

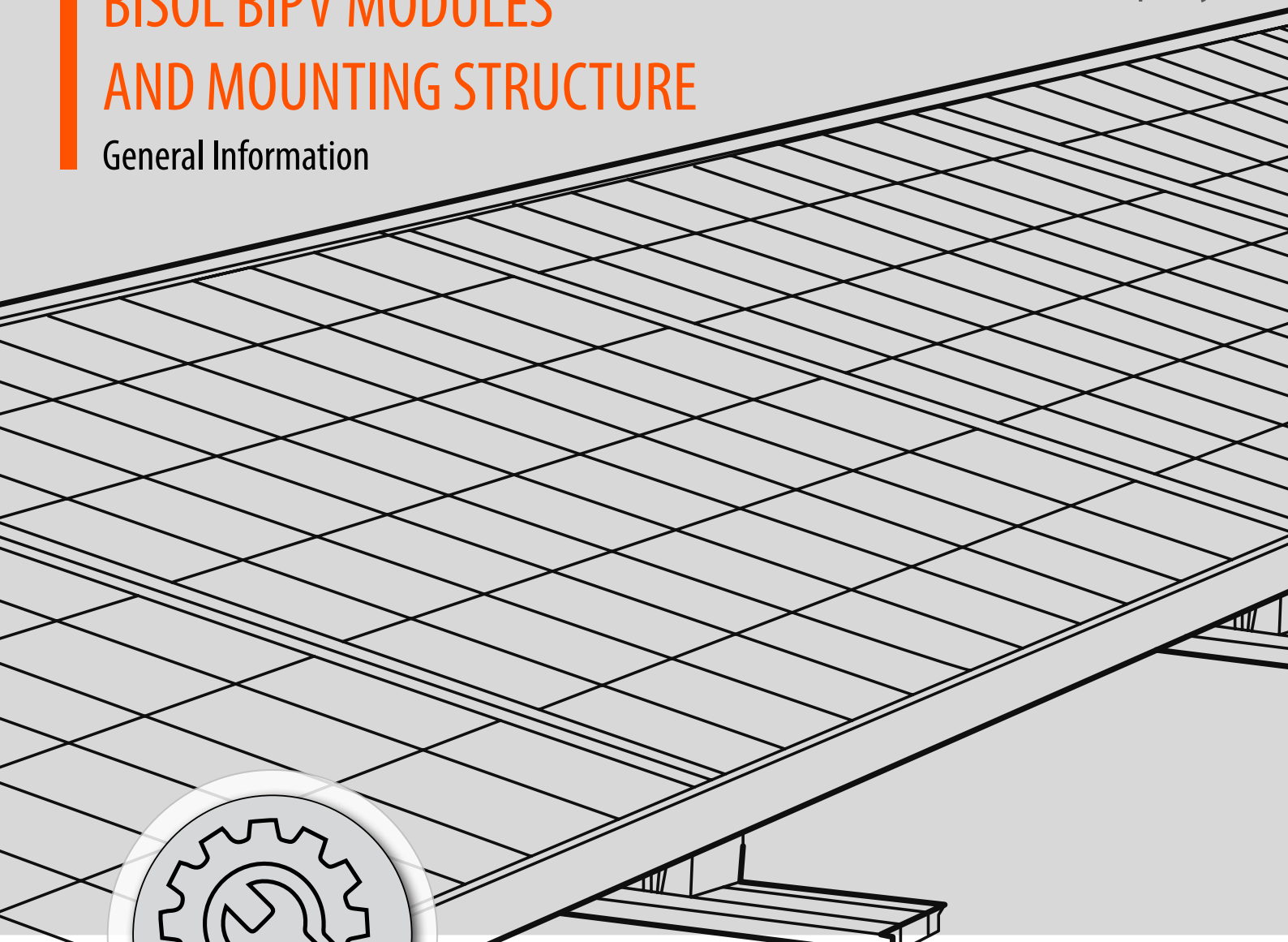
Installation Manual



Solar company!

BISOL BIPV MODULES AND MOUNTING STRUCTURE

General Information



The **sunny** side of **life!**



THANK YOU!

We want to congratulate you for purchasing BISOL BIPV solar modules and express our most sincere gratitude for using products that are high energy efficient and designed for long-term high-performance use. It is our pleasure and delight to know that we have been able to fulfil your expectations with our high-quality materials processed on state-of-the-art automated production line.

We are proud of our products, and we are proud of you as our BISOL ambassador.

BISOL Team



Before starting the installation of BISOL BIPV solar modules, carefully read this entire installation manual. This manual contains important information about safety, installation, wiring, operating, maintenance and similar.

If any further information is necessary, please consult your module dealer or the manufacturer directly. Failure to follow these instructions may result in material damage and can in worst case jeopardize life safety and health.

Store this manual in an easy reachable place.

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1 GENERAL INFORMATION



Notice

BISOL BIPV INSTALLATION MANUAL is the summary of installation manual with title:
Solar Energy Systems by Schweizer: Installation Manual – Photovoltaic In-Roof Mounting System Solrif®.

All information provided (including pictorial material) is owned by the Ernst Schweizer AG. BISOL BIPV INSTALLATION MANUAL is specifically modified for BISOL BIPV modules and mounting structures owners only.

1.1 Information on this Manual

This manual describes the procedure for the in-roof mounting of BISOL BIPV modules as well as for replacing BISOL BIPV modules with Solrif® in-roof mounting system. With in-roof mounting, the PV array substitutes any existing tile roofing. However, tile roofing remains around the PV array. In addition, this manual provides instructions on the maintenance of BISOL BIPV modules with Solrif® in-roof mounting system and their disposal.

Supplementary Documents

Delivery note with article numbers and description of all components delivered.

Limit

- The installation of full-roof PV systems (the roof is covered completely with photovoltaic modules or dummy modules, no tiles are left on the roof) is possible, but is not the subject of this installation manual.
- For connection of the PV array to the inverter, please refer to the inverter supplier's documentation.

This manual is intended for craftspeople who have completed their vocational training in the roofing trade. Furthermore, the craftsman must also have acquired either an additional qualification for the installation of photovoltaic systems or have many years of experience in the installation of photovoltaic systems. With regard to adhering to maintenance procedures, this manual is also directed at the operator of the photovoltaic system.

Before carrying out any work, the implementing or supervising person must:

- Read this manual carefully and understand it, or clarify any ambiguity with the system's planners.
- Instruct assisting personnel according to this manual and supervise them during the entire work process.

The installation company must:

- Keep this manual to hand during the entire work procedure on the building site.
- After the installation work has been completed: hand over this manual to the system operator.

The system operator must:

- Store this manual and the delivery note with the rest of the system documentation.
- Observe the instructions on system maintenance.
- Make this manual and any further relevant documentation available to the specialist personnel who have been commissioned to carry out the maintenance, repair or deinstallation work and enclose them with the documentation for the photovoltaic system again after the work has been completed.

The seller of the system or of the building on which it is installed must:

- Pass on this manual to the new operator as part of the system documentation.

Further applicable documents, regulations and provisions

- Apart from this manual, please observe the module pitch plan and the string plan, the relevant safety regulations, particularly those for working on a roof and for handling electrical currents, as well as the documentation for the other components in the photovoltaic system.
- In the event of discrepancies or other ambiguity, clarify these through the system's planners.

Diagrams in this manual are intended to aid fundamental understanding and show the example of a 3x3-array. The implementation for the actual design must be analogous to this example portrayed here.

1.2 Exclusion of Liability

BISOL Production Ltd. as a manufacturer of BISOL BIPV photovoltaic modules takes no responsibility for the design solutions of individual designers nor for Solrif® system solutions, which as such are a product of Ernst Schweizer AG, all in connection to the installation of photovoltaic modules with Solrif® system.

The information and safety instructions in this manual have been compiled taking into account the currently applicable norms, guidelines and regulations, the latest technology and the long years of experience gathered by BISOL Production Ltd. and Ernst Schweizer AG.

The shipment contents, or the design of the system, can deviate from the descriptions and diagrams specified in this manual because of optional items ordered, manufacture of customised designs or the latest technological changes.

This manual's publication date shall apply. BISOL Production Ltd. reserves the right to update this manual in the light of technical changes to the system as part of further development to improve performance characteristics and safety. The most recent version of this manual is published on official website www.bisol.com.

BISOL Production Ltd. accepts no liability for damages and accidents that may arise in particular from the following causes:

- Inappropriate use of the mounting system
- Non-observance of the information and instructions in this manual
- Work carried out on or with the system by non-qualified or unauthorised personnel
- Mounting of non-original spare parts
- Unauthorised modifications



1.3 Guarantee Conditions

BISOL BIPV photovoltaic modules are subject to the Standard Limited Guarantee (SLG) terms and conditions, which are published on the official website www.bisol.com.

1.4 Customer Service and Product Monitoring

For problems and questions that cannot be solved with the aid of this manual and/or on consultation with the planner, as well as for technical information:

- Please contact the customer service of the BISOL Production Ltd or of Ernst Schweizer AG. Above and beyond customer service, BISOL Production Ltd is interested in experiences that arise from dealing with the system with the objective of constantly improving the system.
- In the event of problems when dealing with the system, interruptions in operation and any errors that occur, please contact BISOL Production Ltd using the contact data in the footer.

2 SAFETY REQUIREMENTS

2.1 Introduction

Installation of the device may only be carried out by authorized personnel and industry experts who are familiar with all the latest international and local guidelines for the installation of PV products. Non-observance of the safety requirements instructions and safety and warning notices specified in local legislation and guidelines can lead to considerable dangers.

2.2 Responsibility

As customer/operator:

Only commission specialist firms which offer guarantees for the professional and safety-oriented work execution with the planning of the system and the execution of the installation, maintenance, repair and deinstallation work.

As employer of the firm executing the work:

Ensure that all work is carried out or supervised by sufficiently qualified specialist personnel, roofing jobs by roofers, AC/DC cabling by electricians. Ensure that at least two persons are present on the construction site at all times while work is being conducted.

Ensure that instructed personnel/assistant personnel were instructed sufficiently on safety-oriented work on the roof and is supervised during the entire work process. Also observe the country-specific accident prevention regulations of the respective trade associations (in Germany: BGV A1 – Principles of Prevention BGV A3 – Electrical Plant and Equipment, BGV C22 – Construction Work).



Ensure collective protection (scaffoldings, roof guard rails) in accordance with the current regulations (installation of photovoltaic systems on roofs is only permissible with collective protection).

Ensure that all personnel that carries out work on the photovoltaic system or supervises such work has read and understood this manual, that assistant personnel were instructed sufficiently and is supervised during the entire work process.

Supply your personnel with personal protective equipment (PPE) in accordance with the current regulations for roof work and enforce the correct use of PPE. Before installing the system, ensure that the roof substructure (rafters, roof battens) corresponds to national regulations in terms of both quality and load-bearing capacity.

As the person executing or supervising the work:

Only tread onto the roof if the conditions for working safely are fulfilled. Instruct assisting personnel on all safety-relevant aspects and supervise them during the entire work process.

The employer in the firm executing the work must ensure that the requisite safety measures have been taken to prevent falls.

The system operator must:

Observe the maintenance intervals stipulated in this manual.

For other information on safety regulations, you can also see:

Installation Manual – General Information at www.ernstschweizer.ch.

3 INSTALLATION MANUAL

DESCRIPTION OF THE BISOL BIPV MODULES WITH SOLRIF® IN-ROOF MOUNTING SYSTEM

3.1 BISOL BIPV Modules with Solrif® In-roof Mounting System Overview

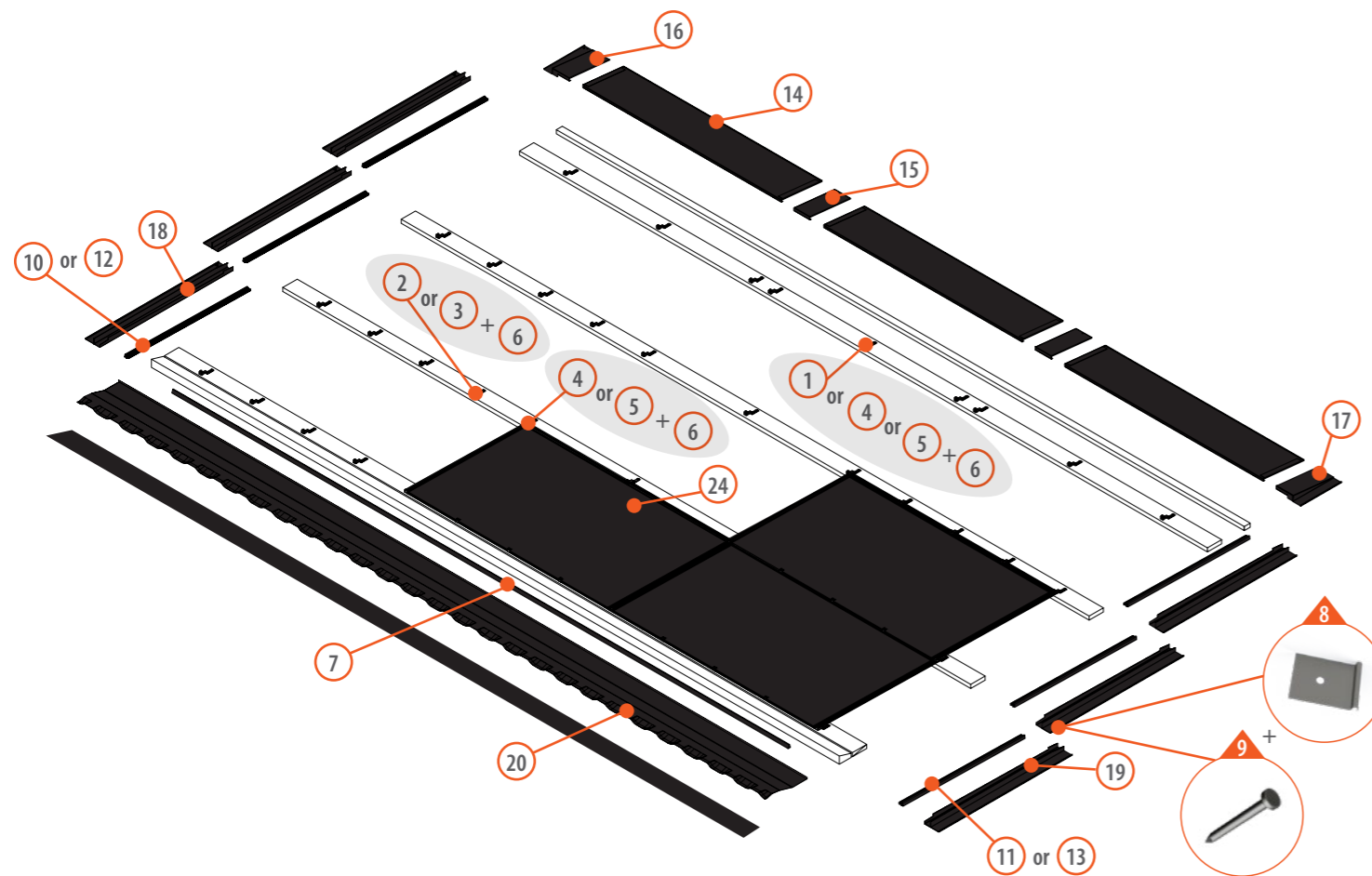


Figure 1: BISOL BIPV modules with Solrif® in-roof mounting system overview

	Component	ID Code	Component description
1		SEK-BIPV-003	Top mounting clamp for flat sheet metal connections, without screws
2		SEK-BIPV-004	Mounting clamp glass stainless spring steel, black, without screws
3		SEK-BIPV-039	Mounting clamp glass stainless spring steel, silver, without screws, sea water resistant
4		SEK-BIPV-009	Mounting clamp profile stainless spring steel, black, without screws
5		SEK-BIPV-048	Mounting clamp profile stainless spring steel, silver, without screws, sea water resistant
6		SEK-BIPV-040	Pan-head screw A2 Torx T20 x 4.5 x 3.5 mm
7		SEK-BIPV-018	Valley sealing strip 1000 x 30 x 40 mm / Solrif® foam
8		SEK-BIPV-019	Fixing for flashing Solrif® 05483 / 20 x 10 x 37 mm
9		SEK-BIPV-020	Roofing nail DIN1160 hot-dip galvanised 2.5 x 25 mm
10		SEK-BIPV-041	Aluminium flashing profile stand. Left, black, 34.5 x 24.5 x module height + 31.5 mm
11		SEK-BIPV-042	Aluminium flashing profile stand. Right, black, 34.5 x 24.5 x module height + 27.5 mm
12		SEK-BIPV-043	Aluminium flashing profile stand. Left, silver, 34.5 x 24.5 x module height + 31.5 mm
13		SEK-BIPV-044	Aluminium flashing profile stand. Right, silver, 34.5 x 24.5 x module height + 27.5 mm
14		SEK-BIPV-045	Top flashing, black, 21 x 341 mm
15		SEK-BIPV-033	Top flashing joiner, black, 133 x 23 x 342 mm
16		SEK-BIPV-034	Flashing corner left, black, 210 x 41 x 342 mm
17		SEK-BIPV-035	Flashing corner right, black, 210 x 41 x 342 mm
18		SEK-BIPV-046	Aluminium flashing side left, black, 1200 x 353 mm
19		SEK-BIPV-047	Aluminium flashing side right, black, 1200 x 353 mm
20		SEK-BIPV-038	Connecting sheet Alu Stretch 300 mm x 5 m
21		SEK-BIPV-049	Eaves profile (31 x 16 x 1200 mm)*
22		SEK-BIPV-050	Profile fixing for eaves profile (30 x 14 x 69 mm)*
23		SEK-BIPV-051	Mounting gauge (W x H x L; (module width + 24) x 14 x 69 mm)*
24		BS0375BB55X4049A	BISOL BIPV PV Module

*Optional.

3.2 Components



Notice

Measurements that are taken from the left-hand edge of the PV array towards the right, meaning horizontally, parallel to the eaves or to the roof ridge, will henceforth be referred to as “width.”

Measurements that are taken from the eaves towards the roof ridge, parallel to the verge, will henceforth be referred to as “height.” Measurements that are taken perpendicular to the roof surface will be referred to as “thickness.” The largest measurement of a component before installation will be referred to as “length” irrespective of its orientation after installation. These descriptions can deviate from those in your supplier’s data sheet, for example, the measurement of the longer side of the module can be described as “length” and that of the shorter side as “width,” irrespective of the module’s orientation after installation.

BISOL BIPV Components Overview

BISOL BIPV Components Overview	
1	BISOL BIPV laminate
2	Solrif® frame profiles
3	Backsheet or glass
4	Connection cables with connectors
5	Junction box

The frames of modules placed side by side interlock. The modules that are installed above overlap the modules below them (like roof tiles). A rubber lip in the upper profile seals between the two modules. Thus the photovoltaic modules form the water-proofing layer on the roof. Hence for roof slopes > 10°, rainproof integration into the roofing is possible in accordance to ZVDH regulations (Central German Roofing Industry Association).

- Only use a BISOL BIPV module within one PV array.

