ALLPRO
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Tower Structural Analysis Report for SBA Communications Corporation

Existing 190' Flagpole

SBA Site Name: Lillington
SBA Site ID Number: NC14882-A-01

Carrier Name: T-Mobile
Carrier ID: 5RA0183A / South Lillington
Application # 115399, v2

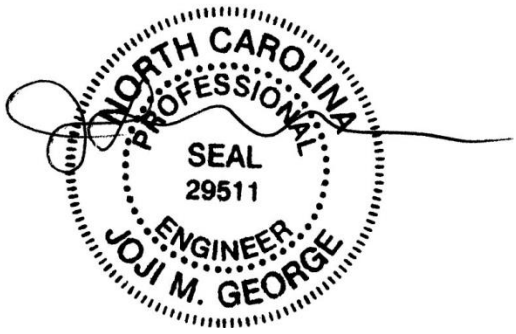
Site Location: 162 Mattie Ridgell Ln.
Lillington, NC 27546
Harnett County

Latitude: 35.379786°
Longitude: -78.820025°

ACGI Job # 20-4260
(Ref ACGI Job # 19-2978, dated 5/10/2019)

ANALYSIS RESULTS		
Tower Components	**56.2 %**	**Pass**
Tower Foundation	**82.2 %**	**Pass**
Net change in Tower stress ratio	**0.3%**	**Change from Previous SA by ACGI, Job # 19-2978, dated 05/10/19**

Prepared By:
Shiqiang Zhang, PE



12/7/2020
Approved By:
Joji M. George, P.E.
NC PE # 29511

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1. ANALYSIS SUMMARY

The existing 190' Monopole Tower located in Lillington, NC was analyzed by Allpro Consulting Group, Inc (ACGI) for the existing loads and the proposed T-Mobile antennas and coaxes as authorized by SBA Communication Corp. Based on the results of the analysis, the existing tower with below mentioned proposed and existing loading is found be **in code compliance** with *TIA - 222-G-Addendum 2, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and* ***North Carolina Building Code 2018 (as per IBC 2015 requirements).***

2. SCOPE & SOURCE OF INFORMATION

The purpose of this structural analysis is to determine whether the existing structure is capable of supporting additional proposed loads.

SOURCE OF INFORMATION		
Tower Data:	DaVinci Engineering, Inc.	Original tower design drawings by DaVinci Engineering, Inc., Job# 9908235-1819, dated 1/6/09.
	Vector Engineers	Original canister design drawing by Vector Engineers, Job# U1151-005-091, dated 03/09/2009.
	FDH Engineering, Inc.	Previous structural analysis by FDH Engineering, Inc., FDH Project # 146EA31400, dated 10/28/14.
	Allpro Consulting Group, Inc	Previous structural analysis by Allpro Consulting Group, Inc, ref # 19-2978, dated 5/10/2019.
Foundation Data:	DaVinci Engineering, Inc.	Original foundation design drawings by DaVinci Engineering, Inc., Job# 9908235-1819, dated 1/6/09.
Geotechnical Report:	Geo-Terrain Organization, Inc.	Geotechnical Exploration report by Geo-Terrain Organization, Inc., Job# 08G-091-063, dated 12/20/08.
Loading Data:	FDH Engineering, Inc.	Existing loadings as per previous structural analysis by FDH Engineering, Inc., FDH Project # 146EA31400, dated 10/28/14.
	SBA Communication Corp.	SBA site summary, dated 2/4/20. Proposed loading for T-Mobile as per application # 115399, v2 by SBA Communication Corp.
Authorization:	SBA Communication Corp.	

3. ANALYSIS METHODS & DATA

The analysis was performed in accordance with Telecommunication Industry Association specification TIA-222-G-Addendum 2. The tower was modeled using TNX Tower, a 3-D finite element program. TNX Tower is a general-purpose modeling, analysis, and design program created specifically for communication towers using the TIA-222-G standards. The 3-D model included the tower, with existing appurtenances and all proposed loads.

SITE DATA	
SBA Site Name:	Lillington
SBA Site Number:	NC14882-A-01
Carrier Site Name:	T-MOBILE/ 5RA0183A / South Lillington
City, State:	Lillington, NC
County:	Harnett
Code Wind Load Requirement:	ANSI/TIA-222-G & ***North Carolina Building Code 2018 (IBC 2015.)*** (117mph Ultimate wind speed equivalent to 91mph Nominal Wind Speed)
Wind Load Used:	ANSI/TIA-222-G-Addendum 2 Code: • Ultimate wind speed of 117 mph (3 second gust wind speed) • Structure Class II*. • Exposure Category C. • Topographic Category 1. • Crest Height 0 ft. • A wind speed of 30 mph is used in combination with ice. • Nominal ice thickness of 0.75 in.
Seismic Requirement:	Spectral Response Acceleration at Short Period (Ss) is 0.185g which less than 1.000 g. Therefore, no seismic check is required as per TIA-222-G section 2.7.3

* This structural analysis is based upon the tower being classified as a class II; however, if a different classification is required subsequent to the date hereof, the tower classification will be changed to meet such requirement and a new structural analysis will be run.

TOWER DATA	
Tower Type:	Flagpole
Height:	190'
Cross Section:	18 Sided Polygon (0'-130') / Round Canister (130'-190')
Steel Strength:	65 ksi (0'-130') / 35 ksi (130'-190')
Type of Foundation:	Tower base: Drilled pier

TOWER HISTORY	
Tower Manufacturer / Model:	DaVinci Engineering Inc.
Date of Original Design:	1/6/09
Previous Modifications:	Unknown
Original Design Code Requirements:	ANSI/TIA-222-G 2005 with 100 mph wind

4. APPURTENANCE LISTING

EXISTING LOAD DESCRIPTION					
ELEV (ft.)	***Qty.***	***Antenna Description***	***Mount Type & Qty.***	***TX. LINE (in)***	***TENANT***
190’±	3	RFS APX16DWV-16DWV-S-E-A20 Panel Antenna	Inside Concealment Canister	(12) 1-5/8” Coax	T-Mobile
	3	TMA’s			
180’±	1	Andrew SBNH-1D4545A Panel Antenna	Inside Concealment Canister	(12) 1-5/8” Coax	Verizon
	2	Andrew SBNHH-1D65C Panel Antenna			
	4	Commscope CBC721-DF-2X Diplexers			
	2	Raycap RRFDC-3315-PF-48 Surge Suppressor			

FINAL PROPOSED T-MOBILE LOAD DESCRIPTION *					
ELEV (ft.)	***Qty.***	***Antenna Description***	***Mount Type & Qty.***	***TX. LINE (in)***	***TENANT***
190’±	**3**	**RFS APXV18-206516S-C-A20 Panel Antennas**	**Inside Concealment Canister**	(11) 1-5/8” Coax **(1) 1-5/8” Hybrid**	**T-Mobile**
	3	**Ericsson KRY 112 489/2 TMA’s**			
170’±	**3**	**RFS APXVAARR18_43-U-NA20 Panel Antennas**			
	3	**Ericsson 4449 B71+B85 Radio RRUs**			

***Canister fit check by others**

Notes:

1. ACGI should be notified of any discrepancies found in the data listed in this report.
2. Notify ACGI of any potential physical and other interference with existing antennas for a redesign.

5. CONCLUSIONS

RESULT SUMMARY		
MEMBER	***% Capacity***	***Pass/Fail***
Canister section (130' to 190')	**53.0 %**	**Pass**
Steel Pole (0' to 130')	**49.5 %**	**Pass**
Base Plate	**56.2 %**	**Pass**
Anchor Bolt	**55.0 %**	**Pass**
FOUNDATION		
Pier Foundation	**Download 7.1 %**	**Pass**
	Required Pier Length 82.2 %	**Pass**
OVERALL TOWER RATING : 82.2 % (Pass)		

As per the results of the analysis, the existing tower is **in code compliance** for the proposed and existing antenna loads.

Maximum tower member stress **is less than 100%**, making the tower **in code compliance** under the TIA-222-G-Addendum 2 code and ***North Carolina Building Code 2018*** (IBC 2015 requirements.)

Tower stress ratio increased by 0.3 % compared to previous SA by Allpro Consulting Group, Inc., ACGI # 19-2978, dated 05/10/2019, due to updated top canister section tnxTower model.

6. DISCLAIMER

Installation procedures and related loading are not within the scope of this analysis. A contractor experienced in similar work should perform all installation work. The engineering services provided by Allpro Consulting Group, Inc. (ACGI) are limited to the computer analysis and calculations of the structure with the proposed and existing loads. This analysis is considered void if the loading mentioned in this report is changed or is different as installed. It is assumed that the existing structure is properly maintained and is in good condition free of any defects. Scope of this analysis does not include existing connections, except as noted in this report.

ACGI does not make any warranties, expressed or implied in connection with this engineering analysis report and disclaims any liability arising from deficiencies or any existing conditions of the original structure. ACGI will not be responsible for consequential or incidental damages sustained by any parties as a result of any data or conclusions included in this Report. The maximum liability of ACGI pursuant to this report shall be limited to the consulting fee received for the preparation of the report. No leg, horizontals, inner bracing bolts were provided for a complete review. They shall be checked.

