.014
Dead+Wind 0 deg - Service	23.188	0.000	-7.570	-804.311	0.000	0.000
Dead+Wind 30 deg - Service	23.188	3.691	-6.556	-696.553	-384.477	-0.003
Dead+Wind 45 deg - Service	23.188	5.220	-5.353	-568.722	-543.739	-0.005
Dead+Wind 60 deg - Service	23.188	6.393	-3.785	-402.123	-665.950	-0.006
Dead+Wind 90 deg - Service	23.188	7.382	0.000	0.101	-768.979	-0.007
Dead+Wind 120 deg - Service	23.188	6.393	3.785	402.325	-665.950	-0.006
Dead+Wind 135 deg - Service	23.188	5.220	5.353	568.924	-543.739	-0.005
Dead+Wind 150 deg - Service	23.188	3.691	6.556	696.755	-384.476	-0.003
Dead+Wind 180 deg - Service	23.188	0.000	7.570	804.512	0.000	0.000
Dead+Wind 210 deg - Service	23.188	-3.691	6.556	696.755	384.476	0.003
Dead+Wind 225 deg - Service	23.188	-5.220	5.353	568.924	543.739	0.005
Dead+Wind 240 deg - Service	23.188	-6.393	3.785	402.325	665.950	0.006
Dead+Wind 270 deg - Service	23.188	-7.382	0.000	0.101	768.979	0.007
Dead+Wind 300 deg - Service	23.188	-6.393	-3.785	-402.123	665.950	0.006
Dead+Wind 315 deg - Service	23.188	-5.220	-5.353	-568.722	543.739	0.005
Dead+Wind 330 deg - Service	23.188	-3.691	-6.556	-696.553	384.477	0.003

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.000	-23.188	0.000	0.000	23.188	0.000	0.000%
2	0.000	-23.188	-19.380	0.000	23.188	19.380	0.000%
3	9.449	-23.188	-16.783	-9.449	23.188	16.783	0.000%
4	13.363	-23.188	-13.704	-13.363	23.188	13.704	0.000%
5	16.367	-23.188	-9.690	-16.367	23.188	9.690	0.000%
6	18.898	-23.188	0.000	-18.898	23.188	0.000	0.000%
7	16.367	-23.188	9.690	-16.367	23.188	-9.690	0.000%
8	13.363	-23.188	13.704	-13.363	23.188	-13.704	0.000%
9	9.449	-23.188	16.783	-9.449	23.188	-16.783	0.000%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
10	0.000	-23.188	19.380	0.000	23.188	-19.380	0.000%
11	-9.449	-23.188	16.783	9.449	23.188	-16.783	0.000%
12	-13.363	-23.188	13.704	13.363	23.188	-13.704	0.000%
13	-16.367	-23.188	9.690	16.367	23.188	-9.690	0.000%
14	-18.898	-23.188	0.000	18.898	23.188	0.000	0.000%
15	-16.367	-23.188	-9.690	16.367	23.188	9.690	0.000%
16	-13.363	-23.188	-13.704	13.363	23.188	13.704	0.000%
17	-9.449	-23.188	-16.783	9.449	23.188	16.783	0.000%
18	0.000	-27.144	0.000	0.000	27.144	0.000	0.000%
19	0.000	-27.144	-15.488	0.000	27.144	15.488	0.000%
20	7.558	-27.144	-13.413	-7.558	27.144	13.413	0.000%
21	10.689	-27.144	-10.952	-10.689	27.144	10.952	0.000%
22	13.092	-27.144	-7.744	-13.092	27.144	7.744	0.000%
23	15.117	-27.144	0.000	-15.117	27.144	0.000	0.000%
24	13.092	-27.144	7.744	-13.092	27.144	-7.744	0.000%
25	10.689	-27.144	10.952	-10.689	27.144	-10.952	0.000%
26	7.558	-27.144	13.413	-7.558	27.144	-13.413	0.000%
27	0.000	-27.144	15.488	0.000	27.144	-15.488	0.000%
28	-7.558	-27.144	13.413	7.558	27.144	-13.413	0.000%
29	-10.689	-27.144	10.952	10.689	27.144	-10.952	0.000%
30	-13.092	-27.144	7.744	13.092	27.144	-7.744	0.000%
31	-15.117	-27.144	0.000	15.117	27.144	0.000	0.000%
32	-13.092	-27.144	-7.744	13.092	27.144	7.744	0.000%
33	-10.689	-27.144	-10.952	10.689	27.144	10.952	0.000%
34	-7.558	-27.144	-13.413	7.558	27.144	13.413	0.000%
35	0.000	-23.188	-7.570	0.000	23.188	7.570	0.000%
36	3.691	-23.188	-6.556	-3.691	23.188	6.556	0.000%
37	5.220	-23.188	-5.353	-5.220	23.188	5.353	0.000%
38	6.393	-23.188	-3.785	-6.393	23.188	3.785	0.000%
39	7.382	-23.188	0.000	-7.382	23.188	0.000	0.000%
40	6.393	-23.188	3.785	-6.393	23.188	-3.785	0.000%
41	5.220	-23.188	5.353	-5.220	23.188	-5.353	0.000%
42	3.691	-23.188	6.556	-3.691	23.188	-6.556	0.000%
43	0.000	-23.188	7.570	0.000	23.188	-7.570	0.000%
44	-3.691	-23.188	6.556	3.691	23.188	-6.556	0.000%
45	-5.220	-23.188	5.353	5.220	23.188	-5.353	0.000%
46	-6.393	-23.188	3.785	6.393	23.188	-3.785	0.000%
47	-7.382	-23.188	0.000	7.382	23.188	0.000	0.000%
48	-6.393	-23.188	-3.785	6.393	23.188	3.785	0.000%
49	-5.220	-23.188	-5.353	5.220	23.188	5.353	0.000%
50	-3.691	-23.188	-6.556	3.691	23.188	6.556	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	0.00074952
3	Yes	6	0.00000001	0.00005172
4	Yes	6	0.00000001	0.00005248
5	Yes	6	0.00000001	0.00005125
6	Yes	4	0.00000001	0.00073690
7	Yes	6	0.00000001	0.00005119
8	Yes	6	0.00000001	0.00005248
9	Yes	6	0.00000001	0.00005175
10	Yes	4	0.00000001	0.00074920

