VSE Project Number:

Solar Power Store Canada LTD
102 Commerce Park Drive#11
Barrie, ON L4N 8W8

REFERENCE:

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: Ontario Building Code (2020 NBC)
Importance Category: Normal
Terrain: Open
1/50 Hourly Wind Pressure: 0.41 kPa
1/50 Ground Snow Load: 2.3 kPa
1/50 Associated Rain Load: 0.4 kPa

Existing Roof Structure

Roof structure: 2x8 rafters @ 24" o.c.
Roofing material: composite shingles
Roof slope: 40°

Connection to Roof

Mounting connection: (1) 5/16" lag screw w/ min. 2.5" threaded embedment into framing at max. 48" o.c. (portrait and landscape) along rails
Install (2) rails per row of panels, evenly spaced
Maximum panel dimension: 89.7x44.6 in
Rail cantilever shall not exceed the lesser of 50% of the connection spacing or maximum cantilever allowed by manufacturer
Connections shall be staggered so as not to overload any existing structural member

Conclusions

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation. 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%. Stress decreases or increases of no more than 5% are considered acceptable. Therefore, 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. Regarding seismic loads, we conclude that any additional forces will be negligible. Because the lateral forces are negligible, the structure 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. 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.

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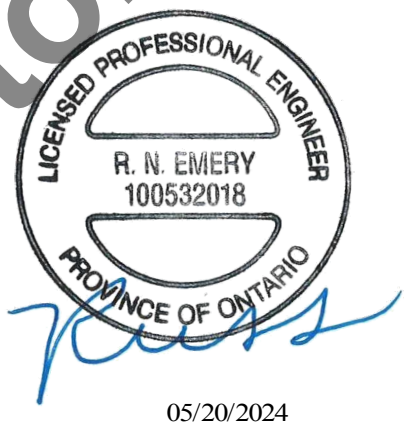


05/20/2024

Russell Emery, P.Eng
ON License: 100532018 - Expires: 10/31/2024
Project Engineer

Enclosures

RNE/shs

JOB NO.: U1869.4157.241
SUBJECT: WIND PRESSURE

PROJECT:

Components and Cladding Wind Calculations

Label: Solar Panel Array

Note: Calculations per 2020 NBC, Division B

SITE-SPECIFIC WIND PARAMETERS:

Hourly Wind Pressure, q_{50} [kPa]:	0.41	Table C-2
Terrain:	Open	4.1.7.3.(5)
Importance Category:	Normal	Table 4.1.2.1
Importance Factor, I_W:	1.00	Table 4.1.7.3

ADDITIONAL INPUT & CALCULATIONS:

Height of Roof, h [m]: 7.6 4.1.7.3.(6)

Comp/Cladding Location: Gable Roofs 27° < a <= 45°

Zone	C_gC_p	γ_a	E
"r"	1.8	1.00	1.5
"s"	2.1	1.00	1.5
"c"	2.1	1.00	1.5

CgCp per Figure 4.1.7.6.-E
γ_a per 4.1.7.13.(3)
E per 4.1.7.13.(4)

Exposure Factor, C_e: 0.95 4.1.7.3.(5)

Topographic Factor, Ct: 1.0 4.1.7.4

Internal Pressure, p_i [kPa]: 0.0

PRESSURES:

4.1.7.13.(2)

Zone "r", p [kPa]:	1.02	(1.0 W, Interior Zones, beyond 'z' from roof edge)
Zone "s", p [kPa]:	1.20	(1.0 W, End Zones, within 'z' from roof edge)
Zone "c", p [kPa]:	1.20	(1.0 W, Corner Zones, within 'z' from roof corner)
z [m]:	1.0	

JOB NO.: U1869.4157.241
SUBJECT: CONNECTION

PROJECT:

Calculate Uplift Forces on Connection

	Pressure (0.9D - 1.4W) [kPa]	Max Trib. Width[1] [m]	Max Trib. Area[2] [m^2]	Max Uplift Force [N]
Zone "r"	1.26	1.2	1.4	1756
Zone "s"	1.51	1.2	1.4	2096
Zone "c"	1.51	1.2	1.4	2096

Calculate Connection Capacity

See CSA O86-14, Clause 12.6.5.1

Nominal Lag Screw Diameter, d_F [in]:	5/16	d_F [mm]:	8
Mean Relative Density of Main Member, G:	0.42		
J_X:	1.0		
Basic Withdrawal Resistance, y_w [N/mm]:	69.5		
Load Duration Factor, K_D:	1.15	Table 5.3.2.2	
Service Condition Factor, K_{SF}:	1.0	Table 12.2.1.6	
Treatment Factor, K_T:	1.0	Clause 12.2.1.8	
Resistance Factor, ϕ:	0.6		
Modified Withdrawal Resistance, Y_w [N/mm]:	79.9		
Lag Screw Embedment[3], L_t [in]:	2.5	L_t [mm]:	64
Number of Lag Screws, n_F:	1		
End Grain Factor, J_E:	1.00		
Factored Withdrawal Resistance, P_{rw} [N]:	3043		
Prying Coefficient:	1.4	(Reduces Factored Resistance)	

Determine Result

Factored Withdrawal Load [N]:	2096
Factored Withdrawal Resistance [N]:	2174

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 length perpendicular to the rails. (2) rails per row of panels.
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.