7. ASSUMPTIONS

This analysis was completed based on the following assumptions:

- Tower has been properly maintained
- Tower erection was in accordance to manufacturer drawings
- Leg flanges have been properly designed by manufacturer to not be a limiting reaction
- Welds have been properly designed and installed by manufacturer to not be a limiting reaction
- Foundation was constructed in accordance to manufacturer drawings
- Foundation does not have structural damage
- Bolts have been properly tightened according to manufacturer specifications
- Appurtenance, mount and transmission line sizes and weights are best estimates using the tnxTower database and manufacturer information

8. SUMMARY OF WORKING PERCENTAGE OF STRUCTURAL COMPONENTS

Section Capacity Table

Section No.	*Elevation ft*	*Component Type*	*Size*	*Critical Element*	*P K*	*øP$_{allow}$ K*	*% Capacity*	*Pass Fail*
L1	190 - 160.5	Pole	TP10.75x10.75x0.365	1	-4.369	375.111	44.7	Pass
L2	160.5 - 160	Pole	TP14x10.75x0.365	2	-4.372	375.111	44.7	Pass
L3	160 - 130.5	Pole	TP14x14x0.75	3	-10.357	983.417	53.0	Pass
L4	130.5 - 130	Pole	TP32x14x0.75	4	-10.363	983.417	53.0	Pass
L5	130 - 88	Pole	TP39.249x32x0.219	5	-15.399	1601.980	37.7	Pass
L6	88 - 47.25	Pole	TP45.845x37.948x0.25	6	-22.846	2112.860	47.8	Pass
L7	47.25 - 0	Pole	TP53.5x44.353x0.313	7	-36.401	3230.110	49.5	Pass
							Summary	
						Pole (L3)	53.0	Pass
						Base Plate	56.2	Pass
						RATING =	**56.2**	**Pass**

APPENDIX

SITE DATA

Hazards by Location

Search Information

Address: 35.379786, -78.820025

Coordinates: 35.381284, -78.822407

Elevation: 203 ft

Timestamp: 2020-12-07T15:05:18.715Z

Hazard Type: Wind

ASCE 7-16

MRI 10-Year	75 mph
MRI 25-Year	84 mph
MRI 50-Year	91 mph
MRI 100-Year	97 mph
Risk Category I	107 mph
Risk Category II	118 mph
Risk Category III	126 mph
Risk Category IV	⚠ 131 mph

You are in a wind-borne debris region if you are also within 1 mile of the coastal mean high water line.

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	107 mph
Risk Category II	117 mph
Risk Category III-IV	125 mph

ASCE 7-05

ASCE 7-05 Wind Speed	94 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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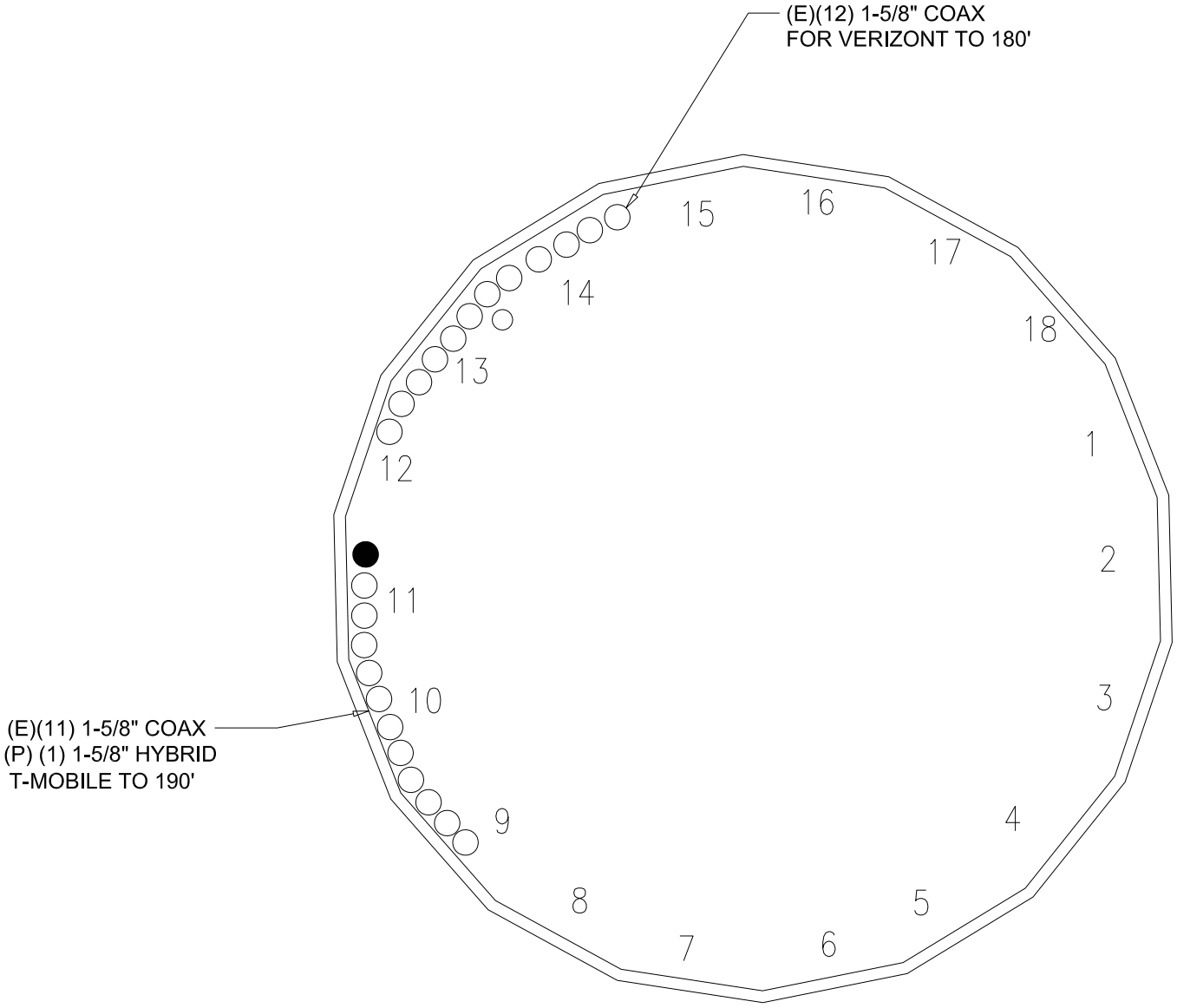
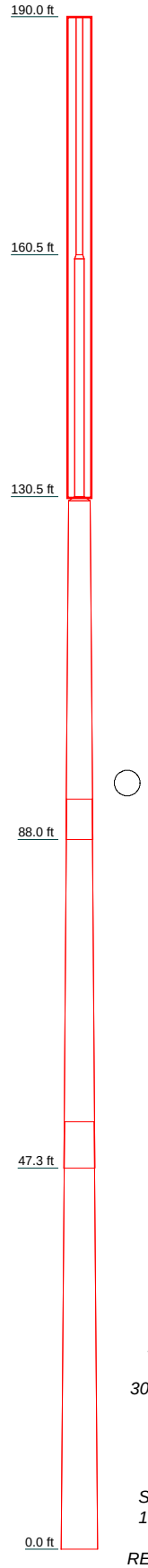
COAX LAYOUT



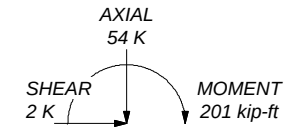
COAX LAYOUT
N.T.S

TOWER ELEVATION DRAWING

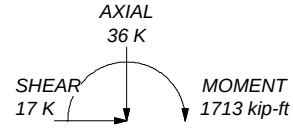
Section	1	2	3	4	5	6	7
Length (ft)	29.500	0.500	29.500	0.500	42.000	45.750	53.000
Number of Sides	1	1	1	1	18	18	18
Thickness (in)	0.365	0.365	0.750	0.750	0.219	0.250	0.313
Socket Length (ft)					5.000	5.750	
Top Dia (in)	10.750	10.750	14.000	14.000	32.000	37.948	44.353
Bot Dia (in)	10.750	14.000	14.000	32.000	39.249	45.845	53.500
Grade	A53-B-35					A572-65	
Weight (K)	1.3	0.0	3.3	0.1	3.7	5.4	9.1



ALL REACTIONS ARE FACTORED



30 mph WIND - 0.750 in ICE



REACTIONS - 91 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
(3) APXV18-206516S-C-A20	190	(2) RRFDC-3315-PF-48	180
(3) KRY 112 489/2	190	Canister 32" x 30'	175
SBNH-1D4545A	180	(3) 4449 B71 + B85	170
(2) SBNHH-1D65C	180	(3) APXVAARR18_43-U-NA20 (Octa)	170
(4) CBC721-DF-2X diplexer	180	Canister 32" x 30'	145

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A53-B-35	35 ksi	63 ksi	A572-65	65 ksi	80 ksi

TOWER DESIGN NOTES

1. Tower is located in Harnett County, North Carolina.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 91 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 30 mph basic wind with 0.75 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 0.000 ft
8. TOWER RATING: 56.2%

