PJF PAUL J. FORD & COMPANY

Date: **December 23, 2015**

Jonathan Jacobsen
Crown Castle
2055 S. Stearman Dr.
Phoenix, AZ 85286

Paul J. Ford and Company
250 East Broad Street #600
Columbus, OH 43215
(614) 221-6679
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Subject: **Structural Analysis Report**

Carrier Designation:	***AT&T Mobility* Co-Locate**	
	Carrier Site Number:	N/A
	Carrier Site Name:	UTL03078
Crown Castle Designation:	**Crown Castle BU Number:**	880534
	Crown Castle Site Name:	KWIK CITY MUFFLER
	Crown Castle JDE Job Number:	358709
	Crown Castle Work Order Number:	1169181
	Crown Castle Application Number:	322642 Rev. 4
Engineering Firm Designation:	**Paul J. Ford and Company Project Number:**	37515-3588.001.7805
Site Data:	**2449 WEST 4000 SOUTH, ROY, Weber County, UT** **Latitude *41° 11' 22.4"*, Longitude *-112° 2' 21"*** **130 Foot - Monopole Tower**	

Dear Jonathan Jacobsen,

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 857234, in accordance with application 322642, revision 4.

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:

LC5: Existing + Proposed Equipment **Sufficient Capacity**
Note: See Table I and Table II for the proposed and existing loading, respectively.

This analysis has been performed in accordance with the 2012 International Building Code based upon an ultimate 3-second gust wind speed of 115 mph converted to a nominal 3-second gust wind speed of 89 mph per section 1609.3.1 as required for use in the ANSI/TIA-222-G-2005 Standard, "Structural Standard for Antenna Supporting Structures and Antennas", with ANSI/TIA-222-G-1-2007 and ANSI/TIA-222-G-2-2009 Addenda per Exception #5 of Section 1609.1.1. Exposure Category C and Risk Category II were used in this analysis.

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

Respectfully submitted by:

Joshua Johnson JJW
Structural Designer

REGISTERED PROFESSIONAL ENGINEER
No. 5114259-2202
RICHARD W. HOFFMAN
STATE OF UTAH

12/23/15

tnxTower Report - version 6.1.4.1

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TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 130-ft Monopole tower designed by ROHN in August of 1996. The tower was originally designed for a wind speed of 85 mph per TIA/EIA-222-E.

2) ANALYSIS CRITERIA

This analysis has been performed in accordance with the 2012 International Building Code based upon an ultimate 3-second gust wind speed of 115 mph converted to a nominal 3-second gust wind speed of 89 mph per section 1609.3.1 as required for use in the ANSI/TIA-222-G-2005 Standard, “Structural Standard for Antenna Supporting Structures and Antennas”, with ANSI/TIA-222-G-1-2007 and ANSI/TIA-222-G-2-2009 Addenda per Exception #5 of Section 1609.1.1. Exposure Category C and Risk Category II were used in this analysis.

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
117.0	118.0	3	alcatel lucent	RRH4X25-WCS	2	3/4	-
		1	andrew	SBNH-1D6565B w/ Mount Pipe			
		3	commscope	SBJAH4-1D65C-DL w/ Mount Pipe			
		1	powerwave technologies	TT19-08BP111-001			
		1	raycap	DC6-48-60-0-8F			
		1	raycap	DC6-48-60-18-8F			
	117.0	3	alcatel lucent	RRH2X60-1900A-4R			
		3	alcatel lucent	RRH2X40-07-L			

Table 2 - Existing 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
127.0	130.0	1	rfs celwave	APXV9ERR18-C w/ Mount Pipe	3 1	1 1/2	1
		2	kmw communications	ET-X-TS-70-16-62-18-iR-RD w/ Mount Pipe			
		3	samsung telecommunications	RRH-P4			
	129.0	3	kmw communications	ET-X-WM-18-65-8P w/ Mount Pipe			
		1	samsung telecommunications	2.5G 8T8R RADAR FILTER			
		3	samsung telecommunications	RRH-B8			
	127.0	1	tower mounts	Platform Mount [LP 502-1]			

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	Number of Feed Lines	Feed Line Size (in)	Note
117.0	118.0	3	andrew	SBNHH-1D65C w/ Mount Pipe	1 1 2 10	5/16 3/8 3/4 7/8	1
		2	powerwave technologies	7750.00 w/ Mount Pipe			
		1	powerwave technologies	7850.00 w/ Mount Pipe			
		1	powerwave technologies	7920.00 w/ Mount Pipe			
		4	powerwave technologies	LGP21402			
	117.0	1	tower mounts	T-Arm Mount [TA 602-3]			
		1	powerwave technologies	LGP21401	4 2	7/8 3/4	2
		5	nokia	CS72993.08			
		6	alcatel lucent	RRH2x40-AWS			
		1	kathrein	800 10765			
106.0	109.0	3	ericsson	KRY 112 144/1	1 1 12	5/16 1-1/4 7/8	1
		3	ericsson	ERICSSON AIR 21 B2A B4P w/ Mount Pipe			
		3	ericsson	ERICSSON AIR 21 B4A B2P w/ Mount Pipe			
	106.0	1	tower mounts	T-Arm Mount [TA 602-3]			
88.0	93.0	-	-	-	1	1/2	1
	91.0	3	cambridge broadband networks	ODU-S AP-S w/ Mount Pipe	4 3	1/4 1” conduit	1
	88.0	1	tower mounts	Side Arm Mount [SO 104-3]			
	86.0	1	cambridge broadband networks	ODU-S AP-S w/ Mount Pipe			
81.0	81.0	4	ems wireless	RV65-18-00DPL2 w/ Mount Pipe	6 2	1-5/8 3/8	1
		1	kmw communications	HB-X-AW-17-65-00T w/ Mount Pipe			
		1	tower mounts	T-Arm Mount [TA 602-3]			
52.0	52.0	1	comsat rsi	P-57C48N-U	1 1	5/8 5/16	1
		1	tower mounts	Pipe Mount [PM 601-1]			

Notes:
1) Existing Equipment
2) Equipment To Be Removed

3) ANALYSIS PROCEDURE

Table 3 - Documents Provided

Document	Remarks	Reference	Source
4-GEOTECHNICAL REPORTS	TERRACON, 61965105, 5/22/1996	1584024	CCISITES
4-TOWER FOUNDATION DRAWINGS/DESIGN/SPECS	TERRACON, 96-222-136-C-0, 9/5/1996	1585046	CCISITES
4-TOWER MANUFACTURER DRAWINGS	ROHN, A962824, 8/29/1996	1617451	CCISITES
4-POST MODIFICATION INSPECTION	SGS, 146054, 4/16/2015	5642124	CCISITES

3.1) Analysis Method

tnxTower (version 6.1.4.1), 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) In accordance with discussions with CCI Corporate Engineering: Based on the assumption that the monopole manufacturer (ROHN/PiRod) has designed the flange plates at splices to adequately develop the full capacity of the unreinforced shaft section using unpublished and/or proprietary methodologies, we are assuming that if our analysis shows that both the existing shaft and the existing flange bolts are at a usage capacity of 100% or less, then the existing flange plates are at a usage capacity of 100% or less and no additional analysis of the flange plate is required.
5) For existing modifications: monopole was modified in conformance with the referenced modification drawings.

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	130 - 97.5	Pole	P24x0.25	1	-8.47	662.26	74.9	Pass
L2	97.5 - 65	Pole	30" x 0.375"	2	-15.36	1311.06	87.7	Pass
L3	65 - 45.833	Pole	36" x 0.375"	3	-19.42	1490.10	90.9	Pass
L4	45.833 - 32.5	Pole	RPS 36" x 0.49541"	4	-22.89	1949.52	88.1	Pass
L5	32.5 - 0	Pole	P42x1/2	5	-32.74	2410.40	94.4	Pass
							Summary	
						Pole (L5)	94.4	Pass
						RATING =	**94.4**	**Pass**

Table 5 - Tower Component Stresses vs. Capacity

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1,2	Flanged Connection	97.5	74.8	Pass
1,2	Flanged Connection	65	87.7	Pass
1	Flanged Connection	32.5	87.8	Pass
1	Anchor Rods	0	94.4	Pass
1	Base Plate	0	94.9	Pass
1	Base Foundation Structural Steel	0	73.5	Pass
1	Base Foundation Soil Interaction	0	18.5	Pass

Structure Rating (max from all components) =	**94.9%**

Notes:
1) See additional documentation in “Appendix C – Additional Calculations” for calculations supporting the % capacity consumed.
2) See assumption #4 on page 5.

APPENDIX A

TNXTOWER OUTPUT

Tower Input Data

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

1) Tower is located in Weber County, Utah.
2) Basic wind speed of 89 mph.
3) Structure Class II.
4) Exposure Category C.
5) Topographic Category 1.
6) Crest Height 0.00 ft.
7) Nominal ice thickness of 0.2500 in.
8) Ice thickness is considered to increase with height.
9) Ice density of 56 pcf.
10) A wind speed of 50 mph is used in combination with ice.
11) Deflections calculated using a wind speed of 60 mph.
12) A non-linear (P-delta) analysis was used.
13) Pressures are calculated at each section.
14) Stress ratio used in pole design is 1.
15) Local bending stresses due to climbing loads, feed line 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		Use TIA-222-G Tension Splice Capacity Exemption		

Pole Section Geometry

Section	*Elevation* *ft*	*Section Length* *ft*	*Pole Size*	*Pole Grade*	*Socket Length* *ft*
L1	130.00-97.50	32.50	P24x0.25	A53-B-42 (42 ksi)	
L2	97.50-65.00	32.50	30" x 0.375"	A53-B-42 (42 ksi)	
L3	65.00-45.83	19.17	36" x 0.375"	A53-B-42 (42 ksi)	
L4	45.83-32.50	13.33	RPS 36" x 0.49541"	Reinf 39.20 ksi (39 ksi)	
L5	32.50-0.00	32.50	P42x1/2	A53-B-42 (42 ksi)	

