TransAmerican
Power Products, Inc.
2427 Kelly Lane
Houston, Texas 77066
PH: 281-444-8277 / FX: 281-444-7270

Page 1 of 1		Job Number:	23513-0285
Eng: MFP		Customer Ref:	TP-11460
		Date:	11/3/2013
Structure:	195-FT MONOPOLE		
Site:	280377, CHESTERBROOKE		
Location:	GUILFORD CO., NC / 36°12'6.9", -79°49'59.8"		
Owner:	AMERICAN TOWER		
Revision No.:	Revision Date:		

DESIGN

Building Code:	2012 NORTH CAROLINA BUILDING CODE		
Design Standard:	ANSI/TIA-222-G-2		
Wind Speed Load Cases:	3-SEC. GUSTED WIND SPEED		
Load Case #1:	90 MPH Design Wind Speed		
Load Case #2:	30 MPH Wind with 0.75" Ice Accumulation		
Load Case #3	60 MPH Service Wind Speed		
Structure Class	Exposure Cat.	Topographic Cat.	Crest Height
II	C		

EQUIPMENT LIST

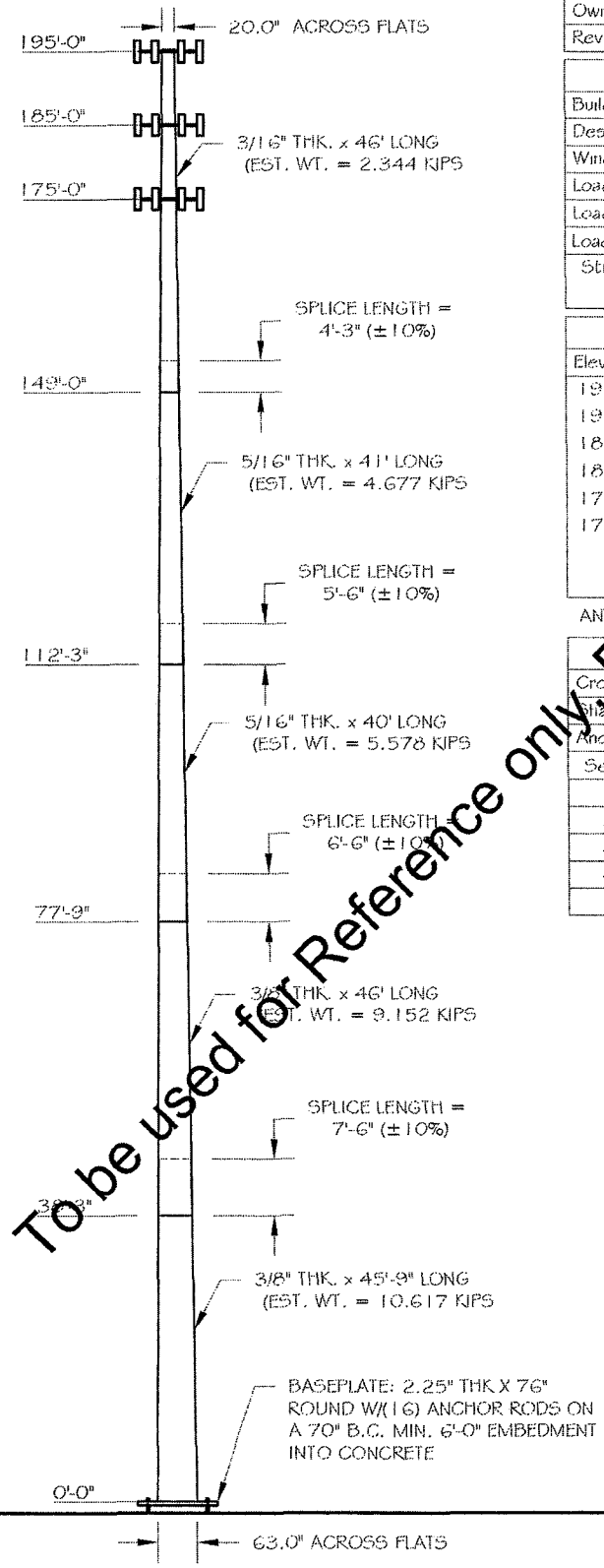
Elev.	Description
195	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
195	T-ARM MOUNTS
185	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
185	T-ARM MOUNTS
175	(12) PANEL ANTENNAS (105 FT2 / 1800 LBS)
175	T-ARM MOUNTS

