

10 April 2018

Project number: U032_AL4A

Power Ark Solar
C8/391 Park Road
Regents Park NSW 2143

Attention : Johnson Xu.

Dear Sir,

RE: POWERARK ROOF MOUNTING FOR LANDSCAPE ORIENTATED
TILT MOUNTED SOLAR PANELS .

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

The panels in landscape orientation are supported by two rows of railing. The railings are supported by the legs which are fixed directly to the rafters, purlins or concrete roof. The spacing of the back legs shall be limited as tabulated below in tables 1.1, 1.2, 10.1 & 10.2 for 1700 long panels and 2.1, 2.2, 20.1 & 20.2 for 2100 panels. Refer to Figure D on page 3 for wind regions and terrain categories as defined in AS1170.2. The spacing for the lower rail fixing can be increased by a third of the shorter legs. [Example: Spacing of longer leg-720. Spacing of lower railing-960].

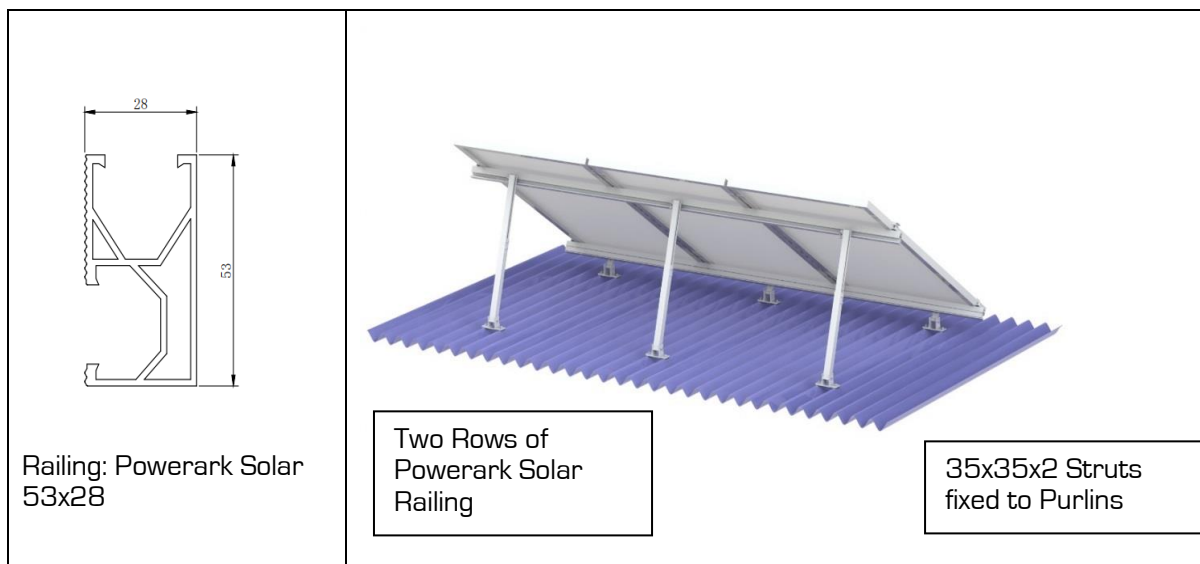


Figure A Rail Detail and Configuration.



Figure B Landscape Orientation.

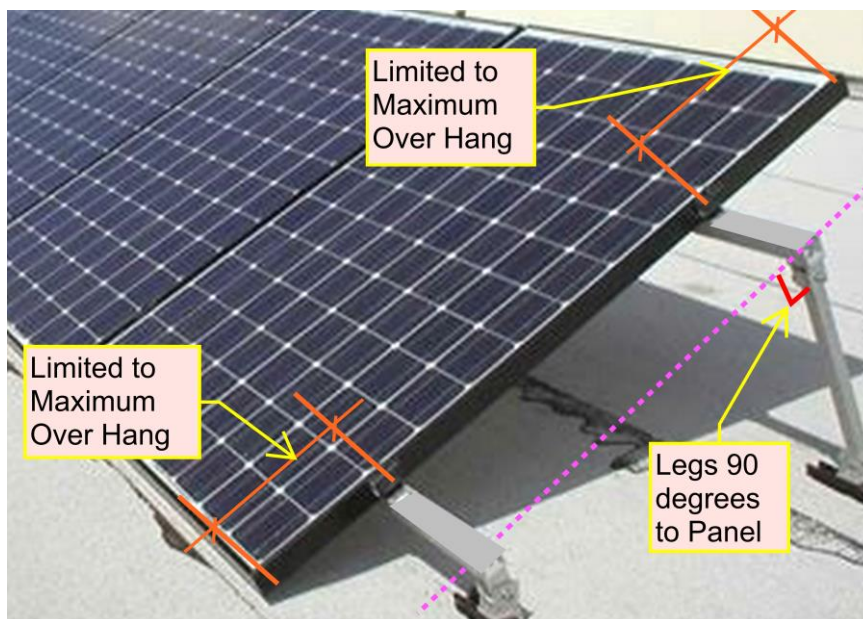


Figure C Criteria for the configuration.



