EM-CING-019-121031

HPC Wireless Services
46 Mill Plain Rd.
Floor 2
Danbury, CT, 06811
P.: 203.797.1112

HPC WIRELESS SERVICES

ORIGINAL

October 26, 2012

VIA OVERNIGHT COURIER

Connecticut Siting Council
10 Franklin Square
New Britain, Connecticut 06051
Attn: Ms. Linda Roberts, Executive Director

Re: New Cingular Wireless PCS, LLC – Exempt Modification
116 Grant Hill Road, Brooklyn, Connecticut

Dear Ms. Roberts:

This letter and attachments are submitted on behalf of New Cingular Wireless PCS, LLC ("AT&T"). AT&T is making modifications to certain existing sites in its Connecticut system in order to implement LTE technology. Please accept this letter and attachments as notification, pursuant to Section 16-50j-73 of the Regulations of Connecticut State Agencies ("R.S.C.A."), of construction that constitutes an exempt modification pursuant to R.C.S.A. Section 16-50j-72(b)(2). In compliance with R.C.S.A. Section 16-50j-73, a copy of this letter and attachments is being sent to the First Selectman of the Town of Brooklyn.

AT&T plans to modify the existing wireless communications facility owned by Crown Castle and located at 116 Grant Hill Road, Brooklyn (coordinates 41° -47'-29" N, 72°-00'-55" W). Attached are a compound plan and elevation depicting the planned changes, and documentation of the structural sufficiency of the structure to accommodate the revised antenna configuration. Also included is a power density report reflecting the modification to AT&T's operations at the site.

The changes to the facility do not constitute a modification as defined in Connecticut General Statutes ("C.G.S.") Section 16-50i(d) because the general physical characteristics of the facility will not be significantly changed. Rather, the planned changes to the facility fall squarely within those activities explicitly provided for in R.C.S.A. Section 16-50j-72(b)(2).

1. AT&T will add three (3) LTE panel antennas on new pipe mounts attached to the existing T-arms, which will be rotated to match the LTEs Azimuths, at a centerline height of approximately 129'. Six (6) RRHs (remote radio units) and one (1) Surge Arrestor will be placed on new mounts behind the LTE antennas at a centerline height of

approximately 129'. AT&T will also place a DC power and fiber run along the existing coaxial cable run. These changes will not extend the height of the approximately 150' structure.

2. AT&T will install two (2) stacked cabinets and one (1) DC Power Plant, on a new 3' x 8" x 10' concrete pad extension. AT&T will also mount a new GPS antenna on the existing Shelter and a new GPS antenna on the existing Ice Bridge. These changes will be within the existing compound and will have no effect on the site boundaries.

3. The proposed changes will not increase the noise level at the existing facility by six (6) decibels or more. The incremental effect of the proposed changes will be negligible.

4. The changes to the facility will not increase the calculated "worst case" power density for the combined operations at the site to a level at or above the applicable standard for uncontrolled environments as calculated for a mixed frequency site. As indicated on the attached report prepared by C Squared Systems, LLC, AT&T's operations at the site will result in a power density of approximately 4.33%; the combined site operations will result in a total power density of approximately 53.22%.

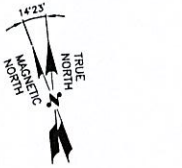
Please feel free to contact me by phone at (860) 798-7454 or by e-mail at jgaudet@hpcwireless.com with questions concerning this matter. Thank you for your consideration.

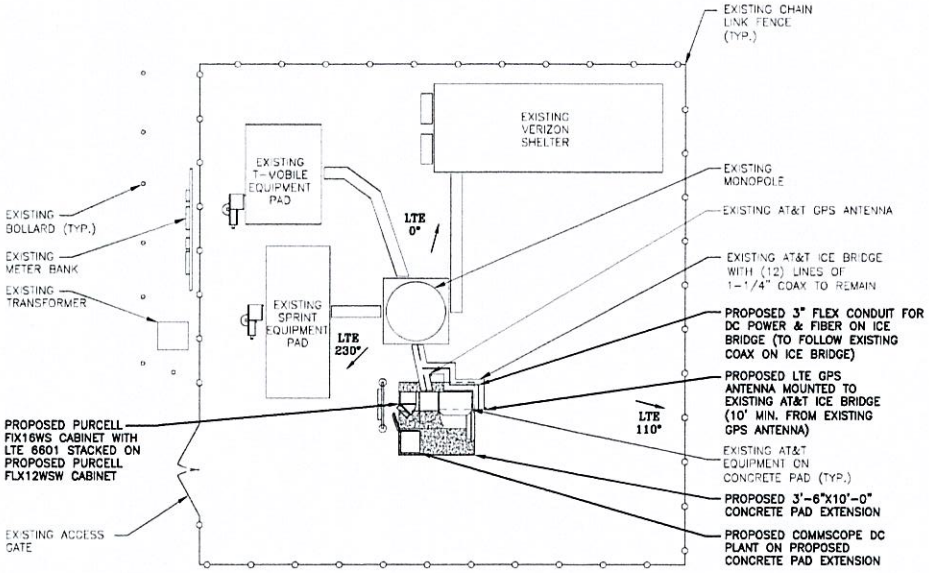
Respectfully yours,

Jennifer Young Gaudet (by mail)

Attachments

cc: Honorable Austin Tanner, First Selectman, Town of Brooklyn
Jean Paul and Dawna G. Bernier (underlying property owners)





COMPOUND PLAN

SCALE: 1/8"=1'-0"

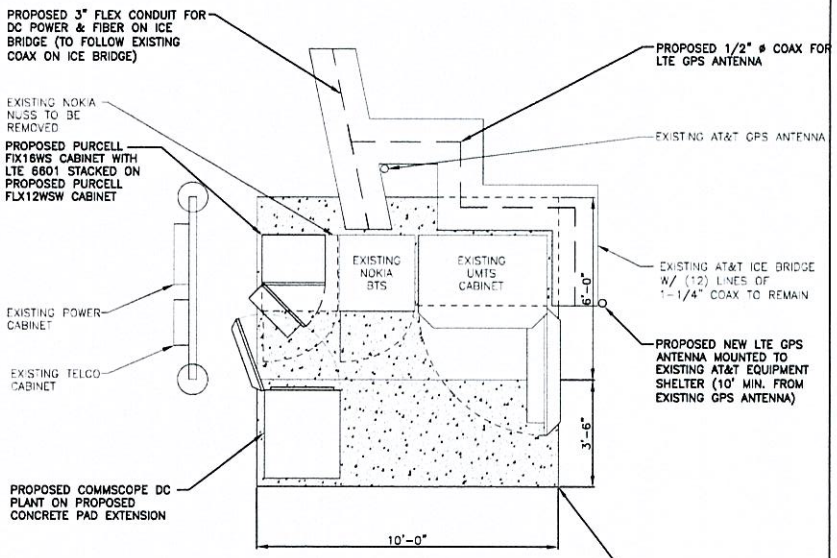
0 4'-0" 8'-0" 16'-0" 24'-0"

NOTE:

REFER TO THE FINAL RF DATA SHEET FOR FINAL ANTENNA SETTINGS.

NOTE:

ALL ANTENNAS AND COAX TO BE INSTALLED IN ACCORDANCE WITH STRUCTURAL ANALYSIS PROVIDED BY CROWN CASTLE AND FINAL AT&T RF DATA SHEET.



PROPOSED COMMSCOPE DC PLANT TO BE INSTALLED AND LIVE PRIOR TO NOKIA NUSS REMOVAL AND PURCELL INSTALLATION.

EQUIPMENT PLAN

SCALE: 1/2"=1'-0"

0 1'-0" 2'-0" 4'-0" 6'-0"

Hudson Design Group LLC
1600 OSGOOD STREET
BUILDING 20 NORTH SUITE 3090
N. ANDOVER, MA 01845
TEL: (978) 557-5553
FAX: (978) 336-5586

NEXLINK GLOBAL SERVICES
a UniTek GLOBAL SERVICES company
800 MARSHALL PHELPS ROAD UNIT#: 2A
WINDSOR, CT 06095

SITE NUMBER: CT5705
SITE NAME: BROOKLYN WEST
CROWN SITE ID: 876390
116 GRANT HILL ROAD
BROOKLYN, CT 06234
WINDHAM COUNTY

at&t
500 ENTERPRISE DRIVE, SUITE 3A
ROCKY HILL, CT 06067

NO.	DATE	REVISIONS	BY	CHK	APP'D
1	10/04/12	ISSUED FOR CONSTRUCTION	RS	DC	DPH
0	07/18/12	ISSUED FOR REVIEW	RS	DC	DPH

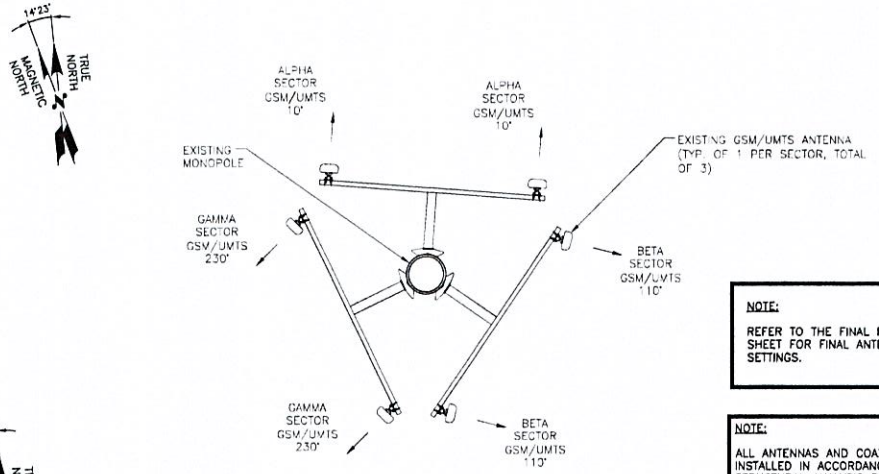
SCALE: AS SHOWN | DESIGNED BY: DC | DRAWN BY: RS

STATE OF CONNECTICUT — DONALD P. HAMM — No. 24173 — LICENSED PROFESSIONAL ENGINEER

AT&T

COMPOUND PLAN & EQUIPMENT PLAN (LTE)

JOB NUMBER	DRAWING NUMBER	REV
5705.01	A-1	1



EXISTING GSM/UMTS ANTENNA PLAN

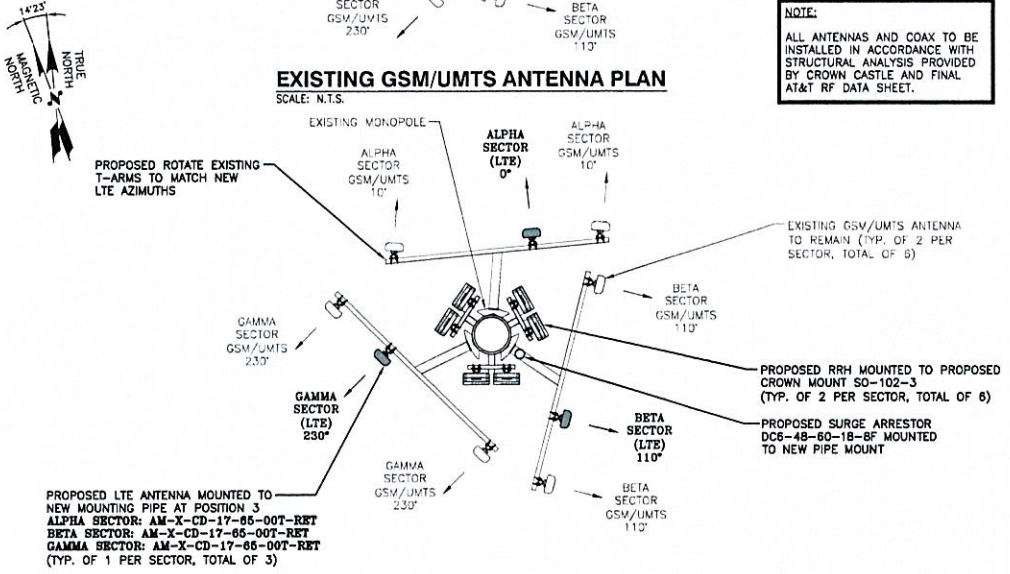
SCALE: N.T.S.

