

# FEAL



## FNE-1100

SISTEM ZA FOTONAPONSKE ELEKTRANE  
*SYSTEM FOR PHOTOVOLTAIC POWER PLANTS*



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# Značajke sistema System characteristics



FOTONAPONSKE ELEKTRANE  
FNE 1100

Tržište solarne energije je u vremenu dinamičnih promjena. Sve brži razvoj fotonaponskih sustava, te njihova implementacija zahtijeva jednostavnu i prilagodljivu podkonstrukciju.

FEAL FNE 1100 sistem sadržava aluminijsku podkonstrukciju dizajniranu za stvaranje modularnih potpornih struktura s mogućnošću postavljanja na krovove obiteljskih kuća za različite vrste konvencionalnih pokrova. Korišteni materijali odabrani su kako bi se osigurala pouzdanost i trajnost tijekom vremena. Elementi konstrukcije izrađeni su od aluminijske legure EN AW-6063 i EN AW-6005.

PHOTOVOLTAIC POWER PLANTS  
FNE 1100

The solar energy market is in a time of dynamic change. Increasingly rapid development of photovoltaic systems, and their implementation requires a simple and flexible substructure. FEAL FNE 1100 system contains an aluminum substructure designed to create modular support structures with the possibility of mounting on the roofs of family houses on different types of conventional roofs. The materials used were selected to ensure reliability and durability over time. The construction elements are made of aluminum alloy EN AW-6063 and EN AW-6005.

## Zašto solarne elektrane?

1. To je jedan od ekološki najčišćih izvora energije, ne stvara buku i ne zagađuje okolinu!
2. Solarnim elektranama pomažemo u očuvanju zaštite našeg planeta sa drastičnim smanjenjem ispuštanja CO<sub>2</sub> u ozon.
3. Samo jedan kWh električne energije dobivene iz Sunca smanjuje emisiju CO<sub>2</sub> za 1 kg.
4. Ulaganje u obnovljive izvore energije zadatak je svakog čovjeka koji u budućnosti teži osvještanoj i ekonomičnoj potrošnji električne energije.

## Why solar power plants?

1. It is one of the most environmentally friendly sources of energy, does not create noise and does not pollute the environment!
2. Solar power plants help to preserve the protection of our planet by drastically reducing CO<sub>2</sub> emissions into ozone.
3. Only one kWh of electricity generated from the Sun reduces CO<sub>2</sub> emissions by 1 kg.
4. Investing in renewable energy sources is an assignment for every man who, in the future, aspires to a refreshing and economical consumption of electricity.

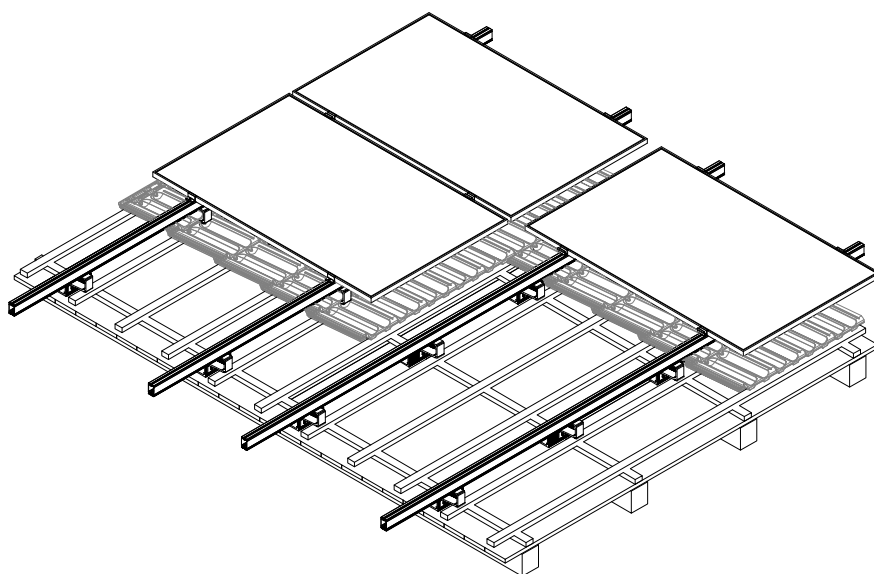
## FNE 1100- Aluminijska konstrukcija za montažu na krovu

## FNE 1100- Aluminum construction for roof mounting

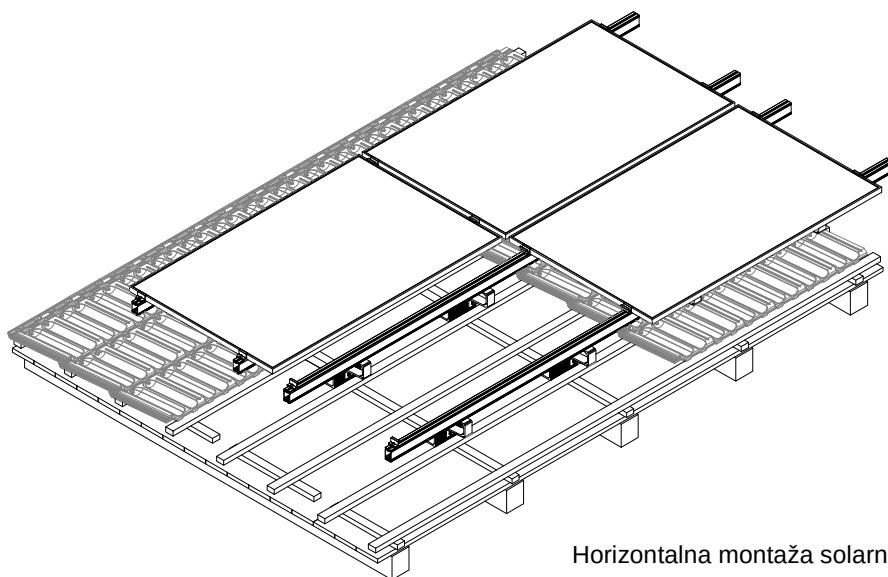
Ovaj sistem dizajniran je za prihvatanje većine standardnih dimenzija solarnih panela.

Njegova glavna karakteristika je mogućnost ugradnje na skoro svim krovovima, neovisno o vrsti crijeva. Sistem FNE 1100 podijeljen je u dvije osnovne cjeline, horizontalno i vertikalno montiranje solarnih panela.

This system is designed to accommodate most of the standard dimensions of solar panels. Its main feature is the possibility to be installed on almost any roof regardless of type of the tile. The FNE 1100 system is divided into two basic parts, horizontal and vertical mounting of solar panels.



Vertikalna montaža solarnih panela  
Vertical installation of solar panels



Horizontalna montaža solarnih panela  
Horizontal installation of solar panels

# Ispitivanja i certifikati

## Testing and certificates



## Statička analiza Strutural analysis

### Sistem FNE 1100

Predmetni paneli se mogu polagati u:

- uspravni položaj
- vodoravne položaj.

Obuhvaćeni su nagibi solarnih panela od 20°, 25°, 30°, 35° i 45°.

Analizirane su brzine vjetra od 20m/s, 25m/s, 30m/s i 35m/s

Kompletan statički proračun proveden je za Kategoriju terena III.

U obzir se uzelo osnovno djelovanje snijega u iznosu od 0,75kN/m<sup>2</sup>.

### System FNE 1100

Examined panels can be layed in:

- vertical position
- horizontal position.

Included slopes of solar panels are 20°, 25°, 30°, 35° and 45°.

Analyzed wind speed are 20m/s, 25m/s, 30m/s i 35m/s

Complete analysis was calculated for Terrain category III.

Considered was also snow load of 0,75kN/m<sup>2</sup>.

### Djelovanja

- Stalno opterećenje**
  - stalno opterećenje uslijed težine panela 0,12 kN/m<sup>2</sup>
- Opterećenje snijegom**
  - regija 2 - intezitet opterećenja 0,6 kN/m<sup>2</sup>; 0,5 kN/m<sup>2</sup>; 0,3 kN/m<sup>2</sup>

### Actions

- Dead load**
  - dead load from panel weight 0,12 kN/m<sup>2</sup>
- Snow load**
  - region 2 - load intesity 0,6 kN/m<sup>2</sup>; 0,5 kN/m<sup>2</sup>; 0,3 kN/m<sup>2</sup>

Opterećenje snijegom - koeficijent nagiba

Snow load - slope coefficient

| Nagib krova $\alpha$ | $0^\circ < \alpha \leq 30^\circ$ | $30^\circ < \alpha < 60^\circ$ | $\alpha \geq 60^\circ$ |
|----------------------|----------------------------------|--------------------------------|------------------------|
| $\mu$                | 0,8                              | $0,8(60-\alpha)/30^\circ$      | 0,0                    |

Opterećenje snijegom za različita područja i nagibe krova

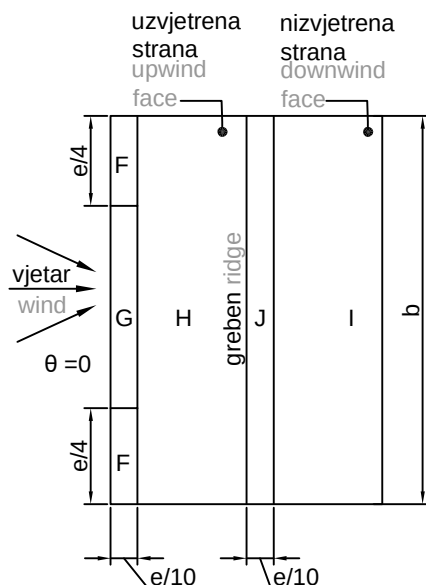
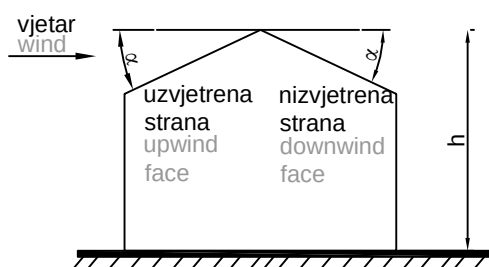
Snow load for different regions and slope angles

| Područje Region | 20°                                   | 25° | 30° | 35°                                    | 45°                                   |
|-----------------|---------------------------------------|-----|-----|----------------------------------------|---------------------------------------|
| 1.              | 0,8x0,50=0,40 kN/m <sup>2</sup>       |     |     | 0,66x0,50=0,33 kN/m <sup>2</sup>       | 0,4x0,50=0,20 kN/m <sup>2</sup>       |
| 2.              | <b>0,8x0,75=0,60 kN/m<sup>2</sup></b> |     |     | <b>0,66x0,75=0,50 kN/m<sup>2</sup></b> | <b>0,4x0,75=0,30 kN/m<sup>2</sup></b> |
| 3.              | 0,8x1,25=1,00 kN/m <sup>2</sup>       |     |     | 0,66x1,25=0,82 kN/m <sup>2</sup>       | 0,4x1,25=0,5 kN/m <sup>2</sup>        |
| 4.              | 0,8x1,50=1,20 kN/m <sup>2</sup>       |     |     | 0,66x1,50=1,00 kN/m <sup>2</sup>       | 0,4x1,50=0,6 kN/m <sup>2</sup>        |

## 3. Opterećenje vjetrom

## 3. Wind load

|      | Kategorije terena<br>Terrain categories                                                                                                                                                                                                                                                                                                                       |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.   | More ili prioblana područja izložena otvorenom moru<br>Sea, coastal area exposed to the open sea                                                                                                                                                                                                                                                              |
| I.   | Jezera ili ravna i horizontalno položena područja sa zanemarivom vegetacijom i bez prepreka<br>Lakes or area with negligible vegetation and without obstacles                                                                                                                                                                                                 |
| II.  | Područja s niskom vegetacijom, npr. travom, i izoliranim preprekama (drveće, zgrade) s razmakom najmanje 20 metara visine prepreke<br>Area with low vegetation such as grass and isolated obstacles (trees, buildings) with separations of at least 20 obstacle heights                                                                                       |
| III. | Područja sa stalnim pokrovom od vegetacije ili zgrade ili područja s izoliranim preprekama s razmakom najviše 20 metara visine prepreke (sela, predgrada, stalna šuma)<br>Area with regular cover of vegetation or buildings or with isolated obstacles with separations of maximum 20 obstacle heights (such as villages suburban terrain, permanent forest) |
| IV.  | Područja s najmanje 15% površine pokrivene zgradama čija prosječna visina premašuje 15 m<br>Area in which at least 15 % of the surface is covered with buildings and their average height exceeds 15 m                                                                                                                                                        |



$e = b$  ili  $2h$   
što je veće what is bigger

Preporučene vrijednosti koeficijenta vanjskog pritiska

Recommended values of external pressure coefficients

| Nagib $\alpha$ | Zone za smjer vjetra $\theta = 0$ Zone for wind direction $\theta = 0$ |            |             |            |             |            |             |            |             |            |
|----------------|------------------------------------------------------------------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
|                | F                                                                      |            | G           |            | H           |            | I           |            | J           |            |
|                | $C_{pe,10}$                                                            | $C_{pe,1}$ | $C_{pe,10}$ | $C_{pe,1}$ | $C_{pe,10}$ | $C_{pe,1}$ | $C_{pe,10}$ | $C_{pe,1}$ | $C_{pe,10}$ | $C_{pe,1}$ |
| 15 °           | -0,9                                                                   | -2,0       | -0,8        | -1,5       | -0,3        |            | -0,4        |            | -1,0        | -1,5       |
|                | +0,2                                                                   |            | +0,2        |            | +0,2        |            | +0,0        |            | +0,0        |            |
| 30 °           | -0,5                                                                   | -1,5       | -0,5        | -1,5       | -0,2        |            | -0,4        |            | -0,5        |            |
|                | +0,7                                                                   |            | +0,7        |            | +0,4        |            | +0,0        |            | +0,0        |            |
| 45 °           | -0,0                                                                   |            | -0,0        |            | -0,0        |            | -0,2        |            | -0,3        |            |
|                | +0,7                                                                   |            | +0,7        |            | +0,6        |            | +0,0        |            | +0,0        |            |

Vrijednosti max tlak / max podtlak za zone H i I [kN/m<sup>2</sup>]Values of max pressure / max suction for zones H and I [kN/m<sup>2</sup>]

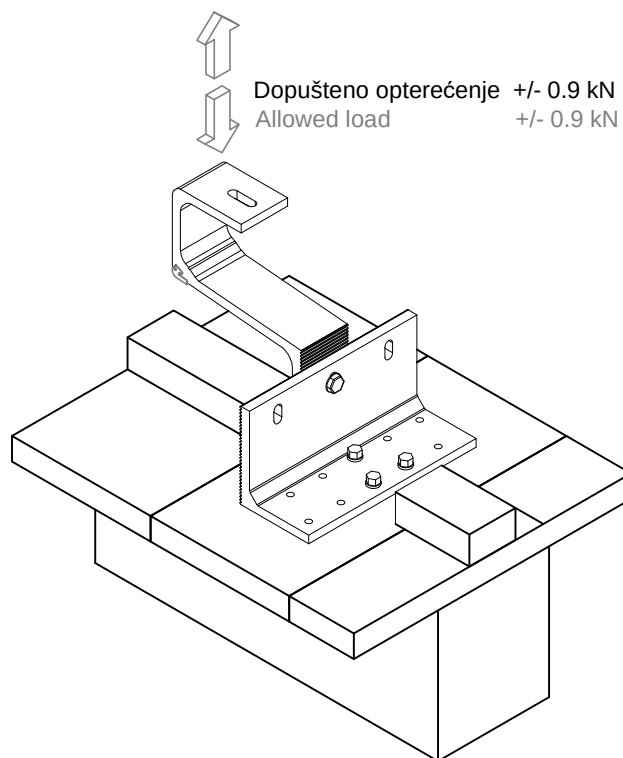
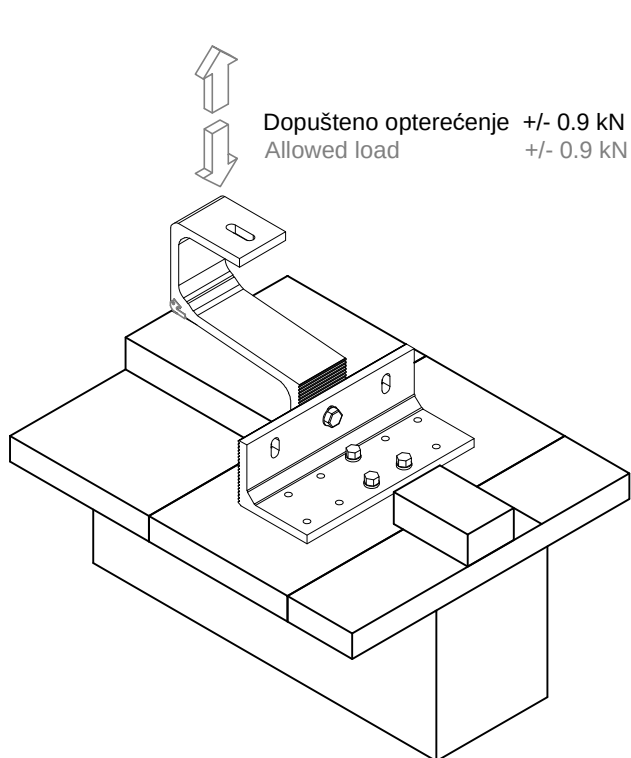
| Brzina vjetra<br>Wind speed | Nagib krova<br>Roof pitch |          |          |          |          |
|-----------------------------|---------------------------|----------|----------|----------|----------|
|                             | 20 °                      | 25 °     | 30 °     | 35 °     | 45 °     |
| 20 m/s                      | 0.1/-0.5                  | 0.1/-0.5 | 0.1/-0.5 | 0.5/-0.5 | 0.5/-0.5 |
| 25 m/s                      | 0.1/-0.7                  | 0.2/-0.7 | 0.2/-0.7 | 0.7/-0.7 | 0.8/-0.7 |
| 30 m/s                      | 0.2/-1.0                  | 0.2/-1.0 | 0.3/-1.1 | 1.0/-1.1 | 1.1/-1.0 |
| 35 m/s                      | 0.3/-1.4                  | 0.3/-1.4 | 0.4/-1.5 | 1.4/-1.4 | 1.5/-1.4 |

**Dopuštene brzine vjetra u odnosu na nagib krova**  
Allowed wind speeds regarding roof pitchSolarni panel 1600 mm x 1000 mm  
Solar panel 1600 mm x 1000 mm

| Nagib krova<br>Roof pitch | Dopuštena brzina vjetra<br>Allowed wind speed |
|---------------------------|-----------------------------------------------|
| 20 °                      | ≤ 35 m/s                                      |
| 25 °                      | ≤ 35 m/s                                      |
| 30 °                      | ≤ 35 m/s                                      |
| 35 °                      | ≤ 35 m/s                                      |
| 45 °                      | ≤ 35 m/s                                      |

Solarni panel 2000 mm x 1000 mm  
Solar panel 2000 mm x 1000 mm

| Nagib krova<br>Roof pitch | Dopuštena brzina vjetra<br>Allowed wind speed |
|---------------------------|-----------------------------------------------|
| 20 °                      | ≤ 35 m/s                                      |
| 25 °                      | ≤ 35 m/s                                      |
| 30 °                      | ≤ 35 m/s                                      |
| 35 °                      | ≤ 30 m/s                                      |
| 45 °                      | ≤ 30 m/s                                      |



Za sve projektne zadatke koji se ne nalaze unutar zadanih gabarita statičke analize, potrebno je provesti zasebnu statičku analizu kojom će se dokazati stabilnost ovog sistema u tim uvjetima.

Za statičku analizu svakog projekta odgovoran je glavni projektant projekta.

For all projects where load requirements are not covered by this analysis, it is necessary to perform separate analysis which will prove stability of the system in those conditions.

Structural analysis of every project is under responsibility of chief project engineer.

