GOODWE

INSTALLATION MANUAL

GOODWE PVBM

UP TO A SUSTAINABLE FUTURE

SUNSHINE TILE(GLOBAL VERSION)

BMT-S2/024A(84W)

GOODWE TECHNOLOGIES CO., LTD.

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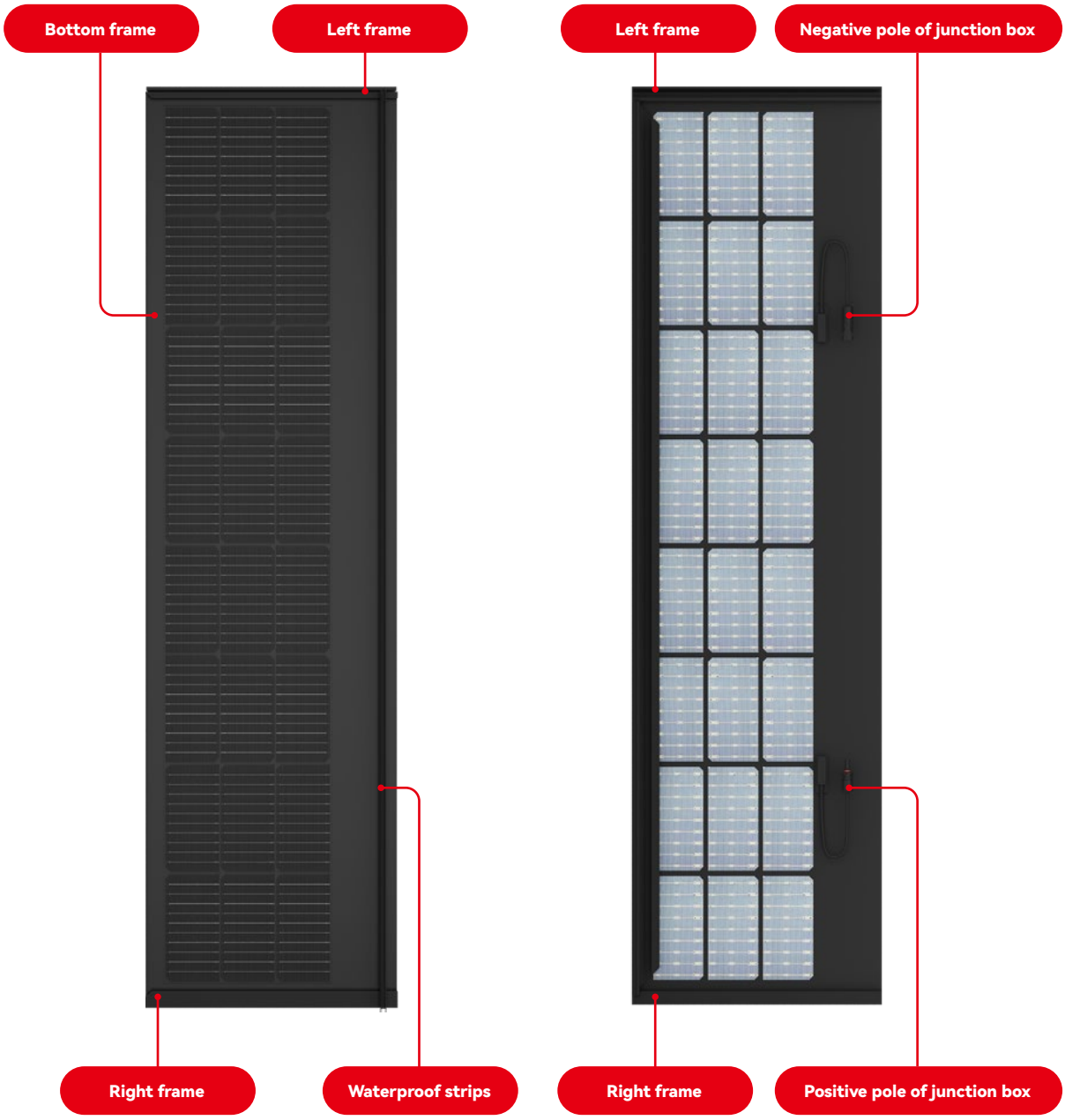
CONTENT

1 DESCRIPTION OF THE MAIN STRUCTURE OF THE SUNSHINE TILE

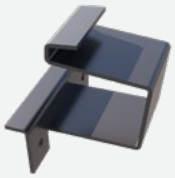


Installation Altitude : <2000m
Fire Protection Level : CLASS A
(According to the corresponding certification standard IEC 61730-2-MST23)
Protection Level : Level II
Maximum Mechanical load : Front 5400Pa; Back 2400Pa

2 INSTALLATION ACCESSORIES LIST

2.1 MOUNTING KIT

PS: Select refer to the appendix 2 for more details. Provided by GoodWe.
Sunshine Global Mounting Kit (standard, can NOT be sourced locally)



Mounting Hook

Hook Screw

2.2 OTHER KIT

PS: Select refer to the appendix 2 for more details.
Sunshine Global ground kit (standard, can be sourced locally)

Screw

External Tooth Washer

Grounding Cable

Sunshine Global left end plugs (optional, can NOT be sourced locally)

Left Plug

Sunshine right end plugs (optional, can NOT be sourced locally)

Right plug

Sunshine Global Adapter Kit (optional, can NOT be sourced locally)

Left adapter

Right adapter

2.3 CEMENT TILE ACCESSORIES

PS: Not provided by GoodWe, can be purchased locally.

Wooden Support Bracket

Cutting Tile Buckle

Ridge Screw

3 INSTALLATION TOOLS LIST

Tape Measure

Electric Impact Wrench

Chalk Line

Electric Saw

Magnetic Philips Bits

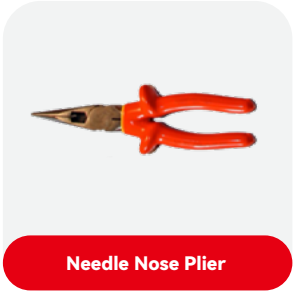
Claw Hammer

Suction Lifter

Utility Knife

Note: This list only indicates the main tools required for the installation of Sunshine Tile structure system and does not include the tools used for the installation of the roof support section and the electrical section. The tools used for the installation of the roof brackets can be referred to the preparation of the building work.

4 TOOLS AND SPARE PARTS FOR ELECTRICAL INSTALLATION



Needle Nose Plier

Wire Cutter

Photovoltaic special crimping pliers

Wire stripping plier

Joint wrench

5 PRE-INSTALLATION INSPECTION WORK OF THE SUNSHINE TILE

WARNING

- Please use insulated tools to reduce the risk of electric shock.
- Please adopt appropriate protective measures (non-slip gloves, work clothes, etc.) to avoid direct contact with 30V DC or higher, and avoid direct contact with sharp edges during installation
- Please do not wear metal ornaments during installation to avoid poking through Sunshine Tiles and causing electric shock hazards.
- The Sunshine Tiles can generate electricity under sunlight, so it is strictly forbidden to short-circuit the output cables, otherwise the cables may overheat and cause the cable sheath to melt.
- During installation, construction workers should wear non-slip shoes or shoe covers and have reliable fall protection.
- Installation should be stopped during rainy weather, when the roof is wet, or when the ground is wet to prevent the risk of falls or electric shock.
- DO NOT allow children or unauthorized personnel to approach the installation area or the storage area of Sunshine Tiles.

● If the surface material is damaged or worn, direct contact with the surface of Sunshine Tiles may result in electric shock.
● Do not attempt to repair any part of Sunshine Tiles.
● The lid of the junction box should be kept closed at all times.
● Do not disassemble, modify, or move any part of Sunshine Tiles.
● Do not artificially concentrate light on Sunshine Tiles.
● It is important to note that only one piece of product can be moved in a single operation when installing Sunshine Tiles.
● DO NOT stand, climb, walk or jump on Sunshine Tiles.
● DO NOT place Sunshine Tiles in an environment that is not reliably supported or not fixed.
Changing the wiring of the bypass diode is prohibited.

BE CAREFUL

● Before installing Sunshine Tiles, the relevant authorities should be contacted to obtain information about the installation site and construction permits, and the requirements for installation and inspection should be observed.
● Check the applicable building codes to ensure that the building and its structure (roof, exterior façade, load bearing, etc.) in which Sunshine Tiles are to be installed have adequate load-bearing capacity.
● Ensure that Sunshine Tiles are installed on a fireproof roof.
● Sunshine Tiles must not be installed near flames or combustible objects.
● Ensure that Sunshine Tiles meet the overall technical requirements of the system.
● Ensure that other system components do not cause damaging mechanical or electrical performance effects on Sunshine Tiles.
● DO NOT lift Sunshine Tiles' adhesive strips, junction boxes, or cables during handling, as it may cause the damage or detachment of these components.
● Dropping Sunshine Tiles during handling may cause the breakage of the products.
● DO NOT twist the products during installation as it will damage the product or cause other injuries.
● DO NOT pull the output cables around the Sunshine Tile frame and support during installation, as it can cause short circuits or fires.
● DO NOT place Sunshine Tiles in direct contact with any rigid material, as this could result in product breakage.
The roof pitch for Sunshine Tile installation should be between 17.5° to 75° ; otherwise, roof leakage may occur.
● The absolute length deviation of the matching cement tiles should be ≤ 4mm, and the absolute width deviation should be ≤ 3mm.
● When construction is interrupted, waterproof protection should be provided for unconnected cable connectors.
● During roof construction, surface protection for Sunshine Tiles should be provided to avoid contamination from cross-construction with materials like paint, which can affect the tiles' appearance and electricity generation.

6 INSTALLATION WORK OF THE SUNSHINE TILE

6.1 UNPACKING AND STACKING

● Sunshine Tiles must be shipped in the boxes provided by GOODWE and should be stored in the original boxes before installation. Please protect the packaging from damage. Follow the recommended unpacking procedure to open Sunshine Tiles' packaging. Careful handling is required during unpacking, transportation and storage.
● Check whether the box is damaged before unpacking.
● Do not stack Sunshine Tiles flat or pile them up on the ground.
● When placing the Sunshine Tiles on site temporarily, they should be placed vertically against a solid surface with max number of tiles of 15 pcs per stack.
● The connecting cables should not be squeezed between two Sunshine Tile frames to avoid cable damage due to compression.
● Uninstalled Sunshine Tiles should be protected against water or humidity during installation.

6.2 SUBSTRATE INSPECTION

● The substrate must be solid and free from defects such as looseness, bulging, pitting, sanding, and shedding of dust. Depressions and cracks should be filled and smoothed with cement mortar.
● The substrate should be flat, dry and clean. The surface should be smooth and uniform. Its flatness can be checked with a 2m straight edge and the maximum gap between the straight edge and the substrate should not exceed 10mm. Gaps are only allowed to change gradually and are not permitted to have abrupt variations.
● The maximum error of the overall flatness of the concrete cast-in-place roof leveling layer should not exceed ±5mm; the ridges, oblique ridges, and drainage ditches should be made into contour strips. After the leveling layer is constructed, it should be cured for 3 to 7 days before subsequent procedures can be carried out.
● After the treatment of the base layer of the roof, the surface flatness, verticality of the elevation, obtuse and acute angles and squareness all need to meet the requirements of the local roof engineering technical specification(AS-2050).

6.3 LAYING WATERPROOF MEMBRANE

● Substrate treatment: The base surface should be firm, dry and clean (free of dust and oil stains), with any raised areas leveled and any depressions or cracks filled with polymer mortar.
● Application of base treatment agent: The container holding the treatment agent should be thoroughly stirred after opening. Begin by applying the agent with a brush around the edges, corners, and joints of the base layer. Subsequently, utilize either brushing or spraying techniques for the application on the base layer. The spray should be even and consistent. After

drying, the surface should be kept clean. If it becomes contaminated, it should be re-brushed and treated, and the adhesive roll material should be applied promptly after drying.

● The direction of laying the roll material should comply with the following regulations:

① When the slope of the roof is less than 3%, the roll material should be laid parallel to the ridge of the roof.

② When the slope of the roof is between 3% and 15%, the roll material can be laid parallel or perpendicular to the roof ridge.

③ When the slope of the roof is greater than 15% or the roof is subject to vibration, the asphalt waterproof roll material should be laid perpendicular to the roof ridge, and the high polymer modified asphalt waterproof roll material can be laid parallel or perpendicular to the roof ridge.

Node Processing: For the eaves trough, deformation joint, flashing, and the roof outlet extending through the roof pipe, the reference for roof access points should follow local roof engineering technical specifications for processing. The parts requiring reinforcement or additional layers should be set according to local regulations.

● Overlap of roll material:

Vertical overlap distance: minimum 80mm

Horizontal overlap distance: minimum 100mm (the isolation paper on the overlapping edge must be removed)

① Firstly, align the roll material with the baseline and spread it out completely. Roll up the roll material (along with the isolation paper) from one end, fold it along the middle line of the roll material, and lightly scratch the backside isolation paper of the roll material with a paper cutter. Carefully tear off a section (about 500mm), and align and position the torn-off section of the roll material with the baseline. Then, re-spread the half-roll material that has been lifted and pull the isolation paper evenly and firmly backward. Slowly pull out all the isolation paper of the half-roll material and press and stick the roll material firmly. Repeat the above method to stick the other half of the roll material. During the pulling and laying process, always pay attention to the integrity of the isolation paper. If it is found to be torn or broken, the laying process should be stopped immediately. After cleaning up the torn residual isolation paper, continue with the construction.

② Vertical surface tiling: The surface should be tiled from bottom to top, and the isolation paper should be peeled off while unfolding the roll material. The node positions should be covered with an additional waterproof layer according to local regulations, and the roll material should be immediately pressed with a rubber roller after tiling.

● Construction inspection:
① Check for any tears, damage, bubbles, curling or opening in all self-adhesive rolls. If there are defects, cut open the defective part, remove the bubbles, then reapply and press firmly.
② Add a waterproofing layer to the ridge with a width no less than 500mm;
③ The waterproofing layer should be laid and overlapped in the direction of water flow;
④ An additional layer should be added to the waterproofing layer at the eaves. In cold areas or high wind areas, a self-adhesive polymer modified asphalt waterproofing layer should be used, with a downward folding width of no less than 100mm and a roof installation width of no less than 900mm;
⑤ The metal flashing should be installed on the additional layer of the waterproofing layer and extend into the eaves;
⑥ A waterproofing layer should be installed on the metal flashing;
⑦ An additional layer should be added to the waterproofing layer at the gutter;
⑧ The additional layer of the waterproofing layer should be extended and laid into the concrete gutter;
⑨ An additional layer should be added to the waterproofing layer along the centerline of the valley, with a width no less than 1000mm;
⑩ The waterproofing layer at the gable wall, vertical wall, parapet wall and other parts should be fully adhered, extending upward along the vertical wall by no less than 250mm;

6.4 FIXING LAYER CHECKING

Before the installation of counter battens and battens, please check the fixing layer of the roof to ensure its smoothness, sufficient thickness and strength, to ensure a secure installation.

6.5 LEVELING, SCREEDING, STRINGLINING:

Based on the characteristics of tiled roof and the actual size of the roof, mark the position lines for the counter battens and battens; The counter battens and battens made of wood should use Grade I or Grade II wood with a moisture content not exceeding 18%, and should be treated for anti-corrosion and anti-insect; The connection between the rafters and the holding layer and between the battens and the rafters should be securely fixed.

