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**STRUCTURAL DESIGN CERTIFICATE – No: CSM-SC033-2013****Job No: 13S-345****Plant Description:**

PV-RooftopRac system solar panel mounting structure with fasteners, Base Rail 40 x 40.

**Client/Owner:**

Suzhou Radiant Photovoltaic Technology Co. Ltd

**Site Address:**

Locations throughout Mainland Australia (Wind Regions A, B, C and D as Per AS/NZS 1170.2:2011).

**Drawings and Documentation Included in this Certificate:**

- The following drawings supplied by Suzhou Radiant Photovoltaic Technology Co. Ltd and nominated in the table below are included in this structural certification.

**Table 1: Certified Drawings**

<b>PV-RooftopRac, Base Rail 40 x 40</b>		
<b>PC No.</b>	<b>Part Name</b>	<b>Drawing No.</b>
1	Base Rail40	10-1110-0000
2	Rail40/60 Splice	10-1410-0101
3	End Clamp 35	10-1210-0101
4	End Clamp 40	10-1210-0401
5	Modules End Clamp Kit	10-1210-0700
6	End Clamp 46	10-1210-0701
7	Click Nut	10-1210-0702
8	Spring 24	10-1210-0703
9	End Clamp 50	10-1210-0901
10	Adjust End Clamp 35-46	10-1210-1000
11	End Clamp 31	10-1210-1101
12	Adjust End Clamp 30-40	10-1210-1200
13	Modules Inter Clamp Kit	10-1310-0300
14	Inter Clamp 35-52	10-1310-0301
15	Inter Clamp30-39	10-1310-0401
16	Profile Splice	10-1410-0100
17	Preassembly RoofHook45-136-166	10-1510-0100
18	Roof Hook Base Plate	10-1510-0101
19	Joint Bar	10-1510-0102
20	Support Bar	10-1510-0103
21	Rail Clamp	10-1510-0104
22	Spring 12	10-1510-0105
23	Rail Support Seat	10-1510-0106
24	Alu RoofHook 360 Degree	10-1510-0300
25	Preassembly RoofHook45-135	10-1511-0100
26	Preassembly Slate RoofHook-5-75	10-1512-0100
27	Hanger bolt M10x200 with Plate	10-1513-0100
28	Base Plate 40x120	10-1513-0101
29	Hangbolt M10x200	10-1513-0102
30	Nylon Ring	10-1513-0103
31	EPDM Rubber 78x35x0.5	10-1514-0303
32	Wave Support	10-1514-0600

33	Trim dek Support	10-1514-0900
34	Trim Deck Seat	10-1514-0901
35	EPDM Rubber	10-1514-0902
36	Klip Lok 406 Clamp Kit	10-1514-1000
37	Klip Lok 406 Clamp-A	10-1514-1001
38	Klip Lok 406 Clamp-B	10-1514-1002
39	Klip Lok 700 Clamp Kit	10-1514-1100
40	Lysaght Kilp Lok 700 Clamp-A	10-1514-0101
41	Lysaght Kilp Lok 700 Clamp-B	10-1514-0102
42	Spring	10-1514-1103
43	Wave Support 360 Degree	10-1514-1400
44	L Support Seat	10-1514-0501
45	Permanent Seat	10-1514-0502
46	Flashing Attachment	10-1515-0000
47	Cut Post	10-1515-0101
48	Permanent Seat	10-1515-0201
49	Rail Base Point	10-1515-0301
50	Flashing	10-1515-0401
51	Spun Cone Flashing	10-1515-0501
52	EPDM Ring	10-1515-0602

- Includes the **following fasteners** to the roof applicable to the **tilled roof assembly** when using the roof hook 10-1510-0100: **Min. two (2) 14g x10TPI x 65mm Storm-Tite (Dual Point) (minimum class 4) Roofing Fastener per support clamp.**

**NOTE** – The Client shall hold all Material Test Certificates for future reference and subsequent design changes.

**The Design was carried out based on the following Standards:**

AS/NZS 1170.0:2011 – Structural Design Actions Part 0: General Principles

AS/NZS 1170.1:2002 A2-2009 – Structural Design Actions Part 1: Permanent, imposed and other actions

AS/NZS 1170.2:2011 – Structural Design Actions Part 2: Wind actions

AS/NZS 1170.2:2011 – Amdt 2/2012-12-24

**Exclusions**

- Solar Panel/Frame certified by others.
- Earthquake Code (AS/NZS 1170.4) not considered - Solar panel is not a major building structure.
- Set-up, instruction and installation manual.
- 304 Stainless Steel should not be used in a Marine environment or in an environment above 50 – 60 °C with chlorides present. The use of 316 Stainless Steel is recommended in these conditions.
- This certification does not include loadings for snow or earthquake loads and represent wind loads only.

