

Roof & Plug

INSTALLATION AND SAFETY MANUAL

SOLAR FLAT-5XL ceramic roof tile



TEJAS BORJA

Since 1899

SOLAR FLAT-5XL

ceramic roof tile

INSTALLATION
and safety manual



IMPORTANT

Before beginning to install SOLAR Flat-5XL ceramic tiles, make sure you know and understand the product's technical characteristics and installation features. Keep this manual for future reference.

To ensure the safety of the installer, equipment and property, this manual must be read carefully before beginning the installation. The instructions in this manual must be followed during transport, installation, testing and maintenance.

Version 1 – February 2021

All the specifications and descriptions in this document are correct at the time of publication. However, and because continuous improvement is one of Tejas Borja's objectives, we reserve the right to make changes to these data at any time. To notify us of any possible inaccuracies or omissions in this document, please send an email to the following address: solar@tejasborja.com.

The data added to the latest versions of our product data sheets may not be in this document. If any information provided in this document conflicts with the information in a data sheet for a product described herein, the latest version of the data sheet takes precedence and prevails over this document. The illustrations, drawings, diagrams and other images in this document are for illustrative purposes only. The products depicted in this document may be slightly different to the real products.

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1 INTRODUCTION

This manual contains information about the installation and correct handling of the **SOLAR FLAT-5XL ceramic roof tile** model photovoltaic modules made by Tejas Borja S.A.U.

Installers must read and understand the contents of this manual before beginning installation.

If in any doubt, please send a message to Tejas Borja Technical Support by emailing solar@tejasborja.com to ask for more information.

When installing the **SOLAR FLAT-5XL ceramic roof tile**, installers must use all the safety measures detailed in this manual as well as complying with all local rules and regulations whether mandated by law or official bodies.

Before installing a solar photovoltaic system, installers must be familiar with its mechanical and electrical requirements. Keep this manual in a safe place for future reference.

The specifications in this manual are subject to change without notice. Always consult the latest version on the Tejas Borja website at tejasborja.com.

The real images included in this document represent the product and give the closest reflection of its real physical appearance. However, Tejas Borja recommends in-person viewing of product samples through its distributors and sales network.

2 LIABILITY NOTICE

This manual provides basic information about the **SOLAR FLAT-5XL ceramic roof tile**.

Tejas Borja will not be liable for any damages, losses, costs or legal liability arising from the use of other equipment or components, incorrect installation, mounting, operation, application and maintenance which is not under the control of Tejas Borja.

Tejas Borja will not be liable for breaches of patent laws or third party rights caused by installation methods or the use of the product.

If the method of installation used deviates from the instructions in this manual, ensure the installation method and the application of the product are viable.

The user does not have the right to sub-licence any of the intellectual property rights or patents associated with the **SOLAR FLAT-5XL ceramic roof tile**.

Tejas Borja reserves the right to modify this manual, technical specifications and all information about the **SOLAR FLAT-5XL ceramic roof tile** at any time.

The installation must always and only be carried out by a qualified installer.

Before beginning the installation, the installer must know all the electrical requirements of the photovoltaic system.

This manual must be read together with the product data sheet and the specifications for the **FLAT-5XL ceramic tile** and its installation guidelines.

3 GENERAL PROVISIONS AND OVERVIEW

Tejas Borja's solar photovoltaic energy solutions can be adapted to meet the specific energy generation requirements of each project and cut electricity bills while helping to reduce our carbon footprint by providing an alternative, environmentally-friendly way to generate electricity.

The choice of material for the roof tiles is crucial to guarantee the durability, protection and energy efficiency of the property, and nor should the importance of the roof's aesthetic appearance be overlooked.

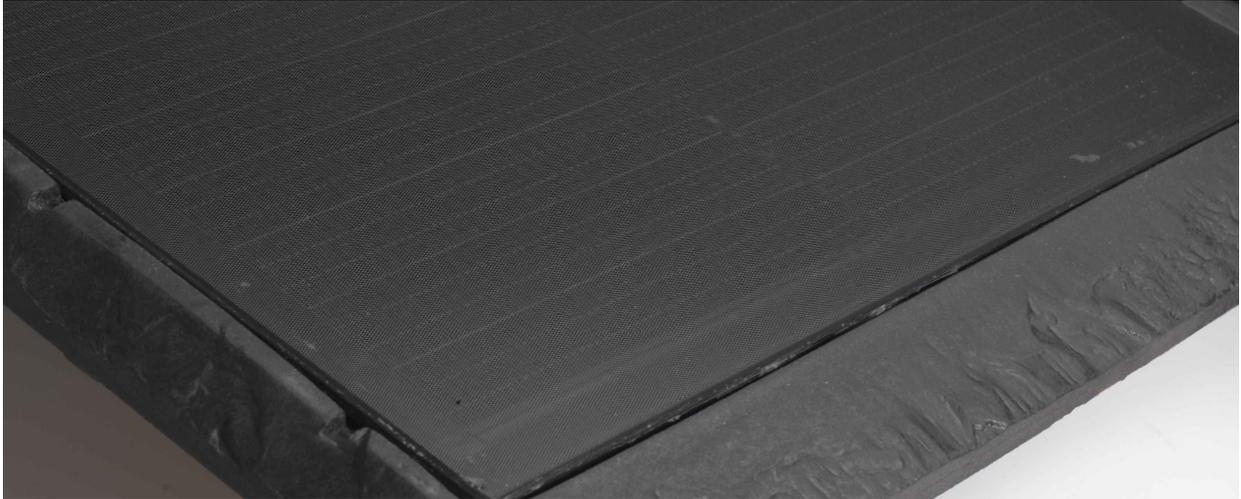
To combine efficiency and style, Tejas Borja's solar solutions are integrated into the ceramic roofing tiles so they impact the original project design as little as possible.

The products in our SOLAR range and our ceramic tiles must always be installed using dry installation systems and connectors which meet international standards to guarantee optimal safety and the maximum watertightness and durability of the roof.

The importance of self-consumption: save while protecting the environment.

Photovoltaic energy is a clean and environmentally-friendly form of energy, ideal for self-consumption and to reduce monthly electricity bills, both for homes and company premises.

A technology which is widely used around the world, photovoltaic panels convert solar energy into electricity. Photovoltaic electrical energy systems are the only ones which, using a renewable source, can produce electricity in the place it is consumed.



3.1 SOLAR FLAT-5XL ceramic roof tile

The **SOLAR FLAT-5XL ceramic roof tile** has been designed to integrate perfectly into the roof.

SOLAR FLAT-5XL ceramic roof tile tiles are the only large ceramic tiles with an integrated solar energy system. They are ideal for providing a reliable supply of solar energy. Thanks to the integration of the solar panel into the tile, the tiles provide all the benefits of a roof made from ceramic tiles in terms of watertightness, without any risk of deterioration or oxidation.

The photovoltaic panel is perfectly integrated into the tile, this being the best way to achieve a roof which captures clean energy without affecting its aesthetic appearance, preserving the line and usual thickness of the covering. This perfect integration is completed with the installation of the roof or facade using FLAT-5XL tiles and other ceramic accessories.

All the electrical components included in the **SOLAR FLAT-5XL ceramic roof tile** have been carefully selected to guarantee the highest quality of the product. The junction box is compact and extremely reliable in harsh environments, its IP67 certification means it provides protection against moisture and its **bypass diode** means it also protects against the flow of inverse currents in darkness, when it is cloudy or when the roof is in shade or covered by leaves or other objects.



The **SOLAR FLAT-5XL ceramic roof tile** has an entirely black (**FULL-BLACK**), anti-reflective finish, with none of the typically visible connections.

The **SOLAR FLAT-5XL ceramic roof tile** is designed for a roof or facade made from **FLAT-5XL flat ceramic tiles** and their complementary special ceramic pieces.

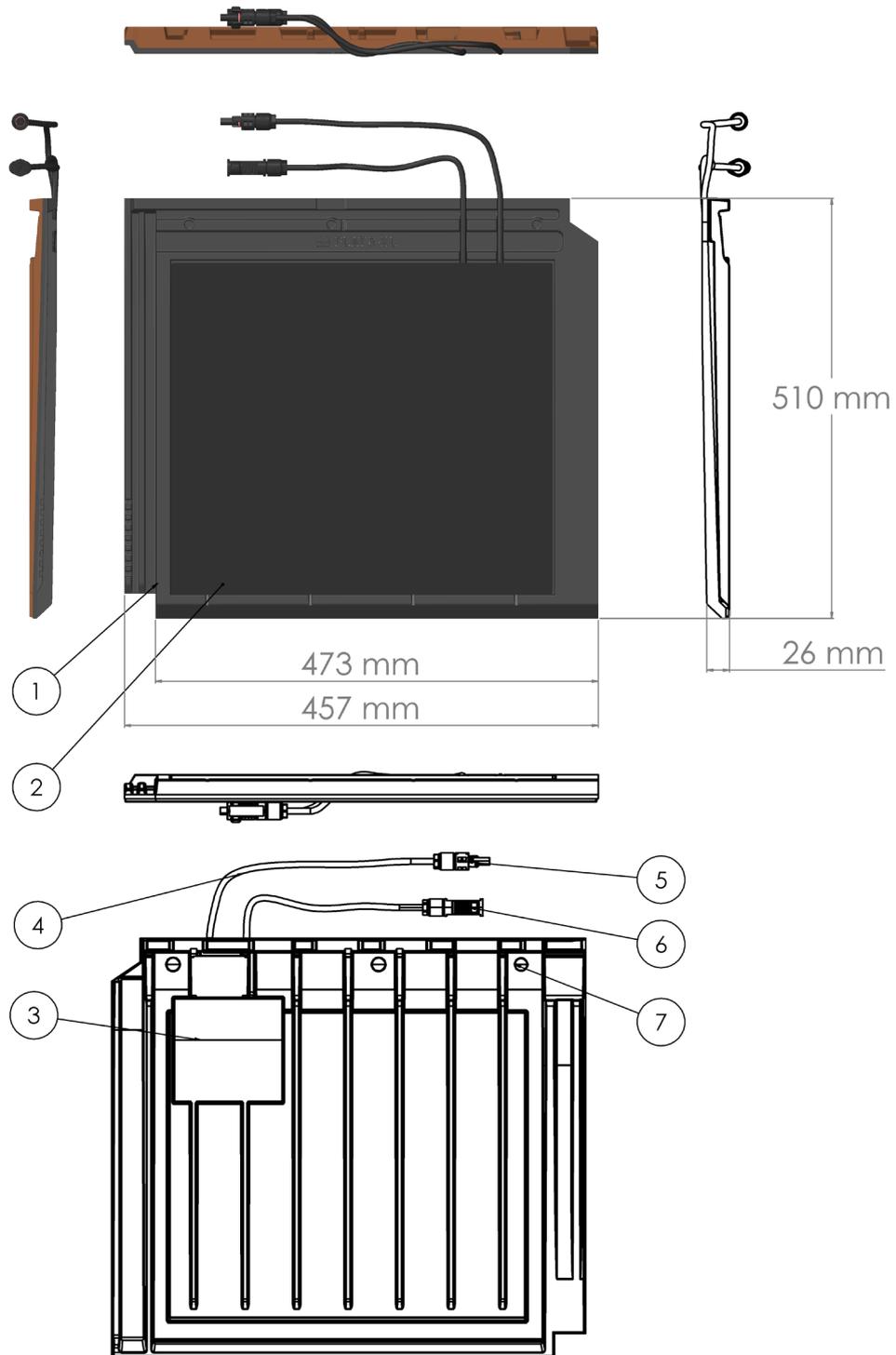
3.1.1 Identification of the product

Each **SOLAR FLAT-5XL ceramic roof tile** carries a unique serial number. Do not remove any labels. The information on them is important for the traceability of the product.



3.1.2 Characteristics and specifications





Key:

- 1 - FLAT-5XL ceramic support
- 2 - Photovoltaic panel
- 3 - Junction box ceramic housing
- 4 - Connection cables

- 5 - MC4 connector (+) positive terminal
- 6 - MC4 connector (-) negative terminal
- 7 - Holes for fixing to the batten*

* Requires 2 screws for fixing to the batten (per solar tile unit): diameter from 3,5 to 4,2 / thread length 45 - 55 mm, depending on the batten type.

The **SOLAR FLAT-5XL ceramic roof tile** comes in two versions to adapt to each project's energy generation needs and available space.:

- **SOLAR FLAT-5XL ceramic roof tile – MONOCRYSTALLINE**
- **SOLAR FLAT-5XL ceramic roof tile – CIGS**

Characteristics SOLAR FLAT-5XL ceramic roof tile - MONOCRYSTALLINE

Dimensions:	457 x 510 mm
Individual weight:	7,50 kg.
Finish:	LEON MATTE / CRISTAL FULL-BLACK
Cell type:	Monocrystalline
Base:	Flat-5XL ceramic roof tile
Fixing system:	3 pre-drilled holes (batten fixing – min. 2 places)
Panel dimensions:	410 x 360 mm (320 x 360 mm useful area)
Equivalence to ceramic tiles:	1 Flat-5XL roof tile
Placing:	Depending on the Flat-5XL roof tile *
Connection:	Mixed (series – parallel)
Maximum power (P_{max}):	24 Wp
Maximum power tolerance:	-5% / +5 %
Maximum power current (I_{mpp}):	1,9 A
Maximum power voltage (V_{mpp}):	12,75 V
Short circuit current (I_{sc}):	2,05 A
Open circuit voltage (V_{oc}):	15,16 V
Temperature coefficient of P_{max} (δ):	-0,38 %/K
Temperature coefficient V_{oc} (β):	-0,30 %/K
Temperature coefficient I_{sc} (α):	0,043 %/K
Maximum system voltage:	600 V (IEC)
Maximum series fuse rating (I_{sf}):	5 A
Operating temperature:	-40 °C a 85 °C.
Standard**:	IEC 61646 - IEC 61730
Front glass panel:	4 mm. tempered glass
Backsheet:	Combination of polymers
Junction box:	IP 67
Connectors:	MC4 or compatible connectors
DC cable:	4,0 sq. mm., (12 AWG)
DC cable length:	2 x 470 mm
Units /sq. m.:	5,85 – 5,50 units
Maximum power/sq. m.***:	143,26 Wp/sq. m.
sq. m. – 1 kWp:	6,98 sq. m.
Units/kWp:	41,32 units



All measurements are approximate.

Note: The SOLAR FLAT-5XL roof tile has an entirely black (FULL-BLACK), anti-reflective finish, with none of the typically visible connections. It is entirely compatible with the FLAT-5XL ceramic tile (see available finishes on the Tejas Borja website).

* SOLAR FLAT-5XL ceramic roof tile must always be installed on ventilated roofs using a double batten system or equivalent.

** Depending on batten spacing.

*** The certification process is pending.

STC standard conditions: irradiance = 1.000 W/sq. m.; cell temperature = 25°C; AM = 1,5.

Characteristics SOLAR FLAT-5XL ceramic roof tile - CIGS

Dimensions:	457 x 510 mm
Individual weight:	7,50 kg.
Finish:	LEON MATTE / CRISTAL FULL-BLACK
Cell type:	CIGS (free from Cd and Pb) ⁽¹⁾
Base:	Flat-5XL ceramic roof tile
Fixing system:	3 pre-drilled holes (batten fixing – min. 2 places)
Panel dimensions:	410 x 360 mm (320 x 360 mm useful area)
Equivalence to ceramic tiles:	1 Flat-5XL roof tile
Placing:	Depending on the Flat-5XL roof tile *
Connection:	Mixed (series – parallel)
Maximum power (P_{max}):	17 Wp
Maximum power tolerance:	-3% / +5 %
Maximum power current (I_{mpp}):	0,54 A
Maximum power voltage (V_{mpp}):	31,7 V
Short circuit current (I_{sc}):	0,61 A
Open circuit voltage (V_{oc}):	40,2 V
Temperature coefficient of P_{max} (δ):	-0,34 %/K
Temperature coefficient V_{oc} (β):	-0,24 %/K
Temperature coefficient I_{sc} (α):	+0,01 %/K
Maximum system voltage:	1.000 V (IEC)
Maximum series fuse rating (I_{sf}):	5 A
Operating temperature:	-40 °C a 85 °C.
Standard**:	IEC 61646 - IEC 61730
Front glass panel:	3,2 mm. tempered glass
Backsheet:	1,8 mm. tempered glass
Junction box:	IP 67
Connectors:	MC4 or compatible connectors
DC cable:	4,0 sq. mm., (12 AWG)
DC cable length:	2 x 600 mm
Units /sq. m.:	5,85 – 5,50 uds
Maximum power/sq. m.***:	102 Wp/sq. m.
sq. m. – 1 kWp:	9,8 sq. m.
Units/kWp:	58,82 units



All measurements are approximate.