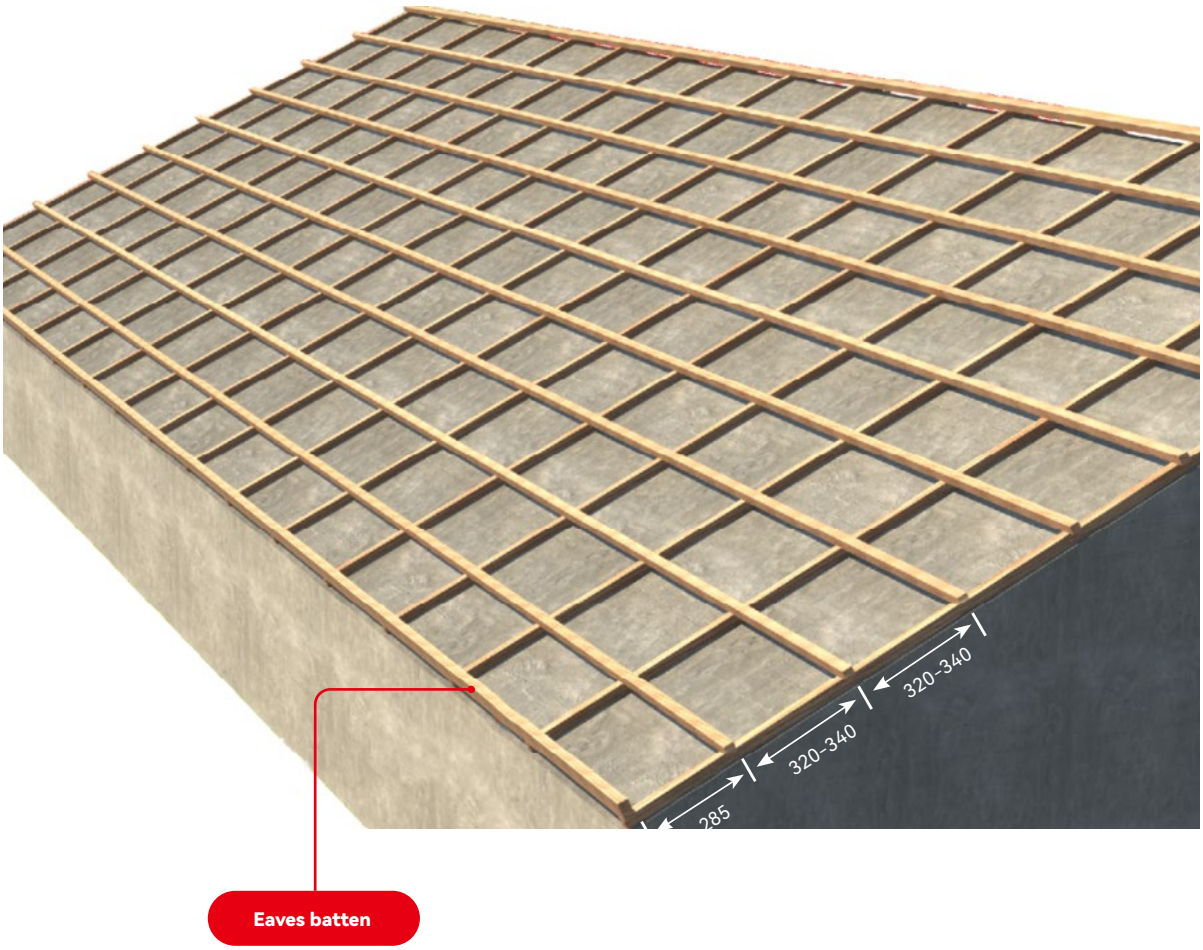
6.6 INSTALLATION OF COUNTER BATTENS:

① The specification of counter batten should not be less than 40*30(H)mm (optional specifications)
② The counter batten should be laid and nailed firmly, straight and flat, with a spacing of 450-600mm.(as shown in the figure below)

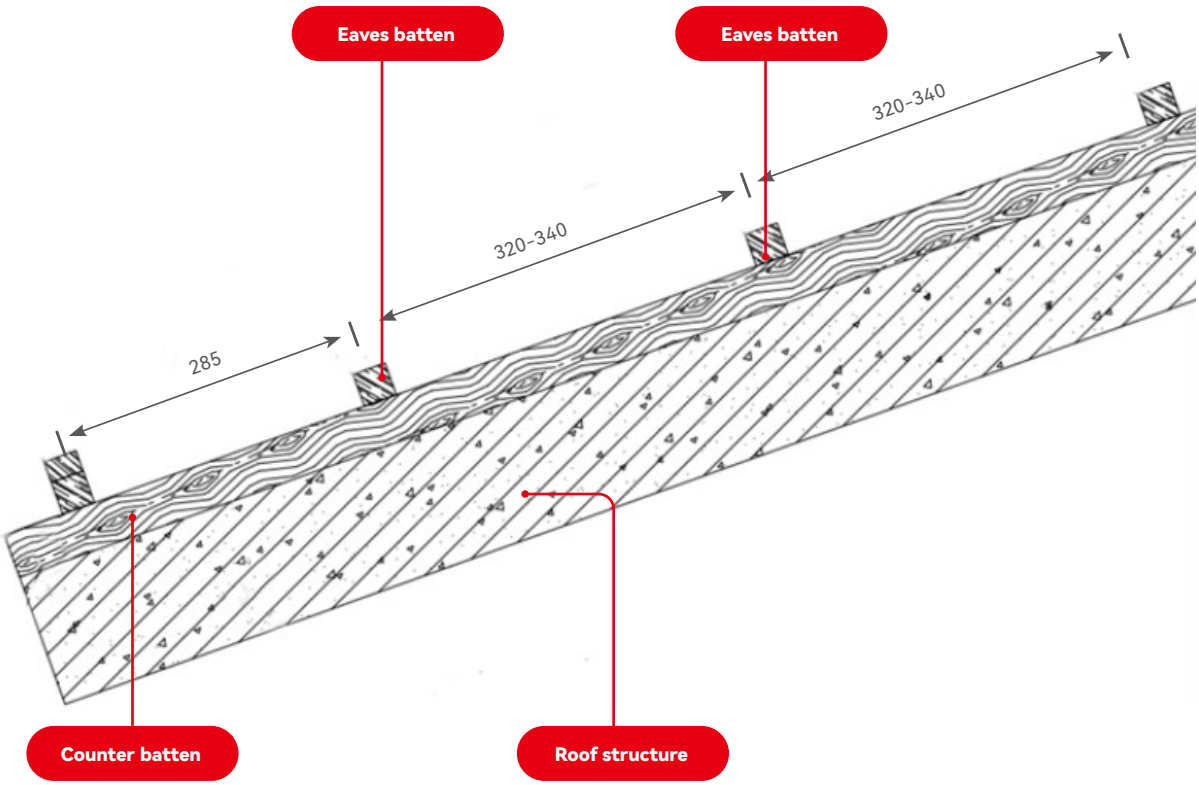
INSTALLATION OF COUNTER BATTEN

6.7 INSTALLATION OF BATTENS:

① The specification of batten should be: 30*30mm wooden batten(Optional specifications, not smaller than this size) ;
② The thickness of the eaves battens should be appropriately increased, and the center distance between the upper row of battens and the eaves battens should be 285mm.
③ The center distance between other batten should be 320-340±5mm. The battens should be laid and nailed firmly, straight and flat, with a smooth surface. (As shown in the figure below)



INSTALLATION OF BATTENS

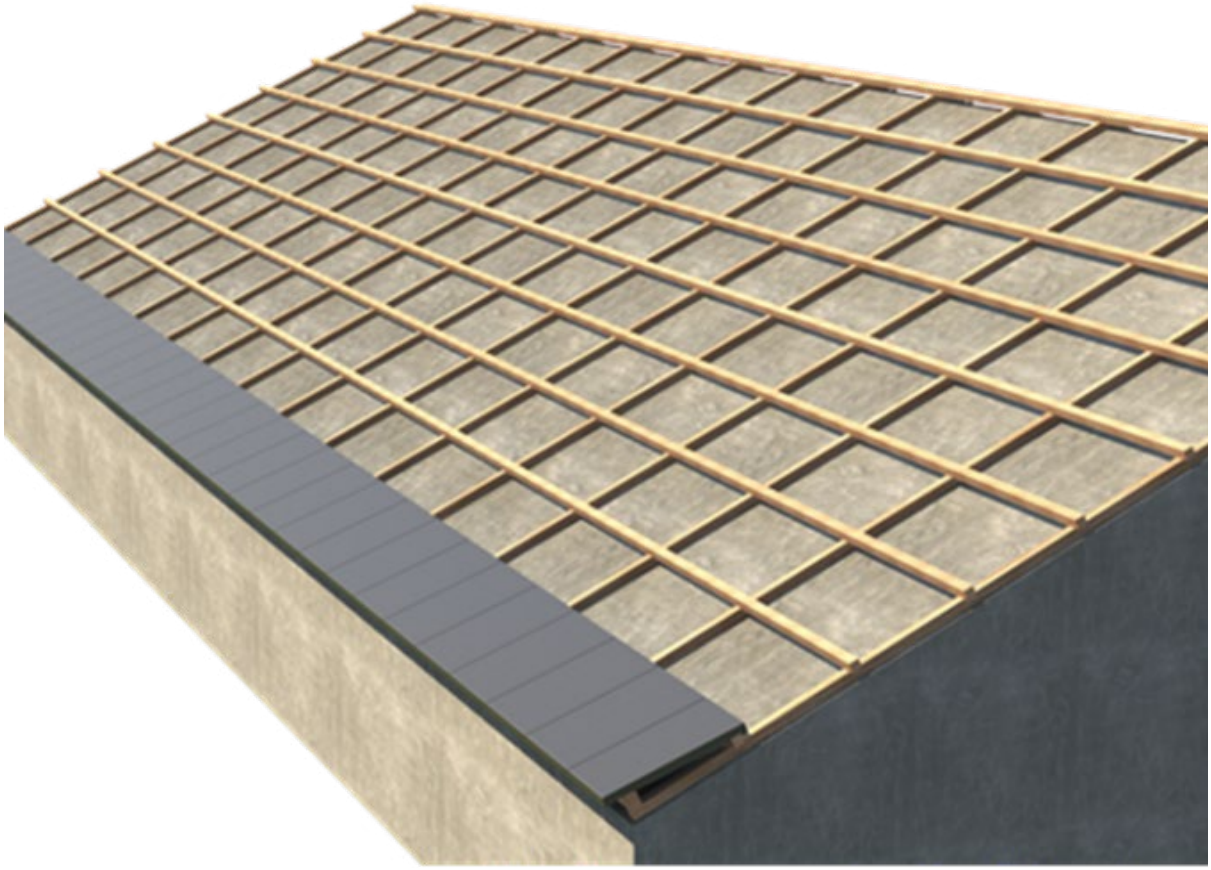


SECTIONAL VIEW OF BATTENS

6.8 INSTALLATION OF SUNSHINE TILES:

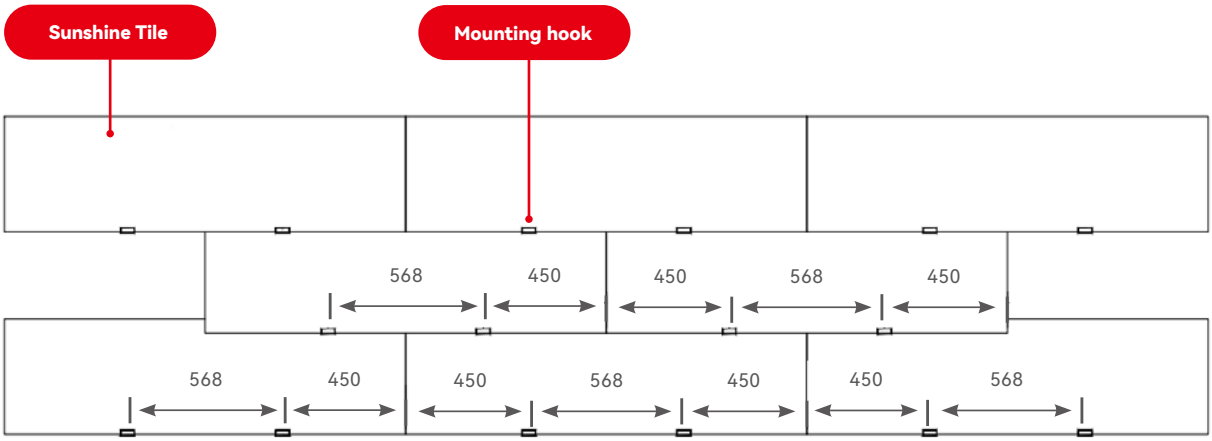
The overall installation sequence is to install from right to left on the same row and from bottom to top row by row.

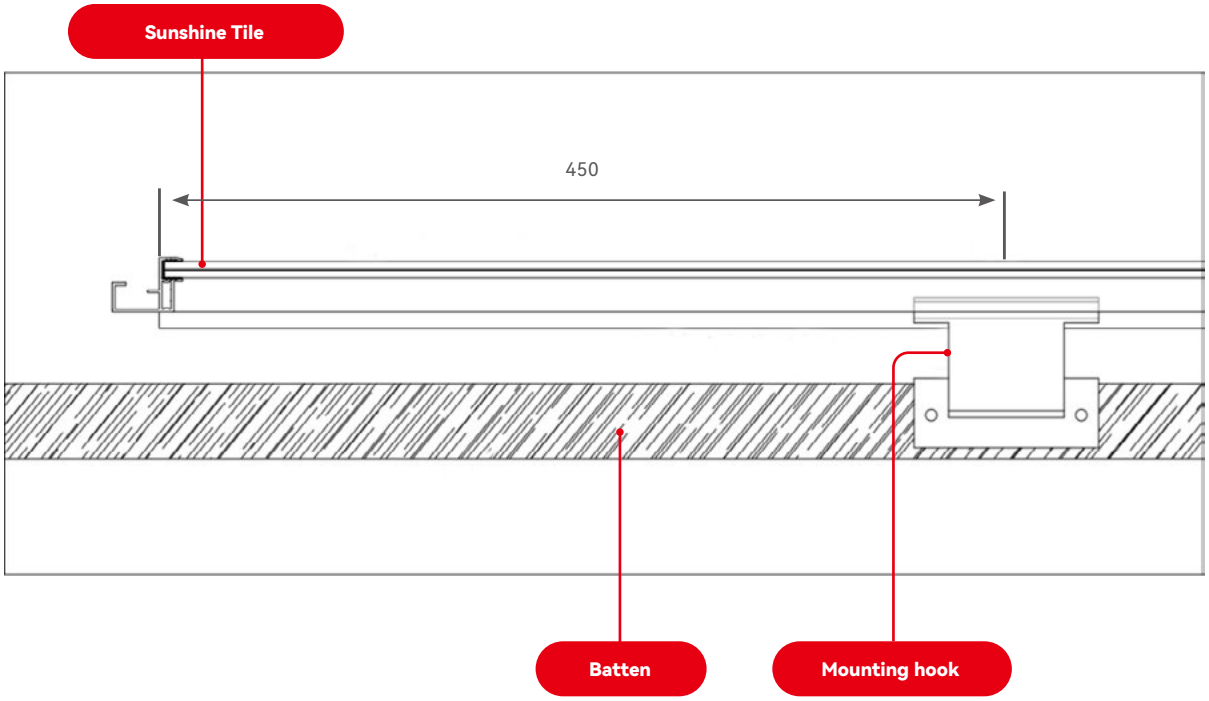
① First install the matching tiles at the eaves position of the roof, with the installation sequence from right to left and from bottom to top. (as shown in the figure below)

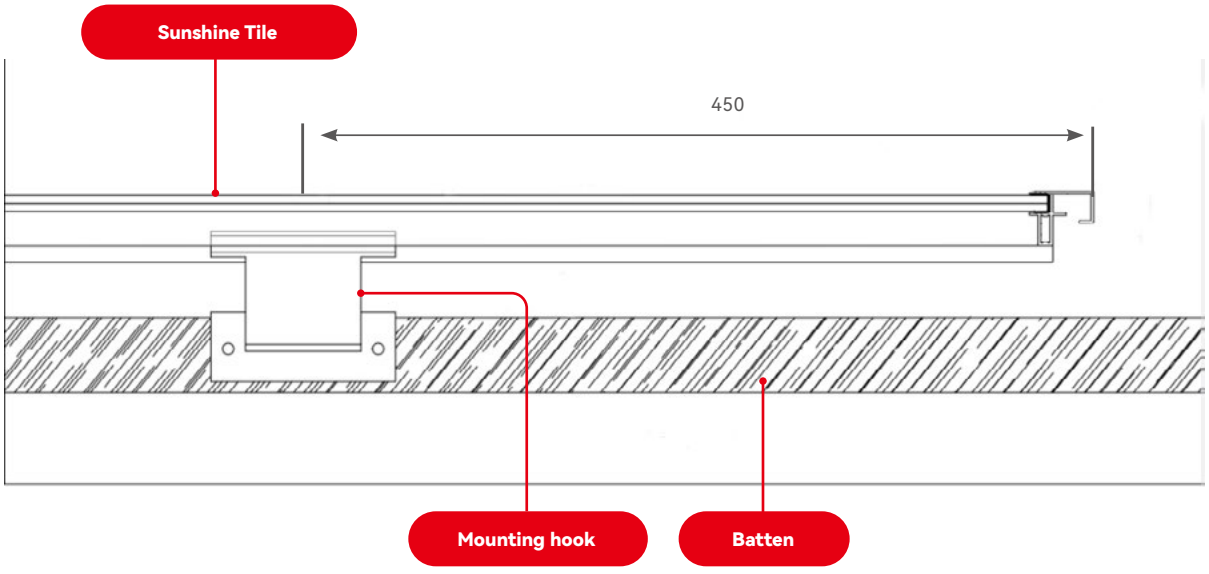


INSTALLATION OF MATCHING TILES ON THE EAVES

② Install the Sunshine Tiles row by row from bottom to top. When installing the Sunshine Tiles, determine the position of the installation hook according to the design plan, and install the hook on the lower side of the Sunshine Tile. Each Sunshine Tile requires 2 installation hooks and 4 installation screws. The position of the installation hook and the side of the Sunshine Tile is shown in the figure below.

