

10 December 2018

Project number: U032_AL4B

Allstar Solar Solutions Pty Ltd
No. 2 Sunjia Village
Shetou Village Zhiqian Town
Jintan Changzhou Jiangsu China

Dear Sir,

RE: ALLSTAR SOLAR 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 Allstar 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).

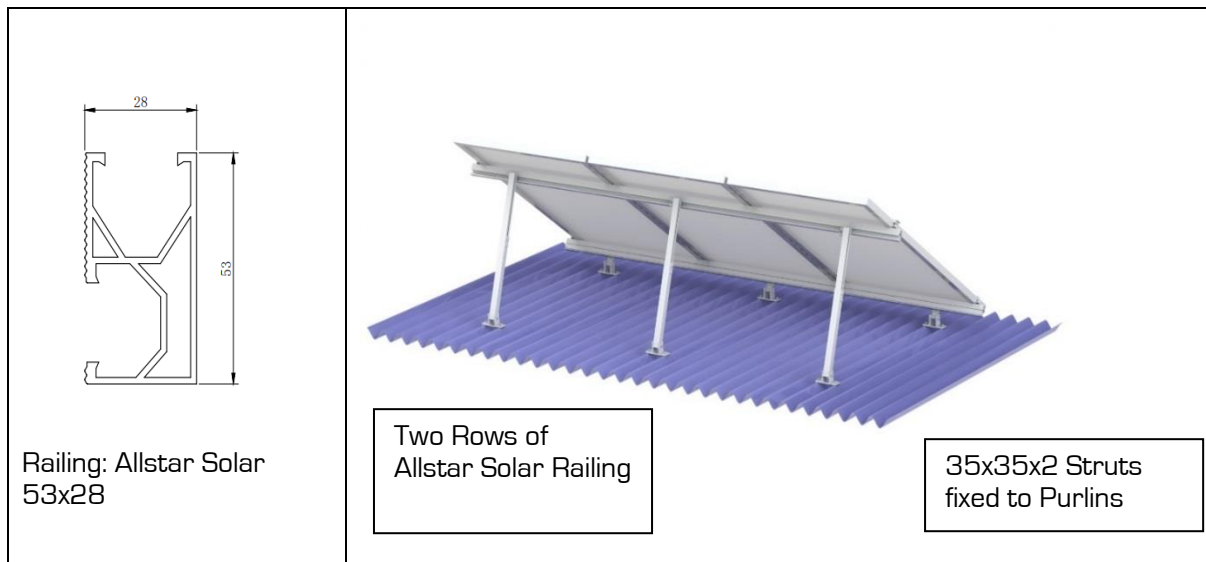


Figure A Rail Detail and Configuration.



Figure B Landscape Orientation.

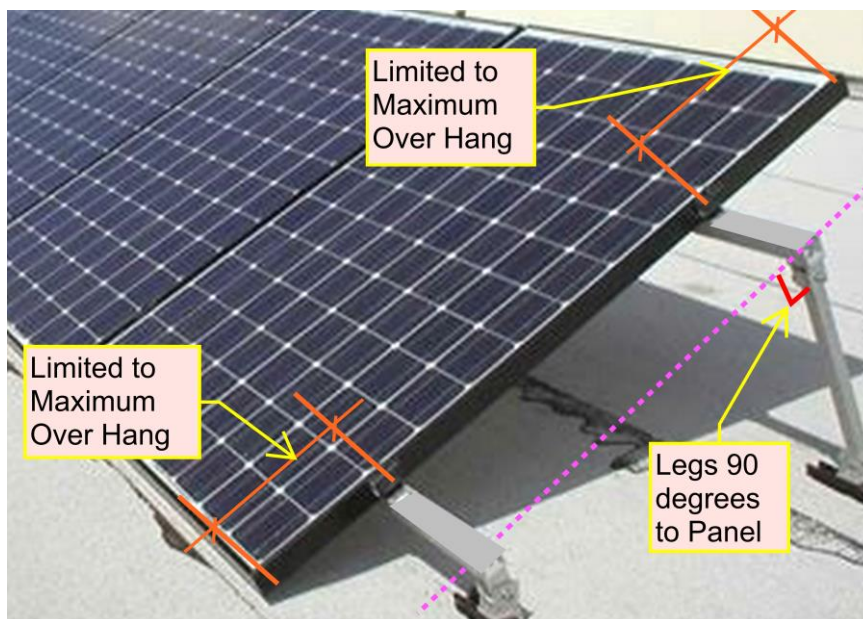


Figure C Criteria for the configuration.

