SPAD
CONSULTING STRUCTURAL AND CIVIL ENGINEERS
think lateral

09 April 2018

Project number:
U032_FP1A

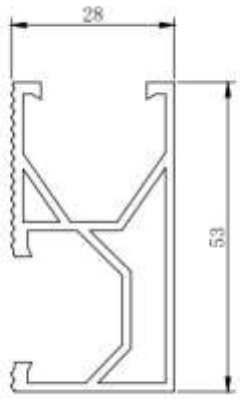
ALL STAR

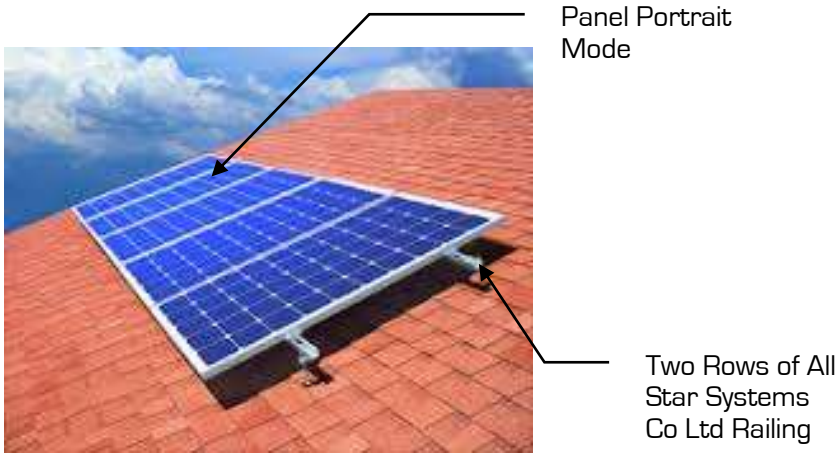
Dear Sir,

RE: ALL STAR ROOF MOUNTING FOR PORTRAIT ORIENTATED FLUSH MOUNTED SOLAR PANELS

As Requested, we have reviewed the structural adequacy of the Aluminum support framing components as detailed in the drawings issued by All Star Solar Solutions We have design investigated for the Aluminum Railing as shown below. The section of the railing is shown below.

The panels are supported by two rows of railing. The railings are fixed directly to the rafters or to the purlins.
The spacing of the fixing of the Railing to the rafter/purlin shall be limited as tabulated below in tables 1.1, 1.2, 2.1, 2.2, 10.1, 10.2, 20.1, & 20.1Refer to" List of Tables" below to choose the appropriate span table. Refer to Figure A for wind regions and terrain categories as defined in AS1170.2. The Central & Edge zones referred to in the tables are depicted in figures B on the following pages





Railing: All Star Solar
53x28

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List of Tables:		
Panel Size	**Terrain Category 2**	**Terrain Category 3**
1700x1100	1.1 & 1.2 (Page 2)	10.1 & 10.2 (Page 4)
2100x1100	2.1 & 2.2 (Page 3)	20.1 & 20.2 (Page 5)

Terrain Category 2 (TC2) Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

Table 1.1 METAL ROOF. Roof Slope: 0 to 15 deg

Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof

	Region A		Region B		Region C		Region D	
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone
5m	1990	1820	1700	1470	1070	870	570	510
10m	1830	1700	1480	1210	960	780	540	480
15m	1760	1570	1330	1090	830	580	500	#N/A
20m	1720	1510	1260	1030	720	540	460	#N/A
Panel size 1700 X 1100								

Terrain Category 2

Table 1.2 METAL & TILED ROOF. Roof Slope: 15 to 30 deg

Maximum spacing (mm) of the fixing of the railing to Pitched METAL& TILED roof

	Region A		Region B		Region C		Region D	
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone
5m	2150	1820	1800	1470	1250	870	790	510
10m	1960	1700	1650	1210	1130	780	590	480
15m	1870	1570	1540	1090	980	580	550	#N/A
20m	1830	1510	1480	1030	870	540	510	#N/A
Panel size 1700 X 1100								

Terrain Category 2

Flush Mount Portrait Oriented

Terrain Category 2 (TC2) Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

Table 2.1 METAL ROOF.					**Roof Slope: 0 to 15 deg**				**Terrain Category 2**
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	1830	1690	1460	1190	870	590	510	#N/A	
10m	1700	1460	1200	980	770	560	470	#N/A	
15m	1570	1320	1080	880	580	510	#N/A	#N/A	
20m	1510	1240	1020	830	540	480	#N/A	#N/A	
Panel size 2100 X 1100									

Table 2.2 METAL & TILED ROOF.					**Roof Slope: 15 to 30 deg**				**Terrain Category 2**
Maximum spacing (mm) of the fixing of the railing to Pitched METAL& TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	1960	1690	1640	1190	1020	590	560	#N/A	
10m	1800	1460	1410	980	910	560	530	#N/A	
15m	1730	1320	1270	880	800	510	480	#N/A	
20m	1700	1240	1200	830	590	480	#N/A	#N/A	
Panel size 2100 X 1100									

Flush Mount Portrait Oriented

Terrain Category 3 (TC3) Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing or light industrial estates.