Allpro Consulting Group, Inc.
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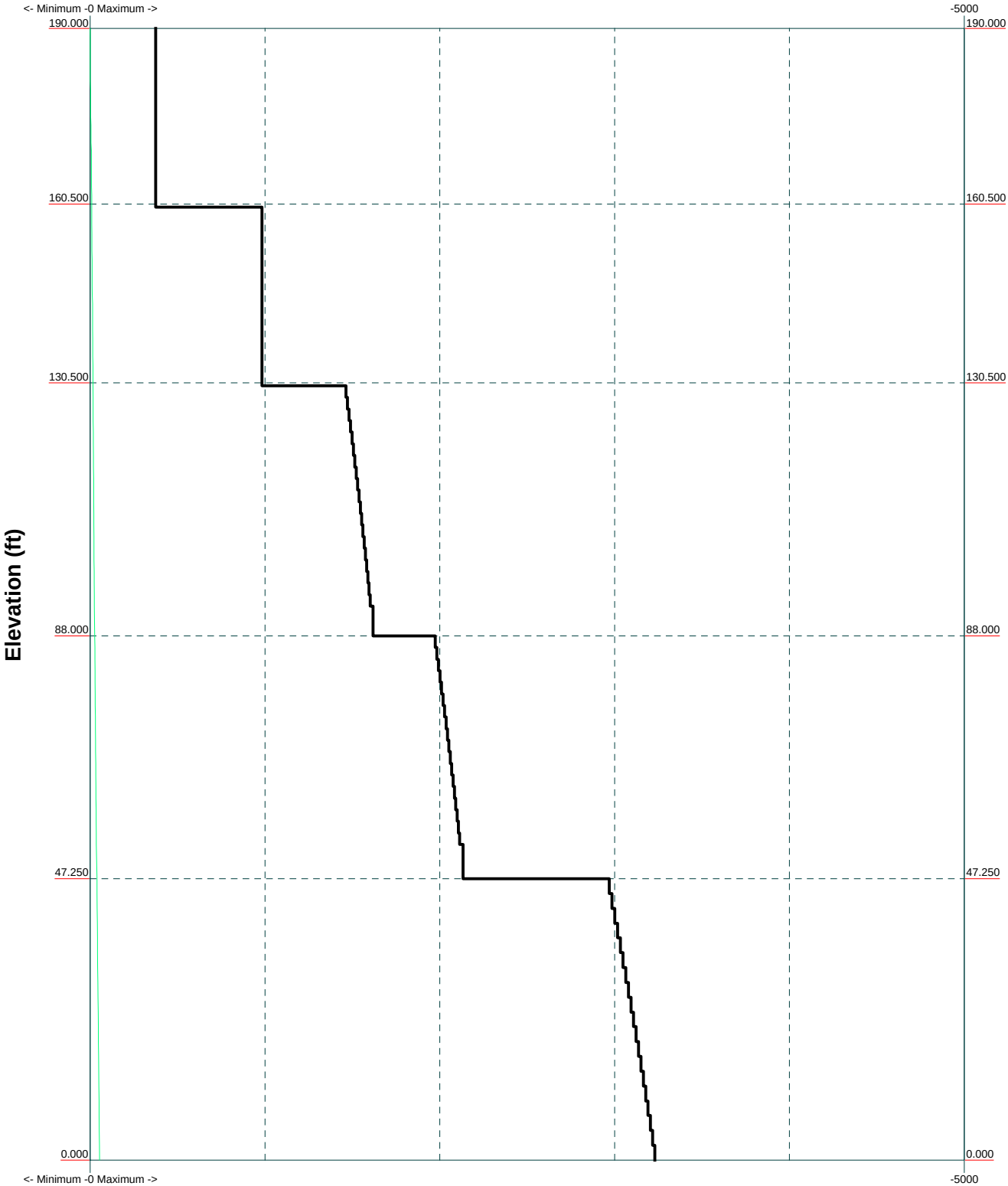
Job: ***20-4260***			
Project: ***NC14882-A-01***			
Client: SBA Communication Corp.	Drawn by: szhang	App'd:	
Code: TIA-222-G	Date: 12/07/20	Scale: NTS	
Path: P:\2020\Structural\20-4260 NC14882-A-01 Lillington MP SA - SBA\TNX\NC14882-A-01_Lillington_T-Mobile_SA ERI_12-02-2020.eri		Dwg No. E-1	

MISCELLANEOUS PLOTS

TIA-222-G - 91 mph/30 mph 0.750 in Ice Exposure C

Leg Capacity ——— **Leg Compression (K)**



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Client: SBA Communication Corp.	Drawn by: szhang	App'd:	
Code: TIA-222-G	Date: 12/07/20	Scale: NTS	
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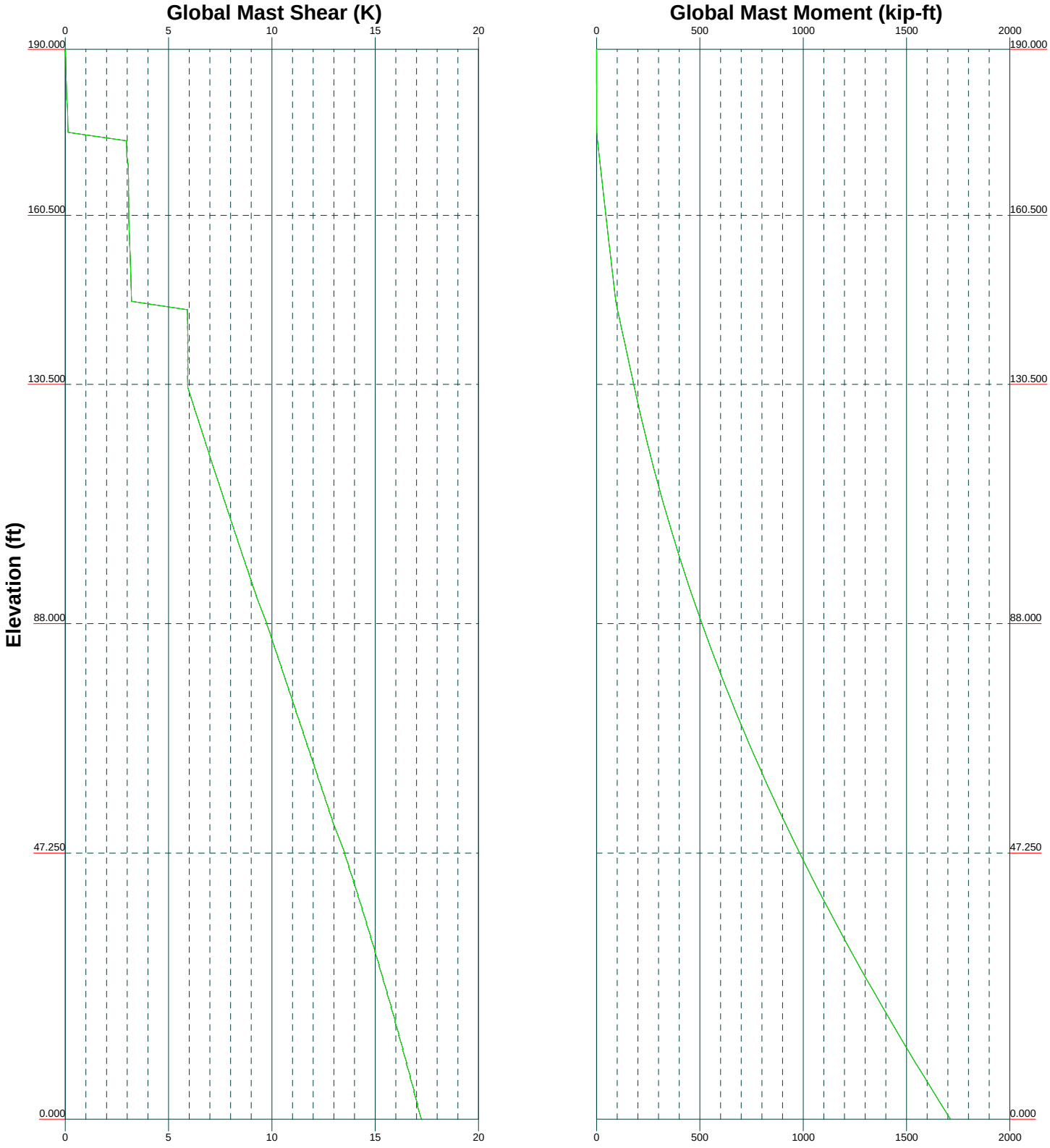
TIA-222-G - 91 mph/30 mph 0.750 in Ice Exposure C

Maximum Values

Vx Vz Mx Mz



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Project: ***NC14882-A-01***			
Client: SBA Communication Corp.	Drawn by: szhang	App'd:	
Code: TIA-222-G	Date: 12/07/20	Scale: NTS	
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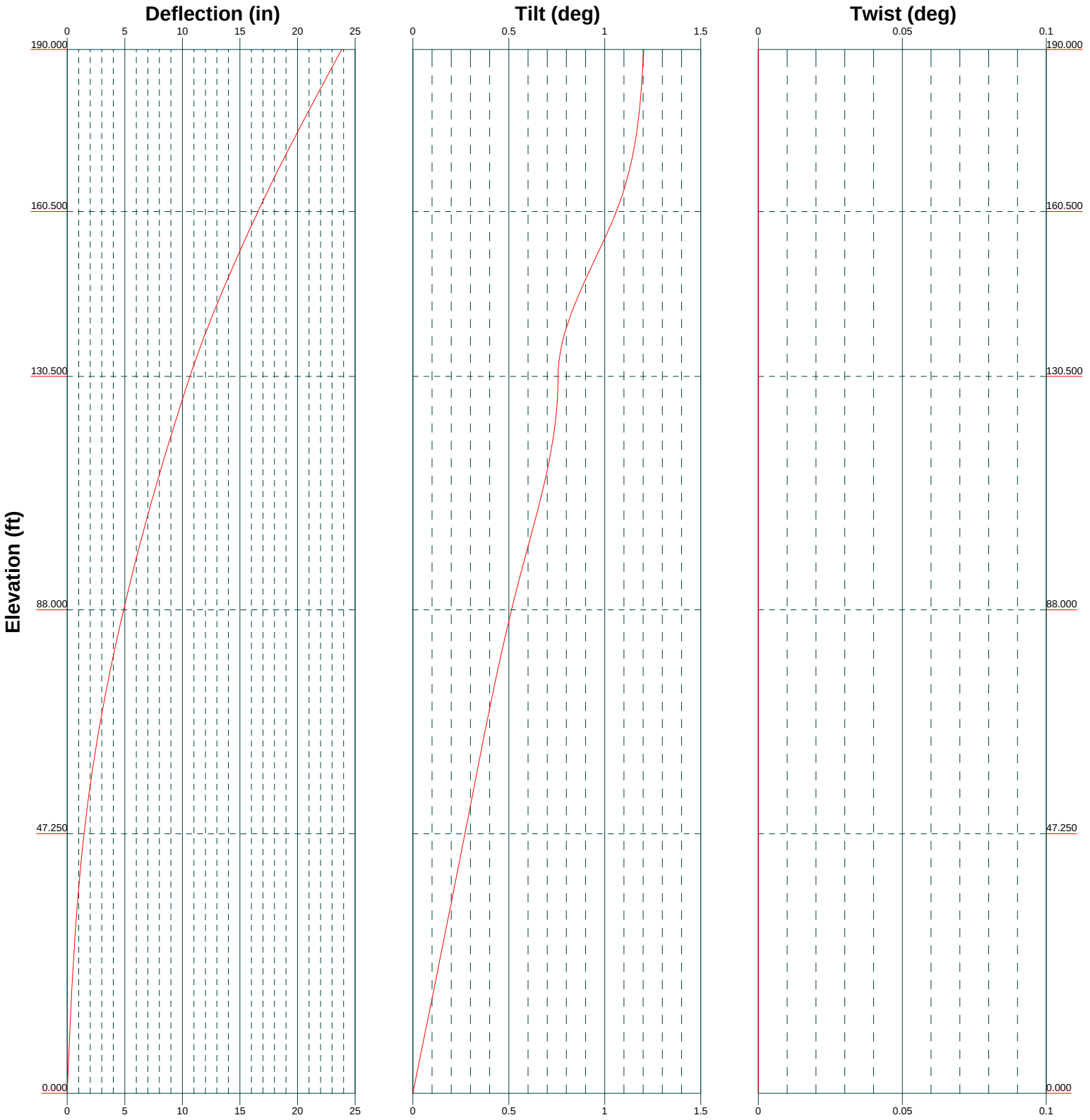
TIA-222-G - Service - 60 mph

