Clenergy PV-ezRack SolarRoof Pro

Code-compliant Installation & Design Manual

according to BS EN 1991-1-3:2003 & BS EN 1991-1-4:2005

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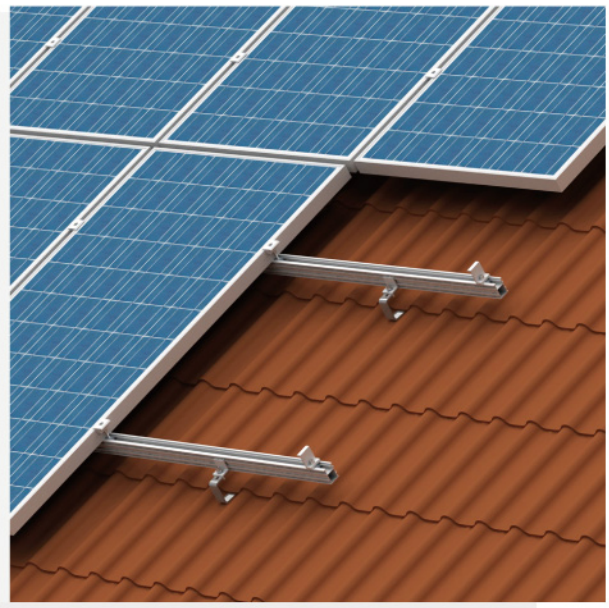

1. Introduction

1.1 The PV-ezRack Pro™ has been developed as a universal system for roof-mounting on pitched and hipped roofs. The use of patented aluminium base rails, the Z-module technology with particularly fast installation.

1.2 Please review this manual thoroughly before installing your SolarRoof Pro™ system.
This manual provides:

a) Supporting documentation for building regulation applications relating to PV-ezRack SolarRoof Pro™ universal PV module mounting system, and
b) Design, specification and installation instructions for SolarRoof Pro ™ universal PV module mounting system.

1.3 SolarRoof Pro™ products, when installed in accordance with this guide, will be structurally adequate and will meet the requirements of BS EN 1991-1-3:2003 and BS EN 1991-1-4-:2005. Please check this is the current version of the installation manual by visiting *www.clenergy.com*.

1.4 The installer is solely responsible for:

- Complying with all applicable local or national building codes, including any that may supersede this manual;
- Ensuring that PV-ezRack and other products are appropriate for the particular installation and the installation environment;
- Ensuring that the roof, its rafters, connections, and other structural support members can support the array under building variable action conditions (this total assembly is hereafter referred to as the roof rafter assembly);
- Using only PV-ezRack parts and installer-supplied parts as specified by PV-ezRack (substitution of parts may void the warranty and invalidate the letter of certification on page 2) ;
- Ensuring that all works are undertaken in a safe manner compliant with the relevant construction safety legislation.
- Ensuring that coach screws have adequate pullout strength and shear capacities as installed;
- Maintaining the waterproof integrity of the roof, including selection of appropriate flashing; and.
- Ensuring safe installation of all electrical aspects of the PV array.

2. Installation Tools

2.1 The following items will be required to enable you to install the SolarRoof Pro™ system:

- 6mm allen key;
- Cordless drill;
- Open-end spanner set 9mm, 10mm, 17mm, 19mm (required only for mounting with hanger bolts);
- Torx-30 (AW 30) bit;
- Angle grinder with stone disk (110v recommended);
- Power lead;
- If necessary, timber to shim the roof hooks.

3. Code Compliant Design & Specification

3.1 This document is provided to support the design, specification and installation of SolarRoof Pro™ PV module mounting system, manufactured by Clenergy (Xiamen) Technology Co.,Ltd. Follow the steps below and the installation instructions section to install SolarRoof Pro™ in compliance with the requirements of BS EN 1991-1-3:2003: Actions on Structures – General Actions (Snow Loads) and BS EN 1991-1-4:2005: Actions on Structures – General Actions (Wind Actions).

3.2 Before proceeding, please note the following:

- This document addresses wind and snow actions. A combination of dead, wind and snow will produce the maximum action on an installation. These loads are considered to act on the entire projected area.
- This document also assumes that the terrain roughness and orography of the site do not present a significant factor. However if the purchaser considers that the terrain roughness and orography of the site does present a significant factor then they should contact Clenergy to obtain engineering data to support the installation.
- The roof on which the SolarRoof Pro™ will be installed must have the capacity to resist the combined permanent and variable actions at each support location that the system exerts.
- SolarRoof Pro™ systems can be used for roof slopes up to 60 degrees. Please verify that the installation site has a roof slope of between 0 15° and 60°, if not the purchaser should contact Clenergy to obtain engineering data to support the installation.

3.3 Using the Excel TOOLS calculation sheet

3.3.1 To assist you in spacing the support feet for the rack there is an Excel TOOL on the Clenergy website www.clenergy.com. The notes in section 3.3 to 3.15 of this manual are to help you in using this tool correctly.

3.3.2 At the start of each section it will tell you what information you require and how this information is used. The Excel TOOLS calculation sheet is split up into readily identifiable sections. Each section is noted with bold underlined text.

3.4 Wind Action

3.4.1 The following information will be required to enable you to complete this section of the Excel TOOLS calculation sheet. Items with this symbol * require you to have this information prior to completing the Excel TOOLS calculation sheet:

3. Code Compliant Design & Specification

- Building height in metres*
- Building length in metres*
- Building width in metres*
- Building location, Countryside / Town*
- Site altitude in metres* AOD
- Roof construction type, monopitch/duopitch / hipped*
- Roof pitch in degrees from horizontal*
- Roof area, (see Fig 4)
- Basic wind velocity, (see Fig 1)
- Distance in kilometres (max 100km) from site to nearest shoreline in prevailing wind direction*
- Distance in kilometres (max 20km) from site location to edge of urban development in prevailing wind direction*
- Exposure correction factor $C_e(z)$, (see Fig 2)
- Exposure correction factor C_e,T, (see Fig 3)

Note: Definition of countryside are lakes or areas with negligible vegetation and without obstacles and areas with low vegetation such as grass and isolated obstacles (tree, buildings) with separations of at least 20 obstacle heights. Definition of town are areas with regular cover or vegetation or buildings or with isolated obstacles with separations of maximum 20 obstacle heights and areas in which at least 15% of the surface is covered with buildings and their average height exceeds 15m.

3.4.2 Within the Excel TOOLS calculation sheet there are a series of comments assigned to a number of the boxes. If you hover the cursor over any one of these boxes a comment will come into view and tell you what you need to do. Pressing the buttons next to the boxes will take you to the relevant tab within the Excel TOOLS calculation sheet and will provide you with additional information. Likewise there is a similar button within the sheet which will take you back to the calculation sheet when pressed.

3.4.3 The following section is an example of the steps required to be able to complete the Excel TOOLS Calculator.

3.5 Determine the basic wind velocity of your installation site

3.5.1 The wind map below (Fig 1) shows the "fundamental values of basic wind velocity" in m/sec before an altitude correction factor, directional factor, seasonal factor and probability factor has been applied.

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3.5.2 The following example shows how the velocity for a site in Sheffield is established. The example uses two different buildings having building heights (h) of 6m and 15m and having site altitudes of 76m and 150m AOD respectively. The buildings will be used as part of the explanation in each section and will allow you to follow each step through.

3.5.3 BS EN 1991-1-4:2005 and the National Annex provide differing values for the directional factor, seasonal factor and probability factor. However, they also allow the use of a conservative value of 1.0 for each of these; which will result in a 'worst case' value being achieved, therefore use :

- Directional factor, c_{dir} = 1.0
- Seasonal factor, c_{season} = 1.0
- Probability factor, c_{prob} = 1.0

3.5.4 By reference to the wind map the basic wind velocity for Sheffield is interpolated as 22.2m/sec. Therefore the fundamental wind velocity for the two sites are as follows:

For buildings with height to eaves less than 10m.

$$v_b = v_{b,map} \times (1 + 0.001A) \times c_{dir} \times c_{season} \times c_{prob}$$

Where A in the equation is the altitude of the site in metres AOD.

- Wind velocity, vb = 22.2 x (1 + 0.001x76) x 1.0 x 1.0 x 1.0
  = 23.89m/sec for a building with a height < 10m

For buildings with at height to eaves greater than 10m.

$$v_b = v_{b,map} \times \left(1 + 0.001A \times (10/z)^{0.2}\right) \times c_{dir} \times c_{season} \times c_{prob}$$

Where A in the equation is the altitude of the site in metres AOD and z is the height of the building to eaves line above ground level in metres.