## Položaj kopči

### Clamp position

- Položaj kopči se određuje na temelju tehničke dokumentacije proizvođača panela te ovisi o dimenzija panela (dužina, širina i visine obodnog profila) i opterećenja koja djeluju na panel (vjetar, snijeg)

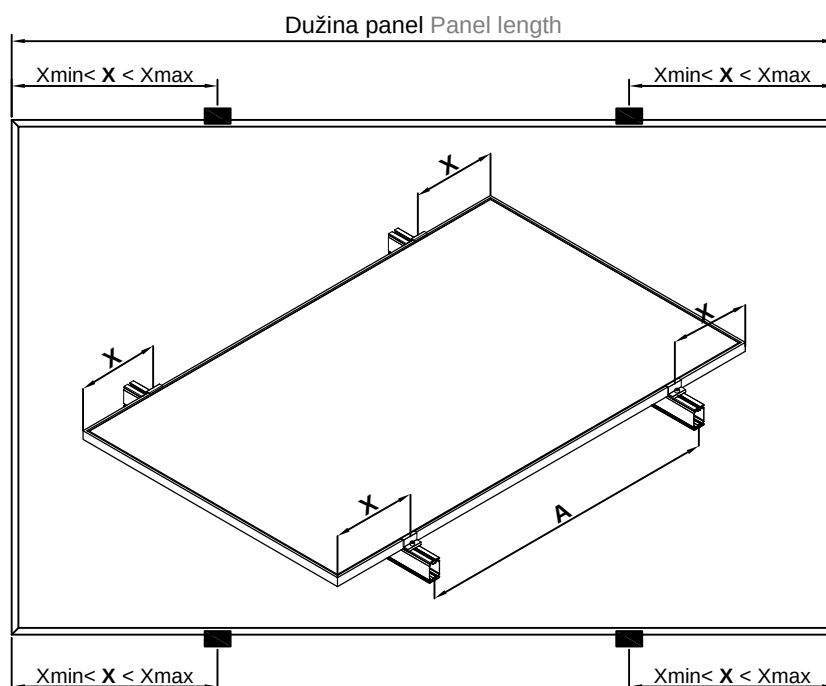
Clamp position is determined based on the technical documentation of the solar panel manufacturer and is dependent on dimensions of the panel (length, width, and the height of the edge profile) and loads that affect (wind, snow)

#### 1. Položaj kopči po dužoj strani panela

**X** - dopušteni razmak ose kopče od kraja panela

#### 1. Clamp position on the longer side of the panel

**X** - allowed distance between clamp axis from the panel end

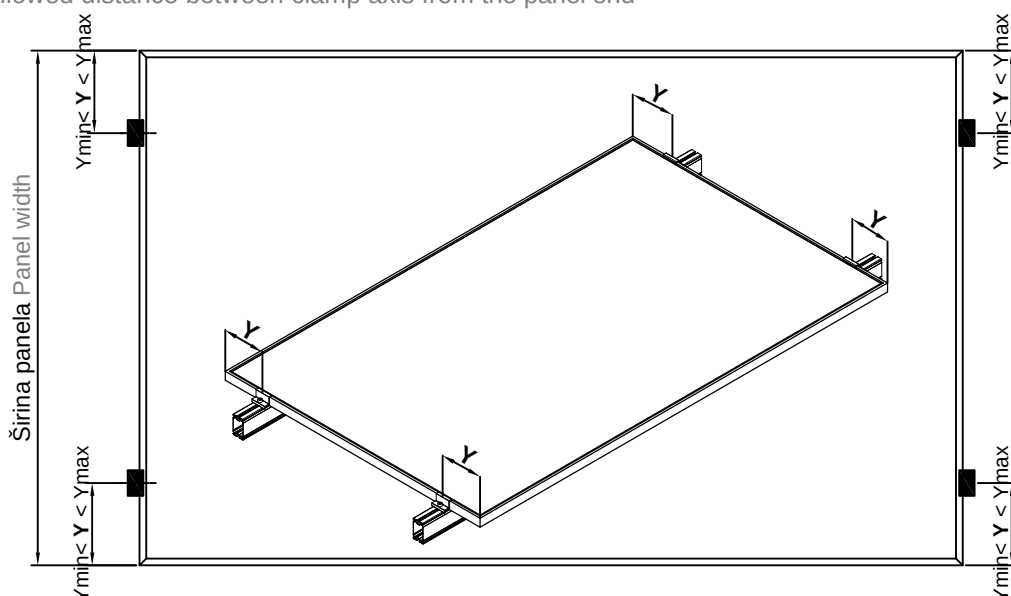


#### 2. Položaj kopči po kraćoj strani panela

**Y** - dopušteni razmak ose kopče od kraja panela

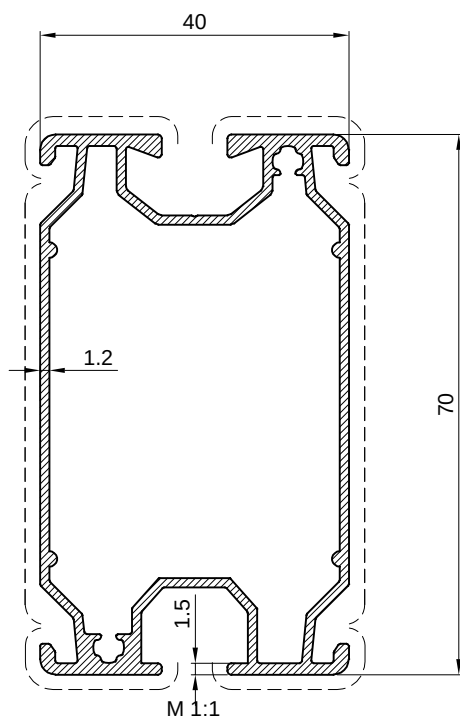
#### 2. Clamp position on the shorter side of the panel

**Y** - allowed distance between clamp axis from the panel end

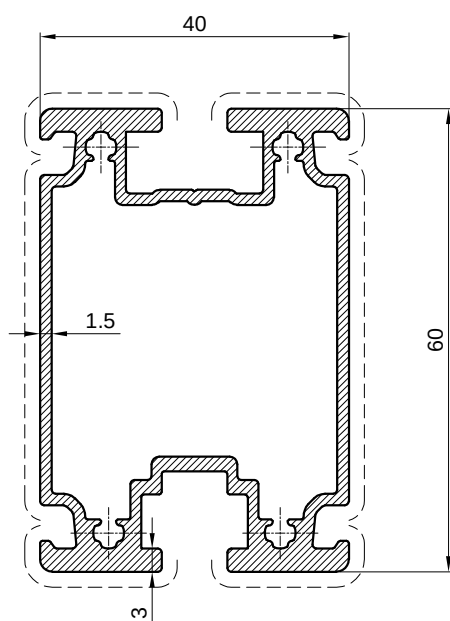


# Profili Profiles





| Profil Profile                             |                                      |        |
|--------------------------------------------|--------------------------------------|--------|
| Art.Br.<br>Art.No.                         | <b>FNE-0006</b>                      |        |
| Težina<br>Weight                           | kg/m                                 | 1.04   |
| Opseg<br>Perimeter                         | mm                                   | 325.75 |
| Moment<br>inercije<br>Moment<br>of inertia | I <sub>x</sub><br>(cm <sup>4</sup> ) | 27.44  |
|                                            | I <sub>y</sub><br>(cm <sup>4</sup> ) | 8.60   |
|                                            | W <sub>x</sub><br>(cm <sup>3</sup> ) | 7.79   |
|                                            | W <sub>y</sub><br>(cm <sup>3</sup> ) | 4.26   |
| L                                          | mm                                   | -      |



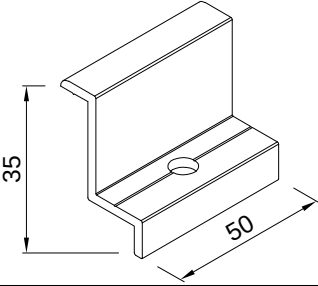
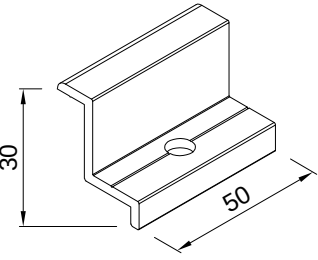
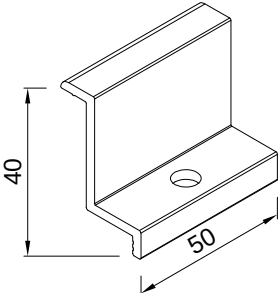
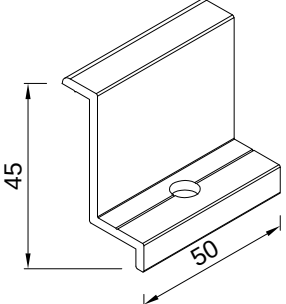
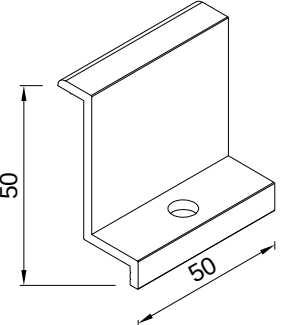
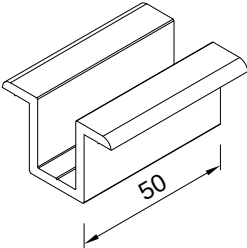
| Profil Profile                             |                                      |        |
|--------------------------------------------|--------------------------------------|--------|
| Art.Br.<br>Art.No.                         | <b>FNE-0004</b>                      |        |
| Težina<br>Weight                           | kg/m                                 | 1.380  |
| Opseg<br>Perimeter                         | mm                                   | 309.25 |
| Moment<br>inercije<br>Moment<br>of inertia | I <sub>x</sub><br>(cm <sup>4</sup> ) | 26.53  |
|                                            | I <sub>y</sub><br>(cm <sup>4</sup> ) | 10.24  |
|                                            | W <sub>x</sub><br>(cm <sup>3</sup> ) | 8.61   |
|                                            | W <sub>y</sub><br>(cm <sup>3</sup> ) | 5.12   |
| L                                          | mm                                   | -      |

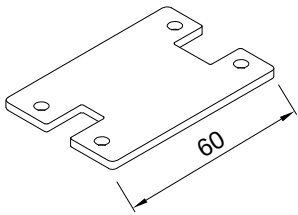
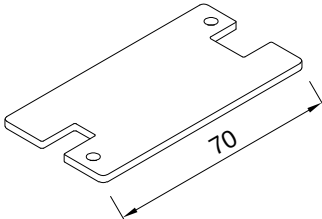
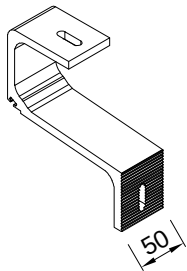
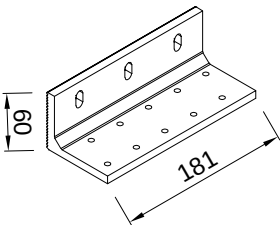
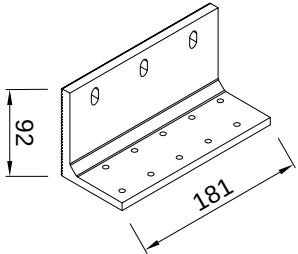


# Vezni elementi

## Connection elements

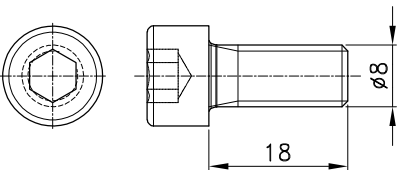
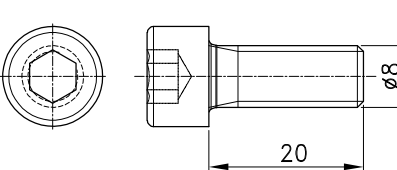
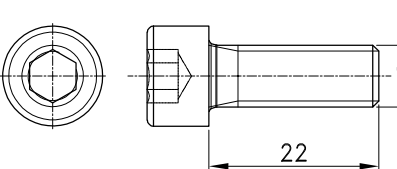
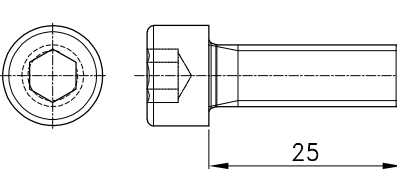
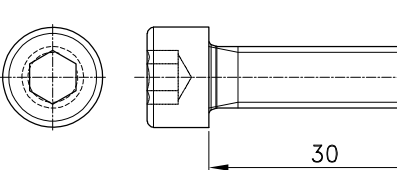
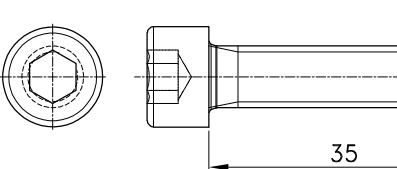
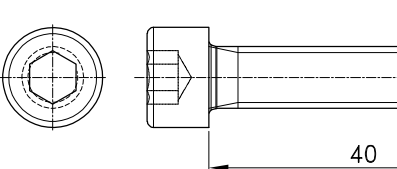


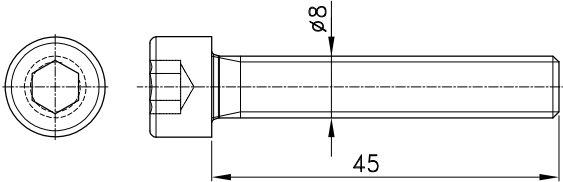
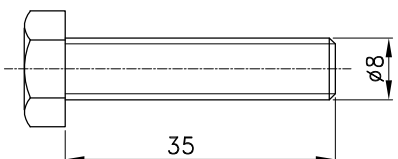
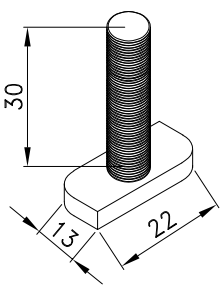
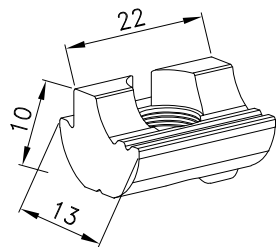
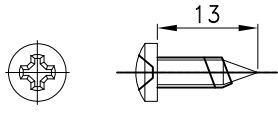
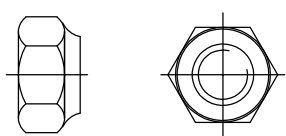
| Oznaka<br>Code | Izgled-presjek<br>View-cross section                                                | Opis<br>Description                                                            | Materijal<br>Material | Napomena<br>Remark |
|----------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------|--------------------|
| 521.421        |    | -Jednostrana kopča za solare-35 mm<br>-Solar panel holder - single sided-35 mm | Al                    |                    |
| 521.426        |    | -Jednostrana kopča za solare-30 mm<br>-Solar panel holder - single sided-30 mm | Al.                   |                    |
| 521.427        |   | -Jednostrana kopča za solare-40 mm<br>-Solar panel holder - single sided-40 mm | Al                    |                    |
| 521.428        |  | -Jednostrana kopča za solare-45 mm<br>-Solar panel holder - single sided-45 mm | Al                    |                    |
| 521.429        |  | -Jednostrana kopča za solare-50 mm<br>-Solar panel holder - single sided-50 mm | Al                    |                    |
| 521.437        |  | -Srednja kopča za solare<br>-Solar panel holder - double sided                 | Al.                   |                    |

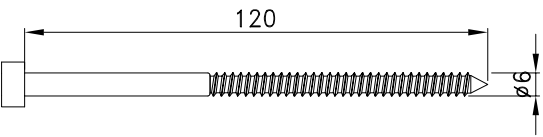
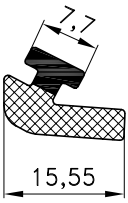
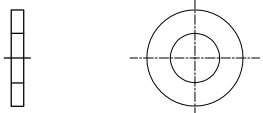
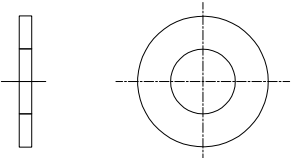
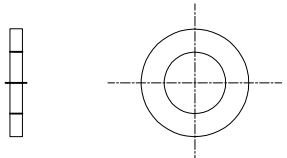
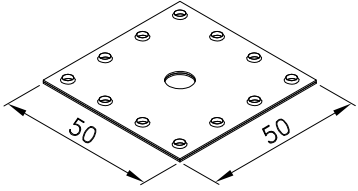
| Oznaka<br>Code | Izgled-presjek<br>View-cross section                                                | Opis<br>Description                                                                                            | Materijal<br>Material | Napomena<br>Remark |
|----------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------|--------------------|
| 521.390        |    | -FNE bočni poklopac 60 (FNE-0004)<br>-FNE side cover 60 (FNE-0004)                                             | Al.                   |                    |
| 521.418        |    | -FNE bočni poklopac 70, (FNE-0006)<br>-FNE side cover 70 (FNE-0006)                                            | Al.                   |                    |
| 521.438        |   | -Gornji nosač podkonstrukcije za solare<br>-Top construction support for solar panels                          | Al.                   |                    |
| 521.440        |  | -Donji nosač podkonstrukcije za solare-<br>60mm<br>-Bottom construction support for solar<br>panels-60mm       | Al.                   |                    |
| 521.441        |  | -Donji nosač podkonstrukcije za solare-<br>92mm<br>-Bottom horizontal construction support for<br>solar panels | Al.                   |                    |
|                |                                                                                     |                                                                                                                |                       |                    |

# Dodaci Accessories



| Oznaka<br>Code | Izgled-presjek<br>View- cross section                                               | Opis<br>Description                                                                                                          | Materijal<br>Material | Napomena<br>Remark |
|----------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------|
| 431.561        |    | <ul style="list-style-type: none"> <li>- Vijak M8x18</li> <li>- DIN 912</li> <li>- Screw M8x18</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.565        |    | <ul style="list-style-type: none"> <li>- Vijak M8x20</li> <li>- DIN 912</li> <li>- Screw M8x20</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.559        |   | <ul style="list-style-type: none"> <li>- Vijak M8x22</li> <li>- DIN 912</li> <li>- Screw M8x22</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.560        |  | <ul style="list-style-type: none"> <li>- Vijak M8x25</li> <li>- DIN 912</li> <li>- Screw M8x25</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.567        |  | <ul style="list-style-type: none"> <li>- Vijak M8x30</li> <li>- DIN 912</li> <li>- Screw M8x30</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.568        |  | <ul style="list-style-type: none"> <li>- Vijak M8x35</li> <li>- DIN 912</li> <li>- Screw M8x35</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |
| 431.566        |  | <ul style="list-style-type: none"> <li>- Vijak M8x40</li> <li>- DIN 912</li> <li>- Screw M8x40</li> <li>- DIN 912</li> </ul> | Inox A2               |                    |

| Oznaka<br>Code | Izgled-presjek<br>View- cross section                                               | Opis<br>Description                                                                                                                                                                    | Materijal<br>Material | Napomena<br>Remark |
|----------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------|
| 431.569        |    | <ul style="list-style-type: none"> <li>- Vijak M8x45</li> <li>- DIN 912</li> <li>- Screw M8x45</li> <li>- DIN 912</li> </ul>                                                           | Inox A2               |                    |
| 431.055        |    | <ul style="list-style-type: none"> <li>- Vijak M8x35</li> <li>- DIN 933</li> <li>- Screw M8x35</li> <li>- DIN 933</li> </ul>                                                           | Inox A2               |                    |
| 431.562        |   | <ul style="list-style-type: none"> <li>- T Vijak M8 x 30</li> <li>- (22 x 13 x 4)</li> <li>- DIN 125</li> <li>- T Screw M8 x 30</li> <li>- (22 x 13 x 4)</li> <li>- DIN 125</li> </ul> | Inox A2               |                    |
| 432.048        |  | <ul style="list-style-type: none"> <li>- Matica sa oprugom M8</li> <li>- (22 x 13 x 10)</li> <li>- Nut with spring M8</li> <li>- (22 x 13 x 10)</li> </ul>                             | Al                    |                    |
| 433.016        |  | <ul style="list-style-type: none"> <li>- Vijak 3.9x13</li> <li>- DIN 7982</li> <li>- Screw 3.9x13</li> <li>- DIN 7982</li> </ul>                                                       | Inox A2               |                    |
| 432.014        |  | <ul style="list-style-type: none"> <li>- Sigurnosna Matica M8</li> <li>- DIN 985</li> <li>- Security Nut M8</li> <li>- DIN 985</li> </ul>                                              | Inox A2               |                    |

| Oznaka<br>Code | Izgled-presjek<br>View- cross section                                                         | Opis<br>Description                                      | Materijal<br>Material | Napomena<br>Remark |
|----------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------|--------------------|
| 433.213        |  <p>M1:2</p> | -Vijak za drvo M6x120<br>-Wood screw M6x120              | Inox A2               |                    |
| 344.105        |              | - Brtva kod FNE 1100<br>- FNE 1100 gasket                | TPE                   |                    |
| 432.112        |             | - Podloška U6<br>- DIN 125<br>- Washer U6<br>- DIN 125   | Inox A2               |                    |
| 432.113        |            | - Podloška U8<br>- DIN 125<br>- Washer U8<br>- DIN 125   | Inox A2               |                    |
| 432.129        |            | - Podloška U8<br>- DIN 1441<br>- Washer U8<br>- DIN 1441 | Inox A2               |                    |
| 522.001        |            | -Pločica za galvanski kontakt<br>-Galvanic contact plate | Inox 304              |                    |



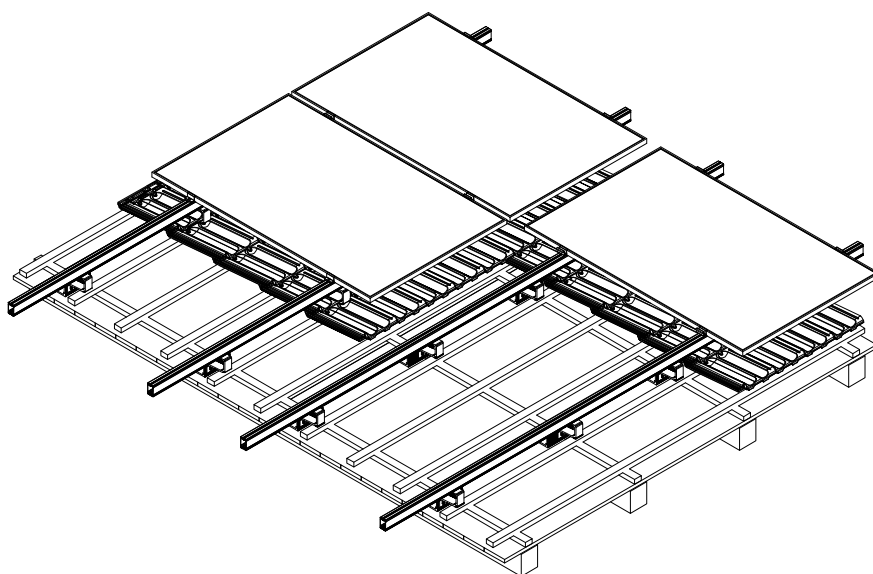
# Presjeci

## Cross sections

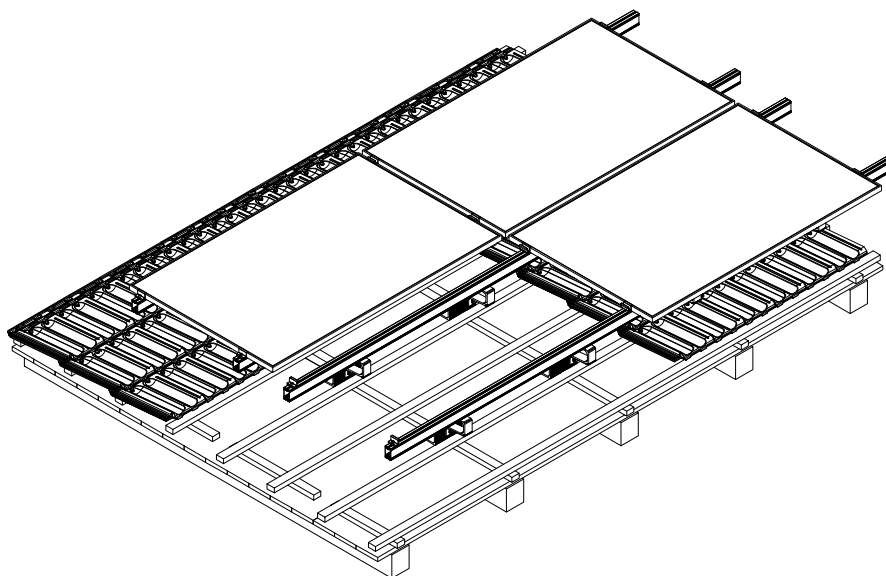


Sistem FNE 1100 podijeljen je u dvije osnovne cjeline, horizontalno i vertikalno montiranje solarnih panela. Solarni paneli dolaze u različitim visinama, zbog toga su razvijene kopče koje odgovaraju tim visinama.