3.2.1 BISOL BIPV Module with Solrif® Frame

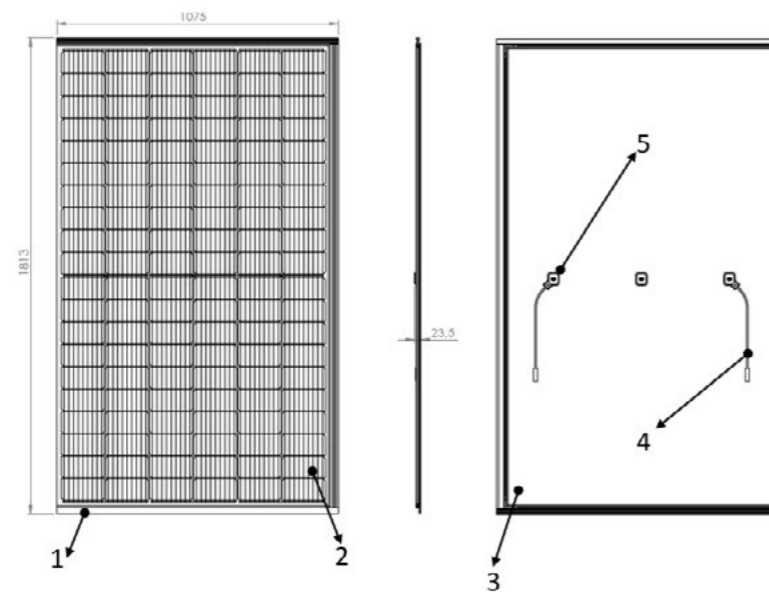


Figure 2: BISOL BIPV module with Solrif® frame overview

3.2.2 Dimension of PV Array and Module Mounting Pitches

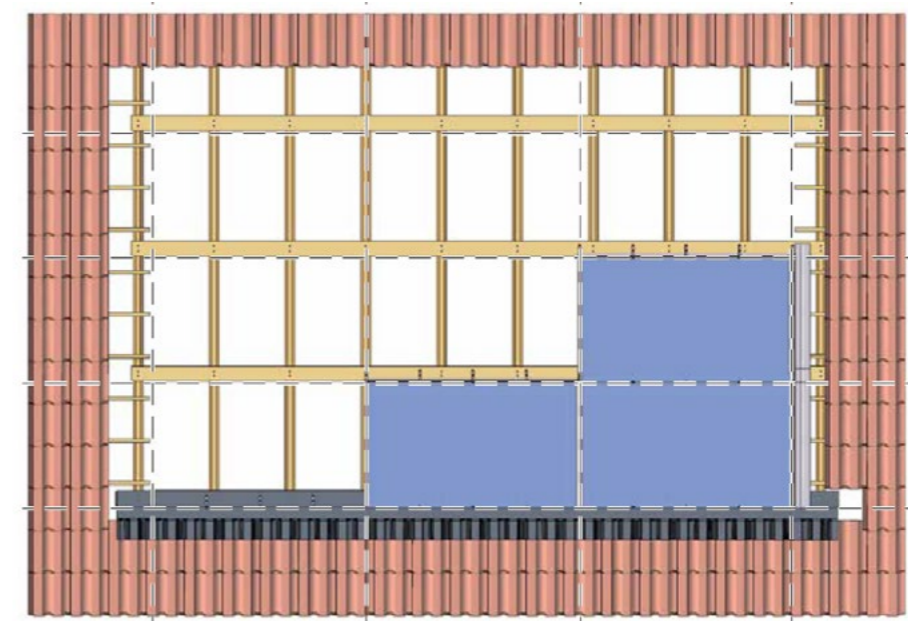


Figure 3: Layout of the module pitch (3 modules BISOL BIPV's inserted)

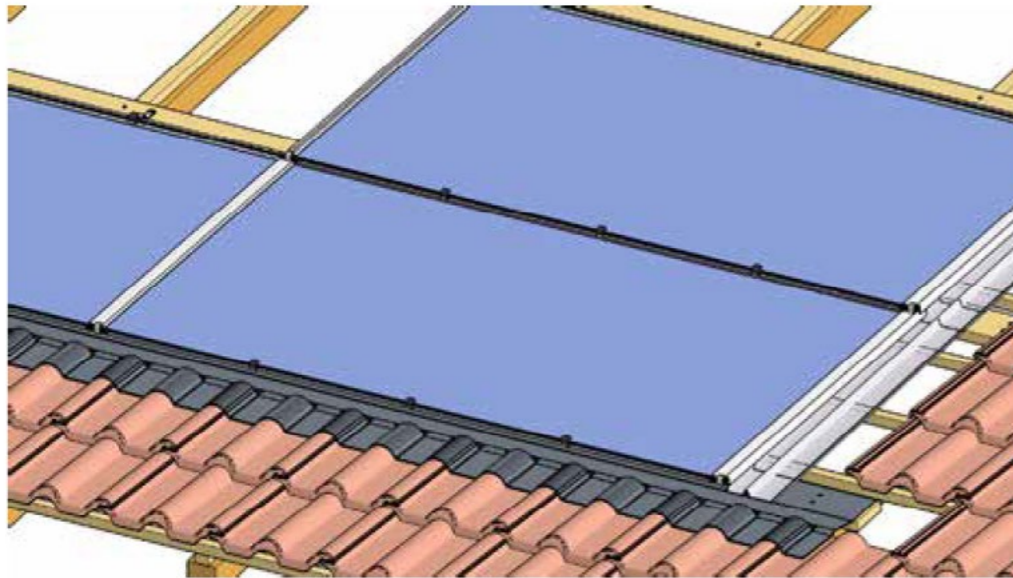


Figure 4: Details

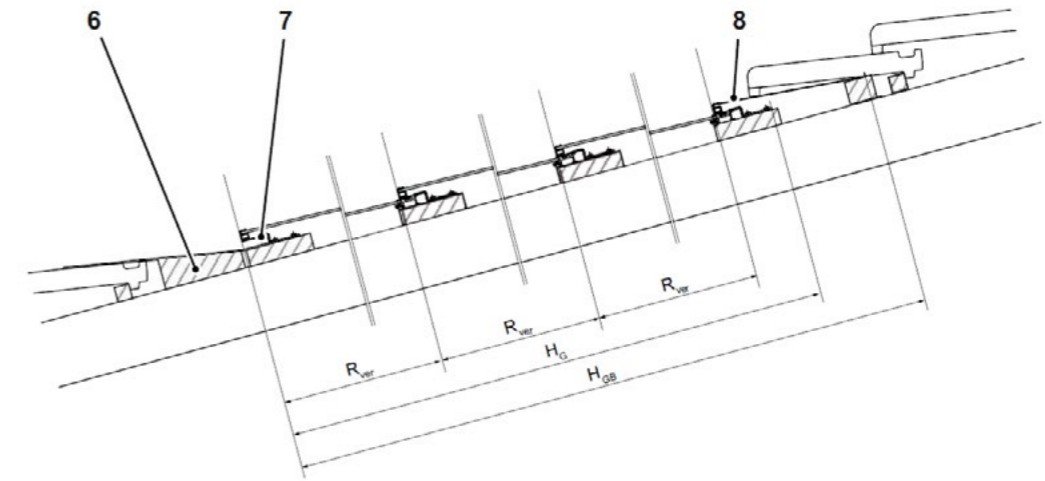


Figure 6: Vertical cross-section

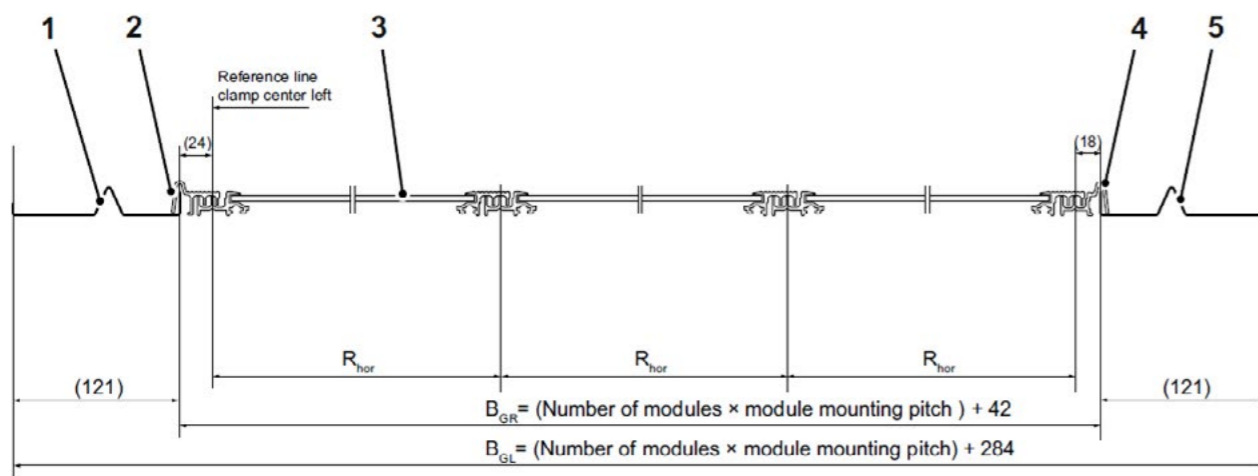


Figure 5: Horizontal cross-section

General Components Overview	
1	Flashing side left
2	Flashing profile left
3	BISOL BIPV module
4	Flashing profile right
5	Flashing side right
6	Wedge plank
7	Mounting Clamp Profile
8	Flashing top
L_B	Width of the laminate
L_H	Height of the laminate
M_B	Width of a single framed module = $L_B + 50$
M_H	Height of a single framed module = $L_H + 32$
R_{hor}	Rhor Horizontal module mounting pitch (distance of any reference point on the module to the same point on the module mounted beside it to the right or left) = $M_B - 18$
R_{ver}	Rver Vertical module mounting pitch (distance of any reference point on the module to the same point on the module mounted above or below it) = $M_H - 32$
N_{hor}	Nhor Number of modules laid out side by side in the PV array
N_{ver}	Nver Number of modules laid out above each other in the PV array
B_{GR}	Width of the PV array between the flashing sides = $(N_{hor} \times R_{hor}) + 42$
B_{GL}	BGL Width of the PV array including the flashing sides = $(N_{hor} \times R_{hor}) + 284$
H_G	HG Height of the PV array between the lower edge of the bottom mounting clamp and the upper edge of the top mounting clamp = $(N_{ver} \times R_{ver}) + 104$
H_{GB}	HGB Height of the PV array between the lower edge of the bottom mounting clamp and the upper edge of the flashing tops = $(N_{ver} \times R_{ver}) + 283$

3.2.3 Substructure

Solrif® battens measuring 120 mm × 30 mm are used as a substructure, which are screwed onto the existing roof construction instead of or in-between the roof battens to which the tiles were attached. Minimum requirements for wood quality: Strength category C24.



Notice

Plan an extra 10 % for cutting losses compared to the batten plan. In addition, keep some spare wood to hand to equalize out any unevenness in the roof construction or to be able to implement connections or linings. A wedge plank is necessary for the bottom gutter of the PV array, see Chapter „Wedge Plank“.

The bottom row of Solrif® battens must extend beyond the flashing sides by at least 150 mm respectively as an overlay for the lead flashing, i. e. the length of the bottom row of Solrif® battens must be at least $B_{GL} + 300$ mm.

All other rows of Solrif® battens must extend beyond the flashing sides by at least 50 mm respectively, i. e. the length of the other rows of Solrif® battens must be at least $B_{GL} + 100$ mm respectively.

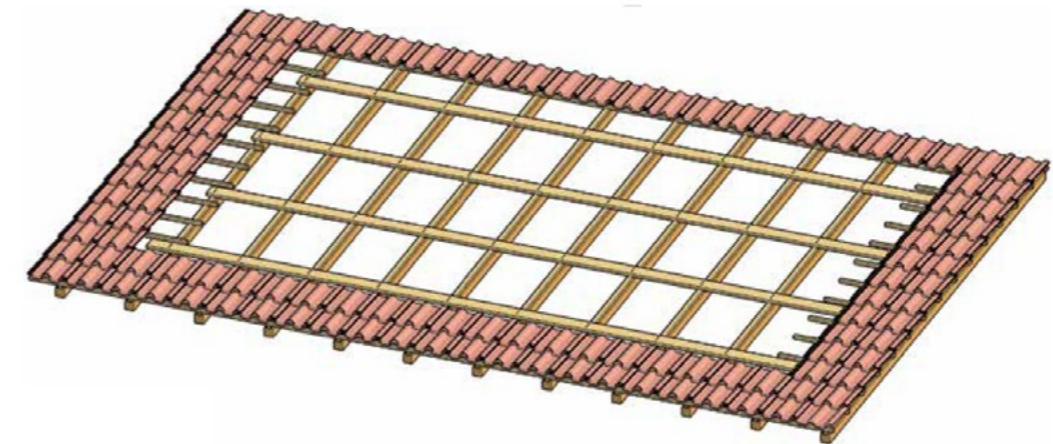


Figure 7: Substructure

3.2.4 Mounting Clamps

BISOL BIPV module with Solrif® frame are attached to the substructure with mounting clamps. There are three different types of clamps:

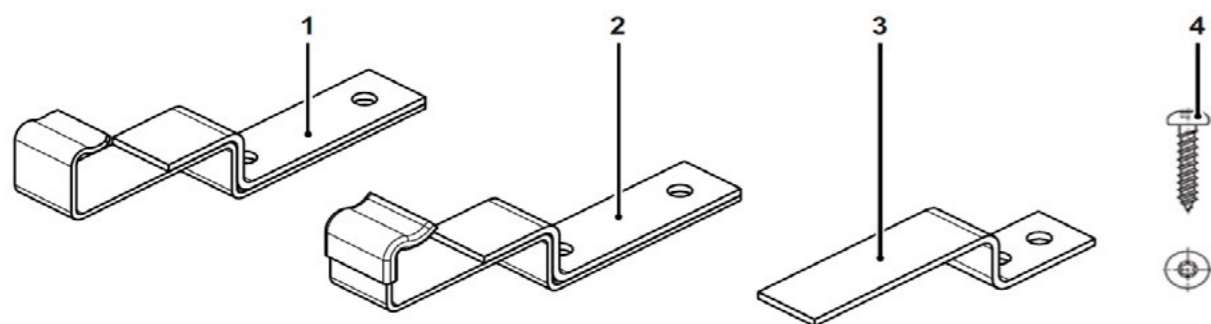


Figure 8: Mounting clamps

		Art. No.	Application
1	Mounting Clamp Profile - raw, 1.4310 - black/browned, 1.4310 - raw seawater-resistant, 1.4404	13318 06497 13995	Fastens overlapping modules in the area of the profiles left/right or flashing tops; always required
2	Mounting Clamp Glass with protective shrink tubing - raw, 1.4310 - black/browned, 1.4310 - raw seawater-resistant, 1.4404	13319 06500 13996	Fastens overlapping modules in the area of the open glass edge; number according to structural analysis requirements
3	Mounting Clamp Top - raw, 1.4310 - raw seawater-resistant, 1.4404	33954 13997	For fastening the top row of modules when not using regular flashings top
4	Wood screw with pan head 4.5x35 SST, with general building inspectorate approval ETA/DIBt (countersunk bolts may not be used)	61831	



Notice

Danger of confusion!

Please be aware that the different types of clamps must be used positioned and in quantities as required according to the roof plan.

Roof plan design needs to be done with PV planning software SPT (proSOLRIF design software SPT at www.ernstschweizer.ch for calculating the number of mounting clamps required per module.)

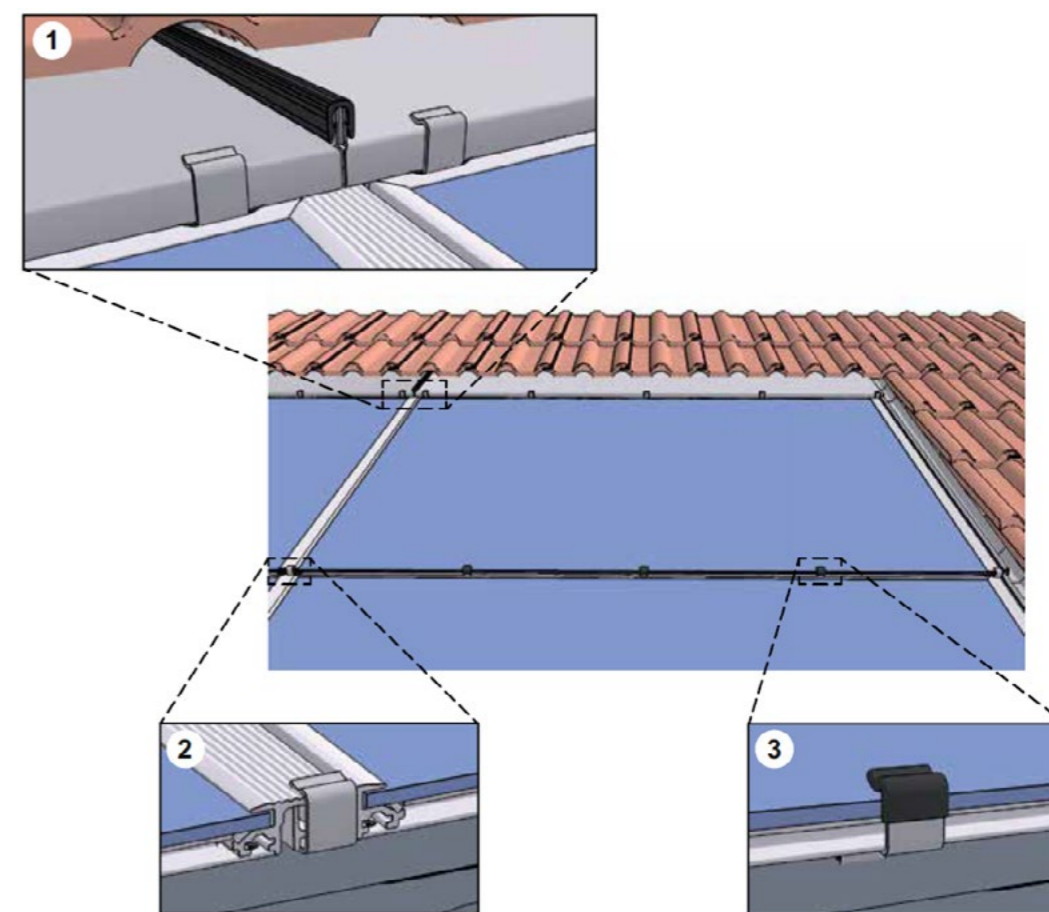


Figure 9: Mounting clamps mounted

1	Mounting clamp profile mounted with the flashing tops
2	Mounting clamp profile for securing the module overlap or the overlap with flashing profiles
3	Mounting clamp glass for securing the bottom module edge

3.2. Flashing Profiles

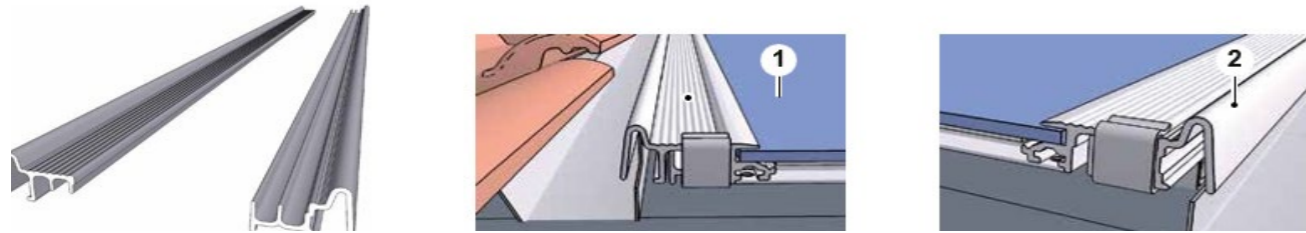


Figure 10: Flashing profiles

1	Flashing profile left
2	Flashing profile right

3.2.6 Side Flashings

The flashing sides create a link between flashing profiles and roof tiles. The flashing tops ensure a transition between the top module edge and the row of tiles that lies above it. They are designed in such a way that they are suitable for many conventional types of roof tiles. In the event of other requirements (e. g. tiling bat tens and Solrif® battens at different levels, special types of tiles, like slate, etc.) please contact BISOL Production Ltd and Ernst Schweizer AG.

