

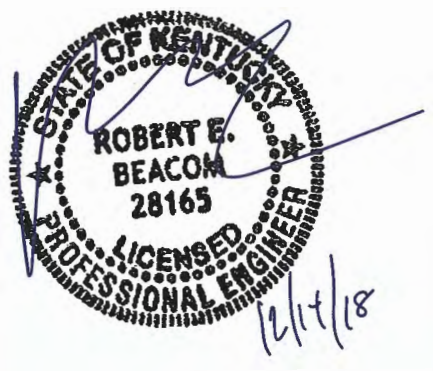


**Structural Design Report**  
280' S3R Series SD Self-Supporting Tower  
Site: Barlow, KY  
Site Number: 232179

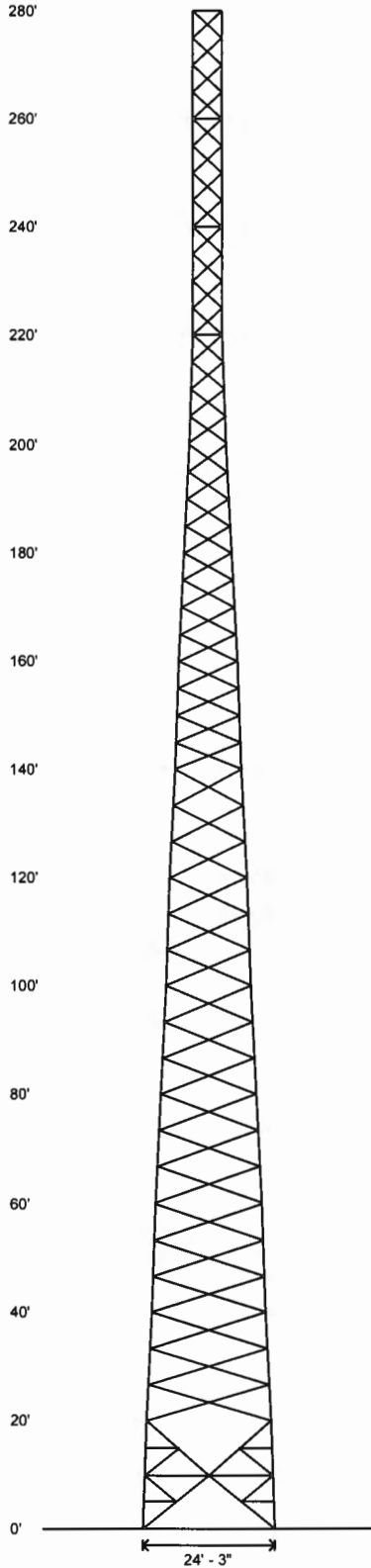
Prepared for: VERIZON WIRELESS  
by: Sabre Towers & Poles™  
Job Number: 19-5171-TJH

**December 13, 2018**

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Legs	4.25 S.R.	4.0 S.R.	3.75 S.R.	3.25 S.R.	3.0 S.R.	2.75 S.R.	2.5 S.R.	2.0 S.R.	1.75 S.R.
Diagonals	L 3 X 3 X 1/4	L 3 X 3 X 3/16	L 2 1/2 X 2 1/2 X 3/16	L 2 X 2 X 3/16	L 2 X 2 X 1/8				
Horizontals	A	NONE							
Internals	C	NONE							
Sub-Diagonals	D	NONE							
Sub-Horizontals	D	NONE							
Brace Bolts	(2) 3/4"	(1) 3/4"							
Top Face Width	22.5'	20.75'	19'	17.25'	15.5'	13.75'	12'	10.25'	8.5'
Panel Count/Height	2 @ 10'	18 @ 6.6667'		28 @ 5'					
Section Weight	6038	5808	5625	4383	4269	3653	3561	2790	2098
						1850	1555	1150	1000



### Design Criteria - ANSI/TIA-222-H

Wind Speed (No Ice)	107 mph
Wind Speed (Ice)	30 mph
Design Ice Thickness	1.50 in
Risk Category	II
Exposure Category	C
Topographic Factor Procedure	Method 1 (Simplified)
Topographic Category	1
Ground Elevation	361 ft

### Base Reactions

Total Foundation		Individual Footing	
Shear (kips)	61.54	Shear (kips)	37.71
Axial (kips)	189.36	Compression (kips)	443
Moment (ft-kips)	8768	Uplift (kips)	382
Torsion (ft-kips)	28.97		

### Material List

Display	Value
A	L 3 X 3 X 1/4
B	L 2 X 2 X 1/8
C	L 3 X 3 X 3/16
D	L 2 1/2 X 2 1/2 X 3/16

### Notes


- 1) All legs are A572 Grade 50.
- 2) All braces are A572 Grade 50.
- 3) All brace bolts are A325-X.
- 4) The tower model is S3R Series SD.
- 5) Transmission lines are to be attached to standard 12 hole waveguide ladders with stackable hangers.
- 6) Azimuths are relative (not based on true north).
- 7) Foundation loads shown are maximums.
- 8) All unequal angles are oriented with the short leg vertical.
- 9) Weights shown are estimates. Final weights may vary.
- 10) This tower design and, if applicable, the foundation design(s) shown on the following page(s) also meet or exceed the requirements of the 2012 International Building Code.
- 11) Tower Rating: 97.02%

	<b>Sabre Communications Corporation</b> 7101 Southbridge Drive P.O. Box 658 Sioux City, IA 51102-0658 Phone: (712) 258-6690 Fax: (712) 279-0614	Job: <b>19-5171-TJH</b> Customer: <b>VERIZON WIRELESS</b> Site Name: <b>Barlow, KY 232179</b> Description: <b>280' S3R</b> Date: <b>12/13/2018</b> By: <b>NM</b>
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**Designed Appurtenance Loading**

Elev	Description	Tx-Line
275	3V-Boom - 12ft Face - 3ft Standoff	
275	(1) RCMDC-6627-PF-48	
275	(3) 4449 B13 + B5	
275	(3) 8843 B2 + B66A	
275	(3) CBC78T-DS-43	
275	(6) JAHH-65C-R3B	(2) 1 1/4"
260	Leg Dish Mount	
260	(1) 8' Solid Dish W/ Radome	(1) 1 5/8"
245	3V-Boom - 10ft Face - 3ft Standoff	

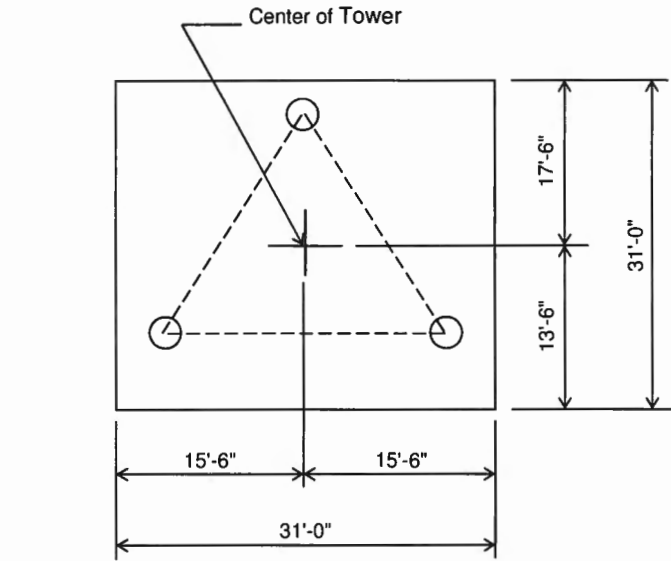
Elev	Description	Tx-Line
245	(6) JAHH-65C-R3B	(12) 1 5/8"
230	3V-Boom - 10ft Face - 3ft Standoff	
230	(6) JAHH-65C-R3B	(12) 1 5/8"
215	3V-Boom - 10ft Face - 3ft Standoff	
215	(6) JAHH-65C-R3B	(12) 1 5/8"
200	3V-Boom - 10ft Face - 3ft Standoff	
200	(6) JAHH-65C-R3B	(12) 1 5/8"
185	Leg Dish Mount	
185	(1) 8' Solid Dish W/ Radome	(1) 1 5/8"

	<b>Sabre Communications Corporation</b> 7101 Southbridge Drive P. O. Box 858 Sioux City, IA 51102-0658 Phone: (712) 258-8690 Fax: (712) 279-0614	Job: <b>19-5171-TJH</b> Customer: <b>VERIZON WIRELESS</b> Site Name: <b>Barlow, KY 232179</b> Description: <b>280' S3R</b> Date: <b>12/13/2018</b> By: <b>NM</b>
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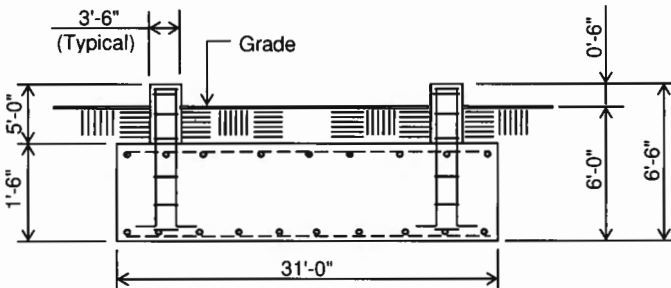
**Customer: VERIZON WIRELESS**

**Site: Barlow, KY 232179**

280 ft. Model S3R Series SD Self Supporting Tower



**PLAN VIEW**



**ELEVATION VIEW**

(58.7 cu. yds.)

(1 REQD.; NOT TO SCALE)

CAUTION: Center of tower is not in center of slab.

**Notes:**

- 1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-14.
- 2) Rebar to conform to ASTM specification A615 Grade 60.
- 3) All rebar to have a minimum of 3" concrete cover.
- 4) All exposed concrete corners to be chamfered 3/4".
- 5) The foundation design is based on the geotechnical report by Alt & Witzig Engineering, Inc., Project No. 18IN0510 dated: August 30th, 2018.
- 6) See the geotechnical report for compaction requirements, if specified.
- 7) 4.5' of soil cover is required over the entire area of the foundation slab.
- 8) The bottom anchor bolt template shall be positioned as closely as possible to the bottom of the anchor bolts.
- 9) Tie overlaps shall be staggered with a nominal 180° separation.

