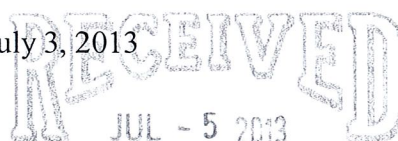


280 Trumbull Street  
Hartford, CT 06103-3597  
Main (860) 275-8200  
Fax (860) 275-8299  
kbaldwin@rc.com  
Direct (860) 275-8345

Also admitted in Massachusetts

July 3, 2013



CONNECTICUT  
SITING COUNCIL

Melanie Bachman  
Acting Executive Director  
Connecticut Siting Council  
10 Franklin Square  
New Britain, CT 06051

Re: **EM-VER-098-120306- 399 Greenwood Road, Norfolk, Connecticut**  
**EM-VER-100-120416- 38 Lower Road, North Canaan, Connecticut**  
**EM-VER-098-120229- 10 Aspohtag Road, Norfolk, Connecticut**  
**EM-VER-120-120214- 35 Lower County Road, Roxbury, Connecticut**  
**EM-VER-122-120430- 52 Library Street, Salisbury, Connecticut**  
**EM-VER-141-121206- 61 Lowell Davis Road, Thompson, Connecticut**  
**EM-VER-143-120214- Burr Mountain Road, Torrington, Connecticut**  
**EM-VER-162-120430- 15 Oakdale Avenue, Winchester, Connecticut**  
**EM-VER-168-120216- 186 Minortown Road, Woodbury, Connecticut**

### Completion of Construction Activity

Dear Ms. Bachman:

The purpose of this letter is to notify the Siting Council that construction activity associated with the above-referenced Cellco Partnership d/b/a Verizon Wireless telecommunications facilities has been completed.

If you have any questions or need any additional information regarding this facility please do not hesitate to contact me.

Sincerely,

Kenneth C. Baldwin

Copy to:  
Sandy M. Carter



*Law Offices*

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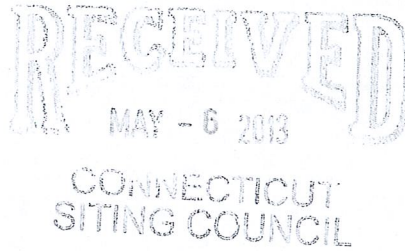
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kbaldwin@rc.com  
Direct (860) 275-8345

Also admitted in Massachusetts



May 3 2013

Melanie A. Bachman  
Acting Executive Director  
Connecticut Siting Council  
10 Franklin Square  
New Britain, CT 06051

Re: **EM-VER-096-120216A – 399 Chestnut Lane, New Milford, Connecticut**  
**EM-VER-098-120306 – 599 Greenwood Road, Norfolk, Connecticut**  
**EM-VER-100-120416 – 38 Lower Road, North Canaan, Connecticut**  
**EM-VER-120-120214 – 38 Lower County Road, Roxbury, Connecticut**  
**EM-VER-122-120430 – 52 Library Street, Salisbury, Connecticut**  
**EM-VER-130-111202 – Old Waterbury Road, Southbury, Connecticut**  
**EM-VER-139-120202A – 2175 Mountain Road, Suffield, Connecticut**

**Completion of Construction Activity**

Dear Ms. Bachman:

The purpose of this letter is to notify the Siting Council that construction activity associated with the above-referenced Cellco Partnership d/b/a Verizon Wireless telecommunications facilities has been completed.

If you have any questions or need any additional information regarding this facility please do not hesitate to contact me.

Sincerely,

Kenneth C. Baldwin

Copy to:  
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# 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](mailto:siting.council@ct.gov)

[www.ct.gov/csc](http://www.ct.gov/csc)

March 23, 2012

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

RE: **EM-VER-098-120306** - Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 599 Greenwoods Road East, Norfolk, 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 following conditions:

- Any deviation from the proposed modification as specified in this notice and supporting materials with Council shall render this acknowledgement invalid;
- Any material changes to this modification as proposed shall require the filing of a new notice with the Council;
- Not less than 45 days after completion of construction, the Council shall be notified in writing that construction has been completed;
- The validity of this action shall expire one year from the date of this letter; and
- The applicant may file a request for an extension of time beyond the one year deadline provided that such request is submitted to the Council not less than 60 days prior to the expiration;

The proposed modifications including the placement of all necessary equipment and shelters within the tower compound are to be implemented as specified here and in your notice dated March 5, 2012. 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. Thank you for your attention and cooperation.

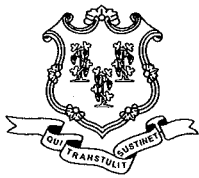
Very truly yours,

Linda Roberts  
Executive Director

LR/CDM/laf

c: The Honorable Susan M. Dyer, First Selectman, Town of Norfolk  
Michael Halloran, Planning & Zoning Official, Town of Norfolk  
Message Center Management





# 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](mailto:siting.council@ct.gov)

[www.ct.gov/csc](http://www.ct.gov/csc)

March 7, 2012

The Honorable Susan M. Dyer  
First Selectman  
Town of Norfolk  
19 Maple Avenue  
P. O. Box 552  
Norfolk, CT 06058

RE: **EM-VER-098-120306** - Cellco Partnership d/b/a Verizon Wireless notice of intent to modify an existing telecommunications facility located at 599 Greenwoods Road East, Norfolk, Connecticut.

Dear First Selectman Dyer:

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

If you have any questions or comments regarding this proposal, please call me or inform the Council by March 21, 2012.

Thank you for your cooperation and consideration.

Very truly yours,

Linda Roberts  
Executive Director

LR/jbw

Enclosure: Notice of Intent

c: Michael Halloran, Planning & Zoning Official, Town of Norfolk



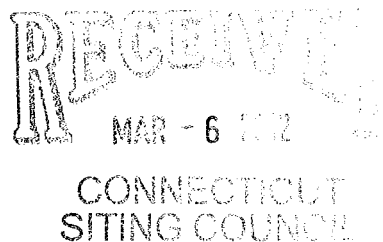
## ROBINSON &amp; COLE

KENNETH C. BALDWIN

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

March 5, 2012

Linda Roberts  
 Executive Director  
 Connecticut Siting Council  
 10 Franklin Square  
 New Britain, CT 06051



Re: **Notice of Exempt Modification – Antenna Swap**  
**599 Greenwoods Road East, Norfolk, Connecticut**

Dear Ms. Roberts:

Cellco Partnership d/b/a Verizon Wireless (“Cellco”) currently maintains twelve (12) wireless telecommunications antennas at the 160-foot level on an existing 180-foot tower at the above-referenced address. The tower is owned by Message Center Management. Cellco’s use of the tower was approved by the Council in 2007 (Docket No. 320). Cellco now intends to replace six (6) of its existing antennas with three (3) model BXA-171085-12BF PCS antennas; two (2) model BXA-70080-6CF LTE antennas; and one (1) model APX75-868011-CT0 LTE antenna, all at the same 160-foot level. Cellco also intends to install six (6) coax cable diplexers to its existing antenna platform. Attached behind Tab 1 are the specifications for the replacement antennas and cable diplexers.

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 Susan M. Dyer, First Selectwoman of the Town of Norfolk. The Town of Norfolk is the owner 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 an increase in the height of the existing tower. Cellco’s replacement antennas and diplexers will be located at the 160-foot level on the existing 180-foot tower.



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# ROBINSON & COLE<sub>LLP</sub>

Linda Roberts  
March 5, 2012  
Page 2

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

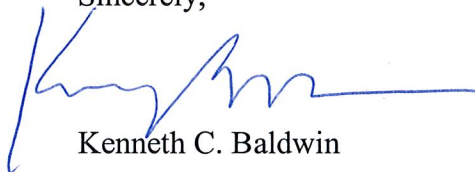
3. The proposed modifications will not increase noise levels at the facility by six decibels or more.

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

Also attached is a Detailed Structural Analysis confirming that the tower and foundation can support Cellco's 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:

Susan M. Dyer, Norfolk First Selectwoman  
Sandy M. Carter





## BXA-171085-12BF-EDIN-X

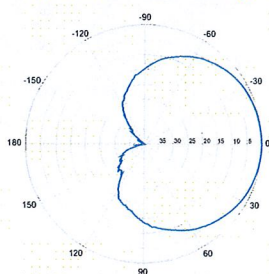
Replace "X" with desired electrical downtilt.

X-Pol | FET Panel | 85° | 18.0 dBi

| Electrical Characteristics              | 1710-2170 MHz                                                   |                                                      |                     |
|-----------------------------------------|-----------------------------------------------------------------|------------------------------------------------------|---------------------|
|                                         | 1710-1880 MHz                                                   | 1850-1990 MHz                                        | 1920-2170 MHz       |
| Frequency bands                         | 1710-1880 MHz                                                   | 1850-1990 MHz                                        | 1920-2170 MHz       |
| Polarization                            | ±45°                                                            | ±45°                                                 | ±45°                |
| Horizontal beamwidth                    | 88°                                                             | 85°                                                  | 80°                 |
| Vertical beamwidth                      | 4.5°                                                            | 4.5°                                                 | 4.5°                |
| Gain                                    | 15.1 dBd / 17.2 dBi                                             | 15.5 dBd / 17.6 dBi                                  | 15.9 dBd / 18.0 dBi |
| Electrical downtilt (X)                 | 0, 2, 4                                                         |                                                      |                     |
| Impedance                               | 50Ω                                                             |                                                      |                     |
| VSWR                                    | ≤1.5:1                                                          |                                                      |                     |
| First upper sidelobe                    | < -17 dB                                                        |                                                      |                     |
| Front-to-back ratio                     | > 30 dB                                                         |                                                      |                     |
| In-band isolation                       | > 28 dB                                                         |                                                      |                     |
| IM3 (20W carrier)                       | < -150 dBc                                                      |                                                      |                     |
| Input power                             | 300 W                                                           |                                                      |                     |
| Lightning protection                    | Direct Ground                                                   |                                                      |                     |
| Connector(s)                            | 2 Ports / EDIN / Female / Bottom                                |                                                      |                     |
| Operating temperature                   | -40° to +60° C / -40° to +140° F                                |                                                      |                     |
| Mechanical Characteristics              |                                                                 |                                                      |                     |
|                                         | 1710-1880 MHz                                                   |                                                      | 1920-2170 MHz       |
| Dimensions Length x Width x Depth       | 1820 x 154 x 105 mm                                             |                                                      | 71.7 x 6.1 x 4.1 in |
| Depth with z-brackets                   | 133 mm                                                          |                                                      | 5.2 in              |
| Weight without mounting brackets        | 6.8 kg                                                          |                                                      | 15 lbs              |
| Survival wind speed                     | > 201 km/hr                                                     |                                                      | > 125 mph           |
| Wind area                               | Front: 0.28 m <sup>2</sup> Side: 0.19 m <sup>2</sup>            | Front: 3.1 ft <sup>2</sup> Side: 2.1 ft <sup>2</sup> |                     |
| Wind load @ 161 km/hr (100 mph)         | Front: 460 N Side: 304 N                                        | Front: 103 lbf Side: 68 lbf                          |                     |
| Mounting Options                        | Part Number                                                     |                                                      | Weight              |
|                                         |                                                                 |                                                      |                     |
| 2-Point Mounting Bracket Kit            | 26799997                                                        |                                                      | 2.3 kg 5 lbs        |
| 2-Point Mounting & Downtilt Bracket Kit | 26799999                                                        |                                                      | 3.6 kg 8 lbs        |
| Concealment Configurations              | For concealment configurations, order BXA-171085-12BF-EDIN-X-FP |                                                      |                     |

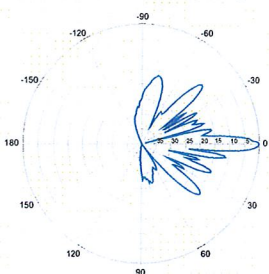


BXA-171085-12BF-EDIN-X



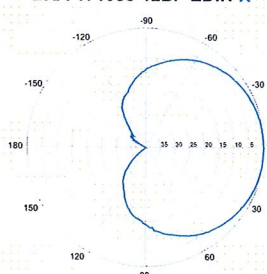
Horizontal | 1710-1880 MHz

BXA-171085-12BF-EDIN-0



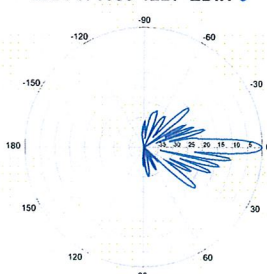
0° | Vertical | 1710-1880 MHz

BXA-171085-12BF-EDIN-X



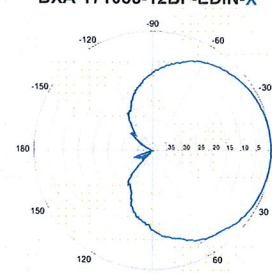
Horizontal | 1850-1990 MHz

BXA-171085-12BF-EDIN-0



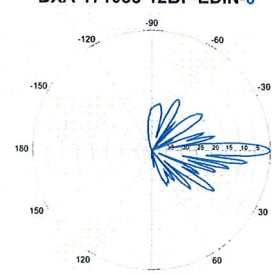
0° | Vertical | 1850-1990 MHz

BXA-171085-12BF-EDIN-X



Horizontal | 1920-2170 MHz

BXA-171085-12BF-EDIN-0



0° | Vertical | 1920-2170 MHz

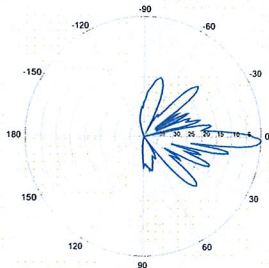
Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.



**BXA-171085-12BF-EDIN-X**

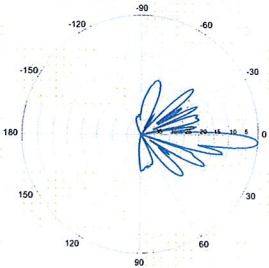
X-Pol | FET Panel | 85° | 18.0 dBi

**BXA-171085-12BF-EDIN-2**



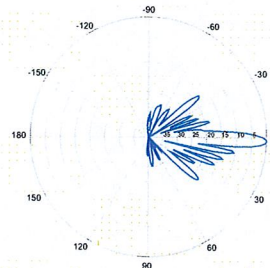
2° | Vertical | 1710-1880 MHz

**BXA-171085-12BF-EDIN-4**



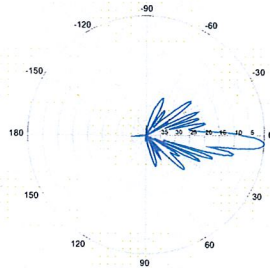
4° | Vertical | 1710-1880 MHz

**BXA-171085-12BF-EDIN-2**



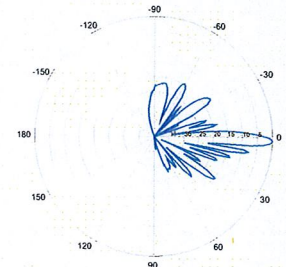
2° | Vertical | 1850-1990 MHz

**BXA-171085-12BF-EDIN-4**



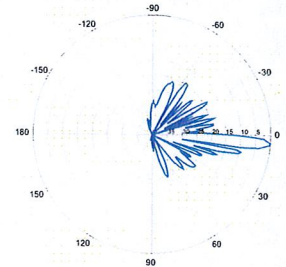
4° | Vertical | 1850-1990 MHz

**BXA-171085-12BF-EDIN-2**



2° | Vertical | 1920-2170 MHz

**BXA-171085-12BF-EDIN-4**



4° | Vertical | 1920-2170 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.



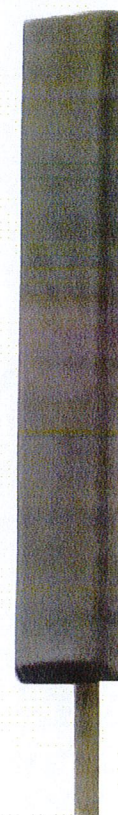
## BXA-70080-6CF-EDIN-X

X-Pol | FET Panel | 80° | 13.5 dBd

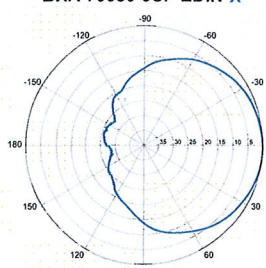
Replace "X" with desired electrical downtilt.

Antenna is also available with NE connector(s). Replace "EDIN" with "NE" in the model number when ordering.

| Electrical Characteristics              | 696-900 MHz                                                   |                       |                     |                 |
|-----------------------------------------|---------------------------------------------------------------|-----------------------|---------------------|-----------------|
| Frequency bands                         | 696-806 MHz                                                   |                       | 806-900 MHz         |                 |
| Polarization                            | ±45°                                                          |                       |                     |                 |
| Horizontal beamwidth                    | 82°                                                           |                       | 80°                 |                 |
| Vertical beamwidth                      | 12°                                                           |                       | 10°                 |                 |
| Gain                                    | 13.0 dBd (15.1 dBi)                                           |                       | 13.5 dBd (15.6 dBi) |                 |
| Electrical downtilt (X)                 | 0, 2, 4, 6, 8, 10                                             |                       |                     |                 |
| Impedance                               | 50Ω                                                           |                       |                     |                 |
| VSWR                                    | ≤1.35:1                                                       |                       |                     |                 |
| Upper sidelobe suppression (0°)         | -18.3 dB                                                      |                       | -18.6 dB            |                 |
| Front-to-back ratio (+/-30°)            | -26.9 dB                                                      |                       | -25.6 dB            |                 |
| Null fill                               | 5% (-26.02 dB)                                                |                       |                     |                 |
| Isolation between ports                 | < -30 dB                                                      |                       |                     |                 |
| Input power with EDIN connectors        | 500 W                                                         |                       |                     |                 |
| Input power with NE connectors          | 300 W                                                         |                       |                     |                 |
| Lightning protection                    | Direct Ground                                                 |                       |                     |                 |
| Connector(s)                            | 2 Ports / EDIN or NE / Female / Center (Back)                 |                       |                     |                 |
| Mechanical Characteristics              |                                                               |                       |                     |                 |
| Dimensions Length x Width x Depth       | 1804 x 204 x 151 mm                                           |                       | 71.0 x 8.0 x 5.9 in |                 |
| Depth with z-brackets                   | 191 mm                                                        |                       | 7.5 in              |                 |
| Weight without mounting brackets        | 8.2 kg                                                        |                       | 18 lbs              |                 |
| Survival wind speed                     | > 201 km/hr                                                   |                       | > 125 mph           |                 |
| Wind area                               | Front: 0.37 m²                                                | Side: 0.27 m²         | Front: 3.9 ft²      | Side: 2.9 ft²   |
| Wind load @ 161 km/hr (100 mph)         | Front: 531 N                                                  | Side: 475 N           | Front: 119 lbf      | Side: 104 lbf   |
| Mounting Options                        | Part Number                                                   | Fits Pipe Diameter    |                     | Weight          |
| 3-Point Mounting & Downtilt Bracket Kit | 36210008                                                      | 40-115 mm 1.57-4.5 in |                     | 6.9 kg 15.2 lbs |
| Concealment Configurations              | For concealment configurations, order BXA-70080-6CF-EDIN-X-FP |                       |                     |                 |

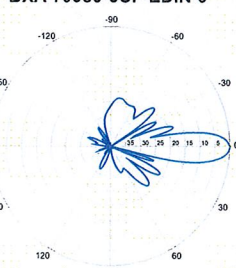


BXA-70080-6CF-EDIN-X



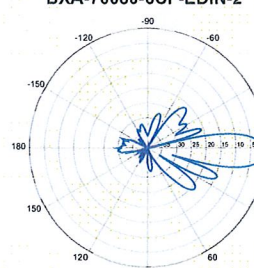
Horizontal | 750 MHz

BXA-70080-6CF-EDIN-0



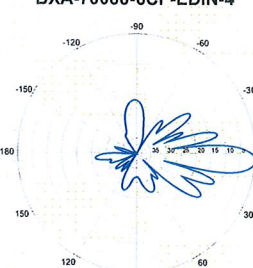
0° | Vertical | 750 MHz

BXA-70080-6CF-EDIN-2

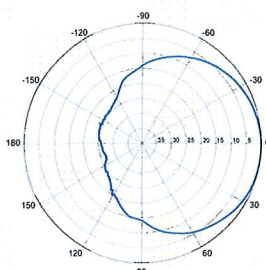


2° | Vertical | 750 MHz

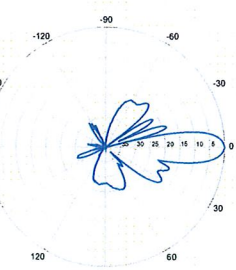
BXA-70080-6CF-EDIN-4



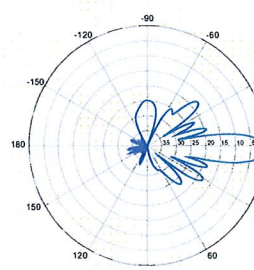
4° | Vertical | 750 MHz



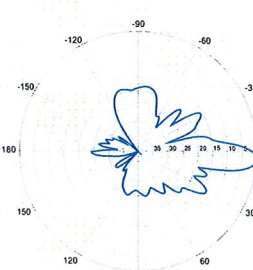
Horizontal | 850 MHz



0° | Vertical | 850 MHz



2° | Vertical | 850 MHz



4° | Vertical | 850 MHz

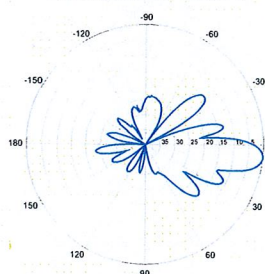
Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.