Note: The SOLAR FLAT-5XL roof tile has an entirely black (FULL-BLACK), anti-reflective finish, with none of the typically visible connections. It is entirely compatible with the FLAT-5XL ceramic tile (see available finishes on the Tejas Borja website).

* SOLAR FLAT-5XL ceramic roof tile must always be installed on ventilated roofs using a double batten system or equivalent.

** Depending on batten spacing.

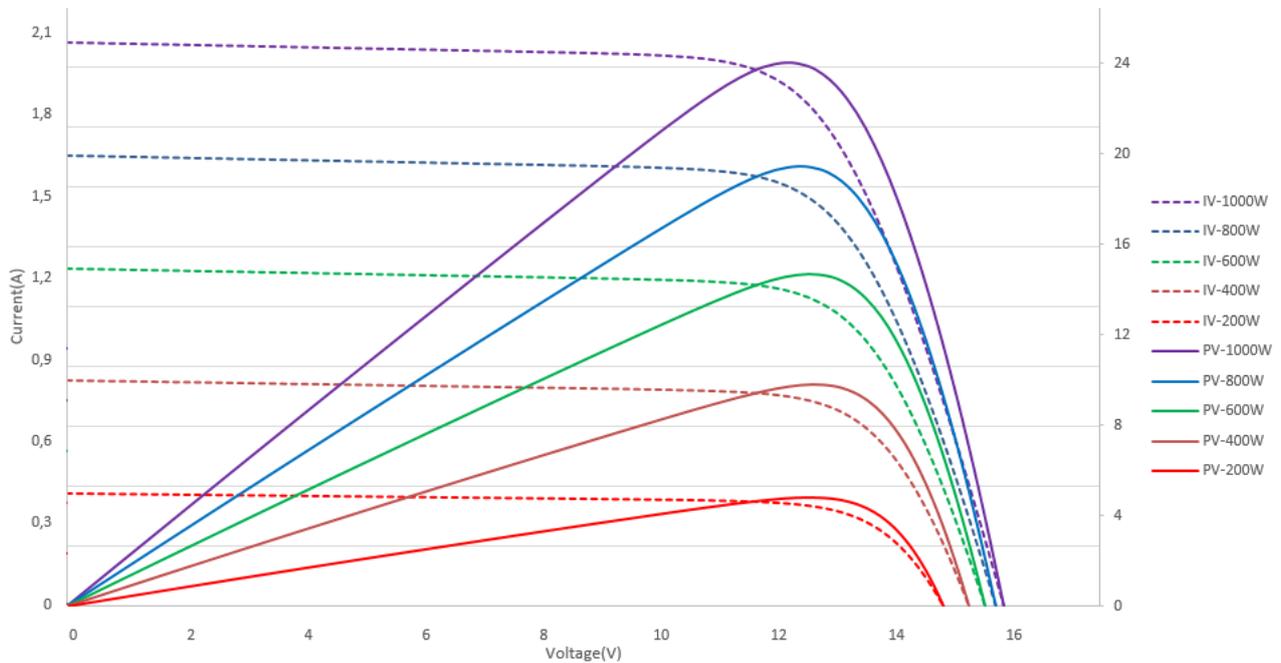
*** The certification process is pending.

STC standard conditions: irradiance = 1.000 W/sq. m.; cell temperature = 25°C; AM = 1,5.

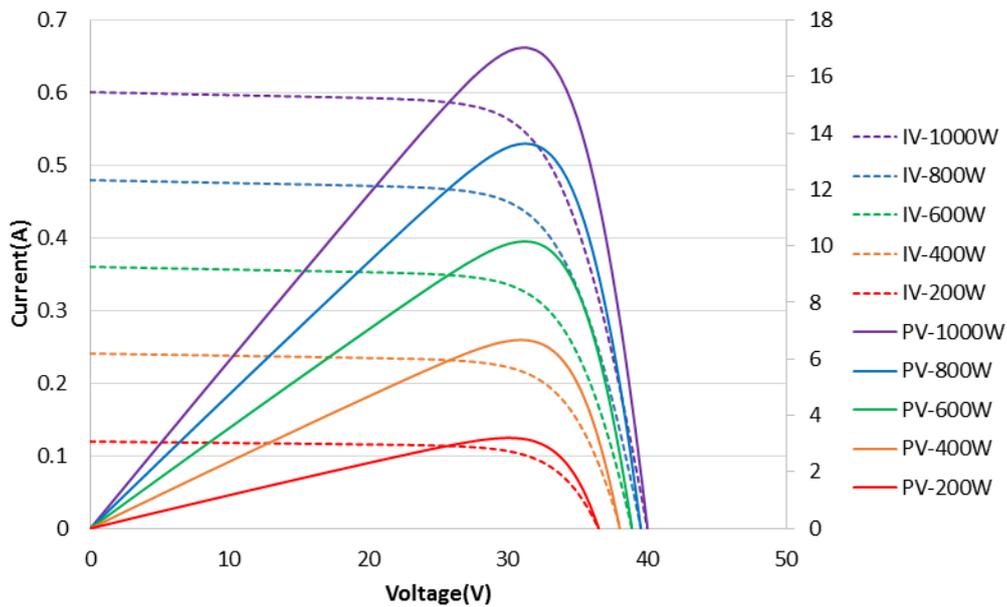
⁽¹⁾ CIGS (copper, indium, gallium and selenium) is an acronym which describes the latest development in high efficiency solar cell technology (this technology is the most effective in shady conditions) providing high performance while free from cadmium and lead.

3.1.3 Voltage curve

(I-V and P-V curves different irradiance levels)



I-V and P-V curves - SOLAR FLAT-5XL ceramic roof tile MONOCRYSTALLINE



I-V and P-V curves - SOLAR FLAT-5XL ceramic roof tile CIGS

In each case the graph shows two curves. The first is the I-V curve, represented by a dotted line. This shows the relationship between current and voltage at different irradiance levels. Each irradiance level is shown in a different colour.

The other is the P-V curve, represented by a continuous line. This shows the relationship between power and voltage at different irradiance levels.

3.1.4 Packaging



- Units / pallet: 36 SOLAR FLAT-5XL ceramic roof tiles
- Pallet weight: 320 kg
- Dimensions: 75 x 112 x 70 (mm)
- Stackable: up to 3 tiers

4 RECEIPT AND STORAGE

Upon receipt, check that the product delivered matches that ordered.

Upon receiving the product and before sending it on to its final destination, the packaging must be checked for any damage. If the packaging is damaged, a photograph must be taken of the packaging and all the solar tiles inside it must be checked for any damage.

Due to the special characteristics of the product, **SOLAR FLAT-5XL ceramic roof tile** must be handled carefully.

Store the packing boxes in a clean, dry place with a relative humidity below 85% and at an ambient temperature between -20°C and 50°C.

DO NOT stack more than the maximum permissible quantity of pallets (up to 3 pallets).

Keep the product in its original packing box until ready to install it.

When they are at the installation site and before beginning the installation, make sure to keep **SOLAR FLAT-5XL ceramic roof tiles** clean and dry, particularly their electrical contacts. The contacts may corrode if their cables are exposed to humid conditions. Any **SOLAR FLAT-5XL ceramic roof tile** with contacts affected by corrosion must not be used.

To ensure the safety of personnel and the product when handling **SOLAR FLAT-5XL ceramic roof tiles**, two people must work together to unpack the modules from their packing boxes.

Do not remove the edges of the modules if the modules are to be temporarily stored off the pallet.

Never use a blade cutting tool (such as a box cutter, knife or similar) to cut the straps; use scissors or pliers.

Never place a **SOLAR FLAT-5XL ceramic roof tile** directly on top of another.

5 SAFETY

5.1 General safety

Specialized skills and knowledge are required to install solar photovoltaic systems. Installation must only be carried out by qualified, trained personnel.

Installers must follow all security precautions when installing SOLAR FLAT-5XL ceramic roof tiles.

Never install solar tiles which are physically damaged and/or present defects in any of their parts or elements.

Only use equipment, tools, connectors, cables, etc. which are appropriate for solar electrical systems.

Follow the laws regarding health and safety at work and local safety regulations regarding fall prevention.

5.2 Warnings

When exposed to direct sunlight, one module alone can generate more than 30 V of DC. Safety measures must be used during installation because contact with a voltage of 30 V or more of DC is dangerous. Avoid contact with electrically charged components and make sure live circuits are isolated before making or breaking any connections.

Installers must assume the risk of injuries which may occur during installation including, but not limited to, electric shock.

When installing the system, you must follow all local, regional and national regulations. When necessary, obtain a building permit.

5.3 Precautions

Do not attempt to remove **SOLAR FLAT-5XL ceramic roof tiles** once they have been installed. Do not remove any label or component from the tiles.

Do not apply paints or adhesives to the upper surface of **SOLAR FLAT-5XL ceramic roof tiles**.

Do not use mirrors or magnifying lenses to concentrate the light onto the solar tiles. Never use artificial means to concentrate sunlight onto the solar modules.

Store on a flat surface in a place which is well ventilated and dry.

5.4 Manual handling safety

Do not disconnect **SOLAR FLAT-5XL ceramic roof tiles** when they are charging.

When handling **SOLAR FLAT-5XL ceramic roof tiles**, always wear appropriate safety footwear and Class 0 insulating gloves which meet the requirements of UNE standard EN 60903:2005 to protect the handler against electric shocks and to prevent the product from falling.

Only work in dry conditions and use dry tools. Unless you have the appropriate protective equipment, do not handle **SOLAR FLAT-5XL ceramic roof tiles** or electric components if they are wet.

Do not pick up a **SOLAR FLAT-5XL ceramic roof tile** by the junction box or the electric cables.

Do not sit, step or walk on a **SOLAR FLAT-5XL ceramic roof tile**. Do not step on the front or rear surface of **SOLAR FLAT-5XL ceramic roof tiles** either before or after installation.

Do not scratch the surface of the glass or panel.

Do not drop **SOLAR FLAT-5XL ceramic roof tiles**, do not drop objects on top of them or subject them to heavy blows.

Do not place any heavy object on top of **SOLAR FLAT-5XL ceramic roof tiles** or on top of any of its components, cables or connectors.

Take care when positioning **SOLAR FLAT-5XL ceramic roof tiles** on the roof surface, particularly when working at a corner.

Do not damage the cables. Do not pinch, twist or stretch them using excessive force.

Improper transport or installation may break the **SOLAR FLAT-5XL ceramic roof tiles** and void the warranty.

SOLAR FLAT-5XL ceramic roof tiles with damaged glass (whether it is broken or scratched) cannot be repaired.

Contact with any damaged surface of a **SOLAR FLAT-5XL ceramic roof tile** may cause an electric discharge. Never use a **SOLAR FLAT-5XL ceramic roof tile** which has broken glass or a damaged backsheet.

Be sure to protect the connector contacts against corrosion and dirt. Check that all the connectors are free of corrosion and clean before connecting them.

Keep the **SOLAR FLAT-5XL ceramic roof tiles** out of the reach of children at all times.

5.5 Electrical safety

You must comply with safety regulations for electrical installations and the electrical code in accordance and national and/or local legislation depending on the location of the installation.

Under normal conditions, the current and/or voltage produced by a **SOLAR FLAT-5XL ceramic roof tile** will probably be superior to those recorded under standard measurement conditions. Consequently, the values for I_{sc} and V_{oc} given for the **SOLAR FLAT-5XL ceramic roof tile** should be multiplied by 1.25 to determine the voltage of the components, the fuse sizes and the size of the controls connected to the photovoltaic output.

Under no circumstances should the open circuit voltage of the installation exceed the maximum voltage of the system (IEC 1.000V / UL 1.000V).

The maximum voltage of the system should not be exceeded under any circumstances. If the voltage of the **SOLAR FLAT-5XL ceramic roof tile** were expected to surpass the values detailed in the data sheet under operating temperatures lower than 25°C, this must be taken into account when designing the photovoltaic system.

Only personnel qualified to work with photovoltaic capture systems should access or work with **SOLAR FLAT-5XL ceramic roof tiles** or on the solar system.

Before connecting the **SOLAR FLAT-5XL ceramic roof tiles** to the inverter, open the circuit breakers and turn off the inverter.

To prevent electrical discharges, do not carry out the installation when the **SOLAR FLAT-5XL ceramic roof tiles**, installation tools or installation area are exposed to water.

Before switching on the system, make sure all the **SOLAR FLAT-5XL ceramic roof tiles** are connected and use a multimeter to check the total voltage of the entire solar tile installation.

Make sure that all connections have been made safely, without any space between the contacts. Any space between contacts may cause an electric arc which is capable of causing a fire and/or electric discharges.

To prevent the appearance of electric arcs and discharges, NEVER disconnect a solar tile when it is charging. If this were ever necessary, cover the surface of the tile with an opaque covering before disconnecting it.

Make sure that the polarity of each **SOLAR FLAT-5XL ceramic roof tile** or string is not inverted in relation to the rest of the tiles or the strings.

For all connections with inverters, regulators, batteries or to the general control panel, take into account the manufacturer's specifications in each case.

The rated electrical characteristics are within a range of +5% to -3% of the values measured under standard test conditions (STC): 1,000 W/sq. m., with a cell temperature of 25°C and a solar spectrum corresponding to an air mass of 1.5.

5.6 Installation safety

Solar photovoltaic tiles convert light energy from sunlight into direct current electricity. They are designed to be installed outdoors on sloping roofs or facades. The proper design of the structures which support the tiles is the responsibility of the system designers and the installers.

Always use tools and PPE which comply with standards for electrical installations and working at height.

All electronic components used in the photovoltaic system (including cables, connectors, charge regulators, inverters, batteries, etc.) must comply with safety regulations.

Never unplug connectors or open the electrical circuit at any point while the circuit is charging or receiving electric current.

To prevent electrical discharges while handling the **SOLAR FLAT-5XL ceramic roof tiles**, we recommend you cover the surface of the solar tiles with an opaque material both while installing and removing them to stop them from generating electricity.

Contact with the electrically charged parts of a **SOLAR FLAT-5XL ceramic roof tile**, such as the terminals, may cause burns, sparks and even lethal shocks, either if the tile is connected or if it is not.

During the installation, do not touch the photovoltaic modules unless necessary. The glass surface and the frame may heat up excessively and there is a risk of burns or electric shock.

Never install or handle **SOLAR FLAT-5XL ceramic roof tiles** if they are wet. Do not carry out the installation in adverse or severe weather conditions such as high winds, heavy rain, snow or hail.

To prevent damage to the cables, keep them out of direct sunlight as much as possible and do not let them be stained by any product used in assembling the roof (foam, adhesives, mortar, asphalt, etc.) before installation.



Only use insulated tools which are authorized for use in electrical installations.

During the installation, repair or removal of photovoltaic systems, metallic accessories (bracelets, watches, rings, earrings or metal piercings anywhere on the body) must not be worn.

