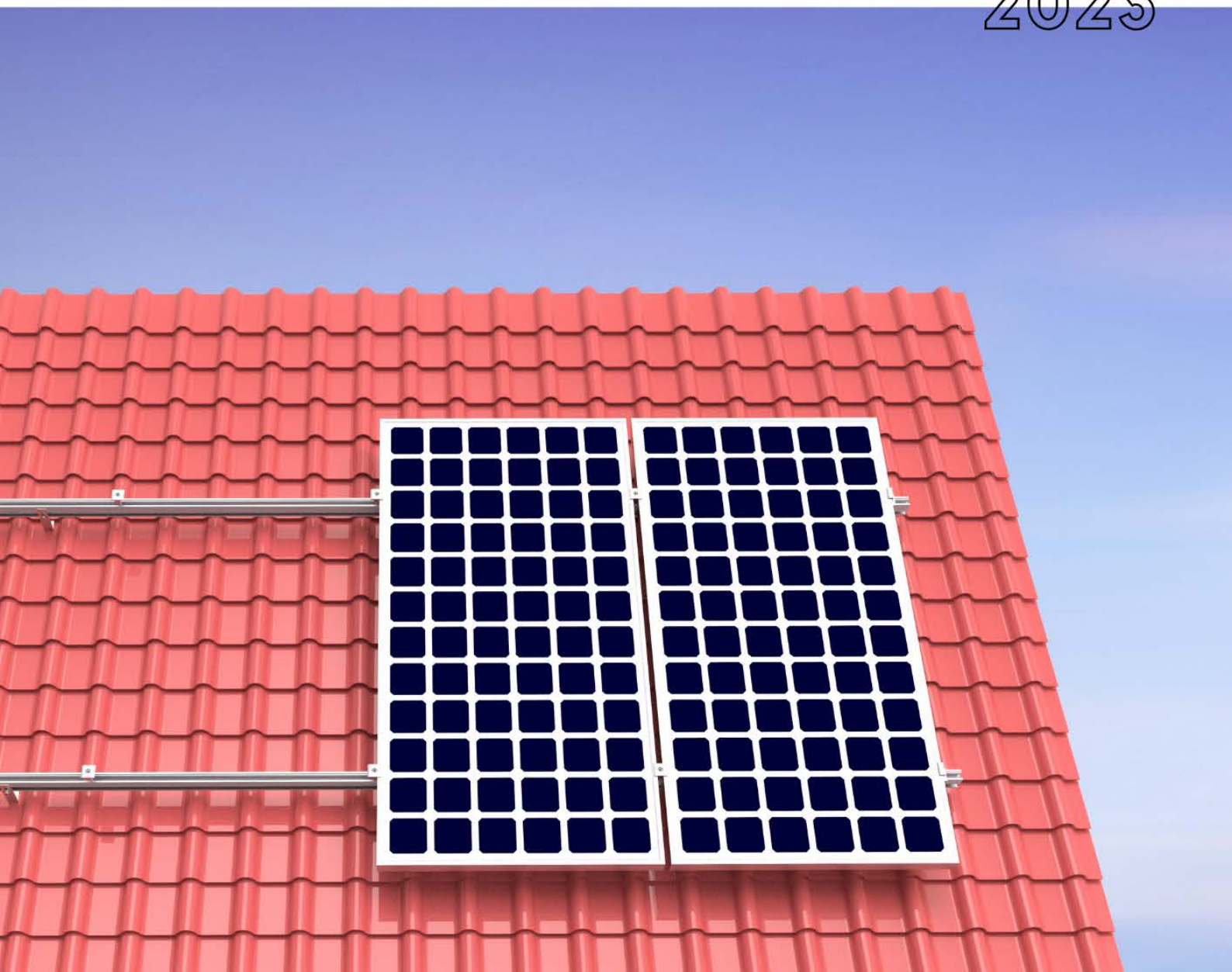
GRACE SOLAR

Solar Roof Mounting System Installation Manual

COMPLYING WITH AS/NZS 1170.2:2021

2023



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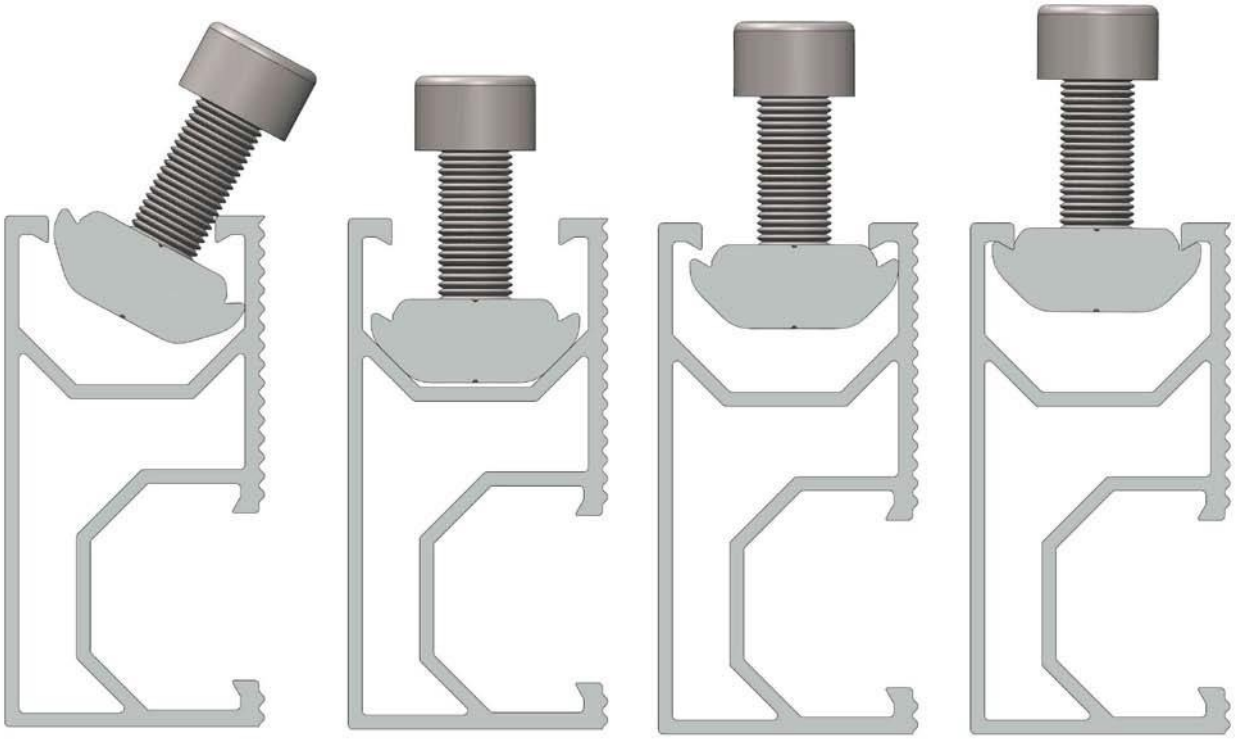
1. Introduction

