A & A Structures LLC

22 Holly Leaf Ct. Bethesda MD 20817
Tell: 240-678-5399
aastructure@gmail.com

March 28, 2021

Ms. Dawn Lea
4459 MacArthur Blvd NW, Washington, DC 20007

Re: Existing roof structure check

Dear Ms. Lea,

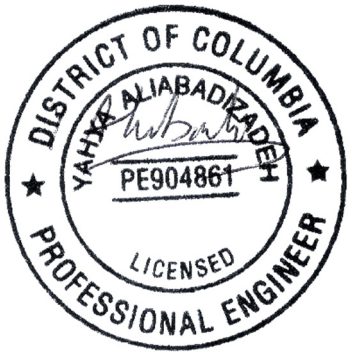
Further to your request, I visited your property located at 4459 MacArthur Blvd NW, Washington, DC 20007. I checked the existing structure for applicable loads. Per my observation, the existing roof of the building is constructed with 2x6 @ 24" O.C. joists. The joists span approximately 14 ft between the supports.

Per my attached calculations, the joists can barely carry the existing applicable snow load. The future development on the neighboring property will certainly add more snowdrift load to the roof which will be beyond the roof structural capacity.

Therefore, the roof structure will not be able to carry the future increased snow load and must be reinforced and strengthened if any additional load will be added.

Thank you for providing us with the opportunity to be of service.

Sincerely,



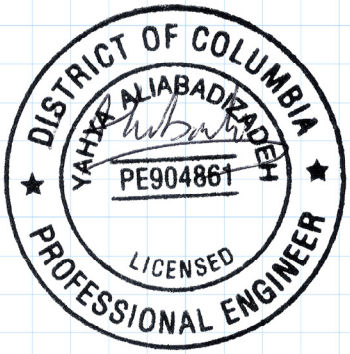
Yahya Aliabadi, PhD, PE
A & A Structures LLC

Structural Calculations

for

Roof joist check for snow load

4459 MacArthur Blvd NW
Washington, DC 20007



Prepared By:

Y. Aliabadi, PhD, PE

E-Mail Address: aastructure@gmail.com

A & A Structures LLC - Structural Calculation Sheets

PROJECT: 4459 MacArthur Blvd NW, Washington, DC 20007 By : YA , Date: 03/28/2021

SUBJECT: Roof Joist check

1 - Objective or Purpose

The following calculation is for Snow Load calculation and Roof Joist check on property located at 4459 MacArthur Blvd NW, Washington, DC 20007

2 - References

2-1 - ASCE 7-10 Minimum design Load for Buildings and other structures.
2-2 - IBC 2013, International Building Code
2-3 - NDS 2009, National Design Specification for Wood construction
2-4 - Field measurments

3 - Calculation basis

Sructural calculation is performed per Reference 2-1 to 2-4.

4 - Assumptions

There is no unverified assumtion in this calculation. Any assumption made in the body of this calculation will be justified in the same section where assumption is made.

5 - Inputs

Snow Load	ASCE 7-10	(Ref. 2-1)
Building Geometry	Field Measurements	(Ref. 2-4)

6 - Methodology

Roof Structure is checked for applicable Dead , Live , Snow loads.

7 - Limitations or restrictions on calculation applicability

This calculation is only applicable for residential building located at 4459 MacArthur Blvd NW, Washington, DC 20007

Snow load :

Caclulate Flat Roof Snow Load :

Ground Snow Load from for District of Columbia region : $p_g := 30\ psf$ (Fig. 7-1, Ref 2-1)

Terrain category for open terrain with scattered obstructions having heights less than 30 ft : Exposure Category = C (26.7.2, Ref 2-1)

Exposure factor for partially exposed roof : $C_e := 1.0$ (Table 7-2, Ref 2-1)

Thermal factor for unheated structures : $C_t := 1.1$ (Table 7-3, Ref 2-1)

Risk category of building : $Risk\_Cat := \text{“II”}$ (Table 1.5-1, Ref 2-1)

Snow Importance factor :

$$I_s := \begin{cases} 0.8 & \text{if } Risk\_Cat = \text{“I”} \\ 1.0 & \text{else if } Risk\_Cat = \text{“II”} \\ 1.1 & \text{else if } Risk\_Cat = \text{“III”} \\ 1.2 & \text{else} \end{cases} \qquad I_s = 1$$ (Table 1.5-2, Ref. 2-1)