11	Yes	6	0.00000001	0.00005175
12	Yes	6	0.00000001	0.00005248
13	Yes	6	0.00000001	0.00005119
14	Yes	4	0.00000001	0.00073690
15	Yes	6	0.00000001	0.00005125
16	Yes	6	0.00000001	0.00005248
17	Yes	6	0.00000001	0.00005172
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00000758
20	Yes	6	0.00000001	0.00012039
21	Yes	6	0.00000001	0.00012992
22	Yes	6	0.00000001	0.00011851
23	Yes	5	0.00000001	0.00000760
24	Yes	6	0.00000001	0.00011841
25	Yes	6	0.00000001	0.00013003
26	Yes	6	0.00000001	0.00012060
27	Yes	5	0.00000001	0.00000757
28	Yes	6	0.00000001	0.00012060
29	Yes	6	0.00000001	0.00013003
30	Yes	6	0.00000001	0.00011841
31	Yes	5	0.00000001	0.00000760
32	Yes	6	0.00000001	0.00011851
33	Yes	6	0.00000001	0.00012992
34	Yes	6	0.00000001	0.00012039
35	Yes	4	0.00000001	0.00024629
36	Yes	5	0.00000001	0.00016679
37	Yes	5	0.00000001	0.00018790
38	Yes	5	0.00000001	0.00016158
39	Yes	4	0.00000001	0.00022165
40	Yes	5	0.00000001	0.00016158
41	Yes	5	0.00000001	0.00018819
42	Yes	5	0.00000001	0.00016719
43	Yes	4	0.00000001	0.00024654
44	Yes	5	0.00000001	0.00016719
45	Yes	5	0.00000001	0.00018819
46	Yes	5	0.00000001	0.00016158
47	Yes	4	0.00000001	0.00022165
48	Yes	5	0.00000001	0.00016158
49	Yes	5	0.00000001	0.00018790
50	Yes	5	0.00000001	0.00016679

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	180 - 131	67.901	43	3.550	0.002
L2	135 - 86.167	37.263	43	2.757	0.001
L3	91 - 42.333	16.345	43	1.730	0.000
L4	48 - 0	4.508	43	0.863	0.000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
179.000	LPA-80080/4CF	43	67.176	3.533	0.002	18426

Maximum Tower Deflections - Design Wind

Section No.	Elevation	Horz. Deflection	Gov. Load Comb.	Tilt	Twist
	ft	in		°	°
L1	180 - 131	172.609	10	9.026	0.009
L2	135 - 86.167	94.891	10	7.021	0.003
L3	91 - 42.333	41.681	10	4.410	0.001
L4	48 - 0	11.506	10	2.203	0.000

Critical Deflections and Radius of Curvature - Design Wind

Elevation	Appurtenance	Gov. Load Comb.	Deflection	Tilt	Twist	Radius of Curvature
ft			in	°	°	ft
179.000	LPA-80080/4CF	10	170.771	8.986	0.009	7539

Compression Checks

Pole Design Data

Section No.	Elevation	Size	L	L_u	Kl/r	F_a	A	Actual P	Allow. P_a	Ratio $\frac{P}{P_a}$
	ft		ft	ft		ksi	in^2	K	K	
L1	180 - 131 (1)	TP23.22x14.89x0.219	49.000	0.000	0.0	39.000	15.740	-2.793	613.873	0.005
L2	131 - 86.167 (2)	TP30.41x22.102x0.281	48.833	0.000	0.0	39.000	26.517	-7.036	1034.180	0.007
L3	86.167 - 42.333 (3)	TP37.29x29.026x0.344	48.667	0.000	0.0	39.000	39.858	-13.519	1554.480	0.009
L4	42.333 - 0 (4)	TP43.8x35.64x0.375	48.000	0.000	0.0	39.000	52.436	-23.170	2044.990	0.011

Pole Bending Design Data

Section No.	Elevation	Size	Actual M_x	Actual f_{bx}	Allow. F_{bx}	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y	Actual f_{by}	Allow. F_{by}	Ratio $\frac{f_{by}}{F_{by}}$
	ft		kip-ft	ksi	ksi		kip-ft	ksi	ksi	
L1	180 - 131 (1)	TP23.22x14.89x0.219	242.216	33.903	39.000	0.869	0.000	0.000	39.000	0.000
L2	131 - 86.167 (2)	TP30.41x22.102x0.281	647.867	40.988	39.000	1.051	0.000	0.000	39.000	0.000
L3	86.167 - 42.333 (3)	TP37.29x29.026x0.344	1220.325	41.832	39.000	1.073	0.000	0.000	39.000	0.000

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 $\frac{f_{by}}{F_{by}}$
L4	42.333 - 0 (4)	TP43.8x35.64x0.375	2054.392	44.318	39.000	1.136	0.000	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	180 - 131 (1)	TP23.22x14.89x0.219	7.238	0.460	26.000	0.036	0.000	0.000	26.000	0.000
L2	131 - 86.167 (2)	TP30.41x22.102x0.281	11.252	0.424	26.000	0.033	0.000	0.000	26.000	0.000
L3	86.167 - 42.333 (3)	TP37.29x29.026x0.344	15.319	0.384	26.000	0.030	0.000	0.000	26.000	0.000
L4	42.333 - 0 (4)	TP43.8x35.64x0.375	19.401	0.370	26.000	0.029	0.000	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	180 - 131 (1)	0.005	0.869	0.000	0.036	0.000	0.874 ✔	1.333	H1-3+VT ✔
L2	131 - 86.167 (2)	0.007	1.051	0.000	0.033	0.000	1.058 ✔	1.333	H1-3+VT ✔
L3	86.167 - 42.333 (3)	0.009	1.073	0.000	0.030	0.000	1.082 ✔	1.333	H1-3+VT ✔
L4	42.333 - 0 (4)	0.011	1.136	0.000	0.029	0.000	1.148 ✔	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	180 - 131	Pole	TP23.22x14.89x0.219	1	-2.793	818.293	65.6	Pass
L2	131 - 86.167	Pole	TP30.41x22.102x0.281	2	-7.036	1378.562	79.4	Pass
L3	86.167 - 42.333	Pole	TP37.29x29.026x0.344	3	-13.519	2072.122	81.1	Pass
L4	42.333 - 0	Pole	TP43.8x35.64x0.375	4	-23.170	2725.972	86.1	Pass
							Summary	
						Pole (L4)	86.1	Pass
						RATING =	**86.1**	**Pass**

