

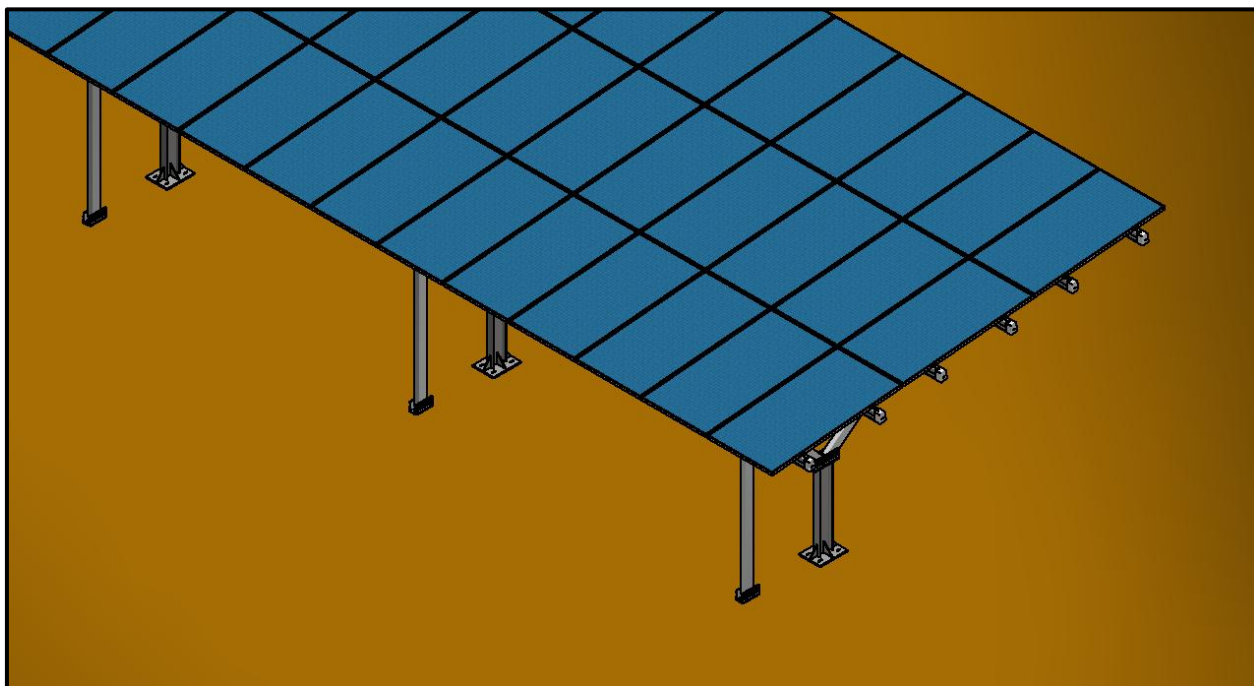
Installation Manual

IM_AXE_CP_EL

Elite Tilted Car Port Mounting System

For framed PV modules in portrait orientation

V0.04



Declaration

- Only the highest quality components are used in the mounting system to ensure a trouble-free operation of your solar power system. The following information explains the proper setup of the Axe Struct carport system tilted in a parking area.
- Any unique structural features must be documented so that the surrounding's unique features can be considered when planning the layout.
- Always fasten the bolted connection by turning the bolt head. Do not turn the nut, just hold it.

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① Components

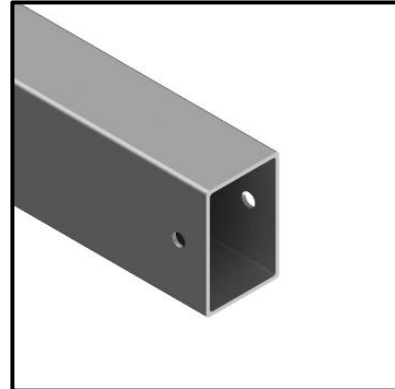
Post
Flanged I-Beam

Connection to the concrete base



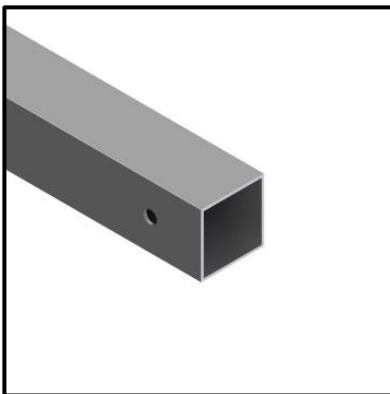
Post
Rectangle Tube

Connection to the Rafter



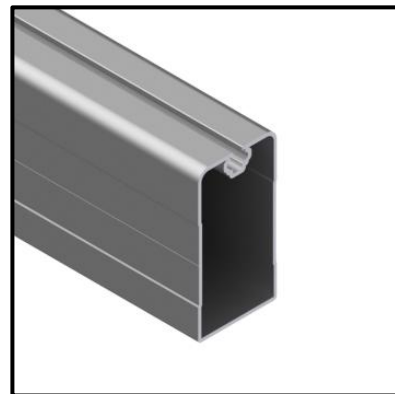
Bracing
AXE_L_SQR_50_50_2_AL

Section for X and V brace

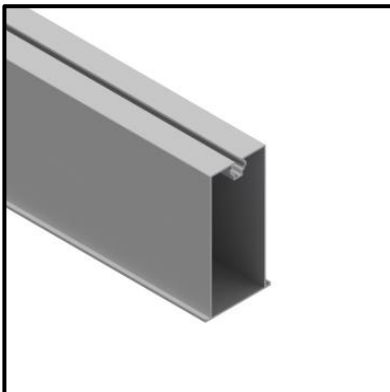


Rafter
AXE_L_RF_170_90_AL

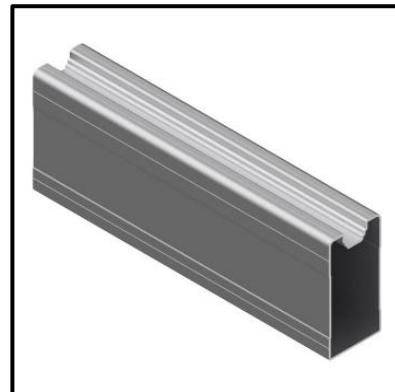
Support for rails



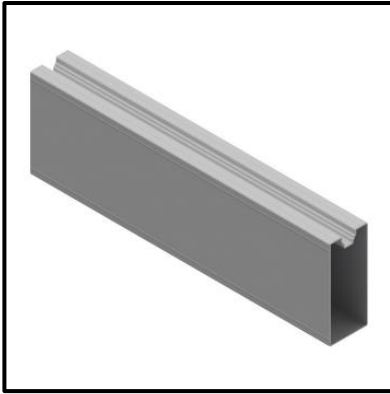
Rail
AXE_L_R_170_80_AL
2.5m, 4.5m & 6m lengths



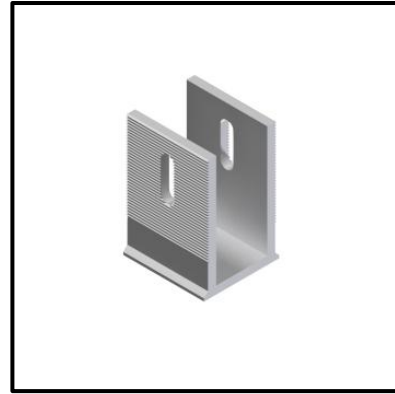
Rafter Extension
AXE_EX_170_90_AL
Joining Rafter sections



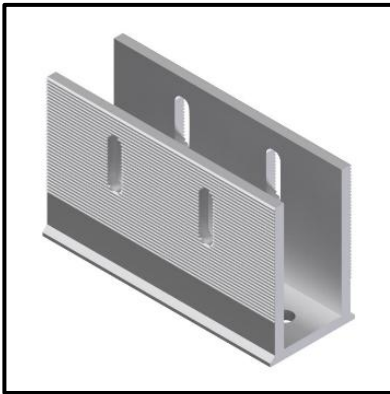
Rail Extension
AXE_EX_170_80_AL
Joining Rail sections



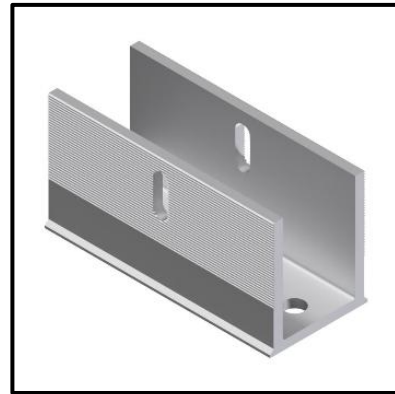
Base Slot Bracket
AXE_BR_BS_S_50_B_AL
Bracing connection



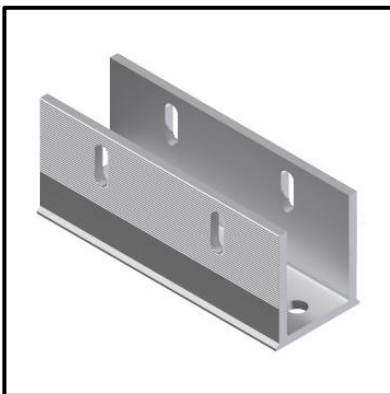
Base Slot Bracket
AXE_BR_BS_D_50_S_AL
Post to base connection



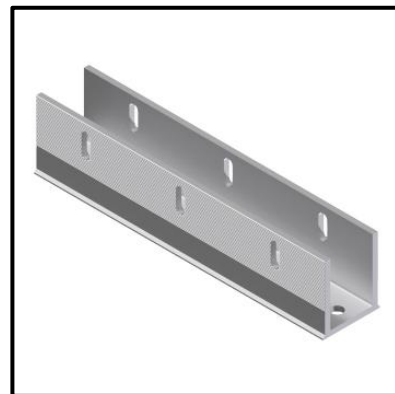
Base Slot Bracket
AXE_BR_BS_S_80_AL
Post to base connection



