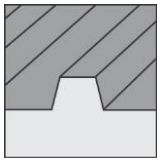
BayWa r.e.
renewable energy

Installation instructions

novotegra
by BayWa r.e.

novotegra for Trapezoidal Sheet Roofs – elevated



CONTENTS

1 General information

Check for completeness
On receipt of the goods, check that your order is complete on delivery based on the enclosed delivery slip. BayWa r.e. Solar Energy Systems assumes no costs or guarantee for any subsequent express deliveries if it only becomes apparent that materials are missing during installation.

Solar modules
The data relating to the permitted loads for the modules and permitted mounting areas is included in the data sheets or installation instructions provided by the solar module manufacturer. In individual cases, check that the mounting system is suitable for the used modules.

Mounting system
All mounting systems described in these installation instructions are intended for installation on pitched roofs, with roof pitches of 0 to 60 degrees. Before installation, read the installation instructions and observe the information, specifications etc.

Roof characteristics
In individual cases, check whether the roof covering is suitable for the mounting system. The substructure must meet the requirements of the mounting system with regard to load-bearing capacity, support structure and condition. For example, with rafter roofs and purlin roofs, the components must be intact (no fungal growth, no rot) and as a minimum requirements should meet the Eurocodes. When securing the mounting system to folded seam roofs or trapezoidal sheet roofs, these statements apply accordingly. Check on-site that the roof covering is secured with sufficient retainers or trapezoidal sheet fasteners to the substructure of the building. In addition, the structural aspects regarding insulation penetrations must be observed (e.g. condensation formation).

Structural analysis
Structural analysis is performed by the Solar-Planit software (Chapter 2).

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2 novotegra: mounting system planning

2.1 Solar-Planit software

2.1.1 General information

The mounting system must be designed using the Solar-Planit or by one of our team.

The Solar-Planit analysis software calculates the load-bearing capacity of the novotegra mounting system and also takes the fastening to the building into consideration (wooden rafters/wooden purlins/trapezoidal sheets etc.). This calculates the load-bearing capacities of the mounting system components in accordance with the system engineering (arrangement of the modules on the roof). On-site deviations from the planning can lead to different results. Load transfer within the building is not taken into account (structural analysis of the building). For products which are not integrated in the Solar-Planit yet, please contact BayWa r.e. Solar Energy Systems sales team for assistance.

If the building is in an exposed location, e.g. at the edge of a slope, site categories I to IV may not be used. Instead, an increased dynamic pressure must be calculated. The Solar-Planit uses the current load assumptions of the Eurocodes and incorporates the division of the roof into an edge and central area as standard. The limit spans and individual profile lengths are specified by the Solar-Planit taking the roof areas into consideration, and must be complied with. The remaining instructions must be observed.

Rail overhangs permitted per the Solar-Planit must be observed. All subsequent specifications and statements assume a symmetrical layout of the modules on the substructure on the long side of the modules. For example, this ensures an even load on the novotegra rails and modules when installing the modules on tiled roofs. For installation on pitched roofs, two novotegra rails (C-rails) per module row or column, landscape or portrait, are fastened depending on the module mounting method (landscape or portrait mounting).

3 novotegra for trapezoidal sheet roof

3.1 Substructure for trapezoidal sheet roofing

The mounting system can either be mounted directly to the trapezoidal sheet roofing or by mounting stock screws, which are anchored to the substructure. Installation of the novotegra substructure for trapezoidal sheet roofs for elevated systems with fastening to the trapezoidal sheet roofing is described below. The requirements and installation steps for fixing to the substructure are described in the “novotegra for corrugated fibre cement/ sandwich roofs” installation instructions and also apply for installing the substructure for trapezoidal roof coverings.

3.2 Elevated mounting for south and north-facing roofs (direct fastening)

3.2.1 General information

The following chapter describes how to install the novotegra mounting system for trapezoidal sheet roofs, with elevated mounting for south and north-facing roofs. The mounting system is connected directly to the roof covering, using technically approved self-drilling screws – the modules must be mounted in landscape. Structural verification using the Solar-Planit software includes fastening to the trapezoidal sheet. The basic profile lengths specified by the planning software must be checked for correctness on-site. Fastening of the roof covering to the substructure must be checked on-site (consult a structural engineer if necessary) and supplemented if required. The mounting system can be used on trapezoidal sheets made of steel sheets, with a sheet thickness of 0.4 mm and made of aluminium, with a sheet thickness of 0.5. Howerver on aluminium sheets direct fixing is recommended from 0.7mm sheet thickness. Direct fixing on the outer shell of sandwich roof elements has an approval for the roof element Kingspan 1000 RW (IPN)/FF (MiWo).

In order to mount the novotegra mounting system for trapezoidal sheet roofs with roof-parallel mounting, the following tools are required:

Tool	Mounting system component
Electric screwdriver	
Torque wrench	
Socket bit for hex-head self-tapping screws, AF8	Self-drilling screws

3.2.2 Roof division

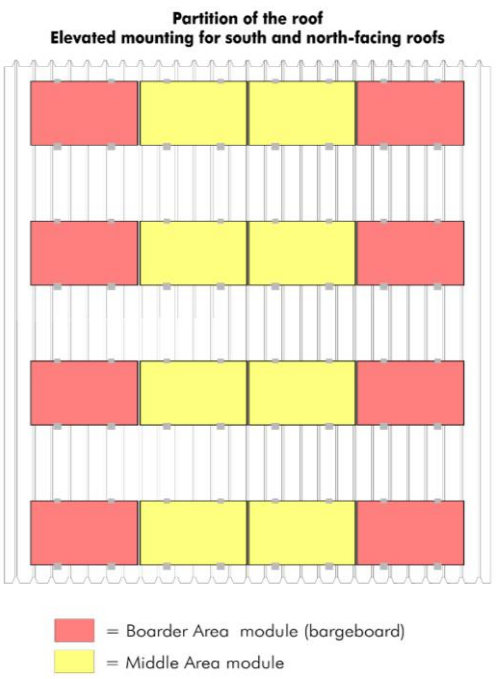


Figure 1 Schematic diagram of roof division

The roof is divided into two areas (Figure 1) according to the various wind loads on the roof. The exposed edge modules at the verge (red surface) must be fastened with reinforcement. The middle modules (yellow surface) must be considered separately and may require reinforced fastening.