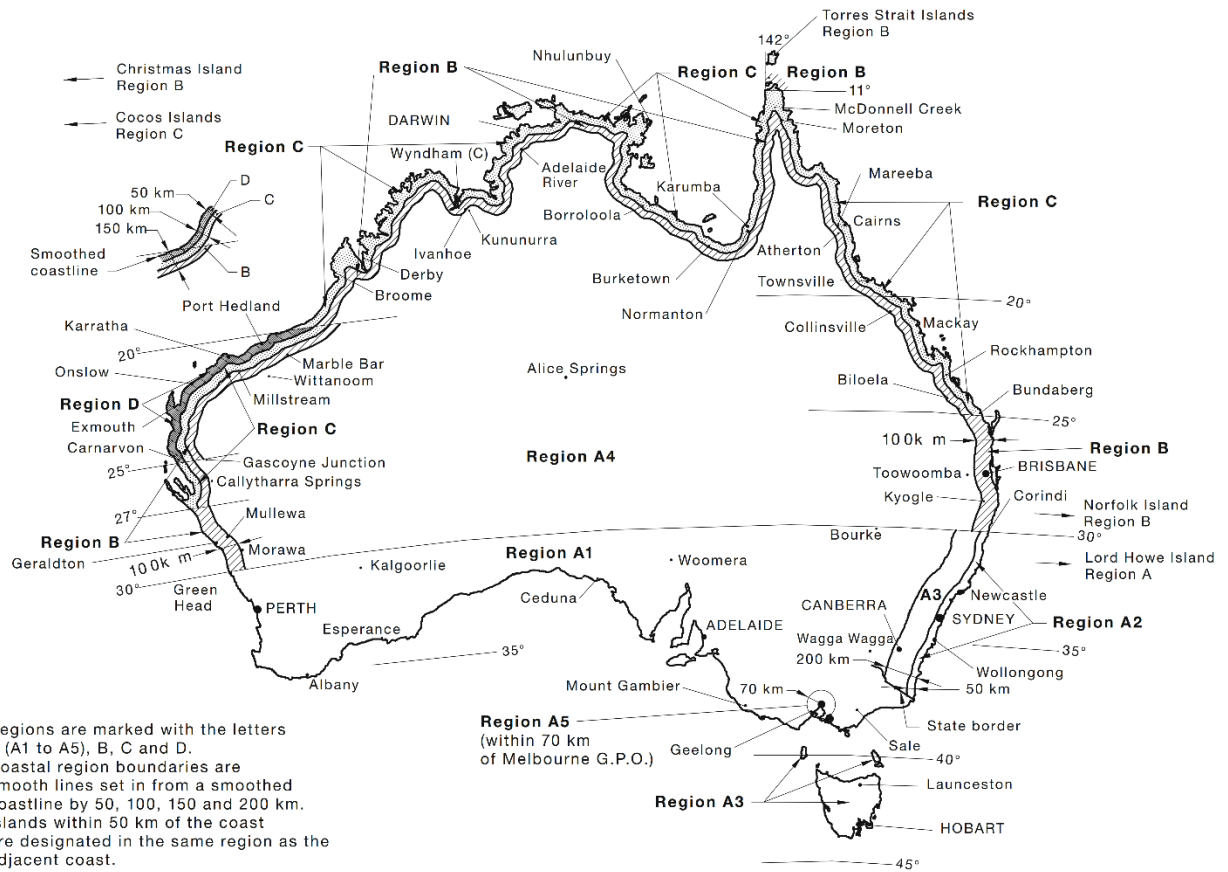


Figure D Wind Regions. AS1170.2

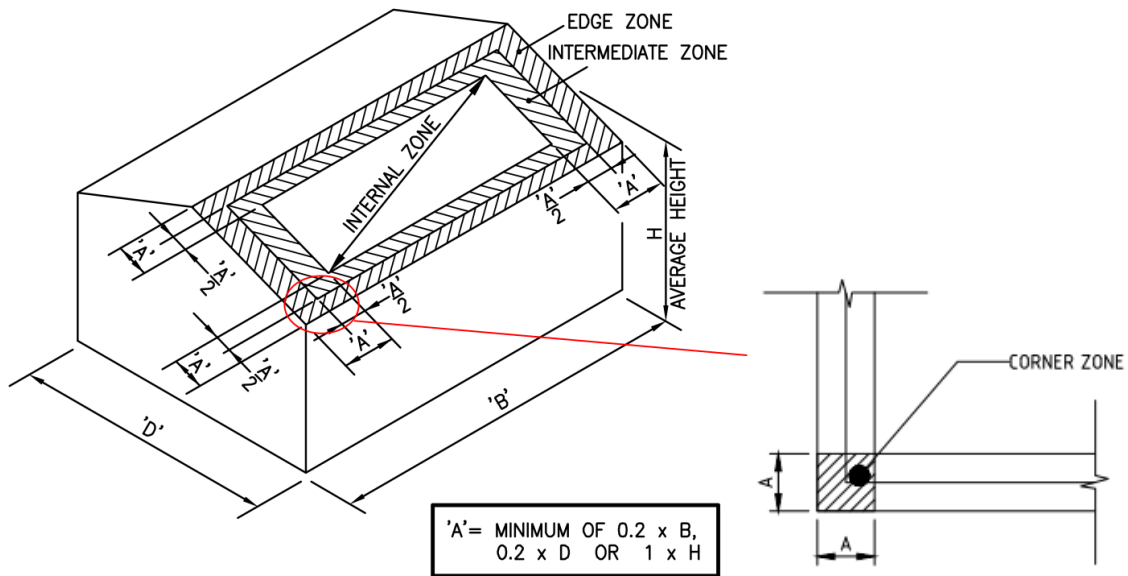


Figure E - Zones. AS1170.2 (See Note 5 on Page 14)

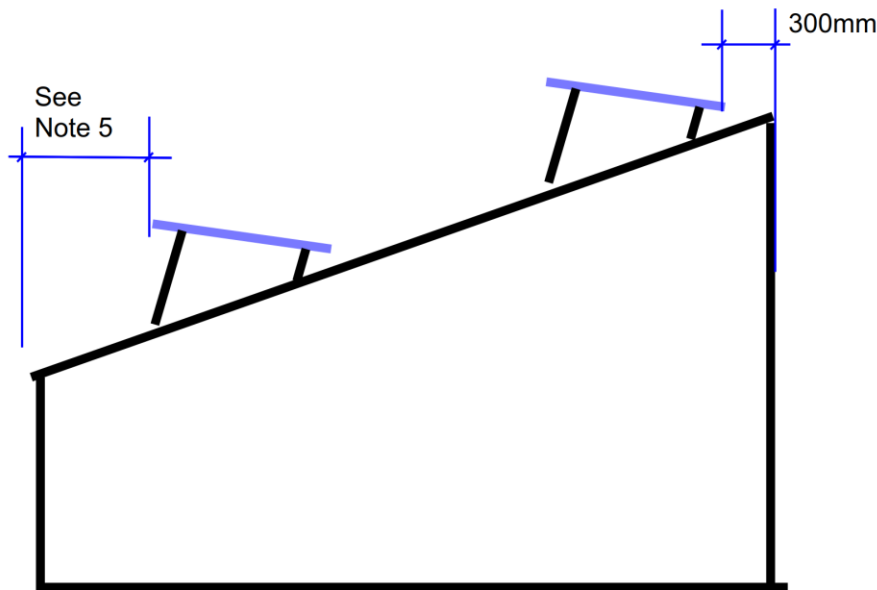


Figure F - Edge Clearance. (See Notes 5 &6 on Page 13)
 Refer to Tables A-1, A2 & A-3 to choose the appropriate spacing requirements.

Table A-1 Calculation of Edge, Intermediate and Corner Zones.

- | | | | |
|-----------------------|--------|--------------------|-------|
| 1. Building Height H: | ___ m. | Use Value of H | ___ m |
| 2. Building Width B: | ___ m. | Calculate 0.2 X B. | ___ m |
| 3. Building Depth D: | ___ m. | Calculate 0.2 X D. | ___ m |

Select the minimum Value of the three (3) results above.