Respect safety regulations (e.g. regulations concerning working in power plant stations) for all the other components of the system such as wires and cables, connectors, load regulators, inverters, storage batteries, rechargeable batteries, etc.

To connect the **SOLAR FLAT-5XL ceramic roof tiles** in series or to connect them to another device, only use identical or compatible connectors. The warranty will be void if the connectors are removed.

During the transport and installation of the mechanical and electrical components, no-one other than installation personnel should be in the immediate area.

5.7 Fire safety

Consult the local authorities regarding the guidelines and requirements for fire safety in buildings and structures. Always comply with the regulations in force.

The construction and installation of roofs (sloping roofs and terraced roofs) may affect the fire safety of the building; improper installation may increase fire risks.

Use the components required by local regulations such as ground fault circuit interrupters and fuses as required by local regulations.

Do not use **SOLAR FLAT-5XL ceramic roof tiles** near to equipment or in places where they could generate flammable gases.

NEVER use water to extinguish electrical fires.

6 GENERAL INSTALLATION INFORMATION

6.1 Installation design

To create an optimal design for an installation using **SOLAR FLAT-5XL ceramic roof tiles**, we recommend you take the following into account:

- Consider the location of the project (area, environment, orientation, shade, etc.).
- Draw up an appropriate design for the sloping roof (gradient, structural load, materials, execution, etc.).
- Ensure compliance with regulations and local rules before proceeding.
- Define the type of installation (limited self-consumption, with sale of excess power generated, with storage, or isolated from the national power grid).

Upon request, Tejas Borja can provide a preliminary project study, together with an installation proposal for a solar photovoltaic energy system made using **SOLAR FLAT-5XL ceramic roof tiles**. The information in any such study serves only as a guide for the design of the photovoltaic installation. Tejas Borja does not undertake any commitment or assume any responsibility for the execution of the project. It will be the accredited installer who must assume responsibility for fulfilling the design criteria and the requirements of the installation.

The design of the installation must take into account local climatic conditions and the characteristics of the inverter, always complying with current regulations.

6.2 Location selection

Choose an appropriate place for the installation of the **SOLAR FLAT-5XL ceramic roof tiles**.

For the best results, **SOLAR FLAT-5XL ceramic roof tile** installations in the northern hemisphere must be orientated towards the south, and in the southern hemisphere towards the north.

The minimum recommended gradient for sloping roofs is 30% (*) to maximise energy production. As a general rule, a tilt angle equal to the latitude facing the equator may be used. However, the installation must always be designed according to local conditions to obtain the best angle.

(*) Minimum recommended gradient for sloping roofs with FLAT-5XL flat ceramic tiles. In zone 1, a protected location, installed in a staggered formation with waterproof sheet and a batten distance of 340 mm on a roof slope of up to 6.5 m. Please consult the table of minimum slope data depending on the roof length and geographical area in accordance with standard UNE-136020.

For detailed information about the best slope gradient, please get in touch with us via email: solar@tejasborja.com.

Although **SOLAR FLAT-5XL ceramic roof tiles** are guaranteed to give high performance and produce the specified energy output, and are highly effective in the shade, their installation in areas where the tiles may be shaded at any time is not recommended. Avoid installing the **SOLAR FLAT-5XL ceramic roof tiles** in places which are frequently shaded. If a **SOLAR FLAT-5XL ceramic roof tile** is affected by total or partial shade, its performance will be impeded, causing a lower power output.

Do not use **SOLAR FLAT-5XL ceramic roof tiles** near to equipment or in places where they could generate flammable gases.

6.3 Climatic conditions

SOLAR FLAT-5XL ceramic roof tiles are guaranteed to function with a linear output of up to 80% for 25 years in the following environmental conditions:

- Operating temperature: -40°C to 85°C.

The system installer must make sure that the installation methods used comply with the aforementioned requirements and any other code or regulations in force.

We can advise you on the design and specification of a SOLAR FLAT-5XL ceramic roof tile installation to meet your needs.

Contact us! solar@tejasborja.com

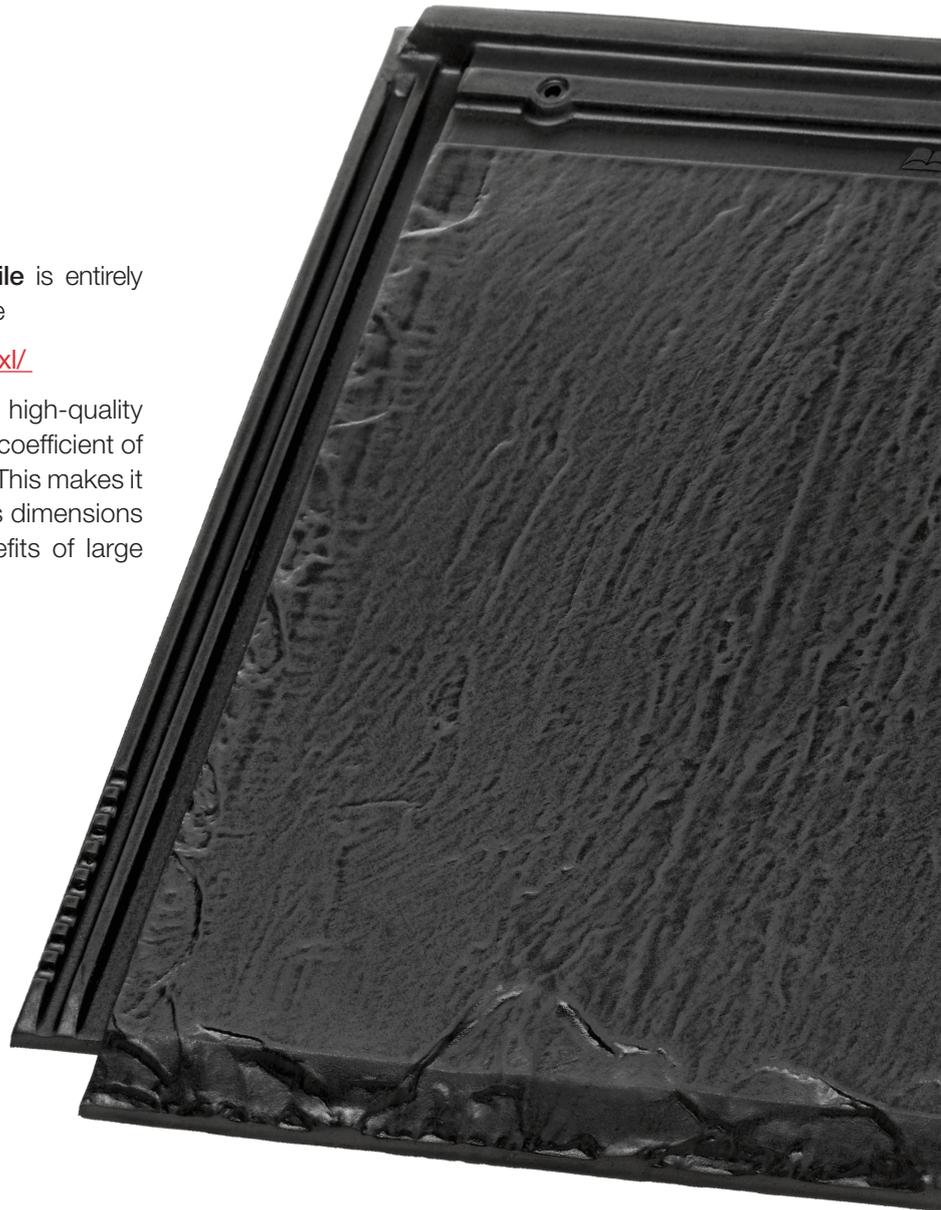
6.4 Compatibility

6.4.1 Ceramic tile – roof covering

The **SOLAR FLAT-5XL ceramic roof tile** is entirely compatible with the FLAT-5XL ceramic tile

<https://tejasborja.com/en/roof-tile/flat-5xl/>

The FLAT-5XL ceramic tile, made from high-quality stoneware clay, has a water absorption coefficient of less than 3%, the lowest on the market. This makes it suitable for installation in any climate. Its dimensions means it offers all the installation benefits of large format tiles.



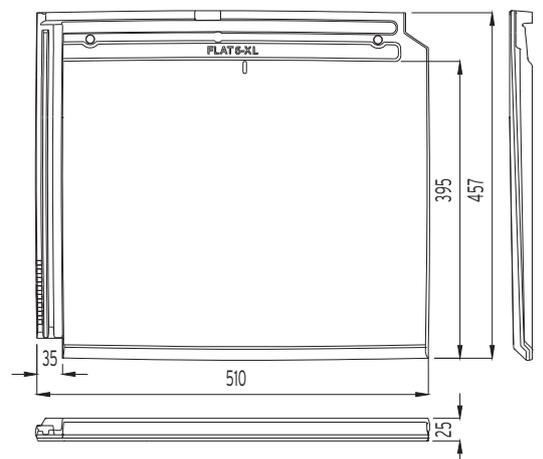


reddot award 2019
winner

The largest ceramic tile ever made
High performance in installation (5 units/sq. m.)
Wide range of finishes
(BorjaJET exclusive)



® TRADE MODEL
> Klinker



Dimensions	457 mm x 510 mm
Minimum pitch recommended	30% - 17° (*)
Weight	6,55 Kg./Unit
Units / sq. m.	5,5 Units
Units per LM eave line	2 Units
Useful width	476 mm
Useful length (Batten distance) VARIABLE	340-385 mm
Pallet data	(G1) 152 Units / 990 Kg.
Minimum order	2 Units **



Approximate values: If the roof tiles are installed on battens, the useful length must be calculated on site. A tolerance of ± 2% is allowed on the dimensions of the roof tiles according to EN 1024.

(*) In zone 1 (protected area), arranged in staggered formation with waterproof membrane and batten distance of 340 mm on a skirt of up to 6.5 m. Check pitch panel according to the roof length and the geographical area according to EN 136020.

** The tiles are subject to minimum order and must be multiples thereof.

6.4.2 Inverters

The choice of inverter will be determined by the project manager in accordance with the project's specifications and requirements while always keeping in mind and complying with local regulations regarding the generation of electrical energy in isolated systems or those connected to the public power grid.

The inverter must be located as near as possible to the property's main switchboard, or very close to the meter, while always being kept out of direct sunlight.

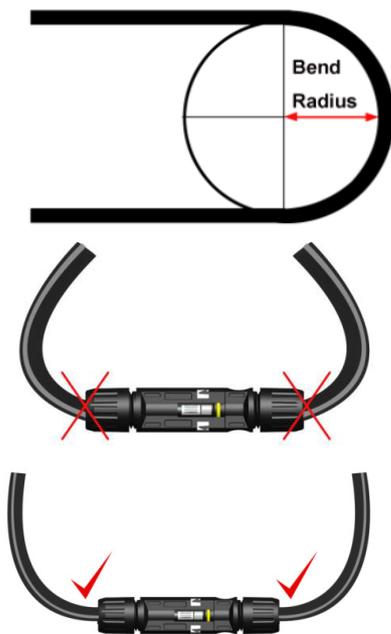
Modifications to the aforementioned system must be carried out under the supervision of the project manager.

6.4.3 Cables and Connectors

To prevent overheating of cables and connectors, the choice of the cross section of the cables and the capacity of the connectors must be contingent upon the maximum short circuit current of the system. The recommended cable to ensure complete safety is a photovoltaic cable with a cross section of 4 sq. mm.

Tejas Borja supplies **SOLAR FLAT-5XL ceramic roof tiles** with connectors used for electrical connections in the system. The recommended connectors are Multi-Contact MC4 or equivalent. To correctly connect the Multi-Contact MC4 connectors, they must be pushed together until you hear a click.

The cable bend radius must be at least six times the exterior diameter of the cable.



All the cabling in the installation must be appropriate for photovoltaic installations in accordance with current regulations.

To make connections in parallel, Multi-Contact MC4 connectors or equivalents must be used, whether you are using string connectors or Y connectors.



Example of a string connector



Example of a Y connector

6.4.4 Obligatory safety features (*)

Fuses - Protection against reverse current. A string fuse must be installed between the inverter and **SOLAR FLAT-5XL ceramic roof tiles**.

Thermal magnetic circuit breaker - Protection against short circuits and overloads in the system. It must be installed between the inverter and the property's electrical system.

Residual current device (RCD) - Protection against contact with live parts of the installation or leakage due to lack of insulation. It must be installed between the inverter and the property's electrical installation.

* According to current regulations in Spain. Please consult local regulations for each project.

6.4.5 Optimizers

Due to the characteristics of the **SOLAR FLAT-5XL ceramic roof tiles**, the use of optimizers in their installation is unnecessary.

6.4.6 Seccionadores CC

Should it be necessary, the type and specifications of the DC isolator switch breaker will be determined, along with its location in the specified string.

In the event an isolator switch breaker is used, check that the voltage and the current of the isolator switch breaker meet the requirements of the installation. You must ensure that the isolator switch breaker is correctly located and labelled.

6.4.7 Batería

In the case of an autonomous installation with a storage system, batteries must be correctly connected to each other and to the property's electrical circuit through a regulator or an inverter/charger.

These batteries must also be large enough to supply sufficient electricity to the property for the desired number of days the property needs to be powered by the electricity stored in the batteries in the event of adverse weather events which impede the proper operating of the **SOLAR FLAT-5XL ceramic roof tile** array.

6.4.8 Inverter/charger

If the installation includes a storage system, the inverter may be replaced by an inverter/charger which combines the functions of the inverter and a regulator in one single device.

6.4.9 Meter

It is possible to install a meter to precisely measure the electricity generated or supplied to the grid at a certain point in the installation through the **SOLAR FLAT-5XL ceramic roof tile** array.

6.4.10 Load regulator

If the installation includes a storage system which uses a conventional inverter, a load regulator must be installed between the **SOLAR FLAT-5XL ceramic roof tile** array and the inverter. This

6.5 Installation requirements

The structure to which **SOLAR FLAT-5XL ceramic roof tiles** are attached must be made from a durable material which is resistant to corrosion, ultraviolet rays and adverse weather conditions.

All the components and materials used in the installation must be made from durable materials which are resistant to corrosion, ultraviolet rays and adverse weather conditions.

In areas which experience heavy snowfalls, take into account the slope of the roof where the photovoltaic system is to be located to prevent the lower edge of the **SOLAR FLAT-5XL ceramic roof tiles** getting covered in snow at any time. Moreover, make sure that the lowest part of the tiles is high enough so as not to be shaded by nearby plants or trees or damaged by sand carried by the wind.

SOLAR FLAT-5XL ceramic roof tiles are to be installed on sloping roofs together with FLAT-5XL ceramic tiles and their complementary special ceramic pieces. When installing **SOLAR FLAT-5XL ceramic roof tiles** on the roof, always leave a safe working area between the edge of the roof and the outer edge of the solar array.

Never place **SOLAR FLAT-5XL ceramic roof tiles** in the first row of tiles at the eaves, in the rows next to the gables, in the rows of tiles below the ridge or next to other joins or singular points in the roof. It is particularly important not to install **SOLAR FLAT-5XL ceramic roof tiles** near to chimney pieces.

SOLAR FLAT-5XL ceramic roof tiles must be safely attached to the mounting structure. **SOLAR FLAT-5XL ceramic roof tiles** must be attached using 2 self-drilling, rustproof screws.

regulator is the device which connects the batteries to the electrical circuit and controls the charge level of the batteries, thereby guaranteeing their optimal charge and extending the useful life of the batteries.

6.4.11 Electrical switchboard

If the property's electrical switchboard does not have enough space to house the necessary protective components for the photovoltaic generator circuit, a switchboard will have to be installed outside the property which can house the necessary protective components.

6.4.12 Monitoring systems

If the client wishes to monitor all the energy flows, opt for zero injection into the grid or manage charging, an energy management device must be installed in the property's electrical circuit after the electric meter.

