SOLARSTONE

Solarstone® Solar Tiled Roof™

Technical Specifications & Installation Manual

Table of Contents

Description

The Solarstone® Solar Tiled Roof™ is a patented building-integrated photovoltaic (BIPV) product developed by Solarstone® in Estonia. The modules for tiled roofs interlock with nearly all flat concrete and clay tiles. One Solar Tiled Roof™ module replaces 5 to 6 roof tiles with a guaranteed seamless transition with tiles around the perimeter.

The Solarstone® Solar Tiled Roof™ combines the aesthetics of traditional tile roofs with the power of solar energy. It's an ideal solution for homeowners who want to reduce their energy bills and carbon footprint without compromising on the looks of their home.

Solarstone® Solar Tiled Roof™ comes in 2 sizes - 90W, 108W depending on the client's preferences.

Why people choose Solar Tiled Roof™:

- Solar power for self-consumption.
- 2in1 system – technology and functionality.
- Streamlined aesthetics for building skins.
- Making the world a greener place.

This guide is intended to provide comprehensive instructions for installing the Solarstone® Solar Tiled Roof™. If you have any questions or concerns that are not addressed in this document, please do not hesitate to reach out to the Solarstone technical support team at support.tech@solarstone.com. It is imperative that you adhere to all safety precautions outlined in this guide as well as any applicable local regulations. Please note that the installation of the Solar Tiled Roof™ requires professional skills and knowledge, and should only be carried out by qualified personnel. To ensure a successful installation, please read this manual in its entirety before beginning the installation process. It is essential that the installation personnel are familiar with the mechanical and electrical requirements of the system.

Specifications

Solar Tiled Roof™

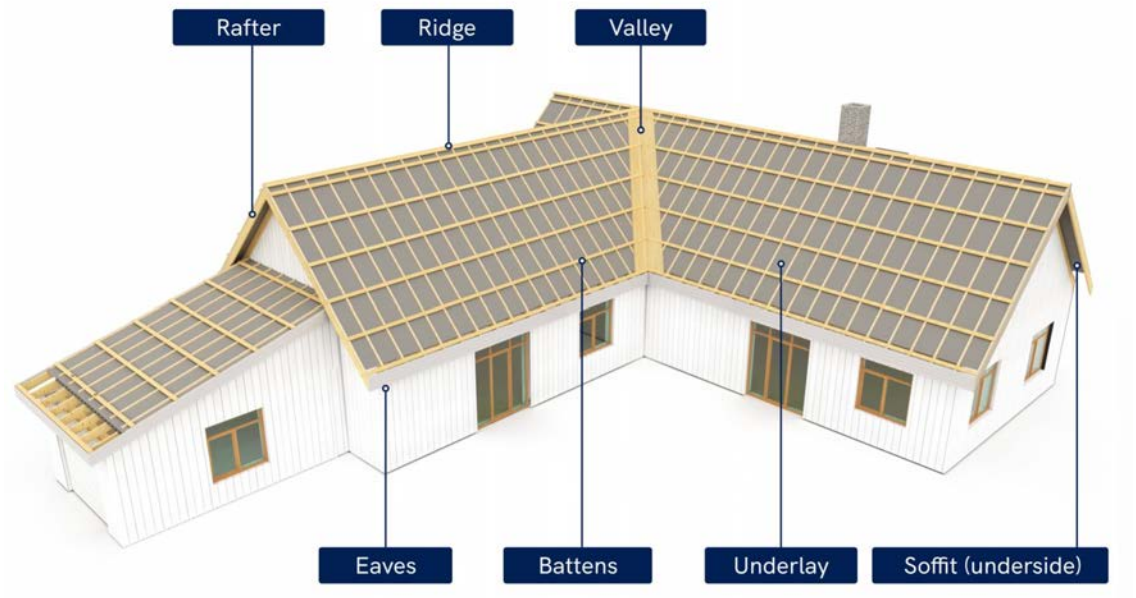
- Solarstone® advises using following module models with given parameters to ensure proper installation and electrical output with version 1.0 in 2023.

Mechanical Specifications		
SOLAR MODULE	**90W**	**108W**
SOLAR CELL	Monocrystalline	
MODULE DIMENSIONS (WxLxH)	1530x395x21 1530x395x30	1824x389x21 1824x389x30
WEIGHT	7kg	8kg
SNOW LOAD	4900 Pa	
WIND LOAD	2400 Pa	
FIRE RESISTANCE	Broof(t1)(t2)	
WARRANTY	25-year linear power and 10-year product warranty	
Electrical Specifications		
INVERTER	Only allowed with AFCI (Arc-Fault Circuit Interrupter) available	
MODULE EFFICIENCY	19%	19%
MODULE OUTPUT	90W	108W
NO OF CELLS	18	22
OPEN CIRCUIT VOLTAGE - VOC	11.9 V ± 5%	14.1 V ± 5%
SHORT CIRCUIT CURRENT - ISC	9.3 A ± 5%	8.7 A ± 5%
MAXIMUM POWER VOLTAGE - VMPP	11.2 V ± 5%	12.6 V± 5%
MAXIMUM POWER CURRENT - IMPP	9.6 A ± 5%	8.6 A ± 5%
CONNECTOR	MC4 (1000V) IP67	

Component List Specification		
SOLARSTONE® SOLAR TILED ROOF™ COMPONENTS	**ITEM**	**PRODUCT**
MODULE	1	
REGULAR CLAMP	2	
L-PROFILE	3	
POLYETHYLENE SEALING TAPE	4	

Solarstone® Solar Tiled Roof™ component list

Roof elements



Necessary tools

Underlayment and marking out tools:

Circular saw

Grinder tool

Chalk Line Tools

Measuring tape

Roofing blade or utility knife

Tacker or Stapler

Hammer

Roofing nail gun

Electrical Tools:

Digital Multimeter and Insulation Tester

Clamp Meter

MC4 Solar PV Cable Crimping Tool Kit with Stripper, Cutter, Spanner

Oxide inhibitor

Safety & Protective Equipment

We advise you to protect yourself with protective equipment at all times and abide by all safety precautions in this guide and local regulations. Nevertheless, it is mandatory to use safety harness equipment, helmet, gloves, safety glasses, etc.

Solarstone® will not take any responsibility for safety nor health issues that have come up during the installation.

Protective equipment

General Roof Safety Harnesses	Safety glasses	Gloves	Other personal protective equipment
			

Steps 1-5 | Roof Preparation

Step 1 | Structural Analysis Before Installation

Ensure that the method used for installing roofing materials and the supporting substructure is strong and able to properly support the chosen product and meet its weight requirements. Additionally, the supporting system should be installed in accordance with local, national, and international standards.

Factors to consider include the weight of the materials, the slope of the roof, the perpendicularity of the structure, the condition of the existing rafters, the suitability of the batten material, and applicable wind and snow load parameters.

Step 2 | Underlay

Install a watertight breathable underlay which evacuates all moisture out of the building structure. Only high quality underlay should be used (in accordance with harmonized European Standard BS EN 13859-1:2014) with a high resistance and stiffness against wind uploads. Other configurations are applicable such as using SBS/PVC underlay, which must be applied if the roof angle is below 18°.

Disclaimer: No roof is 100% waterproof. Proper underlayment helps condensed water or minor leaks (occurring with heavy rainfall) escape directly into the gutter or naturally ventilated soffits.

Step 3 | Counter and Ventilation Battens

Battens must be fixed in place with two screws (5x150) or nails (5x150). The length of the screw or nails must be sufficient to penetrate ventilation battens and counter-battens and enter rafters ⅓ of its length.

For improved ventilation Solarstone® recommends using following batten specifications:

- Ventilation battens

45...53 x 45...53 mm.

- Counter battens

45...53 x 45...53 mm.

- Nordic counter battens

36x76 mm

Step 4 | Diagonals and Slope

- While measuring roof diagonals, make sure that the diagonals match on corners and the roof is at the right angle.
- If diagonal measurements of the roof area do not match, contact your roofing partner to fix or prepare to use custom size tiles or transitional flashings.
- Roof pitch must be greater or equal to 14°. Roof pitches between 14-18° will require SBS/PVC underlay. Always adhere to the tile installation requirements prescribed by the tile manufacturer.