ANTENNA FEED LINES ROUTED ON THE INSIDE OF THE POLE

STRUCTURE PROPERTIES

Cross-Section: 18-SIDED	Taper: 0.23269 in/ft
Shaft Steel: ASTM A572 GR 65	Baseplate Steel: ASTM A572 GR 50
Anchor Rods: 2.25 in. A615 GR. 75 X 7'-0" LONG	

Sect.	Length (ft)	Thickness (in)	Splice (ft)	Top Dia. (in)	Bot Dia. (in)
1	46.00	0.1875	4.25	20.00	30.70
2	41.00	0.3125	5.50	29.34	38.88
3	40.00	0.3125	6.50	36.98	46.28
4	46.00	0.3750	7.50	44.15	54.85
5	45.75	0.3750		52.35	63.00



To be used for Reference only, Per ATC (American Tower)

NORTH CAROLINA PROFESSIONAL SEAL 032804 MICHAEL F. PLAHOVINSAK ENGINEER
11.3.13
MICHAEL F. PLAHOVINSAK, P.E. LIC. #: 032804
614-398-6250 / mike@mfpe.com

BASE REACTIONS FOR FOUNDATION DESIGN

Moment:	5700 ft-kip
Shear:	40 kip
Axial:	63 kip

Tower Input Data

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

Tower is located in Guilford County, North Carolina.
Basic wind speed of 90 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Nominal ice thickness of 0.7500 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.
Temperature drop of 50 °F.
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, feedline supports, and appurtenance mounts are not considered.

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Tapered Pole Section Geometry

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
L1	195.00-149.00	46.00	4.25	[illegible]	20.0000	30.7000	0.1875	0.7500	A572-65 (65 ksi)
L2	149.00-112.25	41.00	5.50	18	29.3364	38.8800	0.3125	1.2500	A572-65 (65 ksi)
L3	112.25-77.75	40.00	6.50	18	36.9748	46.2800	0.3125	1.2500	A572-65 (65 ksi)
L4	77.75-38.25	46.00	7.50	18	44.1429	54.8500	0.3750	1.5000	A572-65 (65 ksi)
L5	38.25-0.00	45.75		18	52.3543	63.0000	0.3750	1.5000	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in²	I in⁴	r in	C in	I/C in³	J in⁴	It/Q in²	w in	w/ft
L1	29.3085	11.7909	584.7409	7.0334	10.1600	57.5532	1170.2512	5.8966	3.1900	17.013
	30.9736	18.1588	2135.8907	10.8319	15.5956	136.9547	4274.5918	9.0811	5.0732	27.057
L2	30.7935	28.7881	3063.8132	10.3035	14.9029	205.5851	6131.6579	14.3968	4.6132	14.762
	39.4798	38.2541	7188.8407	13.6915	19.7510	363.9728	14387.1406	19.1307	6.2929	20.137
L3	38.8444	36.3644	6175.2167	13.0151	18.7832	328.7631	12358.5588	18.1856	5.9576	19.064
	46.9939	45.5940	12171.5825	16.3185	23.5102	517.7141	24359.1808	22.8013	7.5953	24.305
L4	46.3602	52.0947	12607.8995	15.5376	22.4246	562.2354	25232.3888	26.0523	7.1092	18.958
	55.6961	64.8389	24309.0147	19.3386	27.8638	872.4228	48650.0159	32.4256	8.9936	23.983
L5	54.9340	61.8683	21118.6593	18.4526	26.5960	794.0548	42265.1070	30.9400	8.5544	22.812
	63.9719	74.5394	36933.3632	22.2319	32.0040	1154.0233	73915.3243	37.2768	10.4280	27.808

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft²/ft	Weight plf
1 5/8"	C	No	Inside Pole	195.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
						1" Ice	0.00	0.92
1 5/8"	C	No	Inside Pole	185.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
						1" Ice	0.00	0.92
1 5/8"	C	No	Inside Pole	175.00 - 0.00	18	No Ice	0.00	0.92
						1/2" Ice	0.00	0.92
						1" Ice	0.00	0.92

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft²	C_AA_A Side ft²	Weight K
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	195.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
						1" Ice	145.00	145.00	2.88
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	185.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
						1" Ice	145.00	145.00	2.88
(12) Panel w/ mounting (105 ft2 / 1800 lbs)	C	None		0.0000	175.00	No Ice	105.00	105.00	1.80
						1/2" Ice	125.00	125.00	2.34
						1" Ice	145.00	145.00	2.88