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
SFX 500(1/2")	C	No	Inside Pole	128.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.07
127-ft								
LDF2-2R(1")	C	No	Inside Pole	127.00 - 0.00	3	No Ice	0.00	0.30
						1/2" Ice	0.00	0.30
SFX 500(1/2")	C	No	Inside Pole	127.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.07
117-ft								
FB-L98-002-XXX(3/8)	C	No	CaAa (Out Of Face)	117.00 - 0.00	1	No Ice	0.00	0.06
						1/2" Ice	0.00	0.61
7085.05(5/16)	C	No	CaAa (Out Of Face)	117.00 - 0.00	1	No Ice	0.00	0.09
						1/2" Ice	0.00	0.59
AVA5-50(7/8")	C	No	CaAa (Out Of Face)	117.00 - 0.00	5	No Ice	0.00	0.30
						1/2" Ice	0.00	1.28
AVA5-50(7/8")	C	No	CaAa (Out Of Face)	117.00 - 0.00	3	No Ice	0.11	0.30
						1/2" Ice	0.21	1.28
AVA5-50(7/8")	C	No	Inside Pole	117.00 - 0.00	2	No Ice	0.00	0.30
						1/2" Ice	0.00	0.30
WR-VG86ST-BRD(3/4")	C	No	CaAa (Out Of Face)	117.00 - 0.00	2	No Ice	0.00	0.58
						1/2" Ice	0.00	1.38
WR-VG86ST-BRD(3/4")	C	No	CaAa (Out Of Face)	117.00 - 0.00	2	No Ice	0.00	0.58
						1/2" Ice	0.00	1.38
****								
FB-L98-002-XXX(3/8)	C	No	Inside Pole	117.00 - 0.00	2	No Ice	0.00	0.06
						1/2" Ice	0.00	0.06
106-ft								
AVA5-50(7/8")	C	No	CaAa (Out Of Face)	106.00 - 0.00	1	No Ice	0.11	0.30
						1/2" Ice	0.21	1.28
AVA5-50(7/8")	C	No	CaAa (Out Of Face)	106.00 - 0.00	11	No Ice	0.00	0.30
						1/2" Ice	0.00	1.28
123-171-100(5/16")	C	No	CaAa (Out Of Face)	106.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.57
LDF6-50A(1-1/4")	C	No	CaAa (Out Of Face)	106.00 - 0.00	1	No Ice	0.16	0.66
						1/2" Ice	0.25	1.91
****								
SFX 500(1/2")	C	No	Inside Pole	93.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.07
****								
CAT5E(1/4")	C	No	CaAa (Out Of Face)	88.00 - 0.00	4	No Ice	0.00	0.10
						1/2" Ice	0.00	0.56
1" Rigid Conduit (3/4" EMT)	C	No	CaAa (Out Of Face)	88.00 - 0.00	1	No Ice	0.00	0.46
						1/2" Ice	0.00	1.33
1" Rigid Conduit (3/4" EMT)	C	No	Inside Pole	88.00 - 0.00	2	No Ice	0.00	0.46
						1/2" Ice	0.00	0.46
81-ft								
CR 50 1873(1-5/8")	C	No	CaAa (Out Of Face)	81.00 - 0.00	6	No Ice	0.00	0.83
						1/2" Ice	0.00	2.34
FB-L98-002-XXX(3/8)	C	No	CaAa (Out Of Face)	81.00 - 0.00	2	No Ice	0.00	0.06
						1/2" Ice	0.00	0.61
ATCB-B01-005(1/4")	C	No	CaAa (Out Of Face)	81.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.57
51-ft								
241568(5/8)	C	No	CaAa (Out Of Face)	52.00 - 0.00	1	No Ice	0.00	0.19
						1/2" Ice	0.00	0.88
123-171-100(5/16")	C	No	CaAa (Out Of Face)	50.00 - 0.00	1	No Ice	0.00	0.07
						1/2" Ice	0.00	0.57
**								
1" Flat Reinforcement	C	No	CaAa (Out Of Face)	47.50 - 32.50	1	No Ice	0.17	0.00
						1/2" Ice	0.28	0.00

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	130.00-97.50	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	8.701	0.18
L2	97.50-65.00	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	19.364	0.48
L3	65.00-45.83	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	11.698	0.35
L4	45.83-32.50	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	10.166	0.24
L5	32.50-0.00	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	19.364	0.59

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	130.00-97.50	A	0.566	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	17.247	0.60
L2	97.50-65.00	A	0.547	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	37.150	1.71
L3	65.00-45.83	A	0.527	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	21.986	1.17
L4	45.83-32.50	A	0.509	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	18.455	0.79
L5	32.50-0.00	A	0.467	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	34.540	1.81

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	130.00-97.50	-0.3067	0.1771	-0.5252	0.3032
L2	97.50-65.00	-0.6250	0.3609	-0.9941	0.5739
L3	65.00-45.83	-0.6588	0.3803	-1.0556	0.6095
L4	45.83-32.50	-0.7898	0.4560	-1.2070	0.6969
L5	32.50-0.00	-0.6614	0.3819	-1.0413	0.6012

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
APXV9ERR18-C w/ Mount Pipe	A	From Face	4.00 0.00 3.00	0.0000	127.00	No Ice 1/2" Ice	8.42 9.03	7.42 8.53	0.09 0.16
ET-X-TS-70-16-62-18-iR-RD w/ Mount Pipe	B	From Face	4.00 0.00 3.00	0.0000	127.00	No Ice 1/2" Ice	8.70 9.37	6.49 7.69	0.07 0.13
ET-X-TS-70-16-62-18-iR-	C	From Face	4.00	0.0000	127.00	No Ice	8.70	6.49	0.07

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
RD w/ Mount Pipe			0.00 3.00			1/2" Ice	9.37	7.69	0.13
ET-X-WM-18-65-8P w/ Mount Pipe	A	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	7.35 7.92	4.43 5.32	0.06 0.11
ET-X-WM-18-65-8P w/ Mount Pipe	B	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	7.35 7.92	4.43 5.32	0.06 0.11
ET-X-WM-18-65-8P w/ Mount Pipe	C	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	7.35 7.92	4.43 5.32	0.06 0.11
RRH-P4	A	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	3.19 3.44	2.07 2.29	0.06 0.08
RRH-P4	B	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	3.19 3.44	2.07 2.29	0.06 0.08
RRH-P4	C	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	3.19 3.44	2.07 2.29	0.06 0.08
RRH-B8	A	From Face	4.00 0.00 3.00	0.0000	127.00	No Ice 1/2" Ice	3.36 3.61	2.03 2.24	0.06 0.08
RRH-B8	B	From Face	4.00 0.00 3.00	0.0000	127.00	No Ice 1/2" Ice	3.36 3.61	2.03 2.24	0.06 0.08
RRH-B8	C	From Face	4.00 0.00 3.00	0.0000	127.00	No Ice 1/2" Ice	3.36 3.61	2.03 2.24	0.06 0.08
2.5G 8T8R RADAR FILTER	C	From Face	4.00 0.00 2.00	0.0000	127.00	No Ice 1/2" Ice	0.94 1.08	0.35 0.46	0.02 0.03
Platform Mount [LP 502-1]	C	None		0.0000	127.00	No Ice 1/2" Ice	32.35 45.67	32.35 45.67	0.93 1.19
****									
SBNHH-1D65C w/ Mount Pipe	A	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	11.68 12.40	10.24 11.77	0.10 0.20
SBNHH-1D65C w/ Mount Pipe	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	11.68 12.40	10.24 11.77	0.10 0.20
SBNHH-1D65C w/ Mount Pipe	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	11.68 12.40	10.24 11.77	0.10 0.20
7920.00 w/ Mount Pipe	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	8.19 8.70	3.32 3.99	0.05 0.10
7750.00 w/ Mount Pipe	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	6.12 6.63	4.25 5.01	0.06 0.10
7750.00 w/ Mount Pipe	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	6.12 6.63	4.25 5.01	0.06 0.10
7850.00 w/ Mount Pipe	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	5.78 6.23	4.36 5.00	0.07 0.12
(4) LGP21401	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	1.29 1.45	0.36 0.48	0.01 0.02
SBNH-1D6565B w/ Mount Pipe	A	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	8.63 9.29	7.07 8.25	0.07 0.14
SBJAH4-1D65C-DL w/ Mount Pipe	A	From Face	4.00 0.00	0.0000	117.00	No Ice 1/2"	13.12 13.94	10.65 12.17	0.11 0.21

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			1.00			Ice			
SBJAH4-1D65C-DL w/ Mount Pipe	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	13.12 13.94	10.65 12.17	0.11 0.21
SBJAH4-1D65C-DL w/ Mount Pipe	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	13.12 13.94	10.65 12.17	0.11 0.21
TT19-08BP111-001	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	0.64 0.76	0.52 0.62	0.02 0.02
DC6-48-60-0-8F	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	1.47 1.67	1.47 1.67	0.02 0.04
DC6-48-60-18-8F	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	1.47 1.67	1.47 1.67	0.02 0.04
RRH4X25-WCS	A	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	4.45 4.77	3.81 4.11	0.09 0.13
RRH4X25-WCS	B	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	4.45 4.77	3.81 4.11	0.09 0.13
RRH4X25-WCS	C	From Face	4.00 0.00 1.00	0.0000	117.00	No Ice 1/2" Ice	4.45 4.77	3.81 4.11	0.09 0.13
(3) RRH2X40-07-L	A	From Face	4.00 0.00 0.00	0.0000	117.00	No Ice 1/2" Ice	2.12 2.32	1.77 1.97	0.06 0.08
(3) RRH2x60-1900A-4R	A	From Face	4.00 0.00 0.00	0.0000	117.00	No Ice 1/2" Ice	2.18 2.39	1.48 1.66	0.05 0.06
T-Arm Mount [TA 602-3]	C	None		0.0000	117.00	No Ice 1/2" Ice	11.59 15.44	11.59 15.44	0.77 0.99
****									
ERICSSON AIR 21 B2A B4P w/ Mount Pipe	A	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.83 7.35	5.64 6.48	0.11 0.17
ERICSSON AIR 21 B2A B4P w/ Mount Pipe	B	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.83 7.35	5.64 6.48	0.11 0.17
ERICSSON AIR 21 B2A B4P w/ Mount Pipe	C	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.83 7.35	5.64 6.48	0.11 0.17
ERICSSON AIR 21 B4A B2P w/ Mount Pipe	A	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.82 7.34	5.63 6.47	0.11 0.17
ERICSSON AIR 21 B4A B2P w/ Mount Pipe	B	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.82 7.34	5.63 6.47	0.11 0.17
ERICSSON AIR 21 B4A B2P w/ Mount Pipe	C	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	6.82 7.34	5.63 6.47	0.11 0.17
KRY 112 144/1	A	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	0.41 0.50	0.20 0.27	0.01 0.01
KRY 112 144/1	B	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	0.41 0.50	0.20 0.27	0.01 0.01
KRY 112 144/1	C	From Face	4.00 0.00 3.00	0.0000	106.00	No Ice 1/2" Ice	0.41 0.50	0.20 0.27	0.01 0.01
T-Arm Mount [TA 602-3]	C	None		0.0000	106.00	No Ice 1/2" Ice	11.59 15.44	11.59 15.44	0.77 0.99