Thank you for choosing the Grace solar roof mounting system. Xiamen Grace Solar New Energy Technology Co., Ltd., as a trustworthy brand for smart solar mounting system, after more than 10 years of rapid development, now has top 5 global market share and the top 1 market share in Japan. The global cumulative installed capacity is 33GW, and our annual production capacity is 10GW. Hundreds of MW projects have been successfully installed in more than 100 countries and regions.Including Japan, the United States, Australia, Europe, the Middle East and Africa, and Southeast Asia. Integrates new technologies such as AI artificial intelligence, Internet of Things, energy storage, energy Internet, intelligent manufacturing, etc., we have successively launched GS-Light Intelligent tracking mounting system, GS Smart fixed mounting system, GS-Power floating mounting system, and GSBIPV systems. Solution, have for more than 100 patents,very few brand offer complete mounting solutions in both DSP and CSP markets.

Grace Solar has a team of highly sophisticated engineers who have been abroad, and has established a fully equipped key laboratory. Grace Solar products have passed certifications in many countries and regions around the world, including UL, TUV, CE, JIS, MCS, AS/NZS1170 certification, Also new Wind Tunnel Test Report, as well as bank ability report for our GS-light Tracker, Establish long-term and stable strategic partnerships with many Top 500 companies globally. Grace Solar adheres to the brand spirit of " Born from Renewable Energy, Drives solar forward ", based on the energy industry, and constantly exploring ahead, with the original intention of Chinese manufacture and global strategy, Bring Grace Solar to all homes!

2. General Information

Made from custom-built aluminum extrusions and components, Grace Solar's innovated design and improved frame strength greatly simplify solar panel installation. The easy installation four steps make the D-Modules can be put into the D Rail on any position quickly. So, the D-Modules is pre-assembly with the clamp to save your install time.



Tilt-in Align Up Fasten

Easy installation four steps

Grace solar's versatile design makes it suitable for a wide variety of building types and zones including residential, commercial and remote environments.

Gracesolar is backed by a 10-year warranty and is compliant with the Australian/New Zealand Standard on Wind Actions (AS/NZS1170.2:2021).

3. Safety and Installer Responsibilities

**Caution: Please read this section carefully before installation. This section will strictly follow the AS/NZS1170.2:2021 standard to detail the conditions of the installation site and some additional precautions before installing the system. Please install the bracket in the recommended installation position correctly, installing the solar bracket in the wrong position will invalidate the bracket warranty. **

3.1 Handling and Installing Grace solar

It is critically important that safety practices are observed when installing

✓ Do not throw or roughly handle any Grace solar components.

✓ Do not bring Grace solar system into contact with sharp or heavy objects.

✓ Do not modify Grace solar components in any way. The exchange of bolts, drilling of holes, bending or any other physical changes not described in standard installation procedure will void the warranty.

✓ It is the installer's responsibility to verify the integrity of the structure to which Grace solar components is fixed. Roofs or structures with rotten/rusted bearers, undersized bearers, excessively spaced bearers, or any other unsuitable substructure cannot be used with Grace solar components, and installation on such structures will void the warranty, and could result in death or serious injury.

3.2 Wind and Climate Design

AS/NZS1170.2:2021 provides guidance on determining the wind pressures applicable to your Grace solar system install site, taking into account roof shape and geographic location. Sufficient guidance is given in this document, but you may wish to procure a copy of these standards if your company installs Australia/New Zealand wide.

✓ REMEMBER average wind speeds are higher for structures mounted closer to the roof perimeter zone (edge). Refer to 'Fixing within Roof Installation Zone' for more information)

✓ Make sure your installation complies with local and national building codes. Take into account relevant design parameters (wind speed, exposure and topographic factor) when determining the loading for the installation.

✓ If alternative fasteners are used to ix the framing to the roof (assuming supplied fasteners are unsuitable for any reason), all screw fasteners must conform to corrosion resistance Class 4 Australian

Standard AS3566 and be of equal or greater strength to those supplied with your Grace solar system order.

3.3. Determine the wind region of your installation site

According to the requirements of the latest specification AS/NZS1170.2:2021, the planning of the wind area is as follows:

