

September 29, 2020

Power Home Solar and Roofing 919 North Main Street Mooresville, NC 28115 **Design Criteria:**

Ultimate Wind Speed- 120 mph Ground Snow Load- 10 psf Risk Category- II Exposure category- C

RE: Structural Roof Evaluation for the *Harrington Residence*: 503 South 11th Street, Erwin, North Carolina

As per your request, we have evaluated the roof structure under the proposed solar panel array. The information used to evaluate this structure was gathered during a field visit by Power Home Solar and Roofing on behalf of Right Angle Engineering. The roof structure consists of 2x6 rafters spaced at 16" on center. The roof material consists of asphalt shingles. The design criteria used to analyze this structure are listed above and included with this letter. The adopted building codes in this jurisdiction are: *the 2018 North Carolina Building Code*, the 2018 North Carolina Existing Building Code, and ASCE 7-16.

North Carolina Existing Building Code (NCEBC) 2018 section 807.4 indicates that alterations to an existing building that results in less than a 10% increase in the total stress may be performed without a structural evaluation of the existing building. As demonstrated in the attached calculations, the additional weight of the solar panels will be less than 10% increase in the gravity loading and the stress on the existing roof framing.

Based on our assessment we have determined that the existing roof framing will safely and adequately support the additional loads imposed by the solar panels. In order for the loads to be evenly distributed, the roof attachments should be staggered and spread evenly throughout the panel array. Attachment points should be spaced at a maximum of 48" on center. The racking system should be installed per the manufacture's specifications. There should be a minimum of 22 L-foot attachment points to the roof. Each attachment should have a 5/16" or 18/8 SS lag screw with 2.5" minimum penetration centered on each truss top chord. Waterproofing around the roof penetrations is the responsibility of others. Right Angle Engineering assumes no responsibility for improper installation of the solar panels.

Robert D Smythe, P.E. Right Angle Engineering





Design Criteria:			
Design Wind Speed (3 second gust)	120	mph	
Exposure Category	С		
Risk Category	2		
Mean Roof Height	30	ft	
Roof Type	Gable Roof		
Building Type	enclosed		
Roof Dead Load- ASCE Table	C3-1		
Asphalt Shingles	2	psf	-
5/8" Plywood Sheathing	2	psf	
Roof Framing	4	psf	
Insulation	3.85	psf	
Gypsum sheathing	2	psf	
Solar Panel Array	3	psf	
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Dead Load Without Panels	13.85	psf	
Dead Load With Solar panels	16.85	psf	
Roof Live Load			
Existing Roof Live Load	20	psf	ASCE 7-16 Table 4.3-1
Roof Live Load with Solar Panels	0	psf	2018 NCBC 1607.12.5
			_
Roof Snow Load-ASCE 7-16			
Ground Snow Load (pg)	10	psf	Section 7.2
Exposure Factor (Ce)	0.9		Table 7.3-1
Thermal Factor (Ct)	1.1		Table 7.3-2
Importance Factor (Is)	1		Table 1.5-2
Flat Roof Snow Load (Pf)	7		Equation 7.3-1
Slippery surface Slope Factor (Cs)	0.93		Figure 7-2
Nonslippery Surface Slope Factor			
(Cs)	1		Figure 7-2
Roof Snow Load	7	psf	Equation 7.4-1
Reduced Roof Snow Load (Slippery		•	•
Surface)	6	psf	Equation 7.4-1
Load Combinations - ASCE 7-	16 Section 2.4.1		
		With Solar	
	Without Solar Panels	panels	
D+Lr	33.8 psf	16.8 psf	
D + S	20.8 psf	23.3 psf	



Roof Slope 14 degrees Number of panels 15 Panel Area 262.5 ft^2 Wind Calculations- ASCE 7-16 GCp Zone 1 -0.9 Figure 30.3-(2A-5B) GCp Zone 2 -1.7 Figure 30.3-(2A-5B) GCp Zone 3 -2.6 Figure 30.3-(2A-5B) GCpi 0.18 Table 26.13-1 Velocity Pressure (qn) 30.7 psf Qh= .00256KnKhtKaV^22 Equation 26.10-1 Kh 0.98 Table 26.10-1 Ka 1 Equation 26.8-1 Kd 0.85 Table 26.6-1 Designed wind pressure (P) psf Equation 30.8-1 P= 2n(GCh) - (GChi)) Psf Equation 30.8-1 Zone 1 Pressure (P) -33.2 psf Zone 2 Pressure (P) -57.7 psf Zone 3 Pressure (P) -85.4 psf NDS 2015 Table 12K Rear Union Capacity Shear Capacity 190 lbs NDS 2015 Table 12K Nos 2015 Table 12.2A Pullout capacity 665 lbs N	Solar Array 1-				
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·	Number of Panels per rafter	2			
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Without Solar With Solar Percent Panels Panels Increase					
Bending Moment 1266.2 ft-lbs 675.9 ft-lbs 53.4% Less than 105%	Rending Moment				Less than 105%
Vertical Reaction (V1) 337.7 lbs 311 lbs 92.1% Less than 105%					
Vertical Reaction (V2) 337.7 lbs 226.2 lbs 67% Less than 105%					