Element Map

Section No.	Section Elevation ft	Component Type	Element List
L1	180.000-131.000	Pole	1
L2	131.000-86.167	Pole	2
L3	86.167-42.333	Pole	3
L4	42.333-0.000	Pole	4
			Total number of elements: 4

ANCHOR BOLT AND
BASE PLATE ANALYSIS

ANCHOR BOLT AND BASEPLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 2054 \cdot kips \cdot ft$	*user input*
Shear Force:	$Shear := 19.0 \cdot kips$	*user input*
Axial Force:	$Axial := 23.0 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts = N	$N := 12$	*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:	$l := 2.5in$	*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:	$PlateThicknessProvide := 2.625 \cdot in$	*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):

$d_1 := 25.92 \cdot in$ *user input*

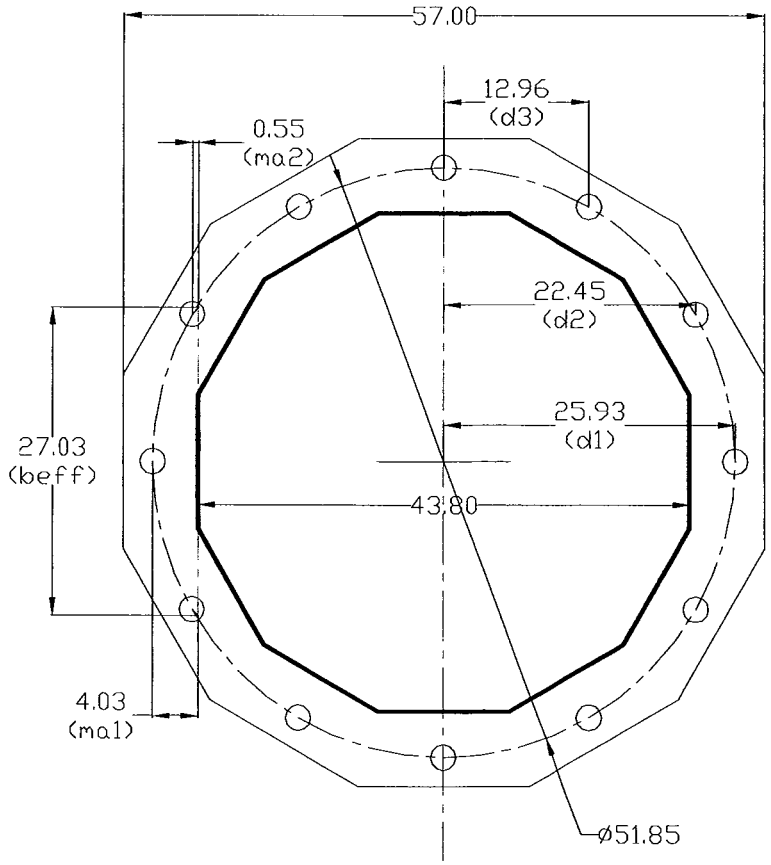
$d_2 := 22.45 \cdot in$ *user input*

$d_3 := 12.96 \cdot in$ *user input*

$MomentArm_1 := 4.03 \cdot in$ *user input*

$MomentArm_2 := 0.55 \cdot in$ *user input*

$EffectiveWidth := 27.03 \cdot in$ *user input*



DETAIL - ANCHOR BOLT AND PLATE

Anchor Bolt Section Properties:

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

$\Sigma d := (d_1)^2 \cdot 2 + (d_2)^2 \cdot 4 + (d_3)^2 \cdot 4$ $\quad \Sigma d = 4.03 \times 10^3 \cdot in^2$

Gross Area of Bolt:

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

Net Area of Bolt:

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

Net Diameter:

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

Radius of Gyration of Bolt:

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

Section Modulus of Bolt:

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

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$M_x := \left(\frac{Shear}{N} \right) \cdot l$ $\quad M_x = 0.33 \cdot kips \cdot ft$

$f_{bx} := \frac{M_x}{S_x}$ $\quad f_{bx} = 4.79 \cdot ksi$

Allowable Bending

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

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:

$$MaxTension := \frac{OM \cdot d_1}{\Sigma d} - \frac{Axial}{N} \qquad MaxTension = 156.55 \cdot kips$$

Check Stresses:

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

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

$AnchorBoltStress = "Not Overstressed"$

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

$PercentStressed = 80.4$

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:

$$MaxCompression := \frac{OM \cdot d_l}{\Sigma d} + \frac{Axial}{N} \qquad MaxCompression = 160.39 \cdot kips$$

$$f_a := \frac{MaxCompression}{A_{net}} \qquad f_a = 49.38 \cdot ksi$$

Check Combined Stresses:

$$StressRatio := \frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \qquad StressRatio = 0.82$$

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

Condition = "Not Overstressed"

Base Plate Analysis:

Force From Bolt(s):

$$C_1 := \frac{OM \cdot d_1}{\Sigma d} + \frac{Axial}{N} \qquad C_1 = 160.39 \cdot kips$$

$$C_2 := \frac{OM \cdot d_2}{\Sigma d} + \frac{Axial}{N} \qquad C_2 = 139.17 \cdot kips$$

Bending Stress In Plate:

$$f_{bp} := \frac{6 \cdot \left(C_1 \cdot MomentArm_1 + 2C_2 \cdot MomentArm_2\right)}{EffectiveWidth \cdot PlateThicknessProvide^2} \qquad f_{bp} = 44.21 \cdot ksi$$

Check Stresses:

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

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

BasePlateStress = "Not Over Stress"

FOUNDATION ANALYSIS

URS

Job	180' Valmont Monopole - Plymouth, CT	Project No.	VZ4-034	Page / Sheet	of / 1 of 2
Description	Caisson Foundation Evaluation	Computed by	JRM	Date	01/16/08
		Checked by		Date	

Check Foundation Depth TIA/EIA-222-F 7.2.5

Shear Force:	$S := 19.0k$		*USER INPUT*
Overturning Moment:	$M := 2054ft \cdot k$		*USER INPUT*
Foundation Diameter:	$d := 5.5ft$		*USER INPUT*
Overall Length of Caisson:	$L_c := 14.25ft$		*USER INPUT*
Depth From Top of Caisson to Grade:	$L_{pag} := 1.0ft$		*USER INPUT*
Depth of Caisson Below Ground Level:	$LD := L_c - L_{pag}$	$LD = 13.2\,ft$	*USER INPUT*

Depth Required:

$$LD1 := 2.0ft + \left(\frac{S \cdot ft^2}{3k \cdot d}\right) + 2ft^{.5}\left(\frac{M \cdot ft}{3 \cdot kd} + \frac{S \cdot ft}{2k} + \frac{S^2 ft^3}{18k^2 d^2}\right)^{.5} \qquad LD1 = 26.4\,ft$$

$DepthCheck := if(LD1 \le LD, "OK", "NO GOOD")$ $DepthCheck = "NO\ GOOD"$

Note: Result not applicable. Actual soil is better than normal soil as defined in TIA/EIA 222 F. Refer to L-Pile analysis.