SOLAR FLAT-5XL ceramic roof tiles must always be installed on ventilated roofs using a double batten system or equivalent. Make sure there is adequate ventilation under the **SOLAR FLAT-5XL ceramic roof tiles** in accordance with current regulations. In general, we recommend a minimum distance of 45 mm between the roof surface and the solar tile frame.

Always follow the instructions and safety precautions which are included with the solar tiles support structures.

When installing **SOLAR FLAT-5XL ceramic roof tiles** onto a roof, make sure that the construction of the roof is adequate. Moreover, to prevent leaks, any perforation made in the roof support in order to install the solar tiles must be properly sealed.

The accumulation of dust on the surface of the solar tiles may reduce their output. Tejas Borja recommends that **SOLAR FLAT-5XL ceramic roof tiles** are installed at a minimum gradient of 30% to help the rain to wash dust from the tiles and ensure the watertightness of the roof.

Make allowances for the linear thermal expansion of the **SOLAR FLAT-5XL ceramic roof tiles** frames (we recommend leaving a minimum distance of 2 mm between one **SOLAR Flat-10 tile** and another).

Make sure the solar tiles are not subject to wind or snow loads which exceed the maximum approved loads or excessive forces due to the thermal expansion of the support structures.

All **SOLAR FLAT-5XL ceramic roof tiles** must be securely attached so they are able to withstand wind and snow loads lower than the maximum approved loads.

We can advise you on the design and specification of a **SOLAR FLAT-5XL ceramic roof tile installation to meet your needs.** Contact us! solar@tejasborja.com

6.6 Pre-installation preparation and precautions

Install the components described in the manual and follow its instructions. Tejas Borja will not be liable for any damages caused due to an installation which does not comply with the instructions in this manual.

Before beginning the installation, the installers must ensure that the amount of **SOLAR FLAT-5XL ceramic roof tiles** and the cabling are compatible with the installation area and must follow the instructions for the installation of the inverter and other system components in accordance with their respective manuals.

When installing the sloping roof with the **SOLAR FLAT-5XL ceramic roof tile** system, the installation personnel must include a ceramic tile installer and an electrician to install the solar tiles.

SOLAR FLAT-5XL ceramic roof tiles are installed in the same way as FLAT-5XL ceramic tiles, the former having been designed to combine perfectly with the latter. Due to its dimensions, one **SOLAR FLAT-5XL ceramic roof tile** is the same size as 1 FLAT-5XL ceramic tile unit.

Before beginning the installation, we recommend you mark out the area where the solar array will be located. Similarly, we recommend having marked out the location of the other elements which make up the solar installation (inverter, fuses, optimizer, etc.) and checked that the solar tiles operate correctly before installing them.

6.6.1 Accessories and tools for the installation

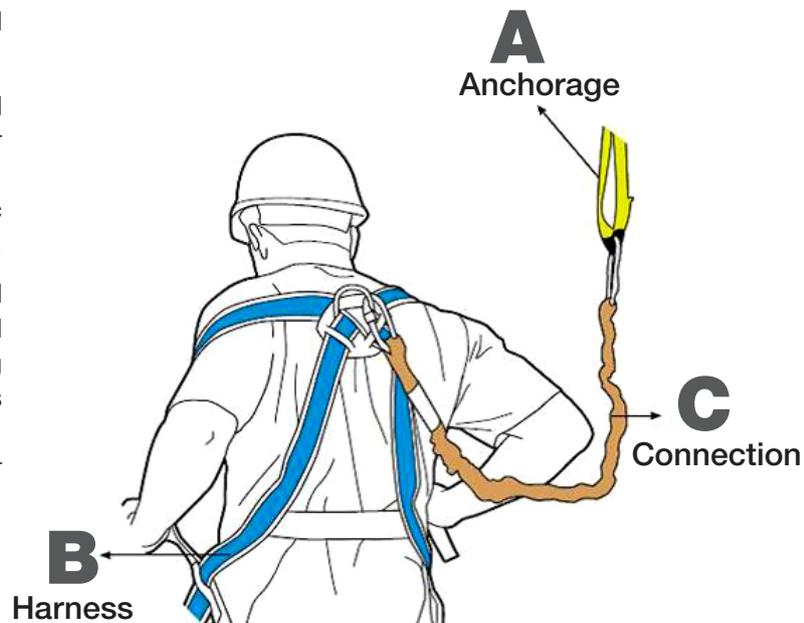
Personal Protective Equipment (PPE):



Slip-resistant footwear



Insulating gloves



Fall protection system for working at height

The type of screw used to fix the **SOLAR FLAT-5XL ceramic roof tiles** in place will depend on the type of batten the tiles are to be fixed to (metal or wood).

Cables to connect the strings in parallel and connectors (see 6.3.4 Cables and connectors).

6.6.2 Batten installation

The roof must be waterproofed before installing both the primary and secondary mounting battens.

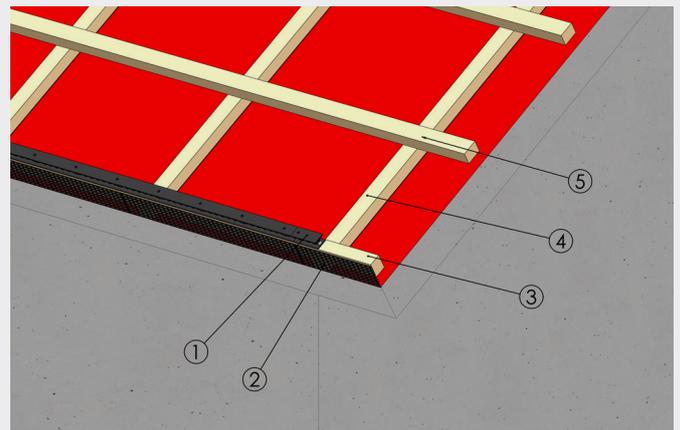
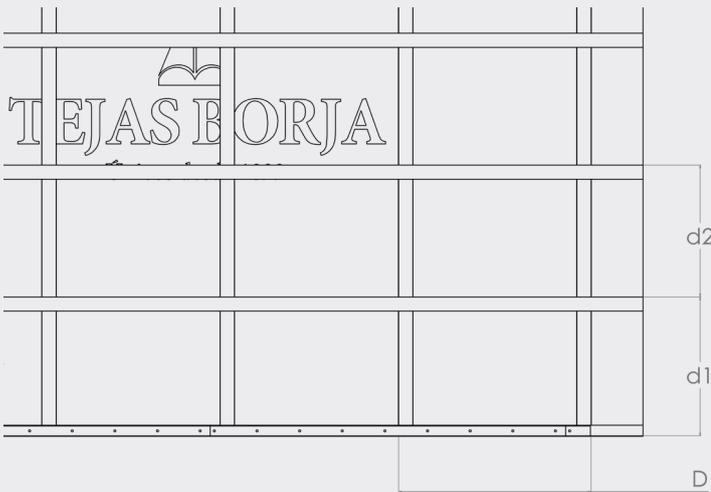
Insulating the roof when installing **SOLAR FLAT-5XL ceramic roof tiles** and completing the roof with FLAT-5XL ceramic tiles and their associated special pieces is not an essential requirement. However, Tejas Borja recommends using the BORJATHERM insulation system to further improve the property or project.

Installers must make sure installations comply with national and/or local regulations to ensure the compatibility of the mounting battens with the dimensions of the **SOLAR FLAT-5XL ceramic roof tile**. If using wooden battens, these must be at least 40 mm (width) x 30 mm (depth). Primary and secondary battens must be used to create an air chamber under the tiles and enable the routing of cables underneath them.

The **SOLAR FLAT-5XL ceramic roof tile** is completely compatible with the FLAT-5XL ceramic tile. Consequently, the distance between two horizontal battens is variable, using the same spacing as that for the ceramic tile (from 340 to 370 mm; a spacing from 355 mm upward is recommended).

The primary battens are installed in the direction of the slope. The recommended spacing between primary battens is from 400 to 600 mm. For other configurations, please consult the Tejas Borja Technical Department. When the roof support structure is protected by a waterproof/breathable membrane, the underside of the battens must be protected with under-batten tape, installed before the primary battens are fixed in place, to prevent water seeping through the screw holes.

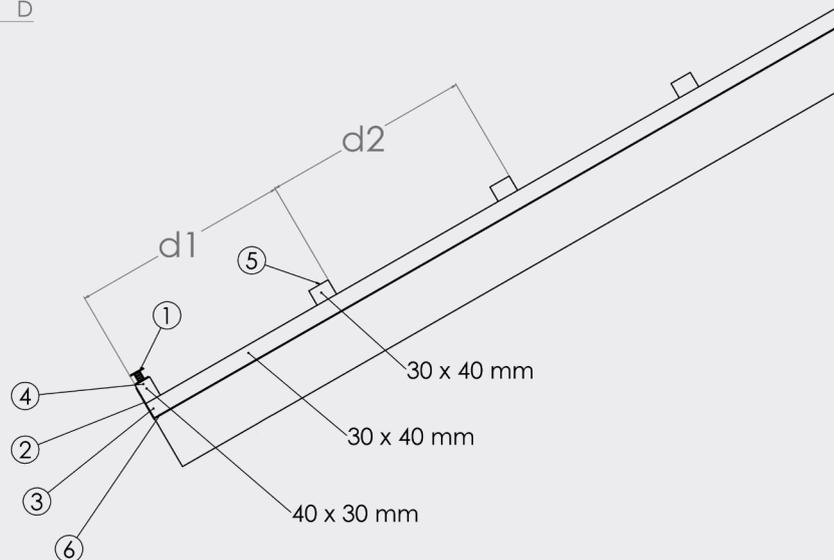
The first batten at the eaves must be at least 2 cm higher than the rest to preserve the slope on the first row of tiles. To achieve this, an eaves batten which is thicker than the rest may be used and/or an additional batten may be added.



Key:

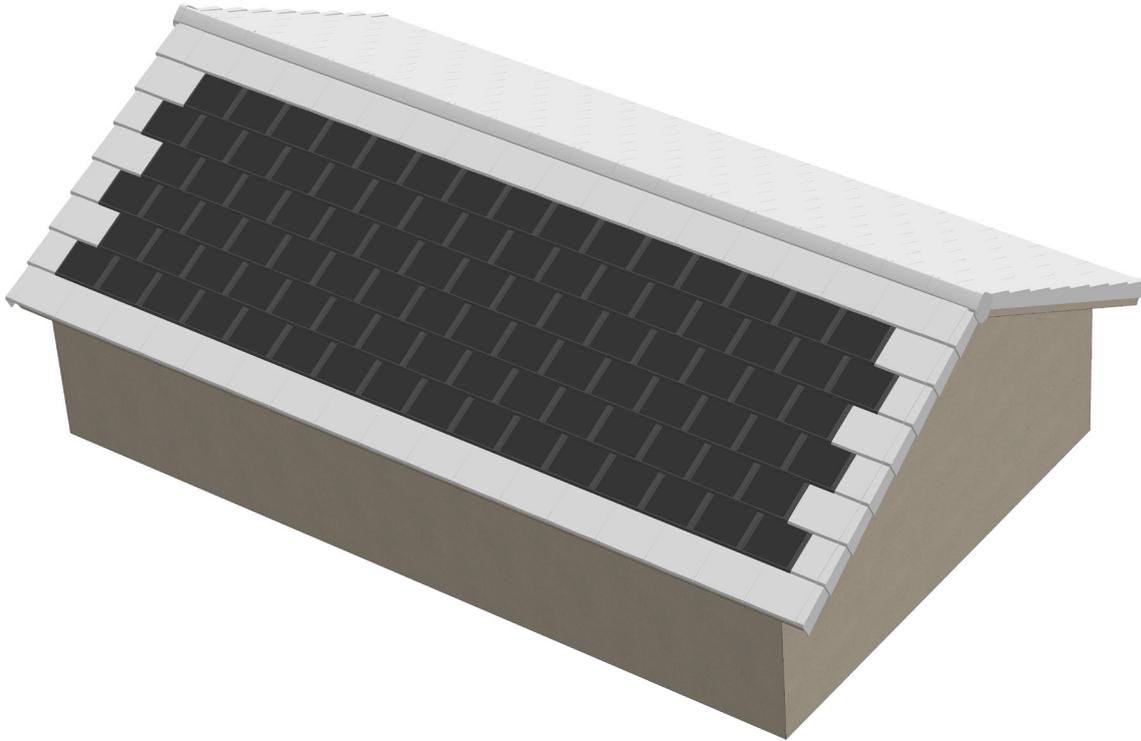
- D - distance between primary battens (400-600 mm)
- d1 - distance to first secondary batten (ensure tile overlap) (345-360 mm)
- d2 - distance to secondary batten (355-370 mm)

- 1 - additional eaves batten
- 2 - eaves grate
- 3 - secondary eaves batten
- 4 - primary batten
- 5 - secondary batten
- 6 - under-batten tape



Air is allowed to flow in through the lowest part of the roof at the eaves by keeping the space between the roof support and the tiles open. Eaves grates and/or combs cover the space under the eaves, preventing birds from entering the gap while allowing air to circulate.

The combination of FLAT-5XL ceramic tiles and **SOLAR FLAT-5XL ceramic roof tiles** means that the perimeter of the roof must always be completed using FLAT-5XL ceramic tiles and their complementary accessories.



6.7 Installation instructions

The installation will always be made on a double batten system or similar to enable ventilation and the cabling for the photovoltaic system to be laid beneath the tiles.

Take into account that the perfect architectural integration of the **SOLAR FLAT-5XL ceramic roof tile** into sloping roofs is completed through the use of FLAT-5XL ceramic tiles and their complementary special pieces. **FLAT-5XL model tiles** must always be installed from right to left.

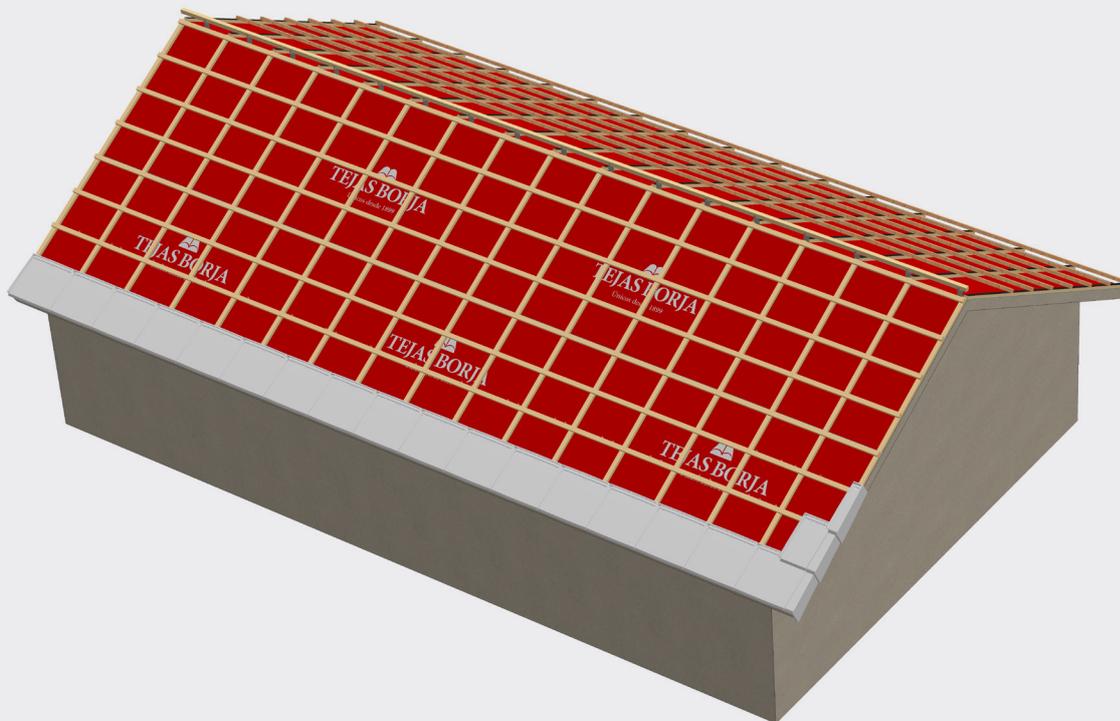
The installation of the roof must always begin with the installation of **FLAT-5XL ceramic tiles** along the eaves. Always use **FLAT-5XL ceramic tiles** in the eaves course, in rows next to side walls and along the ridge.

