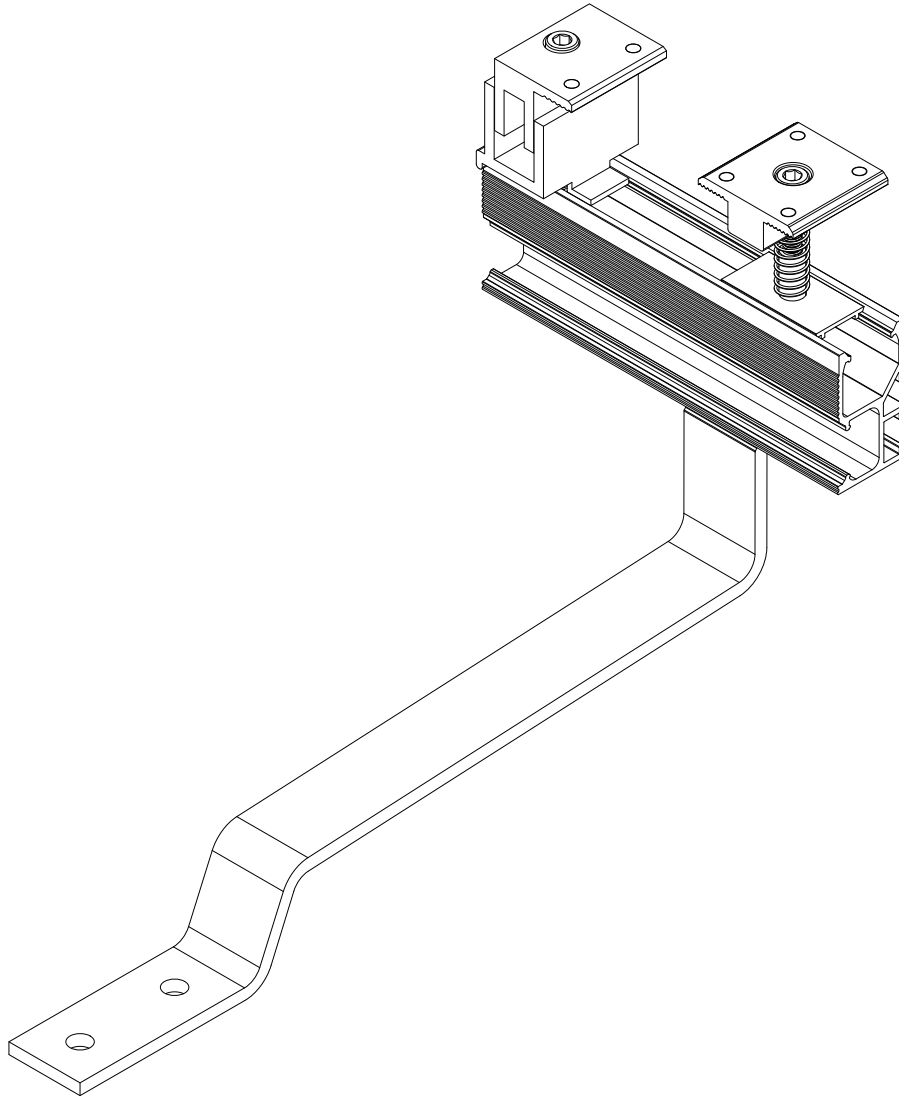


SOLAR*R***RACK**

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Compliance Report Flat Tile Hook

