Date: **March 14, 2014**

Marshall Farris
Crown Castle
5350 North 48th Street, Suite 305
Chandler, AZ 85226
(480) 734-2402

Vertical Structures, Inc.
309 Spangler Drive, Suite E
Richmond, KY 40475
(859) 624-8360
amathis@verticalstructures.com

Subject: **Structural Analysis Report**

Carrier Designation:	***Sprint PCS* Change-Out**	Scenario 2.5B
	Carrier Site Number:	SL03XC106
	Carrier Site Name:	Doc Holliday & Frank Kuba
Crown Castle Designation:	**Crown Castle BU Number:**	880522
	Crown Castle Site Name:	Doc Holliday & Frank Kuba
	Crown Castle JDE Job Number:	253471
	Crown Castle Work Order Number:	688422
	Crown Castle Application Number:	206447 Rev. 0
Engineering Firm Designation:	**Vertical Structures, Inc. Project Number:**	2014-003-008
Site Data:	**2331 North Rulon White Boulevard , Ogden, UT, Weber County** **Latitude *41° 17' 53.6"*, Longitude *-112° 0' 55.1"*** **97.5 Foot - Monopole Tower**	

Dear Marshall Farris,

Vertical Structures, Inc. 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 604195.

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.

The analysis has been performed in accordance with the TIA-222-G standard and local code requirements based upon a wind speed of 90 mph 3-second gust, exposure category C with topographic category 1 and crest height of 0 feet.

All modifications and equipment proposed in this report shall be installed in accordance with the attached drawings for the determined available structural capacity to be effective.

We at *Vertical Structures, Inc.* 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:

Andrew Mathis
Project Engineer

tnxTower Report - version 6.1.4.1

Date: **March 14, 2014**

Marshall Farris
Crown Castle
5350 North 48th Street, Suite 305
Chandler, AZ 85226
(480) 734-2402

Vertical Structures, Inc.
309 Spangler Drive, Suite E
Richmond, KY 40475
(859) 624-8360
amathis@verticalstructures.com

Subject: Structural Analysis Report

Carrier Designation:	***Sprint PCS* Change-Out**	Scenario 2.5B
	Carrier Site Number:	SL03XC106
	Carrier Site Name:	Doc Holliday & Frank Kuba
Crown Castle Designation:	**Crown Castle BU Number:**	880522
	Crown Castle Site Name:	Doc Holliday & Frank Kuba
	Crown Castle JDE Job Number:	253471
	Crown Castle Work Order Number:	688422
	Crown Castle Application Number:	206447 Rev. 0
Engineering Firm Designation:	**Vertical Structures, Inc. Project Number:**	2014-003-008
Site Data:	**2331 North Rulon White Boulevard , Ogden, UT, Weber County** **Latitude *41° 17' 53.6"*, Longitude *-112° 0' 55.1"*** **97.5 Foot - Monopole Tower**	

Dear Marshall Farris,

Vertical Structures, Inc. 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 604195.

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.

The analysis has been performed in accordance with the TIA-222-G standard and local code requirements based upon a wind speed of 90 mph 3-second gust, exposure category C with topographic category 1 and crest height of 0 feet.

All modifications and equipment proposed in this report shall be installed in accordance with the attached drawings for the determined available structural capacity to be effective.

We at *Vertical Structures, Inc.* 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:

Andrew Mathis
Project Engineer

TABLE OF CONTENTS

1) INTRODUCTION

This tower is a 97.5 ft Monopole tower designed by Rohn in 1996. The original design specifications are unknown.

2) ANALYSIS CRITERIA

The structural analysis was performed for this tower in accordance with the requirements of TIA-222-G Structural Standards for Steel Antenna Towers and Antenna Supporting Structures using a 3-second gust wind speed of 90 mph with no ice and 60 mph under service loads, exposure category C with topographic category 1 and crest height of 0 feet.