The ceramic pieces which make up the perimeter of the roof must always be fixed to the support structure mechanically, using screws. Never use mortar in roofs with solar energy systems. In the case of the **FLAT-5XL ceramic tiles** which are used for the eaves course, in addition to mechanical fixings we also recommend you secure the front part of the tiles using adhesive or hooks so the tiles at the eaves do not lift up in the event of high winds.

We recommend the installation of ceramic edge pieces at the sides of the roof. The installation of roofs using **FLAT-5XL ceramic tiles** must start at the right side with a right edge piece. Edge pieces are specifically designed for these points of the roof and are prepared to be watertight and for fixing to the battens with screws.

All the tiles have two pre-drilled holes to facilitate their fixing to the battens.

Once the area where the solar array is to be installed has been marked out and before the installation of the **SOLAR FLAT-5XL ceramic roof tiles**, install the eaves course using **FLAT-5XL ceramic tiles**, starting at the right side of the roof. Continue by installing the second row of tiles from the right side of the roof using a half **FLAT-5XL tile** first and then whole **FLAT-5XL ceramic tiles** until reaching the area marked out for the solar array. The installation of the half **FLAT-5XL tile** at the start of the second row ensures the recommended staggered pattern is created, which should be continued by using a half **FLAT-5XL tile** at the start of alternate rows.



Installing SOLAR FLAT-5XL ceramic roof tiles

Appropriate screws, depending on the type of batten, must be used to attach **SOLAR FLAT-5XL ceramic roof tiles**. Each piece must be fixed in place using the five holes provided for its installation.

During their installation, the circuit voltage in each string of **SOLAR FLAT-5XL ceramic roof tiles** must be checked.

We advise that the installation of each **SOLAR FLAT-5XL ceramic roof tile** is done in such a way as to facilitate electrical checks.

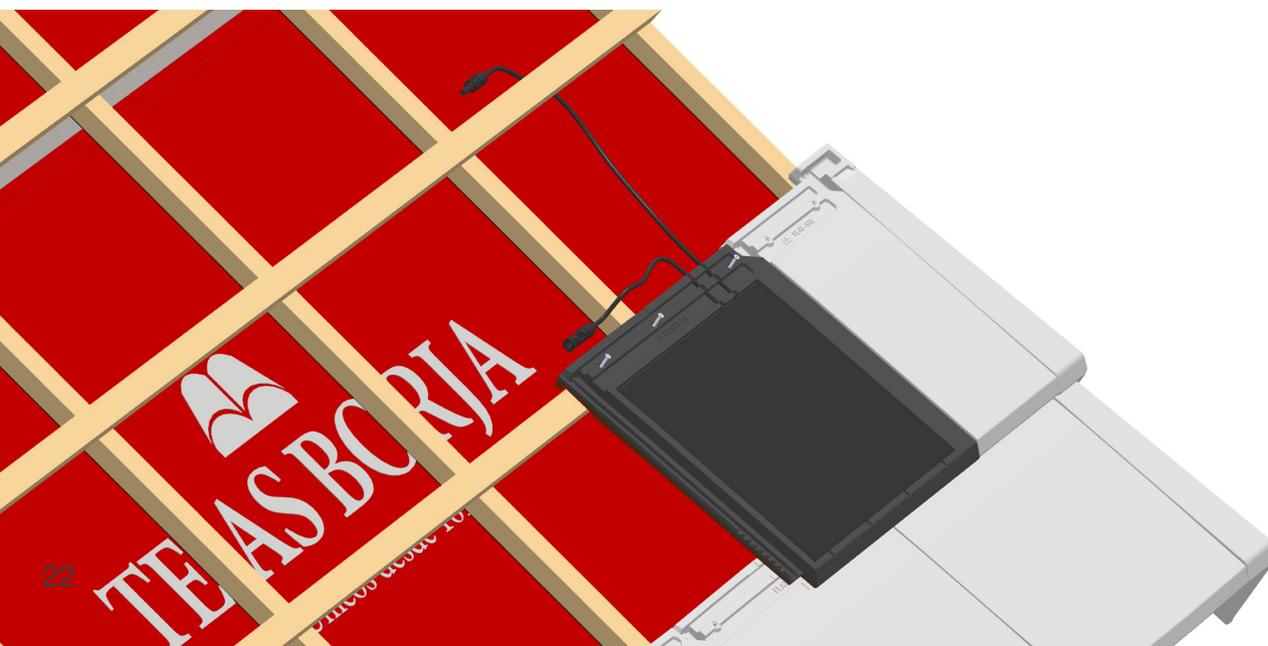
Note: the diagram in this manual places the connections on the left side of the roof to provide, where necessary, ease of access for possible repairs.

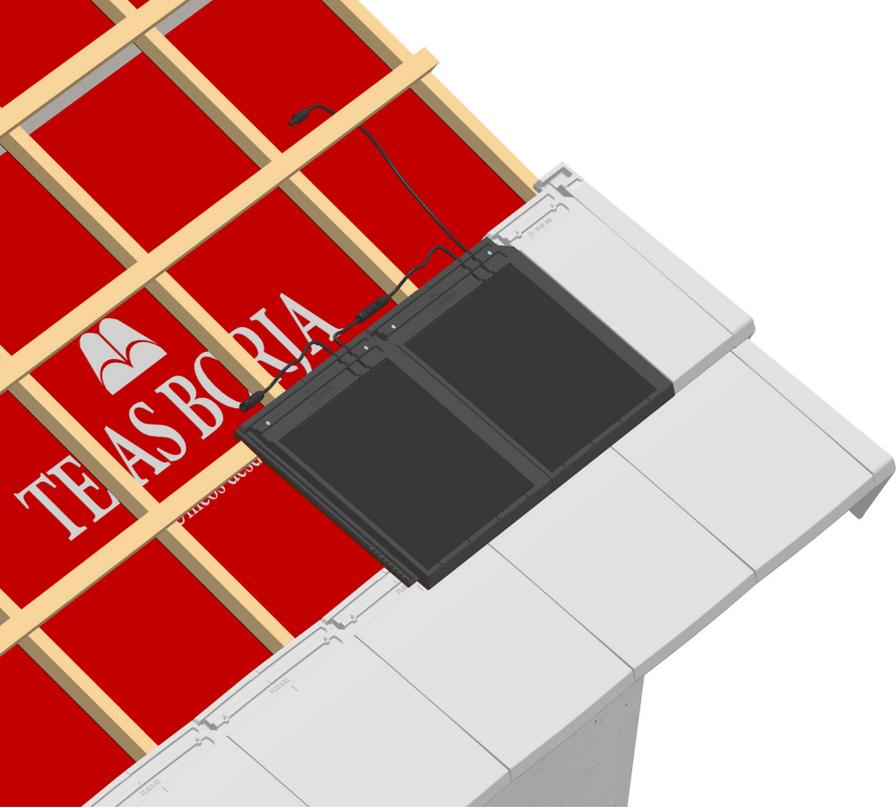
STEP 1

To begin installing the first string of solar tiles, position the first **SOLAR FLAT-5XL ceramic roof tile** overlapping the FLAT-5XL ceramic tile, making sure to keep the connection cables and connectors in sight. Then fix the **SOLAR FLAT-5XL ceramic roof tile** in place using 2 screws (depending on the type of batten).

IMPORTANT: Do not drill the glass or other areas of the **SOLAR FLAT-5XL ceramic roof tile**. Make sure the screws are securely fastened.

It is advisable to use a power drill with torque control to prevent over-fastening the screws.



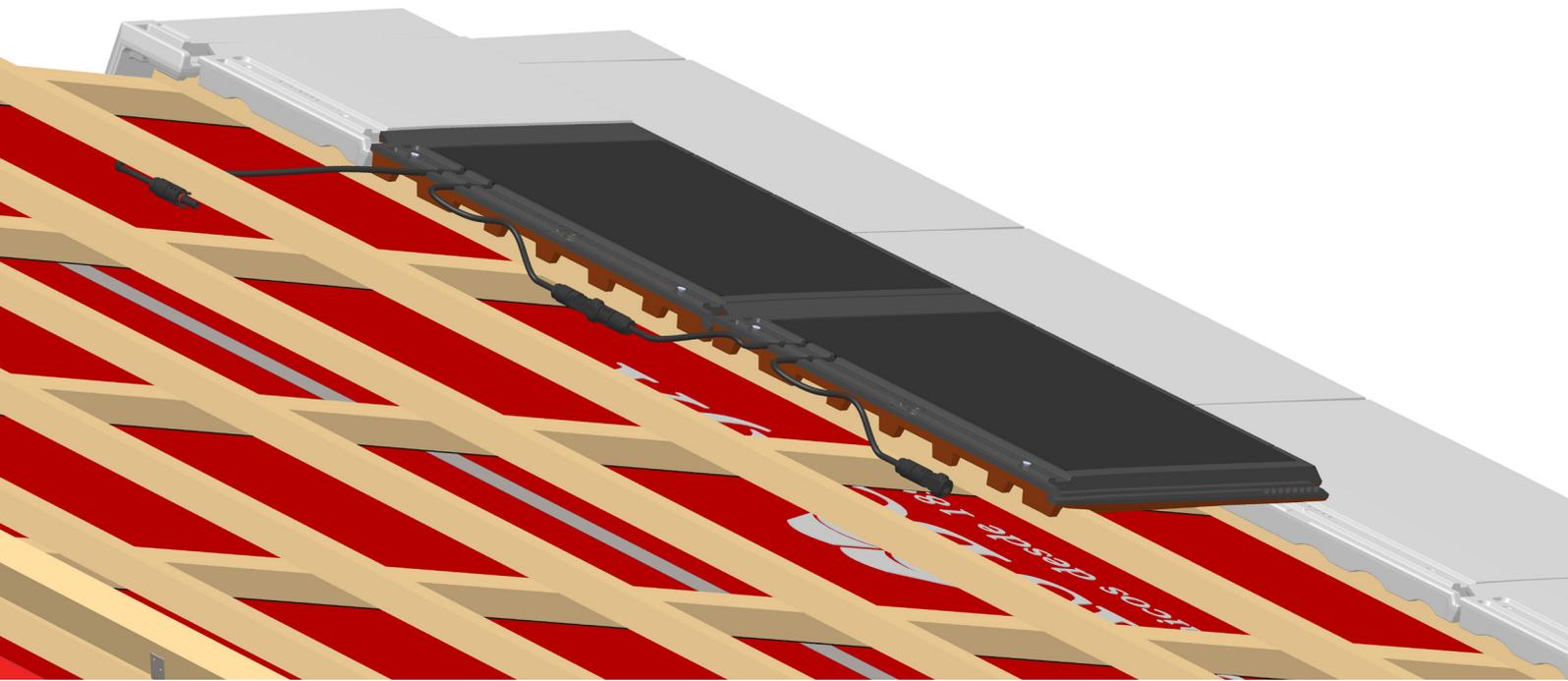


STEP 2

Position the second **SOLAR FLAT-5XL ceramic roof tile** so it overlaps the previous solar tile which has just been installed. Fix the second tile in place using 2 screws, making sure the connection cables and connectors are always kept in view and beneath the secondary batten.

Make the series connection by connecting the first two solar tiles to each other: the negative terminal of the first **SOLAR FLAT-5XL ceramic roof tile** to the positive terminal of the second.

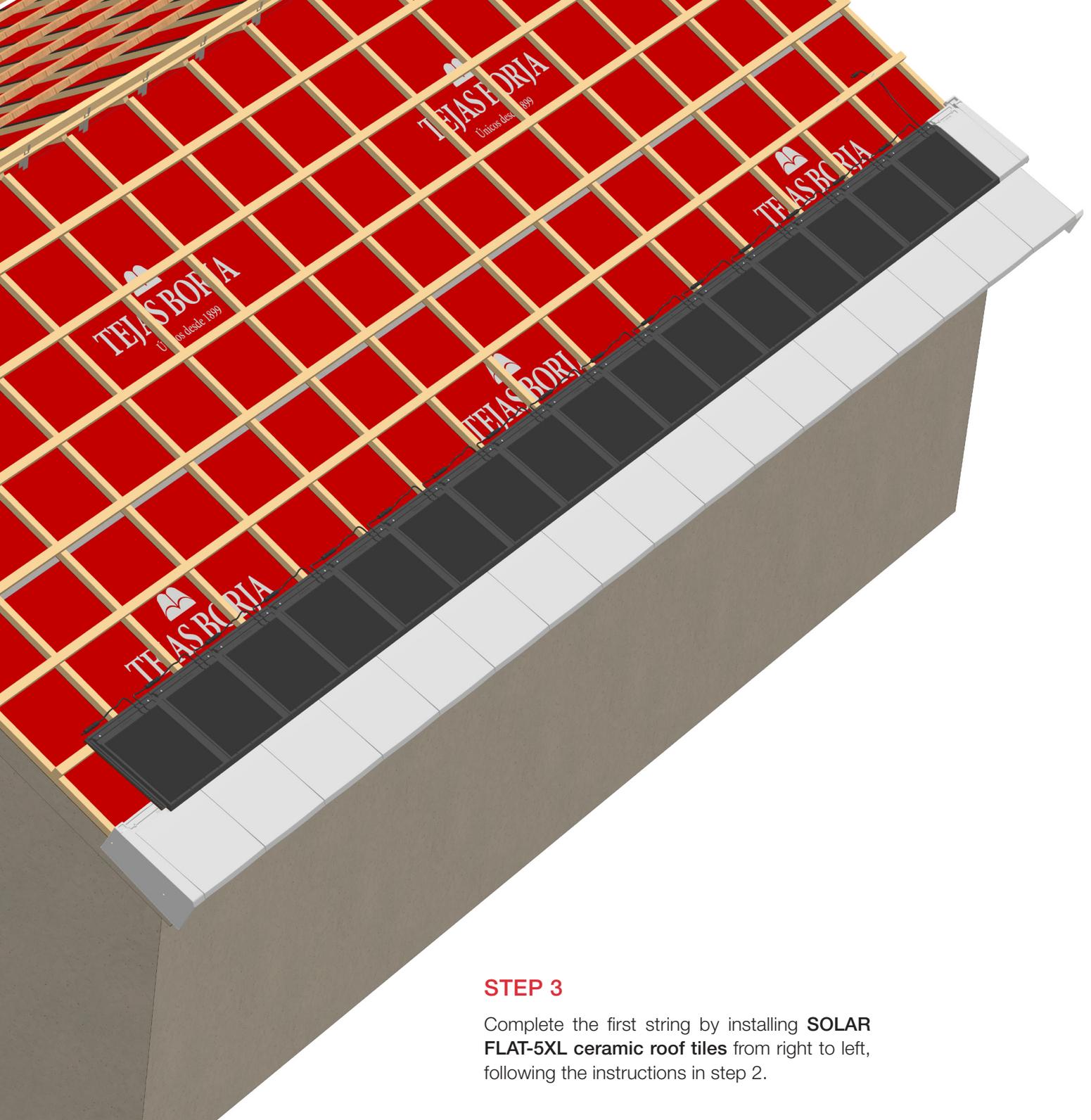
The positive terminal of the first **SOLAR FLAT-5XL ceramic roof tile** is connected, in this example, to the negative terminal of the tile in the row above to continue the string.