Moment Capacity:

Bending Moment:	$Mu := 2075.7ft \cdot k$	*USER INPUT--FROM LPILE*
Moment Capacity:	$Mn := 4107.5ft \cdot k$	*USER INPUT--FROM LPILE*
Factor of Safety:	$FS := \frac{Mn}{Mu}$ $FS = 2.0$	
Factor of Safety Required	$FS_{reqd} := 1.3$ $FOSCheck := if(FS \ge FS_{reqd}, "OK", "NO\ GOOD")$ $FOSCheck = "OK"$	
Factor of Safety Ratio:	$FS_{ratio} := \left(\frac{FS_{reqd}}{FS}\right) = 0.66$	

Axial Capacity:

Applied Axial Load: $A1 := 23.0k$ *USER INPUT*

Concrete Weight: $A2 := .150\frac{k}{ft^3} \cdot LD \cdot \Sigma\frac{d^2}{4}$ $A2 = 47.2 \cdot k$

Total Axial Load: $AT := A1 + A2$ $AT = 70.2 \cdot k$

Number of Rebar: $n := 20$ *USER INPUT*

Area of Rebar: $Ar := 1.560in^2$ *USER INPUT* #11

Rebar Yield Strength: $fy := 60ksi$ *USER INPUT*

Area of Concrete: $Ag := \Sigma\frac{d^2}{4}$

Concrete Comp Strength: $f'c := 3ksi$ *USER INPUT*

Axial Capacity: $Po := n \cdot Ar \cdot fy + (Ag - n \cdot Ar) \cdot 0.85 \cdot f'c$ $Po = 10516.5 \cdot k$

$AxialCheck := if(AT \le Po, "OK", "NO GOOD")$ $AxialCheck = "OK"$

==========

LPILE Plus for Windows, Version 4

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==========

This program is licensed to:

J Mead

URS

Name of input data file: P:\08\MathCAD\Drilled Foundation.lpd
Name of output file: P:\08\MathCAD\Drilled Foundation.lpo
Name of plot output file: P:\08\MathCAD\Drilled Foundation.lpp
Name of runtime file: P:\08\MathCAD\Drilled Foundation.lpr

Time and Date of Analysis

Date: January 16, 2008 Time: 15:35:54

Problem Title

180' Monopole - Plymouth, CT

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 3:
- Computations of Ultimate Bending Moment Capacity and Pile Response Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Deflection tolerance for closure = 1.0000E-05 in
- Maximum number of iterations allowed = 100
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 171.00 in
Depth of ground surface below top of pile = 12.00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	.000	66.000	9.3142E+05	3.4212E+03	3.1200E+06
2	171.000	66.000	9.3142E+05	3.4212E+03	3.1200E+06

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is soft rock (vuggy limestone)
Distance from top of pile to top of layer = 12.000 in
Distance from top of pile to bottom of layer = 300.000 in

(Depth of lowest layer extends 129.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 2 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07800
2	300.00	.07800

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 2 points

Point	Depth X	Cohesion c	Angle of Friction	E50/k_rm	RQD

No.	in	lbs/in**2	Deg.	%	
1	.000	3280.00000	.00	------	------
2	300.000	3280.00000	.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) E50 is reported for clay strata.
(3) k_rm is reported for rock strata.
(4) RQD is input and reported only for rock materials.
(5) Internal default values for E50 will be generated when input value is 0.

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 19000.000 lbs
Bending moment at pile head = 24648000.000 in-lbs
Axial load at pile head = 23000.000 lbs

(Non-zero moment for this load indicates pile-head is free to rotate
under the applied pile-head load)

Computations of Ultimate Moment Capacity and Nonlinear Bending Stiffness

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Pile Description:

The pile shape is a circular solid pile.

Outside Diameter = 66.000 In

Drilled Foundation.lpo

Material Properties:

Compressive Strength of Concrete = 3. Kip/In**2
Yield stress for rebar = 60. Kip/In**2
Modulus of elasticity of steel = 29000. Kip/In**2
Number of reinforcing bars = 20
Area of single rebar = 1.56000 In**2
Number of rows of reinforcing bars = 11
Cover Thickness = 4.000 In

Ultimate squash load capacity = 10516.49 Kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement In**2	Distance to Centroidal Axis In
1	1.560000	29.0000
2	3.120000	27.5806
3	3.120000	23.4615
4	3.120000	17.0458
5	3.120000	8.9615
6	3.120000	.0000
7	3.120000	-8.9615
8	3.120000	-17.0458
9	3.120000	-23.4615
10	3.120000	-27.5806
11	1.560000	-29.0000

Axial Thrust Force = 23.000 Kip

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches
3.301E+06	3.301E+12	.00000100	.00003512	35.116
4.236E+06	8.471E+11	.00000500	.00009239	18.478
7.300E+06	8.111E+11	.00000900	.00016100	17.889
1.034E+07	7.957E+11	.00001300	.00023008	17.699
1.337E+07	7.864E+11	.00001700	.00029966	17.627
1.637E+07	7.797E+11	.00002100	.00036974	17.607
1.936E+07	7.742E+11	.00002500	.00044036	17.614
2.232E+07	7.695E+11	.00002900	.00051151	17.638