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- Wind velocity v_b = 22.2 x (1 + 0.001x150x(10/15)0.2) x 1.0 x 1.0 x 1.0
  = 25.27m/sec for a building with a height > 10m

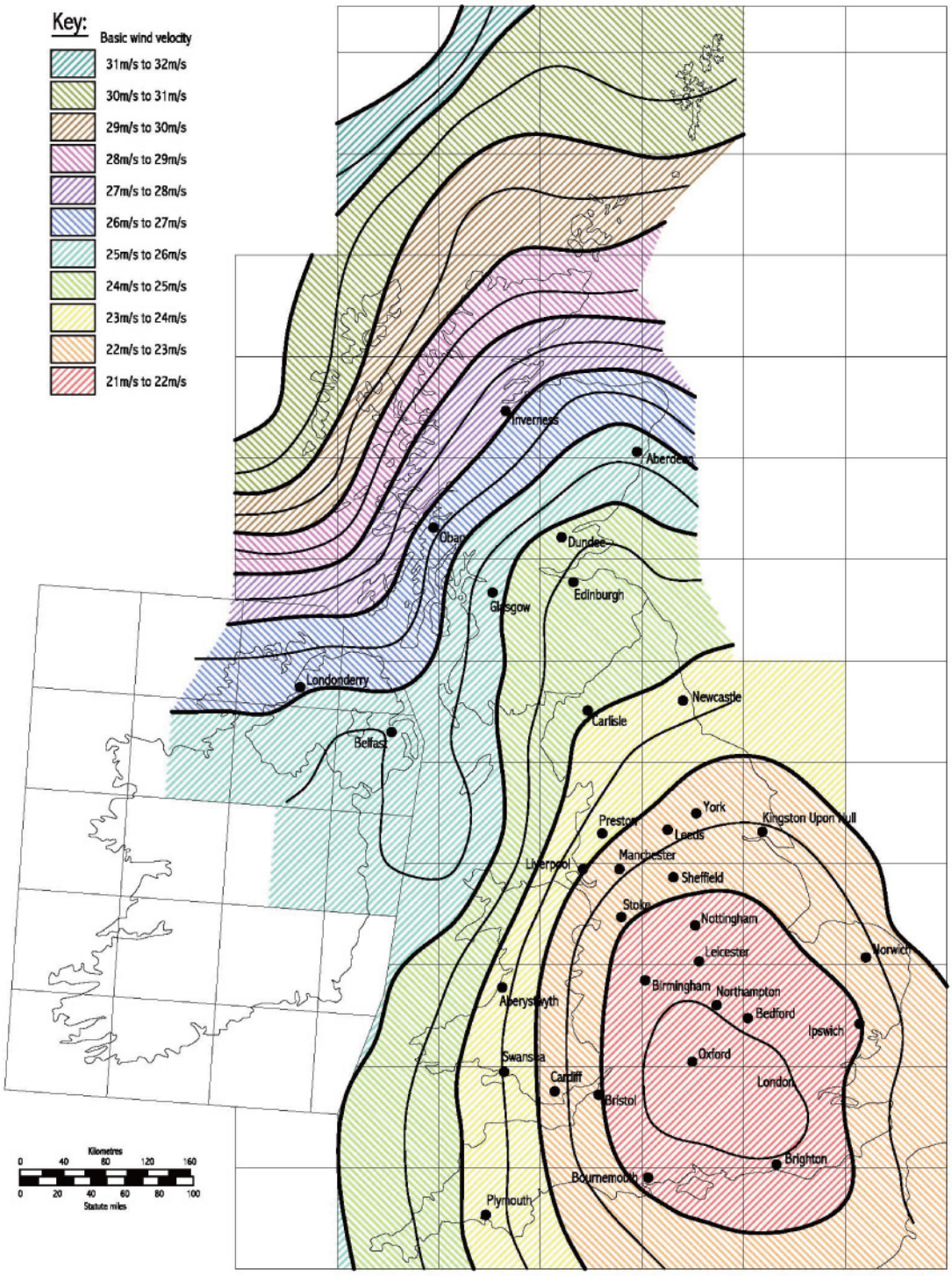

Fig 1. Value of fundamental basic wind velocity map, $v_{b,map}$

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3.6 Determine the height of the building on your installation site

3.6.1 This document provides sufficient information for SolarRoof Pro™ systems to be installed on buildings with a height less than 20 metres. If your building is more than 20 metres in height, please contact Clenergy to obtain engineering data to support your installation.

3.7 Determine the peak velocity pressure of your installation site

3.7.1 The location and elevation of the building influences the peak velocity pressure (kN/m^2) exerted by the wind on the roof surface.

3.7.2 To determine the peak velocity pressure the following steps should be undertaken:

- Determine whether the site is in either a town or a countryside location. If the location is in a town location then the distance from the edge of the town to the site (as the crow flies) will be required
- Determine the distance of the site to the coast.
- Determine the overall height of the building.

3.7.3 The two example sites are situated in a town environment and are in excess of 100km to the closest shoreline with the distances into the town of 6km and 2km respectively.

3.7.4 The following charts (Fig 2. and Fig 3.) should be used to determine the values of exposure correction factors by striking a line across from the relative building height and up from the relative distances to the sea and town.

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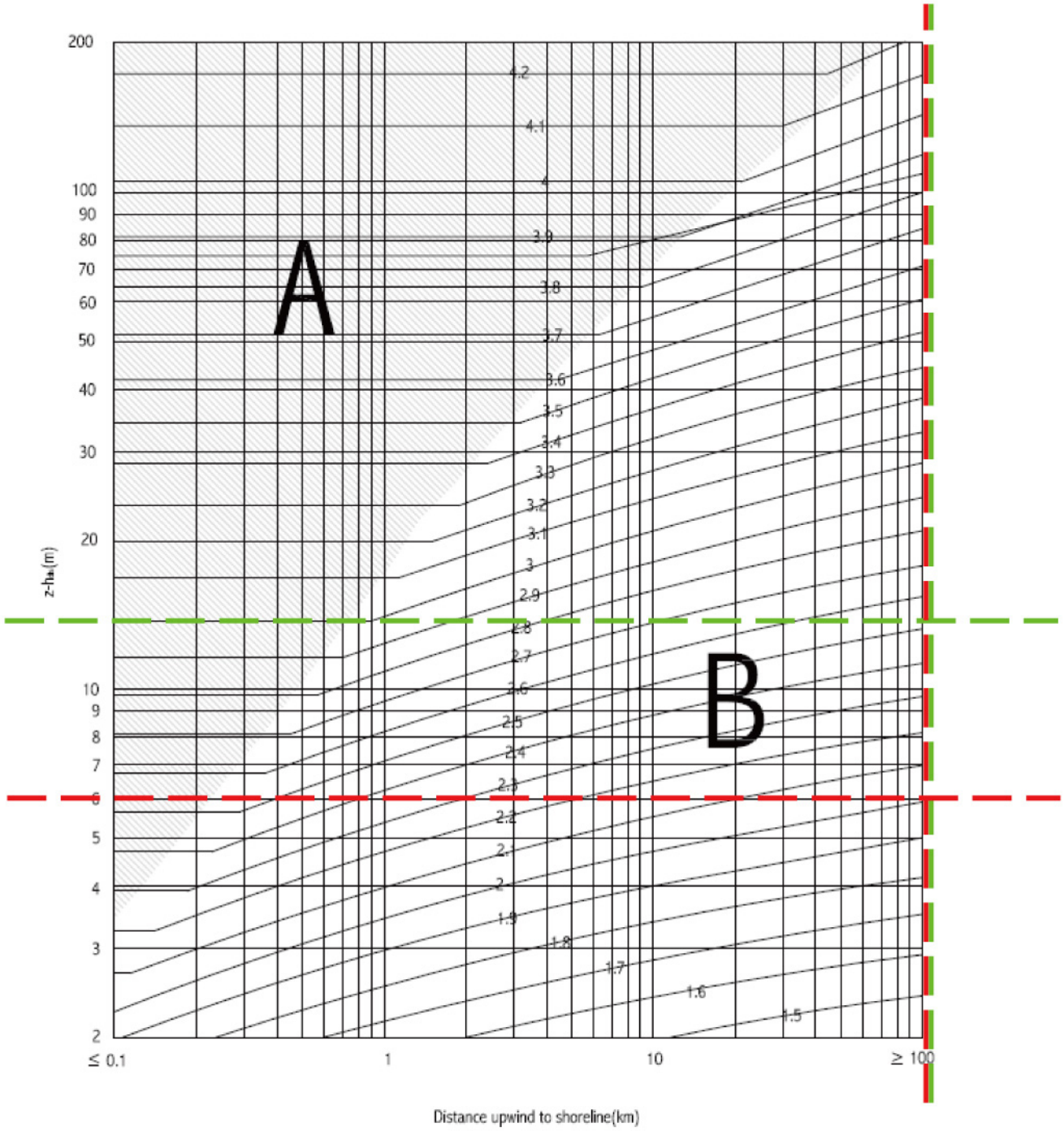

Fig 2. Chart for values of exposure correction factor, Ce (z).