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
95.0	95.0	1	kmw communications	ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe	3	1 7/16	
		3	kmw communications	ET-X-WM-18-65-8P w/ Mount Pipe			
		2	powerwave technologies	P40-16-XLPP-RR w/ Mount Pipe			
		1	samsung telecommunications	2.5G 8T8R Radar Filter BTS			
		3	samsung telecommunications	2.5GHz RRH-V3 BTS			
		3	samsung telecommunications	Optic Fiber Junction Cylinder Splitter			
		3	samsung telecommunications	Power Junction Cylinder Splitter			
		3	samsung telecommunications	RRH-C2 w/ Ext. Filter TMA			
		3	samsung telecommunications	RRH-P4 BTS			

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
95.0	95.0	4	decibel	950F65T2E-M w/ Mount Pipe	6	1 1/4	2
		2	decibel	DB950F40T2E-M w/ Mount Pipe			
		1		Platform Mount [LP 502-1]			1

Notes:
1) Existing Equipment
2) Equipment to be Removed

Table 3 - Design 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)
Unknown						

3) ANALYSIS PROCEDURE

Table 4 - Documents Provided

Document	Remarks	Reference	Source
Online Appplication	Sprint PCS Change-Out Revision #0	206447	CCIsites
Tower Information	TEP Mapping Project No. 52798-15412	4544986	CCIsites
Foundation Information	TEP Mapping Project No. 52798-15412	4544994	CCIsites
Geotechnical Report	Terracon Project No. 61965100	1585020	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. Crown Castle's CCIplate 1.5 analysis tool was used to evaluate the anchor bolts, base plate, and any flange splices.

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) Flange plates are adequate provided the original pole shaft and flange bolts pass.

This analysis may be affected if any assumptions are not valid or have been made in error. Vertical Structures, Inc. should be notified to determine the effect on the structural integrity of the tower.

4) ANALYSIS RESULTS

Table 5 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (lb)	SF*P_allow (lb)	% Capacity	Pass / Fail
L1	97.5 - 65	Pole	P24x1/4	1	-4964.37	662265.00	41.4	Pass
L2	65 - 32.5	Pole	P30x3/8	2	-9711.60	1311060.00	42.0	Pass
L3	32.5 - 0	Pole	P36x3/8	3	-15445.80	1490100.00	51.7	Pass
							Summary	
						Pole (L3)	51.7	Pass
						Rating =	51.7	Pass

Table 6 - Tower Component Stresses vs. Capacity – LC5

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	36.7	Pass
1	Base Plate	0	33.7	Pass
1	Base Foundation	0	27.2	Pass
1	Base Foundation Soil Interaction	0	41.7	Pass
1	Flange Bolts	65	16.2	Pass
1	Flange Bolts	32.5	25.2	Pass

Structure Rating (max from all components) =	51.7%

Notes:
1) See additional documentation in "Appendix C – Additional Calculations" for calculations supporting the % capacity.
2) Capacities up to 105% are considered acceptable based on analysis methods used.