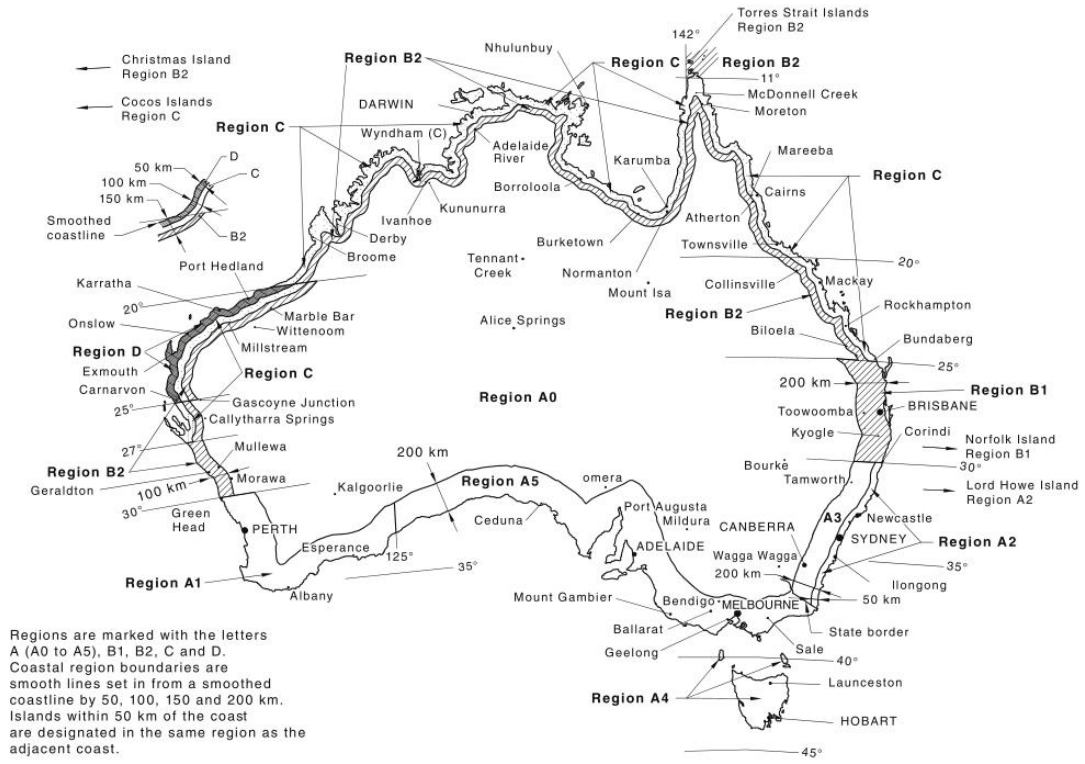


Figure 3.1(A) — Wind regions — Australia

Compared with the wind zone planning requirements of AS/NZS1170.2.2021, the main changes are as follows:

✓ Central Australia is now classified as Wind Region A0 and Terrain Classification 2 instead of Wind Region A4.

✓ Region A1, previously most of the South coast of Australia, now is divided into Regions A1 and A5.

✓ Tasmania is now Region A4.

✓ Region B has been divided into regions B1 and B2. This will affect installations in Northern NSW, Gold Coast, Brisbane, Sunshine Coast, and Gladstone.

✓ Region B1 was increased to include more inland cities around Brisbane. This will likely mean extra structural requirements such as extra rail for installs.

3.4 Determine the Terrain Category

The terrain category will directly affect the value of the wind load, and the size of the wind load will directly affect the structure and installation of the solar support system, so it is very important to determine the terrain category.

Compared with the latest AS/NZS1170.2：2021 specification requirements, Terrain category 1.5 in the previous specification has been deleted, and Terrain category 2.5 has been added. The following is the detailed definition of various terrain categories:

✓ Terrain Category 1 (TC1) – Very exposed open terrain with very few or no obstructions, and all water surfaces (e.g. flat, treeless, poorly grassed plains; open ocean, rivers, canals, bays and lakes).

✓ 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).

✓ Terrain Category 2.5 (TC2.5) – Terrain with some trees or isolated obstructions, terrain in developing outer urban areas with scattered houses, or larger acreage developments with more than two and less then 10 buildings per hectare.

✓ 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, light industrial estates or dense forests).

✓ Terrain Category 4 (TC4) – Terrain with numerous large, high (10 m to 30 m tall) and closely spaced constructions, such as large city centers and well-developed industrial complexes.

** **CAUTION:** In the installation sites of TC2.TC2.5 and TC3, GS solar brackets can be used directly, but if the GS bracket will be installed in the areas of TC1 and TC4, please contact Grace for the details, GS will make different bracket structures for these two areas Optimization, in order to meet the structural requirements and have the best cost performance. **

3.5 Importance Levels of Structure

In the AS / NZS1170.2.2021 specification, The importance level of the structure PV system installs on shall be determined in accordance with the structure occupancy and use. In general term, each of 4 importance levels corresponds to different wind annual probability of exceedance for ultimate limit states depending on the design working life. For Grace Solar mounting system having 25 years design working life, its importance level 1-4 corresponds to 1/100, 1/200, 1/500 and 1/1000 annual probability of exceedance of wind.

Engineering certificates of 1/200 and 1/500 annual probability of exceedance can be found at the end of installation guide. In those certificates, structure type of examples of different importance level have been provided then.

3.6 Determine the Height of the Installation Site

The height of the installation site will affect the stability of the support system. Grace solar support system conducts strict calculations and experiments according to the AS/NZS1170.2:2021 specification. General-purpose products are suitable for installation on roofs with a height of 20m and below. If you plan to install The roof height of the solar system is more than 20m please contact Grace Solar to obtain project specific engineering certificate to support your installation

3.7 Determine Roof slope

For a flat roof solar mounting system, the slope of the roof determines the slope of the solar module. Different slopes make the calculation of the load different, which will greatly affect the structural calculation of the mounting system. Grace Solar Mounting System is suitable for roof slopes from 0° to 60°, which can meet the needs of most users.

3.8 Verify Atmospheric Corrosivity Zone of Installation Site

Please refer to“AS 4312-2008 Atmospheric Corrosivity Zones in Australia”or consult local construction business to verify corrosivity category of installation site to determine appropriate products and interface spacing. When standard products are installed in high corrosivity zones, like C4/C5, interface spacing reduction factor need to be applied.

3.9 Determine the Installation Area of Roof

Even on a roof of the same building, the calculated wind loads for different areas on the roof are different, so it is necessary to confirm the installation area of the solar mounting system before installation. The definition of the roof area is as follows:

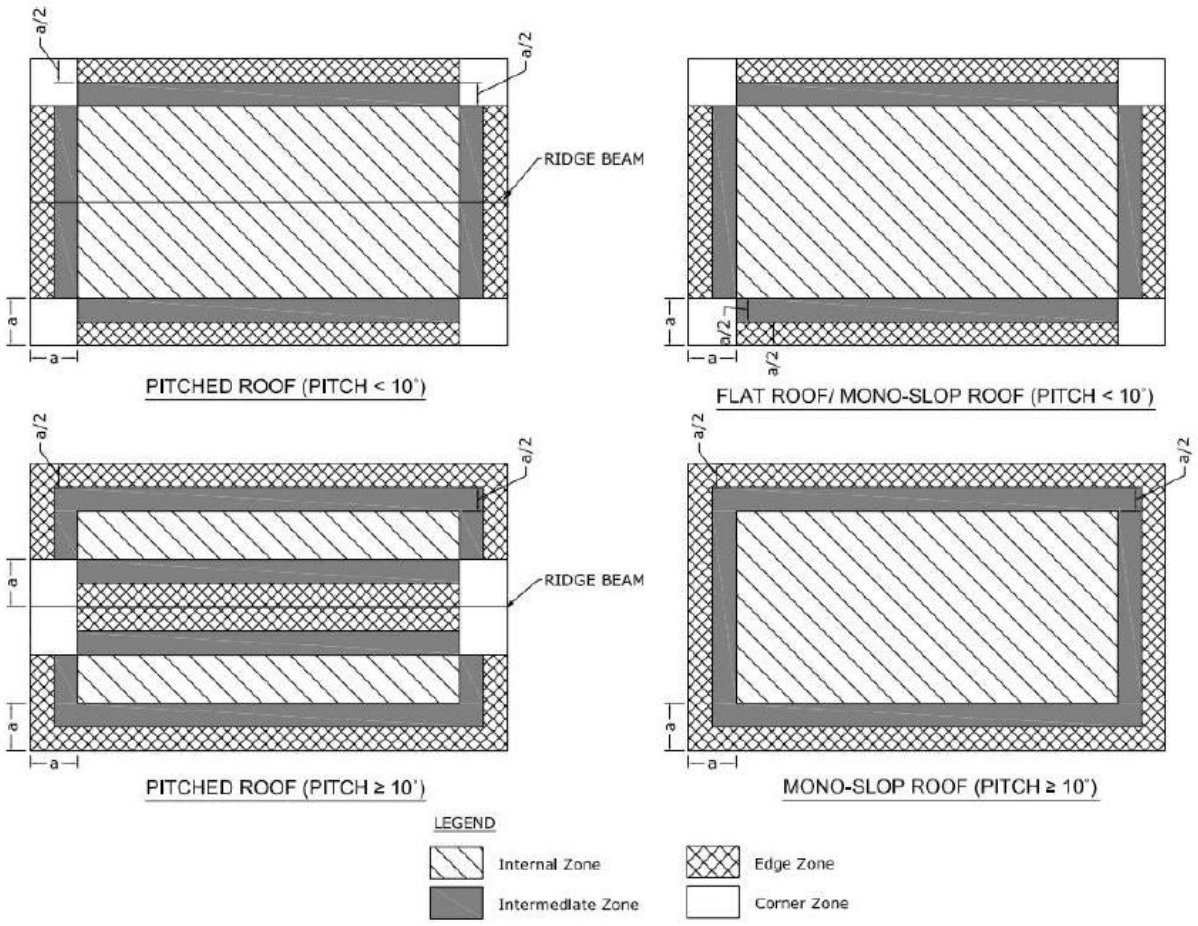


Figure 2 - Roof Zones Definition

In Figure 2, the value of dimension “a” is the minimum of 0.2b or 0.2d, if (h/b) or (h/d) ≥ 0.2; or 2h if both (h/b) and (h/d) < 0.2 (b & d are building dimensions and h is average roof height, see Figure 1)

3.10 Determine the Maximum Rail Support Spacing and Verify Maximum Rail End Overhang

The maximum rail support spacing is limited by design factors such as the wind load, the peak spacing of the tile roof, and the spacing of the purlins on the roof. Before installation, it is necessary to measure and calculate the distance distribution of the purlin support to achieve the best effect. For specific instructions, please refer to the following installation instructions and GS related certification.

The maximum rail overhang of the same rail is generally not greater than 40% of the maximum support span. For example, when the maximum support span of the guide rail is 1000, the maximum rail overhang of the guide rail should not exceed 400.

For specific design requirements, please refer to the product certification at the end of the installation instructions.

3.11 Acquire PV Modules Information

PV module information mainly refers to the datasheet provided by the module manufacturer. Different photovoltaic module manufacturers have different requirements on how to install photovoltaic modules. Before installation, it is necessary to follow the installation instructions of the modules used and install them in strict accordance with the instructions.

3.12 Material of Grace Solar Mounting System

Material	Tensile strength	
	Ultimate	Yield
6005-T5 Aluminum Extruded	260MPa	240Mpa
Stainless Steel 304	635MPa	235MPa
Stainless Steel A2-70	700MPa	450Mpa

3.13 Features of Grace Solar Mounting System

✓ 6005-T5 Aluminum extrusion.

✓ Innovated designed of the D-Modules, which can be pre-assembly with the clamp, make the installation easy and quick.

✓ Suitable for difference conditions and the most solar panels at present market.

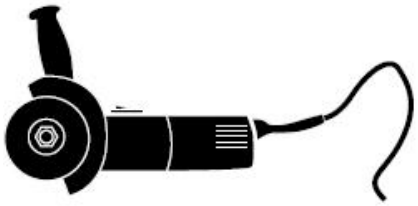
✓ Significantly higher strength-to-weight ratio than other framing products, providing improved efficiency due to greater frame spans, inherent corrosion resistance resulting in low ongoing maintenance and an extended product life.

✓ Complies with Australian/New Zealand Standard on Wind Actions, AS/NZS1170.2.2021

✓ Anodized finish

4. Tools for Installation

The following tools are required for the installation:

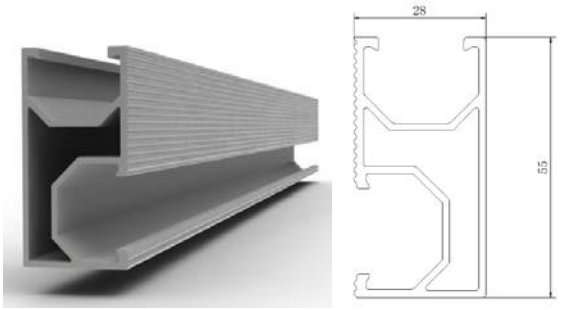
✓ 6 mm Allen key or hexagonal driver bit. If using a 6mm driver bit, make sure the cordless power tool used for the driving has a hand-tight clutch setting a fine (soft) impact drive to prevent damage to the fragile glass panels and threads on the Structure.	
✓ Cordless drill; Drill or impact driver for driving roof material fixings	
✓ Angle grinder; For terracotta tile roof installation, and angle grinder fitted with a continuous edge diamond tipped tile0cutting blade; gloves, hearing protection, a face protection mask, and a suitably rated breathing protection mask for all people in proximity of grinding	
✓ Gloves; Protect the hazard of the sharp corners.	
✓ Cord or color pen; Mark the installation position;	
✓ Spirit level	
✓ Rule	
✓ If necessary, timber to shim the roof hooks	

5. Components Description

GD-Rail

- ✓ hold each panel row
- ✓ length can be customized
- ✓ 6005-T5 extruded aluminum

Standard Rail Length	
808~826mm wide panels	990~1020mm wide panels
2560mm	
3405mm	4200mm



GD Rail Splice Kit

- ✓ Extend GD Rail to any length as required by the quantity or width of the solar panels

Inter Clamp Kit for Framed Modules

- ✓ Fit between two panels
- ✓ Fastened with a 6mm Allen key
- ✓ Standard pre-assembly for the usual panels with thickness 30, 35, 40, 46, 50, 57mm