3.2.3 Arrangement of the base profiles

Before mounting the base profile sections, the module and module fastener layout must be specified. Please note that the modules can only be mounted horizontally. The position of the base profiles is determined based on the position of the module fasteners. The length of the base profiles is determined by the Solar-Planit software. The impacting loads should be distributed as evenly as possible on the roof cladding, i.e. as many ribs as possible are to be connected. Depending on the conditions (module dimensions, loads etc.), horizontal spacing "d" can occur between the rail sections (Figure 2). The base profile sections on the roof are aligned parallel to the ridge or the eaves.

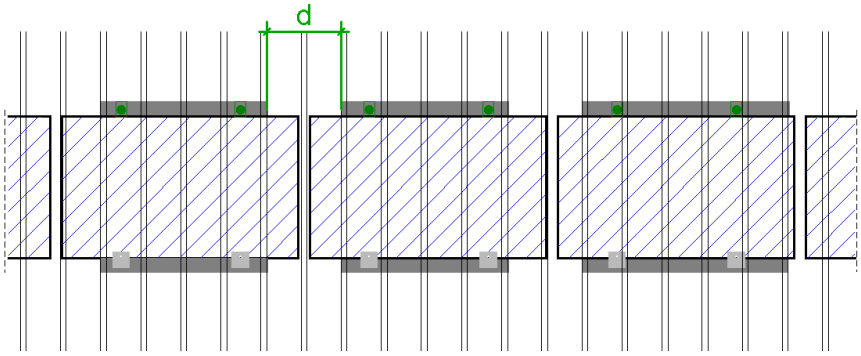


Figure 2 Layout of the base profiles

The base profile sections must be aligned in accordance with Figure 2, so that there are two base profiles under every module, which must be mounted with the mounting spiral facing south (the platform of the mounting spiral faces north Figure 9). Each module fastener or module supports of a module must be assigned to base profile. The distance between these axes is calculated by the planning software on the basis of the data entered, as is the distance between the module rows**.**

3.2.4 Fastening the base profiles

3.2.4.1 Standard fastening

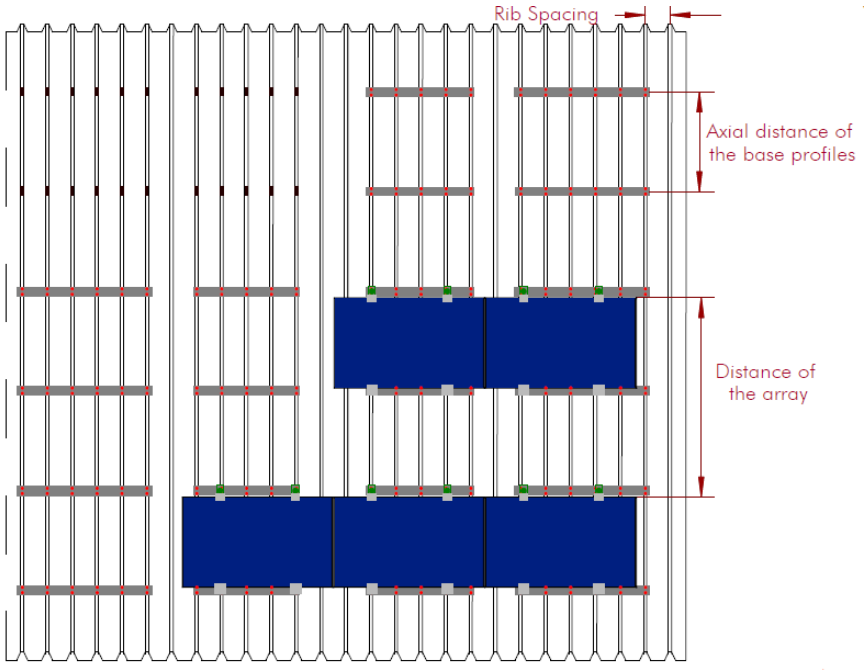


Figure 3 Schematic drawing for fastening the base profiles to the trapezoidal sheet – Standard fastening

With standard fastening, the substructure can be fastened directly to the trapezoidal sheets without additional measures (Figure 3 and Figure 4). Connect the base profile sections along the entire length of the base profiles to every rib using the fastening set (Figure 9).

The following conditions must be observed:

- The base profiles may not overhang, i.e. the base profile ends may not protrude beyond the rib, and must be extended to the next rib.

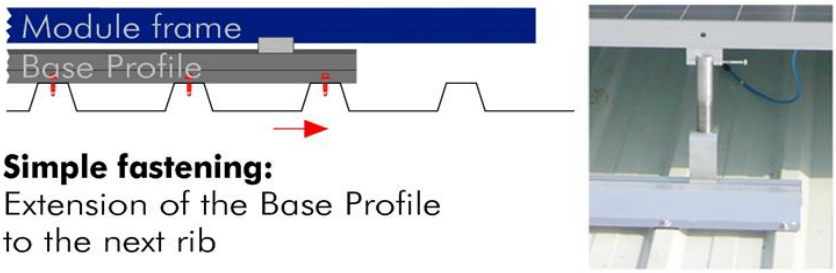


Figure 4 Detail on the fastening the base profile of trapezoidal sheet – Standard fastening

- The base profiles at the edge modules at the verge must be extended to the next rib (Figure 5).