The FNE 1100 system is divided into two basic parts, horizontal and vertical mounting of solar panels. Solar panels come in different heights, which is why different clamps have been developed to match those heights.



Vertikalna montaža solarnih panela  
Vertical installation of solar panels

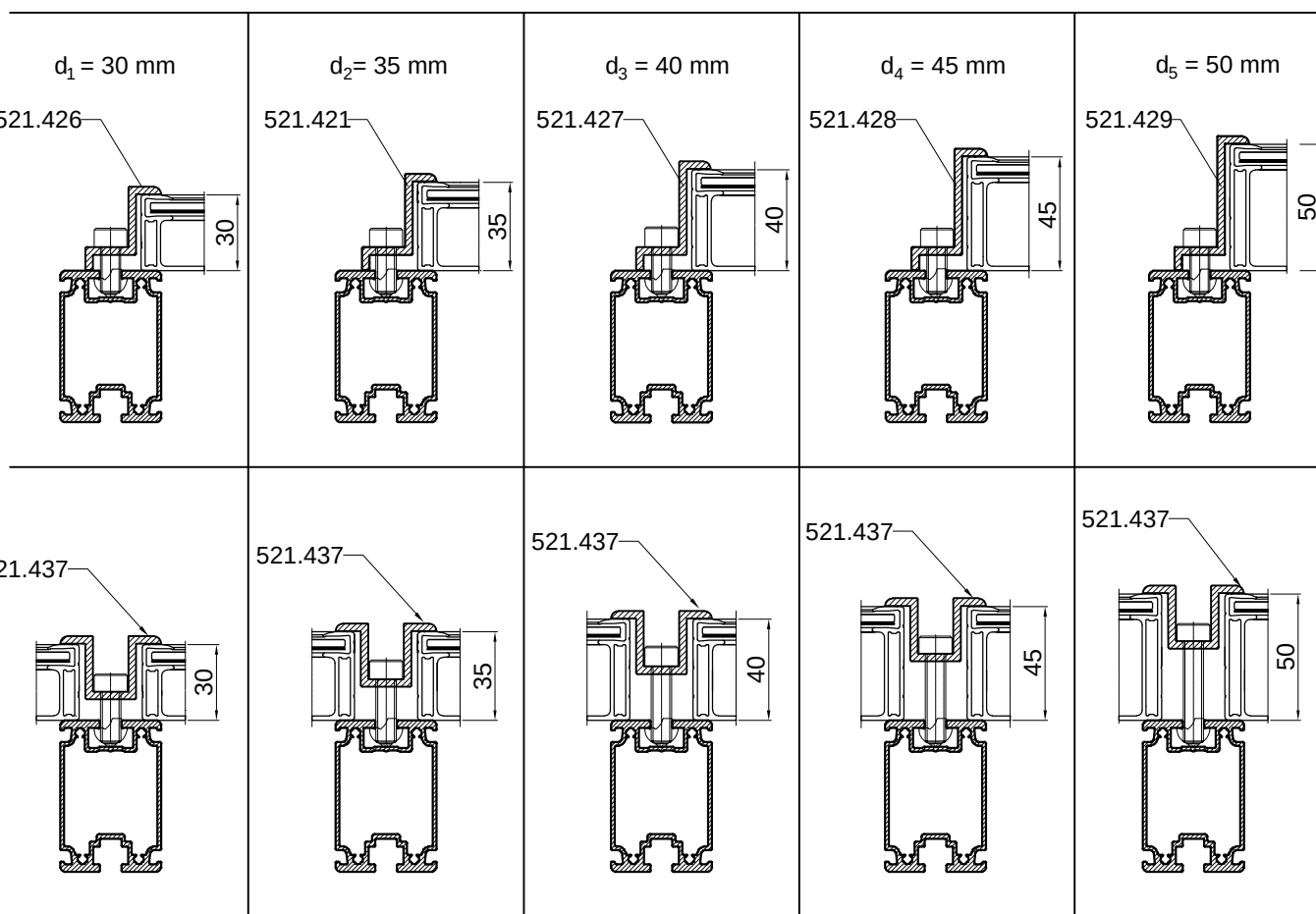


Horizontalna montaža solarnih panela  
Horizontal installation of solar panels

## Dimenzije kopči i vijaka za različite visine solarnih panela

Dimensions of side holders and screws for different heights  
of solar panels

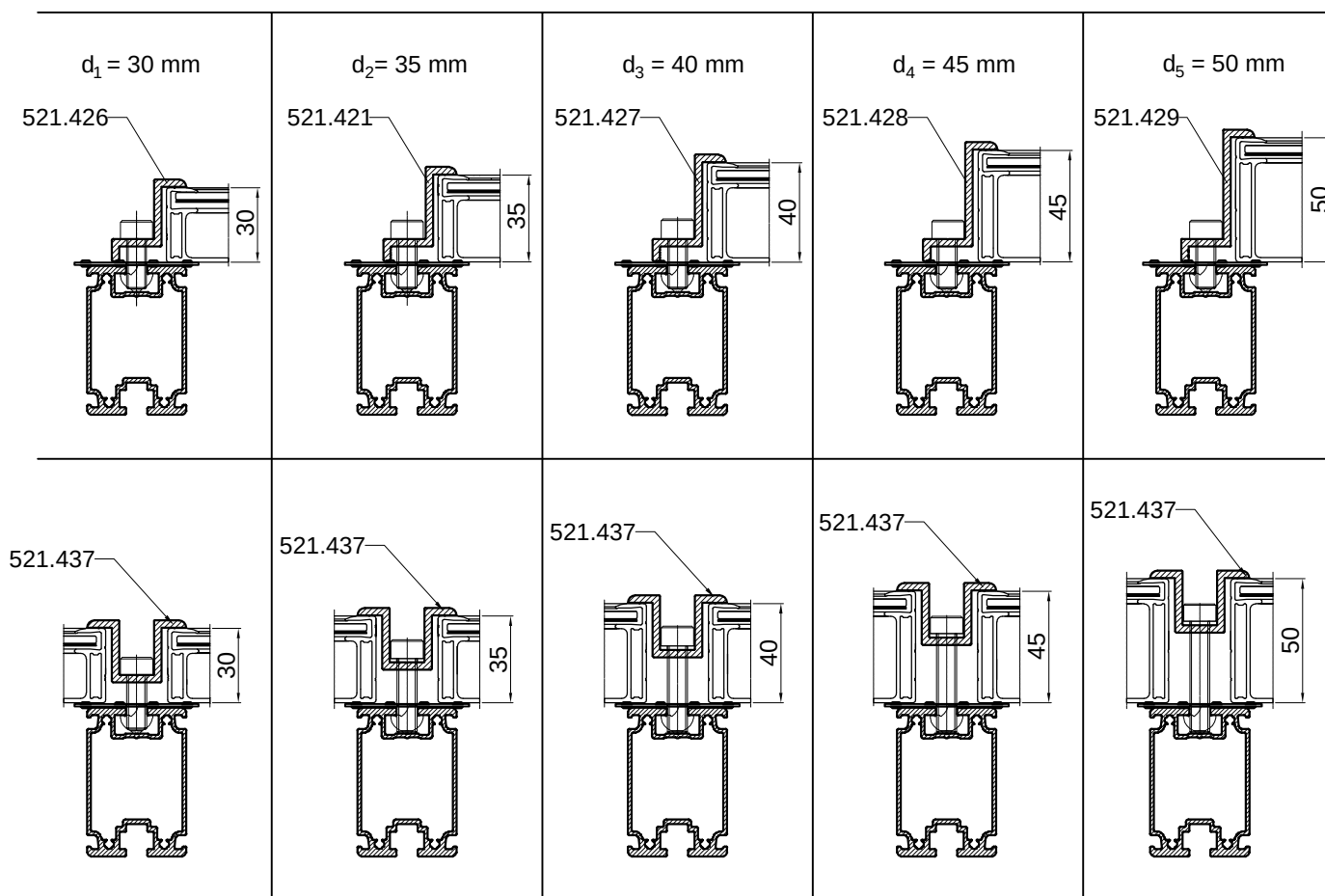
| Visina panela (d)<br>Panel height (d) |       | Korišteni vijak za bočnu kopču<br>Used screw for side holder-<br>single sided | Korišteni vijak za srednju kopču<br>Used screw for side holder-<br>double sided |
|---------------------------------------|-------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| d <sub>1</sub>                        | 30 mm | Vijak M8x18<br>431.561                                                        | Vijak M8x20<br>431.565                                                          |
| d <sub>2</sub>                        | 35 mm | Vijak M8x18<br>431.561                                                        | Vijak M8x25<br>431.560                                                          |
| d <sub>3</sub>                        | 40 mm | Vijak M8x18<br>431.561                                                        | Vijak M8x30<br>431.567                                                          |
| d <sub>4</sub>                        | 45 mm | Vijak M8x18<br>431.561                                                        | Vijak M8x35<br>431.568                                                          |
| d <sub>5</sub>                        | 50 mm | Vijak M8x18<br>431.561                                                        | Vijak M8x40<br>431.566                                                          |



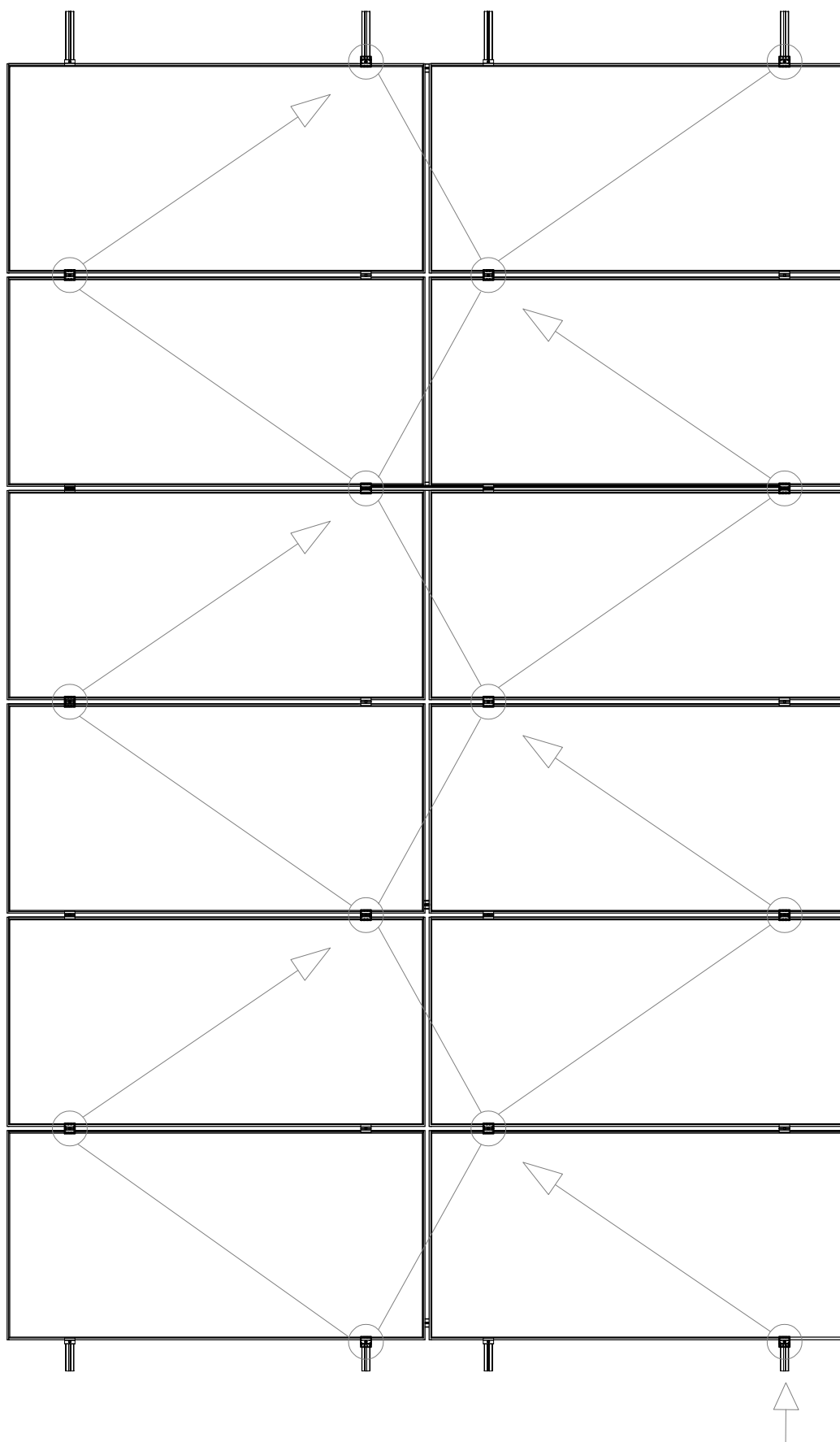
Detalj kopči s pločicom za galvanski kontakt 522.001. Preporučeni broj pločica za jednu sekciju od 12 vertikalno montiranih panela je 6, odnosno pola od ukupnog broja korištenih kopči.

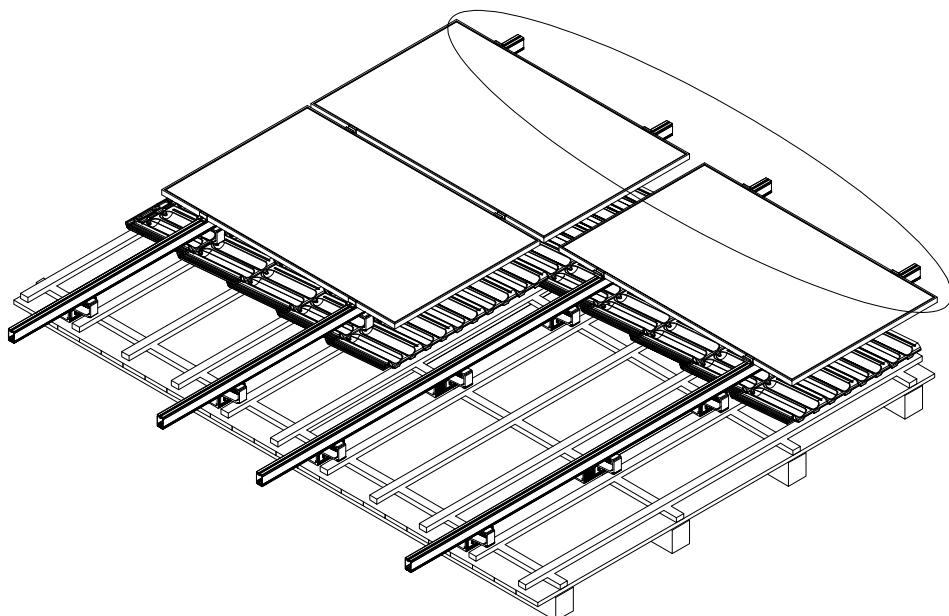
Detail with the galvanic contact plate 522.001. The recommended number of plates for one section of 12 vertically-mounted panels is 6, that is half of the total number of clamps used.

| Visina panela (d)<br>Panel height (d) |       | Korišteni vijak za bočnu kopču<br>Used screw for side holder-<br>single sided | Korišteni vijak za srednju kopču<br>Used screw for side holder-<br>double sided |
|---------------------------------------|-------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| d <sub>1</sub>                        | 30 mm | Vijak M8x20<br>431.565                                                        | Vijak M8x22<br>431.559                                                          |
| d <sub>2</sub>                        | 35 mm | Vijak M8x20<br>431.565                                                        | Vijak M8x30<br>431.567<br>+<br>podloška 432.129                                 |
| d <sub>3</sub>                        | 40 mm | Vijak M8x20<br>431.565                                                        | Vijak M8x35<br>431.568<br>+<br>podloška 432.129                                 |
| d <sub>4</sub>                        | 45 mm | Vijak M8x20<br>431.565                                                        | Vijak M8x40<br>431.566<br>+<br>podloška 432.129                                 |
| d <sub>5</sub>                        | 50 mm | Vijak M8x20<br>431.565                                                        | Vijak M8x45<br>431.569<br>+<br>podloška 432.129                                 |



Prikaz prijedloga rasporeda pločica za galvanski kontakt.  
Proposal of the layout how side holders should be arranged.





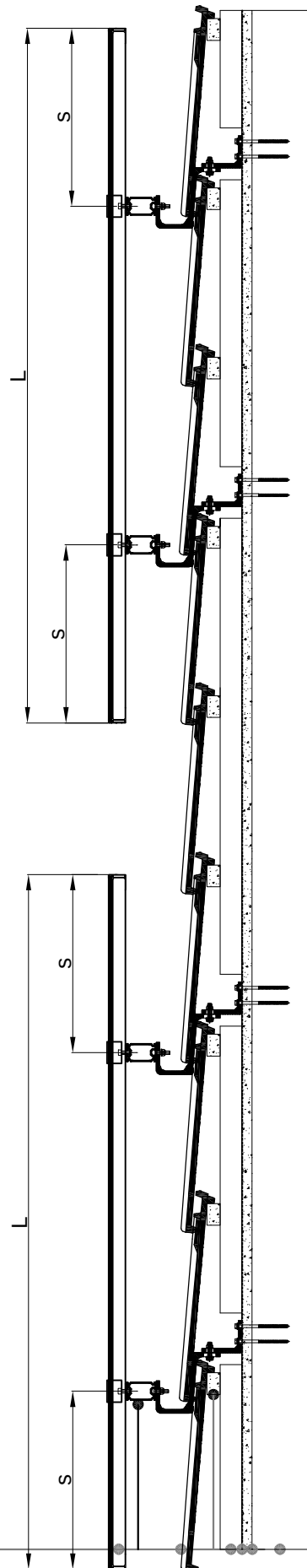
Solarni panel dimenzija:  
LxH=1600±50 x 1000±5  
340<s<1/4L

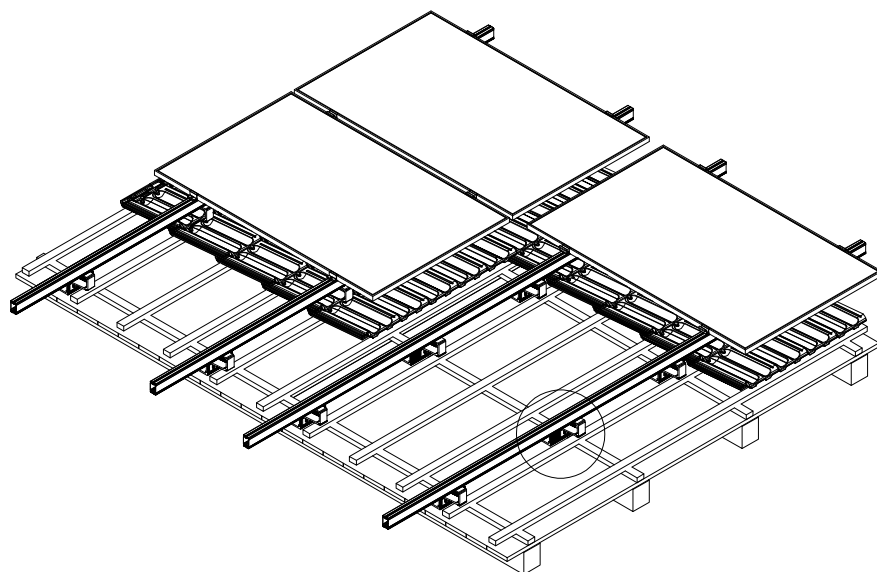
Prikaz rasporeda solarnih panela prilikom vertikalne montaže.

