SPAD
CONSULTING STRUCTURAL AND CIVIL ENGINEERS
think lateral

15 September 2016

Project number: R140_01A

Red Dot Rack Pty Ltd.

Level 19, 144 Edward St

Brisbane Qld 4000

Attention : Peter Secombe.

Dear Sir,

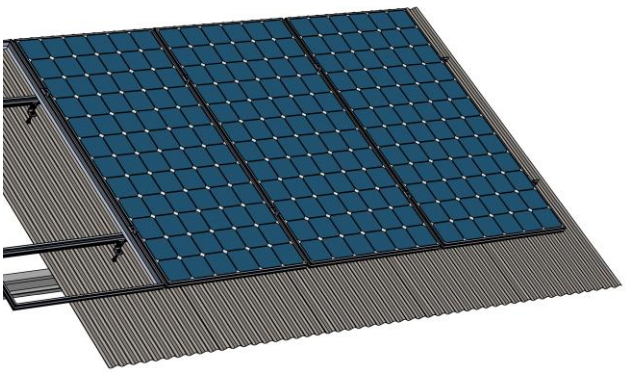
RE: REDDOT SOLAR PANEL SUPPORT FRAME STANDARD KIT FOR TILED AND METAL CLAD PITCHED ROOF

As requested, we have reviewed the structural adequacy of the Aluminum support framing components as detailed in the drawings issued by Red Dot Rack Pty Ltd. We have design investigated for the Aluminum Railing as shown below. The section of the railing is shown below.

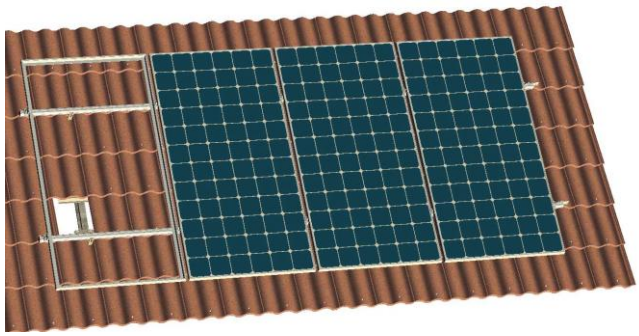
The panels are supported by two rows of railing. The railings are fixed directly to the rafters or to the purlins.

The spacing of the fixing of the Railing to the rafter/purlin in terrain category 2 shall be limited as tabulated below in tables 1.0, 1.1, 2.0 & 2.1. Refer to Figure A on page 5 for wind regions as shown in AS1170.2.The central and end zones referred to in the tables are depicted in figures B & C on page 6.

Iso View With Corrugated Roof



Iso View With Tile Roof



SPAD Pty Ltd ABN 47 090 039 571
Consulting Structural & Civil Engineers
114 Pyrmont Bridge Road, Annandale.
NSW 2038 AUSTRALIA

tel: +61 (2) 9565-5558
fax: +61 (2) 9565-5606
info@spadengineer.com.au
www.spadengineer.com.au

Director: Paheer C Paheerathan
BScEng, MEngSc, FIEAust, CPEng,
NPER (Civil & Structural)

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 1.0 METAL ROOF

Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof
Roof Pitch: 0 to 15deg. *For pitch exceeding 15 degrees use Table 2.0*

	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	2280	2050	1860	1680	1400	1140	880	720
10m	2060	1860	1680	1580	1260	1030	790	650
15m	1950	1760	1600	1430	1090	890	690	570
20m	1900	2000	1550	1350	970	800	620	510

1640 long solar Panels

Table 1.1 METAL ROOF

Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof
Roof Pitch: 0 to 15deg. *For pitch exceeding 15 degrees use Table 2.1*

	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	2080	1870	1690	1530	1160	950	730	600
10m	1880	1690	1530	1310	1040	850	660	540
15m	1780	1610	1460	1190	910	740	570	470
20m	1730	1670	1370	1120	810	660	510	420

1970 long solar Panels

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 2.0 TILED ROOF & For Metal Roofs with Pitch ≥ 15degrees

Maximum spacing (mm) of the fixing of the railing to Rafters
Roof Slope: 15 to 45deg.

	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	2480	2050	2020	1680	1640	1140	1030	720
10m	2240	1860	1820	1580	1470	1030	930	650
15m	2120	1760	1730	1430	1280	890	810	570
20m	2060	2000	1680	1350	1140	800	720	510

1640 long solar Panels

Table 2.1 TILED ROOF & For Metal Roofs with Pitch ≥ 15degrees

Maximum spacing (mm) of the fixing of the railing to Rafters
Roof Slope: 15 to 45deg.

	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	2260	1870	1840	1530	1360	950	860	600
10m	2040	1690	1660	1310	1230	850	770	540
15m	1940	1610	1580	1190	1060	740	670	470
20m	1880	1670	1530	1120	950	660	600	420

1970 long solar Panels

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 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/NZS 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.
- AS 3566.2–2002 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
- Service Deflection Not limited
- Snow loading Not considered
- Earthquake Loading Not considered
- Maximum Roof Pitch 45 degrees
- Minimum pitch for Tiled Roof 15 degrees
- Minimum pitch for Metal Roof 0 degree
- Aluminum Rails & Splice 6005 - T5
- Aluminum Clamps and components 6005, 6061
- Maximum dimensions of Solar panels.
  - 16 Kg panel 1650x990
  - 23 Kg panel 1970x990

List of components related to this framing system that are as tabulated below have been design verified to AS1170.2

