Reviewed for Code Compliance

04/08/2025

STRUCTURAL ENGINEERING

DK Structural Engineering, LLC
3904 Starlight Creek Drive
Celina, Texas 75009

October 15, 2024

Aaron Zajicek
Retherford Enterprises, Inc.
7093 Silverhorn Drive,
Evergreen, Colorado 80439

Subject:	**CO1 Catamount** **Structural Analysis**
Analysis Criteria:	**Codes:** **2021 IBC w/ local amendments** **ASCE 7-16** **AISC 14th Edition**
Engineering Firm Designation:	**DK Structural Engineering, LLC Project Number:** DK24-0346
Site Data:	**CO1 Catamount** **31800 CR 14C** **Steamboat Springs, Colorado 80487** **Routt County**

Aaron,

DK Structural Engineering, LLC (DKSE) is pleased to submit this **"Structural Analysis"** to determine the structural integrity of the above-mentioned localized roof.

The purpose of the analysis is to determine acceptability of the stress levels from new loads on the existing roof members. Based on our analysis we have determined the roof capacities, under the following load case, to be:

Proposed + Existing (Relocated) Equipment **Passing**

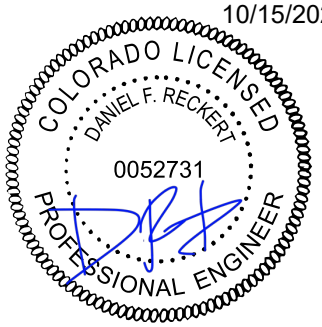
This analysis has been performed in accordance with the 2021 International Building Code and ASCE 7-16 based on ASD load combinations for dead and snow loads.

All modifications and equipment proposed in this report shall be installed per manufacturer specifications and inspected by a third party.

We appreciate the opportunity of providing our continuing professional services to you. If you have any questions or need further assistance on this or any other projects, please send us an email.

Respectfully submitted by:

10/15/2024



Daniel F. Reckert
Structural Engineer
Colorado PE#: 52731
Expires: 10/31/2025

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1) INTRODUCTION

This is an analysis for roof joists under a concealment cupola in Steamboat Springs, Colorado.

2) ANALYSIS CRITERIA

This analysis has been performed in accordance with the 2021 International Building Code and ASCE 7-16.

Table 1 – Final Antenna Information

Mounting Level	Center Line Elevation	Number of Antennas	Mount Location	Antenna Model	Feedlines
25'-8"	26'-7"	**3**	Existing Cupola	**Ericsson AIR 6419**	(2) 6x12 Hybrid
	25'-8"	**3**		**MX12FIT465-01**	
		3		**Ericsson 4890 Radio**	
		3		Ericsson RRU 4449 (relocated from shelter)	
		1		**6627 Raycap OVP**	

1) *Bold loading is proposed.*
2) *All existing loading not shown herein to be removed prior to installation.*

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Performed By	Designation	Date
Mapping Report	DKSE	DK24-0217	07-22-2024
Construction Drawings	Retherford Enterprises	CO1 Catamount	10-14-2024
RF Data Sheet	Verizon Wireless	Site ID: 688464	10-08-2024

3.1) Analysis Method

Mathcad 15 was used to calculate loads and member stresses for various loading cases. Selected output from the analysis is included in Appendix A.

3.2) Assumptions

1) The roof members and their connections have been maintained in accordance with the manufacturer's specification and are in good working condition.
2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
3) Analysis assumes all bolts, nuts, washers, base plates and associated connections were designed by the manufacturer/EOR to support the maximum member loads and are, therefore, passing under this analysis.
4) Check of existing concealment mount members for new loads is provided in a different report and not in the scope of this document.

This analysis may be affected if any assumptions are not valid or have been made in error. DK Structural Engineering, LLC should be notified to determine the effect on the structural integrity of the localized roof if it differs.

4) ANALYSIS RESULTS

Table 3 - Member Capacity (Summary)

Member	Capacity	Code Check	Notes
Joist Vertical Load Comparison	Increase: 1.21%	OK!	1

1) Per IBC, an increase in vertical forces of less than or equal to 5% and an increase in lateral forces of less than 10% are approved by comparison to the original design.

4.1) Recommendations

The existing mount members have sufficient capacity for the relocated and proposed loading as intended. No changes are made to the existing concealment structure and, therefore, the original design still governs.