Maximum Values



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Job: ***20-4260***			
Project: ***NC14882-A-01***			
Client: SBA Communication Corp.	Drawn by: szhang	App'd:	
Code: TIA-222-G	Date: 12/07/20	Scale: NTS	
Path: P:\2020\Structural\20-4260 NC14882-A-01 Lillington MP SA - SBA\TNX\NC14882-A-01_Lillington_T-Mobile_SA ERI_12-02-2020.eri		Dwg No. E-5	

TNX TOWER CALCULATION PRINTOUT

Tower Input Data

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

Tower is located in Harnett County, North Carolina.
ASCE 7-10 Wind Data is used (wind speeds converted to nominal values).
Basic wind speed of 91 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.000 ft.
Nominal ice thickness of 0.750 in.
Ice thickness is considered to increase with height.
Ice density of 56 pcf.
A wind speed of 30 mph is used in combination with ice.
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		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Horizontals		Assume Legs Pinned		Calculate Redundant Bracing Forces
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Ignore Redundant Members in FEA
	Use Moment Magnification	√	Use Clear Spans For Wind Area		SR Leg Bolts Resist Compression
√	Use Code Stress Ratios	√	Use Clear Spans For KL/r		All Leg Panels Have Same Allowable
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		Offset Girt At Foundation
	Escalate Ice	√	Bypass Mast Stability Checks	√	Consider Feed Line Torque
	Always Use Max Kz	√	Use Azimuth Dish Coefficients	√	Include Angle Block Shear Check
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Use TIA-222-G Bracing Resist. Exemption
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Use TIA-222-G Tension Splice Exemption
	Leg Bolts Are At Top Of Section		Add IBC .6D+W Combination		Poles
	Secondary Horizontal Braces Leg		Sort Capacity Reports By Component	√	Include Shear-Torsion Interaction
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Always Use Sub-Critical Flow
	SR Members Have Cut Ends		Treat Feed Line Bundles As Cylinder		Use Top Mounted Sockets
	SR Members Are Concentric		Ignore KL/ry For 60 Deg. Angle Legs		Pole Without Linear Attachments
					Pole With Shroud Or No Appurtenances
					Outside and Inside Corner Radii Are Known

Tapered Pole Section Geometry

Section	*Elevation*	*Section Length*	*Splice Length*	*Number of Sides*	*Top Diameter*	*Bottom Diameter*	*Wall Thickness*	*Bend Radius*	*Pole Grade*
	ft	*ft*	*ft*		*in*	*in*	*in*	*in*	
L1	190.000-160.50	29.500	0.000	Round	10.750	10.750	0.365		A53-B-35

Section	Elevation ft	Section Length ft	Splice Length ft	Number of Sides	Top Diameter in	Bottom Diameter in	Wall Thickness in	Bend Radius in	Pole Grade
	0								(35 ksi)
L2	160.500-160.00	0.500	0.000	Round	10.750	14.000	0.365		A53-B-35
	0								(35 ksi)
L3	160.000-130.50	29.500	0.000	Round	14.000	14.000	0.750		A53-B-35
	0								(35 ksi)
L4	130.500-130.00	0.500	0.000	Round	14.000	32.000	0.750		A53-B-35
	0								(35 ksi)
L5	130.000-88.000	42.000	5.000	18	32.000	39.249	0.219	0.875	A572-65
									(65 ksi)
L6	88.000-47.250	45.750	5.750	18	37.948	45.845	0.250	1.000	A572-65
									(65 ksi)
L7	47.250-0.000	53.000		18	44.353	53.500	0.313	1.250	A572-65
									(65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	10.750	11.908	160.734	3.674	5.375	29.904	321.468	5.951	0.000	0
	10.750	11.908	160.734	3.674	5.375	29.904	321.468	5.951	0.000	0
L2	10.750	11.908	160.734	3.674	5.375	29.904	321.468	5.951	0.000	0
	14.000	15.635	363.605	4.822	7.000	51.944	727.209	7.813	0.000	0
L3	14.000	31.220	687.318	4.692	7.000	98.188	1374.637	15.600	0.000	0
	14.000	31.220	687.318	4.692	7.000	98.188	1374.637	15.600	0.000	0
L4	14.000	31.220	687.318	4.692	7.000	98.188	1374.637	15.600	0.000	0
	32.000	73.631	8993.346	11.052	16.000	562.084	17986.692	36.794	0.000	0
L5	32.460	22.071	2816.453	11.282	16.256	173.256	5636.613	11.038	5.247	23.98
	39.821	27.105	5216.678	13.856	19.938	261.639	10440.220	13.555	6.523	29.811
L6	39.372	29.914	5370.985	13.383	19.278	278.610	10749.038	14.960	6.239	24.956
	46.514	36.180	9502.460	16.186	23.289	408.019	19017.423	18.093	7.629	30.515
L7	45.996	43.682	10703.784	15.634	22.531	475.067	21421.652	21.845	7.256	23.219
	54.277	52.755	18854.852	18.882	27.178	693.754	37734.514	26.383	8.866	28.371

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	Double Angle Stitch Bolt Spacing Redundants in
L1				0	0	1.05			
190.000-160.500									
L2				0	0	1.05			
160.500-160.000									
L3				0	0	1.05			
160.000-130.500									
L4				0	0	1.05			
130.500-130.000									
L5				1	1	1.05			
130.000-88.000									
L6				1	1	1.05			
88.000-47.250									

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	Double Angle Stitch Bolt Spacing Redundants in
L7 47.250-0.000				1	1	1.05			

Monopole Base Plate Data

Base Plate Data	
Base plate is square	
Base plate is grouted	
Anchor bolt grade	A615-75
Anchor bolt size	2.250 in
Number of bolts	10
Embedment length	72.000 in
f'_c	4.000 ksi
Grout space	4.500 in
Base plate grade	A572-60
Base plate thickness	2.000 in
Bolt circle diameter	60.500 in
Outer diameter	68.500 in
Inner diameter	53.500 in
Base plate type	Plain Plate

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
1 5/8	C	No	No	Inside Pole	190.000 - 5.000	11	No Ice	0.000	0.001
							1/2" Ice	0.000	0.001
							1" Ice	0.000	0.001
1 5/8	C	No	No	Inside Pole	190.000 - 5.000	1	No Ice	0.000	0.001
							1/2" Ice	0.000	0.001
							1" Ice	0.000	0.001
*									
1 5/8	C	No	No	Inside Pole	180.000 - 5.000	12	No Ice	0.000	0.001
							1/2" Ice	0.000	0.001
							1" Ice	0.000	0.001

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	190.000-160.500	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.612
L2	160.500-160.000	A	0.000	0.000	0.000	0.000	0.000

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
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.012
L3	160.000-130.500	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.736
L4	130.500-130.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.012
L5	130.000-88.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.048
L6	88.000-47.250	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.017
L7	47.250-0.000	A	0.000	0.000	0.000	0.000	0.000
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	1.055

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	190.000-160.500	A	1.773	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.612
L2	160.500-160.000	A	1.757	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.012
L3	160.000-130.500	A	1.740	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.736
L4	130.500-130.000	A	1.721	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.012
L5	130.000-88.000	A	1.690	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.048
L6	88.000-47.250	A	1.611	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.017
L7	47.250-0.000	A	1.453	0.000	0.000	0.000	0.000	0.000
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	1.055

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	190.000-160.500	0.000	0.000	0.000	0.000
L2	160.500-160.000	0.000	0.000	0.000	0.000
L3	160.000-130.500	0.000	0.000	0.000	0.000
L4	130.500-130.000	0.000	0.000	0.000	0.000

Section	Elevation	CP_X	CP_Z	CP_X Ice	CP_Z Ice
	ft	in	in	in	in
L5	130.000-88.000	0.000	0.000	0.000	0.000
L6	88.000-47.250	0.000	0.000	0.000	0.000
L7	47.250-0.000	0.000	0.000	0.000	0.000

Note: For pole sections, center of pressure calculations do not consider feed line shielding.