Figure 5 Base profile extension at the verge

3.2.4.2 Reinforced fastening

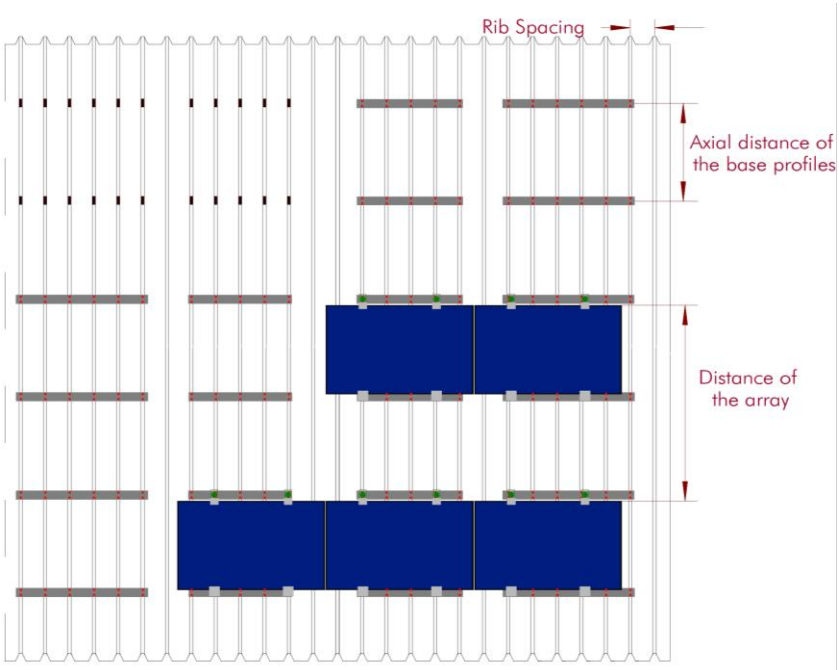


Figure 6 Schematic drawing on fastening the base profiles to the trapezoidal sheet- Reinforced fastening

If the loads are high, the fastening of the substructure may have to be reinforced. Reinforced fastening is required if the minimum distance between the module fastener and fastening set (x_{min}) is lower than the required clearance (Figure 7).

The following conditions must be observed:

- The base profiles may not overhang, i.e. the base profile ends may not protrude beyond the rib, and must be extended to the next rib.
- If the minimum distance x_{min} between the module fastener and the fastening set is not maintained, the base profile must be extended over the next two ribs.
- The base profiles at the edge modules at the verge must be extended to the next rib (Figure 5)

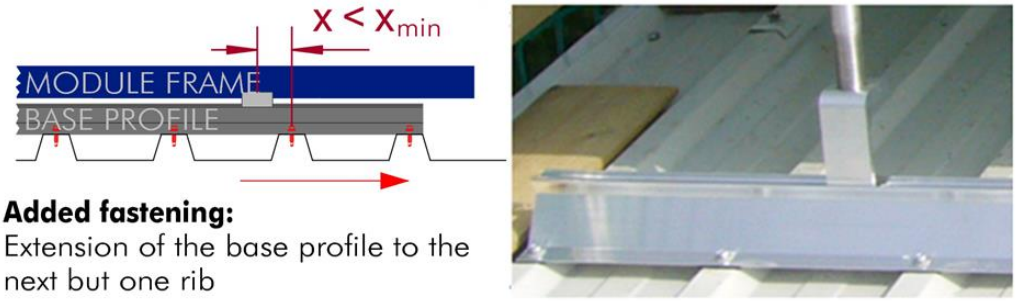


Figure 7 Detail on fastening the base profiles to the trapezoidal sheet – Reinforced fastening

3.2.5 Module mounting in landscape

3.2.5.1 Base profile mounting

Components of the direct fastening set for base profile	Units
Self-drilling screw	2
EPDM seal strip 130 x 45 mm	1

The mounting system for elevated mounting on trapezoidal sheets consists of the base profile and the fastening set. The base profiles must be cut to length on-site. To prevent excessive expansion of the base profiles, the individual length is restricted to 2.0 m.

Figure 8 Base profile with seal and double-sided threaded connection. Rail (left) and mounting spiral (right)

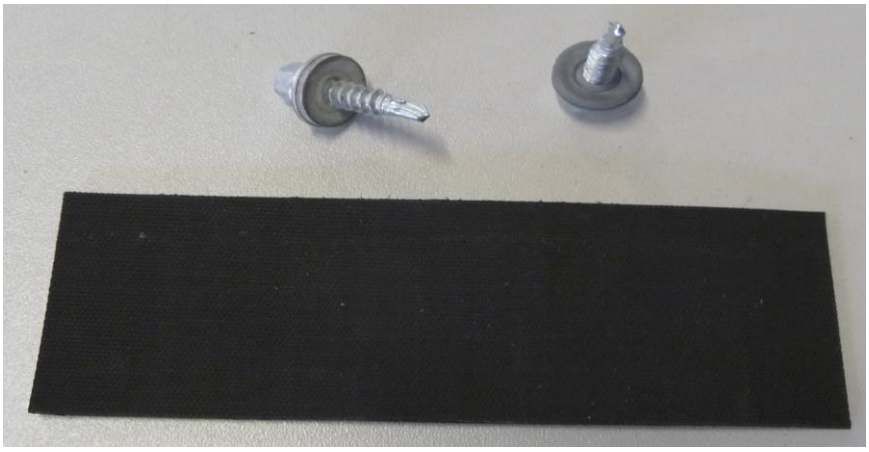


Figure 9 Direct fastening set for base profile

Before mounting the profile sections, fit the self-adhesive 130 x 45 mm EPDM seal strip to the ribs to seal the roof penetration. The base profiles are fastened without pre-drilling the trapezoidal sheets on both sides by the platforms (Figure 27) of the base profiles. The profile sections must be connected to every rib on which the base profile rests. Do not tighten the fastening set excessively, as the self-drilling screw then no longer has a structural effect.

3.2.6 Module fastening and position securing

Mounting system components	Units/ module
Front module bracket set	2
Back module bracket set	2
Module support set	2

Figure 10 Mounting the back (left) and front (right) module bracket set

For each module, two front module bracket sets and back module bracket sets must be screwed through the mounting holes in the module so that they cannot be moved to a tightening torque of 12-14 Nm (Figure 10).

Figure 11 Inserted module support set

At the same time, the module support sets can be inserted in the rear base profiles (Figure 11). The module is then inserted into the base profiles with the front module bracket set, and lowered at the back onto the module support sets. Every module is mounted consecutively in this way. There must be a clearance of at least 10 mm between the modules in a row.

Figure 12 Height-adjustable module supports

The threads of the module supports allow the module to be adjusted accurately to the elevation angle (Figure 12). The module supports are not secured via the screw in the rear module fastener set until after they have been aligned.

To secure the position of the modules, secure them to the front module fastener set using a self-drilling screw (Figure 13). The following regulation per module applies:

Roof orientation	Modules	Module bracket	Number of screws
South-facing	Only verge	Front (outside)	1
North roof	All	Front	2

To secure the modules in position, the self-drilling screws from the direct bracket set for the base profile are used. To secure the modules, place the self-drilling screw into the guide groove of the mounting spiral and screw it into the module bracket through the base profile.