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 90 deg - No Ice
5	0.9 Dead+1.6 Wind 90 deg - No Ice
6	1.2 Dead+1.6 Wind 180 deg - No Ice
7	0.9 Dead+1.6 Wind 180 deg - No Ice
8	1.2 Dead+1.0 Ice+1.0 Temp
9	1.2 Dead+1.0 Wind 0 deg+1.0 Ice+1.0 Temp
10	1.2 Dead+1.0 Wind 90 deg+1.0 Ice+1.0 Temp
11	1.2 Dead+1.0 Wind 180 deg+1.0 Ice+1.0 Temp
12	Dead+Wind 0 deg - Service
13	Dead+Wind 90 deg - Service
14	Dead+Wind 180 deg - Service

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Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	195 - 149	Pole	Max Tension	9	0.00	0.00	-0.00
			Max. Compression	8	-19.17	0.00	0.00
			Max. Mx	4	-8.52	-592.07	0.00
			Max. My	2	-8.52	0.00	592.07
			Max. Vy	4	19.76	-592.07	0.00
			Max. Vx	2	-19.76	0.00	592.07
L2	149 - 112.25	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	8	-29.30	0.00	0.00
			Max. Mx	4	-16.06	-1352.93	0.00
			Max. My	2	-16.06	0.00	1352.93
			Max. Vy	4	23.13	-1352.93	0.00
			Max. Vx	2	-23.13	0.00	1352.93
L3	112.25 - 77.75	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	8	-41.[illegible]	0.00	0.00
			Max. Mx	4	-24.92	-2183.57	0.00
			Max. My	2	-24.92	0.00	2183.57
			Max. Vy	4	26.39	-2183.57	0.00
			Max. Vx	2	-26.39	0.00	2183.57
L4	77.75 - 38.25	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	8	-58.11	0.00	0.00
			Max. Mx	4	-38.04	-3274.31	0.00
			Max. My	2	-38.04	0.00	3274.31
			Max. Vy	4	30.16	-3274.31	0.00
			Max. Vx	2	-30.16	0.00	3274.31
L5	38.25 - 0	Pole	Max Tension	1	0.00	0.00	0.00
			Max. Compression	8	-81.11	0.00	0.00
			Max. Mx	4	-56.33	-4742.85	0.00
			Max. My	2	-56.33	0.00	4742.85
			Max. Vy	4	33.76	-4742.85	0.00
			Max. Vx	2	-33.76	0.00	4742.85

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	195 - 149	43.989	13	2.2552	0.0000
L2	153.25 - 112.25	25.754	13	1.7549	0.0000
L3	117.75 - 77.75	14.450	13	1.2608	0.0000
L4	74.25 - 38.25	7.086	13	0.8107	0.0000
L5	45.75 - 0	2.075	13	0.4128	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
195.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	13	43.989	2.2552	0.0000	25213
185.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	13	39.360	2.1405	0.0000	12606
175.00	(12) Panel w/ mounting (105 ft2 /	13	34.827	2.0239	0.0000	6302

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Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
	1800 lbs)					

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	195 - 149	177.679	2	9.1192	0.0000
L2	153.25 - 112.25	104.177	2	7.1027	0.0000
L3	117.75 - 77.75	58.496	2	5.1062	0.0000
L4	84.25 - 38.25	28.693	2	3.2841	0.0000
L5	45.75 - 0	8.403	2	1.6719	0.0000

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
195.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	177.679	9.1192	0.0000	6521
185.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	150.929	8.6571	0.0000	3259
175.00	(12) Panel w/ mounting (105 ft2 / 1800 lbs)	2	140.761	8.1874	0.0000	1626

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	195 - 149 (1)	TP30.7x20x0.1875	46.00	0.00	0.0	17.5704	-8.52	1117.50	0.008
L2	149 - 112.25 (2)	TP38.88x29.3364x0.3125	41.00	0.00	0.0	36.9843	-16.06	2615.06	0.006
L3	112.25 - 77.75 (3)	TP46.28x36.9748x0.3125	40.00	0.00	0.0	44.0942	-24.92	2929.35	0.009
L4	77.75 - 38.25 (4)	TP54.85x44.1429x0.375	46.00	0.00	0.0	62.7610	-38.04	4188.71	0.009
L5	38.25 - 0 (5)	TP63x52.3543x0.375	45.75	0.00	0.0	74.5394	-56.33	4608.35	0.012

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	195 - 149 (1)	TP30.7x20x0.1875	592.07	679.46	0.871	0.00	679.46	0.000
L2	149 - 112.25 (2)	TP38.88x29.3364x0.3125	1352.93	2004.06	0.675	0.00	2004.06	0.000
L3	112.25 - 77.75 (3)	TP46.28x36.9748x0.3125	2183.57	2680.07	0.815	0.00	2680.07	0.000
L4	77.75 - 38.25 (4)	TP54.85x44.1429x0.375	3274.31	4545.13	0.720	0.00	4545.13	0.000
L5	38.25 - 0 (5)	TP63x52.3543x0.375	4742.85	5945.56	0.798	0.00	5945.56	0.000