End Clamp Kit for Framed Modules

- ✓ Hold the edge of each end panels
- ✓ Fastened with a 6mm Allen key
- ✓ Standard pre-assembly for the usual panels with thickness 30, 35, 40, 46, 50, 57mm

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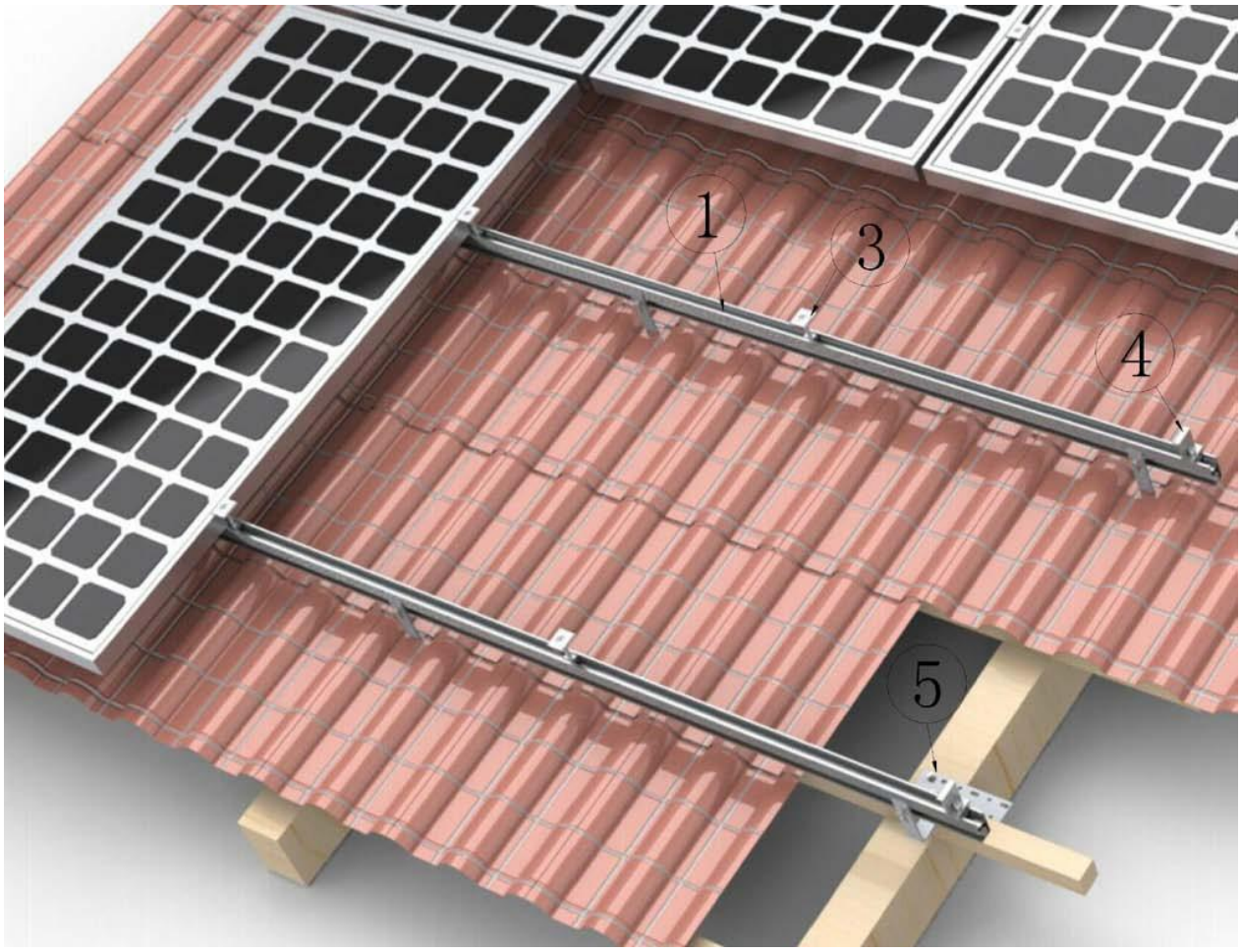
Variety of Roof Hook	
Stainless Steel Roof Hook 1 # ✓ Fix to the rafter below Roman tile roof ✓ Include 3pcs st6.3x80 wood screws	
Stainless Steel Roof Hook 2 # ✓ Fix to the rafter below flat tile roof ✓ Include 2pcs st6.3x80 wood screws	
Stainless Steel Roof Hook 3 # ✓ Side fix to the rafter below Roman tile roof ✓ Include 3pcs st6.3x80 wood screws	
Stainless Steel Roof Hook 4# ✓ Fix to the rafter on slate tile roof ✓ Include 3pcs st6.3x80 wood screws	
Aluminum Tin Roof Hook 5# ✓ Fix to the purlin on tin roof ✓ Include 1pcs st6.3x80 wood screws	
Stainless Steel Roof Hook 6# ✓ Fix to the rafter below Roman tile roof ✓ Include 3pcs st6.3x80 wood screws	

6. System overview

All components of the system are listed below. The version and quantities of the parts can vary, depending of