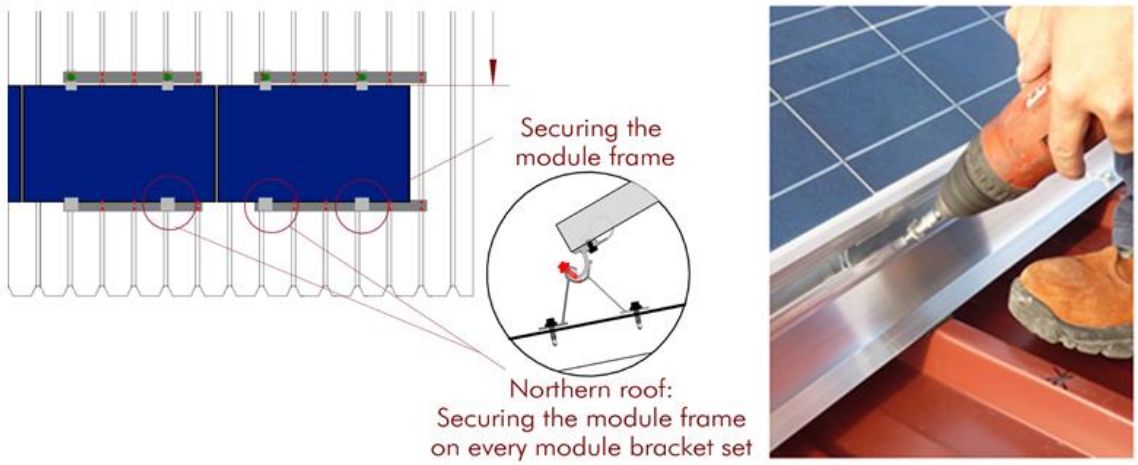


Figure 13 Fastening modules to front module bracket set

The module cables are attached to the module frames using self-locking cable ties. Per module, 2 – 3 cable ties are required depending on the cable length. If the module cables are too short, they must be extended accordingly using extension cable and affixed to the module frame.

3.3 Elevated mounting for east and west-facing roofs (direct fastening)

3.3.1 General information

The following chapter describes how to install the novotegra mounting system for trapezoidal sheet roofs, with elevated mounting for east and west-facing pitched roofs. The substructure is designed as a cross rail assembly (CRA) with a lower rail (C-rail) and a module support rail (base profile) on top of this. The mounting system is connected directly to the roof covering, using technically approved self-drilling screws. The modules must be mounted in landscape. Structural verification using the Solar-Planit software includes fastening to the trapezoidal sheet. The base profile and C-rail lengths specified by the planning software must be checked for correctness on-site. Fastening of the roof covering to the substructure must be checked on-site (consult a structural engineer if necessary) and supplemented if required. The mounting system can be used on trapezoidal sheets made of steel sheets, with a sheet thickness of 0.4 mm and made of aluminium, with a sheet thickness of 0.5. Howerver on aluminium sheets direct fixing is recommended from 0.7mm sheet thickness. Direct fixing on the outer shell of sandwich roof elements has an approval for the roof element Kingspan 1000 RW (IPN)/FF (MiWo).

In order to mount the novotegra mounting system for trapezoidal sheet roofs with roof-parallel mounting, the following tools are required:

Tool	Mounting system component
Electric screwdriver	
Torque wrench	
Socket bit for hex-head self-tapping screws, AF8	Self-drilling screws

3.3.2 Roof division

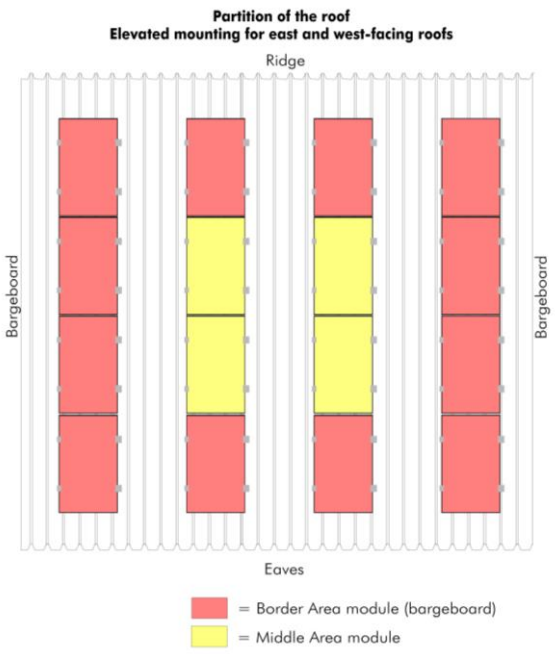


Figure 14 Schematic drawing of roof division

The roof is divided into two areas (Figure 32) the middle (yellow) and the sides (red) according to the various wind loads on the roof. The exposed edge modules at the verge, ridge and eaves (red surface) are considered separately to the middle modules (yellow surface). Both areas may require reinforced fastening of the substructure.

3.3.3 Module arrangement

Before mounting the lower rail, you must determine whether the modules are to be arranged as a module block (Figure 15) or individual modules (Figure 16). Module blocks may not consist of more than 2 modules, due to the temperature-specific expansion.

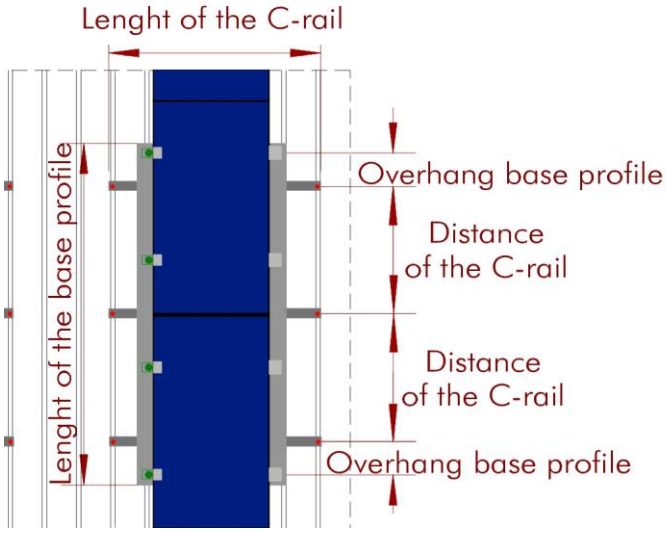


Figure 15 Module block

<u>Cross rail assembly component – Module block</u>

- Lower rail (C-rail): Number and length per structural analysis in Solar-Planit
- Module support rail (base profile): Two base profiles, length per structural analysis using the Solar-Planit software