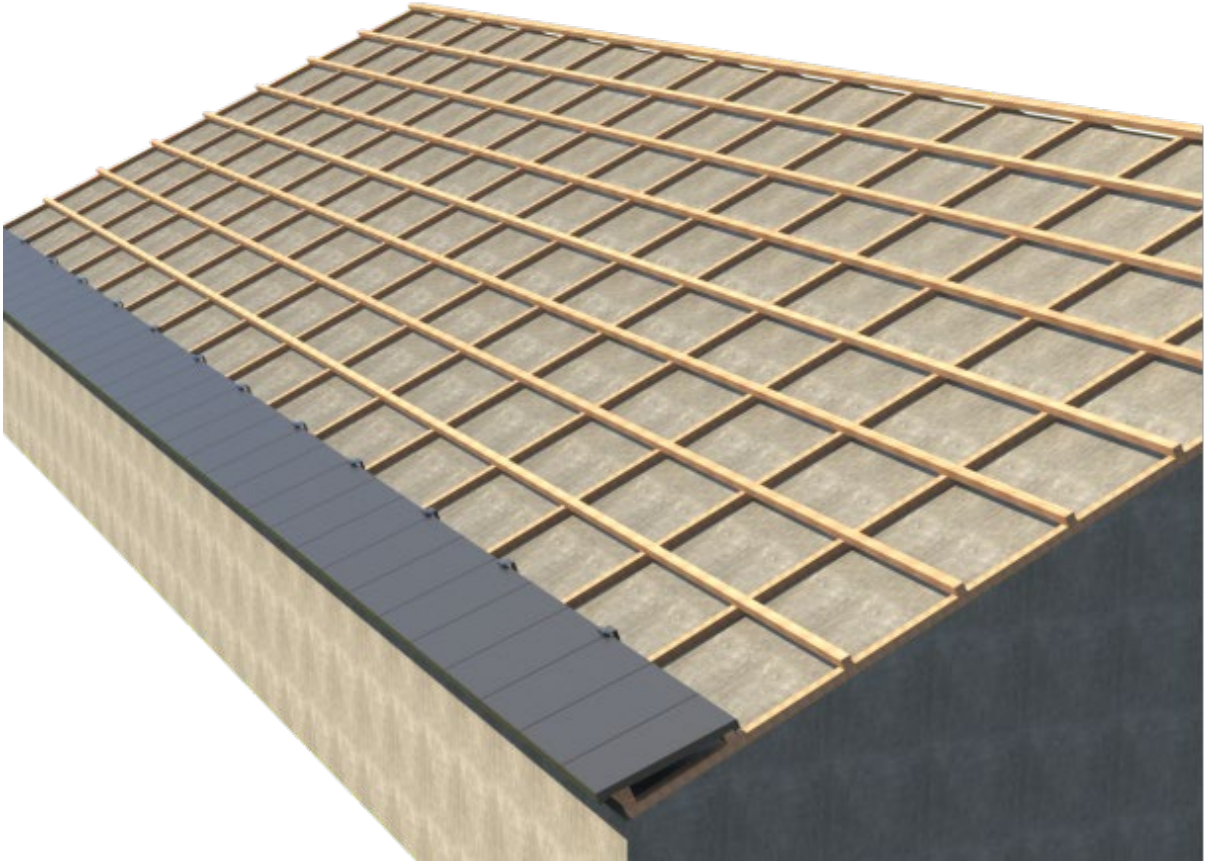




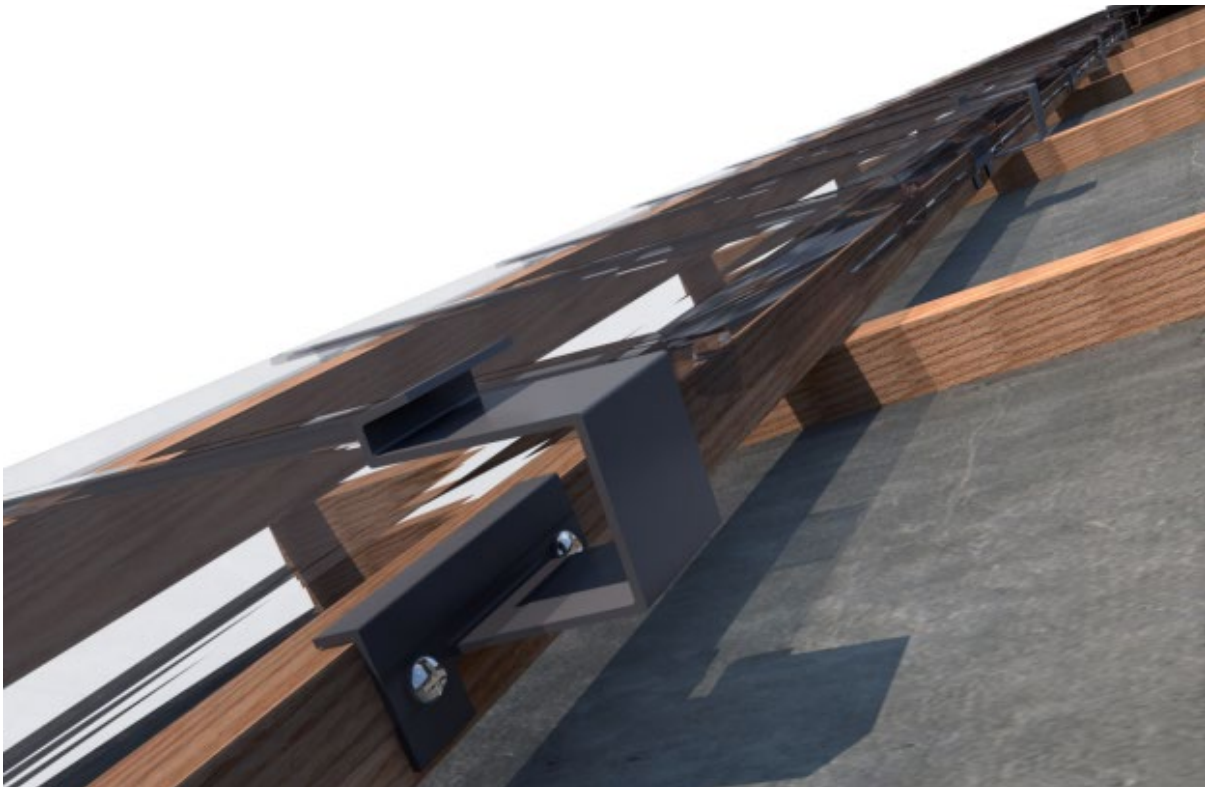


THE CENTER DISTANCE OF THE HOOK FROM THE LEFT EDGE OF SUNSHINE TILE IS 450MM.

③ Once the installation hook position is confirmed, start with the bottom row and lay out the installation hooks as shown in the figure.

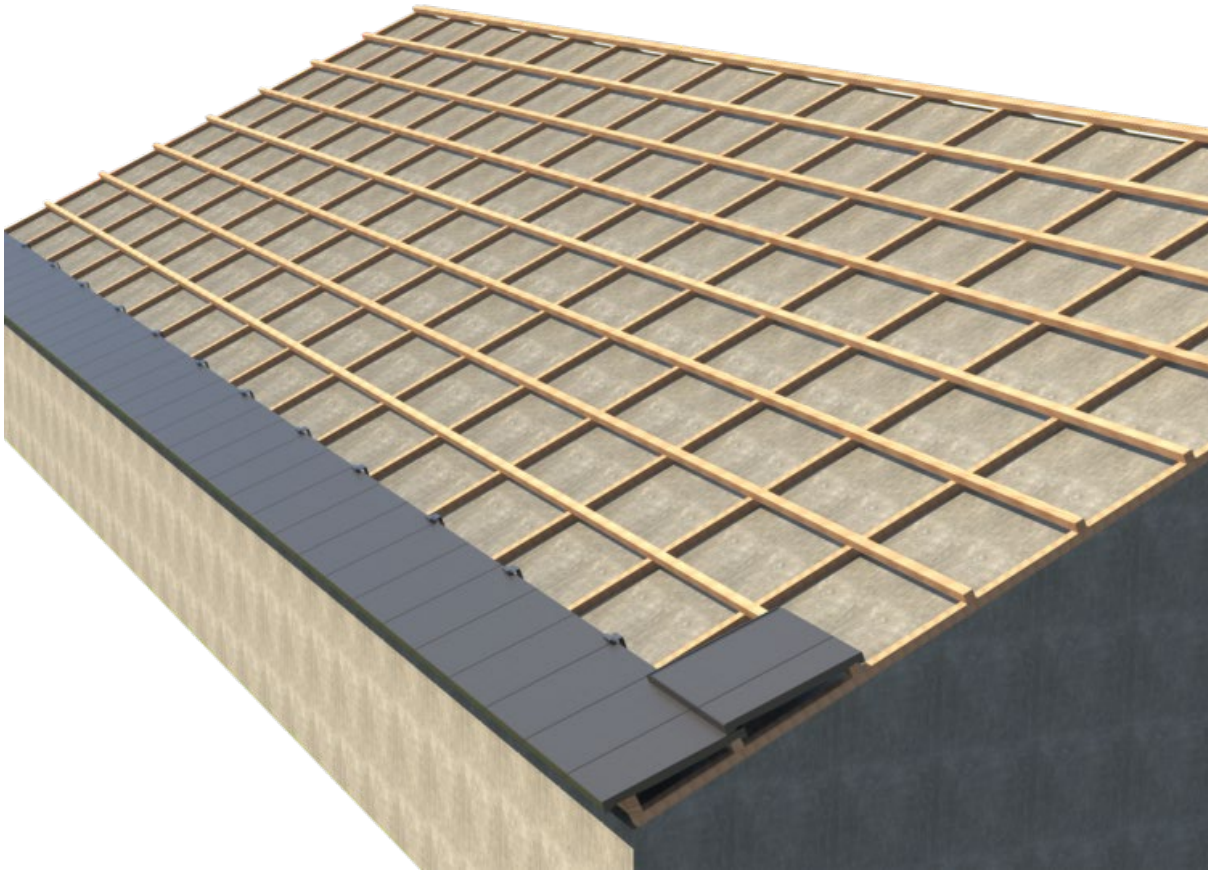


LAYOUT OF MOUNTING HOOKS



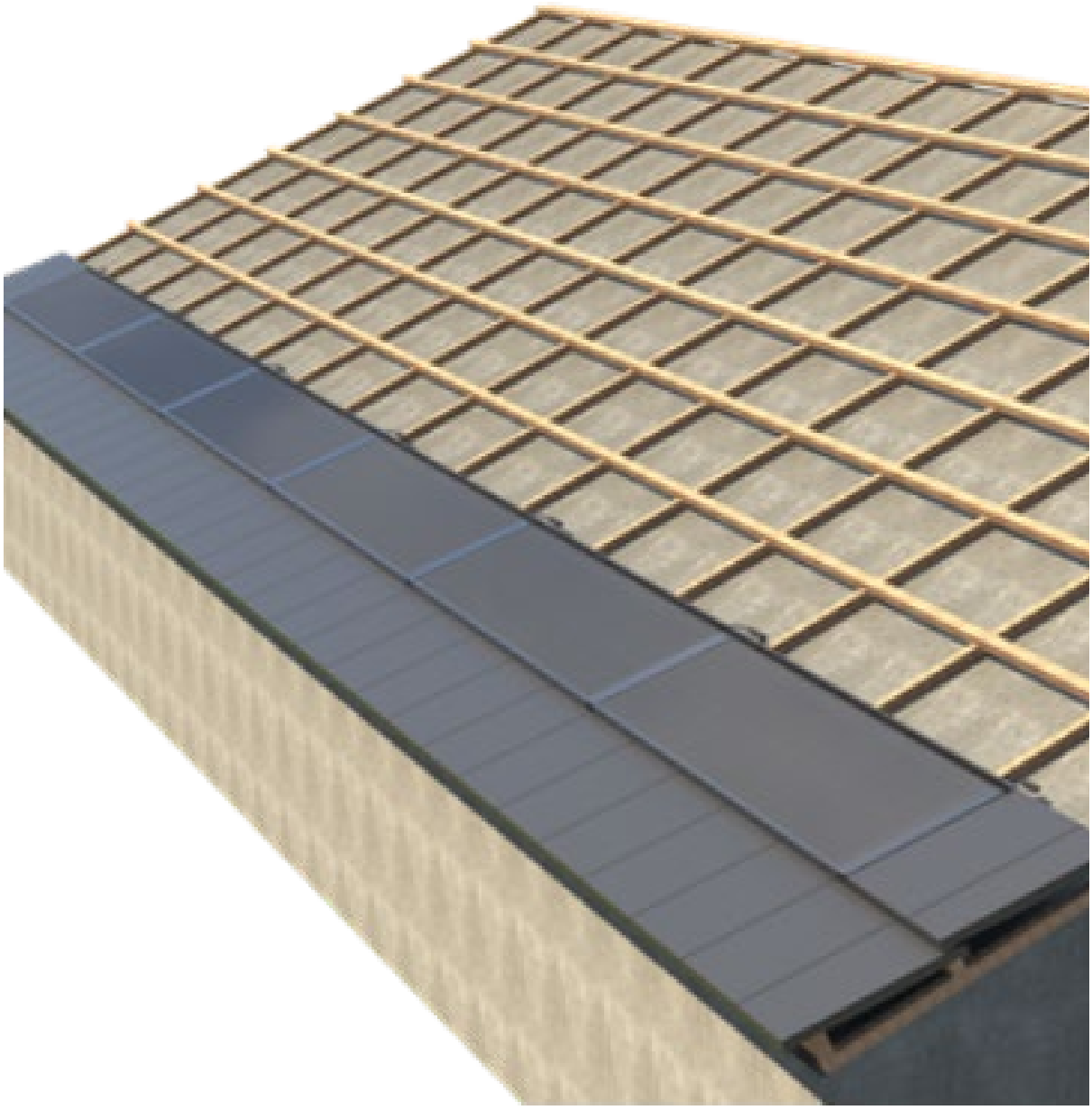
LAYOUT OF MOUNTING HOOKS

④ After completing the installation of the hooks for the entire row of Sunshine Tiles, install the matching tiles on the right side of this row. (as shown in the figure below)