Step 5 | Batten Step

Batten step depends on selected tile model, pitch of the roof and design of the module. Solarstone® has concluded a table for choosing the best combination of concrete/clay tiles with your new Solar Tiled Roof™. All tiles not listed below must be validated with Solarstone® sales engineer in the design phase. Otherwise, please refer to the compatibility table below.

- Before any roofing installation, a technical drawing/projection of the Solar Tiled Roof™ must be done by a professional. Otherwise, one might result in undesirable installation or end-result.
- As information on concrete/clay tiles might change over time, always validate the relevant information with the manufacturer of the tile. Information provided below is indicative to obtain a better understanding when designing and performing the installation.

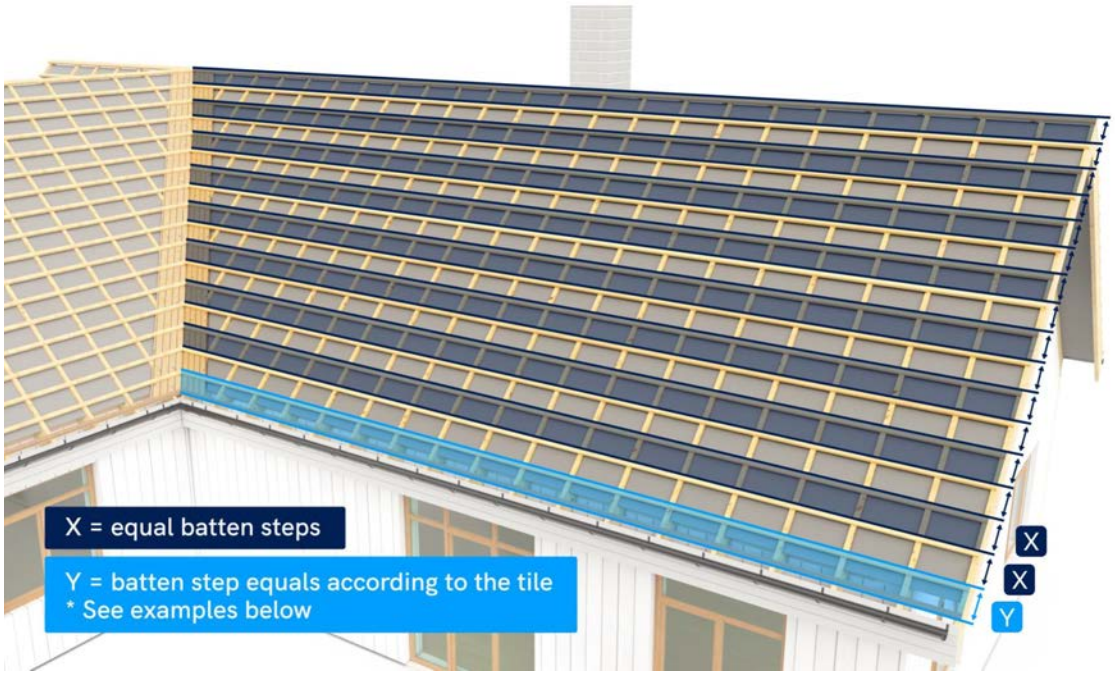
Table 1. Batten step and Solar Tiled Roof™ compatibility table

Compatibility table *-						
Roof Tile model	**Tile manufacturer batten guidelines (mm)**	**Batten spacing with solar tiled roof (mm)**	**Minimum slope (°) without SBS**	**Recommended minimum pitch with solar tiled roof**	**Module Compatibility with tiles**	**Comments**
BMI Monier - Evo	312-340	335-340	19 °	35° *	90 W | 108 W | 21 mm frame	
BMI Monier - Teviva	312-340	335-340	19°	35° *		
BMI Monier - Tegalit | Minster	312-340	335-340	18°	35° *		
BMI Monier - Turmalin	355-380	355-380	14°	14°	108 W | 30 mm frame	on-site grinding required
Benders - Carisma	310-350	340-350	14°	18°	90 W | 30 mm frame	

* Minimum pitch for lower than 35° will be available in Q4 2023. In case of smaller angels, different batten step distances can be used on the roof. For example 335-340 mm batten step for Solar Tiled Roof™ and tile batten step according to tile manufacturer's instructions.

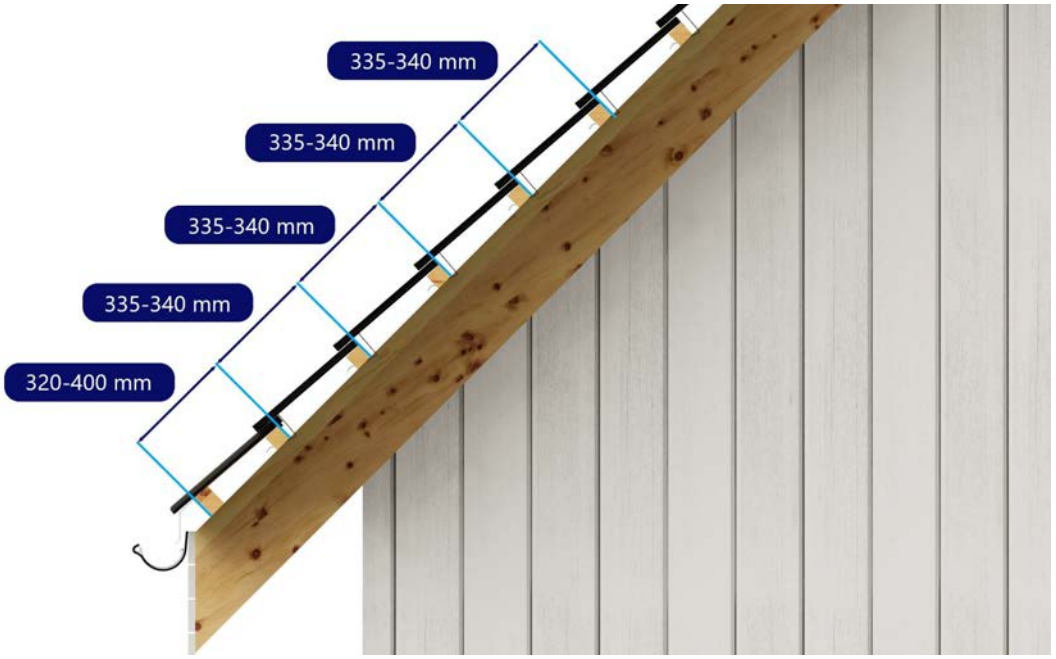
- Solarstone® advises minimum 335 mm batten spacing to provide the best fit. Installations below 335 mm are not allowed due to shading conflict caused by the overlapping module array. Wider application of Solar Tiled Roof™ of different batten gauges will be available in Q4 2023.

- Version 1: Batten step depends on the tile model, module design and the pitch of the roof. Be aware of the fact that the first and the continuous batten steps differ (Y and X) in distances and in measuring style. In case for measuring (Y) take the distance from the bottom of the batten to the top of the next batten. In case for measuring (X) take the distance from the top of the lowest batten to the top of the highest batten.

