



Reviewed for
Code Compliance

03/24/2022

3/2/2022

Active Energies Solar LLC
40928 US-6
Avon, CO 81620

Attn.: To Whom It May Concern

re job: JACONETTA RESIDENCE
24045 CO RD 25
OAK CREEK, CO 80467

The following calculations are for the structural engineering design of the photovoltaic panels and are valid only for the structural info referenced in the stamped plan set. The verification of such info is the responsibility of others.

After review, I certify that the roof structure has sufficient structural capacity for the applied PV loads.

All mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

Design Criteria:

Code:	2018 IBC		
	ASCE 7-16		
Live Load:	20	psf	
Ult Wind Speed:	115	mph	
Exposure Cat:	C		
Ground Snow:	110	psf	Min Roof Snow: NA

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Exp. 10/31/2023

Roof Properties:

	Roof 1
Roof Type =	Metal
Roof Pitch (deg) =	26.6
Mean Roof Height (ft) =	13
Attachment Trib Width (ft) =	2.75
Attachment Spacing (ft) =	2
Framing Type =	Truss
Framing Size =	2x6
Framing OC Spacing (in.) =	24
Section Thickness, b (in.) =	1.5
Section Depth, d (in.) =	5.5
Section Modulus, S _x (in. ³) =	7.6
Moment of Inertia, I _x (in. ⁴) =	20.8
Framing Span (ft) =	8
Deflection Limit D+L (in.) =	1.6
Deflection Limit S or W (in.) =	1.07
Attachments Pattern =	Fully Staggered
Framing Upgrade =	Adequate
Sister Size =	NA
Wood Species =	DF #2
Wood F _b (psi) =	900
Wood F _v (psi) =	180
Wood E (psi) =	1600000
C _D (Wind) =	1.6
C _D (Snow) =	1.15
C _{LS} =	1.15
C _M = C _t = C _L = C _i =	1.0
C _F =	1.3
C _{fu} =	1.00
C _r =	1.15
F' _{b_wind} (psi) =	2476
F' _{b_snow} (psi) =	1779
F' _{v_wind} (psi) =	288
F' _{v_snow} (psi) =	207
M _{allowable_wind} (lb-ft) =	1560
M _{allowable_snow} (lb-ft) =	1121
V _{allowable_wind} (lbs) =	1584
V _{allowable_snow} (lbs) =	1139



$E' \text{ (psi)} = 1600000$

Load Calculation:

Dead Load Calculations:

Panels Dead Load (psf) =	3.0
Roof 1	
Roofing Weight (psf) =	2.0
Decking Weight (psf) =	2.0
Framing Weight (psf) =	0.9
Misc. Additional Weight (psf) =	1.0
Existing Dead Load (psf) =	5.9
Total Dead Load (psf) =	8.9

Snow Load Calculations:

Ground Snow Load, p_g (psf) =	110
Min Flat Snow, p_{f_min} (psf) =	NA
Min Sloped Snow, p_{s_min} (psf) =	NA
Snow Importance Factor, I_c =	1.0
Exposure Factor, C_e =	0.9
Roof 1	
Thermal Factor, C_t =	1.2
Flat Roof Snow, p_f (psf) =	83.16
Slope Factor, C_s =	1.00
Sloped Roof Snow, p_s (psf) =	83

Wind Load Calculations:

Ultimate Wind Speed (mph) =	115
Directionality Factor, k_d =	0.85
Topographic Factor, k_{zt} =	1.0
Roof 1	
Velocity Press Exp Factor, k_z =	0.85
Ground Elevation Factor, k_e =	1.00
Velocity Pressure, q_z (psf) =	24.4
Array Edge Factor, γ_E =	1.25
Solar Equalization Factor, γ_a =	0.64
External Pressure Up, GC_{p_1} =	-1.5
External Pressure Up, GC_{p_2} =	-2.2
External Pressure Up, GC_{p_3} =	-2.3
External Pressure Down, GC_p =	0.6
Design Pressure Up, $p_{_1}$ (psf) =	-29.5
Design Pressure Up, $p_{_2}$ (psf) =	-43.3