**Specification of this Structural Certificate**

- Maximum Solar Panel Size = 2m x 1.0m.
- Maximum L-Foot Spacing (St. Stl /Aluminium) = Refer Table 4.1, 4.2, 4.3 & 4.4
- Minimum four support clamps per Solar Panel.
- Solar Panels to be installed on the building roof only.
- Buildings are to be rectangular or square shape.
- External wind uplift and internal positive wind pressures are considered.
- Wind Regions A,B,C & D have been considered (Refer Table 4.1, 4.2, 4.3 & 4.4)
- Regional wind speed for 500 year ARI.
- See Tables 4.1, 4.2, 4.3 and 4.4 for Building Height conditions based on all Terrain Category, and wind regions for different roof pitch and building dimensions.
- Maximum Building Height is 20 m.
- Building aspect ratio should be equal or less than 0.5. The building aspect ratio is the ratio of height over length or width of the building.
- Maximum roof pitch shall be 0° to 30°.
- Stainless Steel bolts – UNC rolled thread to ASTM A 193 Grade B8 (304 S/S)
  - Material to ASTM A 276 Condition A.
- Stainless Steel nuts – UNC rolled thread to ASTM A 194 Grade 8 (304 S/S)
  - Material to ASTM A 276 Condition A.

**Details of the Design**

Maximum Solar Panel Size	:	2.0m x 1.0m
Maximum Roof Angle or Pitch	:	0° to 30 Degrees
Australian Terrain Category	:	Any Terrain Category
Wind Regions	:	A, B, C & D (Refer Table 4.1, 4.2, 4.3 & 4.4)
Mounting Conditions onto Rails	:	Rail fastened to L-Feet then onto Building Purlin at maximum spacing as per Table 4.1, 4.2, 4.3 & 4.4
Maximum L-feet spacing	:	As per Table 4.1, 4.2, 4.3 & 4.4
Mounting Conditions onto Solar Panels	:	Four clamping positions per solar panel back to rails
Design life of structure	:	20 years

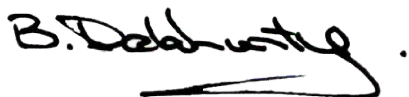
- CSM group has not carried out any inspection of any installed plant being completed, thus this Certificate **Does Not** cover Inspection of the plant for each site location.
- However, specific **building heights over 20m** are **outside these Design parameters within this document** and should be treated as an individual analysis and be verified by the Certifying Engineer.
- It is strongly recommended that all the connections and fasteners should be checked against failure or corrosion immediately after **a 5 year ARI** wind event or annually, whichever comes first.
- The roof, on which the solar assembly is to be installed on, must have the capacity to resist the combined dead and live loads per feet.

If manufactured, constructed and installed in accordance with the abovementioned drawings, specifications, details of the design and OEM Installation Manual, the support structure will be capable of sustaining the load conditions as specified in the Australian standards AS1170.2-2011/Amdt 2-2012 and AS1664.

Certifying Engineer

Signature

Date: 20/12/2013



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## 1. Determine the wind region for your site location

Using the table below determine the region your site location is in paying particular attention to differing regions within 50 and 100km of the coastal perimeter of the nation. (If in doubt consult your engineer)

Wind regions are pre-defined for all of Australia by Australian Standard 1170.

- Most of Australia is designated in Regions A1-7 which indicates a Regional Ultimate Basic Wind Velocity of 45m/sec.
- Several coastal areas including Brisbane are within Region B (57m/sec).
- Region C areas (69m/sec) are generally referred to as Cyclonic and are generally limited to northern coastal areas. Most Region C zones end 100km inland.
- Region D (88m/sec) Australia's worst Cyclonic Region between Carnarvon and Pardoo in Western Australia.