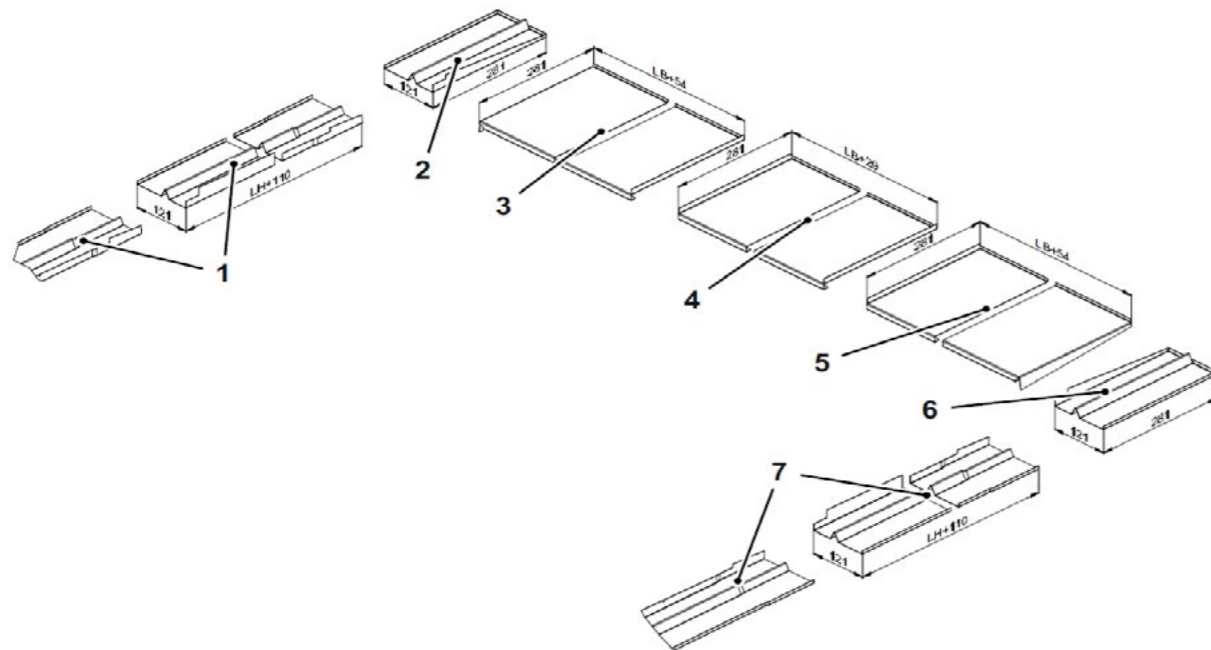


Figure 11: Side flashings

		Measurements height × width L_H = laminate height, L_B = laminate width
1	Flashing side left	$(L_H + 110) \times 121$
2	Flashing side top left	281×121
3	Flashing top left	$281 \times (L_B + 54)$
4	Flashing top middle	$281 \times (L_B + 32)$
5	Flashing top right	$281 \times (L_B + 54)$
6	Flashing side top right	281×121
7	Flashing side right	$(L_H + 110) \times 121$



Notice

When using side flashings other than the original Solrif® side flashings, it must be checked whether galvanic separation is necessary.

3.2.7 Bottom of PV-Array: Lead Flashing, Wedge Plank, Sealing Tape Strip

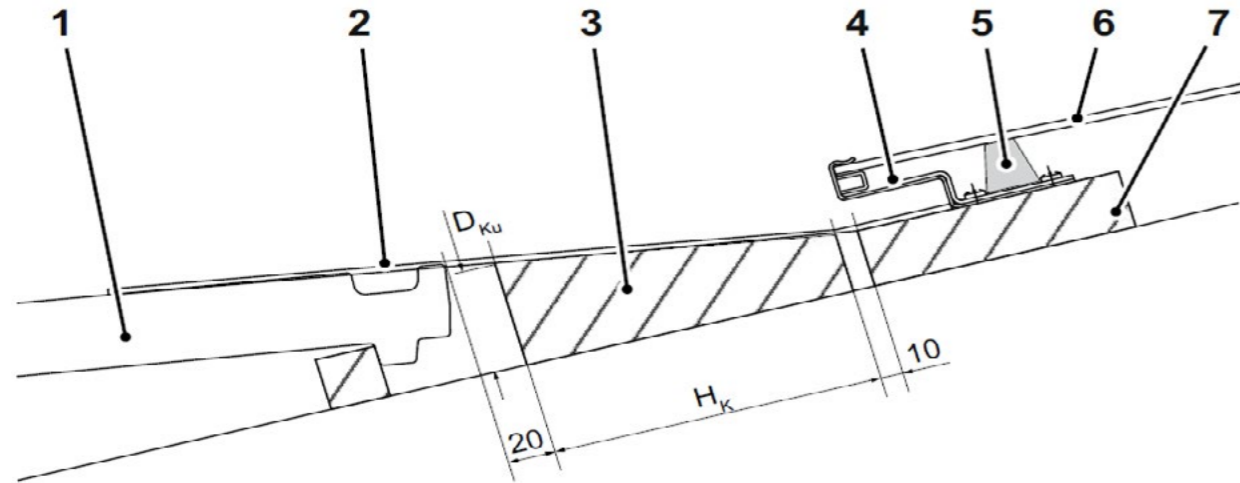


Figure 12: Bottom gutter

1	Roof tile
2	Lead flashing
3	Wedge plank
4	Mounting clamps
5	Sealing tape strip
6	BISOL BIPV module with Solrif® frame
7	Solrif® batten
D_{Ku}	Thickness of the wedge plank at the bottom
H_k	Height of the wedge plank

The BISOL BIPV module with Solrif® frame can be mounted either down to the eaves or with tile roofing between PV array and eaves. Observe the tech note about the application limits (snow loads) in the instruction sheet under customer login at www.ernstschweizer.ch.

When tile roofing is used between PV array and eaves, the transition should be executed using lead flashing and wedge plank.

3.2.7.1 Lead Flashing

For the transition from the bottom edge of the array to the tiles, lead flashing is used as is customary for other roof inserts, for example skylights (lead foil roll 300 mm or black aluminium Mage Flex flashing tape.

280 mm or 450 mm available as accessories, roll length 5 m or 7.5 m). The required height of the lead flashing depends on the roof slope and the tile arch and must be determined in combination with the height of the wedge plank, see Chapter „Wedge Plank“.



Notice

If the lead flashing is to be comprised of several sections of Mage Flex flashing tape, the sections must overlap by at least 100 mm.

3.2.7.2 Wedge Plank

The wedge plank is mounted underneath the bottom Solrif® batten. It supports the lead flashing, ensuring that no trough forms in the lead flashing and thus no water can remain there.

Minimum requirements for wood quality: Strength category C24

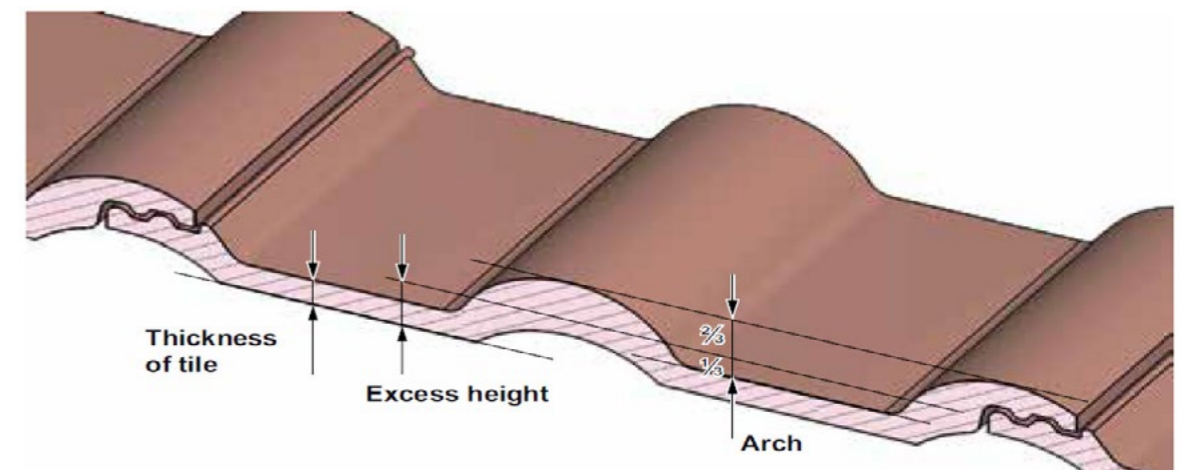


Figure 13: Excess height

Roof slope	Excess height ~20 mm		Excess height ~40 mm	
	H_k	D_{ku}	H_k	D_{ku}
10°	145 mm	50 mm	300 mm	70 mm
15°	75 mm	45 mm	170 mm	65 mm
20°	45 mm	45 mm	110 mm	65 mm
25°	30 mm	40 mm	80 mm	60 mm
30°	20 mm	40 mm	60 mm	60 mm
35°	10 mm	40 mm	45 mm	60 mm
40°	10 mm	35 mm	30 mm	55 mm

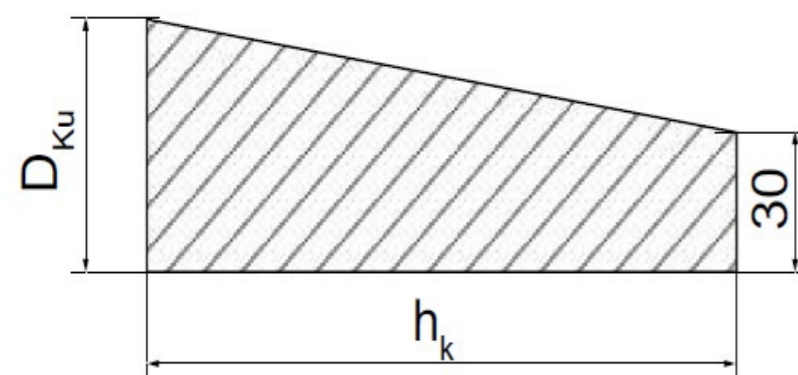


Figure 14: Measurements of the wedge plank

The length of the wedge plank corresponds to the width of the PV array including the flashing sides (B_{gl}).

3.2.7.3 Sealing Tape Strip

The sealing tape strip is mounted onto the lead flashing to close the gap underneath the bottom row of clamps against small animals.

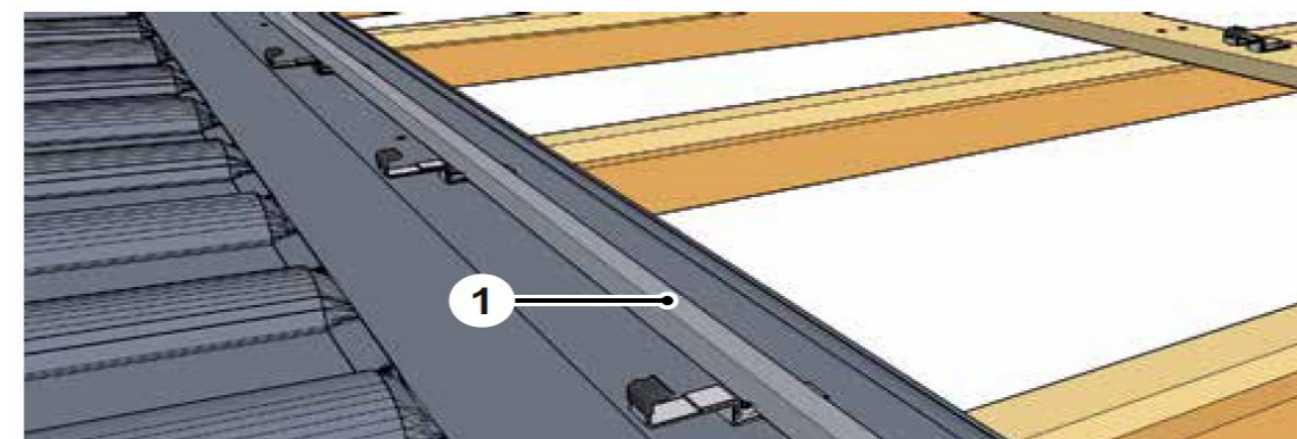


Figure 15: Sealing tape strip

1	Sealing tape strip
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3.2.8 Connection Cables, Cable Strings

Use connection cables and cable strings which fulfil the following requirements:

- Made of flexible copper wire.
- Double insulation, suitable for in-roof installation, meets protection class II (SCII) and IEC 61730.
- Heat resistant up to at least 90 °C.
- Has dimensions in accordance with the regulations at the place of installation.
- Follow the directions for the division of the PV array into strings and the resulting position of connection cables and cable strings in the module pitch plan or string plan which was drawn up by the system planner.
- When the modules are arranged in a series connection, ensure that the maximum permissible system voltage is not exceeded.
- When the modules are arranged in a parallel connection, ensure that every row is fused with its own fuse.
- Observe the instructions of the module manufacturer and of the system planner.

3.2.9 Grounding and Lightning Protection



Notice

The national and local requirements regarding grounding and lightning protection must be observed.

A photovoltaic system does not affect whether lightning protection is necessary or not, i. e. a roof without a photovoltaic system which does not have to be fitted with lightning protection does not need lightning protection even with a photovoltaic system. If lightning protection exists, the photovoltaic system must be integrated into the lightning protection pursuant to the local regulations. You will find further details in the tech note under your customer login at www.ernstschweizer.ch.

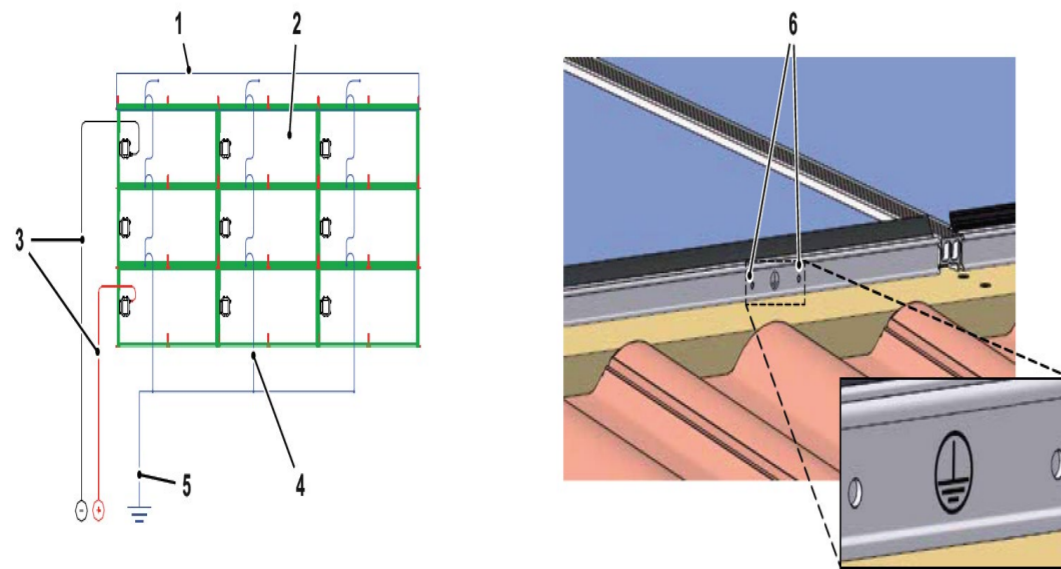


Figure 16: Drilling work for grounding

1	Flashing top
2	Module
3	Cable strings
4	Grounding cables within a grounding string
5	Grounding cables between array and household fuse box
6	Holes (Ø 3.3 mm) for grounding (view onto top module edge)

3.2.10 Mounting Screws for Battens

To mount the Solrif® battens to the counter battens, 2 wood screws with general building inspectorate approval in accordance with roofing standards are required for each intersection of a Solrif® batten and counter batten:

Diameter Length	5 mm
Permissible shape of head	Thickness of the counter batten + 60 mm Countersunk

3.2.11 Other Accessories

3.2.11.1 Fixing for Flashing

Fixing for flashing is used to mount the side flashing onto the Solrif® battens or tiling battens.

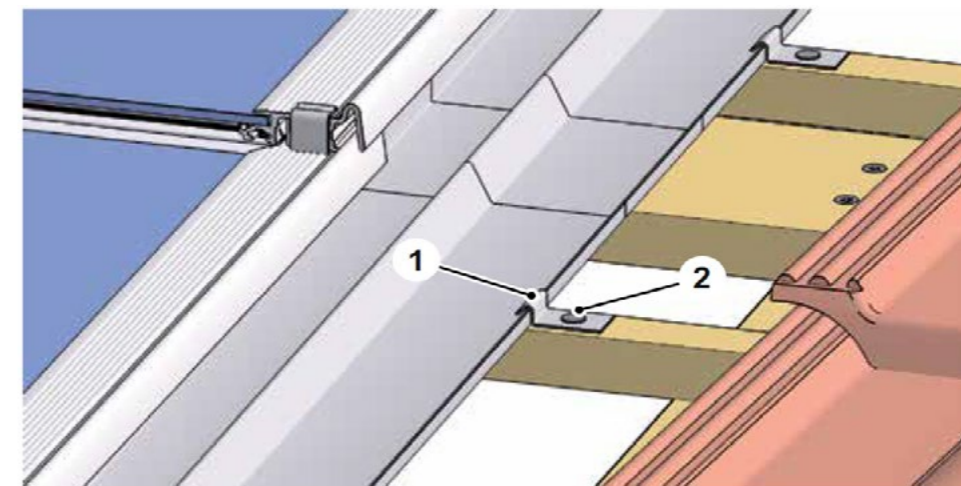


Figure 17: Fixing for flashing on flashing sidesgrounding

1	Fixing for flashing
2	Clout nail 2.5 x 25 mm

3.2.11.2 Protective Profiles

Protective profiles are used to connect flashing tops, see Chapter „Side Flashings“.