# BXA-70080-6CF-EDIN-X

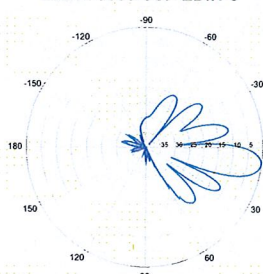
X-Pol | FET Panel | 80° | 13.5 dBd

**BXA-70080-6CF-EDIN-6**



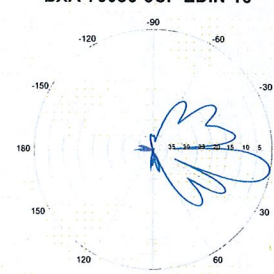
6° | Vertical | 750 MHz

**BXA-70080-6CF-EDIN-8**

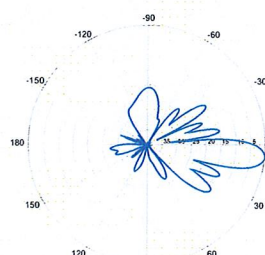


8° | Vertical | 750 MHz

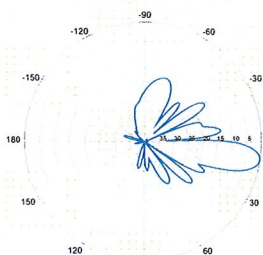
**BXA-70080-6CF-EDIN-10**



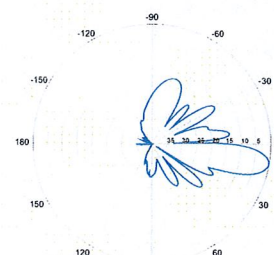
10° | Vertical | 750 MHz



6° | Vertical | 850 MHz



8° | Vertical | 850 MHz



10° | Vertical | 850 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.





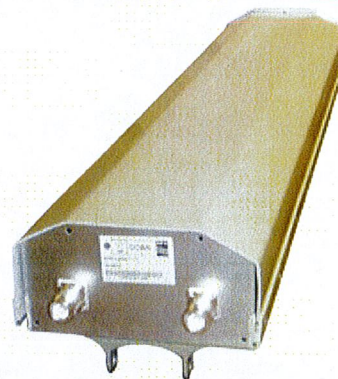
Optimizer® Dual Polarized Antenna, 698-896, 80deg, 13.1dBi, 1.3m, FET, 0deg

### Product Description

Wideband antenna for dense networks where site aspect is essential.

### Features/Benefits

- Wideband performance 698-896 MHz
- High sidelobe suppression
- Null fill
- Dual polarization
- High front-to-back ratio



### Technical Specifications

#### Electrical Specifications

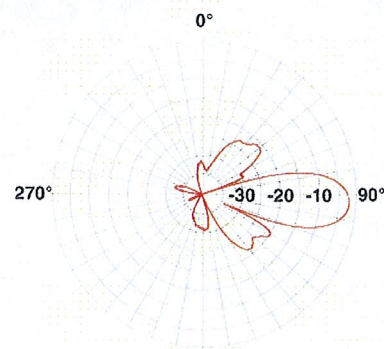
|                                    |                     |
|------------------------------------|---------------------|
| Frequency Range, MHz               | 698-896             |
| Horizontal Beamwidth, deg          | 80 +/-5             |
| Vertical Beamwidth, deg            | 15-19               |
| Electrical Downtilt, deg           | 0                   |
| Gain, dBi (dBd)                    | 13.1 (11)           |
| 1st Upper Sidelobe Suppression, dB | >18                 |
| Upper Sidelobe Suppression, dB     | >18                 |
| Front-To-Back Ratio, dB            | >30                 |
| Polarization                       | Slant +/-45 degrees |
| VSWR                               | 1.40:1              |
| Isolation between Ports, dB        | >30                 |
| 3rd Order IMP @ 2 x 43 dBm, dBc    | >150                |
| Impedance, Ohms                    | 50                  |
| Maximum Power Input, W             | 500                 |
| Lightning Protection               | Chassis Ground      |

#### Mechanical Specifications

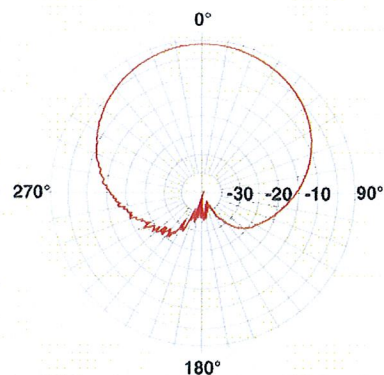
|                                  |                                          |
|----------------------------------|------------------------------------------|
| Dimensions - HxWxD, mm (in)      | 1320.8 x 266.7 x 139.7 (52 x 10.5 x 5.5) |
| Weight w/o Mtg Hardware, kg (lb) | 8 (17.6)                                 |
| Mounting Hardware Material       | Diecasted Aluminum                       |

#### Ordering Information

|                                   |                    |
|-----------------------------------|--------------------|
| Mounting Hardware                 | APM40-2            |
| Mounting Pipe Diameter, mm (in)   | 60-120 (2.36-4.72) |
| Mounting Hardware Weight, kg (lb) | 3.4 (7.5)          |



Vertical Pattern



Horizontal Pattern

### Other Documentation

APM40 Series Datasheet

APM40 Series Installation Instructions

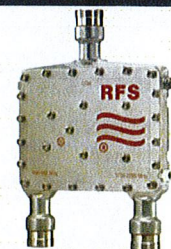




# ShareLite Wideband Diplexer – In-line 698-960 MHz/1710-2200 MHz, DC pass in high frequency path

## Product Description

The ShareLite FD9R6004 Series of diplexers are designed to enable feeder sharing between systems in the 698-960 MHz range and in the 1710-2200 MHz range. The diplexer is equipped with in-line connector placement so it can be installed in the BTS cabinet or at the tower top. This is especially valuable in crowded sites or when the feeders are not easily accessible. Due to its wideband design, the FD9R6004 Series can accommodate many combining solutions between 698-960 MHz and 1710-2200 MHz systems such as LTE 700 MHz, Cellular 800 MHz with PCS, GSM900 with GSM1800, or GSM900 with UMTS. This diplexer features a highly selective filter. It provides a high level of isolation between ports, while keeping the insertion loss on both paths at an extremely low level. The FD9R6004 diplexers are available with various DC pass options, helpful in configurations with or without the Tower Mount Amplifiers installed.



## Features/Benefits

- **LTE ready design**
- **Extremely Low Insertion Loss**
- **High level of Rejection between bands – Protection against interferences**
- **Extremely High Power Handling Capability**
- **Integrated DC block/bypass versions available**
- **Very compact & small size design – Easy installation and reduced tower load**
- **In-line long-neck connectors for easy connection & waterproofing**
- **Exceptional reliability & environmental protection (IP 67)**
- **Equipped with 1 \* Breathable Vent – Prevent any humidity inside the product**
- **Mounting hardware for Wall and Pole mount provided (P/N SEM2-1A)**
- **Grounding already provided through the mounting bracket**
- **Kit available for easy dual mount**

## Technical Specifications

|                                         |                                                                                                                                           |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Product Type                            | Diplexer/Cross Band Coupler                                                                                                               |
| Frequency Range 1, MHz                  | 698-960                                                                                                                                   |
| Frequency Range 2, MHz                  | 1710-2200                                                                                                                                 |
| Application                             | LTE700, GSM900, UMTS, GSM1800, Cellular 800, PCS                                                                                          |
| Configuration                           | Sharelite Single diplexer, outdoor, DC pass in the 1710-2170MHz path, with mounting hardware SEM2-1A                                      |
| Mounting                                | Wall Mounting: With 4 screws (maximum 6mm diameter); Pole Mounting: With included clamp set 40-110mm (1.57-4.33)                          |
| Return Loss All Ports Min/Typ, dB       | 19/23                                                                                                                                     |
| Power Handling Continuous, Max, W       | 1250 at common port; 750 in low frequency path & 500 in high frequency path                                                               |
| Power Handling Peak, Max, W             | 15000 in low frequency path & 8000 in high frequency path                                                                                 |
| Impedance, Ohms                         | 50                                                                                                                                        |
| Insertion Loss, Path 1, dB              | 0.07 typ.                                                                                                                                 |
| Insertion Loss, Path 2, dB              | 0.13 typ.                                                                                                                                 |
| Rejection Between Bands Min/Typ, dB     | 58/64@698-960MHz; 60/70@1710-2200MHz                                                                                                      |
| IMP Level at the COM Port, Typ, dBm     | -112 @ 2x43                                                                                                                               |
| DC Pass in Low Frequency Path           | No                                                                                                                                        |
| DC Pass in High Frequency Path          | Yes                                                                                                                                       |
| Temperature Range, °C (°F)              | -40 to +60 (-40 to +140)                                                                                                                  |
| Environmental                           | ETSI 300-019-2-4 Class 4.1E                                                                                                               |
| Ingress Protection                      | IP 67                                                                                                                                     |
| Lightning Protection                    | EN/IEC61000-4-5 Level 4                                                                                                                   |
| Connectors                              | In-line long-neck 7-16-Female                                                                                                             |
| Weight, kg (lb)                         | 1.2 (2.6)                                                                                                                                 |
| Shipping Weight, kg (lb)                | 3.2 (7) for 2 * single units in 1 * box, 9.8 (21.6) for 6 * units = 3 * Boxes in 1 * overwrap                                             |
| Dimensions, H x W x D, mm (in)          | 147 x 164 x 37 (5.8 x 6.5 x 1.5)                                                                                                          |
| Shipping Dimensions, H x W x D, mm (in) | 254 x 406 x 82 (10 x 16 x 3.2) for 2 * Single Units in 1 * box, 280 x 406 x 241 (11 x 16 x 9.5) for 6 * units = 3 * Boxes in 1 * overwrap |
| Volume, L                               | 0.43                                                                                                                                      |
| Housing                                 | Aluminum                                                                                                                                  |

## Notes

All information contained in the present datasheet is subject to confirmation at time of ordering



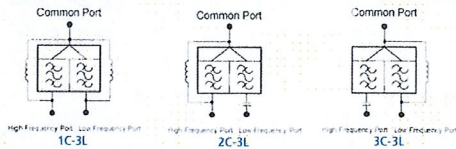


# ShareLite Wideband Diplexer – In-line 698-960 MHz/1710-2200 MHz, DC pass in high frequency path

## Other Documentation

FD9R6004/2C-3L Installation Instructions: [Wideband\\_Diplexer\\_Installation\\_Rev5.pdf](#)

| Selection Guide Diplexer 698-960 / 1710-2200MHz |                    |              |                   |                  |                            |
|-------------------------------------------------|--------------------|--------------|-------------------|------------------|----------------------------|
|                                                 | Model Number       | Full DC Pass | DC Pass High Band | DC Pass Low Band | Mounting Hardware Included |
| Single                                          | FD9R6004/1C-3L     |              |                   |                  | X                          |
|                                                 | FD9R6004/2C-3L     |              |                   |                  | X                          |
|                                                 | FD9R6004/3C-3L     |              |                   |                  | X                          |
| Dual                                            | KIT-FD9R6004/1C-DL |              |                   |                  | X                          |
|                                                 | KIT-FD9R6004/2C-DL |              |                   |                  | X                          |
|                                                 | KIT-FD9R6004/3C-DL |              |                   |                  | X                          |



The FD9R6004 Series is upgradeable to a Dual Diplexer kit by means of 2 diplexers and mounting hardware kits SEM2-1A and SEM2-3

| Mounting Hardware and Ground Cable Ordering Information |                                                                                                                                     |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Model Number                                            | Description                                                                                                                         |
| SEM2-1A                                                 | Mounting Hardware, Pole mount ø40-110mm (Included with the Single and Dual Diplexer) Wall Screws M6 (Not included with the product) |
| SEM2-3                                                  | Assembly kit for 2 pcs of FD9R6004/2C-3L (Can be ordered separately but included with the Dual Diplexer Kit)                        |
| CA020-2                                                 | Ground Cable, 2m, includes lugs (Optional)                                                                                          |
| CA030-2                                                 | Ground Cable, 2m, includes lugs (Optional)                                                                                          |
| SEM6                                                    | Mounting Hardware for 6 Diplexers, Tower Base (Optional)                                                                            |



|                               | General    | Power     | Density |                  |       |                    |
|-------------------------------|------------|-----------|---------|------------------|-------|--------------------|
| Site Name: Norfolk E          |            |           |         |                  |       |                    |
| Tower Height: Verizon @ 160ft |            |           |         |                  |       |                    |
| CARRIER                       | # OF CHAN. | WATTS ERP | HEIGHT  | CALC. POWER DENS | FREQ. | MAX. PERMISS. EXP. |
| *Cingular                     | 6          | 296       | 180     | 0.0197           | 880   | 3.36%              |
| *Cingular                     | 3          | 427       | 180     | 0.0142           | 1930  | 1.42%              |
| Verizon PCS                   | 7          | 317       | 160     | 0.0312           | 1970  | 3.12%              |
| Verizon Cellular              | 9          | 339       | 160     | 0.0429           | 869   | 7.40%              |
| Verizon AWS                   | 1          | 670       | 160     | 0.0094           | 2145  | 0.94%              |
| Verizon 700                   | 1          | 561       | 160     | 0.0079           | 698   | 1.69%              |
|                               |            |           |         |                  |       | 17.93%             |
| * Source: Siting Council      |            |           |         |                  |       |                    |
|                               |            |           |         |                  |       |                    |
|                               |            |           |         |                  |       |                    |
|                               |            |           |         |                  |       |                    |

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

**Site Name:** Norfolk East CT  
**Address:** Greenwoods Road East (Route 44)  
Norfolk, Connecticut

---

*prepared for*



**Verizon Wireless**  
99 East River Drive  
East Hartford, Connecticut 06108

*prepared by*



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

36922265.00000  
VZ5-107 (Rev1)

January 31, 2012



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- 2. INTRODUCTION**
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- 6. DRAWINGS AND DATA**
  - **TNX TOWER INPUT / OUTPUT SUMMARY**
  - **TNX TOWER DETAILED OUTPUT**
  - **ANCHOR BOLT AND BASE PLATE ANALYSIS**
  - **FOUNDATION ANALYSIS**

## 1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 180' steel tapered monopole structure, located at Greenwood Road East (Route 44) in Norfolk, Connecticut. 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 1/2" 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 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|
| <b><u>Remove:</u></b><br>(6) Amphenol LPA-185080-12CF-EDIN-2                                                                                                                                        | Verizon<br>(Existing) | @ 160'                   |
| <b><u>Install:</u></b><br>(1) RFS APX75-868011-CT0<br>(1 per Alpha Sector)<br>(2) Amphenol BXA-70080-6CF-EDIN<br>(1 per Beta & Gamma Sectors)<br>(3) Amphenol BXA-171085-12BF-EDIN<br>(6) Diplexers | Verizon<br>(Proposed) | @ 160'                   |

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

This analysis is based on:

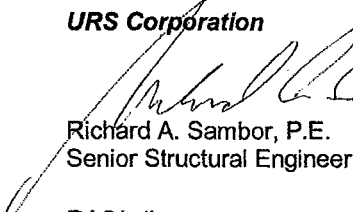
- 1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
- 2) Tower and foundation design documents prepared by Valmont Communications (Order #11004-67), signed and sealed July 19, 2007.
- 3) Geotechnical report prepared by Dr. Clarence Welti, P.E., P.C., dated March 4, 2007.
- 4) Antenna and mount configuration as specified within Section 2 and 6 of this report.

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

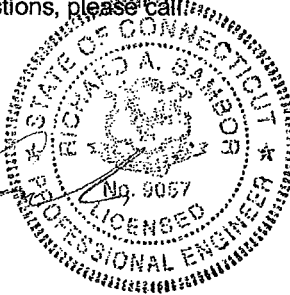
If you should have any questions, please call

Sincerely,

**URS Corporation**

  
Richard A. Sambor, P.E.  
Senior Structural Engineer

RAS/mjk





## 2. INTRODUCTION

The subject tower is located at Greenwood Road East (Route 44) in Norfolk, Connecticut. The structure is an existing 180' steel tapered monopole structure, designed by Valmont Communications (Order #11004-67), signed and sealed July 19, 2007.