State of California

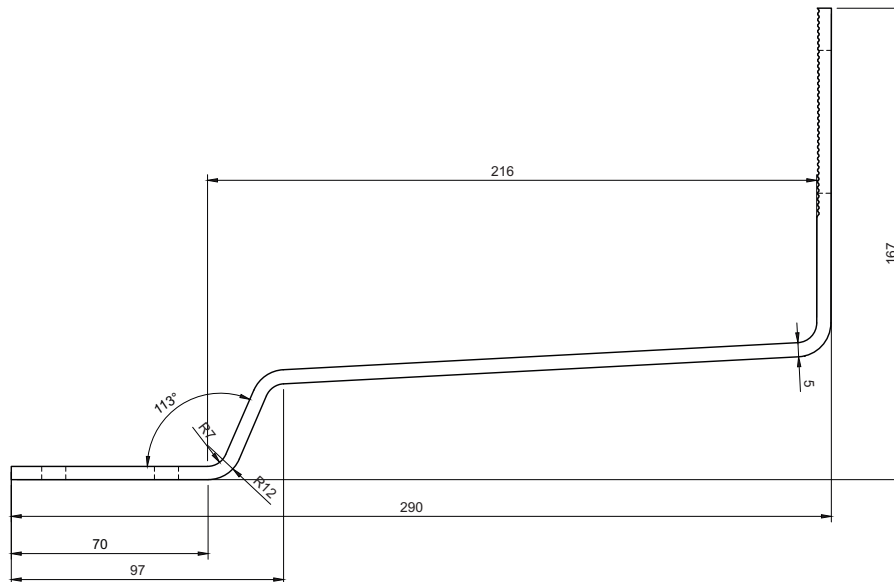
September 25th 2017

**RE: Sunstrong Structural Span Code Compliance of
Stainless Steel Hook (Flat Tile Hook) for State of CA**

The scope of this report focuses on providing a structural evaluation of steel tile hooks intended for mounting solar panels atop of rooftops and which are distributed by SolaRack.

The structural performance of the flat tile hook has been verified to be in compliance with the requirements of the 2016 California Building Code and ASCE 7-10 under prescribed wind loading in the state of California. The specific spacing and layout of the tile hooks under various wind exposures has been laid out in this report in the form of tables/charts for ease of reference. Structural verification of the roof frame members and the solar panels are excluded and beyond the scope of this report.

Figure 1:
Tile Hook Profile



Design Approach

The flat tile hook as illustrated in Figure 1: was modeled as a cantilevered member undergoing wind loads applied as a point load at the end of the hook. The resulting applied bending moments was then checked with the allowable bending moment of the vertical bend section near the base of the hook (where the maximum moment occurs) based on the equation below.

$$F_a = 0.95F_y = 0.95 \times 30 \text{ksi} = 28.5 \text{ksi}$$

F_y L30ksi: A304 Stainless Steel;

The applied bending stress from the various wind loading conditions is based on the following equation, where the geometric properties were derived mathematically from vertical bend section dimensions (See Figure 2):

$$f = M \div S = M \times (1 \div C)$$

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

Figure 2:

Section Properties About Centroidal Axis Parallel to Original Axis					
Φ =	0.000	deg	X-dim =	1.2	in
A =	1.44	in ²	Y-dim =	1.2	in
Xcg =	0.000	in	Sx(top) =	0.3	in ³
Ycg =	0.60	in	Sx(bot) =	0.3	in ³
Ixo =	0.173	in ⁴	Sy(left) =	0.3	in ³
Iyo =	0.2	in ⁴	Sy(right) =	0.3	in ³
Ixyo =	0.0	in ⁴			

Dimensions of Vertical Bend Section Near Base ~ 1.2" x 1.2"

Design Criteria

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

Maximum Effective Wind Speed Considered = 130 mph
Exposure Categories Considered: B & C
Wind Pressure Based on Section 30.5 (C&C Method 1: Simplified)
Gust Factor, $G = 0.85$
Topography Factor, $K_{zt} = 1.0$
Directionality Factor, $K_d = 0.85$
Importance Factor, $I = 1.0$
Roof Zone 2 Wind Pressures Considered
Minimum 2 Rails Per Panel
Maximum Mean Roof Height Considered = 30 ft
Tilt Angles Considered: 0 to 45 degrees
Performance Not Limited to Deflection
Adequacy of Attachments Based on Evaluation Report (Attached)

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 / CALIFORNIA BUILDING CODE 2016
ASCE 7-10 (Wind Loading)
Aluminum Design: Aluminum Design Manual 2010

Flat Tile Hook Span Chart Report

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Figure 3:

SOLARACK® (MAX. 6ft ANCHOR SPACING) FOR WIND EXP. B AND WIND SPEED OF 110 MPH*						
Tilt (degrees)	MeanRoof Height(ft)	Net DesignWind Press(psf)	Adjust. Factor	Adjusted Wind Press(psf)	PointLoad to End of Hook (lbs)	AppliedBending Moment (k in)
0-7	15	36.5	1	36.5	591.30	4.73
0-7	20	36.5	1	36.5	591.30	4.73
0-7	25	36.5	1	36.5	591.30	4.73
0-7	30	36.5	1	36.5	591.30	4.73
7-27	15	34.7	1	34.7	562.14	4.50
7-27	20	34.7	1	34.7	562.14	4.50
7-27	25	34.7	1	34.7	562.14	4.50
7-27	30	34.7	1	34.7	562.14	4.50
27-45	15	25.5	1	25.5	413.10	3.30
27-45	20	25.5	1	25.5	413.10	3.30
27-45	25	25.5	1	25.5	413.10	3.30
27-45	30	25.5	1	25.5	413.10	3.30
* Allowable Bending Moment. Ma =						8.55k in