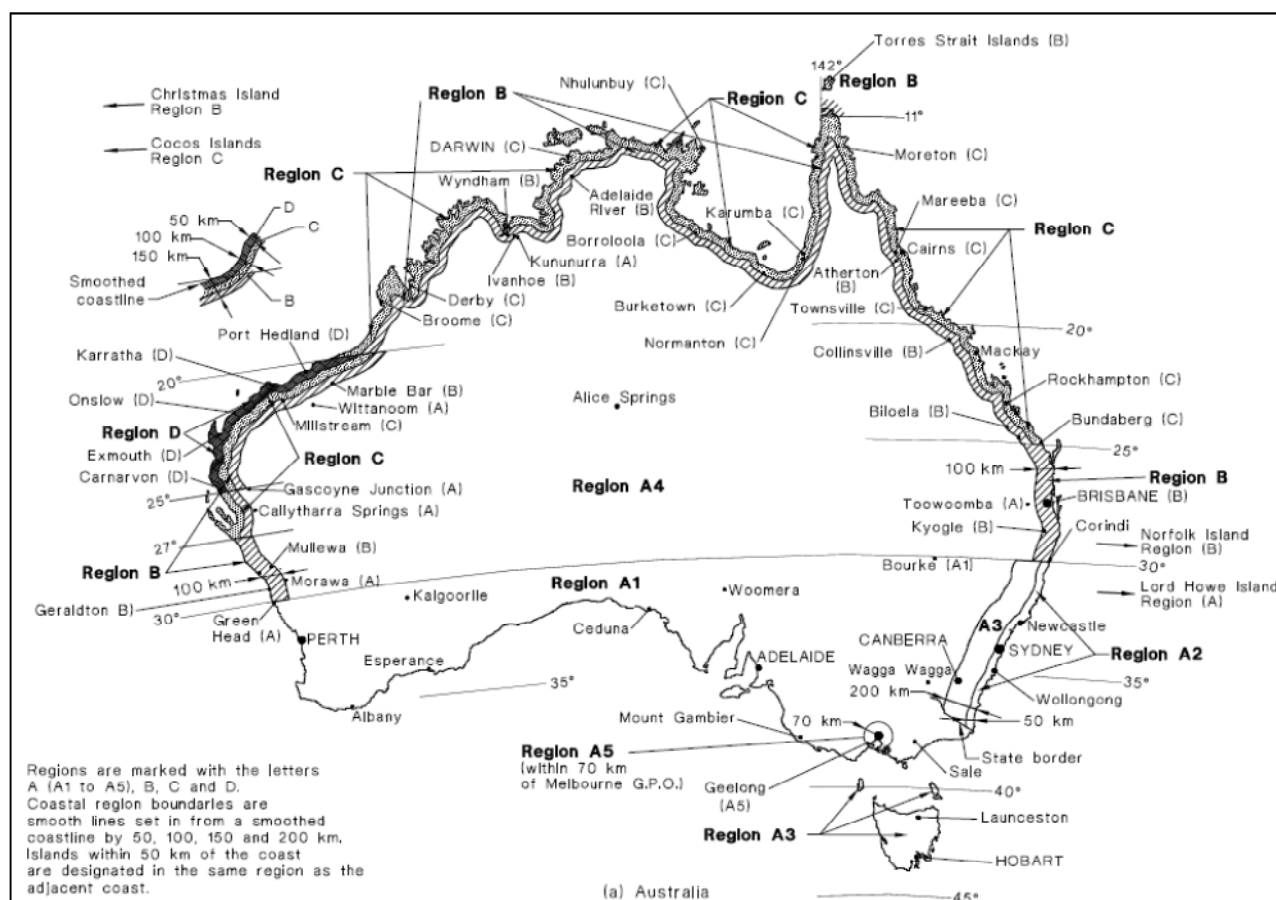


Figure 1 – Australian Wind Zones

## 2. Determine the building height at your site location

This height 'h' is equal to the distance from ground to the mid height of your roof ie, between the eaves and the roof ridge. Most single storey residential buildings will be less than 10m in height.