The inventory is summarized in the table below:

| <b>Antenna Type</b>                                                                                                                                                       | <b>Carrier</b>        | <b>Mount</b>         | <b>Antenna Centerline Elevation</b> | <b>Cable</b>      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------|-------------------------------------|-------------------|
| (12) Powerwave 7770<br>(12) TMAs                                                                                                                                          | AT&T<br>(reserved)    | Low Profile Platform | 180'                                | (12) 1-5/8"       |
| (6) Amphenol LPA-80080-6CF-EDIN-0<br>(6) TMAs                                                                                                                             | Verizon<br>(existing) | Low Profile Platform | 160'                                | (12) 1-5/8"       |
| (1) RFS APX75-868011-CT0<br>(1 per Alpha Sector)<br>(2) Amphenol BXA-70080-6CF-EDIN<br>(1 per Beta & Gamma Sectors)<br>(3) Amphenol BXA-171085-12BF-EDIN<br>(6) Diplexers | Verizon<br>(proposed) | Shared with Above    | 160'                                | Shared with Above |

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 tnx Tower 6.0. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

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

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

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

#### 4. FINDINGS AND EVALUATION

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

##### Tower Component Stress vs. Capacity Summary

| Component<br>(Section No.) | Controlling Component / Elevation   | Stress Ratio<br>(% capacity) | Pass/Fail | Notes: |
|----------------------------|-------------------------------------|------------------------------|-----------|--------|
| Pole Shaft (L3)            | TP48.88x41.4744x0.375 / 45.5'-91.9' | 60.9%                        | Pass      |        |
| Anchor Bolts               | Compression                         | 56%                          | Pass      |        |
| Base Plate                 | Bending                             | 30%                          | Pass      |        |

##### Foundation Summary

| Foundation              | Component   | Stress<br>(% capacity / FOS) | Pass/Fail | Comments:                                                   |
|-------------------------|-------------|------------------------------|-----------|-------------------------------------------------------------|
| Reinforced Concrete Pad | Overturning | 55.9% / 3.58                 | Pass      | Min. F.O.S of 2.0<br>req'd per IBC 2003<br>Section 3108.4.2 |



## 5. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower, base plate, anchor bolts, 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.

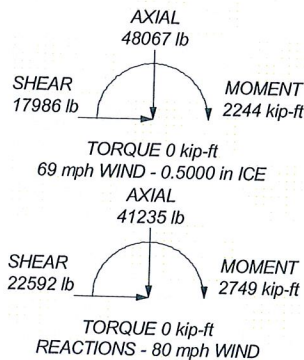
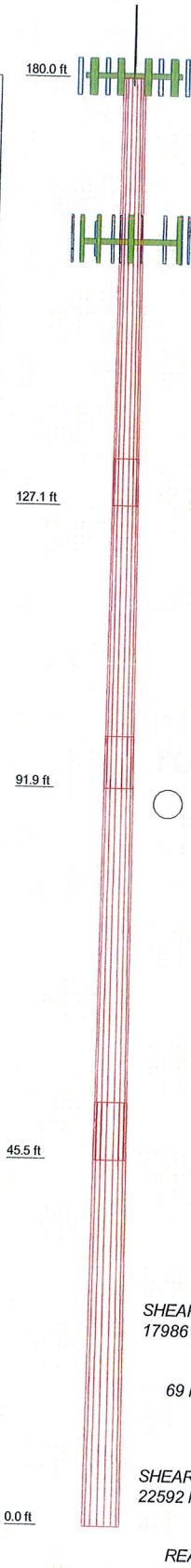
The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire 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**

## **TNX TOWER INPUT/OUTPUT SUMMARY**



| Section            | 1       | 2       | 3       | 4       |
|--------------------|---------|---------|---------|---------|
| Length (ft)        | 52.91   | 41.02   | 52.90   | 52.75   |
| Number of Sides    | 18      | 18      | 18      | 18      |
| Thickness (in)     | 0.2188  | 0.2813  | 0.3750  | 0.5000  |
| Socket Length (ft) | 5.83    | 6.50    | 7.25    | 47.1151 |
| Top Dia (in)       | 31.0500 | 37.2038 | 41.4744 | 54.5000 |
| Bot Dia (in)       | 38.4580 | 42.9470 | 48.8800 | 14330.8 |
| Grade              |         |         | A572-65 |         |
| Weight (lb)        | 4317.3  | 4958.5  | 9599.1  | 14330.8 |



## DESIGNED APPURTENANCE LOADING

| TYPE                                                | ELEVATION | TYPE                                                | ELEVATION |
|-----------------------------------------------------|-----------|-----------------------------------------------------|-----------|
| Lightning Rod 2"x8"                                 | 184       | APX75-868011-CT0 (Verizon)                          | 160       |
| PiROD 13' Low Profile Platform (Monopole) (Carrier) | 180.5     | BXA-70080-6CF-EDIN (Verizon)                        | 160       |
| (4) 7770 (ATI)                                      | 180       | BXA-70080-6CF-EDIN (Verizon)                        | 160       |
| (4) TMA (ATI)                                       | 180       | BXA-171085-12BF-EDIN (Verizon)                      | 160       |
| (4) 7770 (ATI)                                      | 180       | (2) TMA (Verizon)                                   | 160       |
| (4) TMA (ATI)                                       | 180       | BXA-171085-12BF-EDIN (Verizon)                      | 160       |
| (4) 7770 (ATI)                                      | 180       | (2) TMA (Verizon)                                   | 160       |
| (4) TMA (ATI)                                       | 180       | BXA-171085-12BF-EDIN (Verizon)                      | 160       |
| LPA-80080-6CF-EDIN (Verizon)                        | 160       | (2) TMA (Verizon)                                   | 160       |
| Diplexer (Verizon)                                  | 160       | PiROD 13' Low Profile Platform (Monopole) (Carrier) | 160       |
| Diplexer (Verizon)                                  | 160       | LPA-80080-6CF-EDIN (Verizon)                        | 160       |
| LPA-80080-6CF-EDIN (Verizon)                        | 160       | LPA-80080-6CF-EDIN (Verizon)                        | 160       |
| LPA-80080-6CF-EDIN (Verizon)                        | 160       | Diplexer (Verizon)                                  | 160       |
| Diplexer (Verizon)                                  | 160       | Diplexer (Verizon)                                  | 160       |
| Diplexer (Verizon)                                  | 160       | LPA-80080-6CF-EDIN (Verizon)                        | 160       |

## MATERIAL STRENGTH

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

## TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 60.9%

|                                |  |                                                                        |                                  |
|--------------------------------|--|------------------------------------------------------------------------|----------------------------------|
| <b>URS Corporation</b>         |  | Job: <b>Valmont 180' Monopole</b>                                      |                                  |
| 500 Enterprise Drive, Suite 3B |  | Project: <b>Greenwood Road East, Norfolk, CT</b>                       |                                  |
| Rocky Hill, CT                 |  | Client: <b>Verizon</b>                                                 | Drawn by: <b>Matthew Kapinos</b> |
| Phone: (860) 529-8882          |  | Code: <b>TIA/EIA-222-F</b>                                             | Date: <b>01/31/12</b>            |
| FAX: (860) 529-3991            |  | Path: <b>P:\08\Rev1\ERI Files\180' Monopole Norfolk, CT V25107.eri</b> | Scale: <b>NTS</b>                |
|                                |  |                                                                        | Dwg No. <b>E-1</b>               |

## **TNX TOWER DETAILED OUTPUT**

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 1 of 20           |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

## Tower Input Data

There is a pole section.

This tower is designed using the TIA/EIA-222-F standard.

The following design criteria apply:

Tower is located in Litchfield County, Connecticut.

Basic wind speed of 80 mph.

Nominal ice thickness of 0.5000 in.

Ice density of 56 pcf.

A wind speed of 69 mph is used in combination with ice.

Temperature drop of 50 °F.

Deflections calculated using a wind speed of 50 mph.

A non-linear (P-delta) analysis was used.

Pressures are calculated at each section.

Stress ratio used in pole design is 1.333.

Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

## Options

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

## Tapered Pole Section Geometry

| Section | Elevation<br>ft | Section<br>Length<br>ft | Splice<br>Length<br>ft | Number<br>of<br>Sides | Top<br>Diameter<br>in | Bottom<br>Diameter<br>in | Wall<br>Thickness<br>in | Bend<br>Radius<br>in | Pole Grade          |
|---------|-----------------|-------------------------|------------------------|-----------------------|-----------------------|--------------------------|-------------------------|----------------------|---------------------|
| L1      | 180.00-127.09   | 52.91                   | 5.83                   | 18                    | 31.0500               | 38.4580                  | 0.2188                  | 0.8750               | A572-65<br>(65 ksi) |
| L2      | 127.09-91.90    | 41.02                   | 6.50                   | 18                    | 37.2038               | 42.9470                  | 0.2813                  | 1.1250               | A572-65<br>(65 ksi) |
| L3      | 91.90-45.50     | 52.90                   | 7.25                   | 18                    | 41.4744               | 48.8800                  | 0.3750                  | 1.5000               | A572-65<br>(65 ksi) |
| L4      | 45.50-0.00      | 52.75                   |                        | 18                    | 47.1151               | 54.5000                  | 0.5000                  | 2.0000               | A572-65<br>(65 ksi) |



|                                                                                                                                                   |         |                                  |                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|--------------------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page<br>2 of 20                |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date<br>09:55:49 01/31/12      |
|                                                                                                                                                   | Client  | Verizon                          | Designed by<br>Matthew Kapinos |

### Tapered Pole Properties

| Section | Tip Dia.<br>in | Area<br>in <sup>2</sup> | $I$<br>in <sup>4</sup> | $r$<br>in | $C$<br>in | $I/C$<br>in <sup>3</sup> | $J$<br>in <sup>4</sup> | $It/Q$<br>in <sup>2</sup> | $w$<br>in | $w/t$  |
|---------|----------------|-------------------------|------------------------|-----------|-----------|--------------------------|------------------------|---------------------------|-----------|--------|
| L1      | 31.5290        | 21.4065                 | 2570.7854              | 10.9451   | 15.7734   | 162.9823                 | 5144.9536              | 10.7053                   | 5.0798    | 23.222 |
|         | 39.0513        | 26.5500                 | 4904.7913              | 13.5749   | 19.5367   | 251.0557                 | 9816.0364              | 13.2775                   | 6.3836    | 29.182 |
| L2      | 38.6071        | 32.9603                 | 5676.9177              | 13.1075   | 18.8995   | 300.3733                 | 11361.3053             | 16.4833                   | 6.0529    | 21.521 |
|         | 43.6095        | 38.0872                 | 8759.4141              | 15.1463   | 21.8171   | 401.4935                 | 17530.3540             | 19.0472                   | 7.0637    | 25.115 |
| L3      | 43.0382        | 48.9186                 | 10439.5871             | 14.5903   | 21.0690   | 495.4948                 | 20892.9109             | 24.4640                   | 6.6395    | 17.705 |
|         | 49.6341        | 57.7331                 | 17160.7066             | 17.2193   | 24.8310   | 691.0990                 | 34343.9938             | 28.8720                   | 7.9429    | 21.181 |
| L4      | 48.8725        | 73.9781                 | 20309.2142             | 16.5483   | 23.9345   | 848.5348                 | 40645.1517             | 36.9961                   | 7.4123    | 14.825 |
|         | 55.3408        | 85.6980                 | 31571.5320             | 19.1700   | 27.6860   | 1140.3428                | 63184.6066             | 42.8571                   | 8.7120    | 17.424 |

| Tower<br>Elevation  | Gusset<br>Area<br>(per face) | Gusset<br>Thickness | Gusset Grade | Adjust.<br>Factor<br>$A_f$ | Adjust.<br>Factor<br>$A_r$ | Weight Mult. | Double Angle<br>Stitch Bolt<br>Spacing<br>Diagonals | Double Angle<br>Stitch Bolt<br>Spacing<br>Horizontals |
|---------------------|------------------------------|---------------------|--------------|----------------------------|----------------------------|--------------|-----------------------------------------------------|-------------------------------------------------------|
| ft                  | ft <sup>2</sup>              | in                  |              |                            |                            |              | in                                                  | in                                                    |
| L1<br>180.00-127.09 |                              |                     |              | 1                          | 1                          | 1            |                                                     |                                                       |
| L2<br>127.09-91.90  |                              |                     |              | 1                          | 1                          | 1            |                                                     |                                                       |
| L3<br>91.90-45.50   |                              |                     |              | 1                          | 1                          | 1            |                                                     |                                                       |
| L4<br>45.50-0.00    |                              |                     |              | 1                          | 1                          | 1            |                                                     |                                                       |

### Feed Line/Linear Appurtenances - Entered As Area

| Description | Face<br>or<br>Leg | Allow<br>Shield | Component<br>Type | Placement     | Total<br>Number |          | $C_{AA}$  | Weight |
|-------------|-------------------|-----------------|-------------------|---------------|-----------------|----------|-----------|--------|
|             |                   |                 |                   | ft            |                 |          | $ft^2/ft$ | plf    |
| 1 5/8       | A                 | No              | Inside Pole       | 180.00 - 0.00 | 12              | No Ice   | 0.00      | 1.04   |
|             |                   |                 |                   |               |                 | 1/2" Ice | 0.00      | 1.04   |
| 1 5/8       | A                 | No              | Inside Pole       | 160.00 - 0.00 | 12              | No Ice   | 0.00      | 1.04   |
|             |                   |                 |                   |               |                 | 1/2" Ice | 0.00      | 1.04   |

### Feed Line/Linear Appurtenances Section Areas

| Tower<br>Section | Tower<br>Elevation | Face | $A_R$           | $A_F$           | $C_{AA}$<br>In Face | $C_{AA}$<br>Out Face | Weight   |
|------------------|--------------------|------|-----------------|-----------------|---------------------|----------------------|----------|
|                  | ft                 |      | ft <sup>2</sup> | ft <sup>2</sup> | ft <sup>2</sup>     | ft <sup>2</sup>      | lb       |
| L1               | 180.00-127.09      | A    | 0.000           | 0.000           | 0.000               | 0.000                | 1071.108 |
|                  |                    | B    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
|                  |                    | C    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
| L2               | 127.09-91.90       | A    | 0.000           | 0.000           | 0.000               | 0.000                | 878.260  |
|                  |                    | B    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
|                  |                    | C    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
| L3               | 91.90-45.50        | A    | 0.000           | 0.000           | 0.000               | 0.000                | 1158.144 |
|                  |                    | B    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
|                  |                    | C    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
| L4               | 45.50-0.00         | A    | 0.000           | 0.000           | 0.000               | 0.000                | 1135.687 |
|                  |                    | B    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |
|                  |                    | C    | 0.000           | 0.000           | 0.000               | 0.000                | 0.000    |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
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|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

### Feed Line/Linear Appurtenances Section Areas - With Ice

| Tower Section | Tower Elevation<br>ft | Face or Leg | Ice Thickness<br>in | A <sub>R</sub><br>ft <sup>2</sup> | A <sub>F</sub><br>ft <sup>2</sup> | C <sub>A</sub> A <sub>A</sub><br>In Face<br>ft <sup>2</sup> | C <sub>A</sub> A <sub>A</sub><br>Out Face<br>ft <sup>2</sup> | Weight<br>lb |
|---------------|-----------------------|-------------|---------------------|-----------------------------------|-----------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------|
| L1            | 180.00-127.09         | A           | 0.500               | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 1071.108     |
|               |                       | B           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
|               |                       | C           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
| L2            | 127.09-91.90          | A           | 0.500               | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 878.260      |
|               |                       | B           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
|               |                       | C           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
| L3            | 91.90-45.50           | A           | 0.500               | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 1158.144     |
|               |                       | B           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
|               |                       | C           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
| L4            | 45.50-0.00            | A           | 0.500               | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 1135.687     |
|               |                       | B           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |
|               |                       | C           |                     | 0.000                             | 0.000                             | 0.000                                                       | 0.000                                                        | 0.000        |

### Feed Line Center of Pressure

| Section | Elevation<br>ft | CP <sub>x</sub><br>in | CP <sub>z</sub><br>in | CP <sub>x</sub><br>Ice<br>in | CP <sub>z</sub><br>Ice<br>in |
|---------|-----------------|-----------------------|-----------------------|------------------------------|------------------------------|
| L1      | 180.00-127.09   | 0.0000                | 0.0000                | 0.0000                       | 0.0000                       |
| L2      | 127.09-91.90    | 0.0000                | 0.0000                | 0.0000                       | 0.0000                       |
| L3      | 91.90-45.50     | 0.0000                | 0.0000                | 0.0000                       | 0.0000                       |
| L4      | 45.50-0.00      | 0.0000                | 0.0000                | 0.0000                       | 0.0000                       |