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
****									
ODU-S AP-S W/ 6-Ft Mount Pipe	A	From Face	2.00 0.00 3.00	0.0000	88.00	No Ice 1/2" Ice	2.53 3.10	1.94 2.55	0.03 0.06
ODU-S AP-S W/ 6-Ft Mount Pipe	B	From Face	2.00 0.00 3.00	0.0000	88.00	No Ice 1/2" Ice	2.53 3.10	1.94 2.55	0.03 0.06
ODU-S AP-S W/ 6-Ft Mount Pipe	C	From Face	2.00 0.00 3.00	0.0000	88.00	No Ice 1/2" Ice	2.53 3.10	1.94 2.55	0.03 0.06
ODU-S AP-S W/ 6-Ft Mount Pipe	C	From Face	2.00 0.00 -2.00	0.0000	88.00	No Ice 1/2" Ice	2.53 3.10	1.94 2.55	0.03 0.06
Side Arm Mount [SO 104-3]	C	None		0.0000	88.00	No Ice 1/2" Ice	3.30 4.13	3.30 4.13	0.29 0.32
81-ft Existing									
HB-X-AW-17-65-00T w/ Mount Pipe	A	From Face	4.00 0.00 0.00	0.0000	81.00	No Ice 1/2" Ice	3.18 3.55	4.13 4.75	0.04 0.07
RV65-18-00DPL2 w/ Mount Pipe	A	From Face	4.00 0.00 0.00	0.0000	81.00	No Ice 1/2" Ice	3.54 3.95	3.29 4.02	0.03 0.06
RV65-18-00DPL2 w/ Mount Pipe	B	From Face	4.00 0.00 0.00	0.0000	81.00	No Ice 1/2" Ice	3.54 3.95	3.29 4.02	0.03 0.06
(2) RV65-18-00DPL2 w/ Mount Pipe	C	From Face	4.00 0.00 0.00	0.0000	81.00	No Ice 1/2" Ice	3.54 3.95	3.29 4.02	0.03 0.06
T-Arm Mount [TA 602-3]	C	None		0.0000	81.00	No Ice 1/2" Ice	11.59 15.44	11.59 15.44	0.77 0.99
52-ft Existing									
Pipe Mount [PM 601-1]	C	None		0.0000	52.00	No Ice 1/2" Ice	3.00 3.74	0.90 1.12	0.07 0.08

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
P-57C48N-U	A	Paraboloid w/o Radome	From Leg	1.00 0.00 0.00	0.0000		52.00	4.00	No Ice 1/2" Ice	12.57 13.10	0.08 0.15

Tower Pressures - No Ice

G_H = 1.100

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1 130.00-97.50	113.87	1.301	25	65.000	A	0.000	65.000	65.000	100.00	0.000	0.000
					B	0.000	65.000		100.00	0.000	0.000
					C	0.000	65.000		100.00	0.000	8.701
L2 97.50-65.00	81.42	1.212	23	81.250	A	0.000	81.250	81.250	100.00	0.000	0.000
					B	0.000	81.250		100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
					C	0.000	81.250		100.00	0.000	19.364
L3 65.00-45.83	55.42	1.118	22	57.501	A	0.000	57.501	57.501	100.00	0.000	0.000
					B	0.000	57.501		100.00	0.000	0.000
					C	0.000	57.501		100.00	0.000	11.698
L4 45.83-32.50	39.17	1.039	20	39.999	A	0.000	39.999	39.999	100.00	0.000	0.000
					B	0.000	39.999		100.00	0.000	0.000
					C	0.000	39.999		100.00	0.000	10.166
L5 32.50-0.00	16.66	0.868	17	113.750	A	0.000	113.750	113.750	100.00	0.000	0.000
					B	0.000	113.750		100.00	0.000	0.000
					C	0.000	113.750		100.00	0.000	19.364

Tower Pressure - With Ice

G_H = 1.100

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 130.00-97.50	113.87	1.301	8	0.5659	68.065	A	0.000	68.065	68.065	100.00	0.000	0.000
						B	0.000	68.065		100.00	0.000	0.000
						C	0.000	68.065		100.00	0.000	17.247
L2 97.50-65.00	81.42	1.212	7	0.5473	84.214	A	0.000	84.214	84.214	100.00	0.000	0.000
						B	0.000	84.214		100.00	0.000	0.000
						C	0.000	84.214		100.00	0.000	37.150
L3 65.00-45.83	55.42	1.118	7	0.5266	59.183	A	0.000	59.183	59.183	100.00	0.000	0.000
						B	0.000	59.183		100.00	0.000	0.000
						C	0.000	59.183		100.00	0.000	21.986
L4 45.83-32.50	39.17	1.039	6	0.5086	41.129	A	0.000	41.129	41.129	100.00	0.000	0.000
						B	0.000	41.129		100.00	0.000	0.000
						C	0.000	41.129		100.00	0.000	18.455
L5 32.50-0.00	16.66	0.868	5	0.4670	116.279	A	0.000	116.279	116.279	100.00	0.000	0.000
						B	0.000	116.279		100.00	0.000	0.000
						C	0.000	116.279		100.00	0.000	34.540

Tower Pressure - Service

G_H = 1.100

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1 130.00-97.50	113.87	1.301	10	65.000	A	0.000	65.000	65.000	100.00	0.000	0.000
					B	0.000	65.000		100.00	0.000	0.000
					C	0.000	65.000		100.00	0.000	8.701
L2 97.50-65.00	81.42	1.212	9	81.250	A	0.000	81.250	81.250	100.00	0.000	0.000
					B	0.000	81.250		100.00	0.000	0.000
					C	0.000	81.250		100.00	0.000	19.364
L3 65.00-45.83	55.42	1.118	9	57.501	A	0.000	57.501	57.501	100.00	0.000	0.000
					B	0.000	57.501		100.00	0.000	0.000
					C	0.000	57.501		100.00	0.000	11.698
L4 45.83-32.50	39.17	1.039	8	39.999	A	0.000	39.999	39.999	100.00	0.000	0.000
					B	0.000	39.999		100.00	0.000	0.000
					C	0.000	39.999		100.00	0.000	10.166
L5 32.50-0.00	16.66	0.868	7	113.750	A	0.000	113.750	113.750	100.00	0.000	0.000
					B	0.000	113.750		100.00	0.000	0.000
					C	0.000	113.750		100.00	0.000	19.364

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 Wind 330 deg - No Ice
26	1.2 Dead+1.0 Ice
27	1.2 Dead+1.0 Wind 0 deg+1.0 Ice
28	1.2 Dead+1.0 Wind 30 deg+1.0 Ice
29	1.2 Dead+1.0 Wind 60 deg+1.0 Ice
30	1.2 Dead+1.0 Wind 90 deg+1.0 Ice
31	1.2 Dead+1.0 Wind 120 deg+1.0 Ice
32	1.2 Dead+1.0 Wind 150 deg+1.0 Ice
33	1.2 Dead+1.0 Wind 180 deg+1.0 Ice
34	1.2 Dead+1.0 Wind 210 deg+1.0 Ice
35	1.2 Dead+1.0 Wind 240 deg+1.0 Ice
36	1.2 Dead+1.0 Wind 270 deg+1.0 Ice
37	1.2 Dead+1.0 Wind 300 deg+1.0 Ice
38	1.2 Dead+1.0 Wind 330 deg+1.0 Ice
39	Dead+Wind 0 deg - Service
40	Dead+Wind 30 deg - Service
41	Dead+Wind 60 deg - Service
42	Dead+Wind 90 deg - Service
43	Dead+Wind 120 deg - Service
44	Dead+Wind 150 deg - Service
45	Dead+Wind 180 deg - Service
46	Dead+Wind 210 deg - Service
47	Dead+Wind 240 deg - Service
48	Dead+Wind 270 deg - Service
49	Dead+Wind 300 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	130 - 97.5	Pole	Max Tension	36	0.00	-0.00	0.00
			Max. Compression	26	-13.45	2.22	0.09
			Max. Mx	20	-8.49	288.94	-1.10
			Max. My	2	-8.48	0.12	290.48
			Max. Vy	20	-13.44	288.94	-1.10
			Max. Vx	14	13.55	2.99	-289.76
			Max. Torque	14			-1.57
L2	97.5 - 65	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-22.74	4.64	-1.41
			Max. Mx	20	-15.38	812.31	-3.57
			Max. My	14	-15.37	5.83	-817.10
			Max. Vy	20	-18.41	812.31	-3.57

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Vx	14	18.56	5.83	-817.10
			Max. Torque	14			-3.04
L3	65 - 45.833	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-27.98	6.26	-1.90
			Max. Mx	20	-19.45	1185.74	-4.89
			Max. My	14	-19.42	7.64	-1196.47
			Max. Vy	20	-20.60	1185.74	-4.89
			Max. Vx	14	21.32	7.64	-1196.47
			Max. Torque	12			-3.66
L4	45.833 - 32.5	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-32.13	7.35	-2.52
			Max. Mx	20	-22.91	1473.52	-5.91
			Max. My	14	-22.89	8.89	-1493.69
			Max. Vy	20	-22.52	1473.52	-5.91
			Max. Vx	14	23.24	8.89	-1493.69
			Max. Torque	12			-4.19
L5	32.5 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	26	-43.50	10.12	-4.12
			Max. Mx	20	-32.75	2248.45	-8.45
			Max. My	14	-32.74	12.00	-2291.43
			Max. Vy	20	-24.96	2248.45	-8.45
			Max. Vx	14	25.67	12.00	-2291.43
			Max. Torque	12			-5.22

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Pole	Max. Vert	33	43.50	0.02	-7.71
	Max. H_x	20	32.76	24.94	-0.06
	Max. H_z	2	32.76	-0.07	25.41
	Max. M_x	2	2277.39	-0.07	25.41
	Max. M_z	8	2240.18	-24.94	0.07
	Max. Torsion	2	4.95	-0.07	25.41
	Min. Vert	23	24.57	21.64	12.62
	Min. H_x	8	32.76	-24.94	0.07
	Min. H_z	14	32.76	0.07	-25.65
	Min. M_x	14	-2291.43	0.07	-25.65
	Min. M_z	20	-2248.45	24.94	-0.06
	Min. Torsion	12	-5.22	-12.32	-22.28