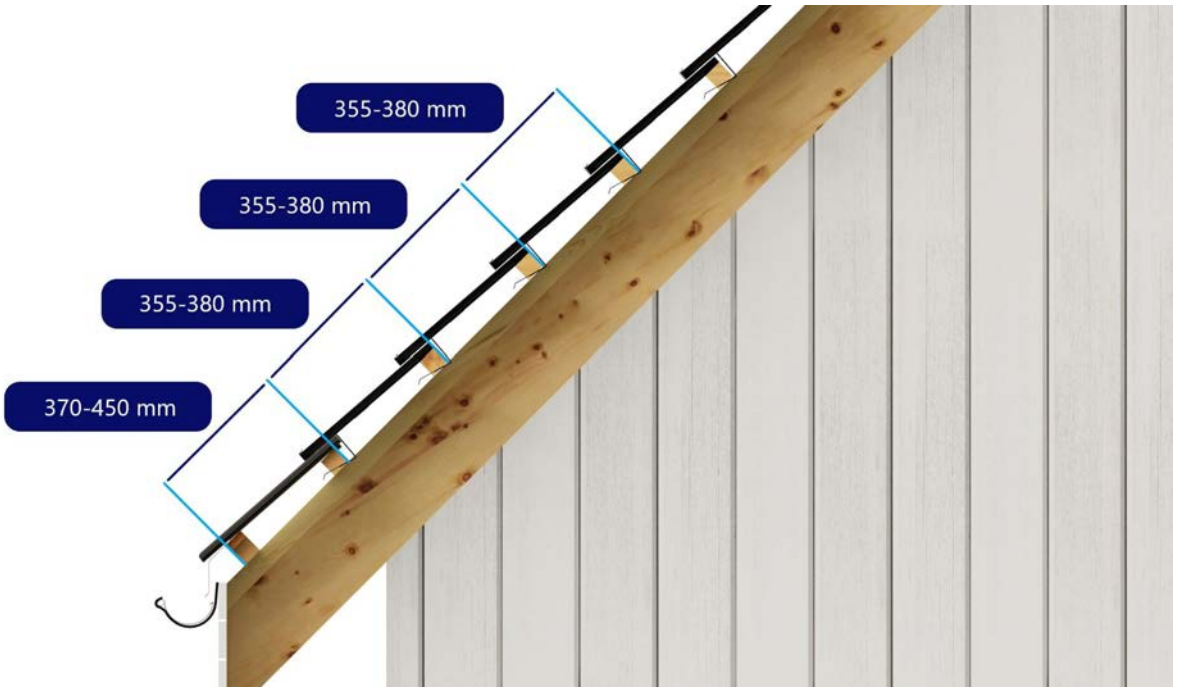


- Below are shown a few examples of batten step gauges for different types of tiles. As mentioned previously, designer of the batten step must consider - pitch of the roof, tile and module design. During the design process of the first batten step (Y) one must also take into consideration that the water must run in the center of the gutter. The latter is related to soffit design and instructions of tile manufacturer.

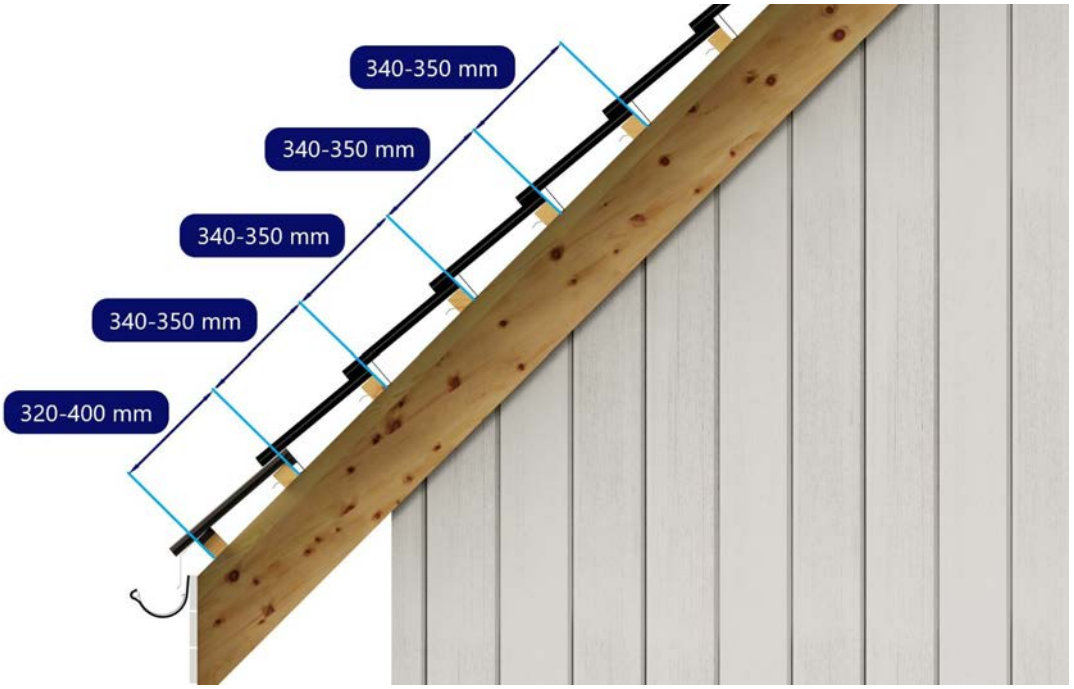
- Batten step according to **BMI Monier - Evo, Teviva, Tegalit, Minster tiles.**



- Batten step according to **BMI Monier - Turmalin**



- Batten step according to **Benders - Carisma**

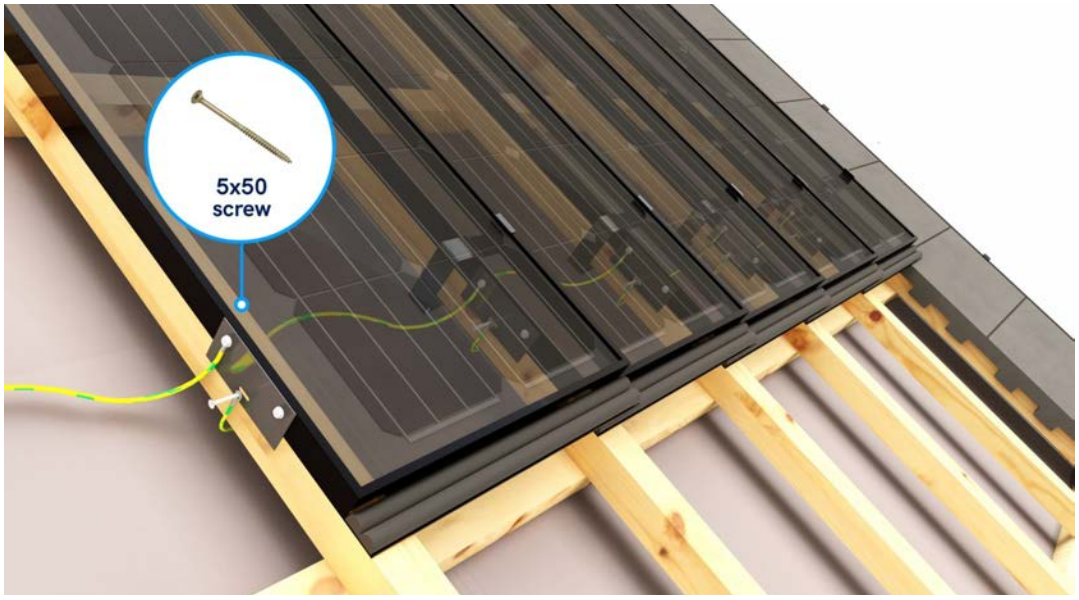


Steps 6 - 12 | Module Installation

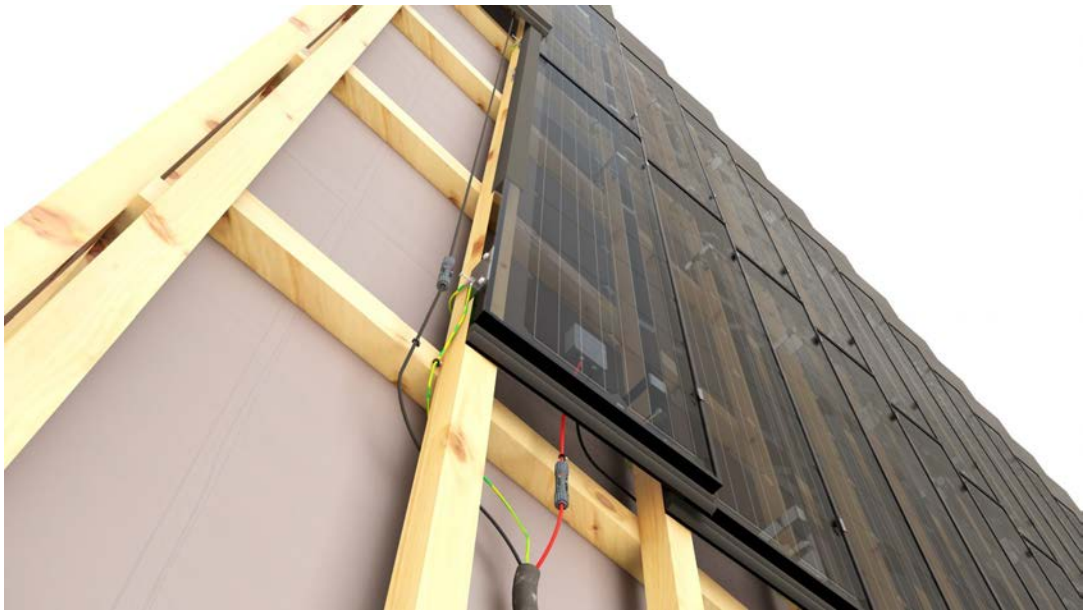
Step 6 | Grounding

- Bring the earth wire down to the inverter. From the inverter the grounding wire is connected to the electrical panel, which leads the grounding wire to the ground.