<u>Cross rail assembly components – Individual module</u>

- Lower rail (C-rails): The number and length of rails depends on the result of structural analysis of Solar-Planit for the module block. This results in the number of rails for the individual module with reference to the module block:

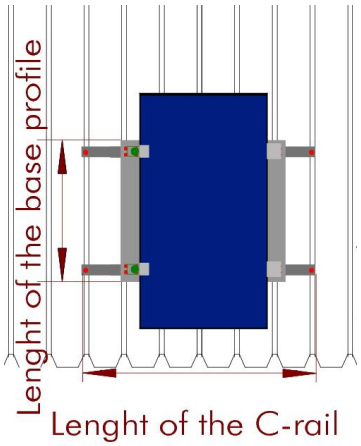


Figure 16 Individual module – 2 C-rails

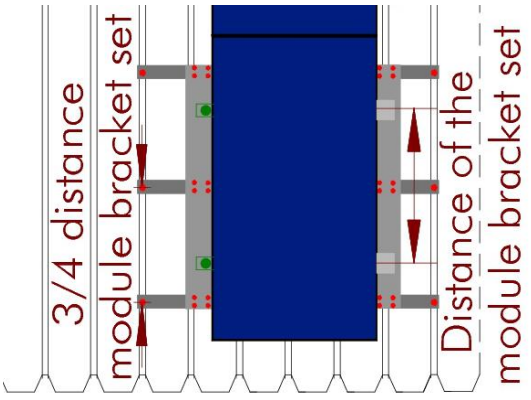


Figure 17b Individual module – 3 C-rails

	For module blocks	For individual modules
Number of rails	≤ 4	2
Number of rails	5 or 6	3
Number of rails	7 or 8	4

- Module support rail (base profile): Two base profiles are required: The length depends on the module and corresponds at least to the distance of the external edges of the front module fasteners. The maximum base profile length is the length of the module.

3.3.4 Arrangement of the C-rails

Before mounting the rail sections, the module block or individual module length layout must be specified. This length is required to mark the axes of the rails. This length also allows you to check the roof division. The correct alignment of the C-rails automatically ensures compliance with the permitted overhangs of the base profiles. Depending on block or individual mounting, the following conditions apply:

Module block:
The C-rails must be aligned symmetrically under the base profiles (Figure 33). For the axial clearance between the C-rails, please refer to the structural analysis of the Solar-Planit. The rail sections on the roof are aligned in parallel to the ridge or the eaves.

Individual module:
The C-rails must be aligned symmetrically under the base profiles. The rail sections on the roof are aligned in parallel to the ridge or the eaves (Figure 17).


Figure 17 C-rail as lower level of the cross rail assembly

3.3.5 Fastening the C-rails

The lower rails of the cross rail assembly must be cut to length on-site. To prevent excessive expansion of the C-rail the individual length is restricted to 2.0 m. The rail sections must be connected to every rib along the entire rail section with the direct fastening set for C-rail (Figure 18).

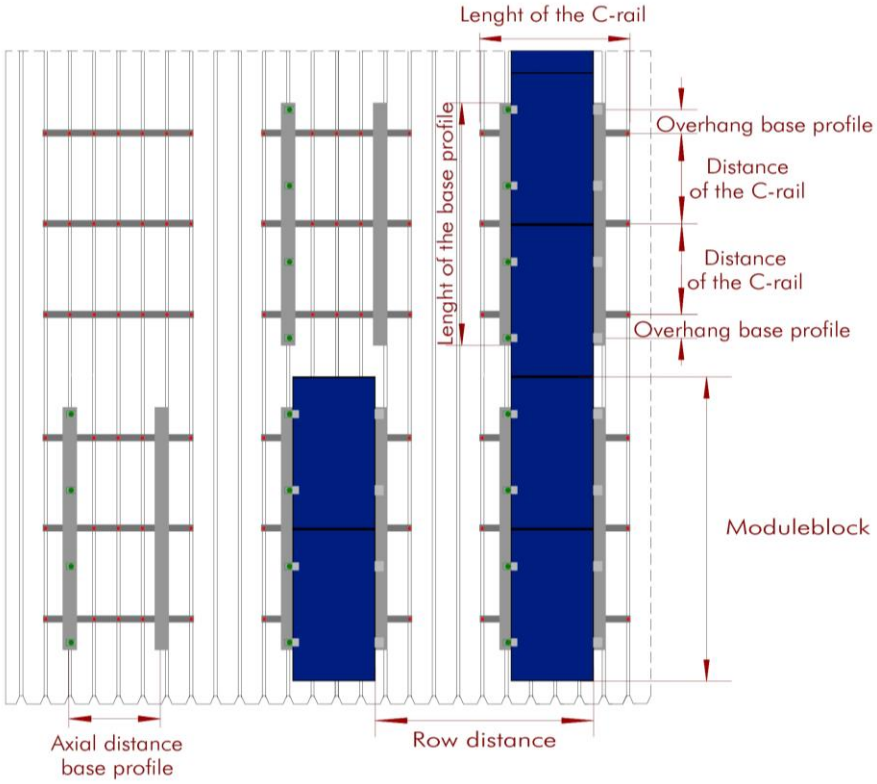


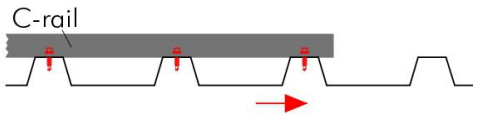
Figure 18 Schematic drawing for fastening the cross rail assembly on the trapezoidal sheet roof

They are fastened through the elongated holes in the rails without pre-drilling the trapezoidal sheet (Figure 37). Do not tighten the fastening set excessively, as the self-drilling screw then no longer has a structural effect.

Attach the self-adhesive 50 x 35 mm EPDM seal strip on the ribs to prevent damage to the trapezoidal sheet roof.