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	27.30	0.00	0.00	0.71	3.38	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	32.76	0.07	-25.41	-2277.39	-3.75	-4.95
0.9 Dead+1.6 Wind 0 deg - No Ice	24.57	0.07	-25.41	-2259.84	-4.75	-4.92
1.2 Dead+1.6 Wind 30 deg - No Ice	32.76	12.63	-21.98	-1972.62	-1130.26	-4.15
0.9 Dead+1.6 Wind 30 deg - No Ice	24.57	12.63	-21.98	-1957.43	-1122.46	-4.12
1.2 Dead+1.6 Wind 60 deg - No Ice	32.76	21.70	-12.73	-1143.35	-1947.37	-1.89
0.9 Dead+1.6 Wind 60 deg - No Ice	24.57	21.70	-12.73	-1134.63	-1933.18	-1.87
1.2 Dead+1.6 Wind 90 deg - No Ice	32.76	24.94	-0.07	-7.31	-2240.18	0.96
0.9 Dead+1.6 Wind 90 deg -	24.57	24.94	-0.07	-7.45	-2223.69	0.97

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
No Ice						
1.2 Dead+1.6 Wind 120 deg - No Ice	32.76	21.54	13.18	1161.03	-1934.18	3.75
0.9 Dead+1.6 Wind 120 deg - No Ice	24.57	21.54	13.18	1151.87	-1920.08	3.75
1.2 Dead+1.6 Wind 150 deg - No Ice	32.76	12.32	22.28	1985.89	-1106.15	5.22
0.9 Dead+1.6 Wind 150 deg - No Ice	24.57	12.32	22.28	1970.25	-1098.51	5.20
1.2 Dead+1.6 Wind 180 deg - No Ice	32.76	-0.07	25.65	2291.43	12.00	4.96
0.9 Dead+1.6 Wind 180 deg - No Ice	24.57	-0.07	25.65	2273.39	10.87	4.94
1.2 Dead+1.6 Wind 210 deg - No Ice	32.76	-12.43	22.34	1993.75	1128.03	3.37
0.9 Dead+1.6 Wind 210 deg - No Ice	24.57	-12.43	22.34	1978.04	1118.15	3.34
1.2 Dead+1.6 Wind 240 deg - No Ice	32.76	-21.60	13.29	1174.67	1950.30	1.20
0.9 Dead+1.6 Wind 240 deg - No Ice	24.57	-21.60	13.29	1165.39	1934.00	1.18
1.2 Dead+1.6 Wind 270 deg - No Ice	32.76	-24.94	0.06	8.45	2248.45	-0.97
0.9 Dead+1.6 Wind 270 deg - No Ice	24.57	-24.94	0.06	8.16	2229.83	-0.98
1.2 Dead+1.6 Wind 300 deg - No Ice	32.76	-21.64	-12.62	-1129.73	1947.79	-3.07
0.9 Dead+1.6 Wind 300 deg - No Ice	24.57	-21.64	-12.62	-1121.12	1931.53	-3.07
1.2 Dead+1.6 Wind 330 deg - No Ice	32.76	-12.51	-21.91	-1964.78	1124.89	-4.43
0.9 Dead+1.6 Wind 330 deg - No Ice	24.57	-12.51	-21.91	-1949.65	1115.08	-4.41
1.2 Dead+1.0 Ice	43.50	-0.00	0.00	4.12	10.12	0.00
1.2 Dead+1.0 Wind 0 deg+1.0 Ice	43.50	0.02	-7.66	-680.26	8.22	-1.65
1.2 Dead+1.0 Wind 30 deg+1.0 Ice	43.50	3.82	-6.63	-588.82	-331.04	-1.24
1.2 Dead+1.0 Wind 60 deg+1.0 Ice	43.50	6.57	-3.84	-339.39	-577.75	-0.43
1.2 Dead+1.0 Wind 90 deg+1.0 Ice	43.50	7.56	-0.02	2.13	-666.62	0.52
1.2 Dead+1.0 Wind 120 deg+1.0 Ice	43.50	6.53	3.92	350.43	-574.70	1.37
1.2 Dead+1.0 Wind 150 deg+1.0 Ice	43.50	3.75	6.69	599.18	-325.50	1.78
1.2 Dead+1.0 Wind 180 deg+1.0 Ice	43.50	-0.02	7.71	691.10	12.11	1.65
1.2 Dead+1.0 Wind 210 deg+1.0 Ice	43.50	-3.77	6.71	601.13	349.21	1.08
1.2 Dead+1.0 Wind 240 deg+1.0 Ice	43.50	-6.55	3.95	353.80	596.98	0.29
1.2 Dead+1.0 Wind 270 deg+1.0 Ice	43.50	-7.56	0.02	6.02	686.96	-0.52
1.2 Dead+1.0 Wind 300 deg+1.0 Ice	43.50	-6.55	-3.81	-336.02	596.14	-1.23
1.2 Dead+1.0 Wind 330 deg+1.0 Ice	43.50	-3.79	-6.61	-586.88	348.01	-1.62
Dead+Wind 0 deg - Service	27.30	0.02	-6.46	-575.82	1.44	-0.47
Dead+Wind 30 deg - Service	27.30	3.21	-5.59	-498.69	-283.63	-0.60
Dead+Wind 60 deg - Service	27.30	5.52	-3.24	-288.83	-490.41	-0.48
Dead+Wind 90 deg - Service	27.30	6.34	-0.02	-1.35	-564.50	-0.21
Dead+Wind 120 deg - Service	27.30	5.47	3.35	294.32	-487.06	0.16
Dead+Wind 150 deg - Service	27.30	3.13	5.66	503.05	-277.53	0.41
Dead+Wind 180 deg - Service	27.30	-0.02	6.52	580.38	5.42	0.47
Dead+Wind 210 deg -	27.30	-3.16	5.68	505.05	287.84	0.40

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
Service						
Dead+Wind 240 deg - Service	27.30	-5.49	3.38	297.77	495.92	0.30
Dead+Wind 270 deg - Service	27.30	-6.34	0.02	2.64	571.36	0.21
Dead+Wind 300 deg - Service	27.30	-5.50	-3.21	-285.38	495.28	0.01
Dead+Wind 330 deg - Service	27.30	-3.18	-5.57	-496.70	287.05	-0.21

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	-27.30	0.00	0.00	27.30	0.00	0.000%
2	0.07	-32.76	-25.41	-0.07	32.76	25.41	0.000%
3	0.07	-24.57	-25.41	-0.07	24.57	25.41	0.000%
4	12.63	-32.76	-21.98	-12.63	32.76	21.98	0.000%
5	12.63	-24.57	-21.98	-12.63	24.57	21.98	0.000%
6	21.70	-32.76	-12.73	-21.70	32.76	12.73	0.000%
7	21.70	-24.57	-12.73	-21.70	24.57	12.73	0.000%
8	24.94	-32.76	-0.07	-24.94	32.76	0.07	0.000%
9	24.94	-24.57	-0.07	-24.94	24.57	0.07	0.000%
10	21.54	-32.76	13.18	-21.54	32.76	-13.18	0.000%
11	21.54	-24.57	13.18	-21.54	24.57	-13.18	0.000%
12	12.32	-32.76	22.28	-12.32	32.76	-22.28	0.000%
13	12.32	-24.57	22.28	-12.32	24.57	-22.28	0.000%
14	-0.07	-32.76	25.65	0.07	32.76	-25.65	0.000%
15	-0.07	-24.57	25.65	0.07	24.57	-25.65	0.000%
16	-12.43	-32.76	22.34	12.43	32.76	-22.34	0.000%
17	-12.43	-24.57	22.34	12.43	24.57	-22.34	0.000%
18	-21.60	-32.76	13.29	21.60	32.76	-13.29	0.000%
19	-21.60	-24.57	13.29	21.60	24.57	-13.29	0.000%
20	-24.94	-32.76	0.06	24.94	32.76	-0.06	0.000%
21	-24.94	-24.57	0.06	24.94	24.57	-0.06	0.000%
22	-21.64	-32.76	-12.62	21.64	32.76	12.62	0.000%
23	-21.64	-24.57	-12.62	21.64	24.57	12.62	0.000%
24	-12.51	-32.76	-21.91	12.51	32.76	21.91	0.000%
25	-12.51	-24.57	-21.91	12.51	24.57	21.91	0.000%
26	0.00	-43.50	0.00	0.00	43.50	-0.00	0.000%
27	0.02	-43.50	-7.66	-0.02	43.50	7.66	0.000%
28	3.82	-43.50	-6.63	-3.82	43.50	6.63	0.000%
29	6.57	-43.50	-3.84	-6.57	43.50	3.84	0.000%
30	7.56	-43.50	-0.02	-7.56	43.50	0.02	0.000%
31	6.53	-43.50	3.92	-6.53	43.50	-3.92	0.000%
32	3.75	-43.50	6.69	-3.75	43.50	-6.69	0.000%
33	-0.02	-43.50	7.71	0.02	43.50	-7.71	0.000%
34	-3.77	-43.50	6.71	3.77	43.50	-6.71	0.000%
35	-6.55	-43.50	3.95	6.55	43.50	-3.95	0.000%
36	-7.56	-43.50	0.02	7.56	43.50	-0.02	0.000%
37	-6.55	-43.50	-3.81	6.55	43.50	3.81	0.000%
38	-3.79	-43.50	-6.61	3.79	43.50	6.61	0.000%
39	0.02	-27.30	-6.46	-0.02	27.30	6.46	0.000%
40	3.21	-27.30	-5.59	-3.21	27.30	5.59	0.000%
41	5.52	-27.30	-3.24	-5.52	27.30	3.24	0.000%
42	6.34	-27.30	-0.02	-6.34	27.30	0.02	0.000%
43	5.47	-27.30	3.35	-5.47	27.30	-3.35	0.000%
44	3.13	-27.30	5.66	-3.13	27.30	-5.66	0.000%
45	-0.02	-27.30	6.52	0.02	27.30	-6.52	0.000%
46	-3.16	-27.30	5.68	3.16	27.30	-5.68	0.000%
47	-5.49	-27.30	3.38	5.49	27.30	-3.38	0.000%
48	-6.34	-27.30	0.02	6.34	27.30	-0.02	0.000%
49	-5.50	-27.30	-3.21	5.50	27.30	3.21	0.000%
50	-3.18	-27.30	-5.57	3.18	27.30	5.57	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	5	0.00000001	0.00009930
3	Yes	5	0.00000001	0.00004463
4	Yes	5	0.00000001	0.00049017
5	Yes	5	0.00000001	0.00021220
6	Yes	5	0.00000001	0.00055436
7	Yes	5	0.00000001	0.00024231
8	Yes	4	0.00000001	0.00032640
9	Yes	4	0.00000001	0.00018034
10	Yes	5	0.00000001	0.00056446
11	Yes	5	0.00000001	0.00024763
12	Yes	5	0.00000001	0.00047436
13	Yes	5	0.00000001	0.00020543
14	Yes	5	0.00000001	0.00010911
15	Yes	5	0.00000001	0.00004895
16	Yes	5	0.00000001	0.00057790
17	Yes	5	0.00000001	0.00025195
18	Yes	5	0.00000001	0.00052411
19	Yes	5	0.00000001	0.00022697
20	Yes	4	0.00000001	0.00050786
21	Yes	4	0.00000001	0.00030331
22	Yes	5	0.00000001	0.00049848
23	Yes	5	0.00000001	0.00021623
24	Yes	5	0.00000001	0.00057815
25	Yes	5	0.00000001	0.00025334
26	Yes	4	0.00000001	0.00000448
27	Yes	4	0.00000001	0.00061024
28	Yes	4	0.00000001	0.00085640
29	Yes	5	0.00000001	0.00005925
30	Yes	4	0.00000001	0.00024090
31	Yes	5	0.00000001	0.00006815
32	Yes	4	0.00000001	0.00086336
33	Yes	4	0.00000001	0.00063032
34	Yes	5	0.00000001	0.00007225
35	Yes	5	0.00000001	0.00005722
36	Yes	4	0.00000001	0.00025698
37	Yes	4	0.00000001	0.00090207
38	Yes	5	0.00000001	0.00007515
39	Yes	4	0.00000001	0.00012479
40	Yes	4	0.00000001	0.00030282
41	Yes	4	0.00000001	0.00038587
42	Yes	4	0.00000001	0.00007113
43	Yes	4	0.00000001	0.00035099
44	Yes	4	0.00000001	0.00029997
45	Yes	4	0.00000001	0.00013000
46	Yes	4	0.00000001	0.00040223
47	Yes	4	0.00000001	0.00032853
48	Yes	4	0.00000001	0.00006958
49	Yes	4	0.00000001	0.00033440
50	Yes	4	0.00000001	0.00037339