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
(3) APXV18-206516S-C-A20	C	None		0.000	190.000	No Ice	0.000	0.000	0.020
						1/2" Ice	0.000	0.000	0.039
						1" Ice	0.000	0.000	0.063
*									
(3) APXVAARR18_43-U-NA20 (Octa)	C	None		0.000	170.000	No Ice	0.000	0.000	0.128
						1/2" Ice	0.000	0.000	0.241
						1" Ice	0.000	0.000	0.362
*									
(3) KRY 112 489/2	C	None		0.000	190.000	No Ice	0.000	0.000	0.015
						1/2" Ice	0.000	0.000	0.020
						1" Ice	0.000	0.000	0.027
*									
(3) 4449 B71 + B85	C	None		0.000	170.000	No Ice	0.000	0.000	0.070
						1/2" Ice	0.000	0.000	0.089
						1" Ice	0.000	0.000	0.110
***									
Canister 32" x 30'	C	None		0.000	175.000	No Ice	48.000	54.000	1.000
						1/2" Ice	49.500	60.000	1.100
						1" Ice	51.000	66.000	1.200
Canister 32" x 30'	C	None		0.000	145.000	No Ice	48.000	54.000	1.000
						1/2" Ice	49.500	60.000	1.100
						1" Ice	51.000	66.000	1.200
***									
SBNH-1D4545A	C	None		0.000	180.000	No Ice	0.000	0.000	0.036
						1/2" Ice	0.000	0.000	0.086
						1" Ice	0.000	0.000	0.141
*									
(2) SBNHH-1D65C	C	None		0.000	180.000	No Ice	0.000	0.000	0.066
						1/2" Ice	0.000	0.000	0.132
						1" Ice	0.000	0.000	0.205
*									
(4) CBC721-DF-2X diplexer	C	None		0.000	180.000	No Ice	0.000	0.000	0.008
						1/2" Ice	0.000	0.000	0.011
						1" Ice	0.000	0.000	0.016
*									
(2) RRFDC-3315-PF-48	C	None		0.000	180.000	No Ice	0.000	0.000	0.032
						1/2" Ice	0.000	0.000	0.061
						1" Ice	0.000	0.000	0.093

Base Plate Design Data

Plate Thickness in	Number of Anchor Bolts	Anchor Bolt Size in	Actual Allowable Ratio Bolt Tension K	Actual Allowable Ratio Bolt Compression K	Actual Allowable Ratio Plate Stress ksi	Actual Allowable Ratio Stiffener Stress ksi	Controlling Condition	Ratio
2.000	10	2.250	125.636 223.654 0.56	132.916 371.266 0.36	27.679 54.000 0.51		Bolt T	0.56 ✔

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	190 - 160.5 (1)	TP10.75x10.75x0.365	29.500	0.000	0.0	11.908	-4.369	375.111	0.012
L2	160.5 - 160 (2)	TP14x10.75x0.365	0.500	0.000	0.0	11.908	-4.372	375.111	0.012
L3	160 - 130.5 (3)	TP14x14x0.75	29.500	0.000	0.0	31.220	-10.357	983.417	0.011
L4	130.5 - 130 (4)	TP32x14x0.75	0.500	0.000	0.0	31.220	-10.363	983.417	0.011
L5	130 - 88 (5)	TP39.249x32x0.219	42.000	0.000	0.0	26.506	-15.399	1601.980	0.010
L6	88 - 47.25 (6)	TP45.845x37.948x0.25	45.750	0.000	0.0	35.392	-22.846	2112.860	0.011
L7	47.25 - 0 (7)	TP53.5x44.353x0.313	53.000	0.000	0.0	52.755	-36.401	3230.110	0.011

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	190 - 160.5 (1)	TP10.75x10.75x0.365	45.025	103.375	0.436	0.000	103.375	0.000
L2	160.5 - 160 (2)	TP14x10.75x0.365	45.023	103.375	0.436	0.000	103.375	0.000
L3	160 - 130.5 (3)	TP14x14x0.75	179.730	346.007	0.519	0.000	346.007	0.000
L4	130.5 - 130 (4)	TP32x14x0.75	179.715	346.007	0.519	0.000	346.007	0.000
L5	130 - 88 (5)	TP39.249x32x0.219	462.669	1259.967	0.367	0.000	1259.967	0.000
L6	88 - 47.25 (6)	TP45.845x37.948x0.25	907.292	1942.208	0.467	0.000	1942.208	0.000
L7	47.25 - 0 (7)	TP53.5x44.353x0.313	1713.275	3539.775	0.484	0.000	3539.775	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	190 - 160.5 (1)	TP10.75x10.75x0.365	3.076	187.556	0.016	0.000	156.996	0.000
L2	160.5 - 160 (2)	TP14x10.75x0.365	3.082	246.251	0.013	0.000	156.996	0.000
L3	160 - 130.5 (3)	TP14x14x0.75	5.934	491.708	0.012	0.000	515.489	0.000
L4	130.5 - 130 (4)	TP32x14x0.75	5.988	1159.690	0.005	0.000	515.489	0.000
L5	130 - 88 (5)	TP39.249x32x0.219	9.250	800.992	0.012	0.000	2525.200	0.000
L6	88 - 47.25 (6)	TP45.845x37.948x0.25	12.949	1056.430	0.012	0.000	3892.458	0.000
L7	47.25 - 0 (7)	TP53.5x44.353x0.313	17.243	1615.060	0.011	0.000	7094.500	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	190 - 160.5 (1)	0.012	0.436	0.000	0.016	0.000	0.447 ✔	1.000	4.8.2 ✔
L2	160.5 - 160 (2)	0.012	0.436	0.000	0.013	0.000	0.447 ✔	1.000	4.8.2 ✔
L3	160 - 130.5 (3)	0.011	0.519	0.000	0.012	0.000	0.530 ✔	1.000	4.8.2 ✔
L4	130.5 - 130 (4)	0.011	0.519	0.000	0.005	0.000	0.530 ✔	1.000	4.8.2 ✔
L5	130 - 88 (5)	0.010	0.367	0.000	0.012	0.000	0.377 ✔	1.000	4.8.2 ✔
L6	88 - 47.25 (6)	0.011	0.467	0.000	0.012	0.000	0.478 ✔	1.000	4.8.2 ✔
L7	47.25 - 0 (7)	0.011	0.484	0.000	0.011	0.000	0.495 ✔	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	190 - 160.5	Pole	TP10.75x10.75x0.365	1	-4.369	375.111	44.7	Pass
L2	160.5 - 160	Pole	TP14x10.75x0.365	2	-4.372	375.111	44.7	Pass
L3	160 - 130.5	Pole	TP14x14x0.75	3	-10.357	983.417	53.0	Pass
L4	130.5 - 130	Pole	TP32x14x0.75	4	-10.363	983.417	53.0	Pass
L5	130 - 88	Pole	TP39.249x32x0.219	5	-15.399	1601.980	37.7	Pass
L6	88 - 47.25	Pole	TP45.845x37.948x0.25	6	-22.846	2112.860	47.8	Pass
L7	47.25 - 0	Pole	TP53.5x44.353x0.313	7	-36.401	3230.110	49.5	Pass
							Summary	
						Pole (L3)	53.0	Pass
						Base Plate	56.2	Pass
						RATING =	**56.2**	**Pass**

MATHCAD CALCULATION PRINTOUT

Existing 190' Flagpole
Pier Evaluation

SBA Site Name: Lillington
SBA Site ID: NC14882-A-01
Carrier Name: T-Mobile

ACGI # 20-4260

Allpro Consulting Group, Inc.
9221 Lyndon B. Johnson Freeway, Suite 204
Dallas, TX 75243
Tel: 972-231-8893, Fax: 866-364-8375

INPUT DATA

-Foundation Reactions-(factored)

Down Load: $P_{dwn} := 36 \cdot kips$

Uplift Load: $P_{up} := 0 \cdot kips$

Shear Load: $S := 17 \cdot kips$

Moment: $M := 1713 \cdot ft \cdot kips$

-Pier Dimensions-

Foundation Dimensions as per Foundation Design by DaVinci Engineering, Job# 9908235-1819, dated 1/6/09.

Width of Pier: $D_{pier} := 7ft$

Extension above grade: $E_{pier} := 0.5ft$

Concrete density See below

Concrete strength $F_c := 4000 \cdot psi$

Rebar Fy $F_y := 60 \cdot ksi$

Foundation design Building code - IBC2015, ACI318-11, TIA-222-G

-Reinforcement Data-

Typical concrete cover $cc := 3.0 \cdot in$

Vertical rebar size $d_{bar} := 11$

Tiebar size $d_{tie} := 5$

ACI Strength reduction factors

$\phi_{comp} := 0.65$ (ACI 9.3.2.2)

$\phi_{tens} := 0.9$ (ACI 9.3.2.2a)

$\phi_{shear} := 0.75$ (ACI 9.3.2.3)

$$\frac{P_{dwn}}{\phi_{tens}} = 40 \cdot kips$$

-Factor of Safety for soil strength-

$\phi_{s\_Bear} := 0.75$ as per TIA-222-G code for bearing, 9.4.1 - for SST/MP

$\phi_{s\_friction} := 0.75$ as per TIA-222-G code for skin friction resistance, 9.4.1

$\phi_{s\_lateral} := 0.75$ as per TIA-222-G code for lateral resistance, 9.4.1

***Soil Properties*- Soil data as per geotechnical exploration report by Geo-Terrain Organization, Inc., Job# 9908235-1819, dated 1/6/09.**

Number of soil layers $NSL := 4$ $j := 1 .. NSL$

Neglected soil height $L_{ngl} := 7 \cdot ft$ = Dia of pier $k := 1 .. NSL$

$i_{neg} := 1$ (neglected soil layer number) $i := 1 .. NSL$

$\alpha := 0.4$

Height $H_j :=$	PHI $\phi_j :=$	Cu $Cu_j :=$	Soil Dens $\gamma_{s_j} :=$	Conc Dens $\gamma_{c_j} :=$	Ult Skin friction $SKU_{dn_j} :=$	$SKU_{up_j} :=$
7·ft	0·deg	0·ksf	120·pcf	150·pcf	0·ksf	0·ksf
2·ft	30·deg	0·ksf	120·pcf	150·pcf	2·ksf	2·ksf
5·ft	30·deg	0·ksf	58·pcf	88·pcf	2·ksf	2·ksf
10ft	34·deg	0·ksf	58·pcf	88·pcf	3·ksf	3·ksf

$L_{pier} := \sum_{j=1}^{NSL} H_j \quad L_{pier} = 24\,ft$

Soil Bearing Safety fator: $SF := 2$

Allowable bearing capacity: $BC_{all} := 3ksf$ (per GEO report)

End Ultimate bearing capacity: $BC_{ult} := BC_{all} \cdot SF = 6 \cdot ksf$

-Pier calculation-

Pier area $A_{pier} := \frac{\pi}{4} D_{pier}^{2} \quad A_{pier} = 38.48\,ft^2$

Pier perimeter $PM_{pier} := \pi \cdot D_{pier} \quad PM_{pier} = 21.99\,ft$

Pier volume $V_{pier} := A_{pier} \cdot (L_{pier} + E_{pier}) \quad V_{pier} = 34.92 \cdot cy$