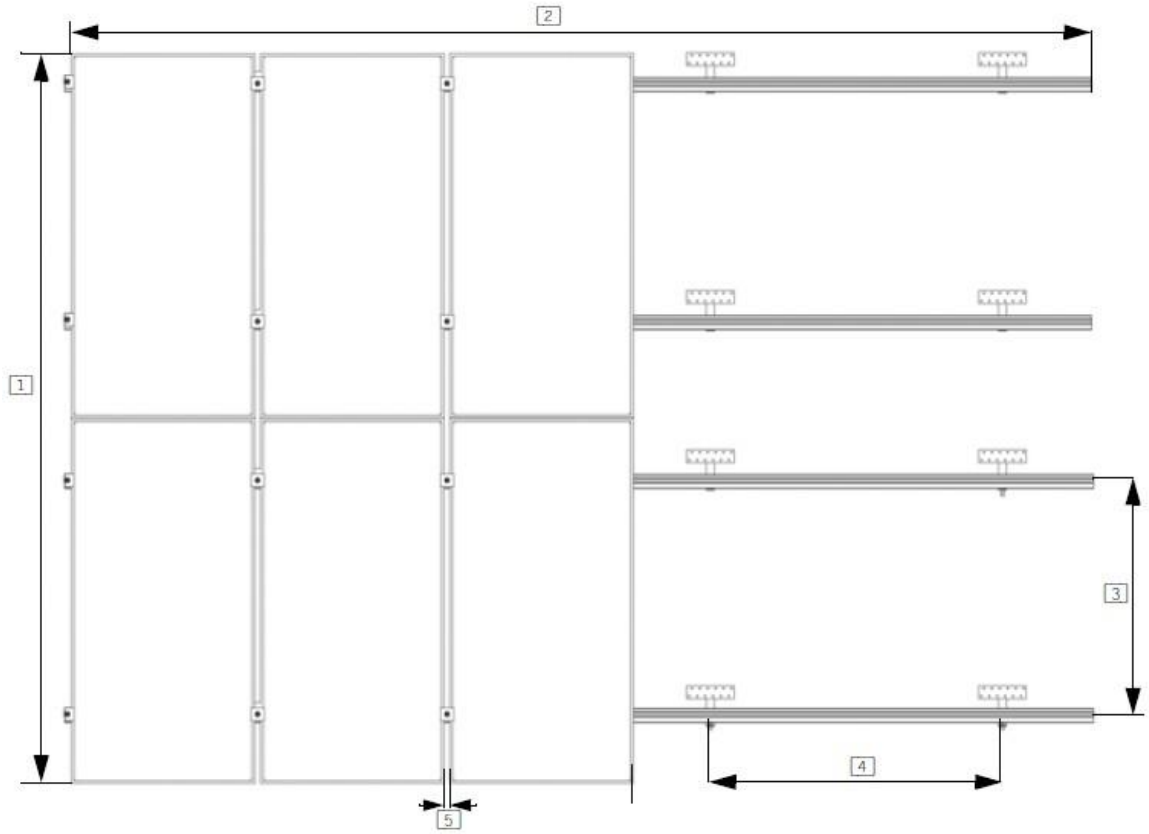
- ✓ Type of roof
- ✓ Number of modules
- ✓ Type of module
- ✓ Site specifics



① GD Rail	② GD Rail Splice (Optional)
③ Inter Clamp	④ End Clamp
⑤ Roof hook	

7. Designing the module field

Below, the distances between roof connections for a portrait installation are specified. Clamp-on roof hooks need to be installed in specific distances, depending on the distance of rafters and the stoical conditions.



Height of the module field: module height x number of modules vertically

1. Width of the module field: number of modules horizontally x (width of the module + 18 mm)+32 mm
2. Distance between roof connections vertically (according to the clamping points pre-defined by the module producer): Quarter-points of the modules, about 1/2 of module height.
3. Distance between roof connections horizontally: Depending on the distance between rafters and on the static requirements (please see the Chapter 8 on page 11).
4. Distance between modules: 17 mm

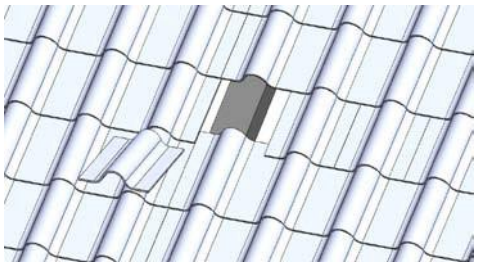
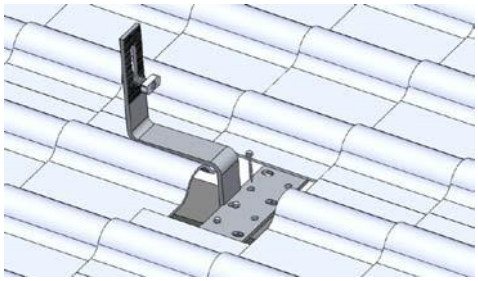
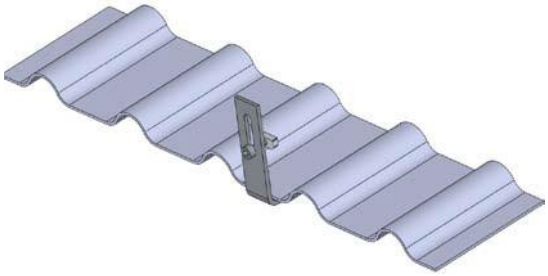
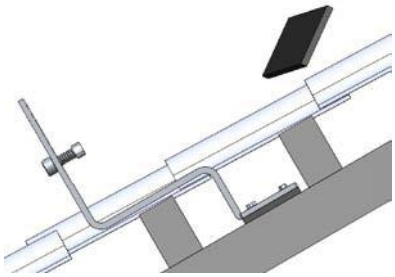
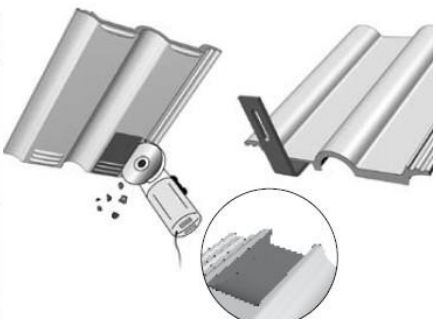
When positioning the modules, please take into consideration

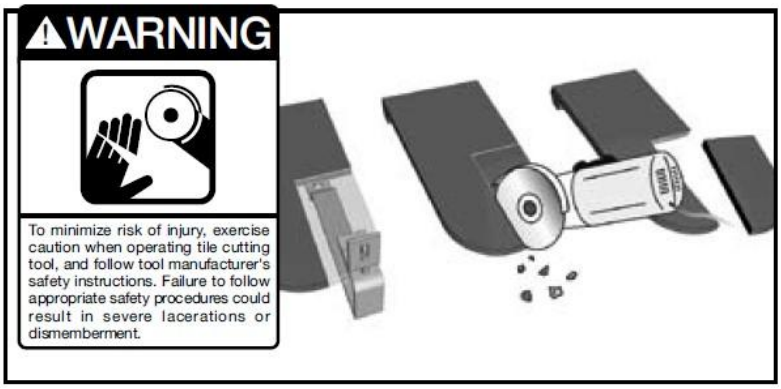
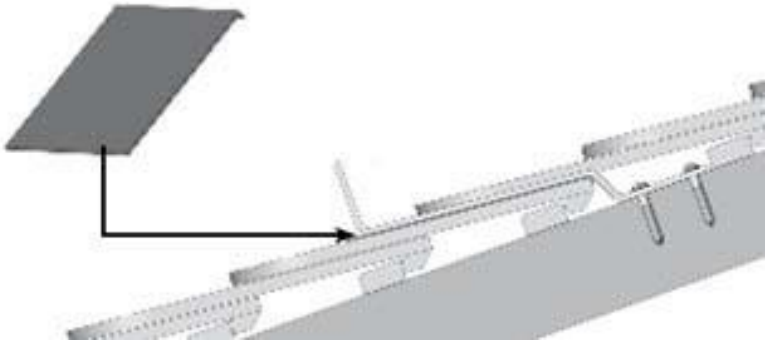
✓ That the values above are