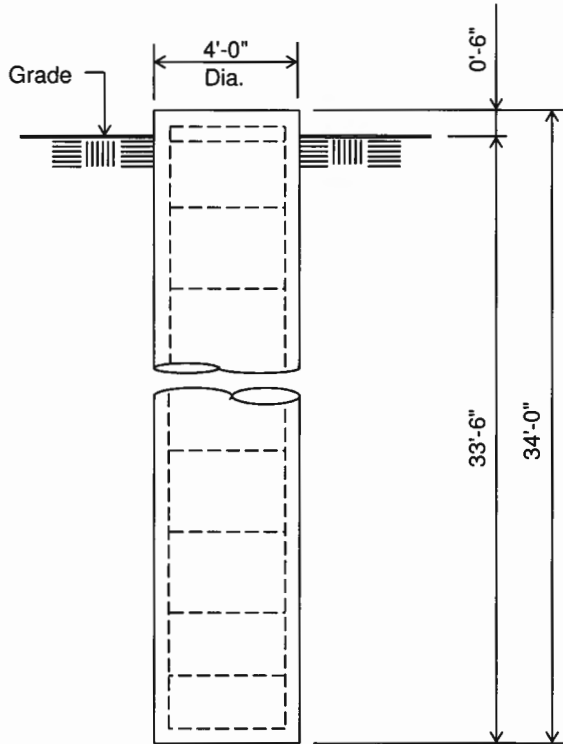
<b>Rebar Schedule per Mat and per Pier</b>	
<b>Pier</b>	(18) #7 vertical rebar w/ hooks at bottom w/ #4 rebar ties, two (2) within top 5" of pier then 4" C/C
<b>Mat</b>	(59) #9 horizontal rebar evenly spaced each way top and bottom. (236 total)
<b>Anchor Bolts per Leg</b>	
(6) 1.25" dia. x 63" F1554-105 on a 10" B.C. w/ 7.5" max. projection above concrete.	

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**Customer: VERIZON WIRELESS**

**Site: Barlow, KY 232179**

280 ft. Model S3R Series SD Self Supporting Tower



**ELEVATION VIEW**

(15.8 cu. yds.)

(3 REQUIRED; NOT TO SCALE)

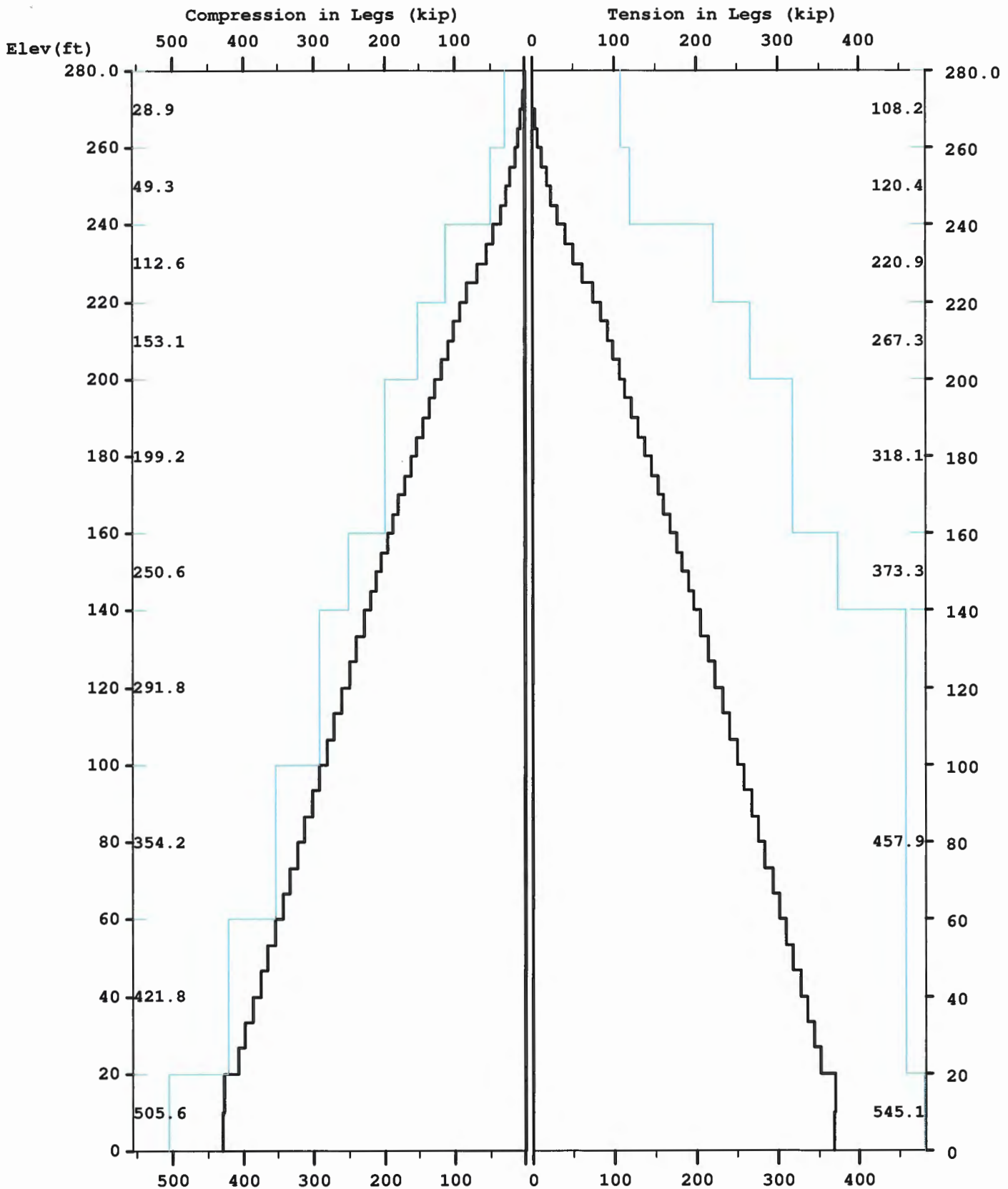
**Notes:**

- 1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-14.
- 2) Rebar to conform to ASTM specification A615 Grade 60.
- 3) All rebar to have a minimum of 3" concrete cover.
- 4) All exposed concrete corners to be chamfered 3/4".
- 5) The foundation design is based on the geotechnical report by Alt & Witzig Engineering, Inc., Project No. 18IN0510 dated: August 30th, 2018.
- 6) See the geotechnical report for drilled pier installation requirements, if specified.
- 7) The bottom anchor bolt template shall be positioned as closely as possible to the bottom of the anchor bolts.
- 8) Tie overlaps shall be staggered with a nominal 180° separation.

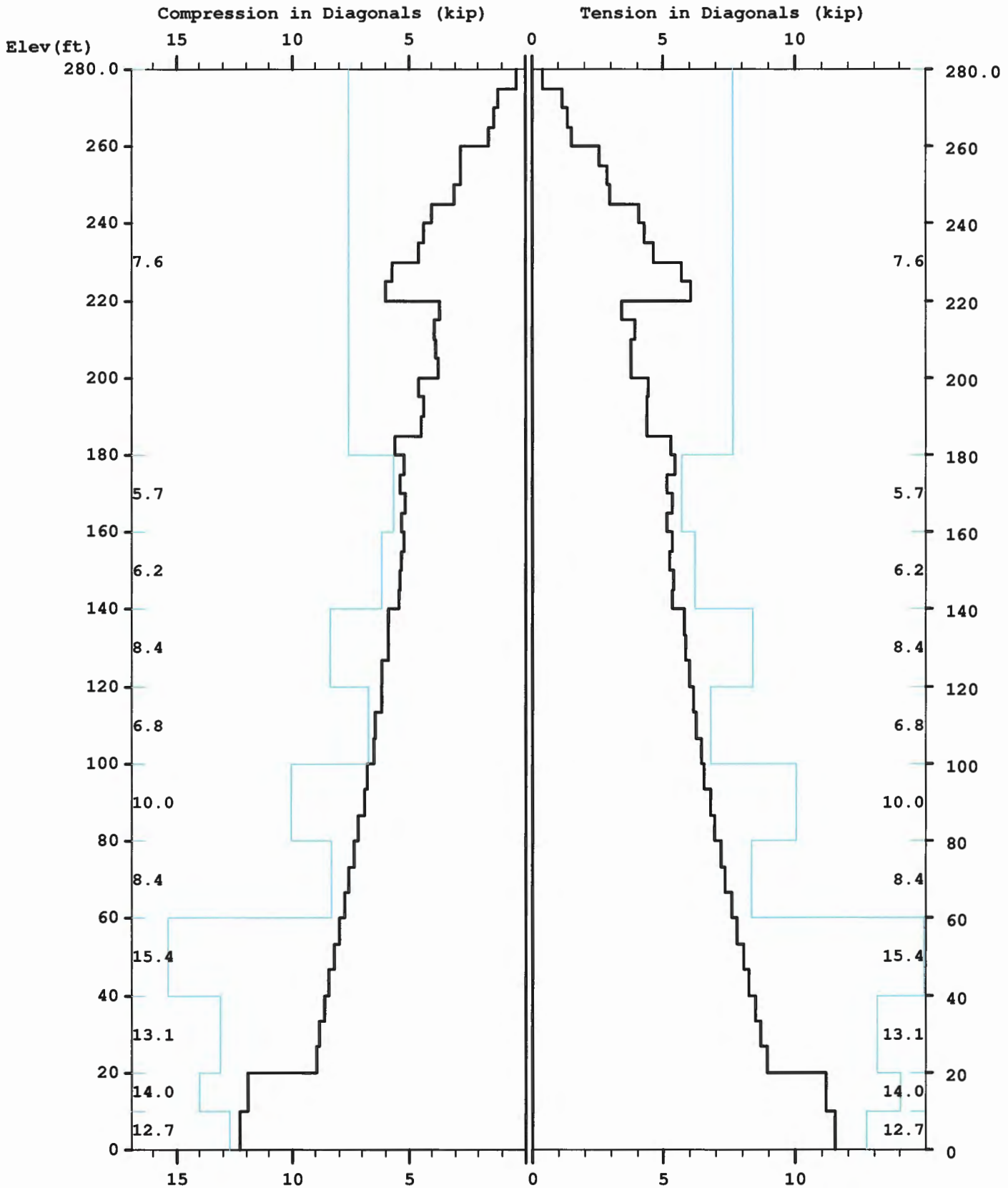
<b>Rebar Schedule per Pier</b>	
<b>Pier</b>	(12) #9 vertical rebar w/ #4 ties, two (2) within top 5" of pier then 12" C/C
<b>Anchor Bolts per Leg</b>	
	(6) 1.25" dia. x 63" F1554-105 on a 10" B.C. w/ 7.5" max. projection above concrete.