APPENDIX A

CALCULATIONS

Equipment Dimensions and Weights:

(3) Proposed AIR 6419 Antenna (1 per sector):

Antenna Dimensions: $W_{ant1} := 83.0 \cdot lbf$ $h_{ant1} := 34.5 \cdot in$ $w_{ant1} := 20.0 \cdot in$

Area of Antenna: $A_{ant1} := h_{ant1} \cdot w_{ant1} = 4.79\ ft^2$

(3) Proposed MX12FIT465-01 Antenna (1 per sector):

Antenna Dimensions: $W_{ant2} := 49.0 \cdot lbf$ $h_{ant2} := 55.0 \cdot in$ $w_{ant2} := 20.0 \cdot in$

Area of Antenna: $A_{ant2} := h_{ant2} \cdot w_{ant2} = 7.64\ ft^2$

(9) Antennas per Original Concealment Design (3 per sector):

Antenna Dimensions: $W_{ant3} := 40 \cdot lbf$ $h_{ant3} := 48 \cdot in$ $w_{ant3} := 9 \cdot in$

Area of Antenna: $A_{ant3} := h_{ant3} \cdot w_{ant3} = 3\ ft^2$

(3) Proposed Ericsson RRU 4890 (1 per sector):

Radio Dimensions: $W_{radio1} := 69.5 \cdot lbf$

(3) Existing Ericsson RRU 4449 (1 per sector) relocated from shelter:

Radio Dimensions: $W_{radio2} := 70 \cdot lbf$

(1) Proposed 6627 OVP (gamma sector):

OVP Weight: $W_{ovp} := 32.7 \cdot lbf$

(1) Existing Concealment Structure:

Concealment Weight: $W_{conceal} := 1800 \cdot lbf$ (estimated from mapping)

** All loading is inside concealment and not subjected to lateral loads**

Check Weight Comparison on Existing Roof Structure:

Existing Weight: $W_{exist} := 9\ W_{ant3} + W_{conceal} = 2160\ lbf$

Proposed Weight: $W_{prop} := 3\ W_{ant1} + 3\ W_{ant2} + 3\ W_{radio1} + 3\ W_{radio2} + W_{conceal} = 2614.5\ lbf$

Trib. Width of Truss: $t_w := 24 \cdot in$

Truss Length: $L_{truss} := 53 \cdot ft$

Roof Dead Load: $DL := 15 \cdot psf$ (estimated for corrugated metal built up roof)

Risk Category: $Cat := \text{“II”}$

Ground Snow Load: $p_g := 85 \cdot psf$ (per Colorado Snow Study 2016)

Exposure Factor: $C_e := 0.9$

Thermal Factor: $C_t := 1.0$

Importance Factor:

$$I_s := \begin{cases} 0.8 & \text{if } Cat = \text{“I”} \\ 1.0 & \text{if } Cat = \text{“II”} \\ 1.1 & \text{if } Cat = \text{“III”} \\ 1.2 & \text{if } Cat = \text{“IV”} \end{cases}$$

Flat Snow Load:

$$P_f := 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot p_g = 53.55 \ \textbf{psf}$$

Minimum Snow Load:

$$P_{f\_min} := \begin{cases} I_s \cdot p_g & \text{if } p_g \le 20 \cdot \textbf{psf} \\ 20 \cdot \textbf{psf} \cdot I_s & \text{if } p_g > 20 \cdot \textbf{psf} \end{cases}$$

$$P_f := \max\left(P_f, P_{f\_min}\right)$$

$$P_f = 53.55 \ psf$$

Existing Vertical Load:

$$V_{exist} := t_w \cdot L_{truss} \cdot \left(P_f + DL\right) + W_{exist} = 9426.3 \ \textbf{lbf}$$

Number of Trusses:

$$n_{truss} := 4$$

(Concealment is attached to 4 trusses)

DL per Joist:

$$DL_{add} := \frac{W_{prop} - W_{exist}}{n_{truss}} = 113.63 \ \textbf{lbf}$$

Increase in Vertical Load:

$$Increase := \frac{V_{exist} + DL_{add}}{V_{exist}} = 101.21\%$$

< than 5%

** Existing Rooftop O.K. per IBC **