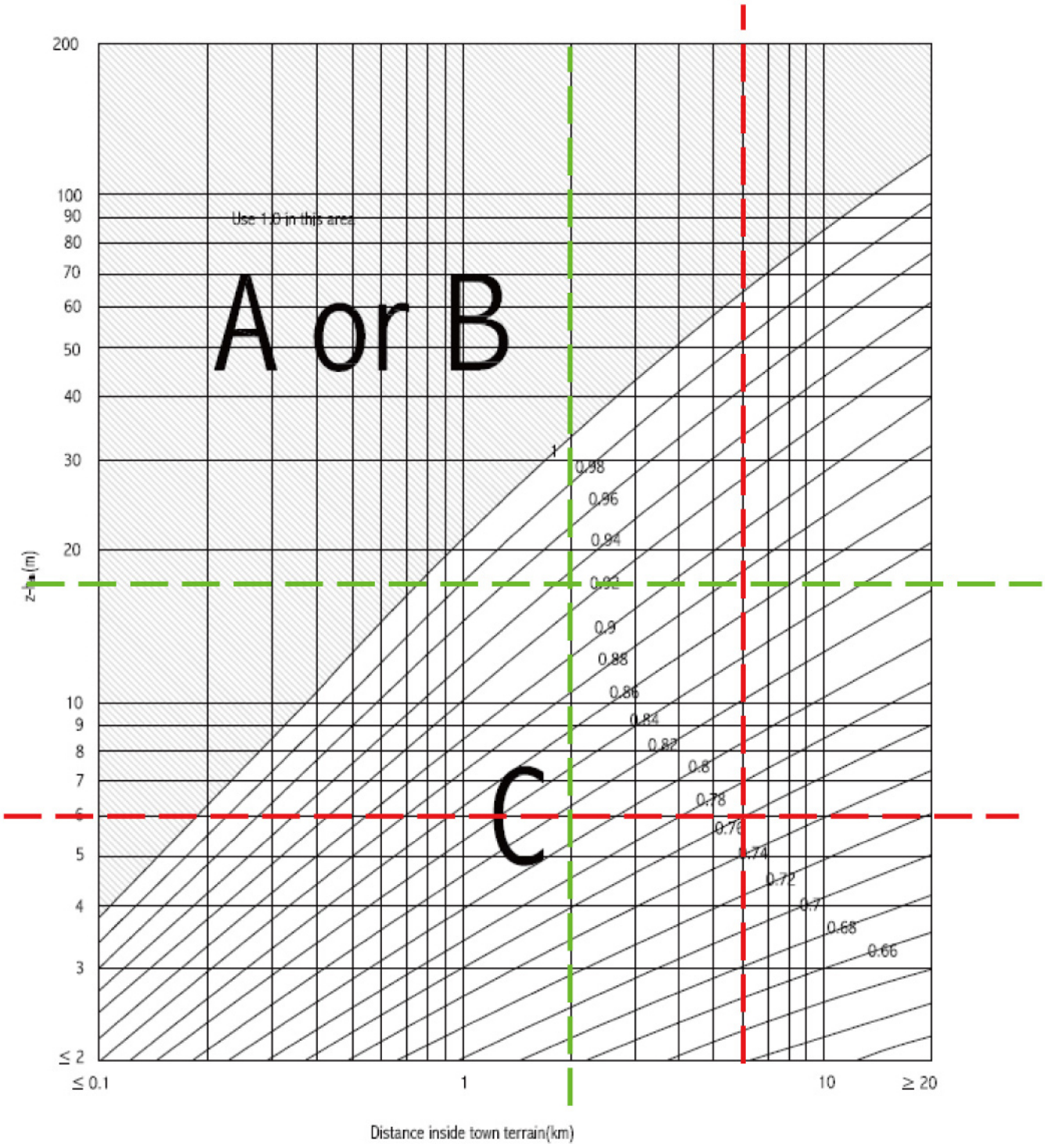

Fig 3. Chart for values of exposure correction factor, Ce,T

3.7.5 The values for the exposure correction factors are as follows:

- 2.01 for distance from shoreline (Ce (z)) and 0.76 for distance in town (Ce,T).
- 2.54 for distance from shoreline (Ce (z)) and 0.91 for distance in town (Ce,T).

3.7.6 These values can now be used to determine the peak velocity pressure for both buildings. Note a conversion factor of 10-3 has been used to convert from newtons to kilonewtons

$$q_b = c_e(z) \times c_{e,T} \times (0.613 \times v_b^{\,2})$$

- Peak velocity pressure, qp = 2.01x0.76x(0.613x23.89²x10-3)
  = 0.53kN/m²
- Peak velocity pressure, qp = 2.54x0.91x(0.613x25.27²x10-3)
  = 0.91kN/m²

3.8 Determine the wind action onto the roof of your installation site.

3.8.1 Finally the wind load onto the roof can be derived by multiplying the peak velocity pressure by an external pressure coefficient. This value is dependant on the type of roof construction and the degree of pitch for the roof.

3.8.2 The types of roof construction considered in this document are monopitch, duopitch with a positive angle only and hipped which will cover the majority of roofs. For any other type of roof construction the purchaser should contact Clenergy to obtain engineering data to support the installation.

3.8.3 For these examples we have assumed that both buildings have a duopitch roof with a roof pitch of 30°. The figure below (Fig 4.) shows the loaded areas as indicated within BS EN 1991-1-4:2005 Figure 7.8 and Table 7.4a showing the corresponding external pressure coefficients for the individual areas.

3.8.4 Wind load effects will need to be checked in the 0°, 90° and 180° directions, the calculator will automatically check for the worst case direction.

3.8.5 From Fig 4 we can see that area H is to be used. This uses an external pressure coefficient ($C_{pe\ suction}$) of -0.2 and ($C_{pe\ pressure}$) of 0.4 with internal pressure coefficients of ($C_{pi\ suction}$) of 0.2 and ($C_{pi\ pressure}$) of -0.3.

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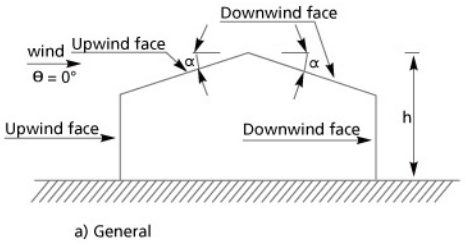
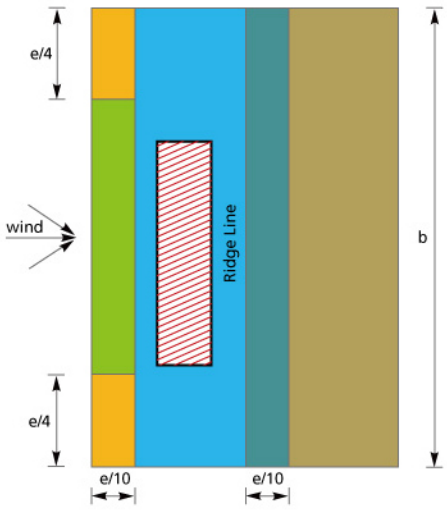
$$W_{kv} = q_p \times (C_{pe} - C_{pi})$$

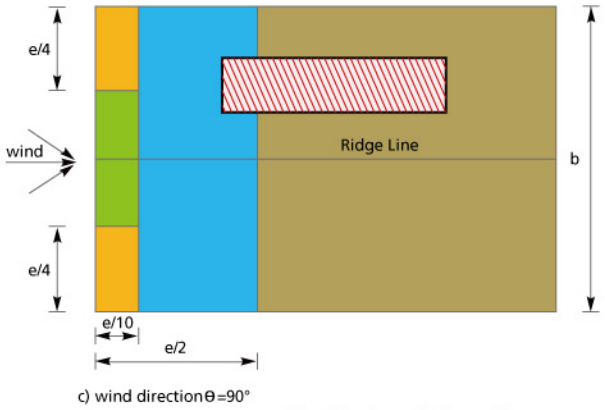
- Wind action, $W_{kv\ suction}$ = 0.53x(-0.2-0.2) = -0.21kN/m²
- Wind action, $W_{kv\ pressure}$ = 0.53x(0.4- -0.3) = 0.37kN/m²
- Wind action, $W_{kv\ suction}$ = 0.91x(-0.2-0.2) = -0.36kN/m²
- Wind action, $W_{kv\ pressure}$ = 0.91x(0.4- -0.3) = 0.64kN/m²



a) General



b) wind direction θ = 0°



c) wind direction θ=90°

Key for duopitch roofs:

Colour Key:
- Roof Area F
- Roof Area G
- Roof Area H
- Roof Area I
- Roof Area J

Notes:
e = b or 2h (whichever is the smaller)
b = crosswind dimension

$C_{pe\ (suction)}$

Pitch Angle α	Zone for wind direction Υ = 0°				
	$C_{pi,10}$ F	$C_{pi,10}$ G	$C_{pi,10}$ H	$C_{pi,10}$ I	$C_{pi,10}$ J
5°	-1.7	-1.2	-0.6	-0.6	-0.6
15°	-0.9	-0.8	-0.3	-0.4	-1.0
30°	-0.5	-0.5	-0.2	-0.4	-0.5
45°	-0.0	-0.0	-0.0	-0.2	-0.3
60°	+0.7	+0.7	+0.7	-0.2	-0.3

$C_{pe\ (pressure)}$

Pitch Angle α	Zone for wind direction Υ = 0°				
	$C_{pi,10}$ F	$C_{pi,10}$ G	$C_{pi,10}$ H	$C_{pi,10}$ I	$C_{pi,10}$ J
5°	0.0	0.0	0.0	-0.6	-0.6
15°	0.2	0.2	0.2	0.0	0.0
30°	0.7	0.7	0.4	0.0	0.0
45°	0.7	0.7	0.6	0.0	0.0
60°	0.7	0.7	0.7	-0.2	-0.3

Denotes PV modules in relation to the wind direction

Fig 4. Wind area location and external pressure coefficients for duopitch roofs.

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3.9 Snow Action

3.9.1 The following information will be required to enable you to complete this section of the Excel TOOLS calculation sheet. Items with this symbol * require you to have this information prior to completing the Excel TOOLS calculation sheet:

- Snow zone number, (see Fig 5)

3.10 Determine the characteristic ground snow load of your installation site

3.10.1 The snow map below (Fig 5) shows the characteristic ground snow action zones and is used along with the site altitude to determine the characteristic value of ground snow loading for the installation site.

3.10.2 The following example shows how the ground snow action value is calculated for the same two example sites in Sheffield.

3.10.3 The snow action map shows that Sheffield has a snow zone number of 4. Therefore the characteristic ground snow loads are as follows:

$$s_k = \left[0.15 + \left(0.1Z + 0.05\right)\right] + \left(\frac{A-100}{525}\right)$$

Where A in the equation is the site altitude in metres AOD and Z is the snow zone number from the map.

- Ground snow action, $S_k = [0.15 + (0.1 \times 4 + 0.05)] + (76 - 100 / 525)$
  $= 0.55 kN/m^2$
- Ground snow action, $S_k = [0.15 + (0.1 \times 4 + 0.05)] + (150 - 100 / 525)$
  $= 0.69 kN/m^2$

3.10.4 This document has assumed the following values for:

- Exposure coefficient, $C_e = 1.0$
- Thermal coefficient, $C_t = 1.0$

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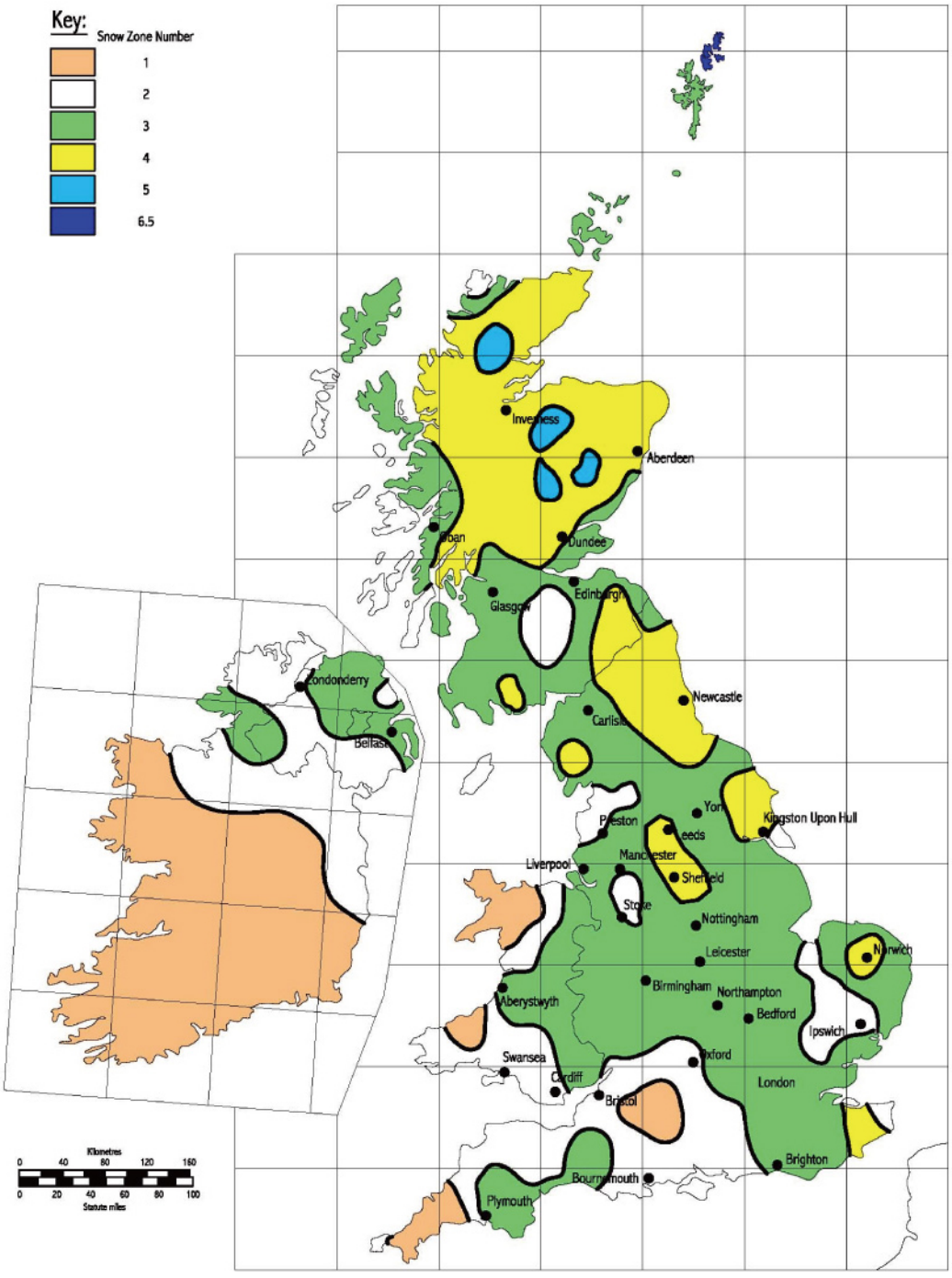

Fig 5. Snow zone locations.

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3.11 Determine characteristic snow load on roof for your installation site

3.11.1 This document recognises that snow can be deposited on a roof in many different patterns and that there are several other factors which contribute to the different patterns being caused. For further information on this reference should be made to BS EN 1991-1-3:2003.

3.11.2 This document assumes that the persistent/transient design situation will govern and that the drifted snow load shape coefficient μ_1 is equal to:

- Angle of roof pitch 0° to 15° = 0.8
- Angle of roof pitch 15° to 30° = 0.8 + 0.4(α - 15) / 15
- Angle of roof pitch 30° to 60° = 1.2(60 - α) / 30

Where α in the equation is the pitch of the roof in degrees.