NOTE: When making any connection using MC4 connectors, you will hear a click if you make the connection correctly. Locate the cables behind the solar tile and fix them to the secondary batten using corrosion-resistant clamps in such a way that the connections will never come into contact with the roof supports.



MC4 Connection



STEP 3

Complete the first string by installing **SOLAR FLAT-5XL ceramic roof tiles** from right to left, following the instructions in step 2.

STEP 4

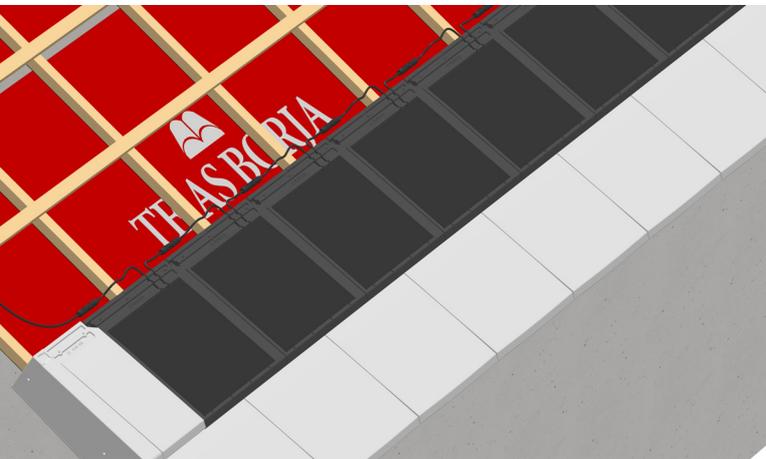
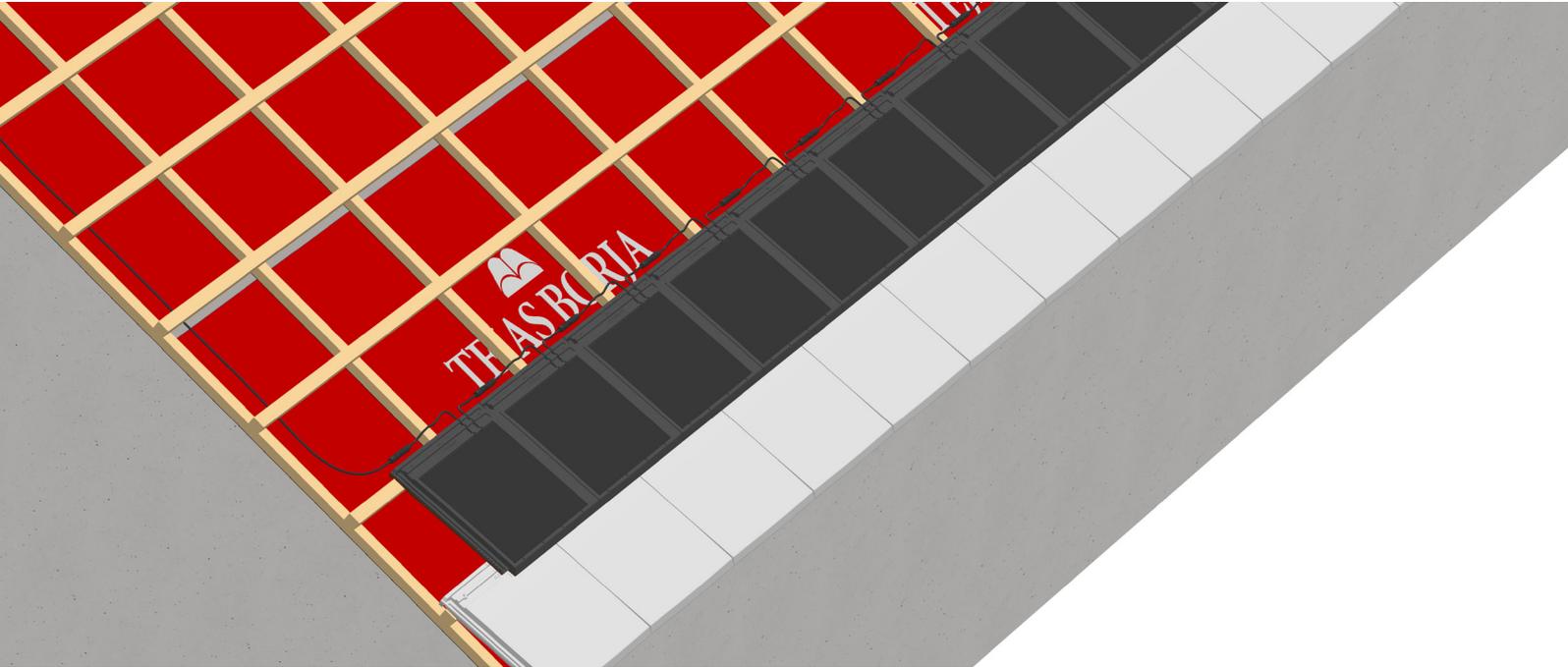
Check that all the connections in the string are correctly connected and that the string voltage is also correct.

Note: A string will not always finish where the row of solar tiles does.

STEP 5

On the left side of the roof, under the secondary batten, position MC4 splitter cables to make the parallel connections between all the strings in the solar array.

The negative terminal of the last solar tile is connected to the corresponding MC4 splitter cable for the parallel connection.



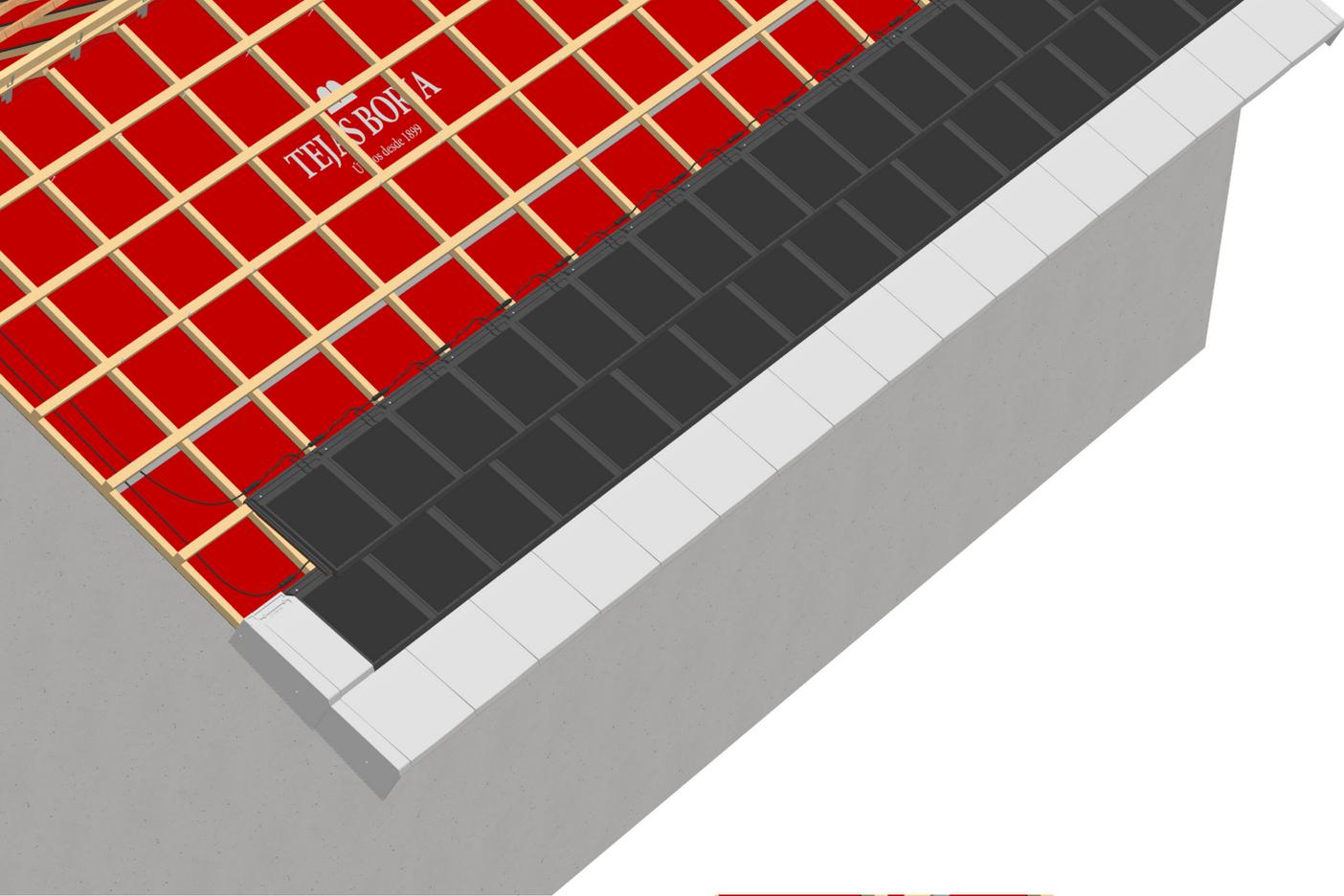
STEP 6

Complete the left side of the roof using a FLAT-5XL ceramic tile and a left FLAT-5XL edge piece. If necessary, to maintain the staggered tile pattern, use a FLAT-5XL half tile.



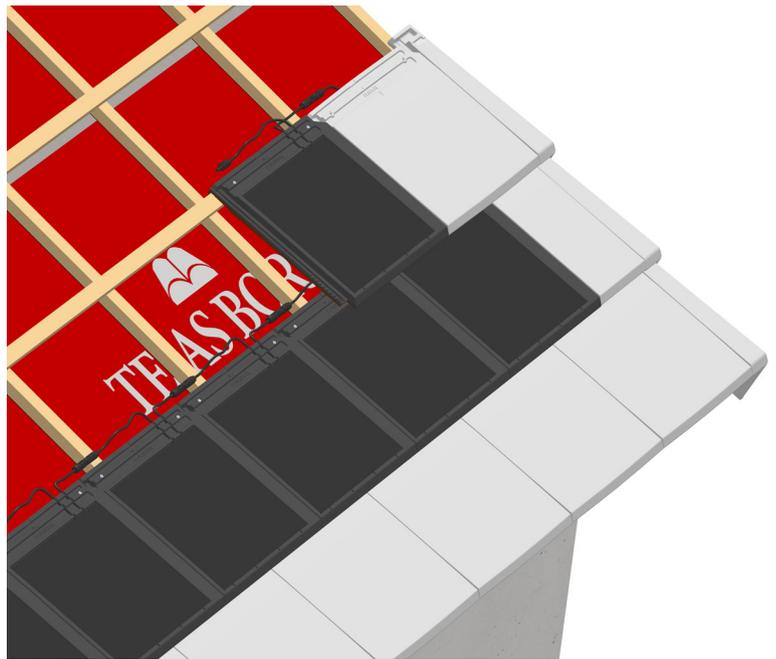
STEP 7

Begin the second row with a right FLAT-5XL edge piece followed by a FLAT-5XL ceramic tile.



STEP 8

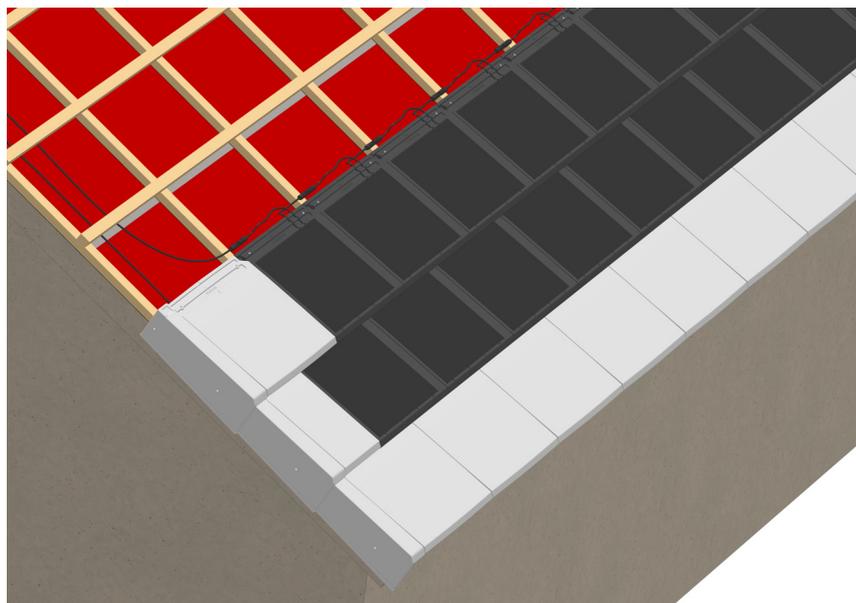
Begin and complete the second row of **FLAT-5XL SOLAR tiles**, completing the fixings and connections in accordance with steps 1, 2, 3, 4, 5 and 6. In this example, a string is made up of two rows of **SOLAR FLAT-5XL tiles**. In this case, the negative terminal of the first solar tile in the second row is connected to the positive terminal of the first tile in the string, which is the first solar tile in the previous row. The positive terminal is connected to the next adjacent solar tile in the same row.



STEP 9

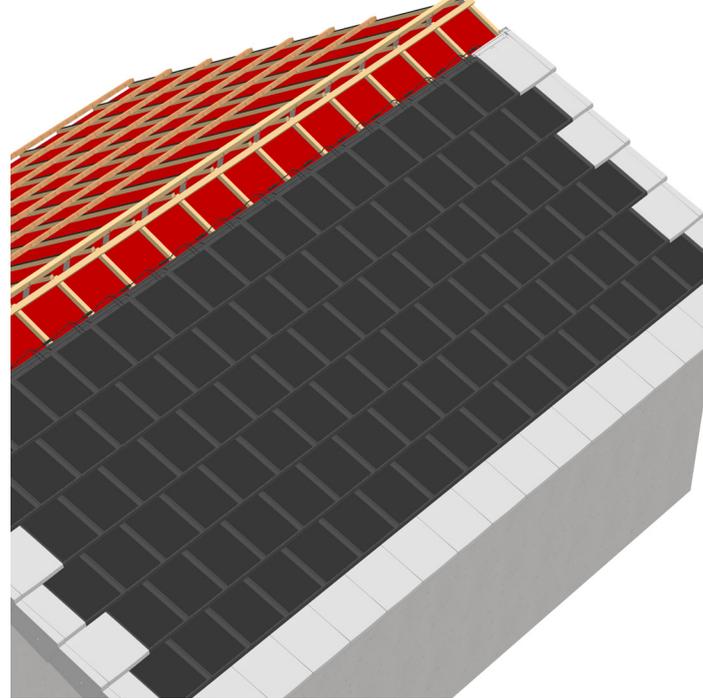
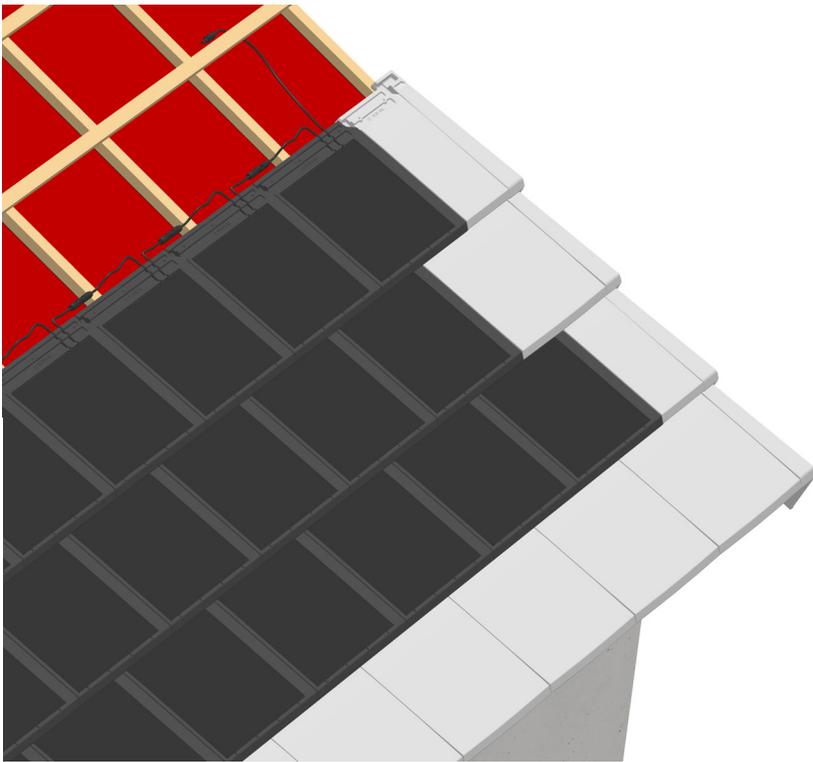
Finish the left side of the roof by installing a FLAT-5XL ceramic tile and left FLAT-5XL edge piece, as detailed in step 6.