Flat roof snow load: $p_{flat} := \max\left(20\ psf \cdot I_s, 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot p_g\right) = 23.1\ psf$ (Eq. 7.3-1, Ref. 2-1)

Minimum flat roof snow load :

$$p_{min} := \begin{cases} I_s \cdot p_g & \text{if } p_g \le 20\ psf \\ I_s \cdot (20\ psf) & \text{else} \end{cases} \qquad = 20\ psf$$ (7.3.4, Ref. 2-1)

Flat roof snow load after minimum snow load is considered: $p_f := \max\left(p_{min}, p_{flat}\right) = 23.1\ psf$

Roof slope factor : $C_s := 1.0$ (Fig. 7-2b, Ref. 2-1)

Sloped roof : $p_s := C_s \cdot p_f = 23.1\ psf$ (Eq. 7.4-1, Ref. 2-1)

Snow density : $\gamma_{snow} := min\left(\left(0.13 \cdot \frac{p_g}{ft} + 14 \cdot pcf\right), 30\ pcf\right) = 17.9\ pcf$ (Eq. 7.7-1, Ref. 2-1)

Height of balanced snow load (Snow drift height): $h_b := \frac{p_s}{\gamma_{snow}} = 1.291\ ft$ (7.7.1, Ref. 2-1)

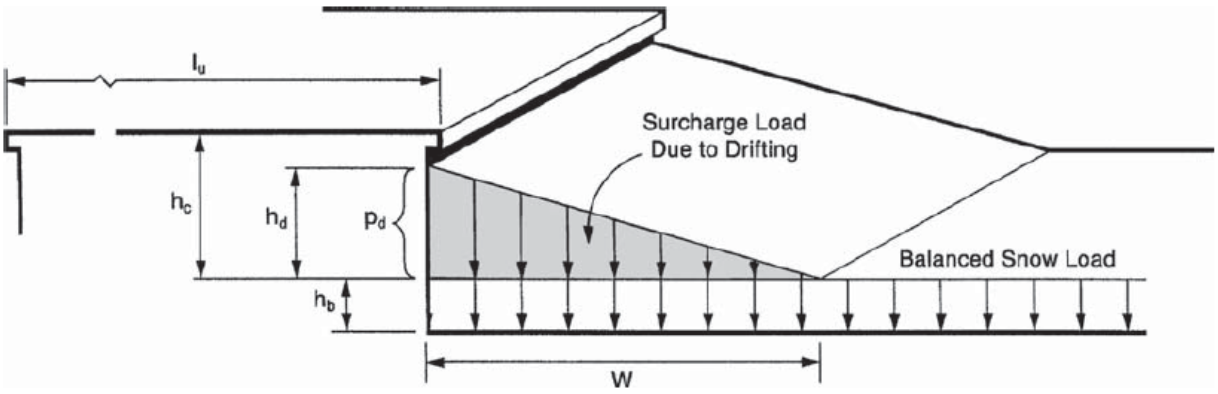


Figure 6 - Configuration of snow drift (Fig. 7-8, Ref. 2-1)

Calculate Snow Drifts near parapet:

Parapet Height per architecture: $h_{pr} := 42\ in$

Clear height : $h_c := h_{pr} - h_b = 2.209\ ft$

$$Calculate\_drift := \begin{cases} \text{if } \frac{h_c}{h_b} < 0.2 \\ \quad \text{“No Drift”} \\ \text{else} \\ \quad \text{“Yes”} \end{cases} \qquad Calculate\_drift = \text{“Yes”}$$ (7.7.1, Ref. 2-1)

Length of the roof upwind of the drift : $l_u := 40\ ft$

If less than 25ft use lu=25 ft $l_u := \max(l_u, 25\ ft) = 40\ ft$

Ground Snow load: $p_g = 30\ psf$

Height of snow drift : $h_d := \frac{3}{4}\left(0.43 \cdot \sqrt[3]{\frac{l_u}{ft}} \cdot \sqrt[4]{\frac{p_g}{psf} + 10} - 1.5\right) ft = 1.649\ ft$ (Fig. 7-9, Ref. 2-1)

$$w := min\left(\begin{cases} \text{if } h_d \le h_c \\ \quad 4 \cdot h_d \\ \text{else} \\ \quad 4 \cdot \frac{h_d^{\,2}}{h_c} \end{cases}, 8\ h_c\right) = 6.595\ ft$$

$$p_d := \begin{cases} \text{if } h_d \le h_c \\ \quad h_d \\ \text{else} \\ \quad h_c \end{cases} = 1.649\ ft$$

A & A Structures LLC - Structural Calculation Sheets

PROJECT: 4459 MacArthur Blvd NW, Washington, DC 20007

By : YA , Date: 03/28/2021

SUBJECT: Roof Joist check

IBC section 1608 requires roofs with a slope less than 1/2" per 12" to be designed for a rain-on-snow surcharge load as determined in accordance with ASCE 7, section 7.10. Section 7.10 does not require a rain-on-snow surcharge for locations where the ground snow load exceeds 20 psf; therefore, rain-on-snow surcharge is not required.