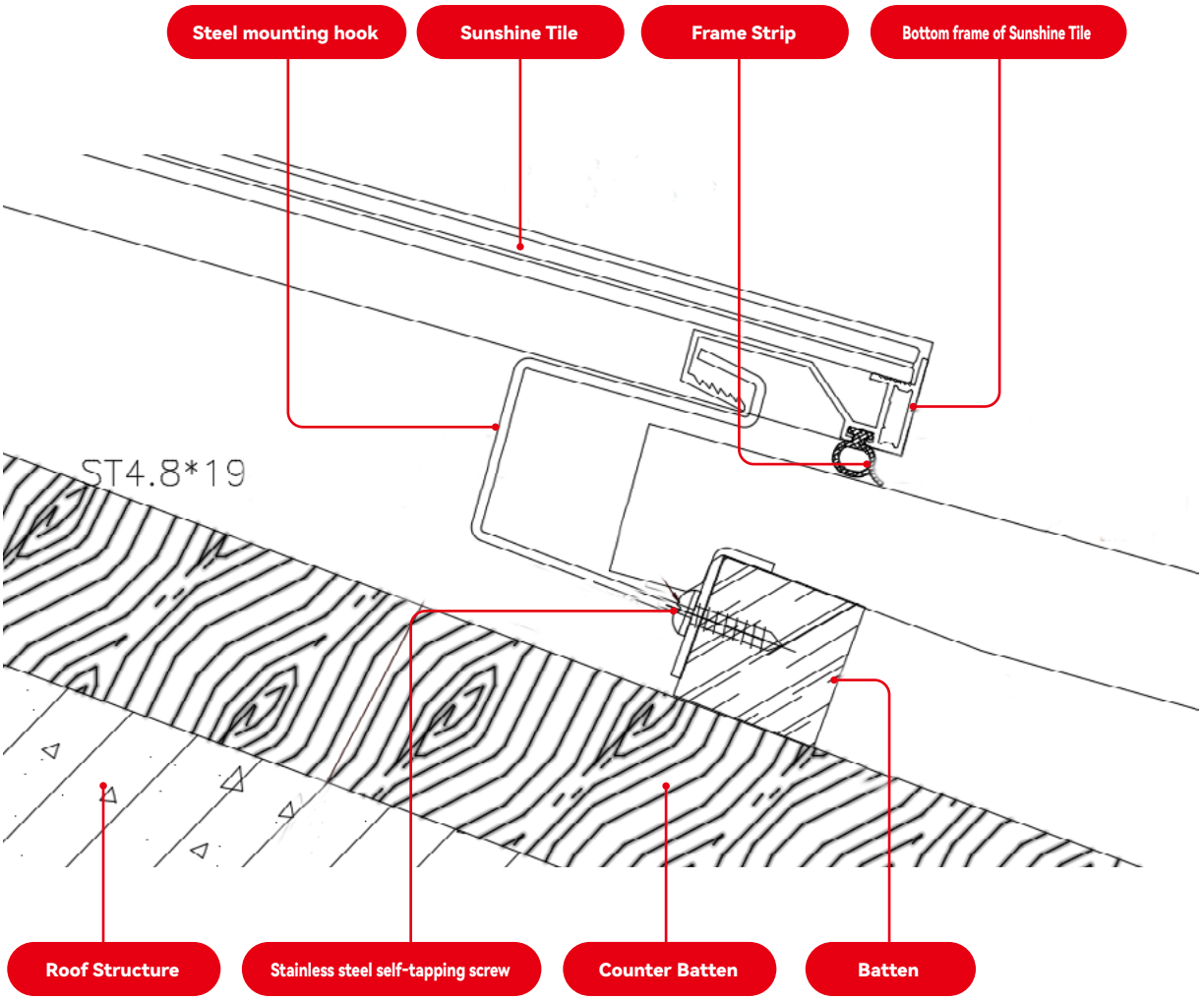


INSTALLATION OF MATCHING TILES ON THE RIGHT

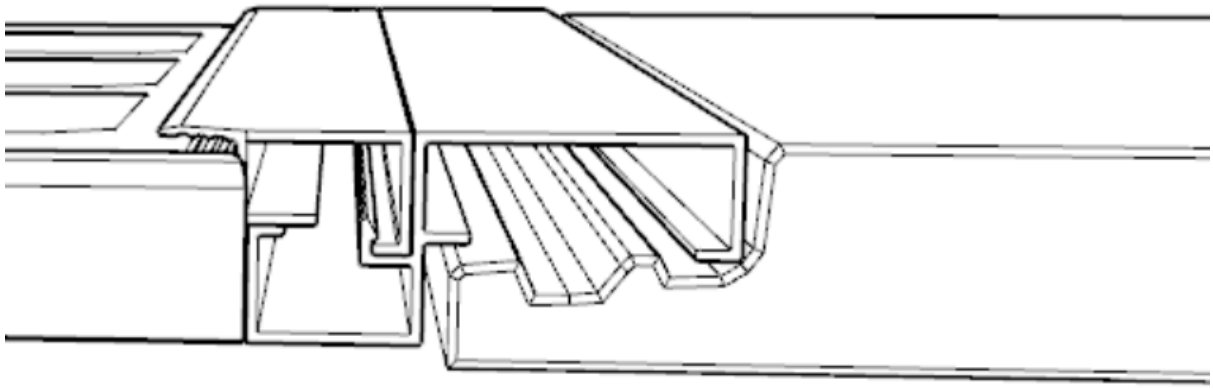
⑤ After installing the right-side matching tile, continue to lay the Sunshine Tiles from right to left, allowing it to fall into the installation hook slot. Then install the left-side matching tile to complete the installation of this row of tiles. (As shown in the figure below)



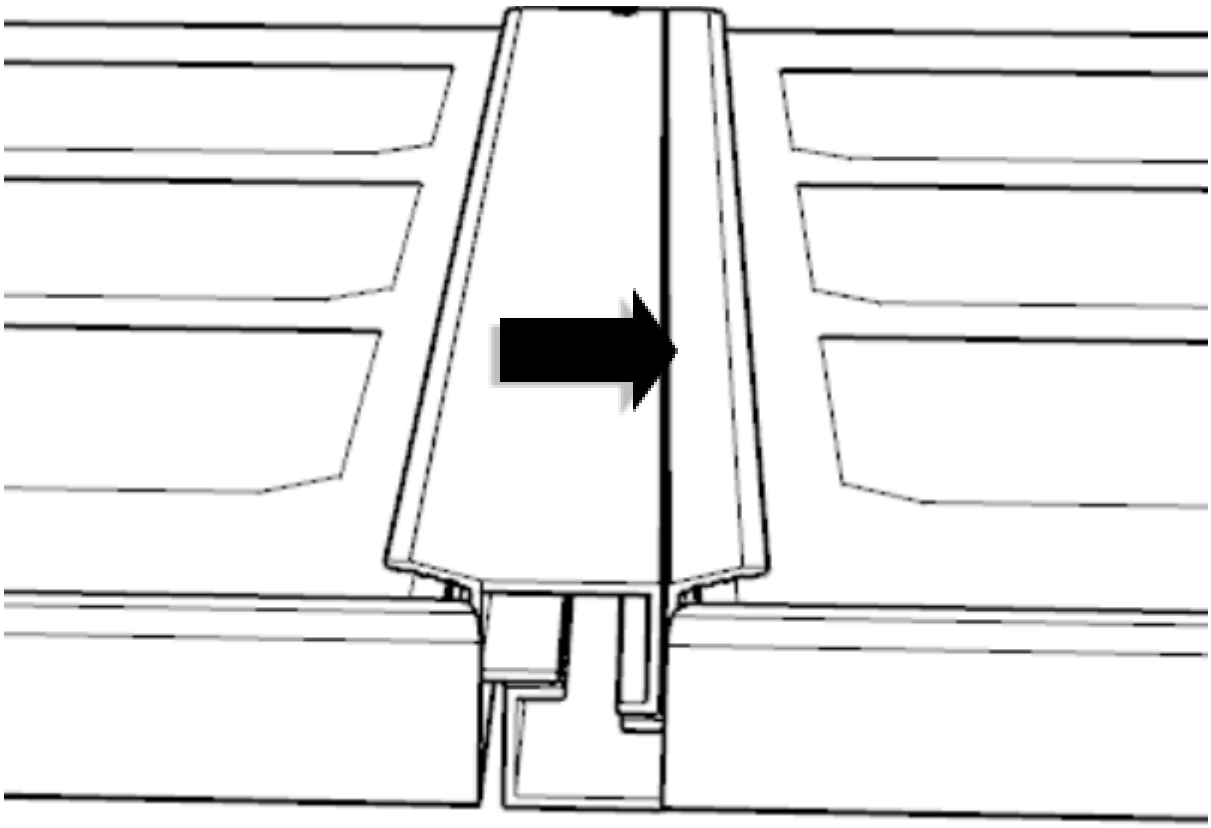
INSTALLATION OF SUNSHINE TILES



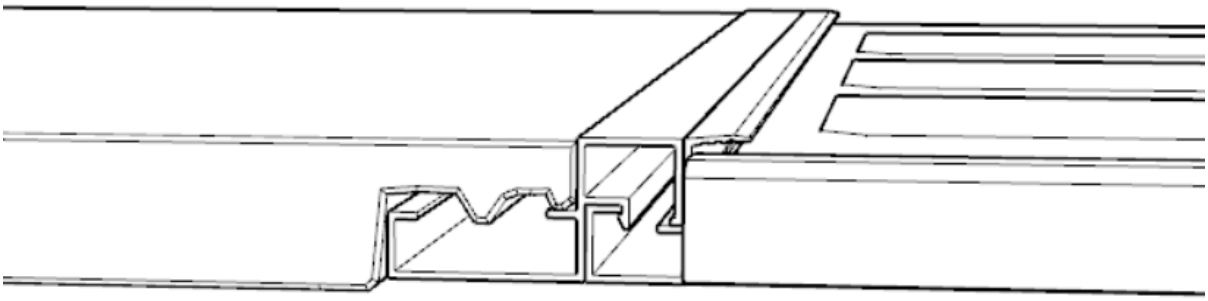
⑥ The left and right laps of Sunshine Tiles are installed as follows:



THE OVERLAP OF SUNSHINE TILE WITH MATCHING TILE ON THE RIGHT AND ADAPTER

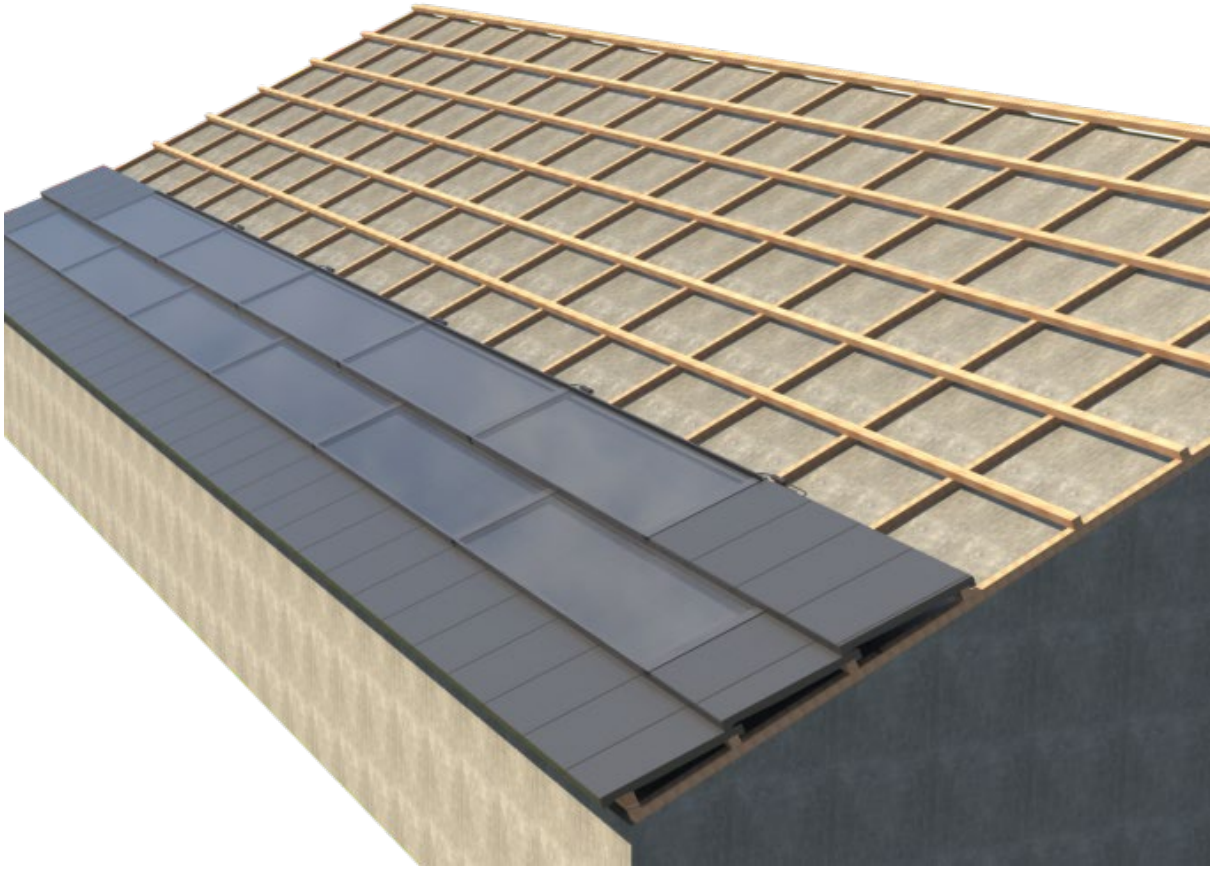


THE OVERLAP OF LEFT AND RIGHT FRAMES OF SUNSHINE TILE

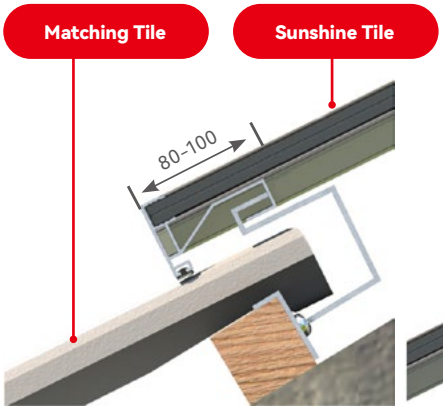


THE OVERLAP OF THE SUNSHINE TILE WITH THE MATCHING TILE ON THE LEFT AND ADAPTER

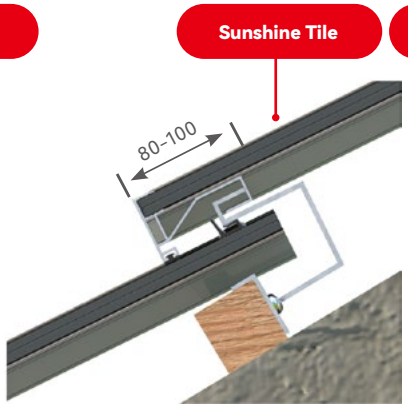
⑦ The matching tiles that directly overlap with the left and right frames of the Sunshine Tiles must be fixed on the battens with self-tapping screws;
⑧ After completing the installation of the entire row of Sunshine Tiles, proceed from bottom to top into the installation of the next row of Sunshine Tiles. The installation method is the same as the previous row. The next row of Sunshine Tiles overlap with the previous row of Sunshine Tiles up and down (as shown in the figure).