3.11.3 Therefore the vertical and horizontal roof snow action for both buildings is equal to:

$$s_{k,v} = \mu_1 \times c_e \times c_t \times s_k \times \cos\alpha$$

- Roof snow action, $s_{k,v}$ = (0.8 + 0.4(30 – 15) / 15) x1.0x1.0x0.55x cos 30

  = 0.57kN/m²

- Roof snow action,$s_{k,v}$ = (0.8 + 0.4(30 – 15) / 15) x1.0x1.0x0.69x cos 30

  = 0.72kN/m²

$$s_{k,h} = \mu_1 \times c_e \times c_t \times s_k \times \sin\alpha$$

- Roof snow action , $s_{k,h}$ = (0.8 + 0.4(30 – 15) / 15) x1.0x1.0x0.55x sin 30

  = 0.33kN/m²

- Roof snow action , $s_{k,h}$ = (0.8 + 0.4(30 – 15) / 15) x1.0x1.0x0.69x sin 30

  = 0.41kN/m²

3.12 Permanent Action

3.12.1 The following information will be required to enable you to complete this section of the Excel TOOLS calculation sheet. Items with this symbol * require

you to have this information prior to completing the Excel TOOLS calculation sheet:

- Height of module in millimetres, (see key)
- Width of module in millimetres, (see key)
- Thickness of module in millimetres, (see key)
- Weight of module in kilograms*

3.13 Determine the permanent action of your photovoltaic cell

3.13.1 The permanent action of the individual cells are calculated using the following formula and will return a value in kN/m². For the two buildings we have chosen to use an Aleo 150 XXL 170W with a module length of 1.6m, a module width of 0.8m and a module weight of 16kg. The permanent action from the cells will have a vertical and horizontal component thus:

$$g_{k,v} = \frac{weight\ \ of\ \ module \times 9.81 \times 10^{-3}}{length\ \ of\ \ module \times width\ \ of\ \ module} \times \cos\alpha$$

Where α in the equation is the pitch of the roof in degrees from horizontal.

- Module dead weight, $g_{k,v} = ((16 \times 9.81 \times 10^{-3}) / (1.6 \times 0.8)) \times \cos 30$

$= 0.11 kN/m^2$

$$g_{k,h} = \frac{weight\ \ of\ \mathrm{module} \times 9.81 \times 10^{-3}}{length\ \ of\ \ \mathrm{module} \times width\ \ of\ \ \mathrm{module}} \times \sin\alpha$$

Where α in the equation is the pitch of the roof in degrees.

- Module permanent weight, $g_{k,h} = ((16 \times 9.81 \times 10^{-3}) / (1.6 \times 0.8)) \times \sin 30$

$= 0.06 kN/m^2$

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3.14 Determine the maximum rail support spacing

3.14.1 The maximum distance between rail supports is very much dependant on the type of support rail being used. Currently the rail selected by Clenergy is ProRail 48 (PR48)

3.14.2 The rails will be required to support the combined dead, snow and wind actions and span between support feet attached to the roof. There are currently ten types of feet being manufactured by Clenergy. Factors are applied to the actions in accordance with BS EN 1990:2002 Eurocode – Basis of structural design. Typically a factor of 1.35 is applied to permanent actions and 1.5 applied to variable actions.

3.14.3 The vertical and horizontal actions applied to the panels are derived using the following formula and using the most onerous values for either the suction or pressure actions from above:

$$F_v = 1.35g_{k,v} + 1.5s_{k,v} + (0.5 \times 1.5w_k)$$

- Vertical load, $F_v = 1.35 \times 0.11 + 1.5 \times 0.58 + (0.5 \times 1.5 \times 0.37)$

$$= 1.30\text{kN/m}^2$$

- Vertical load, $F_v = 1.35 \times 0.11 + 1.5 \times 0.72 + (0.5 \times 1.5 \times 0.64)$

$$= 1.71\text{kN/m}^2$$

$$F_h = 1.35g_{k,h} + 1.5s_{k,h} + (0.5 \times 1.5w_k)$$

- Horizontal load, $F_h = 1.35 \times 0.06 + 1.5 \times 0.33 + (0.5 \times 1.5 \times 0.00)$

$$= 0.58\text{kN/m}^2$$

- Horizontal load, $F_h = 1.35 \times 0.06 + 1.5 \times 0.42 + (0.5 \times 1.5 \times 0.00)$

$$= 0.71\text{kN/m}^2$$

3.14.4 The above values can now be used to determine what the maximum span for the rail. The following formula is used to determine the distance the beam is able to span in millimetres.

$$L < \sqrt{\frac{f_y / 1.1}{\frac{(Fv \times 0.5H)/8}{Wy} + \frac{(Fh \times 0.5H)/8}{Wz}}}$$

Where f_y in the equation is the characteristic strength of the material, F_v and F_h are the vertical and horizontal factored forces being applied, H is the height of the PV module and W_y and W_z are the elastic moduli of the rail around two perpendicular axes.

- $$L < \sqrt{\frac{160/1.1}{\frac{(1.30\times(0.5\times1.6))/8}{3139} + \frac{(0.582\times(0.5\times1.6))/8}{2976}}} = 1494mm$$

- $$L < \sqrt{\frac{160/1.1}{\frac{(1.710\times(0.5\times1.6))/8}{3139} + \frac{(0.708\times(0.5\times1.6))/8}{2976}}} = 1363mm$$

3.15 Verify acceptable rail end overhang

3.15.1 The rail end overhang must equal 50% or less of the foot spacing. For instance if the modules have a foot spacing of 1200mm then the rail end overhang can be up to 600mm. Two feet can support a rail length of up to 2400mm (1200mm between each foot and 600mm of overhang at each end).

3.16 Determine the installation roof area

3.16.1 SolarRoof Pro TM racks should not be installed within the minimum of 0.2b and 0.2d of the roof edge or ridge where b and d are the plan dimensions of the building.

3.16.2 Panels should not be installed above the ridgeline and should project no more than 150mm from the roof plane and should be sited, as far as is practicable, to minimise the effect that the installation will have on the appearance of the building. The panels should also be sited, as far as is practicable, to minimise the effect that the installation will have on the amenity of the area.

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3.16.3 All SolarRoof Pro TM systems may require a Building Regulations application to be made through your local authority building regulations control officer; you should contact them for advice. It should also be noted that other aspects of the work will require building regulations consent such as the electrical installation and we advise that you contact a local part P approved installer who will be able to provide the necessary advice. Planning permission and or conservation area consent may also be required and your local planning authority will be able to advise you further of this.

3.16.4 It is the responsibility of the purchaser to ensure that the existing roof structure is structurally adequate to be able to carry the increased loading that will be generated by the installation of the SolarRoof Pro TM system.

3.16.5 As each roof will be different the capacity of the fixing requires a detailed assessment for each installation. This is not possible to do generically, therefore reference should be made to the relevant code of practice for the type of substrate present. For a timber substrate reference should be made to BS EN 1995-1-1:2004 Eurocode 5: Design of Timber structures – Part 1-1 General – Common rules and rules for buildings. For a steel substrate reference should be made to BS EN 1993-1-1:2005 Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for buildings.

3.16.6 For the purpose of the calculator we have assumed that the grade of timber will have a minimum strength class of C16 as detailed in BS EN 338:2009 Structural timber strength classes. That the minimum edge distances will be adhered to as outlined in Table 8.6 of BS EN 1995-1-1:2004 Eurocode 5: Design of timber structures – Part 1-1 Common rules and rules for buildings. That the material being fixed to is of a sound nature, free of any rot and any degradation.

3.16.7 For assistance with technical queries regarding the use of the on-line calculator tool or for specialist design and installation requirements please contact Clenergy at http://www.clenergy.com .

The UK Clenergy installation manual has been produced with technical support from Morgan Tucker Ltd (morgantucker.co.uk)

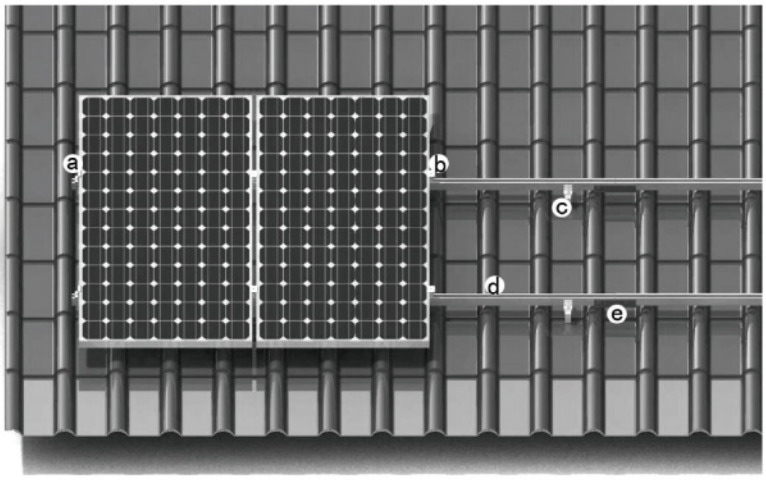
4. Components

Overview of System Components		
 *PV-ezRack ProRail 48*	 *PV-ezRack - Rail Splice*	 *PV-ezRack - Roof hook interface*
 *PV-ezRack - Inter Clamp*	 *PV-ezRack - End Clamp*	