Summary:

Snow Load in flat parts: $SL_{unif} := \max(p_g, p_f) = 30\ psf$

Snow drift: $SD := p_d \cdot \gamma_{snow} = 29.512\ psf$ Max Drift lendth : $w = 6.595\ ft$

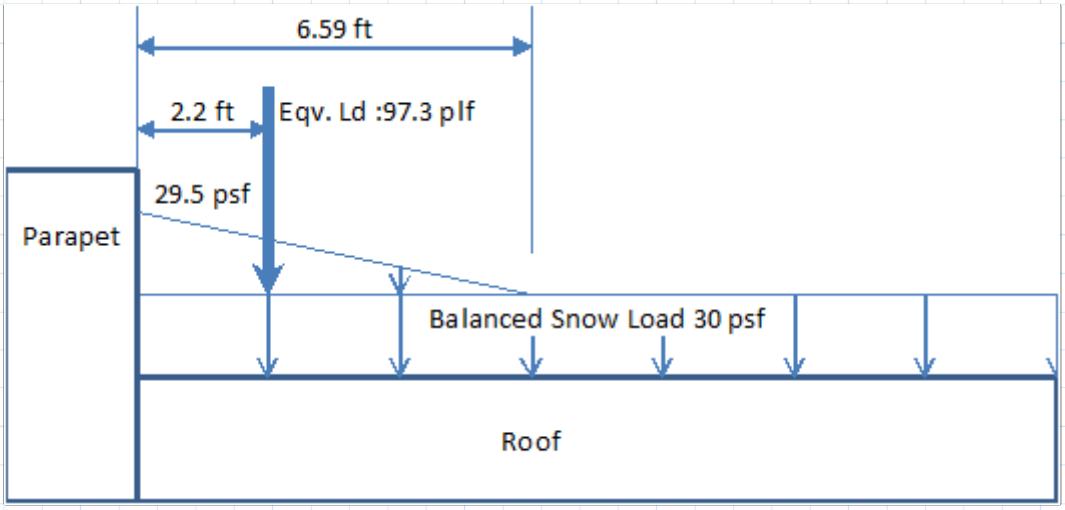


Figure 7 - Snow drift equivalent load

Equivalent Snow Drift : $SD_{eqv} = 97.316\ plf$

Distance of equivalent load to parapet : $SD_{dist} = 2.198\ ft$

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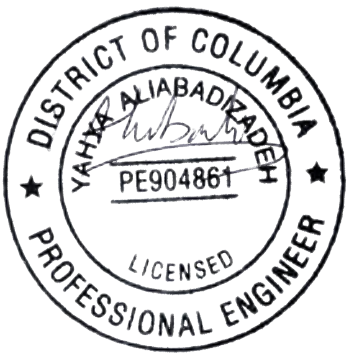
Project Title:
Engineer:
Project ID:
Project Descr:

Building Code Information

Governing Code : IBC 2018, ASCE 7-16, CBC 2019, AISC 360-16, NDS 2018, ACI 318-14, TMS
City Jurisdiction :
Contact Name :
Alternate Contact :
Building Official :
Address : , ,
Phone : Fax : eMail :
Notes :



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Project Title: Roof structure of existing building
Engineer: Y. Aliabadi
Project ID:
Project Descr:

Project Information

Project Title : Roof structure of existing building
Description :

I.D. :
Address : 4459 MacArthur Blvd NW, Washington, DC 20007

Project Leader : Y. Aliabadi
Phone : 240-678-5399 Fax : eMail : aastructure@gmail.com

Project Notes

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Project Title: Roof structure of existing building
Engineer: Y. Aliabadi
Project ID:
Project Descr:

Wood Beam

File: Roof Check.ec6

DESCRIPTION: Roof Joists check for Bending

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method : Allowable Stress Design
Load Combination : IBC 2018

