

# STRUCTURAL CERTIFICATION & SPAN TABLES FOR HEAVY DUTY (HD) MOUNTING SYSTEMS

for State of Nevada

Prepared for: SolaRack

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Prepared By:

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November 12, 2018

The SolaRack logo is positioned in the bottom right corner of the page. It features the word "SOLARACK" in a bold, black, sans-serif font. The letter "R" is significantly larger and stylized, with an orange-to-black gradient and a white outline, making it the focal point of the logo.

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## SolaRack

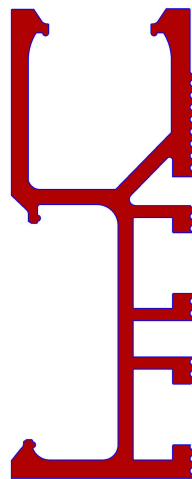
1103 Lawrence Dr., Unit A  
Newbury Park, CA 91320

### RE: Sunstrong Certification & Span Tables for SolaRack HD Mounting Systems

The scope of this report focuses on providing a structural verification of aluminum extruded railing intended for mounting solar panels atop of rooftops for the HD rails manufactured by SolaRack.

The structural performance of the railing has been verified to be in compliance with the requirements of the 2012 International Building Code and ASCE 7-10 under prescribed wind and snow loading in the state of Nevada. The construction and application of the aluminum railing shall be accordance with the installation guide for the solar mounting solutions provided by SolaRack. Structural verification of the roof frame members and the solar panels are excluded and beyond the scope of this report.

Figure 1:



Rail Section Sketch

### Design Approach

The railing section as illustrated in Figure 1: was modeled as a simply supported beam undergoing wind loads applied as a point load from the mid-clamps at the panel joints.

The resulting applied bending moments was then checked with the allowable bending moment of the aluminum rail section based on the equation below:

$$F_a = 0.6 F_y = 0.6 \times 35 \text{ ksi} = 21 \text{ ksi}$$

- $F_y = 35 \text{ ksi}$  (6005 T-5 Aluminum)

The applied bending stress from the worst case loading condition is based on the following equation, where the geometric properties were derived from engineering software (See Figure 2):

$$f = M \div S = M \times (I \div c)$$

- M is the moment based on the wind loads
- S is the section modulus of rail section

Figure 2:

**Geometric Properties**

Area	0.896 in <sup>2</sup>
Ix	0.847 in <sup>4</sup>
Ixy	-0.025 in <sup>4</sup>
Iy	0.139 in <sup>4</sup>
Sx+	0.543 in <sup>3</sup>
Sx-	0.567 in <sup>3</sup>
Sy+	0.272 in <sup>3</sup>
Sy-	0.206 in <sup>3</sup>
Xc	0.674 in
Yc	1.493 in
rx	0.972 in
ry	0.394 in

**Principal Properties**

I1	0.848 in <sup>4</sup>
I2	0.138 in <sup>4</sup>
S1+	0.538 in <sup>3</sup>
S1-	0.562 in <sup>3</sup>
S2+	0.252 in <sup>3</sup>
S2-	0.191 in <sup>3</sup>
r1	0.973 in
r2	0.393 in
α	1.981 deg

**Polar Properties**

Ip	0.986 in <sup>4</sup>
rp	1.049 in

**Overall Properties**

Depth	3.052 in
Perimeter	16.786 in
Weight	0.003 K/ft
Width	1.185 in

**Plastic Properties**

Xpna	0.756 in
Ypna	1.737 in
Zx	0.745 in <sup>3</sup>
Zy	0.290 in <sup>3</sup>

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Worst case loading conditions were based on the following two load combinations per section 2.4 of ASCE 7-10:

1.  $D + 0.6W$
2.  $D + 0.75L + 0.4W + 0.75S$  ( $L=0$ )

Where D is the dead load of the panels and racking equipment, W is the wind uplift loads at the anchors and S represents the ground snow load value. The tabulated results of the maximum rail span according to the worst case loading conditions are provided in this report (See Figure 3).