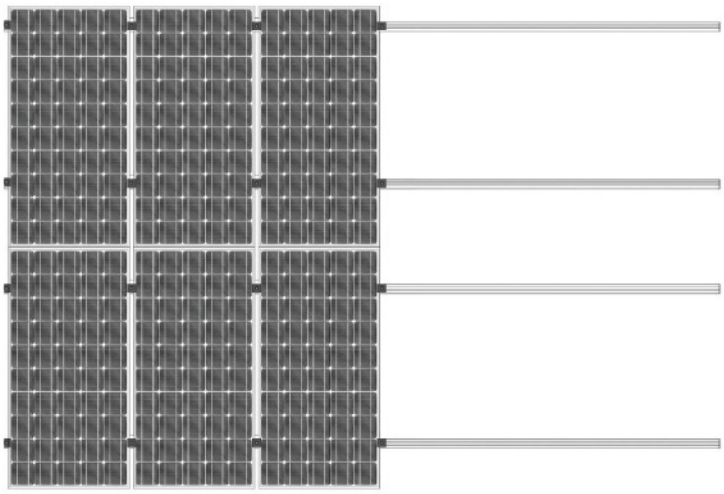
5. Installation Preparation

5.1 Overview of system components

a. Module end clamp
b. Inter-module clamp
c. Pro roof hook
d. Standard rails
e. Splice

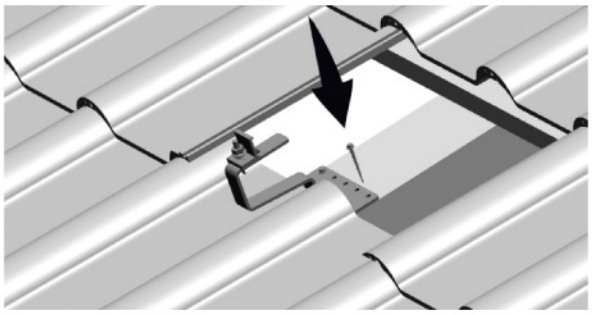
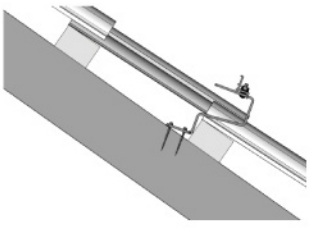
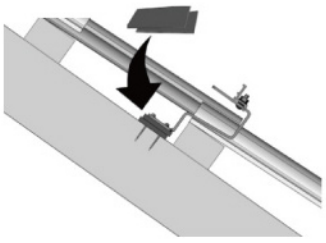
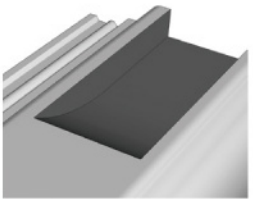
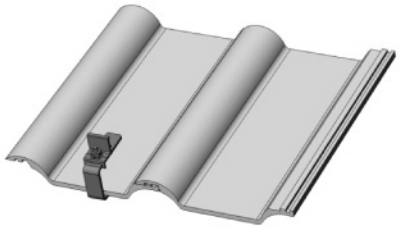


5.2 Planning the module area

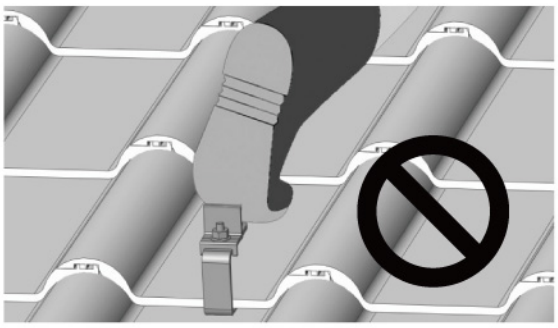
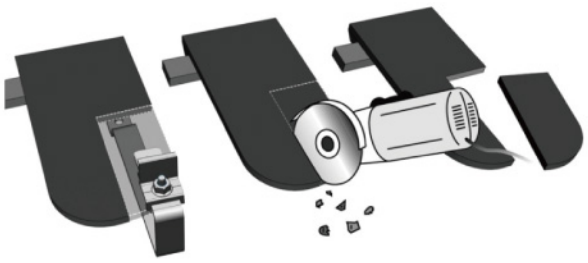
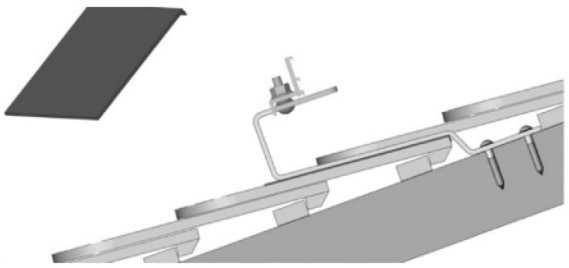
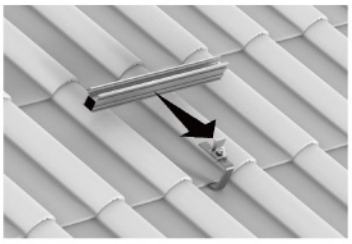
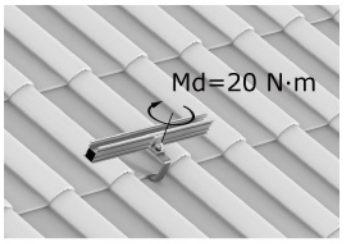
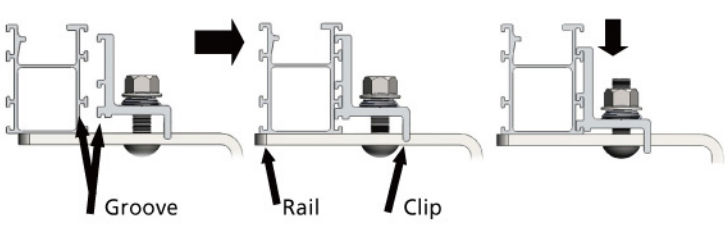


- Number of modules in the vertical direction x module height (please check also the installation manual of the manufacturer of the solar module)
- Number of modules in horizontal direction x (module width + 18mm) + 32mm
- Horizontal spacing of the roof hooks up to 2.0m
- Vertical spacing of the roof hooks = approx. 1/2 to 3/4 of module height
- Distance between the modules: 18mm Caution: Installations that are exposed to the wind or are located on the edge or corners of the roof may make it necessary to leave smaller spaces between modules.

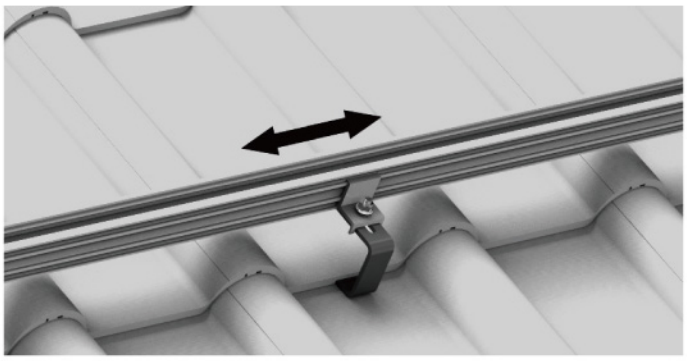
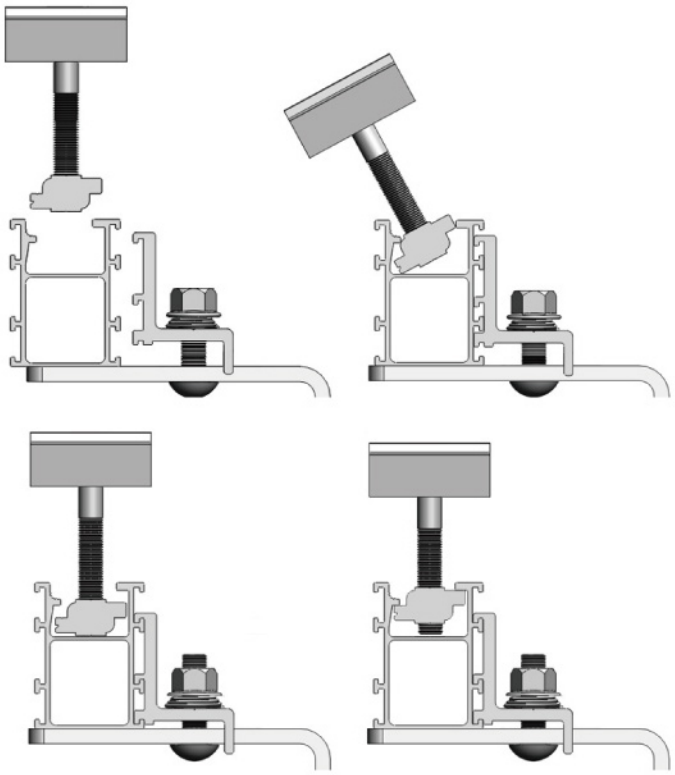
6. Installation Instructions

Tile Roof Hook Installation	
1. Determine the positions of the roof hooks according to your plans. Remove the roof tiles at the marked positions or, if possible, simply lift them up slightly.	
2. Fix the Pro roof hooks to the rafter using three assorts wood screws.	
3. The Pro roof hook must not press against the roof tile. If necessary, shim the Pro roof hook with wood.	Incorrect  Correct 
4. If necessary, use an angle grinder or hammer to cut a recess in the tile that covers the Pro roof hook at the point where the Pro roof hook comes through so that the tile lies flat on the surface. If grooved tiles are used, it will also be necessary to cut a recess in the lower tile.	  