NOTE:

REFER TO THE FINAL RF DATA SHEET FOR FINAL ANTENNA SETTINGS.

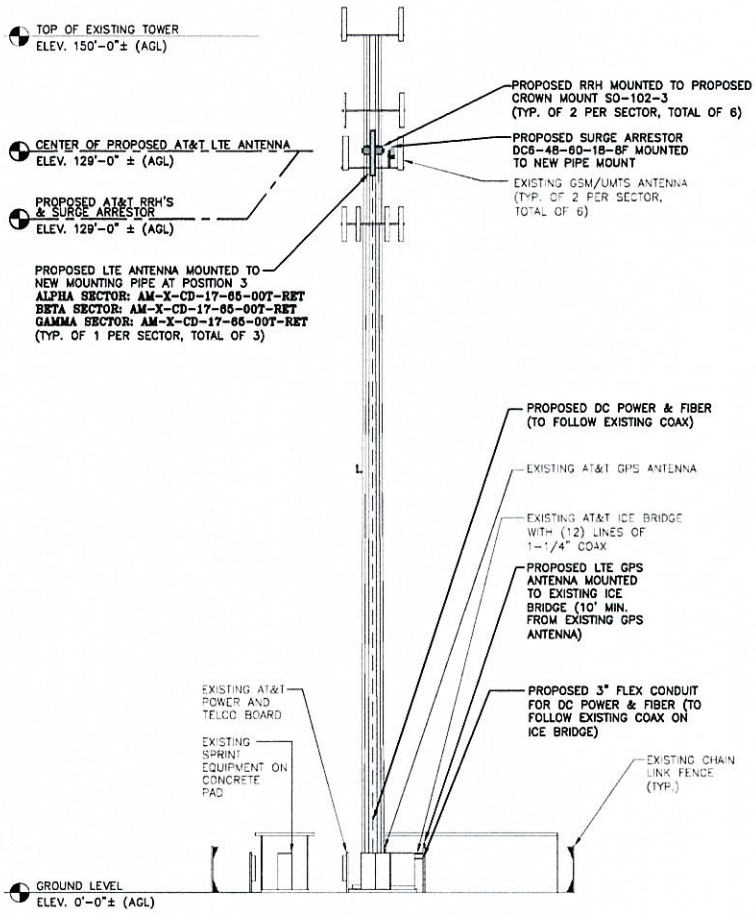
NOTE:

ALL ANTENNAS AND COAX TO BE INSTALLED IN ACCORDANCE WITH STRUCTURAL ANALYSIS PROVIDED BY CROWN CASTLE AND FINAL AT&T RF DATA SHEET.



PROPOSED LTE ANTENNA PLAN

SCALE: N.T.S.



SOUTH ELEVATION

SCALE: 3/32"=1'-0"

0 5'-4" 10'-8" 21'-4" 32'-0"

Hudson Design Group LLC
1600 OSGOOD STREET
BUILDING 20 NORTH, SUITE 3090
N. ANDOVER, MA 01845
TEL: (978) 557-5553
FAX: (978) 336-5586

NEXLINK GLOBAL SERVICES
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800 MARSHALL PHELPS ROAD UNIT#: 2A
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SITE NUMBER: CT5705
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at&t
500 ENTERPRISE DRIVE, SUITE 3A
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SCALE: AS SHOWN | DESIGNED BY: DC | DRAWN BY: RS

STATE OF CONNECTICUT — No. 21173 — LICENSED PROFESSIONAL ENGINEER

AT&T

ANTENNA PLAN & ELEVATION (LTE)

JOB NUMBER	DRAWING NUMBER	REV
5705.01	A-2	1

C Squared Systems, LLC
65 Dartmouth Drive, Unit A3
Auburn, NH 03032
(603) 644-2800
support@csquaredsystems.com

Calculated Radio Frequency Emissions

CT5705

(Brooklyn West)

116 Grant Hill Road, Brooklyn, CT 06234

October 1, 2012

Table of Contents

List of Tables

List of Figures

1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed modifications to the existing AT&T antenna arrays mounted on the monopole tower located at 116 Grant Hill Road in Brooklyn, CT. The coordinates of the tower are 41° 47' 29.4" N, 72° 00' 54.0" W.

AT&T is proposing the following modifications:

1) Install three multi-band (700/850/1900/2100 MHz) antennas for their LTE network (one per sector).

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. RF Exposure Prediction Methods

The emission field calculation results displayed in the following figures were generated using the following formula as outlined in FCC bulletin OET 65:

$$\text{Power Density} = \left(\frac{1.6^2 \times EIRP}{4\pi \times R^2} \right) \text{x Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power

R = Radial Distance = $\sqrt{(H^2 + V^2)}$

H = Horizontal Distance from antenna in meters

V = Vertical Distance from radiation center of antenna in meters

Ground reflection factor of 1.6

Off Beam Loss is determined by the selected antenna pattern

These calculations assume that the antennas are operating at 100 percent capacity and power, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the predicted signal levels reported below are much higher than the actual signal levels will be from the finished modifications.

4. Calculation Results

Table 1 below outlines the power density information for the site. Because the proposed AT&T antennas are directional in nature, the majority of the RF power is focused out towards the horizon. As a result, there will be less RF power directed below the antennas relative to the horizon, and consequently lower power density levels around the base of the tower. Please refer to Attachment C for the vertical patterns of the proposed AT&T antennas. The calculated results for AT&T in Table 1 include a nominal 10 dB off-beam pattern loss to account for the lower relative gain below the antennas.

Carrier	Antenna Height (Feet)	Operating Frequency (MHz)	Number of Trans.	ERP Per Transmitter (Watts)	Power Density (mw/cm^2)	Limit	%MPE
Cingular UMTS	*127*	*880*	*1*	*500*	*0.0111*	*0.5867*	*1.90%*
Cingular GSM	*127*	*1900*	*2*	*427*	*0.0190*	*1.0000*	*1.90%*
Cingular GSM	*127*	*880*	*2*	*296*	*0.0132*	*0.5867*	*2.25%*
Sprint	147	1960	11	250	0.0458	1.0000	4.58%
Voicestream	137	1970	8	246	0.0377	1.0000	3.77%
Verizon Cellular	117	869	9	266	0.0629	0.5793	10.85%
Verizon PCS	117	1970	11	264	0.0763	1.0000	7.63%
Verizon AWS	117	2145	1	670	0.0176	1.0000	1.76%
Verizon LTE	117	698	1	867	0.0228	0.4653	4.89%
AT&T UMTS	129	880	2	565	0.0024	0.5867	0.42%
AT&T UMTS	129	1900	2	875	0.0038	1.0000	0.38%
AT&T LTE	129	734	1	1771	0.0038	0.4893	0.78%
AT&T GSM	129	880	1	283	0.0006	0.5867	0.10%
AT&T GSM	129	1900	4	525	0.0045	1.0000	0.45%
						Total	**35.62%**

Table 1: Carrier Information[1] [2] [3]

[1] The existing CSC filing for Cingular should be removed and replaced with the updated AT&T technologies and values provided in Table 1. The power density information for carriers other than AT&T was taken directly from the CSC database dated 7/26/2012. Please note that %MPE values listed are rounded to two decimal points. The total %MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

[2] In the case where antenna models are not uniform across all 3 sectors for the same frequency band, the antenna model with the highest gain was used for the calculations to present a worse-case scenario.

[3] Antenna height listed for AT&T is in reference to the Paul J.Ford & Company Structural Analysis dated August 15, 2012.

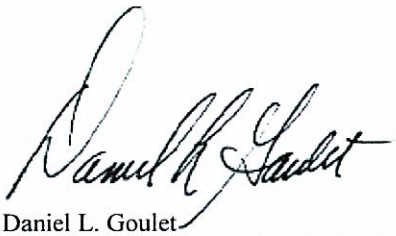
5. Conclusion

The above analysis verifies that emissions from the existing site will be below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Even when using conservative methods, the cumulative power density from the proposed transmit antennas at the existing facility is well below the limits for the general public. The highest expected percent of Maximum Permissible Exposure at ground level is **35.62% of the FCC limit**.

As noted previously, obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. As a result, the predicted signal levels are more conservative (higher) than the actual signal levels will be from the finished modifications.

6. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1 and FCC OET Bulletin 65 Edition 97-01.



Daniel L. Goulet
C Squared Systems, LLC

October 1, 2012
Date

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

ANSI C95.1-1982, American National Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. IEEE-SA Standards Board

IEEE Std C95.3-1991 (Reaff 1997), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. IEEE-SA Standards Board

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[4]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[5]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 2: FCC Limits for Maximum Permissible Exposure (MPE)