### Discrete Tower Loads

| Description                                         | Face or Leg | Offset Type | Offsets:<br>Horz<br>Lateral<br>Vert<br>ft<br>ft<br>ft | Azimuth Adjustment<br>° | Placement<br>ft | C <sub>A</sub> A <sub>A</sub><br>Front<br>ft <sup>2</sup> | C <sub>A</sub> A <sub>A</sub><br>Side<br>ft <sup>2</sup> | Weight<br>lb         |
|-----------------------------------------------------|-------------|-------------|-------------------------------------------------------|-------------------------|-----------------|-----------------------------------------------------------|----------------------------------------------------------|----------------------|
| Lightning Rod 2"x8'                                 | C           | None        |                                                       | 0.0000                  | 184.00          | No Ice<br>1/2" Ice                                        | 2.00<br>3.02                                             | 80.000<br>95.501     |
| PiROD 13' Low Profile Platform (Monopole) (Carrier) | A           | None        |                                                       | 0.0000                  | 180.50          | No Ice<br>1/2" Ice                                        | 15.70<br>20.10                                           | 1300.000<br>1765.000 |
| PiROD 13' Low Profile Platform (Monopole) (Carrier) | A           | None        |                                                       | 0.0000                  | 160.00          | No Ice<br>1/2" Ice                                        | 15.70<br>20.10                                           | 1300.000<br>1765.000 |
| LPA-80080-6CF-EDIN (Verizon)                        | A           | From Face   | 3.50<br>6.00<br>0.00                                  | 0.0000                  | 160.00          | No Ice<br>1/2" Ice                                        | 4.32<br>4.76                                             | 21.000<br>69.256     |
| LPA-80080-6CF-EDIN (Verizon)                        | A           | From Face   | 3.50<br>-6.00<br>0.00                                 | 0.0000                  | 160.00          | No Ice<br>1/2" Ice                                        | 4.32<br>4.76                                             | 21.000<br>69.256     |
| Diplexer (Verizon)                                  | A           | From Face   | 3.50<br>6.00                                          | 0.0000                  | 160.00          | No Ice<br>1/2" Ice                                        | 0.52<br>0.62                                             | 15.000<br>18.242     |

|                                                                                                                                                   |                |                                  |                    |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------------|-------------------|
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|                                                                                                                                                   | <b>Project</b> | Greenwood Road East, Norfolk, CT | <b>Date</b>        | 09:55:49 01/31/12 |
|                                                                                                                                                   | <b>Client</b>  | Verizon                          | <b>Designed by</b> | Matthew Kapinos   |

| <i>Description</i>                | <i>Face<br/>or<br/>Leg</i> | <i>Offset<br/>Type</i> | <i>Offsets:<br/>Horz<br/>Lateral<br/>Vert<br/>ft<br/>ft<br/>ft</i> | <i>Azimuth<br/>Adjustment<br/>°</i> | <i>Placement<br/>ft</i> |                    | <i>C<sub>A</sub>A<sub>A</sub><br/>Front<br/>ft<sup>2</sup></i> | <i>C<sub>A</sub>A<sub>A</sub><br/>Side<br/>ft<sup>2</sup></i> | <i>Weight<br/>lb</i> |
|-----------------------------------|----------------------------|------------------------|--------------------------------------------------------------------|-------------------------------------|-------------------------|--------------------|----------------------------------------------------------------|---------------------------------------------------------------|----------------------|
| Diplexer<br>(Verizon)             | A                          | From Face              | 0.00<br>3.50<br>-6.00                                              | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 0.52<br>0.62                                                   | 0.14<br>0.20                                                  | 15.000<br>18.242     |
| LPA-80080-6CF-EDIN<br>(Verizon)   | B                          | From Face              | 0.00<br>3.50<br>6.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.32<br>4.76                                                   | 9.10<br>9.65                                                  | 21.000<br>69.256     |
| LPA-80080-6CF-EDIN<br>(Verizon)   | B                          | From Face              | 0.00<br>3.50<br>-6.00                                              | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.32<br>4.76                                                   | 9.10<br>9.65                                                  | 21.000<br>69.256     |
| Diplexer<br>(Verizon)             | B                          | From Face              | 0.00<br>3.50<br>6.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 0.52<br>0.62                                                   | 0.14<br>0.20                                                  | 15.000<br>18.242     |
| Diplexer<br>(Verizon)             | B                          | From Face              | 0.00<br>3.50<br>-6.00                                              | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 0.52<br>0.62                                                   | 0.14<br>0.20                                                  | 15.000<br>18.242     |
| LPA-80080-6CF-EDIN<br>(Verizon)   | C                          | From Face              | 0.00<br>3.50<br>6.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.32<br>4.76                                                   | 9.10<br>9.65                                                  | 21.000<br>69.256     |
| LPA-80080-6CF-EDIN<br>(Verizon)   | C                          | From Face              | 0.00<br>3.50<br>-6.00                                              | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.32<br>4.76                                                   | 9.10<br>9.65                                                  | 21.000<br>69.256     |
| Diplexer<br>(Verizon)             | C                          | From Face              | 0.00<br>3.50<br>6.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 0.52<br>0.62                                                   | 0.14<br>0.20                                                  | 15.000<br>18.242     |
| Diplexer<br>(Verizon)             | C                          | From Face              | 0.00<br>3.50<br>-6.00                                              | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 0.52<br>0.62                                                   | 0.14<br>0.20                                                  | 15.000<br>18.242     |
| APX75-868011-CT0<br>(Verizon)     | A                          | From Face              | 0.00<br>3.50<br>0.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 5.31<br>5.72                                                   | 2.94<br>3.27                                                  | 17.600<br>48.671     |
| BXA-70080-6CF-EDIN<br>(Verizon)   | B                          | From Face              | 0.00<br>3.50<br>0.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 5.77<br>6.22                                                   | 4.56<br>5.00                                                  | 18.000<br>54.296     |
| BXA-70080-6CF-EDIN<br>(Verizon)   | C                          | From Face              | 0.00<br>3.50<br>0.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 5.77<br>6.22                                                   | 4.56<br>5.00                                                  | 18.000<br>54.296     |
| BXA-171085-12BF-EDIN<br>(Verizon) | A                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.73<br>5.18                                                   | 3.57<br>4.01                                                  | 15.000<br>42.198     |
| (2) TMA<br>(Verizon)              | A                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 2.18<br>2.38                                                   | 0.37<br>0.49                                                  | 18.000<br>28.150     |
| BXA-171085-12BF-EDIN<br>(Verizon) | B                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.73<br>5.18                                                   | 3.57<br>4.01                                                  | 15.000<br>42.198     |
| (2) TMA<br>(Verizon)              | B                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 2.18<br>2.38                                                   | 0.37<br>0.49                                                  | 18.000<br>28.150     |
| BXA-171085-12BF-EDIN<br>(Verizon) | C                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 4.73<br>5.18                                                   | 3.57<br>4.01                                                  | 15.000<br>42.198     |
| (2) TMA<br>(Verizon)              | C                          | From Face              | 0.00<br>3.50<br>4.00                                               | 0.0000                              | 160.00                  | No Ice<br>1/2" Ice | 2.18<br>2.38                                                   | 0.37<br>0.49                                                  | 18.000<br>28.150     |
| (4) 7770<br>(AT&T)                | A                          | From Face              | 0.00<br>3.50<br>0.00                                               | 0.0000                              | 180.00                  | No Ice<br>1/2" Ice | 5.88<br>6.31                                                   | 2.93<br>3.27                                                  | 39.000<br>71.634     |



|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 5 of 20           |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Description        | Face<br>or<br>Leg | Offset<br>Type | Offsets:<br>Horz<br>Lateral<br>Vert<br>ft<br>ft<br>ft | Azimuth<br>Adjustment<br>° | Placement<br>ft |                    | C <sub>AA</sub><br>Front<br>ft <sup>2</sup> | C <sub>AA</sub><br>Side<br>ft <sup>2</sup> | Weight<br>lb     |
|--------------------|-------------------|----------------|-------------------------------------------------------|----------------------------|-----------------|--------------------|---------------------------------------------|--------------------------------------------|------------------|
| (4) TMA<br>(AT&T)  | A                 | From Face      | 0.00<br>3.50<br>0.00<br>0.00                          | 0.0000                     | 180.00          | No Ice<br>1/2" Ice | 2.18<br>2.38                                | 0.37<br>0.49                               | 18.000<br>28.150 |
| (4) 7770<br>(AT&T) | B                 | From Face      | 0.00<br>3.50<br>0.00<br>0.00                          | 0.0000                     | 180.00          | No Ice<br>1/2" Ice | 5.88<br>6.31                                | 2.93<br>3.27                               | 39.000<br>71.634 |
| (4) TMA<br>(AT&T)  | B                 | From Face      | 0.00<br>3.50<br>0.00<br>0.00                          | 0.0000                     | 180.00          | No Ice<br>1/2" Ice | 2.18<br>2.38                                | 0.37<br>0.49                               | 18.000<br>28.150 |
| (4) 7770<br>(AT&T) | C                 | From Face      | 0.00<br>3.50<br>0.00<br>0.00                          | 0.0000                     | 180.00          | No Ice<br>1/2" Ice | 5.88<br>6.31                                | 2.93<br>3.27                               | 39.000<br>71.634 |
| (4) TMA<br>(AT&T)  | C                 | From Face      | 0.00<br>3.50<br>0.00<br>0.00                          | 0.0000                     | 180.00          | No Ice<br>1/2" Ice | 2.18<br>2.38                                | 0.37<br>0.49                               | 18.000<br>28.150 |

### Tower Pressures - No Ice

$$G_H = 1.690$$

| Section<br>Elevation | z      | K <sub>Z</sub> | q <sub>z</sub> | A <sub>G</sub>  | F<br>a<br>c<br>e | A <sub>F</sub>  | A <sub>R</sub>  | A <sub>leg</sub> | Leg<br>% | C <sub>AA</sub><br>In<br>Face<br>ft <sup>2</sup> | C <sub>AA</sub><br>Out<br>Face<br>ft <sup>2</sup> |
|----------------------|--------|----------------|----------------|-----------------|------------------|-----------------|-----------------|------------------|----------|--------------------------------------------------|---------------------------------------------------|
| ft                   | ft     |                | psf            | ft <sup>2</sup> |                  | ft <sup>2</sup> | ft <sup>2</sup> | ft <sup>2</sup>  |          |                                                  |                                                   |
| L1<br>180.00-127.09  | 152.93 | 1.55           | 25             | 153.245         | A                | 0.000           | 153.245         | 153.245          | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | B                | 0.000           | 153.245         |                  | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | C                | 0.000           | 153.245         |                  | 100.00   | 0.000                                            | 0.000                                             |
| L2<br>127.09-91.90   | 109.34 | 1.408          | 23             | 118.708         | A                | 0.000           | 118.708         | 118.708          | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | B                | 0.000           | 118.708         |                  | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | C                | 0.000           | 118.708         |                  | 100.00   | 0.000                                            | 0.000                                             |
| L3<br>91.90-45.50    | 68.72  | 1.233          | 20             | 176.444         | A                | 0.000           | 176.444         | 176.444          | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | B                | 0.000           | 176.444         |                  | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | C                | 0.000           | 176.444         |                  | 100.00   | 0.000                                            | 0.000                                             |
| L4<br>45.50-0.00     | 22.33  | 1              | 16             | 194.571         | A                | 0.000           | 194.571         | 194.571          | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | B                | 0.000           | 194.571         |                  | 100.00   | 0.000                                            | 0.000                                             |
|                      |        |                |                |                 | C                | 0.000           | 194.571         |                  | 100.00   | 0.000                                            | 0.000                                             |

### Tower Pressure - With Ice

$$G_H = 1.690$$

| Section<br>Elevation | z      | K <sub>Z</sub> | q <sub>z</sub> | t <sub>z</sub> | A <sub>G</sub>  | F<br>a<br>c<br>e | A <sub>F</sub>  | A <sub>R</sub>  | A <sub>leg</sub> | Leg<br>% | C <sub>AA</sub><br>In<br>Face<br>ft <sup>2</sup> | C <sub>AA</sub><br>Out<br>Face<br>ft <sup>2</sup> |
|----------------------|--------|----------------|----------------|----------------|-----------------|------------------|-----------------|-----------------|------------------|----------|--------------------------------------------------|---------------------------------------------------|
| ft                   | ft     |                | psf            | in             | ft <sup>2</sup> |                  | ft <sup>2</sup> | ft <sup>2</sup> | ft <sup>2</sup>  |          |                                                  |                                                   |
| L1                   | 152.93 | 1.55           | 19             | 0.5000         | 157.654         | A                | 0.000           | 157.654         | 157.654          | 100.00   | 0.000                                            | 0.000                                             |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 6 of 20           |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Section<br>Elevation | z      | K <sub>Z</sub> | q <sub>z</sub> | t <sub>z</sub> | A <sub>G</sub>  | F<br>a<br>c<br>e | A <sub>F</sub>  | A <sub>R</sub>  | A <sub>leg</sub> | Leg<br>% | C <sub>A</sub> A <sub>A</sub><br>In<br>Face<br>ft <sup>2</sup> | C <sub>A</sub> A <sub>A</sub><br>Out<br>Face<br>ft <sup>2</sup> |
|----------------------|--------|----------------|----------------|----------------|-----------------|------------------|-----------------|-----------------|------------------|----------|----------------------------------------------------------------|-----------------------------------------------------------------|
| ft                   | ft     |                | psf            | in             | ft <sup>2</sup> |                  | ft <sup>2</sup> | ft <sup>2</sup> | ft <sup>2</sup>  |          |                                                                |                                                                 |
| 180.00-127.09        |        |                |                |                |                 | B                | 0.000           | 157.654         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L2 127.09-91.90      | 109.34 | 1.408          | 17             | 0.5000         | 121.640         | C                | 0.000           | 157.654         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | A                | 0.000           | 121.640         | 121.640          | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | B                | 0.000           | 121.640         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | C                | 0.000           | 121.640         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L3 91.90-45.50       | 68.72  | 1.233          | 15             | 0.5000         | 180.311         | A                | 0.000           | 180.311         | 180.311          | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | B                | 0.000           | 180.311         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | C                | 0.000           | 180.311         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L4 45.50-0.00        | 22.33  | 1              | 12             | 0.5000         | 198.362         | A                | 0.000           | 198.362         | 198.362          | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | B                | 0.000           | 198.362         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                |                 | C                | 0.000           | 198.362         |                  | 100.00   | 0.000                                                          | 0.000                                                           |

### Tower Pressure - Service

$$G_H = 1.690$$

| Section<br>Elevation | z      | K <sub>Z</sub> | q <sub>z</sub> | A <sub>G</sub>  | F<br>a<br>c<br>e | A <sub>F</sub>  | A <sub>R</sub>  | A <sub>leg</sub> | Leg<br>% | C <sub>A</sub> A <sub>A</sub><br>In<br>Face<br>ft <sup>2</sup> | C <sub>A</sub> A <sub>A</sub><br>Out<br>Face<br>ft <sup>2</sup> |
|----------------------|--------|----------------|----------------|-----------------|------------------|-----------------|-----------------|------------------|----------|----------------------------------------------------------------|-----------------------------------------------------------------|
| ft                   | ft     |                | psf            | ft <sup>2</sup> |                  | ft <sup>2</sup> | ft <sup>2</sup> | ft <sup>2</sup>  |          |                                                                |                                                                 |
| L1                   | 152.93 | 1.55           | 10             | 153.245         | A                | 0.000           | 153.245         | 153.245          | 100.00   | 0.000                                                          | 0.000                                                           |
| 180.00-127.09        |        |                |                |                 | B                | 0.000           | 153.245         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | C                | 0.000           | 153.245         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L2                   | 109.34 | 1.408          | 9              | 118.708         | A                | 0.000           | 118.708         | 118.708          | 100.00   | 0.000                                                          | 0.000                                                           |
| 127.09-91.90         |        |                |                |                 | B                | 0.000           | 118.708         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | C                | 0.000           | 118.708         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L3 91.90-45.50       | 68.72  | 1.233          | 8              | 176.444         | A                | 0.000           | 176.444         | 176.444          | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | B                | 0.000           | 176.444         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | C                | 0.000           | 176.444         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
| L4 45.50-0.00        | 22.33  | 1              | 6              | 194.571         | A                | 0.000           | 194.571         | 194.571          | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | B                | 0.000           | 194.571         |                  | 100.00   | 0.000                                                          | 0.000                                                           |
|                      |        |                |                |                 | C                | 0.000           | 194.571         |                  | 100.00   | 0.000                                                          | 0.000                                                           |

### Tower Forces - No Ice - Wind Normal To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F         | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-----------------|-----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup> | lb        | plf   |               |
| L1                   | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245         | 4268.642  | 80.67 | C             |
| 180.00-127.09        |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245         |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245         |           |       |               |
| L2                   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708         | 3004.880  | 85.40 | C             |
| 127.09-91.90         |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708         |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708         |           |       |               |
| L3                   | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444         | 3895.161  | 83.95 | C             |
| 91.90-45.50          |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444         |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444         |           |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571         | 3516.437  | 77.28 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571         |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571         |           |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 1327.52         | 14685.120 |       |               |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 7 of 20           |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F  | w   | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-----------------|----|-----|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup> | lb | plf |               |
|                      |               |                |                  |   |                |                |                |                | kip-ft          |    |     |               |

### Tower Forces - No Ice - Wind 45 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>    | F         | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-------------------|-----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>   | lb        | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245           | 4268.642  | 80.67 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708           | 3004.880  | 85.40 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444           | 3895.161  | 83.95 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571           | 3516.437  | 77.28 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 1327.52<br>kip-ft | 14685.120 |       |               |

### Tower Forces - No Ice - Wind 60 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>    | F         | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-------------------|-----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>   | lb        | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245           | 4268.642  | 80.67 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708           | 3004.880  | 85.40 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444           | 3895.161  | 83.95 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571           | 3516.437  | 77.28 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 1327.52<br>kip-ft | 14685.120 |       |               |

### Tower Forces - No Ice - Wind 90 To Face

|                                                                                                                                                   |                |                                  |                    |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | <b>Job</b>     | Valmont 180' Monopole            | <b>Page</b>        | 8 of 20           |
|                                                                                                                                                   | <b>Project</b> | Greenwood Road East, Norfolk, CT | <b>Date</b>        | 09:55:49 01/31/12 |
|                                                                                                                                                   | <b>Client</b>  | Verizon                          | <b>Designed by</b> | Matthew Kapinos   |

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>    | F         | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-------------------|-----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>   | lb        | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245           | 4268.642  | 80.67 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245           |           |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708           | 3004.880  | 85.40 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708           |           |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444           | 3895.161  | 83.95 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444           |           |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571           | 3516.437  | 77.28 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571           |           |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 1327.52<br>kip-ft | 14685.120 |       |               |

### Tower Forces - With Ice - Wind Normal To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>    | F         | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-------------------|-----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>   | lb        | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 5468.591       | A                | 1 | 0.65           | 1              | 1              | 1              | 157.654           | 3293.597  | 62.25 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 157.654           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 157.654           |           |       |               |
| L2<br>127.09-91.90   | 878.260       | 5848.500       | A                | 1 | 0.65           | 1              | 1              | 1              | 121.640           | 2309.326  | 65.63 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 121.640           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 121.640           |           |       |               |
| L3<br>91.90-45.50    | 1158.144      | 10920.128      | A                | 1 | 0.65           | 1              | 1              | 1              | 180.311           | 2985.388  | 64.34 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 180.311           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 180.311           |           |       |               |
| L4 45.50-0.00        | 1135.687      | 15785.826      | A                | 1 | 0.65           | 1              | 1              | 1              | 198.362           | 2688.720  | 59.09 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 198.362           |           |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 198.362           |           |       |               |
| Sum Weight:          | 4243.200      | 38023.045      |                  |   |                |                |                | OTM            | 1021.36<br>kip-ft | 11277.031 |       |               |

### Tower Forces - With Ice - Wind 45 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-----------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup> | lb       | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 5468.591       | A                | 1 | 0.65           | 1              | 1              | 1              | 157.654         | 3293.597 | 62.25 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 157.654         |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 157.654         |          |       |               |
| L2<br>127.09-91.90   | 878.260       | 5848.500       | A                | 1 | 0.65           | 1              | 1              | 1              | 121.640         | 2309.326 | 65.63 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 121.640         |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 121.640         |          |       |               |
| L3<br>91.90-45.50    | 1158.144      | 10920.128      | A                | 1 | 0.65           | 1              | 1              | 1              | 180.311         | 2985.388 | 64.34 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 180.311         |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 180.311         |          |       |               |



|                                                                                                                                                   |                                  |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job                              | Page              |
|                                                                                                                                                   | Valmont 180' Monopole            | 9 of 20           |
|                                                                                                                                                   | Project                          | Date              |
|                                                                                                                                                   | Greenwood Road East, Norfolk, CT | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client                           | Designed by       |
|                                                                                                                                                   | Verizon                          | Matthew Kapinos   |

| Section Elevation | Add Weight | Self Weight | F a c e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F         | w     | Ctrl. Face |
|-------------------|------------|-------------|---------|---|----------------|----------------|----------------|----------------|-----------------|-----------|-------|------------|
| ft                | lb         | lb          |         |   |                |                |                |                | ft <sup>2</sup> | lb        | plf   |            |
| L4 45.50-0.00     | 1135.687   | 15785.826   | A       | 1 | 0.65           | 1              | 1              | 1              | 198.362         | 2688.720  | 59.09 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
| Sum Weight:       | 4243.200   | 38023.045   |         |   |                |                |                | OTM            | 1021.36 kip-ft  | 11277.031 |       |            |

