



Structural Design Report

150' Monopole

Site: New Milford, CT

Site Number: CT4067

Prepared for: SAI COMMUNICATIONS

by: Sabre Towers & Poles™

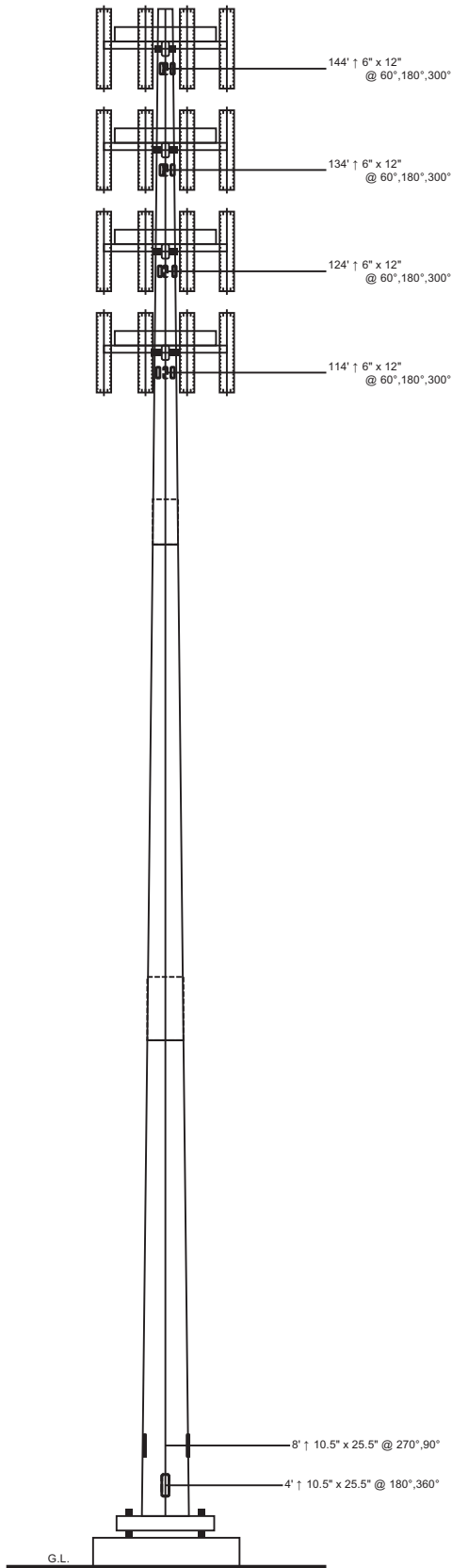
Job Number: 111274

September 25, 2014

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Section	1	2	3
Length (ft)	53' - 0"	53' - 6"	53' - 3"
Number Of Sides	18	18	18
Thickness (in)	5/16"	3/8"	7/16"
Lap Splice (ft)	4' - 6"	6' - 3"	6' - 3"
Top Diameter (in)	16.5"	29.51"	42.03"
Bottom Diameter (in)	31.39"	44.54"	56.99"
Taper (in/ft)		0.281	
Grade		A572-65	
Weight (lbs)	4765	8434	15050



Designed Apurtenance Loading

Elev	Description	Tx-Line
146	Sq. L.P. Platform (Monopole Only) - 12' w/ Handrail	
146	(4) DC6-48-60-18-8Fs	
146	(27) RRHs	(2) 3/4"
146	(12) HPA-65R-BUU-H8-Ks	(8) 1 5/8"
136	Sq. L.P. Platform (Monopole Only) - 12' w/ Handrail	
136	(4) DC6-48-60-18-8Fs	
136	(27) RRHs	(2) 3/4"
136	(12) HPA-65R-BUU-H8-Ks	(8) 1 5/8"
126	Sq. L.P. Platform (Monopole Only) - 12' w/ Handrail	
126	(4) DC6-48-60-18-8Fs	
126	(27) RRHs	(2) 3/4"
126	(12) HPA-65R-BUU-H8-Ks	(8) 1 5/8"
116	Sq. L.P. Platform (Monopole Only) - 12' w/ Handrail	
116	(4) DC6-48-60-18-8Fs	
116	(27) RRHs	(2) 3/4"
116	(12) HPA-65R-BUU-H8-Ks	(8) 1 5/8"