[4] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

[5] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

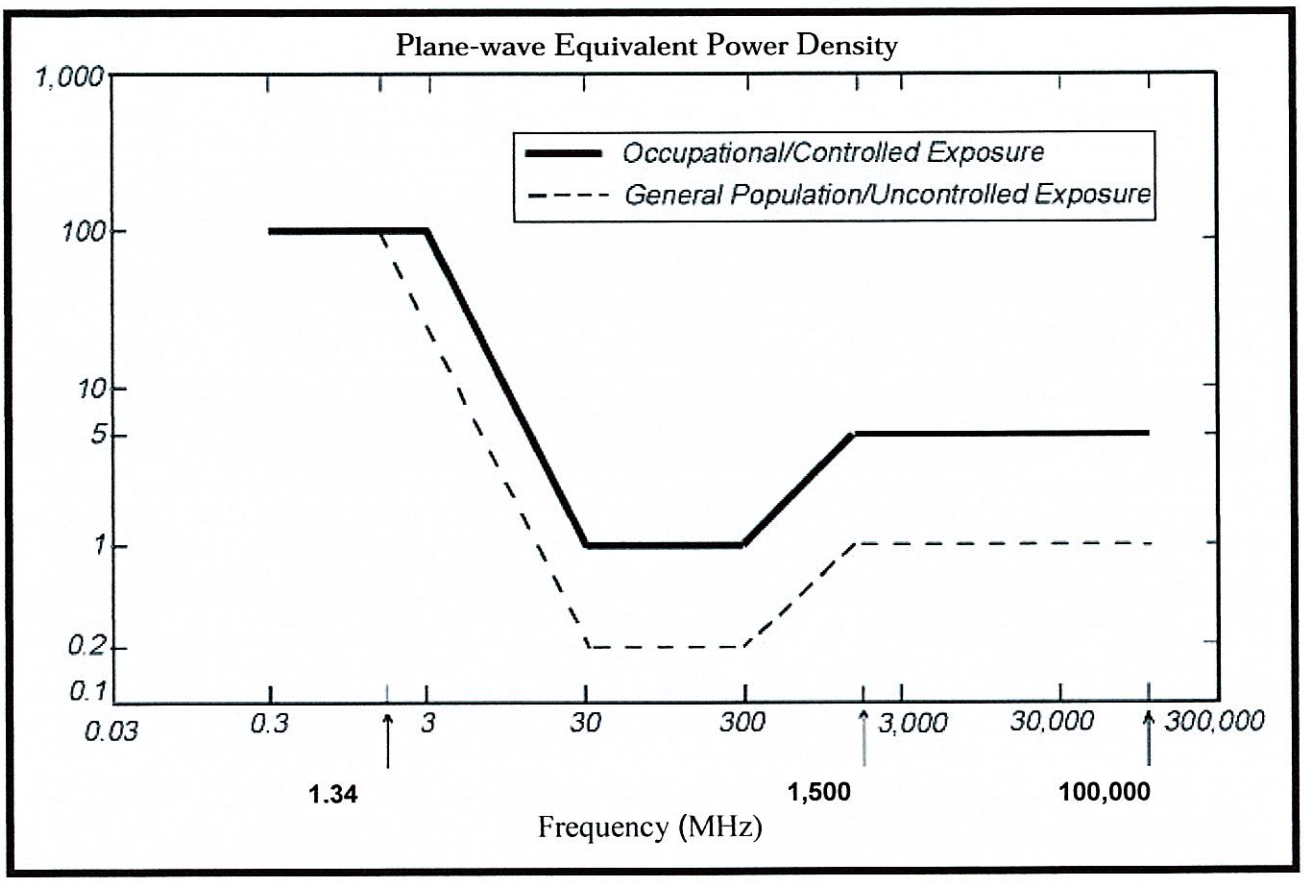
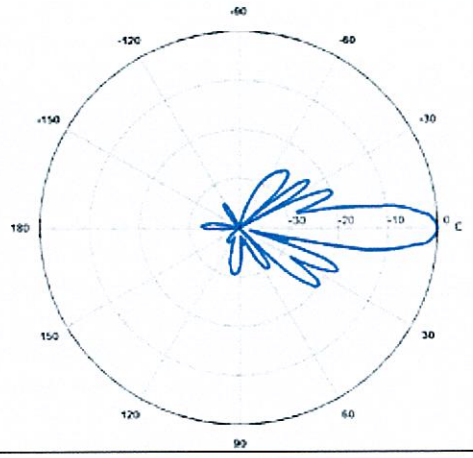


Figure 1: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Antenna Data Sheets and Electrical Patterns

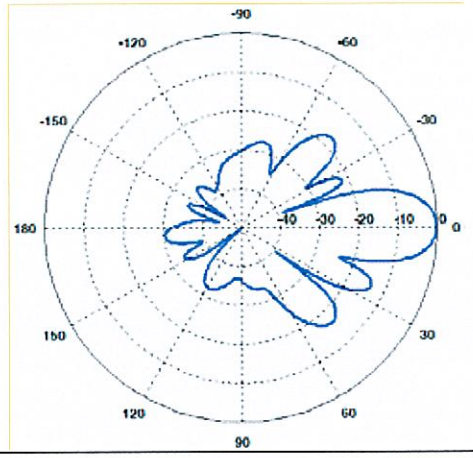
700 MHz

Manufacturer:	KMW
Model #:	AM-X-CD-17-65-00T-RET
Frequency Band:	698-806 MHz
Gain:	14.7 dBd
Vertical Beamwidth:	10°
Horizontal Beamwidth:	66°
Polarization:	Dual Slant ± 45°
Size L x W x D:	96.0" x 11.8" x 6.0"



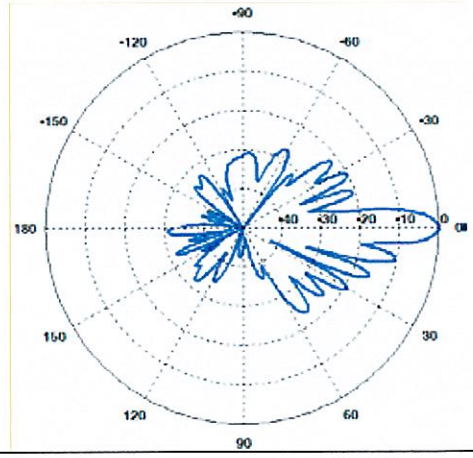
850 MHz

Manufacturer:	Powerwave
Model #:	7770.00
Frequency Band:	824-896 MHz
Gain:	11.5 dBd
Vertical Beamwidth:	15°
Horizontal Beamwidth:	82°
Polarization:	Dual Linear ± 45°
Size L x W x D:	55.0" x 11.0" x 5.0"



1900 MHz

Manufacturer:	Powerwave
Model #:	7770.00
Frequency Band:	1850-1990 MHz
Gain:	13.4 dBd
Vertical Beamwidth:	7°
Horizontal Beamwidth:	86°
Polarization:	Dual Linear ± 45°
Size L x W x D:	55.0" x 11.0" x 5.0"



PAUL J. FORD AND COMPANY
STRUCTURAL ENGINEERS
250 East Broad Street • Suite 1500 • Columbus, Ohio 43215-3708

Date: **August 15, 2012**

Marianne Dunst
Crown Castle USA Inc.
3530 Toringdon Way Suite 300
Charlotte, NC 28277

Paul J Ford and Company
250 E. Broad Street Suite 1500
Columbus, OH 43215
614.221.6679
jwoolley@pjfweb.com

Subject: **Structural Analysis Report**

Carrier Designation:	***AT&T Mobility* Co-Locate**	
	Carrier Site Number:	CT5705
	Carrier Site Name:	AWE-BROOKLYN WEST
Crown Castle Designation:	**Crown Castle BU Number:**	876390
	Crown Castle Site Name:	HAMPTON / BERNIER
	Crown Castle JDE Job Number:	199179
	Crown Castle Work Order Number:	519001
	Crown Castle Application Number:	157933 Rev. 1
Engineering Firm Designation:	**Paul J Ford and Company Project Number:**	37512-2182
Site Data:	**116 Grant Hill Rd., BROOKLYN, Windham County, CT** **Latitude *41° 47' 30.53"*, Longitude *-72° 0' 53.27"*** **150 Foot - Monopole Tower**	

Dear Marianne Dunst,

Paul J Ford and Company is pleased to submit this **"Structural Analysis Report"** to determine the structural integrity of the above mentioned tower. This analysis has been performed in accordance with the Crown Castle Structural 'Statement of Work' and the terms of Crown Castle Purchase Order Number 481666, in accordance with application 157933, revision 1.

The purpose of the analysis is to determine acceptability of the tower stress level. Based on our analysis we have determined the tower stress level for the structure and foundation, under the following load case, to be:

LC7: Existing + Reserved + Proposed Equipment **Sufficient Capacity**
Note: See Table I and Table II for the proposed and existing/reserved loading, respectively.

The structural analysis was performed for this tower in accordance with the requirements of TIA/EIA-222-F Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and the 2005 CT State Building Code using a fastest mile wind speed of 85 mph with no ice, 37.6 mph with 1 inch ice thickness and 50 mph under service loads.

We at *Paul J Ford and Company* appreciate the opportunity of providing our continuing professional services to you and Crown Castle USA Inc.. If you have any questions or need further assistance on this or any other projects please give us a call.

Respectfully submitted by:

John J Woolley, EIT
Structural Engineer

STATE OF CONNECTICUT
JOSEPH PACHICARAH JACOBS
No. PEN 22731
LICENSED PROFESSIONAL ENGINEER

AUG 16 2012

PAUL J. FORD AND COMPANY
STRUCTURAL ENGINEERS
250 East Broad Street • Suite 1500 • Columbus, Ohio 43215-3708

Date: **August 15, 2012**

Marianne Dunst
Crown Castle USA Inc.
3530 Toringdon Way Suite 300
Charlotte, NC 28277

Paul J Ford and Company
250 E. Broad Street Suite 1500
Columbus, OH 43215
614.221.6679
jwoolley@pjfweb.com

Subject: **Structural Analysis Report**

Carrier Designation:	***AT&T Mobility* Co-Locate**	
	Carrier Site Number:	CT5705
	Carrier Site Name:	AWE-BROOKLYN WEST
Crown Castle Designation:	**Crown Castle BU Number:**	876390
	Crown Castle Site Name:	HAMPTON / BERNIER
	Crown Castle JDE Job Number:	199179
	Crown Castle Work Order Number:	519001
	Crown Castle Application Number:	157933 Rev. 1
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We at *Paul J Ford and Company* appreciate the opportunity of providing our continuing professional services to you and Crown Castle USA Inc.. If you have any questions or need further assistance on this or any other projects please give us a call.

Respectfully submitted by:

John J Woolley, EIT
Structural Engineer

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 150 ft Monopole tower designed by ENGINEERED ENDEAVORS, INC. in February of 2000. The tower was originally designed for a wind speed of 90 mph per TIA/EIA-222-F.

2) ANALYSIS CRITERIA

The structural analysis was performed for this tower in accordance with the requirements of TIA/EIA-222-F Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and the 2005 CT State Building Code using a fastest mile wind speed of 85 mph with no ice, 37.6 mph with 1 inch ice thickness and 50 mph under service loads.

Table 1 - Proposed Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
129.0	129.0	6	ericsson	TME RRUS-11	3	3/8	-
		1	tower mounts	Side Arm Mount [SO 102-3]			
127.0	129.0	3	kmw communications	AM-X-CD-17-65-00T-RET w/ Mount Pipe	-	-	-
		1	raycap	DC6-48-60-18-8F			

Table 2 - Existing and Reserved Antenna and Cable Information

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
149.0	151.0	6	decibel	DB980H90E-M w/ Mount Pipe	6	1-5/8	1
	149.0	1	tower mounts	Platform Mount [LP 601-1]			
137.0	138.0	3	ems wireless	RR90-17-02DP w/ Mount Pipe	6	1-5/8	1
		6	ericsson	KRY 112 71/2			
	137.0	1	tower mounts	Platform Mount [LP 712-1]			
127.0	129.0	6	powerwave technologies	7770.00 w/ Mount Pipe	12	1-1/4	1
	127.0	6	powerwave technologies	LGP 17201			
		6	powerwave technologies	LGP13519			
		1	tower mounts	T-Arm Mount [TA 602-3]			
117.0	119.0	3	antel	BXA-171085-12CF-EDIN-2 w/ Mount Pipe	6	1-5/8	2
		3	antel	BXA-70063-6CF-2 w/ Mount Pipe			
		6	antel	LPA-80080/4CF w/ Mount Pipe			
	117.0	1	tower mounts	Platform Mount [LP 303-1]	12	1-5/8	1
76.0	77.0	1	lucent	KS24019-L112A	1	1/2	1
	76.0	1	tower mounts	Pipe Mount [PM 601-1]			

Notes:
1) Existing Equipment
2) Reserved Equipment

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
4-GEOTECHNICAL REPORTS	Criscuolo Shepard, 8/9/1999	1615347	CCISITES
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	EEI, 6459, 2/22/2000	1615410	CCISITES
4-TOWER MANUFACTURER DRAWINGS	EEI, 6459, 2/22/2000	1533003	CCISITES
4-TOWER REINFORCEMENT DESIGN/DRAWINGS/DATA	TEP, 072655, 5/15/08	2255030	CCISITES

3.1) Analysis Method

tnxTower (version 6.0.3.0), a commercially available analysis software package, was used to create a three-dimensional model of the tower and calculate member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

1) Tower and structures were built in accordance with the manufacturer's specifications.
2) The tower and structures have been maintained in accordance with the manufacturer's specification.
3) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
4) Modifications have been installed in conformance with referenced reinforcement drawings.
5) No specific horizontal welds were called out for the base plate stiffeners. 3/8" Groove weld was assumed.