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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 $\frac{M_{uy}}{\phi M_{ny}}$

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	195 - 149 (1)	TP30.7x20x0.1875	19.76	558.75	0.035	0.00	1160.59	0.000
L2	149 - 112.25 (2)	TP38.88x29.3364x0.3125	23.13	1307.53	0.018	0.00	4013.02	0.000
L3	112.25 - 77.75 (3)	TP46.28x36.9748x0.3125	26.39	1464.68	0.018	0.00	5366.70	0.000
L4	77.75 - 38.25 (4)	TP54.85x44.1429x0.375	30.16	2094.35	0.014	0.00	9101.42	0.000
L5	38.25 - 0 (5)	TP63x52.3543x0.375	33.76	2304.17	0.015	0.00	11905.67	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	Ratio $\frac{M_{uy}}{\phi M_{ny}}$	Ratio $\frac{V_u}{\phi V_n}$	Ratio $\frac{T_u}{\phi T_n}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	195 - 149 (1)	0.008	0.871	0.000	0.035	0.000	0.880 ✔	1.000	4.8.2 ✔
L2	149 - 112.25 (2)	0.006	0.675	0.000	0.018	0.000	0.682 ✔	1.000	4.8.2 ✔
L3	112.25 - 77.75 (3)	0.009	0.815	0.000	0.018	0.000	0.824 ✔	1.000	4.8.2 ✔
L4	77.75 - 38.25 (4)	0.009	0.720	0.000	0.014	0.000	0.730 ✔	1.000	4.8.2 ✔
L5	38.25 - 0 (5)	0.012	0.798	0.000	0.015	0.000	0.810 ✔	1.000	4.8.2 ✔

Section Capacity Table

Section No.	Elevation	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
L1	195 - 149	Pole	TP30.7x20x0.1875	1	-8.52	1117.50	88.0	Pass
L2	149 - 112.25	Pole	TP38.88x29.3364x0.3125	2	-16.06	2615.06	68.2	Pass
L3	112.25 - 77.75	Pole	TP46.28x36.9748x0.3125	3	-24.92	2929.35	82.4	Pass
L4	77.75 - 38.25	Pole	TP54.85x44.1429x0.375	4	-38.04	4188.71	73.0	Pass
L5	38.25 - 0	Pole	TP63x52.3543x0.375	5	-56.33	4608.35	81.0	Pass
						Summary		
						Pole (L1)	88.0	Pass
						RATING =	**88.0**	**Pass**

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Job: 195-ft monopole - MFP #23513-0285		Page: BP-G
Project: 280377, Chesterbrooke		Date: 11/3/2013
Client: TAPP (TP-11460)		Designed by: Mike

Anchor Rod and Base Plate Calculation

ANSI/TIA-222-G-2

Factored Base Reactions:		***Pole Shape:***	***Anchor Rods:***	***Base Plate:***
Moment:	4743 ft-kips	18-Sided	(14) 2.25 in. A615 GR. 75	2.25 in. x 74 in. Round
Shear:	34 kips	***Pole Dia. (D_f):***	Anchor Rods Evenly Spaced	fy = 50 ksi
Axial:	56 kips	61.00 in	On a 68 in Bolt Circle	

Anchor Rod Calculation According to TIA-222-G section 4.9.9

ϕ = 0.80 TIA 4.9.9

I_{bolts} = 8092.00 in^2 Moment of Inertia

P_u = 239 kips Tension Force

V_u = 2 kips Shear Force

R_{nt} = 325.00 kips Nominal Tensile Strength

η = 0.50 for detail type (d)

The following Interation Equation Shall Be Satisfied:

$$\left(\frac{P_u + \frac{V_u}{\eta}}{\phi R_{nt}}\right) \leq 1.0$$

$$0.938 \leq 1$$

Base Plate Calculation According to TIA-222-G

ϕ = 0.90 TIA 4.7

M_{PL} = 577.5 in-kip Plate Moment

L = 13.7 in Section Length

Z = 17.3 Plastic Section Modulus

M_P = 866.2 in-kip Plastic Moment

ϕM_n = 779.6 in-kip Factored Resistance

Calculated Moment vs Factored Resistance

577.46 in-kip $\leq$ 780 in-kip

Anchor Rods Are Adequate	**93.8%**	☑
Base Plate is Adequate	**74.1%**	☑

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