- Earth wire is connected to each next module. Cable is brought to the next module from under the upper batten. Solarstone® recommends using a 5,0X50 ESSDRIVE PP model screw for fastening the modules into the battens.



- Plug the last cable with the extension cable that is connected to the inverter. Mate the last grounding wire attached to the module with one leading to the utility room. Make sure the cable length is optimal so that the cables will not be under permanent stress while being connected.



Step 7 | Solar System Planning

When installing a Solarstone® Solar Tiled Roof™, it is essential to carefully consider all complex geometries on the roof, such as chimneys, roof windows, valleys, ventilation systems, and access hatches. Instructions for installing these specific elements can be found in steps 13 through 17 of the installation guide. Furthermore, it is crucial to take into account any potential shading caused by the roof's geometries or surrounding objects such as trees or street light posts, as this may necessitate different design principles and the use of optimization tools. Additionally, the active module should be placed at least 800 mm from the chimney due to fire safety regulations.

Disclaimer: Solar modules can be inherently of different color due to manufacturing processes. Monocrystalline silicon crystals might have a slightly different reflection on light, which may result in undesirable end-result. Every projected roof should be installed with modules from the same batch. Note that PV-modules and tiles have a different final appeal due to inherently materials used.

Step 8 | Determining the Position of the Modules

- Refer to the data sheets and architect's drawings to understand which layout to use and how the system will be located on the roof.
- Mark the exact location of the modules and tiles to make sure the positions are correct and as per design.
- Determine the required space for installation. See product compatibility and data sheet as different tile manufacturers' tiles match with different Solarstone® products.

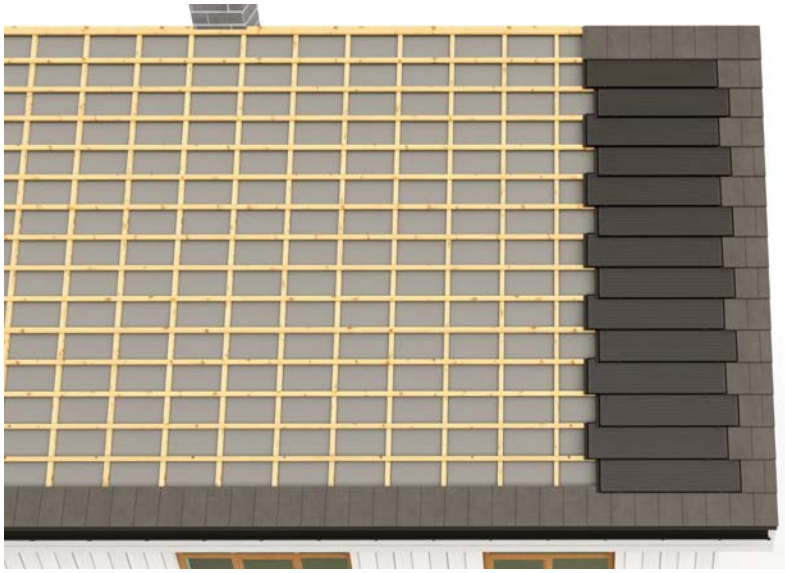
- Leave a minimum of one row for conventional tiles above and below the Solarstone® module array. Single tiles must be placed adjacent to the modules to complete the rows. Follow the same principle when working around an obstruction (skylight, chimney, ventilation outlet etc). Always cut the tiles on the ground to avoid smearing the modules with abrasive concrete/clay dust.
- Lay Solarstone® modules either in straight columns or broken bond to match the design and specification of the preferred layout.
- The PV modules are not meant to be adjacent to roof obstruction such as skylight, chimney, ventilation outlet etc. Obstructions should be sided by roof tiles.

Step 9 | Solar Module Installation Method

It is possible to install Solarstone® Solar Tiled Roof™ in various sequences - by column, broken bond or in a row. In order to optimize the amount of extension cables connecting different strings, the length of the original cables and position of MC4 connectors must be duly evaluated in the design process.

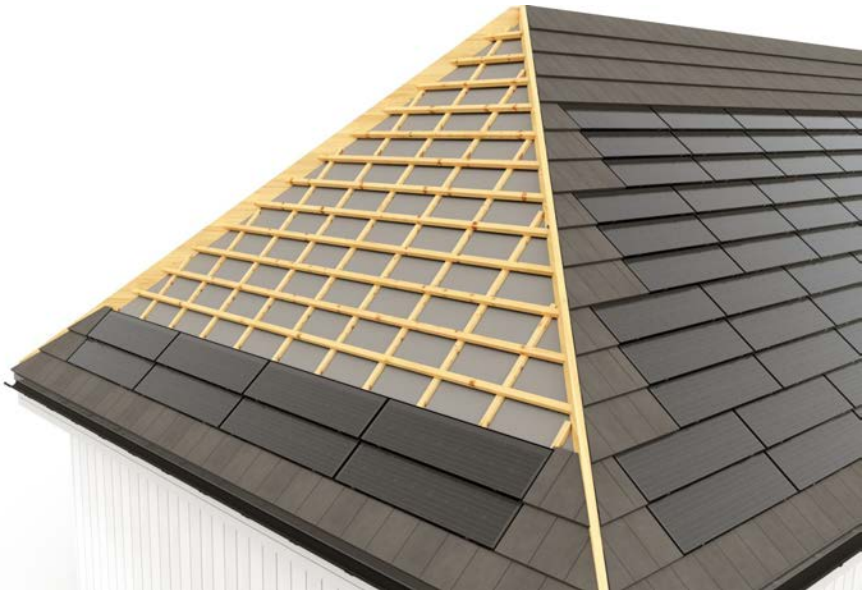
- Version 1: Installation by column

- Version 2: Installation in a broken bond pattern.

