

Date: October 14th, 2024



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Subject: PE Feasibility Letter – Stealth Pole 20-Ft Extension

Carrier Designation: Verizon
Carrier Site Name: DEN Kenton

Engineering Firm Designation: Ahola Engineering LLC Project Number: 600-24-040

Site Address: 11000 East Yale Avenue, Aurora, CO 80014
Arapahoe County
Latitude 39.66691°, Longitude -104.86022°
50'-0" Stealth Monopole Tower

Dear Mr. Ratigan,

Ahola Engineering LLC is pleased to submit this “**Structural Assessment**” to determine the feasibility to extend existing stealth monopole an additional 20'-0" in height from 50'-0" to 70'-0".

The structure assessment and feasibility consisted of reviewing various documents (refer Table 2 below) including the geotechnical report, tower structural drawings, original tower structural calculation package, and tower mapping report. Additional foundation analysis was also performed (refer Appendix A) to better clarify the maximum drilled pier soil and reinforced concrete foundation stress usage. Section 4 (Table 3) provides a list of current stress usages for all the various tower and foundation components. Per the discussion in Section 4.1 (Summary & Recommendations) below, it is believed that a 20'-0" stealth monopole extension could be added without overstressing the main 36" O.D. stealth pole tube or foundation. In addition, any future structural analysis using the current 2021 IBC could likely use somewhat reduced design wind speeds (depending on City of Aurora or Arapahoe County Jurisdiction) as well as an air density factor (i.e., ground elevation factor) reduction to the wind pressure calculation from what was calculated in prior Vector Engineer's structural calc package.

We at Ahola Engineering LLC appreciate the opportunity of providing our continuing professional services to you and Verizon. If you have any questions or need further assistance on this or any other project's please give us a call.

Respectfully submitted by:

Mikko P. Ahola, PE
CO PE # 33495
Expires: 10/31/2025



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1) INTRODUCTION

The structure is an existing 50'-0" stealth monopole tower with a 36" diameter x 3/8" thick steel base tube extending to a height of 34'-6" followed by a 36" diameter FPR shroud extending to the top 50'-0" elevation. The shroud is supported on a 4.5" diameter x 0.237" thick x 15'-5" long center pipe mast bolted to the main steel pole via a base plate with steel reinforcing gussets to a flange plate welded to top of the main 36" steel tube. The FRP shroud is divided into two antenna bays. The stealth tower is supported on a drilled foundation pier.

2) ANALYSIS CRITERIA

Building Code:	2015 IBC / ASCE 7-10 (prior Vector Engineer's Structural Calcs)
TIA-222 Revision:	TIA-222-H
Risk Category:	II
Wind Speed:	115 mph
Exposure Category:	C
Topographic Factor:	1
Ice Thickness:	0.25 in
Wind Speed with Ice:	50 mph
Seismic Design Category:	B
Seismic Ss:	0.203
Seismic S1:	0.057
Service Wind Speed:	60 mph

Table 1 - Existing Verizon Equipment Loading

Mounting Level (ft)	Center Line Elevation (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model1	Number of Feed Lines	Feed Line Size (in)
46'-9" & 39'-0" Verizon	46'-9" & 39'-0" Verizon	6	Commscope	NHH-65B-R2B Panel Antennas	±12	1x1 HCS

Notes: 1. Verizon (3) Ericsson Radio 8843, (3) Ericsson Radio 4449, & (1) Raycap OVP mounted within multiple ports near base of stealth monopole

3) ANALYSIS PROCEDURE

Table 2 – Reference Documents

Document	Reference	Date	Source
Geotechnical Engineering Investigation	Verizon Site Name: DEN Kenton File No. 19-0125	00/17/2019	Martinez Associates
Stealth Pole Structural Fabrication Drawings	Verizon Site Name: DEN Kenton Raycap Job No. VZ19-00977H-32R0	02/28/2020	Raycap/Stealth
Structural Calculations	Verizon Site Name: DEN Kenton Vector Project # U0142-873-191	09/25/2019	Vector Engineers
Stealth Monopole Mapping	Verizon Site Name: DEN Kenton SC Job # 240310	07/19/2024	Structural Components, LLC

3.1) Assessment Methods

Review of existing geotechnical report, Raycap Stealth tower fabrication drawings, stealth monopole structural calculation package, recent tower mapping report as well as use of additional drilled pier foundation spreadsheets were utilized to determine stress usages for various stealth tower and foundation components to determine structural feasibility for 20'-0" pole extension.