Design Pressure Up, p_3 (psf) = -45.3
Design Pressure Down, p (psf) = 16.0

Hardware Checks:

Attachment Checks:

Roof 1	
Attachment Type =	Easy Mounting Foot
Allowable Up Force (lbs) =	202
Allowable Down Force (lbs) =	1000
Allowable Side Force (lbs) =	220
Applied Uplift Force (lbs) =	-163
Uplift DCR =	0.81
Applied Down Force (lbs) =	424
Down DCR =	0.42
Applied Lateral Force (lbs) =	212
Lateral DCR =	0.96

Roof Framing Checks:

Force Checks:

Roof 1	
LC1: D+S	
Applied Moment (lb-ft) =	982
Applied Shear (lbs) =	737
Allowable Moment (lb-ft) =	1121
Allowable Shear (lbs) =	1139
Moment DCR =	0.88
Shear DCR =	0.65
LC2: D+0.6W	
Applied Moment (lb-ft) =	198
Applied Shear (lbs) =	148
Allowable Moment (lb-ft) =	1560
Allowable Shear (lbs) =	1584
Moment DCR =	0.13
Shear DCR =	0.09
LC3: D+0.75(S+0.6W)	
Applied Moment (lb-ft) =	837
Applied Shear (lbs) =	628
Allowable Moment (lb-ft) =	1560
Allowable Shear (lbs) =	1584



Moment DCR = **0.54**
 Shear DCR = **0.40**

LC4: 0.6D+0.6W

Applied Moment (lb-ft) = 132
 Applied Shear (lbs) = 99
 Allowable Moment (lb-ft) = 1560
 Allowable Shear (lbs) = 1584
 Moment DCR = **0.08**
 Shear DCR = **0.06**

Deflection Checks (Service Level):

Roof 1

LC1: D+L

Deflection (in.) = 0.01
 Deflection Limit (in.) = 1.84
 Deflection DCR = **0.01**

LC2: S

Deflection (in.) = 0.09
 Deflection Limit (in.) = 1.23
 Deflection DCR = **0.08**

LC3: W (Down)

Deflection (in.) = 0.01
 Deflection Limit (in.) = 1.23
 Deflection DCR = **0.01**

LC4: W (Up)

Deflection (in.) = -0.01
 Deflection Limit (in.) = 1.23
 Deflection DCR = **0.01**

Seismic Check:

Existing Weight:

Wall Weight (psf) = 17
 Tributary Wall Area (ft²) = 1300
 Total Wall Weight (lbs) = 22100
 Roof Weight (psf) = 6
 Roof Area (ft²) = 3600
 Total Roof Weight (lbs) = 21403
Total Existing Weight (lbs) = 43503

Additional PV Weight:



PV Panel Weight (lbs) = 49
Number of Panels = 16
Total Additional PV Weight (lbs) = 776

Weight Increase:

$$(\text{Existing W} + \text{Additional W})/(\text{Existing W}) = 102\%$$

The increase in 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:

Existing structure is assumed to have been designed and constructed following appropriate codes at time of erection, and assumed to have appropriate permits. The calculations produced are only for the roof framing supporting the proposed PV installation referenced in the stamped planset and were completed according to generally recognized structural analysis standards and procedures, professional engineering and design experience, opinions and judgements. Existing deficiencies which are unknown or were not observable during time of inspection are not included in this scope of work. All PV modules, racking, and mounting equipment shall be designed and installed per manufacturer's approved installation specifications. The Engineer of Record and the engineering consulting firm assume no responsibility for misuse or improper installation. This analysis is not stamped for water leakage. Framing was determined based on information in provided plans and/or photos, along with engineering judgement. Prior to commencement of work, the contractor shall verify the framing sizes, spacings, and spans noted in the stamped plans, calculations, and cert letter (where applicable) and notify the Engineer of Record of any discrepancies prior to starting construction. Contractor shall also verify that there is no damaged framing that was not addressed in stamped plans, calculations, and cert letter (where applicable) and notify the Engineer of Record of any concerns prior to starting construction.