Solar panel dimensions  
LxH=1600±50 x 1000±5  
340<s<1/4L

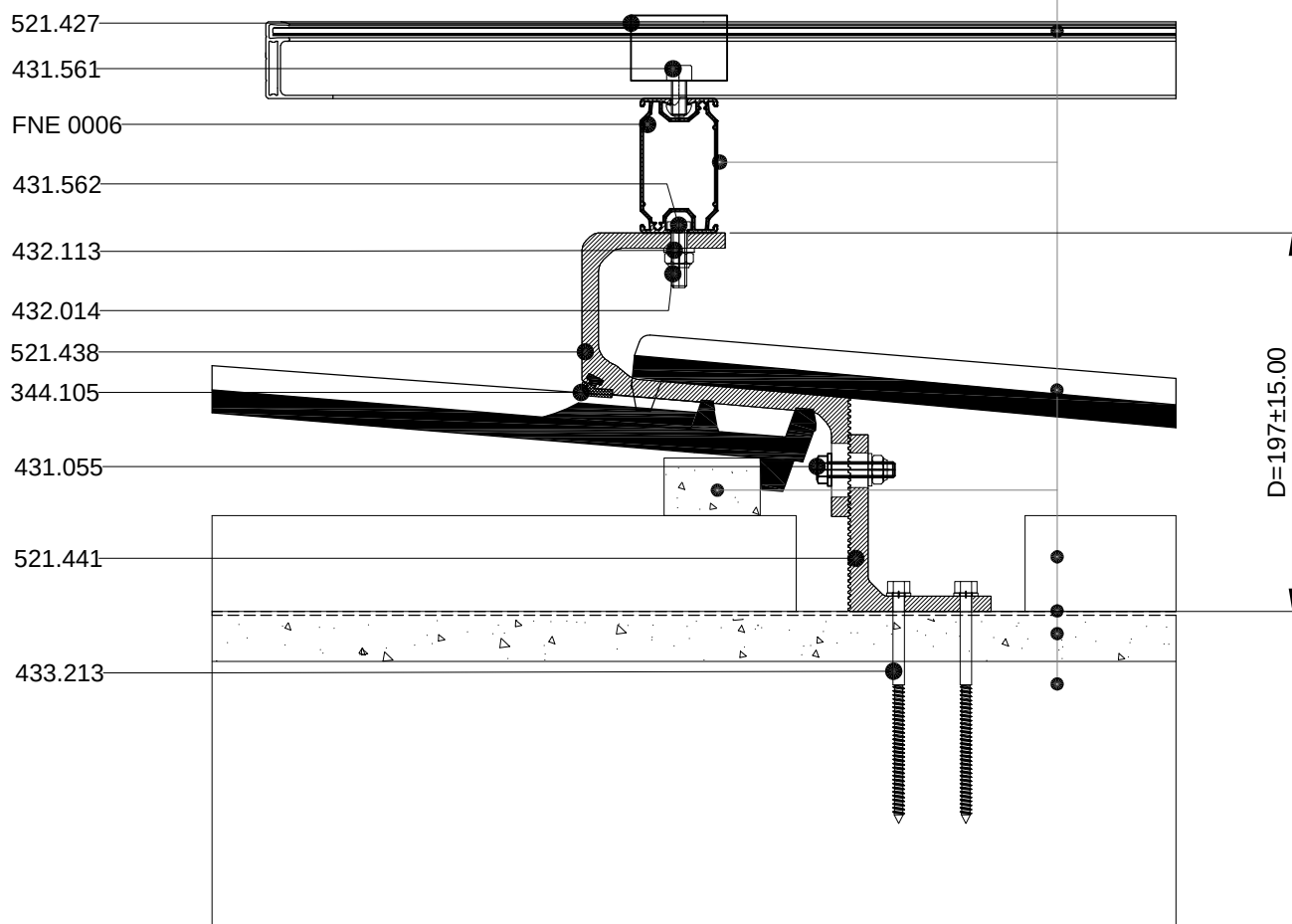
Layout of the solar panels during vertical mounting.

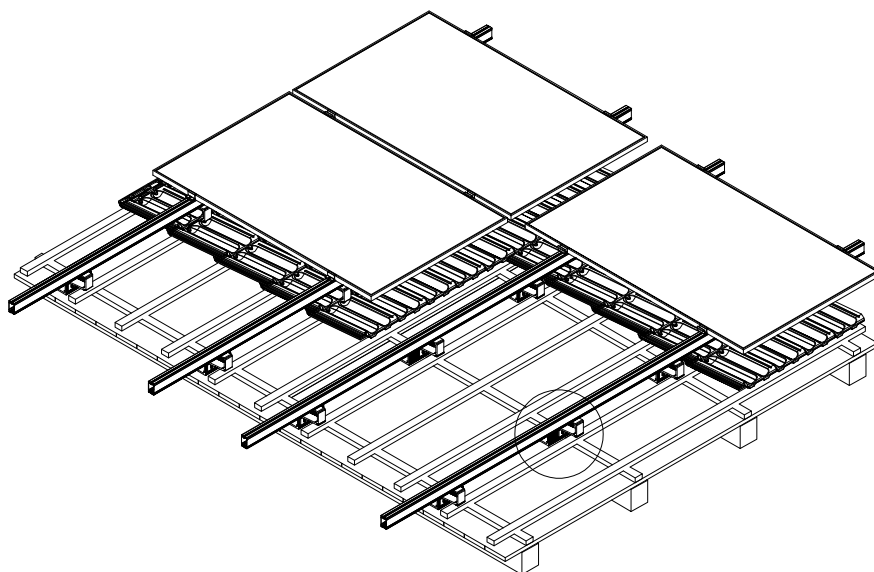
- Rožnik (120x140)
- Rafter(120x140)
- Daščani pokov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel



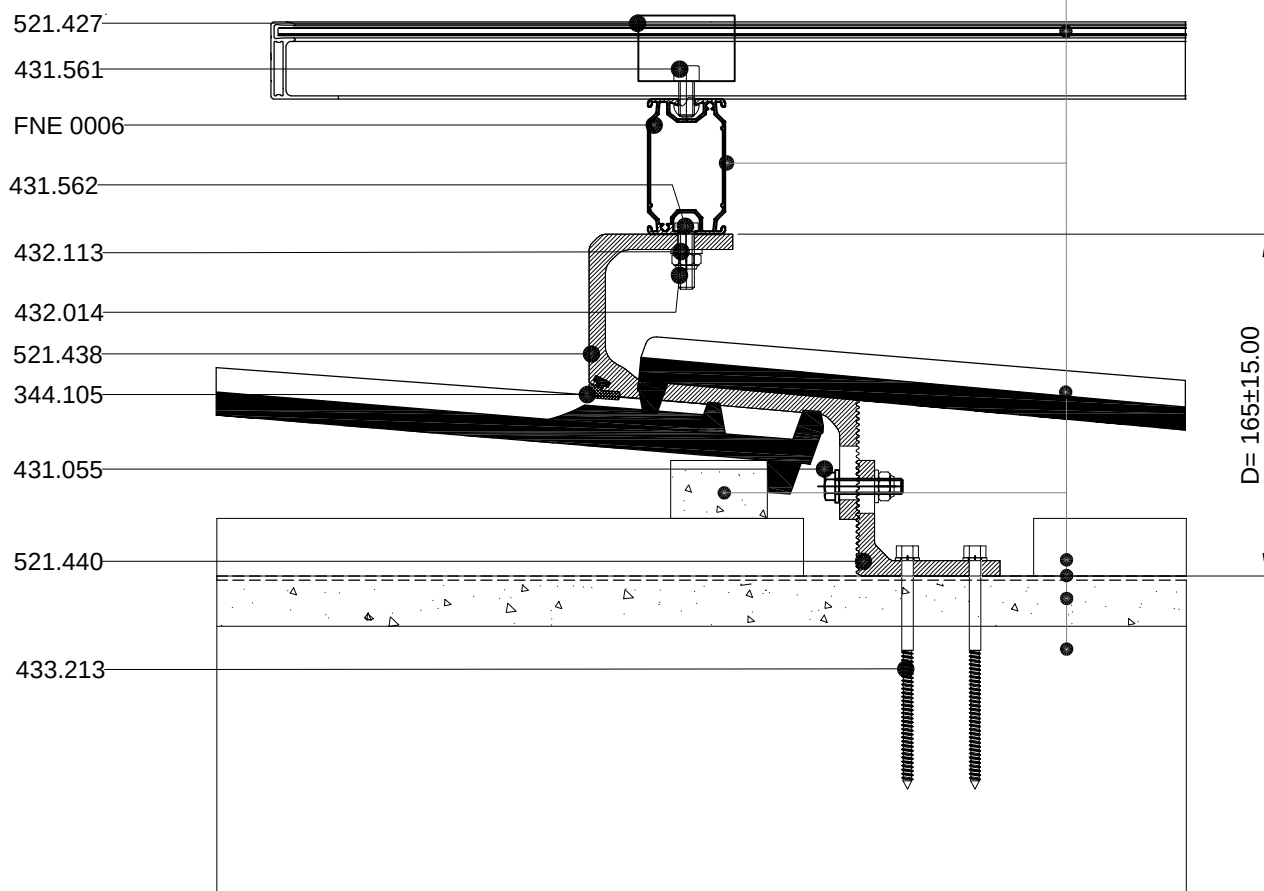


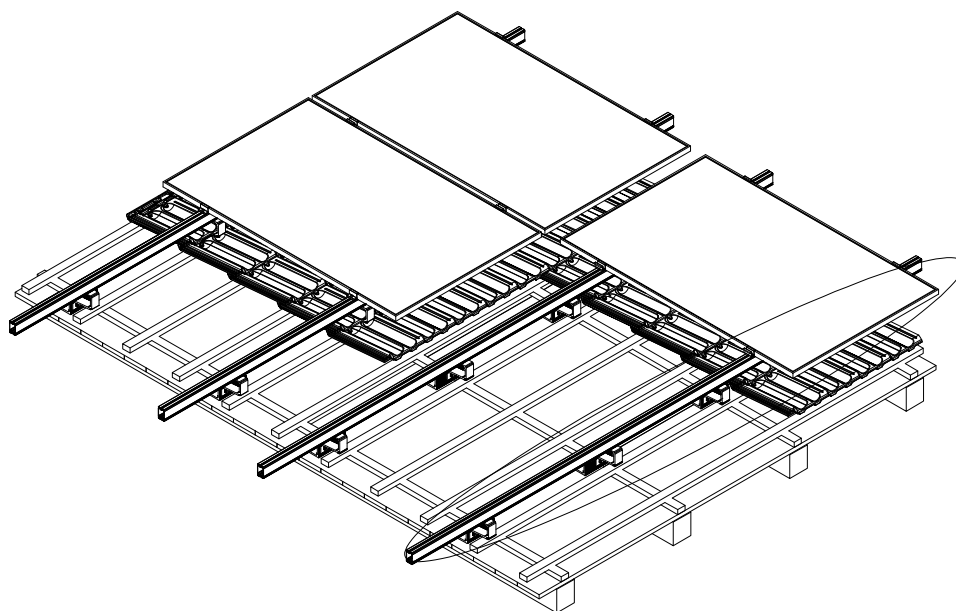
- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel





- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokrov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x30)
- Roof sheathing (50x30)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel





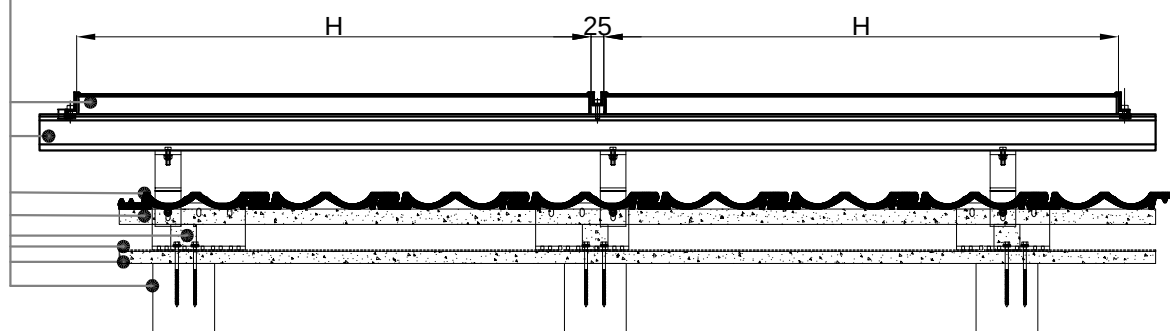
- Rožnik (120x140)
- Rafter(120x140)
- Daščani pokrov (24mm)
- Lining boards
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel

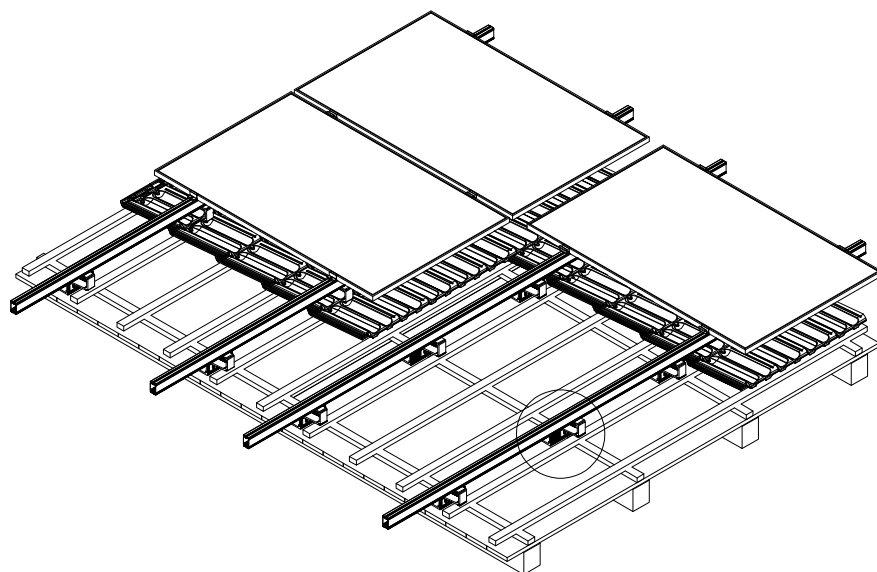
Solarni panel dimenzija:  
 $L \times H = 1600 \pm 50 \times 1000 \pm 5$   
 $340 < s < 1/4L$

Prikaz rasporeda solarnih panela prilikom vertikalne montaže.

Solar panel dimensions  
 $L \times H = 1600 \pm 50 \times 1000 \pm 5$   
 $340 < s < 1/4L$

Layout of the solar panels during vertical mounting.





- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokrov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheeting (50x50)
- Kontra letva (50x30)
- Roof sheeting (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel

521.427

431.562

432.113

432.014

521.438

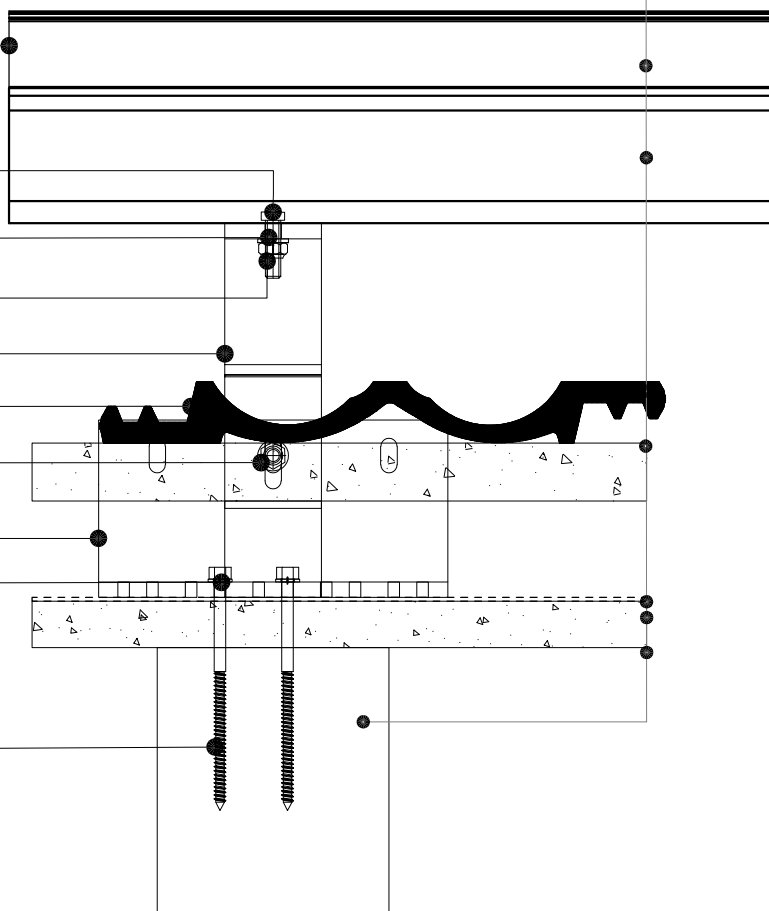
344.105

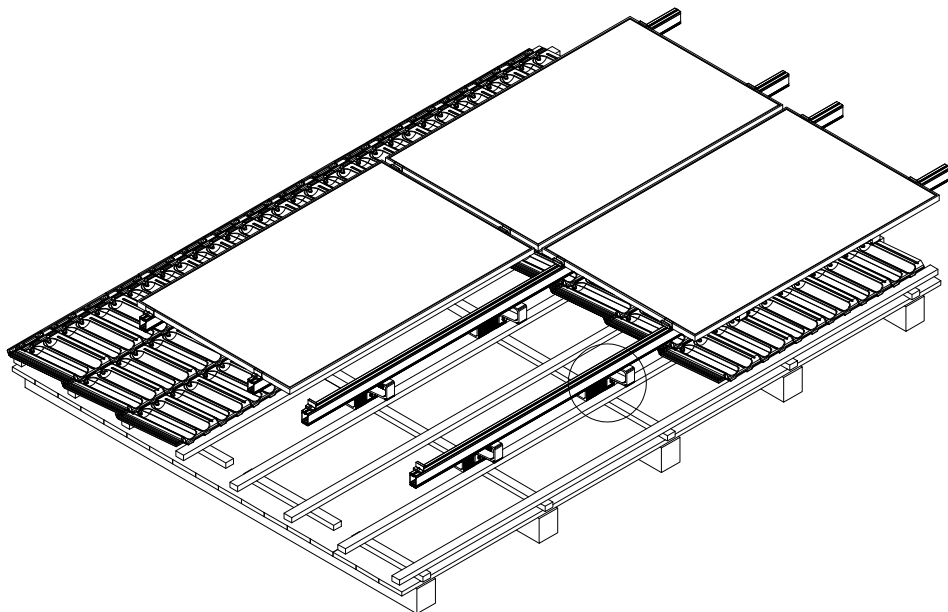
431.055

521.441

432.112

433.213





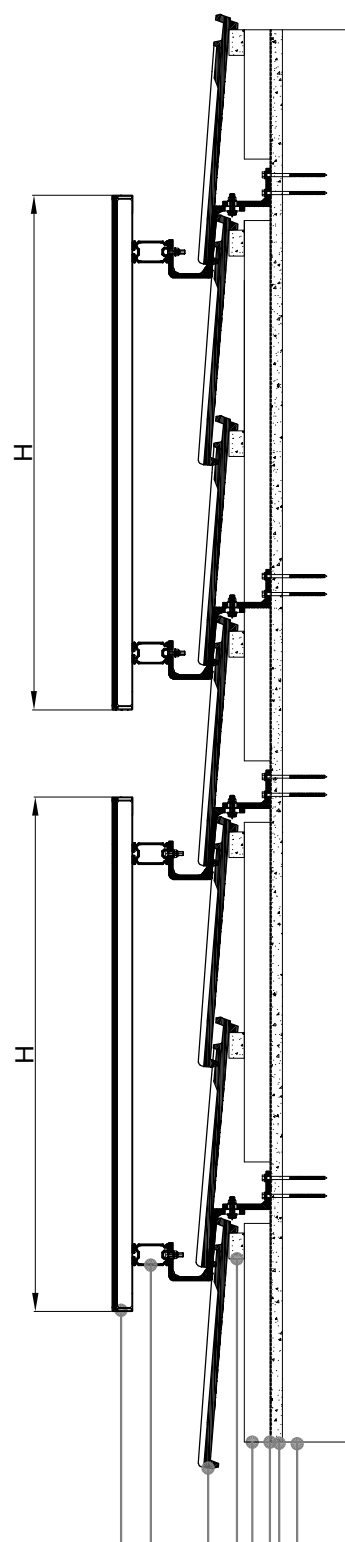
Solarni panel dimenzija:  
 $L \times H = 1600 \pm 50 \times 1000 \pm 5$   
 $340 < s < 1/4L$

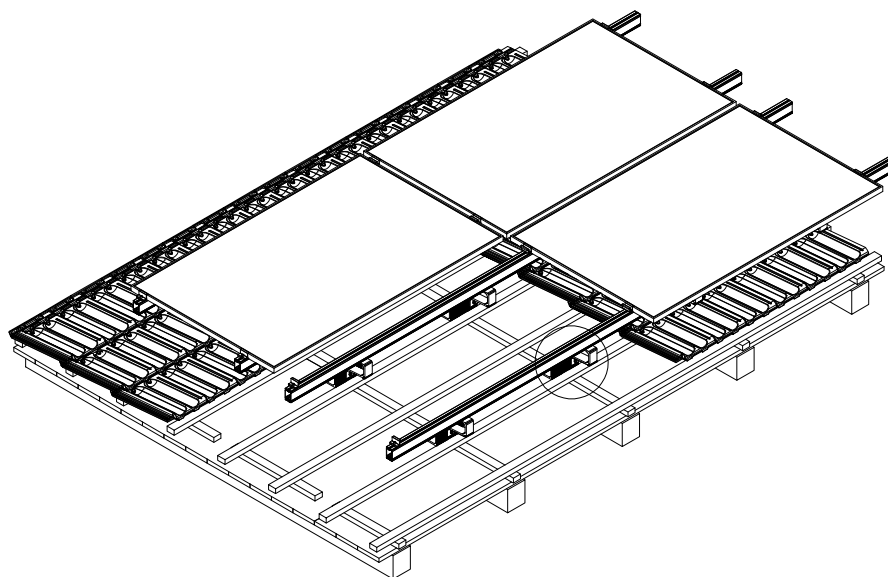
Prikaz rasporeda solarnih panela prilikom horizontalne montaže.