JOB NO.: U1869.4157.241
SUBJECT: GRAVITY LOADS

PROJECT:

CALCULATE ESTIMATED GRAVITY LOADS

ROOF DEAD LOAD (D)			Increase due to pitch	Original loading
Roof Pitch/12	10.07			
Composite Shingles	0.13		1.31	0.10 kPa
1/2" Plywood	0.06		1.31	0.05 kPa
Framing	0.14	kPa		
Insulation	0.03	kPa		
1/2" Gypsum Clg.	0.13	kPa		
M, E & Misc	0.07	kPa		
Total Existing Roof Dead Load	0.56	kPa		
PV Array Dead Load	0.19	kPa		

ROOF LIVE LOAD (L)

Existing Design Roof Live Load [kPa]	1.0	2020 NBC, Division B, Table 4.1.5.3
Roof Live Load With PV Array [kPa]	0	

SNOW LOAD (S):	Existing	w/ Solar Panel Array	2020 NBC, Division B
Roof Slope [x:12]:	10.1	10.1	
Roof Slope [°]:	40	40	
1/50 Ground Snow Load, S_s [kPa]:	2.3	2.3	Table C-2
1/50 Associated Rain Load, S_r [kPa]:	0.4	0.4	Table C-2
Importance Category:	Normal	Normal	Table 4.1.2.1
Importance Factor for Snow, I_s:	1.00	1.00	Table 4.1.6.2.-A
Basic Roof Snow Load Factor, C_b:	0.80	0.80	4.1.6.2.(2)
Wind Exposure Factor, C_w:	1.00	1.00	4.1.6.2.(3) & (4)
Unobstructed Slippery Surface?	No	No	
Slope Factor, C_s:	0.75	0.75	4.1.6.2.(5), (6) & (7)
Shape Factor, C_a:	1.00	1.00	4.1.6.2.(8)
Design Snow Load, S [kPa]:	1.78	1.78	4.1.6.2.(1)

JOB NO.: U1869.4157.241
SUBJECT: MEMBER FORCES

DESIGN LOADS [Pa]:	Load Types:	Snow	Live	Dead	1.25D+1.5S	1.25D+1.5L	Max Load
	Existing Roof	1780	1000	559	3369	2199	3369
	Proposed PV Array	1780	0.00	747	3603	933	3603

Label rafters
Length 5.14 m

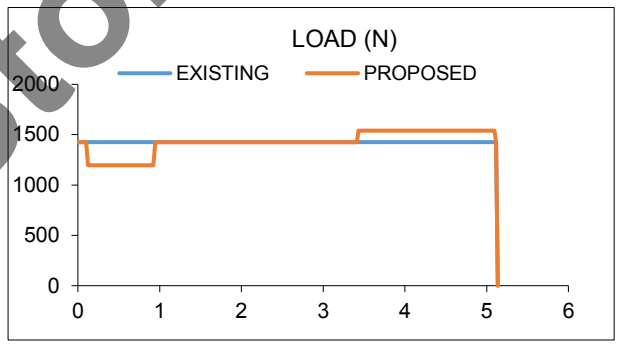
	Existing	Proposed	Check	
M (m-N)	4703	4739	101%	OK

	Existing	Proposed	Check	
V (N)	3663	3802	104%	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%. Stress decreases or increases of no more than 5% are considered acceptable. Therefore, the structure is permitted to remain unaltered.

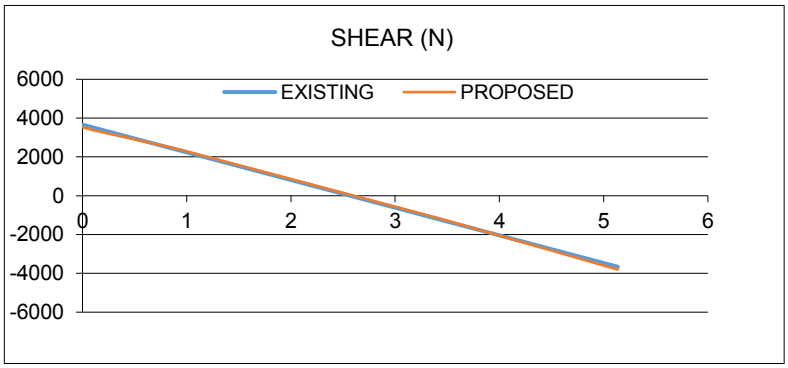
Existing Loads (Distributed)

Cond	Roof Trib (m)	Add'l Live Load (N/m)	Add'l Dead Load (N/m)	Bm wt (N/m)	w_{LL} (N/m)	w_{DL} (N/m)
1	0.6	0	0	0	1085	341



Proposed Loads (Distributed)

Cond	Dist to Load 'a' (m)	Length of Load 'b' (m)	Δ w_{LL} (N/m)	Δ w_{DL} (N/m)
2	0.1	0.8	-342.91	114
3	3.4	1.7	-0.18	114
4				
5				
6				



Proposed Loads as Point Loads

Cond	Dist 'a' (m)	Point Live Load 'P_{LL}' (N)	Point Dead Load 'P_{DL}' (N)
7			
8			
9			
10			
11