A = ___ m. (The above calculated minimum value)

- | | |
|-------------------|----------------------------------------------------------|
| Edge Zone | = Zone from the roof edge to 0.5XA from the Roof Edge. |
| Intermediate Zone | = Zone from the end of Edge zone to A from the Roof Edge |
| Corner Zone | = AXA area at each of the roof corners. |

- Edge & Intermediate zones need NOT be considered for small buildings where the minimum building width is less than 6600mm. (Refer to Tables A-2 and A-3 below). The tabulated Spacing for the internal zone can be used for all the zones.
- Corner zones are applicable only for large buildings where the minimum building width exceeds 13600 and the building height exceeds 2660. (Refer to Tables A-2 and A-3 below).
- Refer to Tables A-2 and A-3 to select the appropriate spacing requirement for each zone based on the value of 'A' as calculated above.

See Appendix A for an Example.

Table A-2 Local Pressure Amplification Zone			
Value of A (m) (Edge Zone width) Refer to Table A -1 above	Panel Installation Zones	Distance from solar panel To Roof Edge (e)m	Applicable Zones for Back Leg Spacing Requirement
$0 \leq A \leq 1.52$ (Building Dim. than 7.6m)	Internal Zone	e not limited	Internal zone
	Intermediate Zone		
	Edge Zone		
	Corner Zone		
$1.52 \leq A \leq 3.04$ (Building Dim between 7.6 to 15.2m)	Internal Zone	$e > A$	Internal Zone
	Intermediate Zone	$e \leq A$	Intermediate Zone
	Edge Zone		
	Corner Zone		
$A \geq 3.04$ (Building Dim. Exceed 15.2m)	Internal Zone	$e > A$	Internal Zone
	Intermediate Zone	$0.5A \leq e \leq A$	Intermediate Zone
	Edge Zone	$e \leq 0.5A$	Edge Zone
	Corner Zone	$e \leq A$ From both roof edge	Corner Zone
Panel Size 2100x1100			

Table A-3 Local Pressure Amplification Zone			
Value of A(m) (Edge Zone width) Refer to Table A -1 above	Panel Installation Zones	Distance from solar panel To Roof Edge (e)m	Applicable Zones for Back Leg Spacing Requirement
$0 \leq A \leq 1.37$ (Building Dim. than 6.85m)	Internal Zone	e not limited	Internal zone
	Intermediate Zone		
	Edge Zone		
	Corner Zone		
$1.37 \leq A \leq 2.74$ (Building Dim between 6.85 to 13.7m)	Internal Zone	$e > A$	Internal Zone
	Intermediate Zone	$e \leq A$	Intermediate Zone
	Edge Zone		Refer to Intermediate Zone
	Corner Zone		Refer to Intermediate Zone
$A \geq 2.74$ (Building Dim. Exceed 13.7m)	Internal Zone	$e > A$	Internal Zone
	Intermediate Zone	$0.5A \leq e \leq A$	Intermediate Zone
	Edge Zone	$e \leq 0.5A$	Edge Zone
	Corner Zone	$e \leq A$ From both roof edge	Corner Zone
Panel Size 1700x1100			

*'A' = the minimum value of 0.2B, 0.2D Or 1H, refer to figure E.

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.

TILT MOUNT LANDSCAPE ORIENTED

Table 1.1						Inclination 0 - 15 degrees	
Maximum spacing of the fixing of the Back legs mm							
Roof Height		Region A	Region B	Region C	Region D		
5m	Internal Zone	1880	1260	720	470		
	Intermediate Zone	1200	840	#N/A	#N/A		
	Edge Zone	900	630				
	Corner Zone	600	420				
10m	Internal Zone	1540	890	660	#N/A		
	Intermediate Zone	1025	590	440			
	Edge Zone	770	440	#N/A			
	Corner Zone	510	#N/A				
15m	Internal Zone	1390	820	580	#N/A		
	Intermediate Zone	920	540	#N/A			
	Edge Zone	690	410				
	Corner Zone	460	#N/A				
20m	Internal Zone	1310	790	520	#N/A		
	Intermediate Zone	870	540	#N/A			
	Edge Zone	650	410				
	Corner Zone	#N/A	#N/A				
Panel size 1700 X 1100							

Terrain Category 2

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

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.