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	130 - 97.5	18.229	46	1.1979	0.0041
L2	97.5 - 65	10.434	46	1.0029	0.0023
L3	65 - 45.833	4.549	46	0.6722	0.0012
L4	45.833 - 32.5	2.243	46	0.4637	0.0007
L5	32.5 - 0	1.148	46	0.3152	0.0004

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
127.00	APXV9ERR18-C w/ Mount Pipe	46	17.476	1.1831	0.0042	36956
117.00	SBNHH-1D65C w/ Mount Pipe	46	14.987	1.1318	0.0036	14213
106.00	ERICSSON AIR 21 B2A B4P w/ Mount Pipe	46	12.349	1.0658	0.0030	7698
88.00	ODU-S AP-S W/ 6-Ft Mount Pipe	46	8.468	0.9172	0.0021	5432
81.00	HB-X-AW-17-65-00T w/ Mount Pipe	46	7.146	0.8461	0.0018	5260
52.00	P-57C48N-U	46	2.892	0.5314	0.0010	5200

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	130 - 97.5	71.797	16	4.7212	0.0249
L2	97.5 - 65	41.119	16	3.9551	0.0166
L3	65 - 45.833	17.934	16	2.6512	0.0099
L4	45.833 - 32.5	8.844	16	1.8285	0.0063
L5	32.5 - 0	4.527	14	1.2427	0.0040

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
127.00	APXV9ERR18-C w/ Mount Pipe	16	68.832	4.6633	0.0242	9578
117.00	SBNHH-1D65C w/ Mount Pipe	16	59.039	4.4618	0.0216	3682
106.00	ERICSSON AIR 21 B2A B4P w/ Mount Pipe	16	48.656	4.2025	0.0187	1993
88.00	ODU-S AP-S W/ 6-Ft Mount Pipe	16	33.376	3.6174	0.0145	1397
81.00	HB-X-AW-17-65-00T w/ Mount Pipe	16	28.168	3.3369	0.0131	1347
52.00	P-57C48N-U	16	11.400	2.0957	0.0074	1322

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	130 - 97.5 (1)	P24x0.25	32.50	0.00	0.0	18.6532	-8.47	662.26	0.013
L2	97.5 - 65 (2)	30" x 0.375"	32.50	0.00	0.0	34.9011	-15.36	1311.06	0.012
L3	65 - 45.833 (3)	36" x 0.375"	19.17	0.00	0.0	41.9697	-19.42	1490.10	0.013
L4	45.833 - 32.5 (4)	RPS 36" x 0.49541"	13.33	0.00	0.0	55.2585	-22.89	1949.52	0.012
L5	32.5 - 0 (5)	P42x1/2	32.50	0.00	0.0	65.1880	-32.74	2410.40	0.014

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} kip-ft	ϕM_{nx} kip-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} kip-ft	ϕM_{ny} kip-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	130 - 97.5 (1)	P24x0.25	291.15	396.68	0.734	0.00	396.68	0.000
L2	97.5 - 65 (2)	30" x 0.375"	819.50	947.86	0.865	0.00	947.86	0.000
L3	65 - 45.833 (3)	36" x 0.375"	1198.90	1338.81	0.895	0.00	1338.81	0.000
L4	45.833 - 32.5 (4)	RPS 36" x 0.49541"	1495.18	1722.22	0.868	0.00	1722.22	0.000
L5	32.5 - 0 (5)	P42x1/2	2291.46	2463.61	0.930	0.00	2463.61	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u K	ϕV_n K	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u kip-ft	ϕT_n kip-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	130 - 97.5 (1)	P24x0.25	13.57	331.13	0.041	1.56	648.61	0.002
L2	97.5 - 65 (2)	30" x 0.375"	18.58	655.53	0.028	2.38	1598.37	0.001
L3	65 - 45.833 (3)	36" x 0.375"	21.24	745.05	0.029	2.59	2189.07	0.001
L4	45.833 - 32.5 (4)	RPS 36" x 0.49541"	23.16	974.76	0.024	2.86	2844.90	0.001
L5	32.5 - 0 (5)	P42x1/2	25.67	1205.20	0.021	4.96	4118.96	0.001

Pole Interaction Design Data

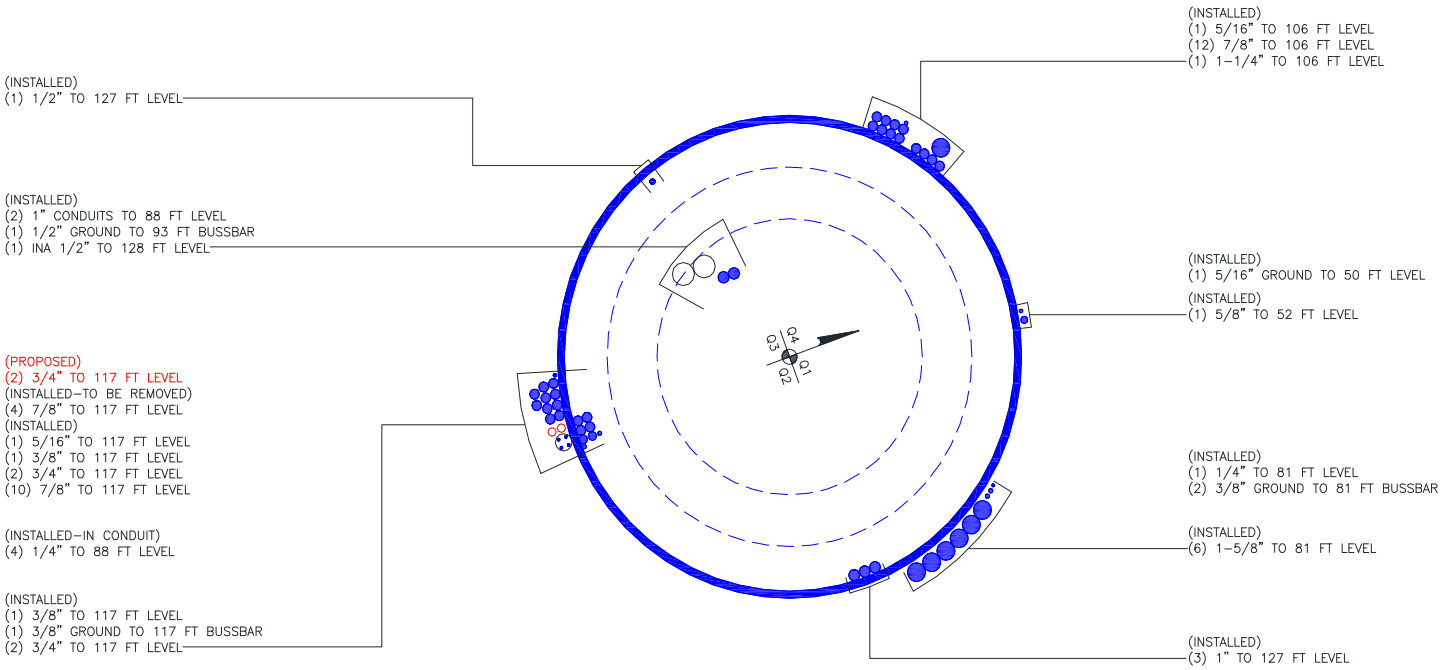
Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	130 - 97.5 (1)	0.013	0.734	0.000	0.041	0.002	0.749 ✔	1.000	4.8.2 ✔
L2	97.5 - 65 (2)	0.012	0.865	0.000	0.028	0.001	0.877 ✔	1.000	4.8.2 ✔
L3	65 - 45.833 (3)	0.013	0.895	0.000	0.029	0.001	0.909 ✔	1.000	4.8.2 ✔
L4	45.833 - 32.5 (4)	0.012	0.868	0.000	0.024	0.001	0.881 ✔	1.000	4.8.2 ✔
L5	32.5 - 0 (5)	0.014	0.930	0.000	0.021	0.001	0.944 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
L1	130 - 97.5	Pole	P24x0.25	1	-8.47	662.26	74.9	Pass
L2	97.5 - 65	Pole	30" x 0.375"	2	-15.36	1311.06	87.7	Pass
L3	65 - 45.833	Pole	36" x 0.375"	3	-19.42	1490.10	90.9	Pass
L4	45.833 - 32.5	Pole	RPS 36" x 0.49541"	4	-22.89	1949.52	88.1	Pass
L5	32.5 - 0	Pole	P42x1/2	5	-32.74	2410.40	94.4	Pass
						Summary		
						Pole (L5)	94.4	Pass
						RATING =	**94.4**	**Pass**