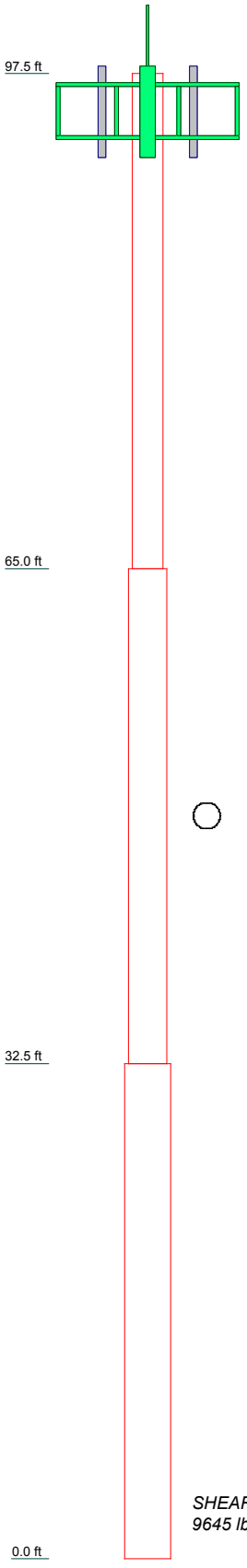
4.1) Recommendations

N/A

APPENDIX A

TNXTOWER OUTPUT

Section	Size	Length (ft)	Grade	Weight (lb)
1	P24x1/4	32.50	A53-B-42	2062.9
2	P30x3/8	32.50		3859.7
3	P36x3/8	32.50		4641.5
				10564.1



ALL REACTIONS ARE FACTORED

AXIAL 15450 lb

SHEAR 9645 lb

MOMENT 678346 lb-ft

TORQUE 255 lb-ft

REACTIONS - 90 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 5/8" x 5'	100	Power Junction Cylinder Splitter (Sprint PCS)	95
Platform Mount [LP 502-1] (Sprint PCS)	95	Optic Fiber Junction Cylinder Splitter (Sprint PCS)	95
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	95	2.5GHz RRH-V3 BTS (Sprint PCS)	95
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	95	RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	95
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	95	RRH-P4 BTS (Sprint PCS)	95
P40-16-XLPP-RR w/ Mount Pipe (Sprint PCS)	95	Power Junction Cylinder Splitter (Sprint PCS)	95
ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe (Sprint PCS)	95	Optic Fiber Junction Cylinder Splitter (Sprint PCS)	95
P40-16-XLPP-RR w/ Mount Pipe (Sprint PCS)	95	2.5GHz RRH-V3 BTS (Sprint PCS)	95
Power Junction Cylinder Splitter (Sprint PCS)	95	RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	95
Optic Fiber Junction Cylinder Splitter (Sprint PCS)	95	RRH-P4 BTS (Sprint PCS)	95
2.5GHz RRH-V3 BTS (Sprint PCS)	95	2.5G 8T8R Radar Filter (Sprint PCS)	95
RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	95	(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	95
RRH-P4 BTS (Sprint PCS)	95	(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	95
		(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	95

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A53-B-42	42 ksi	63 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 90 mph basic wind in accordance with the TIA-222-G Standard.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 51.7%

Vertical Structures, Inc.
309 Spangler Drive, Suite E
Richmond, KY 40475
Phone: (859) 624-8360
FAX: (859) 624-8369

Job: ***Doc Holliday & Frank Kuba, UT BU#880522***		
Project: ***Vertical Structures Job No. 2014-003-008***		
Client: Crown Castle	Drawn by: dalbul	App'd:
Code: TIA-222-G	Date: 03/14/14	Scale: NTS
Path: Y:\DROPBOX\VERTICAL STRUCTURES\2014-003-008\Doc Holliday & Frank Kuba, UT\Report\tnx files\880522.eri		Dwg No. E-1

Tower Input Data

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

Tower is located in Weber County, Utah.
Basic wind speed of 90 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in pole design is 1.
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	97.50-65.00	32.50	P24x1/4	A53-B-42 (42 ksi)	
L2	65.00-32.50	32.50	P30x3/8	A53-B-42 (42 ksi)	
L3	32.50-0.00	32.50	P36x3/8	A53-B-42 (42 ksi)	

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 97.50-65.00				1	1	1		
L2 65.00-32.50				1	1	1		
L3 32.50-0.00				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
Type 2 (1-7/16) (Sprint PCS)	A	No	Inside Pole	95.00 - 3.00	3	No Ice	0.00	0.60