This analysis may be affected if any assumptions are not valid or have been made in error. Paul J Ford and Company should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 4 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass / Fail
L1	150 - 123.29	Pole	TP22.9x17x0.1875	1	-4.87	679.32	40.0	Pass
L2	123.29 - 88.88	Pole	TP30x21.7696x0.3125	2	-10.32	1483.15	75.3	Pass
L3	88.88 - 43.8	Pole	TP39.2x28.4504x0.375	3	-18.68	2329.31	86.0	Pass
L4	43.8 - 0	Pole	TP48x37.2689x0.4375	4	-31.75	3433.55	81.4	Pass
							Summary	
						Pole (L3)	86.0	Pass
						Rating =	86.0	Pass

Table 5 - Tower Component Stresses vs. Capacity

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	71.9	Pass
1	Base Plate	0	62.3	Pass
1	Base Foundation	0	80.8	Pass
1	Base Foundation Soil Interaction	0	74.0	Pass

Structure Rating (max from all components) =	86.0%

Notes:
1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity consumed.

APPENDIX A

TNXTOWER OUTPUT

Tower Input Data

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

1) Tower is located in Windham County, Connecticut.
2) Basic wind speed of 85 mph.
3) Nominal ice thickness of 1.0000 in.
4) Ice density of 56 pcf.
5) A wind speed of 38 mph is used in combination with ice.
6) Temperature drop of 50 °F.
7) Deflections calculated using a wind speed of 50 mph.
8) A non-linear (P-delta) analysis was used.
9) Pressures are calculated at each section.
10) Stress ratio used in pole design is 1.333.
11) Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

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

Tapered Pole Section Geometry

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
L1	150.00-123.29	26.71	3.42	18	17.0000	22.9000	0.1875	0.7500	A572-65 (65 ksi)
L2	123.29-88.88	37.83	4.25	18	21.7696	30.0000	0.3125	1.2500	A572-65 (65 ksi)
L3	88.88-43.80	49.33	5.42	18	28.4504	39.2000	0.3750	1.5000	A572-65 (65 ksi)
L4	43.80-0.00	49.22		18	37.2689	48.0000	0.4375	1.7500	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	17.2623	10.0055	357.3078	5.9684	8.6360	41.3742	715.0858	5.0037	2.6620	14.197
	23.2533	13.5168	880.9281	8.0629	11.6332	75.7253	1763.0154	6.7597	3.7004	19.735
L2	22.8609	21.2827	1237.9542	7.6173	11.0589	111.9416	2477.5374	10.6434	3.2814	10.501

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
	30.4628	29.4463	3278.8026	10.5391	15.2400	215.1445	6561.9196	14.7259	4.7300	15.136
L3	29.8297	33.4167	3327.7547	9.9668	14.4528	230.2502	6659.8882	16.7115	4.3473	11.593
	39.8047	46.2115	8800.5544	13.7829	19.9136	441.9369	17612.688 9	23.1101	6.2392	16.638
L4	39.0438	51.1450	8765.5168	13.0752	18.9326	462.9852	17542.567 4	25.5774	5.7893	13.233
	48.7405	66.0465	18876.281 8	16.8847	24.3840	774.1257	37777.401 5	33.0295	7.6780	17.55

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 150.00-123.29				1	1	1		
L2 123.29-88.88				1	1	1		
L3 88.88-43.80				1	1	1		
L4 43.80-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
LDF7-50A(1-5/8")	C	No	Inside Pole	149.00 - 0.00	6	No Ice	0.00	0.82
						1/2" Ice	0.00	0.82
						1" Ice	0.00	0.82
LDF7-50A(1-5/8")	C	No	Inside Pole	137.00 - 0.00	6	No Ice	0.00	0.82
						1/2" Ice	0.00	0.82
						1" Ice	0.00	0.82
LDF6-50A(1-1/4")	C	No	Inside Pole	127.00 - 0.00	12	No Ice	0.00	0.66
						1/2" Ice	0.00	0.66
						1" Ice	0.00	0.66
FB-L98B-002-75000(3/8")	C	No	CaAa (Out Of Face)	127.00 - 0.00	1	No Ice	0.04	0.06
						1/2" Ice	0.14	0.60
						1" Ice	0.24	1.76
WR-VG122ST-BRDA(3/8)	C	No	CaAa (Out Of Face)	127.00 - 0.00	2	No Ice	0.00	0.20
						1/2" Ice	0.00	0.74
						1" Ice	0.00	1.89
LDF7-50A(1-5/8")	C	No	CaAa (Out Of Face)	117.00 - 0.00	2	No Ice	0.20	0.82
						1/2" Ice	0.30	2.33
						1" Ice	0.40	4.46
LDF7-50A(1-5/8")	C	No	CaAa (Out Of Face)	117.00 - 0.00	10	No Ice	0.00	0.82
						1/2" Ice	0.00	2.33
						1" Ice	0.00	4.46
LDF7-50A(1-5/8")	C	No	CaAa (Out Of Face)	117.00 - 0.00	6	No Ice	0.00	0.82
						1/2" Ice	0.00	2.33
						1" Ice	0.00	4.46
LDF4-50A(1/2")	C	No	Inside Pole	76.00 - 0.00	1	No Ice	0.00	0.15
						1/2" Ice	0.00	0.15
						1" Ice	0.00	0.15

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	150.00-123.29	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.146	0.23

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L2	123.29-88.88	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	12.490	1.04
L3	88.88-43.80	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	19.626	1.49
L4	43.80-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	19.069	1.45

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	150.00-123.29	A	1.000	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.888	0.24
L2	123.29-88.88	A	1.000	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	30.621	3.06
L3	88.88-43.80	A	1.000	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	46.675	4.68
L4	43.80-0.00	A	1.000	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	45.350	4.54

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	150.00-123.29	-0.0080	0.0046	-0.0435	0.0251
L2	123.29-88.88	-0.4138	0.2389	-0.7944	0.4587
L3	88.88-43.80	-0.4908	0.2834	-0.9467	0.5466
L4	43.80-0.00	-0.5046	0.2913	-1.0085	0.5822

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
*****									
(2) DB980H90E-M w/ Mount Pipe	A	From Leg	4.00 0.00 2.00	0.0000	149.00	No Ice 1/2" Ice 1" Ice	4.04 4.50 4.95	3.62 4.48 5.22	0.03 0.06 0.11
(2) DB980H90E-M w/ Mount Pipe	B	From Leg	4.00 0.00 2.00	0.0000	149.00	No Ice 1/2" Ice 1" Ice	4.04 4.50 4.95	3.62 4.48 5.22	0.03 0.06 0.11
(2) DB980H90E-M w/ Mount Pipe	C	From Leg	4.00 0.00	0.0000	149.00	No Ice 1/2"	4.04 4.50	3.62 4.48	0.03 0.06

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			2.00			Ice	4.95	5.22	0.11
						1" Ice			
Platform Mount [LP 601-1]	C	None		0.0000	149.00	No Ice	28.47	28.47	1.12
						1/2" Ice	33.59	33.59	1.51
						1" Ice	38.71	38.71	1.91
8-ft Ladder	C	From Leg	2.00	0.0000	149.00	No Ice	7.07	7.07	0.04
			0.00			1/2" Ice	9.73	9.73	0.07
			-1.00			1" Ice	11.19	11.19	0.08
6' x 2" Mount Pipe	A	From Leg	4.00	0.0000	149.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			2.00			1" Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	B	From Leg	4.00	0.0000	149.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			2.00			1" Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	C	From Leg	4.00	0.0000	149.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			2.00			1" Ice	2.29	2.29	0.05
***									
RR90-17-02DP w/ Mount Pipe	A	From Leg	4.00	0.0000	137.00	No Ice	4.59	3.32	0.03
			0.00			1/2" Ice	5.09	4.09	0.07
			1.00			1" Ice	5.58	4.78	0.11
RR90-17-02DP w/ Mount Pipe	B	From Leg	4.00	0.0000	137.00	No Ice	4.59	3.32	0.03
			0.00			1/2" Ice	5.09	4.09	0.07
			1.00			1" Ice	5.58	4.78	0.11
RR90-17-02DP w/ Mount Pipe	C	From Leg	4.00	0.0000	137.00	No Ice	4.59	3.32	0.03
			0.00			1/2" Ice	5.09	4.09	0.07
			1.00			1" Ice	5.58	4.78	0.11
(2) KRY 112 71/2	A	From Leg	4.00	0.0000	137.00	No Ice	0.68	0.51	0.01
			0.00			1/2" Ice	0.80	0.62	0.02
			1.00			1" Ice	0.93	0.74	0.03
(2) KRY 112 71/2	B	From Leg	4.00	0.0000	137.00	No Ice	0.68	0.51	0.01
			0.00			1/2" Ice	0.80	0.62	0.02
			1.00			1" Ice	0.93	0.74	0.03
(2) KRY 112 71/2	C	From Leg	4.00	0.0000	137.00	No Ice	0.68	0.51	0.01
			0.00			1/2" Ice	0.80	0.62	0.02
			1.00			1" Ice	0.93	0.74	0.03
Platform Mount [LP 712-1]	C	None		0.0000	137.00	No Ice	24.53	24.53	1.34
						1/2" Ice	29.94	29.94	1.65
						1" Ice	35.35	35.35	1.96
6' x 2" Mount Pipe	A	From Leg	4.00	0.0000	137.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			1.00			1" Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	B	From Leg	4.00	0.0000	137.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			1.00			1" Ice	2.29	2.29	0.05
6' x 2" Mount Pipe	C	From Leg	4.00	0.0000	137.00	No Ice	1.43	1.43	0.02
			0.00			1/2" Ice	1.92	1.92	0.03
			1.00			1" Ice	2.29	2.29	0.05
***									
(2) RRUS-11	A	From Leg	2.00	0.0000	129.00	No Ice	4.42	1.19	0.05