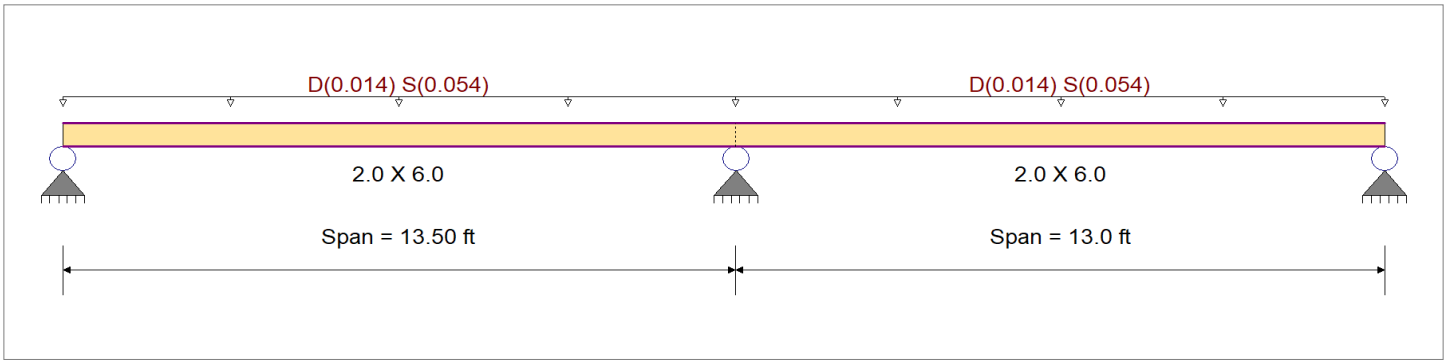
Wood Species : Hem-Fir (North)
Wood Grade : Select Structural

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	1300 psi
Fb -	1300 psi
Fc - Prll	1700 psi
Fc - Perp	405 psi
Fv	145 psi
Ft	775 psi

E : Modulus of Elasticity

Ebend- xx	1700 ksi
Eminbend - xx	620 ksi
Density	28.72 pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Load for Span Number 1
Uniform Load : D = 0.0070, S = 0.0270 ksf, Tributary Width = 2.0 ft, (Snow Load)
Load for Span Number 2
Uniform Load : D = 0.0070, S = 0.0270 ksf, Tributary Width = 2.0 ft, (Snow Load)

No additional capacity for snow drift

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.999 : 1	Maximum Shear Stress Ratio	=	0.404 : 1
Section used for this span		2.0 X 6.0	Section used for this span		2.0 X 6.0
	=	1,493.87 psi		=	67.36 psi
	=	1,495.00 psi		=	166.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	13.500 ft	Location of maximum on span	=	13.047 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.290 in	Ratio =	557 >=240
Max Upward Transient Deflection	0.000 in	Ratio =	0 <240
Max Downward Total Deflection	0.366 in	Ratio =	442 >=180
Max Upward Total Deflection	-0.001 in	Ratio =	177873 >=180

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Max Stress Ratios M	Max Stress Ratios V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	Moment Values M	Moment Values fb	Moment Values F'b	Shear Values V	Shear Values fv	Shear Values F'v
D Only					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.263	0.106	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.31	307.56	1170.00	0.11	13.87	130.50
Length = 13.0 ft	2	0.263	0.106	0.90	1.000	1.00	1.00	1.00	1.00	1.00	0.31	307.56	1170.00	0.11	13.87	130.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.999	0.404	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.49	1,493.87	1495.00	0.54	67.36	166.75
Length = 13.0 ft	2	0.999	0.404	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.49	1,493.87	1495.00	0.53	67.36	166.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.801	0.324	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.20	1,197.30	1495.00	0.43	53.99	166.75
Length = 13.0 ft	2	0.801	0.324	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.20	1,197.30	1495.00	0.42	53.99	166.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 13.50 ft	1	0.089	0.036	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.18	184.54	2080.00	0.07	8.32	232.00

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Wood Beam

File: Roof Check.ec6

DESCRIPTION: Roof Joists check for Bending

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 13.0 ft	2	0.089	0.036	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.18	184.54	2080.00	0.07	8.32	232.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.3657	5.807		0.0000	0.000
+D+S	2	0.2810	7.626	+D+S	-0.0009	0.218

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	0.348	1.127	0.327
Overall MINimum	0.277	0.895	0.260
D Only	0.072	0.232	0.067
+D+S	0.348	1.127	0.327
+D+0.750S	0.279	0.903	0.262
+0.60D	0.043	0.139	0.040
S Only	0.277	0.895	0.260