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 lb
L1	97.50-65.00	A	0.000	0.000	0.000	0.000	54.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
L2	65.00-32.50	A	0.000	0.000	0.000	0.000	58.50
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00
L3	32.50-0.00	A	0.000	0.000	0.000	0.000	53.10
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	97.50-65.00	0.0000	0.0000	0.0000	0.0000
L2	65.00-32.50	0.0000	0.0000	0.0000	0.0000
L3	32.50-0.00	0.0000	0.0000	0.0000	0.0000

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice

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* lb
Lightning Rod 5/8" x 5' **	C	None		0.0000	100.00	No Ice	0.31	0.31	6.20
Platform Mount [LP 502-1] (Sprint PCS)	C	None		0.0000	95.00	No Ice	32.35	32.35	925.00
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	7.81	4.89	65.60
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	7.81	4.89	65.60
ET-X-WM-18-65-8P w/ Mount Pipe (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	7.81	4.89	65.60
P40-16-XLPP-RR w/ Mount Pipe (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	9.49	4.94	74.90
ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	8.91	6.69	71.10
P40-16-XLPP-RR w/ Mount Pipe (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	9.49	4.94	74.90
Power Junction Cylinder Splitter (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	0.24	0.24	3.30
Optic Fiber Junction Cylinder Splitter (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	0.26	0.26	1.96
2.5GHz RRH-V3 BTS (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	2.80	1.42	59.50
RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	6.20	5.16	81.80
RRH-P4 BTS (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	20.0000	95.00	No Ice	3.19	2.07	59.50
Power Junction Cylinder Splitter (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	0.24	0.24	3.30
Optic Fiber Junction Cylinder Splitter (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	0.26	0.26	1.96
2.5GHz RRH-V3 BTS (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	2.80	1.42	59.50
RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	6.20	5.16	81.80
RRH-P4 BTS (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	3.19	2.07	59.50
Power Junction Cylinder Splitter (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	0.24	0.24	3.30
Optic Fiber Junction Cylinder	C	From	3.50	10.0000	95.00	No Ice	0.26	0.26	1.96

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 lb
Splitter (Sprint PCS)		Centroid-Face	0.00 0.00						
2.5GHz RRH-V3 BTS (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	2.80	1.42	59.50
RRH-C2 w/ Ext. Filter TMA (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	6.20	5.16	81.80
RRH-P4 BTS (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	3.19	2.07	59.50
2.5G 8T8R Radar Filter (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	10.0000	95.00	No Ice	0.94	0.35	22.00
(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	A	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	1.90	1.90	26.00
(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	B	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	1.90	1.90	26.00
(2) 8'x2" Antenna Mount Pipe (Sprint PCS)	C	From Centroid-Face	3.50 0.00 0.00	0.0000	95.00	No Ice	1.90	1.90	26.00

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
L1	97.5 - 65 (1)	P24x1/4	32.50	0.00	0.0	18.6532	-4964.37	662265.00	0.007
L2	65 - 32.5 (2)	P30x3/8	32.50	0.00	0.0	34.9011	-9711.60	1311060.00	0.007
L3	32.5 - 0 (3)	P36x3/8	32.50	0.00	0.0	41.9697	-15445.80	1490100.00	0.010

Pole Bending Design Data

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
L1	97.5 - 65 (1)	P24x1/4	161256.67	396683.33	0.407	0.00	396683.33	0.000
L2	65 - 32.5 (2)	P30x3/8	390956.67	947858.33	0.412	0.00	947858.33	0.000
L3	32.5 - 0 (3)	P36x3/8	678346.67	1338808.33	0.507	0.00	1338808.33	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V_u lb	ϕV_n lb	Ratio $\frac{V_u}{\phi V_n}$	Actual T_u lb-ft	ϕT_n lb-ft	Ratio $\frac{T_u}{\phi T_n}$
L1	97.5 - 65 (1)	P24x1/4	6120.12	331132.00	0.018	69.76	648610.83	0.000
L2	65 - 32.5 (2)	P30x3/8	7959.33	655528.00	0.012	69.73	1598366.67	0.000
L3	32.5 - 0 (3)	P36x3/8	9651.73	745048.00	0.013	69.72	2189066.67	0.000