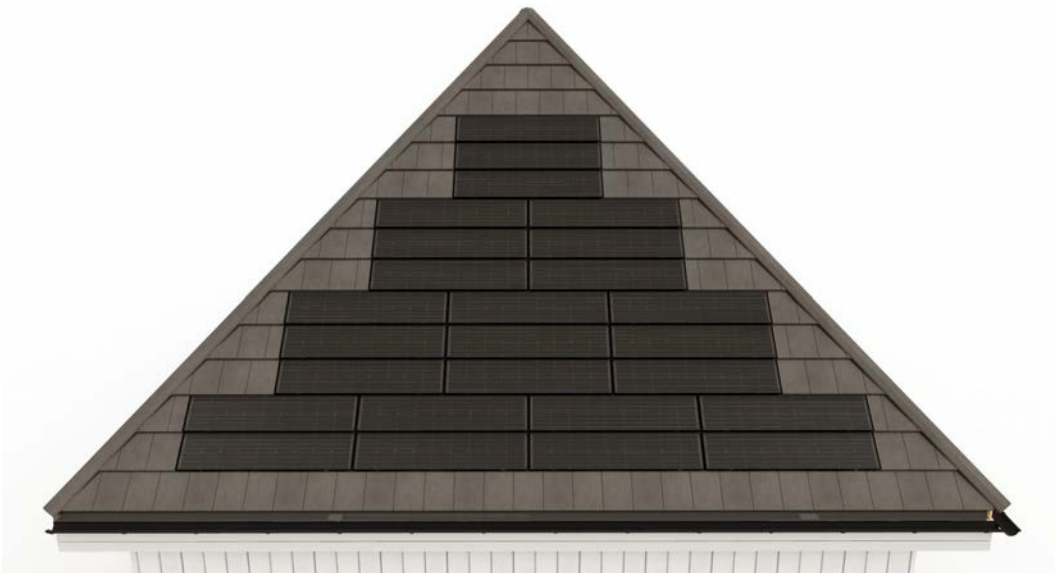


- Version 3: Installation in a row

- Version 4: Installation in a row on a hip roof



- Version 4: Installation on a hip roof



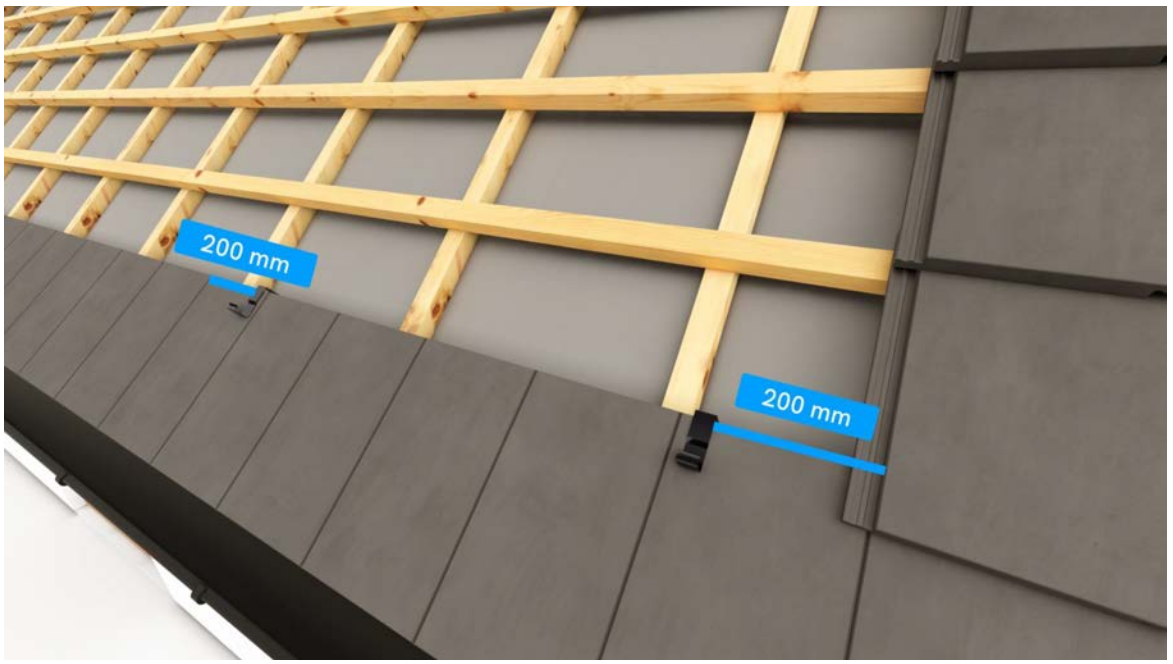
Step 10 | Installation of Clamps

Step 10, 11 and 12 are performed at the same time simultaneously, therefore consider working through these two steps before installing the modules.

Solar Tiled Roof™ is only installed in landscape mode. This step will demonstrate how Solar Tiled Roof™ clamps are to be installed. Number of clamps required is derived from the local wind uplift factor. The standard solution is shown below:

- Solar Tiled Roof™ is placed with 2 clamps.
- Clamps are positioned 200 mm inwards from both sides of the module.
- Clamps only fix the module if they are clicked into it. Clamps are not screwed into the battens.

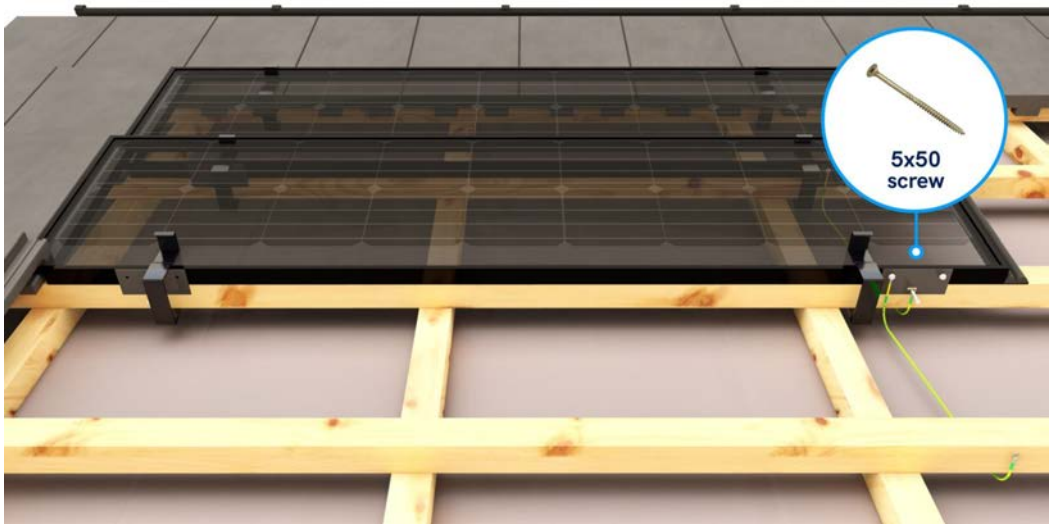
- Position clamps 200 mm from the outer sides of the module. In some cases the position of the clamps need to be altered due to the conflicting position of the counter-battens.



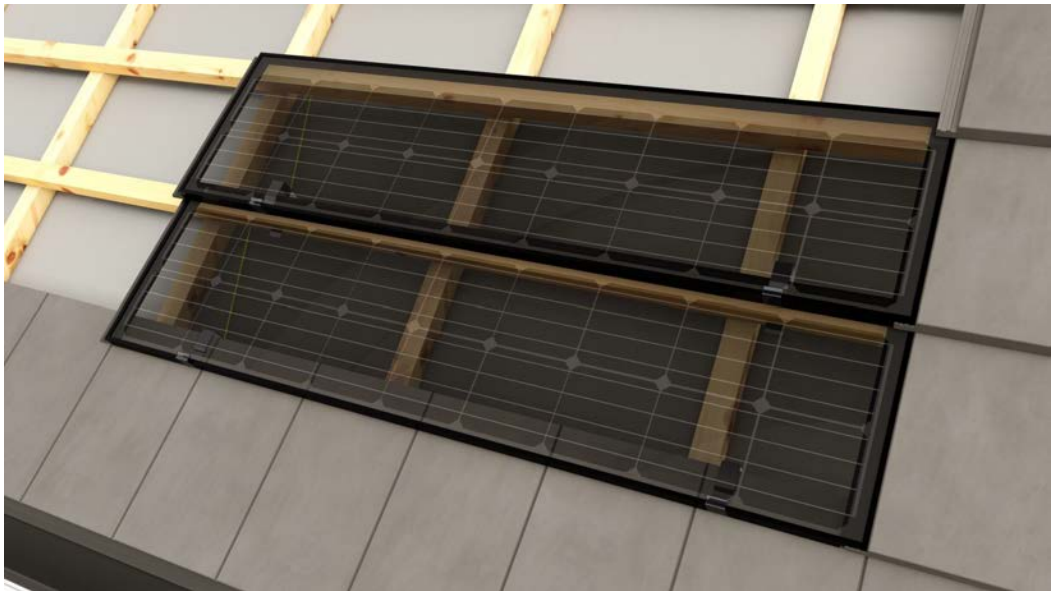
- Bring the clamp over the tile and batten. Clamps are not fastened with screws.

- Install the first module, add clamps and gently pull out the grounding wire to be connected to the next module in the column.

- Drive the screw through the hole of the terminal ring and fasten the module through the metal plate fixed to the module.



- Add the next module. Repeat the process until the string is complete.