2.525E+07	7.653E+11	.00003300	.00058325	17.674
2.817E+07	7.613E+11	.00003700	.00065559	17.719
3.106E+07	7.575E+11	.00004100	.00072855	17.770
3.392E+07	7.539E+11	.00004500	.00080218	17.826
3.648E+07	7.444E+11	.00004900	.00087401	17.837
3.826E+07	7.219E+11	.00005300	.00093981	17.732
4.452E+07	5.363E+11	.00008300	.00136951	16.500
4.674E+07	4.137E+11	.00011300	.00174721	15.462
4.778E+07	3.341E+11	.00014300	.00210451	14.717
4.854E+07	2.806E+11	.00017300	.00247253	14.292
4.920E+07	2.424E+11	.00020300	.00282545	13.918
4.936E+07	2.119E+11	.00023300	.00315349	13.534
4.948E+07	1.882E+11	.00026300	.00348674	13.258
4.953E+07	1.689E+11	.00029300	.00386758	13.200

Ultimate moment capacity at concrete strain of 0.003 = 4.929E+07 In-lb

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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 19000.000 lbs
Specified bending moment at pile head = 24648000.000 in-lbs
Specified axial load at pile head = 23000.000 lbs

(Non-zero moment for this load does not indicate free-head conditions)

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res p lbs/in
0.000	.031412	2.46E+07	19000.0	-.001425	880.0	7.66E+11	0.000
1.710	.029023	2.47E+07	19000.0	-.001369	881.1	7.66E+11	0.000
3.420	.026728	2.47E+07	19000.0	-.001314	882.3	7.66E+11	0.000
5.130	.024528	2.47E+07	19000.0	-.001259	883.5	7.66E+11	0.000
6.840	.022422	2.48E+07	19000.0	-.001204	884.6	7.66E+11	0.000
8.550	.020411	2.48E+07	19000.0	-.001149	885.8	7.66E+11	0.000
10.260	.018494	2.48E+07	19000.0	-.001093	886.9	7.66E+11	0.000
11.970	.016672	2.49E+07	19000.0	-.001038	888.1	7.66E+11	0.000
13.680	.014946	2.49E+07	-22913.7	-9.82E-04	889.2	7.66E+11	-49021.813

15.390	.013314	2.48E+07	-102165.1	-9.27E-04	885.3	7.66E+11	-43669.936
17.100	.011777	2.46E+07	-172530.3	-8.71E-04	876.8	7.66E+11	-38628.563
18.810	.010334	2.42E+07	-234537.6	-8.17E-04	864.4	7.67E+11	-33894.568
20.520	.008983	2.38E+07	-288708.6	-7.64E-04	848.4	7.67E+11	-29463.353
22.230	.007722	2.32E+07	-335556.1	-7.11E-04	829.4	7.68E+11	-25329.029
23.940	.006550	2.26E+07	-375581.7	-6.60E-04	807.8	7.69E+11	-21484.598
25.650	.005464	2.19E+07	-409274.5	-6.11E-04	783.9	7.70E+11	-17922.108
27.360	.004461	2.12E+07	-437108.9	-5.63E-04	758.2	7.71E+11	-14632.796
29.070	.003539	2.04E+07	-459544.1	-5.17E-04	730.9	7.73E+11	-11607.225
30.780	.002694	1.96E+07	-477022.6	-4.72E-04	702.5	7.74E+11	-8835.432
32.490	.001923	1.88E+07	-489969.4	-4.30E-04	673.1	7.75E+11	-6307.049
34.200	.001223	1.80E+07	-498791.7	-3.90E-04	643.1	7.77E+11	-4011.372
35.910	5.91E-04	1.71E+07	-503878.0	-3.51E-04	612.7	7.78E+11	-1937.481
37.620	2.27E-05	1.62E+07	-505598.1	-3.14E-04	582.1	7.80E+11	-74.347
39.330	-4.84E-04	1.54E+07	-504303.0	-2.80E-04	551.4	7.82E+11	1589.098
41.040	-9.34E-04	1.45E+07	-500324.6	-2.47E-04	521.0	7.84E+11	3063.958
42.750	-.001330	1.37E+07	-493976.1	-2.16E-04	490.8	7.86E+11	4361.219
44.460	-.001674	1.28E+07	-485551.8	-1.88E-04	461.1	7.88E+11	5491.703
46.170	-.001971	1.20E+07	-475327.9	-1.61E-04	432.0	7.91E+11	6466.104
47.880	-.002224	1.12E+07	-463562.2	-1.36E-04	403.5	7.93E+11	7294.897
49.590	-.002435	1.04E+07	-450495.1	-1.12E-04	375.8	7.95E+11	7988.250
51.300	-.002609	9.66E+06	-436349.8	-9.09E-05	348.9	7.99E+11	8556.001
53.010	-.002746	8.93E+06	-421332.7	-7.11E-05	322.9	8.03E+11	9007.832
54.720	-.002852	8.22E+06	-405634.2	-5.28E-05	297.9	8.06E+11	9353.040
56.430	-.002927	7.54E+06	-389428.9	-3.62E-05	273.8	8.10E+11	9600.511
58.140	-.002975	6.89E+06	-372876.8	-2.10E-05	250.7	8.16E+11	9758.709
59.850	-.002999	6.26E+06	-356123.3	-7.27E-06	228.6	8.23E+11	9835.958
61.560	-.003000	5.67E+06	-339300.2	5.07E-06	207.5	8.30E+11	9840.239
63.270	-.002981	5.10E+06	-322525.7	1.61E-05	187.5	8.37E+11	9779.038
64.980	-.002945	4.57E+06	-305905.9	2.60E-05	168.5	8.43E+11	9659.358
66.690	-.002893	4.06E+06	-289535.1	3.33E-05	150.4	1.30E+12	9487.751
68.400	-.002831	3.57E+06	-273483.4	3.71E-05	133.4	2.56E+12	9286.125
70.110	-.002766	3.12E+06	-257788.0	3.91E-05	117.3	3.30E+12	9071.102
71.820	-.002697	2.69E+06	-242468.0	4.07E-05	102.1	3.30E+12	8847.013
73.530	-.002627	2.29E+06	-227537.9	4.19E-05	87.9107	3.30E+12	8615.098
75.240	-.002554	1.92E+06	-213010.1	4.30E-05	74.5715	3.30E+12	8376.526
76.950	-.002479	1.56E+06	-198894.9	4.39E-05	62.1002	3.30E+12	8132.390
78.660	-.002404	1.23E+06	-185201.2	4.47E-05	50.4713	3.30E+12	7883.713
80.370	-.002327	929626.5	-171935.7	4.52E-05	39.6593	3.30E+12	7631.448
82.080	-.002249	646772.2	-159103.9	4.56E-05	29.6378	3.30E+12	7376.483
83.790	-.002171	385487.5	-146709.8	4.59E-05	20.3805	3.30E+12	7119.638
85.500	-.002092	145021.3	-134755.7	4.60E-05	11.8609	3.30E+12	6861.673
87.210	-.002013	-75380.7	-123243.2	4.60E-05	9.3935	3.30E+12	6603.287
88.920	-.001934	-276474.1	-112172.3	4.60E-05	16.5182	3.30E+12	6345.120
90.630	-.001856	-459013.6	-101542.2	4.58E-05	22.9856	3.30E+12	6087.757