Pole Interaction Design Data

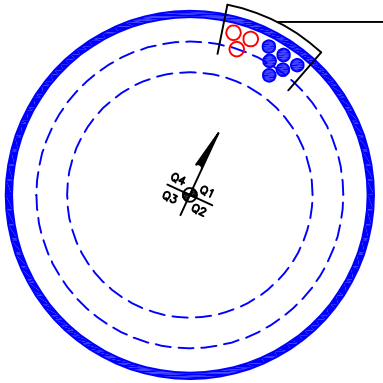
Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	97.5 - 65 (1)	0.007	0.407	0.000	0.018	0.000	0.414 ✔	1.000	4.8.2 ✔
L2	65 - 32.5 (2)	0.007	0.412	0.000	0.012	0.000	0.420 ✔	1.000	4.8.2 ✔
L3	32.5 - 0 (3)	0.010	0.507	0.000	0.013	0.000	0.517 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail
L1	97.5 - 65	Pole	P24x1/4	1	-4964.37	662265.00	41.4	Pass
L2	65 - 32.5	Pole	P30x3/8	2	-9711.60	1311060.00	42.0	Pass
L3	32.5 - 0	Pole	P36x3/8	3	-15445.80	1490100.00	51.7	Pass
							Summary	
						Pole (L3)	51.7	Pass
						RATING =	**51.7**	**Pass**

APPENDIX B

BASE LEVEL DRAWING



(PROPOSED)
(3) 1-7/16" TO 95 FT LEVEL
(INSTALLED-TO BE REMOVED)
(6) 1-1/4" TO 95 FT LEVEL
(SPRINT PCS)

BUSINESS UNIT: 880522 TOWER ID: C_BASELEVEL

07/11/07	NEW BUILD PER WORK ORDER # 168944	MLK
09/12/08	DECOMMISSIONED PER WORK ORDER # 246833	LAN
10/12/11	AS-BUILT INFORMATION ADDED PER WORK ORDER # 455146	MG
09/11/12	APPLICATION ADDED PER WORK ORDER # 505446	MDB

DRAWN BY: MLK
CHECKED BY: PS
DRAWING DATE: 7/11/07

SITE NUMBER:
SITE NAME:

SITE NAME

DOC HOLIDAY & FRANK KUBA

BUSINESS UNIT NUMBER

880522

SITE ADDRESS

2331 N. RULON WHITE BLVD.
OGDEN, UT 84404
WEBER COUNTY
USA

SHEET TITLE

BASE LEVEL

SHEET NUMBER

A1-0

BASE LEVEL DRAWING

SCALE: 1" = 1'-0" | 1

APPENDIX C

ADDITIONAL CALCULATIONS

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#: *880522*
Site Name: *Doc Holliday & Frank Kuba, UT*
App #: *206447, Rev. 0*
Pole Manufacturer: *Other*

Reactions		
Mu:	678.346	ft-kips
Axial, Pu:	15.450	kips
Shear, Vu:	9.645	kips
Eta Factor, η	0.55	TIA G (Fig. 4-4)

Anchor Rod Data		
Qty:	16	
Diam:	1.5	in
Rod Material:	Other	
Strength (Fu):	125	ksi
Yield (Fy):	109	ksi
Bolt Circle:	41	in

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

Anchor Rod Results

		Rigid
Max Rod (Cu+ Vu/ή):	51.7 Kips	AISC LRFD
Allowable Axial, Φ*Fu*Anet:	141.0 Kips	φ*Tn
Anchor Rod Stress Ratio:	36.7% **Pass**	

Plate Data		
Diam:	47	in
Thick:	2	in
Grade:	36	ksi
Single-Rod B-eff:	7.07	in

Base Plate Results Flexural Check

		Rigid
Base Plate Stress:	10.9 ksi	AISC LRFD
Allowable Plate Stress:	32.4 ksi	φ*Fy
Base Plate Stress Ratio:	33.7% **Pass**	Y.L. Length: 19.62