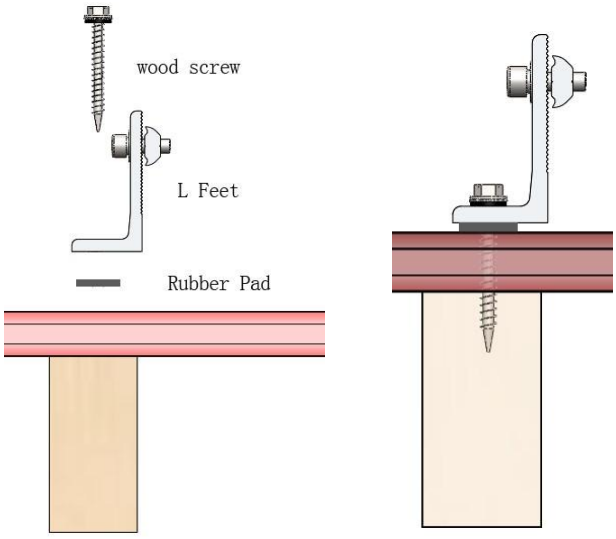
✓ That dimensions of tiles or other roof covering and the position of the rafters define the precise actual horizontal distance between roof connections

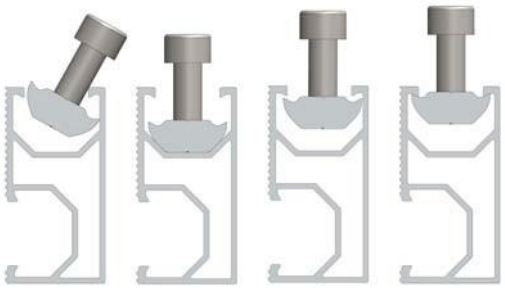
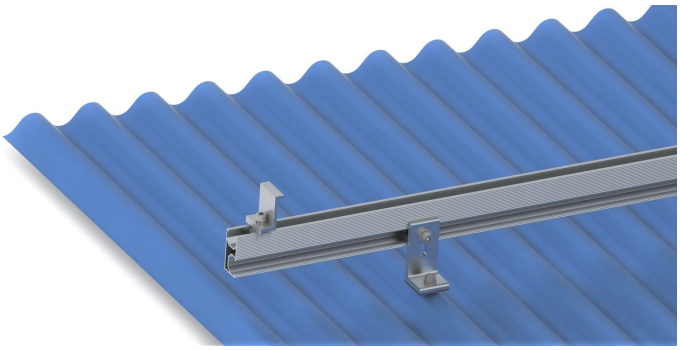
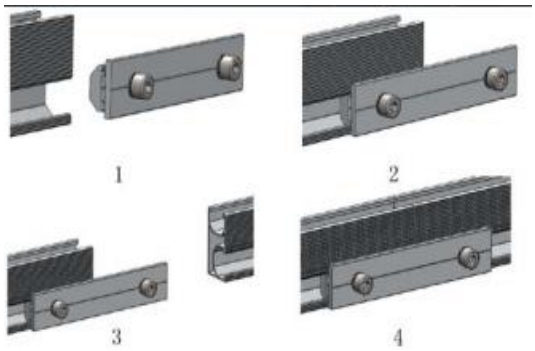
✓ That the distance between roof laths defines the precise actual vertical distance between roof connections.

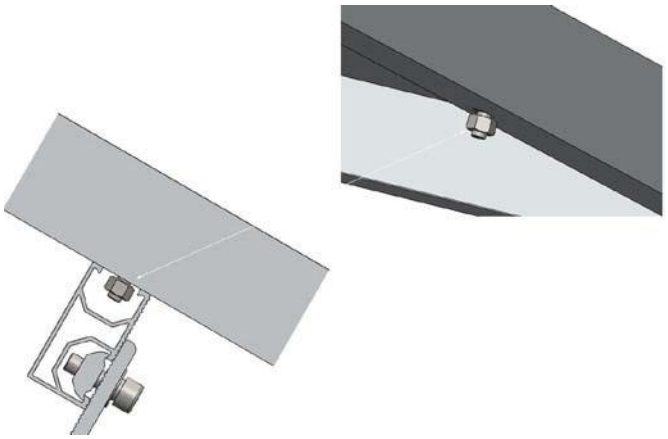
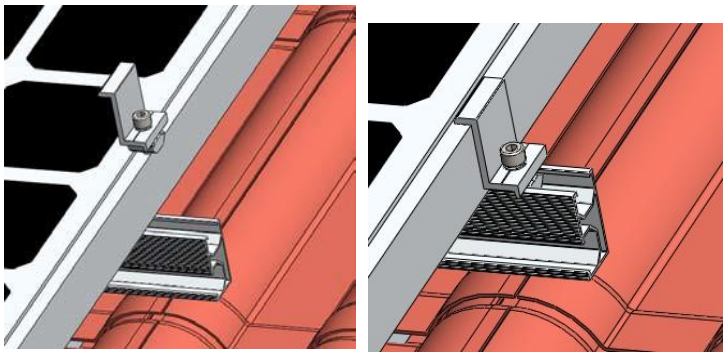
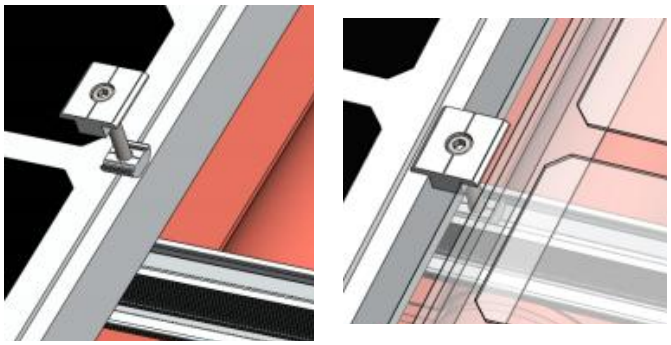
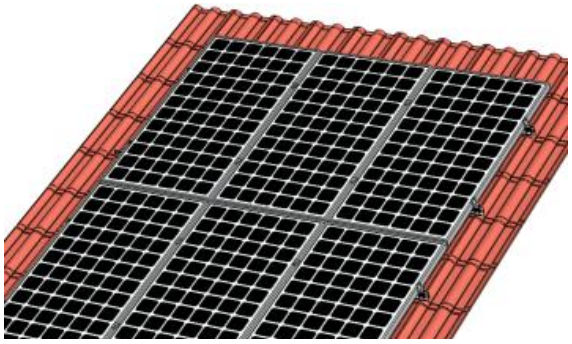
8. Installation