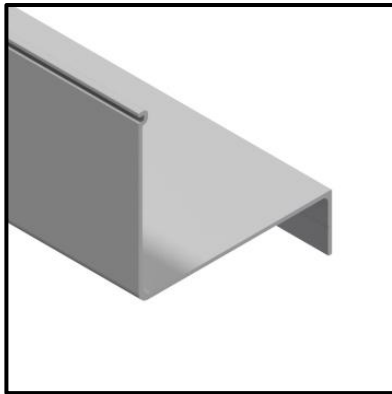
Base Slot Bracket
AXE_BR_BS_D_80_AL
Post to base connection



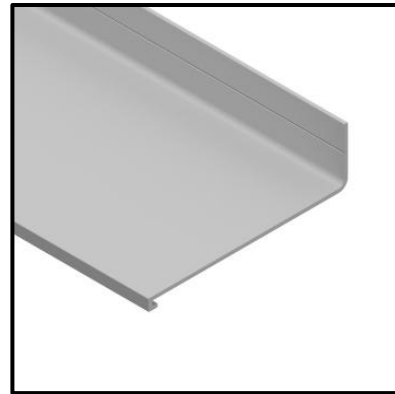
Base Slot Bracket
AXE_BR_BS_T_80_AL
Post to base connection



Cable Tray Housing
AXE_L_CT_H_60_70_AL
Cable management system

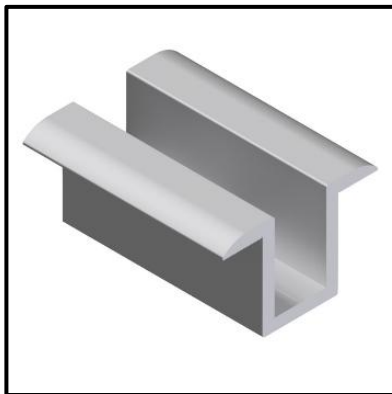


Cable Tray Cover
AXE_L_CT_C_60_70_AL
Cable management system



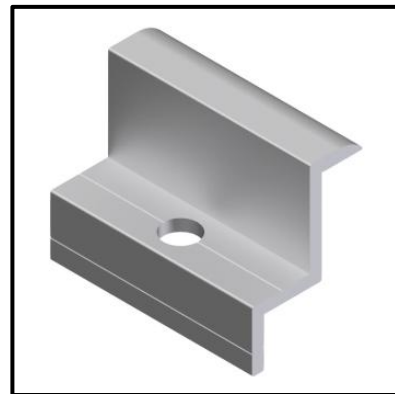
Mid Clamp
AXE_CM_AP_AL

For PV modules with 30, 35 & 40mm frame heights



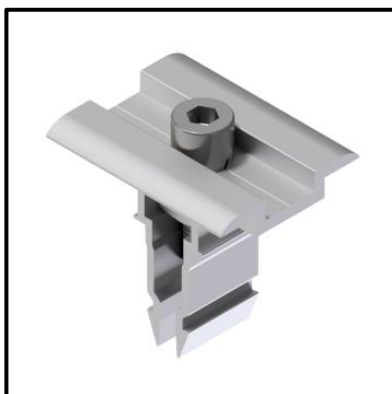
End Clamp
AXE_CE_AP_AL

For PV modules with 30, 35 & 40mm frame heights



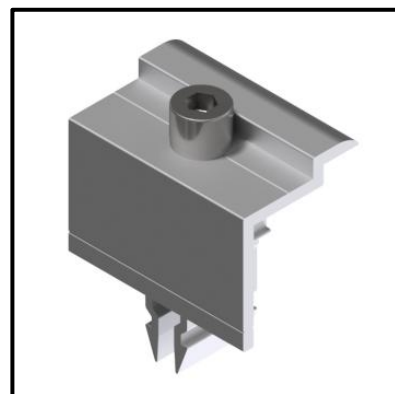
Mid Clamp
AXE_CM_CF_AL

For PV modules with 30mm and 35mm frame heights



End Clamp
AXE_CE_CF_AL

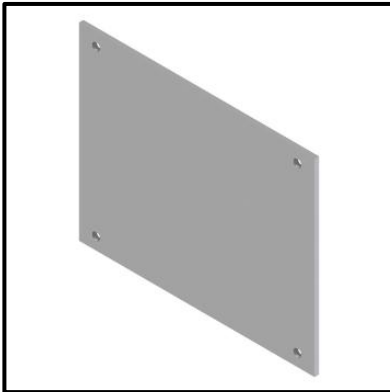
For PV modules with 30mm and 35mm frame heights