Table 10.1 METAL ROOF. **Roof Slope: 0 to 15 deg**

Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof

	Region A		Region B		Region C		Region D	
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone
5m	2180	1980	1820	1690	1510	1250	960	780
10m	2180	1980	1820	1690	1220	1000	760	550
15m	2030	1860	1720	1520	1070	870	570	510
20m	1930	1770	1610	1370	870	590	510	#N/A

Panel size 1700 X 1100

Terrain Category 3

Table 10.2 METAL & TILED ROOF. **Roof Slope: 15 to 30 deg**

Maximum spacing (mm) of the fixing of the railing to Pitched METAL & TILED roof

	Region A		Region B		Region C		Region D	
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone
5m	2380	1980	1950	1690	1690	1250	1130	780
10m	2380	1980	1950	1690	1430	1000	900	550
15m	2200	1860	1830	1520	1250	870	790	510
20m	2080	1770	1750	1370	1020	590	560	#N/A

Panel size 1700 X 1100

Terrain Category 3

Flush Mount Portrait Oriented

Terrain Category 3 (TC3) Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing or light industrial estates.

Table 20.1 METAL ROOF.					**Roof Slope: 0 to 15 deg**				**Terrain Category 3**
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	1990	1820	1690	1450	1240	1010	770	560	
10m	1990	1820	1690	1450	990	810	550	490	
15m	1860	1720	1520	1250	870	590	510	#N/A	
20m	1780	1600	1370	1110	590	530	#N/A	#N/A	
Panel size 2100 X 1100									

Table 20.2 METAL & TILED ROOF.					**Roof Slope: 15 to 30 deg**				**Terrain Category 3**
Maximum spacing (mm) of the fixing of the railing to Pitched METAL & TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2150	1820	1790	1450	1460	1010	910	560	
10m	2150	1820	1790	1450	1170	810	700	490	
15m	2000	1720	1700	1250	1020	590	560	#N/A	
20m	1900	1600	1560	1110	830	530	500	#N/A	
Panel size 2100 X 1100									

Flush Mount Portrait Oriented

Our design investigation is based on the following Australian Standards and sections of Building Code of Australia relevant to structural issues.

- AS/NZS 1170.0-2002 Structural design Actions Part 0: General principles.
- AS/NZS 1170.2-2011(R2016) Structural design Actions Part 2: Wind actions.
- AS 1664.1-1997 Aluminum structures Part 1: Limit state design.
- AS/NZS 4673-2001 Cold Formed Stainless Steel.
- AS 1684.1-1999 Residential timber-framed construction - Design criteria.
- AS 1684.2-2010 Residential timber-framed construction - Non-cyclonic areas.
- AS 1684.3-2010 Residential timber-framed construction - Cyclonic areas.
- AS 1720.1-2010 Timber structures - Design methods.pdf.
- AS 3566.1-2002 Self-drilling screws for the building and construction industries.
- AS3566.2–2002 Part 2: Corrosion resistance requirements.
- ISO3506:1-2009 Mechanical Properties of Corrosion-Resistance Stainless Steel Fasteners.

Following design criteria has been used for the structural verification.

- Design Life 25 years
- Importance Level Type 2: Ordinary
- Annual Probability of exceedance 1/200
- Terrain Category to AS1170.2 2 & 3
- Service Deflection Not limited
- Snow loading Not considered
- Earthquake Loading Not considered
- Maximum Roof Pitch 30 degrees
- Minimum pitch for Tiled Roof 15 degrees
- Aluminum Rails 6005 - T5
- Maximum dimensions & Minimum weight of Solar panels.
  - 18 Kg panel 1700X1100
  - 25 Kg panel 2100X1100
- Panel Orientation Portrait.

Figure A.

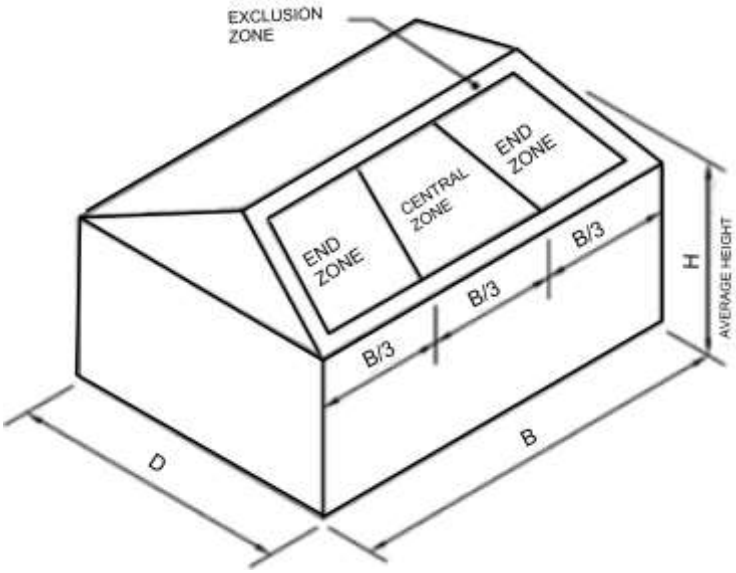

Figure B.