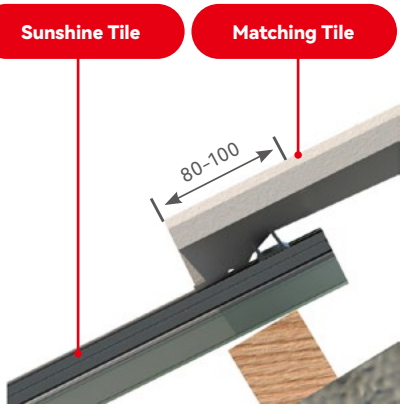
⑨ After each row of Sunshine Tiles is installed, the overlap with the previous row of Sunshine Tiles should be checked to avoid covering the solar cells of the previous row of tiles. The overlap distance between upper and lower tiles should be 80-100mm ± 5mm (as shown in the figure below).



Sunshine Tiles on the upper row overlap with matching tiles on lower row

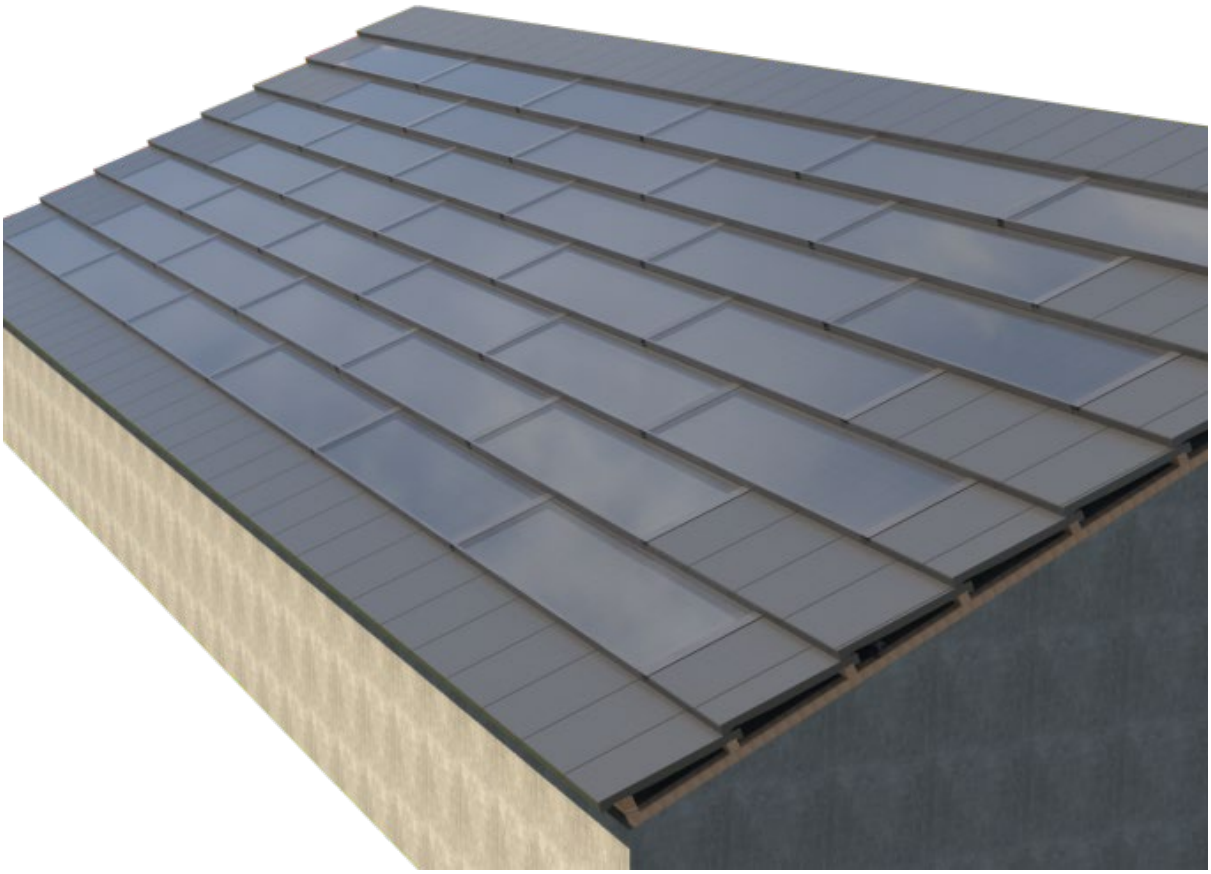


Sunshine Tiles on the upper row overlap with Sunshine Tiles on lower row



Matching tiles on the upper row overlap with Sunshine Tiles on lower row

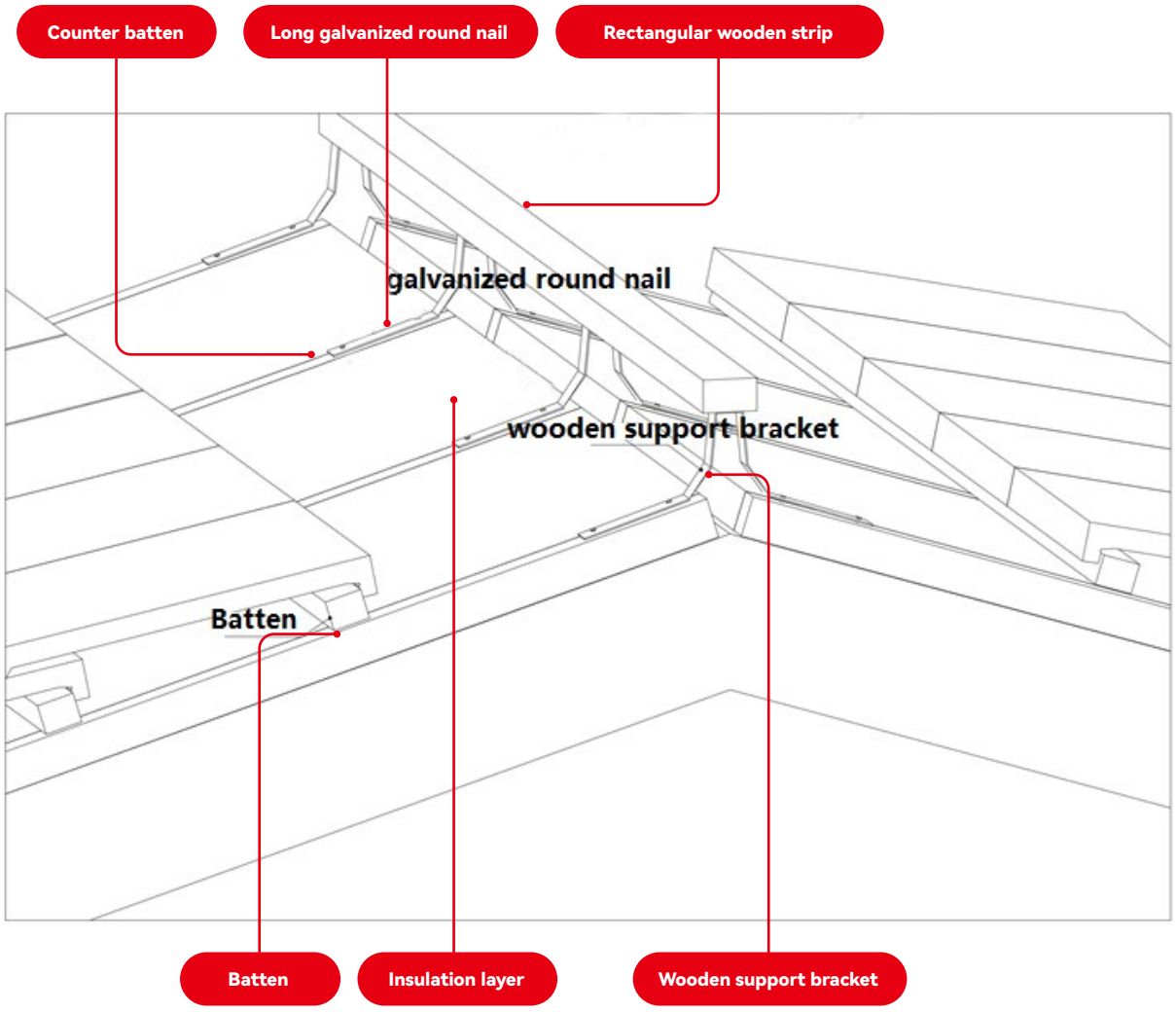
⑩ Install the Sunshine Tile and its matching tiles row by row from bottom to top until the entire roof is installed.

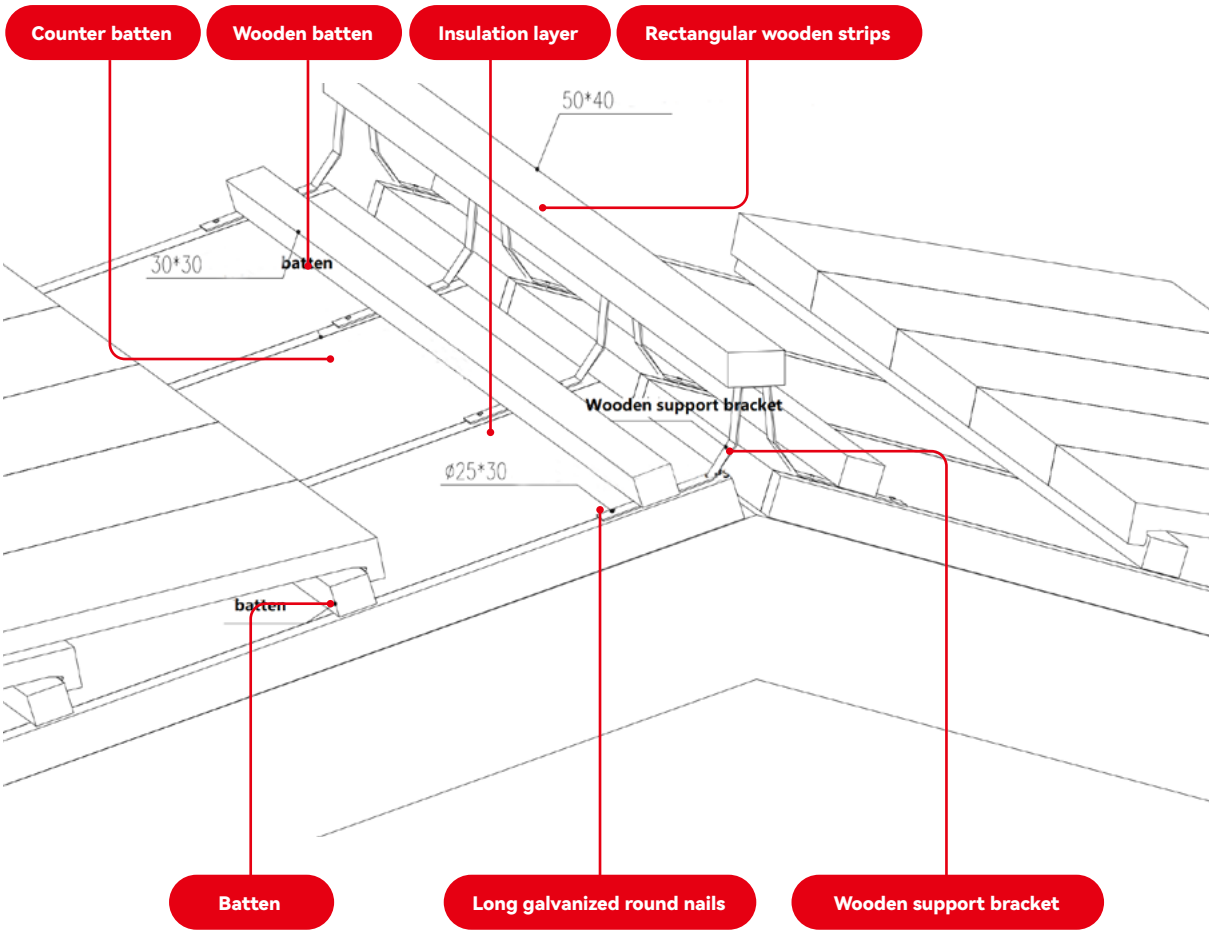


6.9 CONSTRUCTION OF THE VENTILATED RIDGE (INSTALLATION OF WOODEN SUPPORT BRACKETS, WATERPROOF MEMBRANE AND RIDGE TILES)

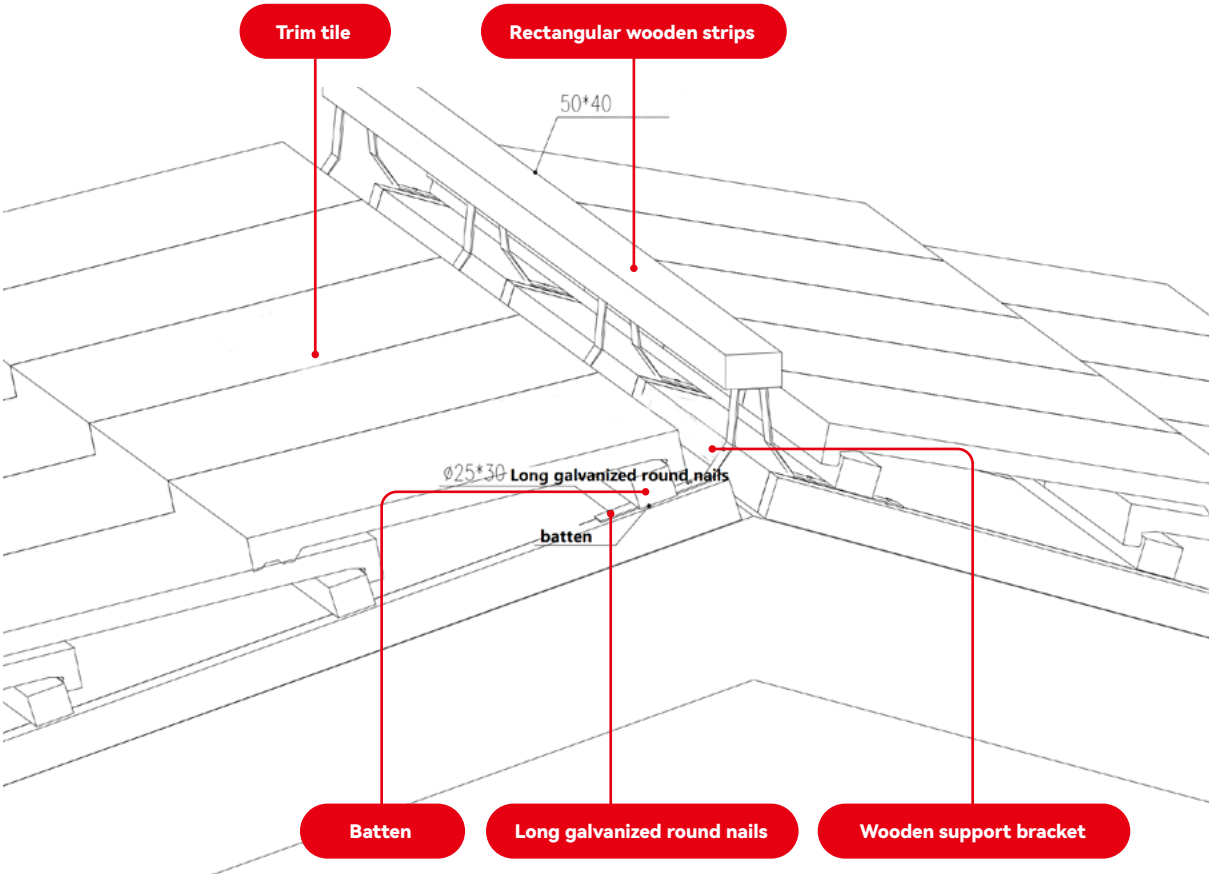
Ventilated roof system is recommended for Sunshine Tile roof system to ensure the thermal comfort of the building and maximize energy production. There are a variety of ventilated roof systems compatible with Sunshine Tile roof system based on the brand and type of compatible tile selected. Below is a general recommendation provided for the construction of ventilated ridge. Below steps are for reference only.

① Fix the wooden support brackets and support wood using the snapped structural lines of the main and hip ridges as a reference line. Adjust the wooden support brackets by the measured height of the brackets during pre-laying. Fix one section to the wooden brackets with screws and the other side to the counter batten with steel nails/shoot nails. Fix 50 x 40mm support wood (antiseptic treatment required) to the wooden support brackets, and finally install the top tile batten.