Components	**Part Number**	**Description**
Pro Standard Rail	300-0001	Rail L4200mm
Splice for Pro Standard Rail	303-0001	Expanding rail length
Mid Clamp Kit	301-0001	Fastening parts
End clamp Kit	302-0001	Fastening parts
Standard Tile Interface	105-0001	Fixed on roofs
L Feet Hook	304-0001	Fixed on roofs

Figure A. Wind Regions to AS1170.2

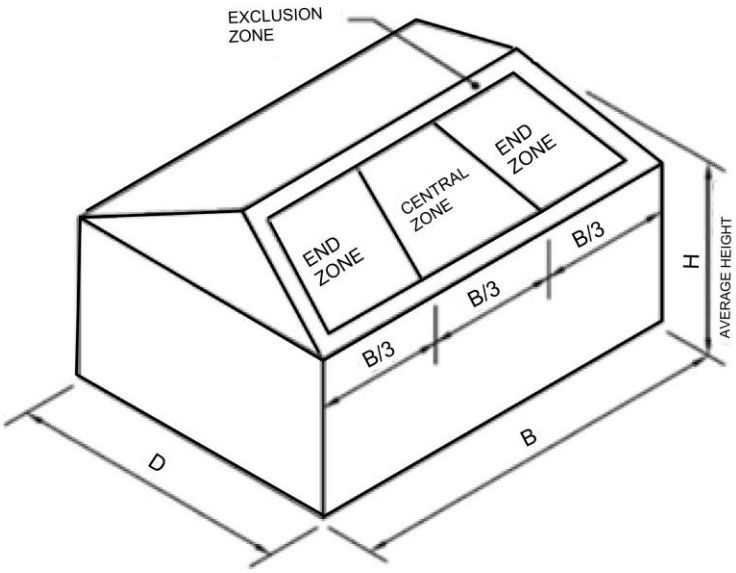


Figure B. Central & End Zones Plan View

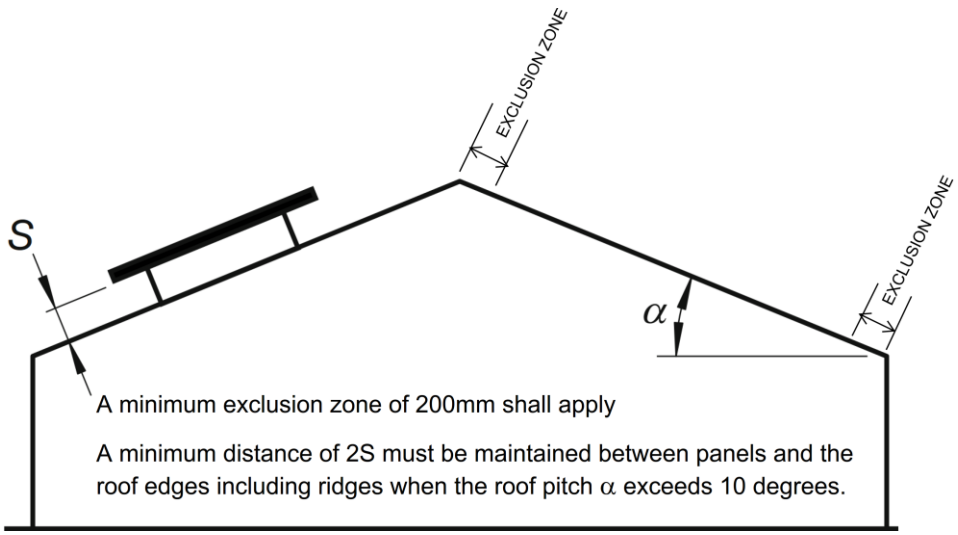


Figure C. Central & End Zones Sectional View

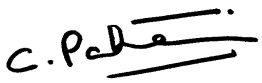
Subject to the following qualifications we certify that the above mentioned frames are structurally adequate and conform to the above Australian standards.

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 1640 and 1970 long solar panels shall have a minimum of two rows of railing fixed to the roof framing.
4. The deflection of the railing and the frame system has not been controlled in the design. If deflection/deformation has to be limited then spacing shall be reduced as advised by a practicing structural engineer.
5. The roofing to which the panels are to be installed shall conform to the relevant Australian Standards including AS1684, AS4440, AS1720, AS4100 and AS4600.
6. 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.
7. The existing framing shall be verified for compliance to Clause D6, of AS1170.2.
8. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.
9. The spacing of the rail fixings shall not exceed the recommended spacing, and shall be reduced to match the location of the roof rafters.
10. The cantilever span of the panel shall not exceed 25% of panel length (i.e. 412mm for 1650 long).
11. The cantilever span of the railing shall not exceed 33% of the adjacent spacing of the installed fixings.
12. Each fixing shall have a minimum of two gauge 14 screws.
13. The screws used to attach the railing to the roof framing shall conform to AS3566, ISO 3506.1.
14. 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.

15. Timber with Joint Type classification J4 to J6 are excluded unless tested for Screw capacity. i.e. minimum joint strength requirement shall be J3. Please refer Table AS1720.1.
16. Predrilled holes shall be used for all screw fixings into timber. The width of Timber purlins shall not be less than 35mm. The minimum embedment for each screw shall be 50mm. Minimum edge distance for screws shall be 17mm.
17. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.
18. The installation and fixings shall be periodically inspected and maintained.
19. We have relied upon the material properties; of the components; supplied by Red Dot Rack Pty Ltd.
20. The following are excluded from this certification.
    - x Tilt mounting systems.
    - x Framing of the PV Cells.

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

Yours faithfully,
SPAD PTY LTD



Paheer C Paheerathan
BScEng, MEngSc, FIEAust, CPEng, NER (Civil & Structural) 142156; RPEQ-09066; VBA-EC27368.
Director