VSE Project Number: U2513.0239.211

July 14, 2021

Third Sun Solar
762 West Union Street, Suite C
Athens, OH 45701

REFERENCE: Stoneridge Building: 4019 West Dublin Granville Road, Dublin, OH 43017
                        Third Sun Solar Project: 21-0031
                        Solar Array Installation

To Whom It May Concern:

Per your request, we have reviewed the existing structure at the above referenced site. The purpose of our review was to determine the adequacy of the existing structure to support the proposed installation of solar panels on the roof as shown on the panel layout plan.

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation.

Design Parameters

   Code: 2017 Ohio Building Code (2015 IBC) & 2019 Residential Code of Ohio (2018 IRC)
   Risk Category: II
   Design wind speed, Vult: 115 mph (3-sec gust) per ASCE 7-10
   Wind exposure category: C
   Ground snow load, Pg: 20 psf

Existing Roof Structure

   Roof structure: 2x4 manufactured trusses @ 24" o.c.
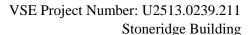   Roofing material: composite shingles
   Roof slope: 18°

Connection to Roof

   Mounting connection: (1) 5/16" lag screw w/ min. 2.5" threaded embedment into framing at max. 48" o.c. along rails
   (2) rails per row of panels, evenly spaced; panel length perpendicular to the rails not to exceed 79.1 in. Rail cantilever shall not exceed 50% of connection spacing.

Conclusions

Based upon our review, 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 (Ohio Building Code, Section 1607.12.5). 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 3404.3 of the Ohio Building Code are met and the structure is permitted to remain unaltered.

The solar array will be flush-mounted (no more than 10" 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. Because the increase in lateral forces is less than 10%, this addition meets the requirements of the exception in Section 3404.4 of the Ohio Building Code. Thus the existing lateral force resisting system is permitted to 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 Vector Structural Engineering, LLC 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 is 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. Vector Structural Engineering assumes no responsibility for improper installation of the solar array.

VECTOR STRUCTURAL ENGINEERING, LLC
OH Firm License: 3392

07/14/2021

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Coleman Larsen, P.E.
OH License: 81862 - Expires: 12/31/2021
Project Engineer

Enclosures

CDL/bac

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Components and Cladding Wind Calculations

Label: Solar Panel Array   Note: Calculations per ASCE 7-10

SITE-SPECIFIC WIND PARAMETERS:

Basic Wind Speed [mph]:	115	Notes:
Exposure Category:	C	
Risk Category:	II	

ADDITIONAL INPUT & CALCULATIONS:

Height of Roof, h [ft]:	15	(Approximate)	Hip?
Comp/Cladding Location:	Gable/Hip Roofs 7° < θ ≤ 27°		No
Enclosure Classification:	Enclosed Buildings		
Zone 1 GC_p:	0.9	Figure 30.4-2B (enter negative pressure coefficients)	
Zone 2 GC_p:	1.6		
Zone 3 GC_p:	2.5		
α:	9.5	Table 26.9-1	
z_g [ft]:	900	Table 26.9-1	
K_h:	0.85	Table 30.3-1	
K_{zt}:	1	Equation 26.8-1	
K_d:	0.85	Table 26.6-1	
Velocity Pressure, q_h [psf]:	24.4	Equation 30.3-1	
GC_{pi}:	0	Table 26.11-1	

PRESSURES: $$p = q_h \left[(GC_p) - (GC_{pi}) \right]$$ Equation 30.9-1

Zone 1, p [psf]:	21.7	psf (1.0 W, Interior Zones, beyond 'a' from roof edge)
Zone 2, p [psf]:	40.1	psf (1.0 W, End Zones, within 'a' from roof edge)
Zone 3, p [psf]:	61.7	psf (1.0 W, Corner Zones, within 'a' from roof corner)
		(a= 6 ft)

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Calculate Uplift Forces on Connection