Load Case Reactions

Description	Axial (kips)	Shear (kips)	Moment (ft-k)	Deflection (ft)	Sway (deg)
3s Gusted Wind	58.6	45.9	5465	13.2	9.92
3s Gusted Wind 0.9 Dead	44.2	45.9	5372	12.9	9.65
3s Gusted Wind&Ice	73.5	7	783	1.8	1.36
Service Loads	48.1	10.3	1213	2.9	2.19

Base Plate Dimensions

Shape	Width	Thickness	Bolt Circle	Bolt Qty	Bolt Diameter
Square	64.75"	2.75"	63.75"	20	2.25"

Anchor Bolt Dimensions

Length	Diameter	Hole Diameter	Weight	Type	Finish
84"	2.25"	2.625"	2757	A615-75	Galv-18"

Notes

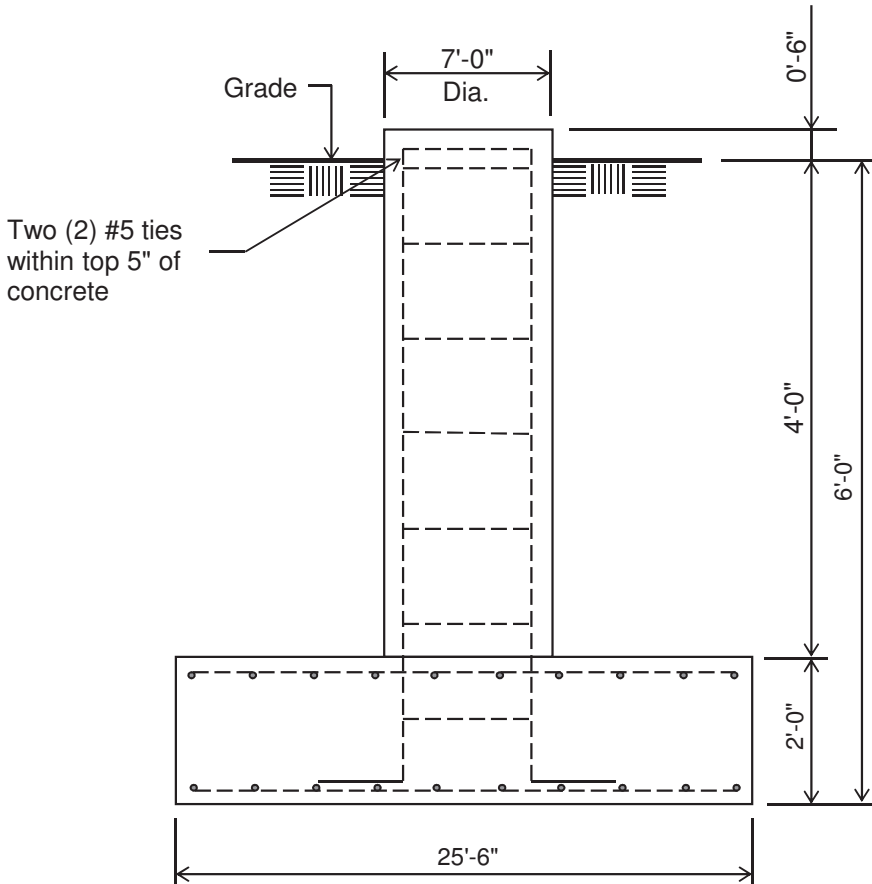
- 1) Antenna Feed Lines Run Inside Pole
- 2) All dimensions are above ground level, unless otherwise specified.
- 3) Weights shown are estimates. Final weights may vary.
- 4) The Monopole was designed for a basic wind speed of 95 mph with 0" of radial ice, and 40 mph with 1" of radial ice, in accordance with ANSI/TIA-222 -G-2 (2009), Structure Class II, Exposure Category C, Topographic Category 1.
- 5) Full Height Step Bolts

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Customer: SAI COMMUNICATIONS