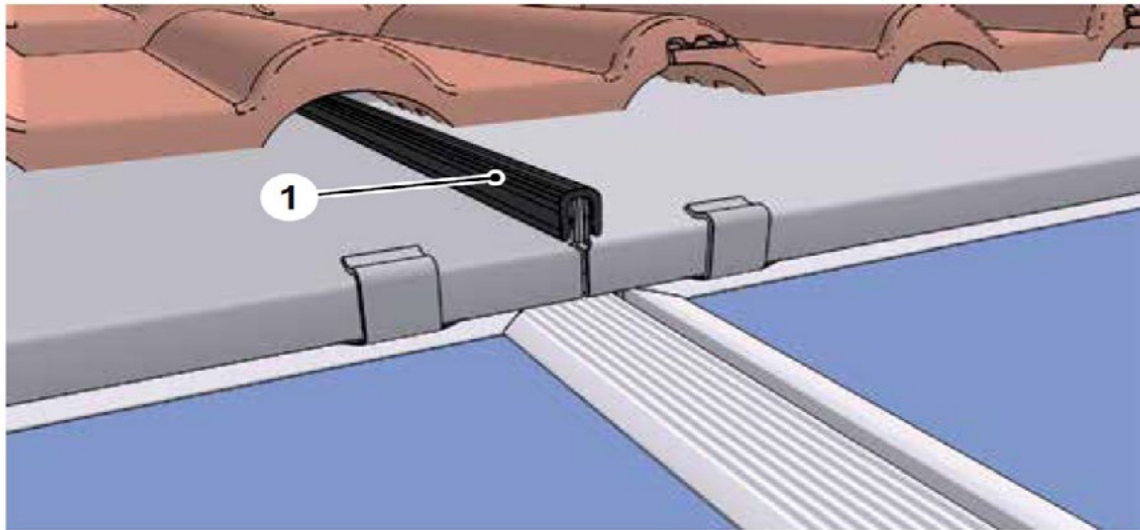


Figure 18: Protective profile (view onto top edge of array)

1	Protective profile
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3.2.11.3 L-Section to Support the Bottom Row of Mounting Clamps

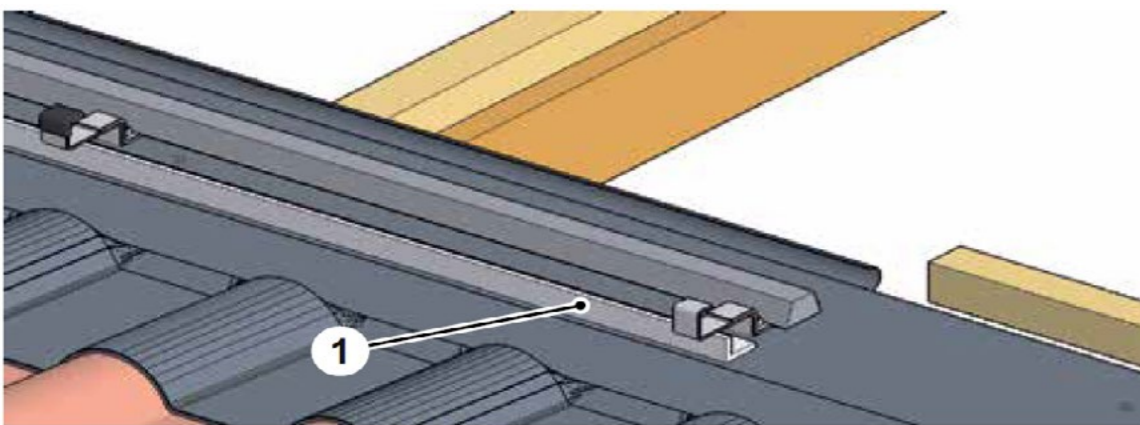


Figure 19: L-section

1	L-section
---	-----------

In elevated snow load conditions (> 2,400 Pa) the bottom row of mounting clamps must be supported (to be provided by the customer: e. g. using a 16 mm aluminium L-section, a piece of wood or similar).

3.3 Technical Data/Limit of Application

Roof plan design needs to be done with PV planning software SPT (proSOLRIF design software SPT at www.ernstschweizer.ch for calculating the number of mounting clamps required per module).

Measurements/Weight of the Modules	see the module manufacturer's data sheet
Max. snow load	5,400 N/m ² **, structural design must be observed (proSOLRIF design software at www.ernstschweizer.ch for calculating the number of mounting clamps required per module.)
Max. wind load (suction)	2,400 N/m ² **, structural design must be observed (proSOLRIF design software at www.ernstschweizer.ch for calculating the number of mounting clamps required per module.)
Substructure	Requirements according to the effects (wind and snow loads) on the supporting structures and taking into account the planned implementation of the PV array (Germany: DIN 1055-4 Wind loads, DIN 1055-5 – Snow and ice loads, EN 1991-1-3 – Snow loads (Eurocode 1), EN 1991-1-4 – Wind loads (Eurocode 1))
Acceptable deviation from the flatness of the substructure	0.5 % (5 mm per meter)
Acceptable roof slope where there is a rainproof roof underlay	22 ... 65°*
Acceptable roof slope where there is a watertight roof underlay	10 ... 65°*
Min. permissible distance to the coast when using non-salt-water-resistant mounting clamps	3 km**
Min. permissible distance to the coast when using salt-water-resistant mounting clamps	50 m**
<p>* With roof slopes below 32°, drainage of the roof underlay into the rain gutter must be ensured. **Please also observe the limit of application stipulated by the module manufacturer or the system planner.</p> <p>In the case of renovation, the characteristics of the roof underlay foil on roof slopes < 32° must be checked for conformity with the above-mentioned requirements and replaced if necessary.</p>	



4 TRANSPORTATION

4.1 Transportation in Packaging

- Please observe the personnel requirements pursuant to Chapter „Responsibility“.
- Please observe the handling instructions on the packaging.

4.2 Transportation of Individual Modules

Unprotected glass rim on the lower edge of the module.

Risk of damage to module!

- Do not set the module down on its glass rim.
- Leave the module in its original packaging until immediately prior to insertion into the PV array.
- Never hold or carry the module under any circumstances by its connection cables or junction box.



5 INSTALLATION

5.1 Checking the Requirements

5.1.1 Roof Plan and String Plan

Ensure that a roof plan and a string plan are supplied which contain at least the following information:

- Description of the system as well as of the snow and wind load assumed for the system
- Positioning of the PV array within the roof area
- Positioning, number and type of mounting clamps
- Specification of all module mounting pitches measured from a reference point
- Division of the PV array into strings
- Grounding and lightning protection cables

5.1.2 Limit of Application

Deviation of actual conditions from the values used in the design. Deadly danger!

Check whether the limit of use the parameters stated in the project documentation (location, roof pitch, building height, wind and snow load area) correspond to the current buildings, see also section “Technical data / Limit of application”.

- Make sure that the roof lining meets the requirements of protection against rain or waterproofness, depending on the slope of the roof.
- Observe local roofing regulations or country-specific ventilation regulations.

5.1.3 Safety at Work

- Ensure that the roof is protected by collective protection (scaffolding, roof railings) in accordance with local regulations.
- Ensure that all personnel are equipped with personal protective equipment (PPE) in accordance with legal regulations and use it correctly.
- Ensure that support staff are properly trained and supervised throughout the work process.

5.1.4 Checking the Content of the Shipment

Combining connectors from different manufacturers. Danger of failure!

- Make sure that all BISOL BIPV modules have the same type of connector and are produced by the same manufacturer.
- Ensure that connectors of the same type as the BISOL BIPV modules are used for the connecting cables and cable sets.
- Do not make any connections using components from different manufacturers or types, even if they seem compatible.
- Check that the supplied material is in perfect condition and fully delivered.
- Make sure that the slats have a cross-section of 120 mm × 30 mm and that all types of coniferous wood meet at least strength category C24.
- Make sure that two wood screws approved by the General Building Inspectorate (ETA) type 5 × 120/6 are used to mount each batten.
- Be sure to use 4.5 × 35 SST flat-head wood screws to secure the mounting brackets. The use of countersunk screws is not permitted.

5.2 Tools

- Cordless screwdriver with T25 bit
- Disk grinder
- Screwdrivers of various sizes
- Carpenter's hammer
- Wood saw
- Twine, e. g. chalk line
- Tape measure
- Folding yardstick
- Aiming stake
- Carpenter's pencil
- Mandatory to use: When installing BISOL BIPV module with Solrif® frame, mounting gauge is mandatory to use (gauge for easy and correct positioning of the mounting clamps, matching the BISOL BIPV module.)

5.3 Mounting

5.3.1 Preparing the Roof

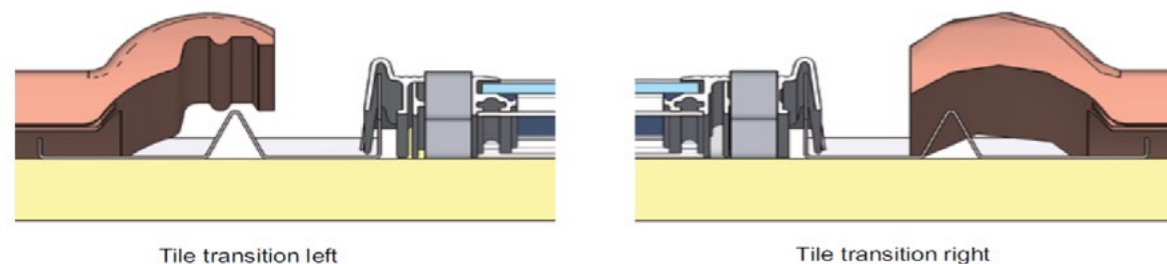


Figure 20: Tile transition

1. Remove the tiles according to the roof plan (PV planning software SPT) and calculated size of the PV array plus one or two rows of tiles at the bottom (depending on the roof slope and the height of the tile) and one tile column on each side, to the left and right of the PV array.

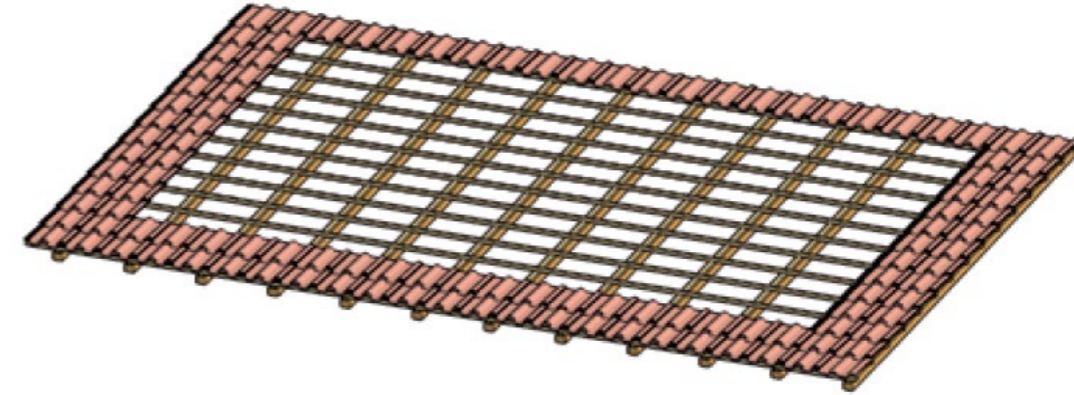


Figure 21: Removed tiles

To avoid collision with junction boxes:

2. Remove the tiling battens in the area of the PV array, but not from the flashing sides.

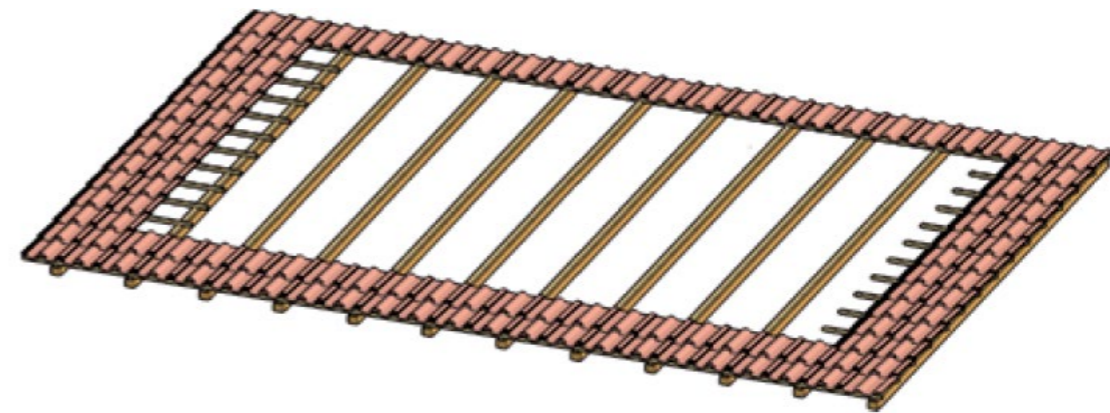


Figure 22: Removed tiling battens

- As shown on the picture below. The evenness of the roof needs to be checked and corrected, if necessary. Respecting the stated conditions below is mandatory.

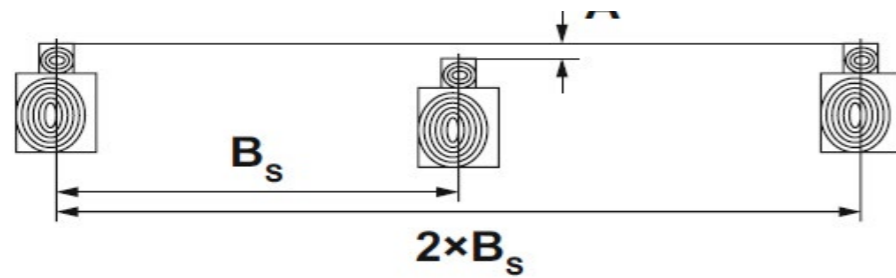


Figure 23: Cross section of rafters and counter battens

- Check whether the roof fulfils the following requirements across the entire PV array:

$$A \leq 1 \text{ cm}$$

$$A / (2 \times B_s) \leq 0.5 \%$$

If the requirements are not fulfilled:

- Even out the troughs by nailing on pieces of wood (shifts).

5.3.2 Calibrating and Placing the Substructure

“Calibrating” is the fitting and alignment of the PV array within the remaining roofing. For definitions of the individual measurements, see Chapter „Dimension of PV Array and Module Mounting Pitches” on page 12, for the placement of the reference points, see also Chapter „Preparing the Roof”.



Notice

In the following diagrams, the lead flashing is blanked out (the lead flashing has to be placed before the mounting clamps are mounted!) for better understanding.

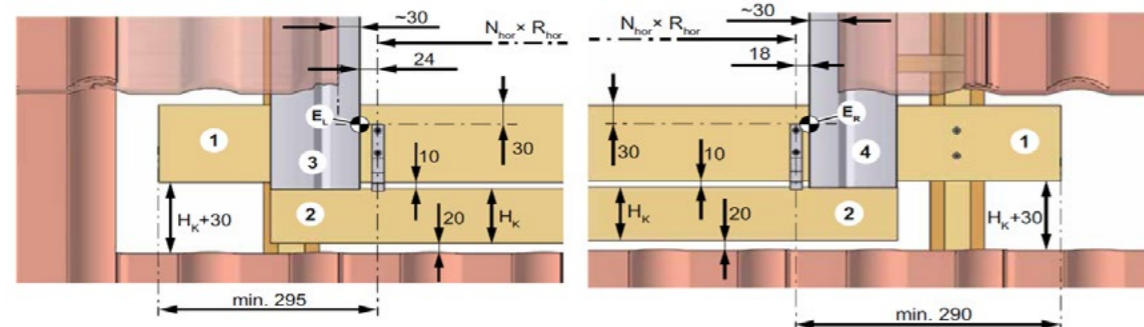


Figure 24: Calibration

1	Bottom Solrif® batten
2	Wedge plank
3	Flashing side left
4	Flashing side right
N_{hor}	Number of modules side by side in the PV array
R_{hor}	Horizontal module mounting pitch
$N_{hor} \times R_{hor}$	Distance between the centre lines of the outermost mounting clamps
H_k	Height of the wedge plank (depends on the roof slope and the shape of the tile, see „Wedge Plank”).
E_l	Reference point bottom left
E_B	Reference point bottom right

5.3.2.1 Mounting the Solrif® Battens

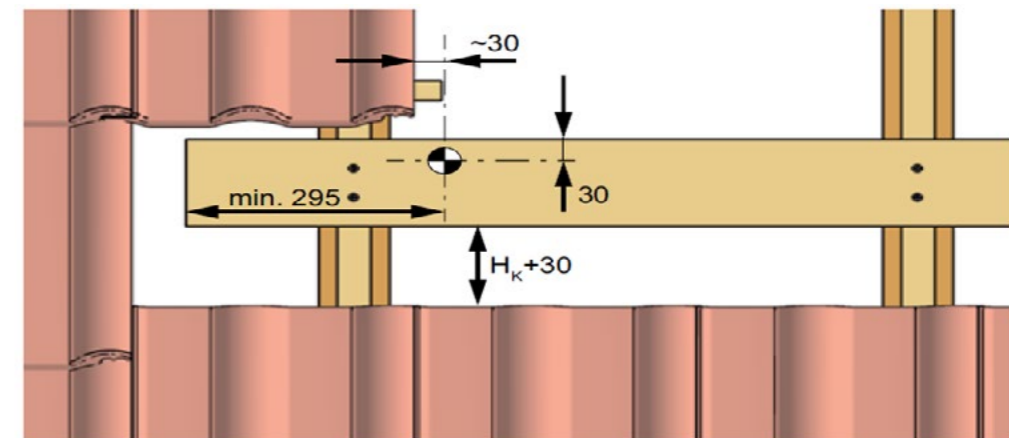


Figure 25: Mounting the bottom batten

- Mount the bottom Solrif® batten at a distance of the height of the wedge plank plus 30 mm from the upper edge of the bottom row of tiles, observing Chapter „Rules for Mounting Solrif® Battens”.

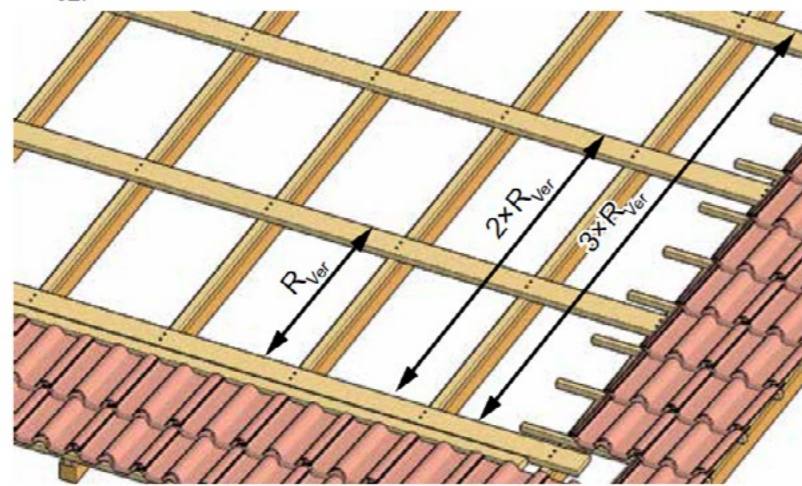


Figure 26: Mounting further battens

2. Mount the other rows of battens at intervals of $x \times R_{Ver}$ (measured from the bottom row of battens) respectively and mount them with two mounting screws each to each rafter/each counter batten.