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Maximum

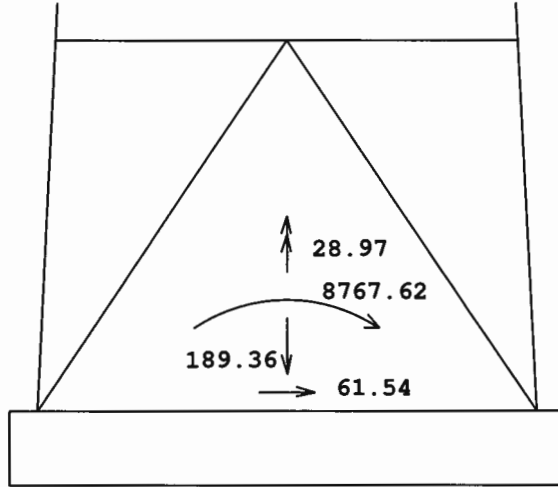


Maximum

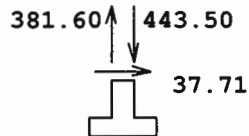
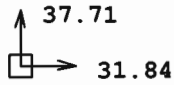


Maximum

TOTAL FOUNDATION LOADS (kip, ft-kip)



INDIVIDUAL FOOTING LOADS (kip)





Latticed Tower Analysis (Unguyed)  
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Sabre Towers and Poles

on: 13 dec 2018 at: 13:23:34

MAST GEOMETRY ( ft )

PANEL TYPE	NO.OF LEGS	ELEV.AT BOTTOM	ELEV.AT TOP	F.W..AT BOTTOM	F.W..AT TOP	TYPICAL PANEL HEIGHT
X	3	275.00	280.00	5.00	5.00	5.00
X	3	260.00	275.00	5.00	5.00	5.00
X	3	255.00	260.00	5.00	5.00	5.00
X	3	240.00	255.00	5.00	5.00	5.00
X	3	235.00	240.00	5.00	5.00	5.00
X	3	220.00	235.00	5.00	5.00	5.00
X	3	215.00	220.00	5.44	5.00	5.00
X	3	200.00	215.00	6.75	5.44	5.00
X	3	180.00	200.00	8.50	6.75	5.00
X	3	160.00	180.00	10.25	8.50	5.00
X	3	140.00	160.00	12.00	10.25	5.00
X	3	120.00	140.00	13.75	12.00	6.67
X	3	100.00	120.00	15.50	13.75	6.67
X	3	80.00	100.00	17.25	15.50	6.67
X	3	60.00	80.00	19.00	17.25	6.67
X	3	40.00	60.00	20.75	19.00	6.67
X	3	20.00	40.00	22.50	20.75	6.67
V	3	10.00	20.00	23.37	22.50	10.00
A	3	0.00	10.00	24.25	23.37	10.00

MEMBER PROPERTIES

MEMBER TYPE	BOTTOM ELEV ft	TOP ELEV ft	X-SECTN AREA in.sq	RADIUS OF GYRAT in	ELASTIC MODULUS ksi	THERMAL EXPANSN /deg
LE	260.00	280.00	2.405	0.438	29000.	0.0000117
LE	240.00	260.00	3.142	0.438	29000.	0.0000117
LE	220.00	240.00	4.909	0.438	29000.	0.0000117
LE	200.00	220.00	5.940	0.438	29000.	0.0000117
LE	160.00	200.00	7.069	0.438	29000.	0.0000117
LE	140.00	160.00	8.296	0.438	29000.	0.0000117
LE	100.00	140.00	11.045	0.438	29000.	0.0000117
LE	60.00	100.00	12.566	0.438	29000.	0.0000117
LE	0.00	60.00	14.186	0.438	29000.	0.0000117
DI	160.00	280.00	0.484	0.626	29000.	0.0000117
DI	140.00	160.00	0.715	0.626	29000.	0.0000117
DI	100.00	140.00	0.902	0.626	29000.	0.0000117
DI	60.00	100.00	1.090	0.626	29000.	0.0000117
DI	20.00	60.00	1.688	0.626	29000.	0.0000117
DI	0.00	20.00	1.438	0.626	29000.	0.0000117
HO	275.00	280.00	0.484	0.626	29000.	0.0000117
HO	255.00	260.00	0.484	0.626	29000.	0.0000117
HO	235.00	240.00	0.484	0.626	29000.	0.0000117
HO	215.00	220.00	0.484	0.626	29000.	0.0000117
HO	0.00	10.00	1.438	0.626	29000.	0.0000117
BR	0.00	10.00	1.090	0.000	29000.	0.0000117

FACTORED MEMBER RESISTANCES

BOTTOM ELEV ft	TOP ELEV ft	LEGS		DIAGONALS		HORIZONTALS		INT BRACING	
		COMP kip	TENS kip	COMP kip	TENS kip	COMP kip	TENS kip	COMP kip	TENS kip
275.0	280.0	28.89	108.24	7.62	7.62	7.37	7.37	0.00	0.00
260.0	275.0	28.89	108.24	7.62	7.62	0.00	0.00	0.00	0.00
255.0	260.0	49.29	120.41	7.62	7.62	7.37	7.37	0.00	0.00
240.0	255.0	49.29	120.41	7.62	7.62	0.00	0.00	0.00	0.00
235.0	240.0	112.60	220.89	7.62	7.62	7.37	7.37	0.00	0.00
220.0	235.0	112.60	220.89	7.62	7.62	0.00	0.00	0.00	0.00

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215.0	220.0	153.15	267.28	7.62	7.62	7.37	7.37	0.00	0.00
200.0	215.0	153.15	267.28	7.62	7.62	0.00	0.00	0.00	0.00
180.0	200.0	199.21	318.09	7.62	7.62	0.00	0.00	0.00	0.00
160.0	180.0	199.21	318.09	5.68	5.68	0.00	0.00	0.00	0.00
140.0	160.0	250.56	373.31	6.19	6.19	0.00	0.00	0.00	0.00
120.0	140.0	291.83	457.90	8.39	8.39	0.00	0.00	0.00	0.00
100.0	120.0	291.83	457.90	6.77	6.77	0.00	0.00	0.00	0.00
80.0	100.0	354.16	457.90	10.03	10.03	0.00	0.00	0.00	0.00
60.0	80.0	354.16	457.90	8.35	8.35	0.00	0.00	0.00	0.00
40.0	60.0	421.75	457.90	15.39	15.39	0.00	0.00	0.00	0.00
20.0	40.0	421.75	457.90	13.14	13.14	0.00	0.00	0.00	0.00
10.0	20.0	505.61	545.12	14.02	14.02	0.00	0.00	0.00	0.00
0.0	10.0	505.61	545.12	12.71	12.71	13.05	13.05	9.39	9.39

=====  
 \* Only 3 condition(s) shown in full  
 \* RRUS/TMAs were assumed to be behind antennas  
 \* Some wind loads may have been derived from full-scale wind tunnel testing  
 =====

LOADING CONDITION A

107 mph wind with no ice. Wind Azimuth: 0°

PL - 0

MAST LOADING

LOAD TYPE	ELEV ft	APPLY RADIUS ft	LOAD AZI	LOAD AZI	FORCES		MOMENTS	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	275.0	0.00	0.0	0.0	1.98	2.79	0.00	0.00
C	245.0	0.00	0.0	0.0	1.74	2.10	0.00	0.00
C	230.0	0.00	0.0	0.0	1.71	2.10	0.00	0.00
C	215.0	0.00	0.0	0.0	1.69	2.10	0.00	0.00
C	200.0	0.00	0.0	0.0	1.66	2.10	0.00	0.00
D	280.0	0.00	180.0	0.0	0.06	0.05	0.00	0.00
D	275.0	0.00	180.0	0.0	0.06	0.05	0.00	0.00
D	275.0	0.00	42.0	0.0	0.07	0.06	0.01	0.03
D	260.0	0.00	42.0	0.0	0.07	0.06	0.01	0.03
D	260.0	0.00	42.0	0.0	0.08	0.07	0.02	0.03
D	245.0	0.00	42.0	0.0	0.07	0.06	0.02	0.03
D	245.0	0.00	42.0	0.0	0.11	0.08	0.05	0.08
D	240.0	0.00	42.0	0.0	0.11	0.08	0.05	0.08
D	240.0	0.00	42.0	0.0	0.12	0.11	0.05	0.08
D	230.0	0.00	42.0	0.0	0.11	0.10	0.05	0.08
D	230.0	0.00	56.0	0.0	0.13	0.12	0.06	0.10
D	220.0	0.00	56.0	0.0	0.14	0.12	0.06	0.10
D	220.0	0.00	57.2	0.0	0.14	0.14	0.06	0.10
D	215.0	0.00	57.2	0.0	0.14	0.14	0.06	0.10
D	215.0	0.00	83.4	0.0	0.15	0.15	0.06	0.11
D	200.0	0.00	87.2	0.0	0.15	0.15	0.06	0.10
D	200.0	0.00	90.5	0.0	0.17	0.19	0.06	0.06
D	185.0	0.00	93.1	0.0	0.18	0.19	0.05	0.06
D	185.0	0.00	84.7	0.0	0.18	0.19	0.06	0.06
D	160.0	0.00	86.2	0.0	0.18	0.19	0.06	0.06
D	160.0	0.00	80.8	0.0	0.18	0.22	0.08	0.07
D	140.0	0.00	82.6	0.0	0.19	0.23	0.07	0.06
D	140.0	0.00	78.2	0.0	0.19	0.26	0.09	0.07
D	120.0	0.00	79.5	0.0	0.19	0.27	0.08	0.07
D	120.0	0.00	76.2	0.0	0.19	0.27	0.10	0.07
D	100.0	0.00	77.2	0.0	0.19	0.27	0.09	0.07
D	100.0	0.00	74.7	0.0	0.20	0.30	0.11	0.07
D	80.0	0.00	75.5	0.0	0.21	0.31	0.10	0.07
D	80.0	0.00	73.4	0.0	0.20	0.31	0.12	0.07
D	60.0	0.00	74.1	0.0	0.20	0.31	0.12	0.07
D	60.0	0.00	72.4	0.0	0.21	0.38	0.14	0.07
D	40.0	0.00	72.9	0.0	0.21	0.39	0.13	0.07
D	40.0	0.00	71.5	0.0	0.20	0.39	0.15	0.07
D	20.0	0.00	72.0	0.0	0.20	0.40	0.14	0.07
D	20.0	0.00	70.8	0.0	0.15	0.34	0.16	0.06
D	10.0	0.00	70.8	0.0	0.15	0.34	0.16	0.06
D	10.0	0.00	71.1	0.0	0.18	0.41	0.15	0.06
D	0.0	0.00	71.1	0.0	0.18	0.41	0.15	0.06

ANTENNA LOADING  
=====

.....ANTENNA.....	ATTACHMENT				.....ANTENNA FORCES.....			
TYPE	ELEV ft	AZI	RAD ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	260.0	0.0	4.4	0.0	1.40	0.00	0.40	0.00
STD+R	185.0	0.0	6.2	0.0	1.31	0.00	0.40	0.00