Figure 19 Direct fastening set for C-rail before and after mounting

3.3.5.1 Standard fastening



Simple fastening:
Extension of the C-rail to the next rib

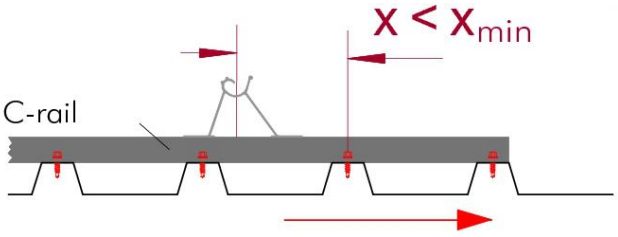
Figure 20 Detail on fastening the cross rail assembly to the trapezoidal sheet roof – Standard fastening.

With standard fastening, (Figure 20) the substructure can be fastened to the trapezoidal sheet roof without additional measures.

The following condition must be observed:

- The C-rails may not protrude, i.e. the ends of the rails may not extend beyond the rib. If this is the case, the C-rails must be extended to the next rib.

3.3.5.2 Reinforced fastening



Added fastening:
Extension of the C-rail to the next but one rib

Figure 21 Detail for fastening the cross rail assembly to the trapezoidal sheet roof- Reinforced fastening

High loads can make reinforced fastening (Figure 21) of the lower rail of the cross rail assembly necessary. Reinforced fastening is required if the minimum distance between base profile load transfer axis and fastening set (x_{min}) is lower than the required clearance. The minimum clearance (x_{min}) is specified in the Solar-Planit software.

The following conditions must be observed:

- The C-rails may not protrude, i.e. the ends of the rails may not extend beyond the rib. If this is the case, the C-rails must be extended to the next rib.

- If the minimum clearance x_{min} between the base profile load transfer axis and the direct fastening set for C-rails is not maintained, the lower rail must be extended over the next two ribs.

3.3.6 Arrangement of the base profiles

The base profiles form the module support rail. They lie on the C-rails and run at right-angles to the ridge and eaves. They must be aligned symmetrically on the C-rails. The permitted overhangs of the base profiles are specified by the Solar-Planit software, and must be observed while complying with the prescribed rail clearances (Figure 18).

Figure 22 Platform (left) and mounting spiral (right)

One front and one rear base profile run under the module; the rails must be mounted such that the mounting spiral faces south (the platform of the mounting spiral faces north - Figure 22). The distance between the base profile axes is calculated by the planning software based on the data entered, as is the distance between the module rows.

3.3.7 Fastening the base profiles

Figure 23 Indirect fastening set for base profile

The base profile is fastened to the C-rails below it using the indirect fastening set for base profiles (Figure 23). The base profiles must be cut to length on-site. In order to prevent excessive expansion of the base profiles, the individual length must only be long enough that two modules (standard length up to 1.70 m – for longer lengths please consult the BayWa r.e. Solar Energy Systems GmbH sales department) can be mounted beside one another.

The base profiles are fastened on both sides through the platforms of the base profiles without drilling the C-rail into the flange of the C-rails (Figure 24). Do not tighten the fastening set excessively, as the self-drilling screw then no longer has a structural effect. The base profile must be screwed to the C-rail with four self-drilling screws at every intersection.

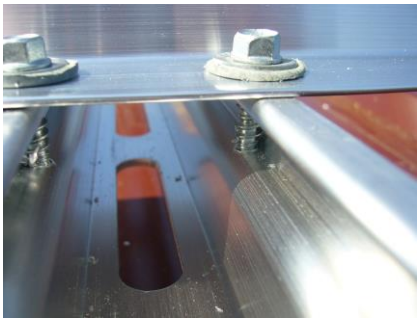


Figure 24 Base profile fastening to C-rails

3.3.8 Module fastening and position securing

Mounting system components	Units/ module
Front module bracket set	2
Rear module bracket set	2
Module support set	2

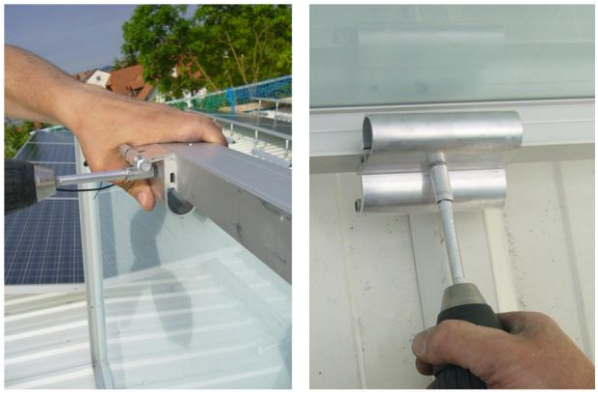


Figure 25 Mounting the module fastener set at the rear (left)

For each module, two front module bracket sets and back module bracket sets must be screwed through the mounting holes in the module so that they cannot be moved to a tightening torque of 12-14 Nm (Figure 25).

Figure 26 Inserted module support set

At the same time, the module support sets can be inserted in the rear base profiles (Figure 26).The module is then inserted into the base profiles with the front module bracket set, and lowered at the back onto the module support sets. Every module is mounted consecutively in this way. There must be a clearance of at least 10 mm between the modules in a row.

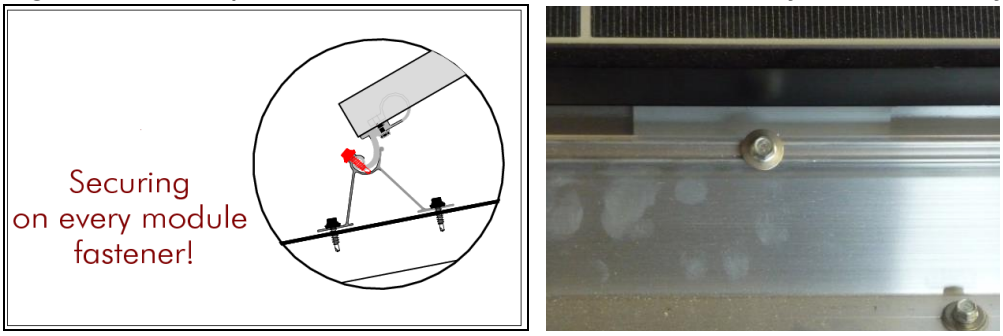
Figure 27 Height - adjustable module support

The threads of the module supports allow the module to be adjusted accurately to the elevation angle (Figure 27). The module supports are not secured via the screw at the rear module bracket set until after they have been aligned.