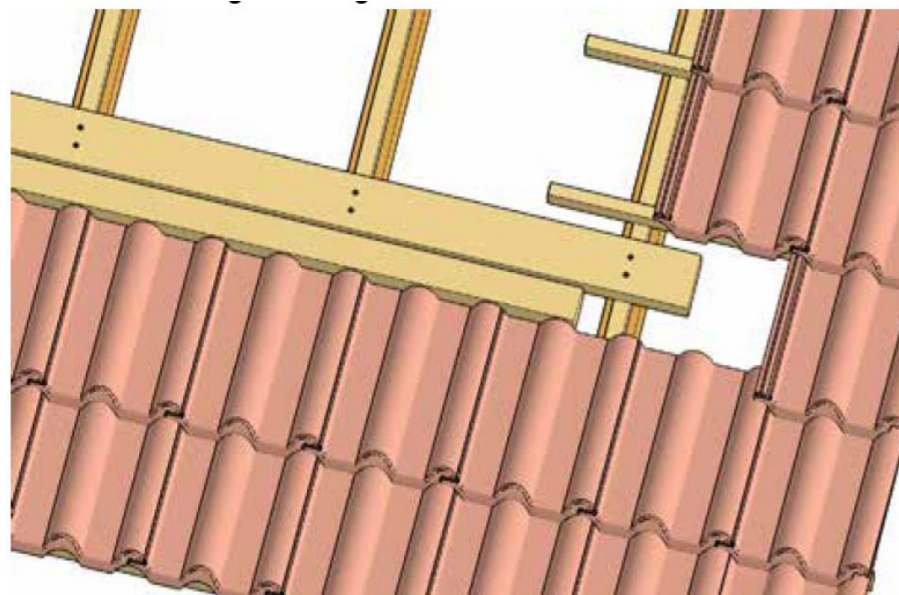


Figure 27: Mounting the wedge plank

3. Mount the wedge plank at a distance of ca. 10 mm from the bottom edge of the bottom row of battens, observing Chapter „Rules for Mounting Battens“.

5.3.3 Determining the Reference Point and Perpendicularity of the PV Array



Notice

The perpendicularity of the PV array is a basic prerequisite for trouble-free and successful installation.

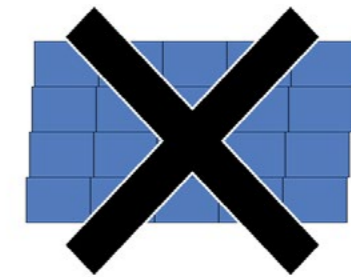


Figure 28: Rectangular and “warped” PV array

1. In the left-hand bottom corner of the PV array, determine reference point EL (1), see Chapter „Preparing the Roof“.



Notice

Do NOT fully screw in the screws that subsequently must be placed: tension lines or tape measures must be tied to them!

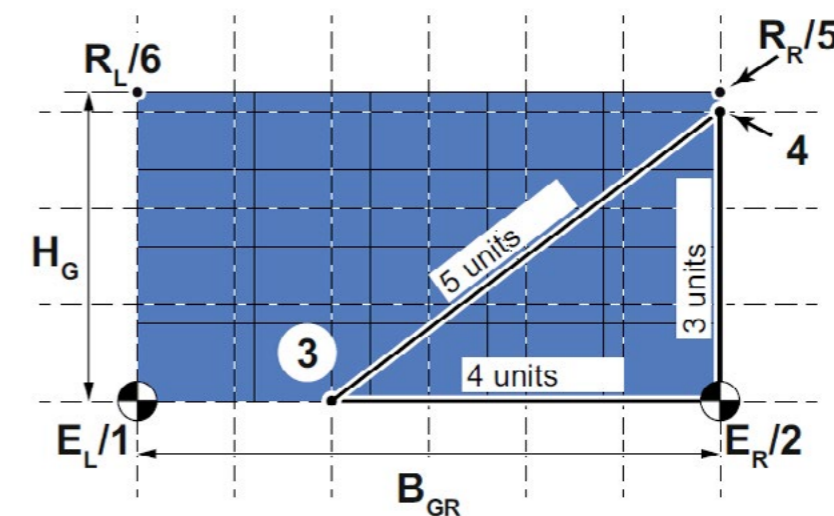


Figure 29: Calibration

2. Place a screw in the position of the left-hand reference point E_L (1).
3. Place a screw in the position of the right-hand reference point E_R (2) (distance to left-hand reference point = B_{GR}).
4. Stretch a tension line tightly between the two reference points E_L (1) and E_R (2).
5. Measure along the line from E_R (2) to E_L (1) a distance of 4 "units" (e. g. meters) and mark the point (3) with a screwed-in wood screw.
6. Attach the tape measure to right-hand reference point E_R (2) and draw a "compass circle" with the radius of 3 "units" in the right-hand top corner of the PV array.
7. Attach the tape measure to point (3) and draw a "compass circle" with the radius of 5 "units" in the right-hand top corner of the PV array.
 - The intersection of the two compass circles is point (4).
8. Extend the line from the right-hand reference point E_R (2) to (4) at the height of H_G on the PV array; this gives you the preliminary right-hand top reference point R_R (5).
9. Mark the right-hand top reference point R_R (5) with a screwed-in wood screw.
10. Attach the tape measure to the wood screw (5) and draw a "compass circle" with the radius of B_{GR} in the left-hand upper corner of the PV array.
11. Attach the tape measure to the left-hand bottom reference point E_L (1) and draw a "compass circle" with the radius of H_G in the left-hand upper corner of the PV array.
 - The intersection of the two compass circles is point (6), the preliminary left-hand top reference point R_L .
12. Measure the diagonal of the PV array from point (1) to point (5).
13. Measure the diagonal of the PV array from point (2) to point (6).
 - The diagonals must be the same length within the limits of measurement accuracy.
14. Check that the reference point in the left-hand top of the PV array R_L is at a distance of ca. 30 mm from the vertical tile edge.

If this is confirmed:

15. Mark the right-hand PV array edge (2) to (5) across all battens, e. g. with a tension line.

5.3.4 Mounting the Lead Flashing

1. Roll the lead flashing out over the bottom row of battens and the wedge plank and place it in such a way that the lead flashing extends past the wedge plank on both sides by at least 150 mm respectively.

If the lead flashing comprises several strips:

2. Ensure the strips overlap by at least 100 mm.

For roof slopes <22°:

3. Place the lead flashing in such a way that the top edge of the lead flashing extends past the top edge of the bottom batten by 20 mm.

For roof slopes >22°:

4. Place the lead flashing in such a way that the top edge of the lead flashing is flush with the top edge of the bottom batten.

5. Feel out the positions of the two screws that mark the bottom reference points E_L and E_R , pierce the lead flashing at these points or make 2 short crossed cuts.
6. Press the screw heads through the lead flashing.
7. Remove the two screws, put sealing washers on them and screw them back in so far that the screws are still protruding about 20 mm from the lead flashing.

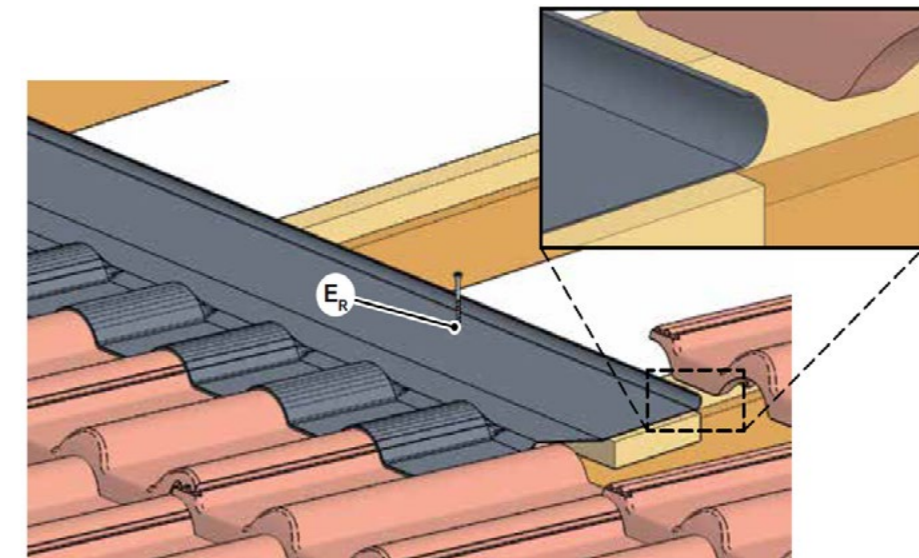


Figure 30: Lead flashing on roof slopes < 22°

8. Flange out the top edge of the lead flashing about 20 mm wide.

5.3.5 Laying Cable Conduits, Connection Cables and Cable Strings

1. Lay cable conduits for connection cables and cable strings according to local and national regulations.
2. Lay connection cables and cable strings according to the string plan.

5.3.6 Marking the Horizontal Positions of the Mounting Clamps Profile

1. Stretch a line between the two bottom left reference points EL and bottom right ER (see Diag. "Calibration").
2. Stretch a line between the right-hand reference point ER and the top right reference point RR (see Diag. "Calibration").



Notice

Measuring the clamp positions from one clamp to the next will lead to measurement chain errors. Determine the position of each Mounting Clamp Profile from the right-hand reference line (= tension line on the right-hand edge of the PV array).

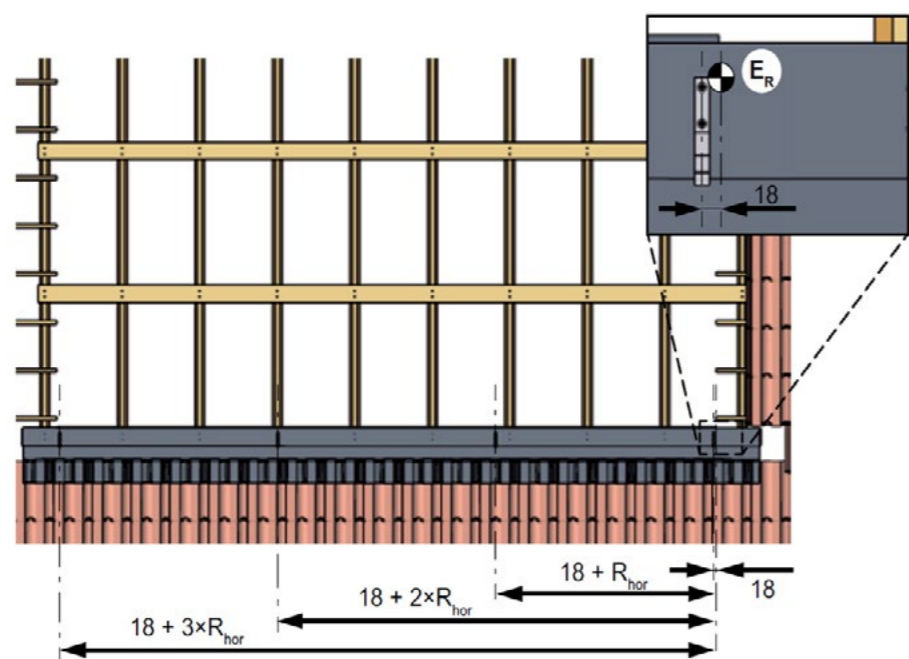


Figure 31: Mounting clamps horizontal positions

3. On each batten, mark the horizontal positions of the Mounting Clamps Profile at the following positions starting from the tension line on the right-hand edge of the PV array:

- 18 mm
- $18 \text{ mm} + R_{\text{hor}}$
- $18 \text{ mm} + 2 \times R_{\text{hor}}$
- ...
- $18 \text{ mm} + N_{\text{hor}} \times R_{\text{hor}}$

5.3.7 Laying the Bottom Row of Modules

1. On the bottom batten, mount the Mounting Clamps Profile with 2 screws each, horizontal position at the marked points, vertical position such that the top edge of the mounting clamps is at the same height as the tension line (the mounting clamps should NOT push away the tension line!).

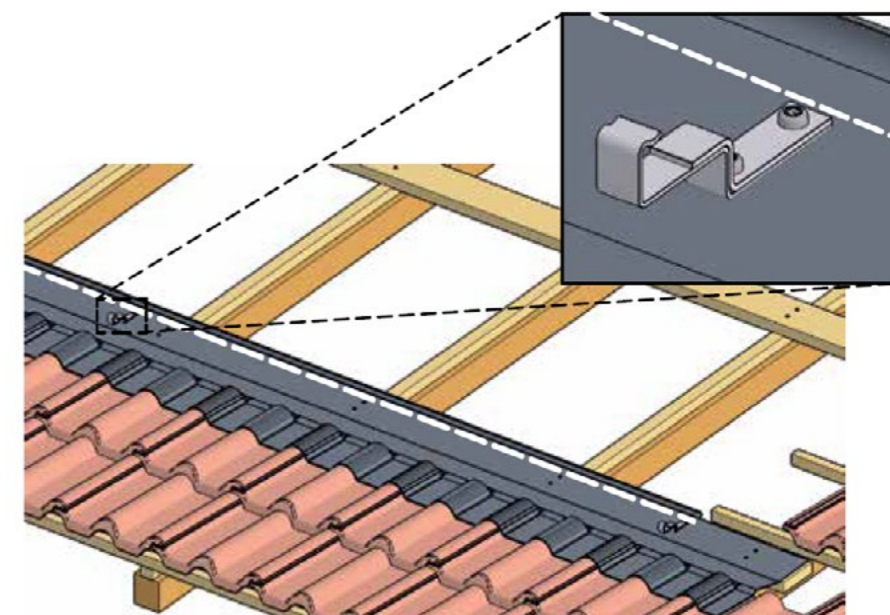


Figure 32: Mounting clamps bottom row

If you are using a mounting gauge:

2. Remove the tension line at the bottom end of the PV array and screw in the screws at positions E_L and E_R tightly.

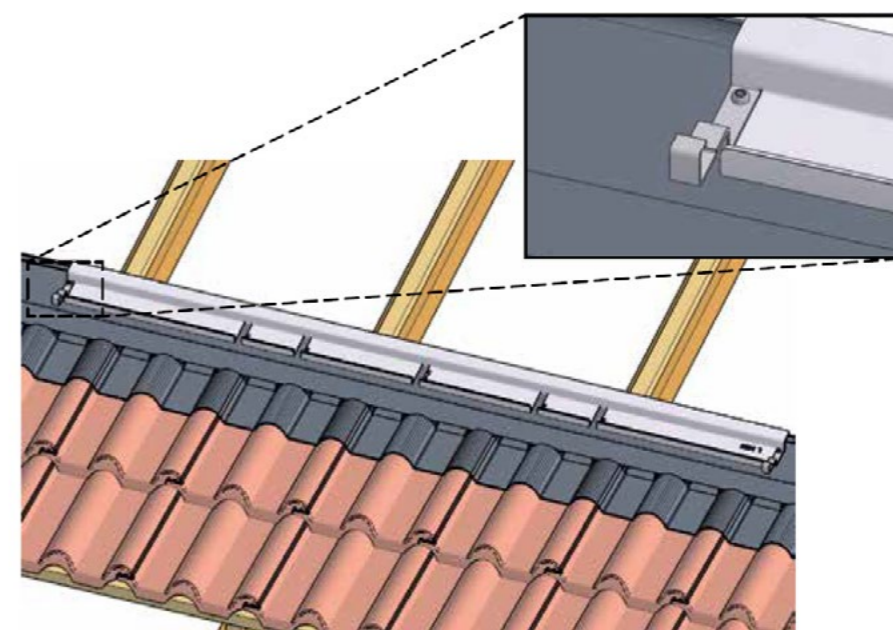


Figure 33: Fitting the mounting gauge

If Mounting Clamps Glass are to be additionally placed (see roof plan):

3. Fit the mounting gauge into Mounting Clamps Profile.

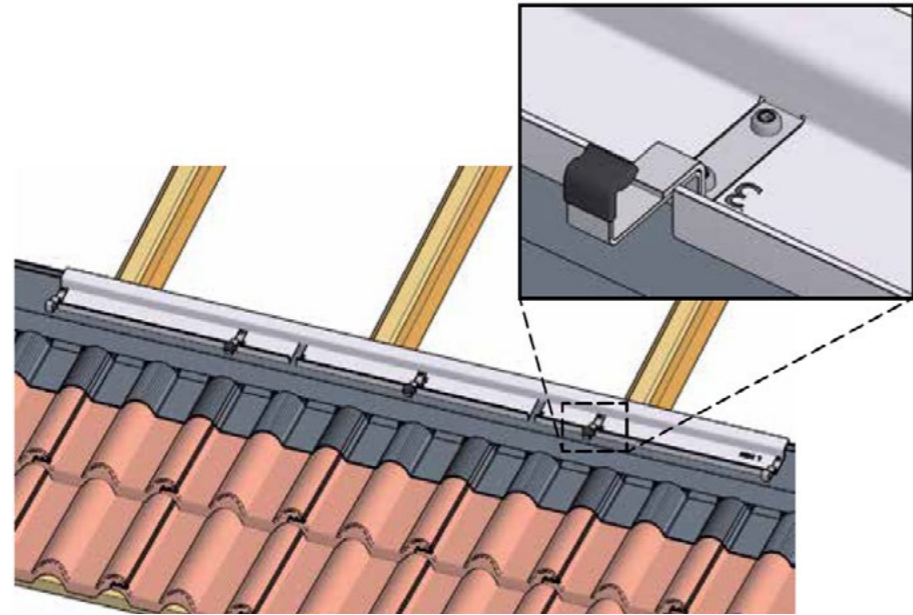


Figure 34: Fitting the mounting gauge

4. Push in the Mounting Clamps Glass until they click into place in the recesses of the mounting gauge and mount them with two screws each onto the bottom batten.

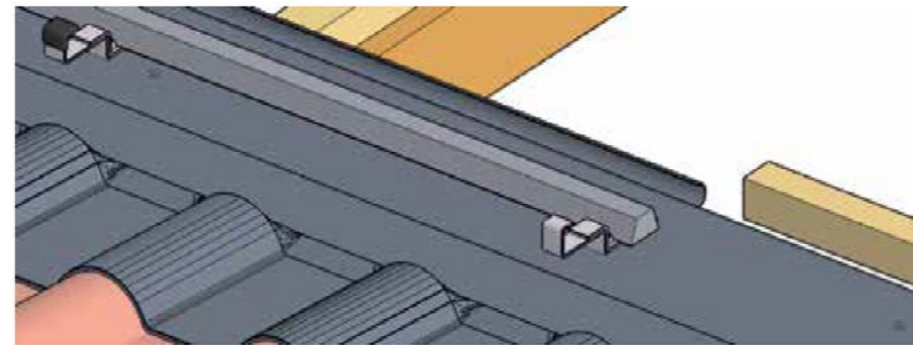


Figure 35: Laying the sealing tape strip

5. Lay the sealing tape strip over the mounting clamps.

When used in areas with high snow loads:

6. Support the bottom row of clamps, see Chapter „L-Section to Support the Bottom Row of Mounting Clamps“.

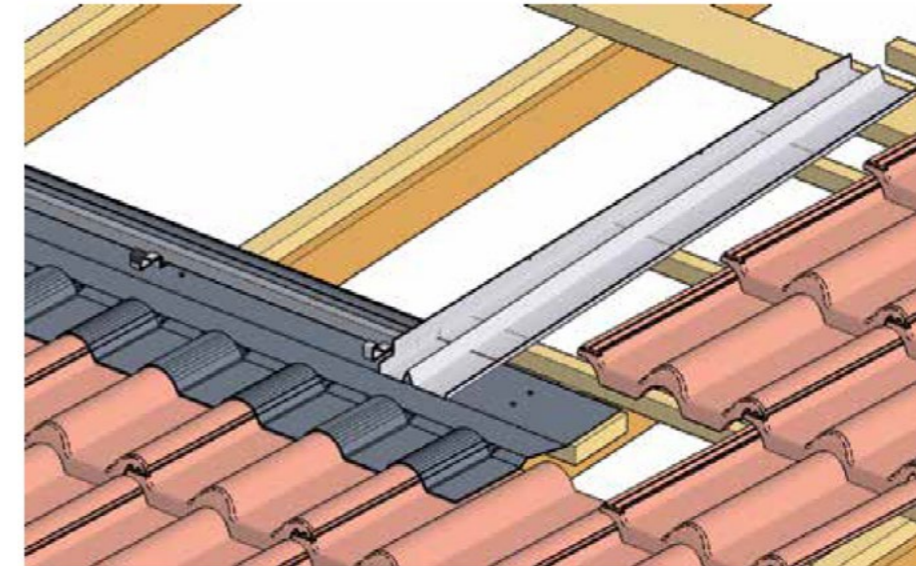


Figure 36: Flashing side right

7. Place a flashing side in the right-hand bottom corner of the PV array so that its left-hand edge is flush with the vertical reference line on the right-hand edge of the PV array.