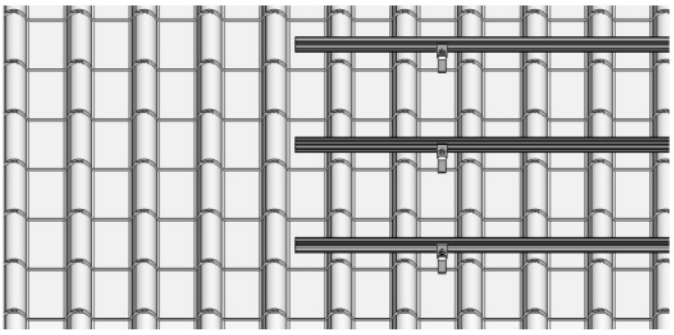
6. Installation Instructions

Tile Roof Hook Installation	
5. Caution! Do not use fitted Pro roof hooks as a ladder, as this extreme point load could damage the tile below.	
6. Variation for installation on plain tile roofs. With plain tile roof cladding, a recess must be cut into the tiles around the position of the Pro roof hook.	
7. A titanium zinc metal sheet must be cut to fit on site, with an overlap of at least 20 mm around the recess, and installed under the Pro roof hooks. Caution!	
8. Installation of the rails on Pro roof hooks. If your set of rails consists of rails of different lengths, always begin with the shortest piece. Attach clip to top of roof rack, offer pro-rack beam up to clip so that the groves align on both sections. Tighten the screws with the Allen wrench until secure.	  

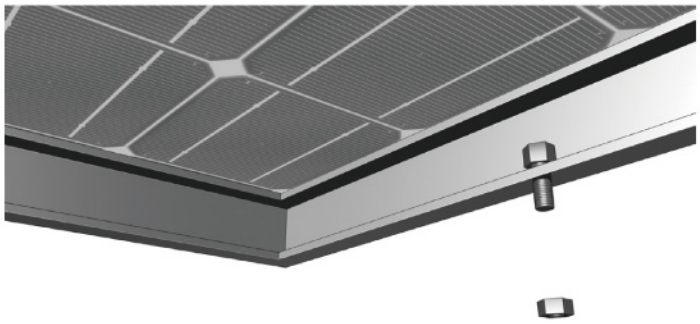
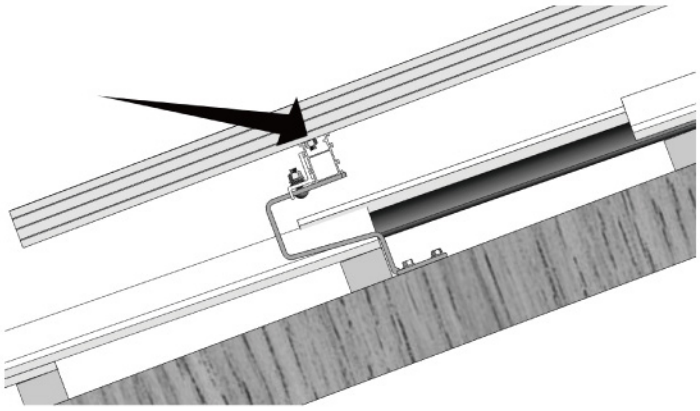
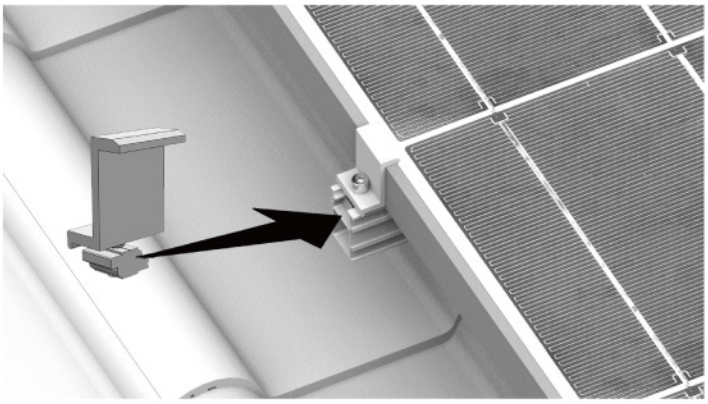
6. Installation Instructions

Tile Roof Hook Installation	
9. An optimum adjustment of the vertical and horizontal position can be made by taking advantage of the long hole in the Pro roof hooks and the still loose connection of the Clip.	
10. For easy use of the Z module, you must make sure that the thread of the screws does not project through the lower side of the Z Module (max. flush). Position the Z-Module in the rail channel and fasten it loosely with 2 to 3 turns of the screw. The screws can still be freely moved in the rail channel. Slide the screws to their final position in connection with the inter-module clamp, module end clamp or Pro roof hooks/hanger bolts and fasten firmly (recommended torque is 20 N.m).	

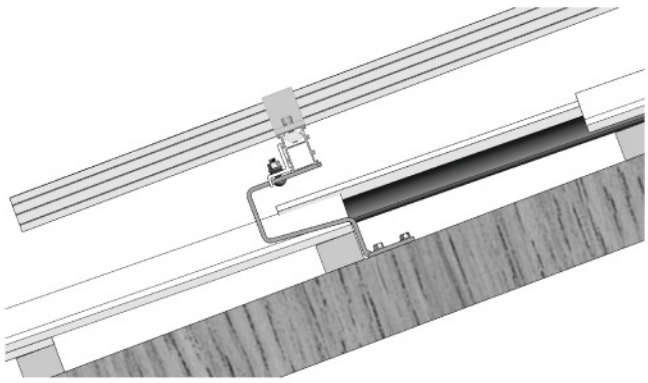
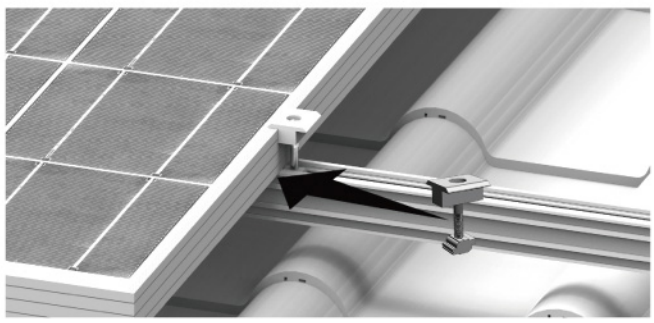
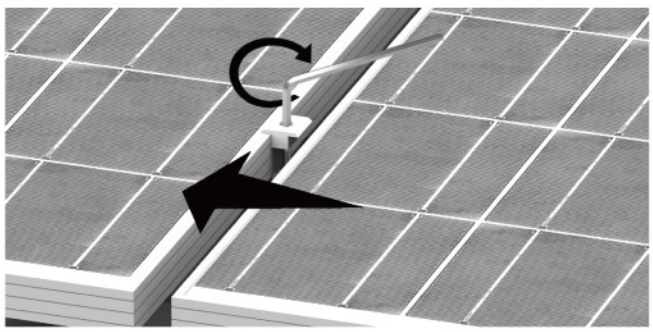
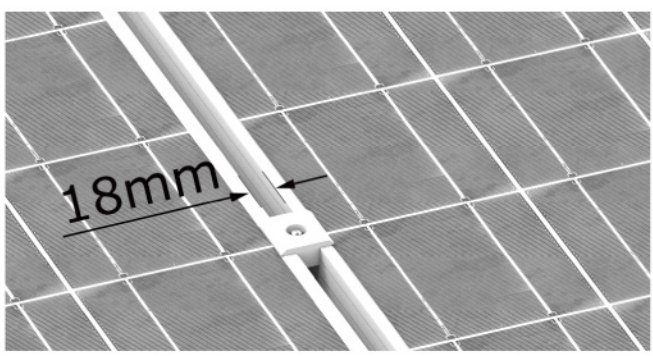
6. Installation Instructions

Base Rail Installation	
11. Position the first frame rails for each row and fasten them temporarily to the roof cladding using a cord. Tighten the Allen bolts or the nuts on the T-head bolts that are used to fasten the roof hooks/hanger bolts (recommended torque is 8 Nm).	
12. Installation of the splice with base rails To connect multiple rails together, slide the splices on the rear side of the pre-assembled rails halfway to the side. Fasten the first M8 Allen bolt firmly using the Allen key. Now slide the next rail segment into the splice.	
13. Tighten the second M8 Allen bolt using the Allen key. The connection is finished. An expansion gap at the rail joints is recommended. For this purpose, leave a gap about the same width as a finger between the rail joints and then loosely tighten the M8 allen bolt.	