Post Connector

AXE_PC_B_AL

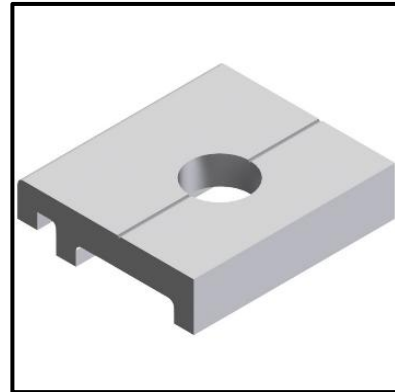
X Brace connection



Rail Clip

AXE_CP_GM_AL

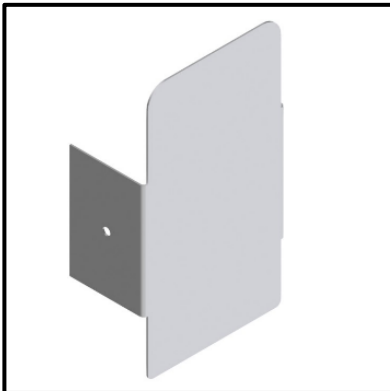
Rail to Rafter connection



End Cap

AXE_EC_170_90_AL

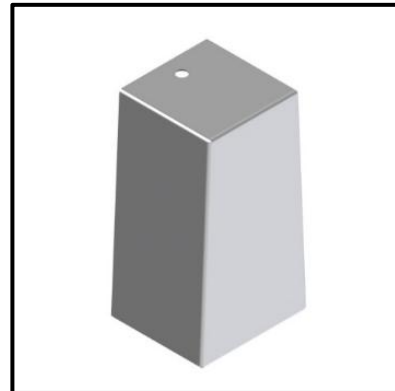
Rounding of Rafter ends



End Cap

AXE_EC_170_90_AL

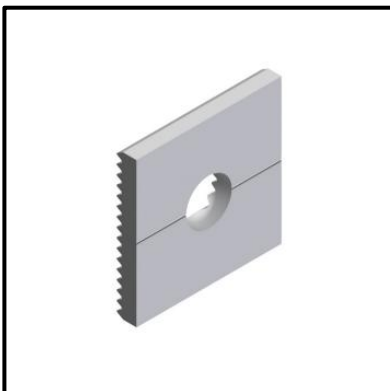
Rounding of Rafter ends



Base Slot Washer

AXE_WB_12/16_AL

Base connection washer



Wire Rope Length

AXE_RW_L_8_GS

Cable bracing



Wire Rope Turn Buckle

AXE_RW_L_8_GS

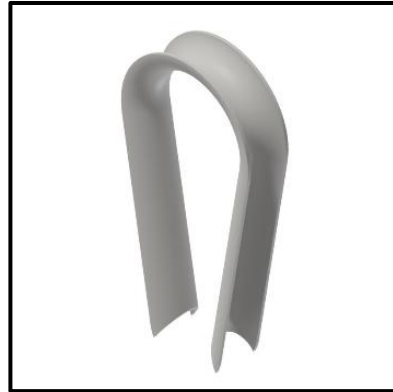
Cable bracing connection



Wire Rope Thimble

AXE_RW_T_8_SS

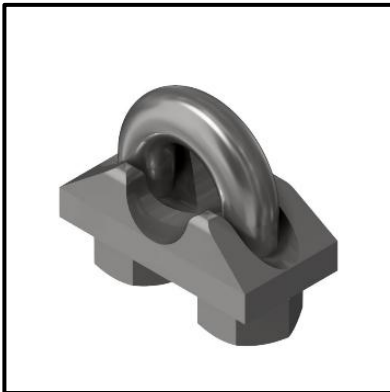
Cable bracing connection



Wire Rope Clamp

AXE_RW_C_8_SS

Cable bracing connection



Eye Nut

AXE_NE_16_SS

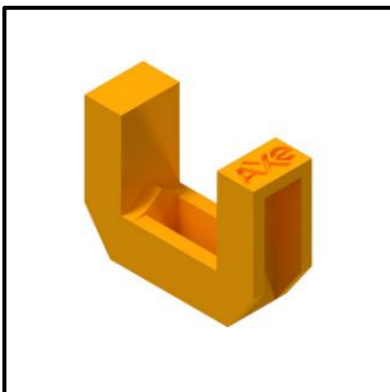
Cable bracing connection



Nut Stopper

AXE_NST_8/10_PP

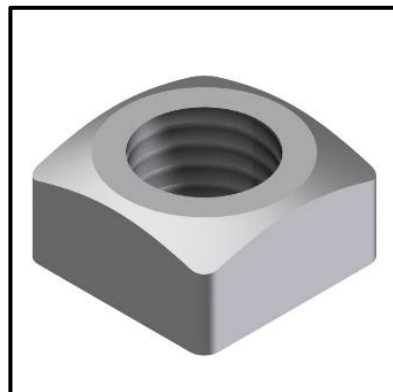
Guiding M8/10 Square nut into position



Square Nut

AXE_NSQ_8/10_SS

Rail and PV connection



Self-Drilling Tek Screw

AXE_ST_6.3_22_SC

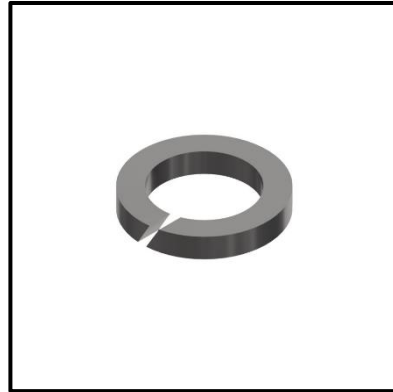
Rail extension connection



Spring Washer

AXE_WS_8/10/12/16/20_SS

Post, Rafter, Rail and PV module connections



Cap Screw Hexagon

AXE_CS_8_SS

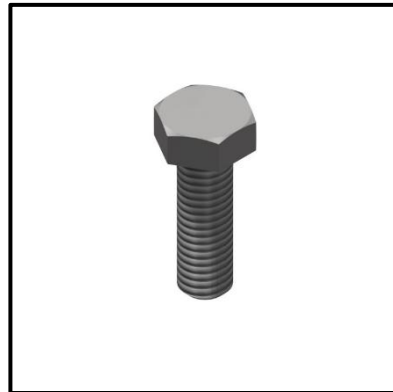
PV module connection



Bolt Hexagon

AXE_CS_10/12/16/20_SS

Post, Rafter and Bracing connections



Hex Nut

AXE_NH_12/16/20_SS

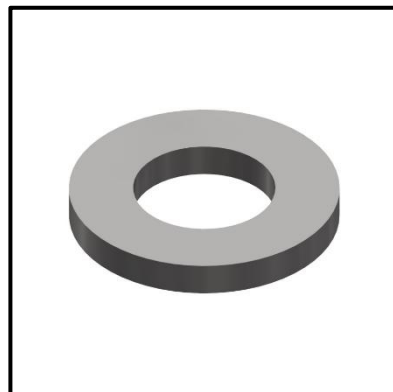
Post, Rafter and Bracing connections



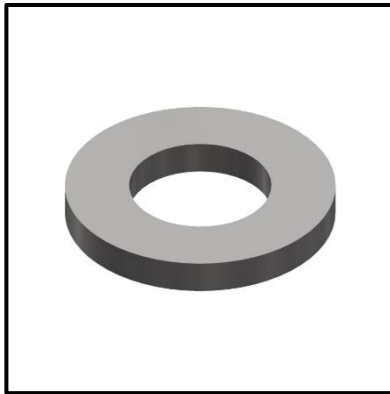
Plain Washer

AXE_WP_12/16/20_SS

Post, Rafter and Bracing connections



Plain Washer
AXE_WP_20_PE
Post connection



Cable Clip
AXE_CFC_SS
Cable Management system



Torque settings

The specified settings below are assumed to have a dry application. Should a lubrication agent or anti-seizing be used, 80% of the below-listed values would apply. Fastening should cease when aluminium sections start to deform visually.

Size	Stainless Steel (N·m)	Galvanized Grade 8.8
M8	18 N·m	N/A
M10	38 N·m	N/A
M12	60 N·m	93 N·m
M16	150 N·m	230 N·m
M20	300 N·m	464 N·m
M24	N/A	798 N·m

Seizing (Galling) Prevention

Copper slip paste should be applied to all threaded connections, specifically stainless-steel fasteners. This will prevent fasteners from seizing and promote good practice. A further step to prevent seizing is to tighten fasteners at low rpm, without interruptions and apply steady pressure.

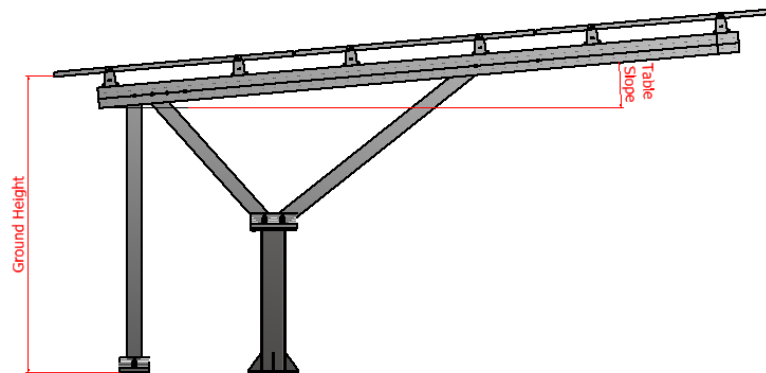
② Configuration options

Car Ports are offered in a Single Park or a Double Park.

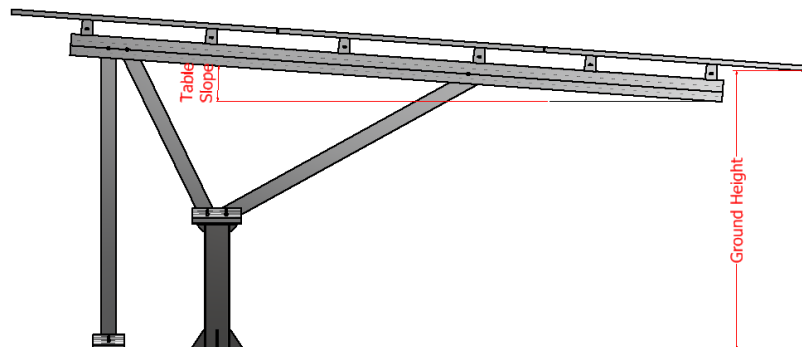
- Single Park: Cars can enter the carport only from one side.
- Double Park: Cars can enter the carport from both sides.

Side views of Single Park:

- *Single Park Away from Entry:*

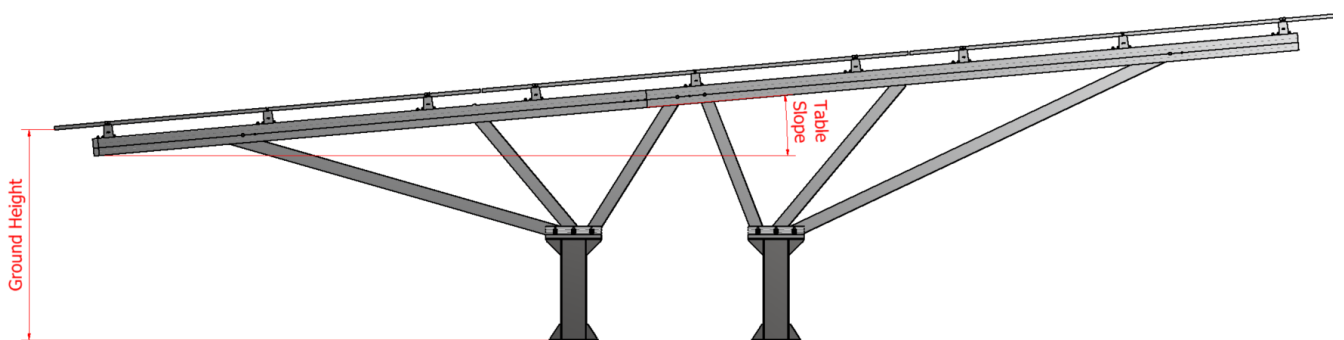
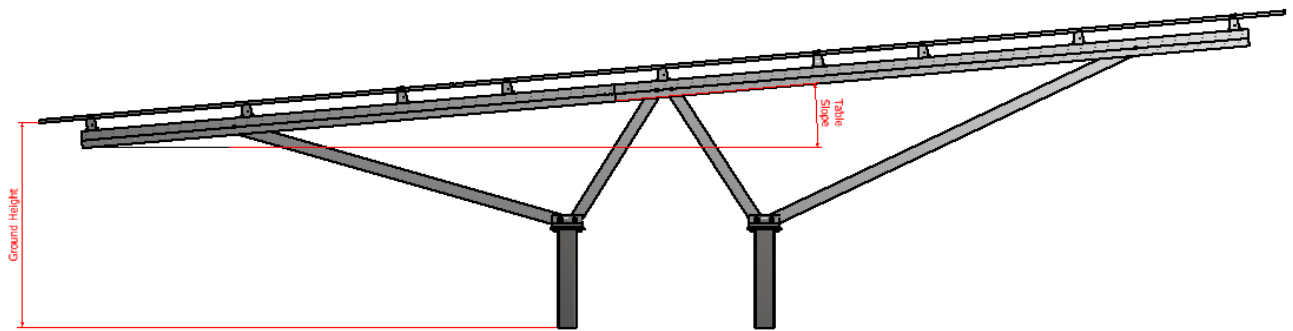


- *Single Park Towards Entry:*

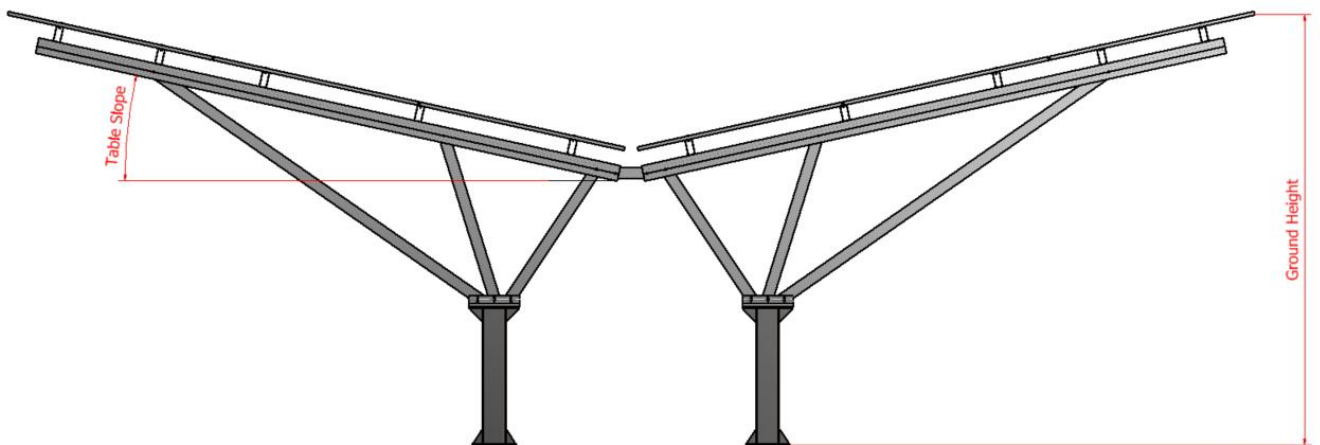


Side views of Double Park:

- *Double Park Mono Pitch:*



- *Double Park Butterfly:*



To maintain continuity throughout this document, all images are based on the Single Park configuration. Please refer to the project-specific layout drawings for foundation specifications and column spacing details.