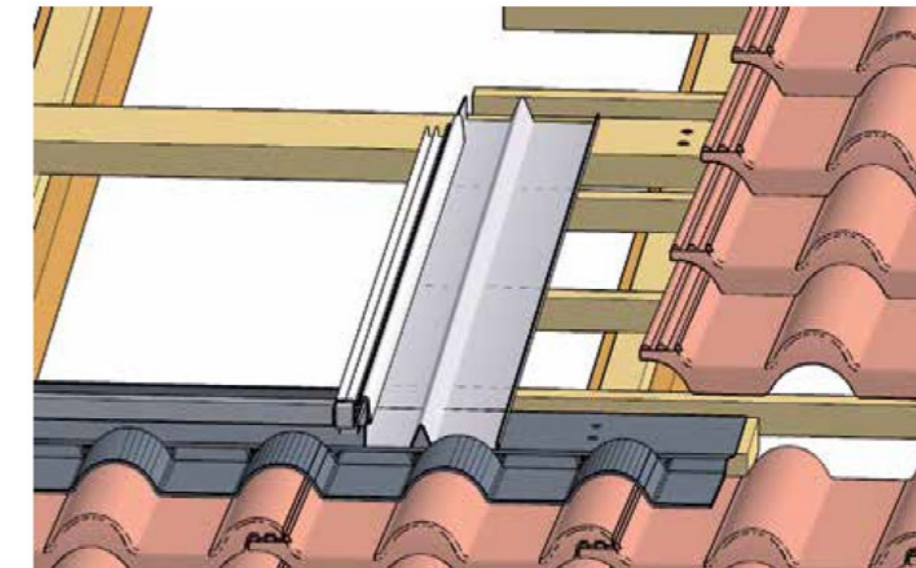


Figure 37: Flashing profile right

8. Lay the flashing profile right onto the flashing side and push it into the Mounting Clamp Profile.
9. Attach the first module to the associated cable string or connection cable.

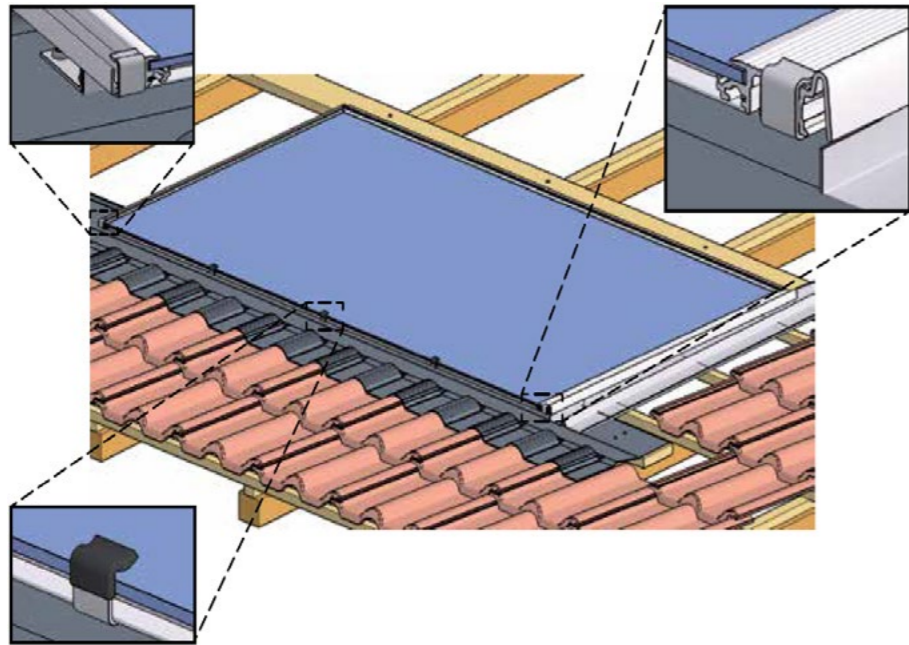


Figure 38: Lay the first module

10. Lay the first module in the right-hand bottom corner of the PV array (insert bottom edge into the mounting clamps, then lower down).



Notice

Treading on modules that have already been laid

Risk of damage to property! Cell breakage!

If treading on modules that have already been laid is unavoidable, proceed as follows to avoid inadmissible point loading:

Cover the modules with rigid foam panels or similar.

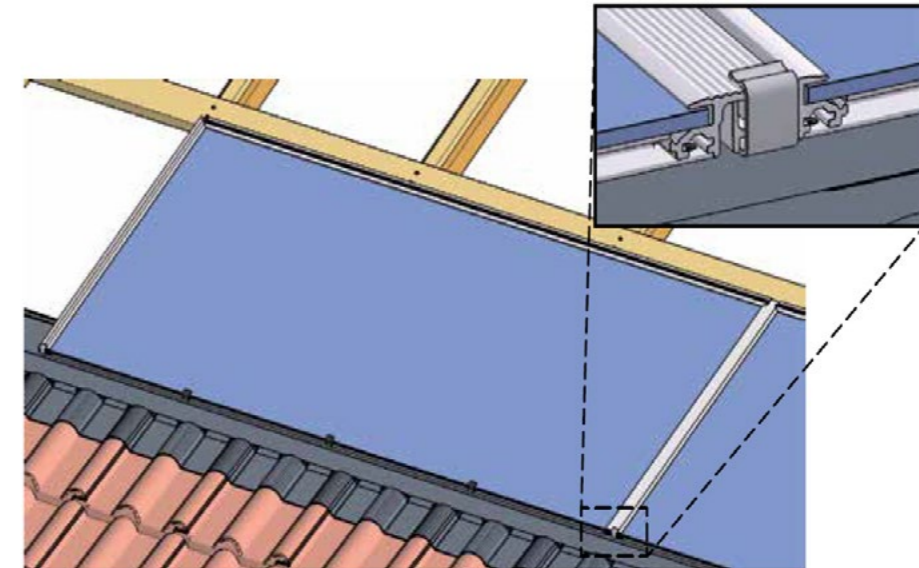


Figure 39: Lay remaining modules

11. Lay the remaining modules in the bottom row and at the same time connect the connection cables and grounding/lightning protection cables according to the string plan.

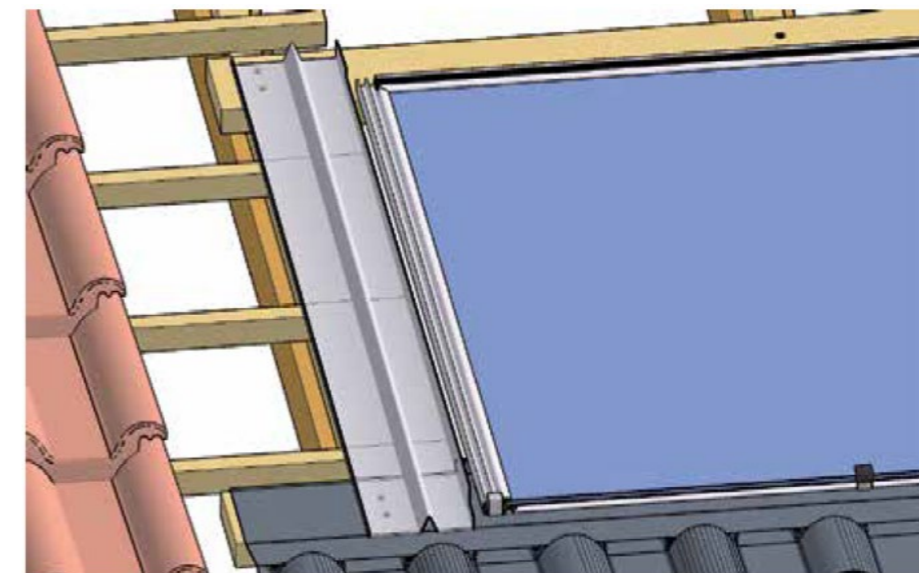


Figure 40: Laying flashing side left

On the left-hand edge of the PV array:

12. Place the flashing side left with the right-hand edge flush with the last module.

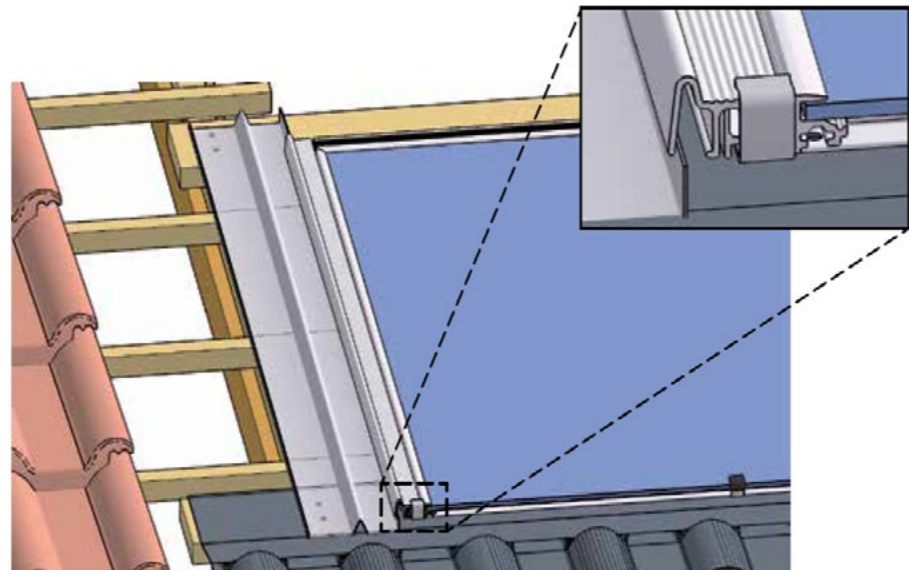


Figure 41: Inserting flashing profile left

13. Push the flashing profile left into the left-hand bottom Mounting Clamp Profile as a gutter.

5.3.8 Laying the Remaining PV Array



Notice

The distance of 15 mm between the upper edges of the modules and the recess of the mounting clamp above must be observed. This distance enables individual modules in the PV array to be replaced at a later stage.

The width of the mounting clamps is 16.5 mm. Thus the mounting clamp is NOT suitable as a spacing template for placing the next row of mounting clamps.

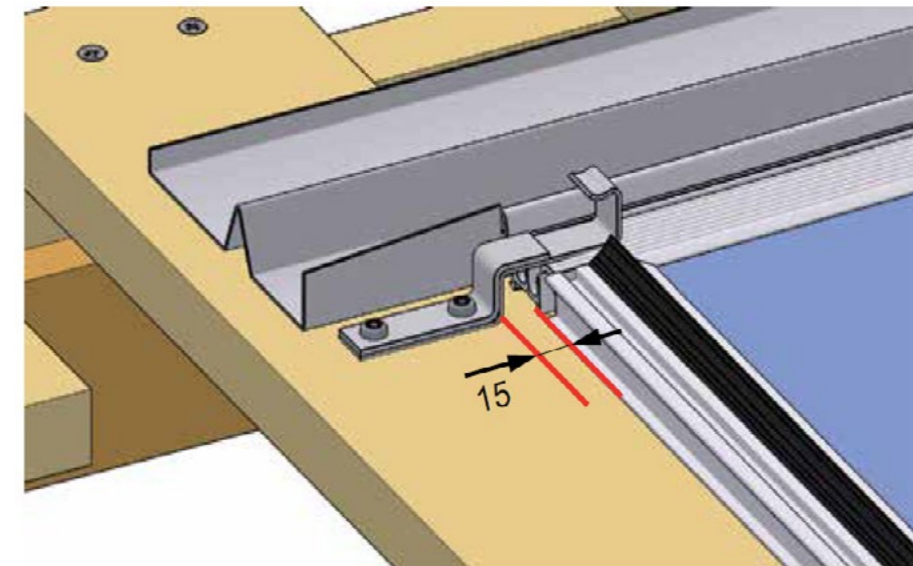


Figure 42: Mounting clamp distance

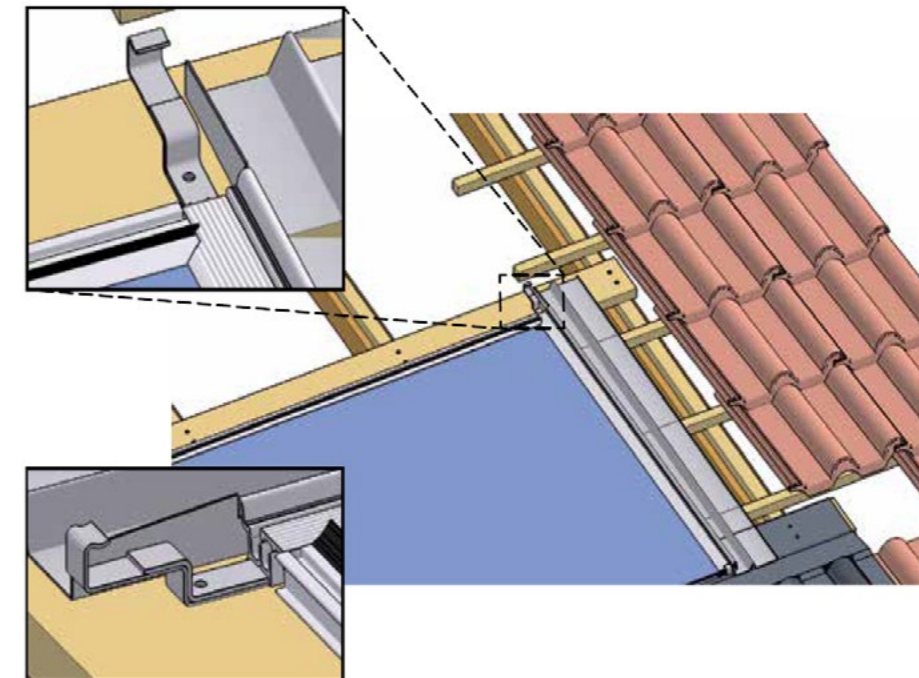


Figure 43: Push in mounting clamps the wrong way around

1. In order to be able to draw a marking line, push a mounting clamp temporarily the wrong way around into the flashing profile right.

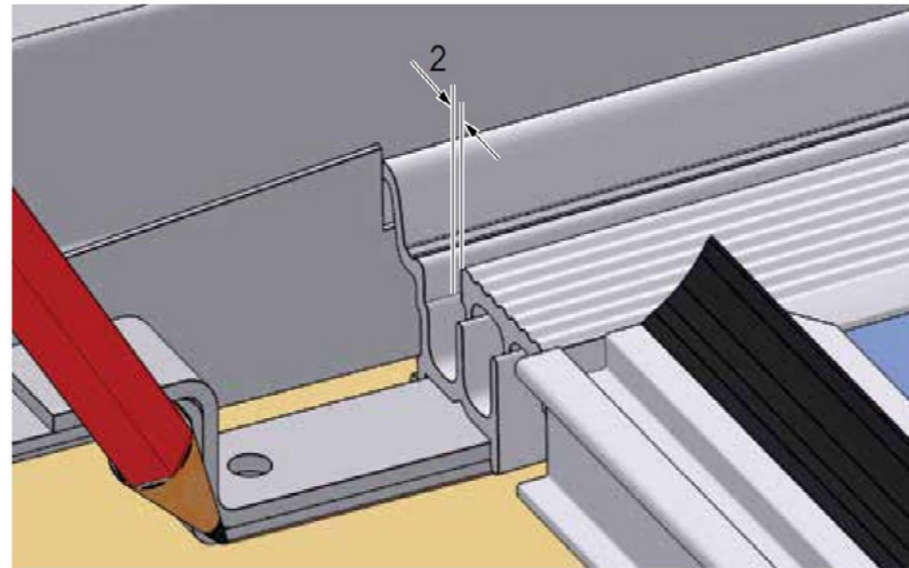


Figure 44: Marking the position of the left-hand edge of the mounting clamp

2. In doing so, ensure that the flashing profile right maintains a distance of 2 mm to the module frame.
3. Mark left-hand edge of the inserted mounting clamp on the batten.

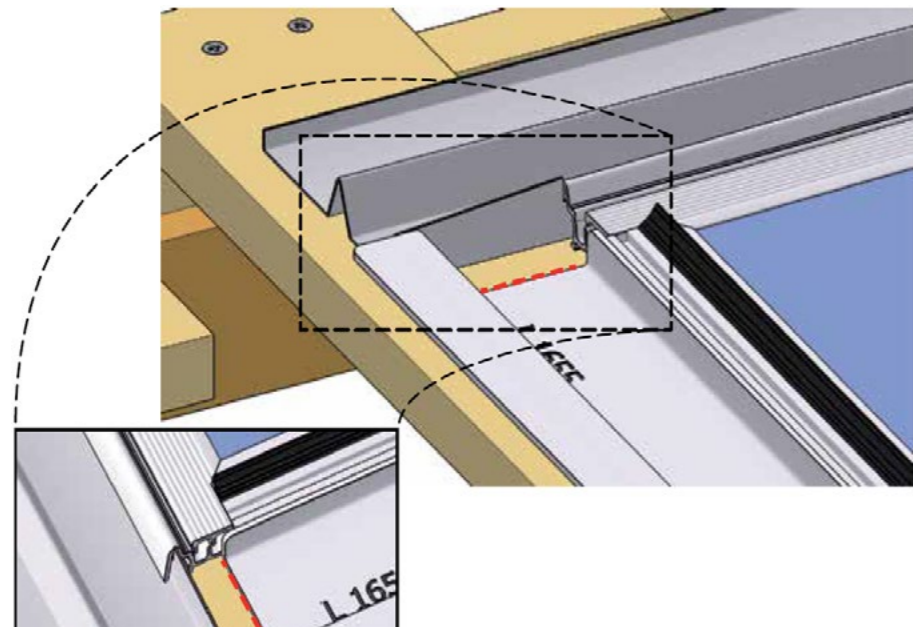


Figure 45: Aligning the mounting clamp

4. Lay the mounting gauge onto the top edge of the right-hand module and align the mounting gauge to the line you just marked.