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

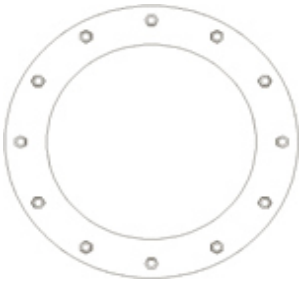
Stiffener Results

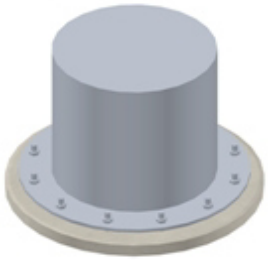
Horizontal Weld :	n/a
Vertical Weld:	n/a
Plate Flex+Shear, fb/Fb+(fv/Fv)^2:	n/a
Plate Tension+Shear, ft/Ft+(fv/Fv)^2	n/a
Plate Comp. (AISC Bracket):	n/a

Pole Results

Pole Punching Shear Check: n/a

Pole Data		
Diam:	36	in
Thick:	0.375	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	60	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

CAISSON Version 10.40 10:29:19 AM Friday, March 14, 2014
Vertical Structures, Inc.

Project Title: Doc Holliday & Frank Kuba, UT BU#880522
Project Notes: Vertical Structures Job No. 2014-003-008

******* I N P U T D A T A

Pier Properties

Diameter (ft)	Distance of Top of Pier above Ground (ft)	Concrete Strength (ksi)	Steel Yield Strength (ksi)
6.00	0.50	3.00	60.00

Soil Properties

Layer	Type	Thickness (ft)	Depth at Top of Layer (ft)	Density (lbs/ft^3)	CU (psf)	KP	PHI (deg)
1	Clay	2.50	0.00	117.0			
2	Clay	2.50	2.50	117.0	579.0		
3	Clay	17.50	5.00	47.0	579.0		

Design (Factored) Loads at Top of Pier

Moment (ft-k)	Axial Load (kips)	Shear Load (kips)	Additional Safety Factor Against Soil Failure
678.3	15.4	9.64	3.20

******* R E S U L T S

Calculated Pier Properties

Length (ft)	Weight (kips)	End Bearing Pressure (psf)
22.500	95.426	546.4

Ultimate Resisting Forces Along Pier

Type	Distance of Top of Layer to Top of Pier (ft)	Thickness (ft)	Density (lbs/ft^3)	CU (psf)	KP	Force (kips)	Arm (ft)
Clay	0.50	2.50	117.0			0.00	1.75
Clay	3.00	2.50	117.0	579.0		69.48	4.25
Clay	5.50	7.81	47.0	579.0		216.96	9.40
Clay	13.31	9.19	47.0	579.0		-255.50	17.90

Shear and Moments Along Pier

Distance below Top of Pier (ft)	Shear (with Safety Factor) (kips)	Moment (with Safety Factor) (ft-k)	Shear (without Safety Factor) (kips)	Moment (without Safety Factor) (ft-k)
0.00	30.9	2238.9	9.7	699.6
2.25	30.9	2308.5	9.7	721.4
4.50	-10.7	2346.8	-3.4	**733.4**
6.75	-73.3	2252.3	-22.9	703.8
9.00	-135.8	2017.1	-42.4	630.3
11.25	-198.3	1641.2	-62.0	512.9
13.50	-250.1	1125.6	-78.2	351.7
15.75	-187.6	633.1	-58.6	197.9
18.00	-125.1	281.4	-39.1	87.9
20.25	-62.5	70.3	-19.5	22.0
22.50	0.0	0.0	0.0	0.0

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#: *880522*
Site Name: *Doc Holliday & Frank Kuba, UT*
App #: *206447, Rev. 0*