### Tower Forces - With Ice - Wind 60 To Face

| Section Elevation | Add Weight | Self Weight | F a c e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F         | w     | Ctrl. Face |
|-------------------|------------|-------------|---------|---|----------------|----------------|----------------|----------------|-----------------|-----------|-------|------------|
| ft                | lb         | lb          |         |   |                |                |                |                | ft <sup>2</sup> | lb        | plf   |            |
| L1 180.00-127.09  | 1071.108   | 5468.591    | A       | 1 | 0.65           | 1              | 1              | 1              | 157.654         | 3293.597  | 62.25 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 157.654         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 157.654         |           |       |            |
| L2 127.09-91.90   | 878.260    | 5848.500    | A       | 1 | 0.65           | 1              | 1              | 1              | 121.640         | 2309.326  | 65.63 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 121.640         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 121.640         |           |       |            |
| L3 91.90-45.50    | 1158.144   | 10920.128   | A       | 1 | 0.65           | 1              | 1              | 1              | 180.311         | 2985.388  | 64.34 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 180.311         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 180.311         |           |       |            |
| L4 45.50-0.00     | 1135.687   | 15785.826   | A       | 1 | 0.65           | 1              | 1              | 1              | 198.362         | 2688.720  | 59.09 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
| Sum Weight:       | 4243.200   | 38023.045   |         |   |                |                |                | OTM            | 1021.36 kip-ft  | 11277.031 |       |            |

### Tower Forces - With Ice - Wind 90 To Face

| Section Elevation | Add Weight | Self Weight | F a c e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F         | w     | Ctrl. Face |
|-------------------|------------|-------------|---------|---|----------------|----------------|----------------|----------------|-----------------|-----------|-------|------------|
| ft                | lb         | lb          |         |   |                |                |                |                | ft <sup>2</sup> | lb        | plf   |            |
| L1 180.00-127.09  | 1071.108   | 5468.591    | A       | 1 | 0.65           | 1              | 1              | 1              | 157.654         | 3293.597  | 62.25 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 157.654         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 157.654         |           |       |            |
| L2 127.09-91.90   | 878.260    | 5848.500    | A       | 1 | 0.65           | 1              | 1              | 1              | 121.640         | 2309.326  | 65.63 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 121.640         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 121.640         |           |       |            |
| L3 91.90-45.50    | 1158.144   | 10920.128   | A       | 1 | 0.65           | 1              | 1              | 1              | 180.311         | 2985.388  | 64.34 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 180.311         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 180.311         |           |       |            |
| L4 45.50-0.00     | 1135.687   | 15785.826   | A       | 1 | 0.65           | 1              | 1              | 1              | 198.362         | 2688.720  | 59.09 | C          |
|                   |            |             | B       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
|                   |            |             | C       | 1 | 0.65           | 1              | 1              | 1              | 198.362         |           |       |            |
| Sum Weight:       | 4243.200   | 38023.045   |         |   |                |                |                | OTM            | 1021.36 kip-ft  | 11277.031 |       |            |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 10 of 20          |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

### Tower Forces - Service - Wind Normal To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>   | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|------------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>  | lb       | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245          | 1667.438 | 31.51 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708          | 1173.781 | 33.36 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444          | 1521.547 | 32.79 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571          | 1373.608 | 30.19 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 518.56<br>kip-ft | 5736.375 |       |               |

### Tower Forces - Service - Wind 45 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>   | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|------------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>  | lb       | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245          | 1667.438 | 31.51 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708          | 1173.781 | 33.36 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444          | 1521.547 | 32.79 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571          | 1373.608 | 30.19 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 518.56<br>kip-ft | 5736.375 |       |               |

### Tower Forces - Service - Wind 60 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>  | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|-----------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup> | lb       | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245         | 1667.438 | 31.51 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245         |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245         |          |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708         | 1173.781 | 33.36 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708         |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708         |          |       |               |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 11 of 20          |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>   | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|------------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>  | lb       | plf   |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444          | 1521.547 | 32.79 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571          | 1373.608 | 30.19 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 518.56<br>kip-ft | 5736.375 |       |               |

### Tower Forces - Service - Wind 90 To Face

| Section<br>Elevation | Add<br>Weight | Self<br>Weight | F<br>a<br>c<br>e | e | C <sub>F</sub> | R <sub>R</sub> | D <sub>F</sub> | D <sub>R</sub> | A <sub>E</sub>   | F        | w     | Ctrl.<br>Face |
|----------------------|---------------|----------------|------------------|---|----------------|----------------|----------------|----------------|------------------|----------|-------|---------------|
| ft                   | lb            | lb             |                  |   |                |                |                |                | ft <sup>2</sup>  | lb       | plf   |               |
| L1<br>180.00-127.09  | 1071.108      | 4317.331       | A                | 1 | 0.65           | 1              | 1              | 1              | 153.245          | 1667.438 | 31.51 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 153.245          |          |       |               |
| L2<br>127.09-91.90   | 878.260       | 4958.495       | A                | 1 | 0.65           | 1              | 1              | 1              | 118.708          | 1173.781 | 33.36 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 118.708          |          |       |               |
| L3<br>91.90-45.50    | 1158.144      | 9599.062       | A                | 1 | 0.65           | 1              | 1              | 1              | 176.444          | 1521.547 | 32.79 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 176.444          |          |       |               |
| L4 45.50-0.00        | 1135.687      | 14330.794      | A                | 1 | 0.65           | 1              | 1              | 1              | 194.571          | 1373.608 | 30.19 | C             |
|                      |               |                | B                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
|                      |               |                | C                | 1 | 0.65           | 1              | 1              | 1              | 194.571          |          |       |               |
| Sum Weight:          | 4243.200      | 33205.682      |                  |   |                |                |                | OTM            | 518.56<br>kip-ft | 5736.375 |       |               |

### Force Totals

| Load<br>Case             | Vertical<br>Forces | Sum of<br>Forces<br>X | Sum of<br>Forces<br>Z | Sum of<br>Overturning<br>Moments, M <sub>x</sub> | Sum of<br>Overturning<br>Moments, M <sub>z</sub> | Sum of Torques |
|--------------------------|--------------------|-----------------------|-----------------------|--------------------------------------------------|--------------------------------------------------|----------------|
|                          | lb                 | lb                    | lb                    | kip-ft                                           | kip-ft                                           | kip-ft         |
| Leg Weight               | 33205.682          |                       |                       |                                                  |                                                  |                |
| Bracing Weight           | 0.000              |                       |                       |                                                  |                                                  |                |
| Total Member Self-Weight | 33205.682          |                       |                       |                                                  |                                                  |                |
| Total Weight             | 41235.482          |                       |                       | 0.00                                             | -0.00                                            |                |
| Wind 0 deg - No Ice      |                    | -21.784               | -22554.249            | 0.00                                             | -0.00                                            |                |
| Wind 30 deg - No Ice     |                    | 11270.836             | -19521.661            | -2664.51                                         | 3.48                                             | 0.30           |
| Wind 45 deg - No Ice     |                    | 15950.645             | -15932.859            | -2305.79                                         | -1331.25                                         | 0.35           |
| Wind 60 deg - No Ice     |                    | 19543.445             | -11258.259            | -1881.63                                         | -1884.48                                         | 0.33           |
| Wind 90 deg - No Ice     |                    | 22579.403             | 21.784                | -1329.24                                         | -2309.28                                         | 0.30           |
| Wind 120 deg - No Ice    |                    | 19565.228             | 11295.990             | 3.49                                             | -2668.54                                         | 0.17           |
| Wind 135 deg - No Ice    |                    | 15981.452             | 15963.666             | 1335.28                                          | -2312.76                                         | 0.00           |
| Wind 150 deg - No Ice    |                    | 11308.567             | 19543.445             | 1886.56                                          | -1889.41                                         | -0.09          |
| Wind 180 deg - No Ice    |                    | 21.784                | 22554.249             | 2309.28                                          | -1337.29                                         | -0.17          |
| Wind 210 deg - No Ice    |                    | -11270.836            | 19521.661             | 2664.51                                          | -3.49                                            | -0.30          |
| Wind 225 deg - No Ice    |                    | -15950.645            | 15932.859             | 2305.79                                          | 1331.25                                          | -0.35          |
|                          |                    |                       |                       | 1881.63                                          | 1884.47                                          | -0.33          |

|                                                                                                                                                   |         |                                  |                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|--------------------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page<br>12 of 20               |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date<br>09:55:49 01/31/12      |
|                                                                                                                                                   | Client  | Verizon                          | Designed by<br>Matthew Kapinos |

| Load Case              | Vertical Forces<br>lb | Sum of Forces X<br>lb | Sum of Forces Z<br>lb | Sum of Overturning Moments, M <sub>x</sub><br>kip-ft | Sum of Overturning Moments, M <sub>z</sub><br>kip-ft | Sum of Torques<br>kip-ft |
|------------------------|-----------------------|-----------------------|-----------------------|------------------------------------------------------|------------------------------------------------------|--------------------------|
| Wind 240 deg - No Ice  |                       | -19543.445            | 11258.259             | 1329.24                                              | 2309.28                                              | -0.30                    |
| Wind 270 deg - No Ice  |                       | -22579.403            | -21.784               | -3.48                                                | 2668.53                                              | -0.17                    |
| Wind 300 deg - No Ice  |                       | -19565.228            | -11295.990            | -1335.27                                             | 2312.76                                              | 0.00                     |
| Wind 315 deg - No Ice  |                       | -15981.452            | -15963.666            | -1886.56                                             | 1889.40                                              | 0.09                     |
| Wind 330 deg - No Ice  |                       | -11308.567            | -19543.445            | -2309.28                                             | 1337.28                                              | 0.17                     |
| Member Ice             | 4817.363              |                       |                       |                                                      |                                                      |                          |
| Total Weight Ice       | 48066.896             |                       |                       | 0.01                                                 | -0.02                                                |                          |
| Wind 0 deg - Ice       |                       | -17.294               | -17955.789            | -2156.72                                             | 2.74                                                 | 0.24                     |
| Wind 30 deg - Ice      |                       | 8972.902              | -15541.522            | -1866.39                                             | -1077.59                                             | 0.28                     |
| Wind 45 deg - Ice      |                       | 12698.552             | -12684.431            | -1523.07                                             | -1525.37                                             | 0.27                     |
| Wind 60 deg - Ice      |                       | 15558.817             | -8962.917             | -1075.96                                             | -1869.19                                             | 0.24                     |
| Wind 90 deg - Ice      |                       | 17975.759             | 17.294                | 2.78                                                 | -2159.95                                             | 0.14                     |
| Wind 120 deg - Ice     |                       | 15576.111             | 8992.872              | 1080.78                                              | -1871.96                                             | 0.00                     |
| Wind 135 deg - Ice     |                       | 12723.010             | 12708.889             | 1527.01                                              | -1529.28                                             | -0.07                    |
| Wind 150 deg - Ice     |                       | 9002.857              | 15558.817             | 1869.18                                              | -1082.39                                             | -0.14                    |
| Wind 180 deg - Ice     |                       | 17.294                | 17955.789             | 2156.75                                              | -2.79                                                | -0.24                    |
| Wind 210 deg - Ice     |                       | -8972.902             | 15541.522             | 1866.42                                              | 1077.54                                              | -0.28                    |
| Wind 225 deg - Ice     |                       | -12698.552            | 12684.431             | 1523.10                                              | 1525.32                                              | -0.27                    |
| Wind 240 deg - Ice     |                       | -15558.817            | 8962.917              | 1075.98                                              | 1869.15                                              | -0.24                    |
| Wind 270 deg - Ice     |                       | -17975.759            | -17.294               | -2.75                                                | 2159.91                                              | -0.14                    |
| Wind 300 deg - Ice     |                       | -15576.111            | -8992.872             | -1080.75                                             | 1871.91                                              | 0.00                     |
| Wind 315 deg - Ice     |                       | -12723.010            | -12708.889            | -1526.98                                             | 1529.23                                              | 0.07                     |
| Wind 330 deg - Ice     |                       | -9002.857             | -15558.817            | -1869.16                                             | 1082.34                                              | 0.14                     |
| Total Weight           | 41235.482             |                       |                       | 0.00                                                 | -0.00                                                |                          |
| Wind 0 deg - Service   |                       | -8.509                | -8810.253             | -1040.82                                             | 1.36                                                 | 0.12                     |
| Wind 30 deg - Service  |                       | 4402.670              | -7625.649             | -900.70                                              | -520.02                                              | 0.13                     |
| Wind 45 deg - Service  |                       | 6230.721              | -6223.773             | -735.01                                              | -736.12                                              | 0.13                     |
| Wind 60 deg - Service  |                       | 7634.158              | -4397.757             | -519.23                                              | -902.06                                              | 0.12                     |
| Wind 90 deg - Service  |                       | 8820.079              | 8.509                 | 1.36                                                 | -1042.40                                             | 0.07                     |
| Wind 120 deg - Service |                       | 7642.667              | 4412.496              | 521.59                                               | -903.42                                              | 0.00                     |
| Wind 135 deg - Service |                       | 6242.755              | 6235.807              | 736.94                                               | -738.05                                              | -0.03                    |
| Wind 150 deg - Service |                       | 4417.409              | 7634.158              | 902.06                                               | -522.38                                              | -0.07                    |
| Wind 180 deg - Service |                       | 8.509                 | 8810.253              | 1040.83                                              | -1.36                                                | -0.12                    |
| Wind 210 deg - Service |                       | -4402.670             | 7625.649              | 900.70                                               | 520.02                                               | -0.13                    |
| Wind 225 deg - Service |                       | -6230.721             | 6223.773              | 735.01                                               | 736.12                                               | -0.13                    |
| Wind 240 deg - Service |                       | -7634.158             | 4397.757              | 519.23                                               | 902.06                                               | -0.12                    |
| Wind 270 deg - Service |                       | -8820.079             | -8.509                | -1.36                                                | 1042.40                                              | -0.07                    |
| Wind 300 deg - Service |                       | -7642.667             | -4412.496             | -521.59                                              | 903.42                                               | 0.00                     |
| Wind 315 deg - Service |                       | -6242.755             | -6235.807             | -736.94                                              | 738.05                                               | 0.03                     |
| Wind 330 deg - Service |                       | -4417.409             | -7634.158             | -902.06                                              | 522.38                                               | 0.07                     |

## Load Combinations

| Comb. No. | Description                |
|-----------|----------------------------|
| 1         | Dead Only                  |
| 2         | Dead+Wind 0 deg - No Ice   |
| 3         | Dead+Wind 30 deg - No Ice  |
| 4         | Dead+Wind 45 deg - No Ice  |
| 5         | Dead+Wind 60 deg - No Ice  |
| 6         | Dead+Wind 90 deg - No Ice  |
| 7         | Dead+Wind 120 deg - No Ice |
| 8         | Dead+Wind 135 deg - No Ice |
| 9         | Dead+Wind 150 deg - No Ice |
| 10        | Dead+Wind 180 deg - No Ice |
| 11        | Dead+Wind 210 deg - No Ice |



|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 13 of 20          |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Comb. No. | Description                  |
|-----------|------------------------------|
| 12        | Dead+ Wind 225 deg - No Ice  |
| 13        | Dead+ Wind 240 deg - No Ice  |
| 14        | Dead+ Wind 270 deg - No Ice  |
| 15        | Dead+ Wind 300 deg - No Ice  |
| 16        | Dead+ Wind 315 deg - No Ice  |
| 17        | Dead+ Wind 330 deg - No Ice  |
| 18        | Dead+ Ice+Temp               |
| 19        | Dead+ Wind 0 deg+Ice+Temp    |
| 20        | Dead+ Wind 30 deg+Ice+Temp   |
| 21        | Dead+ Wind 45 deg+Ice+Temp   |
| 22        | Dead+ Wind 60 deg+Ice+Temp   |
| 23        | Dead+ Wind 90 deg+Ice+Temp   |
| 24        | Dead+ Wind 120 deg+Ice+Temp  |
| 25        | Dead+ Wind 135 deg+Ice+Temp  |
| 26        | Dead+ Wind 150 deg+Ice+Temp  |
| 27        | Dead+ Wind 180 deg+Ice+Temp  |
| 28        | Dead+ Wind 210 deg+Ice+Temp  |
| 29        | Dead+ Wind 225 deg+Ice+Temp  |
| 30        | Dead+ Wind 240 deg+Ice+Temp  |
| 31        | Dead+ Wind 270 deg+Ice+Temp  |
| 32        | Dead+ Wind 300 deg+Ice+Temp  |
| 33        | Dead+ Wind 315 deg+Ice+Temp  |
| 34        | Dead+ Wind 330 deg+Ice+Temp  |
| 35        | Dead+ Wind 0 deg - Service   |
| 36        | Dead+ Wind 30 deg - Service  |
| 37        | Dead+ Wind 45 deg - Service  |
| 38        | Dead+ Wind 60 deg - Service  |
| 39        | Dead+ Wind 90 deg - Service  |
| 40        | Dead+ Wind 120 deg - Service |
| 41        | Dead+ Wind 135 deg - Service |
| 42        | Dead+ Wind 150 deg - Service |
| 43        | Dead+ Wind 180 deg - Service |
| 44        | Dead+ Wind 210 deg - Service |
| 45        | Dead+ Wind 225 deg - Service |
| 46        | Dead+ Wind 240 deg - Service |
| 47        | Dead+ Wind 270 deg - Service |
| 48        | Dead+ Wind 300 deg - Service |
| 49        | Dead+ Wind 315 deg - Service |
| 50        | Dead+ Wind 330 deg - Service |