Figure 4:

SOLARACK® (MAX. 6ft ANCHOR SPACING) FOR WIND EXP. B AND WIND SPEED OF 130 MPH*						
Tilt (degrees)	MeanRoof Height(ft)	Net Design Wind Press(psf)	Adjust. Factor	Adjusted Press(psf)	PointLoad to End of Hook (lbs)	AppliedBending Moment (k in)
0-7	15	51	1	51	826.20	6.61
0-7	20	51	1	51	826.20	6.61
0-7	25	51	1	51	826.20	6.61
0-7	30	51	1	51	826.20	6.61
7-27	15	48.4	1	48.4	784.08	6.27
7-27	20	48.4	1	48.4	784.08	6.27
7-27	25	48.4	1	48.4	784.08	6.27
7-27	30	48.4	1	48.4	784.08	6.27
27-45	15	35.6	1	35.6	576.72	4.61
27-45	20	35.6	1	35.6	576.72	4.61
27-45	25	35.6	1	35.6	576.72	4.61
27-45	30	35.6	1	35.6	576.72	4.61
* Allowable Bending Moment. Ma =						8.55k in

Flat Tile Hook Span Chart Report

State of California

Figure 5:

SOLARACK® (MAX. 4ft ANCHOR SPACING) FOR WIND EXP. C AND WIND SPEED OF 110 MPH*						
Tilt (degrees)	MeanRoof Height(ft)	Net Design Wind Press(psf)	Adjust. Factor	Adjusted Wind Press(psf)	Point Load to Railing (lbs)	Applied Bending Moment (k in)
0-7	15	36.5	1.21	44.165	577.15	6.93
0-7	20	36.5	1.29	47.085	655.99	7.87
7-27	15	34.7	1.21	41.987	548.69	6.58
7-27	20	34.7	1.29	44.763	623.64	7.48
7-27	25	34.7	1.35	46.845	683.00	8.20
27-45	15	25.5	1.21	30.855	403.21	4.84
27-45	20	25.5	1.29	32.895	458.29	5.50
27-45	25	25.5	1.35	34.425	501.92	6.02
27-45	30	25.5	1.4	35.7	539.78	6.48
* Allowable Bending Moment. Ma =						8.55k in

Figure 6:

SOLARACK® (MAX. 4ft ANCHOR SPACING) FOR WIND EXP. C AND WIND SPEED OF 130 MPH*						
Tilt (degrees)	MeanRoof Height(ft)	Net Design Wind Press.	Adjust. Factor	Adjusted Wind Press(psf)	Point to End of (lbs)	Applied Bending Moment (k in)
0-7	15	51	1.21	61.71	806.43	6.45
0-7	20	51	1.29	65.79	916.59	7.33
0-7	25	51	1.35	68.85	1003.83	8.03
7-27	15	48.4	1.21	58.564	765.31	6.12
7-27	20	48.4	1.29	62.436	869.86	6.96
7-27	25	48.4	1.35	65.34	952.66	7.62
7-27	30	48.4	1.4	67.76	1024.53	8.20
27-45	15	35.6	1.21	43.076	562.92	4.50
27-45	20	35.6	1.29	45.924	639.81	5.12
27-45	25	35.6	1.35	48.06	700.71	5.61
27-45	30	35.6	1.4	49.84	753.58	6.03
* Allowable Bending Moment. Ma =						8.55k in

Flat Tile Hook

The use of the span values provided in Figures 3 through 6 and installation of the railing framing shall be subject to the following qualification and conditions.

There shall be a minimum of 2 rails provided per solar panel.

Anchor spacing along the rail shall not exceed **48** inches.

All other components such as clamps and splices shall be installed per manufacturer's specifications

All other components such as clamps and splices shall be installed per manufacturer's specifications 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).

Structural verification of the existing roof frame members and panel railings 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,



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President

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