Engineering Alliance, Inc

https://www.eng-alliance.com

02 October 2025

UNIRAC

1411 Broadway Blvd. NE

Albuquerque, NM 87102

REFERENCE: Nancy Bogut: 2333 Sw Old Port Rd, Lee'S Summit, MO 64082, USA

Solar Array Installation

To Whom It May Concern:

We have reviewed the existing structure referenced above. The purpose of the review was to evaluate its adequacy to support the proposed installation of solar panels on the roof as shown on the panel layout plan drawings. Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation.

Design Parameter

Code: International Building Code 2018 (IBC 2018)

Risk Category: II

Design wind speed: 90 MPH

Wind exposure category: C

Ground snow load: 20 PSF

Seismic design category: B

Existing Roof Structure

Roof Structure: 2"X6" Rafters + Diagonal Bracing +Collar Ties@ 16" O.C

Roofing material: Asphalt Shingle

Connection to Roof

Mounting connection: Four #14 wood screw fully embedment into framing at max. 32 in O.C. along rails
Two rails per row of panels, evenly spaced; panel length perpendicular to the rails not to exceed 44.6 in

Conclusions

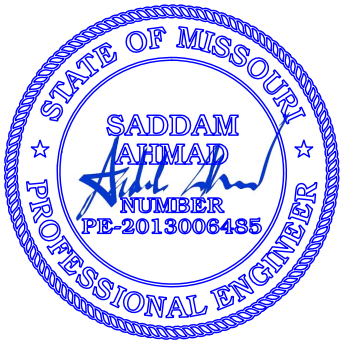
Based upon our evaluation, we conclude that the existing structure is adequate to support the proposed solar panel installation. In the area of the solar array, other live loads will not be present or will be greatly reduced (Section 1607.13.5.1 (2018 IBC)). The glass surface of the solar panels allows for a lower slope factor per ASCE 7, resulting in reduced design snow load on the panels. The stresses of the structural elements, resulting from the altered gravity loads in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 503.3 of the 2018 IEBC are met and the structure is permitted to remain unaltered.

The solar array will be flush-mounted (not more than 5 in above the roof surface) and parallel to the roof surface. Thus, we conclude that any additional wind loading on the structure related to the addition of the proposed solar array is negligible. The attached calculations verify the capacity of the connections of the solar array to the existing roof against wind (uplift), the governing load case. Regarding seismic loads, we conclude that any additional forces will be small. As per Section 1613.1, Exception-1 of the 2018 IBC, detached one- and two-family dwellings with Seismic Design Category A, B or C or located where the mapped short-period spectral response acceleration, Ss, is less than 0.4 g are exempted from seismic load. Therefore the existing lateral force resisting system can remain unaltered.

Limitations

Installation of the solar panels must be performed in accordance with manufacturer recommendations. All work performed must be in accordance with accepted industry-wide methods and applicable safety standards. The contractor must notify Engineering Alliance Inc. should any damage, deterioration or discrepancies between the as-built condition of the structure and the condition described in this letter be found. Connections to existing roof framing must be staggered, except at array ends, so as not to overload any existing structural member. The use of solar panel support span tables provided by others are allowed only where the building type, site conditions, site-specific design parameters, and solar panel configuration match the description of the span tables. The design of the solar panel racking (mounts, rails, etc.) and electrical engineering is the responsibility of others. Waterproofing around the roof penetrations is the responsibility of others. Engineering Alliance Inc assumes no responsibility for improper installation of the solar array.

Please feel free to call or email for any questions or clarifications.



02-OCT-2025

Prepared by

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Designer:	SA	Date:	02 October 2025

Calculations per ASCE 7-16
International Building Code 2018 (IBC 2018)

ROOF DEAD LOAD (D):

Material	Design material weight (psf)	Increase due to pitch	Material weight (psf)
Asphalt Shingle	2.38	1.19	2
1/2" Plywood	1.2	1.19	1
Framing	3		3
Insulation	0.5		0.5
1/2" Gypsum Clg.	2.4	1.19	2
M, E & Misc	1.5		1.5
Total Dead Load	**11.0**		
PV Array Dead Load	**3.6**	1.19	3

ROOF LIVE LOAD (Lr):

Existing Design Roof Live Load [psf]	20	ASCE 7-16, Table 4.3-1
Roof Live Load With PV Array [psf]	0	Section 1607.13.5.1 (2018 IBC)

SEISMIC LOAD, (E):

Risk category:	II	Table 1.5-1
Seismic Design Category:	B	Table 11.6-2
I_p:	1	Table 1.5-2
Site Class:	D	
R_p:	1.5	Table 13.6-1
S_s:	0.099	
S_1:	0.068	
a_p:	1	Table 13.6-1
z:	1	ft
h:	1	ft
z/h:	1	
F_a:	1.6	Table 11.4-1
F_v:	2.4	Table 11.4-2
S_{MS}:	0.158	Eqs. 11.4-1
S_{M1}:	0.163	Eqs. 11.4-2
S_{DS}:	0.106	Eqs. 11.4-3
S_{D1}:	0.109	Eqs. 11.4-4

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SITE-SPECIFIC WIND PARAMETERS:

Basic Wind Speed [mph]:	90	
Exposure Category:	C	Sec. 26.7.3
Risk Category:	II	Table 1.5-1
Height of Roof, h [ft]:	35	(Approximate)
Roof Slope [°]:	33	
Site Elevation [ft]:	986	
Comp/Cladding Location:	Hip Roofs, 27° < θ ≤ 45°	FIGURE_30.3_2H
Enclosure Classification:	Enclosed Buildings	
Zone 1 GCp:	1.3	(abs. value)
Zone 2r GCp:	1.7	(abs. value)
Zone 2e, 3 GCp:	2.3	(abs. value)
α:	9.5	Table 26.11-1
z_g [ft]	900	Table 26.11-1
K_h:	1.01	Table 26.10-1
K_e:	0.96	Table 26.9-1
K_{zt}:	1	Equation 26.8-1
K_d:	0.85	Table 26.6-1
Velocity Pressure, q_h [psf]:	17.26	Equation 26.10-1
γ_E:	1.5	
γ_a:	0.65	SEAOC PV2-2017 Fig. 12

PRESSURES:

$$p = q_h(GC_p)(\gamma_E)(\gamma_a) \qquad (lb/ft^2)$$ Equation 29.4-7

a [ft] :	3.0	
Zone 1 :	21.5	psf (1.0 W)
Zone 2r :	28.7	psf (1.0 W)
Zone 2e, 3 :	38.1	psf (1.0 W)

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COMPARE WIND & SEISMIC LOADS FOR CONNECTION (1 Sq. Ft. Section)

Wind Load, W:

Wind pressure, p:	12.9	psf (Zone 1: 0.6 W from wind pressure calculation)
Height, h:	1	ft
Width, w:	1	ft
Fperp:	12.9	lb (Uplift)

Seismic Load, E:

0.7 * F_p,min:	0.067	lb	Equation 13.3-3
0.7 * F_p,max:	0.355	lb	Equation 13.3-2
0.7 * F_p,vert:	0.044	lb	Sec 13.3.1.2
0.7 * F_p,long:	0.177	lb	Equation 13.3-1
0.7*F_p,perp:	0.134	lb (uplift)	

Wind (uplift) Controls Connection Design

CHECK INCREASE IN OVERALL SEISMIC LOADS

SEISMIC:

Seismic Design Category:	B

As per Section 1613.1, Exception-1 of the 2018 IBC, Seismic load is Exempted.

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Wood Screw Connection

Tributary Length (in):	44.6
Max Tributary Width (in):	32

Capacity:

Wood Screw Size :	#14	
C_d:	1.6	NDS Table 2.3.2
Grade:	SPF (G = 0.42)	
Capacity [lbs/in]:	121	NDS Table 12.2B
Number of Screws in tension:	4	
Prying Coefficient:	1.4	
Total Capacity [lbs]:	135	

Demand:

Zone	Pressure (0.6 Wind) (psf)	Max Tributary Width (ft)	Max. Trib. Length (ft)	Max. Trib. Area2 (ft2)	Max. Uplift Force
Zone 1 :	9.9	2.7	1.9	5.0	49
Zone 2r :	14.2	2.7	1.9	5.0	70
Zone 2e, 3 :	19.9	2.7	1.9	5.0	99

Total Tension Force(lbs):	99

Demand< Capacity: 73%, OK

Notes

1. Embedment is measured from the top of the framing member to the beginning of the tapered tip of the screw. Embedment in sheathing or other material is not effective. The length of the tapered tip is not part of the embedment length.
2. 'Max. Trib Area' is the product of the 'Max. Tributary Width' (along the rails) and 1/2 the panel width/height (perpendicular to the rails).

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SNOW LOAD (S):

	Existing	w/ Solar Panel Array	
Roof Slope [x:12]:	7.8	7.8	
Roof Slope [°]:	33	33	
Snow Ground Load, p_g [psf]:	20	20	Section 7.2
Surface Roughness Category:	C	C	Sec. 26.7.2
Exposure of Roof:	Fully Exposed	Fully Exposed	Table 7.3-1
Exposure Factor, C_e:	0.9	0.9	Table 7.3-1
Thermal Factor, C_t:	1.2	1.2	Table 7.3-2
Risk Category:	II	II	Table 1.5-1
Importance Factor, I_s:	1	1	Table 1.5-2
Flat Roof Snow Load, p_f [psf]:	15	15	Equation 7.3-1
Minimum Roof Snow Load, p_m [psf]:	0	0	Section 7.3.4
Unobstructed Slippery Surface?	NO	YES	Section 7.4
Slope Factor Figure:	Figure 7-2c	Figure 7-2c	Section 7.4
Roof Slope Factor, C_s:	1.00	0.67	Figure 7.4-1
Sloped Roof Snow Load, p_s [psf]:	15	10	Equation 7.4-1
Design Snow Load, S [psf]:	15	10	

Summary of Loads

	Existing	With PV Array
D [psf]	11	15
Lr [psf]	20	0
S [psf]	15	10

Maximum Gravity Loads:

	Existing	With PV Array	
(D + Lr) / Cd [psf]	25	16	ASCE 7-16, Section 2.4.1
(D + S) / Cd [psf]	23	21	ASCE 7-16, Section 2.4.1

(Cd = Load Duration Factor = 0.9 for D, 1.15 for S, and 1.25 for Lr)

Maximum Gravity Load [psf]:	25	21

Ratio Proposed Loading to Current Loading: **87%** **OK**

The gravity loads and; thus, the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 503.3 of the 2018 IEBC are met and the structure is permitted to remain unaltered.