Whilst this certification cover building heights to 20m it is important to get special engineering advice for buildings over this maximum height.

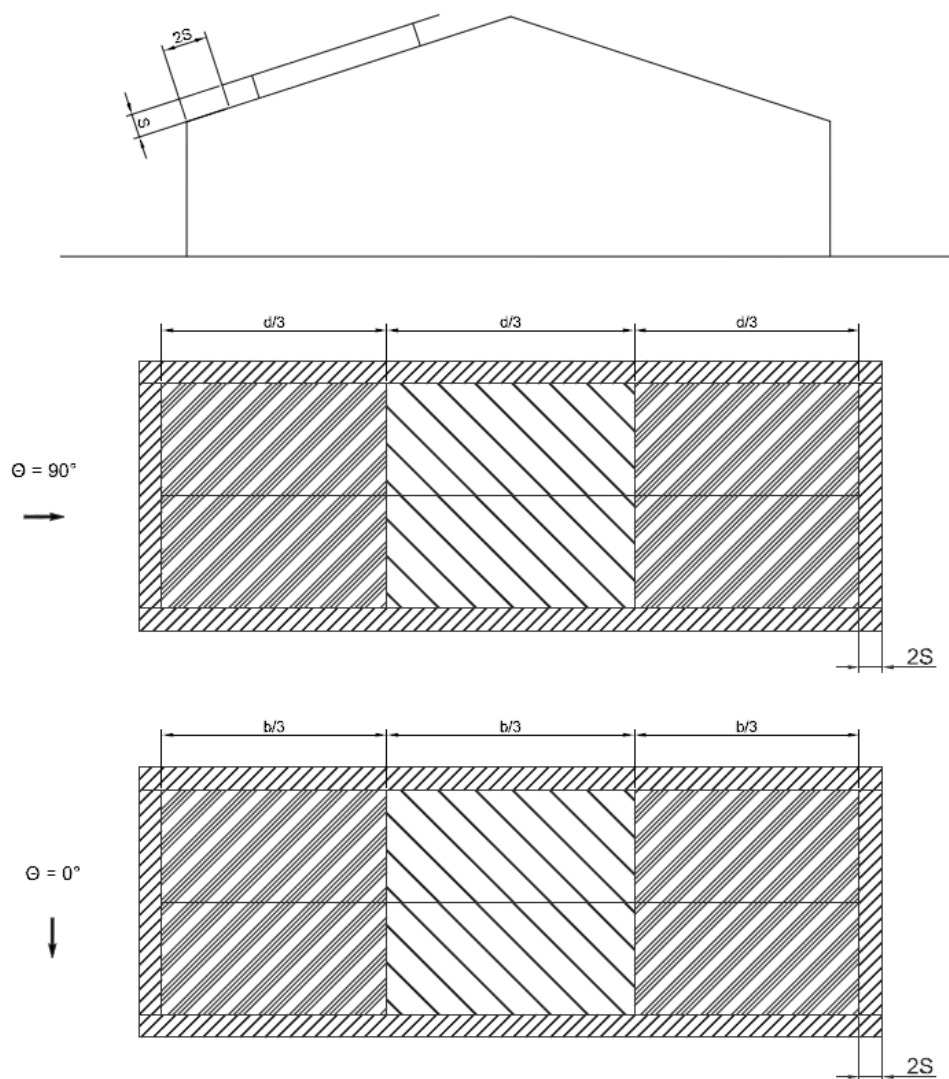
## 3. Determine Roof Installation Area

The solar roof panel system **should not be installed within the 2s of the roof edge, ie** = twice the minimum gap 'S' between the underside of the panel and the top of roof surface, where 'S' is the gap (usually between 50mm and 300mm) between the underside of the panel and the roof.(no pitch frames).

**N.B If this gap 'S' is greater than 300mm advise the consultant as other tables are applicable.**

Refer roof installation areas in Figure 2 below.

Use table 4.3 or 4.4 for End zones and tables 4.1 or 4.2 for the middle zone.



N.B.  $2S$  = TWICE THE MINIMUM GAP BETWEEN THE UNDERSIDE OF THE PANEL AND THE ROOF SURFACE, WHERE "S" IS THE GAP BETWEEN 50mm AND 300mm BETWEEN THE UNDERSIDE OF THE PANEL AND THE ROOF (NO PITCH FRAMES).