LOADING CONDITION k =====

107 mph wind with no ice. Wind Azimuth: 0

PL - 0

MAST LOADING  
=====

LOAD TYPE	ELEV ft	APPLY..LOAD.. RADIUS ft	..AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	275.0	0.00	0.0	0.0	1.98	2.09	0.00	0.00
C	245.0	0.00	0.0	0.0	1.74	1.58	0.00	0.00
C	230.0	0.00	0.0	0.0	1.71	1.58	0.00	0.00
C	215.0	0.00	0.0	0.0	1.69	1.58	0.00	0.00
C	200.0	0.00	0.0	0.0	1.66	1.58	0.00	0.00
D	280.0	0.00	180.0	0.0	0.06	0.04	0.00	0.00
D	275.0	0.00	180.0	0.0	0.06	0.04	0.00	0.00
D	275.0	0.00	42.0	0.0	0.07	0.04	0.01	0.03
D	260.0	0.00	42.0	0.0	0.07	0.04	0.01	0.03
D	260.0	0.00	42.0	0.0	0.08	0.05	0.01	0.03
D	245.0	0.00	42.0	0.0	0.07	0.05	0.01	0.03
D	245.0	0.00	42.0	0.0	0.11	0.06	0.03	0.08
D	240.0	0.00	42.0	0.0	0.11	0.06	0.03	0.08
D	240.0	0.00	42.0	0.0	0.12	0.08	0.03	0.08
D	230.0	0.00	42.0	0.0	0.11	0.08	0.03	0.08
D	230.0	0.00	56.0	0.0	0.13	0.09	0.05	0.10
D	220.0	0.00	56.0	0.0	0.14	0.09	0.05	0.10
D	220.0	0.00	57.2	0.0	0.14	0.11	0.05	0.10
D	215.0	0.00	57.2	0.0	0.14	0.11	0.05	0.10
D	215.0	0.00	83.4	0.0	0.15	0.11	0.05	0.11
D	200.0	0.00	87.2	0.0	0.15	0.11	0.04	0.10
D	200.0	0.00	90.5	0.0	0.17	0.14	0.04	0.06
D	185.0	0.00	93.1	0.0	0.18	0.14	0.04	0.06
D	185.0	0.00	84.7	0.0	0.18	0.14	0.05	0.06
D	160.0	0.00	86.2	0.0	0.18	0.15	0.04	0.06
D	160.0	0.00	80.8	0.0	0.18	0.17	0.06	0.07
D	140.0	0.00	82.6	0.0	0.19	0.17	0.05	0.06
D	140.0	0.00	78.2	0.0	0.19	0.20	0.07	0.07
D	120.0	0.00	79.5	0.0	0.19	0.20	0.06	0.07
D	120.0	0.00	76.2	0.0	0.19	0.20	0.07	0.07
D	100.0	0.00	77.2	0.0	0.19	0.20	0.07	0.07
D	100.0	0.00	74.7	0.0	0.20	0.23	0.08	0.07
D	80.0	0.00	75.5	0.0	0.21	0.23	0.08	0.07
D	80.0	0.00	73.4	0.0	0.20	0.23	0.09	0.07
D	60.0	0.00	74.1	0.0	0.20	0.24	0.09	0.07
D	60.0	0.00	72.4	0.0	0.21	0.29	0.10	0.07
D	40.0	0.00	72.9	0.0	0.21	0.29	0.10	0.07
D	40.0	0.00	71.5	0.0	0.20	0.29	0.11	0.07
D	20.0	0.00	72.0	0.0	0.20	0.30	0.11	0.07
D	20.0	0.00	70.8	0.0	0.15	0.26	0.12	0.06
D	10.0	0.00	70.8	0.0	0.15	0.26	0.12	0.06
D	10.0	0.00	71.1	0.0	0.18	0.31	0.12	0.06
D	0.0	0.00	71.1	0.0	0.18	0.31	0.12	0.06

ANTENNA LOADING  
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.....ANTENNA.....	ATTACHMENT				.....ANTENNA FORCES.....			
TYPE	ELEV ft	AZI	RAD ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	260.0	0.0	4.4	0.0	1.40	0.00	0.30	0.00
STD+R	185.0	0.0	6.2	0.0	1.31	0.00	0.30	0.00

LOADING CONDITION AU

30 mph wind with 1.5 ice. Wind Azimuth: 0

PL - 0

MAST LOADING

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LOAD TYPE	ELEV ft	APPLY.. RADIUS ft	LOAD..AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
					HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	275.0	0.00	0.0	0.0	0.29	5.78	0.00	0.00
C	245.0	0.00	0.0	0.0	0.25	4.66	0.00	0.00
C	230.0	0.00	0.0	0.0	0.25	4.64	0.00	0.00
C	215.0	0.00	0.0	0.0	0.24	4.63	0.00	0.00
C	200.0	0.00	0.0	0.0	0.24	4.61	0.00	0.00
D	280.0	0.00	180.0	0.0	0.01	0.19	0.00	0.00
D	275.0	0.00	180.0	0.0	0.01	0.19	0.00	0.00
D	275.0	0.00	42.0	0.0	0.01	0.19	0.07	0.01
D	260.0	0.00	42.0	0.0	0.01	0.19	0.07	0.01
D	260.0	0.00	42.0	0.0	0.01	0.24	0.08	0.01
D	255.0	0.00	42.0	0.0	0.01	0.24	0.08	0.01
D	255.0	0.00	42.0	0.0	0.01	0.21	0.08	0.01
D	245.0	0.00	42.0	0.0	0.01	0.21	0.08	0.01
D	245.0	0.00	42.0	0.0	0.01	0.26	0.20	0.01
D	240.0	0.00	42.0	0.0	0.01	0.26	0.20	0.01
D	240.0	0.00	42.0	0.0	0.01	0.32	0.20	0.01
D	235.0	0.00	42.0	0.0	0.01	0.32	0.20	0.01
D	235.0	0.00	42.0	0.0	0.01	0.29	0.20	0.01
D	230.0	0.00	42.0	0.0	0.01	0.29	0.20	0.01
D	230.0	0.00	62.1	0.0	0.02	0.35	0.21	0.01
D	220.0	0.00	62.1	0.0	0.02	0.35	0.21	0.01
D	220.0	0.00	63.2	0.0	0.02	0.40	0.21	0.01
D	215.0	0.00	63.2	0.0	0.02	0.40	0.21	0.01
D	215.0	0.00	91.3	0.0	0.02	0.42	0.23	0.01
D	205.0	0.00	93.2	0.0	0.02	0.43	0.22	0.01
D	205.0	0.00	95.1	0.0	0.02	0.43	0.21	0.01
D	200.0	0.00	95.1	0.0	0.02	0.43	0.21	0.01
D	200.0	0.00	85.6	0.0	0.02	0.52	0.17	0.00
D	185.0	0.00	87.6	0.0	0.02	0.53	0.15	0.00
D	185.0	0.00	79.6	0.0	0.02	0.53	0.19	0.00
D	160.0	0.00	80.5	0.0	0.02	0.56	0.17	0.00
D	160.0	0.00	76.3	0.0	0.02	0.59	0.22	0.00
D	140.0	0.00	77.7	0.0	0.02	0.60	0.20	0.00
D	140.0	0.00	74.3	0.0	0.02	0.63	0.26	0.00
D	120.0	0.00	75.2	0.0	0.02	0.64	0.23	0.00
D	120.0	0.00	72.7	0.0	0.02	0.64	0.29	0.00
D	100.0	0.00	73.4	0.0	0.02	0.66	0.27	0.00
D	100.0	0.00	71.4	0.0	0.02	0.71	0.32	0.00
D	80.0	0.00	72.0	0.0	0.02	0.72	0.30	0.00
D	80.0	0.00	70.4	0.0	0.02	0.72	0.36	0.00
D	60.0	0.00	70.9	0.0	0.02	0.74	0.33	0.00
D	60.0	0.00	69.6	0.0	0.02	0.82	0.39	0.00
D	40.0	0.00	70.0	0.0	0.02	0.84	0.37	0.00
D	40.0	0.00	69.0	0.0	0.02	0.83	0.42	0.00
D	20.0	0.00	69.3	0.0	0.02	0.84	0.40	0.00
D	20.0	0.00	68.4	0.0	0.02	0.74	0.50	0.00
D	10.0	0.00	68.4	0.0	0.02	0.74	0.50	0.00
D	10.0	0.00	68.4	0.0	0.02	0.99	0.62	0.00
D	0.0	0.00	68.4	0.0	0.02	0.99	0.62	0.00

ANTENNA LOADING

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.....ANTENNA..... TYPE	.....ATTACHMENT.....		.....ANTENNA FORCES.....					
	ELEV ft	AZI ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip	
STD+R	260.0	0.0	4.4	0.0	0.12	0.00	1.57	0.00
STD+R	185.0	0.0	6.2	0.0	0.11	0.00	1.53	0.00

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS:

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ELEV AZI TYPE .....BEAM DEFLECTIONS (deg).....

ft	deg	*	19-5171-TJH			TOTAL
			PITCH	YAW	ROLL	
260.0	0.0	STD+R	1.315 J	0.469 AL	-1.551 S	1.396 b
185.0	0.0	STD+R	0.827 J	0.218 AL	-0.978 S	0.855 J

MAXIMUM TENSION IN MAST MEMBERS (kip)

