



June 22, 2023

To: Blue Raven Solar

1403 North Research Way, Building J

Orem, UT. 84097

Subject: Certification Letter

Alvarado Residence 399 Kotata Ave Bunnlevel, NC. 28323

To Whom It May Concern,

A jobsite observation of the condition of the existing framing system was performed by an audit team of Blue Raven Solar. All review is based on these observations and the design criteria listed below and only deemed valid if provided information is true and accurate.

On the above referenced project, the roof structural framing has been reviewed for additional loading due to the installation of the solar PV addition to the roof. The structural review only applies to the section of the roof that is directly supporting the solar PV system and its supporting elements. The observed roof framing is described below. If field conditions differ, contractor to notify engineer prior to starting construction.

The roof structure of (MP1) consists of composition shingle on roof plywood that is supported by pre-manufactured trusses that are spaced at @ 24"o.c.. The top chords, sloped at 30 degrees, are 2x4 sections, the bottom chords are 2x4 sections and the web members are 2x4 sections. The truss members are connected by steel gusset plates. The max unsupported projected horizontal top chord span is approximately 7'-0".

The existing roof framing system of (MP1) is judged to be adequate to withstand the loading imposed by the installation of the solar panels. No reinforcement is necessary.

The spacing of the solar standoffs should be kept at 72" o.c. for landscape and 48" o.c. for portrait orientation, with a staggered pattern to ensure proper distribution of loads.

The scope of this report is strictly limited to an evaluation of the fastener attachment, underlying framing and supporting structure only. The attachment's to the existing structure are required to be in a staggered pattern to ensure proper distribution of loading. All panels, racking and hardware shall be installed per manufacturer specifications and within specified design limitations. All waterproofing shall be provided by the manufacturer.

Note: Seismic check is not required since Ss<.4g and Seismic Design Category (SDC) < B

Design Criteria:

- Applicable Codes = 2018 North Carolina State Building Code (NCSBC), ASCE 7-10
- Roof Dead Load = 7 psf (MP1)
- Roof Live Load = 20 psf
- Wind Speed = 115 mph (Vult), Exposure C, Risk Category II
- Ground Snow Load = 15 psf Roof Snow Load = 10.5 psf
- Attachment: 1 5/16 dia. lag screw with 2.5 inch min. embedment depth, at spacing shown above.

Please contact me with any further questions or concerns regarding this project.

Sincerely,



Digitally signed by John A. Calvert Date: 2023.06.22 10:02:59 -06'00'



Gravity Loading

Roof Snow Load Calculations		
p _g = Ground Snow Load =	15 psf	_
$p_f = 0.7 C_e C_t I p_g$		(ASCE7 - Eq 7-1)
C _e = Exposure Factor =	1	(ASCE7 - Table 7-2)
C _t = Thermal Factor =	1	(ASCE7 - Table 7-3)
I = Importance Factor =	1	
p _f = Flat Roof Snow Load =	10.5 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
Cs = Slope Factor =	1	
p _s = Sloped Roof Snow Load =	10.5 psf	

PV Dead Load = 3 psf (Per Blue Raven S	iolar)
DL Adjusted to 30 Degree Slope	3.46 psf
PV System Weight	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
X Standoff Spacing =	4.00 ft
Y Standoff Spacing =	6.08 ft
Standoff Tributary Area =	24.33 sft
Point Loads of Standoffs	73 lh

Note: PV standoffs are staggered to ensure proper distribution of loading

Roof Live Load = 20 psf

Note: Roof live load is removed in area's covered by PV array.

Roof Dead Load (MP1)		
Composition Shingle	4.00	•
Roof Plywood	2.00	
2x4 Top Chords @ 24"o.c.	0.73	
Vaulted Ceiling	0.00	(Ceiling Not Vaulted)
Miscellaneous	0.27	_
Total Roof DL (MP1)	7.0 psf	
DL Adjusted to 30 Degree Slope	8.1 psf	



Wind Calculations

Per ASCE 7-10 Components and Cladding

Input Variables						
Wind Speed	115 mph					
Exposure Category	С					
Roof Shape	Hip/Gable					
Roof Slope	30 degrees					
Mean Roof Height	20 ft					
Effective Wind Area	21.3 ft					