#### LEGEND

 EXCLUSION ZONE

 END ZONE

 MIDDLE ZONE

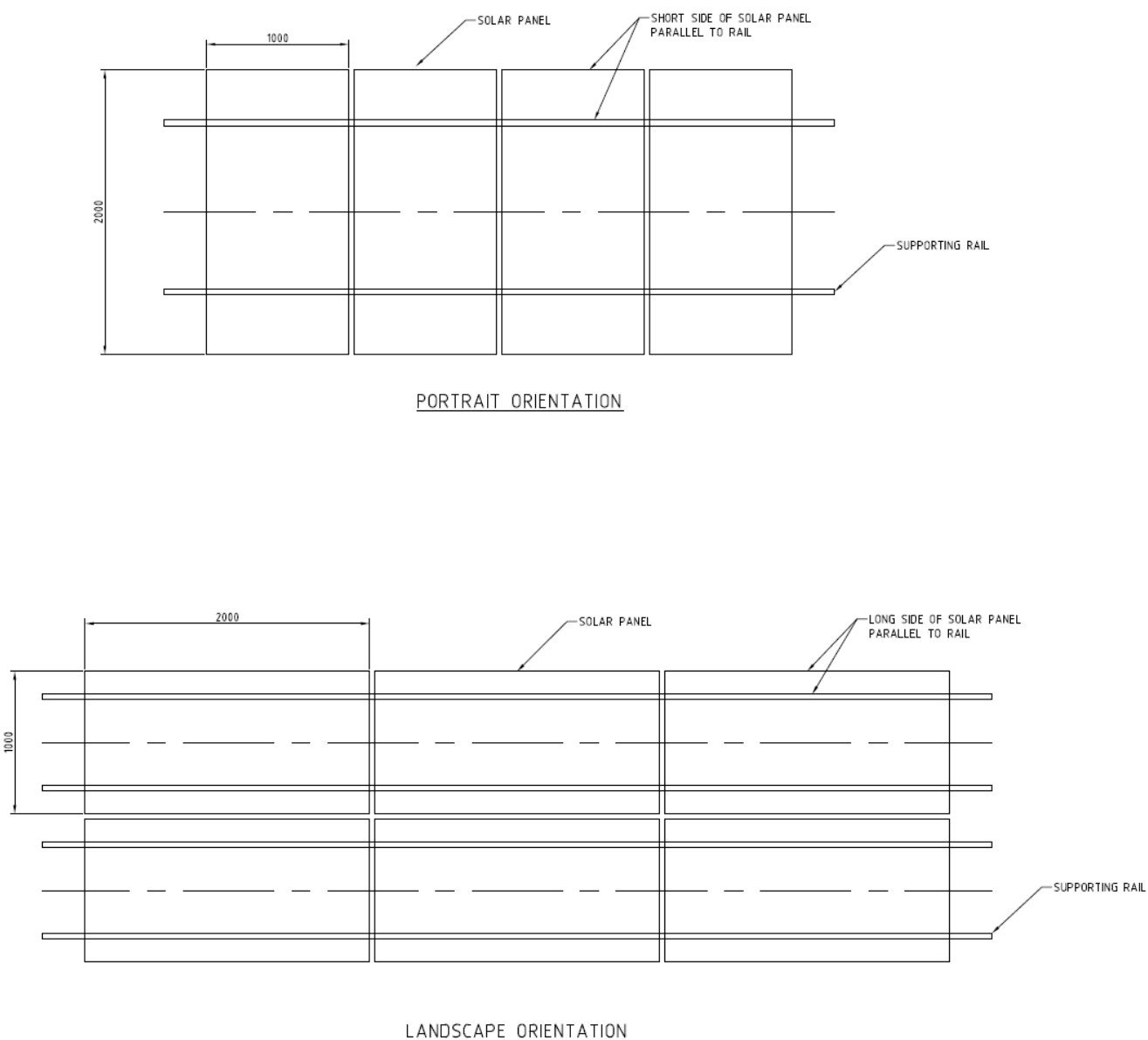
$b$  Breath of structure, normal to the wind stream

$d$  Depth parallel to the wind stream

**Figure 2 – Roof Installation Areas (Middle, End or Exclusion)**

#### 4. Determine whether your solar layout is in Portrait or Landscape Orientation

Portrait orientation denotes the short side of the solar panel (1m) is installed parallel the supporting rail and for landscape orientation the long side of the solar panel (2m) is installed parallel the supporting rail. Refer Figure 3 below for examples of portrait or landscape orientation. Use table 4.1 or 4.3 for portrait orientation and tables 4.2 or 4.4 for landscape orientation.