92.340	-.001778	-623752.0	-91351.0	4.55E-05	28.8222	3.30E+12	5831.727
94.050	-.001700	-771437.7	-81596.1	4.51E-05	34.0547	3.30E+12	5577.509
95.760	-.001624	-902814.3	-72274.0	4.47E-05	38.7093	3.30E+12	5325.532
97.470	-.001548	-1.02E+06	-63380.6	4.42E-05	42.8122	3.30E+12	5076.179
99.180	-.001472	-1.12E+06	-54911.0	4.36E-05	46.3892	3.30E+12	4829.784
100.890	-.001398	-1.21E+06	-46859.9	4.30E-05	49.4659	3.30E+12	4586.643
102.600	-.001325	-1.28E+06	-39221.7	4.24E-05	52.0674	3.30E+12	4347.007
104.310	-.001253	-1.34E+06	-31990.0	4.17E-05	54.2185	3.30E+12	4111.089
106.020	-.001183	-1.39E+06	-25158.4	4.10E-05	55.9437	3.30E+12	3879.066
107.730	-.001113	-1.43E+06	-18720.1	4.03E-05	57.2670	3.30E+12	3651.079
109.440	-.001045	-1.45E+06	-12668.2	3.95E-05	58.2121	3.30E+12	3427.237
111.150	-9.78E-04	-1.47E+06	-6995.4	3.88E-05	58.8022	3.30E+12	3207.618
112.860	-9.12E-04	-1.48E+06	-1694.5	3.80E-05	59.0599	3.30E+12	2992.269
114.570	-8.48E-04	-1.48E+06	3241.9	3.72E-05	59.0076	3.30E+12	2781.212
116.280	-7.85E-04	-1.47E+06	7820.9	3.65E-05	58.6672	3.30E+12	2574.442
117.990	-7.23E-04	-1.45E+06	12050.1	3.57E-05	58.0600	3.30E+12	2371.932
119.700	-6.63E-04	-1.42E+06	15936.6	3.50E-05	57.2072	3.30E+12	2173.632
121.410	-6.03E-04	-1.39E+06	19487.5	3.43E-05	56.1291	3.30E+12	1979.472
123.120	-5.46E-04	-1.36E+06	22709.8	3.35E-05	54.8460	3.30E+12	1789.363
124.830	-4.89E-04	-1.32E+06	25610.5	3.29E-05	53.3774	3.30E+12	1603.201
126.540	-4.33E-04	-1.27E+06	28196.0	3.22E-05	51.7428	3.30E+12	1420.864
128.250	-3.79E-04	-1.22E+06	30473.0	3.15E-05	49.9610	3.30E+12	1242.220
129.960	-3.25E-04	-1.17E+06	32447.5	3.09E-05	48.0505	3.30E+12	1067.120
131.670	-2.73E-04	-1.11E+06	34125.4	3.03E-05	46.0295	3.30E+12	895.410
133.380	-2.22E-04	-1.05E+06	35512.5	2.98E-05	43.9156	3.30E+12	726.924
135.090	-1.71E-04	-987974.0	36614.1	2.92E-05	41.7265	3.30E+12	561.487
136.800	-1.22E-04	-924544.1	37435.3	2.87E-05	39.4792	3.30E+12	398.920
138.510	-7.29E-05	-859947.7	37980.7	2.83E-05	37.1906	3.30E+12	239.040
140.220	-2.49E-05	-794652.3	38254.9	2.79E-05	34.8772	3.30E+12	81.658
141.930	2.24E-05	-729118.1	38262.0	2.75E-05	32.5553	3.30E+12	-73.415
143.640	6.90E-05	-663798.6	38005.6	2.71E-05	30.2410	3.30E+12	-226.370
145.350	1.15E-04	-599141.0	37489.4	2.68E-05	27.9502	3.30E+12	-377.396
147.060	1.61E-04	-535586.9	36716.4	2.65E-05	25.6985	3.30E+12	-526.681
148.770	2.06E-04	-473572.9	35689.5	2.62E-05	23.5014	3.30E+12	-674.411
150.480	2.50E-04	-413530.9	34411.1	2.60E-05	21.3741	3.30E+12	-820.764
152.190	2.94E-04	-355888.9	32883.5	2.58E-05	19.3319	3.30E+12	-965.916
153.900	3.38E-04	-301071.3	31108.6	2.56E-05	17.3897	3.30E+12	-1110.034
155.610	3.82E-04	-249499.6	29087.9	2.55E-05	15.5625	3.30E+12	-1253.277
157.320	4.26E-04	-201592.6	26823.0	2.54E-05	13.8652	3.30E+12	-1395.796
159.030	4.69E-04	-157767.0	24314.8	2.53E-05	12.3125	3.30E+12	-1537.728
160.740	5.12E-04	-118437.9	21564.3	2.52E-05	10.9190	3.30E+12	-1679.203
162.450	5.55E-04	-84018.9	18572.2	2.51E-05	9.6996	3.30E+12	-1820.333
164.160	5.98E-04	-54922.8	15339.0	2.51E-05	8.6687	3.30E+12	-1961.219
165.870	6.41E-04	-31561.4	11865.0	2.51E-05	7.8410	3.30E+12	-2101.945
167.580	6.84E-04	-14346.4	8150.4	2.51E-05	7.2311	3.30E+12	-2242.580

169.290	7.27E-04	-3688.9	4195.4	2.51E-05	6.8535	3.30E+12	-2383.173
171.000	7.69E-04	0.0	0.0	2.51E-05	6.7228	3.30E+12	-2523.756