Solar panel dimensions  
 $L \times H = 1600 \pm 50 \times 1000 \pm 5$   
 $340 < s < 1/4L$

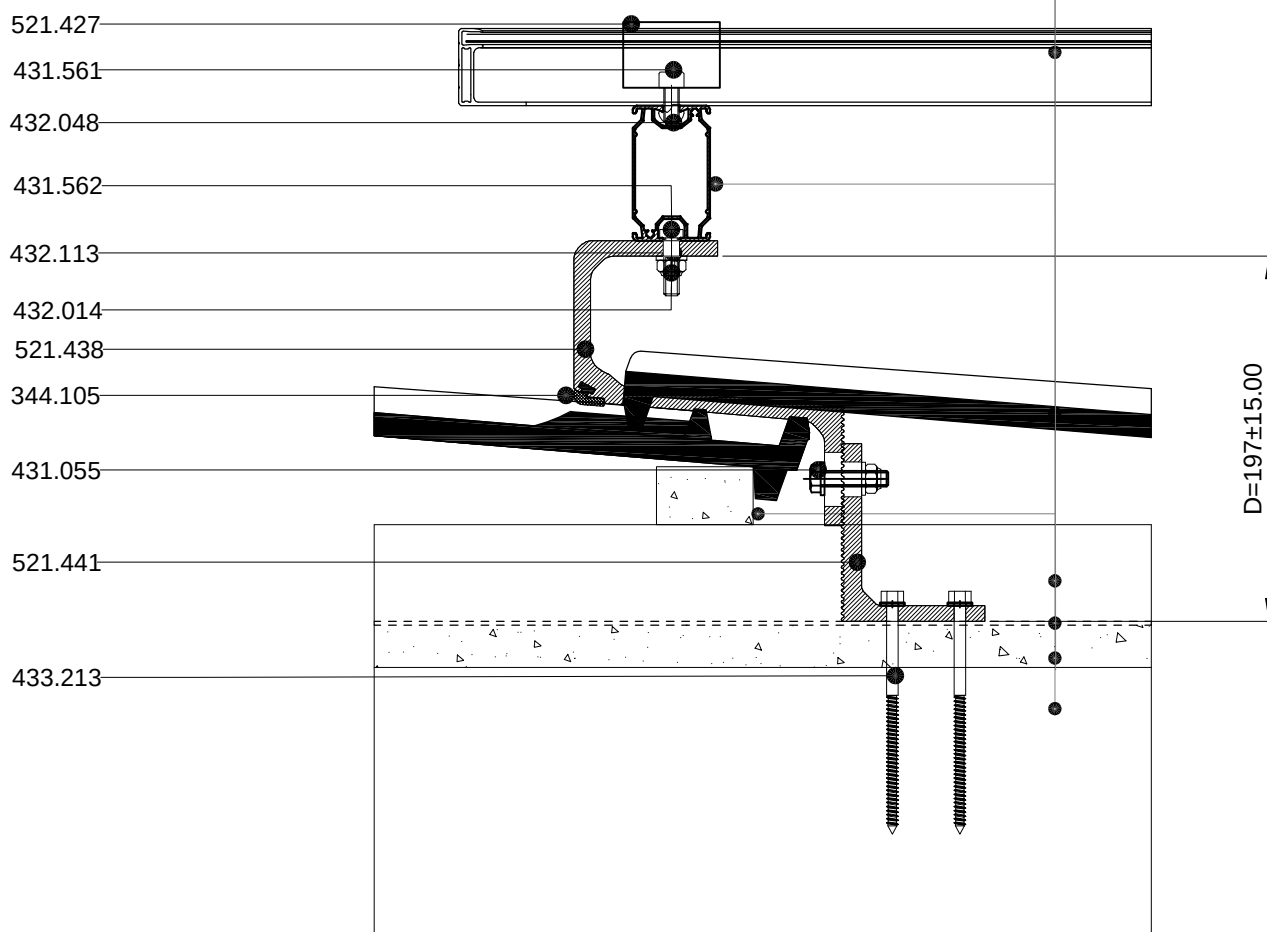
Layout of the solar panels during horizontal mounting.

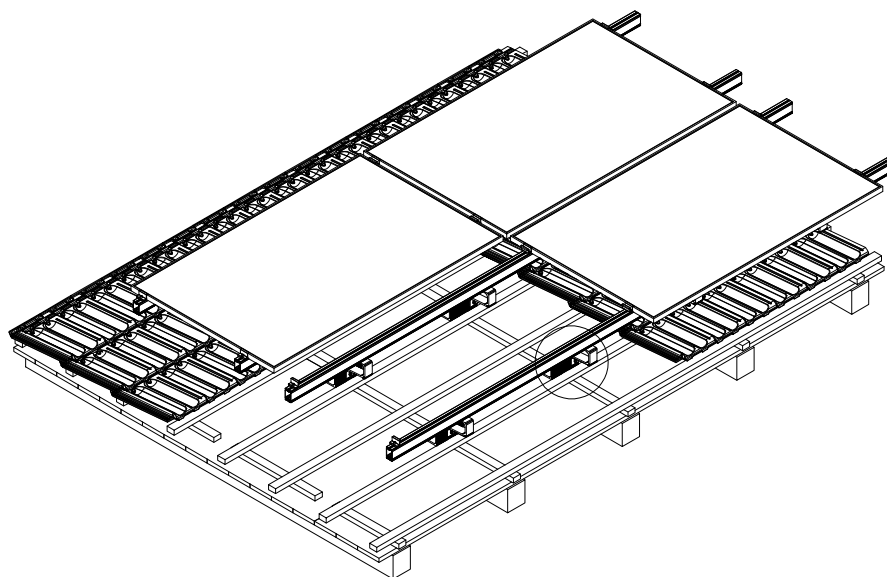
- Rožnik (120x140)
- Rafter(120x140)
- Daščani pokrov (24mm)
- Lining boards
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel



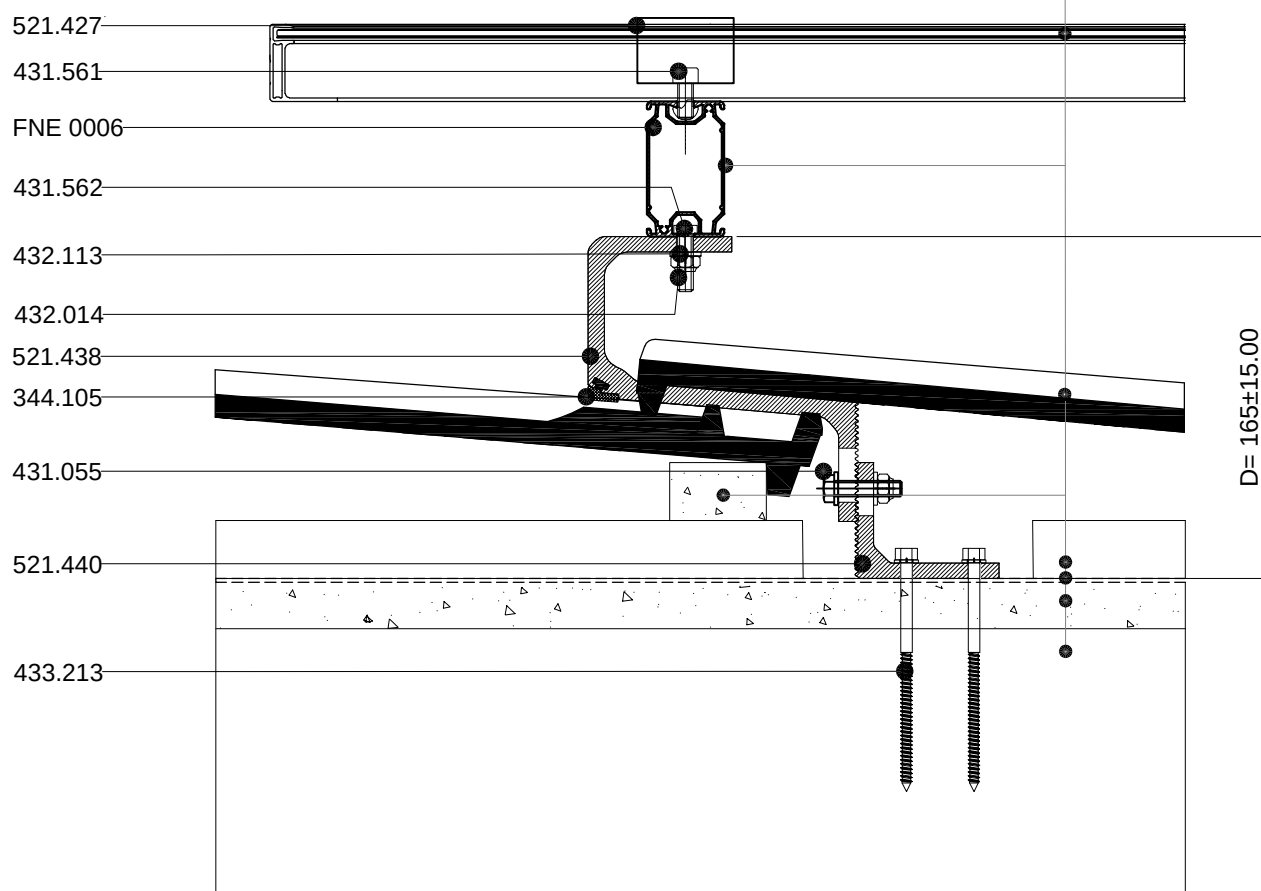


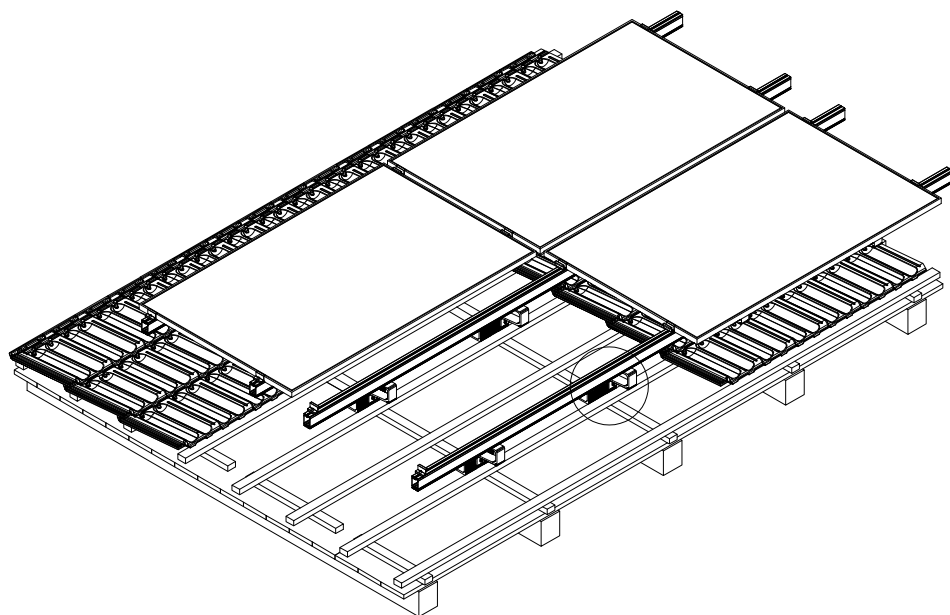
- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel





- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokrov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x30)
- Roof sheathing (50x30)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel





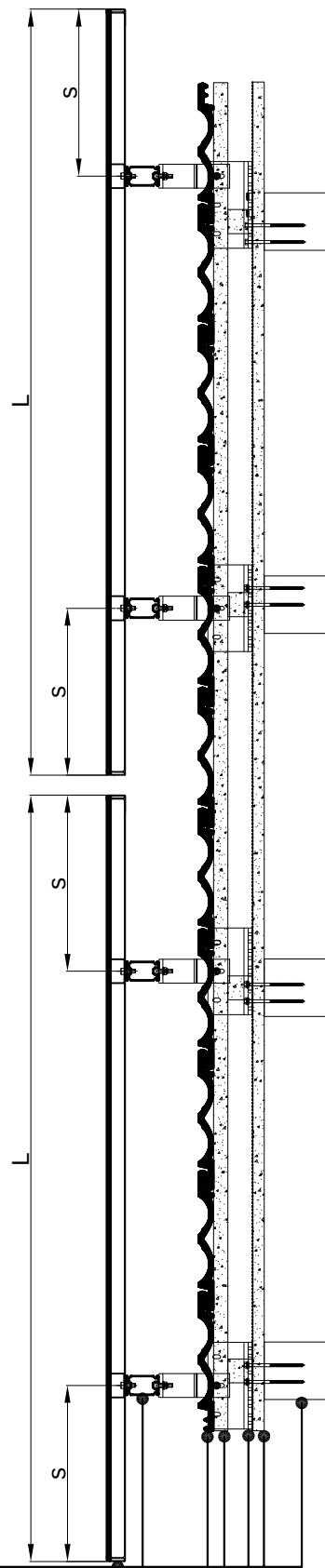
Solarni panel dimenzija:  
LxH=1600±50 x 1000±5  
340<s<1/4L

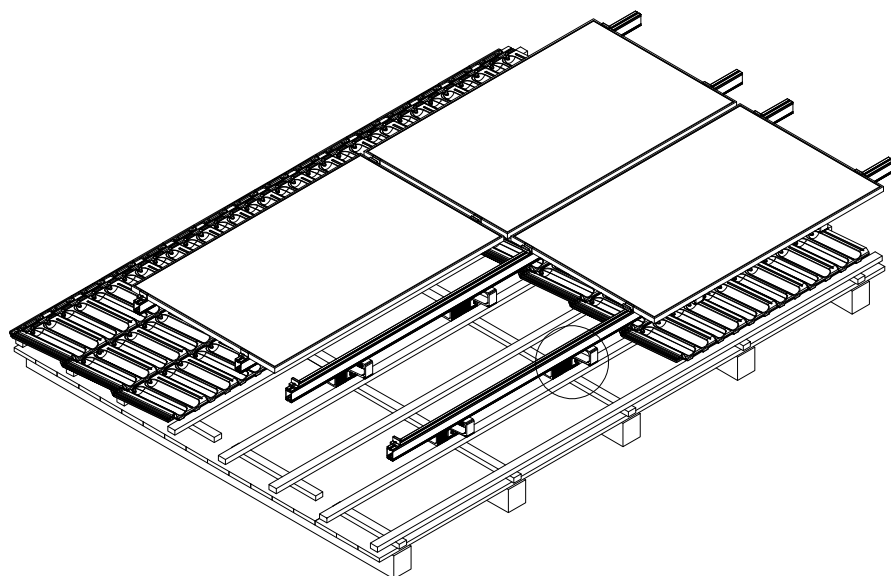
Prikaz rasporeda solarnih panela prilikom horizontalne montaže.

Solar panel dimensions  
LxH=1600±50 x 1000±5  
340<s<1/4L

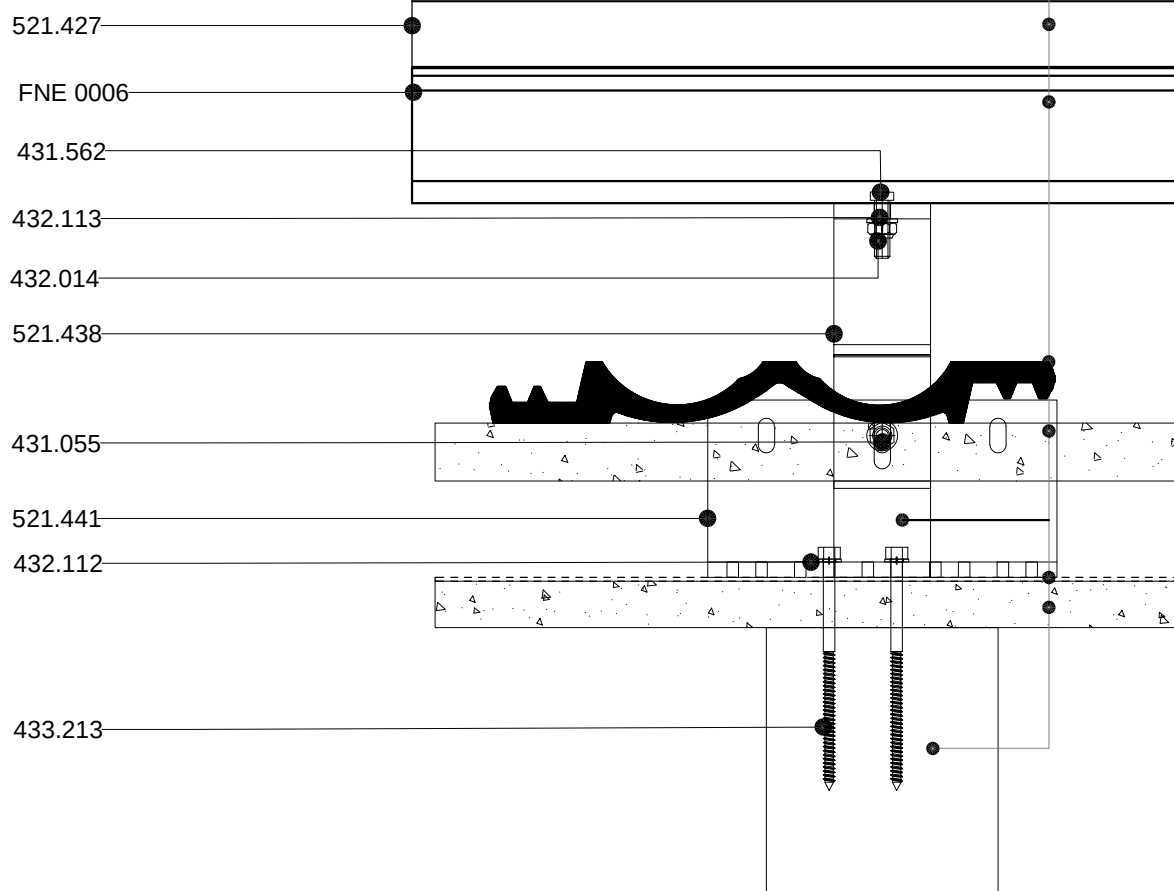
Layout of the solar panels during horizontal mounting.

- Rožnik (120x140)
- Rafter(120x140)
- Daščani pokrov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel





- Rožnik (120x140)
- Rafter (120x140)
- Daščani pokrov (24mm)
- Lining boards (24mm)
- Hidroizolacija
- Waterproofing
- Letva (50x50)
- Roof sheathing (50x50)
- Kontra letva (50x30)
- Roof sheathing (50x30)
- Crijep
- Tile
- FNE-0006
- FNE-0006
- Solarni panel
- Solar panel



# Obrada i montaža

## Processing and montage



Za analizu aluminijske podkonstrukcije za fotonaponske elektrane najvažnije je definirati solarni panel.

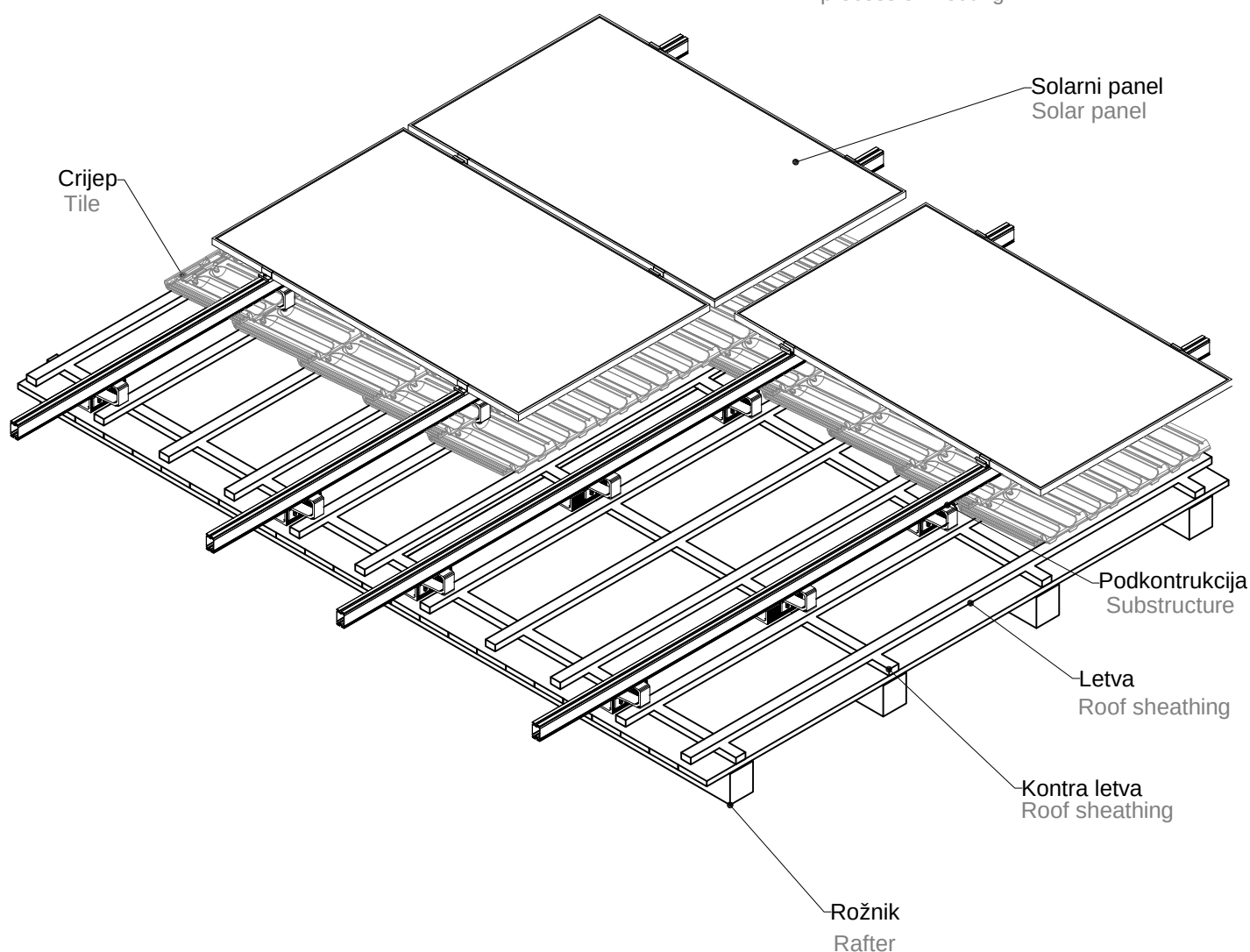
Na osnovu solarnog panela i lokacijskih uvjeta projektant izabire optimalnu aluminijsku konstrukciju i način slaganja solarnih panela.