Figure D Wind Regions. AS1170.2

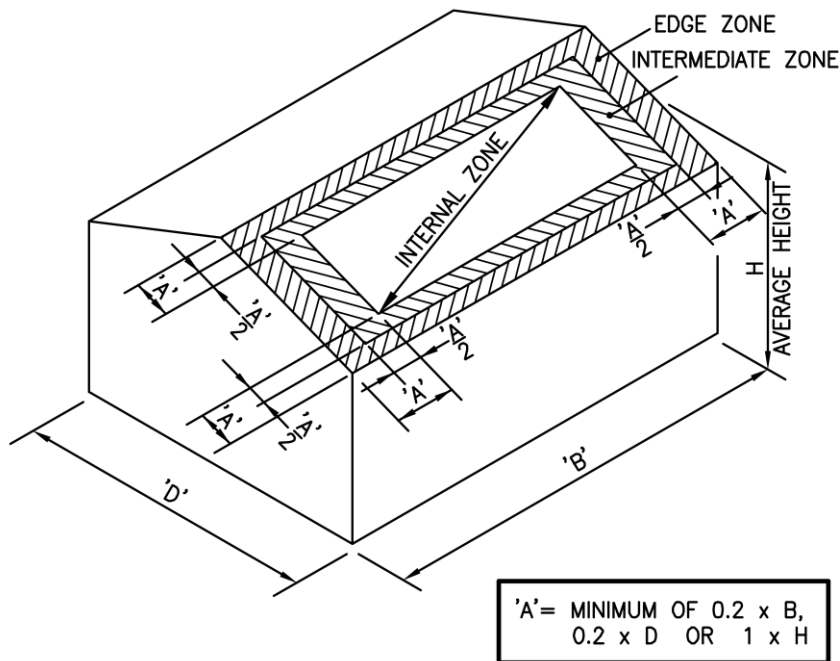


Figure E - Edge Zones. AS1170.2 (See Note 5 on Page 10)

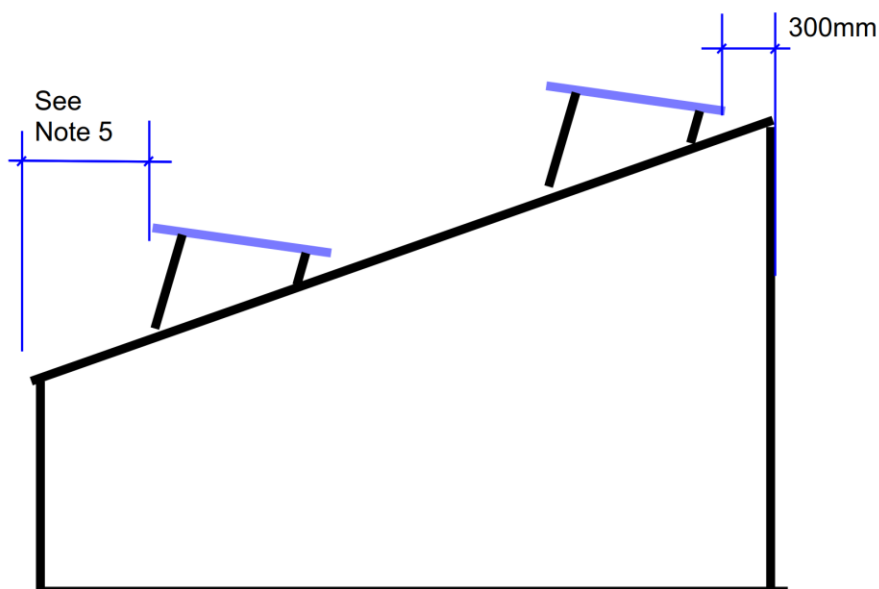


Figure F - Edge Clearance .(See Notes 5 &6 on Page 10)

List of Tables:		
Panel Size	Terrain Category 2	Terrain Category 3
1700x1100	1.1 & 1.2 (Page 5)	10.1 & 10.2 (Page 7)
2100x1100	2.1 & 2.2 (Page 6)	20.1 & 20.2 (Page 8)

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 Inclination 0 - 15 degrees					Terrain Category 2
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	1880	1260	720	470	
10m	1540	890	660	#N/A	
15m	1390	820	580	#N/A	
20m	1310	790	520	#N/A	
Panel size 1700 X 1100					

Table 1.2 Inclination 15-30 degrees					Terrain Category 2
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	870	670	390	#N/A	
10m	760	#N/A	#N/A	#N/A	
15m	720	#N/A	#N/A	#N/A	
20m	700	#N/A	#N/A	#N/A	
Panel size 1700 X 1100					

#N/A : Failure of screw fixing to purlins.