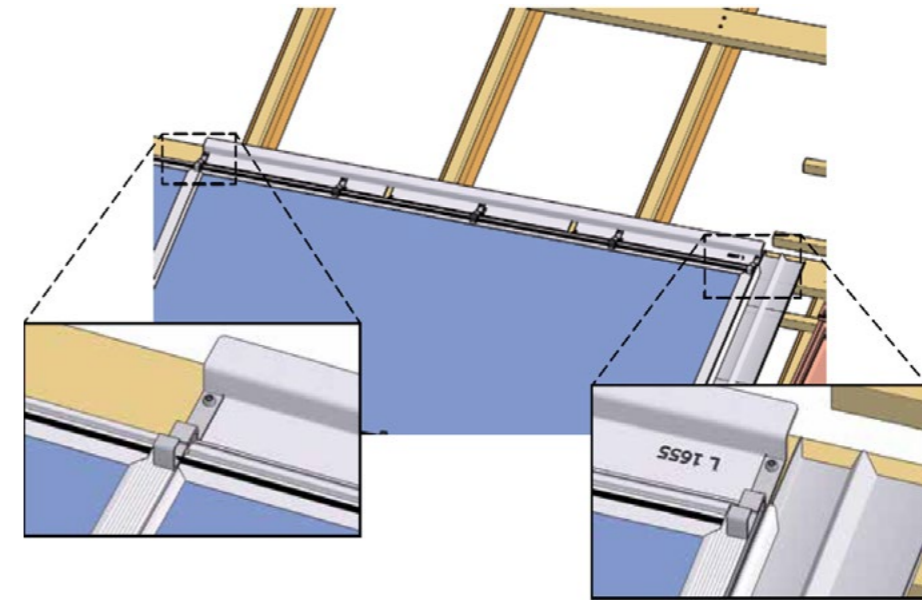


Figure 46: Mounting the remaining mounting clamps

5. Mount all the clamps for this module according to the roof plan with the aid of the mounting gauge.
6. Proceed in the same manner for the remaining mounting clamps in this row.

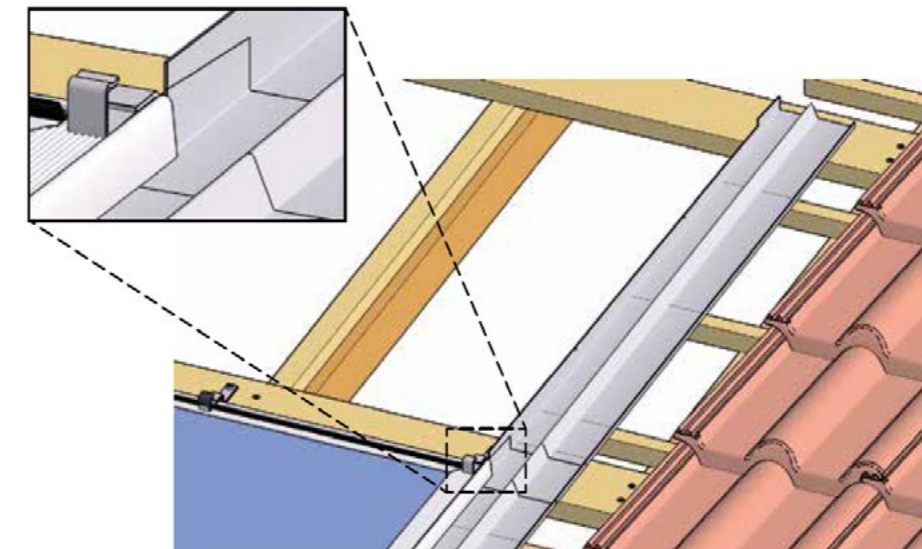


Figure 47: Push in flashing side right

7. Push the flashing side right into the lower lying right-hand profile until it clicks into place.

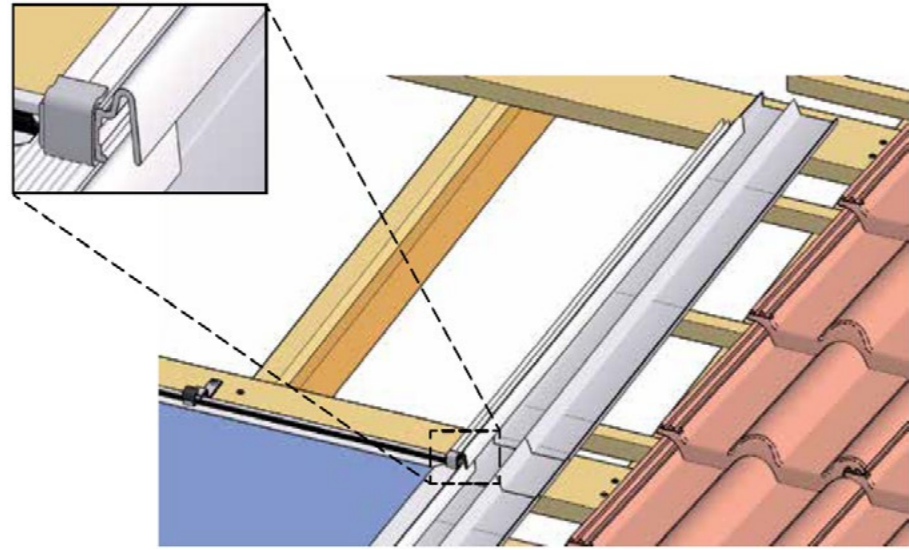


Figure 48: Push in the flashing profile right

8. Push the flashing profile right into the mounting clamp profile.

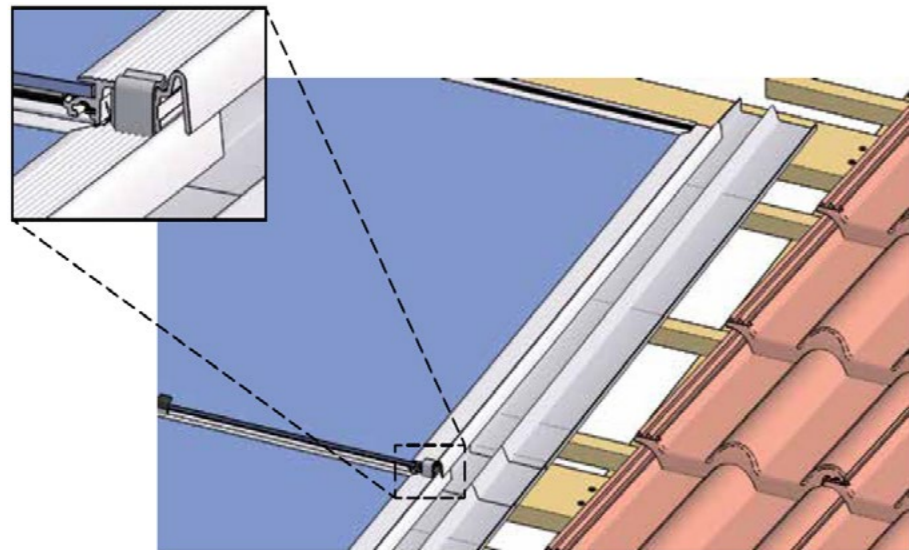


Figure 49: Lay remaining modules

- 9. Lay the second row of modules and connect the cables according to the string plan at the same time.
- 10. Mount the next row of mounting clamps.
- 11. Complete the PV array including side flashings and flashing profiles like in the bottom row.

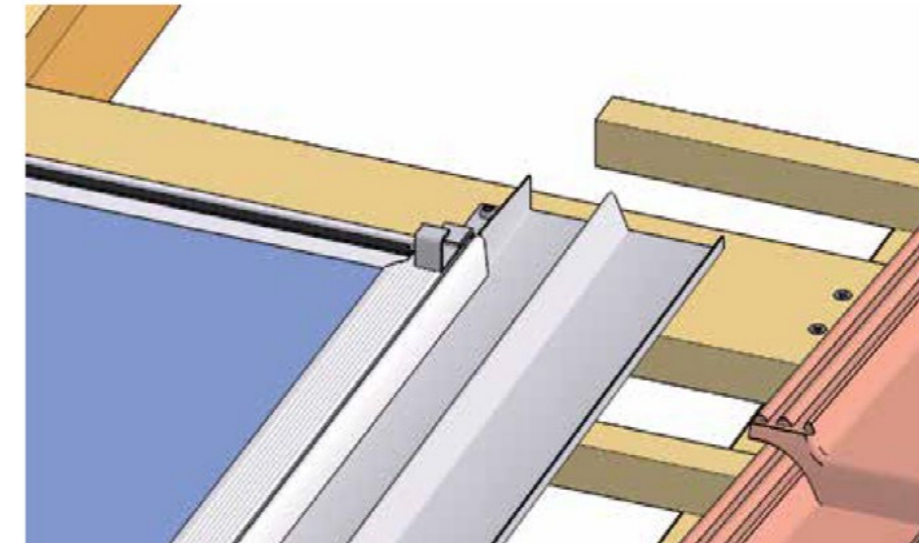


Figure 50: Mounting clamps top row edge

Placing the top row mounting clamps:

12. Place the outside left-hand and the outside right-hand mounting clamps like in the rows below.

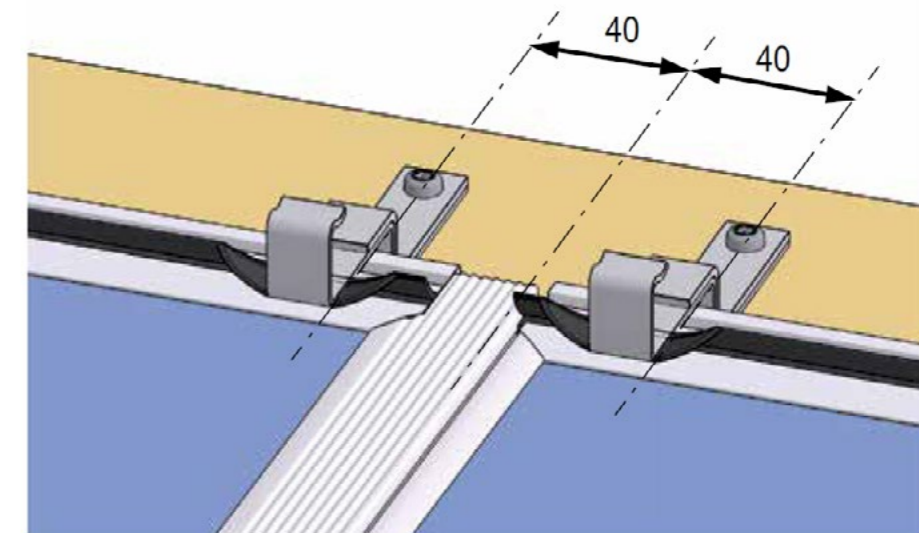


Figure 51: Mounting clamps top row transitions

13. At the module transitions:

Do NOT place the Mounting Clamps Profile at the marked positions, rather place two Mounting Clamps Profile instead of one, each one offset by 40 mm to the left and to the right respectively of the marking. Like in the rows below, maintain a distance of 15 mm between the top edge of the module and the recess of the mounting clamp.

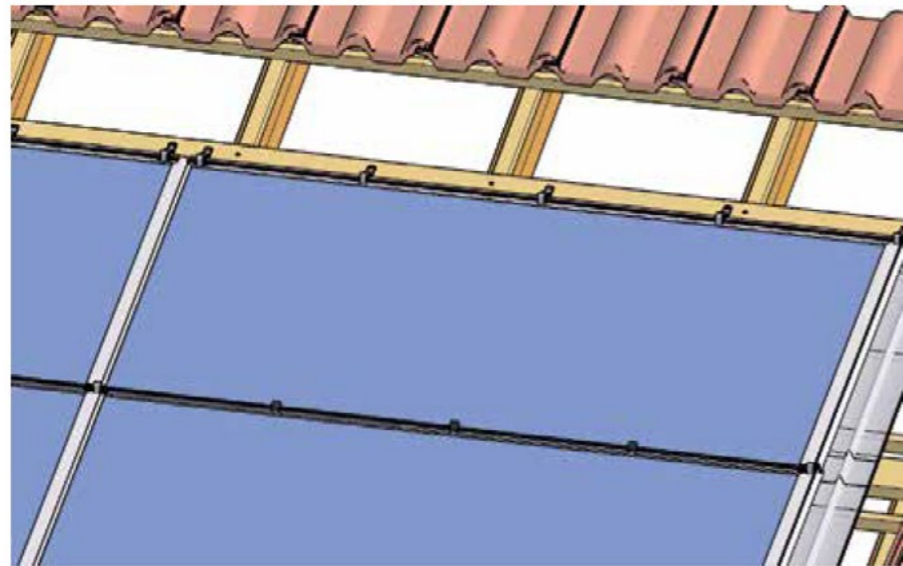


Figure 52: Top row mounting clamp positions and spacing (maximum number of clamps in this example)

14. Depending on the roof plan: Insert further Mounting Clamps Profile accordingly.

5.3.9 Top of the Array

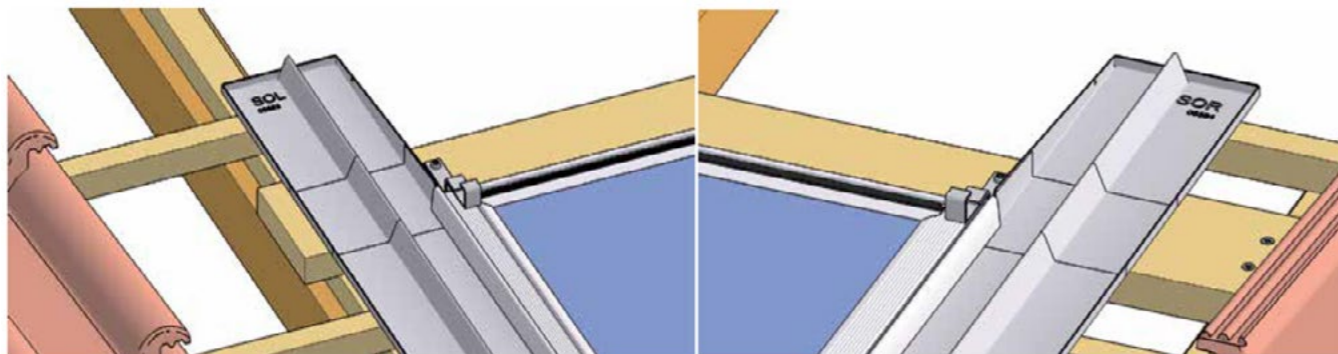


Figure 53: Array top left and right

1. Push the flashing side top right into the flashing profile underneath it.
2. Push the flashing side top left into the flashing profile underneath it.
3. Ensure that the side flashings on the top left-hand side and the top right-hand side are sufficiently supported at the top end, e. g. by tiling battens.

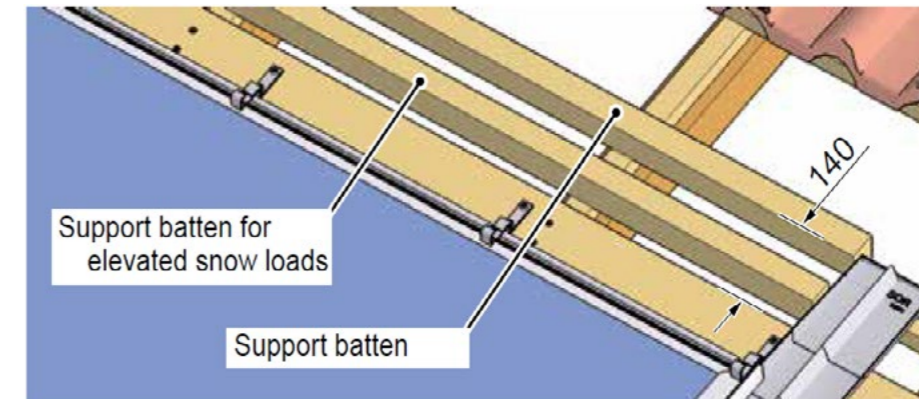


Figure 54: Support battens

4. Mount a 40 mm thick support batten under the top ends of the flashing tops; distance between the top edge of the top batten and the bottom edge of the support batten = 140 mm.

For elevated snow loads:

5. Mount another support batten that is approx. 45 mm thick in the middle between the top batten and the support batten that has just been placed.

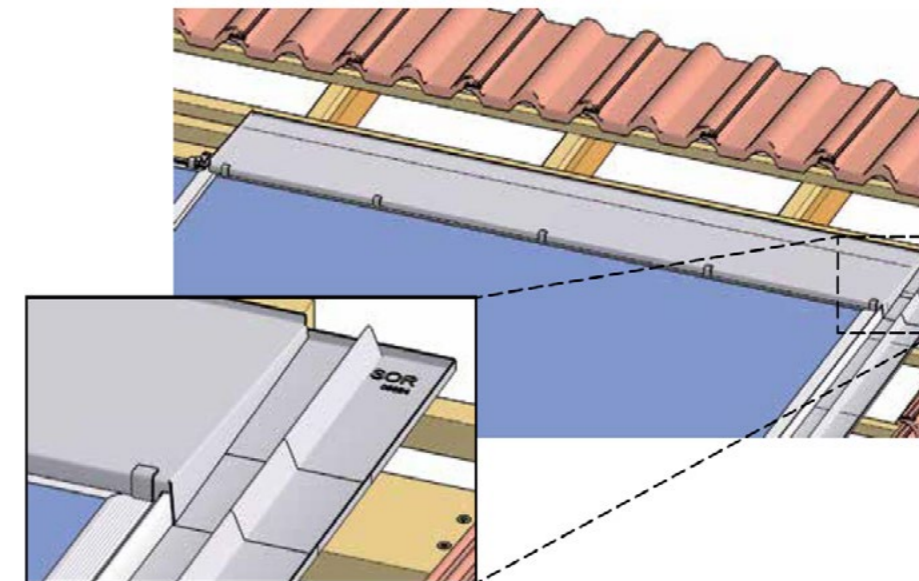


Figure 55: Insert flashing top right

6. Push the flashing top right into the mounting clamp underneath it and over the vertical side of the flashing side top right.

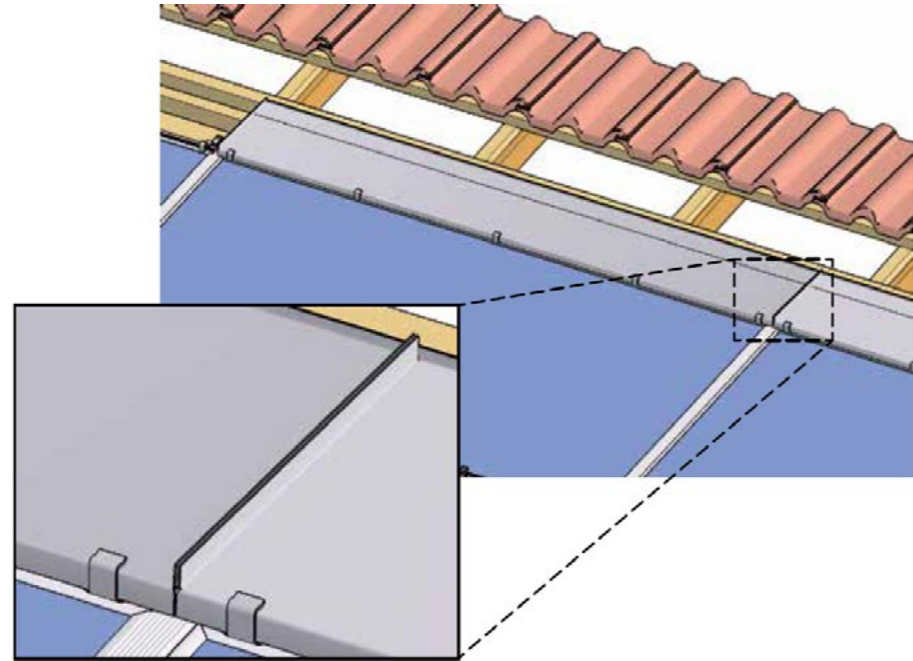


Figure 56: Flashing top middleclamp

7. Push the flashing top middle(s) into the mounting clamp underneath. The standing seams join up with the neighbouring flashing tops.