Weighted average unit weight of concrete

$$\gamma_{cave} := \frac{\sum_{n=1}^{NSL} \left[\left(\gamma_{c_n} \right) \cdot H_n \right]}{\sum_{n=1}^{NSL} H_n} \qquad \gamma_{cave} = 111.25 \cdot pcf$$

Pier concrete weight $W_{pier} := V_{pier} \cdot \gamma_{cave} \quad W_{pier} = 104.89 \cdot kips$

Net Concrete Weight due to the removal

$$\gamma_{net} := \frac{\sum_{n=1}^{NSL} \left[\left(\gamma_{c_n} - \gamma_{s_n} \right) \cdot H_n \right]}{\sum_{n=1}^{NSL} H_n} \qquad \gamma_{net} = 30 \cdot pcf$$

Net Pier concrete weight $W_{netpier} := V_{pier} \cdot \gamma_{net} \quad W_{netpier} = 28.29 \cdot kips$

-Download capacity-

$\alpha = 0.4$ - (average value for soils 0.4)

$\sigma_{v_0} := 0.0 \cdot ksf$

$TL_0 := 0 \cdot ft$

$\sigma_{v_i} := \sigma_{v_{i-1}} + 1.0 \cdot \gamma_{s_i} \cdot H_i$

$SKFN_k := SKU_{dn_k} \cdot PM_{pier} \cdot H_k$ $P_k := if\left[k = NSL, \left[A_{pier} \cdot \left(BC_{ult}\right)\right], 0 \cdot kips\right]$ $SKUFN_k := SKU_{up_k} \cdot PM_{pier} \cdot H_k$

$SKFN_k =$

0	$\cdot lb$
87964.59	
219911.49	
659734.46	

$P_k =$

0	$\cdot lb$
0	
0	
230907.06	

$P_{dcap} := \sum_k P_k \cdot \phi_{s\_Bear} + \sum_k SKFN_k \cdot \phi_{s\_friction}$

Total download acting $P_{tdwn} := P_{dwn} + W_{netpier}$

$P_{dcap} = 898.89 \cdot kips$ > $P_{tdwn} = 64.29 \cdot kips$ $\frac{P_{tdwn}}{P_{dcap}} = 7.15 \cdot \%$ **OK!**

-Uplift capacity-

$SKFUN_k := \pi \cdot D_{pier} \cdot H_k \cdot SKU_{up_k}$

Negative skin friction: $N_{sf} := 0psf$ (Assumed)

$SKFUN_k =$

0 lb
87964.59
219911.49
659734.46

$P_{uptot} := P_{up} + N_{sf} \cdot \pi \cdot D_{pier} \cdot \left(H_1\right)$ Total uplift load

$P_{ucap} := \sum_k SKFUN_k \cdot \phi_{s\_friction} + W_{pier}$

$P_{ucap} = 830.6 \cdot kips$ > $P_{uptot} = 0 \cdot kips$ $\frac{P_{uptot}}{P_{ucap}} = 0 \cdot \%$ **OK!**

-Required Pier Length Based on Brohm's method for granular soils-

$$PP_i := \left(2 \cdot Cu_i \cdot \sqrt{\tan\left(45 \cdot deg + \frac{\phi_i}{2}\right)^2} + \sigma_{v_i} \cdot \tan\left(45 \cdot deg + \frac{\phi_i}{2}\right)^2\right) \cdot \phi_{s\_lateral}$$

$PP_j =$

630
2430
3082.5
5173.06

$\cdot psf$ $\quad PP_j := PP_j + PP_{j-1}$

$PP_j =$

630
3060
6142.5
11315.56

$\cdot psf$ $\quad PP := \dfrac{\sum_j (PP_j \cdot H_j)}{\sum_j H_j}$ $\quad PP = 6.43 \cdot ksf$

Passive pressure $\quad PP_{allw} := \dfrac{PP}{L_{pier}}$ $\quad PP_{allw} = 0.27 \cdot kcf$

Depth to point of zero shear

$$f := \left(\frac{S}{D_{pier} \cdot PP_{allw}}\right)^{\frac{1}{2}} \cdot 0.816 \qquad f = 2.46\,ft$$

-Required pier length- $\quad$ try $\quad L_1 := 40 \cdot ft$

$A := root\left[S \cdot (E_{pier} + L_1) + M - \left[D_{pier} \cdot PP_{allw} \cdot L_1^{\,3} \cdot (.5)\right], L_1\right]$ $\quad A = 12.74\,ft$

$L_{req} := A + L_{ngl}$

$L_{req} = 19.74\,ft$ < Available $\quad L_{pier} = 24\,ft$ $\quad Ratio := \dfrac{L_{req}}{L_{pier}}$ $\quad Ratio = 0.822$ $\quad$ **OK!**

-Maximum Bending Moment for Reinforcement Design-

$M_{max} := S \cdot (E_{pier} + L_{ngl} + f) - S \cdot \dfrac{f}{3} + M$ $\quad M_{max} = 1868.34 \cdot ft\_kip$

Location @ $f + L_{ngl} = 9.46\,ft$ below ground level

REINFORCEMENT CALCULATIONS

Effective pier diameter $D_{eff} := D_{pier} - cc \cdot 2$ $D_{eff} = 6.5\,ft$

-Minimum required area of steel per ACI-

$Area_{stlmin} := 0.005 \cdot \frac{\pi}{4} \cdot D_{pier}^{2}$ -(ACI 10.8.4) & (ACI 10.9.1)

$Area_{stlmin} = 27.71 \cdot in^{2}$

-Rebar details-

Selected rebar size $d_{bar} = 11$

-Rebar details-

$No := (0 \;\; 1 \;\; 2 \;\; 3 \;\; 4 \;\; 5 \;\; 6 \;\; 7 \;\; 8 \;\; 9 \;\; 10 \;\; 11 \;\; 12 \;\; 13 \;\; 14 \;\; 15 \;\; 16 \;\; 17 \;\; 18)^{T}$

$d_b := (0 \;\; 0 \;\; 0 \;\; 0.375 \;\; 0.5 \;\; 0.625 \;\; 0.75 \;\; 0.875 \;\; 1.00 \;\; 1.125 \;\; 1.25 \;\; 1.41 \;\; 0 \;\; 0 \;\; 1.693 \;\; 0 \;\; 0$

$A_b := (0 \;\; 0 \;\; 0 \;\; 0.11 \;\; 0.20 \;\; 0.31 \;\; 0.44 \;\; 0.60 \;\; 0.79 \;\; 1.00 \;\; 1.27 \;\; 1.56 \;\; 0 \;\; 0 \;\; 2.25 \;\; 0 \;\; 0 \;\; 0 \;\; 4$

$B := d_{bar}$ $d_{b_B} = 1.41 \cdot in$ Bar area= $Area_{abar} := A_{b_B}$ $Area_{abar} = 1.56 \cdot in^{2}$

-Number of vertical rebars required-

$NRB := ceil\left(\frac{Area_{stlmin}}{Area_{abar}}\right)$ $NRB = 18$ $Area_{stluse} := Area_{abar} \cdot NRB$

No. Of Bars Used

$D := 84in$

$cc = 3 \cdot in$

$D_{verticalrod} := 1.75in$

$Spacing := 6.0087in$ Approximated in Circular Measure

$D_{tie} := 0.625in$

Actual Diameter

$D_{actual} := D - 2 \cdot cc - D_{verticalrod} - 2 \cdot D_{tie} = 75 \cdot in$

$Used_{NRB} := 3.14 \frac{D_{actual}}{Spacing} = 39.19$

No. of used Rebars $NRB := 20$

$\frac{P_{dwn}}{\phi_{tens}} = 40000\,lb$

$Mn := 68566in \cdot kips$

$\phi_{tens} \cdot Mn = 5142.45 \cdot kips \cdot ft$ > $M_{max} = 1868.34 \cdot kips \cdot ft$ $\frac{M_{max}}{\phi_{tens} Mn} = 36.33 \cdot \%$ **OK!**

Use ($NRB = 20$) $d_{bar} = 11$ vertical bars $Area_{stluse} = 28.08 \cdot in^2$

Vertical bar spacing $S_{bar} := D_{eff} \cdot \frac{\pi}{NRB} - d_{b_B}$ $S_{bar} = 10.84 \cdot in$

$Area_{use} := Area_{abar} \cdot NRB$ $Area_{use} = 31.2 \cdot in^2$

-Check pier in compression-

$P_{comp} := 0.80 \cdot \phi_{comp} \cdot \left[0.85 \cdot F_c \cdot \left(A_{pier} - Area_{use}\right) + F_y \cdot Area_{use}\right]$ (ACI 10.3.6.2 - (10-2)

$P_{comp} = 10716.13 \cdot kips$ > $P_{dwn} = 36 \cdot kips$ **OK!**

EVALUATION SUMMARY

-Pier Dimensions-

Depth of pier	$L_{pier} = 24\,ft$	Concrete strength	$F_c = 4000 \cdot psi$
Extension above grade	$E_{pier} = 0.5\,ft$	Rebar Fy	$F_y = 60 \cdot ksi$
Total length of pier	$L_{tot} := L_{pier} + E_{pier}$	$L_{tot} = 24.5\,ft$	
Diameter	$D_{pier} = 7\,ft$		
Volume of pier concrete	$V_{pier} = 34.92 \cdot cy$		
Weight of pier concrete	$W_{pier} = 104.89 \cdot kips$		

Calculations summary

-Download capacity-

$P_{dcap} = 898.89 \cdot kips$ > $P_{dwn} = 36 \cdot kips$ $\frac{P_{tdwn}}{P_{dcap}} = 7.15 \cdot \%$ **OK!**

-Uplift capacity-

$P_{ucap} = 830.6 \cdot kips$ > $P_{uptot} = 0 \cdot kips$ $\frac{P_{uptot}}{P_{ucap}} = 0 \cdot \%$ **OK!**

-Required Pier Length Based on Brohm's method for granular soils-

$L_{req} = 19.74\,ft$ < $L_{pier} = 24\,ft$ **OK!** $\frac{L_{req}}{L_{pier}} = 82.23 \cdot \%$

