September 16, 2020

Everest Solar Systems, LLC
2835 La Mirada Drive
Suite A
Vista, CA 92081

RE: ***CrossRail PV Panel Mounting System Evaluation***

To whom it may concern:
Please see the attached comprehensive structural analysis of the Everest Solar CrossRail Solar PV Mounting System for typical installations in the State of Texas. When installed per the conditions and design criteria described herein, the CrossRail Solar PV Mounting System is compliant with the sections of the design reference documents noted below.

Design Reference Documents

- *2012 International Building Code*
- *2012 International Residential Code*
- ASCE/SEI 7-10 – *Minimum Design Loads for Buildings and Other Structures*
- *2010 Aluminum Design* Manual, by the Aluminum Association
- Section and materials data provided by Everest Solar Systems for four (4) Rail Types
  - Rail section properties appear in the appendix to this report

Overview

The CrossRail PV-panel roof mounting system consists of extruded aluminum support rails spanning between points of attachment on an existing roof structure. This analysis is limited to capacity of the CrossRail only. Attachment of the CrossRail Mounting System to the existing roof structure shall be the responsibility of the installer and should be analyzed by a registered design professional where required by the local authority having jurisdiction.

Methods & Design Parameters

Applicable combinations of dead, wind, snow, and seismic loads were evaluated in accordance with current code requirements to determine allowable rail span lengths, based on assumptions of single-span conditions and allowable deflection of L/60.

Design wind pressures were determined using Components and Cladding calculations in Chapter 26-30 of ASCE 7-10, using the loading parameters listed below. Configurations not conforming to these parameters will require additional analysis. Calculation of applicable roof snow load should be based upon ground snow load maps and equations and factors of ASCE 7-10, Chapter 7 and applicable sections of the 2012 IBC. For designated Case Study areas noted in the 2012 International Building Code, refer to local jurisdiction requirements for snow and wind load determination. Seismic criteria were considered per provisions of ASCE 7-10 Chapter 13 with parameters specified below. While seismic effects did not appear to govern the capacity of this

system, applicable seismic detailing requirements should be satisfied when installed per the manufacturer instructions and additional installation notes specified herein.

Loading Parameters:

- Ground snow load: Varies
- Ultimate 3-second gust wind speed (V): 110-200 mph
- Building roof mean height: 30 ft. or less
- Roof wind pressure region: Zone 1 - Zone 3
- Structural risk category: II
- Wind exposure: B, C, D
- Seismic site class: D
- Seismic design category: A through E
- 0.2s MCE_R ground motion parameter (S_S): Not to exceed 2.000
- 1s MCE_R ground motion parameter (S_1): Not to exceed 1.250
- Component importance factor (I_p): 1.0
- Component acceleration factor, (a_p): 1.0
- Component response modification factor (R_p): 1.5
- Panel orientation: Portrait or Landscape
- Panel installation angle: Flush with roof slope
- Roof slope (θ): 0-7°, >7-27°, >27-45°

Design Results

The allowable span lengths of the system are principally controlled by applicable wind and snow loads to the structure. Refer to the CrossRail span tables in the appendix to this document for recommended rail configurations based on combinations of these loading parameters. Note that reaction loads provided in the attached tables are only applicable when used with the corresponding span length recommendations provided therein. These reactions may be scaled linearly when shorter spans are used.

Installation Notes

The following guidelines apply to all installations using the CrossRail product line:

- Tables assume two independent support rails per row with either panel orientation.
- Maximum end cantilever of aluminum support rail shall not exceed one-third (1/3) of allowable span in the roof wind pressure zone of the cantilever.
- Rails shall be continuous (not spliced) over a minimum of two supports unless using an approved Everest Solar structural splice.
- Installation over roof overhangs or within 10” of any roof edge is not advised.
- Observe all local jurisdictional requirements regarding roof setback requirements.
- Ensure that actual span length does not exceed capacity of roof attachment.

Summary

This assessment has provided design validation for code-compliant installations of the CrossRail PV Mounting System in the State of Texas. For the configurations and design loadings noted previously, the attached span tables represent maximum span lengths based on allowable stresses and deflection criteria. For all other configurations, refer to Everest Solar Systems for engineering support.

This report does not provide analysis of roof attachment hardware, nor of any existing structures, as may be required by the local authority having jurisdiction.

We appreciate the opportunity to have assisted you with this project. Should you have any further questions regarding this analysis, please feel free to contact us by phone or email.

Best Regards,

Exp: 6/30/21

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Attachments:
1. Table 1.1 – CrossRail Section Properties
2. Table 1.2 – Ground Snow to Roof Snow Conversion Chart
3. Table 2.1 – Maximum Span Length per given Roof Pitch and Wind Exposure
4. Table 2.2 – Maximum Uplift Force per given Roof Pitch and Wind Exposure
5. Table 2.3 – Maximum Down Force per given Roof Pitch and Wind Exposure
6. Table 2.4 – Maximum Shear per given Roof Pitch and Wind Exposure

Table 1.1: CrossRail Section Properties					
	44-X	**48-X**	**48-XL**	**80**	Unit
Cross Sectional Area (A)	0.4050	0.4800	0.6520	0.7780	in^2
Moments of Interia:					
Vertical (Ix)	0.1360	0.193	0.245	0.8010	in^4
Horizontal (Iy)	0.1220	0.136	0.179	0.1980	in^4
Section Modulii:					
Vertical (Sx)	0.1490	0.208	0.242	0.4860	in^3
Horizontal (Sy)	0.1450	0.1520	0.214	0.2520	in^3

Material: 6000 Series Aluminum
Ultimate Tensile Strength: 37.7 ksi
Yield Strength: 34.8 ksi

Table 1.2 - Ground Snow to Roof Snow Conversion**			
Ground	**Roof Snow per Slope (Ps)**		
Snow Load (Pg)	**0-7**	**7-45**	**45-55**
0	0	0	0
10	10	10	10
20	20	20	20
30	30	20	20
40	30	30	20
50	40	30	30
60	50	40	30
70	60	50	40

**Table Assumes the following:
Panel Surface is Unobstructed Slippery Surface
Cs - Derived per ASCE 7-10 per Figure 7-2c
Ce = 0.9, Ct = 1.2, Is = 1.0

Note: this table may be used as a guide for design professionals of record to convert ground snow to roof snow for use in the above referenced tables. Conversion does not account for project specfic conditions that may affect design roof snow load such as drift, exposure, importance factor, etc. All project design snow loads shall be verified in accordance with local building codes and the Authority Having Jurisdiction (AHJ).