**Figure 3 – Examples Portrait or Landscape Orientation**

## 5. Determine the Maximum Support Spacing for the Base Rail 40 – Drawing No. 10-1110-0000

The following tables 4.1 and 4.2 are used to determine the maximum rail support spacing (**within the middle zones of the roof as per Figure 2 above**) for either a tin or a tiled roof for a solar panel of maximum 2.0m long x 1.0m wide.

**N.B**

1. Portrait orientation denotes the short side of the solar panel (1m) is installed parallel the supporting rail and for landscape orientation the long side of the solar panel (2m) is installed parallel the supporting rail.
2. The following tables 4.1-4.4 have been calculated based on a minimum of 2 rails per supporting panel. Should this differ please advise the consultant.
3. The following tables only apply to buildings whose heights are not greater than twice their width.

**Table 4.1 – Maximum Rail Support Spacing for Roofs, Portrait Orientation – Middle Zone**

Maximum Rail Support Spacing for Roofs (m)				
Building height (h)	Wind Region A	Wind Region B	Wind Region C	Wind Region D
<5m	1600	1200	1000	800
5 to 10m	1500	1100	900	700
10 to 15m	1400	1100	900	700
15 to 20m	1400	1100	900	700

Table 4.1 is used for portrait orientation within the middle zone as per Figure 2 above.

**N.B.** These tables are based on AS1170.2-2011 (A2) Table D11.

**Table 4.2 – Maximum Rail Support Spacing for Tin Roofs, Landscape Orientation – Middle Zone**

Maximum Rail Support Spacing for Roofs (m)				
Building height (h)	Wind Region A	Wind Region B	Wind Region C	Wind Region D
<5m	1800	1800	1400	1100
5 to 10m	1800	1600	1300	1000
10 to 15m	1800	1600	1300	1000
15 to 20m	1800	1500	1300	1000

Table 4.2 is used for landscape orientation within the middle zone as per Figure 2 above.

**N.B** These tables are based on AS1170.2-2011 (A2) Table D11.

The following tables 4.3 and 4.4 are used to determine the maximum rail support spacing (**within the end zone of the roof as per Figure 2 above**) for either a tin or a tiled roof for a solar panel of maximum 2.0m long x 1.0m wide.



**Table 4.3 – Maximum Rail Support Spacing for Roofs, Portrait Orientation – End Zone**

Maximum Rail Support Spacing for Roofs (m)				
Building height (h)	Wind Region A	Wind Region B	Wind Region C	Wind Region D
<5m	1400	1100	900	700
5 to 10m	1300	1000	800	700
10 to 15m	1300	1000	800	600
15 to 20m	1200	1000	800	600

Table 4.3 is used for portrait orientation within the end zone as per Figure 2 above.

N.B These tables are based on AS1170.2-2011 (A2) Table D11.

**Table 4.4 – Maximum Rail Support Spacing for Tin Roofs, Landscape Orientation– End Zone**

Maximum Rail Support Spacing for Roofs (m)				
Building height (h)	Wind Region A	Wind Region B	Wind Region C	Wind Region D
<5m	1800	1600	1300	1000
5 to 10m	1800	1500	1200	900
10 to 15m	1800	1400	1200	900
15 to 20m	1800	1400	1100	900

Table 4.4 is used for landscape orientation within the end zone as per Figure 2 above.

N.B These tables are based on AS1170.2-2011 (A2) Table D11.

#### 6. Check Acceptable End of Rail Overhang

Rail End Overhang must not equal greater than 30 percent or less of the Base Rail 40 spacing. Thus, if the foot spacing is 1200mm, the Rail End Over hang can be up to 400mm ie,  $1200/3 = 400\text{mm}$ . In this case, two feet can support a rail of as much as 2000mm (1200mm between the feet and 400mm of overhang at each end).