In order to secure the modules in position, they must be secured with a self-drilling screw at the front module bracket set and possibly at the module support set depending on the roof pitch and the loads which occur. The following regulation per module applies:

Roof orientation	Diagonal	Module	Position securing	Number of screws
East and west-facing roof	No	All	Front module bracket	2 front
East and west-facing roof	Yes	All	Module bracket, front and rear	2 front and 1 rear

To secure the modules in position, the self-drilling screws from the indirect fastening set for base profile are used.
Depending on the roof pitch and the loads which occur, it may be necessary to secure



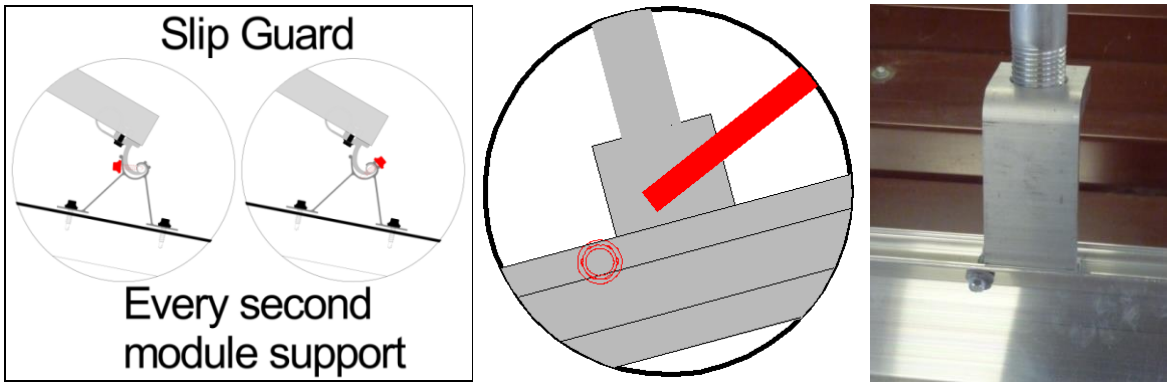


Figure 28 Position securing at front module fastener set (top) and at module support set (bottom)

the modules additional with diagonal reinforcements and a slip guard on the module support. The Solar-Planit software will indicate this when the system is being planned. If this is the case, contact BayWa r.e. Solar Energy Systems sales team.

To secure the modules at the front, place the self-drilling screw into the guide groove of the mounting spiral and screw it into the module bracket through the base profile. Rear slip guard is implemented by screwing the self-drilling screw into the base profile under the module support (Figure 29). The self-drilling screw can either be screwed in through the mounting spiral or the platform (Figure 28).

The module cables are attached to the module frames using self-locking cable ties. Per module, 2 – 3 cable ties are required depending on the cable length. If the module cables are too short, they must be extended accordingly using extension cable and affixed to the module frame.

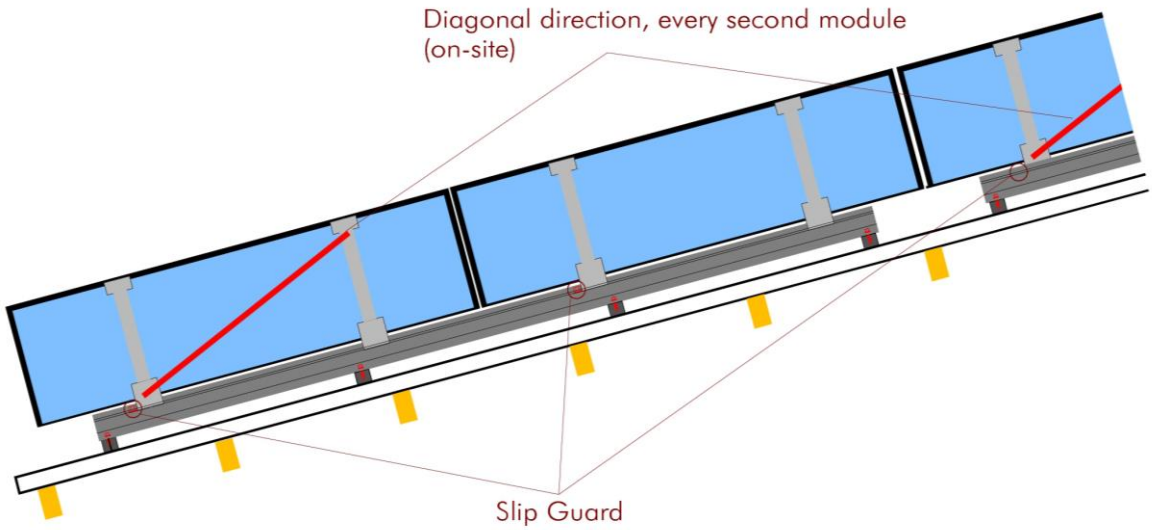


Figure 29 Diagonals for slip protection on highly-sloped roofs and high downward forces

4 Earthing the mounting system/ electrical installation

Please use the country-specific requirements for earthing the mounting system and the lightning protection. In the following an example of requirements for GB is listed.

4.1 Earthing the mounting system

In the UK, please consult the DTI Guide “Photovoltaics in Buildings – Guide to the Installation of PV Systems”, and/ or BS 7430, BS 6651 and BS 7671 to determine earthing/bonding requirements for your array. Please also refer the DTI guide for details of lightning protection measures, along with BS 6651.

Earthing via the roofing sheet may be possible, as the mounting system is fastened directly to this with self-tapping screws.

Earthing via the rails can be achieved using the novotegra earth connectors (Figure 30). Separate sections of panels must be connected together via the rail. These points must then be connected to each other and then to the earthing terminal/spike.