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================================================================================

                    LPile for Windows, Version 2018-10.006

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

Path to file locations:
\2020\Structrural\20-4260 NC14882-A-01 Lillington MP SA - SBA\LPile\

Name of input data file:
20-4260 PIER.lp10

Name of output report file:
20-4260 PIER.lp10

Name of plot output file:
20-4260 PIER.lp10

Name of runtime message file:
20-4260 PIER.lp10



--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  December 7, 2020            Time:  15:49:31



--------------------------------------------------------------------------------
                                  Problem Title
```

NC14882-A-01 Lillington T-Mobile
Job Number: 20-4260
Client: SBA
Engineer: Steve Zhang
Description:

Program Options and Settings

Computational Options:
- Compute nonlinear bending properties of pile only

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Output Options:
- Output files use decimal points to denote decimal symbols.
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	24.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	84.0000
2	24.000	84.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	24.000000 ft
Shaft Diameter	=	84.000000 in
Shear capacity of section	=	0.0000 lbs

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from input values

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	24.000000 ft
Shaft Diameter	=	84.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.625000 in
Number of Reinforcing Bars	=	20 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	5542. sq. in.
Total Area of Reinforcing Steel	=	31.200000 sq. in.
Area Ratio of Steel Reinforcement	=	0.56 percent
Edge-to-Edge Bar Spacing	=	10.375773 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	13.83
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	20607.936 kips
Tensile Load for Cracking of Concrete	=	-2396.286 kips
Nominal Axial Tensile Capacity	=	-1872.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.410000	1.560000	37.670000	0.00000
2	1.410000	1.560000	35.826299	11.640670
3	1.410000	1.560000	30.475670	22.141870
4	1.410000	1.560000	22.141870	30.475670
5	1.410000	1.560000	11.640670	35.826299
6	1.410000	1.560000	0.00000	37.670000
7	1.410000	1.560000	-11.640670	35.826299
8	1.410000	1.560000	-22.141870	30.475670
9	1.410000	1.560000	-30.475670	22.141870
10	1.410000	1.560000	-35.826299	11.640670
11	1.410000	1.560000	-37.670000	0.00000

12	1.410000	1.560000	-35.826299	-11.640670
13	1.410000	1.560000	-30.475670	-22.141870
14	1.410000	1.560000	-22.141870	-30.475670
15	1.410000	1.560000	-11.640670	-35.826299
16	1.410000	1.560000	0.00000	-37.670000
17	1.410000	1.560000	11.640670	-35.826299
18	1.410000	1.560000	22.141870	-30.475670
19	1.410000	1.560000	30.475670	-22.141870
20	1.410000	1.560000	35.826299	-11.640670

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 10.376 inches
between bars 17 and 18.

Ratio of bar spacing to maximum aggregate size = 13.83

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Input Axial Thrust Forces:

Number of Axial Thrust Force Values Determined from Input Data = 1

Number	Axial Thrust Force kips
1	40.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 40.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
3.12500E-07	3403.	1.08894E+10	47.2877950	0.00001478	-0.00001147	0.0618758	0.4247394	
6.25000E-07	6791.	1.08657E+10	44.6514082	0.00002791	-0.00002459	0.1163865	0.8016943	
9.37500E-07	10164.	1.08416E+10	43.7726546	0.00004104	-0.00003771	0.1705174	1.1786503	
0.00000125	13522.	1.08174E+10	43.3333019	0.00005417	-0.00005083	0.2242685	1.5556072	
0.00000156	16864.	1.07932E+10	43.0697088	0.00006730	-0.00006395	0.2776399	1.9325649	
0.00000188	20192.	1.07690E+10	42.8939951	0.00008043	-0.00007707	0.3306314	2.3095235	
0.00000219	23504.	1.07448E+10	42.7684981	0.00009356	-0.00009019	0.3832432	2.6864828	
0.00000250	26801.	1.07206E+10	42.6743867	0.0001067	-0.0001033	0.4354752	3.0634430	
0.00000281	26801.	9529387703.	19.9399611	0.00005608	-0.0001802	0.2294515	-5.1906407	C
0.00000313	26801.	8576448932.	19.6663258	0.00006146	-0.0002010	0.2510176	-5.7921767	C
0.00000344	26801.	7796771757.	19.4350082	0.00006681	-0.0002219	0.2724172	-6.3944539	C
0.00000375	26801.	7147040777.	19.2429083	0.00007216	-0.0002428	0.2937657	-6.9966587	C
0.00000406	26801.	6597268409.	19.0809774	0.00007752	-0.0002637	0.3150631	-7.5987911	C
0.00000438	26801.	6126034952.	18.9427520	0.00008287	-0.0002846	0.3363093	-8.2008508	C
0.00000469	26801.	5717632622.	18.8193777	0.00008822	-0.0003055	0.3574262	-8.8033971	C
0.00000500	26801.	5360280583.	18.7099344	0.00009355	-0.0003265	0.3784519	-9.4061595	C
0.00000531	26801.	5044969960.	18.6138563	0.00009889	-0.0003474	0.3994273	-10.0088465	C
0.00000563	26801.	4764693851.	18.5289171	0.0001042	-0.0003683	0.4203522	-10.6114579	C
0.00000594	26801.	4513920491.	18.4533591	0.0001096	-0.0003892	0.4412266	-11.2139935	C
0.00000625	26801.	4288224466.	18.3857762	0.0001149	-0.0004101	0.4620503	-11.8164530	C
0.00000656	26801.	4084023301.	18.3250301	0.0001203	-0.0004310	0.4828235	-12.4188364	C
0.00000688	26801.	3898385878.	18.2701895	0.0001256	-0.0004519	0.5035459	-13.0211435	C

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 0.00000719        26801.   3728890840.    18.2204849     0.0001310    -0.0004728
0.5242175   -13.6233739 C
 0.00000750        26801.   3573520388.    18.1752754     0.0001363    -0.0004937
0.5448383   -14.2255276 C
 0.00000781        26801.   3430579573.    18.1340223     0.0001417    -0.0005146
0.5654081   -14.8276043 C
 0.00000813        26801.   3298634205.    18.0962700     0.0001470    -0.0005355
0.5859270   -15.4296039 C
 0.00000844        26801.   3176462568.    18.0616303     0.0001524    -0.0005564
0.6063948   -16.0315261 C
 0.00000875        26801.   3063017476.    18.0280558     0.0001577    -0.0005773
0.6267531   -16.6338058 C
 0.00000906        26801.   2957396184.    17.9970200     0.0001631    -0.0005982
0.6470579   -17.2360269 C
 0.00000938        26801.   2858816311.    17.9683529     0.0001685    -0.0006190
0.6673123   -17.8381665 C
 0.00000969        26801.   2766596430.    17.9418262     0.0001738    -0.0006399
0.6875163   -18.4402244 C
 0.00001000        26801.   2680140291.    17.9172400     0.0001792    -0.0006608
0.7076697   -19.0422004 C
 0.00001031        26801.   2598923919.    17.8944185     0.0001845    -0.0006817
0.7277725   -19.6440942 C
 0.00001063        26801.   2522484980.    17.8732069     0.0001899    -0.0007026
0.7478245   -20.2459056 C
 0.00001094        26801.   2450413981.    17.8534678     0.0001953    -0.0007235
0.7678258   -20.8476347 C
 0.00001125        26801.   2382346926.    17.8350792     0.0002006    -0.0007444
0.7877763   -21.4492806 C
 0.00001156        26801.   2317959171.    17.8179324     0.0002060    -0.0007652
0.8076758   -22.0508435 C
 0.00001188        26801.   2256960245.    17.8019299     0.0002114    -0.0007861
0.8275244   -22.6523231 C
 0.00001219        26801.   2199089470.    17.7869844     0.0002168    -0.0008070
0.8473219   -23.2537191 C
 0.00001281        26801.   2091816813.    17.7599574     0.0002275    -0.0008487
0.8867635   -24.4562595 C
 0.00001344        26801.   1994523008.    17.7363092     0.0002383    -0.0008904
0.9260001   -25.6584632 C
 0.00001406        26801.   1905877541.    17.7155940     0.0002491    -0.0009321
0.9650309   -26.8603280 C
 0.00001469        26801.   1824776369.    17.6974417     0.0002599    -0.0009738
1.0038555   -28.0618521 C
 0.00001531        26801.   1750295700.    17.6815429     0.0002707    -0.0010155
1.0424733   -29.2630339 C
 0.00001594        26801.   1681656653.    17.6676368     0.0002816    -0.0010572
1.0808836   -30.4638706 C
 0.00001656        26801.   1618197912.    17.6555018     0.0002924    -0.0010988
1.1190859   -31.6643607 C
 0.00001719        26801.   1559354351.    17.6449488     0.0003033    -0.0011405
1.1570796   -32.8645023 C
 0.00001781        26801.   1504640164.    17.6358150     0.0003141    -0.0011821
1.1948640   -34.0642932 C
 0.00001844        27232.   1476978954.    17.6279601     0.0003250    -0.0012237
1.2324386   -35.2637314 C
 0.00001906        28112.   1474730749.    17.6212619     0.0003359    -0.0012653
1.2698026   -36.4628149 C
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 0.00001969        28992.   1472594521.    17.6156140     0.0003468    -0.0013069
1.3069555   -37.6615417 C
 0.00002031        29871.   1470559784.    17.6109229     0.0003577    -0.0013485
1.3438967   -38.8599095 C
 0.00002094        30749.   1468617301.    17.6071065     0.0003686    -0.0013901
1.3806255   -40.0579163 C
 0.00002156        31627.   1466758904.    17.6040921     0.0003796    -0.0014317
1.4171412   -41.2555599 C
 0.00002219        32504.   1464977346.    17.6018153     0.0003905    -0.0014732
1.4534433   -42.4528382 C
 0.00002281        33381.   1463266171.    17.6002189     0.0004015    -0.0015147
1.4895310   -43.6497489 C