Loads Already Factored		
For M (WL)	1.3	<----Disregard
For P (DL)	1.3	<----Disregard

Pier Properties

Concrete:

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

Reinforcement:

Clear Cover to **Tie**=	4.00	in
Horiz. **Tie** Bar Size=	4	
Vert. Cage Diameter =	5.16	ft
Vert. Cage Diameter =	61.87	in
Vertical Bar Size =	9	
Bar Diameter =	1.13	in
Bar Area =	1	in^2
Number of Bars =	20	
As Total=	20	in^2
A s/ Aconc, Rho:	0.0049	0.49%

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:	0.49%	**OK**

Ref. Shaft Max Axial Capacities, ϕ Max(Pn or Tn):		
Max Pu = (φ=0.65) Pn.		
Pn per ACI 318 (10-2)	5996.29	kips
at Mu=(ϕ=0.65)Mn=		ft-kips
Max Tu, (φ=0.9) Tn =	1080	kips
at Mu=ϕ=(0.90)Mn=	0.00	ft-kips

Maximum Shaft Superimposed Forces		
TIA Revision:	G	
Max. Factored Shaft Mu:	733.4	ft-kips **(* Note)**
Max. Factored Shaft Pu:	11.588	kips
Max Axial Force Type:	Comp.	

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

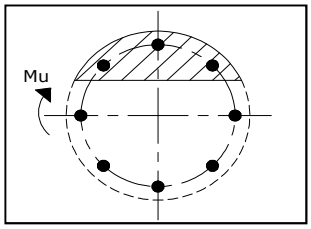
Load Factor	Shaft Factored Loads		
1.00	Mu:	733.4	ft-kips
1.00	Pu:	11.588	kips

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**	

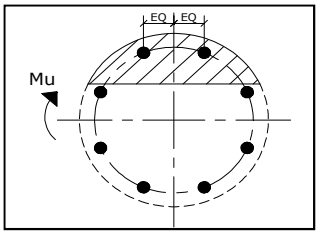
Solve (Run) <-- Press Upon Completing All Input

Results:

Governing Orientation Case: **2**



Case 1



Case 2

Dist. From Edge to Neutral Axis:	**10.95**	in
Extreme Steel Strain, ϵt:	**0.0152**	
	ϵt > 0.0050, Tension Controlled	
Reduction Factor,φ:	**0.900**	

Output Note: Negative Pu=Tension

For Axial Compression, φ Pn = Pu:	11.59	kips
Drilled Shaft Moment Capacity, φMn:	**2694.03**	ft-kips
Drilled Shaft Superimposed Mu:	**733.40**	ft-kips

(Mu/φMn, Drilled Shaft Flexure CSR:	**27.2%**

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

Site Data

BU#: *880522*
Site Name: *Doc Holliday & Frank Kuba, UT*
App #: *206447, Rev. 0*

Reactions		
Mu	161.257	ft-kips
Axial, Pu:	4.964	kips
Shear, Vu:	6.120	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:	12		
Diameter (in.):	1.5	Bolt Fu:	105
Bolt Material:	A325	Bolt Fy:	81
N/A:		<-- Disregard	
N/A:		<-- Disregard	
Circle (in.):	35		

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:	Fillet	
Groove Depth:		<-- Disregard
Groove Angle:		<-- Disregard
Fillet H. Weld:		in
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

Pole Data		
Diam:	24	in
Thick:	0.25	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	60	ksi
Reinf. Fillet Weld	0	"0" if None