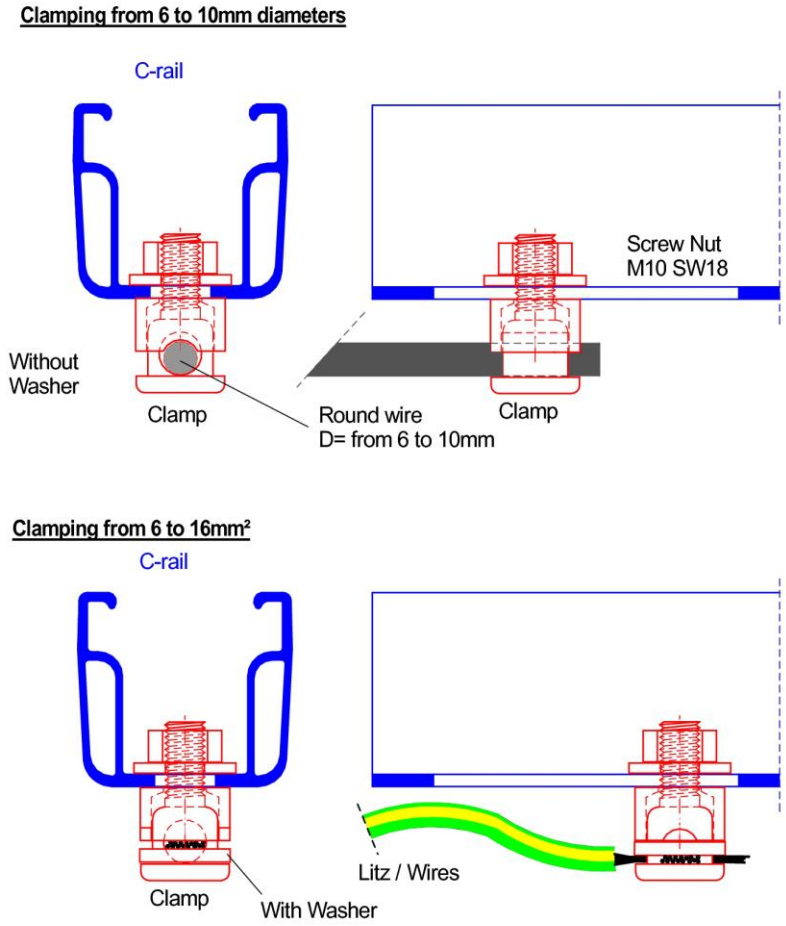


Figure 30 Using the earth connectors

4.2 Laying the main DC cables

To prevent contact with dangerous DC voltage on subsequent electrical connection of the modules, lay the main DC wire from the roof to the DC isolator and DC load circuit breaker or other approved load separators first. When passing the cables through the roof, ensure that the cable insulation is not damaged and the cable does not rub or kink in the penetration.

5 Safety instructions and warnings

When performing any work, please observe the relevant safety standards, including those regarding working on-site, working on electrical systems and working at height, along with the specifications and instructions provided by the module, inverter and cable manufacturers. The installation of solar photovoltaic panels should only be carried out by qualified personnel.

Local construction and safety regulations must also be observed.

The structural design of the mounting system takes the following standards into account:

Design loads	Content
EN 1991-1-3	Snow loads (Eurocode 1)
EN 1991-1-4	Wind loads (Eurocode 1)
DIN V ENV 1999-1-1	EC 9: Dimensioning and design of aluminium structures, Part 1-1 General dimensioning rules; dimensioning rules for building construction
DIN 18800-1	Steel structures. Dimensioning and design
DIN V ENV 1993-1-1	EC 3: Dimensioning and design of steel structures; Part 1-1: General dimensioning rules; dimensioning rules for building construction
EN 10088	Stainless steels
DIN 1052	Design, calculation and dimensioning of wooden structures

Guarantee/ product liability (exclusion)

In addition to the abovementioned regulations and safety instructions, the valid technical regulations and rules must be observed by the specialist installers.
The installer is responsible for dimensioning the novotegra mounting system
The installer is responsible for connecting the interfaces between the mounting system and building. That also includes ensuring that the building envelope is sealed.
For flat roofs, the roof seal must be evaluated with regard to the material of the seal strip, resistance, aging, compatibility with other materials, overall condition of the roof seal, requirement of a separating system between the roof seal and mounting system on-site by the installer under their own responsibility. The required and necessary measures or precautions to protect the roof seal for mounting the substructure of a PV system must be performed by the installer with the assistance of a technical specialist if necessary. BayWa r.e. Solar Energy Systems shall not accept liability for incorrect or insufficient measures and precautions for protecting the roof seal!
The installer must verify the coefficients of friction applied in the calculation for proving the anti-slip properties of PV systems on flat roofs. Coefficients of friction calculated on-site can be incorporated and must be provided to BayWa r.e. Solar Energy Systems for calculation. BayWa r.e. Solar Energy Systems shall not accept liability for the correctness of the assumed values or for damage due to the use of incorrect values.
The tightening torques specified must be observed.
No components may be omitted or own components added.
All specifications and statistics refer to installation of the mounting system in Germany – unless explicitly stated otherwise. Other regulations may apply in other countries. As a result, no liability can be accepted for installation of the mounting system outside Germany – without the approval of BayWa r.e. Solar Energy Systems.

The specifications of the module, cable and inverter manufacturers must be adhered to. If they contradict these installation instructions, please consult us, or the manufacturer in question for components not delivered by BayWa r.e. Solar Energy Systems, before installing the novotegra mounting system.

When our sales staff draw up quotations for novotegra systems, they are not always sufficiently aware of the local conditions, and as a result, the quoted quantities may change during installation. These changes largely concern the number of fastening material to the building envelope (e.g. roof hooks). If this is the case, the additional components required per the dimensioning absolutely must be installed.

BayWa r.e. Solar Energy Systems GmbH accepts no liability for damage resulting from incorrect handling of the installed components.

BayWa r.e. Solar Energy Systems is not liable for incorrectly or incompletely filled in data entry forms. Accurate and completely filled-in data entry forms are essential for correct dimensioning.

The mounting instructions, guarantee conditions and liability exclusion information must be observed.

The listed standards and guidelines are specified for Germany. The latest versions must be observed. Outside Germany, the corresponding national standards and guidelines must be applied.

The corresponding accident prevention guidelines must be observed.

Internal tests were also carried out to guarantee load-bearing capacities. Please note that the technical approvals and Z-9.1-453 and Z-9.1-652 must be complied with for screw fastening of roof hooks to rafters.

Local construction and safety regulations must also be observed.

Notizen:

Notizen

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