

Date of Issue: 20/12/2013 8:35 PM

## 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**

| PV-RooftopRac, Base Rail 40 x 40 |                                 |              |
|----------------------------------|---------------------------------|--------------|
| PC No.                           | Part Name                       | Drawing No.  |
| 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  |

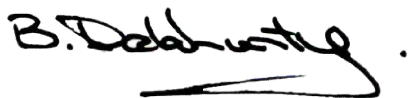
- CSM group has not carried out any inspection of any installed plant being completed, thus this Certificate **Does Not** cover Inspection of the plant for each site location.
- However, specific **building heights over 20m** are **outside these Design parameters within this document** and should be 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.

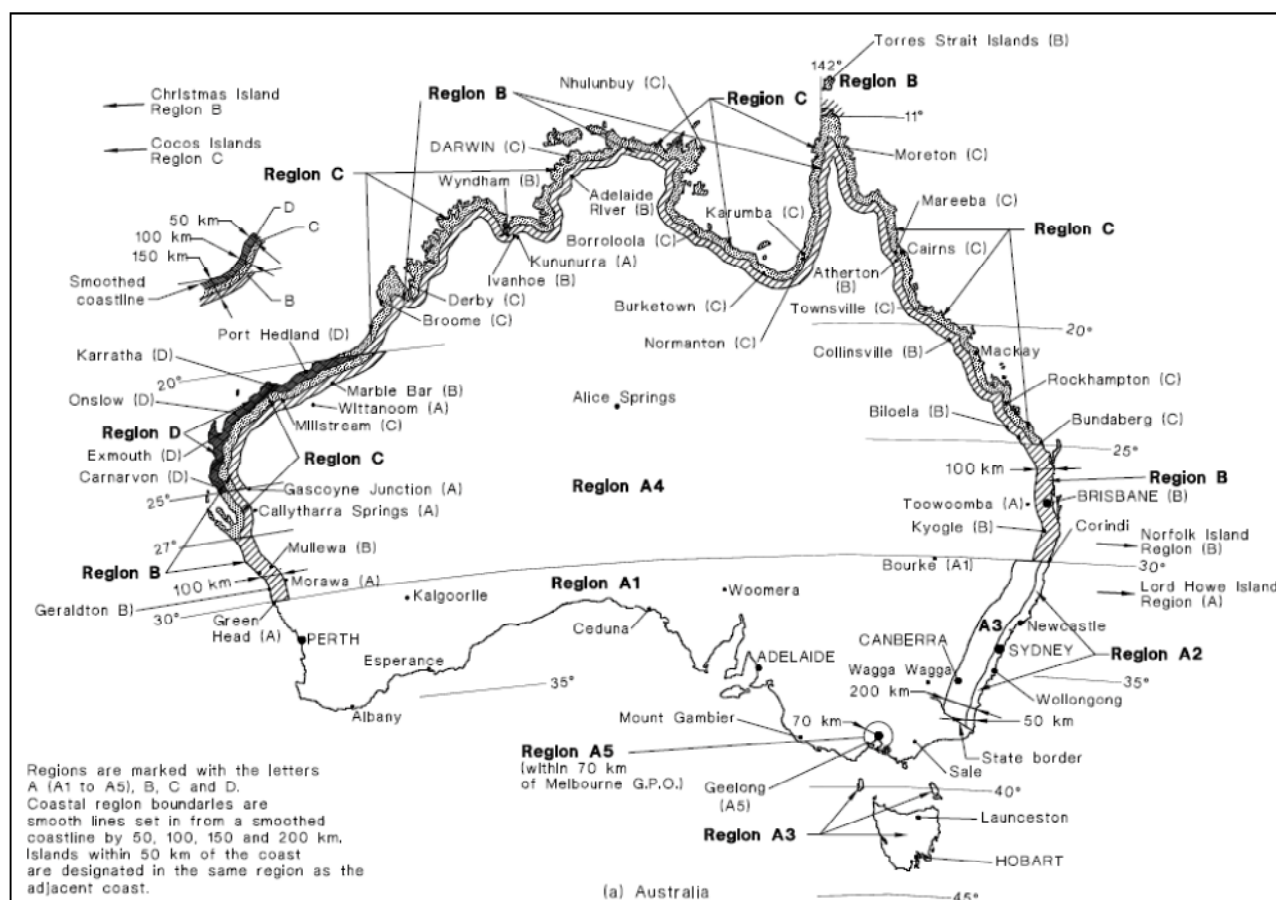


Figure 1 – Australian Wind Zones

## 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.

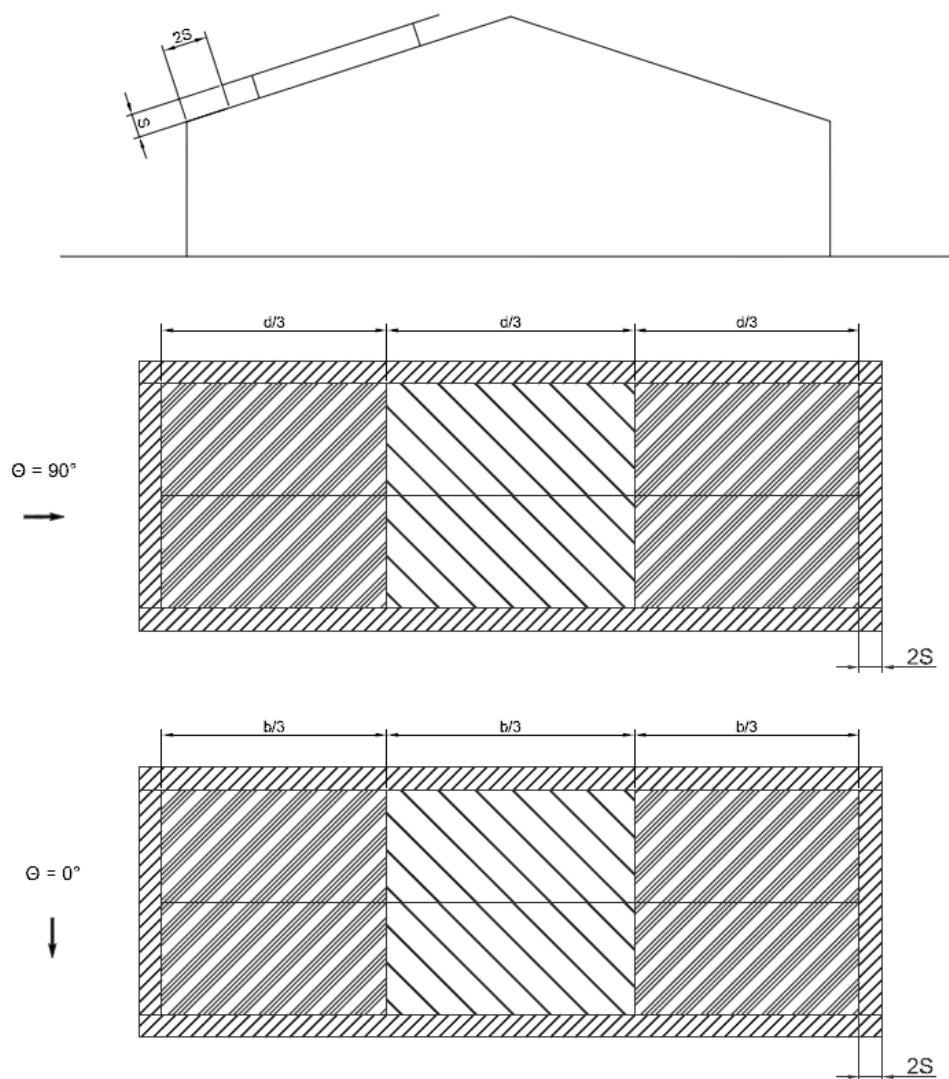
## 3. Determine Roof Installation Area

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

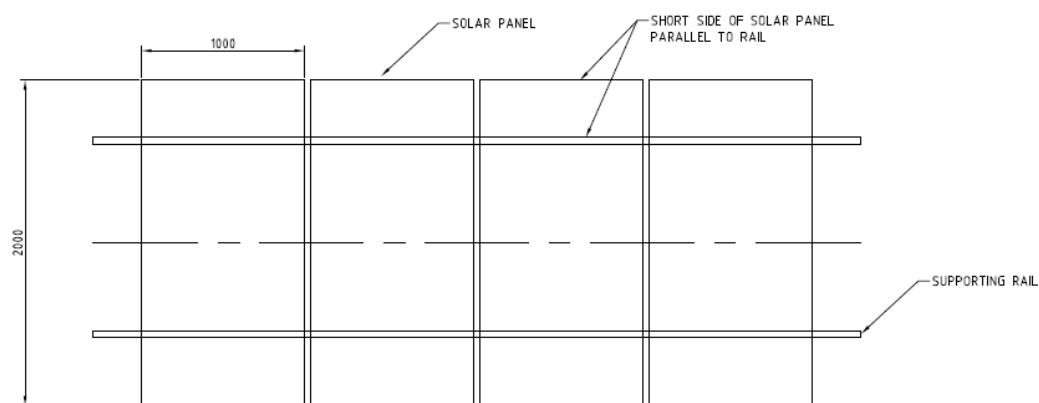
b Breath of structure, normal to the wind stream

d Depth parallel to the wind stream

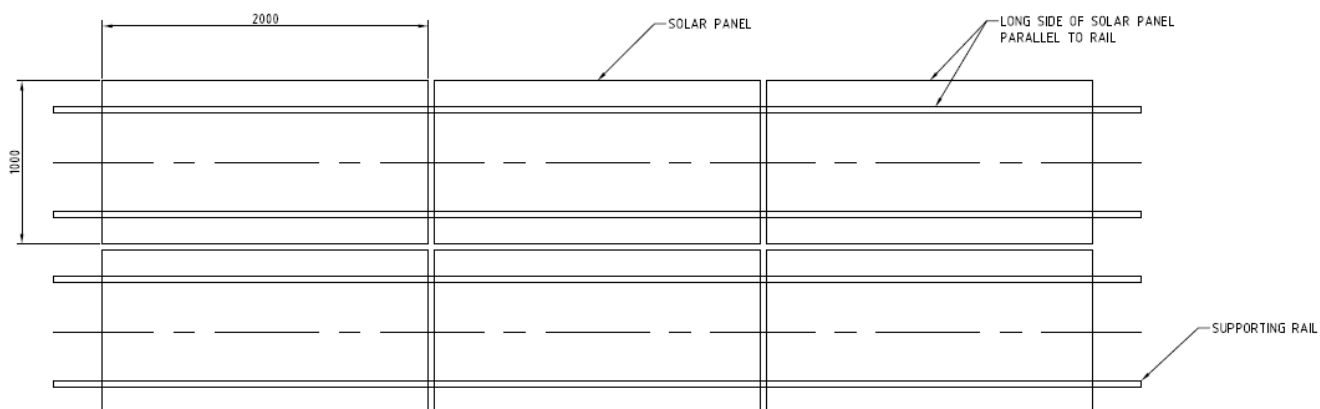
**Figure 2 – Roof Installation Areas (Middle, End or Exclusion)**

#### 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.



PORTRAIT ORIENTATION



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.