10/13/2022

RE: Structural Certification for Installation of Residential Solar
JAMES BROWN:155 BRAE DRIVE, LILLINGTON, NC 27546, USA

Attn: To Whom It May Concern

This Letter is for the existing roof framing which supports the new PV modules as well as the attachment of the PV system to existing roof framing. From the field observation report, the roof is made of Single Layer of Composition Shingle roofing over roof plywood supported by 2X4 Trusses at 24 inches. The slope of the roof was approximated to be 30 degrees. The maximum allowable chord span is 8 feet between supports.

After review of the field observation data and based on our structural capacity calculation, **the existing roof framing has been determined to be adequate to support the imposed loads without structural upgrades.** Contractor shall verify that existing framing is consistent with the described above before install. Should they find any discrepancies, a written approval from SEOR is mandatory before proceeding with install. Capacity calculations were done in accordance with applicable building codes.

Design Criteria

Code	2018 North Carolina Building Code/IBC 2015				
Risk category		II	Wind Load	(component and Cladding)	
Roof Dead Load	Dr	10 psf		V(ult)	118 mph
PV Dead Load	DPV	3 psf		Exposure	B
Roof Live Load	Lr	20 psf			
Ground Snow	S	15 psf			

If you have any questions on the above, please do not hesitate to call.

Sincerely,

Structural Letter for PV Installation

Date: 10/13/2022
Job Address: **155 BRAE DRIVE**
LILLINGTON, NC 27546, USA
Job Name: **JAMES BROWN**
Job Number: **221013JB**

Scope of Work

This Letter is for the existing roof framing which supports the new PV modules as well as the attachment of the PV system to existing roof framing. All PV mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

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Engineering Calculations Summary

Code	2018 North Carolina Building Code/IBC 2015		
Risk category		II	
Roof Dead Load	Dr	10	psf
PV Dead Load	DPV	3	psf
Roof Live Load	Lr	20	psf
Ground Snow	S	15	psf
Wind Load	(component and Cladding)		
	V (Ult)	118	mph
	Exposure	B	

References

2 NDS for Wood Construction

Sincerely,

Wind Load Cont.

Risk Category =	II	ASCE 7-10 Table 1.5-1
Wind Speed (3s gust), V =	**118 mph**	**ASCE 7-10 Figure 26.5-1A**
Roughness =	**B**	**ASCE 7-10 Sec 26.7.2**
Exposure =	**B**	**ASCE 7-10 Sec 26.7.3**
Topographic Factor, K_{ZT} =	1.00	ASCE 7-10 Sec 26.8.2
Pitch =	30.0 Degrees	
Adjustment Factor, λ =	1	ASCE 7-10 Figure 30.5-1
a =	3.60 ft	ASCE 7-10 Figure 30.5-1

Where a: 10% of least horizontal dimension or 0.4h, whichever is smaller, but not less than 4% of least horizontal dimension or 3ft (0.9m)

Uplift (0.6W)	Zone 1 (psf)	Zone 2 (psf)	Zone 3 (psf)	
Pnet30=	-17.5	-21.1	-21.1	Figure 30.5-1
Pnet = 0.6 x λ x KZT x Pnet30)=	10.50	12.65	12.65	Equation 30.5-1
Downpressure (0.6W)	Zone 1 (psf)	Zone 2 (psf)	Zone 3 (psf)	
Pnet30=	19.1	19.1	19.1	Figure 30.5-1
Pnet = 0.6 x λ x KZT x Pnet30)=	11.49	11.49	11.49	Equation 30.5-1

Rafter Attachments: 0.6D+0.6W (CD=1.6)

Connection Check

Attachement max. spacing=	4	ft	
5/16" Lag Screw Withdrawal Value=	266	lbs/in	Table 12.2A - NDS
Lag Screw Penetration	2.5	in	DFL Assumed
Prying Coefficient	1.4	in	
Allowable Capacity=	760		

Zone	Trib Width	Area (ft)	Uplift (lbs)	Down (lbs)		
1	4	11.0	95.7	159.4		
2	4	11.0	119.3	159.4		
3	4	11.0	119.3	159.4		
		Max=	119.3		<	760
			CONNECTION IS OK			

1. Pv seismic dead weight is negligible to result in significant seismic uplift, therefore the wind uplift governs
2. Embedment is measured from the top of the framing member to the tapered tip of a lag screw. Embedment in sheading or other material does not count.