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = .0314 in
Computed slope at pile head = -1.4245E-03
Maximum bending moment = 24908298.726 lbs-in
Maximum shear force = -505598.070 lbs
Depth of maximum bending moment = 13.680 in
Depth of maximum shear force = 37.620 in
Number of iterations = 7
Number of zero deflection points = 2

Summary of Pile-head Response

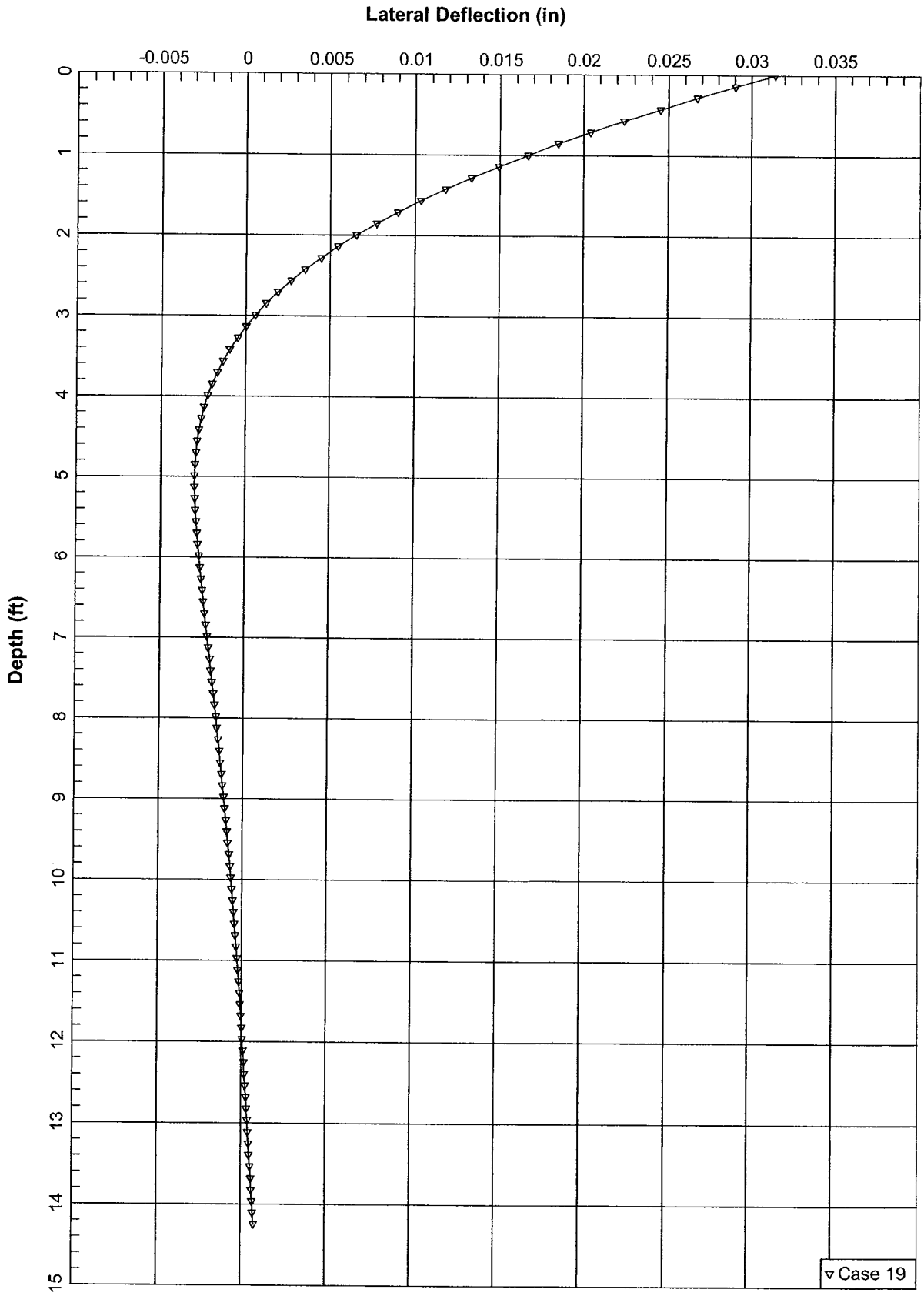
Definition of symbols for pile-head boundary conditions:

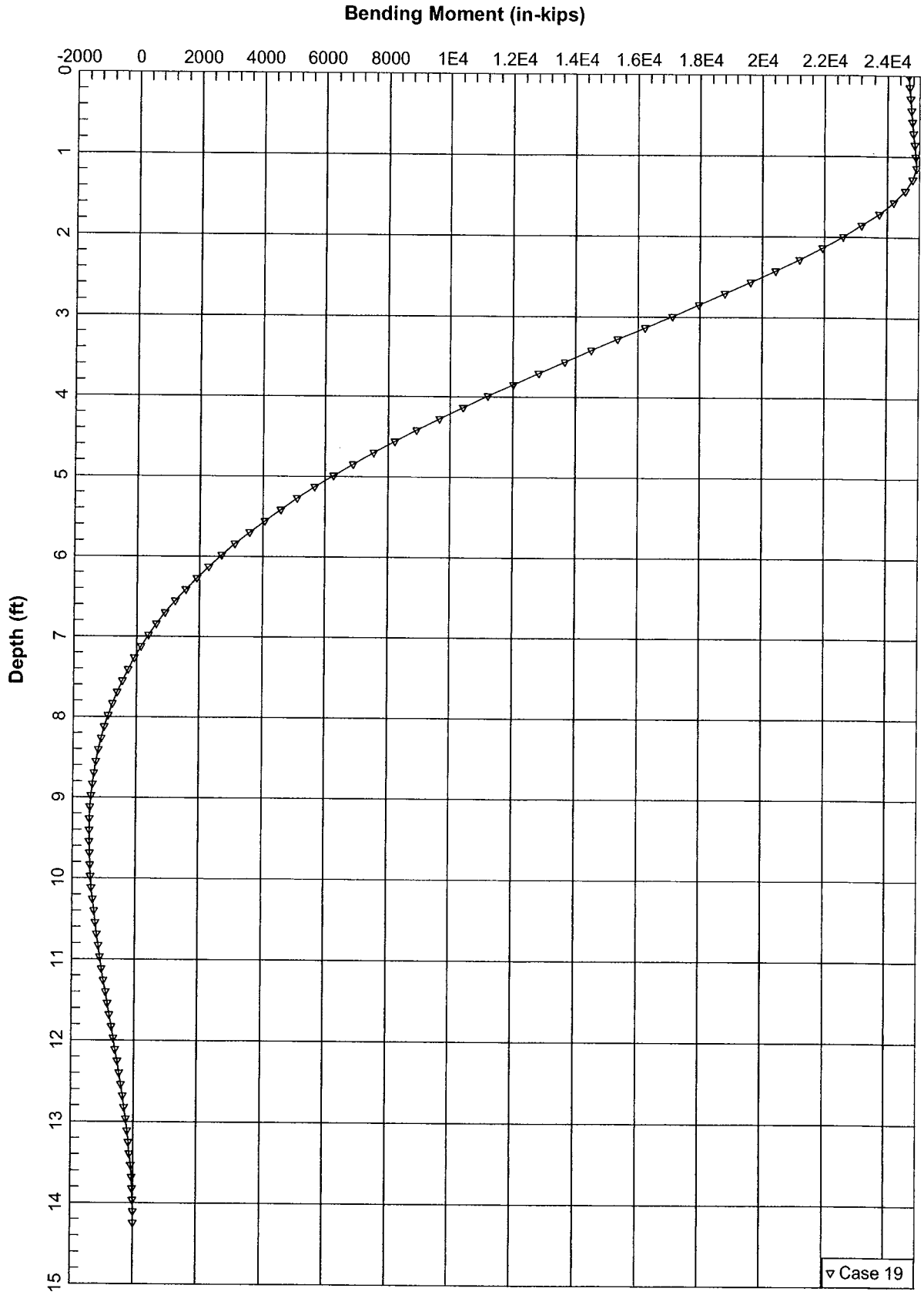
y = pile-head displacment, in
M = pile-head moment, lbs-in
V = pile-head shear force, lbs
S = pile-head slope, radians
R = rotational stiffness of pile-head, in-lbs/rad