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00			1/2" Ice	4.71	1.35	0.07
			0.00			1" Ice	5.00	1.53	0.10
(2) RRUS-11	B	From Leg	2.00	0.0000	129.00	No Ice	4.42	1.19	0.05
			0.00			1/2" Ice	4.71	1.35	0.07
			0.00			1" Ice	5.00	1.53	0.10
(2) RRUS-11	C	From Leg	2.00	0.0000	129.00	No Ice	4.42	1.19	0.05
			0.00			1/2" Ice	4.71	1.35	0.07
			0.00			1" Ice	5.00	1.53	0.10
Side Arm Mount [SO 102-3]	C	None		0.0000	129.00	No Ice	3.00	3.00	0.08
						1/2" Ice	3.48	3.48	0.11
						1" Ice	3.96	3.96	0.14
***									
(2) 7770.00 w/ Mount Pipe	A	From Leg	4.00	0.0000	127.00	No Ice	6.12	4.25	0.06
			0.00			1/2" Ice	6.63	5.01	0.10
			2.00			1" Ice	7.13	5.71	0.16
(2) 7770.00 w/ Mount Pipe	B	From Leg	4.00	0.0000	127.00	No Ice	6.12	4.25	0.06
			0.00			1/2" Ice	6.63	5.01	0.10
			2.00			1" Ice	7.13	5.71	0.16
(2) 7770.00 w/ Mount Pipe	C	From Leg	4.00	0.0000	127.00	No Ice	6.12	4.25	0.06
			0.00			1/2" Ice	6.63	5.01	0.10
			2.00			1" Ice	7.13	5.71	0.16
(2) LGP 17201	A	From Leg	4.00	0.0000	127.00	No Ice	1.95	0.52	0.03
			0.00			1/2" Ice	2.13	0.64	0.04
			0.00			1" Ice	2.33	0.77	0.06
(2) LGP 17201	B	From Leg	4.00	0.0000	127.00	No Ice	1.95	0.52	0.03
			0.00			1/2" Ice	2.13	0.64	0.04
			0.00			1" Ice	2.33	0.77	0.06
(2) LGP 17201	C	From Leg	4.00	0.0000	127.00	No Ice	1.95	0.52	0.03
			0.00			1/2" Ice	2.13	0.64	0.04
			0.00			1" Ice	2.33	0.77	0.06
(2) LGP13519	A	From Leg	4.00	0.0000	127.00	No Ice	0.34	0.21	0.01
			0.00			1/2" Ice	0.42	0.28	0.01
			0.00			1" Ice	0.51	0.36	0.01
(2) LGP13519	B	From Leg	4.00	0.0000	127.00	No Ice	0.34	0.21	0.01
			0.00			1/2" Ice	0.42	0.28	0.01
			0.00			1" Ice	0.51	0.36	0.01
(2) LGP13519	C	From Leg	4.00	0.0000	127.00	No Ice	0.34	0.21	0.01
			0.00			1/2" Ice	0.42	0.28	0.01
			0.00			1" Ice	0.51	0.36	0.01
AM-X-CD-17-65-00T-RET w/ Mount Pipe	A	From Leg	4.00	0.0000	127.00	No Ice	11.55	8.94	0.09
			0.00			1/2" Ice	12.27	10.45	0.17
			2.00			1" Ice	13.00	11.99	0.27
AM-X-CD-17-65-00T-RET w/ Mount Pipe	B	From Leg	4.00	0.0000	127.00	No Ice	11.55	8.94	0.09
			0.00			1/2" Ice	12.27	10.45	0.17
			2.00			1" Ice	13.00	11.99	0.27
AM-X-CD-17-65-00T-RET w/ Mount Pipe	C	From Leg	4.00	0.0000	127.00	No Ice	11.55	8.94	0.09
			0.00			1/2" Ice	12.27	10.45	0.17
			2.00			1" Ice	13.00	11.99	0.27
DC6-48-60-18-8F	B	From Leg	4.00	0.0000	127.00	No Ice	1.47	1.47	0.02

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00			1/2" Ice	1.67	1.67	0.04
			2.00			1" Ice	1.88	1.88	0.06
T-Arm Mount [TA 602-3]	C	None		0.0000	127.00	No Ice	11.59	11.59	0.77
						1/2" Ice	15.44	15.44	0.99
						1" Ice	19.29	19.29	1.21
***									
(2) LPA-80080/4CF w/ Mount Pipe	A	From Leg	4.00	0.0000	117.00	No Ice	2.86	7.23	0.03
			0.00			1/2" Ice	3.22	7.92	0.07
			2.00			1" Ice	3.59	8.63	0.13
(2) LPA-80080/4CF w/ Mount Pipe	B	From Leg	4.00	0.0000	117.00	No Ice	2.86	7.23	0.03
			0.00			1/2" Ice	3.22	7.92	0.07
			2.00			1" Ice	3.59	8.63	0.13
(2) LPA-80080/4CF w/ Mount Pipe	C	From Leg	4.00	0.0000	117.00	No Ice	2.86	7.23	0.03
			0.00			1/2" Ice	3.22	7.92	0.07
			2.00			1" Ice	3.59	8.63	0.13
BXA-70063-6CF-2 w/ Mount Pipe	A	From Leg	4.00	0.0000	117.00	No Ice	7.97	5.80	0.04
			0.00			1/2" Ice	8.61	6.95	0.10
			2.00			1" Ice	9.22	7.82	0.17
BXA-70063-6CF-2 w/ Mount Pipe	B	From Leg	4.00	0.0000	117.00	No Ice	7.97	5.80	0.04
			0.00			1/2" Ice	8.61	6.95	0.10
			2.00			1" Ice	9.22	7.82	0.17
BXA-70063-6CF-2 w/ Mount Pipe	C	From Leg	4.00	0.0000	117.00	No Ice	7.97	5.80	0.04
			0.00			1/2" Ice	8.61	6.95	0.10
			2.00			1" Ice	9.22	7.82	0.17
BXA-171085-12CF-EDIN-2 w/ Mount Pipe	A	From Leg	4.00	0.0000	117.00	No Ice	5.34	5.60	0.05
			0.00			1/2" Ice	6.03	6.90	0.09
			2.00			1" Ice	6.69	8.11	0.15
BXA-171085-12CF-EDIN-2 w/ Mount Pipe	B	From Leg	4.00	0.0000	117.00	No Ice	5.34	5.60	0.05
			0.00			1/2" Ice	6.03	6.90	0.09
			2.00			1" Ice	6.69	8.11	0.15
BXA-171085-12CF-EDIN-2 w/ Mount Pipe	C	From Leg	4.00	0.0000	117.00	No Ice	5.34	5.60	0.05
			0.00			1/2" Ice	6.03	6.90	0.09
			2.00			1" Ice	6.69	8.11	0.15
Platform Mount [LP 303-1]	C	None		0.0000	117.00	No Ice	14.66	14.66	1.25
						1/2" Ice	18.87	18.87	1.48
						1" Ice	23.08	23.08	1.71
***									
Pipe Mount [PM 601-1]	C	None		0.0000	76.00	No Ice	3.00	0.90	0.07
						1/2" Ice	3.74	1.12	0.08
						1" Ice	4.48	1.34	0.09
KS24019-L112A	C	From Leg	4.00	0.0000	76.00	No Ice	0.16	0.16	0.01
			0.00			1/2" Ice	0.22	0.22	0.01
			1.00			1" Ice	0.30	0.30	0.01

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	1.36	50.88	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	2.67	77.68	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	3.91	86.82	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	3.80	86.80	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	804.48 kip-ft	11.75		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	1.36	50.88	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	2.67	77.68	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	3.91	86.82	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	3.80	86.80	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	804.48 kip-ft	11.75		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	1.36	50.88	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	2.67	77.68	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	3.91	86.82	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	3.80	86.80	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	804.48 kip-ft	11.75		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.24	1.76	A	1	0.65	1	1	1	48.857	0.30	11.20	C
			B	1	0.65	1	1	1	48.857			
			C	1	0.65	1	1	1	48.857			
L2 123.29-88.88	3.06	4.42	A	1	0.65	1	1	1	81.026	0.71	20.61	C
			B	1	0.65	1	1	1	81.026			
			C	1	0.65	1	1	1	81.026			
L3 88.88-43.80	4.68	8.65	A	1	0.65	1	1	1	136.323	1.00	22.24	C
			B	1	0.65	1	1	1	136.323			
			C	1	0.65	1	1	1	136.323			
L4 43.80-0.00	4.54	12.20	A	1	0.65	1	1	1	165.072	0.93	21.32	C
			B	1	0.65	1	1	1	165.072			
			C	1	0.65	1	1	1	165.072			
Sum Weight:	12.52	27.03						OTM	201.15 kip-ft	2.94		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.24	1.76	A	1	0.65	1	1	1	48.857	0.30	11.20	C
			B	1	0.65	1	1	1	48.857			
			C	1	0.65	1	1	1	48.857			
L2 123.29-88.88	3.06	4.42	A	1	0.65	1	1	1	81.026	0.71	20.61	C
			B	1	0.65	1	1	1	81.026			
			C	1	0.65	1	1	1	81.026			
L3 88.88-43.80	4.68	8.65	A	1	0.65	1	1	1	136.323	1.00	22.24	C
			B	1	0.65	1	1	1	136.323			
			C	1	0.65	1	1	1	136.323			
L4 43.80-0.00	4.54	12.20	A	1	0.65	1	1	1	165.072	0.93	21.32	C
			B	1	0.65	1	1	1	165.072			
			C	1	0.65	1	1	1	165.072			
Sum Weight:	12.52	27.03						OTM	201.15 kip-ft	2.94		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.24	1.76	A	1	0.65	1	1	1	48.857	0.30	11.20	C
			B	1	0.65	1	1	1	48.857			
			C	1	0.65	1	1	1	48.857			
L2 123.29-88.88	3.06	4.42	A	1	0.65	1	1	1	81.026	0.71	20.61	C
			B	1	0.65	1	1	1	81.026			
			C	1	0.65	1	1	1	81.026			
L3 88.88-43.80	4.68	8.65	A	1	0.65	1	1	1	136.323	1.00	22.24	C
			B	1	0.65	1	1	1	136.323			
			C	1	0.65	1	1	1	136.323			
L4 43.80-0.00	4.54	12.20	A	1	0.65	1	1	1	165.072	0.93	21.32	C
			B	1	0.65	1	1	1	165.072			
			C	1	0.65	1	1	1	165.072			
Sum Weight:	12.52	27.03						OTM	201.15	2.94		

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2 kip-ft	F K	w plf	Ctrl. Face

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	0.47	17.61	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	0.92	26.88	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	1.35	30.04	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	1.32	30.03	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	278.37 kip-ft	4.06		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	0.47	17.61	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	0.92	26.88	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	1.35	30.04	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	1.32	30.03	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	278.37 kip-ft	4.06		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F K	w plf	Ctrl. Face
L1 150.00-123.29	0.23	1.07	A	1	0.65	1	1	1	44.405	0.47	17.61	C
			B	1	0.65	1	1	1	44.405			
			C	1	0.65	1	1	1	44.405			
L2 123.29-88.88	1.04	3.27	A	1	0.65	1	1	1	75.291	0.92	26.88	C
			B	1	0.65	1	1	1	75.291			
			C	1	0.65	1	1	1	75.291			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F K	w plf	Ctrl. Face
L3 88.88-43.80	1.49	6.68	A	1	0.65	1	1	1	128.809	1.35	30.04	C
			B	1	0.65	1	1	1	128.809			
			C	1	0.65	1	1	1	128.809			
L4 43.80-0.00	1.45	9.81	A	1	0.65	1	1	1	157.772	1.32	30.03	C
			B	1	0.65	1	1	1	157.772			
			C	1	0.65	1	1	1	157.772			
Sum Weight:	4.21	20.83						OTM	278.37 kip-ft	4.06		