Nakon odabira tipa konstrukcije započinje proces montaže solarnih panela na krov.

For the analysis of the aluminum substructure for photovoltaic power plants, the most important thing is to define a solar panel.

Based on the solar panel and location conditions, the designer chooses the optimal aluminum construction and the way of assembling the solar panels.

After selecting the type of construction begins the process of mouting.





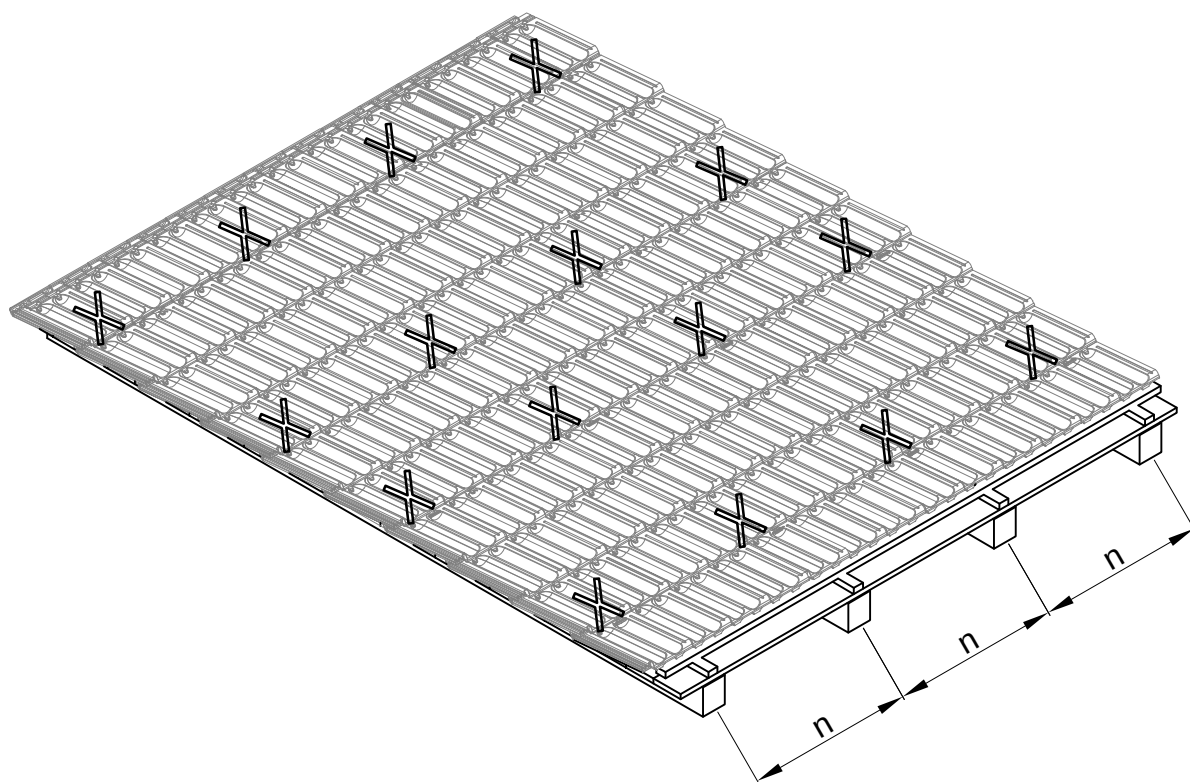
### 1. ODREĐIVANJE POLOŽAJA DONJEG NOSAČA

Montaža donjeg nosača 521.440 (521.441) se uvijek izvodi iznad rožnika krovne konstrukcije.

Prvi korak montaže podkonstrukcije solarnih panela započinje mjerenjem i označavanjem mjesta na koji dolazi donji držač 521.440 (521.441) podkonstrukcije.

### 1. POSITIONING OF THE BOTTOM CARRIER

The bottom support 521.440 (521.441) is always installed directly on the rafter. First step of mounting of the substructure of the solar panels begins with measuring and marking of a place where the bottom carrier 521.440 (521.441) will be placed.



n-udaljenost između rožnika

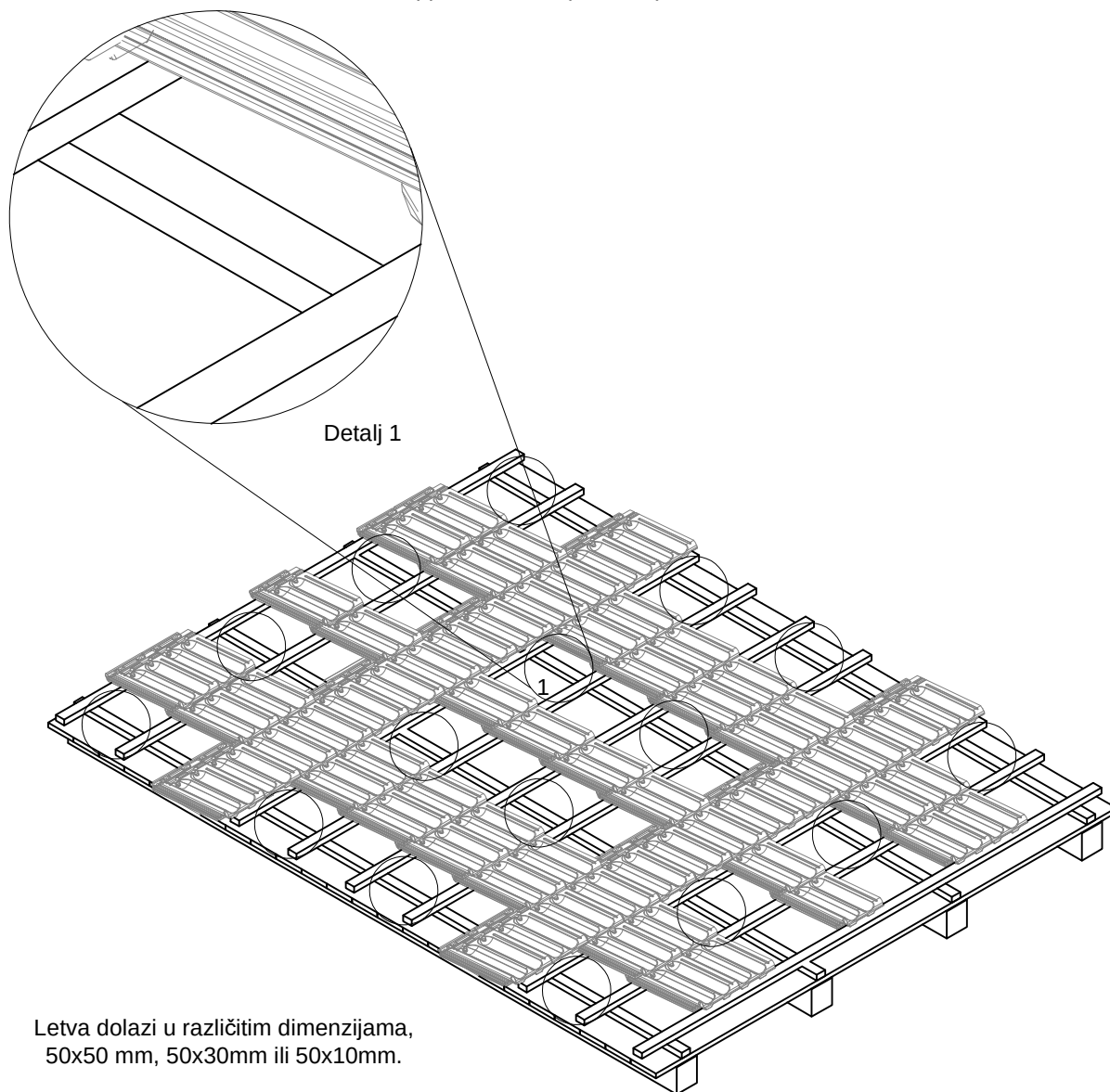
n-distance between rafters

## 2. OBRADA LETVE

Nakon što smo odredili mjesta na koje dolazi donji nosač 521.440 (521.441), u drugom koraku montaže uklanjamo crijep s označenog mjesta, te vršimo obradu letve tako što s mjesta na koje dolazi donji nosač 521.440 odstranimo 120 mm materijala dužinom.

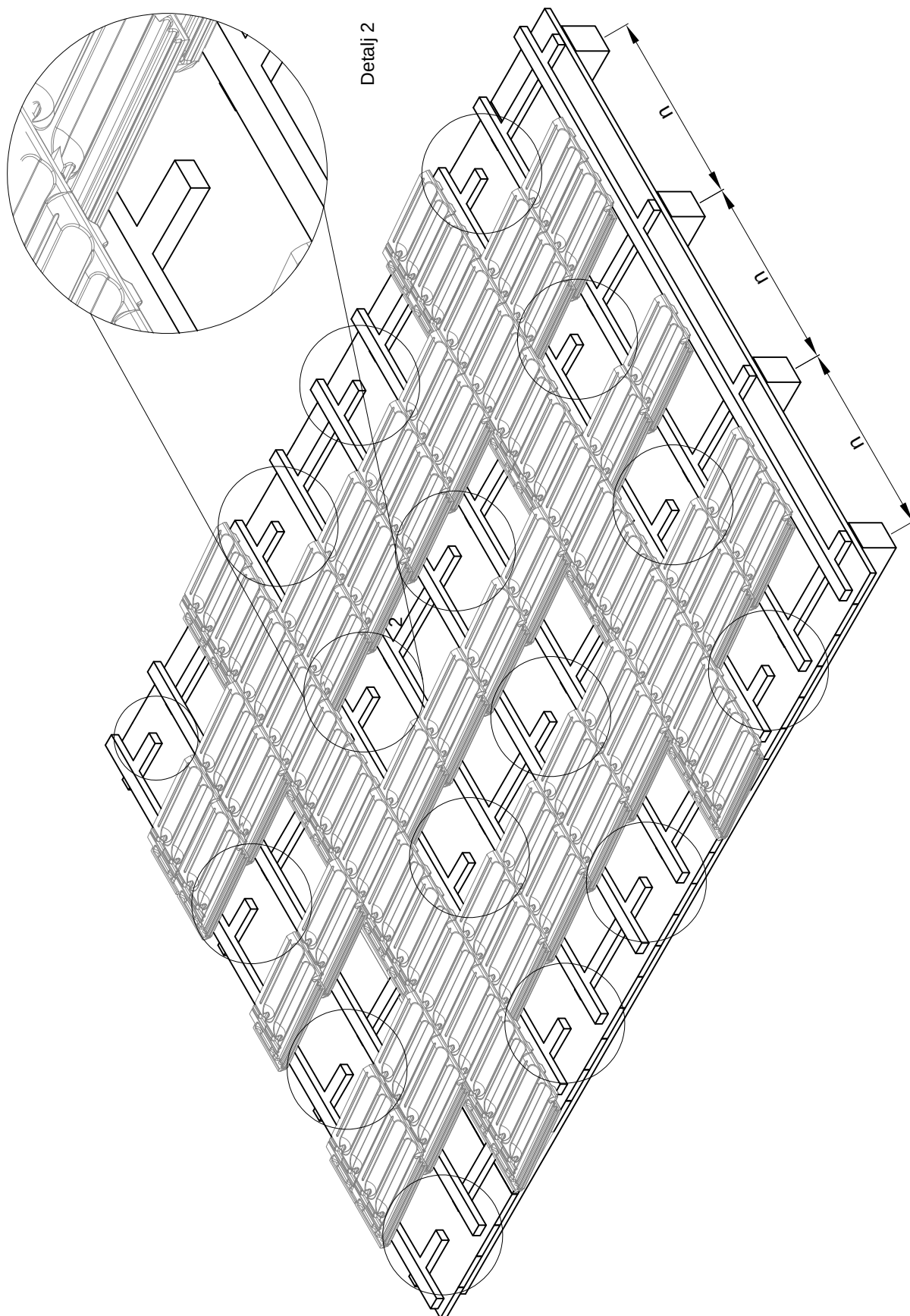
## 2. ROOF SHEETING PROCESSING

Once we have determined the location of the bottom support 521.440 (521.441) in the second step of mounting remove the tile from the marked place, and process the roof sheeting by removing 120 mm of material in length from the place where the bottom support 521.440 (521.441) comes in.



Letva dolazi u različitim dimenzijama,  
50x50 mm, 50x30mm ili 50x10mm.

Roof sheeting comes in different dimensions,  
50x50 mm, 50x30mm ili 50x10mm.

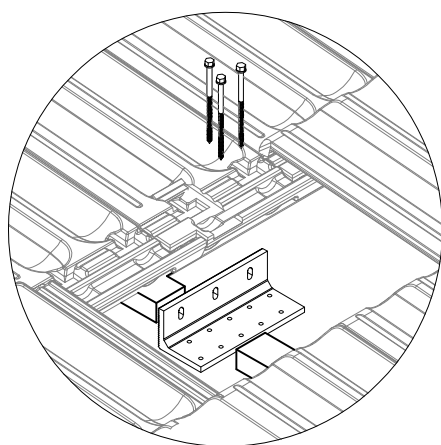


### 3. POSTAVLJANJE DONJEG NOSAČA

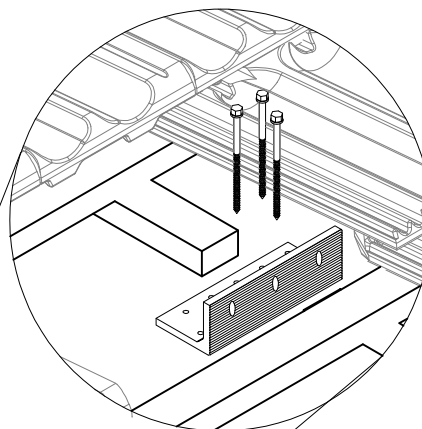
Nakon obrade crijepa i letve na mjestu na koje ćemo postaviti donji nosač 521.440 (521.441) prvo postavljamo sloj silikona kako bismo zaštitili hidroizolaciju. Nakon toga postavljamo donji nosač 521.440 na predviđeno mjesto, koji pričvrstimo pomoću vijaka za drvo 433.213.

### 3. BOTTOM CARRIER MOUNTING

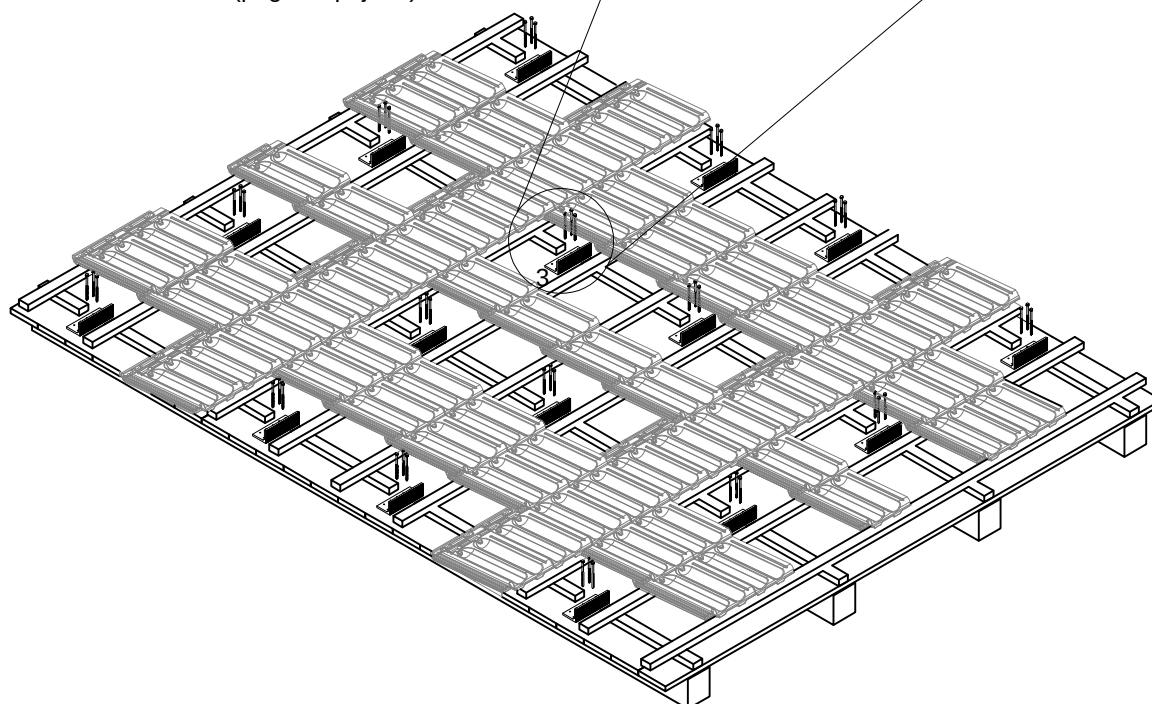
After processing the tiles and roof sheeting, first place a layer of silicone on the place where you will place the bottom support 521.440 (521.441) to protect the waterproofing. After that, place bottom support in the intended place and fasten it with wood screws 433.211.

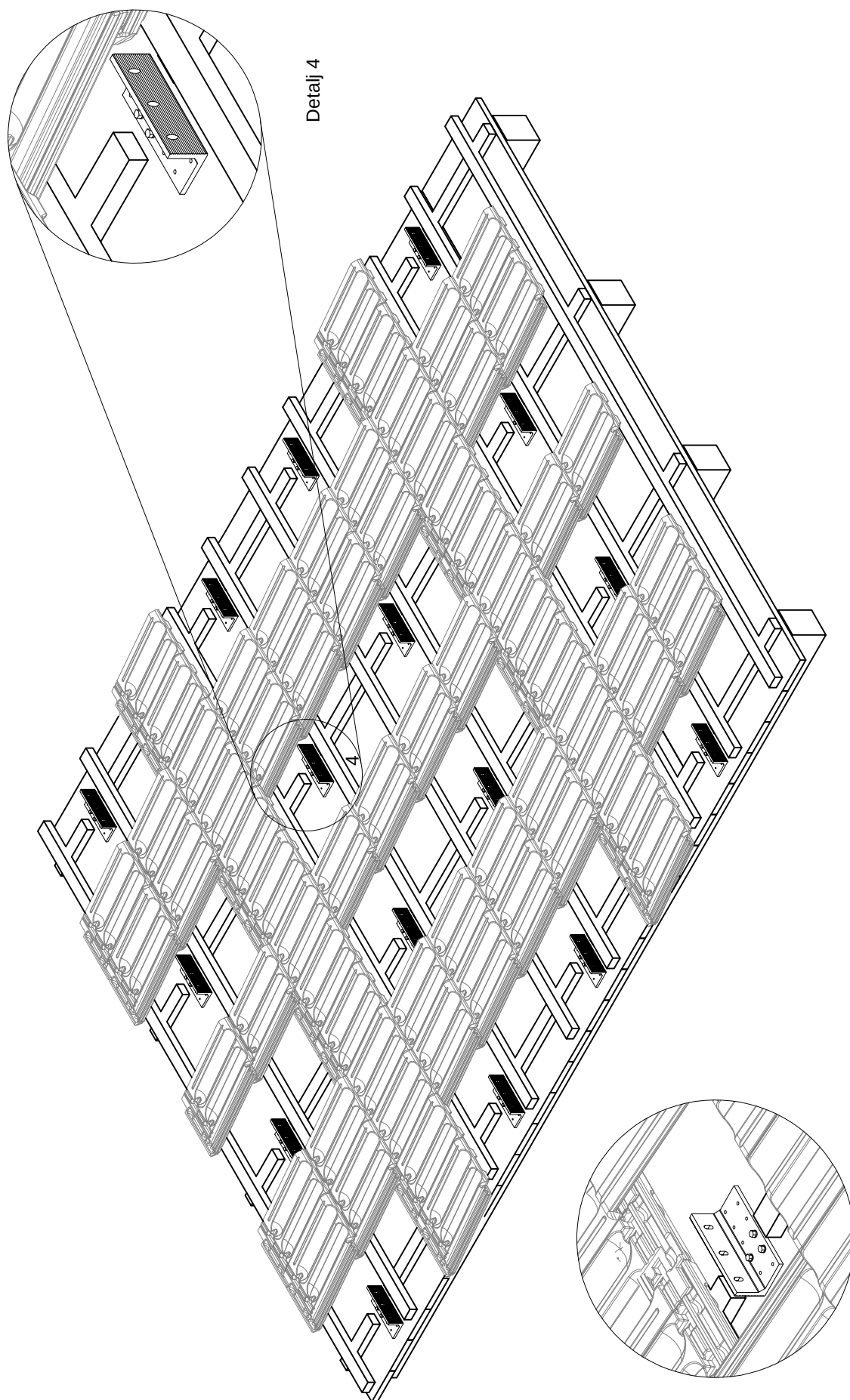


Detalj 3  
(pogled sprijeda)