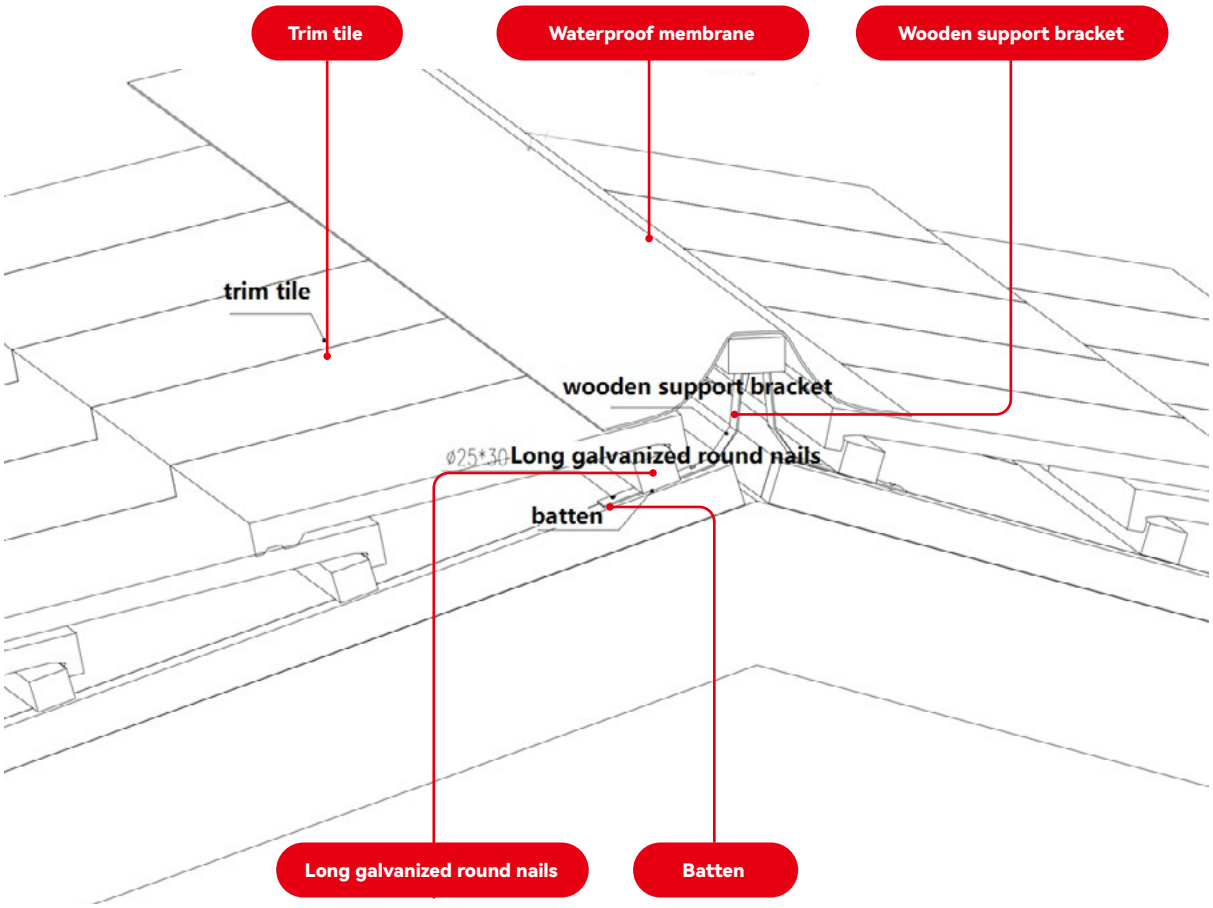

Counter batten
Long galvanized round nail
Rectangular wooden strip
galvanized round nail
wooden support bracket
Batten
Batten
Insulation layer
Wooden support bracket



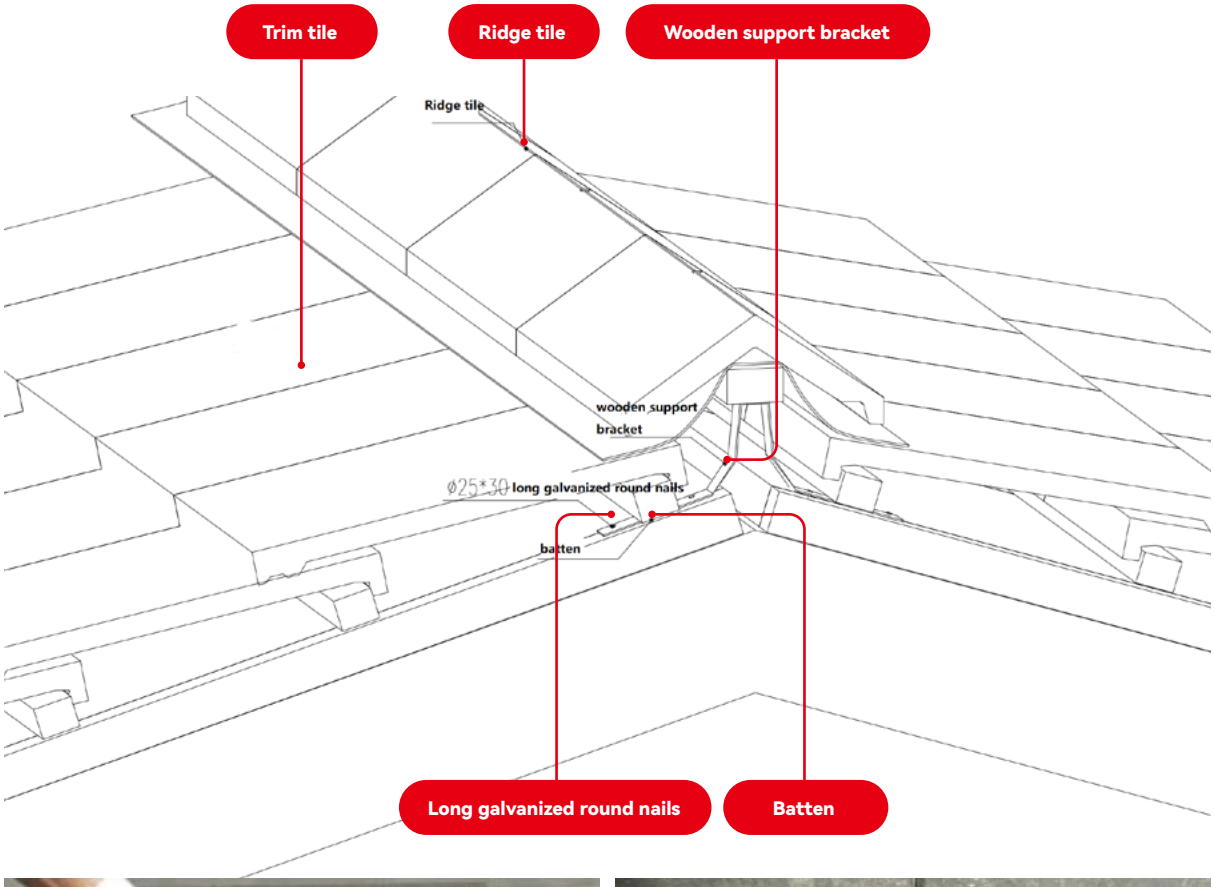
② Install the trim tiles on the top row.



③ Lay waterproof membrane.



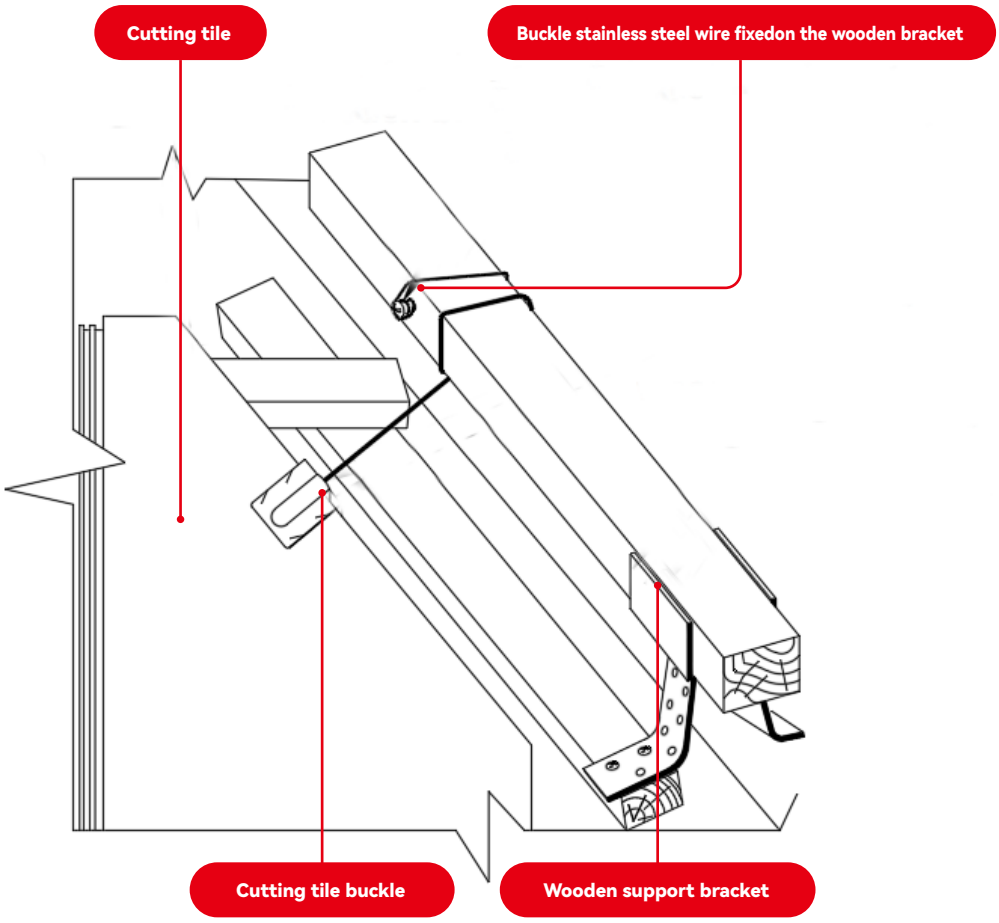
④ Install the ridge tiles: pre-lay the ridge tiles. Once everything is confirmed to be in order, use the ridge tile screws to secure the ridge tiles in place. (The construction method for the regular ridge tile and the angled ridge tile is the same.)

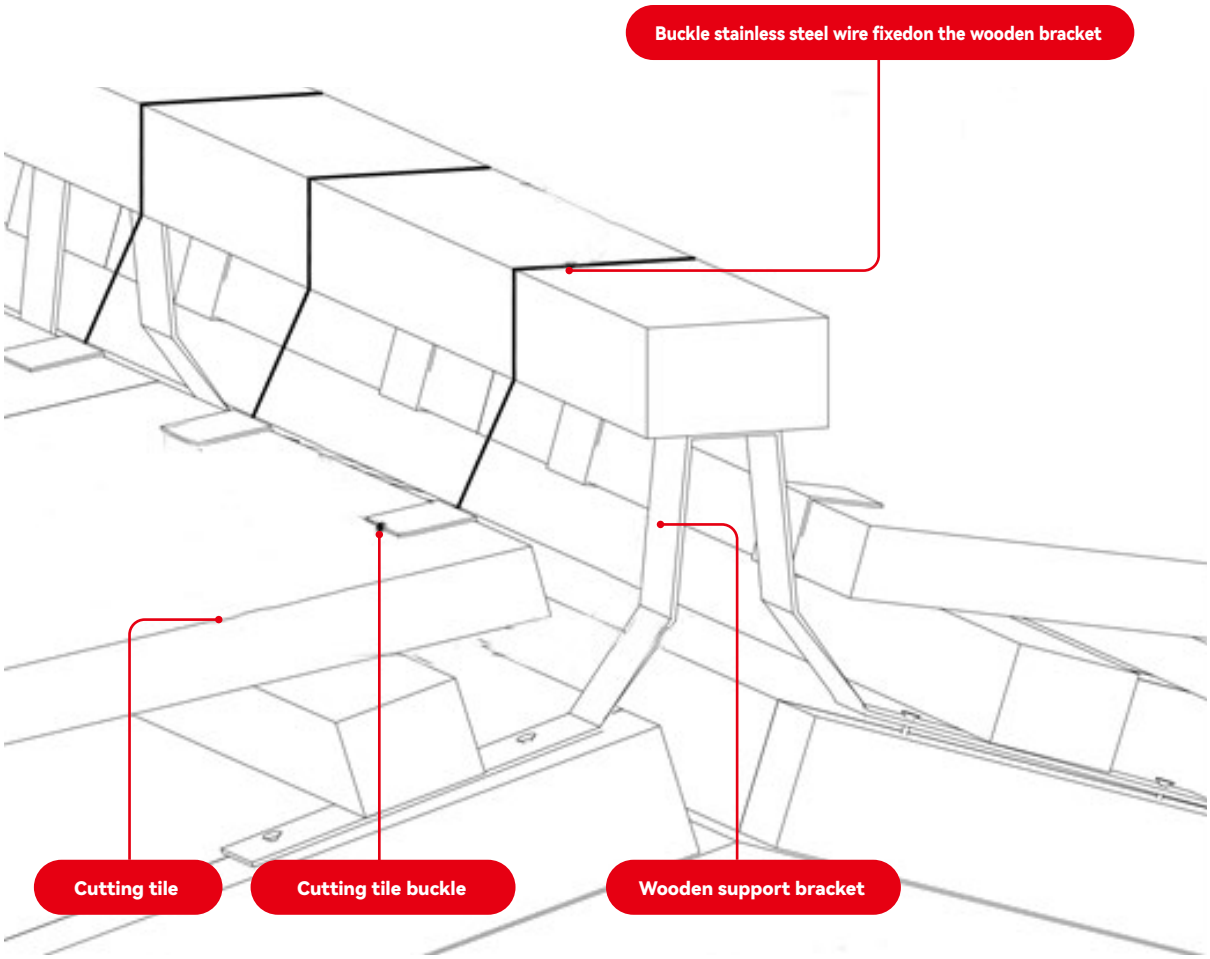


6.10 INSTALLATION OF THE CUTTING TILE BUCKLE

During the installation process, if you need to cut at the slanting ridge and the front ridge, but there is no tile head after cutting and thus cannot be fixed. The installation can be done by using the cutting tile buckle.

As is shown in the figure below, we use the cutting tile buckle to snap on the tile, and then use its own stainless steel wire to fix on the wooden bar, so as to fix the cutting tile.

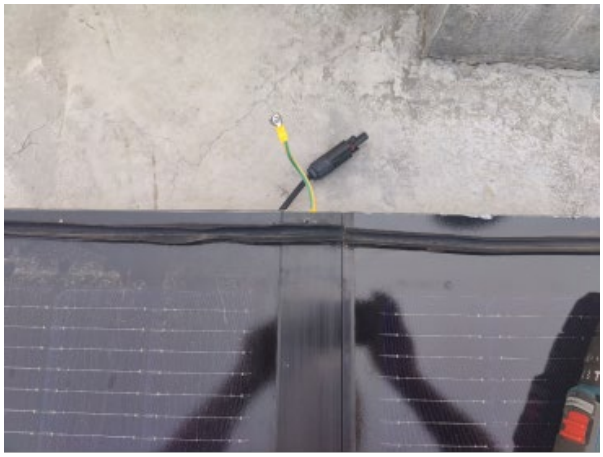

Cutting tile
Buckle stainless steel wire fixedon the wooden bracket
Cutting tile buckle
Wooden support bracket


Buckle stainless steel wire fixedon the wooden bracket
Cutting tile
Cutting tile buckle
Wooden support bracket

6.11 INSTALLATION OF LIGHTNING PROTECTION CONNECTION WIRES

① Before installation, the grounding cables can be uniformly connected to the grounding hole on the left frame of the Sunshine Tile in the box. Install the external tooth washer, grounding cables, and self-tapping screws (with a diameter of ≥ 4.8mm) in sequence, and tighten the screws.