ELEV ft	LEGS	DIAG	HORIZ	BRACE
280.0	-----	-----	0.24 C	0.00 A
	0.16 AE	0.38 S		
275.0	-----	-----	0.03 g	0.00 A
	0.63 k	1.16 n		
270.0	-----	-----	0.02 A	0.00 A
	3.78 k	1.35 D		
265.0	-----	-----	0.03 J	0.00 A
	6.96 k	1.51 AF		
260.0	-----	-----	0.49 AF	0.00 A
	11.26 k	2.58 D		
255.0	-----	-----	0.08 M	0.00 A
	17.18 k	2.87 D		
250.0	-----	-----	0.02 m	0.00 A
	23.37 k	2.96 AF		
245.0	-----	-----	0.07 A	0.00 A
	30.25 k	4.07 D		
240.0	-----	-----	0.51 A	0.00 A
	39.77 k	4.27 n		
235.0	-----	-----	0.18 A	0.00 A
	49.79 k	4.63 D		
230.0	-----	-----	0.07 AC	0.00 A
	60.71 k	5.68 D		
225.0	-----	-----	0.20 A	0.00 A
	74.39 k	6.01 D		
220.0	-----	-----	0.55 AC	0.00 A
	84.01 k	3.43 k		
215.0	-----	-----	0.16 A	0.00 A
	91.47 k	3.91 X		
210.0	-----	-----	0.03 A	0.00 A
	98.93 k	3.77 AH		
205.0	-----	-----	0.16 A	0.00 A
	106.43 k	3.75 X		
200.0	-----	-----	0.01 AU	0.00 A
	113.33 k	4.40 k		
195.0	-----	-----	0.12 A	0.00 A
	121.72 k	4.35 S		
190.0	-----	-----	0.07 e	0.00 A
	129.31 k	4.37 AH		
185.0	-----	-----	0.09 A	0.00 A
	137.53 k	5.29 AH		
180.0	-----	-----	0.09 e	0.00 A
	144.93 k	5.44 F		
175.0	-----	-----	0.08 A	0.00 A
	153.56 k	5.15 AH		
170.0	-----	-----	0.06 e	0.00 A
	160.78 k	5.31 F		
165.0	-----	-----	0.07 A	0.00 A
	168.77 k	5.14 AH		
160.0	-----	-----	0.05 J	0.00 A
	175.84 k	5.31 F		
155.0	-----	-----	0.05 A	0.00 A
	183.39 k	5.21 AH		
150.0	-----	-----	0.05 M	0.00 A
	190.30 k	5.37 F		
145.0	-----	-----	0.05 A	0.00 A
	197.57 k	5.33 AH		
140.0	-----	-----	0.05 M	0.00 A
	205.43 k	5.80 F		
133.3	-----	-----	0.05 A	0.00 A
	214.77 k	5.83 AE		
126.7	-----	-----	0.04 M	0.00 A
	223.61 k	5.99 F		
120.0	-----	-----	0.05 A	0.00 A
	232.70 k	6.12 AE		
113.3	-----	-----	0.04 A	0.00 A
	241.44 k	6.23 F		
106.7	-----	-----	0.04 A	0.00 A
	250.34 k	6.43 AE		

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100.0	-----			0.03 A	0.00 A
	258.96 k	6.54 j			
93.3	-----			0.04 A	0.00 A
	267.70 k	6.80 AE			
86.7	-----			0.03 A	0.00 A
	276.27 k	6.94 U			
80.0	-----			0.03 A	0.00 A
	284.97 k	7.20 AE			
73.3	-----			0.03 A	0.00 A
	293.52 k	7.36 U			
66.7	-----			0.03 A	0.00 A
	302.16 k	7.60 AE			
60.0	-----			0.03 A	0.00 A
	310.65 k	7.78 U			
53.3	-----			0.03 A	0.00 A
	319.16 k	8.03 AE			
46.7	-----			0.02 A	0.00 A
	327.59 k	8.22 U			
40.0	-----			0.02 A	0.00 A
	336.10 k	8.48 U			
33.3	-----			0.04 AE	0.00 A
	344.54 k	8.70 U			
26.7	-----			0.16 AC	0.00 A
	353.00 k	8.96 S			
20.0	-----			0.22 A	0.00 A
	369.91 k	11.17 AT			
10.0	-----			0.62 k	0.00 AF
	368.97 k	11.50 AT			
0.0	-----			0.00 A	0.00 A

MAXIMUM COMPRESSION IN MAST MEMBERS (kip)

ELEV ft	LEGS	DIAG	HORIZ	BRACE
280.0	-----		-0.24 U	0.00 A
	-0.25 C	-0.37 A		
275.0	-----		-0.02 y	0.00 A
	-2.64 BM	-1.17 V		
270.0	-----		-0.02 AC	0.00 A
	-6.01 S	-1.34 V		
265.0	-----		-0.01 AO	0.00 A
	-9.45 S	-1.55 D		
260.0	-----		-0.62 F	0.00 A
	-14.58 S	-2.75 G		
255.0	-----		-0.05 AC	0.00 A
	-20.66 S	-2.77 AF		
250.0	-----		-0.02 CA	0.00 A
	-26.88 S	-3.04 D		
245.0	-----		-0.05 AC	0.00 A
	-35.31 S	-4.03 V		
240.0	-----		-0.43 AC	0.00 A
	-45.07 S	-4.37 D		
235.0	-----		-0.16 AC	0.00 A
	-55.75 S	-4.57 n		
230.0	-----		-0.07 A	0.00 A
	-68.29 S	-5.73 D		
225.0	-----		-0.17 AC	0.00 A
	-82.62 S	-6.01 D		
220.0	-----		-0.64 A	0.00 A
	-92.65 S	-3.64 S		
215.0	-----		-0.14 AC	0.00 A
	-102.21 S	-3.87 AH		
210.0	-----		-0.02 AC	0.00 A
	-110.19 S	-3.87 S		
205.0	-----		-0.13 AC	0.00 A
	-118.42 S	-3.74 X		
200.0	-----		0.00 AC	0.00 A
	-127.18 S	-4.58 S		
195.0	-----		-0.10 AC	0.00 A
	-136.47 S	-4.35 AH		
190.0	-----		-0.04 w	0.00 A
	-144.73 S	-4.48 S		
185.0	-----		-0.09 k	0.00 A

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180.0	-154.26 S	-5.59 F	-0.05 t	0.00 A
175.0	-162.45 S	-5.21 AH	-0.07 AC	0.00 A
170.0	-171.51 S	-5.37 F	-0.04 AO	0.00 A
165.0	-179.61 S	-5.14 AH	-0.06 AC	0.00 A
160.0	-188.17 S	-5.31 F	-0.04 AO	0.00 A
155.0	-196.14 S	-5.19 AE	-0.04 AC	0.00 A
150.0	-204.45 S	-5.35 F	-0.04 AO	0.00 A
145.0	-212.31 S	-5.35 AE	-0.04 AC	0.00 A
140.0	-220.40 S	-5.44 F	-0.04 AO	0.00 A
133.3	-229.45 S	-5.89 U	-0.05 AC	0.00 A
126.7	-240.11 S	-5.91 F	-0.04 AC	0.00 A
120.0	-250.42 S	-6.16 U	-0.04 AC	0.00 A
113.3	-260.90 S	-6.20 U	-0.03 AC	0.00 A
106.7	-271.14 S	-6.46 U	-0.04 AC	0.00 A
100.0	-281.50 S	-6.54 U	-0.03 AC	0.00 A
93.3	-291.73 S	-6.80 U	-0.03 AC	0.00 A
86.7	-302.12 S	-6.93 U	-0.03 AC	0.00 A
80.0	-312.42 S	-7.20 U	-0.03 AC	0.00 A
73.3	-322.83 S	-7.35 U	-0.02 AC	0.00 A
66.7	-333.17 S	-7.59 U	-0.03 AC	0.00 A
60.0	-343.59 S	-7.75 U	-0.02 AC	0.00 A
53.3	-354.04 S	-8.01 U	-0.02 AC	0.00 A
46.7	-364.65 S	-8.20 U	-0.02 AC	0.00 A
40.0	-375.25 S	-8.46 U	-0.02 AC	0.00 A
33.3	-385.92 S	-8.64 U	-0.05 C	0.00 A
26.7	-396.60 S	-8.82 U	-0.19 A	0.00 A
20.0	-407.30 S	-8.96 U	-0.18 AC	0.00 A
10.0	-427.23 S	-11.91 S	-0.75 S	0.00 D
0.0	-428.48 S	-12.27 S	0.00 A	0.00 A

FORCE/RESISTANCE RATIO IN LEGS

MAST ELEV ft	-- LEG COMPRESSION --			---- LEG TENSION ----		
	MAX COMP	COMP RESIST	FORCE/ RESIST RATIO	MAX TENS	TENS RESIST	FORCE/ RESIST RATIO
280.00	0.25	28.89	0.01	0.16	108.24	0.00
275.00	2.64	28.89	0.09	0.63	108.24	0.01
270.00	6.01	28.89	0.21	3.78	108.24	0.03
265.00	9.45	28.89	0.33	6.96	108.24	0.06
260.00	14.58	49.29	0.30	11.26	120.41	0.09
255.00	20.66	49.29	0.42	17.18	120.41	0.14

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250.00	26.88	49.29	0.55	23.37	120.41	0.19
245.00	35.31	49.29	0.72	30.25	120.41	0.25
240.00	45.07	112.60	0.40	39.77	220.89	0.18
235.00	55.75	112.60	0.50	49.79	220.89	0.23
230.00	68.29	112.60	0.61	60.71	220.89	0.27
225.00	82.62	112.60	0.73	74.39	220.89	0.34
220.00	92.65	153.15	0.60	84.01	267.28	0.31
215.00	102.21	153.15	0.67	91.47	267.28	0.34
210.00	110.19	153.15	0.72	98.93	267.28	0.37
205.00	118.42	153.15	0.77	106.43	267.28	0.40
200.00	127.18	199.21	0.64	113.33	318.09	0.36
195.00	136.47	199.21	0.69	121.72	318.09	0.38
190.00	144.73	199.21	0.73	129.31	318.09	0.41
185.00	154.26	199.21	0.77	137.53	318.09	0.43
180.00	162.45	199.21	0.82	144.93	318.09	0.46
175.00	171.51	199.21	0.86	153.56	318.09	0.48
170.00	179.61	199.21	0.90	160.78	318.09	0.51
165.00	188.17	199.21	0.94	168.77	318.09	0.53
160.00	196.14	250.56	0.78	175.84	373.31	0.47
155.00	204.45	250.56	0.82	183.39	373.31	0.49
150.00	212.31	250.56	0.85	190.30	373.31	0.51
145.00	220.40	250.56	0.88	197.57	373.31	0.53
140.00	229.45	291.83	0.79	205.43	457.90	0.45
133.33	240.11	291.83	0.82	214.77	457.90	0.47
126.67	250.42	291.83	0.86	223.61	457.90	0.49
120.00	260.90	291.83	0.89	232.70	457.90	0.51
113.33	271.14	291.83	0.93	241.44	457.90	0.53
106.67	281.50	291.83	0.96	250.34	457.90	0.55
100.00	291.73	354.16	0.82	258.96	457.90	0.57
93.33	302.12	354.16	0.85	267.70	457.90	0.58
86.67	312.42	354.16	0.88	276.27	457.90	0.60
80.00	322.83	354.16	0.91	284.97	457.90	0.62
73.33	333.17	354.16	0.94	293.52	457.90	0.64
66.67	343.59	354.16	0.97	302.16	457.90	0.66
60.00	354.04	421.75	0.84	310.65	457.90	0.68
53.33	364.65	421.75	0.86	319.16	457.90	0.70
46.67	375.25	421.75	0.89	327.59	457.90	0.72
40.00	385.92	421.75	0.92	336.10	457.90	0.73
33.33	396.60	421.75	0.94	344.54	457.90	0.75
26.67	407.30	421.75	0.97	353.00	457.90	0.77



20.00	427.23	505.61	0.84	369.91	545.12	0.68
10.00	428.48	505.61	0.85	368.97	545.12	0.68
0.00						