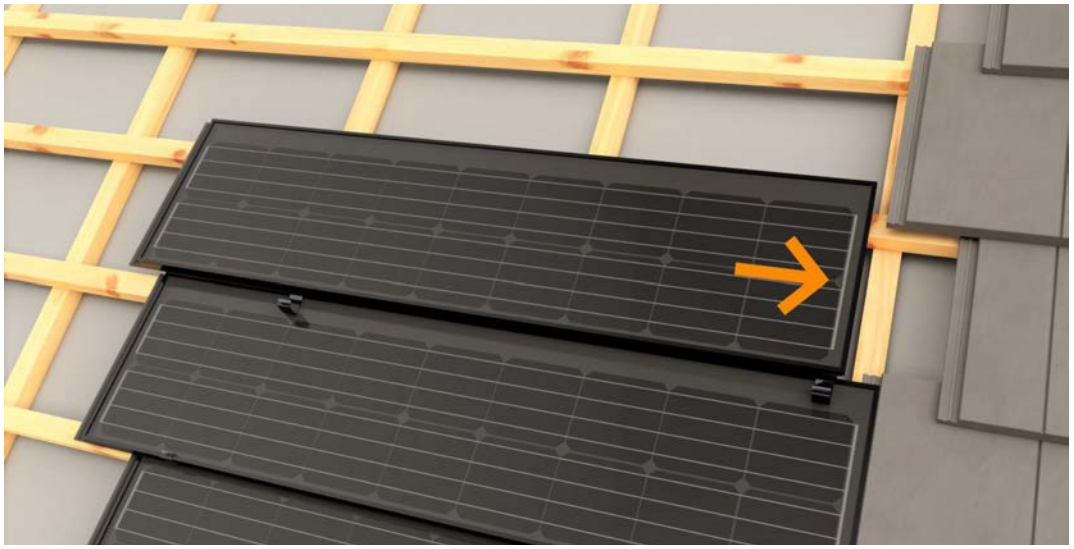


Step 11 | Mechanical Installation of the Module

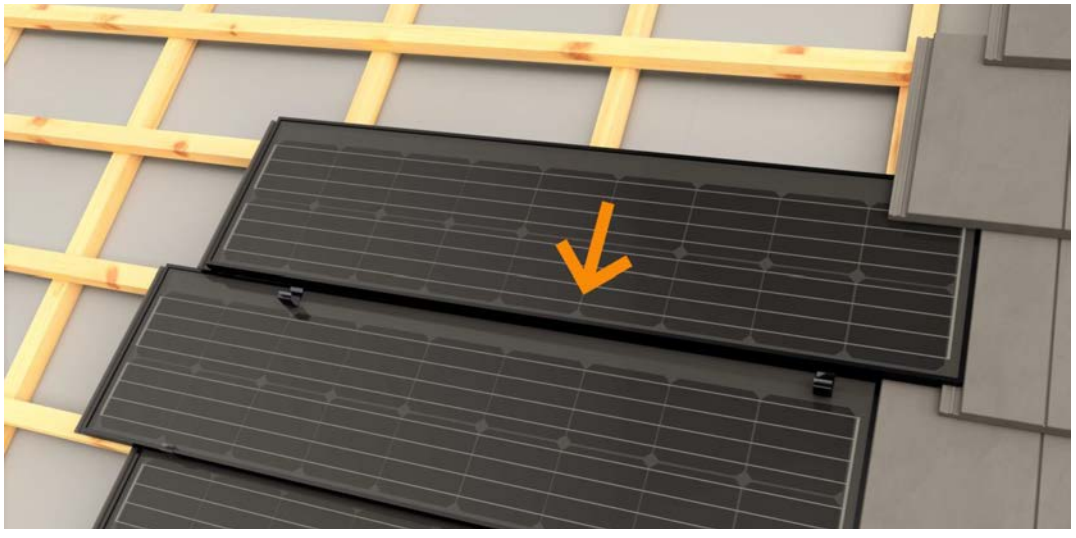
Step 10, 11 and 12 are done at the same time simultaneously, therefore consider working through these two steps before installing the modules.

Solar modules are installed from right to left, progressing with full columns.

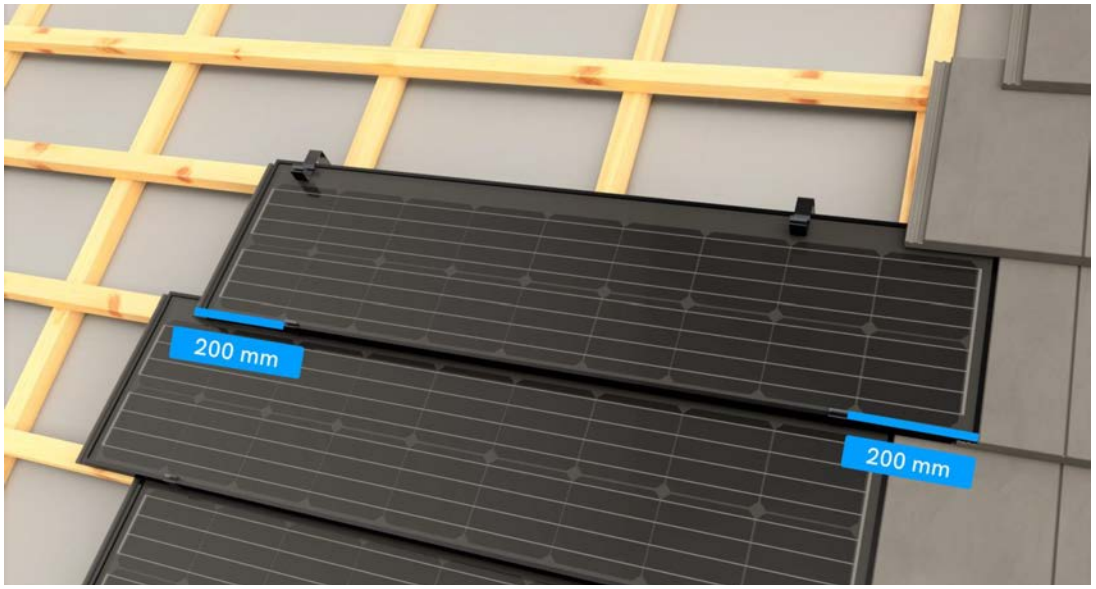
- Slide the upper right corner of the module under the lower corner of the upper tile.



- Drop the lower part of the module into the clamps.

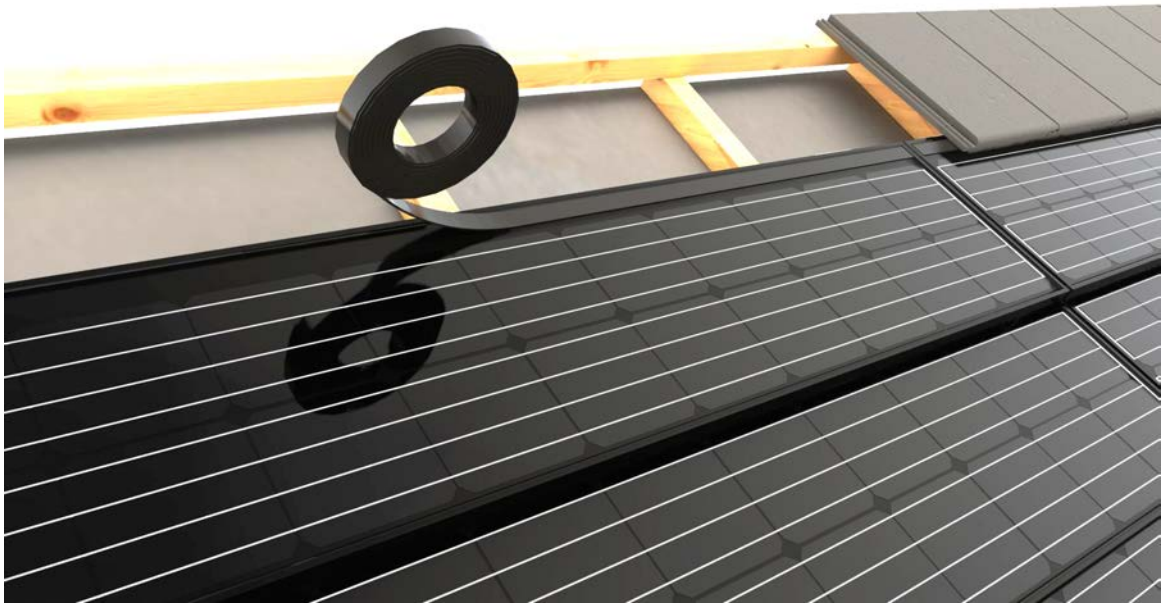


- Press the module into the clamps until it clicks and the clamps have full contact with the module.



- Freestanding plastic L-Profile (38x38x1) is added to the last module. This will protect the glass surface of the module from any damage from the tile.

- Another option would be using a 3x30 polyethylene sealing tape.



- Cover the tape within the glass area. Do not add tape on the PV-module frame or on the cells.