② Installation of a complete row of Sunshine Tiles. Before installing the next row of Sunshine Tiles, pull out the end of the grounding cable (left side in the figure below), and connect the end of the grounding cable to the right frame of the Sunshine Tile at the overlapping position (right side in the figure below).;



③ Before the installation of the next row, you should also check whether the connection wire of the grounding hole is connected at the most two ends of this row of Sunshine Tiles, and confirm that it is connected before installing the next row of Sunshine Tiles.
④ Continuing with the installation of the Sunshine Tiles on the next row, connect the frames of all rows using grounding cables in the manner shown in the diagram below. This will create a conductive pathway between all the frames of the Sunshine Tiles, leading to a bus bar which will then be connected to the grounding flat iron. The grounding flat iron should be buried in the ground.

7 ELECTRICAL INSTALLATION

7.1 ELECTRICAL PROPERTY

● The nominal values of electrical performance parameters such as Isc, Voc and Pmax of Sunshine Tile have an error of ±3% from those under standard test conditions. Standard test conditions for Sunshine Tile: irradiance 1000 W/m2, cell temperature 25° C, atmospheric mass AM 1.5.

● When Sunshine Tiles are connected in series, the total voltage is the sum of voltage of every single Sunshine Tile in the string, and when Sunshine Tiles are connected in parallel, the final current is the sum of the current of every string of Sunshine Tiles, as shown in Figure 7-1. Sunshine Tiles of different electrical performance models should not be connected in one string.

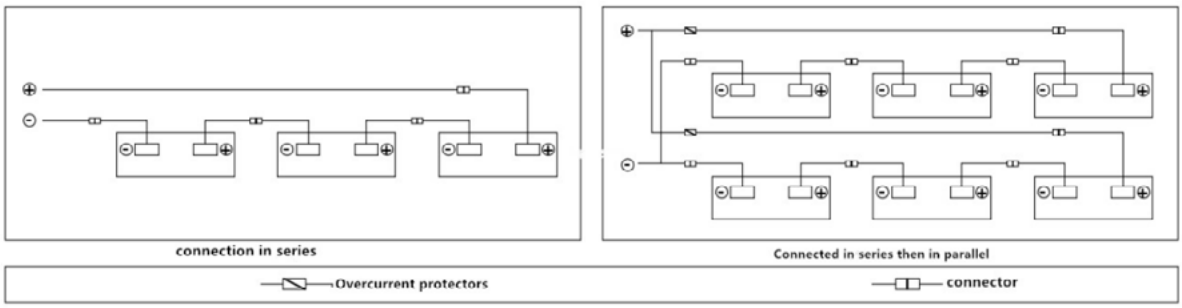


FIGURE 7-1 SERIES-PARALLEL ELECTRICAL DIAGRAM

● The maximum number of single strings of Sunshine Tiles that can be connected in series must be calculated in accordance with the requirements of local electrical requirements and regulations. and the value of its open-circuit voltage at the lowest expected local temperature conditions must not exceed the maximum system voltage value specified for Sunshine Tiles (maximum system voltage for the products is DC1000V/DC1500V - the actual system voltage is designed according to the selection of the product models and inverters) and other values required for DC electrical components.

● The open circuit voltage correction factor can be calculated with following formula:

$$CVoc=1-\beta Voc\times(25-T)$$

where T is the minimum ambient temperature expected at the system installation location and β(%/° C) is the temperature coefficient of the open circuit voltage of selected Sunshine Tiles (refer to the corresponding Sunshine Tiles parameter table).

● If a reverse current exceeding the maximum fuse current of the Sunshine Tile may pass through the product, an overcurrent protection device of the same size must be used to protect the product. If the number of parallel connections is more than or equal to 2 strings, there must be an overcurrent protection device on each string of the products, as shown in the figure 7-1.

7.2 CABLE AND GROUNDING CABLES

● Sunshine Tiles shall be connected by using IP68 rated junction boxes, which shall provide safe protection for the conductors and their corresponding connections, and accessible protection for non-insulated live parts. The junction box consists of a connected cable and IP68 rated connectors to facilitate series connection between Sunshine Tiles. A single product has two separate wires connected to two separate junction boxes, one positive and one negative. Two Sunshine Tiles can be connected in series by inserting the positive connector into the socket of the negative connector of the adjacent product.

● Use dedicated solar cables and appropriate connectors (wires should be encased in age-resistant conduit or, if exposed to air, should be age-resistant themselves) and ensure that the cables are electrically and mechanically sound, in accordance with local fire, building and electrical codes. Installers should only use single-core solar cables, 2.5-16mm2 (5-14 AWG), 90° C rated, with appropriate insulation to withstand the maximum possible system open circuit voltage (as approved by EN 50618). Appropriate wire sizes need to be selected to minimize voltage drop. All wiring and electrical connections comply with the requirements of the appropriate National Electrical Code or standard. Avoid mechanical damage to the cable or Sunshine Tiles when the cable is secured to the bracket. Do not press the cable with force. The cable shall be secured to the bracket by specially designed aging resistant cable ties and wire clips. Although the cable is resistant to aging and water, it should be protected from direct sunlight and rain. The minimum bending radius of the cable should be 43mm.

FIGURE 7-2 MINIMUM BENDING RADIUS OF THE CABLE

7.3 CONNECTOR

● Please keep the connector dry and clean, and make sure that the nut of the connector is tightened before connecting. Do not connect the connector when it is wet, dirty or in other unfavorable condition. If the connector is not connected properly to the other polarity, the connector is not waterproof. It is necessary to connect or take appropriate measures to avoid the infiltration of water vapor and dust as soon as possible after the module is mechanically installed to the roof. Avoid having connectors being exposed to direct sunlight and immersed in water. Avoid having connectors falling on the ground or on the roof. Incorrect connections may produce arcing and electric shock. Make sure all electrical connections are secure. Make sure that all connectors with locking are fully connected.
● It is not recommended that connectors of different models be connected and used together.

7.4 BYPASS DIODE

● The cell strings within a solar module are protected by bypass diodes in parallel and encapsulated in a junction box. When a hot spot phenomenon occurs locally in a module, the diode will activate so that string current no longer flows from the hot spot cells, thus limiting module heating and performance loss. Note that the bypass diode is not an overcurrent protection device. Contact the installer or system maintainer when a diode failure is detected or suspected. Do not attempt to open the module's junction box by yourself.

7.5 ELECTRICAL REQUIREMENTS FOR THE INSTALLATION OF SUNSHINE TILES

● Inspection before installation
① No visible defects.
② Models and specifications should meet the requirements of the design drawings.
③ Accessories and spare parts are available;
④ For electrical parameters, please refer to the appendix product specification.
● Preparation of main tools
① Multimeter: For measuring the open-circuit voltage of Sunshine Tiles.
② Angle measuring instrument, level, etc.: measuring the installation angle of the Sunshine Tiles array.
③ Electric welding machine: for bracket lightning protection and grounding operations
④ Installation tools and spare parts covered in Section 4.

7.6 MATERIAL PREPARATION

Please check whether the type and quantity of the arriving material is correct against the material list in configuration sheet.
● Sunshine Tile Electrical Wiring Requirements
① Wiring with clear, unambiguous and easily understood wire number identification.
② Jumper cable diameter must exceed the original Sunshine Tile cable diameter, and flame retardant and insulation performance should also be no less than that of Sunshine Tile cable.

③ The Sunshine Tiles should be connected in the shortest way possible. When encountering Sunshine Tiles that need to be connected over long distances, the total length of each set of serial connecting cables should be minimized as much as possible to minimize any differences in length.
④ The wiring terminals should be in good contact. When connecting each part of the Sunshine Tile in series, it is best to test once each section is completed with a multimeter to string connectivity.

● Electrical wiring method of the Sunshine Tile
① Wiring in accordance with the wiring in the electrical schematic.
② For products connected in series, the "+" pole of one product is connected to the "-" pole of another product. Extension cables are required if connection of products between different rows is needed. Please use extension cables that are for solar application specifically. Under normal circumstances, the second row can be installed and wired only after the following row has been installed and wired.
③ When installing Sunshine Tiles of the same model, extension cables are required for cross-connections. Before moving on to the installation of the next row, one end of the extension cable should be connected and reserved, while the other end is led out to the position where the cross-connection is needed and left waiting for connection (as shown in Figure 7-3).

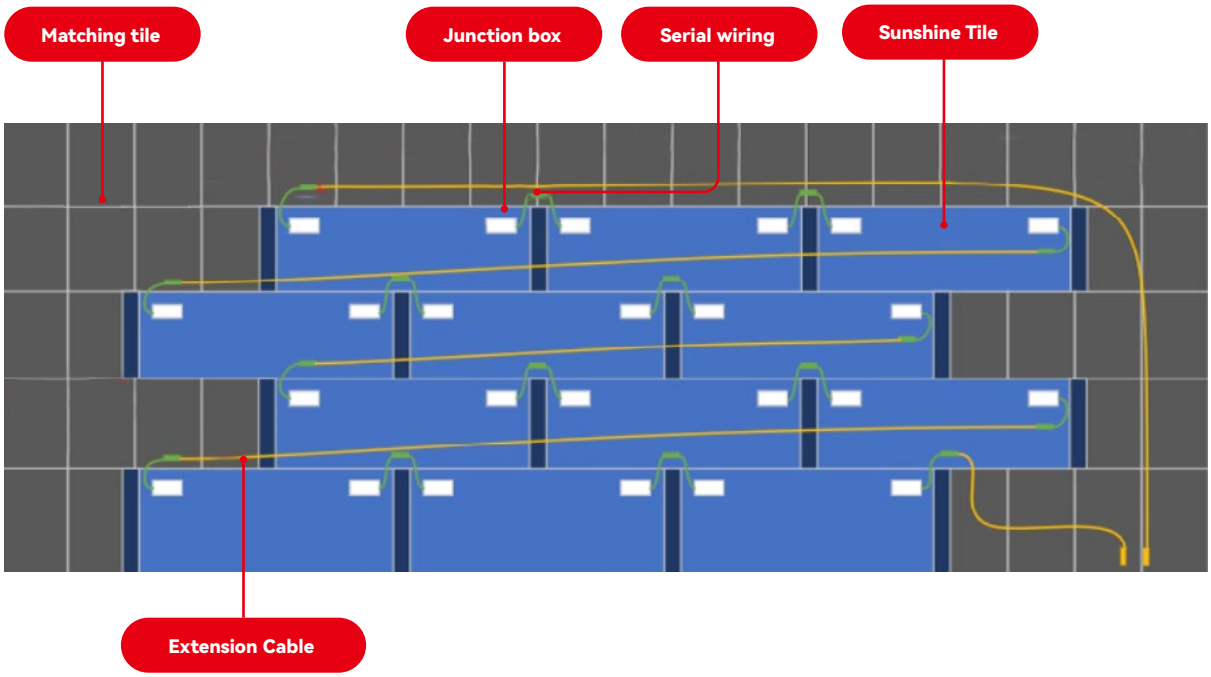


FIGURE 7-3 OPERATION INSTRUCTIONS FOR CONNECTING JUMPER CABLES TO THE SAME TYPE OF THE SUNSHINE TILE(BACK VIEW OF THE ROOF)

④ After connecting a group of series connections as shown in the drawing, connect the remaining group of "+" and "-" pole terminals to the inverter;
Note: This document only describes the wiring requirements and wiring principles. Since the roof of each site may not be the same, it is impossible to make uniform wiring regulations for each project. Wiring can be done later in accordance with the Sunshine tile installation layout drawings in each project.

7.7 COMBINER KIT (CABLE AND TERMINAL) INSTALLATION REQUIREMENTS

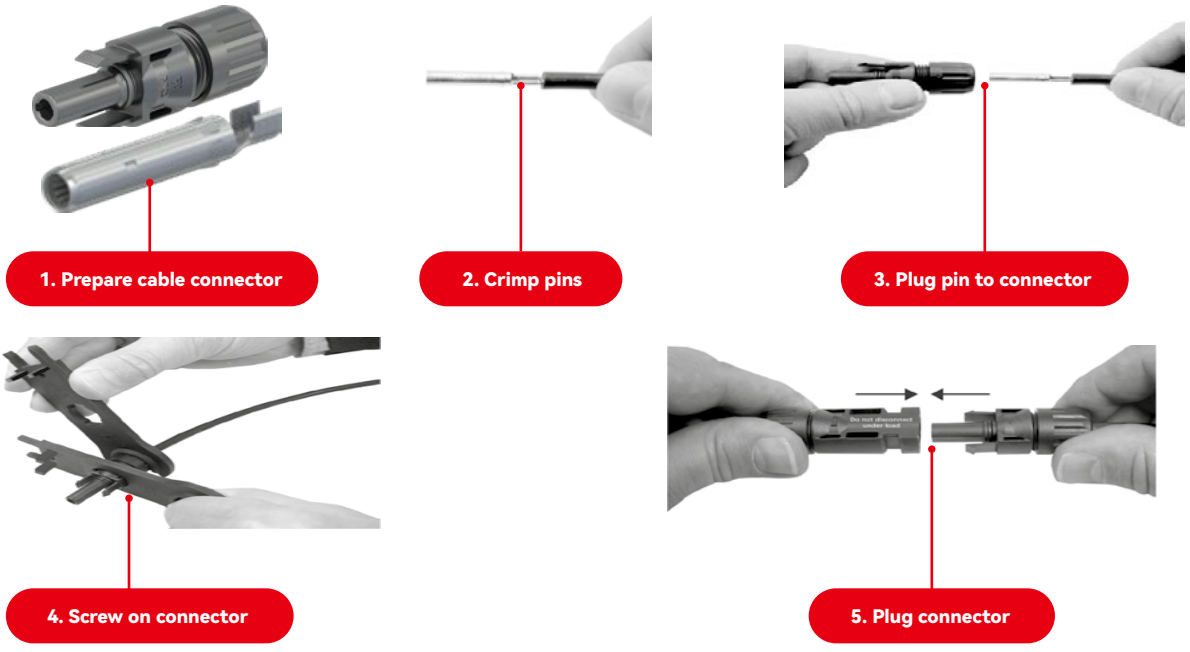
① Connect the combiner kit to Sunshine tile array according to the electrical schematic.
② Ensure that the docking plug is fully inserted and the connection is secure.
③ The combiner kit can be fixed on the bracket, and the wiring should be neat and easy to maintain.
④ Avoid applying force to the cable during the connection of the cable to prevent friction from damaging the cable jacket due to wind-induced vibration.
⑤ After connecting the combiner kit's mating terminals, use Photovoltaic special crimping pliers to clamp the terminals at both ends, just like the mating terminals of the Sunshine Tile.

