RAULI

# INSTALLATION INSTRUCTION

## RAULI ALL BLACK

Solar panel mounting system for tilted roofs

# CONTENT

## 1. INSTALLATION

The solar panels are installed as shown in Figure 1 in either a vertical or horizontal position. However, the mounting rails are always mounted on the roof sideways, parallel to the roof ridge. The space required for solar panels on the roof depends largely on whether the panels are installed in a vertical or horizontal position. Always wear appropriate protective equipment during installation.

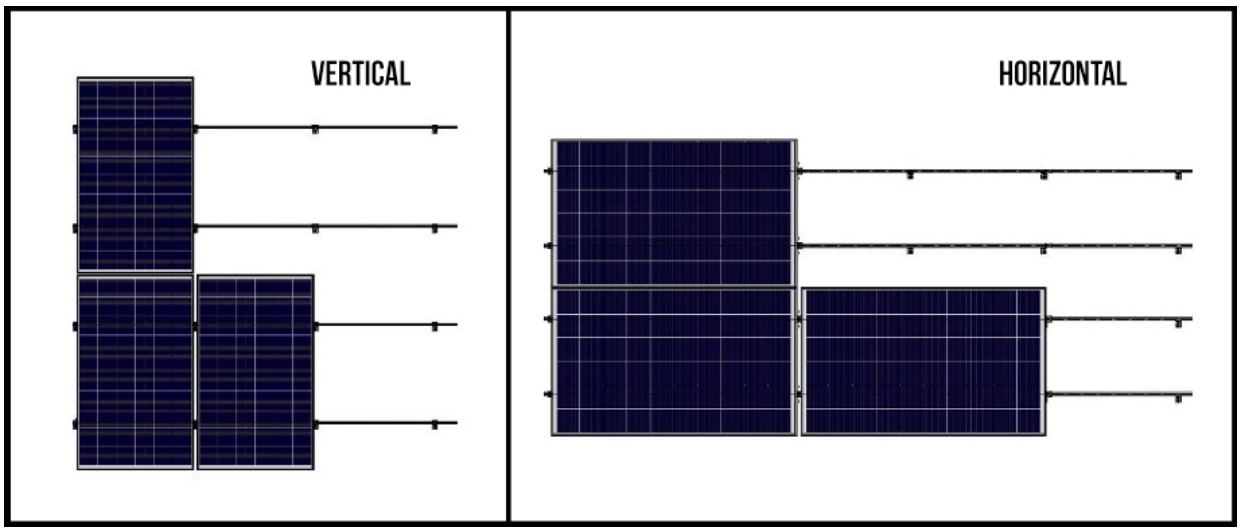



*Figure 1*

## 2. DESIGN

The design of the space must take into account possible shading elements such as chimneys, ventilation ducts, skylights, snow barriers and walkways. A 60-cell solar panel is usually 991mm wide and 1650mm high, but there may be a few millimeters of difference in the dimensions of different panel types. An intermediate fastening clip with a width of 30 mm is installed between the solar panels. In addition, approximately 43 mm of free space should be left at the ends of the mounting rails for the end fastening clips.

The space required for solar panels is calculated using Equation (1) for vertical installation and Equation (2) for horizontal installation.

$$L = 2 \times 43mm + (N \times 991) + (N - 1) \times 30mm \quad (1)$$

$$L = 2 \times 43mm + (N \times 1650) + (N - 1) \times 30mm \quad (2)$$

where $N$ is the number of solar panels, 991 panel width, and 1650 panel height

These equations are used to calculate in Table 1 the space required for different panel quantities for vertical or horizontal installations.

Table 1.

| Solar panels | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Vertical | 1077 | 2098 | 3119 | 4140 | 5161 | 6182 | 7203 | 8224 | 9245 | 10266 |
| Horizontal | 1736 | 3416 | 5096 | 6776 | 8456 | 10136 | 11816 | 13496 | 15176 | 16856 |

For vertical installations, the distance between the profile rails from the edge of the panel should be as shown in Figure 2. In this case, the panel is installed according to the general instructions of the manufacturers and can withstand a snow load of 5400Pa (550kg / m2) and a wind load of 2400Pa (225kg / m2) (eg Trunsun, JA-Solar). However, always check the permitted installation distances in the panel manufacturer's instructions. According to these instructions, the profile rail should be approximately 413mm from the edge of the panel (1650mm * 0.25 ≈ 413mm ± 50mm). In horizontal installations, the distance between the profile rails on the short side is about 248mm from the edge. (991mm * 0.25 × 248mm ± 20mm). It is recommended that the panels be installed in a vertical position. This results in better snow load resistance and much faster installation.

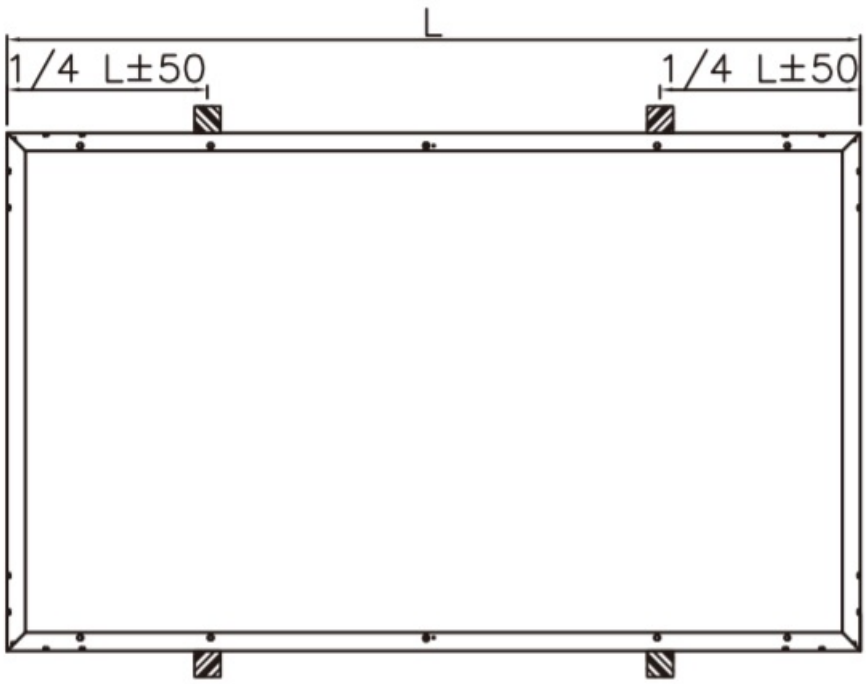



*Figure 2*

The distance between the roof brackets depends on the type of roof, but with a bracket spacing of 800 - 1000 mm, sufficient installation strength is achieved in both vertical and horizontal installations. If the distance between the brackets is more than 1000 mm, an intermediate bracket or bolt connection is used to extend the profiles, if necessary. The brackets are attached directly in line with each other. Solar panels should be placed below the roof ridge. It is advisable to leave at least 200 mm of installation space on the edges of the roof. If the distance of the panels down from the roof ridge is more than 3000mm, we recommend installing a snow barrier above the panel system. The distance to the snow barrier below the panels should be about 500mm as recommended. This way, too much snow is not formed on the panels and snow barriers work as planned. We recommend the use of a grate-shaped snow barrier (eg Nesco - Varma snow barrier) if the distance from the panels to the snow barrier is less than 500 mm.

# 3. SOLAR BRACKETS

The RAULI All Black series has different types of roof brackets. The All In One -universal bracket is suitable for corrugated sheet metal, brick pattern sheet metal, profile sheet metal and felt roofs. With counter parts, the bracket is also suitable for machine and lock seam roofs. The brick bracket fits most corrugated brick roofs. The RAULI Nordic bracket fits to the tile brick. The profile bracket is suitable for square, high-profile sheet metal roofs.

## 3.1 UNIVERSAL BRACKET FOR CORRUGATED SHEET METAL ROOF

The bracket shown in Figure 3 is used as the bracket for corrugated sheet metal roofs. The corrugated roof bracket is attached to the bottom of the corrugated roof profile. The bracket is attached to the ribs with two 7x50 roof bracket screws and sealing rubber rings are placed under the bracket.