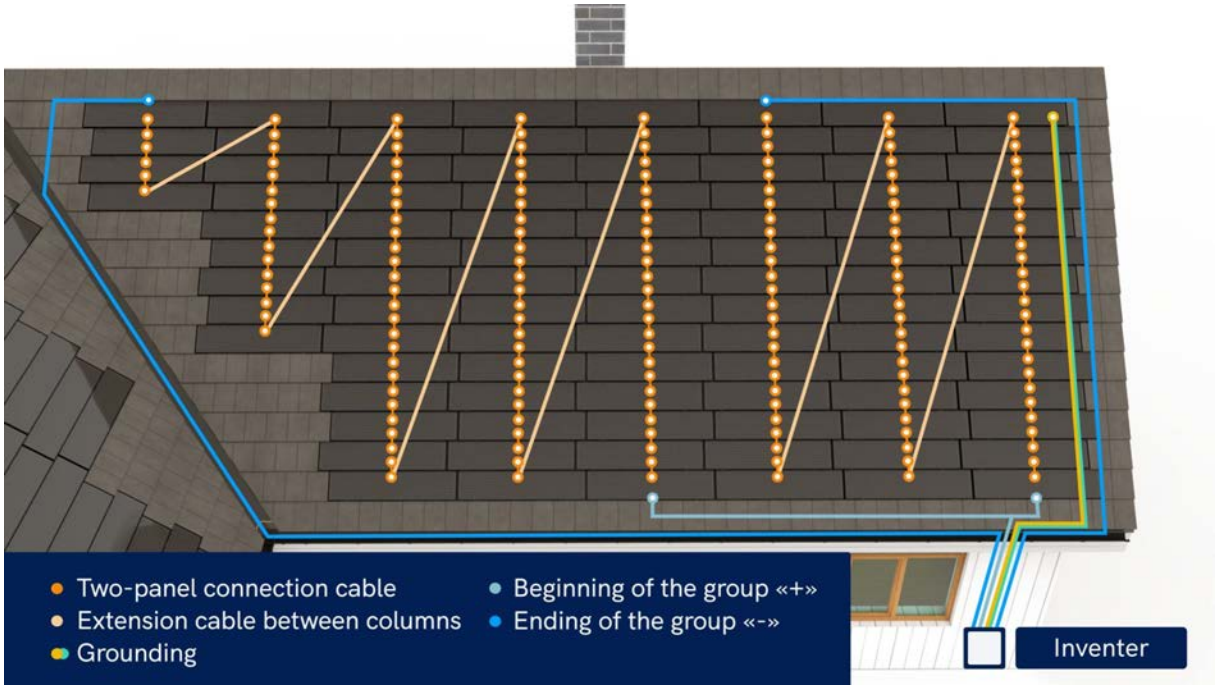
Step 12 | Cable Connections

Follow the regular solar installation principles and manufacturer's instructions when connecting the solar cables.

- Connected MC4 connectors must be lifted and not laid on the underlay. Optimal cable length must be considered in every single string to avoid connecting cable strings under permanent stress.
- Check the compatibility of MC4 connectors when field and module cables are mated. Connectors made by different manufacturers may be sometimes described as "MC compatible", but may not conform to the requirements for a safe electrical connection with long term stability.
- Use only MC4 connectors recommended by the PV-module manufacturers and provided by Solarstone, which is noted under installation manual specifications.
- MC4 connectors are connected correctly if both connectors ‘click’ to each other.
- Use of electrical contact grease (applied to male MC4 connector) is allowed only when validated by the module producer and/or MC4 manufacturer.
- Always refer to local solar guidelines, PV module manuals and best practices.
- Certified electrician is only allowed to perform electrical operations, proficient in calculating cable and wire size. You should be familiar with, and adhere to relevant solar and electrical installation regulations.

- Back end of the module. Green/yellow cable is for earth, black cable is neutral and red is live.

- Recommended cable routing method

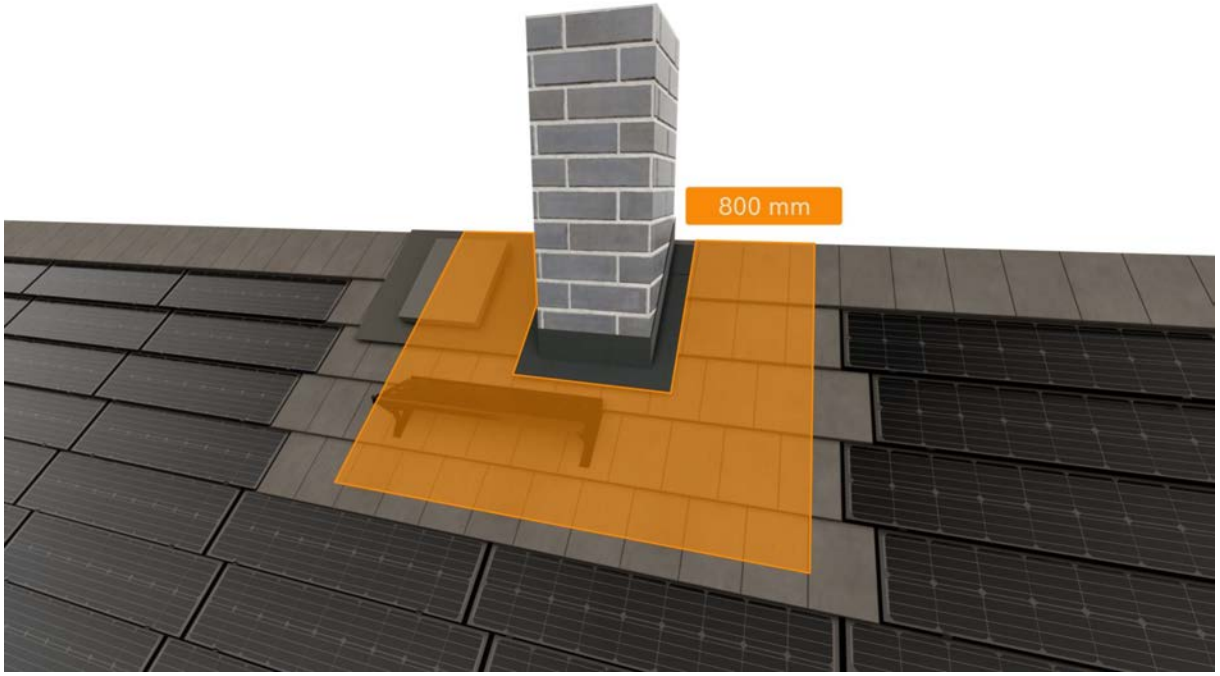


Disclaimer: It is mandatory to ONLY use arc fault detection inverters in combination with Solarstone products.

Extras

Step 13 | Chimney

It is not allowed to install active modules around active chimneys closer than 800 mm. Always abide by the local, national and international laws.



- Always make sure that the distance between the chimney and the active module is 800 mm. In addition, as previously mentioned, the tile module distance from the chimney must be 20mm according to the EVS 812-3:2018 in Estonia. Different countries have different regulations in this matter, therefore always abide by the local, national and international laws.

