



January 12, 2016

To: 1st Light Energy
1869 Moffat Blvd.
Manteca, CA 95336

Subject: Structural Certification for Installation of Solar Panels
McGeachy Residence
6-11 Beach 69th Street
Arverne, NY. 11692

To Whom It May Concern,

A design check for the subject residence was done on the existing roofing and framing systems for the installation of solar panels over the roof. From a field inspection of the property, the existing roof support structures were observed by the client's auditors as follows:

The roof structure of (MP1/MP2) consists of composition shingle on roof plywood that is supported by nominal 2x10 rafters @ 16"o.c., paired with nominal 2x10 ceiling joists @ 16"o.c.. There are 2x6 collar ties at every rafter which frame out an enclosed attic. The rafters are supported mid-span by vertical struts which work with collar ties and ceiling joists to provide a truss system to support the rafters above. The rafters have a max projected horizontal span of 10'-0", with a slope of 22 degrees. The rafters are connected at the ridge to a continuous 2x12 ridge board and are supported at the eave by a load bearing wall.

The existing roof framing system of (MP1/MP2) 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 48" o.c. with a staggered pattern to ensure proper distribution of loads.

I further certify that all applicable loads required by the codes and design criteria listed below were applied to the AEE SnapNRack solar rail system and analyzed. Furthermore, the installation crews have been thoroughly trained to install the solar panels based on the specific roof installation instructions developed by AEE SnapNRack for the racking system and AEE for the roof connections. Finally, I accept the certifications indicated by the solar panel manufacturer for the ability of the panels to withstand high wind and snow loads.

Design Criteria:

- Applicable Codes = 2010 Building Code of NY State, ASCE 7-05, and 2005 NDS
- Roof Dead Load = 13 psf (MP1/MP2)
- Roof Live Load = 20 psf
- Wind Speed = 110 mph, Exposure B
- Ground Snow Load = 20 psf - Roof Snow Load = 14 psf

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

Sincerely,

Elaine Huang, P.E.
Project Engineer



Gravity Loading

Roof Snow Load Calculations		
p_g = Ground Snow Load =	20 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 =	14.0 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
C_s = Slope Factor =	1	
p_s = Sloped Roof Snow Load =	14.0 psf	

PV Dead Load = 4 psf (Per 1st Light Energy)

Roof Dead Load (MP1/MP2)		
Composition Shingle	4.00	
Roof Plywood	2.00	
2x10 Rafters @ 16"o.c.	2.90	
Vaulted Ceiling	4.00	(Enclosed Attic)
Miscellaneous	0.10	
Total Roof DL (MP1/MP2)	13.0 psf	
DL Adjusted to 22 Degree Slope	14.0 psf	

Wind Calculations

Per ASCE 7-05 Components and Cladding

Input Variables	
Wind Speed	110 mph
Exposure Category	B
Roof Shape	Gable/Hip
Roof Slope	22 degrees
Mean Roof Height	20 ft
Building Least Width	40 ft
Effective Wind Area	17.5 ft

Design Wind Pressure Calculations	
Wind Pressure $P = qh(G \cdot C_p)$	
$qh = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I$	(Eq. 6-15)
K_z (Exposure Coefficient) = 0.7	(Table 6-3)
K_{zt} (topographic factor) = 1	(Fig. 6-4)
K_d (Wind Directionality Factor) = 0.85	(Table 6-4)
V (Design Wind Speed) = 110 mph	
I Importance Factor = 1	(Table 6-1)
$qh = 18.43$	

Standoff Uplift Calculations				
	Zone 1	Zone 2	Zone 3	Positive
$G C_p =$	-0.85	-1.45	-2.30	0.40
Uplift Pressure =	-15.67 psf	-26.72 psf	-42.39 psf	10.0 psf
X Standoff Spacing =	4.00	4.00	4.00	
Y Standoff Spacing =	2.75	2.75	2.75	
Tributary Area =	11.00	11.00	11.00	
Footing Uplift =	-172 lb	-294 lb	-466 lb	

(Fig. 6-11)
(Minimum)

Standoff Uplift Check	
Maximum Design Uplift = -294 lb	
Standoff Uplift Capacity = 400 lb	
400 lb capacity > 294 lb demand Therefore, OK	

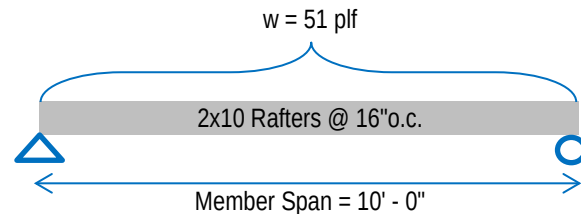
Fastener Capacity Check	
Fastener = 1 - 5/16" dia Lag	
Number of Fasteners = 1	
Embedment Depth = 2.5	
Pullout Capacity Per Inch = 250 lb	
Fastener Capacity = 625 lb	
w/ F.S. of 1.5 = 417 lb	
417 lb capacity > 294 lb demand Therefore, OK	

Framing Check (MP1/MP2)

PASS

Dead Load 14.0 psf
 PV Load 4.0 psf
 Snow Load 14.0 psf

Governing Load Combo = DL + LL
 Total Load 38.0 psf



Member Properties				
Member Size	S (in ³)	I (in ⁴)	Lumber Sp/Gr	Member Spacing
2x10	21.39	98.93	SPF#2	@ 16"o.c.

Check Bending Stress							
Fb (psi) =	f'b	x	Cd	x	Cf	x	Cr
	875	x	1.25	x	1.1	x	1.15

(NDS Table 4.3.1)

Allowed Bending Stress = 1383.5 psi

Maximum Moment = $(wL^2) / 8$
 = 633.683 ft#
 = 7604.19 in#

Actual Bending Stress = (Maximum Moment) / S
 = 355.5 psi

Allowed > Actual -- 25.7% Stressed -- Therefore, OK

Check Deflection	
Allowed Deflection (Total Load) =	$L/180$ (E = 1400000 psi Per NDS)
	= 0.666 in
Deflection Criteria Based on =	Simple Span
Actual Deflection (Total Load) =	$(5 * w * L^4) / (384 * E * I)$
	= 0.083 in
	= L/1446 > L/180 Therefore OK

Allowed Deflection (Live Load) = $L/240$
 0.5 in
 Actual Deflection (Live Load) = $(5 * w * L^4) / (384 * E * I)$
 0.044 in
 L/2728 > L/240 Therefore OK

Check Shear	
Member Area = 13.9 in ²	Fv (psi) = 135 psi (NDS Table 4A)
Allowed Shear = Fv * A = 1873 lb	Max Shear (V) = w * L / 2 = 253 lb

Allowed > Actual -- 13.6% Stressed -- Therefore, OK