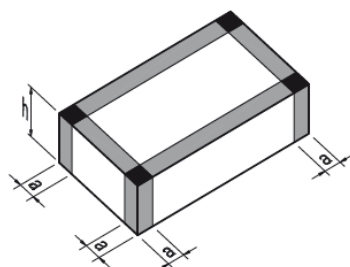
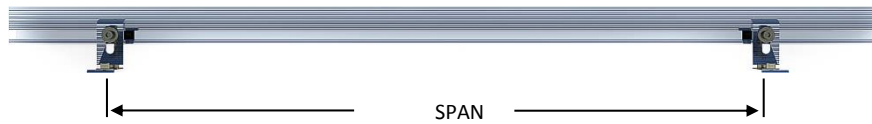
### **Design Criteria**

The following parameters were considered in determining the values of the allowable span charts of the railing:

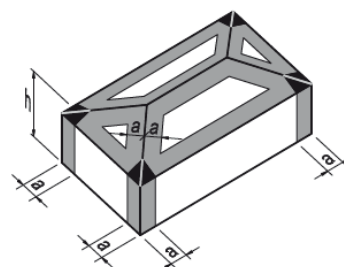
- Maximum Building Height Considered = 30 ft
- Exposure Categories Considered: B & C
- Wind Pressure Based on Section 30.4 (Method 1)
- Gust Factor,  $G = 0.85$
- Topography Factor,  $K_{zt} = 1.0$
- Directionality Factor,  $K_d = 0.85$
- Importance Factor,  $I = 1.0$
- Gable & Flat Roofs Type Considered
- Zone 2 Pressures Only Considered
- Minimum 2 Rails Per Panel
- Maximum Cantilever of Railing from Anchor = 12 inches
- Tilt Angles Considered: 0 to 30 degrees
- Performance Not Limited to Deflection
- Adequacy of Attachments Based on Evaluation Report By Others

Figure 3:

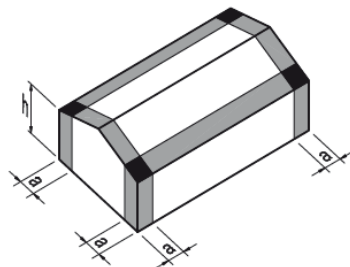
ZONE 2 ( EXPOSURE C)						ZONE 2 ( EXPOSURE B)					
LOAD		RAIL SPAN				LOAD		RAIL SPAN			
Snow (PSF)	Wind (MPH)	4'	6'	8'	10'	Snow (PSF)	Wind (MPH)	4'	6'	8'	10'
0-10	110					0-10	110				
	130						130				
	150						150				
20	110					20	110				
	130						130				
	150						150				
30	110					30	110				
	130						130				
	150						150				
40	110					40	110				
	130						130				
	150						150				
50	110					50	110				
	130						130				
	150						150				
60	110					60	110				
	130						130				
	150						150				
70	110					70	110				
	130						130				
	150						150				
80	110					80	110				
	130						130				
	150						150				
90	110					90	110				
	130						130				
	150						150				
100	110					100	110				
	130						130				
	150						150				



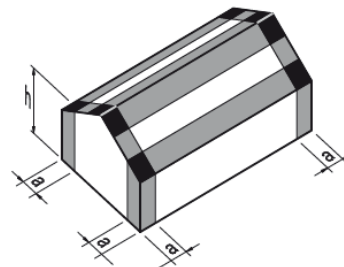
Flat Roof



Hip Roof ( $7^\circ < \theta \leq 27^\circ$ )



Gable Roof ( $\theta \leq 7^\circ$ )



Gable Roof ( $7^\circ < \theta \leq 45^\circ$ )

Interior Zones  
Roofs - Zone 1 / Walls - Zone 4
 End Zones  
Roofs - Zone 2 / Walls - Zone 5
 Corner Zones  
Roofs - Zone 3

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## **Design Code References**

The following engineering references were considered in determining the values of the wind load conditions and material properties of the aluminum railing:

- IBC 2012
- ASCE 7-10 (Wind & Snow Loading)
- Aluminum Design: Aluminum Design Manual 2010

The structural verification and installation of the HD rails shall be subject to the following qualification and conditions.

- There shall be a minimum of 2 rails provided per solar panel.
- Panels shall be considered slippery surface for accumulation of snow.
- All other components such as clamps and splices shall be installed per installation manual
- The deflection of the railing has not been controlled in the design. If deflection has to be limited, then spacing shall be reduced as advised by a practicing structural engineer.
- Building is not a special occupancy structure such as a public school, public safety building or assembly building.
- The installation of the framing shall conform to relevant Building Codes, Manufacturer's specifications and good building practice.
- The cantilever span of the railing shall not exceed 12 inches.
- Attachment of lag screws shall be installed per the requirements of 2012 National Design (NDS).

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- Structural verification of the existing roof frame members and solar panels are excluded in this report.
  - Proper attachment to roof frame member shall be verified a qualified inspector or building official.
  - Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.
  - The installation and fixings shall be periodically inspected and maintained.

Please feel free to contact us with any questions or concerns regarding the information provided in this report.

Respectfully Submitted,



**Dayanand Bettadapura, P.E.**  
Lead Engineer

