

STRUCTURAL CERTIFICATION & SPAN TABLES FOR MCR MOUNTING SYSTEMS

for State of California

Prepared for: SolaRack

Prepared By:



November 12, 2018

SOLARACK

SolaRack

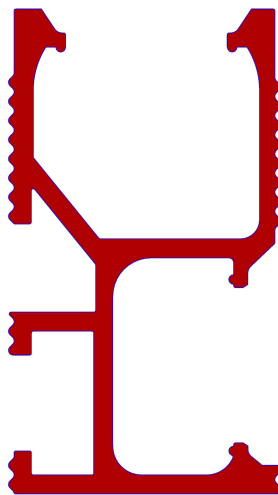
1103 Lawrence Dr., Unit A
Newbury Park, CA 91320

RE: Sunstrong Certification & Span Tables for SolaRack MCR 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 MCR 2.0 racking manufactured by SolaRack.

The structural performance of the railing has been verified to be in compliance with the requirements of the 2016 California Building Code and ASCE 7-10 under prescribed wind and snow loading in the state of California. 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	0.501 in ²
Ix	0.201 in ⁴
Ixy	0.000 in ⁴
Iy	0.073 in ⁴
Sx+	0.187 in ³
Sx-	0.218 in ³
Sy+	0.120 in ³
Sy-	0.143 in ³
Xc	0.480 in
Yc	0.921 in
rx	0.633 in
ry	0.381 in

Principal Properties

I1	0.201 in ⁴
I2	0.073 in ⁴
S1+	0.187 in ³
S1-	0.218 in ³
S2+	0.119 in ³
S2-	0.142 in ³
r1	0.633 in
r2	0.381 in
α	-0.191 deg

Polar Properties

Ip	0.274 in ⁴
rp	0.739 in

Overall Properties

Depth	1.994 in
Perimeter	11.976 in
Weight	0.002 K/ft
Width	1.119 in

Plastic Properties

Xpna	0.375 in
Ypna	0.996 in
Zx	0.267 in ³
Zy	0.164 in ³

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).

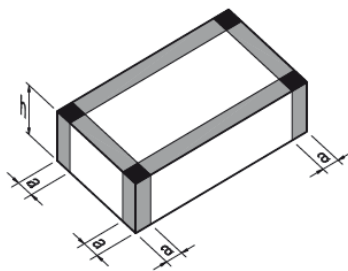
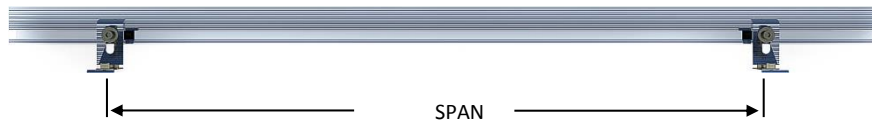
Design Criteria

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

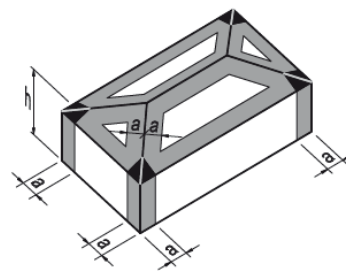
- Maximum Building Height Considered = 30 ft
- Exposure Categories Considered: B & C
- Wind Pressure Based on Section 30.4 (Method 1)
- Gust Factor, $G = 0.85$
- Topography Factor, $K_{zt} = 1.0$
- Directionality Factor, $K_d = 0.85$
- Importance Factor, $I = 1.0$
- Gable & Flat Roofs Type Considered
- 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:

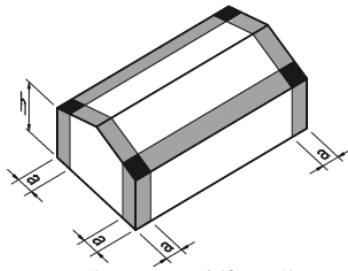
ZONE 2 (EXPOSURE C)					ZONE 2 (EXPOSURE B)							
LOAD		RAIL SPAN				LOAD		RAIL SPAN				
Snow (PSF)	Wind (MPH)	2'	4'	6'	8'	Snow (PSF)	Wind (MPH)	2'	4'	6'	8'	
0-10	110	■	■	■	■	0-10	110	■	■	■	■	
	130	■	■	■	■		20	110	■	■	■	■
	150	■	■	■	■			130	■	■	■	■
110	■	■	■	■	150	■		■	■	■		
30	110	■	■	■	■	30	110	■	■	■	■	
	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	■	■	■	■		125	■	■	■	■	
	150	■	■	■	■		140	■	■	■	■	
90	110	■	■	■	■	90	110	■	■	■	■	
	130	■	■	■	■		130	■	■	■	■	
	150	■	■	■	■		150	■	■	■	■	
100	110	■	■	■	■	100	110	■	■	■	■	
	130	■	■	■	■		130	■	■	■	■	
	150	■	■	■	■		150	■	■	■	■	



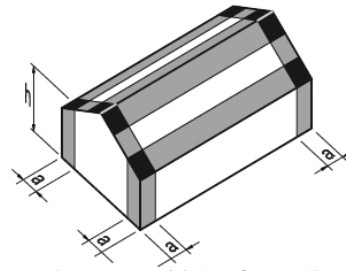
Flat Roof



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



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



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



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 2015
- ASCE 7-10 (Wind & Snow Loading)
- Aluminum Design: Aluminum Design Manual 2010

The structural verification and installation of the MCR 2.0 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 2015 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,



Phong "Paul" Truong, P.E.
President