Site: New Milford, CT CT4067

150' Monopole at
95 mph Wind with no ice and 40 mph Wind with 1 in. Ice per ANSI/TIA-222-G.
Antenna Loading per Page 1



ELEVATION VIEW
(54.58 Cu. Yds. each)
(1 REQUIRED; NOT TO SCALE)

Notes:

- 1). Concrete shall have a minimum 28-day compressive strength of 4000 PSI, in accordance with ACI 318-05
- 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 Design Earth Technology, Project No. 2014.09, dated August 4, 2014.
- 6). See the geotechnical report for compaction requirements, if specified.
- 7). The foundation is based on the following factored loads:
Moment (kip-ft) = 5465
Axial (kips) = 58.6
Shear (kips) = 45.9

Rebar Schedule per Pad and Pier	
Pier	(32) #10 vertical rebar w/hooks at bottom w/#5 ties, two within top 5" of top of pier then 12" C/C
Pad	(47) #9 horizontal rebar evenly spaced each way top and bottom (188 Total)

8). This is a design drawing only. Please see final construction drawings for all installation details.

TOP DIAMETER 16.50 in. [16.75 in. Point-Point]
 BOTTOM DIAMETER 56.99 in. [57.87 in. Point-Point]
 POLE HEIGHT 149.00 ft. 18 SIDED FLAT ORIENTATION
 BASE HEIGHT 1.00 ft. ABOVE GROUND
 E-MODULUS 29000 ksi [12000 ksi SHEAR MODULUS]

APPURTENANCES

ATTACH POINTS:	NO.	X,ft	Qty	Description	Status
	1	145.00	1	User Defined Loading	Future Appurt
	2	135.00	1	User Defined Loading	Future Appurt
	3	125.00	1	User Defined Loading	Future Appurt
	4	115.00	1	User Defined Loading	Future Appurt

Some wind forces may have been derived from full-scale wind tunnel tests.

Pole Section	Bottom X,ft.	Thick in.	Connect Type	LAP in.	Taper in/ft	Length ft.	Weight lbs	Steel Spec	Pole Finish
1	53.00	.31250	SLIP-JNT	54.	.2810	53.00	4227	A572-65	GALVANIZE
2	102.00	.37500	SLIP-JNT	75.	.2810	53.50	7939	A572-65	GALVANIZE
3	149.00	.43750	C-WELD		.2810	53.25	12347	A572-65	GALVANIZE