## Maximum Member Forces

| Section No. | Elevation ft      | Component Type | Condition        | Gov. Load Comb. | Force lb   | Major Axis Moment kip-ft | Minor Axis Moment kip-ft |
|-------------|-------------------|----------------|------------------|-----------------|------------|--------------------------|--------------------------|
| L1          | 180 - 127.087     | Pole           | Max Tension      | 1               | 0.000      | 0.00                     | 0.00                     |
|             |                   |                | Max. Compression | 18              | -11562.108 | -0.02                    | -0.01                    |
|             |                   |                | Max. Mx          | 6               | -7872.085  | -393.20                  | -0.61                    |
|             |                   |                | Max. My          | 10              | -7874.653  | -0.60                    | -392.50                  |
|             |                   |                | Max. Vy          | 6               | 12120.935  | -393.20                  | -0.61                    |
|             |                   |                | Max. Vx          | 2               | -12095.061 | 0.62                     | 392.50                   |
|             |                   |                | Max. Torque      | 3               |            |                          | -0.34                    |
|             |                   |                | Max Tension      | 1               | 0.000      | 0.00                     | 0.00                     |
| L2          | 127.087 - 91.9003 | Pole           | Max. Compression | 18              | -17898.972 | -0.02                    | -0.01                    |
|             |                   |                | Max. Mx          | 6               | -13400.100 | -864.91                  | -1.39                    |
|             |                   |                | Max. My          | 10              | -13402.196 | -1.39                    | -863.30                  |
|             |                   |                | Max. Vy          | 6               | 15168.287  | -864.91                  | -1.39                    |
|             |                   |                | Max. Vx          | 2               | -15142.221 | 1.39                     | 863.30                   |
|             |                   |                |                  |                 |            |                          |                          |

|                                                                                                                                                   |         |                                  |                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|--------------------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page<br>14 of 20               |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date<br>09:55:49 01/31/12      |
|                                                                                                                                                   | Client  | Verizon                          | Designed by<br>Matthew Kapinos |

| Section No. | Elevation ft      | Component Type | Condition        | Gov. Load Comb. | Force lb   | Major Axis Moment kip-ft | Minor Axis Moment kip-ft |
|-------------|-------------------|----------------|------------------|-----------------|------------|--------------------------|--------------------------|
| L3          | 91.9003 - 45.5003 | Pole           | Max. Torque      | 3               |            |                          | -0.34                    |
|             |                   |                | Max Tension      | 1               | 0.000      | 0.00                     | 0.00                     |
|             |                   |                | Max. Compression | 18              | -29336.357 | -0.02                    | -0.01                    |
|             |                   |                | Max. Mx          | 6               | -23777.163 | -1646.82                 | -2.42                    |
|             |                   |                | Max. My          | 10              | -23778.351 | -2.42                    | -1644.03                 |
|             |                   |                | Max. Vy          | 6               | 18969.904  | -1646.82                 | -2.42                    |
|             |                   |                | Max. Vx          | 10              | 18943.941  | -2.42                    | -1644.03                 |
|             |                   |                | Max. Torque      | 3               |            |                          | -0.34                    |
| L4          | 45.5003 - 0       | Pole           | Max Tension      | 1               | 0.000      | 0.00                     | 0.00                     |
|             |                   |                | Max. Compression | 18              | -48066.896 | -0.02                    | -0.01                    |
|             |                   |                | Max. Mx          | 6               | -41223.766 | -2746.56                 | -3.60                    |
|             |                   |                | Max. My          | 10              | -41223.797 | -3.60                    | -2742.42                 |
|             |                   |                | Max. Vy          | 6               | 22600.789  | -2746.56                 | -3.60                    |
|             |                   |                | Max. Vx          | 10              | 22575.603  | -3.60                    | -2742.42                 |
|             |                   |                | Max. Torque      | 3               |            |                          | -0.34                    |
|             |                   |                | Max. Torque      | 3               |            |                          | -0.34                    |

### Maximum Reactions

| Location | Condition           | Gov. Load Comb. | Vertical lb | Horizontal, X lb | Horizontal, Z lb |
|----------|---------------------|-----------------|-------------|------------------|------------------|
| Pole     | Max. Vert           | 23              | 48066.896   | -17975.765       | -17.294          |
|          | Max. H <sub>x</sub> | 14              | 41235.482   | 22579.406        | 21.784           |
|          | Max. H <sub>z</sub> | 2               | 41235.482   | 21.784           | 22554.252        |
|          | Max. M <sub>x</sub> | 2               | 2742.41     | 21.784           | 22554.252        |
|          | Max. M <sub>z</sub> | 6               | 2746.56     | -22579.406       | -21.784          |
|          | Max. Torsion        | 11              | 0.34        | 11270.836        | -19521.661       |
|          | Min. Vert           | 1               | 41235.482   | -4.262           | -2.461           |
|          | Min. H <sub>x</sub> | 6               | 41235.482   | -22579.406       | -21.784          |
|          | Min. H <sub>z</sub> | 10              | 41235.482   | -21.784          | -22554.252       |
|          | Min. M <sub>x</sub> | 10              | -2742.42    | -21.784          | -22554.252       |
|          | Min. M <sub>z</sub> | 14              | -2746.56    | 22579.406        | 21.784           |
|          | Min. Torsion        | 3               | -0.34       | -11270.836       | 19521.661        |

### Tower Mast Reaction Summary

| Load Combination           | Vertical lb | Shear <sub>x</sub> lb | Shear <sub>z</sub> lb | Overturning Moment, M <sub>x</sub> kip-ft | Overturning Moment, M <sub>z</sub> kip-ft | Torque kip-ft |
|----------------------------|-------------|-----------------------|-----------------------|-------------------------------------------|-------------------------------------------|---------------|
| Dead Only                  | 41235.482   | 4.262                 | 2.461                 | 0.00                                      | -0.01                                     | 0.00          |
| Dead+Wind 0 deg - No Ice   | 41235.482   | -21.784               | -22554.252            | -2742.41                                  | 3.60                                      | 0.30          |
| Dead+Wind 30 deg - No Ice  | 41235.482   | 11270.836             | -19521.661            | -2373.21                                  | -1370.17                                  | 0.34          |
| Dead+Wind 45 deg - No Ice  | 41235.482   | 15950.645             | -15932.859            | -1936.64                                  | -1939.58                                  | 0.33          |
| Dead+Wind 60 deg - No Ice  | 41235.482   | 19543.445             | -11258.259            | -1368.09                                  | -2376.80                                  | 0.30          |
| Dead+Wind 90 deg - No Ice  | 41235.482   | 22579.406             | 21.784                | 3.60                                      | -2746.56                                  | 0.17          |
| Dead+Wind 120 deg - No Ice | 41235.482   | 19565.229             | 11295.990             | 1374.32                                   | -2380.39                                  | 0.00          |
| Dead+Wind 135 deg - No Ice | 41235.482   | 15981.453             | 15963.666             | 1941.72                                   | -1944.66                                  | -0.09         |
| Dead+Wind 150 deg - No Ice | 41235.482   | 11308.567             | 19543.445             | 2376.80                                   | -1376.40                                  | -0.17         |
| Dead+Wind 180 deg - No Ice | 41235.482   | 21.784                | 22554.252             | 2742.42                                   | -3.60                                     | -0.30         |
| Dead+Wind 210 deg - No Ice | 41235.482   | -11270.836            | 19521.661             | 2373.21                                   | 1370.17                                   | -0.34         |
| Dead+Wind 225 deg - No Ice | 41235.482   | -15950.645            | 15932.859             | 1936.64                                   | 1939.58                                   | -0.33         |
| Dead+Wind 240 deg - No Ice | 41235.482   | -19543.445            | 11258.259             | 1368.09                                   | 2376.80                                   | -0.30         |

|                                                                                                                                                   |         |                                  |             |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|-------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page        | 15 of 20          |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date        | 09:55:49 01/31/12 |
|                                                                                                                                                   | Client  | Verizon                          | Designed by | Matthew Kapinos   |

| Load Combination            | Vertical<br>lb | Shear <sub>x</sub><br>lb | Shear <sub>y</sub><br>lb | Overturning<br>Moment, M <sub>x</sub><br>kip-ft | Overturning<br>Moment, M <sub>y</sub><br>kip-ft | Torque<br>kip-ft |
|-----------------------------|----------------|--------------------------|--------------------------|-------------------------------------------------|-------------------------------------------------|------------------|
| Dead+Wind 270 deg - No Ice  | 41235.482      | -22579.406               | -21.784                  | -3.60                                           | 2746.56                                         | -0.17            |
| Dead+Wind 300 deg - No Ice  | 41235.482      | -19565.229               | -11295.990               | -1374.32                                        | 2380.39                                         | 0.00             |
| Dead+Wind 315 deg - No Ice  | 41235.482      | -15981.453               | -15963.666               | -1941.72                                        | 1944.66                                         | 0.09             |
| Dead+Wind 330 deg - No Ice  | 41235.482      | -11308.567               | -19543.445               | -2376.79                                        | 1376.40                                         | 0.17             |
| Dead+Ice+Temp               | 48066.896      | 0.000                    | 0.000                    | 0.01                                            | -0.02                                           | 0.00             |
| Dead+Wind 0 deg+Ice+Temp    | 48066.896      | -17.294                  | -17955.796               | -2239.20                                        | 2.86                                            | 0.24             |
| Dead+Wind 30 deg+Ice+Temp   | 48066.896      | 8972.905                 | -15541.528               | -1937.76                                        | -1118.80                                        | 0.28             |
| Dead+Wind 45 deg+Ice+Temp   | 48066.896      | 12698.556                | -12684.436               | -1581.31                                        | -1583.70                                        | 0.27             |
| Dead+Wind 60 deg+Ice+Temp   | 48066.896      | 15558.822                | -8962.920                | -1117.10                                        | -1940.68                                        | 0.24             |
| Dead+Wind 90 deg+Ice+Temp   | 48066.896      | 17975.765                | 17.294                   | 2.90                                            | -2242.56                                        | 0.14             |
| Dead+Wind 120 deg+Ice+Temp  | 48066.896      | 15576.117                | 8992.875                 | 1122.11                                         | -1943.56                                        | 0.00             |
| Dead+Wind 135 deg+Ice+Temp  | 48066.896      | 12723.014                | 12708.894                | 1585.41                                         | -1587.78                                        | -0.07            |
| Dead+Wind 150 deg+Ice+Temp  | 48066.896      | 9002.860                 | 15558.822                | 1940.67                                         | -1123.79                                        | -0.14            |
| Dead+Wind 180 deg+Ice+Temp  | 48066.896      | 17.294                   | 17955.796                | 2239.23                                         | -2.91                                           | -0.24            |
| Dead+Wind 210 deg+Ice+Temp  | 48066.896      | -8972.905                | 15541.528                | 1937.79                                         | 1118.75                                         | -0.28            |
| Dead+Wind 225 deg+Ice+Temp  | 48066.896      | -12698.556               | 12684.436                | 1581.34                                         | 1583.65                                         | -0.27            |
| Dead+Wind 240 deg+Ice+Temp  | 48066.896      | -15558.822               | 8962.920                 | 1117.12                                         | 1940.63                                         | -0.24            |
| Dead+Wind 270 deg+Ice+Temp  | 48066.896      | -17975.765               | -17.294                  | -2.87                                           | 2242.51                                         | -0.14            |
| Dead+Wind 300 deg+Ice+Temp  | 48066.896      | -15576.117               | -8992.875                | -1122.08                                        | 1943.51                                         | 0.00             |
| Dead+Wind 315 deg+Ice+Temp  | 48066.896      | -12723.014               | -12708.894               | -1585.38                                        | 1587.72                                         | 0.07             |
| Dead+Wind 330 deg+Ice+Temp  | 48066.896      | -9002.860                | -15558.822               | -1940.64                                        | 1123.74                                         | 0.14             |
| Dead+Wind 0 deg - Service   | 41235.482      | -8.509                   | -8810.255                | -1071.85                                        | 1.40                                            | 0.12             |
| Dead+Wind 30 deg - Service  | 41235.482      | 4402.671                 | -7625.650                | -927.55                                         | -535.52                                         | 0.13             |
| Dead+Wind 45 deg - Service  | 41235.482      | 6230.722                 | -6223.774                | -756.92                                         | -758.07                                         | 0.13             |
| Dead+Wind 60 deg - Service  | 41235.482      | 7634.159                 | -4397.758                | -534.71                                         | -928.96                                         | 0.12             |
| Dead+Wind 90 deg - Service  | 41235.482      | 8820.081                 | 8.509                    | 1.41                                            | -1073.48                                        | 0.07             |
| Dead+Wind 120 deg - Service | 41235.482      | 7642.668                 | 4412.497                 | 537.15                                          | -930.36                                         | 0.00             |
| Dead+Wind 135 deg - Service | 41235.482      | 6242.756                 | 6235.808                 | 758.91                                          | -760.06                                         | -0.03            |
| Dead+Wind 150 deg - Service | 41235.482      | 4417.410                 | 7634.159                 | 928.96                                          | -537.96                                         | -0.07            |
| Dead+Wind 180 deg - Service | 41235.482      | 8.509                    | 8810.255                 | 1071.85                                         | -1.41                                           | -0.12            |
| Dead+Wind 210 deg - Service | 41235.482      | -4402.671                | 7625.650                 | 927.55                                          | 535.52                                          | -0.13            |
| Dead+Wind 225 deg - Service | 41235.482      | -6230.722                | 6223.774                 | 756.92                                          | 758.07                                          | -0.13            |
| Dead+Wind 240 deg - Service | 41235.482      | -7634.159                | 4397.758                 | 534.71                                          | 928.95                                          | -0.12            |
| Dead+Wind 270 deg - Service | 41235.482      | -8820.081                | -8.509                   | -1.41                                           | 1073.48                                         | -0.07            |
| Dead+Wind 300 deg - Service | 41235.482      | -7642.668                | -4412.497                | -537.14                                         | 930.36                                          | 0.00             |
| Dead+Wind 315 deg - Service | 41235.482      | -6242.756                | -6235.808                | -758.91                                         | 760.06                                          | 0.03             |
| Dead+Wind 330 deg - Service | 41235.482      | -4417.410                | -7634.159                | -928.95                                         | 537.95                                          | 0.07             |

## Solution Summary

| Load Comb. | Sum of Applied Forces |            |            | Sum of Reactions |           |            | % Error |
|------------|-----------------------|------------|------------|------------------|-----------|------------|---------|
|            | PX<br>lb              | PY<br>lb   | PZ<br>lb   | PX<br>lb         | PY<br>lb  | PZ<br>lb   |         |
| 1          | 0.000                 | -41235.482 | 0.000      | -4.262           | 41235.482 | -2.461     | 0.012%  |
| 2          | -21.784               | -41235.482 | -22554.249 | 21.784           | 41235.482 | 22554.252  | 0.000%  |
| 3          | 11270.836             | -41235.482 | -19521.661 | -11270.836       | 41235.482 | 19521.661  | 0.000%  |
| 4          | 15950.645             | -41235.482 | -15932.859 | -15950.645       | 41235.482 | 15932.859  | 0.000%  |
| 5          | 19543.445             | -41235.482 | -11258.259 | -19543.445       | 41235.482 | 11258.259  | 0.000%  |
| 6          | 22579.403             | -41235.482 | 21.784     | -22579.406       | 41235.482 | -21.784    | 0.000%  |
| 7          | 19565.228             | -41235.482 | 11295.990  | -19565.229       | 41235.482 | -11295.990 | 0.000%  |
| 8          | 15981.452             | -41235.482 | 15963.666  | -15981.453       | 41235.482 | -15963.666 | 0.000%  |
| 9          | 11308.567             | -41235.482 | 19543.445  | -11308.567       | 41235.482 | -19543.445 | 0.000%  |
| 10         | 21.784                | -41235.482 | 22554.249  | -21.784          | 41235.482 | -22554.252 | 0.000%  |
| 11         | -11270.836            | -41235.482 | 19521.661  | 11270.836        | 41235.482 | -19521.661 | 0.000%  |
| 12         | -15950.645            | -41235.482 | 15932.859  | 15950.645        | 41235.482 | -15932.859 | 0.000%  |
| 13         | -19543.445            | -41235.482 | 11258.259  | 19543.445        | 41235.482 | -11258.259 | 0.000%  |
| 14         | -22579.403            | -41235.482 | -21.784    | 22579.406        | 41235.482 | 21.784     | 0.000%  |
| 15         | -19565.228            | -41235.482 | -11295.990 | 19565.229        | 41235.482 | 11295.990  | 0.000%  |

|                                                                                                                                                   |         |                                  |                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------|--------------------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | Job     | Valmont 180' Monopole            | Page<br>16 of 20               |
|                                                                                                                                                   | Project | Greenwood Road East, Norfolk, CT | Date<br>09:55:49 01/31/12      |
|                                                                                                                                                   | Client  | Verizon                          | Designed by<br>Matthew Kapinos |

| Load<br>Comb. | Sum of Applied Forces |            |            | Sum of Reactions |           |            | % Error |
|---------------|-----------------------|------------|------------|------------------|-----------|------------|---------|
|               | PX<br>lb              | PY<br>lb   | PZ<br>lb   | PX<br>lb         | PY<br>lb  | PZ<br>lb   |         |
| 16            | -15981.452            | -41235.482 | -15963.666 | 15981.453        | 41235.482 | 15963.666  | 0.000%  |
| 17            | -11308.567            | -41235.482 | -19543.445 | 11308.567        | 41235.482 | 19543.445  | 0.000%  |
| 18            | 0.000                 | -48066.896 | 0.000      | 0.000            | 48066.896 | 0.000      | 0.000%  |
| 19            | -17.294               | -48066.896 | -17955.789 | 17.294           | 48066.896 | 17955.796  | 0.000%  |
| 20            | 8972.902              | -48066.896 | -15541.522 | -8972.905        | 48066.896 | 15541.528  | 0.000%  |
| 21            | 12698.552             | -48066.896 | -12684.431 | -12698.556       | 48066.896 | 12684.436  | 0.000%  |
| 22            | 15558.817             | -48066.896 | -8962.917  | -15558.822       | 48066.896 | 8962.920   | 0.000%  |
| 23            | 17975.759             | -48066.896 | 17.294     | -17975.765       | 48066.896 | -17.294    | 0.000%  |
| 24            | 15576.111             | -48066.896 | 8992.872   | -15576.117       | 48066.896 | -8992.875  | 0.000%  |
| 25            | 12723.010             | -48066.896 | 12708.889  | -12723.014       | 48066.896 | -12708.894 | 0.000%  |
| 26            | 9002.857              | -48066.896 | 15558.817  | -9002.860        | 48066.896 | -15558.822 | 0.000%  |
| 27            | 17.294                | -48066.896 | 17955.789  | -17.294          | 48066.896 | -17955.796 | 0.000%  |
| 28            | -8972.902             | -48066.896 | 15541.522  | 8972.905         | 48066.896 | -15541.528 | 0.000%  |
| 29            | -12698.552            | -48066.896 | 12684.431  | 12698.556        | 48066.896 | -12684.436 | 0.000%  |
| 30            | -15558.817            | -48066.896 | 8962.917   | 15558.822        | 48066.896 | -8962.920  | 0.000%  |
| 31            | -17975.759            | -48066.896 | -17.294    | 17975.765        | 48066.896 | 17.294     | 0.000%  |
| 32            | -15576.111            | -48066.896 | -8992.872  | 15576.117        | 48066.896 | 8992.875   | 0.000%  |
| 33            | -12723.010            | -48066.896 | -12708.889 | 12723.014        | 48066.896 | 12708.894  | 0.000%  |
| 34            | -9002.857             | -48066.896 | -15558.817 | 9002.860         | 48066.896 | 15558.822  | 0.000%  |
| 35            | -8.509                | -41235.482 | -8810.253  | 8.509            | 41235.482 | 8810.255   | 0.000%  |
| 36            | 4402.670              | -41235.482 | -7625.649  | -4402.671        | 41235.482 | 7625.650   | 0.000%  |
| 37            | 6230.721              | -41235.482 | -6223.773  | -6230.722        | 41235.482 | 6223.774   | 0.000%  |
| 38            | 7634.158              | -41235.482 | -4397.757  | -7634.159        | 41235.482 | 4397.758   | 0.000%  |
| 39            | 8820.079              | -41235.482 | 8.509      | -8820.081        | 41235.482 | -8.509     | 0.000%  |
| 40            | 7642.667              | -41235.482 | 4412.496   | -7642.668        | 41235.482 | -4412.497  | 0.000%  |
| 41            | 6242.755              | -41235.482 | 6235.807   | -6242.756        | 41235.482 | -6235.808  | 0.000%  |
| 42            | 4417.409              | -41235.482 | 7634.158   | -4417.410        | 41235.482 | -7634.159  | 0.000%  |
| 43            | 8.509                 | -41235.482 | 8810.253   | -8.509           | 41235.482 | -8810.255  | 0.000%  |
| 44            | -4402.670             | -41235.482 | 7625.649   | 4402.671         | 41235.482 | -7625.650  | 0.000%  |
| 45            | -6230.721             | -41235.482 | 6223.773   | 6230.722         | 41235.482 | -6223.774  | 0.000%  |
| 46            | -7634.158             | -41235.482 | 4397.757   | 7634.159         | 41235.482 | -4397.758  | 0.000%  |
| 47            | -8820.079             | -41235.482 | -8.509     | 8820.081         | 41235.482 | 8.509      | 0.000%  |
| 48            | -7642.667             | -41235.482 | -4412.496  | 7642.668         | 41235.482 | 4412.497   | 0.000%  |
| 49            | -6242.755             | -41235.482 | -6235.807  | 6242.756         | 41235.482 | 6235.808   | 0.000%  |
| 50            | -4417.409             | -41235.482 | -7634.158  | 4417.410         | 41235.482 | 7634.159   | 0.000%  |