FORCE/RESISTANCE RATIO IN DIAGONALS

MAST ELEV ft	- DIAG COMPRESSION -			--- DIAG TENSION ---		
	MAX COMP	COMP RESIST	FORCE/ RESIST RATIO	MAX TENS	TENS RESIST	FORCE/ RESIST RATIO
280.00	0.37	7.62	0.05	0.38	7.62	0.05
275.00	1.17	7.62	0.15	1.16	7.62	0.15
270.00	1.34	7.62	0.18	1.35	7.62	0.18
265.00	1.55	7.62	0.20	1.51	7.62	0.20
260.00	2.75	7.62	0.36	2.58	7.62	0.34
255.00	2.77	7.62	0.36	2.87	7.62	0.38
250.00	3.04	7.62	0.40	2.96	7.62	0.39
245.00	4.03	7.62	0.53	4.07	7.62	0.53
240.00	4.37	7.62	0.57	4.27	7.62	0.56
235.00	4.57	7.62	0.60	4.63	7.62	0.61
230.00	5.73	7.62	0.75	5.68	7.62	0.75
225.00	6.01	7.62	0.79	6.01	7.62	0.79
220.00	3.64	7.62	0.48	3.43	7.62	0.45
215.00	3.87	7.62	0.51	3.91	7.62	0.51
210.00	3.87	7.62	0.51	3.77	7.62	0.49
205.00	3.74	7.62	0.49	3.75	7.62	0.49
200.00	4.58	7.62	0.60	4.40	7.62	0.58
195.00	4.35	7.62	0.57	4.35	7.62	0.57
190.00	4.48	7.62	0.59	4.37	7.62	0.57
185.00	5.59	7.62	0.73	5.29	7.62	0.69
180.00	5.21	5.68	0.92	5.44	5.68	0.96
175.00	5.37	5.68	0.95	5.15	5.68	0.91
170.00	5.14	5.68	0.91	5.31	5.68	0.93
165.00	5.31	5.68	0.93	5.14	5.68	0.90
160.00	5.19	6.19	0.84	5.31	6.19	0.86
155.00	5.35	6.19	0.86	5.21	6.19	0.84
150.00	5.35	6.19	0.86	5.37	6.19	0.87
145.00	5.44	6.19	0.88	5.33	6.19	0.86
140.00	5.89	8.39	0.70	5.80	8.39	0.69
133.33	5.91	8.39	0.70	5.83	8.39	0.69
126.67	6.16	8.39	0.73	5.99	8.39	0.71
120.00	6.20	6.77	0.92	6.12	6.77	0.90
113.33	6.46	6.77	0.95	6.23	6.77	0.92

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106.67	6.54	6.77	0.97	6.43	6.77	0.95
100.00	6.80	10.03	0.68	6.54	10.03	0.65
93.33	6.93	10.03	0.69	6.80	10.03	0.68
86.67	7.20	10.03	0.72	6.94	10.03	0.69
80.00	7.35	8.35	0.88	7.20	8.35	0.86
73.33	7.59	8.35	0.91	7.36	8.35	0.88
66.67	7.75	8.35	0.93	7.60	8.35	0.91
60.00	8.01	15.39	0.52	7.78	15.39	0.51
53.33	8.20	15.39	0.53	8.03	15.39	0.52
46.67	8.46	15.39	0.55	8.22	15.39	0.53
40.00	8.64	13.14	0.66	8.48	13.14	0.65
33.33	8.82	13.14	0.67	8.70	13.14	0.66
26.67	8.96	13.14	0.68	8.96	13.14	0.68
20.00	11.91	14.02	0.85	11.17	14.02	0.80
10.00	12.27	12.71	0.97	11.50	12.71	0.91
0.00						

MAXIMUM INDIVIDUAL FOUNDATION LOADS: (kip)

NORTH	LOAD EAST	COMPONENTS DOWN	UPLIFT	TOTAL SHEAR
37.71 s	31.84 e	443.50 s	-381.60 k	37.71 s

MAXIMUM TOTAL LOADS ON FOUNDATION : (kip & kip-ft)

HORIZONTAL			DOWN	OVERTURNING		TORSION	
NORTH	EAST	TOTAL @ 0.0		NORTH	EAST	TOTAL @ 0.0	
61.5 s	52.9 b	61.5 s	189.4 BK	8767.6 s	7480.3 b	8767.6 s	29.0 AT

Latticed Tower Analysis (Unguyed)  
 Processed under license at:

(c)2015 Guymast Inc. 416-736-7453

Sabre Towers and Poles

on: 13 dec 2018 at: 13:24:12

\*\*\*\*\*  
 \*\*\*\*\* Service Load Condition \*\*\*\*\*  
 \*\*\*\*\*

- \* Only 1 condition(s) shown in full
- \* RRUS/TMAS were assumed to be behind antennas
- \* Some wind loads may have been derived from full-scale wind tunnel testing

LOADING CONDITION A

MAST LOADING  
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LOAD TYPE	ELEV ft	APPLY. RADIUS ft	LOAD. AZI	AT AZI	LOAD AZI	.....FORCES.....		.....MOMENTS.....	
						HORIZ kip	DOWN kip	VERTICAL ft-kip	TORSNAL ft-kip
C	275.0	0.00	0.0	0.0	0.0	0.62	2.33	0.00	0.00
C	245.0	0.00	0.0	0.0	0.0	0.55	1.75	0.00	0.00
C	230.0	0.00	0.0	0.0	0.0	0.54	1.75	0.00	0.00
C	215.0	0.00	0.0	0.0	0.0	0.53	1.75	0.00	0.00
C	200.0	0.00	0.0	0.0	0.0	0.52	1.75	0.00	0.00
D	280.0	0.00	180.0	0.0	0.0	0.02	0.05	0.00	0.00
D	260.0	0.00	42.0	0.0	0.0	0.02	0.05	0.02	0.01
D	260.0	0.00	42.0	0.0	0.0	0.03	0.06	0.01	0.01
D	245.0	0.00	42.0	0.0	0.0	0.02	0.05	0.01	0.01
D	245.0	0.00	42.0	0.0	0.0	0.03	0.07	0.04	0.03
D	240.0	0.00	42.0	0.0	0.0	0.03	0.07	0.04	0.03
D	240.0	0.00	42.0	0.0	0.0	0.04	0.09	0.04	0.03
D	230.0	0.00	42.0	0.0	0.0	0.04	0.09	0.04	0.03
D	230.0	0.00	56.0	0.0	0.0	0.04	0.10	0.05	0.03
D	220.0	0.00	56.0	0.0	0.0	0.04	0.10	0.05	0.03
D	220.0	0.00	57.2	0.0	0.0	0.05	0.12	0.05	0.03
D	215.0	0.00	57.2	0.0	0.0	0.05	0.12	0.05	0.03
D	215.0	0.00	83.4	0.0	0.0	0.05	0.13	0.05	0.03
D	200.0	0.00	87.2	0.0	0.0	0.05	0.13	0.05	0.03
D	200.0	0.00	90.5	0.0	0.0	0.05	0.16	0.05	0.02
D	185.0	0.00	93.1	0.0	0.0	0.06	0.16	0.04	0.02
D	185.0	0.00	84.7	0.0	0.0	0.06	0.16	0.05	0.02
D	160.0	0.00	86.2	0.0	0.0	0.06	0.16	0.05	0.02
D	160.0	0.00	80.8	0.0	0.0	0.06	0.19	0.06	0.02
D	140.0	0.00	82.6	0.0	0.0	0.06	0.19	0.06	0.02
D	140.0	0.00	78.2	0.0	0.0	0.06	0.22	0.07	0.02
D	120.0	0.00	79.5	0.0	0.0	0.06	0.22	0.07	0.02
D	120.0	0.00	76.2	0.0	0.0	0.06	0.22	0.08	0.02
D	100.0	0.00	77.2	0.0	0.0	0.06	0.23	0.08	0.02
D	100.0	0.00	74.7	0.0	0.0	0.06	0.25	0.09	0.02
D	80.0	0.00	75.5	0.0	0.0	0.06	0.26	0.09	0.02
D	80.0	0.00	73.4	0.0	0.0	0.06	0.26	0.10	0.02
D	60.0	0.00	74.1	0.0	0.0	0.06	0.26	0.10	0.02
D	60.0	0.00	72.4	0.0	0.0	0.07	0.32	0.11	0.02
D	40.0	0.00	72.9	0.0	0.0	0.07	0.32	0.11	0.02
D	40.0	0.00	71.5	0.0	0.0	0.06	0.33	0.12	0.02
D	20.0	0.00	72.0	0.0	0.0	0.06	0.33	0.12	0.02
D	20.0	0.00	70.8	0.0	0.0	0.05	0.28	0.13	0.02
D	10.0	0.00	70.8	0.0	0.0	0.05	0.28	0.13	0.02
D	10.0	0.00	71.1	0.0	0.0	0.06	0.34	0.13	0.02
D	0.0	0.00	71.1	0.0	0.0	0.06	0.34	0.13	0.02

ANTENNA LOADING  
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.....ANTENNA..... TYPE	ELEV ft	AZI	ATTACHMENT		.....ANTENNA FORCES.....			
			RAD ft	AZI	AXIAL kip	SHEAR kip	GRAVITY kip	TORSION ft-kip
STD+R	260.0	0.0	4.4	0.0	0.44	0.00	0.34	0.00
STD+R	185.0	0.0	6.2	0.0	0.41	0.00	0.34	0.00

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MAXIMUM MAST DISPLACEMENTS:  
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ELEV ft	-----DEFLECTIONS (ft)-----			--TILTS (DEG)---		TWIST DEG
	NORTH	EAST	DOWN	NORTH	EAST	
280.0	1.192 S	-1.009 J	0.012 S	0.498 S	-0.422 J	-0.147 d
275.0	1.148 S	-0.972 J	0.012 S	0.498 S	-0.423 J	-0.147 d
270.0	1.104 S	-0.935 J	0.012 S	0.497 S	-0.422 J	-0.147 d
265.0	1.061 S	-0.898 J	0.011 S	0.495 S	-0.420 J	-0.147 d
260.0	1.017 S	-0.862 J	0.011 S	0.492 S	-0.416 J	-0.148 d
255.0	0.974 S	-0.825 J	0.011 S	0.487 S	-0.412 J	-0.141 d
250.0	0.932 S	-0.789 J	0.011 S	0.480 S	-0.406 J	-0.134 d
245.0	0.889 S	-0.753 J	0.010 S	0.472 S	-0.399 J	-0.128 d
240.0	0.848 S	-0.718 J	0.010 S	0.460 S	-0.389 J	-0.122 d