③ Layout positioning

Profile cross-sections and the span between posts vary based on the selected PV module and site conditions. These should be determined through structural analysis. A geotechnical report is also required to establish the concrete dimensions to support the posts.

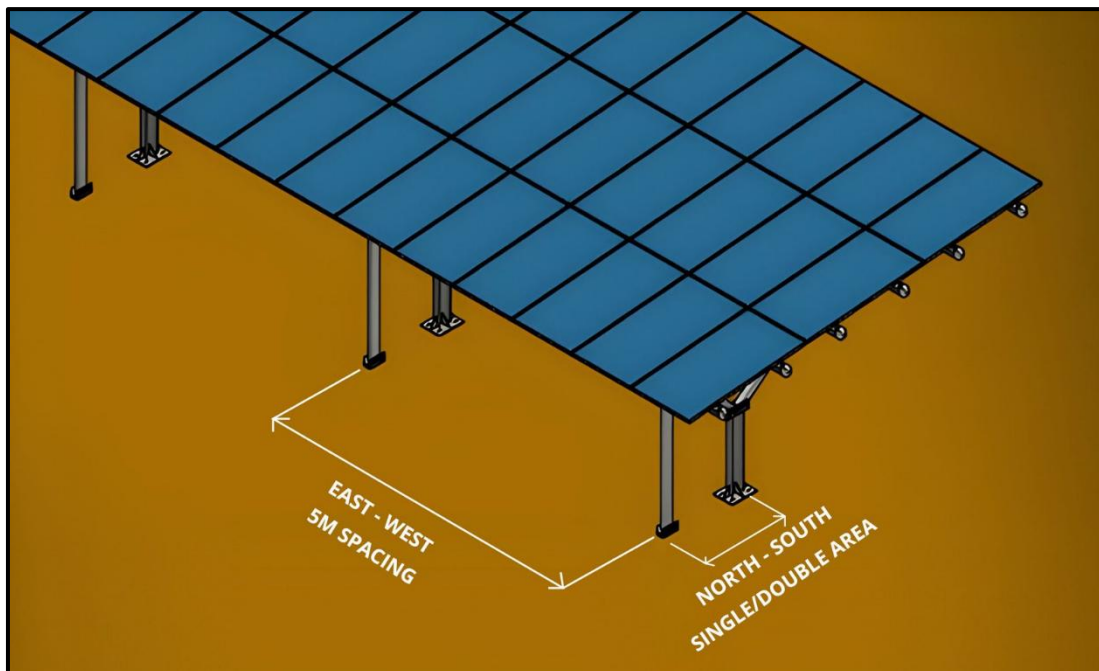
A minimum distance of 20 mm must be maintained between PV modules. Mid Clamps can be used as spacers to maintain this distance.

The carport system is designed based on the following:

- Table slope
- Double or Single Park configuration
- Total PV modules per table
- Height above ground level

The spacing between posts in the East-West direction is standardised at 7.5 m and 5 m for three and two cars to park next to one another respectively. The double-parking option in the North-South direction allows for additional symmetrical parking space.

The lateral cantilever of the rails at the table ends must be equal unless otherwise specified. Please refer to the project-specific layout drawings for details.

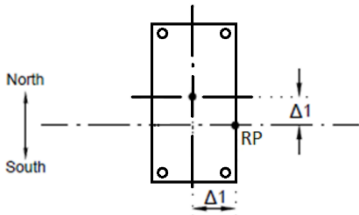
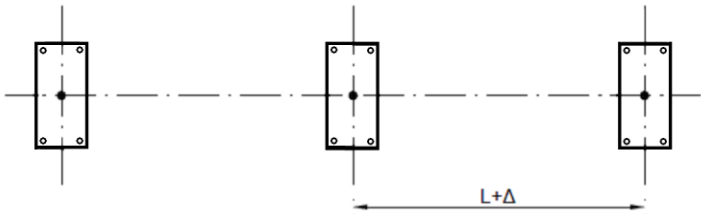
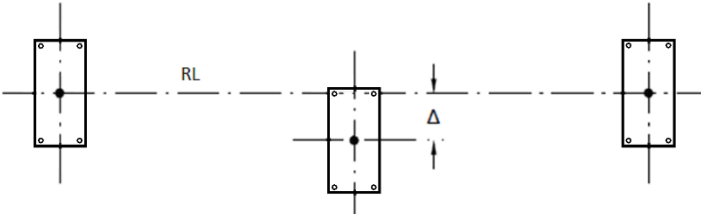
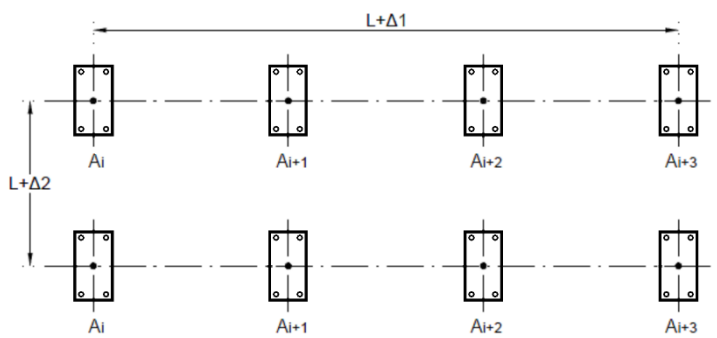


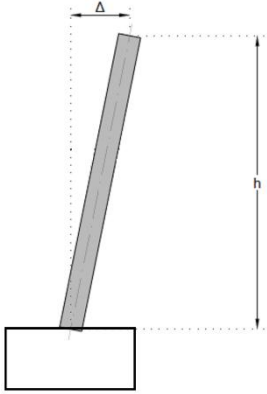
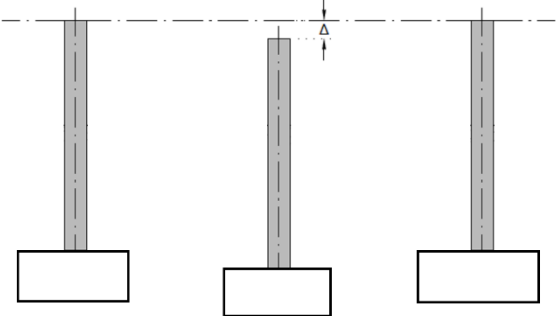
④ Foundation fixings

Mark out positions of foundation locations. Prepare designated areas for concrete bases, including compaction. Place/cast reinforced concrete bases.

To ensure accurate foundation alignment, it is important that the alignment with the natural contour slope must be allowed. However, if the natural gradient exceeds 2% along the length of the table, corrective measures must be implemented to achieve the required 2% tolerance.

Tolerances to consider for aligning post positions in concrete bases (measured at ground level):

Description	Depiction	Tolerance
Individual 4-rod grouping position relative to the reference point (RP)		$\Delta 1 = \pm 5\text{mm}$
Individual 4-rod grouping spacing relative to the adjacent 4-rod grouping		$\Delta = \pm 5\text{mm}$
General 4-rod grouping alignment relative to the reference line (RL)		$\Delta = \pm 5\text{mm}$
Overall table length and North–South spacing		$\Delta 1 = \pm 20\text{mm}$ $\Delta 2 = \pm 5\text{mm}$

Individual post inclination		$\Delta = h/300$
Individual base level relevant to adjacent base		$\Delta = \pm 5\text{mm}$

The images in the table above depict the use of base plates on the posts; however, these principles can also be applied to posts that are cast directly into the concrete.

⑤ Foundation connection

The following sections outline essential guidelines for on-site earthworks and the construction of a suitable foundation. For precise foundation design and rebar scheduling, consult the relevant layout drawings.

To establish a resilient foundation, it is advisable to follow these key instructions. Utilise concrete with a minimum strength of 30 MPa, as this significantly enhances structural integrity. It is crucial to allow sufficient time for proper concrete curing, with a minimum duration of 7 days.

When executing compaction, the following parameters should be targeted:

- 450mm over excavations
- Rip & Recompact 150mm in-situ material
- 150mm G5 to 95% MOD ASSHTO
- 150mm G5 to 95% MOD ASSHTO or higher, depending on soil conditions.

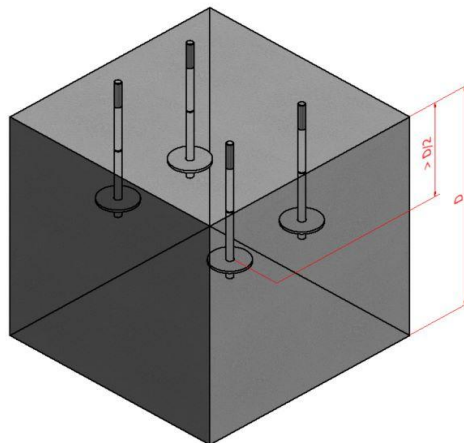
The above is just a reference and is subject to change depending on the soil compaction assessment.

Treaded rods onto a base plate:

Utilise a guide plate to cast four threaded rods into each concrete base. The Threaded Rods must be either pre-cast or doveled into the Concrete Bases to securely anchor the posts. Ensure that the Threaded Rods are sized M20 and are Hot Dip Galvanised.