 0.00002344        34257.   1461619611.    17.5992517     0.0004125    -0.0015563
1.5254037   -44.8462898 C
 0.00002406        35132.   1460032496.    17.5988678     0.0004235    -0.0015978
1.5610608   -46.0424587 C
 0.00002469        36007.   1458500177.    17.5990262     0.0004345    -0.0016393
1.5965015   -47.2382534 C
 0.00002531        36881.   1457018464.    17.5996897     0.0004455    -0.0016808
1.6317253   -48.4336714 C
 0.00002594        37754.   1455583570.    17.6008250     0.0004565    -0.0017222
1.6667313   -49.6287106 C
 0.00002656        38627.   1454192062.    17.6024018     0.0004676    -0.0017637
1.7015189   -50.8233685 C
 0.00002719        39499.   1452840822.    17.6043927     0.0004786    -0.0018051
1.7360875   -52.0176428 C
 0.00002781        40371.   1451527010.    17.6067727     0.0004897    -0.0018466
1.7704363   -53.2115311 C
 0.00002844        41241.   1450248036.    17.6095191     0.0005008    -0.0018880
1.8045646   -54.4050309 C
 0.00002906        42112.   1449001530.    17.6126112     0.0005119    -0.0019294
1.8384718   -55.5981398 C
 0.00002969        42981.   1447785322.    17.6160301     0.0005230    -0.0019708
1.8721570   -56.7908554 C
 0.00003031        43850.   1446597418.    17.6197583     0.0005341    -0.0020122
1.9056195   -57.9831750 C
 0.00003094        44718.   1445435985.    17.6237799     0.0005452    -0.0020535
1.9388587   -59.1750962 C
 0.00003156        45586.   1444299333.    17.6280804     0.0005564    -0.0020949
1.9718738   -60.0000000 CY
 0.00003219        46453.   1443185903.    17.6326463     0.0005676    -0.0021362
2.0046640   -60.0000000 CY
 0.00003281        47319.   1442094253.    17.6374652     0.0005787    -0.0021775
2.0372285   -60.0000000 CY
 0.00003344        48159.   1440262253.    17.6394780     0.0005898    -0.0022189
2.0692665   -60.0000000 CY
 0.00003406        48915.   1436025691.    17.6318546     0.0006006    -0.0022607
2.1000888   -60.0000000 CY
 0.00003469        49559.   1428735185.    17.6115943     0.0006109    -0.0023028
2.1293645   -60.0000000 CY
 0.00003531        50106.   1418933774.    17.5807771     0.0006208    -0.0023454
2.1572669   -60.0000000 CY
 0.00003594        50648.   1409331079.    17.5507437     0.0006307    -0.0023880
2.1849301   -60.0000000 CY
 0.00003656        51189.   1400045821.    17.5220030     0.0006406    -0.0024306
2.2124117   -60.0000000 CY
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 0.00003719        51728.   1391001431.    17.4942169     0.0006506    -0.0024732
2.2396824   -60.0000000 CY
 0.00003969        53284.   1342578936.    17.3246543     0.0006876    -0.0026462
2.3393923   -60.0000000 CY
 0.00004219        54697.   1296533115.    17.1591708     0.0007239    -0.0028198
2.4344029   -60.0000000 CY
 0.00004469        55937.   1251728715.    16.9866811     0.0007591    -0.0029947
2.5236777   -60.0000000 CY
 0.00004719        56768.   1203031004.    16.7844523     0.0007920    -0.0031717
2.6046621   -60.0000000 CY
 0.00004969        57597.   1159178353.    16.6045582     0.0008250    -0.0033487
2.6836021   -60.0000000 CY
 0.00005219        58423.   1119473712.    16.4438134     0.0008582    -0.0035256
2.7604795   -60.0000000 CY
 0.00005469        59238.   1083204348.    16.2927343     0.0008910    -0.0037027
2.8344141   -60.0000000 CY
 0.00005719        59766.   1045091644.    16.1123818     0.0009214    -0.0038823
2.9006805   -60.0000000 CY
 0.00005969        60195.   1008501791.    15.9351488     0.0009511    -0.0040626
2.9634632   -60.0000000 CY
 0.00006219        60622.    974826519.    15.7734766     0.0009809    -0.0042428
3.0245709   -60.0000000 CY
 0.00006469        61047.    943727538.    15.6255740     0.0010108    -0.0044230
3.0839893   -60.0000000 CY
 0.00006719        61468.    914872015.    15.4855726     0.0010404    -0.0046033
3.1411306   -60.0000000 CY
 0.00006969        61882.    887992395.    15.3499404     0.0010697    -0.0047841
3.1956798   -60.0000000 CY
 0.00007219        62294.    862952141.    15.2248456     0.0010990    -0.0049647
3.2485911   -60.0000000 CY
 0.00007469        62705.    839566274.    15.1092432     0.0011285    -0.0051453
3.2998504   -60.0000000 CY
 0.00007719        63048.    816810402.    14.9915385     0.0011572    -0.0053266
3.3480321   -60.0000000 CY
 0.00007969        63265.    793916600.    14.8626407     0.0011844    -0.0055094
3.3920510   -60.0000000 CY
 0.00008219        63459.    772119703.    14.7388461     0.0012113    -0.0056924
3.4341725   -60.0000000 CY
 0.00008469        63645.    751522759.    14.6156034     0.0012378    -0.0058760
3.4739021   -60.0000000 CY
 0.00008719        63827.    732060633.    14.4966044     0.0012639    -0.0060598
3.5118210   -60.0000000 CY
 0.00008969        64008.    713672864.    14.3850032     0.0012902    -0.0062436
3.5484194   -60.0000000 CY
 0.00009219        64188.    696271905.    14.2802048     0.0013165    -0.0064273
3.5836865   -60.0000000 CY
 0.00009469        64367.    679779455.    14.1816773     0.0013428    -0.0066109
3.6176115   -60.0000000 CY
 0.00009719        64545.    664125264.    14.0889435     0.0013693    -0.0067945
3.6501832   -60.0000000 CY
 0.00009969        64722.    649246128.    14.0015743     0.0013958    -0.0069780
3.6813904   -60.0000000 CY
  0.0001022        64898.    635085029.    13.9191830     0.0014224    -0.0071614
3.7112216   -60.0000000 CY
  0.0001047        65071.    621575792.    13.8393776     0.0014488    -0.0073449
3.7394340   -60.0000000 CY
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    0.0001072        65239.    608643623.    13.7577908     0.0014747    -0.0075291
  3.7655912   -60.0000000 CY
    0.0001097        65406.    596292485.    13.6805749     0.0015006    -0.0077132
  3.7904345   -60.0000000 CY
    0.0001122        65572.    584483428.    13.6074449     0.0015266    -0.0078972
  3.8139528   -60.0000000 CY
    0.0001147        65737.    573180893.    13.5381408     0.0015527    -0.0080811
  3.8361345   -60.0000000 CY
    0.0001172        65901.    562352352.    13.4724252     0.0015788    -0.0082650
  3.8569680   -60.0000000 CY
    0.0001197        66064.    551967992.    13.4100806     0.0016050    -0.0084487
  3.8764414   -60.0000000 CY
    0.0001222        66173.    541572431.    13.3401069     0.0016300    -0.0086338
  3.8936319   -60.0000000 CY
    0.0001247        66277.    531547742.    13.2724834     0.0016549    -0.0088188
  3.9094991   -60.0000000 CY
    0.0001272        66349.    521663458.    13.2014892     0.0016791    -0.0090047
  3.9236367   -60.0000000 CY
    0.0001297        66416.    512123728.    13.1328972     0.0017032    -0.0091906
  3.9365511   -60.0000000 CY
    0.0001322        66482.    502939914.    13.0673933     0.0017273    -0.0093764
  3.9483015   -60.0000000 CY
    0.0001347        66546.    494079769.    13.0027962     0.0017513    -0.0095624
  3.9587613   -60.0000000 CY
    0.0001372        66605.    485501242.    12.9349906     0.0017745    -0.0097492
  3.9677501   -60.0000000 CY
    0.0001522        66943.    439869406.    12.5838044     0.0019151    -0.0108687
  3.9986156   -60.0000000 CY
    0.0001672        67257.    402283703.    12.3108384     0.0020582    -0.0119855
  3.9983155   -60.0000000 CY
    0.0001822        67538.    370707064.    12.0841341     0.0022016    -0.0131022
3.9949101    60.0000000 CY
    0.0001972        67789.    343778386.    11.8871954     0.0023440    -0.0142197
3.9863173    60.0000000 CY
    0.0002122        68024.    320586737.    11.7283367     0.0024886    -0.0153351
3.9994805    60.0000000 CY
    0.0002272        68245.    300392829.    11.6002908     0.0026354    -0.0164483
3.9864960    60.0000000 CY
    0.0002422        68427.    282536023.    11.4850510     0.0027815    -0.0175622
3.9995411    60.0000000 CY
    0.0002572        68539.    266492736.    11.3707759     0.0029244    -0.0186793
3.9793131    60.0000000 CY
    0.0002722        68589.    251990229.    11.2397605     0.0030593    -0.0198044
3.9919814    60.0000000 CYT
    0.0002872        68621.    238941344.    11.1188851     0.0031932    -0.0209305
3.9995560    60.0000000 CYT
    0.0003022        68646.    227162531.    11.0172946     0.0033293    -0.0220545
3.9852921    60.0000000 CYT
    0.0003172        68668.    216490597.    10.9281269     0.0034663    -0.0231775
3.9740774    60.0000000 CYT
    0.0003322        68689.    206778100.    10.8490367     0.0036039    -0.0242998
3.9896175    60.0000000 CYT
    0.0003472        68699.    197874049.    10.7860036     0.0037448    -0.0254190
3.9984485    60.0000000 CYT
    0.0003622        68707.    189699864.    10.7312783     0.0038867    -0.0265370
3.9928140    60.0000000 CYT
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Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	40.000	68566.608	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	68567.	26.000000	44568.	1.4456E+09
1	0.70	68567.	28.000000	47997.	1.4406E+09
1	0.75	68567.	30.000000	51425.	1.3961E+09

The analysis ended normally.