APPENDIX B

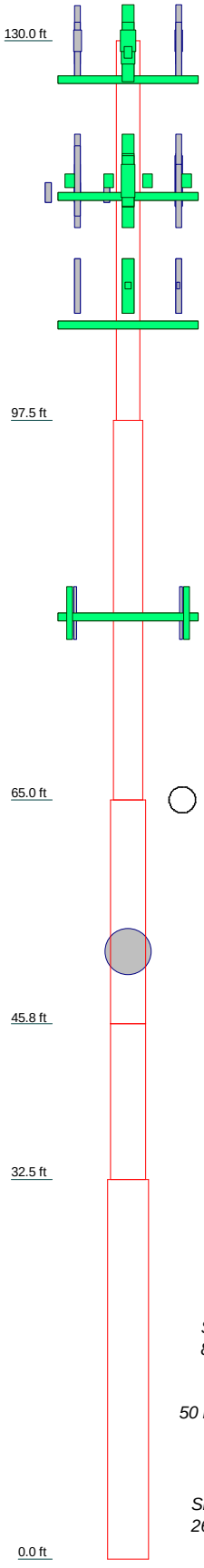
BASE LEVEL DRAWING



APPENDIX C

ADDITIONAL CALCULATIONS

Section	Size	Length (ft)	Grade	Weight (K)
1	P24x0.25	32.50	A53-B-42	2.1
2	30" x 0.375"	32.50		3.9
3	36" x 0.375"	19.17		2.7
4	RPS 36" x 0.49541"	13.33	A53-B-42 Reinf 39.20 ksi	2.5
5	P42x1/2	32.50	A53-B-42	7.2
				18.4



ALL REACTIONS ARE FACTORED

AXIAL 43 K
SHEAR 8 K
MOMENT 695 kip-ft
TORQUE 2 kip-ft
50 mph WIND - 0.2500 in ICE

AXIAL 33 K
SHEAR 26 K
MOMENT 2291 kip-ft
TORQUE 5 kip-ft
REACTIONS - 89 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
APXV9ERR18-C w/ Mount Pipe	127	RRH4X25-WCS	117
ET-X-TS-70-16-62-18-iR-RD w/ Mount Pipe	127	(3) RRH2X40-07-L	117
ET-X-TS-70-16-62-18-iR-RD w/ Mount Pipe	127	(3) RRH2x60-1900A-4R	117
ET-X-WM-18-65-8P w/ Mount Pipe	127	T-Arm Mount [TA 602-3]	117
ET-X-WM-18-65-8P w/ Mount Pipe	127	ERICSSON AIR 21 B2A B4P w/ Mount Pipe	106
ET-X-WM-18-65-8P w/ Mount Pipe	127	ERICSSON AIR 21 B2A B4P w/ Mount Pipe	106
RRH-P4	127	ERICSSON AIR 21 B2A B4P w/ Mount Pipe	106
RRH-P4	127	ERICSSON AIR 21 B4A B2P w/ Mount Pipe	106
RRH-P4	127	ERICSSON AIR 21 B4A B2P w/ Mount Pipe	106
RRH-B8	127	ERICSSON AIR 21 B4A B2P w/ Mount Pipe	106
RRH-B8	127	KRY 112 144/1	106
RRH-B8	127	KRY 112 144/1	106
2.5G 8T8R RADAR FILTER	127	KRY 112 144/1	106
Platform Mount [LP 502-1]	127	T-Arm Mount [TA 602-3]	106
SBNHH-1D65C w/ Mount Pipe	117	ODU-S AP-S W/ 6-Ft Mount Pipe	88
SBNHH-1D65C w/ Mount Pipe	117	ODU-S AP-S W/ 6-Ft Mount Pipe	88
SBNHH-1D65C w/ Mount Pipe	117	ODU-S AP-S W/ 6-Ft Mount Pipe	88
7920.00 w/ Mount Pipe	117	ODU-S AP-S W/ 6-Ft Mount Pipe	88
7750.00 w/ Mount Pipe	117	Side Arm Mount [SO 104-3]	88
7750.00 w/ Mount Pipe	117	HB-X-AW-17-65-00T w/ Mount Pipe	81
7850.00 w/ Mount Pipe	117	RV65-18-00DPL2 w/ Mount Pipe	81
(4) LGP21401	117	RV65-18-00DPL2 w/ Mount Pipe	81
SBNH-1D6565B w/ Mount Pipe	117	(2) RV65-18-00DPL2 w/ Mount Pipe	81
SBJAH4-1D65C-DL w/ Mount Pipe	117	T-Arm Mount [TA 602-3]	81
SBJAH4-1D65C-DL w/ Mount Pipe	117	Pipe Mount [PM 601-1]	52
SBJAH4-1D65C-DL w/ Mount Pipe	117	P-57C48N-U	52
TT19-08BP111-001	117		
DC6-48-60-0-8F	117		
DC6-48-60-18-8F	117		
RRH4X25-WCS	117		
RRH4X25-WCS	117		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A53-B-42	42 ksi	63 ksi	Reinf 39.20 ksi	39 ksi	49 ksi

TOWER DESIGN NOTES

1. Tower is located in Weber County, Utah.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 89 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 50 mph basic wind with 0.25 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 94.4%

Paul J. Ford and Company
250 East Broad St., Suite 600
Columbus, Ohio
Phone: 614.221.6679
FAX:

Job: **37515-3588.001.7805**		
Project: **BU 880534**		
Client: CCI	Drawn by: jjohnson	App'd:
Code: TIA-222-G	Date: 12/29/15	Scale: NTS
Path:		Dwg No. E-1

Stiffened or Unstiffened, Exterior Flange Plate - Any Bolt Material TIA Rev G

Site Data

BU#: *880534*
Site Name: *KWIK CITY MUFFLER*
App #:

Reactions		
Mu	290.99	ft-kips
Axial, Pu:	8.5	kips
Shear, Vu:	13.56	kips
Elevation:	97.5	feet

Bolt Threads:
X-Excluded
φVn=φ(0.55*Ab*Fu)
φ=0.75, φ*Vn (kips):
76.54

Pole Manufacturer:	Rohn

If No stiffeners, Criteria: TIA G <-Only Applcable to Unstiffened Cases

Bolt Data			
Qty:	12		
Diameter (in.):	1.5	Bolt Fu:	105
Bolt Material:	A325	Bolt Fy:	81
N/A:	0	<-- Disregard	
N/A:	0	<-- Disregard	
Circle (in.):	35.5		

Plate Data		
Diam:	41	in
Thick, t:	2	in
Grade (Fy):	36	ksi
Strength, Fu:	58	ksi
Single-Rod B-eff:	6.28	in

Stiffener Data (Welding at Both Sides)		
Config:	0	*
Weld Type:	0	
Groove Depth:	0	in **
Groove Angle:	0	degrees
Fillet H. Weld:	0	<-- Disregard
Fillet V. Weld:	0	in
Width:	0	in
Height:	0	in
Thick:	0	in
Notch:	0	in
Grade:	0	ksi
Weld str.:	0	ksi

Pole Data		
Diam:	24	in
Thick:	0.25	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	53	ksi
Reinf. Fillet Weld	0	"0" if None

Flange Bolt Results — Rigid

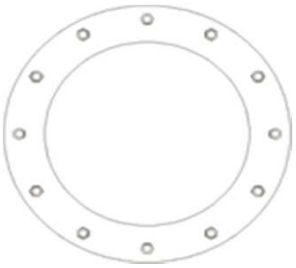
Bolt Tension Capacity, φ*Tn,**B1**:	111.04	kips	φ*Tn
Adjusted φ*Tn (due to Vu=Vu/Qty), **B**:	111.03	kips	φTn[(1-(Vu/φVn)^2]^0.5
Max Bolt directly applied Tu:	32.08	Kips	
Min. PL "tc" for **B** cap. **w/o** Pry:	2.601	in	
Min PL "treq" for actual **T w/ Pry**:	1.056	in	
Min PL "t1" for actual **T w/o Pry**:	1.398	in	
T allowable with Prying:	84.34	kips	0≤α'≤1 case
Prying Force, q:	0.00	kips	
Total Bolt Tension=Tu+q:	32.08	kips	
Prying Bolt Stress Ratio=(Tu+q)/(B):	28.9%	**Pass**	

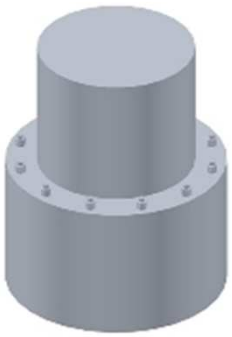
Exterior Flange Plate Results — Flexural Check — Rigid

Compression Side Plate Stress:	Rohn/Pirod, OK	TIA G
Allowable Plate Stress:	32.4 ksi	φ*Fy
Compression Plate Stress Ratio:	Rohn/Pirod, OK	Comp. Y.L. Length:
No Prying		26.16
Tension Side Stress Ratio, (treq/t)^2:	27.9% **Pass**	

n/a

Stiffener Results	N/A for Rohn / Pirod
Horizontal Weld :	N/A
Vertical Weld:	N/A
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	N/A
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	N/A
Plate Comp. (AISC Bracket):	N/A
Pole Results	
Pole Punching Shear Check:	N/A





* 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

Stiffened or Unstiffened, Exterior Flange Plate - Any Bolt Material TIA Rev G

Site Data

BU#: *880534*
Site Name: *KWIK CITY MUFFLER*
App #:

Reactions		
Mu	819.14	ft-kips
Axial, Pu:	15.44	kips
Shear, Vu:	18.57	kips
Elevation:	65	feet