Design Wind Pressure Calculations					
Wind Pressure P = qh*G*Cn					
qh = 0.00256 * Kz * Kzt * Kd * V^2	(Eq. 30.3-1)				
Kz (Exposure Coefficient) = 0.9	(Table 30.3-1)				
Kzt (topographic factor) = 1	(Fig. 26.8-1)				
Kd (Wind Directionality Factor) = 0.85	(Table 26.6-1)				
V (Design Wind Speed) = 115 mph	(Fig. 26.5-1A)				
Risk Category = II	(Table 1.5-1)				
qh = 25.90					
0.6 * qh = 15.54					

Standoff Uplift Calculations-Portrait							
	Zone 1	Zone 2	Zone 3	Positive			
GCp =	-0.94	-1.15	-1.15	0.86	(Fig. 30.4-1		
Uplift Pressure =	-14.55 psf	-17.80 psf	-17.80 psf	22.4 psf			
X Standoff Spacing =	4.00	4.00	2.67				
Y Standoff Spacing =	6.08	3.041666667	3.041666667				
Tributary Area =	24.33	12.17	8.11				
Dead Load on Attachment=	73.00	36.50	24.33				
Footing Uplift (0.6D+0.6W)=	-310 lb	-195 lb	-130 lb				

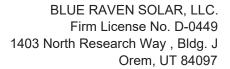
Standoff Uplift Calculations-Landscape						
	Zone 1	Zone 2	Zone 3	Positive		
GCp =	-0.94	-1.15	-1.15	0.86	(Fig. 30.4-1)	
Uplift Pressure =	-14.55 psf	-17.80 psf	-17.80 psf	10.5 psf		
X Standoff Spacing =	6.00	6.00	4.00			
Y Standoff Spacing =	3.50	1.75	1.75			
Tributary Area =	21.00	10.50	7.00			
Dead Load on Attachment=	63.00	31.50	21.00			
Footing Uplift (0.6D+0.6W) =	-268 lb	-168 lb	-112 lb			

Standoff Uplift Check

Maximum Design Uplift = -310 lb Standoff Uplift Capacity = 450 lb 450 lb capacity > 310 lb demand **Therefore**, **OK**

Fastener Capacity Check

Fastener = 1 - 5/16" dia. lag
Number of Fasteners = 1
Embedment Depth = 2.5
Pullout Capacity Per Inch = 250 lb
Fastener Capacity = 625 lb
w/ F.S. of 1.5 & DOL of 1.6= 667 lb
667.2 lb capacity > 310 lb demand Therefore, OK



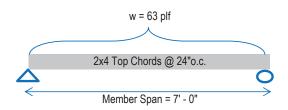


Framing Check

(MP1) PASS

Dead Load 8.1 psf PV Load 3.5 psf Live Load 20.0 psf

Governing Load Combo = DL + LL Total Load 31.5 psf



Member Properties							
Member Size	S (in^3)	I (in^4)	Lumber Sp/Gr	Member Spacing			
2x4	3.06	5.36	DF#2	@ 24"o.c.			

Check Bending Stress								
Fb (psi) =	f'b	Х	Cd	Χ	Cf	Χ	Cr	(NDS Table 4.3.1)
	900	Х	1.25	Х	1.5	Х	1.15	

Allowed Bending Stress = 1940.6 psi

Maximum Moment = $(wL^2) / 8$ = 386.4508 ft#

= 4637.41 in#

Actual Bending Stress = (Maximum Moment) / S

= 1514.3 psi

Allowed > Actual -- 78.1% Stressed -- Therefore, OK

	(Check Defl	ecti	on	
Allowed Deflection (Total Load)	=	L/180			(E = 1600000 psi Per NDS)
	=	= 0.466 in			
Deflection Criteria Based on	=	Continuo	us S	Span	
Actual Deflection (Total Load)	=	(w*L^4) /	(18	5*E*I)	
	=	= 0.166 in			
	:	= L/507	>	L/180	Therefore OK
Allowed Deflection (Live Load)	=	L/240			
		0.35 in			
Actual Deflection (Live Load)	=	(w*L^4) /	(18	5*E*I)	
		0.105 in			
		L/800	>	L/240	Therefore OK

 Check Shear

 Member Area = 5.3 in^2
 Fv (psi) = 180 psi
 (NDS Table 4A)

 Allowed Shear = Fv * A = 945 lb
 Max Shear (V) = w * L / 2 = 221 lb

Allowed > Actual -- 23.4% Stressed -- Therefore, OK