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235.0	0.807 S	-0.684 J	0.010 S	0.451 S	-0.381 J	-0.116 d
230.0	0.768 S	-0.650 J	0.010 S	0.439 S	-0.371 J	-0.110 d
225.0	0.728 S	-0.617 J	0.009 S	0.425 S	-0.359 J	-0.104 d
220.0	0.691 S	-0.586 J	0.009 S	0.407 S	-0.344 J	-0.098 d
215.0	0.656 S	-0.556 J	0.009 S	0.392 S	-0.331 J	-0.092 d
210.0	0.621 S	-0.527 J	0.009 S	0.378 S	-0.319 J	-0.088 d
205.0	0.588 S	-0.499 J	0.009 S	0.362 S	-0.306 J	-0.083 d
200.0	0.557 S	-0.472 J	0.008 S	0.347 S	-0.293 J	-0.079 d
195.0	0.526 S	-0.446 J	0.008 S	0.335 S	-0.283 J	-0.075 d
190.0	0.497 S	-0.421 J	0.008 S	0.322 S	-0.272 J	-0.072 d
185.0	0.468 S	-0.397 J	0.008 S	0.309 S	-0.262 J	-0.069 d
180.0	0.441 S	-0.374 J	0.007 S	0.297 S	-0.251 J	-0.063 d
175.0	0.414 S	-0.352 J	0.007 S	0.284 S	-0.240 J	-0.057 d
170.0	0.389 S	-0.330 J	0.007 S	0.271 S	-0.229 J	-0.052 d
165.0	0.364 S	-0.310 J	0.007 S	0.258 S	-0.218 J	-0.047 d
160.0	0.341 S	-0.290 J	0.007 S	0.245 S	-0.207 J	-0.042 d
155.0	0.319 S	-0.272 J	0.006 S	0.234 S	-0.198 J	-0.039 d
150.0	0.298 S	-0.254 J	0.006 S	0.223 S	-0.189 J	-0.036 d
145.0	0.279 S	-0.237 J	0.006 S	0.212 S	-0.179 J	-0.034 d
140.0	0.260 S	-0.221 J	0.006 S	0.201 S	-0.170 J	-0.031 d
133.3	0.236 S	-0.201 J	0.005 S	0.189 S	-0.161 J	-0.028 d
126.7	0.213 S	-0.182 J	0.005 S	0.178 S	-0.151 J	-0.026 d
120.0	0.192 S	-0.164 J	0.005 S	0.167 S	-0.142 J	-0.024 d
113.3	0.172 S	-0.147 J	0.005 S	0.156 S	-0.133 J	-0.022 d
106.7	0.153 S	-0.131 J	0.005 S	0.145 S	-0.123 J	-0.020 d
100.0	0.136 S	-0.116 J	0.004 S	0.134 S	-0.114 J	-0.018 d
93.3	0.120 S	-0.102 J	0.004 S	0.125 S	-0.106 J	-0.016 d
86.7	0.104 S	-0.089 J	0.004 S	0.115 S	-0.098 J	-0.014 d
80.0	0.090 S	-0.077 J	0.004 S	0.105 S	-0.090 J	-0.013 d
73.3	0.077 S	-0.066 J	0.003 S	0.096 S	-0.082 J	-0.011 d
66.7	0.065 S	-0.055 J	0.003 S	0.086 S	-0.073 J	-0.010 d
60.0	0.054 S	-0.046 J	0.003 S	0.077 S	-0.065 J	-0.008 d
53.3	0.044 S	-0.038 J	0.003 S	0.068 S	-0.058 J	-0.007 d
46.7	0.036 S	-0.031 J	0.002 S	0.060 S	-0.051 J	-0.006 d
40.0	0.028 S	-0.024 J	0.002 S	0.051 S	-0.044 J	0.005 h
33.3	0.021 S	-0.018 J	0.002 U	0.043 S	-0.037 J	0.004 h
26.7	0.015 S	-0.013 J	0.001 C	0.034 S	-0.029 J	0.003 h
20.0	0.007 S	-0.006 J	0.001 I	0.025 S	-0.021 J	0.002 h
10.0	0.002 U	-0.002 L	0.001 C	0.013 S	-0.011 J	0.001 h
0.0	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A	0.000 A

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS:

ELEV ft	AZI deg	TYPE *	.....BEAM DEFLECTIONS (deg).....			
			PITCH	YAW	ROLL	TOTAL
260.0	0.0	STD+R	0.416 J	0.148 d	-0.492 S	0.442 J
185.0	0.0	STD+R	0.262 J	0.069 d	-0.309 S	0.270 J

MAXIMUM TENSION IN MAST MEMBERS (kip)

ELEV ft	LEGS	DIAG	HORIZ	BRACE
280.0	-----	-----	0.08 o	0.00 A
	0.03 g	0.12 e		
275.0	-----	-----	0.01 g	0.00 A
	0.00 A	0.36 D		
270.0	-----	-----	0.01 A	0.00 A
	0.51 A	0.43 D		
265.0	-----	-----	0.01 b	0.00 A
	1.48 A	0.47 V		
260.0	-----	-----	0.15 X	0.00 A
	2.64 M	0.84 D		
255.0	-----	-----	0.03 M	0.00 A
	4.38 A	0.92 D		
250.0	-----	-----	0.00 C	0.00 A
	6.32 A	0.92 V		
245.0	-----	-----	0.03 A	0.00 A
	7.99 A	1.29 D		
240.0	-----	-----	0.19 A	0.00 A
	10.97 A	1.32 D		
235.0	-----	-----	0.07 A	0.00 A
	13.98 A	1.48 D		
230.0	-----	-----	0.02 S	0.00 A
	16.96 A	1.79 D		

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225.0	-----		0.07 A	0.00 A
	21.17 A	1.91 D		
220.0	-----		0.14 S	0.00 A
	24.16 A	1.04 A		
215.0	-----		0.06 A	0.00 A
	25.88 A	1.25 X		
210.0	-----		0.01 A	0.00 A
	28.13 A	1.17 X		
205.0	-----		0.06 A	0.00 A
	30.33 A	1.18 X		
200.0	-----		0.00 A	0.00 A
	31.95 A	1.37 A		
195.0	-----		0.04 A	0.00 A
	34.38 A	1.38 S		
190.0	-----		0.03 e	0.00 A
	36.62 A	1.35 X		
185.0	-----		0.03 A	0.00 A
	38.80 A	1.62 X		
180.0	-----		0.03 e	0.00 A
	40.94 A	1.74 F		
175.0	-----		0.03 A	0.00 A
	43.53 A	1.59 X		
170.0	-----		0.02 e	0.00 A
	45.58 A	1.69 F		
165.0	-----		0.02 A	0.00 A
	47.94 A	1.59 X		
160.0	-----		0.02 J	0.00 A
	49.94 A	1.68 F		
155.0	-----		0.02 A	0.00 A
	52.13 A	1.62 X		
150.0	-----		0.02 M	0.00 A
	54.07 A	1.70 F		
145.0	-----		0.02 A	0.00 A
	56.16 A	1.66 X		
140.0	-----		0.02 M	0.00 A
	58.34 A	1.83 F		
133.3	-----		0.02 A	0.00 A
	60.96 A	1.82 S		
126.7	-----		0.02 M	0.00 A
	63.39 A	1.89 F		
120.0	-----		0.02 A	0.00 A
	65.92 A	1.92 S		
113.3	-----		0.01 M	0.00 A
	68.32 A	1.97 F		
106.7	-----		0.02 A	0.00 A
	70.78 A	2.01 S		
100.0	-----		0.01 M	0.00 A
	73.12 A	2.07 j		
93.3	-----		0.01 A	0.00 A
	75.49 A	2.14 S		
86.7	-----		0.01 A	0.00 A
	77.78 A	2.18 S		
80.0	-----		0.01 A	0.00 A
	80.13 A	2.26 S		
73.3	-----		0.01 A	0.00 A
	82.42 A	2.32 S		
66.7	-----		0.01 A	0.00 A
	84.74 A	2.39 S		
60.0	-----		0.01 A	0.00 A
	86.96 A	2.45 S		
53.3	-----		0.01 A	0.00 A
	89.14 A	2.53 S		
46.7	-----		0.01 A	0.00 A
	91.29 A	2.59 S		
40.0	-----		0.01 A	0.00 A
	93.47 A	2.67 S		
33.3	-----		0.01 g	0.00 A
	95.61 A	2.74 S		
26.7	-----		0.04 S	0.00 A
	97.76 A	2.83 S		
20.0	-----		0.08 A	0.00 A
	102.56 A	3.49 j		
10.0	-----		0.17 A	0.00 Y
	101.51 A	3.59 j		
0.0	-----		0.00 A	0.00 A

## MAXIMUM COMPRESSION IN MAST MEMBERS (kip)

ELEV ft	LEGS	DIAG	HORIZ	BRACE
280.0	----- -0.10 o	-0.12 M	-0.08 g	0.00 A
275.0	----- -1.36 s	-0.38 D	0.00 o	0.00 A
270.0	----- -2.51 e	-0.42 V	0.00 s	0.00 A
265.0	----- -3.62 s	-0.50 D	0.00 A	0.00 A
260.0	----- -5.48 s	-0.90 G	-0.20 h	0.00 A
255.0	----- -7.45 s	-0.86 V	-0.01 s	0.00 A
250.0	----- -9.43 s	-0.97 D	-0.01 F	0.00 A
245.0	----- -12.54 s	-1.28 V	-0.01 s	0.00 A
240.0	----- -15.68 s	-1.41 D	-0.11 G	0.00 A
235.0	----- -19.21 s	-1.43 D	-0.04 s	0.00 A
230.0	----- -23.61 s	-1.83 D	-0.02 A	0.00 A
225.0	----- -28.27 s	-1.91 D	-0.04 s	0.00 A
220.0	----- -31.50 s	-1.20 S	-0.23 A	0.00 A
215.0	----- -35.09 s	-1.21 X	-0.03 s	0.00 A
210.0	----- -37.70 s	-1.24 S	0.00 s	0.00 A
205.0	----- -40.45 s	-1.18 X	-0.03 s	0.00 A
200.0	----- -43.69 s	-1.46 S	0.00 A	0.00 A
195.0	----- -46.82 s	-1.36 X	-0.03 s	0.00 A
190.0	----- -49.55 s	-1.43 S	-0.01 M	0.00 A
185.0	----- -52.91 s	-1.80 F	-0.03 A	0.00 A
180.0	----- -55.66 s	-1.62 X	-0.01 b	0.00 A
175.0	----- -58.63 s	-1.72 F	-0.02 A	0.00 A
170.0	----- -61.38 s	-1.60 X	-0.01 s	0.00 A
165.0	----- -64.21 s	-1.69 F	-0.02 h	0.00 A
160.0	----- -66.93 s	-1.63 S	-0.01 s	0.00 A
155.0	----- -69.72 s	-1.70 F	-0.01 h	0.00 A
150.0	----- -72.40 s	-1.68 S	-0.01 s	0.00 A
145.0	----- -75.14 s	-1.73 F	-0.01 s	0.00 A
140.0	----- -78.24 s	-1.86 S	-0.01 s	0.00 A
133.3	----- -81.90 s	-1.88 F	-0.01 s	0.00 A
126.7	----- -85.46 s	-1.94 S	-0.01 s	0.00 A
120.0	----- -89.06 s	-1.97 S	-0.01 s	0.00 A
113.3	----- -92.61 s	-2.04 S	-0.01 s	0.00 A
106.7	----- -96.18 s	-2.07 S	-0.01 s	0.00 A
100.0	----- -99.74 s	-2.15 S	-0.01 s	0.00 A
93.3	----- -103.36 s	-2.19 S	-0.01 s	0.00 A
86.7	-----		-0.01 s	0.00 A