Bolt Threads:
X-Excluded
φVn=φ(0.55*Ab*Fu)
φ=0.75, φ*Vn (kips):
76.54

Pole Manufacturer:	Rohn

If No stiffeners, Criteria:	TIA G	<-Only Applcable to Unstiffened Cases

Bolt Data			
Qty:	16		
Diameter (in.):	1.5	Bolt Fu:	105
Bolt Material:	A325	Bolt Fy:	81
N/A:	0	<-- Disregard	
N/A:	0	<-- Disregard	
Circle (in.):	41.5		

Plate Data		
Diam:	47	in
Thick, t:	2	in
Grade (Fy):	36	ksi
Strength, Fu:	58	ksi
Single-Rod B-eff:	5.89	in

Stiffener Data (Welding at Both Sides)		
Config:	0	*
Weld Type:	0	
Groove Depth:	0	in **
Groove Angle:	0	degrees
Fillet H. Weld:	0	<-- Disregard
Fillet V. Weld:	0	in
Width:	0	in
Height:	0	in
Thick:	0	in
Notch:	0	in
Grade:	0	ksi
Weld str.:	0	ksi

Pole Data		
Diam:	30	in
Thick:	0.375	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	53	ksi
Reinf. Fillet Weld	0	"0" if None

Flange Bolt Results

			Rigid
Bolt Tension Capacity, φ*Tn,**B1**:	111.04	kips	φ*Tn
Adjusted φ*Tn (due to Vu=Vu/Qty), **B**:	111.02	kips	φTn[(1-(Vu/φVn)^2]^0.5
Max Bolt directly applied Tu:	58.25	Kips	
Min. PL "tc" for **B** cap. **w/o** Pry:	2.686	in	
Min PL "treq" for actual **T w/ Pry**:	1.477	in	
Min PL "t1" for actual **T w/o Pry**:	1.946	in	
T allowable with Prying:	81.93	kips	0≤α'≤1 case
Prying Force, q:	0.00	kips	
Total Bolt Tension=Tu+q:	58.25	kips	
Prying Bolt Stress Ratio=(Tu+q)/(B):	52.5%	**Pass**	

Exterior Flange Plate Results — Flexural Check

			Rigid
Compression Side Plate Stress:	Rohn/Pirod,	OK	TIA G
Allowable Plate Stress:	32.4	ksi	φ*Fy
Compression Plate Stress Ratio:	Rohn/Pirod,	OK	Comp. Y.L. Length:
No Prying			28.67
Tension Side Stress Ratio, (treq/t)^2:	54.5%	**Pass**	

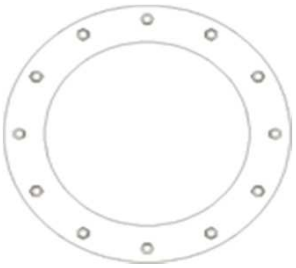
n/a

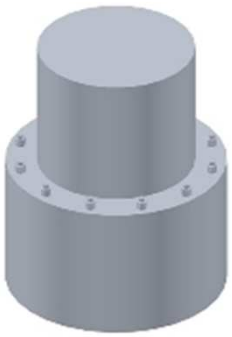
Stiffener Results — N/A for Rohn / Pirod

Horizontal Weld :	N/A
Vertical Weld:	N/A
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	N/A
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	N/A
Plate Comp. (AISC Bracket):	N/A

Pole Results

Pole Punching Shear Check: N/A





* 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

PAUL J. FORD AND COMPANY
STRUCTURAL ENGINEERS
250 East Broad Street • Suite 600 • Columbus, Ohio 43215-3708

v4.4 - Effective 7-12-13

Date: 12/23/2015
PJF Project: 37515-3588.001.7805
Client Ref. # 880534
Site Name: KWIK CITY MUFFLER
Description: 32.5ft Flange
Owner: CCI
Engineer: JRJ

Asymmetric Bolt Analysis

Moment =	1495	k-ft	TIA Ref.	G	Location =	Flange Plate		
Axial =	23.0	kips	ASIF =	1.0000	η =	0.50	for BP, Rev. G Sect. 4.9.9	
Shear =	23.2	kips	Max Ratio =	105.0%	Threads =	N-Included	for FP, Rev. G	
Anchor Qty =	22							

**** For Flange Plates: Prying action is not considered in the bolt loads. ****

Item	Nominal Bolt Dia, in	Spec	Fy, ksi	Fu, ksi	Location, degrees	Bolt Circle, in	Area Override, in^2	Area, in^2	Max Net Compression, kips	Max Net Tension, kips	Load for Capacity Calc, kips	Capacity Override, kips	Capacity, kips	Capacity Ratio
1	1.500	A325	81	105	0.0	47.00	0.00	1.77	53.40	51.56	51.56	0.00	111.03	46.4%
2	1.500	A325	81	105	20.0	47.00	0.00	1.77	55.79	53.96	53.96	0.00	111.03	48.6%
3	1.500	A325	81	105	40.0	47.00	0.00	1.77	57.69	55.86	55.86	0.00	111.03	50.3%
4	1.500	A325	81	105	60.0	47.00	0.00	1.77	58.41	56.58	56.58	0.00	111.03	51.0%
5	1.500	A325	81	105	80.0	47.00	0.00	1.77	57.75	55.91	55.91	0.00	111.03	50.4%
6	1.500	A325	81	105	100.0	47.00	0.00	1.77	56.00	54.16	54.16	0.00	111.03	48.8%
7	1.500	A325	81	105	120.0	47.00	0.00	1.77	53.90	52.06	52.06	0.00	111.03	46.9%
8	1.500	A325	81	105	140.0	47.00	0.00	1.77	52.35	50.52	50.52	0.00	111.03	45.5%
9	1.500	A325	81	105	160.0	47.00	0.00	1.77	52.01	50.17	50.17	0.00	111.03	45.2%
10	1.500	A325	81	105	180.0	47.00	0.00	1.77	52.88	51.04	51.04	0.00	111.03	46.0%
11	1.500	A325	81	105	200.0	47.00	0.00	1.77	54.33	52.50	52.50	0.00	111.03	47.3%
12	1.500	A325	81	105	220.0	47.00	0.00	1.77	55.51	53.67	53.67	0.00	111.03	48.3%
13	1.500	A325	81	105	240.0	47.00	0.00	1.77	55.75	53.91	53.91	0.00	111.03	48.6%
14	1.500	A325	81	105	260.0	47.00	0.00	1.77	54.87	53.03	53.03	0.00	111.03	47.8%
15	1.500	A325	81	105	280.0	47.00	0.00	1.77	53.20	51.36	51.36	0.00	111.03	46.3%
16	1.500	A325	81	105	300.0	47.00	0.00	1.77	51.53	49.69	49.69	0.00	111.03	44.8%
17	1.500	A325	81	105	320.0	47.00	0.00	1.77	50.77	48.93	48.93	0.00	111.03	44.1%
18	1.500	A325	81	105	340.0	47.00	0.00	1.77	51.45	49.61	49.61	0.00	111.03	44.7%
19	0.000				0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
20	2.250	Williams R71	127.7	150	0.0	58.00	0.00	4.14	153.86	149.55	149.55	260.00	260.00	57.5%
21	2.250	Williams R71	127.7	150	134.0	58.00	0.00	4.14	151.51	147.20	147.20	260.00	260.00	56.6%
22	2.250	Williams R71	127.7	150	251.0	58.00	0.00	4.14	160.57	156.26	156.26	260.00	260.00	60.1%
								44.24						

Stiffened or Unstiffened, Exterior Flange Plate - Any Bolt Material TIA Rev G

Reactions		
Mu	1025	ft-kips
Axial, Pu:	16.5	kips
Shear, Vu:	16.7	kips
Elevation:	32.5	feet

Bolt Threads:
N-Included
Vn=φ(0.45*Ab*Fu)
φ=0.75, φ*Vn (kips):
62.62

Site Data

BU#:	***Reactions adjusted to account for micro jumps***
Site Name:	
App #:	

Pole Manufacturer:	Other

If No stiffeners, Criteria:	TIA G	<-Only Applcable to Unstiffened Cases

Bolt Data			
Qty:	18		
Diameter (in.):	1.5	Bolt Fu:	105
Bolt Material:	A325	Bolt Fy:	81
N/A:	0	<-- Disregard	
N/A:	0	<-- Disregard	
Circle (in.):	47.5		

Plate Data		
Diam:	53	in
Thick, t:	2	in
Grade (Fy):	36	ksi
Strength, Fu:	58	ksi
Single-Rod B-eff:	6.28	in

Stiffener Data (Welding at Both Sides)		
Config:	0	*
Weld Type:		
Groove Depth:		in **
Groove Angle:		degrees
Fillet H. Weld:		<-- Disregard
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

Pole Data		
Diam:	36	in
Thick:	0.375	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	53	ksi
Reinf. Fillet Weld	0	"0" if None

Flange Bolt Results

Bolt Tension Capacity, φ*Tn,**B1**:	111.04	kips	Rigid
Adjusted φ*Tn (due to Vu=Vu/Qty), **B**:	111.03	kips	φTn[(1-(Vu/φVn)^2]^0.5
Max Bolt directly applied Tu:	56.63	Kips	
Min. PL "tc" for **B** cap. **w/o** Pry:	2.601	in	
Min PL "treq" for actual **T w/ Pry**:	1.403	in	
Min PL "t1" for actual **T w/o Pry**:	1.857	in	
T allowable with Prying:	84.34	kips	0≤α'≤1 case
Prying Force, q:	0.00	kips	
Total Bolt Tension=Tu+q:	56.63	kips	
Prying Bolt Stress Ratio=(Tu+q)/(B):	51.0%	**Pass**	

Exterior Flange Plate Results Flexural Check

Compression Side Plate Stress:	28.4	ksi	Rigid
Allowable Plate Stress:	32.4	ksi	TIA G
Compression Plate Stress Ratio:	87.8%	**Pass**	φ*Fy
No Prying			Comp. Y.L. Length:
Tension Side Stress Ratio, (treq/t)^2:	49.2%	**Pass**	30.99

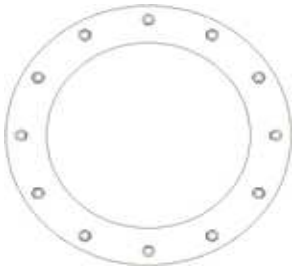
n/a

Stiffener Results

Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2:	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check: n/a



* 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

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

TIA Rev G Assumption: Clear space between bottom of leveling nut and top of concrete **not** exceeding (1)*(Rod Diameter)

