

**Structural Analysis for
SBA Network Services, Inc.**

**120 ft Monopole W/ Proposed 10 ft Extension
SBA Site Name: Middletown
SBA Site ID: CT13064-A**


FDH Project Number 10-02146E S2

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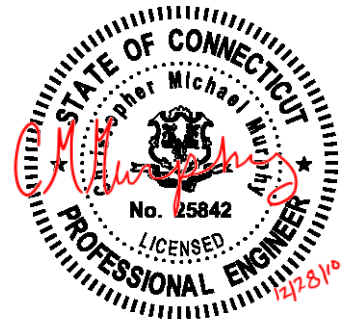


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EXECUTIVE SUMMARY

At the request of SBA Network Services, Inc., FDH Engineering, Inc. performed a structural analysis of the monopole located in Middletown, CT to determine whether the tower is structurally adequate to support both the existing and proposed loads, pursuant to the *Structural Standard for Antenna Supporting Structures and Antennas, ANSI/TIA-222-G*. Information pertaining to the existing/proposed antenna loading, current tower geometry, member sizes, and soil parameters was obtained from:

- Radian Communication Services (File No. 060-3494) original design drawings dated December 15, 2006
- FDH, Inc. (Job No. 08-07129T) TIA Inspection Report dated October 12, 2008
- Gemini Geotechnical Associates, Inc. (Site No. 999-0049) Geotechnical Engineering Report dated November 30, 2006
- SBA Network Services, Inc.

The *basic design wind speed* per the *ANSI/TIA-222-G* standard is 110 mph without ice and 50 mph with 3/4" radial ice. Ice is considered to increase in thickness with height.

Conclusions

With the existing and proposed antennas from AT&T in place at 130 ft on a proposed 10 ft extension, the tower does not meet the requirements of the *ANSI/TIA-222-G* standard. However, provided the foundation was constructed per the original design drawings (see Radian File No. 060-3494), the foundation should have the necessary capacity to support the existing and proposed loading. For a more detailed description of the analysis of the tower, see the **Results** section of this report.

Our structural analysis has been performed assuming all information provided to FDH Engineering, Inc. is accurate (i.e. the steel data, tower layout, existing antenna loading, and proposed antenna loading) and that the tower has been properly erected and maintained per the original design drawings.

Recommendations

To ensure the requirements of the *ANSI/TIA-222-G* standard are met with the existing and proposed loading in place, we have the following recommendations:

1. The proposed coax should be installed inside the monopole shaft.
2. The proposed TMAs and RRHs should be installed behind the proposed panel antennas.
3. Reinforcement of the tower's baseplate is required to support the existing and proposed loading.
4. Reinforcement of the tower's anchor bolts is required to support the existing and proposed loading.

We would anticipate the construction cost for a turnkey design/build modification project of this nature to range in price from approximately \$30,000 to \$40,000 (which should include the engineering design fees, inspection fees, and construction fees).

APPURTENANCE LISTING

The proposed and existing antennas with their corresponding cables/coax lines are shown in **Table 1**. *If the actual layout determined in the field deviates from this layout, FDH Engineering, Inc. should be contacted to perform a revised analysis.*

Table 1 – Appurtenance Loading

Existing Loading:

Antenna No.	Antenna Elevation (ft)	Description	Coax and Lines ¹	Carrier	Mount Elevation (ft)	Mount Type
1-6	120.85	(6) RFS APXV86-906515	(12) 1-5/8"	Nextel	120.85	(6) Pipe Mounts
7-9	112	(3) Jaybeam X65-13-04	(12) 1-5/8"	Verizon	112	(3) Pipe Mounts
10-12	101	(3) RFS APXV18-206517S	(6) 1-5/8"	Pocket	101	(3) Pipe Mounts
13-17	90	(3) Argus LLPX310R (1) Andrew VHLP2-11 Dish (1) Andrew VHLP2.5-11 Dish (3) Samsung 2.5GHz RRH BTSs	(3) 5/16" (2) 1/2" (3) 5/8" (3) 1/4"	Clearwire	90	(3) Pipe Mounts

¹ Coax located inside the pole's shaft unless otherwise noted.