SECTION PROPERTIES

X,ft	UP,ft	D,in	T,in	Area in ²	Iz in ⁴	IxIy in ⁴	SxSy in ³	w/t	d/t	F _y (ksi)	
149.00	.00	16.50	.3125	16.06	1062	531	63.4	7.55	52.8	65.00	TOP
145.00	4.00	17.62	.3125	17.17	1302	651	72.8	8.18	56.4	65.00	P01
140.00	9.00	19.03	.3125	18.56	1642	821	85.0	8.97	60.9	65.00	
135.00	14.00	20.43	.3125	19.96	2040	1020	98.3	9.77	65.4	65.00	P02
130.00	19.00	21.84	.3125	21.35	2500	1250	112.7	10.56	69.9	65.00	
125.00	24.00	23.24	.3125	22.74	3022	1511	128.0	11.35	74.4	65.00	P03
120.00	29.00	24.65	.3125	24.14	3612	1806	144.3	12.14	78.9	65.00	
115.00	34.00	26.05	.3125	25.53	4274	2137	161.6	12.94	83.4	65.00	P04
110.00	39.00	27.46	.3125	26.92	5012	2506	179.8	13.73	87.9	65.00	
105.00	44.00	28.86	.3125	28.32	5832	2916	199.0	14.52	92.4	65.00	
100.50	48.50	30.13	.3125	29.57	6642	3321	217.1	15.24	96.4	65.00	Slip-B01
96.00	53.00	30.77	.3750	36.17	8442	4221	270.2	12.70	82.0	65.00	Slip-T02
91.00	58.00	32.17	.3750	37.85	9668	4834	295.9	13.36	85.8	65.00	
86.00	63.00	33.58	.3750	39.52	11006	5503	322.8	14.03	89.5	65.00	
81.00	68.00	34.98	.3750	41.19	12464	6232	350.9	14.69	93.3	65.00	
76.00	73.00	36.39	.3750	42.86	14042	7021	380.0	15.35	97.0	65.00	
71.00	78.00	37.79	.3750	44.54	15752	7876	410.5	16.01	100.8	65.00	
66.00	83.00	39.20	.3750	46.21	17592	8796	442.0	16.67	104.5	65.00	
61.00	88.00	40.60	.3750	47.88	19574	9787	474.8	17.33	108.3	65.00	
56.00	93.00	42.01	.3750	49.55	21698	10849	508.7	17.99	112.0	65.00	
53.25	95.75	42.78	.3750	50.47	22926	11463	527.8	18.35	114.1	65.00	Slip-B02
48.25	100.75	43.44	.4375	59.71	27884	13942	632.2	15.74	99.3	65.00	
47.00	102.00	43.79	.4375	60.19	28576	14288	642.7	15.88	100.1	65.00	Slip-T03
42.00	107.00	45.19	.4375	62.14	31444	15722	685.2	16.45	103.3	65.00	
37.00	112.00	46.60	.4375	64.10	34498	17249	729.1	17.02	106.5	65.00	
32.00	117.00	48.00	.4375	66.05	37748	18874	774.4	17.58	109.7	65.00	
27.00	122.00	49.41	.4375	68.00	41190	20595	821.0	18.15	112.9	65.00	
22.00	127.00	50.81	.4375	69.95	44838	22419	869.0	18.72	116.1	65.00	
17.00	132.00	52.22	.4375	71.90	48696	24348	918.4	19.28	119.4	65.00	
12.00	137.00	53.62	.4375	73.85	52768	26384	969.1	19.85	122.6	65.00	
7.00	142.00	55.03	.4375	75.80	57062	28531	1021.2	20.41	125.8	65.00	
2.00	147.00	56.43	.4375	77.75	61580	30790	1074.6	20.98	129.0	65.00	
.00	149.00	56.99	.4375	78.53	63454	31727	1096.4	21.21	130.3	65.00	BASE

CASE - 3: 3s Gusted Wind&Ice **ANSI-TIA-222-G**

WIND OLF	1.00	GUSTED WIND (3sec)	40.0 mph	64.4 kph
VERTICAL OLF	1.20	EXP-CAT/STRUC_CLASS	C-II	
DESIGN ICE	1.00 in	EXP-POWER COEFF.	.2105	
GUST FACTOR (Gh)	1.10	REFERENCE HEIGHT	900.0 ft	
FORCE COEFF (Cf)	1.20	PRESSURE @ 32.7 ft	4.3 psf	204.8 Pa
IMPORTANCE FAC (I)	1.00	BASE ABOVE Grd	1.0	
DIRECTION FAC (Kd)	.95	CREST HEIGHT	.0 ft	
TOPOGRAPHIC CAT	1			

APPURTENANCES **Sabre Areas**

#	Qty	Description	Center Line Elev-Ft	WEIGHT each Lbs	AREA each Ft^2	Tx-CABLE		WIND Psf	FORCES		MOM. Lg-X Ft-K
						Type	Qty #/Ft		Tra-Y Kips	Ax-Z Kips	
1	1	User Defined Loading	145.0	2655	174.6			5.9	1.02	-3.2	-.1
	12	HPA-65R-BUU-H8-K	145.0	141	.0	1 5/8"	8	1.04	5.9	.00	-2.4
	27	RRH	145.0	50	.0	3/4"	2	.50	5.9	.00	-1.6
	4	DC6-48-60-18-8F	145.0	39	.0	None	1	.00	5.9	.00	-.1
2	1	User Defined Loading	135.0	2655	174.6			5.8	1.01	-3.2	-.1
	12	HPA-65R-BUU-H8-K	135.0	141	.0	1 5/8"	8	1.04	5.8	.00	-2.3
	27	RRH	135.0	50	.0	3/4"	2	.50	5.8	.00	-1.6
	4	DC6-48-60-18-8F	135.0	39	.0	None	1	.00	5.8	.00	-.1
3	1	User Defined Loading	125.0	2655	174.6			5.7	.99	-3.2	.0
	12	HPA-65R-BUU-H8-K	125.0	141	.0	1 5/8"	8	1.04	5.7	.00	-2.2
	27	RRH	125.0	50	.0	3/4"	2	.50	5.7	.00	-1.6
	4	DC6-48-60-18-8F	125.0	39	.0	None	1	.00	5.7	.00	-.1
4	1	User Defined Loading	115.0	2655	174.6			5.6	.98	-3.2	.0
	12	HPA-65R-BUU-H8-K	115.0	141	.0	1 5/8"	8	1.04	5.6	.00	-2.1
	27	RRH	115.0	50	.0	3/4"	2	.50	5.6	.00	-1.6
	4	DC6-48-60-18-8F	115.0	39	.0	None	1	.00	5.6	.00	-.1