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80.0	-106.97 s	-2.27 s	-0.01 s	0.00 A
73.3	-110.60 s	-2.33 s	-0.01 s	0.00 A
66.7	-114.23 s	-2.40 s	-0.01 s	0.00 A
60.0	-117.87 s	-2.45 s	-0.01 s	0.00 A
53.3	-121.58 s	-2.54 s	-0.01 s	0.00 A
46.7	-125.36 s	-2.60 s	0.00 s	0.00 A
40.0	-129.15 s	-2.67 s	0.00 s	0.00 A
33.3	-132.97 s	-2.74 s	-0.02 C	0.00 A
26.7	-136.80 s	-2.79 s	-0.07 A	0.00 A
20.0	-140.63 s	-2.83 U	-0.04 s	0.00 A
10.0	-147.40 s	-3.80 s	-0.25 s	0.00 G
0.0	-148.44 s	-3.91 s	0.00 A	0.00 A

MAXIMUM INDIVIDUAL FOUNDATION LOADS: (kip)

NORTH	LOAD EAST	COMPONENTS DOWN	UPLIFT	TOTAL SHEAR
12.59 s	10.65 e	153.57 s	-105.06 A	12.59 s

MAXIMUM TOTAL LOADS ON FOUNDATION : (kip & kip-ft)

HORIZONTAL			DOWN	OVERTURNING			TORSION
NORTH	EAST	TOTAL @ 0.0		NORTH	EAST	TOTAL @ 0.0	
19.4 S	-16.6 J	19.4 S	65.0 X	2769.9 S	-2364.1 J	2769.9 S	9.1 h

**MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES**

Tower Description 280' S3R Series SD  
 Customer VERIZON WIRELESS  
 Project Number 19-5171-TJH  
 Date 12/13/2018  
 Engineer NM

<b>Overall Loads:</b>			
Factored Moment (ft-kips)	8767.62		
Factored Axial (kips)	189.36		
Factored Shear (kips)	61.54		
<b>Individual Leg Loads:</b>			
Factored Uplift (kips)	382.00		
Factored Download (kips)	444.00		
Factored Shear (kips)	38.00		
		Tower eccentric from mat (ft)=	2
Width of Tower (ft)	24.25	Allowable Bearing Pressure (ksf)	3.00
Ultimate Bearing Pressure	9.00	Safety Factor	3.00
Bearing $\Phi$ s	0.75		
Bearing Design Strength (ksf)	6.75	Max. Factored Net Bearing Pressure (ksf)	4.49
Water Table Below Grade (ft)	999		
Width of Mat (ft)	31	Minimum Mat Width (ft)	30.08
Thickness of Mat (ft)	1.5		
Depth to Bottom of Slab (ft)	6		
Bolt Circle Diameter (in)	10		
Effective Anchor Bolt Embedment	52.625	Minimum Pier Diameter (ft)	2.17
Diameter of Pier (ft)	3.5	Equivalent Square b (ft)	3.10
Ht. of Pier Above Ground (ft)	0.5		
Ht. of Pier Below Ground (ft)	4.5		
Quantity of Bars in Mat	59		
Bar Diameter in Mat (in)	1.128		
Area of Bars in Mat (in <sup>2</sup> )	58.96		
Spacing of Bars in Mat (in)	6.29	Recommended Spacing (in)	6 to 12
Quantity of Bars Pier	18		
Bar Diameter in Pier (in)	0.875		
Tie Bar Diameter in Pier (in)	0.5	Minimum Pier A <sub>s</sub> (in <sup>2</sup> )	6.93
Spacing of Ties (in)	4	Recommended Spacing (in)	5 to 12
Area of Bars in Pier (in <sup>2</sup> )	10.82		
Spacing of Bars in Pier (in)	5.93		
f'c (ksi)	4.5		
fy (ksi)	60		
Unit Wt. of Soil (kcf)	0.12		
Unit Wt. of Concrete (kcf)	0.15		
Volume of Concrete (yd <sup>3</sup> )	58.73		



**MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES (CONTINUED)**

**Two-Way Shear:**

Average d (in)	13.872		
$\phi v_c$ (ksi)	0.201	$v_u$ (ksi)	0.158
$\phi v_c = \phi(2 + 4/\beta_c)f_c^{1/2}$	0.302		
$\phi v_c = \phi(\alpha_s d/b_o + 2)f_c^{1/2}$	0.237		
$\phi v_c = \phi 4f_c^{1/2}$	0.201		
Shear perimeter, $b_o$ (in)	204.37		
$\beta_c$	1		

**Stability:**

Overturning Design Strength (ft-k)	11045.8	Factored Overturning Moment (ft-k)	9167.6
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**One-Way Shear:**

$\phi V_c$ (kips)	519.3	$V_u$ (kips)	509.1
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**Pier Design:**

Design Tensile Strength (kips)	584.5	$T_u$ (kips)	382.0
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**Shear:**

$\phi$	0.75		
$V_c$ (kips)	84.9		
$V_s$ (kips)	197.9	$V_{s,max}$ (kips)	757.3
$\phi V_n$ (kips)	212.1	$V_u$ (kips)	38.0
Maximum Spacing (in)	11.15	(Only if Shear Ties are Required)	
Actual Hook Development (in)	12.74	Req'd Hook Development $l_{dh}$ (in) - Tension	10.96
		Req'd Hook Development $l_{dc}$ (in) - Compression	11.81

**Anchor Bolt Pull-Out:**

$N_{ua} / \phi N_n$	0.81	$V_{ua} / \phi V_n$	0.17
Pier Rebar Development Length (in)	41.18	Required Length of Development (in)	23.48

**Flexure in Slab:**

$\phi M_n$ (ft-kips)	3350.7	$M_u$ (ft-kips)	3335.0
a (in)	2.49		
Steel Ratio	0.01143		
$\beta_1$	0.825		
Maximum Steel Ratio ( $\rho_t$ )	0.0197		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	93.61	Required Development in Pad (in)	16.77

Condition	1 is OK, 0 Fails
Minimum Mat Width	1
Maximum Soil Bearing Pressure	1
Pier Area of Steel	1
Pier Shear	1
Two-Way Shear	1
Overturning	1
Anchor Bolt Pull-Out	1
Flexure	1
Steel Ratio	1
Interaction Diagram Visual Check	1
One-Way Shear	1
Hook Development	1
Minimum Mat Depth	1
Anchor Bolt Punching Shear	1

**DRILLED STRAIGHT PIER DESIGN BY SABRE TOWERS & POLES**

Tower Description 280' S3R Series SD  
 Customer Name VERIZON WIRELESS  
 Job Number 19-5171-TJH  
 Date 12/13/2018  
 Engineer NM

Factored Uplift (kips)	382
Factored Download (kips)	444
Factored Shear (kips)	38
Ultimate Bearing Pressure	12
Bearing $\phi_s$	0.75
Bearing Design Strength (ksf)	9
Water Table Below Grade (ft)	999
Bolt Circle Diameter (in)	10
Effective Anchor Bolt Embedment	52.625
Pier Diameter (ft)	4
Ht. Above Ground (ft)	0.5
Pier Length Below Ground (ft)	33.5
Quantity of Bars	12
Bar Diameter (in)	1.128
Area of Bars (in <sup>2</sup> )	11.99
Spacing of Bars (in)	10.32
Tie Bar Diameter (in)	0.5
Spacing of Ties (in)	12
$f'_c$ (ksi)	4.5
$f_y$ (ksi)	60

Minimum Pier Diameter (ft) 2.17

Minimum Area of Steel (in<sup>2</sup>) 9.05

Unit Wt. of Concrete (kcf)	0.15
Download Friction $\phi_s$	0.75
Uplift Friction $\phi_s$	0.75
Volume of Concrete (yd <sup>3</sup> )	15.82
Skin Friction Factor for Uplift	1
Ignore Bottom Length in Download?	<input type="checkbox"/>

Length to Ignore Download (ft) **0**

Depth at Bottom of Layer (ft)	Ult. Skin Friction (ksf)	(Ult. Skin Friction)*(Uplift Factor)	$\gamma$ (kcf)
6	0.00	0.00	0.12
23.5	1.20	1.20	0.12
28.5	1.20	1.20	0.13
35	2.00	2.00	0.13
0	0.00	0.00	0
0	0.00	0.00	0
0	0.00	0.00	0
0	0.00	0.00	0
0	0.00	0.00	0
0	0.00	0.00	0

**DRILLED STRAIGHT PIER DESIGN BY SABRE TOWERS & POLES (CONTINUED)**

**Download:**

Factored Net Weight of Concrete (kips)	14.8		
Bearing Design Strength (kips)	113.1		
Skin Friction Design Strength (kips)	348.7		
Download Design Strength (kips)	461.8	Factored Net Download (kips)	458.8

**Uplift:**

Nominal Skin Friction (kips)	465.0		
W <sub>c</sub> , Weight of Concrete (kips)	64.1		
W <sub>R</sub> , Soil Resistance (kips)	2070.4		
$\phi_s W_r + 0.9W_c$ (kips)	1610.5		
Uplift Design Strength (kips)	406.4	Factored Uplift (kips)	382.0

**Tension:**

Design Tensile Strength (kips)	647.6	T <sub>u</sub> (kips)	382.0
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**Shear:**

$\phi$	0.75		
V <sub>c</sub> (kips)	142.9		
V <sub>s</sub> (kips)	75.4	V <sub>s,max</sub> (kips)	989.2
$\phi V_n$ (kips)	163.7	V <sub>u</sub> (kips)	38.0

**Anchor Bolt Pull-Out:**

N <sub>ua</sub> / $\phi N_n$	0.81	V <sub>ua</sub> / $\phi V_n$	0.17
Rebar Development Length (in)	39.17	Required Length of Development (in)	30.27

Condition	1 is OK, 0 Fails
Download	1
Uplift	1
Area of Steel	1
Shear	1
Anchor Bolt Pull-Out	1
Interaction Diagram Visual Check	1