TILT MOUNT LANDSCAPE ORIENTATED

Table 1.2						Inclination 15-30 degrees	
Maximum spacing of the fixing of the Back legs mm						Terrain Category 2	
Roof Height		Region A	Region B	Region C	Region D		
5m	Internal Zone	870	670	390	#N/A		
	Intermediate Zone	580	440	#N/A	#N/A		
	Edge Zone	430	#N/A				
	Corner Zone	#N/A					
10m	Internal Zone	760	#N/A	#N/A	#N/A		
	Intermediate Zone	540					
	Edge Zone	#N/A					
	Corner Zone						
15m	Internal Zone	720	#N/A	#N/A	#N/A		
	Intermediate Zone	480					
	Edge Zone	#N/A					
	Corner Zone						
20m	Internal Zone	700	#N/A	#N/A	#N/A		
	Intermediate Zone	460					
	Edge Zone	#N/A					
	Corner Zone						
Panel size 1700 X 1100							

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

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.

TILT MOUNT LANDSCAPE ORIENTATED

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
5m	Internal Zone	1450	950	570	#N/A
	Intermediate Zone	960	630	#N/A	
	Edge Zone	720	470		
	Corner Zone	#N/A	#N/A		
10m	Internal Zone	1060	790	520	#N/A
	Intermediate Zone	700	520	#N/A	
	Edge Zone	530	#N/A		
	Corner Zone	#N/A			
15m	Internal Zone	1010	720	450	#N/A
	Intermediate Zone	670	480	#N/A	
	Edge Zone	500	#N/A		
	Corner Zone	#N/A			
20m	Internal Zone	980	680	390	#N/A
	Intermediate Zone	650	450	#N/A	
	Edge Zone	490	#N/A		
	Corner Zone	#N/A			
Panel size 2100 X 1100					

Terrain Category 2

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

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.

TILT MOUNT LANDSCAPE ORIENTED

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
5m	Internal Zone	770	#N/A	#N/A	#N/A
	Intermediate Zone	510			
	Edge Zone	380			
	Corner Zone	#N/A			
10m	Internal Zone	640	#N/A	#N/A	#N/A
	Intermediate Zone	420			
	Edge Zone	#N/A			
	Corner Zone				
15m	Internal Zone	570	#N/A	#N/A	#N/A
	Intermediate Zone	#N/A			
	Edge Zone				
	Corner Zone				
20m	Internal Zone	540	#N/A	#N/A	#N/A
	Intermediate Zone	#N/A			
	Edge Zone				
	Corner Zone				
Panel size 2100 X 1100					

Terrain Category 2

#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.

TILT MOUNT LANDSCAPE ORIENTATED

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	Internal Zone	2290	1530	920	660	
	Intermediate Zone	1520	1020	610	440	
	Edge Zone	1140	765	460	#N/A	
	Corner Zone	760	510	307		
10m	Internal Zone	2290	1530	780	540	
	Intermediate Zone	1520	1020	520	#N/A	
	Edge Zone	1140	765	390		
	Corner Zone	760	510	260		
15m	Internal Zone	1970	1320	720	470	
	Intermediate Zone	1310	880	480	#N/A	
	Edge Zone	980	660	#N/A		
	Corner Zone	650	440	#N/A		
20m	Internal Zone	1760	1160	600	#N/A	
	Intermediate Zone	1170	770	400		
	Edge Zone	880	580	#N/A		
	Corner Zone	580	#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.

TILT MOUNT LANDSCAPE ORIENTED

Table 10.2		Inclination 15-30 degrees			
Maximum spacing of the fixing of the Back legs mm					
Roof Height		Region A	Region B	Region C	Region D
5m	Internal Zone	1230	760	580	#N/A
	Intermediate Zone	820	500	#N/A	
	Edge Zone	615	#N/A		
	Corner Zone	400			
10m	Internal Zone	1230	760	460	#N/A
	Intermediate Zone	820	500	#N/A	
	Edge Zone	610	#N/A		
	Corner Zone	400			
15m	Internal Zone	910	700	390	#N/A
	Intermediate Zone	600	467	#N/A	
	Edge Zone	455	#N/A		
	Corner Zone	#N/A			
20m	Internal Zone	830	630	#N/A	#N/A
	Intermediate Zone	550	420		
	Edge Zone	410	#N/A		
	Corner Zone	#N/A			
Panel size 1700 X 1100					

Terrain Category 3

#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.