Flange Bolt Results

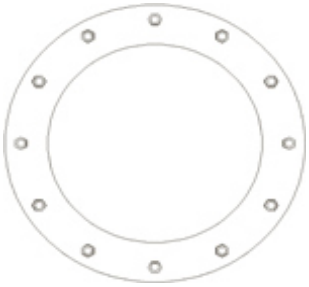
			Rigid
Bolt Tension Capacity, φ*Tn, **B1**:	111.04	kips	φ*Tn
Adjusted φ*Tn (due to Vu=Vu/Qty), **B**:	111.04	kips	φTn[(1-(Vu/φVn)^2]^0.5
Max Bolt directly applied Tu:	18.02	Kips	
Min. PL "tc" for **B** cap. **w/o** Pry:	2.535	in	
Min PL "treq" for actual **T w/ Pry**:	0.772	in	
Min PL "t1" for actual **T w/o Pry**:	1.021	in	
T allowable with Prying:	87.61	kips	0≤α'≤1 case
Prying Force, q:	0.00	kips	
Total Bolt Tension=Tu+q:	18.02	kips	
Prying Bolt Stress Ratio=(Tu+q)/(B):	16.2%	**Pass**	

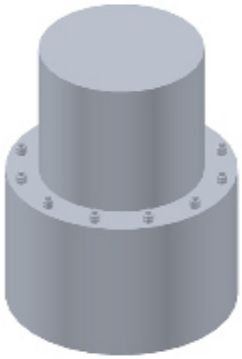
Exterior Flange Plate Results Flexural Check

		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		25.48
Tension Side Stress Ratio, (treq/t)^2:	14.9% **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#: *880522*
Site Name: *Doc Holliday & Frank Kuba, UT*
App #: *206447, Rev. 0*

Reactions		
Mu	390.957	ft-kips
Axial, Pu:	9.712	kips
Shear, Vu:	7.959	kips
Elevation:	32.5	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:	16		
Diameter (in.):	1.5	Bolt Fu:	105
Bolt Material:	A325	Bolt Fy:	81
N/A:		<-- Disregard	
N/A:		<-- Disregard	
Circle (in.):	41		

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:	Fillet	
Groove Depth:		<-- Disregard
Groove Angle:		<-- Disregard
Fillet H. Weld:		in
Fillet V. Weld:		in
Width:		in
Height:		in
Thick:		in
Notch:		in
Grade:		ksi
Weld str.:		ksi

Pole Data		
Diam:	30	in
Thick:	0.375	in
Grade:	42	ksi
# of Sides:	0	"0" IF Round
Fu	60	ksi
Reinf. Fillet Weld	0	"0" if None

Flange Bolt Results

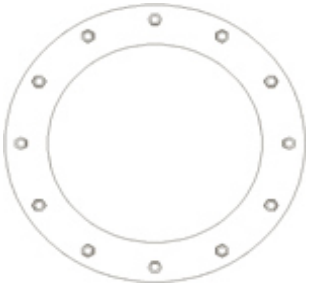
			Rigid
Bolt Tension Capacity, φ*Tn,**B1**:	111.04	kips	φ*Tn
Adjusted φ*Tn (due to Vu=Vu/Qty), **B**:	111.04	kips	φTn[(1-(Vu/φVn)^2]^0.5
Max Bolt directly applied Tu:	28.00	Kips	
Min. PL "tc" for **B** cap. **w/o** Pry:	2.618	in	
Min PL "treq" for actual **T w/ Pry**:	0.998	in	
Min PL "t1" for actual **T w/o Pry**:	1.315	in	
T allowable with Prying:	85.20	kips	0≤α'≤1 case
Prying Force, q:	0.00	kips	
Total Bolt Tension=Tu+q:	28.00	kips	
Prying Bolt Stress Ratio=(Tu+q)/(B):	25.2%	**Pass**	

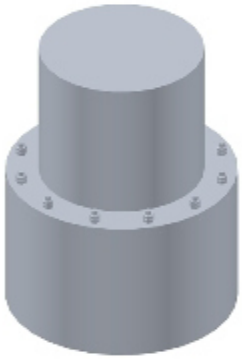
Exterior Flange Plate Results Flexural Check

		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		27.95
Tension Side Stress Ratio, (treq/t)^2:	24.9% **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