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 60 deg - No Ice
5	Dead+Wind 90 deg - No Ice
6	Dead+Wind 120 deg - No Ice
7	Dead+Wind 150 deg - No Ice
8	Dead+Wind 180 deg - No Ice
9	Dead+Wind 210 deg - No Ice
10	Dead+Wind 240 deg - No Ice
11	Dead+Wind 270 deg - No Ice
12	Dead+Wind 300 deg - No Ice
13	Dead+Wind 330 deg - No Ice
14	Dead+Ice+Temp
15	Dead+Wind 0 deg+Ice+Temp
16	Dead+Wind 30 deg+Ice+Temp
17	Dead+Wind 60 deg+Ice+Temp
18	Dead+Wind 90 deg+Ice+Temp
19	Dead+Wind 120 deg+Ice+Temp
20	Dead+Wind 150 deg+Ice+Temp
21	Dead+Wind 180 deg+Ice+Temp
22	Dead+Wind 210 deg+Ice+Temp
23	Dead+Wind 240 deg+Ice+Temp
24	Dead+Wind 270 deg+Ice+Temp
25	Dead+Wind 300 deg+Ice+Temp
26	Dead+Wind 330 deg+Ice+Temp
27	Dead+Wind 0 deg - Service
28	Dead+Wind 30 deg - Service
29	Dead+Wind 60 deg - Service
30	Dead+Wind 90 deg - Service
31	Dead+Wind 120 deg - Service
32	Dead+Wind 150 deg - Service
33	Dead+Wind 180 deg - Service
34	Dead+Wind 210 deg - Service
35	Dead+Wind 240 deg - Service
36	Dead+Wind 270 deg - Service
37	Dead+Wind 300 deg - Service
38	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	150 - 123.29	Pole	Max Tension	5	0.00	0.00	0.00
			Max. Compression	14	-11.26	0.01	-0.29
			Max. Mx	11	-4.86	120.00	-0.05
			Max. My	8	-4.87	-0.03	-120.10

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vy	11	-11.63	120.00	-0.05
			Max. Vx	8	11.63	-0.03	-120.10
			Max. Torque	13			0.92
L2	123.29 - 88.88	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-21.50	2.31	-1.63
			Max. Mx	11	-10.32	651.90	-0.31
			Max. My	8	-10.32	0.38	-651.84
			Max. Vy	11	-18.12	651.90	-0.31
			Max. Vx	8	18.12	0.38	-651.84
			Max. Torque	6			-0.87
L3	88.88 - 43.8	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-34.22	7.16	-4.44
			Max. Mx	11	-18.68	1532.02	-0.82
			Max. My	8	-18.68	1.24	-1531.60
			Max. Vy	11	-21.87	1532.02	-0.82
			Max. Vx	8	21.87	1.24	-1531.60
			Max. Torque	6			-1.05
L4	43.8 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	14	-52.63	13.70	-8.22
			Max. Mx	11	-31.75	2699.05	-1.49
			Max. My	8	-31.75	2.40	-2698.14
			Max. Vy	11	-25.47	2699.05	-1.49
			Max. Vx	8	25.47	2.40	-2698.14
			Max. Torque	13			1.25

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	14	52.63	-0.00	0.00
	Max. H_x	11	31.77	25.45	-0.00
	Max. H_z	2	31.77	0.00	25.45
	Max. M_x	2	2695.16	0.00	25.45
	Max. M_z	5	2694.25	-25.45	-0.00
	Max. Torsion	13	1.25	12.73	22.04
	Min. Vert	11	31.77	25.45	-0.00
	Min. H_x	5	31.77	-25.45	-0.00
	Min. H_z	8	31.77	0.00	-25.45
	Min. M_x	8	-2698.14	0.00	-25.45
	Min. M_z	11	-2699.05	25.45	-0.00
	Min. Torsion	7	-1.25	-12.73	-22.04

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	31.77	0.00	-0.00	1.45	2.33	-0.00
Dead+Wind 0 deg - No Ice	31.77	-0.00	-25.45	-2695.16	2.40	-0.94
Dead+Wind 30 deg - No Ice	31.77	12.73	-22.04	-2334.21	-1346.12	-0.38
Dead+Wind 60 deg - No Ice	31.77	22.04	-12.73	-1347.03	-2333.30	0.28
Dead+Wind 90 deg - No Ice	31.77	25.45	0.00	1.49	-2694.25	0.87
Dead+Wind 120 deg - No Ice	31.77	22.04	12.73	1350.01	-2333.30	1.23
Dead+Wind 150 deg - No Ice	31.77	12.73	22.04	2337.19	-1346.12	1.25
Dead+Wind 180 deg - No Ice	31.77	-0.00	25.45	2698.14	2.40	0.94
Dead+Wind 210 deg - No Ice	31.77	-12.73	22.04	2337.19	1350.92	0.38
Dead+Wind 240 deg - No Ice	31.77	-22.04	12.73	1350.01	2338.10	-0.28
Dead+Wind 270 deg - No Ice	31.77	-25.45	0.00	1.49	2699.05	-0.87
Dead+Wind 300 deg - No Ice	31.77	-22.04	-12.73	-1347.03	2338.10	-1.23

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	K	K	K	kip-ft	kip-ft	kip-ft
Dead+Wind 330 deg - No Ice	31.77	-12.73	-22.04	-2334.21	1350.92	-1.25
Dead+Ice+Temp	52.63	0.00	-0.00	8.22	13.70	0.00
Dead+Wind 0 deg+Ice+Temp	52.63	0.00	-6.52	-710.16	13.84	-0.39
Dead+Wind 30 deg+Ice+Temp	52.63	3.26	-5.65	-613.90	-345.40	-0.19
Dead+Wind 60 deg+Ice+Temp	52.63	5.65	-3.26	-350.93	-608.37	0.07
Dead+Wind 90 deg+Ice+Temp	52.63	6.52	-0.00	8.31	-704.63	0.31
Dead+Wind 120 deg+Ice+Temp	52.63	5.65	3.26	367.54	-608.37	0.46
Dead+Wind 150 deg+Ice+Temp	52.63	3.26	5.65	630.51	-345.39	0.49
Dead+Wind 180 deg+Ice+Temp	52.63	0.00	6.52	726.77	13.84	0.39
Dead+Wind 210 deg+Ice+Temp	52.63	-3.26	5.65	630.51	373.07	0.19
Dead+Wind 240 deg+Ice+Temp	52.63	-5.65	3.26	367.54	636.04	-0.07
Dead+Wind 270 deg+Ice+Temp	52.63	-6.52	-0.00	8.31	732.29	-0.31
Dead+Wind 300 deg+Ice+Temp	52.63	-5.65	-3.26	-350.92	636.04	-0.46
Dead+Wind 330 deg+Ice+Temp	52.63	-3.26	-5.65	-613.90	373.07	-0.49
Dead+Wind 0 deg - Service	31.77	0.00	-8.81	-933.09	2.41	-0.33
Dead+Wind 30 deg - Service	31.77	4.40	-7.63	-807.88	-464.89	-0.13
Dead+Wind 60 deg - Service	31.77	7.63	-4.40	-465.80	-806.97	0.10
Dead+Wind 90 deg - Service	31.77	8.81	-0.00	1.50	-932.18	0.30
Dead+Wind 120 deg - Service	31.77	7.63	4.40	468.79	-806.97	0.43
Dead+Wind 150 deg - Service	31.77	4.40	7.63	810.88	-464.89	0.44
Dead+Wind 180 deg - Service	31.77	0.00	8.81	936.09	2.41	0.33
Dead+Wind 210 deg - Service	31.77	-4.40	7.63	810.88	469.71	0.13
Dead+Wind 240 deg - Service	31.77	-7.63	4.40	468.79	811.79	-0.10
Dead+Wind 270 deg - Service	31.77	-8.81	-0.00	1.50	937.00	-0.30
Dead+Wind 300 deg - Service	31.77	-7.63	-4.40	-465.80	811.79	-0.43
Dead+Wind 330 deg - Service	31.77	-4.40	-7.63	-807.88	469.71	-0.44

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	K	K	K	K	K	K	
1	0.00	-31.77	0.00	-0.00	31.77	0.00	0.000%
2	0.00	-31.77	-25.45	0.00	31.77	25.45	0.008%
3	12.73	-31.77	-22.04	-12.73	31.77	22.04	0.000%
4	22.04	-31.77	-12.73	-22.04	31.77	12.73	0.000%
5	25.45	-31.77	0.00	-25.45	31.77	-0.00	0.008%
6	22.04	-31.77	12.73	-22.04	31.77	-12.73	0.000%
7	12.73	-31.77	22.04	-12.73	31.77	-22.04	0.000%
8	0.00	-31.77	25.45	0.00	31.77	-25.45	0.008%
9	-12.73	-31.77	22.04	12.73	31.77	-22.04	0.000%
10	-22.04	-31.77	12.73	22.04	31.77	-12.73	0.000%
11	-25.45	-31.77	0.00	25.45	31.77	-0.00	0.008%
12	-22.04	-31.77	-12.73	22.04	31.77	12.73	0.000%
13	-12.73	-31.77	-22.04	12.73	31.77	22.04	0.000%
14	0.00	-52.63	0.00	-0.00	52.63	0.00	0.001%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
15	0.00	-52.63	-6.53	-0.00	52.63	6.52	0.002%
16	3.26	-52.63	-5.65	-3.26	52.63	5.65	0.002%
17	5.65	-52.63	-3.26	-5.65	52.63	3.26	0.002%
18	6.53	-52.63	0.00	-6.52	52.63	0.00	0.002%
19	5.65	-52.63	3.26	-5.65	52.63	-3.26	0.002%
20	3.26	-52.63	5.65	-3.26	52.63	-5.65	0.002%
21	0.00	-52.63	6.53	-0.00	52.63	-6.52	0.002%
22	-3.26	-52.63	5.65	3.26	52.63	-5.65	0.002%
23	-5.65	-52.63	3.26	5.65	52.63	-3.26	0.002%
24	-6.53	-52.63	0.00	6.52	52.63	0.00	0.002%
25	-5.65	-52.63	-3.26	5.65	52.63	3.26	0.002%
26	-3.26	-52.63	-5.65	3.26	52.63	5.65	0.002%
27	0.00	-31.77	-8.81	-0.00	31.77	8.81	0.003%
28	4.40	-31.77	-7.63	-4.40	31.77	7.63	0.003%
29	7.63	-31.77	-4.40	-7.63	31.77	4.40	0.003%
30	8.81	-31.77	0.00	-8.81	31.77	0.00	0.003%
31	7.63	-31.77	4.40	-7.63	31.77	-4.40	0.003%
32	4.40	-31.77	7.63	-4.40	31.77	-7.63	0.003%
33	0.00	-31.77	8.81	-0.00	31.77	-8.81	0.003%
34	-4.40	-31.77	7.63	4.40	31.77	-7.63	0.003%
35	-7.63	-31.77	4.40	7.63	31.77	-4.40	0.003%
36	-8.81	-31.77	0.00	8.81	31.77	0.00	0.003%
37	-7.63	-31.77	-4.40	7.63	31.77	4.40	0.003%
38	-4.40	-31.77	-7.63	4.40	31.77	7.63	0.003%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00000001
2	Yes	16	0.00007834	0.00012442
3	Yes	21	0.00000001	0.00008202
4	Yes	21	0.00000001	0.00008208
5	Yes	16	0.00007835	0.00012119
6	Yes	21	0.00000001	0.00008445
7	Yes	21	0.00000001	0.00008101
8	Yes	16	0.00007833	0.00012454
9	Yes	21	0.00000001	0.00008344
10	Yes	21	0.00000001	0.00008338
11	Yes	16	0.00007833	0.00012136
12	Yes	21	0.00000001	0.00008110
13	Yes	21	0.00000001	0.00008454
14	Yes	11	0.00000001	0.00000944
15	Yes	17	0.00010212	0.00004665
16	Yes	17	0.00010197	0.00008552
17	Yes	17	0.00010197	0.00008611
18	Yes	17	0.00010214	0.00004602
19	Yes	17	0.00010194	0.00009222
20	Yes	17	0.00010194	0.00008665
21	Yes	17	0.00010209	0.00004766
22	Yes	17	0.00010188	0.00009486
23	Yes	17	0.00010188	0.00009420
24	Yes	17	0.00010207	0.00004759
25	Yes	17	0.00010191	0.00008833
26	Yes	17	0.00010191	0.00009401
27	Yes	16	0.00008361	0.00005107
28	Yes	16	0.00008330	0.00012448
29	Yes	16	0.00008330	0.00012475
30	Yes	16	0.00008361	0.00005081
31	Yes	16	0.00008330	0.00013745
32	Yes	16	0.00008330	0.00011956
33	Yes	16	0.00008360	0.00005123
34	Yes	16	0.00008329	0.00013183
35	Yes	16	0.00008329	0.00013151
36	Yes	16	0.00008360	0.00005104