Foundation connection

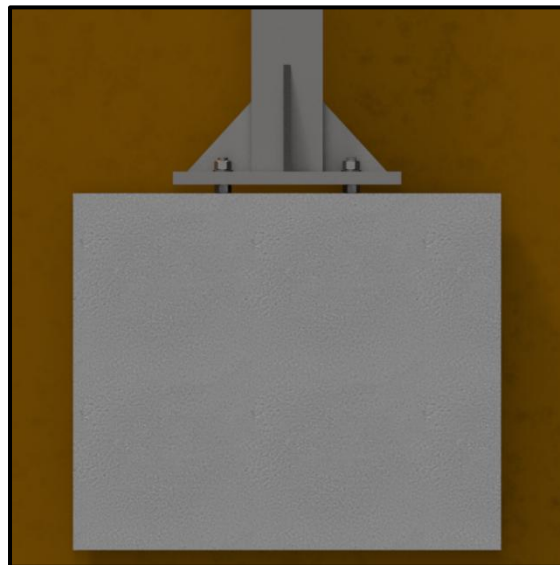
We strongly recommend pre-casting the M20 threaded rods in the concrete base, along with a bolted washer with an outer diameter of 80 mm and a thickness of 5 mm. This washer should be positioned lower than the midpoint of the base depth. Alternatively, at your own risk, you may consider using chemical anchors. It is essential to strictly adhere to the specifications and installation methods provided by the suppliers.



The Posts are fixed on the Concrete Bases through the Treaded Rods. M20 Hex Nuts are placed underneath the baseplate to vertically align Posts. Posts are fixed with M20 Plain Washers and M20 Hex Nuts. Torque Hex Nuts to 464 N·m.



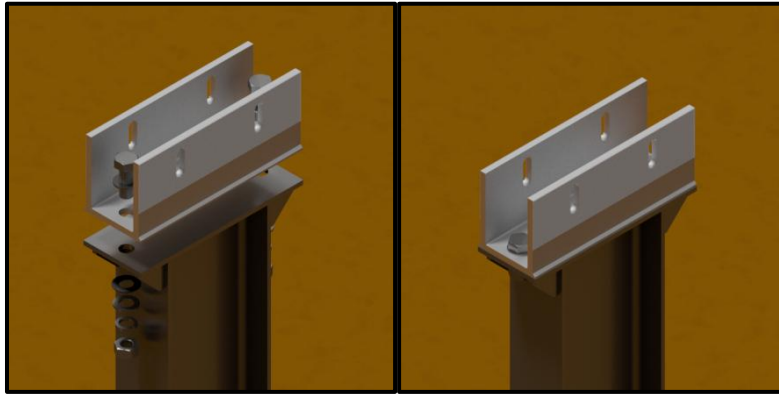
The Gap between the Concrete Base and the Base Plate of the Posts must be filled with Grout once the Post is secured in position. A maximum thickness of 50mm structural grouting can be used underneath Posts.



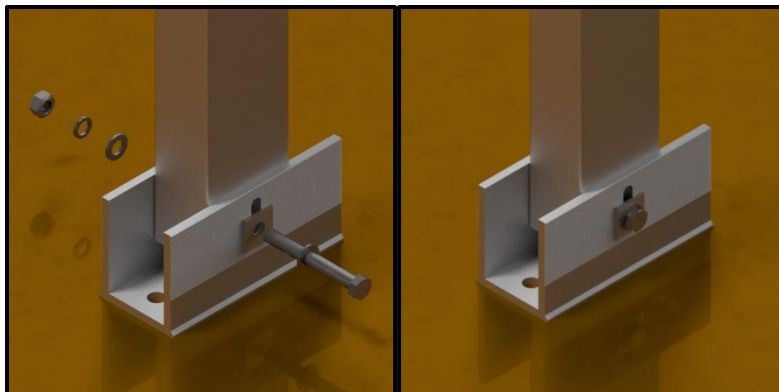
The Base Slot Brackets are fixed with M20 Plain Washers and M20 Hex Nuts. Torque M20 Hex Nut to 464 N·m.

Follow a similar process to mount the Single Base Slot Brackets to the Concrete Bases. The Single Base Slot Brackets are secured to the concrete bases using M20 Threaded Rods that are Hot Dip Galvanized. The Base Slot Brackets are fixed in place with M20 Plain washers and M20 Hex Nuts. Torque the M20 Hex Nuts to 464 N·m.

The Double Base Slot Brackets are secured to the I-Beam post using M20x50 Hex Bolts. M20 Spring Washers, M20 Stainless Steel Plain Washers, M20 EPDM Plain Washers and M20 Hex Nuts are positioned underneath the base plate, and the bolts are inserted from the top down. Torque M20 Hex Bolt to 300 N-m.



Once the RHS/SHS is in position and the holes are aligned, insert the M16x140mm Hex Bolt through the M16 Plain Washer, followed by the M16 Base Slot Washer, then through the Base Slot Bracket and Post. On the opposite side, add another M16 Base Slot Washer, M16 Plain Washer, M16 Spring Washer, and M16 Hex Nut. Finally, torque the M16 Hex Bolt to 150 N-m to ensure a secure and stable connection.



With the vertical back Post secured at the base, position the two shorter posts in the Base Slot Bracket on the I-Beam. Secure these two posts to the Base Slot Bracket on the I-Beam in the same manner as the back post is fixed to its Single Base Slot Bracket, as described above.



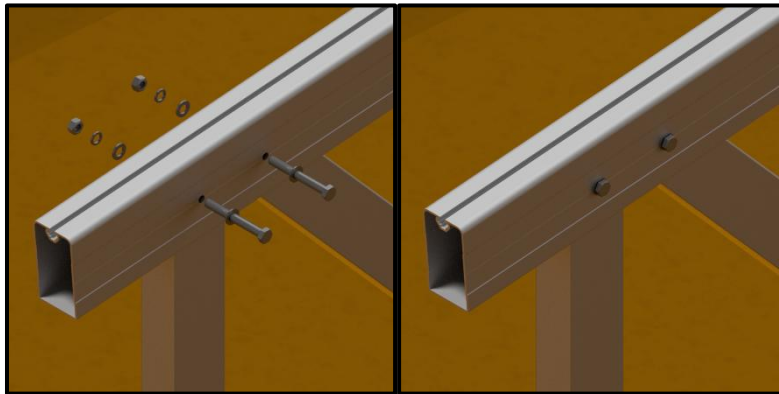
⑥ Mounting rafters

The Rafter is connected to the Back long aluminium Post and the two shorter Posts are connected to the I-Beam. Use M16x140 Hex Bolts, M16 Plain Washers, M16 Spring Washers and M16 Hex Nuts to align the connection.

The M16x140 Hex Bolts, M16 Plain Washers, M16 Spring Washers and M16 Hex Nuts connections are torqued to 150 N·m once all the Rafters have been aligned on a single table. This alignment must be done for both the bottom and top end of the Rafters in a vertical and horizontal plane.

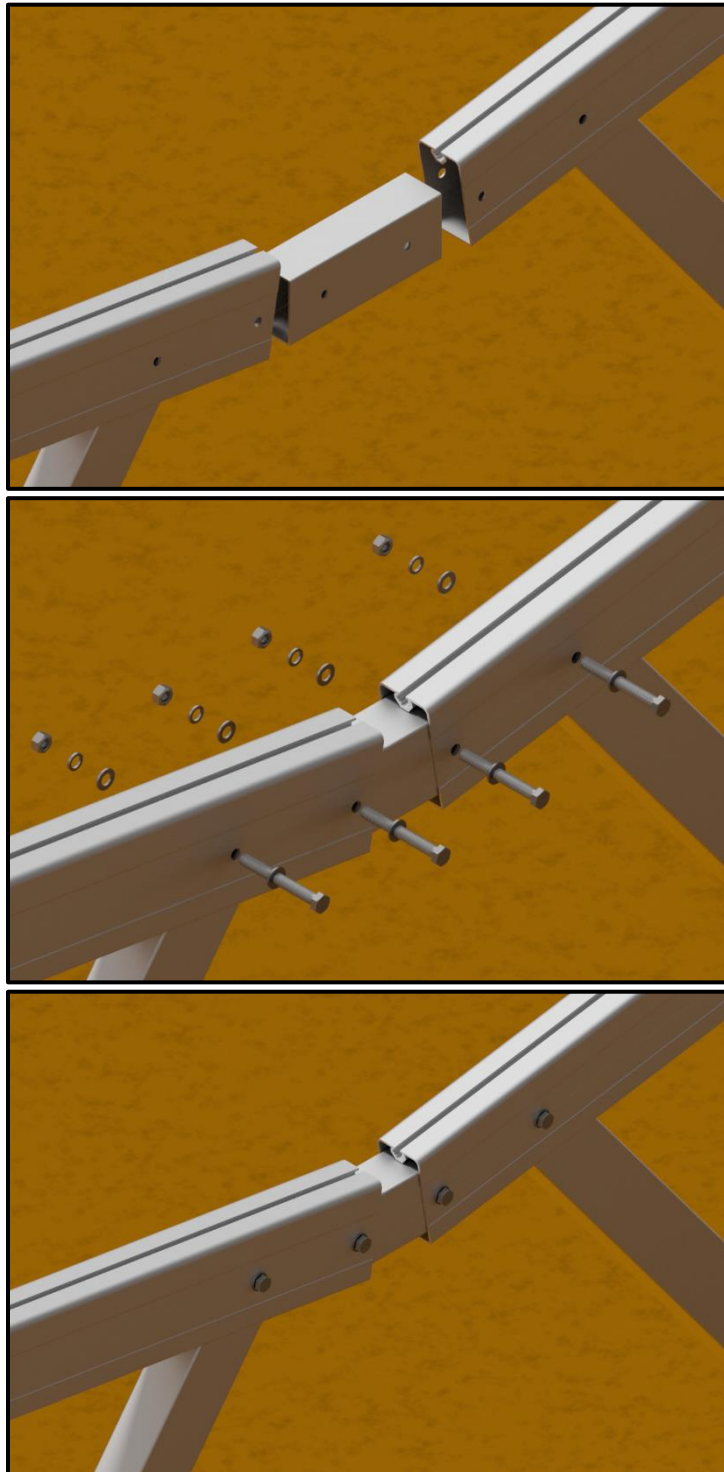
Recommendation

Use the pre-drilled holes and slots on the rafters to connect the first and last rafters on each table. Once the outer rafters of each table are assembled, stretch a gut line between them. The base slot brackets in the middle of the table can then be aligned with the two outer base slot brackets following the gut line as a reference.