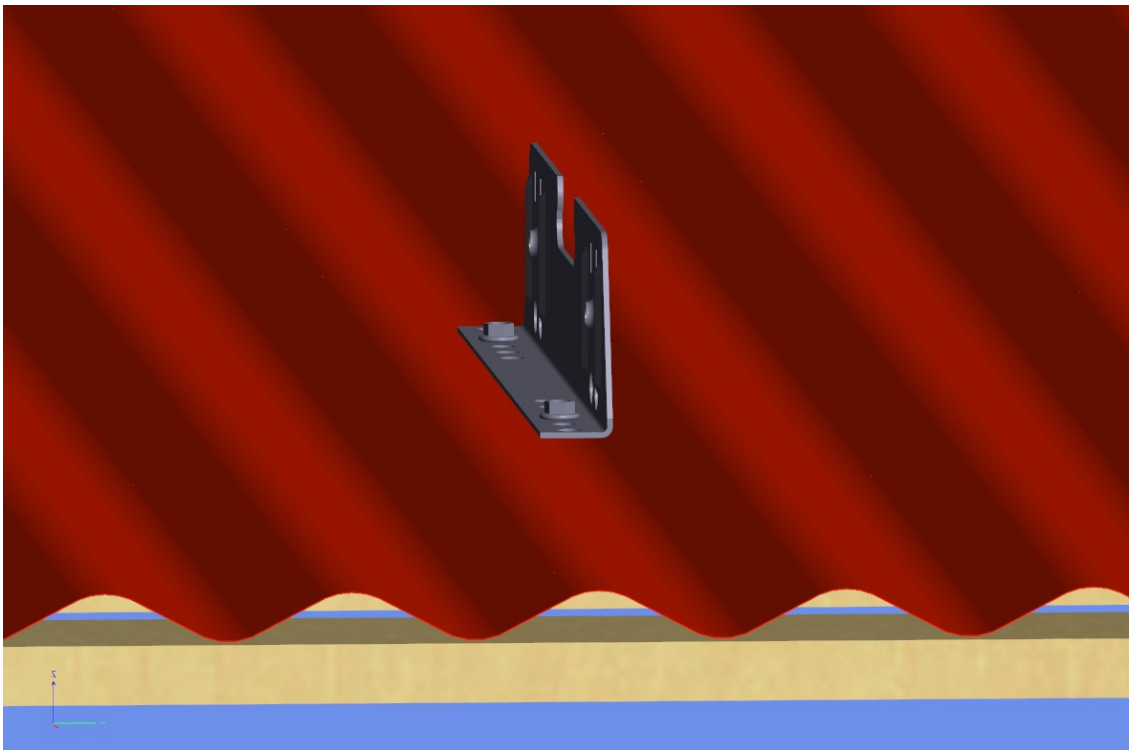


*Figure 3*

The screws are installed as far as possible in the middle of the roof board according to figure 4.

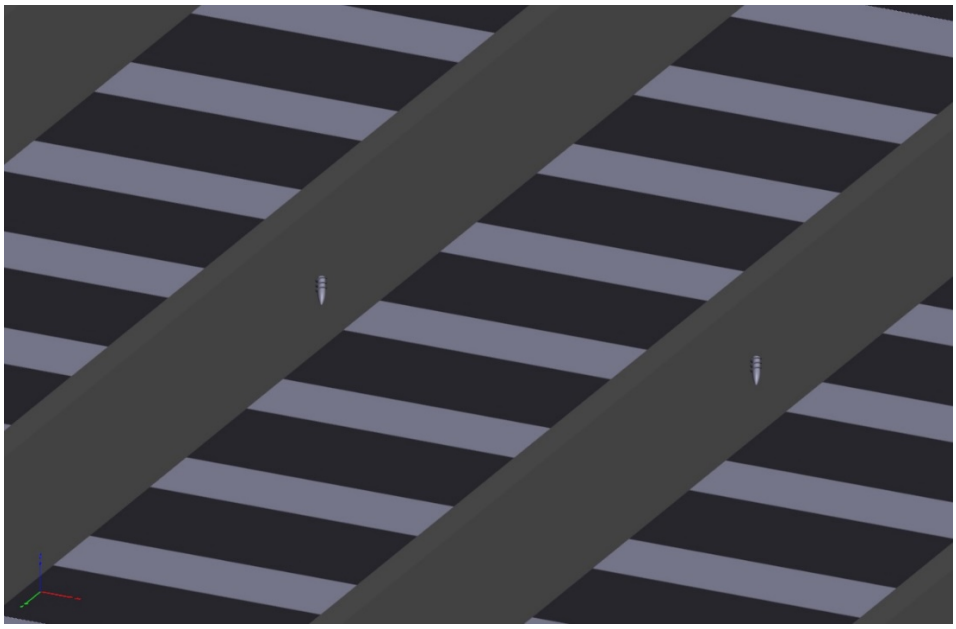


*Figure 4*

### 3.2 UNIVERSAL BRACKET FOR MACHINE AND LOCK SEAM ROOF

The bracket shown in Figure 5 is used for the seamed roofs. It allows a sturdy installation without making holes to the roof. The seam roof bracket is attached to the roof seams as shown in Figures 5 and 6. The roof seam damper may be slightly flexible. Do not overtight the counter parts so that the brackets tooth does not penetrate the roof damper. The bracket fits a maximum seam of 32 mm.

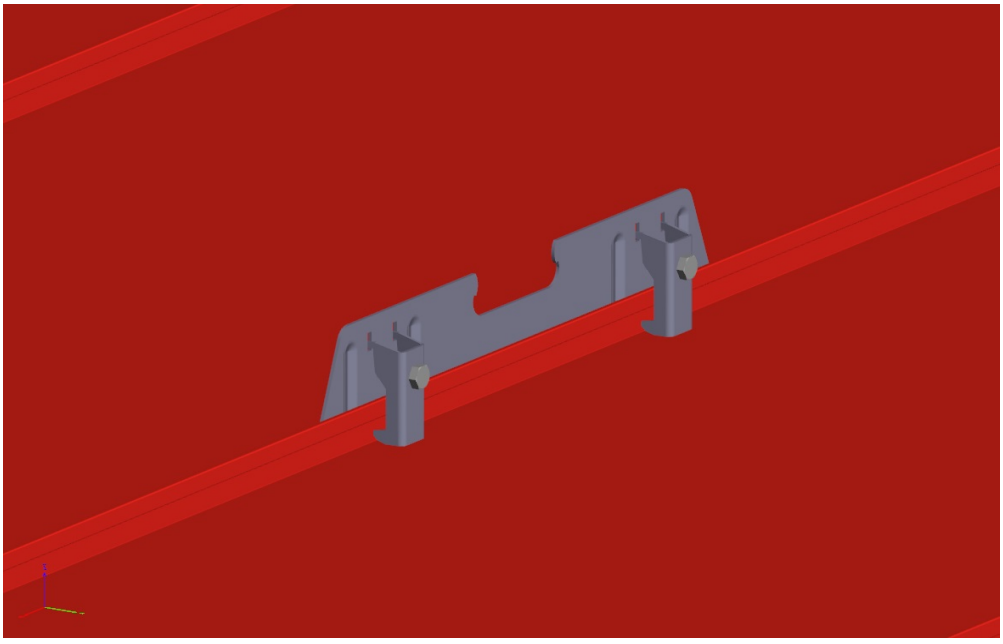


*Figure 5*

The seam roof brackets are installed at the seam points at approximately 1000mm intervals, depending on the seam division. In practice, this dimension is the installation of the bracket on every other seam (Figure 6).