Site Data	
BU#:	*880534*
Site Name:	
App #:	
Pole Manufacturer:	*Other*

Reactions		
Mu:	2291	ft-kips
Axial, Pu:	33	kips
Shear, Vu:	26	kips
Eta Factor, η	0.55	TIA G (Fig. 4-4)

Anchor Rod Data		
Qty:	18	
Diam:	1.5	in
Rod Material:	Other	
Strength (Fu):	125	ksi
Yield (Fy):	109	ksi
Bolt Circle:	47.5	in

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

Anchor Rod Results

		Rigid
Max Rod (Cu+ Vu/ή):	133.1 Kips	AISC LRFD
Allowable Axial, Φ*Fu*Anet:	141.0 Kips	φ*Tn
Anchor Rod Stress Ratio:	94.4% **Pass**	

Plate Data		
Diam:	53	in
Thick:	2	in
Grade:	36	ksi
Single-Rod B-eff:	7.33	in

Base Plate Results Flexural Check

		Rigid
Base Plate Stress:	30.7 ksi	AISC LRFD
Allowable Plate Stress:	32.4 ksi	φ*Fy
Base Plate Stress Ratio:	94.9% **Pass**	Y.L. Length: 22.19

Stiffener Data (Welding at both sides)		
Config:	0	*
Weld Type:		
Groove Depth:		in **
Groove Angle:		degrees
Fillet H. Weld:		<-- Disregard
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

n/a

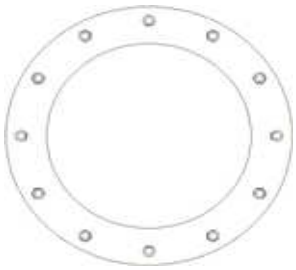
Stiffener Results

Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check: n/a

Pole Data		
Diam:	42	in
Thick:	0.5	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	63	ksi
Reinf. Fillet Weld	0	"0" if None



* 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

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Job Number:	37515-3588.001.7805	**Page:**	1
Site Number:	880534	**By:**	JRJ
Site Name:	Kwik City Muffler	**Date:**	12/23/2015

DRILLED PIER SOIL AND STEEL ANALYSIS - TIA-222-G

Factored Base Reactions from RISA

	Comp. (+)	Tension (-)	
Moment, Mu =	2291.0		k-ft
Shear, Vu =	26.0		kips
Axial Load, Pu1 =	33.0		kips (from 1.2D + 1.6W)*
Axial Load, Pu2 =	24.8	0.0	kips (from 0.9D + 1.6W)**
OTMu =	2304.0	0.0	k-ft @ Ground

***Axial Load, Pu1 will be used for Soil Compression Analysis.**

****Axial Load, Pu2 will be used for Steel Analysis.**

Safety Factors / Load Factors / Φ Factors

Tower Type =	Monopole DP
ACI Code =	ACI 318-05
Seismic Design Category =	D
Reference Standard =	TIA-222-G
Use 1.3 Load Factor?	Yes
Load Factor =	1.00

Drilled Pier Parameters

Diameter =	6 ft
Height Above Grade =	0.5 ft
Depth Below Grade =	38 ft
fc' =	3 ksi
εc =	0.003 in/in

	Safety Factor	**Φ Factor**
Soil Lateral Resistance =	2.00	0.75
Skin Friction =	2.00	0.75
End Bearing =	2.00	0.75
Concrete Wt. Resist Uplift =	1.25	

Mat Ftdn. Cap Width =	ft
Mat Ftdn. Cap Length =	ft
Depth Below Grade =	ft

Load Combinations Checked per TIA-222-G

1. (0.75) Ult. Skin Friction + (0.75) Ult. End Bearing + (1.2) Effective Soil Wt. - (1.2) Buoyant Conc. Wt. ≥ Comp.
2. (0.75) Ult. Skin Friction + (0.9) Buoyant Conc. Wt. ≥ Uplift

Steel Parameters

Number of Bars =	20
Rebar Size =	#10
Rebar Fy =	60 ksi
Rebar MOE =	29000 ksi
Tie Size =	#4
Side Clear Cover to Ties =	5 in

Soil Parameters

Water Table Depth =	10.00 ft
Depth to Ignore Soil =	4.17 ft
Depth to Full Cohesion =	0 ft
Full Cohesion Starts at?*	Ground

Above Full Cohesion Lateral Resistance = 4(Cohesion)(Dia)(H)

Below Full Cohesion Lateral Resistance = 8(Cohesion)(Dia)(H)

Direct Embed Pole Shaft Parameters

Dia @ Grade =	in
Dia @ Depth Below Grade =	in
Number of Sides =	
Thickness =	in
Fy =	ksi
Backfill Condition =	

Maximum Capacity Ratios

Maximum Soil Ratio =	110.0%
Maximum Steel Ratio =	105.0%

Note: The drilled pier foundation was analyzed using the methodology in the software 'PLS-Caisson' (Version 8.10, or newer, by Power Line Systems, Inc.). Per the methods in PLS-Caisson, the soil reactions of cohesive soils are calculated using 8CD independent of the depth of the soil layer. The depth of soil to be ignored at the top of the drilled pier is based the recommendations of the site specific geotechnical report. In the absence of any recommendations, the frost depth at the site or one half of the drilled pier diameter (whichever is greater) shall be ignored.

Define Soil Layers

Note: Cohesion = Undrained Shear Strengh = Unconfined Compressive Strength / 2

Layer	Thickness ft	Unit Weight pcf	Cohesion psf	Friction Angle degrees	Soil Type	Ultimate End Bearing psf	Comp. Ult. Skin Friction psf	Tension Ult. Skin Friction psf	Depth ft
1	24	110		28	Sand				24
2	18	110		30	Sand	6000			42
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Soil Results: Overturning

Depth to COR =	26.77	ft, from Grade	Shear, Vu =	26.00	kips
Bending Moment, Mu =	3000.01	k-ft, from COR	Resisting Shear, ΦVn =	140.74	kips
Resisting Moment, ΦMn =	16238.73	k-ft, from COR			

MOMENT RATIO = 18.5% OK **SHEAR RATIO = 18.5% OK**

Soil Results: Uplift

Uplift, Tu =	0.00	kips
Uplift Capacity, ΦTn =	102.50	kips

UPLIFT RATIO = 0.0% OK

Soil Results: Compression

Compression, Cu =	33.00	kips
Comp. Capacity, ΦCn =	73.12	kips

COMPRESSION RATIO = 45.1% OK

Steel Results (ACI 318-05):

Minimum Steel Area =	13.57	sq in	Axial Load, Pu =	59.10	kips @ 8.50 ft Below Grade
Actual Steel Area =	25.40	sq in	Moment, Mu =	2485.01	k-ft @ 8.50 ft Below Grade
			Moment, ΦMn =	3382.01	k-ft
Axial, ΦPn (min) =	-1371.60	kips, Where ΦMn = 0 k-ft			
Axial, ΦPn (max) =	6157.61	kips, Where ΦMn = 0 k-ft			

MOMENT RATIO = 73.5% OK

Moment Capacity of Drilled Concrete Shaft (Caisson) for TIA Rev F or G

Note: Shaft assumed to have ties, not spiral, transverse reinforcing

Site Data

BU#: *880534*
Site Name: *Kwik City Muffler*
App #:

Loads Already Factored		
For M (WL)	1	<----Disregard
For P (DL)	1	<----Disregard

Pier Properties

Concrete:

Pier Diameter =	6.0	ft
Concrete Area =	4071.5	in^2

Reinforcement:

Clear Cover to **Tie**=	5.00	in
Horiz. **Tie** Bar Size=	4	
Vert. Cage Diameter =	4.98	ft
Vert. Cage Diameter =	59.73	in
Vertical Bar Size =	10	
Bar Diameter =	1.27	in
Bar Area =	1.27	in^2
Number of Bars =	20	
As Total=	25.4	in^2
A s/ Aconc, Rho:	0.0062	0.62%

ACI 10.5 , ACI 21.10.4, and IBC 1810.
Min As for Flexural, Tension Controlled, Shafts:
(3)*(Sqrt(f'c)/Fy: 0.0027
200 / Fy: 0.0033

Minimum Rho Check:

Actual Req'd Min. Rho:	0.33%	Flexural
Provided Rho:	0.62%	**OK**

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn.		
Pn per ACI 318 (10-2)	6157.61	kips
at Mu=(ϕ=0.65)Mn=	3151.60	ft-kips
Max Tu, (φ=0.9) Tn =	1371.6	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces

TIA Revision:	G	
Max. Factored Shaft Mu:	2485.01	ft-kips **(* Note)**
Max. Factored Shaft Pu:	59.1	kips
Max Axial Force Type:	Comp.	

(*) Note: Max Shaft Superimposed Moment does not necessarily equal to the shaft top reaction moment

Load Factor	Shaft Factored Loads		
1.00	Mu:	2485.01	ft-kips
1.00	Pu:	59.1	kips

Material Properties

Concrete Comp. strength, f'c =	3000	psi
Reinforcement yield strength, Fy =	60	ksi
Reinforcing Modulus of Elasticity, E =	29000	ksi
Reinforcement yield strain =	0.00207	
Limiting compressive strain =	0.003	

ACI 318 Code

Select Analysis ACI Code= 2005

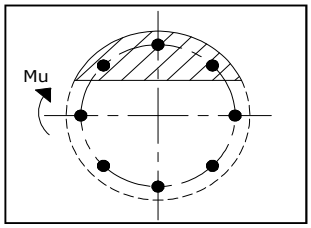
Seismic Properties

Seismic Design Category =	D
Seismic Risk =	**High**

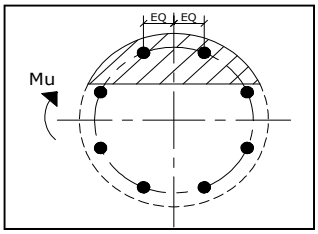
Solve (Run) <-- Press Upon Completing All Input

Results:

Governing Orientation Case: **1**



Case 1



Case 2

Dist. From Edge to Neutral Axis:	**12.87**	in
Extreme Steel Strain, ϵt:	**0.0123**	
	ϵt > 0.0050, Tension Controlled	
Reduction Factor,φ:	**0.900**	

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	59.10	kips
Drilled Shaft Moment Capacity, φMn:	**3382.01**	ft-kips
Drilled Shaft Superimposed Mu:	**2485.01**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**73.5%**