8 ELECTRICAL CONSTRUCTION PROCESS

8.1 CONSTRUCTION PROCESS

● Operating conditions
① Assembly of product array is completed.
② Installation of inverter and distribution box is completed.
● Preparation of main tools
① Impact drill: For drilling holes in the installation position of PVC and other line pipes and pipe cards.
② Crimper: For on-site DC cable splice plug production.
③ Multimeter, megohmmeter: For cable conduction and insulation testing.
④ Wire stripping pliers: for cable stripping.
● Main Material
① DC cables for photovoltaics.
② AC cables.
③ Cable DC connectors use the same type of the product or a compatible one which satisfy local standards and requirements.
● Installation Engineering Process
Determine the cable run and AC/DC conduit requirement after on-site measurement.
① Conduit is required for cables between array and inverter.
② Conduit is required for cables between inverter and distribution box, distribution box and household electricity box.
● Conduit laying requirements
① Follow local electrical standards and regulations when designing and laying the conduits,

requirements of local standards and regulations prevails if contradictions is found.
When laying electrical conduits on the wall, they should be laid in the corners of the wall, in the same direction along rainfall pipes and air-conditioning pipes.
② It is advisable to avoid the crossover of AC and DC directions in the piping between equipment.
● Cable laying
Requirements for cable laying:
① When wiring each system, the type of conductor, voltage level, etc. are inspected according to the provisions of the current national standards.
② Remove water and debris from the conduit or wire channel before threading.
③ When using the crimping method to connect the wire, the specifications of the terminal copper sleeve crimp should be consistent with the cross-section of the cable core.
④ AC and DC cables should be run in different conduits to ensure safety.
⑤ After the cable is installed, the joints should be glued and sealed to prevent water from seeping into the conduit. The opening of exposed conduits should be plugged with soft cloth to avoid the entry of foreign objects.
⑥ Cable bending radius ≥ 6D.
⑦ Wiring through conduits to avoid high temperature heat generating objects as much as possible.
⑧ Conduits need to be secured by conduit clips.
⑨ The AC and DC cables connected to the inverter and distribution box should to be marked with the cable number at both ends.
● DC side cable connector installation:
① Arrange cable connectors and pins according to their intended polarity.
② Strip the DC PV cable by using wire strippers according to the length of the copper core pins.
③ Insert the DC PV cable into the pins, and crimp the pins.
④ Insert the pins into the male and female connectors and fasten them with the special screwdriver.
⑤ Plugging in the male and female cable connectors and test the tightness of the connection.



CABLE CONNECTOR PRODUCTION METHOD

● Sub-project requirements

① PVC flame-retardant rigid plastic pipe and its attached oxygen index should be 27% or more.

② Insulation of the cables should be tested before being threaded into conduits.

③ The minimum allowable bending radius of the cable laid through the pipe is six times of cable diameter.

④ The conduit clip spacing of exposed conduits should be:

a.Φ20 pipes are laid openly along the wall with a maximum distance of 1.5m between pipe clips;

b.Φ25 pipes are laid openly along the wall with a maximum distance of 2m between pipe clips.

c.Allowable value of deviation for the laying of open piping.

Straightness	<1.5mm/m
Verticality	<1.5mm/m

⑤ Cables from different circuits, different voltages or AC and DC cables, should not be worn in the same conduit.

⑥ There shall be no joints in the wires in the conduits.

⑦ Connect the plugs tightly.

8.2 LIGHTNING PROTECTION AND EARTHING

● Lightning Protection

Refer to local lightning protection design specifications for buildings.

● Functional grounding - Repeated grounding of distribution boxes and inverters

Functional earthing:

Distribution box and inverter should not be grounded repeatedly. Use tinned copper braided tape or soft copper wire to connect the grounding busbar of the equipment with the grounding electrode.

Note:

TCO effect: After running for a relatively short period of time, it was found that some thin-film modules experienced so-called TCO (transparent conductive oxide) layer damage. Once the conductive layer on the inside of the glass cover is damaged, it cannot be repaired and will cause significant power loss.

Ground resistance measurement: The requirement for the overall system grounding resistance value is no more than 4 ohms.

● Pre-commissioning inspection

Correctly connect the Sunshine Tile array, inverter, and AC grid according to the installation process described above. Ensure that the AC and DC side voltages meet the machine startup conditions.

● Sunshine Tile Array

Before the inverter is turned on, it is necessary to check the solar tile array on site and check whether the open-circuit voltage of each solar tile meets the requirements.

① Accurately record all values measured on site;

② Ensure correct polarity, otherwise the machine will be severely damaged;
③ Use a megohmmeter to test the insulation resistance of each solar tile array positive and negative pole to ground>40MΩ.

8.3 SAFETY PRECAUTIONS:

● Electrical operation requirements:
Requirements: Professional electricians and welders work with certification.
● Direct current connection of Sunshine PV modules
① Do not open the junction box on the back of the Sunshine Tile;
② Do not touch the positive and negative poles of the Sunshine Tile directly with your hands;
③ Do not directly unplug the positive and negative terminals of the string under power;
④ Do not apply mechanical force to the wires on the back of the Sunshine Tile.
⑤ After the DC cable is laid between the array and the inverter, measure the insulation resistance between the positive and negative poles to ground to avoid grounding and electric shock accidents caused by cable sheath damage.

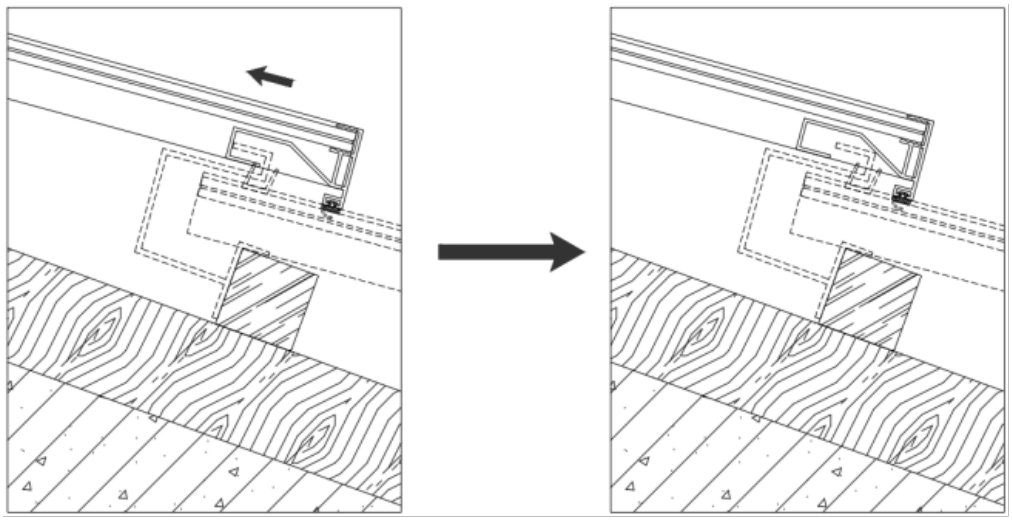
● Inverter and distribution box-side connection
① After the AC cable is laid, the insulation resistance between each phase, neutral, and ground should be measured first. After the measured resistance value is qualified, electrical commissioning can be performed;
② When making cable heads, the stripping length should meet the construction process requirements, and the compression should be tight when entering the circuit breaker and power supply, without any loose connection.

9 MAINTENANCE OF SUNSHINE TILES

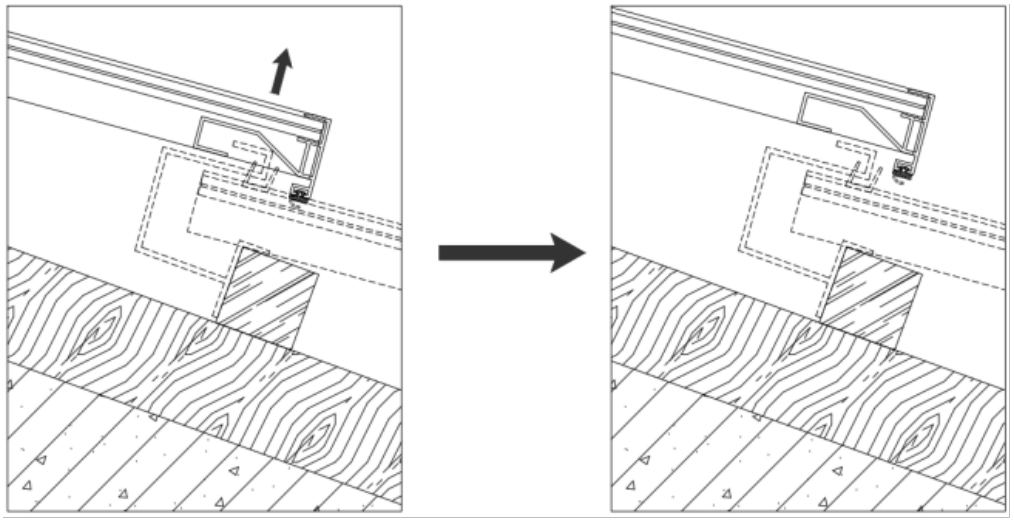
If a damaged or faulty Sunshine Tile needs to be replaced after installation, the damaged Tile must be repaired or replaced as soon as possible. Refer to the following detailed disassembly steps for Sunshine Tile repair and replacement.
When disassembling the Sunshine Tile, pay attention to slip prevention, wear slip-resistant shoes or slip-resistant shoe covers, and use a suction cup for disassembly and replacement.

9.1 REMOVAL OF SUNSHINE TILES

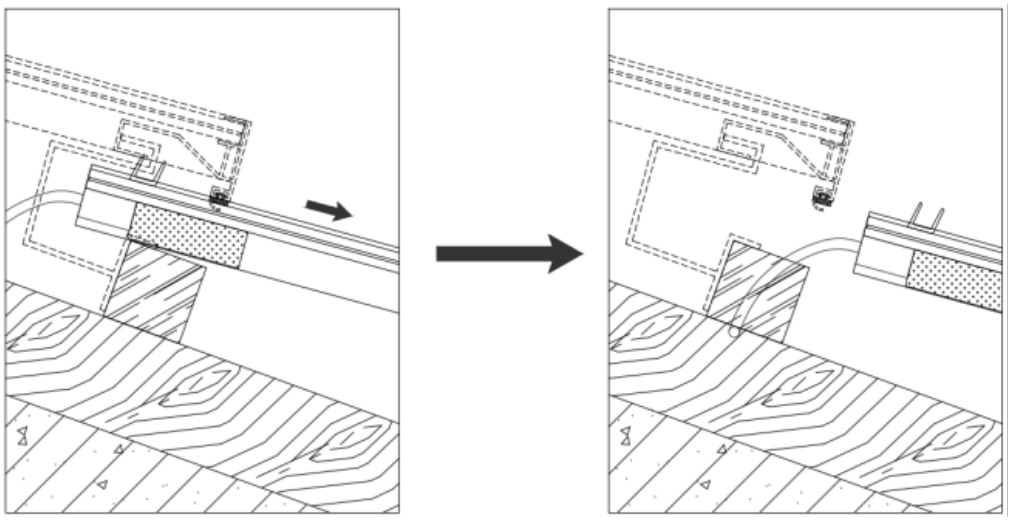
● First, push the target Sunshine Tile upward to make the bottom of the solar panel fall out of the hook range. (As shown in the figure below)



● Lift the lower part of the target Sunshine Tile upward slightly. (as shown in the below figure)



● Gently pull the target Sunshine Tile downwards to expose the cable connector on the upper side of the tile; loosen the connector and remove the target Sunshine Tile as a whole. (See figure below)



Replacement and Installation of Sunshine Tiles

- Lift the left side of the tile that needs to be replaced slightly;
- Place the replacement Sunshine Tile to make it overlap with the surrounding tiles
- Connect the wires of the replacement Sunshine Tile firmly with those of the adjacent tiles, and check whether the circuit is intact;
- Push the replacement Sunshine Tile upwards;
- Lay the Sunshine Tile flat and move it downwards until it falls into the installation hook groove;
- The replacement and installation is complete.

10 CAUTIONS

- All electrical installations must comply with electrical installation standards and be installed by electrical professionals. Make sure that the input and output switches are in the off state;
- DC input must never be connected to the inverter output terminal, and it is forbidden to short-circuit or ground the output circuit;
- The wiring between DC input and inverter should be as short as possible;
- Different colour cables should be selected for distinction during the connection process. Connect the positive pole with a red cable and the negative pole with a blue cable;
- To ensure the balance between each Sunlight Tile string, the selected DC cables should have the same cross-sectional area;
- Before making electrical connections, be sure to cover the Sunlight Tiles with an opaque material or disconnect the DC-side circuit breaker. Exposed to sunlight, the Sunlight Tile array will generate dangerous voltages;
- The grounding terminal of the system must be reliably grounded, and the grounding wire should be kept as short as possible. Do not connect it to the common ground of other high-current equipment such as welding machines and motors.

11 APPENDIX

11.1 SUNSHINE TILE (GLOBAL VERSION) PHOTOVOLTAIC PRODUCT TECHNICAL SPECIFICATIONS BMT-S2/024A (84W)

Electrical Properties	BMT-S2/024A (84W)
Testing Condition	1000W/m²,25℃ ,AM 1.5
Power	84W
Power/m²	160-175W/ m²
Voc	8.34V
ISC	12.89A
Impp	12.37A
Vmpp	6.80V
Pmax & Voc & Isc tolerance	±3%
Power Sorting tolerance	0/+3W

Working parameters	
Working temperature	-40℃ ~+85℃
Maximum System Voltage	1500V
Maximum Series Fuse Rating	25A
The rated operating temperature	45±2℃
Bifaciality Coefficients	70±5%
Fire-resistant Class	A
Protection Class	II

Temperature Parameters

Isc TP	0.048%/℃
Voc TP	-0.28%/℃
PMPP TP	-0.35%/℃

Structure Parameters

Dimension	1556±2 (Length) *420±1 (Width) *23.5±1 (Height)
Weight	11±0.5kg
Cell	Monocrystalline silicon solar cells (24pieces)
Cable	4mm²
Connector1	Manufacturer: Ningbo Huayu Photovoltaic Technology Co.,Ltd Model: PV-H4
Connector2	Manufacturer: NINGBO GZX PV TECHNOLOGY CO.,LTD. Model: PV-GZX1500
Apply gradient	17.5° -75°

Load Capacity

Maximum static load on the front	5400Pa
Maximum static load on rear side	2400Pa

Manufacturer

GOODWE POWER SUPPLY TECHNOLOGY CO., LTD

No.208 Tongrui Rd., EDZ, Guangde, Anhui, China.

Made in China.

11.2 BOM LIST

● Mounting Kit

PS: Select one or two the following mounting kits according to the design. Provided by GoodWe.

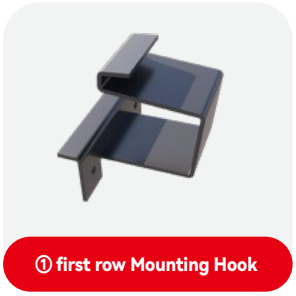
Sunshine Global Mounting Kit (standard, can NOT be sourced locally)

① Mounting Hook

② Hook Screw

①	Function	Providing wind resistance
	Quantity	2 pcs
②	Function	Fixing Mounting hooks to tile battens
	Quantity	4 pcs

Mounting Kit (Direct Hook) (optional, can NOT be sourced locally)



① first row Mounting Hook

② Hook Screw

①	Function	Providing wind resistance
	Quantity	1 pcs
②	Function	Fixing Mounting hooks to tile battens
	Quantity	2 pcs

Mounting Kit (8cm) (optional, can NOT be sourced locally)

① Mounting Hook

② Hook Screw

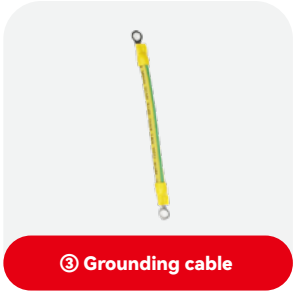
①	Function	Providing wind resistance
	Quantity	1pcs
②	Function	Fixing Mounting hooks to tile battens
	Quantity	2 pcs

Other Kit

Sunshine Global ground kit (standard, can be sourced locally)

① Screw

② External tooth washers



③ Grounding cable

①	Function	Fixing of grounding elements
	Quantity	2 pcs
②	Function	Securing the screw to prevent loosening
	Quantity	2 pcs
③	Function	Grounding of Sunshine frames
	Quantity	1 pcs

Sunshine Global left end plugs (optional, can NOT be sourced locally)

Left plug

Function	Block the edges
Quantity	1 pcs

Sunshine right end plugs (optional, can NOT be sourced locally)

Right plug

Function	Block the edges
Quantity	1 pcs

Sunshine Global Adapter Kit (optional, can NOT be sourced locally)

① Left adapter

② Right adapter

① Function	Connecting Sunshine tiles with matching concrete tiles
Quantity	1 pcs per row

② Function	Connecting Sunshine tiles with matching concrete tiles
Quantity	1 pcs per row