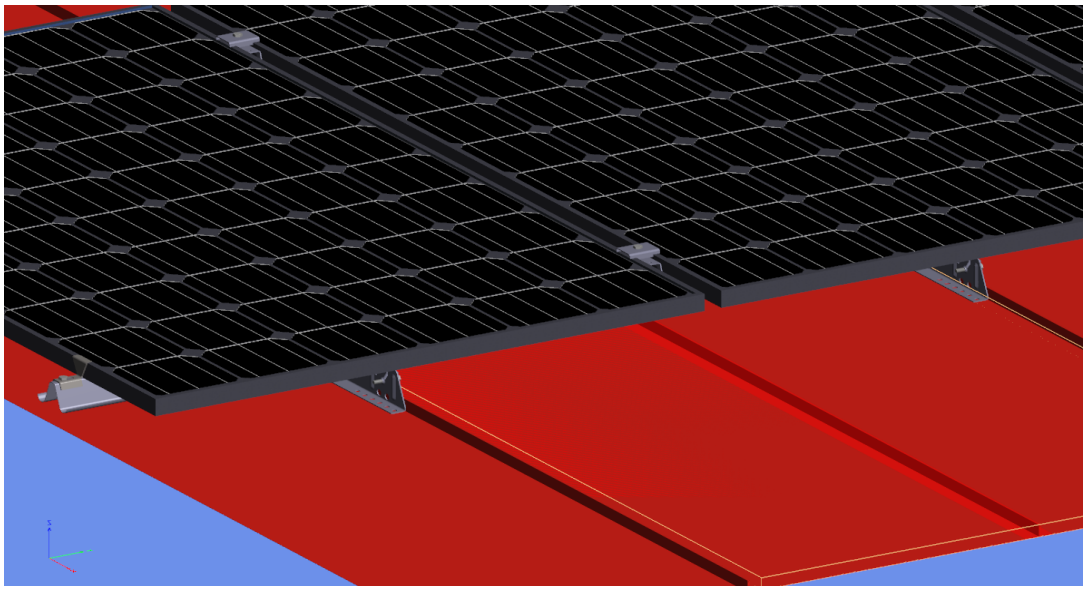


*Figure 6*

### 3.3 GENERAL BRACKET FOR SQUARE PROFILE SHEET METAL

For profile sheet metal roofs, the bracket shown in Fig. 7 is used as the bracket. The bracket is suitable for profile sheets with a maximum height of 45 mm. The bracket comes at the bottom of the profile. Standard 7x50 roof mounting screws are used if the roof has ribs. If the roof is self-supporting (without ribs), it is fastened to the roof with at least four profiled sheet metal roof screws. Do not overtighten the screw so that it does not rotate around the damper. The thread formed in the damper may disappear and the screw will remain loose. Sealing rubber rings are installed between the bracket and the roof at the screws.

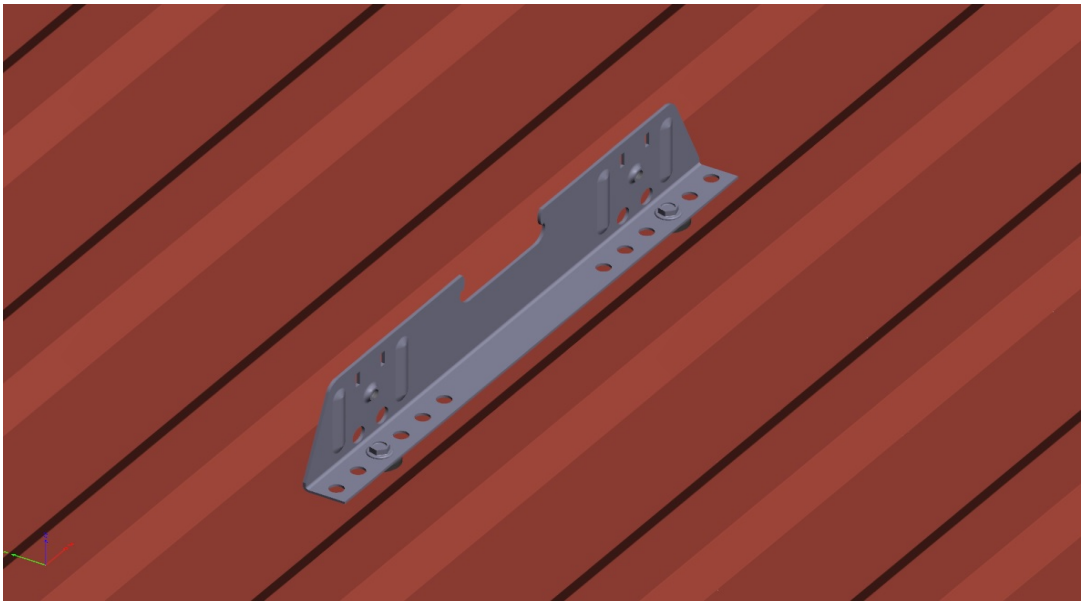


*Figure 7*

### 3.4 GENERAL BRACKET FOR A TILE PATTERN SHEET METAL ROOF

The bracket shown in Figure 8 is used as a bracket for a brick patterned sheet metal roof. The bracket is mounted to the roof with two 7x50 roof bracket screws. An extension ring is also mounted on the lower end of the bracket to raise the bracket to the correct position. There are two dimensions of extension rings, 16 and 21 mm. Of these, 21mm is the more common option. A sealing rubber ring is installed between the bracket and the roof and under the  ring at the screws.

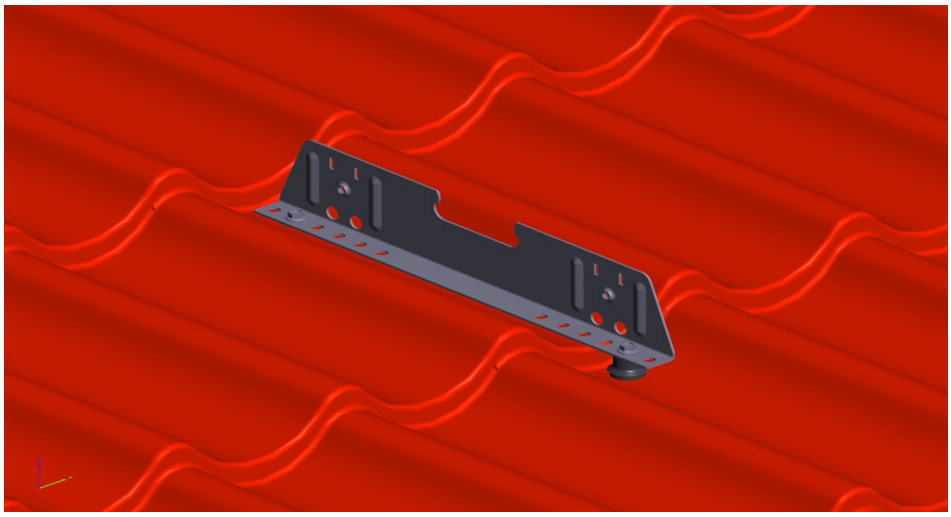


*Figure 8*

### 3.5 UNIVERSAL BRACKET FOR BITUMEN ROOF

For bitumen roofs, the bracket shown in Figure 9 is used. Prior to installation, make sure that the roof structure allows installation in accordance with the instructions. In bitumen roof installations, the bracket is screwed to the decking with two 7x50 roof bracket screws. Sealing rubber rings are installed between the bracket and the roof at the screws. For some roof types, a longer screw must be used to allow the screw to reach deep enough into the roof structure.

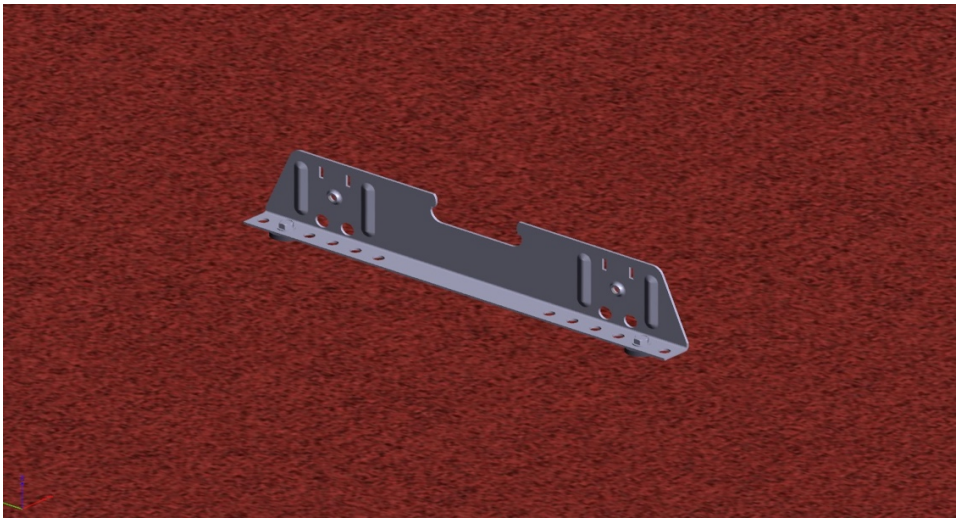


*Figure 9*

### 3.6 BRACKET FOR SQUARE PROFILE SHEET METAL ROOF (HIGH PROFILE)

For profile sheet metal roofs (high profile), the bracket shown in Figures 10 and 11 is used. The bracket is suitable for self-supporting sheet metal roofs with a high corrugated profile. An adhesive sealing tape is attached to the bottom of the bracket. The bracket is mounted on the roof with four profile sheet metal roof screws. Do not overtighten the screw so that it does not rotate around the damper. The thread formed in the damper may disappear and the screw will remain loose.