## Non-Linear Convergence Results

| Load<br>Combination | Converged? | Number<br>of Cycles | Displacement<br>Tolerance | Force<br>Tolerance |
|---------------------|------------|---------------------|---------------------------|--------------------|
| 1                   | Yes        | 4                   | 0.00000001                | 0.00005362         |
| 2                   | Yes        | 4                   | 0.00000001                | 0.00012366         |
| 3                   | Yes        | 5                   | 0.00000001                | 0.00025961         |
| 4                   | Yes        | 5                   | 0.00000001                | 0.00029127         |
| 5                   | Yes        | 5                   | 0.00000001                | 0.00025533         |
| 6                   | Yes        | 4                   | 0.00000001                | 0.00012656         |
| 7                   | Yes        | 5                   | 0.00000001                | 0.00025923         |
| 8                   | Yes        | 5                   | 0.00000001                | 0.00029317         |
| 9                   | Yes        | 5                   | 0.00000001                | 0.00026028         |
| 10                  | Yes        | 4                   | 0.00000001                | 0.00016463         |
| 11                  | Yes        | 5                   | 0.00000001                | 0.00025491         |
| 12                  | Yes        | 5                   | 0.00000001                | 0.00029129         |
| 13                  | Yes        | 5                   | 0.00000001                | 0.00025943         |
| 14                  | Yes        | 4                   | 0.00000001                | 0.00009577         |
| 15                  | Yes        | 5                   | 0.00000001                | 0.00025923         |
| 16                  | Yes        | 5                   | 0.00000001                | 0.00029317         |



|                                                                                                                                                   |                                  |                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------|
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|                                                                                                                                                   | <b>Project</b>                   | <b>Date</b>        |
|                                                                                                                                                   | Greenwood Road East, Norfolk, CT | 09:55:49 01/31/12  |
|                                                                                                                                                   | <b>Client</b>                    | <b>Designed by</b> |
|                                                                                                                                                   | Verizon                          | Matthew Kapinos    |

|    |     |   |            |            |
|----|-----|---|------------|------------|
| 17 | Yes | 5 | 0.00000001 | 0.00025794 |
| 18 | Yes | 4 | 0.00000001 | 0.00000001 |
| 19 | Yes | 5 | 0.00000001 | 0.00017277 |
| 20 | Yes | 5 | 0.00000001 | 0.00045927 |
| 21 | Yes | 5 | 0.00000001 | 0.00051606 |
| 22 | Yes | 5 | 0.00000001 | 0.00045538 |
| 23 | Yes | 5 | 0.00000001 | 0.00017296 |
| 24 | Yes | 5 | 0.00000001 | 0.00046008 |
| 25 | Yes | 5 | 0.00000001 | 0.00051900 |
| 26 | Yes | 5 | 0.00000001 | 0.00046103 |
| 27 | Yes | 5 | 0.00000001 | 0.00017284 |
| 28 | Yes | 5 | 0.00000001 | 0.00045498 |
| 29 | Yes | 5 | 0.00000001 | 0.00051606 |
| 30 | Yes | 5 | 0.00000001 | 0.00045910 |
| 31 | Yes | 5 | 0.00000001 | 0.00017292 |
| 32 | Yes | 5 | 0.00000001 | 0.00046002 |
| 33 | Yes | 5 | 0.00000001 | 0.00051894 |
| 34 | Yes | 5 | 0.00000001 | 0.00045884 |
| 35 | Yes | 4 | 0.00000001 | 0.00004607 |
| 36 | Yes | 4 | 0.00000001 | 0.00063607 |
| 37 | Yes | 4 | 0.00000001 | 0.00071947 |
| 38 | Yes | 4 | 0.00000001 | 0.00061385 |
| 39 | Yes | 4 | 0.00000001 | 0.00004406 |
| 40 | Yes | 4 | 0.00000001 | 0.00062957 |
| 41 | Yes | 4 | 0.00000001 | 0.00072507 |
| 42 | Yes | 4 | 0.00000001 | 0.00063522 |
| 43 | Yes | 4 | 0.00000001 | 0.00004791 |
| 44 | Yes | 4 | 0.00000001 | 0.00061192 |
| 45 | Yes | 4 | 0.00000001 | 0.00071955 |
| 46 | Yes | 4 | 0.00000001 | 0.00063488 |
| 47 | Yes | 4 | 0.00000001 | 0.00004290 |
| 48 | Yes | 4 | 0.00000001 | 0.00062956 |
| 49 | Yes | 4 | 0.00000001 | 0.00072508 |
| 50 | Yes | 4 | 0.00000001 | 0.00062316 |

### Maximum Tower Deflections - Service Wind

| Section No. | Elevation<br>ft   | Horz. Deflection<br>in | Gov. Load<br>Comb. | Tilt<br>° | Twist<br>° |
|-------------|-------------------|------------------------|--------------------|-----------|------------|
| L1          | 180 - 127.087     | 31.169                 | 40                 | 1.4515    | 0.0008     |
| L2          | 132.92 - 91.9003  | 17.523                 | 40                 | 1.2391    | 0.0005     |
| L3          | 98.4003 - 45.5003 | 9.578                  | 40                 | 0.9184    | 0.0003     |
| L4          | 52.7503 - 0       | 2.759                  | 40                 | 0.4685    | 0.0001     |

### Critical Deflections and Radius of Curvature - Service Wind

| Elevation<br>ft | Appurtenance                                 | Gov. Load<br>Comb. | Deflection<br>in | Tilt<br>° | Twist<br>° | Radius of Curvature<br>ft |
|-----------------|----------------------------------------------|--------------------|------------------|-----------|------------|---------------------------|
| 184.00          | Lightning Rod 2"x8"                          | 40                 | 31.169           | 1.4515    | 0.0008     | 63299                     |
| 180.50          | PiROD 13' Low Profile Platform<br>(Monopole) | 40                 | 31.169           | 1.4515    | 0.0008     | 63299                     |
| 180.00          | (4) 7770                                     | 40                 | 31.169           | 1.4515    | 0.0008     | 63299                     |
| 160.00          | PiROD 13' Low Profile Platform               | 40                 | 25.142           | 1.3841    | 0.0007     | 15824                     |

|                                                                                                                                                   |                |                                  |                    |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------------|-------------------|
| <b>tnxTower</b><br><br><b>URS Corporation</b><br>500 Enterprise Drive, Suite 3B<br>Rocky Hill, CT<br>Phone: (860) 529-8882<br>FAX: (860) 529-3991 | <b>Job</b>     | Valmont 180' Monopole            | <b>Page</b>        | 18 of 20          |
|                                                                                                                                                   | <b>Project</b> | Greenwood Road East, Norfolk, CT | <b>Date</b>        | 09:55:49 01/31/12 |
|                                                                                                                                                   | <b>Client</b>  | Verizon                          | <b>Designed by</b> | Matthew Kapinos   |

| Elevation  | Appurtenance | Gov. Load Comb. | Deflection | Tilt | Twist | Radius of Curvature |
|------------|--------------|-----------------|------------|------|-------|---------------------|
| ft         |              |                 | in         | °    | °     | ft                  |
| (Monopole) |              |                 |            |      |       |                     |

### Maximum Tower Deflections - Design Wind

| Section No. | Elevation         | Horz. Deflection | Gov. Load Comb. | Tilt   | Twist  |
|-------------|-------------------|------------------|-----------------|--------|--------|
|             | ft                | in               |                 | °      | °      |
| L1          | 180 - 127.087     | 79.666           | 7               | 3.7117 | 0.0021 |
| L2          | 132.92 - 91.9003  | 44.804           | 7               | 3.1689 | 0.0012 |
| L3          | 98.4003 - 45.5003 | 24.495           | 7               | 2.3492 | 0.0007 |
| L4          | 52.7503 - 0       | 7.058            | 7               | 1.1986 | 0.0002 |

### Critical Deflections and Radius of Curvature - Design Wind

| Elevation | Appurtenance                              | Gov. Load Comb. | Deflection | Tilt   | Twist  | Radius of Curvature |
|-----------|-------------------------------------------|-----------------|------------|--------|--------|---------------------|
| ft        |                                           |                 | in         | °      | °      | ft                  |
| 184.00    | Lightning Rod 2"x8'                       | 7               | 79.666     | 3.7117 | 0.0021 | 24947               |
| 180.50    | PIROD 13' Low Profile Platform (Monopole) | 7               | 79.666     | 3.7117 | 0.0021 | 24947               |
| 180.00    | (4) 7770                                  | 7               | 79.666     | 3.7117 | 0.0021 | 24947               |
| 160.00    | PIROD 13' Low Profile Platform (Monopole) | 7               | 64.270     | 3.5395 | 0.0017 | 6235                |

### Compression Checks

### Pole Design Data

| Section No. | Elevation             | Size                    | L     | L <sub>u</sub> | Kl/r  | F <sub>a</sub> | A               | Actual P   | Allow. P <sub>a</sub> | Ratio P/P <sub>a</sub> |
|-------------|-----------------------|-------------------------|-------|----------------|-------|----------------|-----------------|------------|-----------------------|------------------------|
|             | ft                    |                         | ft    | ft             |       | ksi            | in <sup>2</sup> | lb         | lb                    |                        |
| L1          | 180 - 127.087 (1)     | TP38.458x31.05x0.2188   | 52.91 | 180.00         | 162.6 | 5.649          | 25.9830         | -7870.780  | 146776.000            | 0.054                  |
| L2          | 127.087 - 91.9003 (2) | TP42.947x37.2038x0.2813 | 41.02 | 180.00         | 145.7 | 7.033          | 37.2748         | -13399.000 | 262148.000            | 0.051                  |
| L3          | 91.9003 - 45.5003 (3) | TP48.88x41.4744x0.375   | 52.90 | 180.00         | 128.1 | 9.097          | 56.5250         | -23776.600 | 514217.000            | 0.046                  |
| L4          | 45.5003 - 0 (4)       | TP54.5x47.1151x0.5      | 52.75 | 180.00         | 112.7 | 11.762         | 85.6980         | -41223.801 | 1008000.00            | 0.041                  |

### Pole Bending Design Data

|                                                                                                                                                   |                |                                  |                    |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------------|-------------------|
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|                                                                                                                                                   | <b>Project</b> | Greenwood Road East, Norfolk, CT | <b>Date</b>        | 09:55:49 01/31/12 |
|                                                                                                                                                   | <b>Client</b>  | Verizon                          | <b>Designed by</b> | Matthew Kapinos   |

| Section No. | Elevation<br>ft       | Size                    | Actual<br>$M_x$<br>kip-ft | Actual<br>$f_{bx}$<br>ksi | Allow.<br>$F_{bx}$<br>ksi | Ratio<br>$\frac{f_{bx}}{F_{bx}}$ | Actual<br>$M_y$<br>kip-ft | Actual<br>$f_{by}$<br>ksi | Allow.<br>$F_{by}$<br>ksi | Ratio<br>$\frac{f_{by}}{F_{by}}$ |
|-------------|-----------------------|-------------------------|---------------------------|---------------------------|---------------------------|----------------------------------|---------------------------|---------------------------|---------------------------|----------------------------------|
| L1          | 180 - 127.087 (1)     | TP38.458x31.05x0.2188   | 393.56                    | 19.644                    | 36.649                    | 0.536                            | 0.00                      | 0.000                     | 36.649                    | 0.000                            |
| L2          | 127.087 - 91.9003 (2) | TP42.947x37.2038x0.2813 | 865.71                    | 27.019                    | 39.000                    | 0.693                            | 0.00                      | 0.000                     | 39.000                    | 0.000                            |
| L3          | 91.9003 - 45.5003 (3) | TP48.88x41.4744x0.375   | 1648.22                   | 29.860                    | 39.000                    | 0.766                            | 0.00                      | 0.000                     | 39.000                    | 0.000                            |
| L4          | 45.5003 - 0 (4)       | TP54.5x47.1151x0.5      | 2748.64                   | 28.924                    | 39.000                    | 0.742                            | 0.00                      | 0.000                     | 39.000                    | 0.000                            |

### Pole Shear Design Data

| Section No. | Elevation<br>ft       | Size                    | Actual<br>$V$<br>lb | Actual<br>$f_v$<br>ksi | Allow.<br>$F_v$<br>ksi | Ratio<br>$\frac{f_v}{F_v}$ | Actual<br>$T$<br>kip-ft | Actual<br>$f_{vt}$<br>ksi | Allow.<br>$F_{vt}$<br>ksi | Ratio<br>$\frac{f_{vt}}{F_{vt}}$ |
|-------------|-----------------------|-------------------------|---------------------|------------------------|------------------------|----------------------------|-------------------------|---------------------------|---------------------------|----------------------------------|
| L1          | 180 - 127.087 (1)     | TP38.458x31.05x0.2188   | 12134.000           | 0.467                  | 26.000                 | 0.036                      | 0.00                    | 0.000                     | 26.000                    | 0.000                            |
| L2          | 127.087 - 91.9003 (2) | TP42.947x37.2038x0.2813 | 15181.400           | 0.407                  | 26.000                 | 0.031                      | 0.00                    | 0.000                     | 26.000                    | 0.000                            |
| L3          | 91.9003 - 45.5003 (3) | TP48.88x41.4744x0.375   | 18982.801           | 0.336                  | 26.000                 | 0.026                      | 0.00                    | 0.000                     | 26.000                    | 0.000                            |
| L4          | 45.5003 - 0 (4)       | TP54.5x47.1151x0.5      | 22613.400           | 0.264                  | 26.000                 | 0.020                      | 0.00                    | 0.000                     | 26.000                    | 0.000                            |

### Pole Interaction Design Data

| Section No. | Elevation<br>ft       | Ratio<br>$P$<br>$P_a$ | Ratio<br>$f_{bx}$<br>$F_{bx}$ | Ratio<br>$f_{by}$<br>$F_{by}$ | Ratio<br>$f_v$<br>$F_v$ | Ratio<br>$f_{vt}$<br>$F_{vt}$ | Comb.<br>Stress<br>Ratio | Allow.<br>Stress<br>Ratio | Criteria  |
|-------------|-----------------------|-----------------------|-------------------------------|-------------------------------|-------------------------|-------------------------------|--------------------------|---------------------------|-----------|
| L1          | 180 - 127.087 (1)     | 0.054                 | 0.536                         | 0.000                         | 0.036                   | 0.000                         | 0.590                    | 1.333                     | H1-3+VT ✓ |
| L2          | 127.087 - 91.9003 (2) | 0.051                 | 0.693                         | 0.000                         | 0.031                   | 0.000                         | 0.744                    | 1.333                     | H1-3+VT ✓ |
| L3          | 91.9003 - 45.5003 (3) | 0.046                 | 0.766                         | 0.000                         | 0.026                   | 0.000                         | 0.812                    | 1.333                     | H1-3+VT ✓ |
| L4          | 45.5003 - 0 (4)       | 0.041                 | 0.742                         | 0.000                         | 0.020                   | 0.000                         | 0.783                    | 1.333                     | H1-3+VT ✓ |

### Section Capacity Table

| Section No. | Elevation<br>ft   | Component<br>Type | Size                    | Critical<br>Element | $P$<br>lb  | $SF * P_{allow}$<br>lb | %<br>Capacity | Pass<br>Fail |
|-------------|-------------------|-------------------|-------------------------|---------------------|------------|------------------------|---------------|--------------|
| L1          | 180 - 127.087     | Pole              | TP38.458x31.05x0.2188   | 1                   | -7870.780  | 195652.400             | 44.3          | Pass         |
| L2          | 127.087 - 91.9003 | Pole              | TP42.947x37.2038x0.2813 | 2                   | -13399.000 | 349443.269             | 55.8          | Pass         |
| L3          | 91.9003 -         | Pole              | TP48.88x41.4744x0.375   | 3                   | -23776.600 | 685451.233             | 60.9          | Pass         |

|                                                                                                                                                   |                |                                  |                    |                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|--------------------|-------------------|
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|                                                                                                                                                   | <b>Project</b> | Greenwood Road East, Norfolk, CT | <b>Date</b>        | 09:55:49 01/31/12 |
|                                                                                                                                                   | <b>Client</b>  | Verizon                          | <b>Designed by</b> | Matthew Kapinos   |

| Section No. | Elevation ft           | Component Type | Size               | Critical Element | P lb       | SF*P <sub>allow</sub> lb | % Capacity      | Pass Fail        |
|-------------|------------------------|----------------|--------------------|------------------|------------|--------------------------|-----------------|------------------|
| L4          | 45.5003<br>45.5003 - 0 | Pole           | TP54.5x47.1151x0.5 | 4                | -41223.801 | 1343663.94<br>4          | 58.7            | Pass             |
|             |                        |                |                    |                  |            |                          | Summary         |                  |
|             |                        |                |                    |                  |            |                          | Pole (L3)       | 60.9 Pass        |
|             |                        |                |                    |                  |            |                          | <b>RATING =</b> | <b>60.9 Pass</b> |

# **ANCHOR BOLT AND BASE PLATE ANALYSIS**



## ANCHOR BOLT AND BASE PLATE ANALYSIS

### Input Data

#### Tower Reactions:

Overturning Moment: OM := 2749·ft·kips user input  
Shear Force: Shear := 22.6·kips user input  
Axial Force: Axial := 41.2·kips user input

#### Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts = N  $N_w := 20$  user input  
Diameter of Bolt Circle:  $D_{bc} := 61.84\text{in}$  user input  
Bolt "Column" Distance:  $l_w := 3\text{in}$  user input  
Bolt Ultimate Strength:  $F_u := 100\text{ksi}$  user input  
Bolt Yield Strength:  $F_y := 75\text{ksi}$  user input  
Bolt Modulus:  $E := 29000\text{ksi}$  user input  
Thickness Of Anchor Bolts  $D := 2.25\text{in}$  user input  
Threads per Inch:  $n := 4.5$  user input

#### Base Plate Data:

Plate Yield Strength:  $F_{y_{bp}} := 60\text{ksi}$  user input  
Base Plate Thickness: PlateThickness := 2.75·in user input  
Base Plate Diameter:  $D_{bp} := 68.89\text{in}$  user input  
Outer Pole Diameter:  $D_{pole} := 54.5\text{in}$  user input

## Geometric Layout Data:

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

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

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

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

|                               |                                  |
|-------------------------------|----------------------------------|
| $d_1 = 9.55 \cdot \text{in}$  | $d_7 = 25.01 \cdot \text{in}$    |
| $d_2 = 18.17 \cdot \text{in}$ | $d_8 = 18.17 \cdot \text{in}$    |
| $d_3 = 25.01 \cdot \text{in}$ | $d_9 = 9.55 \cdot \text{in}$     |
| $d_4 = 29.41 \cdot \text{in}$ | $d_{10} = 0.00 \cdot \text{in}$  |
| $d_5 = 30.92 \cdot \text{in}$ | $d_{11} = -9.55 \cdot \text{in}$ |
| $d_6 = 29.41 \cdot \text{in}$ | etc.                             |

Critical Distances For Bending in Plate:

Outer Pole Radius:  $R_{pole} := \frac{D_{pole}}{2}$   $R_{pole} = 27.25 \cdot \text{in}$

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

|                               |                                  |
|-------------------------------|----------------------------------|
| $MA_1 = 0.00 \cdot \text{in}$ | $MA_7 = 0.00 \cdot \text{in}$    |
| $MA_2 = 0.00 \cdot \text{in}$ | $MA_8 = 0.00 \cdot \text{in}$    |
| $MA_3 = 0.00 \cdot \text{in}$ | $MA_9 = 0.00 \cdot \text{in}$    |
| $MA_4 = 2.16 \cdot \text{in}$ | $MA_{10} = 0.00 \cdot \text{in}$ |
| $MA_5 = 3.67 \cdot \text{in}$ | $MA_{11} = 0.00 \cdot \text{in}$ |
| $MA_6 = 2.16 \cdot \text{in}$ | etc.                             |

Effective Width of Baseplate for Bending:  $\text{EffectiveWidth} := .90 \cdot 2 \cdot \sqrt{\left( \frac{D_{bp}}{2} \right)^2 - \left( \frac{D_{pole}}{2} \right)^2}$   $\text{EffectiveWidth} = 37.92 \cdot \text{in}$



## Anchor Bolt Analysis:

Polar Moment of Inertia  $I_p$ :

$$I_p := \sum_i (d_i)^2 \quad I_p = 9.560 \times 10^3 \cdot \text{in}^2$$

Gross Area of Bolt:

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

Net Area of Bolt:

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

Net Diameter:

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

Radius of Gyration of Bolt:

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

Section Modulus of Bolt:

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

## Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left( \frac{\text{Shear}}{N} \right) \cdot l \quad M_x = 0.282 \cdot \text{ft} \cdot \text{kips}$$

$$f_{bx} := \frac{M_x}{S_x} \quad f_{bx} = 4.1 \cdot \text{ksi}$$

Allowable Bending

$$F_{bx} := 1.33 \cdot 0.60 \cdot F_y \quad F_{bx} = 59.9 \cdot \text{ksi}$$

Note: 1.33 increase allowed per TIA/EIA

## Check Tensile Forces:

Maximum Tensile Force (Gross Area):

$$\text{AllowableTension} := 1.33 \cdot (0.33 \cdot A_g \cdot F_u)$$

$$\text{AllowableTension} = 174.5 \cdot \text{kips}$$

Note: 1.33 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$$F_{\text{net.area}} := 1.33 \cdot (0.60 \cdot A_n \cdot F_y)$$

$$F_{\text{net.area}} = 194.4 \cdot \text{kips}$$

Note: 1.33 increase allowed per TIA/EIA

Applied Tension:

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

$$\text{MaxTension} = 104.6 \cdot \text{kips}$$

Check Stresses:

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

$$\frac{\text{MaxTension}}{F_{\text{net.area}}} = 0.5$$

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

Condition = "OK"



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## Check Compression & Combined Stresses (if required):

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

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

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

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

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

Allowable Compressive Force:

$$K := 0.65$$

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

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

$$F_a := 1.33 \cdot F_a \quad \text{Note: 1.33 increase allowed per TIA/EIA} \quad F_a = 59.9 \text{ ksi}$$

Applied Compressive Force:

$$\text{MaxCompression} := \frac{OM \cdot R_{bc}}{I_p} + \frac{\text{Axial}}{N} \quad \text{MaxCompression} = 108.7 \text{ kips}$$

$$f_a := \frac{\text{MaxCompression}}{A_n} \quad f_a = 33.5 \text{ ksi}$$

Check Combined Stresses:

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} = 0.56$$

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

Condition = "OK"



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## Base Plate Analysis:

Force from Bolt(s):

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

$$C_1 = 35.0 \cdot \text{kips}$$

$$C_7 = 88.4 \cdot \text{kips}$$

$$C_2 = 64.8 \cdot \text{kips}$$

$$C_8 = 64.8 \cdot \text{kips}$$

$$C_3 = 88.4 \cdot \text{kips}$$

$$C_9 = 35.0 \cdot \text{kips}$$

$$C_4 = 103.5 \cdot \text{kips}$$

$$C_{10} = 2.1 \cdot \text{kips}$$

$$C_5 = 108.7 \cdot \text{kips}$$

$$C_{11} = -30.9 \cdot \text{kips}$$

$$C_6 = 103.5 \cdot \text{kips}$$

etc.

Bending Stress in Plate:

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

$$f_{bp} = 17.7 \cdot \text{ksi}$$

Check Stresses:

$$\frac{f_{bp}}{1.33 \cdot 0.75 F_{y_{bp}}} = 0.30$$

$$Condition := \text{if} \left( \frac{f_{bp}}{1.33 \cdot 0.75 F_{y_{bp}}} < 1.00, "OK", "Overstressed" \right)$$

Condition = "OK"

## **FOUNDATION ANALYSIS**

## MONOPOLE FOUNDATION ANALYSIS

### TOWER FORCES:

Moment Caused by Tower  $M_t := 2749 \cdot \text{ft} \cdot \text{kips}$   
Shear at Base of Tower  $S_t := 22.6 \text{ kip}$   
Max Compressive Force  $C_t := 41.2 \cdot \text{kip}$   
Height of Tower  $H_t := 180 \cdot \text{ft}$   
Base Plate Bolt Circle  $MP := 61.84 \text{ in}$

### FOOTING DIMENSIONS:

Overall Depth of Footing  $D_f := 4.5 \text{ ft}$   
Length of Pier  $L_p := 0 \cdot \text{ft}$   
Extension of Pier Above Grade  $L_{pag} := 0 \cdot \text{ft}$   
Diameter of Pier  $d_p := 0 \cdot \text{ft}$   
Thickness of Footing  $T_f := 4.5 \cdot \text{ft}$   
Width of Footing:  $W_f := 30.5 \text{ ft}$   
Length of Anchor Bolts:  $L_{st} := 48 \text{ in}$   
Projection of anchor bolts above pier  $A_{BP} := 9.75 \cdot \text{in}$

### PIER REINFORCEMENT:

Bar Size  $BS_{pier} := 0$  Bar Diameter  $d_{bpier} := 0 \cdot \text{in}$   
Number of Bars  $NB_{pier} := 0$  Bar Area  $A_{bpier} := 0 \cdot \text{in}^2$

### PAD REINFORCEMENT:

TOP: Bar Size  $BS_{top} := 8$  Bar Diameter  $d_{btop} := 1.00 \cdot \text{in}$   
Number of Bars  $NB_{top} := 46$  Bar Area  $A_{btop} := 0.79 \cdot \text{in}^2$   
-----  
BOTTOM: Bar Size  $BS_{bot} := 8$  Bar Diameter  $d_{bbot} := 1.00 \cdot \text{in}$   
Number of Bars  $NB_{bot} := 46$  Bar Area  $A_{bot} := 0.79 \cdot \text{in}^2$

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

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

### PROPERTIES:

Compressive Strength of Concrete  $f_c := 3000 \text{ psi}$   
Yield Strength of Steel Reinforcement  $f_y := 60000 \cdot \text{psi}$   
Yield Strength of Anchor Bolt  $f_{ya} := 75000 \cdot \text{psi}$   
Internal Friction Angle of Soil  $\phi_s := 0 \cdot \text{deg}$   
Allowable Bearing Capacity  $q_s := 6000 \cdot \text{psf}$   
Unit Weight of Soil  $\gamma_s := 0 \cdot \text{pcf}$   
Unit Weight of Concrete  $\gamma_c := 150 \cdot \text{pcf}$   
Depth to Neglect  $n := 4.5 \text{ ft}$   
Cohesion of Clay Type Soil  $c_w := 0 \cdot \text{ksf}$   
Note: Use 0 for Sandy Soil  
Seismic Zone Factor:  $Z := 2$   
UBC Fig 23-2  
Coefficient of Friction between Concrete:  $\mu := .20$   
Clear Cover of Reinforcement Pier:  $C_{vr\_pier} := 3 \cdot \text{in}$   
Clear Cover of Reinforcement Pad:  $C_{vr\_pad} := 3 \cdot \text{in}$   
Anchor Bolt Diameter  $d_{anchor} := 2.25 \text{ in}$   
Anchor bolt area  $A_{anchor} := 3.97 \cdot \text{in}^2$



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## CHECK ANCHOR STEEL EMBEDMENT

Depth:  $D_{ab} := L_{st} - A_{BP}$   $D_{ab} = 3.1875 \cdot \text{ft}$   $L_{anchor} := \frac{(0.11 \cdot f_y) \cdot \text{in}}{\sqrt{f_c \cdot \text{psi}}}$   $L_{anchor} = 10.0416 \cdot \text{ft}$   
DepthCheck := if( $D_{ab} \geq L_{anchor}$ , "Okay", "No Good")  
DepthCheck = "No Good" **Note: anchor plate is provided**

## STABILITY OF FOOTING

Passive Pressure:  $P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$   $P_{pn} = 0 \cdot \text{ksf}$   
 $P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$   $P_{pt} = 0 \cdot \text{ksf}$   
 $P_{top} := \text{if}[n < (D_f - T_f), P_{pt}, P_{pn}]$   $P_{top} = 0 \cdot \text{ksf}$   
 $P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$   $P_{bot} = 0 \cdot \text{ksf}$   
 $P_{ave} := \frac{P_{top} + P_{bot}}{2}$   $P_{ave} = 0 \cdot \text{ksf}$   
 $T_p := \text{if}[n < (D_f - T_f), T_f, (D_f - n)]$   $T_p = 0 \cdot \text{ft}$   
 $A_p := W_f \cdot T_p$   $A_p = 0 \cdot \text{ft}^2$   
Ultimate Shear:  $S_u := P_{ave} \cdot A_p$   $S_u = 0 \cdot \text{kip}$   
Weight of Concrete Pad:  $WT_c := [(W_f^2 \cdot T_f) + d_p^2 \cdot L_p] \cdot \gamma_c$   $WT_c = 627.9187 \cdot \text{kip}$   
Weight of Soil above Footing:  $WT_{s1} := \left[ W_f^2 \cdot (|L_p - L_{pag}|) - \frac{d_p^2 \cdot \pi}{4} \cdot (|L_p - L_{pag}|) \right] \cdot \gamma_s$   $WT_{s1} = 0 \cdot \text{kip}$   
Weight of Soil Wedge at back face:  $WT_{s2} := \left( \frac{D_f \cdot \tan(\phi_s)}{2} \cdot W_f \right) \cdot \gamma_s$   $WT_{s2} = 0 \cdot \text{kip}$   
Total Weight:  $WT_{tot} := WT_c + WT_{s1} + C_t$   $WT_{tot} = 669.1187 \cdot \text{kip}$   
Resisting Moment:  $M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left( W_f + \frac{D_f \cdot \tan(\phi_s)}{3} \right)$   $M_r = 10204.0609 \cdot \text{kip} \cdot \text{ft}$   
Overturning Moment:  $M_{ot} := M_t + S_t \cdot (L_p + T_f)$   $M_{ot} = 2850.7 \cdot \text{kip} \cdot \text{ft}$   
Factor of Safety:  $FS := \frac{M_r}{M_{ot}}$   $FS_{req} := 2$   $FS = 3.58$   
SafetyCheck := if( $FS > FS_{req}$ , "Okay", "No Good") SafetyCheck = "Okay"



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## SHEAR CAPACITY IN PIER

FS := 2

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

$$S_p = 66.9119 \cdot \text{kips}$$

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

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

## BEARING PRESSURE CAUSED BY FOOTING

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

$$A_{mat} = 930.25 \cdot \text{ft}^2$$

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

$$S = 4728.7708 \cdot \text{ft}^3$$

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

$$P_{max} = 1.3221 \cdot \text{ksf}$$

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

$$P_{min} = 0.1164 \cdot \text{ksf}$$

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

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

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

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

Distance to Resultant of Pressure Distribution:

$$X_p := \frac{\frac{P_{max}}{P_{max} - P_{min}} \cdot \frac{1}{3}}{\frac{W_f}{6}}$$

$$X_p = 11.1486 \cdot \text{ft}$$

Distance to Kern:

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

$$X_k = 5.0833 \cdot \text{ft}$$

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

Eccentricity:

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

$$e = 4.2604$$

Adjusted Soil Pressure:

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

$$P_a = 1.3309 \cdot \text{ksf}$$

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

$$q_{adj} = 1.3221 \cdot \text{ksf}$$

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

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

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## CONCRETE BEARING CAPACITY (ACI 10.17)

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

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

$$P_b = 0 \cdot \text{kip}$$

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

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

**Note: Above result not applicable due to absence of pier.**

## SHEAR STRENGTH OF CONCRETE

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

$$\phi_{cs} := .85 \quad (\text{ACI 9.3.2.3})$$

$$d := T_f - C_{vrpad} - d_{bbot}$$

$$d = 50 \cdot \text{in}$$

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

$$d_1 = 15.25 \cdot \text{ft}$$

$$d_2 := d_1 - d$$

$$d_2 = 11.0833 \cdot \text{ft}$$

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

$$L = 32.9689 \cdot \text{ft}$$

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

$$\text{Slope} = 0.0395 \cdot \text{kcf}$$

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

$$V_{req} = 617.1851 \cdot \text{kip}$$

ACI 11.3.1.1

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

$$V_{Avail} = 1703.9649 \cdot \text{kip}$$

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

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

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

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

$$b_o = 13.09 \cdot \text{ft}$$

Area included inside bo:

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

$$A_{bo} = 13.6354 \cdot \text{ft}^2$$

Area outside of bo:

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

$$A_{out} = 916.6146 \cdot \text{ft}^2$$



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

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

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

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

$$v_u = 12.2681 \cdot \text{ksf}$$

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

$$V_u = 1559.0657 \cdot \text{kips}$$

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

$$V_{req} = 2026.7854 \cdot \text{kips}$$

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

$$V_{avail} = 1462.613 \cdot \text{kips}$$

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

PunchingShearCheck = "No Good"

**Note: Above result not applicable due to absence of pier.**

## STEEL REINFORCEMENT IN THE PAD

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

Take Maximum Bending at face of Pier:

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

$$q_b = 0.7193 \cdot \text{ksf}$$

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

$$M_n = 5743.6387 \cdot \text{kip} \cdot \text{ft}$$

ACI 10.2.7.3

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

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

$$R_u = 12052.2 \text{ lbf}$$

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

$$\rho = 0.0014$$

$$\rho_{min} := 1.0 \cdot \rho$$

$$\rho_{min} = 0.0014$$

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

$\rho_{sh} = 0.0018$

(ACI 7.12.2.1b)

FOR BOTTOM BARS:

$$A_s := \max(\rho, \rho_{\min}, \rho_{sh}) \cdot W_f \cdot d$$

$$A_s = 32.94 \cdot \text{in}^2$$

$$A_{s_{\text{prov}}} := A_{\text{bot}} \cdot \text{NB}_{\text{bot}}$$

$$A_{s_{\text{prov}}} = 36.34 \cdot \text{in}^2$$

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

PadReinforcement = "Okay"

FOR TOP BARS:

$$A_s := \rho_{sh} \cdot (W_f \cdot d)$$

$$A_s = 32.94 \cdot \text{in}^2$$

$$A_{s_{\text{prov}}} := A_{\text{bot}} \cdot \text{NB}_{\text{top}}$$

$$A_{s_{\text{prov}}} = 36.34 \cdot \text{in}^2$$

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

PadReinforcement = "Okay"

TENSION (ACI 12.2.3)

## DEVELOPMENT LENGTH OF PAD REINFORCEMENT

Bar Spacing:

$$B_{s\text{Pad}} := \frac{W_f - 2 \cdot \text{Cvr}_{\text{pad}} - \text{NB}_{\text{bot}} \cdot d_{\text{bbot}}}{\text{NB}_{\text{bot}} - 1}$$

$$B_{s\text{Pad}} = 6.9778 \cdot \text{in}$$

Development Length Factors:

Reinforcement Location Factor

$$\alpha := 1.0$$

Coating Factor

$$\beta := 1.0$$

Concrete strength Factor

$$\lambda := 1.0$$

Reinforcement Size Factor

$$\gamma := 1.0$$

Spacing or Cover Dimension:

$$c := \text{if}\left(\text{Cvr}_{\text{pad}} < \frac{B_{s\text{Pad}}}{2}, \text{Cvr}_{\text{pad}}, \frac{B_{s\text{Pad}}}{2}\right)$$

$$c = 3 \cdot \text{in}$$

Transverse Reinforcement Index As allowed by ACI 12.2.4

$$k_{tr} := 0$$

$$L_{\text{dbt}} := \frac{3}{40} \cdot \frac{f_y}{\sqrt{f_c \cdot \text{psi}}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{c + k_{tr}} \cdot d_{\text{bbot}}$$

$$L_{\text{dbt}} = 27.3861 \cdot \text{in}$$

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

Minimum Development Length:  
(ACI 12.2.1)

$$L_{\text{dbtCheck}} := \text{if}(L_{\text{dbt}} \geq L_{\text{dbmin}}, \text{"Use } L_{\text{dbt}}", \text{"Use } L_{\text{dbmin}}")$$

$$L_{\text{dbtCheck}} = \text{"Use } L_{\text{dbt}}"$$

Available Length in Pad:

$$L_{\text{Pad}} := \frac{W_f}{2} - \frac{d_p}{2} - \text{Cvr}_{\text{pad}}$$

$$L_{\text{Pad}} = 180 \cdot \text{in}$$

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

LpadTension = "Okay"