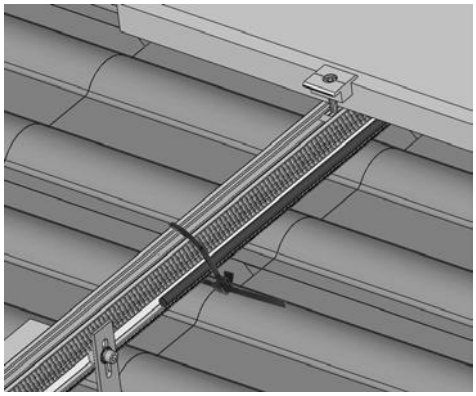
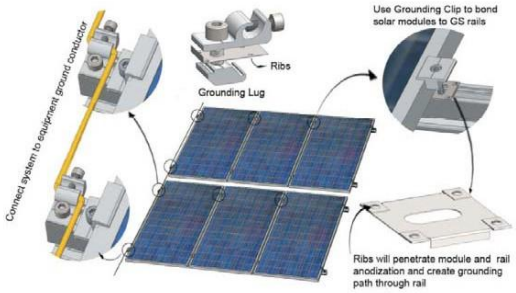
Install on Roman Tile Roof	
1. Remove the roof tiles at the marked positions or simply lift them up slightly.	
2. Input the roof hook to the wooden beam. Fix the roof hooks with 3x wood screws (M6x80).	
3. Cover the hooks by the removed tile	
4. The roof hook must not press against the roof tile. Place it flat. If necessary, shim the roof hook with wood.	 Wrong Correct
5. If necessary, use an angle grinder or hammer to cut a concavity in the tile that covers the roof hook at the point where the roof hook comes through. (Caution! Must not use fixed roof hook as a ladder, as this extreme point load could damage the tile below.	 

Install on Plain Tile Roof	
6. Mark roof hook installation points, and cut recesses for hooks into plain tiles/slate at each installation point.	
7. Cut titanium zinc metal sheets to fit and install them under the roof hooks. Fix the roof hooks to the rafter using two 6 x 80 mm wood screws.	

Install on Tin Roof	
1. Mark roof hook installation points and use the power tool to drill the wood screw through the point to fasten the L feet with the purlin.	

Install The GD-Rail	
2. D-Module quick mount. Four steps to quick mount the D-Module into GD-Rail channel. Move the assembly to It's desired final position, and fastens firmly in place by torque bolt to 10Nm.	
3. Connect the roof hook with the GD Rail. a. Insert the D-Module into the side channel of the GD Rail as the step 9 shown. b. Adjust the GD Rail to be level. c. Fasten the bolt.	
4. GD Rail connect Put the GD Rail Splice into the side channel of the GD Rail about 75mm, then fasten the M8 Bolt.	

Install the module	
5. Installing anti-slip protection The anti-lip protection is only necessary on the lowermost row of modules. At first, fit two bolts M6*20 and nuts into the lower holes of each module. Then place the first module of the bottom row so that the anti-slip protection sits in the rail channel of the lowest row of rails	
6. Fixing the outer modules by End clamp. a. Put the end clamp kit into the top channel of the GD-Rail as the step 9. b. Push the side of module to firmly against the end clamp and then fasten the bolt.	
7. Fixing the inter modules by inter clamp. a. Put the inter clamp kit into the top channel of the GD-Rail as the step 9. b. Push the Inter-module clamp firmly against the already fixed module. c. Push the next module against	
8. Installing the further rows of modules	

Cable tie and Grounding	
9. Tie cable with the rail a. Tie the cable with the rail using the zip tie	
10. Grounding Please see the Grace solar Grounding System Installation Guide	

9. Warranty

Xiamen Grace Solar New Energy Technology Co., Ltd. warrants that its Grace Solar Panel Mounting System is free from defects in materials and workmanship for a period of 10 years from the date on which the Frame is purchased from Grace Solar, on the terms set out in this warranty.

In the event that the Frame does not conform to this warranty during the Warranty Period, Grace Solar will, at its option, either repair or replace the Frame or pay the cost of having the Frame repaired or replaced. To the extent permitted by law, Grace Solar's total liability under this warranty will in no circumstances exceed the repair or replacement of the Frame or payment of the cost of having the Frame repaired or replaced. In the event of replacement of the Frame, any remaining part of the Warranty Period will be transferred to the replacement Frame.

This warranty will not apply to any defect or damage to the Frame arising directly or indirectly from:

1. Shipment or storage of the Frame;
2. Improper installation, maintenance, repair or use of the Frame;
3. Normal wear and tear;
4. Misuse, neglect, abuse, accidental damage or modification to the Frame;
5. Failure to observe the instructions set out in the System Manual; or
6. Power failure, power surges, lightning, fire, explosion, flood, extreme weather conditions, environmental disasters or other causes outside Grace Solar's control, as determined by Grace Solar in its sole discretion.

This warranty does not cover, and under no circumstances will Grace Solar be liable for, any costs associated with the removal, shipping, handling or re-installation of the Frame or the costs of sending personnel to any site to repair or replace the Frame.

This warranty is only provided to the original purchaser of the Grace Solar panels mounting system (Purchaser) or, where the Purchaser is an installer or builder who on-supplies the Frame to another party, to that other party (End-User). This warranty is not transferable.

Where an End-User wants make a claim under this warranty, the End-User must in the first instance contact the installer or builder from whom the Frame was purchased.

This warranty will not apply to any claims received by Grace Solar after the expiration of the Warranty Period.

Grace Solar makes no warranties, express or implied, other than the warranties made herein, and specifically disclaim all other warranties, representations and conditions to the extent permitted by law. To the extent permitted by law, in no circumstances will Grace Solar be liable for direct, indirect, special or consequential damages arising from a defective Frame or for any damage or injury to persons or property. Grace Solar's aggregate liability, if any, in damages or otherwise, will not exceed the invoice value of the Frame at the time of purchase from Grace Solar.

Any provision contained in this warranty which is prohibited or unenforceable in any jurisdiction will be deemed to be ineffective to the extent of such prohibition or unenforceability and will not invalidate the remaining provisions nor affect the validity or enforceability of that provision in any other jurisdiction.