RESULTS

X, ft	Kzt	WIND psf	ICE in	FORCES, kips			MOMENTS, ft-kips			F'y ksi	Inter 4.8.2
				ShearX	ShearY	AxialZ	BendX	BendY	TorqZ		
149.00	1.00	7.08	2.33	.0	.01	-.2	.0	.0	.0	82.55	.000
145.00	1.00	7.04	2.32	.0	1.28	-8.1	-.2	.0	.0	82.55	.007
140.00	1.00	6.99	2.31	.0	1.39	-8.8	-6.7	.0	.0	82.55	.019
135.00	1.00	6.94	2.30	.0	2.65	-16.7	-13.7	.0	.0	82.55	.034
130.00	1.00	6.88	2.30	.0	2.74	-17.4	-26.9	.0	.0	82.55	.050
125.00	1.00	6.82	2.29	.0	3.97	-25.3	-40.6	.0	.0	82.55	.066
120.00	1.00	6.77	2.28	.0	4.05	-26.2	-60.5	.0	.0	82.55	.082
115.00	1.00	6.71	2.27	.0	5.25	-34.1	-80.8	.0	.0	82.55	.099
110.00	1.00	6.65	2.26	.0	5.32	-35.0	-107.0	.0	.0	82.55	.114
105.00	1.00	6.58	2.25	.0	5.39	-36.1	-133.6	.0	.0	82.55	.126
100.50	1.00	6.52	2.24	.0	5.46	-37.5	-157.8	.0	.0	82.55	.135
96.00	1.00	6.46	2.23	.0	5.54	-39.1	-182.4	.0	.0	82.55	.124
91.00	1.00	6.39	2.22	.0	5.62	-40.6	-210.2	.0	.0	82.55	.129
86.00	1.00	6.31	2.20	.0	5.69	-41.9	-238.3	.0	.0	82.55	.133
81.00	1.00	6.23	2.19	.0	5.77	-43.2	-266.7	.0	.0	82.55	.137
76.00	1.00	6.15	2.18	.0	5.85	-44.6	-295.5	.0	.0	82.55	.140
71.00	1.00	6.07	2.16	.0	5.92	-46.0	-324.8	.0	.0	82.55	.142
66.00	1.00	5.98	2.15	.0	6.00	-47.5	-354.4	.0	.0	81.78	.145
61.00	1.00	5.88	2.13	.0	6.08	-49.1	-384.4	.0	.0	81.00	.147
56.00	1.00	5.78	2.11	.0	6.14	-50.4	-414.8	.0	.0	80.22	.150
53.25	1.00	5.72	2.10	.0	6.21	-52.1	-431.7	.0	.0	79.80	.151
48.25	1.00	5.60	2.08	.0	6.26	-53.6	-462.8	.0	.0	82.55	.130
47.00	1.00	5.57	2.08	.0	6.31	-55.1	-470.6	.0	.0	82.55	.131
42.00	1.00	5.44	2.05	.0	6.40	-57.3	-502.1	.0	.0	82.03	.132
37.00	1.00	5.30	2.03	.0	6.47	-59.2	-534.1	.0	.0	81.37	.133
32.00	1.00	5.15	2.00	.0	6.55	-61.2	-566.4	.0	.0	80.70	.134
27.00	1.00	4.97	1.97	.0	6.63	-63.2	-599.2	.0	.0	80.03	.134
22.00	1.00	4.77	1.93	.0	6.71	-65.2	-632.3	.0	.0	79.37	.135
17.00	1.00	4.53	1.88	.0	6.79	-67.3	-665.9	.0	.0	78.70	.136
12.00	1.00	4.37	1.82	.0	6.87	-69.5	-699.8	.0	.0	78.03	.137
7.00	1.00	4.37	1.74	.0	6.96	-71.7	-734.2	.0	.0	77.37	.137
2.00	1.00	4.37	1.57	.0	7.02	-73.2	-769.0	.0	.0	76.70	.138
.00	1.00	4.37	1.41	.0	7.04	-73.5	-783.0	.0	.0	76.43	.138