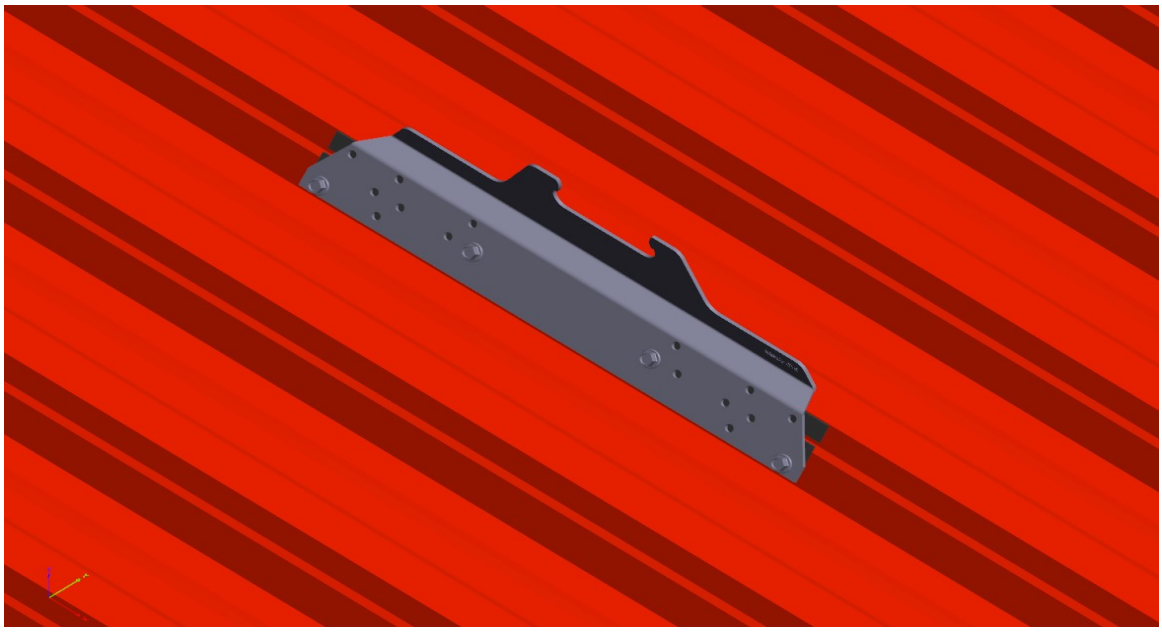


*Figure 10*

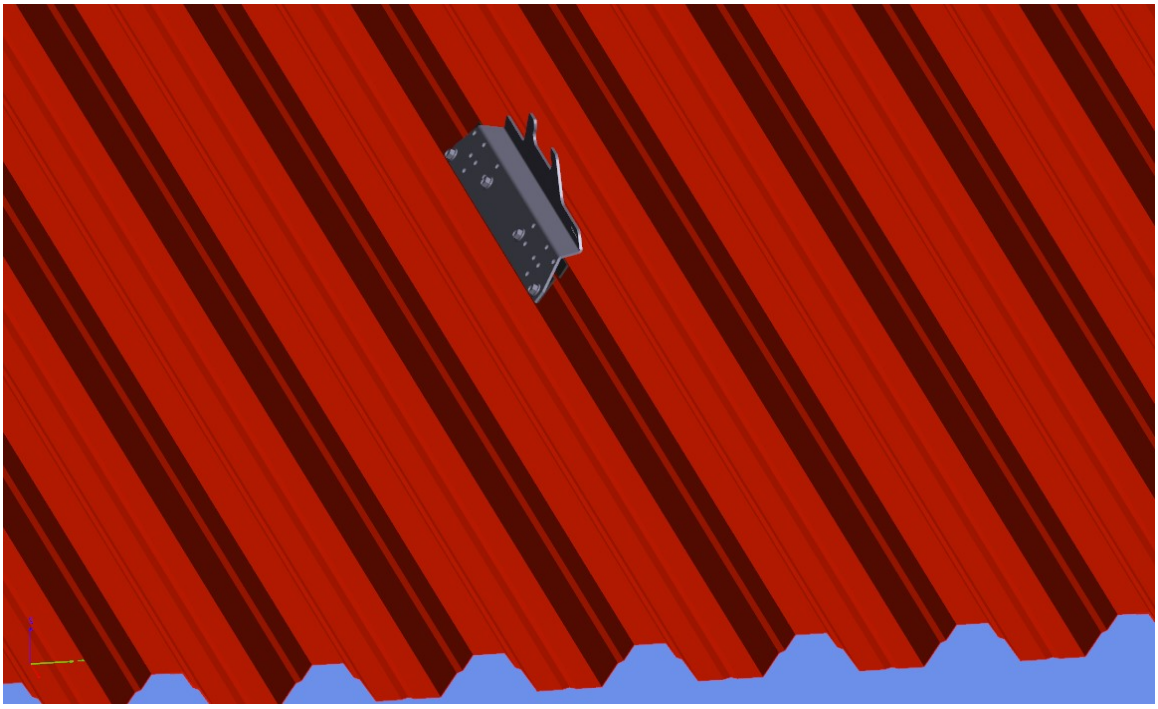


*Figure 11*

### 3.7 BRACKET FOR CORRUGATED TILE ROOF

For brick roofs, a brick roof bracket as shown in Figure 12 is used. The bracket is suitable for common corrugated roofs. Make sure the bracket fits before installation. The RAULI Nordic brick bracket fits smooth tile bricks. Place the bracket so that it lies on the edge of the brick on the right side of the bracket. Slide the bracket upwards so that there is a small gap between the bracket and the brick. Attach to the ribs with at least two 7x50 roof mounting screws (Figure 13). The fastening screws must not puncture the free-hanging underlay.