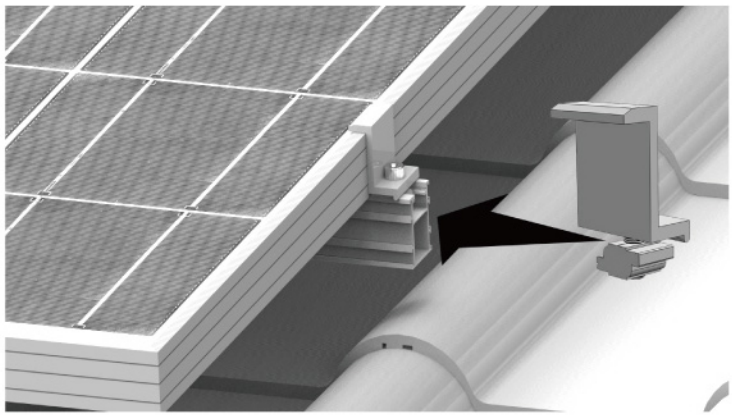
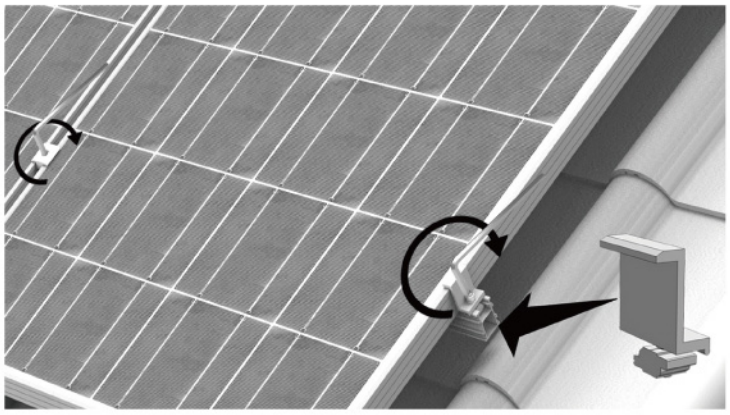
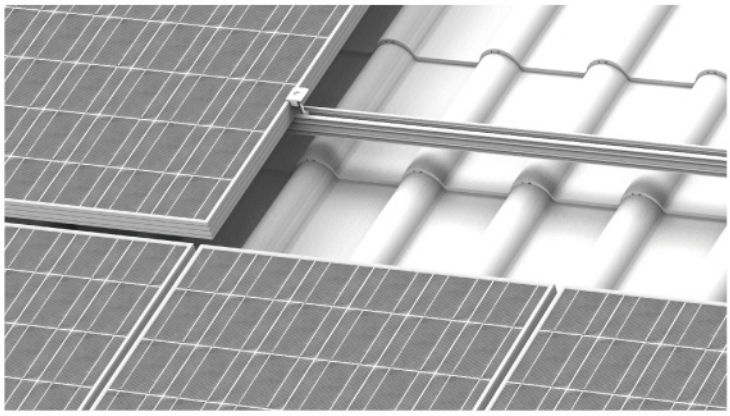
6. Installation Instructions

PV Module Installation	
14. Before installing the modules, add anti-slip protection to the lowest row of modules (horizontal rail installation only). To do this, fasten M6 x 20 mm bolts (with the shank downwards) to the lower mounting holes of the module frame using M6 nuts. When installing large modules (e.g. ASE250) M8 x 20 mm bolts must be used.	
15. 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.	
16. Slide the module end clamp tightly against the module and fasten tightly using the Allen bolt (recommended torque is 8 Nm).	

6. Installation Instructions

PV Module Installation	
17. Cross-section through the module end clamp when installation step 20 has been correctly performed.	
18. Slide the pre-assembled inter-module clamp into the rails from above, place it firmly against the module and fasten loosely (approx. 2 - 3 turns).	
19. Now slide the next module against the previously installed module and tighten the inter-module clamp using the Allen key (recommended torque is 8 Nm). Take care that the anti-slip protection sits in the rail channel of the lowest row of rails.	 

6. Installation Instructions

PV Module Installation	
20. If your system does not use a telescopic mounting, position the last module of the row in the base rail and fasten the module using the module end clamp (recommended torque is 8 Nm).	
21. Place the last module in the row on the rails (with the first row of modules, take care that the anti-slip protection sits properly in the rail channel) and fasten the last-inter-module clamp and the module end clamp using the Allen key (recommended torque is 8 Nm).	
22. Now slide in the first module of the next row from above onto the corresponding module of the row beneath. A separation from the lower module can be maintained for optical reasons. An intermodule clamp can be used as a separator, so that the vertical and horizontal separation of the modules is identical. Continue mounting the modules as described in steps 16 to 22 until all modules are installed. The installation is finished.	

7. Warranty

CLENERGY WARRANTY TERMS AND CONDITIONS FOR ASSAMBLY SYSTEMS

1. SCOPE OF APPLICATION

1.1 This Warranty Terms and Conditions (hereinafter referred to as WTC) of Clenergy Germany GmbH (hereinafter referred to as Clenergy) shall apply in addition to the General Terms and Conditions (hereinafter referred to as GTC) of Clenergy at all sales of assembly systems to its buyers. The German version of the WTC applies.

1.2 The services granted by this WTC shall only be regarded as a voluntary special service by Clenergy insofar as they exceed the minimal statutory requirements for warranty. **The WTC shall not create an independent cause of action for the buyer but only modify the statutory regulations (dependent Warranty).** An independent promise of guarantee exceeding the contents of these WTC shall not be granted.

2. START AND PERIOD OF WARRANTY

2.1 The warranty period is ten (10) years and begins with the passing of risk of loss or damage to buyer in accordance with the ICC Incoterms 2010.

3. EXERCISE OF WARRANTY RIGHTS

3.1 The warranty case shall be reported to Clenergy in writing; the kind and the extent of the alleged defect shall be described herein. The terms for inspection and objection according to GTC shall be observed. Noncompliance with the inspection and objection obligations shall make the warranty rights cease to exist.

4. SCOPE OF WARRANTY

4.1 Clenergy warrants that the goods to be supplied conform to the specifications stated in the contract and are free of essential deficits. However, this shall not be considered as an independent guarantee declaration, but as an agreement regarding condition of the goods.

4.2 Upon Clenergy's choice the remedy of defects shall be made either by repair or by new delivery. Clenergy shall be entitled to engage a Third Party to arrange removal of defects.

4.3 In the case of culpably unjustified warranty demand the buyer shall refund the caused damage to Clenergy.

5. PROPER USE AND EXCEMPTION FROM WARRANTY

5.1 The warranty services described above can only be granted if the object of purchase is used, operated and assembled in a proper way. Therefore the defects of goods resulting not only from material or production defect will not be remedied by Clenergy. This can especially (but not limited to) apply in the following cases:

- The buyer or the installer omits to follow the assembly, operation or maintenance instructions which causes defect(s) of the goods;
- Replacement(s), repair(s) or modification(s) of the goods are not made by Clenergy, a Third Party engaged by Clenergy or without consent of Clenergy;
- Improper use of the goods or the use contrary to the way of use specified in contract/conventional way of use;
- Vandalism, destruction by external influences and/or by human beings and/or animals;
- Improper storage, transporting after passing of risk of loss or damage before the installation if that causes defect(s) of the purchased object;
- Damages of the building stock or its incompatibility with the goods causing the defects of the goods;
- Use of the purchased object on mobile units such as vehicles or ships;
- Acts of God, e.g. flooding, fire, explosions, rock fall, direct or indirect lightning stroke or other extreme weather situations such as hail, hurricanes, tornados, sandstorms or other circumstances out of Clenergy's influence.

5.2 Furthermore the warranty is excluded if the defect arises because of the use contrary to standard use condition described as follows:

- Use of the goods only under sufficient statics, especially – installation on a carrying facility which is strong enough to carry the weight of the product and to stand possible weather-related charges such as water, wind, leaves or snow;
- Wind velocities exceeding the limit values specified in the product description.

5.3 The warranty services shall be excluded if and when the manufacturer label(s) and/or serial number(s) of the goods is/are changed, erased, detached or unreadable.

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