DISPLACEMENTS

ELEV X, ft	DEFLECTION feet			ROTATION, degrees				
	X	Y	Z	XY-Result	X	Y	Z	XY-Result
149.00	.00	1.84	-.02	1.84< 1.24%>	-1.36	.00	.00	1.36

SHAPE: 18 SIDED POLYGON with FLAT-FLAT ORIENTATION
 BOLTS: QUADRANT SPACED BOLTS 6.00 in. ON CENTER
 LOCATE:

POLE DATA

DIAMETER = 56.99 in.	BASE	AXIAL FORCE= -58.6 kips	Vert
PLATE = .4375 in.	ACTIONS	SHEAR X = 32.5 kips	Long
TAPER = .2810 in/ft		SHEAR Y = 32.5 kips	Tran
POLE Fy = 65.00 ksi		X-AXIS MOM = 3863.8 ft-kips	Tran
		Y-Axis MOM = 3863.8 ft-kips	Long
		Z-Axis MOM = .0 ft-kips	Vert

DESIGN CASE = 1 3s Gusted Wind

Design: ANY Orientation Reactions at 45.00 deg to X-AXIS

BOLT LOADS

AXIAL - COMPRESSION	= 208.67 kips	
AXIAL - TENSION	= 202.81 kips	
SHEAR	= 3.25 kips	
AXIAL STRESS	= 64.21 ksi	
SHEAR STRESS	= 1.06 ksi	
YIELD STRENGTH Fy	= 75.00 ksi	
ULT. STRENGTH Fu	= 100.00 ksi	Interaction
ALLOW STRESS Fa [.80 x 1.00]	= 80.00 ksi	.829 TIA-G
SHEAR Fv [.80 x .40]	= 32.00 ksi	
TENSION AREA REQUIRED	= 2.61 in ²	
TENSION AREA FURNISHED	= 3.25 in ²	
ROOT AREA FURNISHED	= 3.07 in ²	

A615 :: ANCHOR BOLT DESIGN USED

20 Bolts on a 63.750 in. Bolt Circle SHIP
 2.250 in. Diameter 67.13 in. Embedded (lbs)
 12.00 in. Exposed 84.00 in. Total Length 2683

CONCRETE - Fc= 4000 psi

ANCHOR BOLTS are STRAIGHT w\ UPLIFT NUT

BASE PLATE

[Bend Model: 1/4 Circ]
 YIELD STRENGTH = 50.0 ksi
 BEND LINE WIDTH = 45.2 in.
 PLATE MOMENT = 3274.0 in-k
 THICKNESS REQD = 2.537 in.
 BENDING STRESS = 38.3 ksi
 ALLOWABLE STRESS = 45.0 ksi
 [Fy x .90 x 1.00]

BASE PLATE USED

2.75 in. THICK SHIP
 64.75 in. SQUARE (lbs)
 44.50 in. CENTER HOLE 1612
 15.00 in. CORNER CLIP

LOAD CASE SUMMARY

LC	FORCES- (kips)			MOMENTS- (ft-k)			ABolt-Str		Plate-Str		Design Code
	Axial	ShearX	ShearY	X-axis	Y-axis	TorQ	CSR	Allow ksi	Actual ksi	Allow ksi	
1	58.6	32.5	32.5	3864	3864	0	.829	75.00	38.29	45.00	TIA-G
2	44.2	32.5	32.5	3798	3798	0	.813	75.00	37.51	45.00	TIA-G
3	73.5	5.0	5.0	553	553	0	.132	75.00	6.11	45.00	TIA-G
4	48.1	7.3	7.3	857	857	0	.191	75.00	8.83	45.00	TIA-G