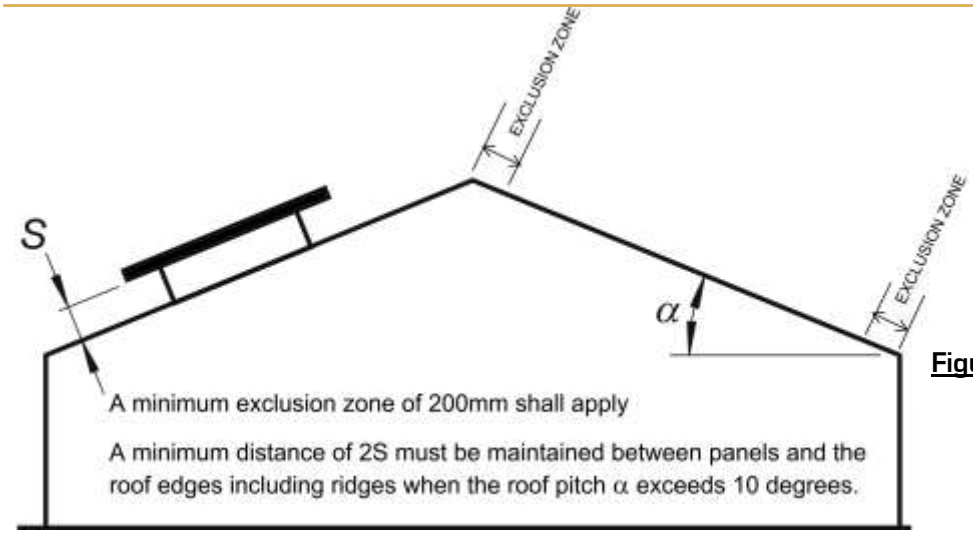

Figure C.

Subject to the following qualifications we certify that the above mentioned frames are structurally adequate and conform to the above Australian standards.

1. The gap between the underside of the solar panels and the roof shall be between 50mm minimum and 300mm maximum. Nominate the actual gap as "S" mm.
2. The solar panels shall be installed 2xS mm or 200 mm (whichever is greater) away from the roof edges and the ridge. Example: If the gap below the panel is 150mm then the panels shall be located 300mm away from the roof edge and the ridge. See Figure C above.
3. Each row of solar panels shall have a minimum of two rows of railing fixed to the roof framing.
4. The connections between the solar panels shall be flexible to accommodate deflection of the railing.
5. The deflection of the railing has not been controlled in the design. If defection has to be limited then spacing shall be reduced as advised by a practicing structural engineer.
6. The roofing to which the panels are to be installed shall conform to the relevant Australian Standards including AS1684, AS4440, AS1720, AS4100 and AS4600.
7. The buildings to which the panels are to be installed shall be of approved construction and conform to BCA and the relevant Australian Standards. The roof framing and the building shall be regularly maintained as required.
8. The existing roof framing shall be verified for compliance to Clause D6, of AS1170.2.
9. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.

10. The spacing of the rail fixings shall not exceed the recommended spacing, and shall be reduced to match the location of the roof rafters.
11. The cantilever span of the panel shall not exceed 25% of panel length (i.e. 425mm for 1700 long).
12. The cantilever span of the railing shall not exceed 33% of the adjacent spacing of the installed fixings.
13. Each fixing shall have a minimum of two gauge 14 screws.
14. The screws used to attach the railing to the roof framing shall conform to AS3566, ISO 3506.1.
15. The cold formed steel purlins shall have a minimum base material thickness of 1.2mm in Regions A & B and 1.9mm in Regions C & D.
16. The Minimum Timber Joint Type classification shall be as follows:

Wind Regions	Seasoned	Unseasoned	Joint Classification as in
A & B	JD1 to JD5	J1 to J4	Tables H2.3 & H3.1 of
C & D	JD1 to JD4	J1 to J3	AS1720.1.

17. Predrilled holes shall be used for all screw fixings into timber. The width of Timber purlins shall not be less than 35mm. Minimum edge distance for screws shall be 17mm. The minimum embedment for each screw shall be 35mm.
18. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.
19. The installation and fixings shall be periodically inspected and maintained.
20. The following are excluded from this certification.
    - Framing of the solar panel assembly.
    - Material Testing and or Verification of test certificates for the materials and components.

Should you have any queries, please feel free to call Paheer on 9565-5558.

Yours faithfully,
SPAD PTY LTD

C. Pad

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