La Luz Engineering, PLLC

February 17, 2022

SolarTyme
6710 Jefferson Davis Hwy
Richmond, VA 23237

Re: Structural Review of Existing Roof for New Photovoltaic Panel Installation
Allgood Residence – 55 Huzzas Cir, Cameron, NC 28326

Per your request, we have reviewed the existing roof framing which will receive new solar panel arrays for this project. This review was performed in accordance with the provisions of the 2018 North Carolina Residential Code, 2018 North Carolina Existing Building Code and American Wood Council National Design Specification (NDS) for Wood Construction 2015 Edition. Moreover, the review evaluates the ability of the existing structure to handle gravitational loads and wind uplift loads from the addition of the proposed PV system. The calculations on the following pages detail the modifications to gravitational loading and wind uplift respectively.

The existing roof framing members are 2" x 8" wood rafters at 16" on center. The roofing material is composite shingle. There are fifteen 365W photovoltaic modules which will be installed on the roof of this residence. Ironridge railing and attachments will be used for this project.

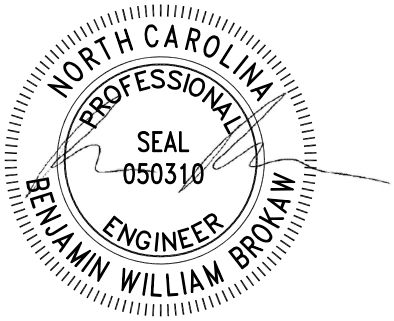
Per the ASD load calculations section of the calculations below, the PV system installation results in a decrease in loading to the existing roof structure. Based on this analysis the roof framing was found to adequately support the proposed PV system.

The proposed PV system roof attachments are 4.75" x 5/16" Diameter lag bolts at a 48" maximum attachment spacing. The calculations in the *Uplift Capacity* section of the calculations demonstrate the lag bolts will provide adequate resistance to uplift based on a 2.5-inch embedment depth. This analysis is based on the American Wood Council National Design Specification (NDS) for Wood Construction 2015 Edition.

Structural analysis of the entire structure was not completed, and we are not the original Engineer of Record for this residence. We did not inspect the residence and all roof framing dimensions are based on the contractor's site analysis and plan drawings. Our structural review was limited to analyzing the existing structural roof members for the addition of the photovoltaic panels, based on our understanding of the existing residence, as described above. The truss connections have not been reviewed and the type and quality of wood used for construction is unknown. We are also not the Engineer of Record for the solar hardware, connections or layout. La Luz Engineering does not assume responsibility for improper installation of any solar hardware.

Regards,
La Luz Engineering, PLLC

Ben Brokaw, P.E.
Principal



2/17/2022

Site Information

Wind	120 mph
Exposure	C
Lumber	Southern Pine
Grade	No. 2
Modulus of Elasticity	1,400,000

Panel Information

Panel Type	Aptos365W		
Panel Length		69.1	in
Panel Width		40.9	in
Panel Weight		45.2	lbs

Roof Material	Composite Shingle			
Roof Dead Load		Q_D =	10	psf
PV System Dead Load		Q_{PV} =	3	psf
Framing Spacing		s_{roof} =	16	in
Linear Dead Load	$w_D = (Q_D + Q_{PV})^* s_{roof}$ =		17.33	plf

Gravitational Loading

**R324.4.1*

Existing Live Load	LL_E =	20	psf	Table 1607.1
Existing Snow Load	SL_E =	10	psf	
Existing Roof Dead Load	DL_E =	10	psf	
Installed PV System Live Load	LL_{pv} =	0	psf	
Installed PV System Snow Load	SL_{pv} =	8	psf	
Installed PV System Total Dead Load	DL_{pv} =	13	psf	

ASD Load Combinations	Existing	Installed PV
DL	10 psf	13 psf
DL + LL	30 psf	13 psf
DL + SL	20 psf	21 psf
DL + .75LL + .75SL	32.5 psf	19 psf

Maximum Existing Load M_{el} 32.5 psf

Maximum Installed PV System Load M_{pv} 21 psf

M_{el} > M_{pv} {OK}

Uplift Demand / Lag Screw Check

Mean Roof Height	<	30	
Exposure		C	
Height & Exposure Adjustment Coefficient		1.00	Table 27.6-2
Effective Wind Area		10	ft^2
*Design Wind Pressure (*most conservative value)*	p =	-78.00	Table 27.6-2
Trib. Depth for Each Rail	d_{pv} = L/2 =	2.88	ft
Trib. Depth for Each Rail	b_{pv} = W/2 =	1.70	ft
Screw Anchor Spacing	S_{pv} =	4	ft (max)
Uplift Force on Each Screw, Portrait	$U_L = (p + Q_{pv}) * d_{pv} * s_{pv}$ =	-863.75	lbs (Upwards)
Uplift Force on Each Screw, Landscape	$U_w = (p + Q_{pv}) * b_{pv} * s_{pv}$ =	-511.25	lbs (Upwards)

Design Uplift Force **$P_{uplift} = 0.6*[Max (U_L , U_W)]$ = -518.25 lbs (Upwards)**

Uplift Capacity

NDS 2015 Adjustment Factors

C_D = 1.6

C_M = 1

C_t = 1

SG = 0.55

Lumber Specific Gravity	SG =	0.55	NDS Supplement Table 4a	
Lag Screw Diameter	D =	5/16	in	
Withdraw Design /in	$1800*SG^{3/2}*D^{3/4}$ =	307	lbs/in	NDS 2015 12.1-1
Embedment Depth	l_p =	2.5	in	
Total Nominal Withdrawal Value	$W = W * l_p$ =	767	lbs	
Withdrawal Design Value	$W' = W * C_D * C_M * C_t$ =	1227	lbs	NDS 2015 Table 11.3.1

Demand-Capacity Ratio **P uplift / W' = 0.42 < 1 {OK}**