Step 14 | Installation of Roof Accessories

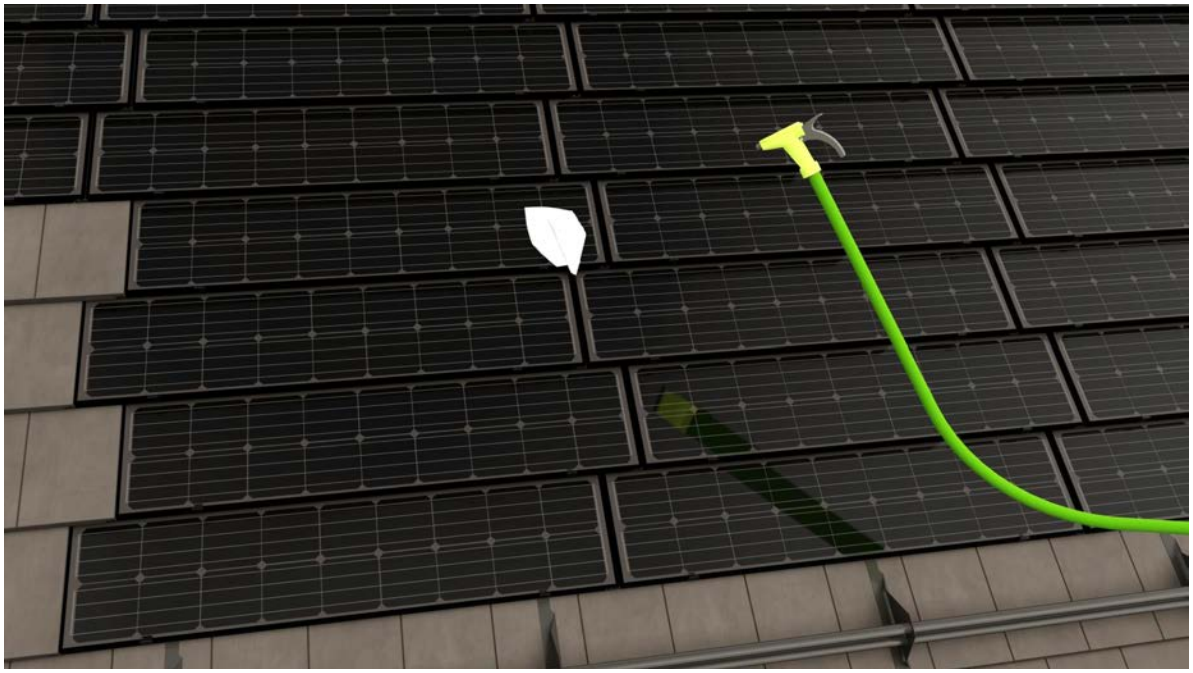
Installation of roof accessories is only permitted on top of roof tiles. Never install roof accessories on active modules. For fastening roof accessories, Solarstone® advises using fastening screws 8 x 50. These are usually provided together within the roofing accessories package. Always adhere to local requirements when designing and performing relevant installations.

- Snow guard installation requires an additional batten for snow guard hooks.

Step 15 | Maintenance of the Modules

Carrying out periodical maintenance provides maximum efficiency of the Solar Tiled Roof™. In areas with high dust concentration, plant or tree pollination or other types of pollution regular wash should be considered.

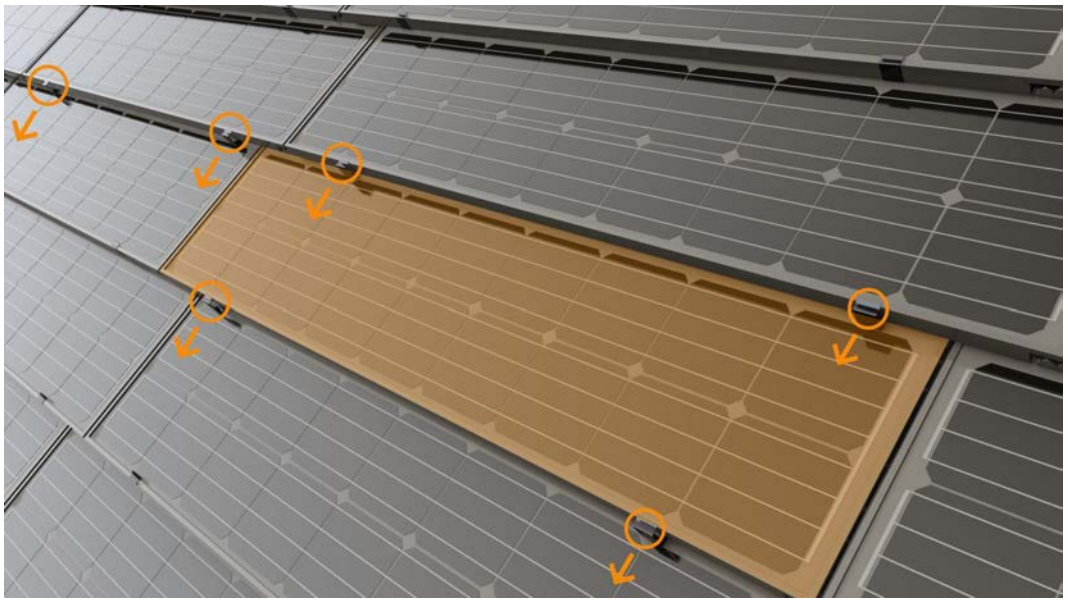
- If accessible, modules can be cleaned with the help of the simplest means such as water and a cloth.
- Cleaning should take place only in the morning, evening or on a rainy day when the irradiance isn't high.
- It's not permitted to step on a module whilst cleaning (during installation or once installed). Use a ladder or remotely operated boom lift for easy access.
- Perform a visual inspection once a year to validate if the panel mounting elements may have come loose.
- Do not use metal tools such as spades, knives or abrasive sponges for cleaning.
- Make sure that all visible cables and plugs in the technical room are properly secured and not loose.
- When cleaning with a pressure washer, the pressure must be less than 690 KPa.
- Do not use steam or corrosive chemicals to speed up cleaning.



Step 16 | Replacing Modules

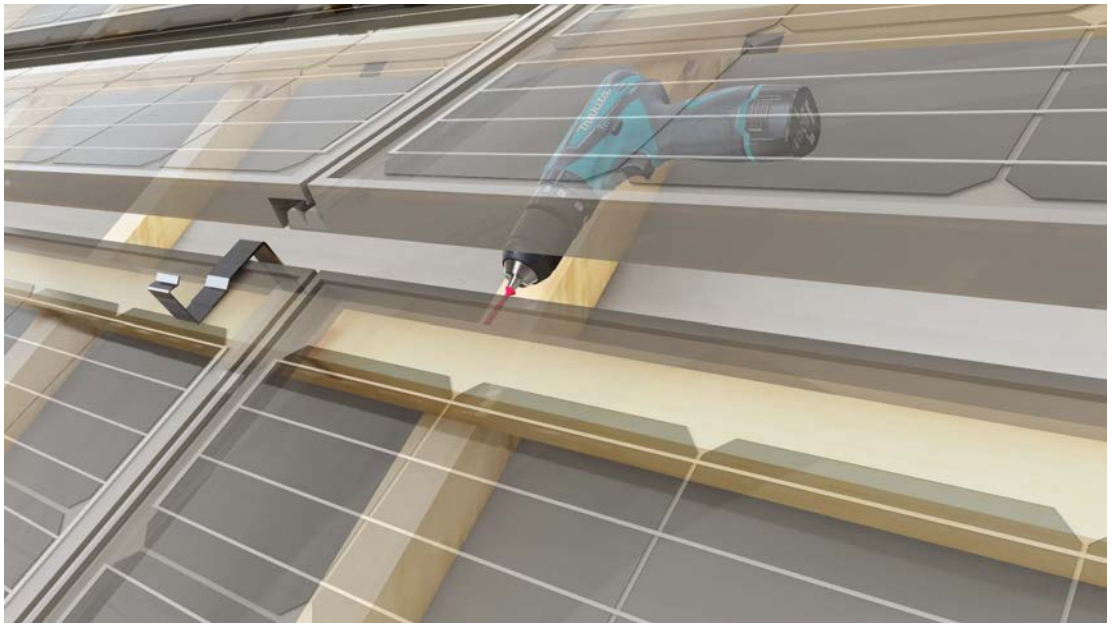
Note that it is forbidden to step on the modules, therefore use cherry picker for accessing the module. The system must be turned off before the start of this step.

- In order to change the module (either visibly damaged or non-functional), pull the clamps approximately 15 millimeters downwards so that module would click-out from the clamps. There is sufficient space for the module to move and be released from the clamps.



- Move the module upwards, to start unfastening the lower module from the aluminum sheet.

- Unfasten the module from the batten.



- If the module has been freed from the clamps, lift the aluminum sheet part over the batten and pull it downward.

Step 17 | Lightning Protection

Ring earth electrodes must be in contact with the ground. It must be installed as a closed ring with a depth of 0.8m according to DIN 18014 around the external foundation of the building. Active module must be a minimum 0.8m away from the ring earth electrode. Always abide by your local, national and international laws.

Version

NO	DATE	DESCRIPTION	WHO
1.0	03.04.2023	Released version	Mattis Jürimäe, Alari Merbach, Henri Lass

SOLARSTONE OÜ

12916046 | EE101855882

Tallinna tn 58, 71018 Viljandi, Estonia

sales@solarstone.com | +372 5631 6666