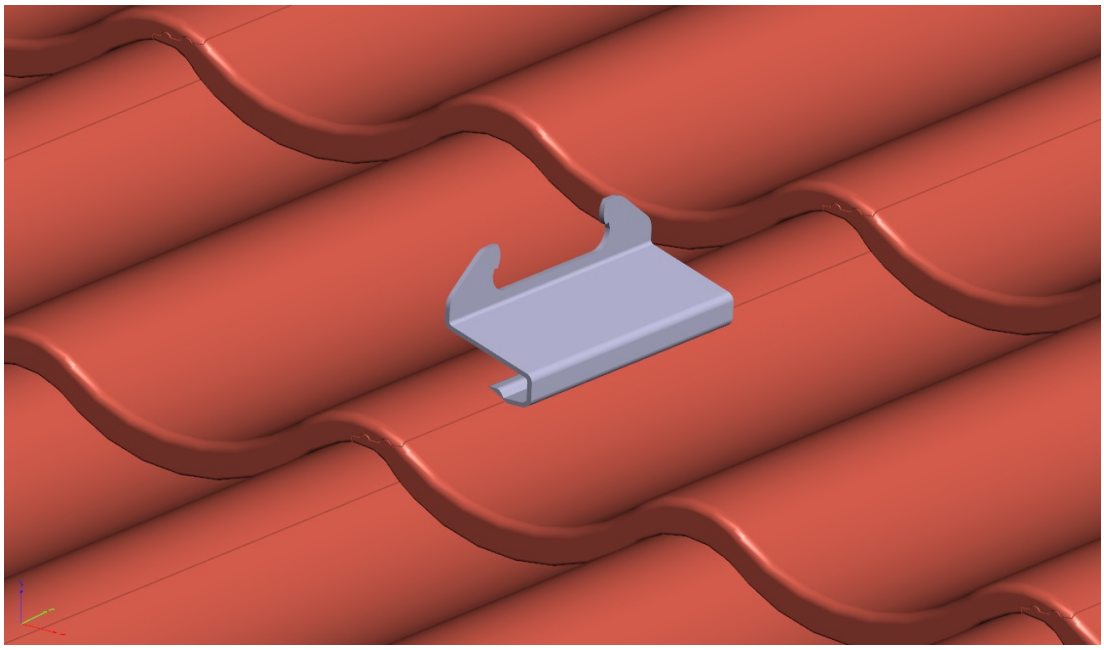


*Figure 12*

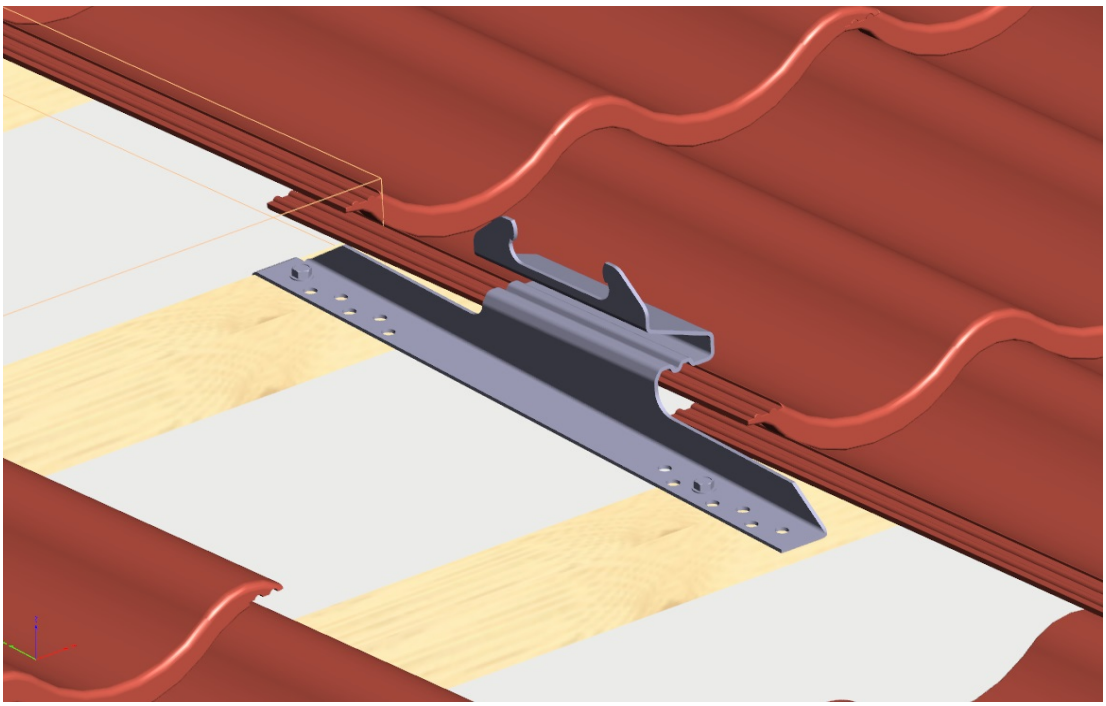


*Figure 13*

# 4. PROFILE RAILS

## 4.1 CONNECTING THE RAILS

The profile rails can be connected to each other in three ways: Overlapping at the bracket, tightening with the intermediate clip of the panels or with a bolt at the ends of the profiles.

### 4.1.1 PRESSING THE PROFILE TO THE BRACKET

Place the profiles on top of each other and overlap on the roof bracket and press them together on top of each other onto the roof bracket. First, one side of the hem through the tooth profile by tilting and then pressing the other side of the top profile of the hem directly to the roof (Figure 14).

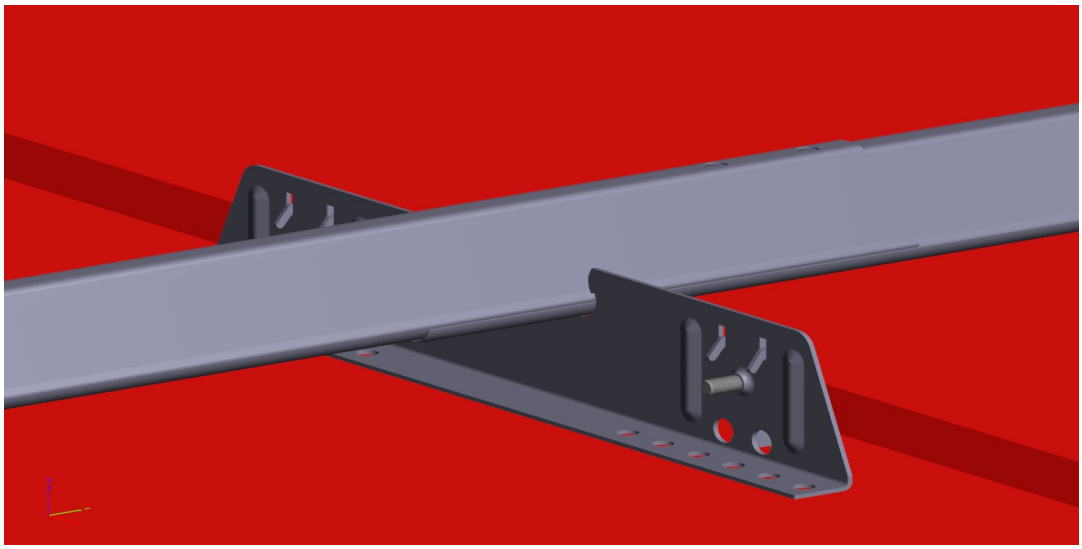


*Figure 14*

Carefully make sure that the edges of the profile go over the locking tooth, all the way to the bottom (Fig. 15). In this case, the profiles lock firmly in place. It is sufficient for the profiles to overlap by about 20 mm at the bracket. In this mounting method, it is not necessary to leave thermal interruptions in the profile.

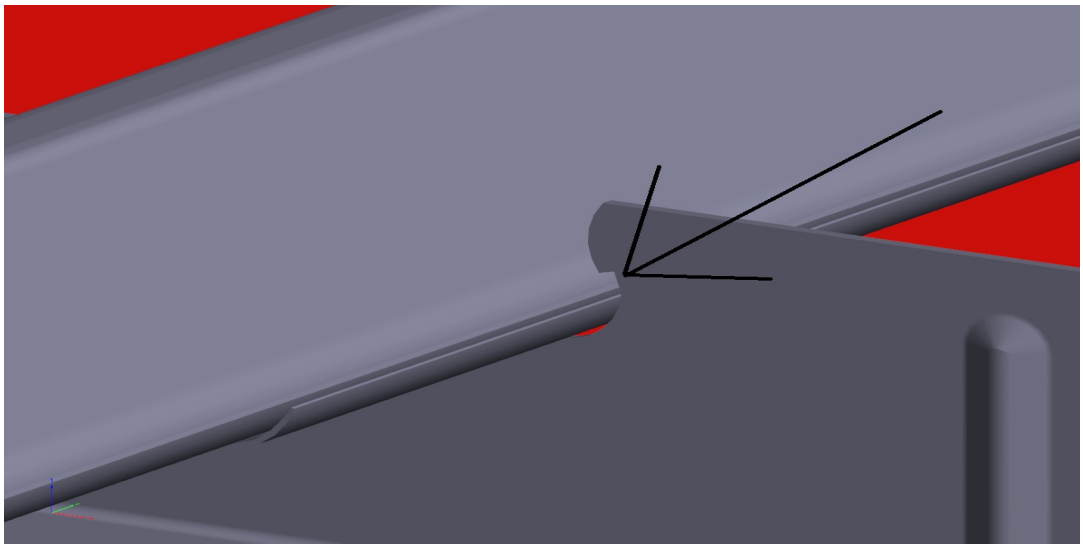


*Figure 15*

The profile must not be struck or hacked, as its shape may be damaged. If the uppermost profile does not go all the way in, you can try putting them back on and press the hem of the profile well towards the roof again. The profiles must not be removed, for example by twisting with pliers. The profile comes off the bracket when it is hand-pressed together from below the profile. Squeezing the rail requires a lot of force, but with the right technique, it comes off easily. Be sure to wear protective gloves when handling profiles.

### 4.1.2 CONNECTION WITH INTERMEDIATE FASTENING CLIPS

Attach the panel with an intermediate clip, so that the overlapping profiles under the panel are tightened against each other. This can occur when the profile dimension is not sufficient to overlap at the bracket and the ends of the profiles are spaced apart from the brackets (Figure 16).