The positive terminal of the last tile in the string is connected to the corresponding MC4 splitter cable for the parallel connection, placing the cable underneath the second batten.



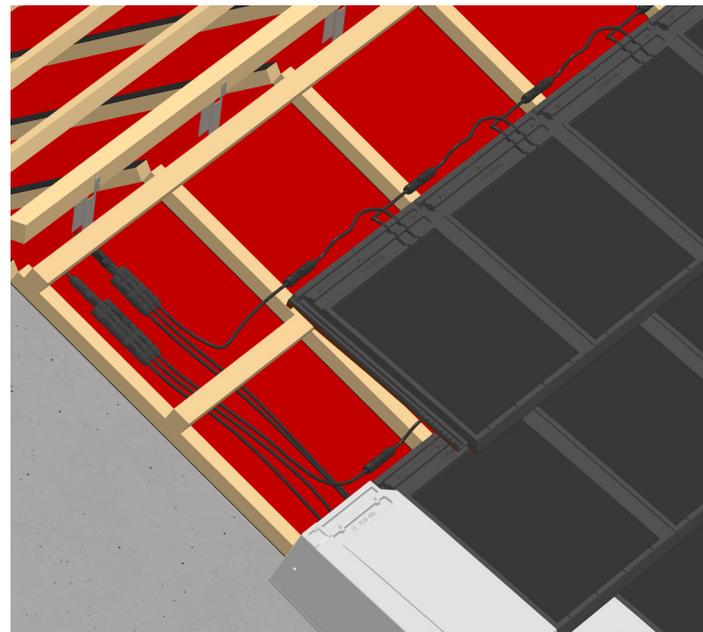
STEP 10

Complete the array with all its component strings, installing a FLAT-5XL half tile in alternate rows. Follow the same installation steps and complete the fixings and connections following steps 1, 2, 3, 4, 5, 6, 7, 8 and 9, finishing on the left side of the roof with a FLAT-5XL tile and edge piece (step 6), installing a FLAT-5XL half tile in alternate rows (step 9).



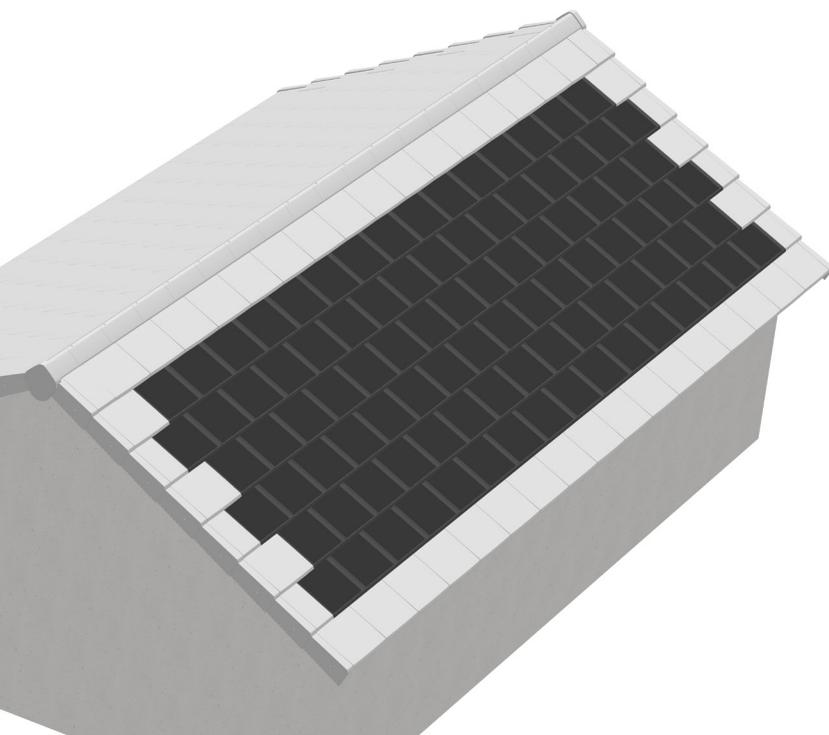
STEP 11

Connect the installation to the inverter and ensure that the connections in parallel are correctly executed.



STEP 12

Finally, complete the roof with the installation of FLAT-5XL ceramic tiles and their complementary special pieces on the left side of the roof.



And finish off the roof with ceramic tiles and pieces.

6.8 Electrical installation

You must use components which are compatible with the mounting structure to prevent galvanic corrosion.

Do not mix other modules or different solar tiles (earth connection, cabling) in the same system.

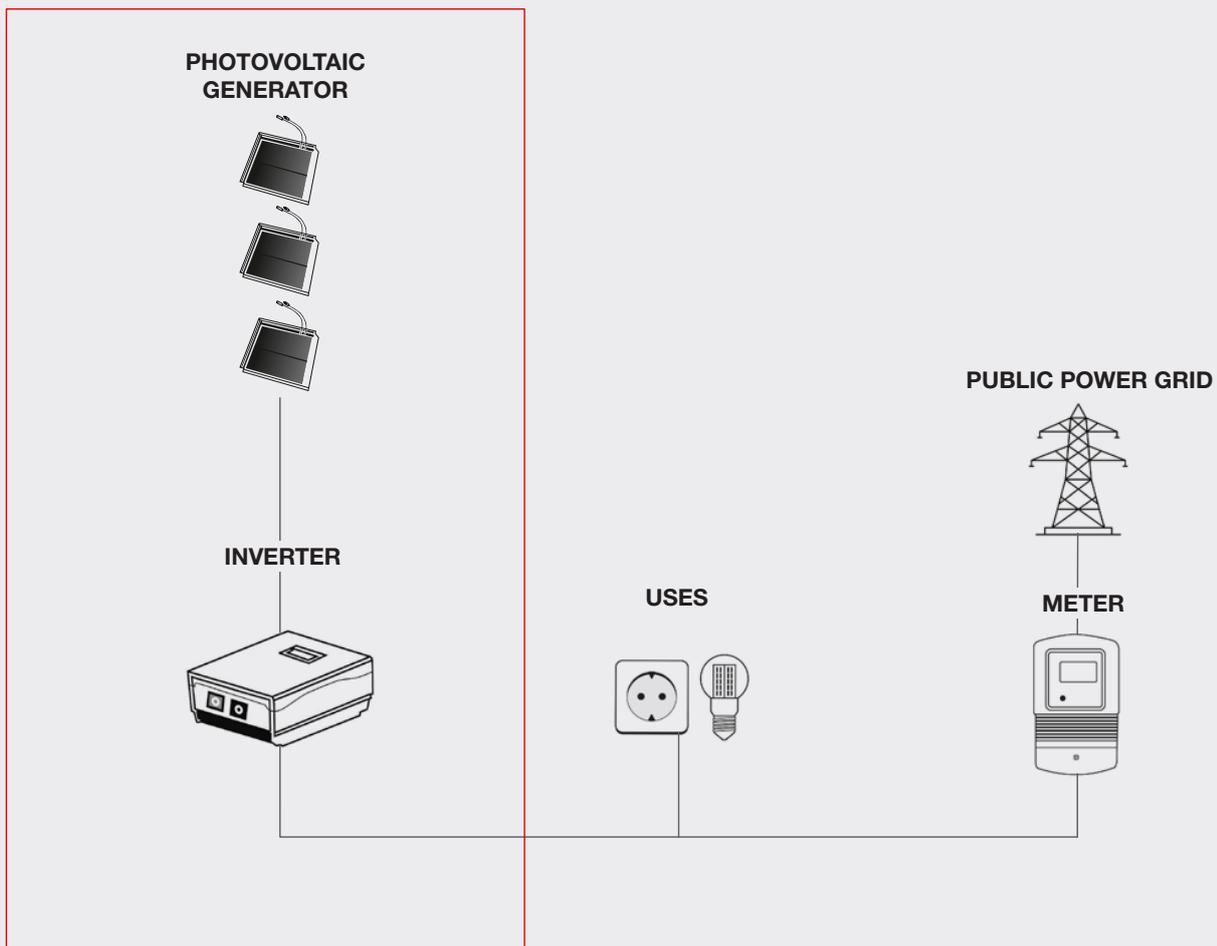
Excess cabling must be organized or fixed in place adequately. For example, fixing cables to the mounting structure using non-metallic cable clamps. Prevent the connectors remaining in contact with the roof supports at all costs.

In the case of applications which require a high operating voltage, various **SOLAR FLAT-5XL ceramic tiles** may be connected in series; the total voltage will be the sum of the voltages across each tile.

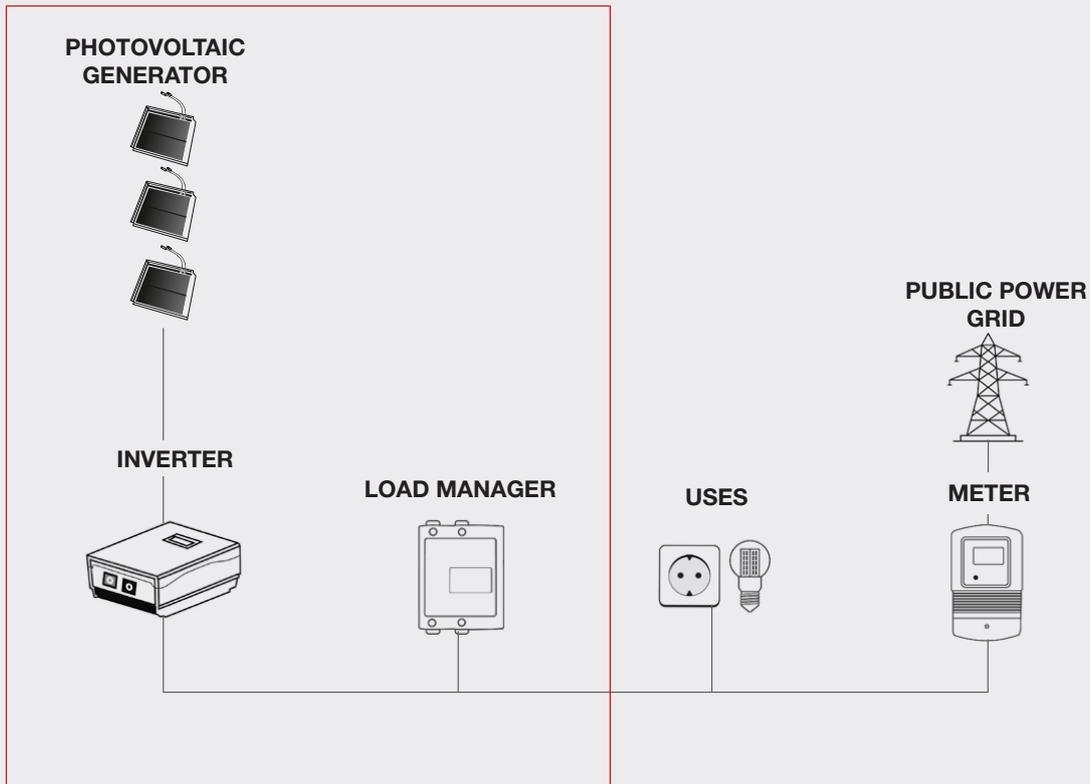
In the case of applications which require high operating currents, various string of tiles may be connected in parallel; the total current will be the sum of the current in each string.

Installations diagram

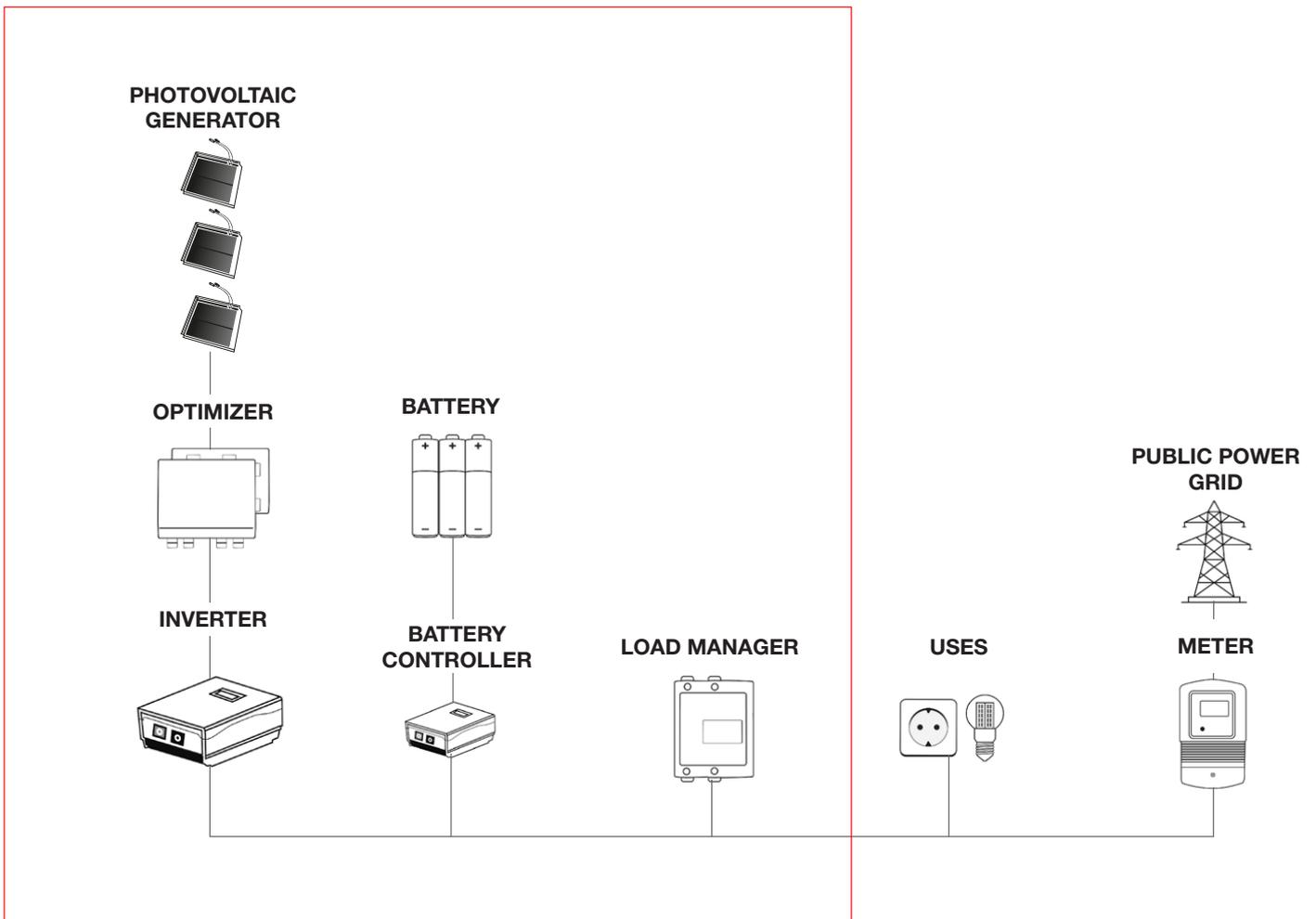
BASIC SYSTEM



RECOMMENDED SYSTEM



EXTENDED SYSTEM



The maximum number of solar tiles which may be connected in series depends on the system design, the type of inverter used and the environmental conditions.

