

March 31, 2021

BES Project Number: 0331202115 John Rodgers

Power Home Solar, LLC 919 N Main St. Mooresville, NC 28115

Project Location: John Rodgers: 35 Allegheny Dr., Spring Lake, NC 28390 Solar Array Installation

To Whom It May Concern:

Per your request, BES has reviewed the existing structure at the above referenced location. The purpose of this review was to determine the adequacy of the existing structure to support the proposed installation of solar panels on the roof as shown on the attached panel layout plan.

Based upon our review, we certify that the following, mounting connection: (1) 5/16" lag screw w/min. 2.5" embedment into framing at max 48" o/c along rails (2) rails per row of panels, evenly spaced; panel length perpendicular to the rails not to exceed 67 in. Solar module mounting hardware design is by the manufacturer.

Limitations: Installation of the solar panels must be performed in accordance with manufacturer recommendations. All work performed must be in accordance with accepted industry-wide methods and applicable safety standards. The contractor must notify BES should any damage, deterioration or discrepancies between the as-built condition of the structure and the condition described in this letter be found. Connections to existing roof framing must be staggered, except at array ends, so as to not overload any existing structural member. The design of the solar panel racking (mounts, rails, etc.) is the responsibility of the manufacturer. Waterproofing around the roof penetrations is the responsibility of others. BES assumes no responsibility for improper installation of the solar array.

Sincerely,



Jermey Bowers M.E., P.E. *Principal Engineer*

PHONE (260) 333-0900 FAX (260) 333-0901 Bowers Engineering Services 121 S. Main ST Auburn, IN (260) 333-0900

Structural Analysis

Location

35 Allegheny Dr. Spring Lake, NC 28390

Roof Mount Solar

3/31/2021



Project: 0331202115 Rev:

Page 1 of 5

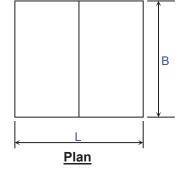
BES		Date: 3/3	1/2021 Connections
121 South Main ST		Dutci Cro	
Auburn, IN			
Cust. Name:	Bowers Engineering Services	Subject: Roof Mo	unt
Job Number:	0331202115	Originator	0 Checker:
	<u>STRUCTURAL</u>	<u>SUMMARY</u>	
<u>CODE SPEC</u>	WIN	D	
IBC 2015	VV 11N		
		Speed: 119 MPH	
ASCE 7-10		Exp.: C	
Risk Cat:	11		
Wind Load - uplift			
wind Load - upint		Max lb	
Zone 1	-29.06 psf	-195.31 lb	
Zone 2	1	-234.73 lb	
	1	-234.73 lb	
Zone 3	1	-234.75 10	
Max trib	11.20 ft2		
Max loading at connection			
Negitive	-234.73 lb/fastener		
Connection (Pull Out)			
Lag screw	5/16 in		
Cd			
embedment	2.5 in		
Nominal CapacityPrying	205.00 lbs G=0.42		
Max capacity (lbs)		234.73	ОК
Note:			
* Lag screws to be diameter :	5/16x2.5inches long		
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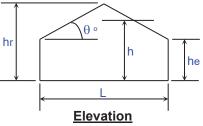
* All fasteners need to be placed at roof rafters.

BES 121 South Main ST Auburn, IN	WIND LOADING Per ASCE 7-10				
Cust Name:	Bowers Engineering Services	Subject:	Roof Mount		
Job Number:	0331202115	Originator:	0	Checker:	

Input Data:

Wind Speed, V =	119	mph (Wind Map, Figure 26.5-1A-C)		
Bldg. Classification =	II	(Table 1-1 Occupancy Category)		
Exposure Category =	С	(Sect. 26.7)		
Ridge Height, hr =	36.67	ft. (hr >= he)		
Eave Height, he =	15.00	ft. (he <= hr)		
Building Width =	52.00	ft. (Normal to Building Ridge)		
Building Length =	69.00	ft. (Parallel to Building Ridge)		
Roof Type =	Gable	(Gable or Monoslope)		
Topo. Factor, Kzt =	1.00	(Sect. 26.8 & Figure 26.8-1)		
Direct. Factor, Kd =	0.85	(Table 26.6)		
Enclosed? (Y/N)	Y	(Sect. 28.6-1 & Figure 26.11-1)		
Hurricane Region?	N			
Component Name =	Decking	(Purlin, Joist, Decking, or Fastener)		
Effective Area, Ae =	11.1	ft.^2 (Area Tributary to C&C)		
Overhangs? (Y/N)	N	(if used, overhangs on all sides)		





Resulting Parameters and Coefficients:

Roof Angle, $\theta = 39.81$ deg. Mean Roof Ht., h = 25.84 ft. (h = (hr+he)/2, for roof angle >10 deg.)