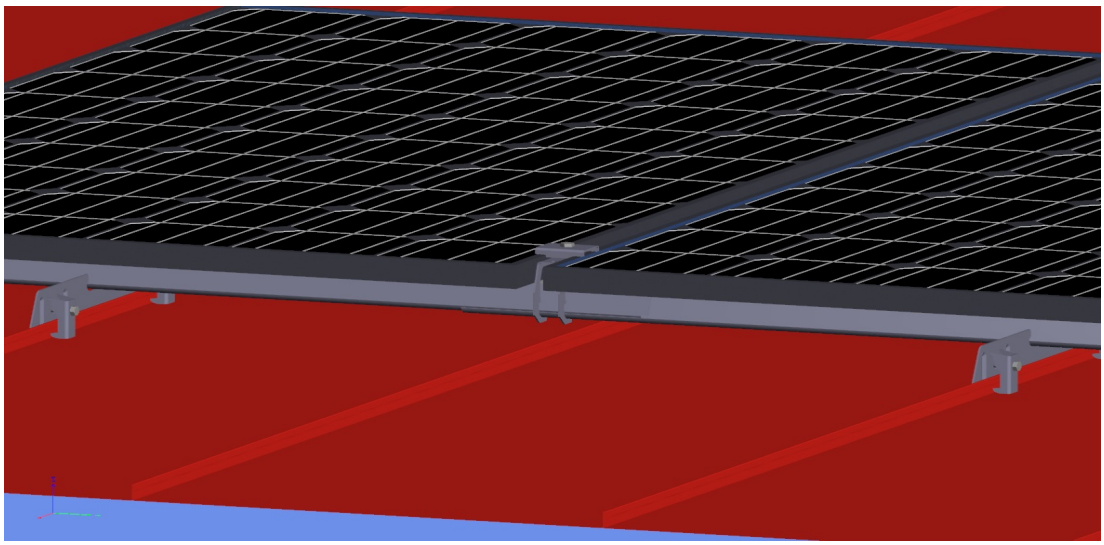


*Figure 16*

### 4.1.3 BOLT CONNECTION FROM THE PROFILE HOLES

In some cases, it may be necessary to connect the rails to each other with a bolt. Connect them with an M8x25 bolt and an M8 nut through the holes in the end. In this case, make sure that the bolt at the joint does not hit the panel frame (Fig. 17).

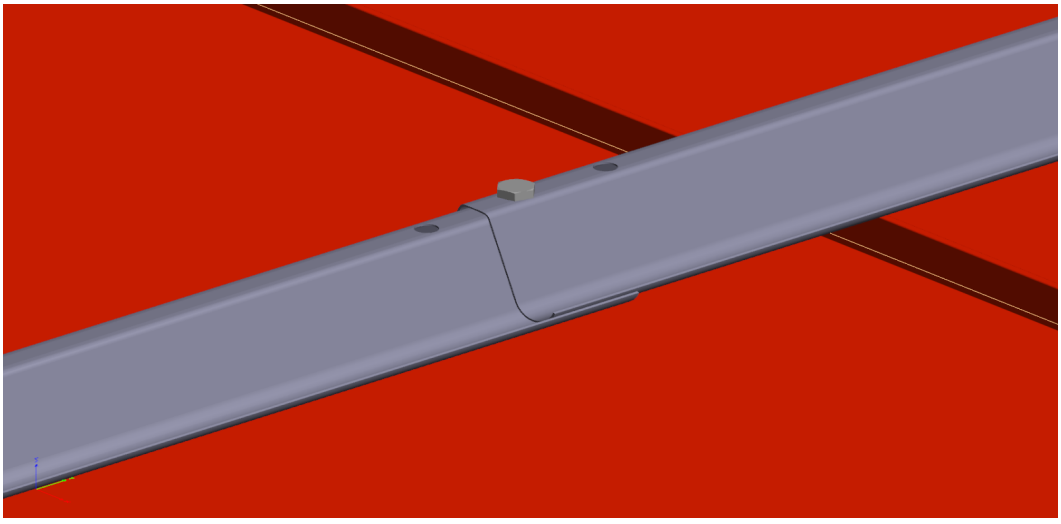


*Figure 17*

### 4.2 LOCKING THE RAILS

The panel system should be locked in place with one piece of 300mm rail when there are no other overlapping connections to the rails at the bracket. The panel system may move slightly if the rails are only single in the brackets. This is encountered, for example, in a situation where there are only one or two panels in a panel row mounted on one profile rail. For this assembly, it is sufficient to install one locking piece on top of the bracket (Fig. 18). This locks the panel field in place (Figure 19).

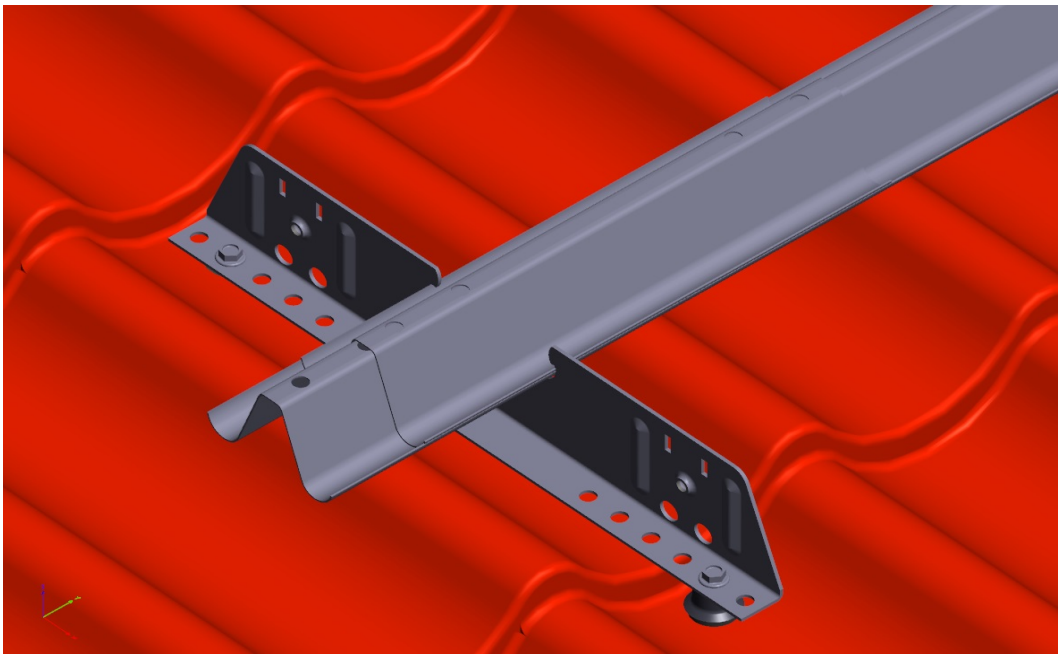


*Figure 18*

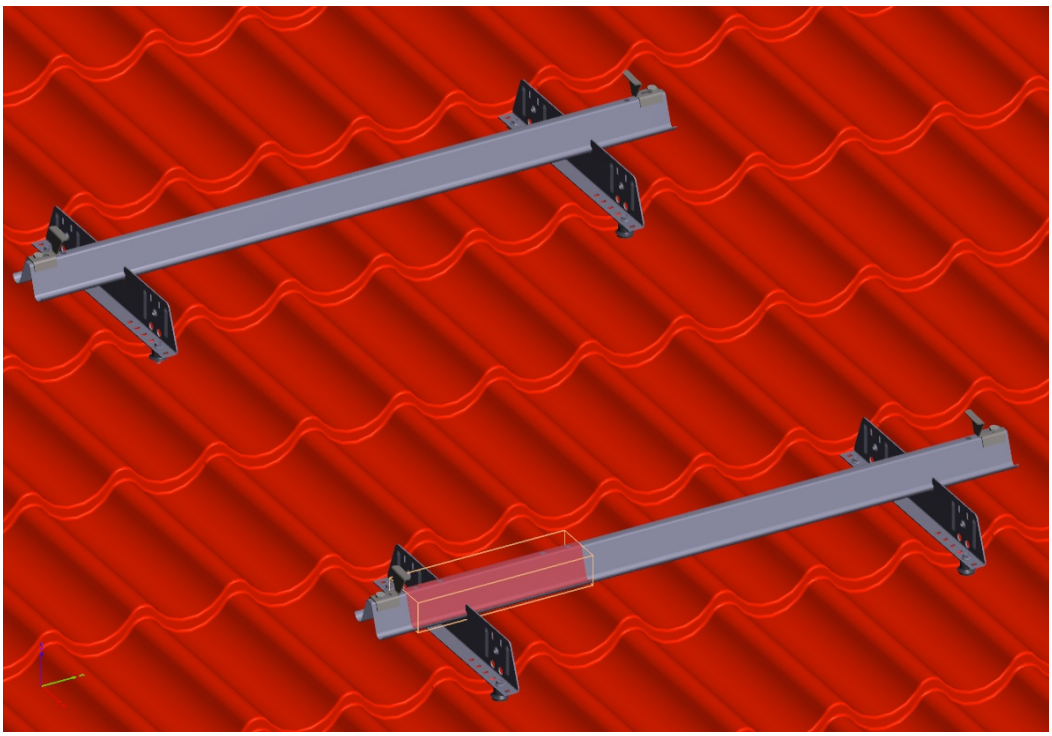


*Figure 19*

## 5. END FASTENING CLIPS

The solar panels are attached to the profile rail at the ends of the panel row with end clips (Fig. 20). The end clip fits into a 35mm thick panel frame with a basic order. The end clips are attached to the end of the profile rail with an M8x25 black bolt and a hot-dip galvanized M8 nut. Put the nut in place, tighten torque about 20Nm. The end clip has a 20mm adjustment range. When starting to install the panel system, it is advisable to tighten the clip to the middle position.