4) STRUCTURAL ASSESSMENT RESULTS

Table 3 – Summary of Existing Structure Stresses vs. Capacity

Stealth Monopole / Foundation Component	Elevation (ft)	% Capacity	Pass / Fail
Lower 36" O.D. x 0.375" Thick Steel Base Tube	0'-0" – 34'-6"	7.9	Pass
Upper 4.5" O.D. x 0.237" Thick Center Mast Pipe	34'-6" – 50'-0"	68.3	Pass
Upper Mast Pipe Base Plate 1/4" Thick Steel Reinforcing Gussets	34'-6"	83.0	Pass
Lower 36" O.D. Base Tube OVP Port Holes	8'-8"	21.0	Pass
Lower 36" O.D. Base Tube RRH Port Holes	5'-10"	22.0	Pass
Lower 36" O.D. Base Tube RRH Port Holes	3'-0"	25.0	Pass
Stealth Monopole Anchor Bolts – (4) 2-1/4" Dia. (Tension and/or Compression)	0'-0"	9.0	Pass
Stealth Monopole Base Plate (40" Square x 2" Thick)	0'-0"	6.0	Pass
5'-6" Diameter x 16'-6" Drilled Foundation Pier (Foundation Soil Rating – Vertical Compression)	0'-0" – 16'-6" Depth	38.3	Pass
5'-6" Diameter x 16'-6" Drilled Pier (Reinforced Concrete Foundation Structural Rating – Compression)	0'-0" – 16'-6" Depth	3.9	Pass
Existing Pole Structure & Foundation Rating (max from all components) =			83.0%

4.1) Summary & Recommendations

Per review and assessment of documents provided in Table 2, along with additional drilled pier foundation analysis (refer Appendix A), the maximum existing stealth pole stress usage is shown to be 83.0% and maximum foundation stress usage is determined to be 38.3%. The higher stealth pole stress usage occurs mainly on the upper 4.5" O.D. x 15'-5" tall mast pipe and/or upper mast pipe steel reinforcing gussets attaching it to the lower 36" O.D. x 34'-6" tall base steel tube. The maximum stress usage on all components of the lower 36" O.D. steel tube (including anchor bolts, base plate, and port holes) is shown to be 25%. As such, both the lower stealth tube and foundation currently have low stress usages (i.e., < 38.3%).

Based on this existing pole stress usage assessment, it is believed that the current stealth pole could be extended an additional 20'-0". Such extension should consist of a matching 36" O.D. x 0.375" thick x 20'-0" long steel tube extension. The bottom of the new 36" O.D. pole extension and top of the existing 36" O.D. tube at the 34'-6" height would need welded exterior flange plates with matching bolt holes (size & number of exterior flange bolts and flange plate thickness to be determined upon final design). In addition, the top of the new 36" O.D. x 20'-0" pole extension would require a 6-faceted welded flange plate (matching existing one at the 34'-6" pole height as shown on Sheet S4 of the Raycap stealth pole shop drawings) to reattach the upper 4.5" O.D. x 0.237" thick x 15'-5" center mast pipe supporting the FRP shroud. The final max pole height would then become 70'-0".

APPENDIX A
SUPPORTING CALCULATIONS

Drilled Pier Foundation

	N/A
Site Name:	DEN Kenton
Order Number:	50' Stealth Monopole

TIA-222 Revision:	G
Tower Type:	Monopole

Applied Loads		
	Comp.	Uplift
Moment (kip-ft)	76.647	
Axial Force (kips)	7.789	
Shear Force (kips)	2.965	

Material Properties		
Concrete Strength, f _c :	4	ksi
Rebar Strength, F _y :	60	ksi

Pier Design Data		
Depth	16.5	ft
Ext. Above Grade	0.5	ft
Pier Section 1		
<i>From 0.5' above grade to 16.5' below grade</i>		
Pier Diameter	5.5	ft
Rebar Quantity	22	
Rebar Size	8	
Clear Cover to Ties	3	in
Tie Size	4	

Analysis Results		
Soil Lateral Capacity	Compression	Uplift
D _{v=0} (ft from TOC)	5.29	-
Soil Safety Factor	19.44	-
Max Moment (kip-ft)	87.59	-
Rating	6.8%	-

Soil Vertical Capacity	Compression	Uplift
Skin Friction (kips)	32.07	-
End Bearing (kips)	178.19	-
Weight of Concrete (kips)	72.70	-
Total Capacity (kips)	210.26	-
Axial (kips)	80.49	-
Rating	38.3%	-

Reinforced Concrete Capacity	Compression	Uplift
Critical Depth (ft from TOC)	5.13	-
Critical Moment (kip-ft)	87.58	-
Critical Moment Capacity	2230.84	-
Rating	3.9%	-

Soil Interaction Rating	38.3%
Structural Foundation Rating	3.9%

Check Limitation	
N/A	<input type="checkbox"/>

Soil Profile													
Groundwater Depth	23	ft	# of Layers	1									

Layer	Top (ft)	Bottom (ft)	Thickness (ft)	γ _{soil} (pcf)	γ _{concrete} (pcf)	Cohesion (ksf)	Angle of Friction (degrees)	Calculated Ultimate Skin Friction Comp (ksf)	Calculated Ultimate Skin Friction Uplift (ksf)	Ultimate Skin Friction Comp Override (ksf)	Ultimate Skin Friction Uplift Override (ksf)	Ult. Gross Bearing Capacity (ksf)	SPT Blow Count	Soil Type
1	0	16.5	16.5	110	150	0	28	0.000	0.000	0.15	0.15	10		Cohesionless