Detalj 3





Detalj 4

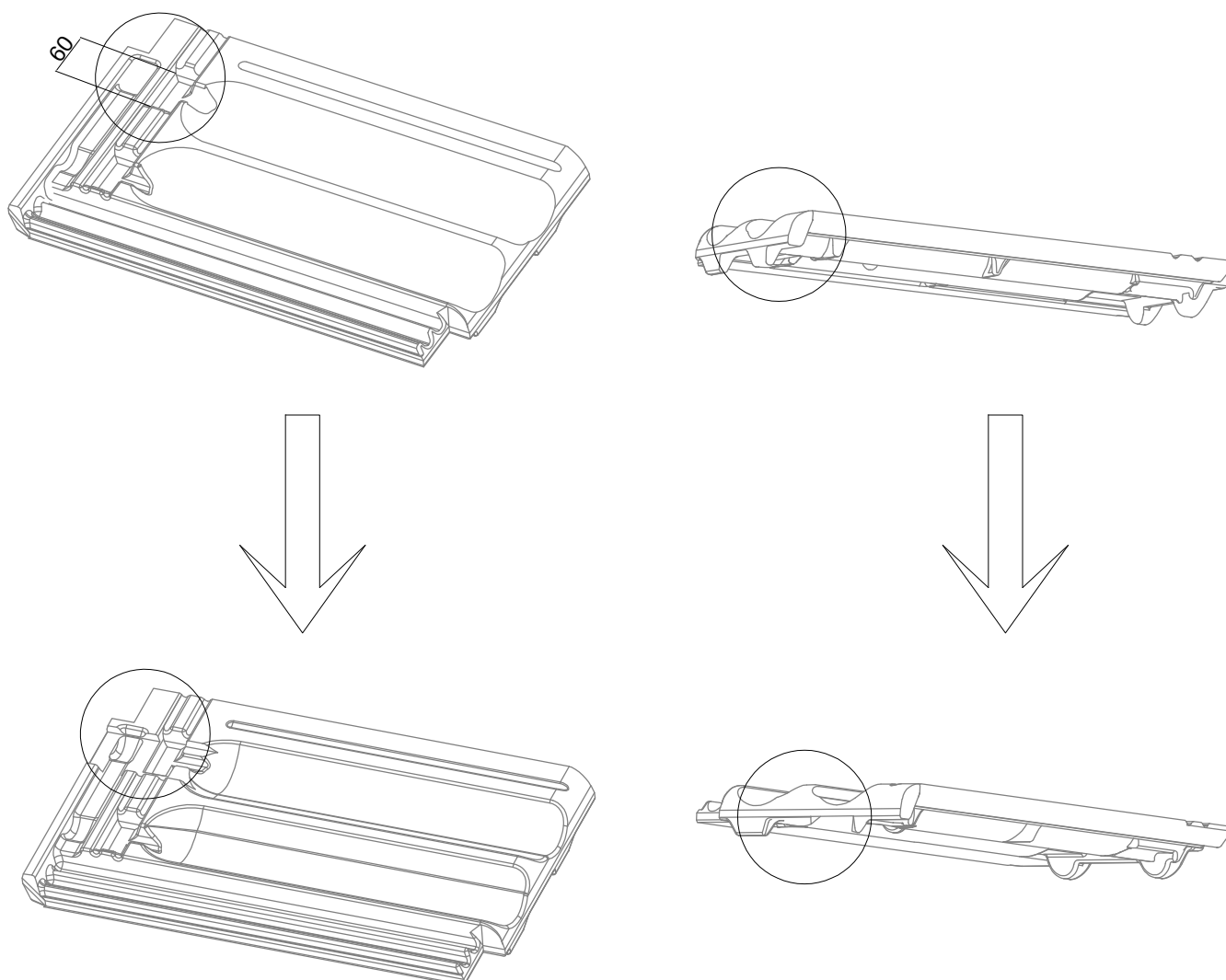
Detalj 4  
(pogled srijeda)

## 4. OBRADA CRIJEPA

Četvrti korak montaže je obrada crijepa. Dodatnom obradom uklonimo dio materijala s gornjeg i donjeg crijepa ispod kojeg će se nalaziti nosač. Obrada crijepa ovisi o tipu crijepa (mediteranski, kontinentalni ili ravni).

## 4. TILE PROCESSING

The fourth step of mounting is tile processing. With additional processing remove a part of the material from the top and bottom of the tile, where support will be placed. Tile processing depends on the type of tile (mediterranean, continental or flat).

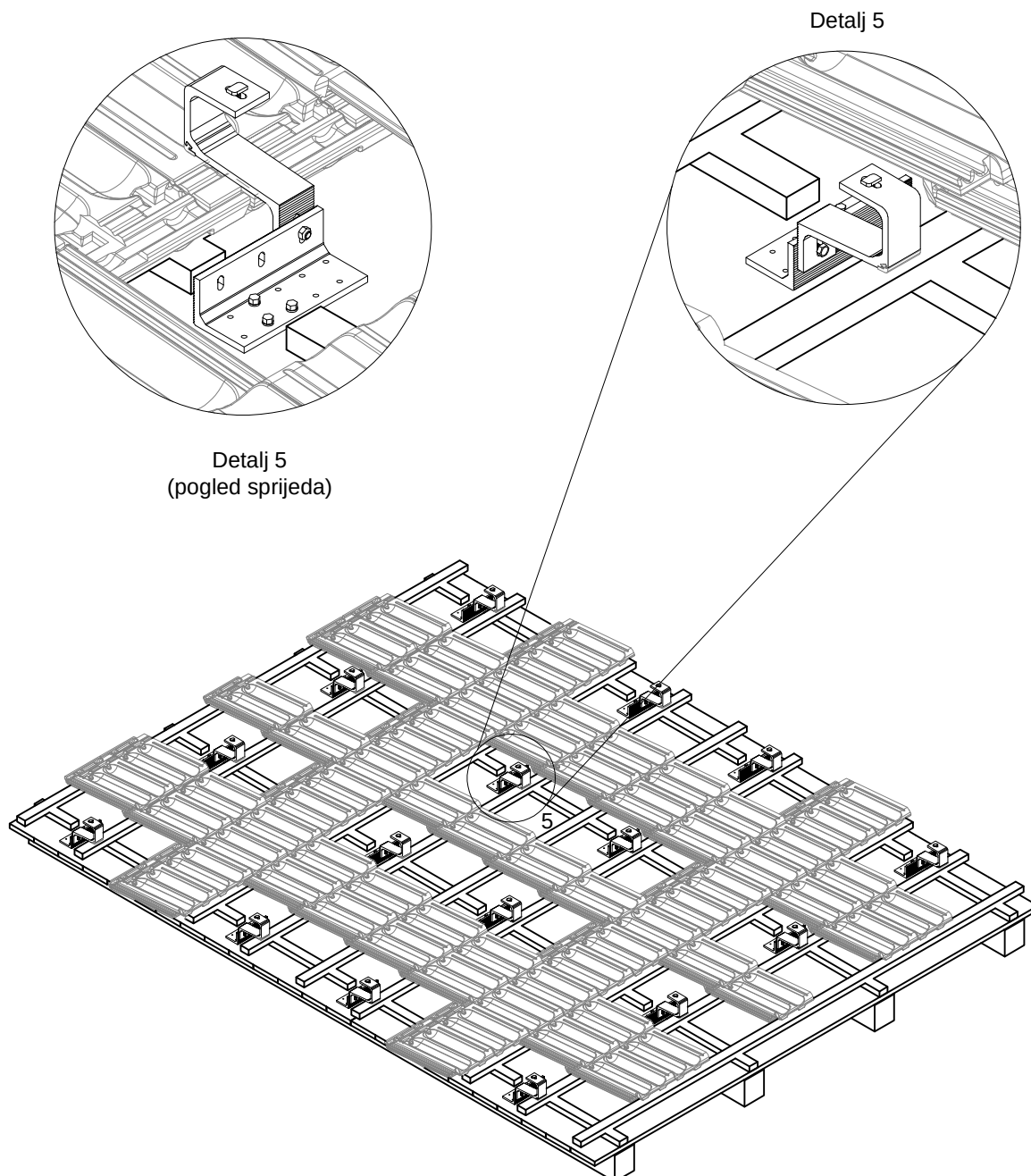


## 5. POSTAVLJANJE GORNJEG NOSAČA

Donji nosač 521.440 (521.441) spajamo s gornjim 521.439 pomoću vijka 431.568. Nakon toga vraćamo uklonjeni crijep koji se prije toga obradi na označenim mjestima.

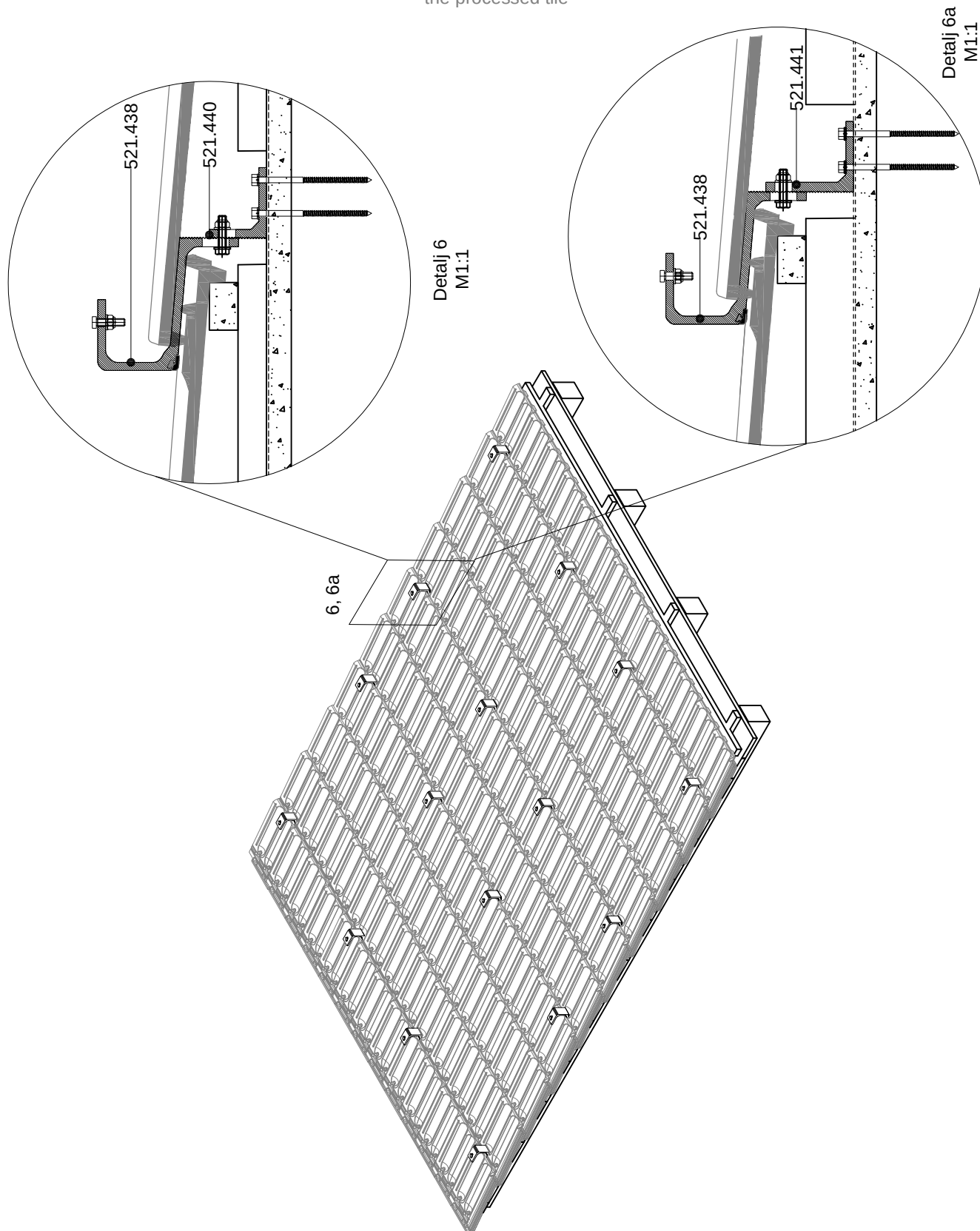
## 5. TOP CARRIER MOUNTING

Connect bottom support 521.440 (521.441) with top carrier 521.439 by screw 431.568. After that, return removed tile which must be processed before returning.



Prikaz spojenog gornjeg i donjeg nosača nakon vraćanja  
obrađenog crijeva

Display of the joined top and bottom support after returning  
the processed tile



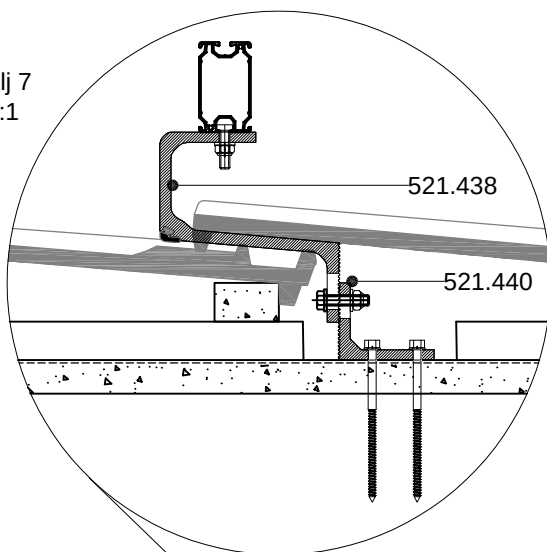
### 6. SPAJANJE GORNJEG NOSAČA S GREDOM PODKONSTRUKCIJE

Obradeni crijep vraćamo na odgovarajuće mjesto i spajamo gornji nosač s gredom podkonstrukcije pomoću vijka 431.567.

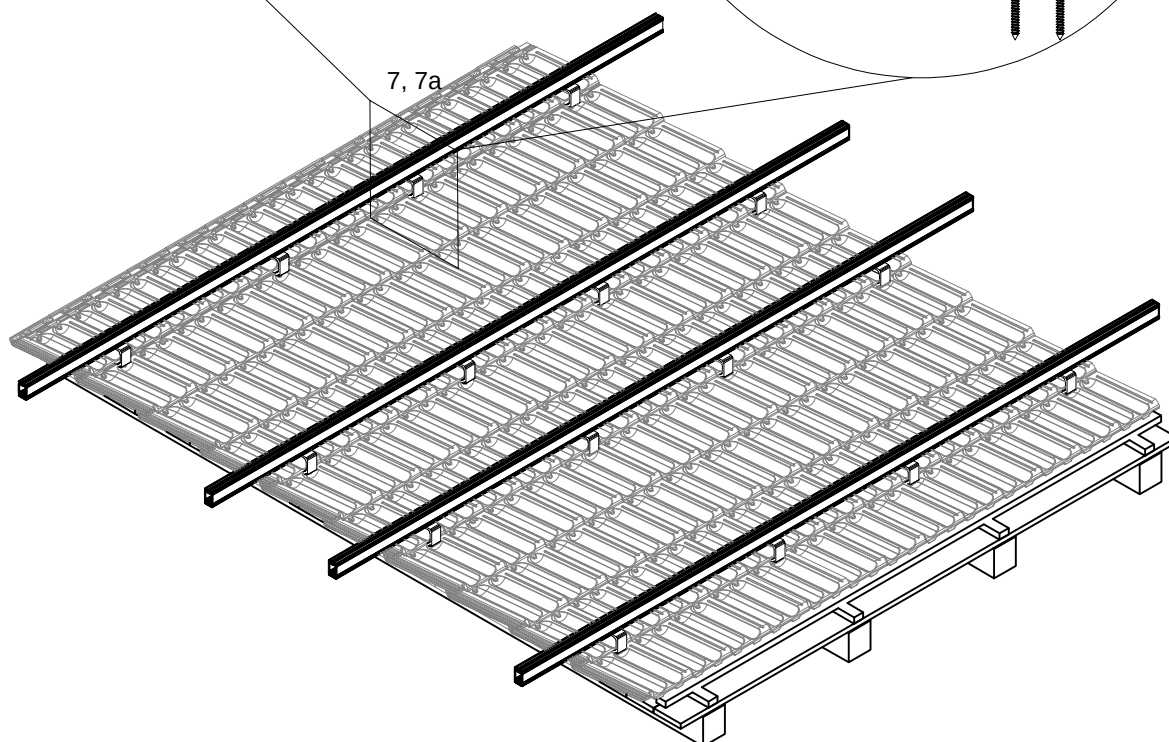
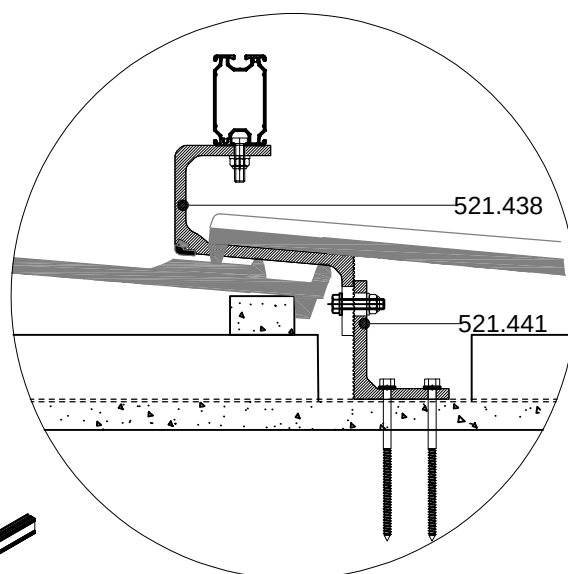
### 6. TOP CARRIER CONNECTION WITH THE SUBSTRUCTURE BEAM

Put the processed tile back in its position and connect top support and substructure beam with the screw 431.567.

Detalj 7  
M1:1



Detalj 7a  
M1:1



### 7. POSTAVLJANJE SOLARNIH PANELA

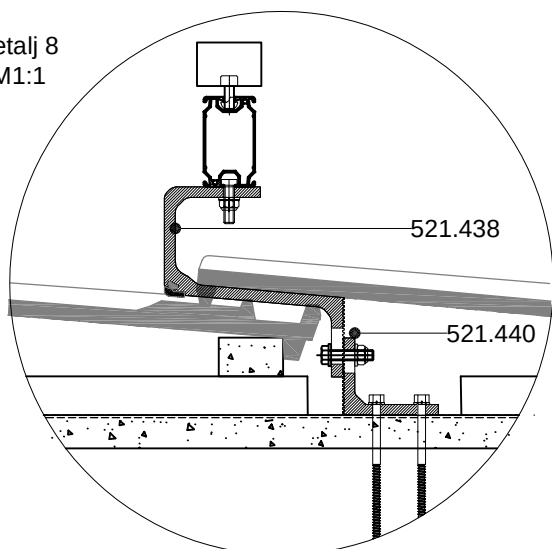
Nakon završene montaže konstrukcije, slijedi montaža solarnih panela. Montaža se izvodi od jednog ruba prema drugom te od vrha prema dnu.

Zbog lakše montaže preporučuje se da se kopče i matice sa oprugom prethodno povežu te kao opuštene montiraju prije panela.

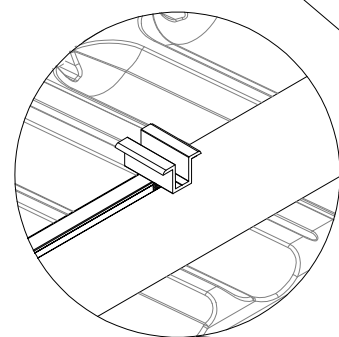
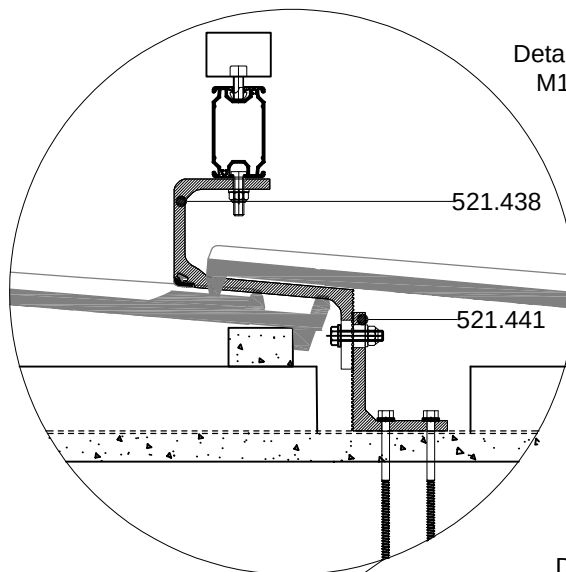
### 7. TOP CARRIER CONNECTION WITH THE SUBSTRUCTURE BEAM

After the assembly of the structure is completed, the installation of solar panels follows. Mounting is performed from one edge to the other and from top to bottom. For easier installation, it is recommended that the spring-loaded buckles and nuts be pre-connected and mounted as loose before the panel.