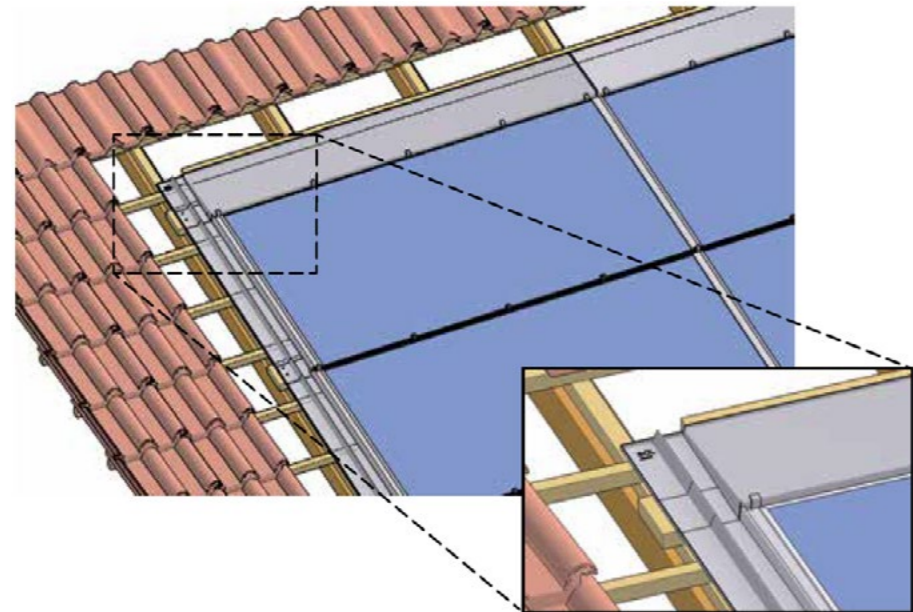


Figure 57: Flashing top left

8. Finish with the flashing top left. The left-hand seam of the flashing top covers the seam of the flashing side top left.

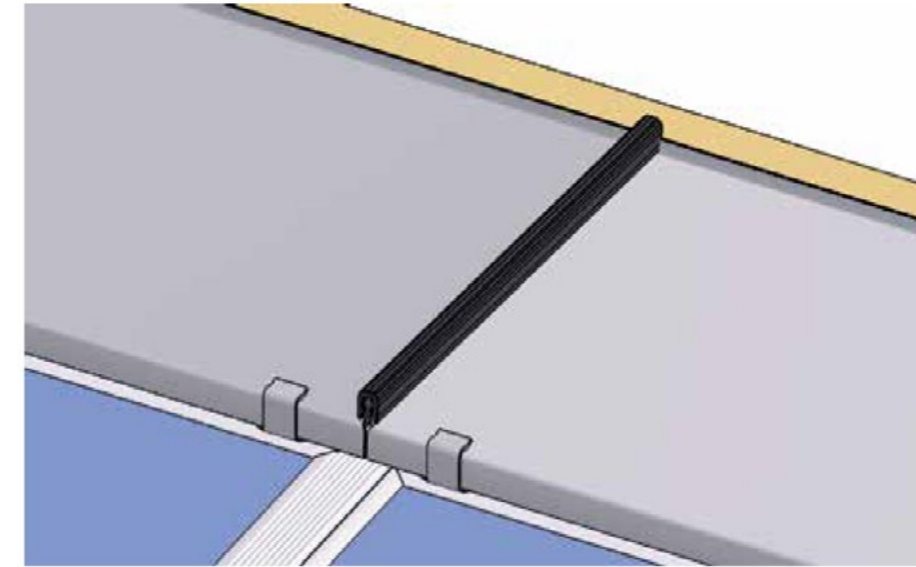


Figure 58: Mounting protective profile

9. Connect the flashing tops with one another using protective profiles.

5.3.10 Finishing Process

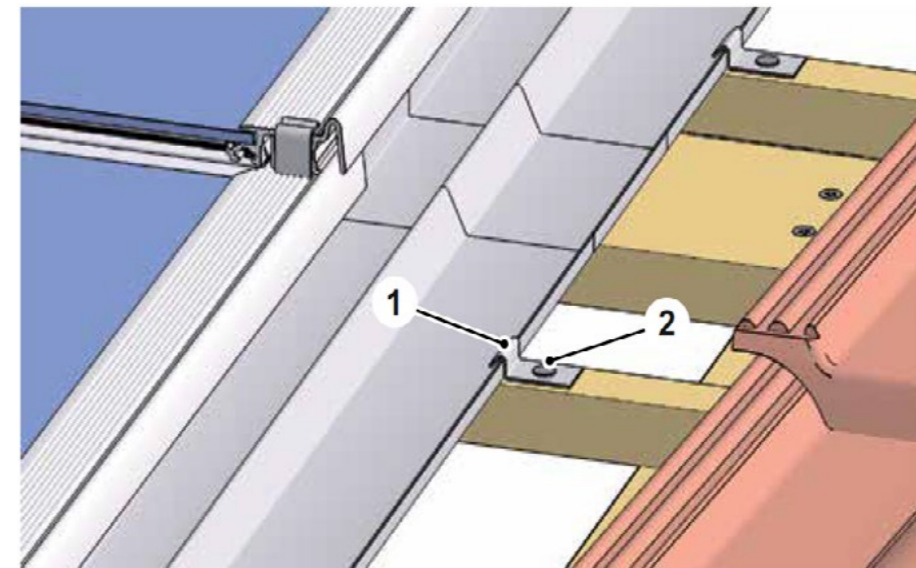


Figure 59: Fixing for flashing on flashing sides

1	Fixing for flashing
2	Clout nail 2.5 x 25 mm

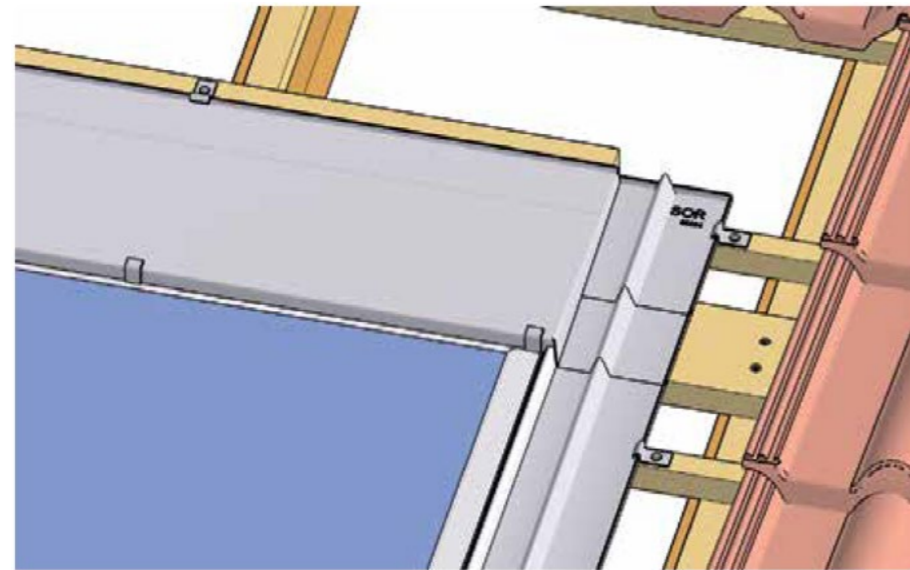


Figure 60: Fixing for flashing on flashing side top right and flashing top

1. Mount the flashing sides and flashing tops onto the tiling battens, battens and/or support battens using fixing for flashing as follows:

- Flashing sides left and right: 2 fixings per flashing
- Flashing sides top left and top right: 1 fixing per flashing
- Flashing tops: at least 3 fixings per flashing

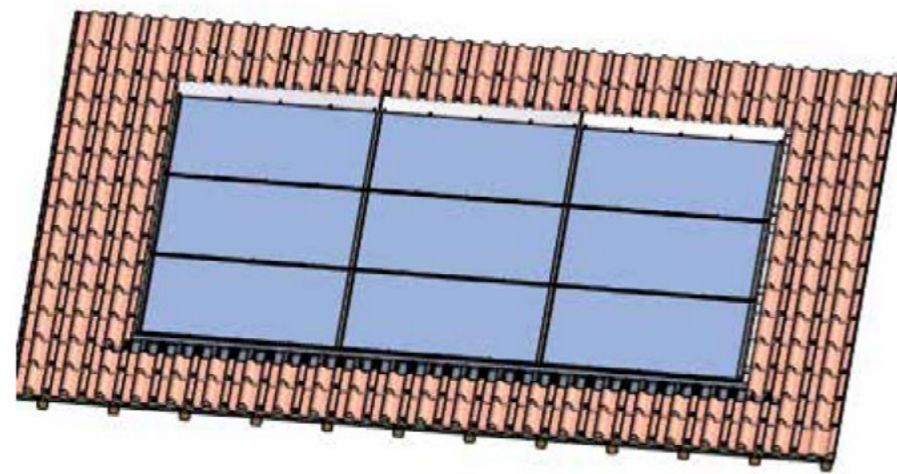


Figure 61: Tile roofing

2. Complete the tile roofing.

Depending on how tiles and protective profiles meet on the flashing tops:

3. Cut the tiles if necessary, using a disk grinder in such a way that the tiles lie smoothly on the flashing tops, including in the area of the protective profiles.

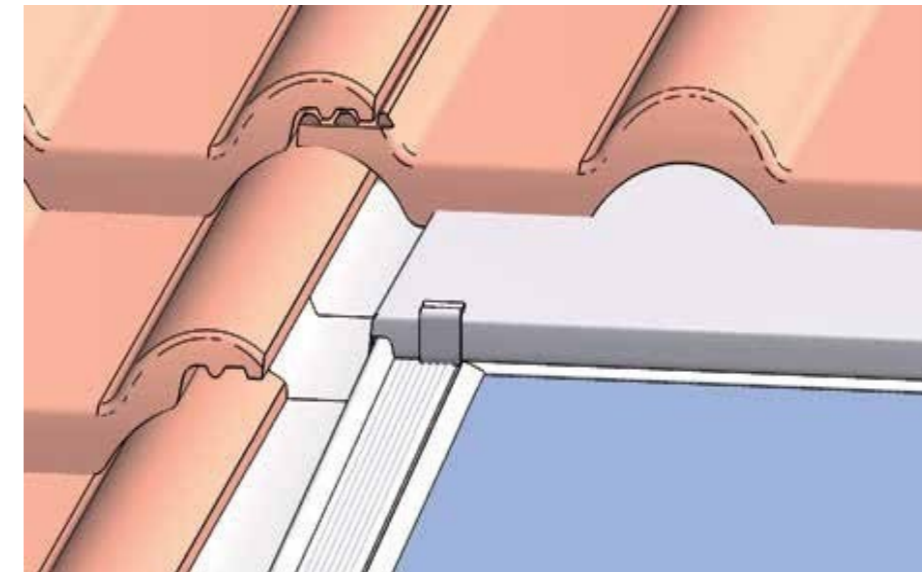


Figure 62: Left-hand top edge

4. Wherever necessary, remove overhangs and edges on the roof tiles that will overlap with the flashing tops so that the roof tiles will lie as flat as possible.

Depending on the transition on the right-hand edge of the PV array:

5. Cut the tiles in such a way that no water can seep down onto the roof underlay at the sides.

Congratulations! This completes the installation process and the photovoltaic roof is now installed.

6 MAINTENANCE

Unqualified personnel treading on the roof
Mortal danger!

- Any work that requires stepping onto the roof may only be carried out by specialist personnel.

Falls due to working without personal protective equipment against falls (PPEAF)
Mortal danger!

The installation of the photovoltaic system is only permitted with collective protection. However, certain work may also be carried out before the installation with PPEAF (checking the existing building structure, taking measurements), and likewise maintenance work on the installed photovoltaic system. When work is carried out using PPEAF:

- Only allow personnel who are trained in its use to carry out work using PPEAF.
- Only use regulation PPEAF including lanyards with energy absorbers.
- Permit no personnel to work alone using PPEAF
- The persons present in the workplace must always be able to rescue persons using PPEAF with their own equipment (even hanging for only a few minutes in the safety harness carries the risk of permanent injury!).
- Installation work is only permissible with collective protection (scaffoldings, roof guard rails) in accordance with the local regulations.

Slipping on damp roofs that are covered in algae, moss or soiled by other means
Danger of injury!

- Before stepping onto roofs that are covered with dew, allow them to dry off
- Descend immediately from roofs that are soiled if it starts to rain

6.1 Maintenance Plan

When	What	Who
After exceptional meteorological events, but at least once a year	Visual inspection	No special requirements
Quarterly	Yield check	No special requirements
If yield declines significantly	Check the PV array with an infrared camera	Specialist personnel, alternatively: Operator with relevant equipment and competence
If PV array soiled for instance fallen leaves	Spray off the leaves with a water jet from the ground	No special requirements

6.2 Replacing Modules

1. Shift the module to the left of the defective module upwards until it detaches from the mounting clamps on the bottom edge (when replacing modules on the left-hand edge of the PV array, the flashing profile must be pushed upwards).
2. Lift up the right-hand corner of the module to the left of the defective module by about 3 to 5 cm and secure the module in this position using a wooden wedge.
3. Shift the defective module upwards until it detaches from the mounting clamps on the bottom edge.
4. Lift up the defective module by the bottom edge and pull it downward and out.
5. Disconnect the connections to the neighbouring modules in the string and secure the loose cable ends of the neighbouring modules so that these do not “disappear” down between the PV array and the roof underlay.
6. Disconnect the grounding cable and secure the loose cable end so that grounding continues to be provided for all remaining modules.
7. Remove the defective module.
8. Connect the grounding cable to the replacement module.
9. Establish connections to the neighbouring modules in the string.
10. Mount the replacement module under the raised module or the flashing profile left beside it, push it under the module above it (at the top edge of the PV array: under the side flashing) until it clicks into place and lower it.
11. Pull the replacement module downwards until it clicks into place into the bottom mounting clamps.
12. Remove the wooden wedge under the right-hand bottom corner of the module to the left of the replacement module.
13. Pull the module or the flashing profile left beside the replacement module downwards until it clicks into place into the bottom mounting clamps.

7 DEINSTALLATION AND DISPOSAL

Incorrect handling because of insufficient qualification and expertise.

Danger of severe injuries!

- Deinstallation and disposal of PV systems may only be carried out by qualified specialist firms.
- Commission only a specialist firm for in-roof photovoltaic systems to carry out deinstallation and disposal.

8 ADDITIONAL INSTRUCTIONS

8.1 Rules for Mounting Battens

- The open end of a 120 mm × 30 mm batten may only overlap the rafter/the counter batten by max. 200 mm.
- If the open end overlaps the rafter/the counter batten by more than 200 mm, the batten must be continued as far as the next rafter/next counter batten.

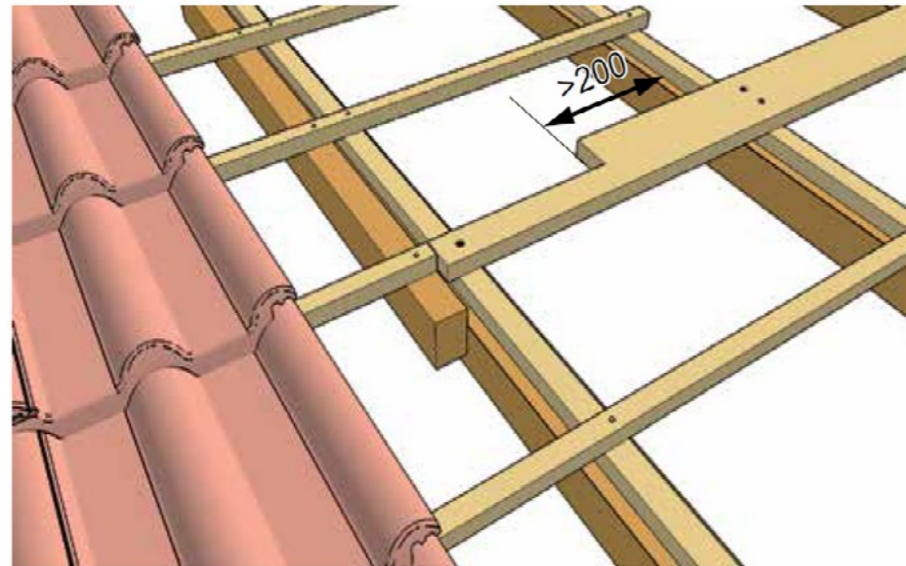


Figure 63: Cutting a batten to size

- If the batten collides with a tiling batten, the batten must be continued as far as the next rafter / next counter batten and cut to size in such a way that it replaces the tiling batten in this section (see diagram).

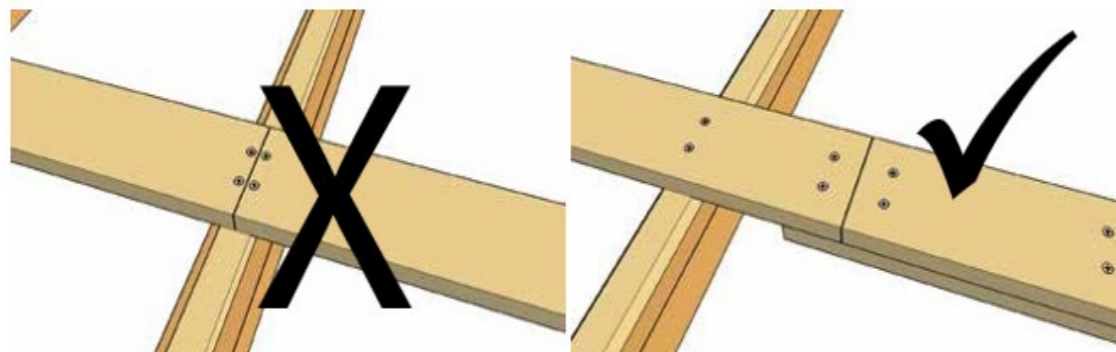


Figure 64: Incorrect / correct joints

Battens must be mounted with screws according to „Mounting Screws for Battens“ on page 25. The use of nails is not acceptable.

- Mounting screws must observe the following minimum intervals:
- 31.5 mm distance in the direction of the grain (from the end of the wedge plank / batten)
- 22.5 mm perpendicular to the direction of the grain (from the edge of the wedge plank / batten).

The mounting of two adjoining battens onto a single counter batten (as in the above diagram) is NOT acceptable if the distance of the end of the batten to fall short of the minimum of 31.5 mm.

To ensure that the required minimum distance is observed, the rafter/the counter batten must be “doubled” at the sides and the adjoining batten mounted onto it (as depicted in the drawing „Rules for Mounting Battens“).

9 FURTHER INFORMATION

You will find further information at www.bisol.com or www.ernstschweizer.ch.



BISOL Production, Ltd.

🏠 Latkova vas | 59a SI-3312 Prebold | Slovenia

☎ +386 (0)3 703 22 50

✉ info@bisol.com

🌐 www.bisol.com