MAT FOUNDATION DESIGN BY SABRE TOWERS & POLES

150' Monopole SAI COMMUNICATIONS New Milford, CT (111274) 9-25-14 TTW

Overall Loads:

Factored Moment (ft-kips)	5465
Factored Axial (kips)	58.6
Factored Shear (kips)	45.9
Bearing Design Strength (ksf)	40
Water Table Below Grade (ft)	999
Width of Mat (ft)	25.5
Thickness of Mat (ft)	2
Depth to Bottom of Slab (ft)	6
Quantity of Bolts in Bolt Circle	20
Bolt Circle Diameter (in)	63.75
Top of Concrete to Top of Bottom Threads (in)	60
Diameter of Pier (ft)	7
Ht. of Pier Above Ground (ft)	0.5
Ht. of Pier Below Ground (ft)	4
Quantity of Bars in Mat	47
Bar Diameter in Mat (in)	1.128
Area of Bars in Mat (in ²)	46.97
Spacing of Bars in Mat (in)	6.50
Quantity of Bars Pier	32
Bar Diameter in Pier (in)	1.27
Tie Bar Diameter in Pier (in)	0.625
Spacing of Ties (in)	12
Area of Bars in Pier (in ²)	40.54
Spacing of Bars in Pier (in)	7.41
f'c (ksi)	4
fy (ksi)	60
Unit Wt. of Soil (kcf)	0.125
Unit Wt. of Concrete (kcf)	0.15

Max. Net Bearing Press. (ksf)	8.30
Allowable Bearing Pressure (ksf)	26.67
Safety Factor	2.00
Ultimate Bearing Pressure (ksf)	53.33
Bearing Φs	0.75

Minimum Pier Diameter (ft)	6.81
Equivalent Square b (ft)	6.20

Recommended Spacing (in)	6 to 12
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Minimum Pier A _s (in ²)	27.71
Recommended Spacing (in)	6 to 12

Volume of Concrete (yd³) 54.58

Two-Way Shear Action:

Average d (in)	19.872
φV _c (kips)	1394.4
φV _c = φ(2 + 4/β _c)f'c ^{1/2} b _o d	2091.7
φV _c = φ(α _s d/b _o +2)f'c ^{1/2} b _o d	1546.4
φV _c = φ4f'c ^{1/2} b _o d	1394.4
Shear perimeter, b _o (in)	326.32
β _c	1

V _u (kips)	114.7
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One-Way Shear:

φV _c (kips)	653.8
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V _u (kips)	384.6
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Stability:

Overtuning Design Strength (ft-k)	6606.9
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Total Applied M (ft-k)	5763.4
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Pier Design:

ϕV_n (kips)	610.1	V_u (kips)	45.9
$\phi V_c = \phi 2(1 + N_u / (2000 A_g)) f'_c{}^{1/2} b_w d$	610.1		
V_s (kips)	0.0	*** $V_s \text{ max} = 4 f'_c{}^{1/2} b_w d$ (kips)	1428.0
Maximum Spacing (in)	8.77	(Only if Shear Ties are Required)	
Actual Hook Development (in)	18.74	Req'd Hook Development l_{dh} (in)	16.87
		*** Ref. To Spacing Requirements ACI 11.5.4.3	

Flexure in Slab:

ϕM_n (ft-kips)	3913.9	M_u (ft-kips)	3196.6
a (in)	2.71		
Steel Ratio	0.00772		
β_1	0.85		
Maximum Steel Ratio (ρ_t)	0.0181		
Minimum Steel Ratio	0.0018		
Rebar Development in Pad (in)	112.78	Required Development in Pad (in)	25.82

Condition	1 is OK, 0 Fails
Maximum Soil Bearing Pressure	1
Pier Area of Steel	1
Pier Shear	1
Interaction Diagram Visual Check	1
Two-Way Shear Action	1
One-Way Shear Action	1
Overtuning	1
Flexure	1
Steel Ratio	1
Length of Development in Pad	1
Hook Development	1