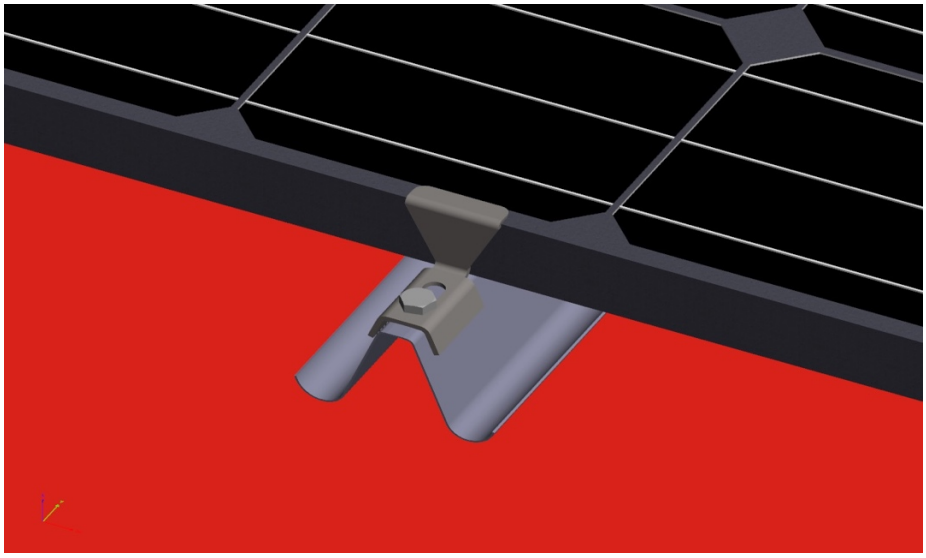


*Figure 20*

## 6. INTERMEDIATE FASTENING CLIPS

The fastening between the panels to the profile rail is carried out with intermediate clips as shown in Fig. 21. The intermediate clip is suitable for all panel types and is attached to the profile rail using the intermediate clip body and the M8x40 bolt. A suitable tightening torque for the clip bolt is approx. 20Nm. The hat part of the intermediate clip has teeth, so it bites well into the panel frame. Do not overtighten. The torque is exceeded if the hat part of the intermediate clip bends under the bolt.

NOTE! Before installing the intermediate clips, note the installation of the earthing plates, which can be found in chapter 8.1.

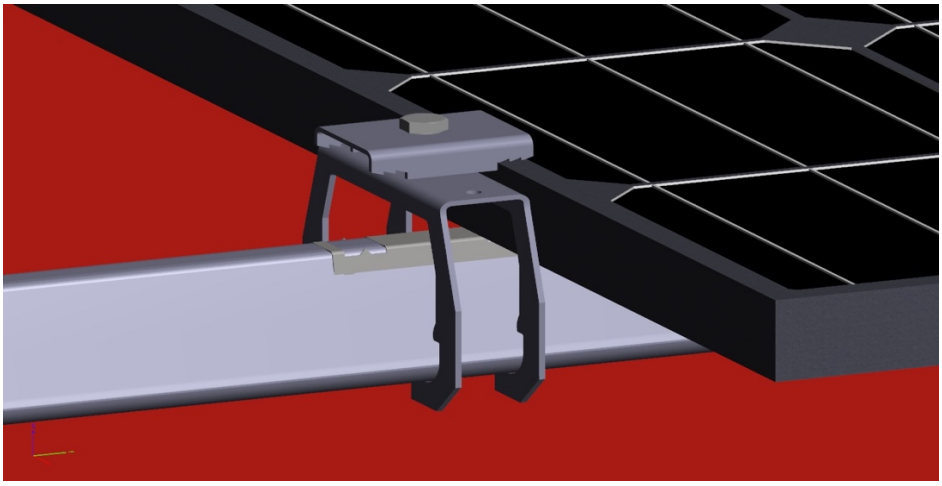
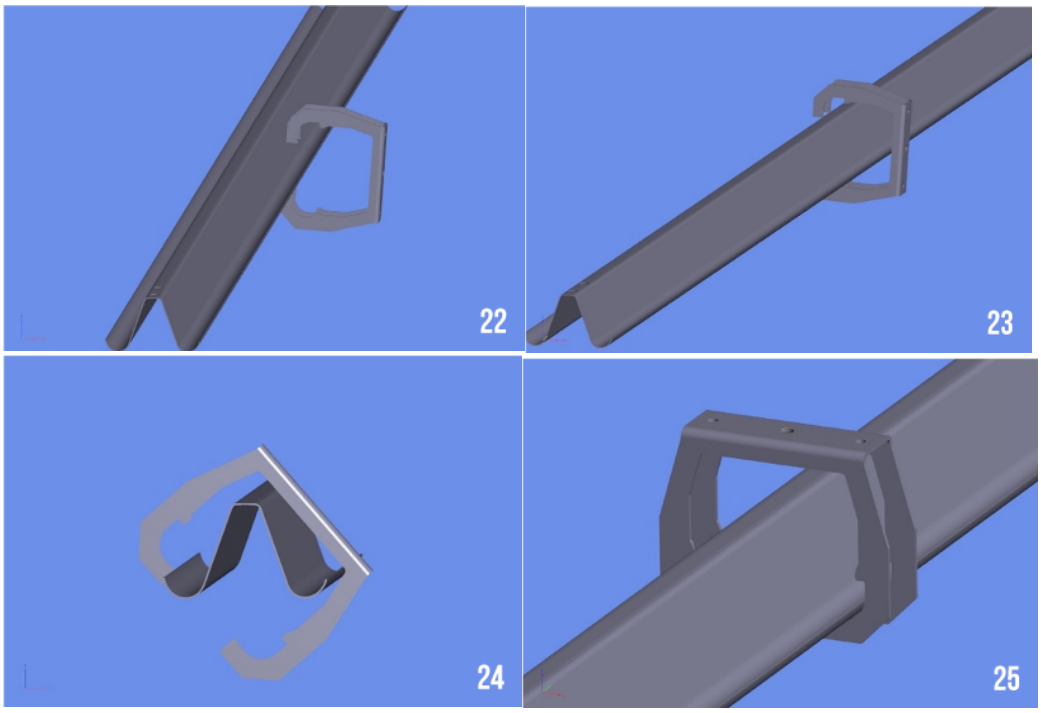


*Figure 21*

### 6.1 MOUNTING THE INTERMEDIATE CLIP BODY TO THE RAIL

The body part goes into place in the middle of the rail. Place the "legs" of the body over both sides of the profile. Then turn the bracket into place towards the mounting position and pull upwards. The bracket locks in the mounting position. Figures 22-25




## 7. CONSTRUCTION OF THE PANEL SYSTEM

Press the profile rails into place and make sure that the ends of the first rails are flush with the edge of the roof. However, leave the last rails at the other end of the field still loose. Start fixing the bottom panel row and set the end clips distance adjustment halfway. Continue paneling until there are one or two panels in a row without installing. Take a measure from the edge of the panel to the end of the profile and attach the profiles. You can get the right dimension (L) from the formula:

$L = 43mm + (N \times 991) + (N \times 30mm)$ Vertical installation

$L = 43mm + (N \times 1650) + (N \times 30mm)$ Horizontal installation

where $N$ is the number of solar panels, 991 is the panel width and 1650 is the panel height.

At the end of the profile, the end clips has a 20mm adjustment range. Exceeding the profile from the last bracket max.500mm.

## 8. GROUNDING

The system is grounded directly to the side of the profile rail. The tool used is a 14mm cup blade with a 6mm guide drill. A 6mm hole is drilled in the rail and a larger 14mm perimeter drill lightly touches the surface of the profile, taking the paint around the hole away. It is a good idea to make a hole under the panels so that the earth cable is better hidden. The cable lug M6 / 6 is installed in the hole with an M6x25 stainless steel bolt and an M6 stainless steel nut. An earth cable, eg 6mm2, is inserted, directly from the equipotential rail of the building (Fig. 26). The ground cable is routed to the farthest rail and chained so that each rail is at the same potential.