Butterfly Rafter connection:

Connect the two Rafters by using M16x140 Hex Bolts, M16 Plain Washers, M16 Spring Washers and M16 Hex Nuts connections are torqued to 150 N·m. Once all the Rafters have been aligned on a single table. This alignment must be done for both the bottom and top end of the Rafters in a vertical and horizontal plane.



⑦ Bracing installation

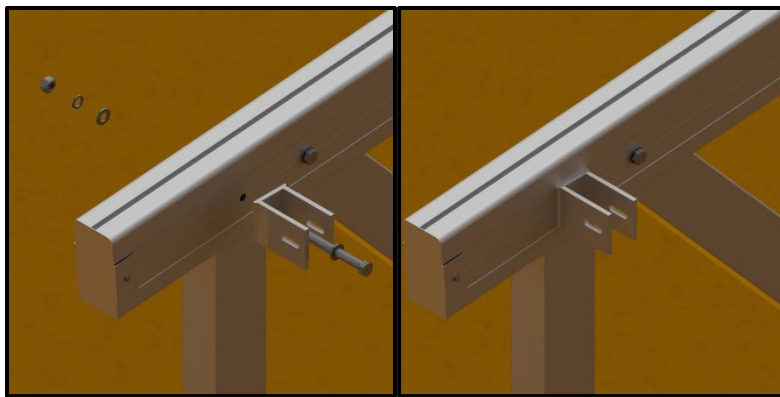
Three different bracing options are available.

- X-Bracing
- V-Bracing
- Bracing Cables

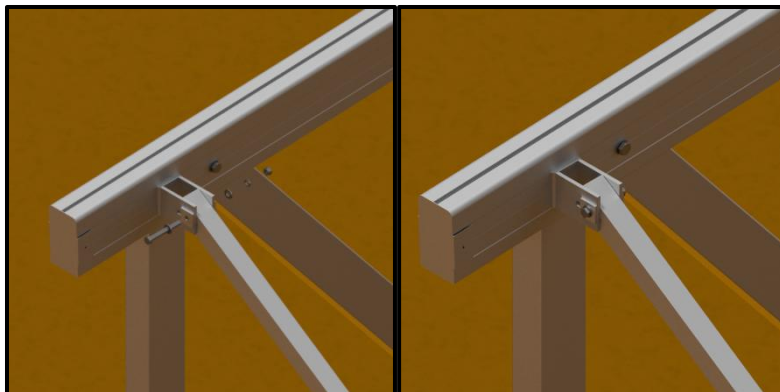
One of these options will be offered depending on the structure and site conditions.

X-Bracing:

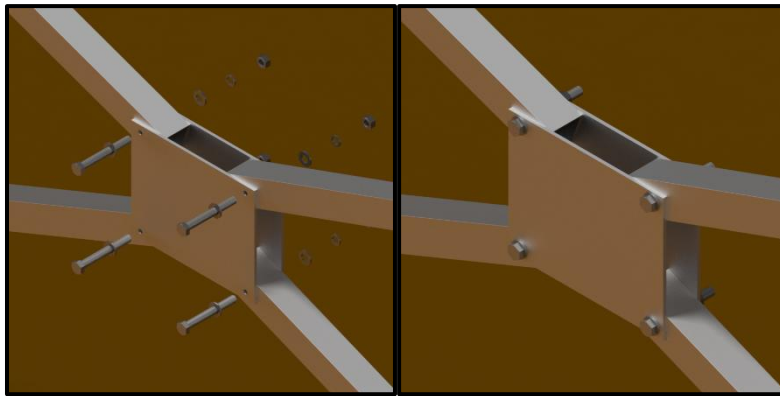
Connect the Base Slot Bracket to the Rafter using M16x140 Hex Bolts, M16 Plain Washers, M16 Spring Washers and M16 Hex Nuts.



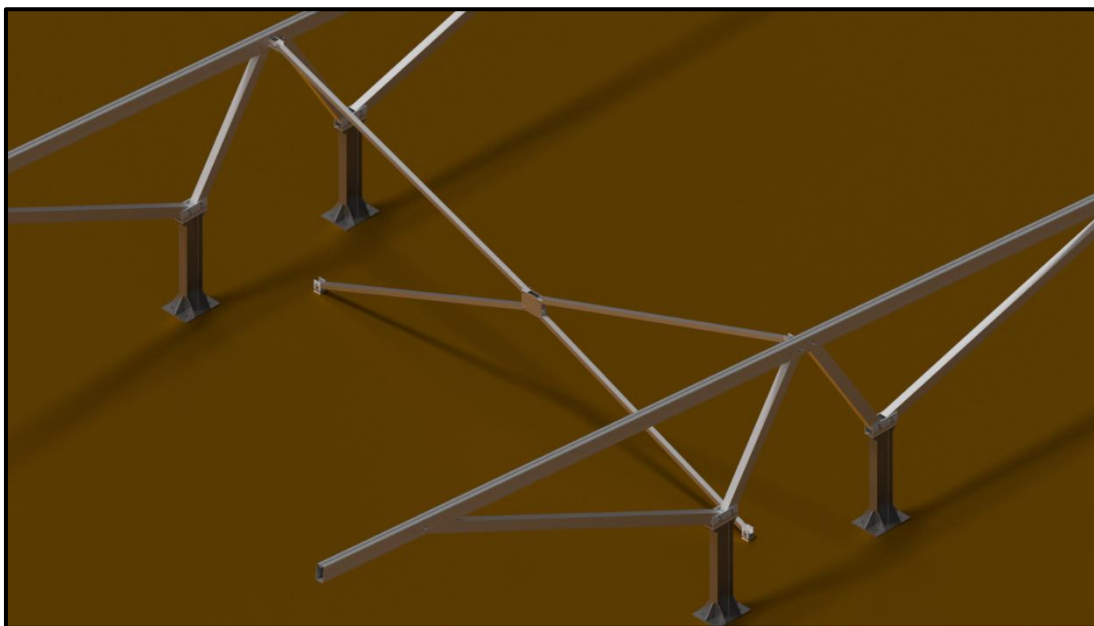
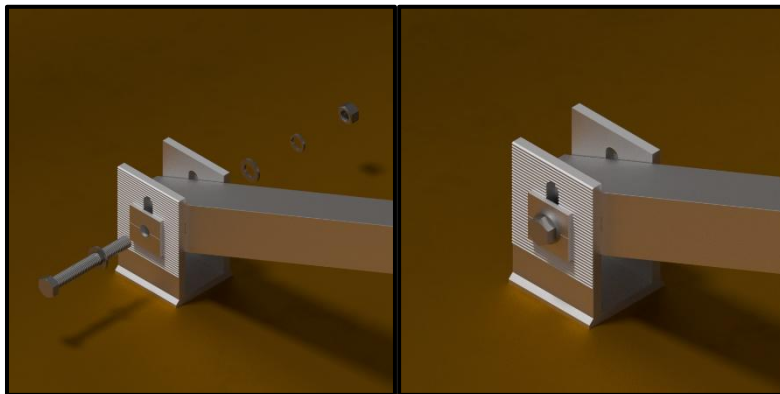
Connect the Square Tube to the Base Slot Bracket using M12x100 Hex Bolts, M12 Plain Washers, M12 Base Slot Washers, M12 Spring Washers and M12 Hex Nuts.



Connect the Square Tube to the Post Connector using M12x100 Hex Bolts, M12 Plain Washers, M12 Spring Washers and M12 Hex Nuts.

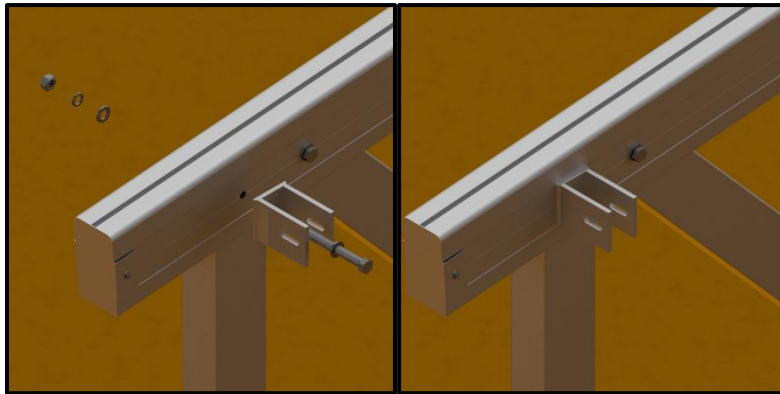


Connect the Square Tube to the two bottom Base Slot Brackets using M12x100 Hex Bolts, M12 Plain Washers, M12 Base Slot Washers, M12 Spring Washers and M12 Hex Nuts completing the X-bracing configuration.