37	Yes	16	0.00008329	0.00011998
38	Yes	16	0.00008329	0.00013793

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 123.29	38.450	35	2.2815	0.0080
L2	126.71 - 88.88	27.612	35	2.1103	0.0033
L3	93.13 - 43.8	14.451	35	1.5518	0.0015
L4	49.22 - 0	3.826	35	0.7287	0.0005

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
149.00	(2) DB980H90E-M w/ Mount Pipe	35	37.974	2.2760	0.0078	20768
137.00	RR90-17-02DP w/ Mount Pipe	35	32.307	2.2028	0.0050	7987
129.00	(2) RRUS-11	35	28.636	2.1345	0.0036	4964
127.00	(2) 7770.00 w/ Mount Pipe	35	27.741	2.1135	0.0033	4607
117.00	(2) LPA-80080/4CF w/ Mount Pipe	35	23.429	1.9816	0.0023	3915
76.00	Pipe Mount [PM 601-1]	35	9.353	1.2185	0.0012	2908

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	150 - 123.29	110.473	11	6.5589	0.0230
L2	126.71 - 88.88	79.366	11	6.0692	0.0093
L3	93.13 - 43.8	41.565	11	4.4646	0.0043
L4	49.22 - 0	11.013	10	2.0978	0.0015

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
149.00	(2) DB980H90E-M w/ Mount Pipe	11	109.107	6.5433	0.0223	7400
137.00	RR90-17-02DP w/ Mount Pipe	11	92.842	6.3342	0.0144	2844
129.00	(2) RRUS-11	11	82.307	6.1387	0.0102	1766
127.00	(2) 7770.00 w/ Mount Pipe	11	79.737	6.0784	0.0094	1638
117.00	(2) LPA-80080/4CF w/ Mount Pipe	11	67.358	5.6997	0.0066	1387
76.00	Pipe Mount [PM 601-1]	10	26.909	3.5065	0.0033	1019

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P K	Allow. P_a K	Ratio $\frac{P}{P_a}$
L1	150 - 123.29 (1)	TP22.9x17x0.1875	26.71	0.00	0.0	39.000	13.0672	-4.87	509.62	0.010
L2	123.29 - 88.88 (2)	TP30x21.7696x0.3125	37.83	0.00	0.0	39.000	28.5292	-10.32	1112.64	0.009
L3	88.88 - 43.8 (3)	TP39.2x28.4504x0.375	49.33	0.00	0.0	39.000	44.8057	-18.68	1747.42	0.011
L4	43.8 - 0 (4)	TP48x37.2689x0.4375	49.22	0.00	0.0	39.000	66.0465	-31.75	2575.81	0.012

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	150 - 123.29 (1)	TP22.9x17x0.1875	120.10	20.370	39.000	0.522	0.00	0.000	39.000	0.000
L2	123.29 - 88.88 (2)	TP30x21.7696x0.3125	652.11	38.762	39.000	0.994	0.00	0.000	39.000	0.000
L3	88.88 - 43.8 (3)	TP39.2x28.4504x0.375	1532.50	44.278	39.000	1.135	0.00	0.000	39.000	0.000
L4	43.8 - 0 (4)	TP48x37.2689x0.4375	2699.86	41.852	39.000	1.073	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V K	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	150 - 123.29 (1)	TP22.9x17x0.1875	11.63	0.890	26.000	0.068	0.92	0.076	26.000	0.003
L2	123.29 - 88.88 (2)	TP30x21.7696x0.3125	18.12	0.635	26.000	0.049	0.29	0.008	26.000	0.000
L3	88.88 - 43.8 (3)	TP39.2x28.4504x0.375	21.87	0.488	26.000	0.038	0.28	0.004	26.000	0.000
L4	43.8 - 0 (4)	TP48x37.2689x0.4375	25.48	0.386	26.000	0.030	0.28	0.002	26.000	0.000

Pole Interaction Design Data

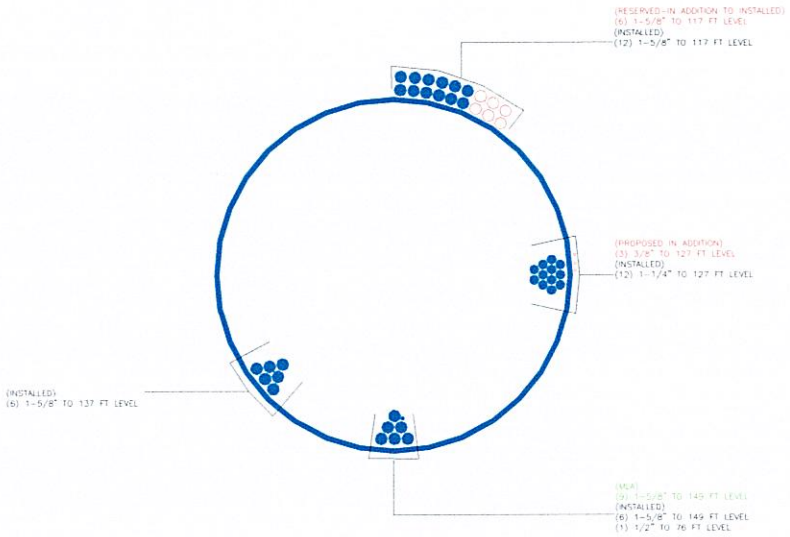
Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	150 - 123.29 (1)	0.010	0.522	0.000	0.068	0.003	0.533 ✔	1.333	H1-3+VT ✔
L2	123.29 - 88.88 (2)	0.009	0.994	0.000	0.049	0.000	1.004 ✔	1.333	H1-3+VT ✔
L3	88.88 - 43.8 (3)	0.011	1.135	0.000	0.038	0.000	1.146 ✔	1.333	H1-3+VT ✔
L4	43.8 - 0 (4)	0.012	1.073	0.000	0.030	0.000	1.086 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	$SF*P_{allow}$ K	% Capacity	Pass Fail
L1	150 - 123.29	Pole	TP22.9x17x0.1875	1	-4.87	679.32	40.0	Pass
L2	123.29 - 88.88	Pole	TP30x21.7696x0.3125	2	-10.32	1483.15	75.3	Pass
L3	88.88 - 43.8	Pole	TP39.2x28.4504x0.375	3	-18.68	2329.31	86.0	Pass
L4	43.8 - 0	Pole	TP48x37.2689x0.4375	4	-31.75	3433.55	81.4	Pass
							Summary	
						Pole (L3)	86.0	Pass
						RATING =	**86.0**	**Pass**

APPENDIX B

BASE LEVEL DRAWING

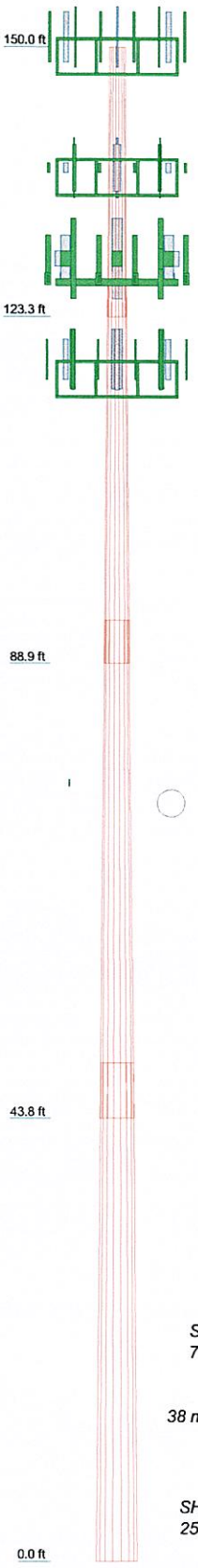

(RESERVED - IN ADDITION TO INSTALLED)
(6) 1-5/8" TO 117 FT LEVEL
(INSTALLED)
(12) 1-5/8" TO 117 FT LEVEL
(PROPOSED IN ADDITION)
(3) 3/8" TO 127 FT LEVEL
(INSTALLED)
(12) 1-1/4" TO 127 FT LEVEL
(INSTALLED)
(6) 1-5/8" TO 137 FT LEVEL
(MLA)
(3) 1-5/8" TO 149 FT LEVEL
(INSTALLED)
(6) 1-5/8" TO 149 FT LEVEL
(1) 1/2" TO 76 FT LEVEL

APPENDIX C

ADDITIONAL CALCULATIONS

Section	1	2	3	4
Length (ft)	26.71	37.83	49.33	49.22
Number of Sides	18	18	18	18
Thickness (in)	0.1875	0.3125	0.3750	0.4375
Socket Length (ft)	3.42	4.25	5.42	
Top Dia (in)	17.0000	21.7696	28.4504	37.2689
Bot Dia (in)	22.9000	30.0000	39.2000	48.0000
Grade	A572-65			
Weight (K)	1.1	3.3	6.7	9.8