In addition, an earth plate is installed between the profiles at each rail joint. This ensures that the mounting rails are at the same potential. In systems with more comprehensive surge protection, a thicker 16mm2 cable, for example, is used for earthing.

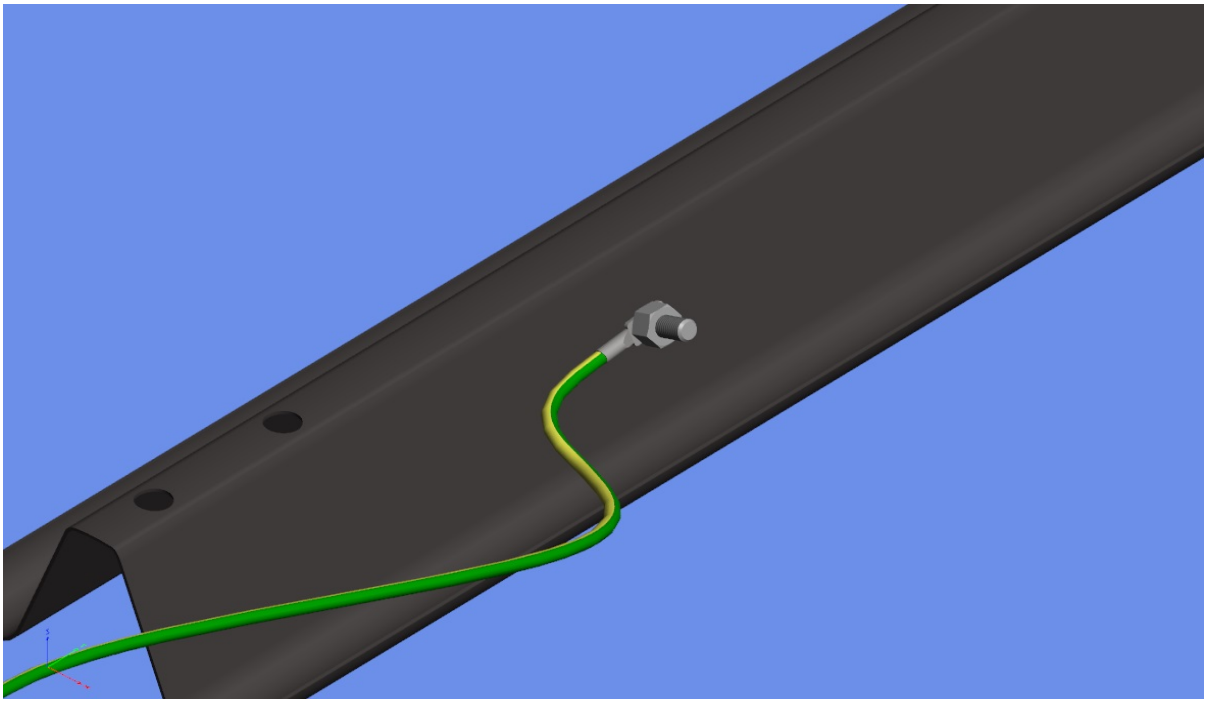


*Figure 26*

## 8.1 THE GROUND PLATE

Between each panel, a ground plate is installed on the lower profile rail at the intermediate clips as shown in Figures 27 and 28. The ground plate has sharp teeth that remove paint from the surface of the profile. This gives the same potential between the panels and the rails. The ground plate ensures the electrical connection between the profile rails and the solar panels. In addition, the ground plate adds friction to the rail surface, keeping the panel better in the place.

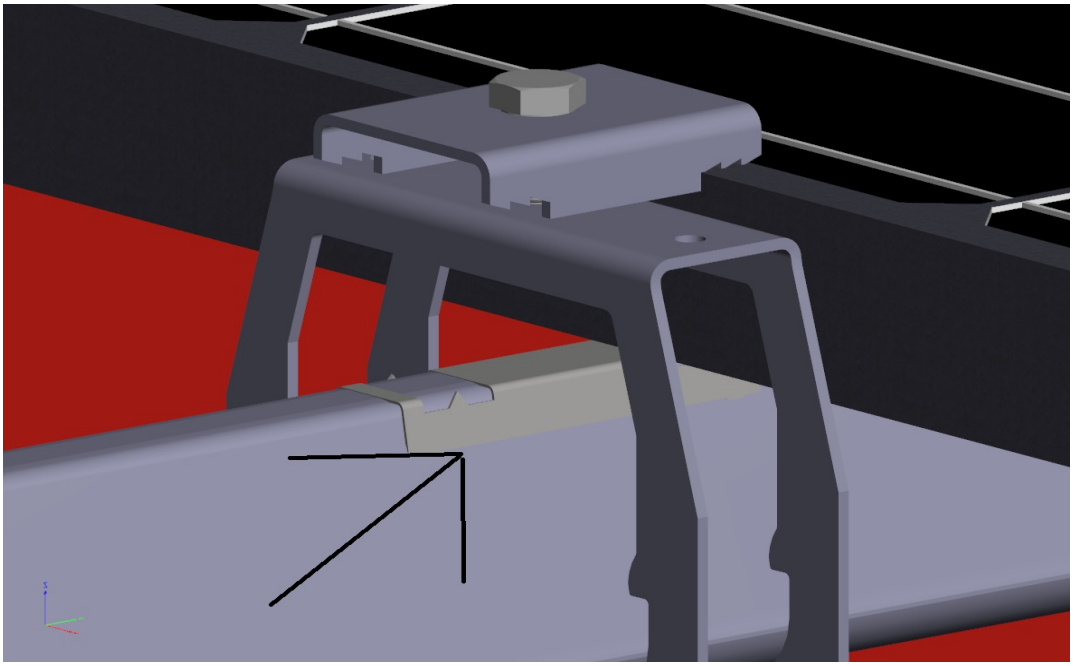


*Figure 27*

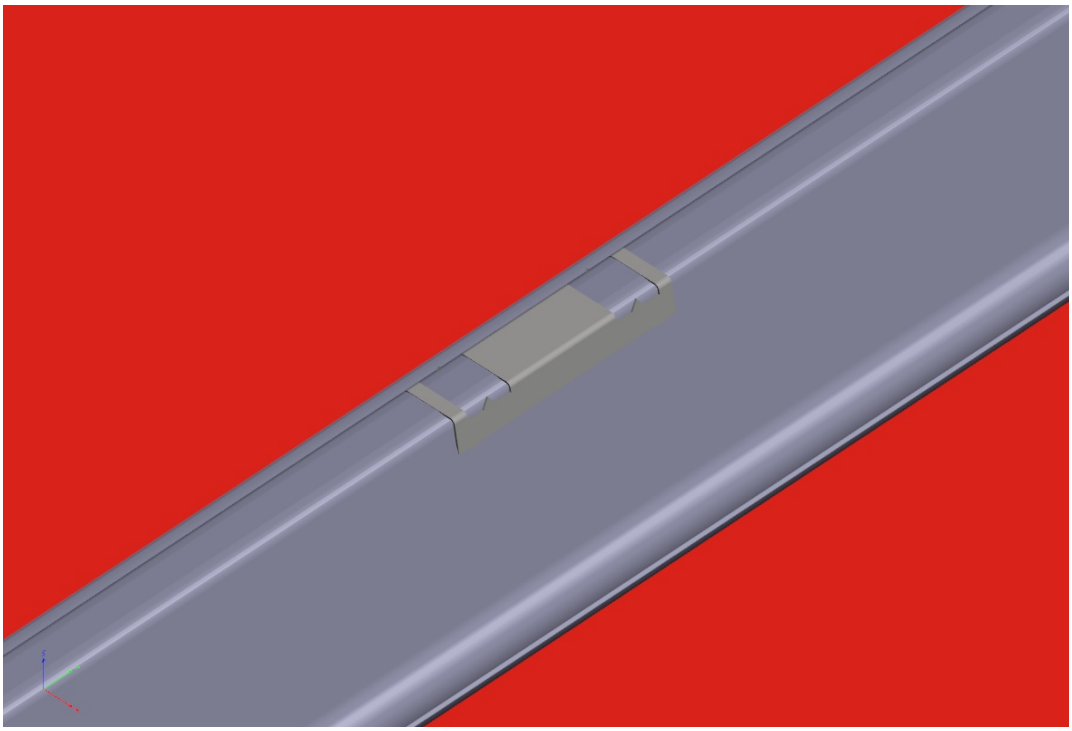


*Figure 28*