Roof External Pressure Coefficients, GCp:

GCp Zone 1-3 Pos. = (Fig. 30.4-2A, 30.4-2B, and 30.4-2C) 0.90 GCp Zone 1 Neg. = -0.99 (Fig. 30.4-2A, 30.4-2B, and 30.4-2C) GCp Zone 2 Neg. = -1.19 (Fig. 30.4-2A, 30.4-2B, and 30.4-2C) (Fig. 30.4-2A, 30.4-2B, and 30.4-2C) GCp Zone 3 Neg. = -1.19 Positive & Negative Internal Pressure Coefficients, GCpi (Figure 26.11-1): +GCpi Coef. = 0.00 (positive internal pressure) -GCpi Coef. = 0.00 (negative internal pressure) If $z \le 15$ then: $Kz = \overline{2.01^*(15/zg)}^{(2/\alpha)}$, If z > 15 then: $Kz = 2.01^*(z/zg)^{(2/\alpha)}$ (Table 30.3-1) α= 9.50 (Table 26.9-1) zg = 900 (Table 26.9-1) 0.95 Kh = (Kh = Kz evaluated at z = h)

Velocity Pressure: $qz = 0.00256*Kz*Kzt*Kd*V^2$ (Sect. 30.3.2, Eq. 30.3-1) qh = 29.33 psf $qh = 0.00256*Kh*Kzt*Kd*V^2$ (qz evaluated at z = h)

Design Net External Wind Pressures (Sect. 30.4 & 30.6): For h <= 60 ft.: p = qh*((GCp) - (+/-GCpi)) (psf) For h > 60 ft.: p = q*(GCp) - qi*(+/-GCpi) (psf) where: q = qh for roof qi = qh for roof (conservatively assumed per Sect. 30.6)

PAGE 3 of 5

Wind Load Tabulation for Roof Components & Cladding							
Component	Z	Kh	qh	p = Net Design Pressures (psf)			
	(ft.)		(psf)	Zone 1,2,3 (+)	Zone 1 (-)	Zone 2 (-)	Zone 3 (-)
Decking	0	0.95	29.33	26.26	-29.06	-34.93	-34.93
	15.00	0.95	29.33	26.26	-29.06	-34.93	-34.93
	20.00	0.95	29.33	26.26	-29.06	-34.93	-34.93
	25.00	0.95	29.33	26.26	-29.06	-34.93	-34.93
For z = he:	15.00	0.95	29.33	26.26	-29.06	-34.93	-34.93
For $z = h$:	25.84	0.95	29.33	26.26	-29.06	-34.93	-34.93

ft.

Notes: 1. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.

- 2. Width of Zone 2 (edge), 'a' = 5.20
- 3. Width of Zone 3 (corner), 'a' = 5.20 ft.

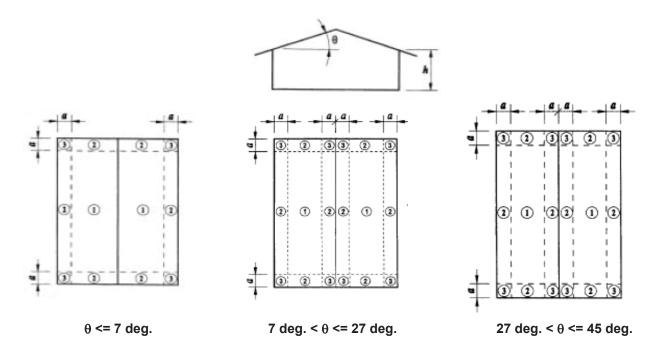
4. For monoslope roofs with $\theta \le 3$ degrees, use Fig. 30.4-2A for 'GCp' values with 'qh'.

5. For buildings with h > 60' and θ > 10 degrees, use Fig. 30.6-1 for 'GCpi' values with 'qh'.

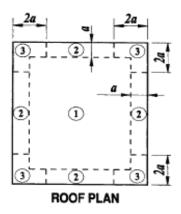
- 6. For all buildings with overhangs, use Fig. 30.4-2B for 'GCp' values per Sect. 30.10.
- 7. If a parapet >= 3' in height is provided around perimeter of roof with $\theta \le 10$ degrees, Zone 3 shall be treated as Zone 2.
- 8. Per Code Section 30.2.2, the minimum wind load for C&C shall not be less than 16 psf.
- 9. References : a. ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures".
 - b. "Guide to the Use of the Wind Load Provisions of ASCE 7-02" by: Kishor C. Mehta and James M. Delahay (2004).

PAGE 4of 5

Roof Components and Cladding:







 $\frac{\text{Roof Zones for Buildings with h > 60 ft.}}{\text{(for Gable Roofs <= 10° and Monoslope Roofs <= 3°)}}$

PAGE 5 of 5