Total Weight (K): 20.8



AXIAL
53 K

SHEAR
7 K

MOMENT
735 kip-ft

TORQUE 0 kip-ft
38 mph WIND - 1.0000 in ICE

AXIAL
32 K

SHEAR
25 K

MOMENT
2700 kip-ft

TORQUE 1 kip-ft
REACTIONS - 85 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
(2) DB980H90E-M w/ Mount Pipe	149	(2) LGP 17201	127
(2) DB980H90E-M w/ Mount Pipe	149	(2) LGP13519	127
(2) DB980H90E-M w/ Mount Pipe	149	(2) LGP13519	127
Platform Mount [LP 601-1]	149	(2) LGP13519	127
8-ft Ladder	149	AM-X-CD-17-65-00T-RET w/ Mount Pipe	127
6' x 2" Mount Pipe	149		
6' x 2" Mount Pipe	149	AM-X-CD-17-65-00T-RET w/ Mount Pipe	127
6' x 2" Mount Pipe	149		
RR90-17-02DP w/ Mount Pipe	137	AM-X-CD-17-65-00T-RET w/ Mount Pipe	127
RR90-17-02DP w/ Mount Pipe	137		
RR90-17-02DP w/ Mount Pipe	137	DC6-48-60-18-8F	127
(2) KRY 112 71/2	137	T-Arm Mount [TA 602-3]	127
(2) KRY 112 71/2	137	(2) LPA-80080/4CF w/ Mount Pipe	117
(2) KRY 112 71/2	137	(2) LPA-80080/4CF w/ Mount Pipe	117
Platform Mount [LP 712-1]	137	(2) LPA-80080/4CF w/ Mount Pipe	117
6' x 2" Mount Pipe	137	BXA-70063-6CF-2 w/ Mount Pipe	117
6' x 2" Mount Pipe	137	BXA-70063-6CF-2 w/ Mount Pipe	117
6' x 2" Mount Pipe	137	BXA-70063-6CF-2 w/ Mount Pipe	117
(2) RRUS-11	129	BXA-171085-12CF-EDIN-2 w/ Mount Pipe	117
(2) RRUS-11	129	BXA-171085-12CF-EDIN-2 w/ Mount Pipe	117
(2) RRUS-11	129	BXA-171085-12CF-EDIN-2 w/ Mount Pipe	117
Side Arm Mount [SO 102-3]	129		
(2) 7770.00 w/ Mount Pipe	127	Platform Mount [LP 303-1]	117
(2) 7770.00 w/ Mount Pipe	127	Pipe Mount [PM 601-1]	76
(2) 7770.00 w/ Mount Pipe	127	KS24019-L112A	76
(2) LGP 17201	127		
(2) LGP 17201	127		

MATERIAL STRENGTH

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

TOWER DESIGN NOTES

1. Tower is located in Windham County, Connecticut.
2. Tower designed for a 85 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 38 mph basic wind with 1.00 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 86%

Paul J Ford and Company
250 E. Broad Street Suite 1500
Columbus, OH 43215
Phone: 614.221.6679
FAX: 614.448.4105

Job:	***150' Monopole / Hampton Bernier***		
Project:	***PJF 37512-2182 / BU 876390***		
Client: Crown Castle	Drawn by: John J Woolley	App'd:	
Code: TIA/EIA-222-F	Date: 08/16/12	Scale: NTS	
Path: G:\TOWER\375_Crown_Castle\2012\37512-2182 BU 876390\37512-2182.en		Dwg No. E-1	

Stiffened or Unstiffened, Ungrouted, Circular Base Plate - Any Rod Material

TIA Rev F

Site Data

BU#: *879390*
Site Name:
App #:

Pole Manufacturer:	*Other*

Reactions		
Moment:	2700	ft-kips
Axial:	32	kips
Shear:	25	kips

If No stiffeners, Criteria:	AISC ASD	<-Only Applcable to Unstiffened Cases

Anchor Rod Data		
Qty:	16	
Diam:	2.25	in
Rod Material:	A615-J	
Strength (Fu):	100	ksi
Yield (Fy):	75	ksi
Bolt Circle:	57	in

Plate Data		
Diam:	63	in
Thick:	2	in
Grade:	60	ksi
Single-Rod B-eff:	9.52	in

Stiffener Data (Welding at both sides)		
Config:	1	*
Weld Type:	Groove	
Groove Depth:	0.375	in **
Groove Angle:	45	degrees
Fillet H. Weld:	0.3125	<-- Disregard
Fillet V. Weld:	0.375	in
Width:	7	in
Height:	18	in
Thick:	0.75	in
Notch:	0.75	in
Grade:	50	ksi
Weld str.:	70	ksi

Pole Data		
Diam:	48	in
Thick:	0.4375	in
Grade:	65	ksi
# of Sides:	18	"0" IF Round
Fu	80	ksi
Reinf. Fillet Weld	0	"0" if None

Stress Increase Factor		
ASIF:	1.333	

Anchor Rod Results

		Stiffened
Maximum Rod Tension:	140.1 Kips	Service, ASD
Allowable Tension:	195.0 Kips	Fty*ASIF
Anchor Rod Stress Ratio:	71.9% **Pass**	

Base Plate Results

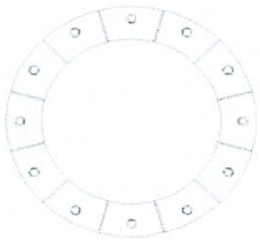
	Flexural Check	Stiffened
Base Plate Stress:	37.3 ksi	Service, ASD
Allowable Plate Stress:	60.0 ksi	0.75*Fy*ASIF
Base Plate Stress Ratio:	62.3% **Pass**	Y.L. Length: N/A, Roark

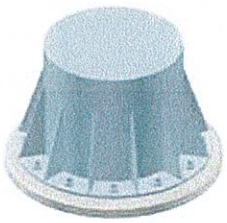
Stiffener Results

Horizontal Weld :	52.3% **Pass**
Vertical Weld:	40.9% **Pass**
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	17.3% **Pass**
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	52.8% **Pass**
Plate Comp. (AISC Bracket):	59.6% **Pass**

Pole Results

Pole Punching Shear Check:	10.5% **Pass**





* 0 = none, 1 = every bolt, 2 = every 2 bolts, 3 = 2 per bolt

** Note: for complete joint penetration groove welds the groove depth must be exactly 1/2 the stiffener thickness for calculation purposes

PJF job no. **37512-2182** Project name **150' Monopole**

Foundation Loads:

Pole weight or tower leg compression =	**32**	(kips)
Horizontal load at top of pier =	**25**	(kips)
Overturning moment at top of pier=	**2700**	(ft-kips)

Design criteria:

Safety factor against overturning =	**1.5**	

Soil Properties:

Soil density =	**125**	(pcf)
Allowable soil bearing =	**3**	(ksf)
Depth to water table =	**4**	(ft)

Dimensions:

Pier shape (round or square)	**S**	("R" or "S")
Pier width =	**6.5**	(ft)
Pier height above grade =	**1**	(ft)
depth to bottom of footing =	**5**	(ft)
Footing thickness =	**3**	(ft)
Footing width =	**25.25**	(ft)
Footing length =	**25.25**	(ft)

Concrete:

Concrete strength =	**4**	(ksi)
Rebar strength =	**60**	(ksi)
ultimate load factor =	**1.3**	

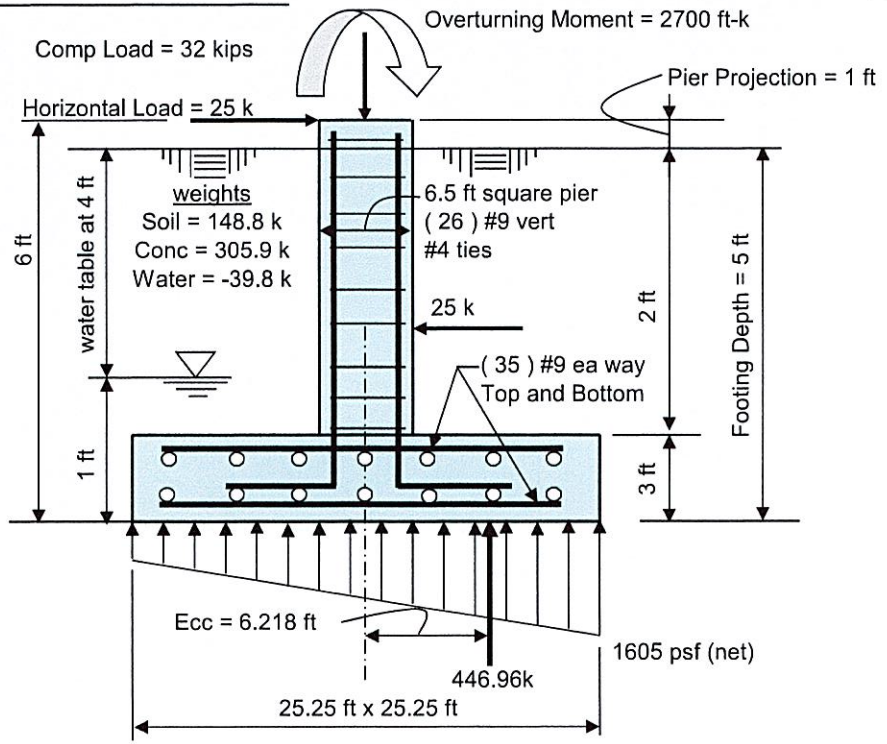
Reinforcing Steel:

	Pad	
minimum cover over rebar =	**3**	inches
size of pad rebar =	**#9**	bar
quantity of pad rebar =	**35**	(ea direction)

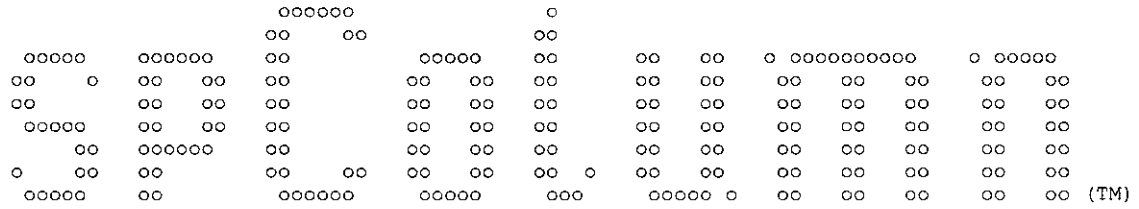
Reinforcing Steel:

	Pier	
size of vert rebar in pier=	**#9**	bar
vertical rebar quantity =	**26**	
size of pier ties =	**#4**	bar
minimum cover over rebar =	**3**	inches

Total volume of concrete = 75.5 cu yd



Summary of analysis results	
Maximum Net Soil Bearing = 1.605 ksf Allowable Net Soil Bearing = 3 ksf **Soil Bearing Stress Ratio = 0.53 Okay**	Ult Bending Shear Capacity = 126 psi Ult Bending Shear Stress = 27 psi **Bending Shear Stress Ratio = 0.21 Okay**
Ftg Overturning Resistance = 5643 ft-kips Overturning Moment = 2779 ft-kips Required Overturning Safety Factor = 1.5 Overturning Safety Factor = 2.031 **Ratio = 0.74 Okay**	Pad Bending Moment Capacity= 4771 ft-k Pad Bending Moment = 1305 ft-k **Bending Moment Stress Ratio = 0.27 OK**



spColumn v4.80 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: G:\TOWER\375_Crown_Castle\2012\37512-2182 BU 876390\37512-2182.col
Project:
Column: Engineer:
Code: ACI 318-11 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
==========
Rectangular: Width = 78 in Depth = 78 in

Gross section area, Ag = 6084 in^2
Ix = 3.08459e+006 in^4 Iy = 3.08459e+006 in^4
rx = 22.5167 in ry = 22.5167 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Circular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 27.00 in^2 at rho = 0.44% (Note: rho < 0.50%)
Minimum clear spacing = 7.01 in

27 #9 Cover = 3 in

Factored Loads and Moments with Corresponding Capacities:
==========

No.	Pu kip	Mux k-ft	PhiMnx k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	32.00	3607.50	4466.33	1.238	6.02	73.82	0.03392	0.900

*** End of output ***