Tilt Mount Landscape 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					Inclination 0 - 15 degrees				
Maximum spacing of the fixing of the Back legs mm									
Roof Height	Region A	Region B	Region C	Region D	Terrain Category 2				
5m	1450	950	570	#N/A					
10m	1060	790	520	#N/A					
15m	1010	720	450	#N/A					
20m	980	680	390	#N/A					
Panel size 2100 X 1100									

Table 2.2					Inclination 15 - 30 degrees				
Maximum spacing of the fixing of the Back legs mm									
Roof Height	Region A	Region B	Region C	Region D	Terrain Category 2				
5m	770	#N/A	#N/A	#N/A					
10m	640	#N/A	#N/A	#N/A					
15m	570	#N/A	#N/A	#N/A					
20m	540	#N/A	#N/A	#N/A					
Panel size 2100 X 1100									

#N/A : Failure of screw fixing to purlins.

Tilt Mount Landscape 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					Terrain Category 3
Inclination 0 - 15 degrees					
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	2290	1530	920	660	
10m	2290	1530	780	540	
15m	1970	1320	720	470	
20m	1760	1160	600	#N/A	
Panel size 1700 X 1100					

Table 10.2					Terrain Category 3
Inclination 15-30 degrees					
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	1230	760	580	#N/A	
10m	1230	760	460	#N/A	
15m	910	700	390	#N/A	
20m	830	630	#N/A	#N/A	
Panel size 1700 X 1100					

#N/A : Failure of screw fixing to purlins.

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					Terrain Category 3
Inclination 0 - 15 degrees					
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	1800	1050	820	520	
10m	1800	1050	660	410	
15m	1540	990	570	#N/A	
20m	1250	910	410	#N/A	
Panel size 2100 X 1100					

Table 20.2					Terrain Category 3
Inclination 15 - 30 degrees					
Maximum spacing of the fixing of the Back legs mm					
Roof Height	Region A	Region B	Region C	Region D	
5m	940	630	440	#N/A	
10m	940	630	#N/A	#N/A	
15m	810	550	#N/A	#N/A	
20m	730	#N/A	#N/A	#N/A	
Panel size 2100 X 1100					

#N/A : Failure of screw fixing to purlins.

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 7 degrees
- Aluminum Rails 6005 - T5
- Maximum dimensions of Solar panels.
 - 18 Kg panel 1700X1100
 - 25 Kg panel 2100X1100
- Panel Orientation Landscape.

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

1. Each row of 1700/2100 long solar panels shall have a minimum of two rows of railing to support the panels. The upper railing is supported with back legs (struts). The struts are perpendicular to the panels (See figure C). The struts shall be directly fixed to the purlins or Rafters. The lower railing shall be fixed to the roof purlins with shorter legs of with a use of a base bracket.
2. The cantilever span of the panel shall not exceed 25% of panel length (ex 425mm for 1700 long). (See Figure C)
3. The cantilever span of the railing shall not exceed 33% of the adjacent spacing of the installed fixings.
4. The spacing of the rail fixings shall not exceed the recommended spacing and shall be reduced to match the location of the roof rafters or purlins.
5. The panel edge that is supported by the longer leg shall not be located within the edge zone, minimum of 0.2b, or 0.2d, or h, as defined in Clause 5.4.4 of AS1170.2.
6. The panel edge that is supported by the short leg shall have a clearance of 300 from the roof edge.
7. 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.
8. The roofing to which the panels are to be installed shall conform to the relevant Australian Standards including AS1684, AS4440, AS1720, AS4100 and AS4600.
9. 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.
10. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.
11. Each fixing shall have a minimum 2 gauge 14 screws.
12. The screws used to attach the railing to the roof framing shall conform to AS3566, ISO 3506.1.
13. 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.
14. The Minimum Timber Joint Type classification shall be as follows:

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

15. 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 35mm.
16. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.
17. The installation and fixings shall be periodically inspected and maintained.
18. The following are excluded from this certification.
 - x Framing of the solar panel assembly.
 - x 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



Paheer C Paheerathan
BScEng, MEngSc, FIEAust, CPEng, NPER (Civil & Structural) 142156, RPEQ-09066, NTBPPB 216724ES
Director