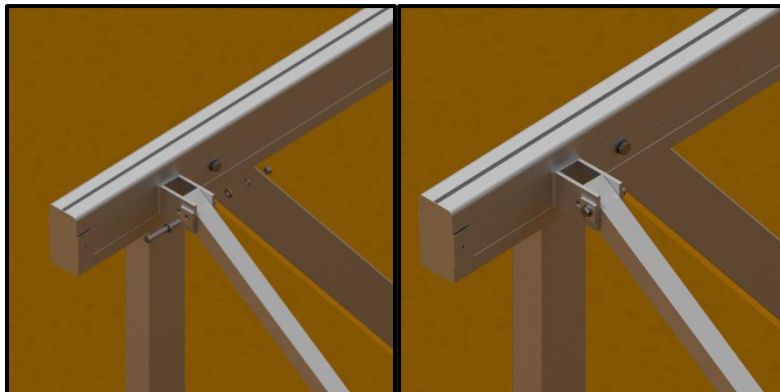


V-Bracing:

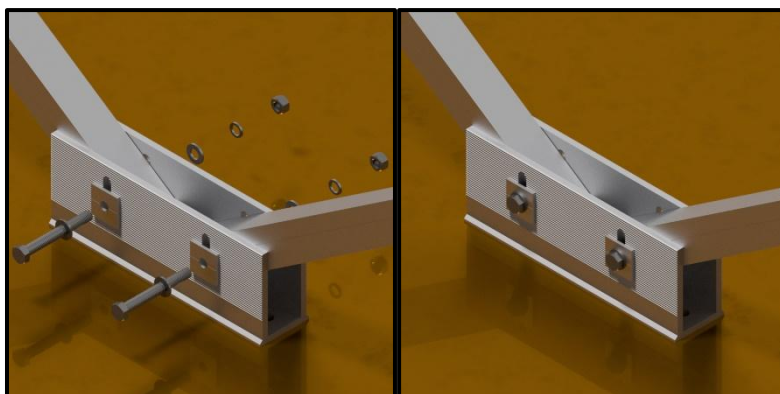
Connect the Base Slot Bracket to the Rafter using M16x140 Hex Bolts, M16 Plain Washers, M16 Spring Washers and M16 Hex Nuts.



Connect the Square Tube to the Base Slot Bracket using M12x100 Hex Bolts, M12 Plain Washers, M12 Base Slot Washers, M12 Spring Washers and M12 Hex Nuts.



Connect the Square Tube to the bottom Base Slot Bracket using M12x100 Hex Bolts, M12 Plain Washers, M12 Base Slot Washers, M12 Spring Washers and M12 Hex Nuts completing the V-bracing configuration.



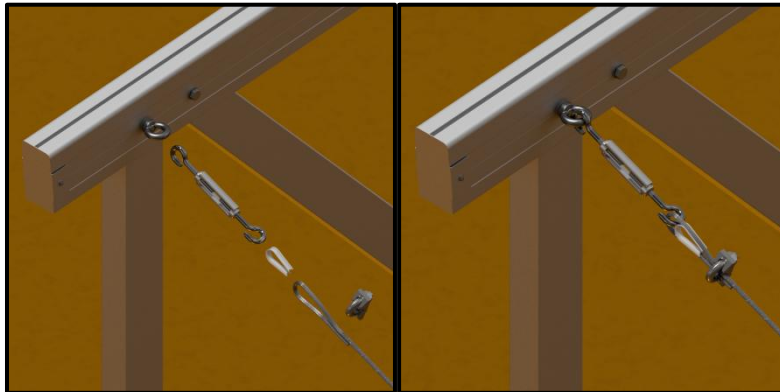


Square Tube Delivery

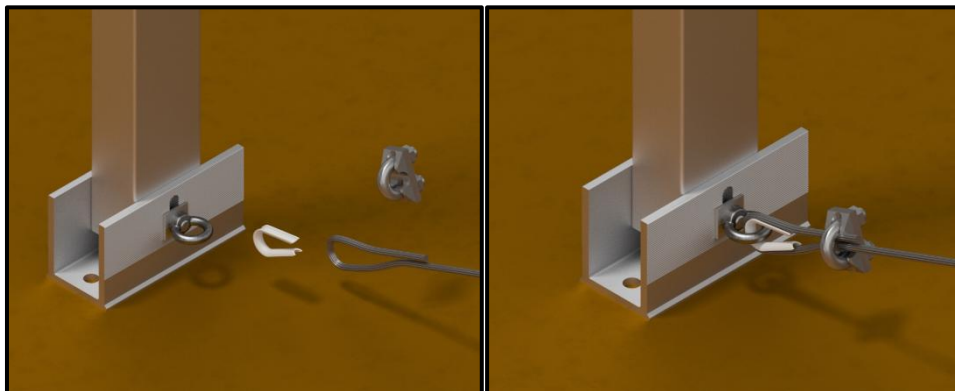
The square tube sections will be delivered with one pre-drilled hole, while the second hole must be drilled on-site. Additionally, as the square tube may not be the precise required length, it will need to be shortened on-site as needed.

Bracing Cables:

Connect the M16 Eye Nut to the Rafter using M16x140 Hex Bolts, M16 Plain Washers, and M16 Spring Washer. Prepare the end of the Wire Rope using the Wire Rope Thimble and Wire Rope Clamp and connect the Wire Rope to the Eye Nut using the Wire Rope Turn Buckle.

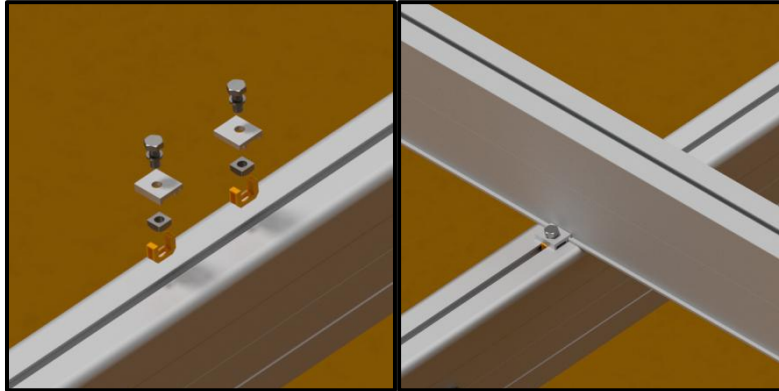


Connect the M16 Eye Nut to the Base Slot Bracket using M16x140 Hex Bolts, M16 Plain Washers, M16 Base Slot Washers, and M16 Spring Washers. Connect the Wire Rope to the Eye Nut using the Wire Rope Thimble and Wire Rope Clamp.

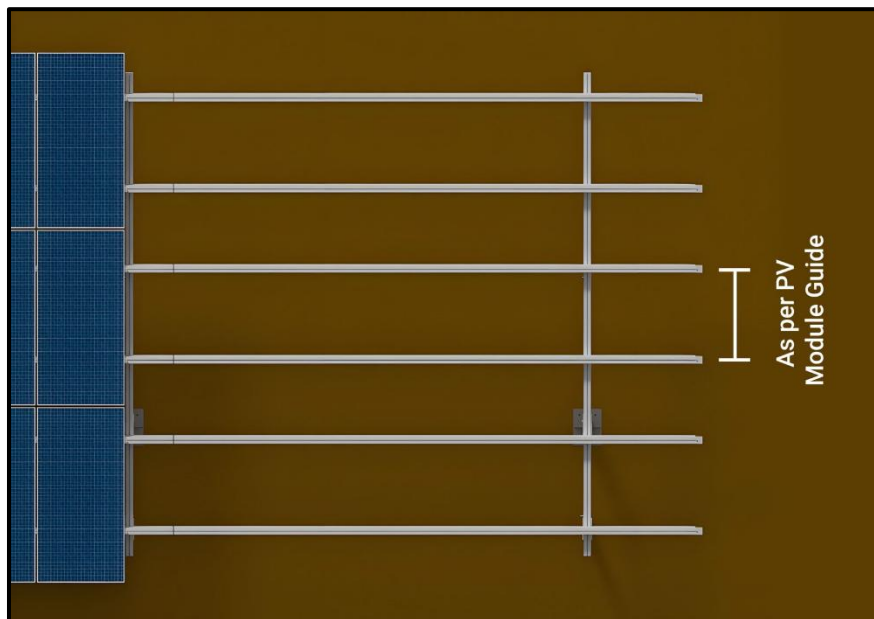


⑧ Mounting rails

Position the Rails perpendicular to the Rafters. Insert Nut Stoppers into the rafters next to the rail and place an M10 Square Nut at each M10 Nut Stopper. Slide the M10 Square Nut at an angle into the rail cavity so that it falls vertically, with one flat side facing upwards. Attach the Rail Clips to the rail and position the Nut Stopper to align the hole of the Square Nut with the Rail Clip. Use M10 x 25 Hex-Bolt, M10 Spring Washer and M10 Square Nut to tighten the connection to 38 N-m.



The rail spacing is dependent on the dimensions of the PV module used. PV module installation manuals indicate supporting requirements.



Please refer to the project-specific layout drawings for the rail configuration. Standard rail lengths of 2.5 m, 4.5 m, and 6.0 m will be used for the configuration of the top structure.

⑨ Joining rails

Mark the midpoint of the Rail Extension, then slide the Rail Extension halfway into the adjoining rails. Secure the connection by using eight M6.3 Self-Drilling Tek Screws to tighten it.