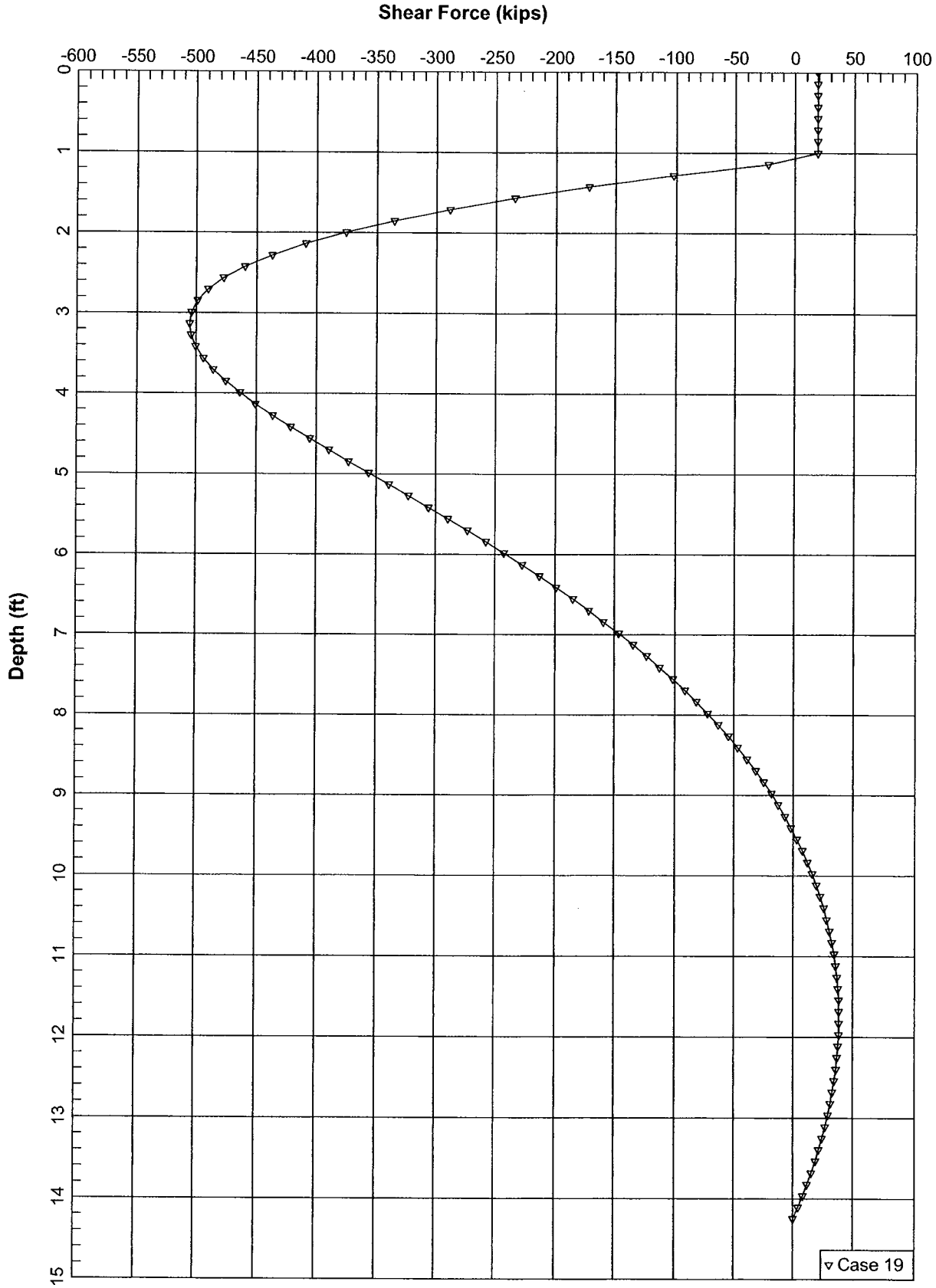
BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load lbs	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs

1 V= 19000.000 M= 2.46E+07 23000.0000 .031412 2.491E+07 -5.056E+05

The analysis ended normally.


Lateral Deflection (in)
-0.005
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Case 19


Bending Moment (in-kips)
-2000
0
2000
4000
6000
8000
1E4
1.2E4
1.4E4
1.6E4
1.8E4
2E4
2.2E4
2.4E4
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Case 19


Shear Force (kips)
-600
-550
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Case 19