Proposed Loading:

Antenna No.	Antenna Elevation (ft)	Description	Coax and Lines	Carrier	Mount Elevation (ft)	Mount Type
1-9	130	(9) Powerwave P65-16-XLH-RR (6) Powerwave TT19-08BP111-001 TMAs (6) Ericsson RRUS-11 RRHs	(18) 1-5/8" (1) 1/2"	AT&T	130	(1) Low-Profile Platform (EPA= 18ft ²)

RESULTS

Based on information obtained from the original design drawings, the yield strength of steel for individual members was as follows:

Table 2 - Material Strength

Member Type	Yield Strength
Tower Shaft Sections	65 ksi
Base Plate	50 ksi
Anchor Bolts	105 ksi

Table 3 displays the summary of the ratio (as a percentage) of force in the member to their capacities. Values greater than 100% indicate locations where the maximum force in the member exceeds its capacity. **Table 4** displays the maximum foundation reactions. **Table 5** displays the maximum antenna rotations at service wind speed.

If the assumptions outlined in this report differ from actual field conditions, FDH Engineering, Inc. should be contacted to perform a revised analysis. Furthermore, as no information pertaining to the allowable twist and sway requirements for the existing or proposed appurtenances was provided, deflection and rotation were not taken into consideration when performing this analysis.

See the **Pole Profile & Base Level Sketch** for detailed modeling information.

Table 3 – Summary of Working Percentage of Structural Components

Section No.	Elevation ft	Component Type	Size	% Capacity	Pass Fail
L1	130 - 120.5	Pole	TP18x18x0.25	23.0	Pass
L2	120.5 - 120	Pole	TP21.74x18x0.25	23.0	Pass
L3	120 - 87.42	Pole	TP29.89x21.74x0.1875	64.2	Pass
L4	87.42 - 43.3367	Pole	TP36.31x28.5352x0.25	91.1	Pass
L5	43.3367 - 0	Pole	TP42.5x35.0541x0.3125	96.1	Pass
	0	Anchor Bolts	(14) 1.5"Ø w/ BC = 47.25"	124.4	Fail
	0	Base Plate	PL 51.75" Round x 1.5" Thk	114.3	Fail

Table 4 – Maximum Base Reactions

Base Reactions	Current Analysis* (ANSI/TIA-222-G)	Original Design (ANSI/TIA-222-G)
Axial	26 k	39 k
Shear	25 k	20 k
Moment	2,343 k-ft	1,864 k-ft

*Foundation determined adequate based on independent evaluation.

GENERAL COMMENTS

This engineering analysis is based upon the theoretical capacity of the structure. It is not a condition assessment of the tower and its foundation. It is the responsibility of SBA Network Services, Inc. to verify that the tower modeled and analyzed is the correct structure (with accurate antenna loading information) modeled. If there are substantial modifications to be made or the assumptions made in this analysis are not accurate, FDH Engineering, Inc. should be notified immediately to perform a revised analysis.

LIMITATIONS

All opinions and conclusions are considered accurate to a reasonable degree of engineering certainty based upon the evidence available at the time of this report. All opinions and conclusions are subject to revision based upon receipt of new or additional/updated information. All services are provided exercising a level of care and diligence equivalent to the standard and care of our profession. No other warranty or guarantee, expressed or implied, is offered. Our services are confidential in nature and we will not release this report to any other party without the client's consent. The use of this engineering work is limited to the express purpose for which it was commissioned and it may not be reused, copied, or distributed for any other purpose without the written consent of FDH Engineering, Inc.