#### 7. Confirm Roof slope

The Base Rail of Roof Top Rac PV solar system can be used for the roof pitch angle up to 30 degrees.

#### 8. Determine the Type of Fastener and Minimum Number of Fasteners to be used

The following table 7.1 determines the correct fasteners to attach the Base Rail 40 to the roof supports being a timber rafter or truss and or a steel purlin or truss. The length of the fastener will vary according to the roofing profile; however the 65mm length should be applicable for most installations.

**Table 7.1 – Fasteners used to attach Base Rail 40 through Tin Roof into either Timber or Steel Rafters/Trusses or Purlins**

### Storm-Tite Roofing Fasteners – (for use greater than 1000m from the coast)

#### – Dual Point for Timber and Steel Drilling (max. 2.0mm thick steel)

Code	Point	Gauge	TPI	Length	Finish
C14-1465-D4Z	Dual	14	10	65mm	Class 4
C14-14125-D4Z	Dual	14	14	125mm	Class 4
C14-14150-D4Z	Dual	14	14	150mm	Class 4

#### – Steel Drilling Point (above 2.0mm thick steel)

Code	Point	Gauge	TPI	Length	Finish
C14-1025-S4Z	SD	14	10	25mm	Class 4
C14-1050-S4Z	SD	14	10	50mm	Class 4
C14-1070-S4Z	SD	14	10	70mm	Class 4
C141080-S4Z	SD	14	10	80mm	Class 4
C14-10100-S4Z	SD	14	10	100mm	Class 4
C14-10125-S4Z	SD	14	20	125mm	Class 4
C14-20150-S4Z	SD	14	20	150mm	Class 4

### Buildex- Stainless Steel Roofing Fasteners

#### – (for use within 1000m of the coast into steel purlins)

##### Hex. Head with Al/Neo (S Pt)



Gauge	T.P.I	Length	Pack	Part Number	Pack Type	Finish
14	14	31	500	6-397-0107-7	Bulk	Grade 305
14	14	52	500	6-397-0108-8	Bulk	Grade 305
14	14	70	500	6-397-0109-9	Bulk	Grade 305
14	14	80	500	6-397-0110-1	Bulk	Grade 305
14	14	90	500	6-397-0111-1	Bulk	Grade 305

#### – (for use within 1000m of the coast into timber rafters/trusses)

##### Hex. Head with 16mm aluminium bonded washer



Gauge	T.P.I	Length	Pack	Part Number	Pack Type	Finish
14	10	25	500	6-037-0022-4	Bulk	Grade 304
14	10	50	500	6-037-0023-2	Bulk	Grade 304
14	10	65	500	6-037-0024-1	Bulk	Grade 304
14	10	75	500	6-037-0025-9	Bulk	Grade 304
14	10	90	500	6-037-0026-7	Bulk	Grade 304

#### Fastener Notes:

1. Minimum embedment length into timber to be not less than 35mm.
2. Never set drill on impact when installing screws, otherwise fastener warranties are void
3. Use Dual Point screws up to 2.0mm thick steel purlins or rafters
4. Use Steel Point screws over to 2.0mm thick steel purlins or rafters
5. Use Stainless Steel screws within 1000m of the coast
6. The use of the clamp type roof fasteners are authorised use in for wind region A only individual certifications are required for other wind regions

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**Note: The installer is solely responsible for:**

- Complying with all applicable local or national building codes.
- Ensuring that the Roof Top Rac and fasteners used and or other products are appropriate for the particular installation at the particular installation environment;
- Ensuring that the roof and its components ie, rafters, connections, and other structural support members can support the solar array assembly under building live load conditions;
- Using only Roof Top Rac parts and installer-supplied parts as specified by Suzhou Radiant Photovoltaic Technology Co. Ltd
- Ensuring that roof screws have adequate pullout strength and shear capacities as installed and nominated above;
- Maintaining the waterproof integrity of the roof, including selection of appropriate flashing and fasteners;
- Ensuring safe installation of all electrical components of the PV solar assembly.
- Ensuring that dissimilar metals have a rubber pad between them such as aluminium and galvanised steel.