Vertical Load Resisting System Design

Roof Framing **Trusses**

Snow Load Fully Exposed

pg=	15	psf	ASCE 7-10 , Section 7.2	**p_f =**	10	psf	
C_e =	0.9		ASCE 7-10 , Table 7-2	**$p_{fmin.}$ =**	**15.0**	psf	
C_t =	1.1		ASCE 7-10 , Table 7-3	**p_s =**	**15**	psf	24.0 plf
I_s =	1.0		ASCE 7-10 , Table 1.5-1				

Max Length, L = **8** ft (Beam maximum Allowable Horizontal Span)

Tributary Width, W_T = **24** in

Dr = **10** psf 20 plf

PvDL = 3 psf 6 plf

Load Case: DL+0.6W

Pnet+ $P_{pv}\cos(\theta)+P_{DL}$= 49.0 plf

Max Moment, M_u = 241 lb-ft Conservatively

Pv max Shear 159.4 lbs

Max Shear, V_u=wL/2+Pv Point Load = 263 lbs

Load Case: DL+0.75(0.6W+S)

0.75(Pnet+Ps)+ $P_{pv}\cos(\theta)+P_{DL}$= 60 plf

M_{down}= 297 lb-ft

Mallowable = Sx x Fb' (wind)= 634 lb-ft > 297 lb-ft **OK**

Load Case: DL+S

Ps+ $P_{pv}\cos(\theta)+P_{DL}$= 49 plf

M_{down}= 242 lb-ft

Mallowable = Sx x Fb' (wind)= 456 lb-ft > 242 lb-ft **OK**

Max Shear, V_u=wL/2+Pv Point Load = 263 lbs

Member Capacity

DF-L No.2

2X4	Design Value	C_L	C_F	C_i	C_r	K_F	ϕ	λ	Adjusted Value
F_b =	900 psi	1.0	1.5	1.0	1.15	2.54	0.85	0.8	1553 psi
F_v =	180 psi	N/A	N/A	1.0	N/A	2.88	0.75	0.8	180 psi
E =	1600000 psi	N/A	N/A	1.0	N/A	N/A	N/A	N/A	1600000 psi
E_{min} =	580000 psi	N/A	N/A	1.0	N/A	1.76	0.85	N/A	580000 psi

Depth, d = 3.5 in

Width, b = 1.5 in

Cross-Sectonal Area, A = 5.25 in^2

Moment of Inertia, I_{xx} = 5.35938 in^4

Section Modulus, S_{xx} = 3.0625 in^3

Allowable Moment, $M_{all} = F_b'S_{xx}$ = 396.2 lb-ft DCR=M_u/M_{all} = 0.48 < 1 **Satisfactory**

Allowable Shear, $V_{all} = 2/3F_v'A$ = 630.0 lb DCR=V_u/V_{all} = 0.42 < 1 **Satisfactory**

Siesmic Loads Check

Roof Dead Load	10	psf
% or Roof with Pv	12.4%	
Dpv and Racking	3	psf
Averarage Total Dead Load	10.4	psf
Increase in Dead Load	2.5%	**OK**

The increase in seismic Dead weight as a result of the solar system is less than 10% of the existing structure and therefore no further seismic analysis is required.

Limits of Scope of Work and Liability

We have based our structural capacity determination on information in pictures and a drawing set titled PV plans - JAMES BROWN. The analysis was according to applicable building codes, professional engineering and design experience, opinions and judgments. The calculations produced for this structure's assessment are only for the proposed solar panel installation referenced in the stamped plan set and were made according to generally recognized structural analysis standards and procedures.