APPENDIX

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod	130	X65-13-04 W/ Mount Pipe (Verizon)	112
(3) P65-16-XLH-RR W/ Mount Pipe (ATI)	130	X65-13-04 W/ Mount Pipe (Verizon)	112
		X65-13-04 W/ Mount Pipe (Verizon)	112
(3) P65-16-XLH-RR W/ Mount Pipe (ATI)	130	APXV18-206517S W/Mount Pipe (Pocket)	101
(3) P65-16-XLH-RR W/ Mount Pipe (ATI)	130	APXV18-206517S W/Mount Pipe (Pocket)	101
(2) TT19-08BP111-001 TMA (ATI)	130	APXV18-206517S W/Mount Pipe (Pocket)	101
(2) TT19-08BP111-001 TMA (ATI)	130	VHLP2.5-11 (Clearwire)	90.0001
(2) TT19-08BP111-001 TMA (ATI)	130	LLPX310R W/ Mount Pipe (Clearwire)	90
(2) RRUS-11 RRH (ATI)	130	LLPX310R W/ Mount Pipe (Clearwire)	90
(2) RRUS-11 RRH (ATI)	130	2.5 GHz RRH BTS (Clearwire)	90
(2) RRUS-11 RRH (ATI)	130	2.5 GHz RRH BTS (Clearwire)	90
Low-Profile Platform (ATI)	130	2.5 GHz RRH BTS (Clearwire)	90
(2) APXV86-906515 W/ Mount Pipe (Nextel)	120.85	2.5 GHz RRH BTS (Clearwire)	90
		VHLP2-11 (Clearwire)	90
(2) APXV86-906515 W/ Mount Pipe (Nextel)	120.85	LLPX310R W/ Mount Pipe (Clearwire)	90
(2) APXV86-906515 W/ Mount Pipe (Nextel)	120.85		

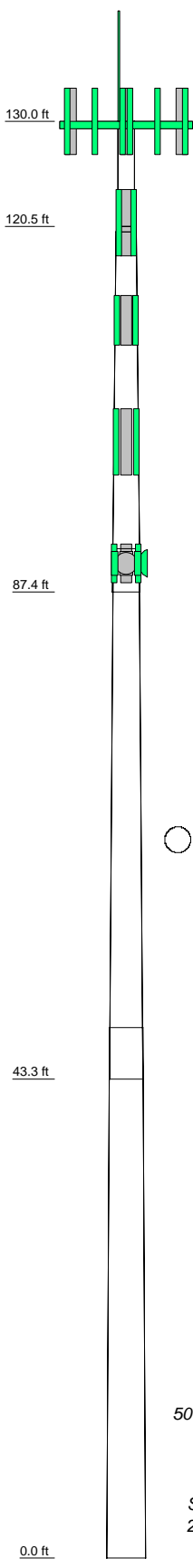
MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A500-50	50 ksi	62 ksi	A572-65	65 ksi	80 ksi

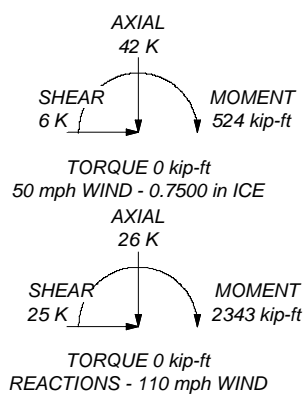
TOWER DESIGN NOTES

1. Tower is located in Middlesex County, Connecticut.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 110 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 50 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 0.00 ft

Section	1	2	3	4	5	6.2	12.6
Length (ft)	9.50	0.50	32.58	48.00	48.00	48.00	48.00
Number of Sides	1	1	18	18	18	18	18
Thickness (in)	0.2500	0.2500	0.1875	0.2500	0.3125	0.3125	0.3125
Socket Length (ft)	0.2500	0.2500	3.92	4.67	35.0541	42.5000	42.5000
Top Dia (in)	18.0000	18.0000	21.7400	28.5352	36.3100	42.5000	42.5000
Bot Dia (in)	18.0000	18.0000	21.7400	28.5352	36.3100	42.5000	42.5000
Grade	A500-50	A500-50	A500-50	A572-65	A572-65	A572-65	A572-65
Weight (K)	0.5	0.0	1.7	4.2	6.2	6.2	12.6



ALL REACTIONS
ARE FACTORED



 Tower Analysis	FDH Engineering, Inc. 2730 Rowland Road Raleigh, North Carolina Phone: (919) 755-1012 FAX: (919) 755-1031	Job: Middletown (CT13064-A) Project: 10-02146E S2 Client: SBA Network Services, Inc. Code: TIA-222-G Path:
	Drawn by: BAB Date: 12/28/10	App'd: Scale: NTS Dwg No. E-1
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