TILT MOUNT LANDSCAPE ORIENTED

Table 20.1		Inclination 0 - 15 degrees			
Maximum spacing of the fixing of the Back legs mm					
Roof Height		Region A	Region B	Region C	Region D
5m	Internal Zone	1800	1050	820	520
	Intermediate Zone	1200	700	540	#N/A
	Edge Zone	900	520	#N/A	
	Corner Zone	600	#N/A		
10m	Internal Zone	1800	1050	660	410
	Intermediate Zone	1200	700	#N/A	#N/A
	Edge Zone	900	520		
	Corner Zone	600	#N/A		
15m	Internal Zone	1540	990	570	#N/A
	Intermediate Zone	1020	660	#N/A	
	Edge Zone	770	490		
	Corner Zone	510	330		
20m	Internal Zone	1250	910	410	#N/A
	Intermediate Zone	830	600	#N/A	
	Edge Zone	620	450		
	Corner Zone	410	#N/A		
Panel size 2100 X 1100					

Terrain Category 3

#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.

TILT MOUNT LANDSCAPE ORIENTED

Table 20.2						Inclination 15 - 30 degrees			
Maximum spacing of the fixing of the Back legs mm									
Roof Height		Region A	Region B	Region C	Region D				
5m	Internal Zone	940	630	440	#N/A				
	Intermediate Zone	620	420	#N/A					
	Edge Zone	470	#N/A						
	Corner Zone	#N/A							
10m	Internal Zone	940	630	#N/A	#N/A				
	Intermediate Zone	620	420						
	Edge Zone	470	#N/A						
	Corner Zone	#N/A							
15m	Internal Zone	810	550	#N/A	#N/A				
	Intermediate Zone	540	#N/A						
	Edge Zone	#N/A							
	Corner Zone								
20m	Internal Zone	730	#N/A	#N/A	#N/A				
	Intermediate Zone	480							
	Edge Zone	#N/A							
	Corner Zone								
Panel size 2100 X 1100									

Terrain Category 3

#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. Refer to Tables A-1, A-2, & A3, for the spacing requirements where the panel's longer legs are located within the edge/intermediate zones as defined in Clause 5.4.4 of AS1170.2.
6. The set out of the intermediate, Edge, and corner zones shall be as specified in Tables A-1 A-2 and A-3.
7. The maximum spacing of the legs & fixing shall conform to the worst case if the panel spans across different zones (Internal, Intermediate, Edge & Corner). Example: Fixing for a panel located partly in the internal zone and partly in the intermediate zone shall be that for the intermediate zone.
8. All panels shall have a minimum clearance of 300 from the roof edge.
9. The deflection of the railing has not been controlled in the design. If deflection has to be limited then spacing shall be reduced as advised by a practicing structural engineer.
10. The roofing to which the panels are to be installed shall conform to the relevant Australian Standards including AS1684, AS4440, AS1720, AS4100 and AS4600.
11. 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.
12. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.
13. Each fixing shall have a minimum 2 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 Tables H2.3 & H3.1 of AS1720.1.
A & B	JD1 to JD5	J1 to J4	
C & D	JD1 to JD4	J1 to J3	

17. 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.
18. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.

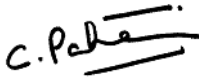
19. The installation and fixings shall be periodically inspected and maintained.

20. The following are excluded from this certification.

- 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, NER (Structural) 142156, RPEQ-09066, NTBPA 216724ES, EC27362(VIC)
Director

Appendix A

Example:

A building of 10.0 (B) x 8.0 (D) x 5.0 (H), located in TC 2, Region A,
PV Panels: 2100x1100 Portrait inclined at 10degrees.

Step 1: Check A from Table A-1,

Building Height H:	5.0 m.	Use Value of H	5.0 m
Building Width B:	8.0 m.	Calculate 0.2 X B.	1.6 m
Building Depth D:	10.0 m.	Calculate 0.2 X D.	2.0 m

A= minimum {0.2b,0.2d H} = **1.6m**

Step 2: Find Spacing Requirements from Tables A-2 or A-3

Panel Size 2100X1100: Got to Table A-2.

A =1.6. i.e. $1.52 < A < 3.04$

Intermediate zone spacing will be applicable for a) Intermediate, b) Edge and c) Corner zones.

Step 3:

2100x1100 Panel , 0 to 15 deg inclination, in Terrain Category 2: Go to Table 2.1.

Spacing in internal zone = 1450

Spacing for all other zones = 967.