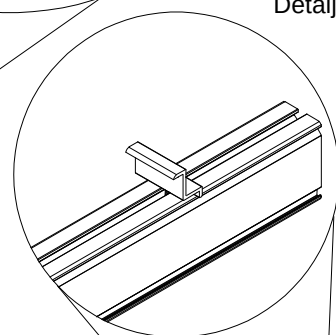
Detalj 8  
M1:1



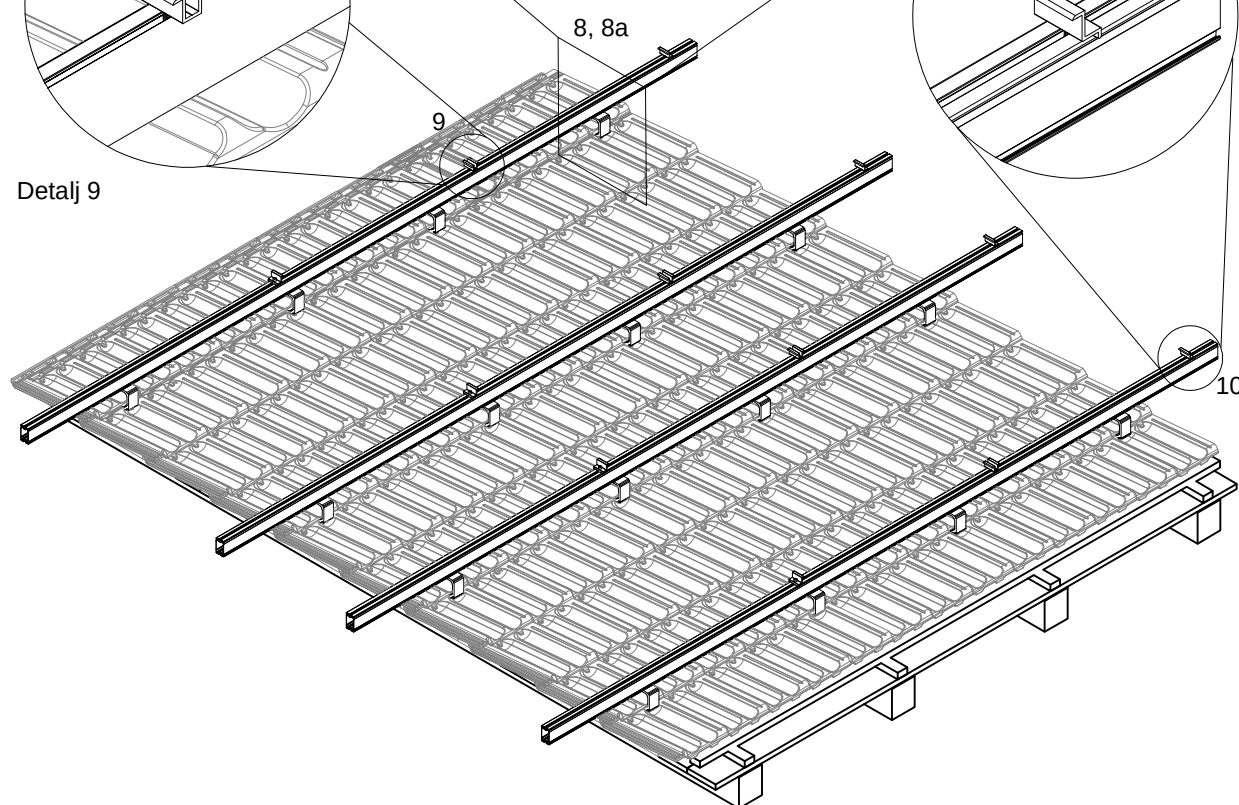
Detalj 8a  
M1:1

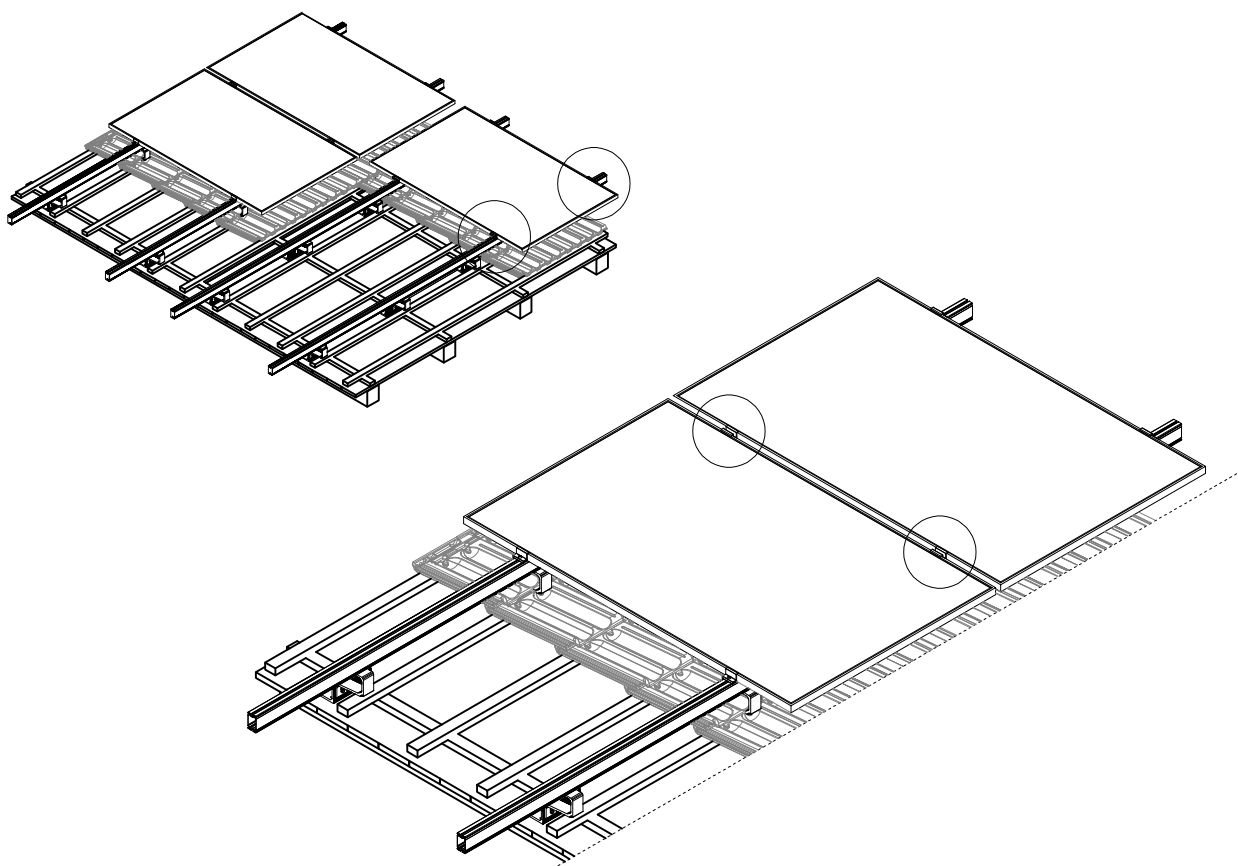


Detalj 9



Detalj 10





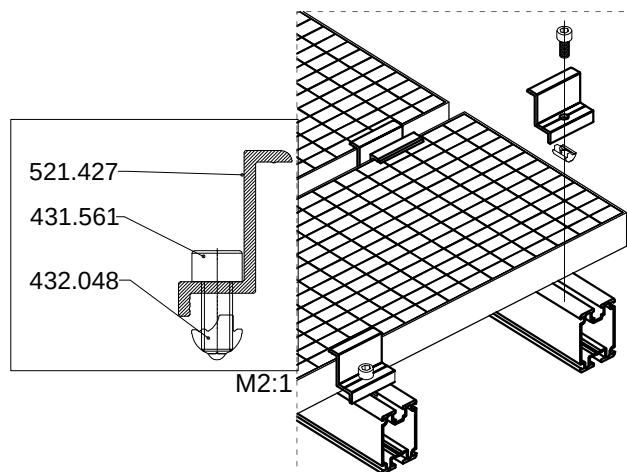
### Držač solarnog panela-jednostrani

Pričvršćivanje krajnjih panela izvodi se jednostranim držačem 521.427 i veznim elementima 431.561 i 432.048.

Jednostrane držače učvrstiti uporabom moment ključa i silom od 15 Nm.

Fastening of the end panels is performed with a 521.427 clip and connecting elements 431.561 and 432.048.

Secure the edge clips using a torque wrench and a force of 15 Nm.



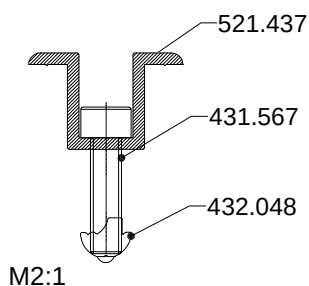
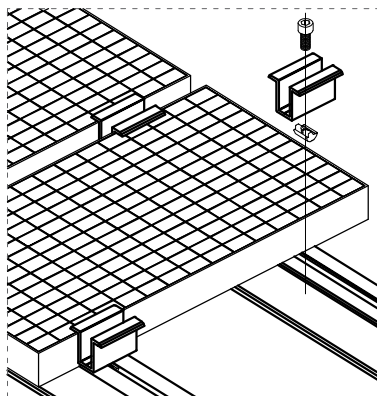
### Držač solarnog panela-dvostrani

Pričvršćivanje srednjih panela izvodi se dvostranim držačem 521.437 i veznim elementima 431.567 i 432.048.

Srednje kopče učvrstiti uporabom moment ključa i silom od 15 Nm.

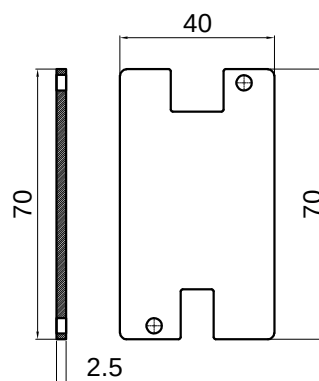
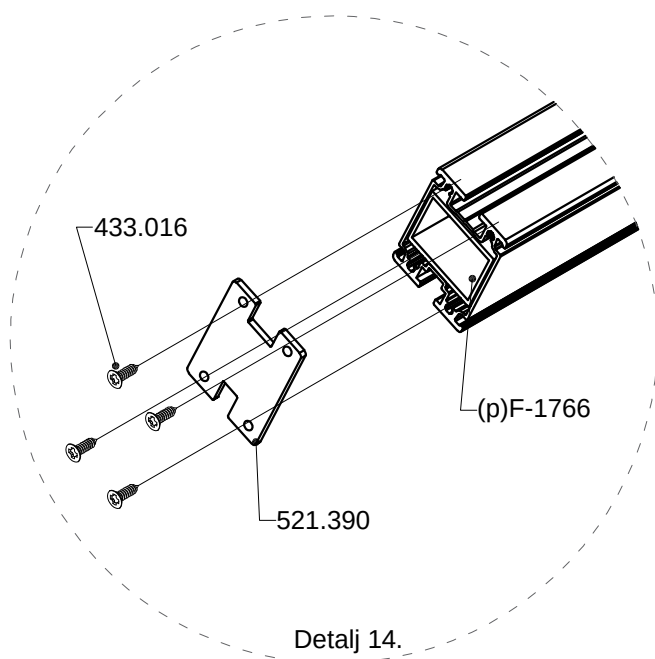
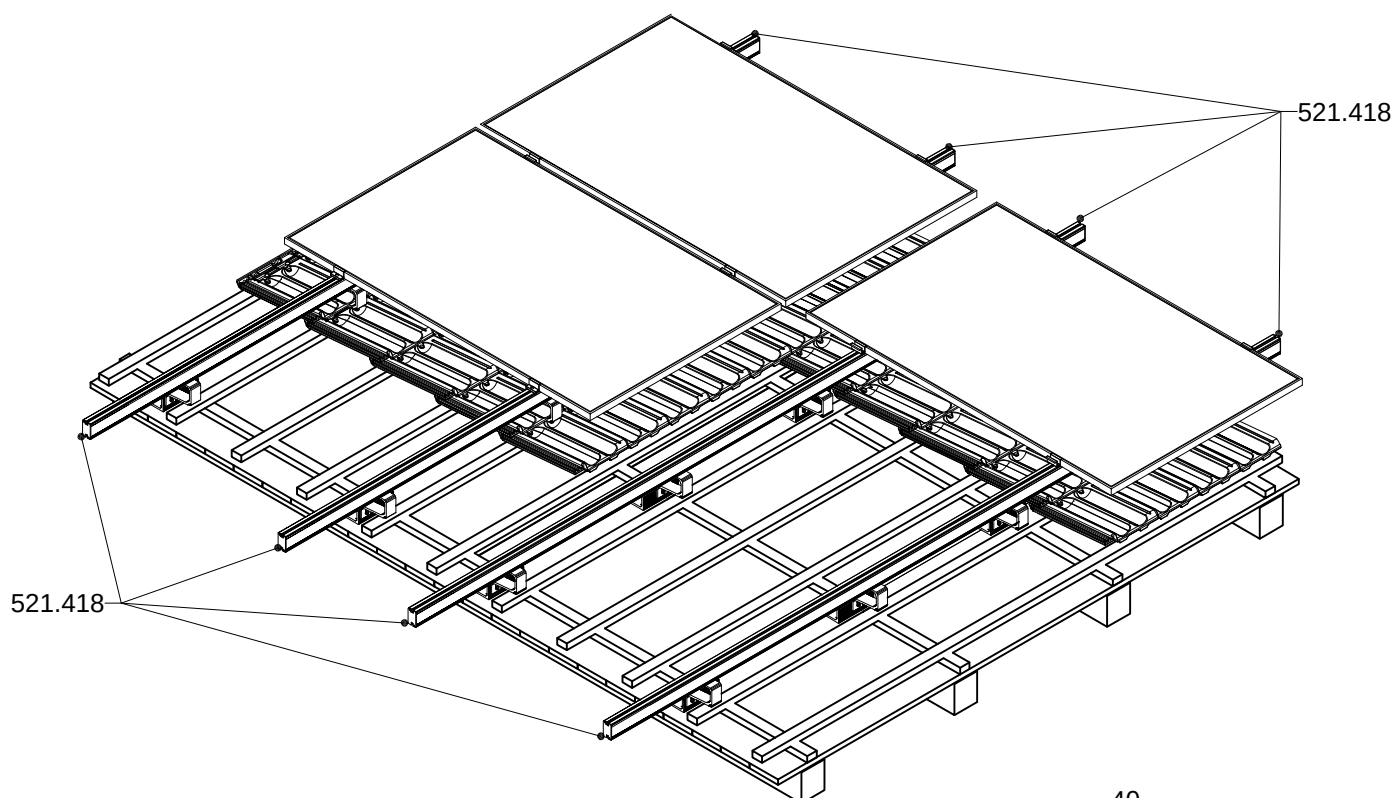
Fastening of the middle panels is performed with the 521.437 buckle and connecting elements 431.567 and 432.048.

Tighten the middle clips using a torque wrench and a force of 15 Nm.



Na krajeve svih horizontalnih greda potrebno je montirati čepove.  
Čepovi služe kako bi se spriječio ulazak vode i stvaranje osinjaka koji mogu prouzrokovati otežan pristup konstrukciji.

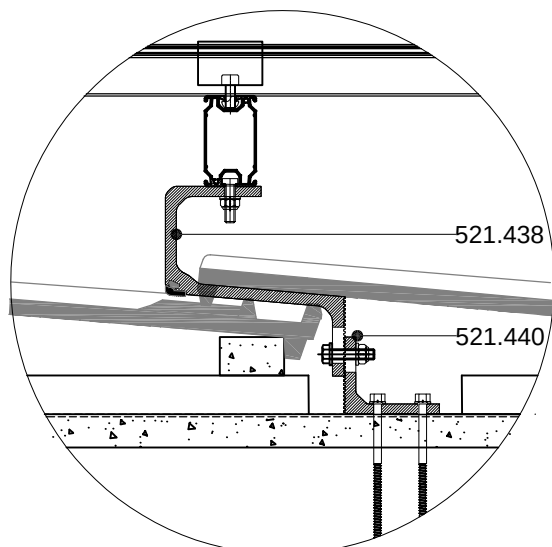
On all horizontal beams it is necessary to mount plugs at the ends. The plugs serve to prevent water from entering and the formation of wasp's nest which can cause difficult access to the structure.



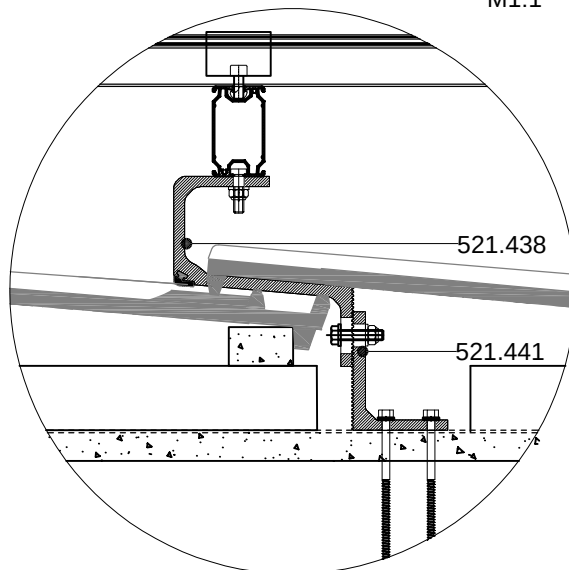
Profil FNE 0001 koristi čep 521.392  
Profil FNE 0004 koristi čep 521.390  
Profil FNE 0005 koristi čep 521.391  
Profil FNE 0006 koristi čep 521.418

Profile FNE 0001 uses plug 521.392  
Profile FNE 0004 uses plug 521.390  
Profile FNE 0005 uses plug 521.391  
Profile FNE 0006 uses plug 521.418

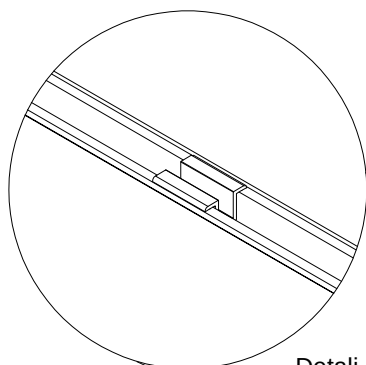
Prikaz podkonstrukcije s postavljenim solarnim panelima.  
Display of the substructure with installed solar panels.



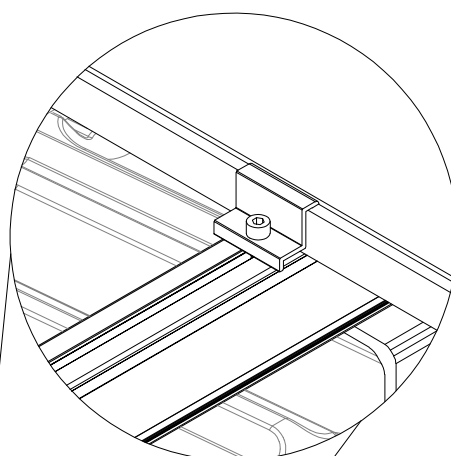
Detalj 11  
M1:1



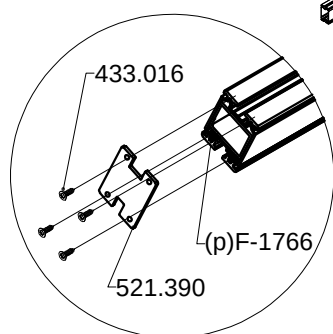
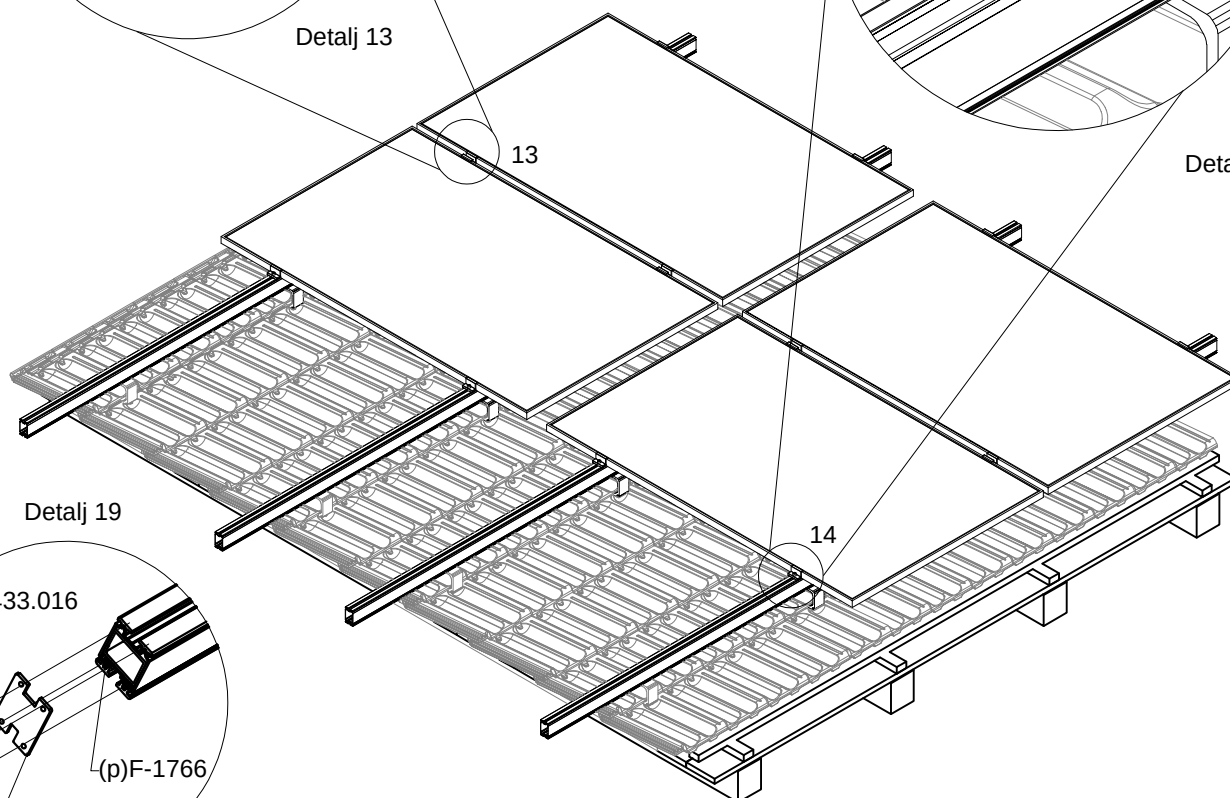
Detalj 12  
M1:1



Detalj 13



Detalj 14



Detalj 19





# FEAL

## FNE-1100

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