The number of connections in parallel is determined by the system design parameters such as the current or output power.

Long term exposure to wet environments may cause poor connector connectivity, giving rise to current leakage and poor conductivity. Tejas Borja recommends appropriate handling of all cables and connectors to prevent moisture intrusion. Depending on the amount of moisture it is exposed to, Tejas Borja

recommends regular inspections of the installation system to maintain optimum module performance.

The direct current generated by photovoltaic systems, once converted into alternating current, may be fed into the public power grid. The policies of electricity companies regarding the connection of renewable energy systems to their networks varies from one country to another. You must always consult a qualified systems designer or integrator. Normally, work permits, inspections and authorizations from relevant bodies are required.

6.9 Connection to the inverter

For safety reasons, please follow the following instructions and recommendations for the connection of the **SOLAR FLAT-5XL ceramic roof tile** array to the inverter.

The inverter must be located as close as possible to the **SOLAR FLAT-5XL ceramic roof tile** array so the connection cables can be as short as possible.

All the cabling between the solar tiles and the inverter must be secured using clamps or cable clips. Always use corrosion-resistant fixing elements.

The inverter must always be installed in a vertical position. Check local regulations, the technical specifications for the inverter and its installation manual before starting the installation. Always follow the wiring diagram.

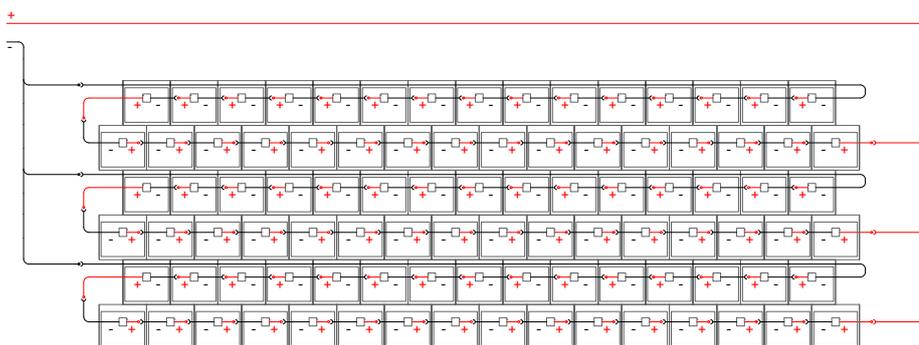
6.10 System wiring diagram

Before beginning the installation, consult the wiring diagram and check the batten layout is suitable to hold the array of **SOLAR FLAT-5XL ceramic roof tiles**, the connections between them and the other elements in the installation.

A solar installation array made using **SOLAR FLAT-5XL ceramic roof tiles** will always be formed by series and parallel connections.

SOLAR FLAT-5XL ceramic roof tiles include individual pre-connected wires to connect one tile to another.

The diagram below shows the recommended cabling for 93 **SOLAR FLAT-5XL ceramic roof tiles** in 3 strings which each contain 31 tiles (the diagram is not to be scaled up).



Wiring diagram for the system with **SOLAR FLAT-5XL ceramic roof tiles**

The recommended installation direction is from right to left for strings, and from below to above for parallel connections. To connect the inverter, use a MC4 cable or equivalent cable of the same length. This cable (bridge) may be used to check that each row of solar tiles is correctly interconnected, once a complete row has been installed and before beginning the installation of the row above.

Notes: All the tile-to-tile connections and connections to the inverter must be completed by connecting a negative terminal to a positive terminal, with all the connectors having been designed for this purpose (male – female).

6.11 Commissioning

Inspect all the cabling and check the mechanical fixings of the cabling and the rest of the elements.

Check that the segmentation of DC and AC in the installation is correct.

If the installation design includes string fuses, check these are installed and working.

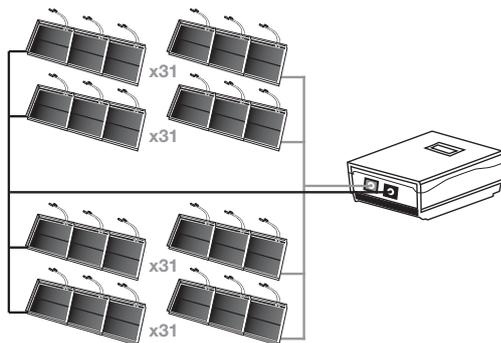
Follow the instructions for installing the inverter contained in the relevant manual.

7 INSTALLATION EXAMPLE

7.1 SOLAR FLAT-5XL ceramic roof tile MONOCRYSTALLINE

For a 3 kW installation with a 3.000 W inverter, 124 SOLAR FLAT-5XL MONOCRYSTALLINE tiles will be required. The optimum configuration features 4 strings in parallel with 31 tiles in each string. The power output of this configuration is 3.001 Wp, producing an annual energy output of 4.685 kWh.

The financial saving is estimated to be up to €18.960 over 20 years compared to alternative annual electricity costs. The installation also reduces the property's carbon footprint by 1.782 kg/year.

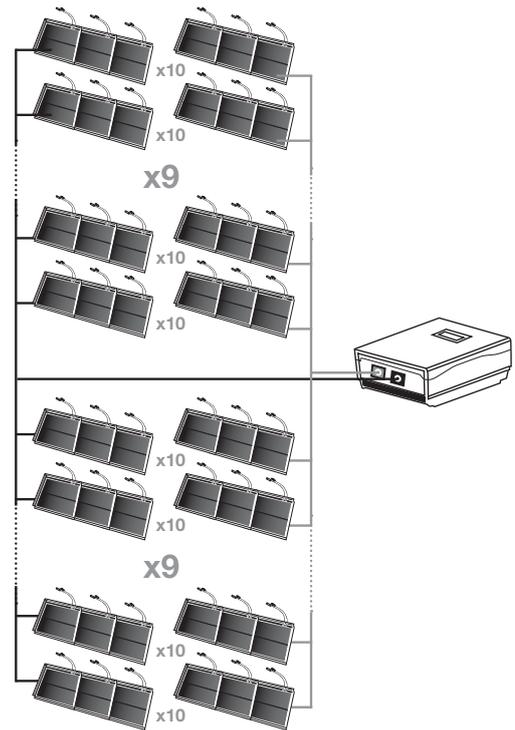


<u>STRING CONFIGURATION</u>	
31 // 31	
+	
31 // 31	

7.2 SOLAR FLAT-5XL ceramic roof tile CIGS

For a 3 kW installation with a 3.000 W inverter, 180 SOLAR FLAT-5XL CIGS tiles will be required. The optimum configuration features 18 strings in parallel with 10 tiles in each string. This power output of this configuration is 3.060 Wp, producing an annual energy output of 4.792 kWh.

The financial saving is estimated to be up to €19.168 over 20 years compared to alternative annual electricity costs. The installation also reduces the property's carbon footprint by 1.801 kg/year.



<u>STRING CONFIGURATION</u>	
10 // 10 // 10 // 10 // 10 // 10 // 10 // 10 // 10	
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**We can advise you on the design and specification of
a SOLAR FLAT-5XL ceramic roof tile installation to meet your needs.
Contact us! solar@tejasborja.com**

8 MAINTENANCE

The manufacturer recommends that any kind of work or maintenance on sloping roofs made using Tejas Borja products be carried out by trained personnel always following the instructions in the relevant manual and current regulations. Always use PPE.

To ensure the optimal performance of the **SOLAR FLAT-5XL ceramic roof tiles**, Tejas Borja recommends the following maintenance measures:

An annual service is recommended. Clean the glass surface of the solar tiles. When cleaning, always use clean water and a sponge or non-abrasive cloth.

Carry out a visual inspection of the **SOLAR FLAT-5XL ceramic roof tiles** to check for any possible damage and/or defects.

Inspect all the visible cabling and check the mechanical fixings of the cabling. Make repairs where necessary.

Check the inverter is operating correctly and check the error code logs if available.

Check the performance of the registration system and test the voltage. The voltage and current report must be within the parameters of the system design.

If a problem occurs, contact Technical Support.

In the event it is necessary to replace any piece of the installation, the installer must make sure that the new pieces are specified by the manufacturer and their characteristics are the same as those of the original pieces. Non-authorized substitutions may lead to fires, electric discharges or other hazards and the voiding of the warranty.

Warning: maintenance must be carried out by trained personnel, respecting the manufacturer's instructions for each system component (solar tiles, inverters, batteries, etc.).

Compile a maintenance report, including the expected electricity output and the real output. Note any time of inactivity or failures in the system during the maintenance process. The completed report must include the date and must be duly signed.

9 PRECAUTIONS FOR SYSTEM SHUTDOWN

When in operation, the installation has a high voltage and current which may put the lives of those handling it at risk.

To prevent the generation of electricity during removal, **SOLAR FLAT-5XL ceramic roof tiles** must be completely covered with an opaque material.

Removal of the tiles must only be carried out AFTER the system has been turned off. Follow the instruction manuals for each component in the system. Only trained personnel may detach and remove the solar tiles.

10 WARRANTY

The **SOLAR FLAT-5XL ceramic roof tile** has a 10-year warranty.

a) SOLAR FLAT-5XL ceramic roof tile MONOCRYSTALLINE – The first year, output will be above 99% and over 80% for 20 years after the start of the WARRANTY.

b) SOLAR FLAT-5XL ceramic roof tile CIGS – The first year, output will be above 97% and above 80% for 25 years from the start of the WARRANTY.

*Check the terms and conditions of the warranty for the **SOLAR FLAT-5XL ceramic roof tile** on our website.*

11 GLOSSARY

A

Accumulator: An installation component capable of storing electrical energy by converting it into chemical energy. It is made up of several batteries connected in series or parallel.

Air mass: Measurement of the distance light travels through the atmosphere in its path to the surface of the Earth.

Alternating current: In an alternating current (AC) the electrons, from their fixed position in the cable (mean), oscillate from one side of the mean to the other within the same space or amplitude and at a determined frequency (number of oscillations per second)

B

Battery: Batteries or accumulators store excess energy generated by the photovoltaic system so it can be supplied at times when the system is not generating power (for example at night or on cloudy days).

Bypass diode: A device connected in parallel to the modules to divert the flow of current when solar cells are shaded or a cell fails.

C

Cell efficiency: The percentage of solar energy (captured by a solar cell exposed to full sunlight) which is transformed into electrical energy.

Charge regulator: Also called the control unit or charge controller. A component which controls the flow of current towards the battery and from the battery to devices in order to protect the battery from electrical surges and discharges.

Connection to the public power grid: A system generating electricity may be connected to the public power grid.

D

Direct current: Direct current (DC) is generated from a continuous stream of electrons (negatively charged) always travelling in the same direction, from the negative terminal to the positive terminal. As the electrons set off in this direction, the gaps or absence of electrons (positive charged particles) move in the opposite direction, from the positive to the negative terminal.

E

Electric intensity (Current): Electrical magnitude defined as the amount of electricity that passes through a section of conductor cable in one second. It is measured in amperes (A).

Electric tension (Voltage): Difference in electric potential which must exist between connection terminals or between two live points in a system for current to flow through said system. The unit of measurement is the volt (V).

Electrical conductor: Any material capable of conducting an electric current.

Electrical installation: Group of devices and associated circuits for a specific purpose: the production, conversion, transformation, transmission, distribution or use of electrical energy.

Electrical power: The capacity of electrical devices to produce work (the amount of energy consumed per unit time). The unit of measurement is the watt (W) or kilowatt (kW).

Electricity consumption: Number of watt hours (Wh) or kilowatt hours (kWh) used to make an electrical device function for a given time. Depends on the power of the device and the amount of time it is using electricity.

Electricity meter: An instrument which measures the electrical energy consumed. It may be the property of the client or the electricity company. It measures consumption in kWh.

G

Grounding (Earthing): Connection to the ground to use as a backup pathway, providing an alternative route for the current to flow back to the ground in an electrical circuit and arbitrarily as a zero potential point.

I

I-V curve: Current (I) and voltage (V) curves show the I and V characteristics of a particular photovoltaic module, measured under specific radiation conditions. Essential information to characterize photovoltaic modules.

J

Junction box: A box integrated into the solar tile which houses the cables used for electrical connections.

K

Kilowatt (kW): A thousand watts (1 kW = 1.000 W)

L

Load: Any electrical component that consumes electric power. This will depend on each system and varies during the day in accordance with the way in which the system works.

Load controller: A component in the photovoltaic system which regulates battery charging.

M

Maximum power current: Current corresponding to the maximum power point.

Maximum power point: Point on the I-V curve where the product of I x V (power) has its maximum value (the top of the curve).

Maximum power voltage: Voltage corresponding to the maximum power point.

Module or solar photovoltaic module: A group of interconnected solar cells within a sealed unit.

N

Nominal power: Power according to the specifications or nameplate of a generating unit.

O

Open circuit voltage: Voltage measured at the terminals in a photovoltaic system at zero current.

Orientation (Azimuth): Angle of orientation of the surface of a panel in relation to the solar south. The geographical south (or true solar south) should not be confused with the magnetic south, which is shown by a compass, although in Spain the difference between the two is not very significant.

P

Parallel connection: Connection method in which all the positive terminals of a module are connected together at one point in the circuit and all the negative terminals are connected together at another point. If the modules in the circuit are all the same, the total circuit current is equal to the sum of the individual module currents. The voltage is equal across all modules in the circuit.

Peak sun hours: Hours in which the solar irradiance reaches an average of 1 kWh/sq. m..

Performance: The relationship between the energy which is really converted into useful energy and that which a certain device needs to function.

Pitch: The angle between the photovoltaic panel and a perfectly horizontal or level surface.

S

Series connection (String): Connection method in which the positive terminal of a module is connected to the negative terminal of the next module and so on. If the modules are all the same, the voltage across the circuit is the sum of the individual voltage drops across each module and the current that flows through the modules is the same.

Short circuit: An unintended connection between two conductors of different phases or a connection between these and a neutral conductor.

Short circuit current: Current which is measured at the terminals of a module when a short circuit occurs.

Solar array: A group of solar photovoltaic modules installed and electrically connected.

Solar cell or photovoltaic cell: A device which converts sunlight (photons) into electricity. It is the fundamental element in solar photovoltaic panels.

Solar radiation: Amount of energy from the sun which reaches a surface in a certain period of time.

Solar Tile : A Tile with photovoltaic properties and characteristics. In addition to generating clean and renewable energy, it is an element which integrates completely into the outer layer of the roof, ensuring the watertightness of the roof and contributing aesthetic value.

Standard test conditions (STC): Conditions under which photovoltaic modules are tested in the laboratory (1 kWh/sq. m. solar radiation, cell temperature at 25°C and solar spectrum corresponding to an air mass of 1,5).

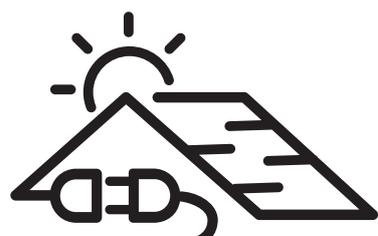
String: See Series connection.

Switch: Device used to connect or disconnect part of an electrical installation.

W

Wp (Watt peak): Unit of measurement for a solar photovoltaic module which denotes the maximum power the module can generate under standard operating conditions (1.000 W/sq. m., 25°C and air mass of 1,5).





Roof & Plug

TEJAS BORJA, S.A.U.

Ctra. Lliria a Pedralba, Km. 3
46160 Lliria, Valencia, SPAIN
T.+34 96 279 80 16
F. +34 96 278 25 63
info@tejasborja.com

tejasborja.com