	Pressure (0.6 Dead -0.6 Wind) (psf)	Max Trib. Width[1] (ft)	Max Trib. Area[2] (ft^2)	Max Uplift Force (lbs)
Zone 1	11.2	4.0	13.2	148
Zone 2	22.2	4.0	13.2	293
Zone 3	35.2	4.0	13.2	464

Calculate Connection Capacity

Lag Screw Size [in]:	5/16	
C_d:	1.6	NDS Table 2.3.2
Embedment[3] [in]:	2.5	
Grade:	SPF (G = 0.42)	
Nominal Capacity [lbs/in]:	205	NDS Table 12.2A
Number of Screws:	1	
Prying Coefficient:	1.4	
Total Capacity [lbs]:	586	

Determine Result

Maximum Demand [lbs]:	464
Lag Screw Capacity [lbs]:	586

Result: **Capacity > Demand, Connection is adequate.**

Notes

1. 'Max Trib. Width' is the width along the rails tributary to the connection.
2. 'Max Trib Area' is the product of the 'Max. Trib Width' and 1/2 the panel width/height perpendicular to the rails. (2) rails per row of panels. Length of panels perpendicular to the rails shall not exceed 79".
3. Embedment is measured from the top of the framing member to the beginning of the tapered tip of the lag screw. Embedment in sheathing or other material is not effective. The length of the tapered tip is not part of the embedment length.

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GRAVITY LOADS

Roof Pitch: 3.9   :12

ROOF DEAD LOAD (D)

	Design material weight [psf]	Increase due to pitch	Material weight [psf]
Composite Shingles	2.1	1.05	2.0
1/2" Plywood	1.1	1.05	1.0
Framing	3.0		3.0
Insulation	0.5		0.5
1/2" Gypsum Clg.	2.1	1.05	2.0
M, E & Misc	1.5		1.5
Total Existing Roof DL	10.3		
PV Array DL	3.2	1.05	3

ROOF LIVE LOAD (Lr)

Existing Design Roof Live Load [psf]	20	ASCE 7-10 Table 4-1
Roof Live Load With PV Array [psf]	0	Ohio Building Code, Section 1607.12.5

SNOW LOAD (S):

	Existing	w/ Solar Array	
Roof Slope [x:12]:	3.9	3.9	
Roof Slope [°]:	18	18	
Ground Snow Load, p_g [psf]:	20	20	ASCE 7-10, Section 7.2
Terrain Category:	C	C	ASCE 7-10, Table 7-2
Exposure of Roof:	Fully Exposed	Fully Exposed	ASCE 7-10, Table 7-2
Exposure Factor, C_e:	0.9	0.9	ASCE 7-10, Table 7-2
Thermal Factor, C_t:	1.1	1.1	ASCE 7-10, Table 7-3
Risk Category:	II	II	ASCE 7-10, Table 1.5-1
Importance Factor, I_s:	1.0	1.0	ASCE 7-10, Table 1.5-2
Flat Roof Snow Load, p_f [psf]:	14	14	ASCE 7-10, Equation 7.3-1
Minimum Roof Snow Load, p_m [psf]:	0	0	ASCE 7-10, Section 7.3.4
Unobstructed Slippery Surface?	No	No	ASCE 7-10, Section 7.4
Slope Factor Figure:	Figure 7-2b	Figure 7-2b	ASCE 7-10, Section 7.4
Roof Slope Factor, C_s:	1.00	1.00	ASCE 7-10, Figure 7-2
Sloped Roof Snow Load, p_s [psf]:	14	14	ASCE 7-10, Equation 7.4-1
Design Snow Load, S [psf]:	14	14	

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Summary of Loads

	Existing	With PV Array
D [psf]	10	13
Lr [psf]	20	0
S [psf]	14	14

Maximum Gravity Loads:

	Existing	With PV Array	
(D + Lr) / Cd [psf]	24	15	ASCE 7-10, Section 2.4.1
(D + S) / Cd [psf]	21	24	ASCE 7-10, 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]:	24	24

Ratio Proposed Loading to Current Loading:	**98%**	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 3404.3 of the Ohio Building Code are met and the structure is permitted to remain unaltered.