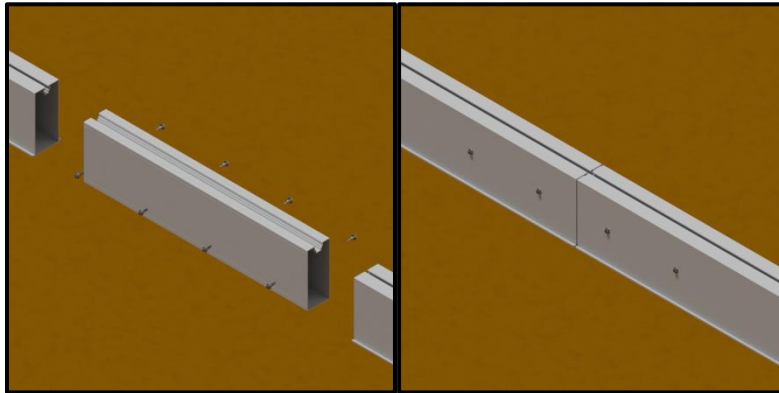
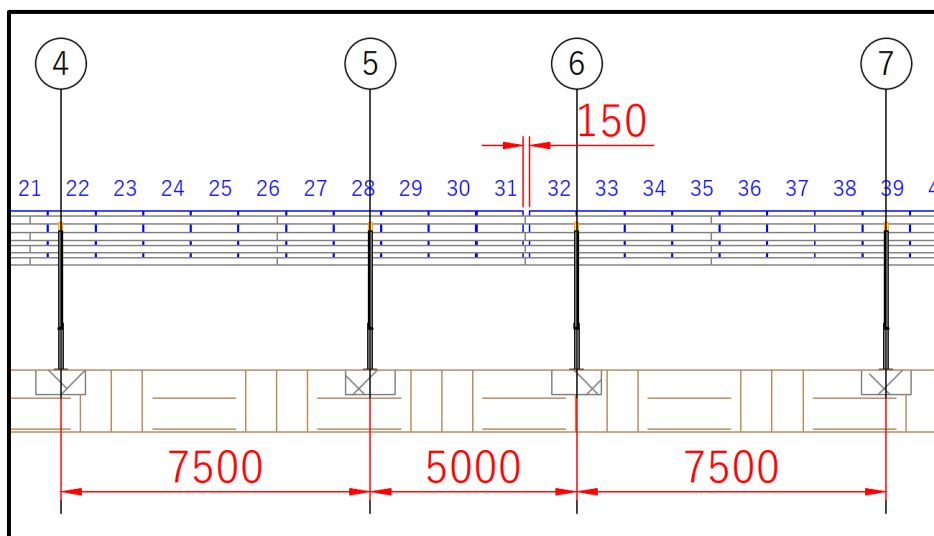
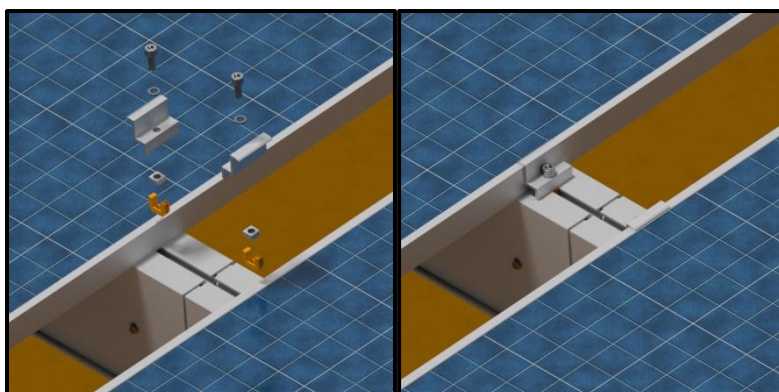


Table sections exceeding ± 35 m will require a 150 mm thermal expansion gap. The expansion gap will be positioned within a 5 m bay. Refer to the project-specific layout drawings for the positioning of the expansion gap, if applicable.

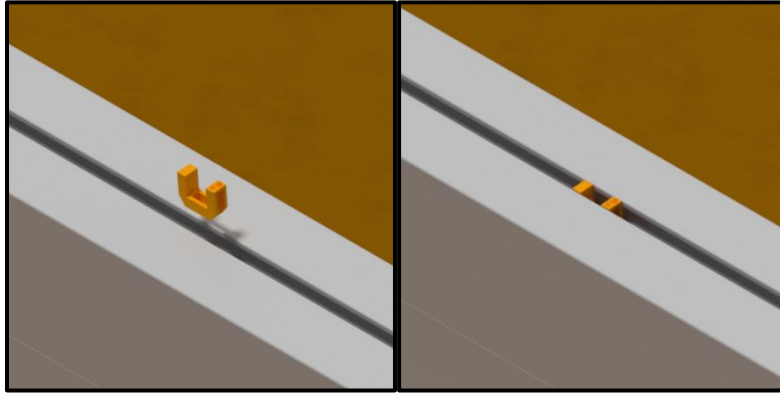


The Extension will only be connected to the Rail on one side of the splice, leaving a 10mm gap between the Rails. PV Panels should be fixed with End Clamps on both sides of the expansion gap.

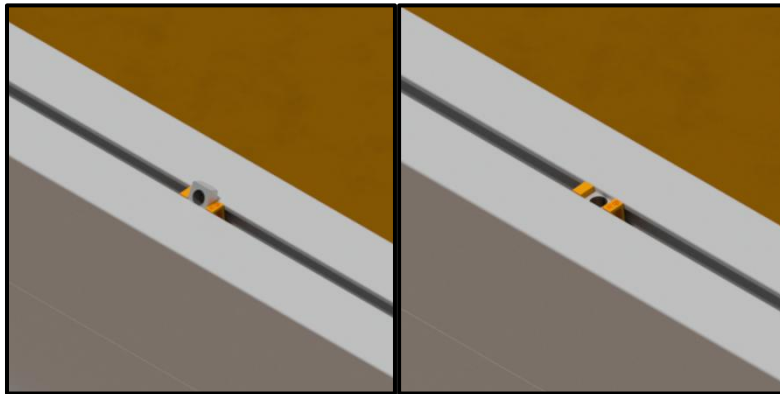


⑩ PV module installation

Insert Nut Stoppers into the rail gap where the installation of PV module Clamps will be.

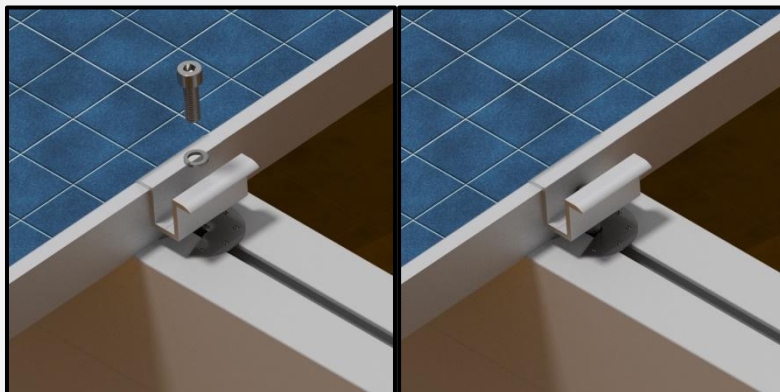


Position a M8 Square Nut at each Nut Stopper. Slide M8 Square Nut at an angle into Rail cavity so that it falls vertically with flat side facing upwards.

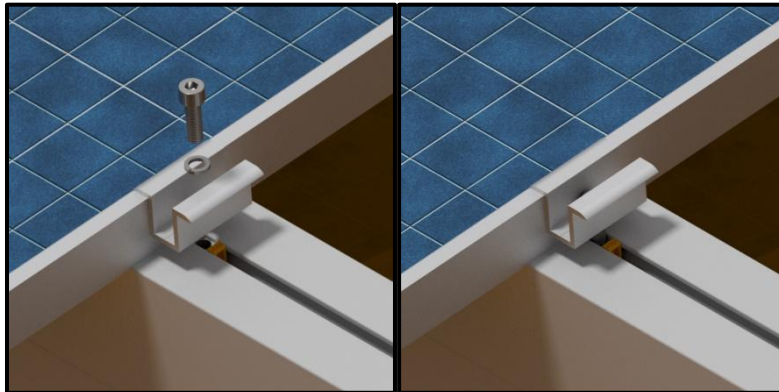


Earthing insurance

To ensure effective earthing of photovoltaic (PV) modules and maintain electrical continuity, the anodised layer on the module frames must be breached using Earth Plates. Begin by positioning the Nut Stopper and Square Nut in the Rail cavity to match the PV module's clamping configuration. Next, place the Earth Plate on the rail with its long lip securely seated in the rail cavity behind the Nut Stopper. Slightly lift the PV module and slide the Earth Plate along the rail until the short lip contacts the side of the module. Lower the module onto the Earth Plate so the spikes pierce the anodised layer, aligning the Square Nut with the central hole of the Earth Plate. This process ensures a secure connection and reliable earthing for the system.

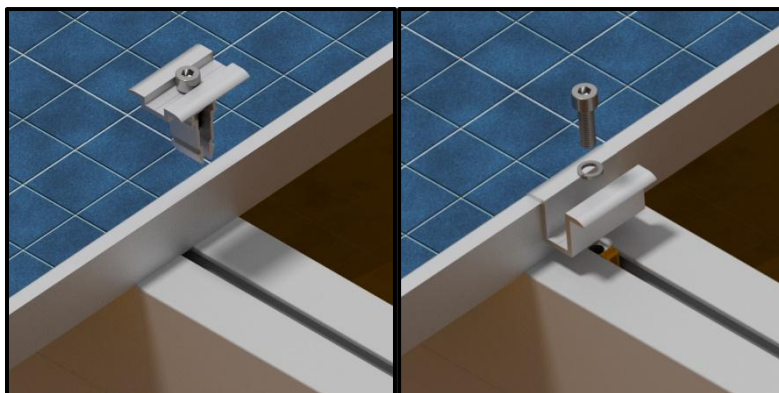


PV modules should be laid onto the Rails in a portrait orientation, ensuring each module is supported by two rail lengths. Install PV module clamps at four locations: one Clamp on each opposing long side and two Clamps on the short sides. These Clamps secure the PV modules firmly to the Rails. Tighten the M8 Hex-Cap Screws to a torque of 18 N·m to ensure proper fastening and stability.

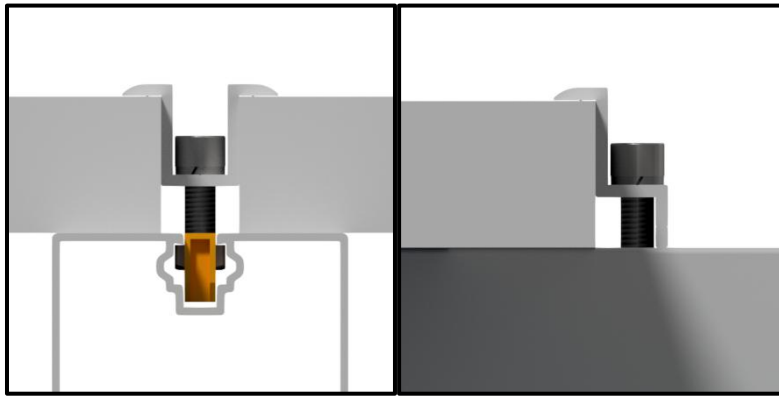


Click Fix:

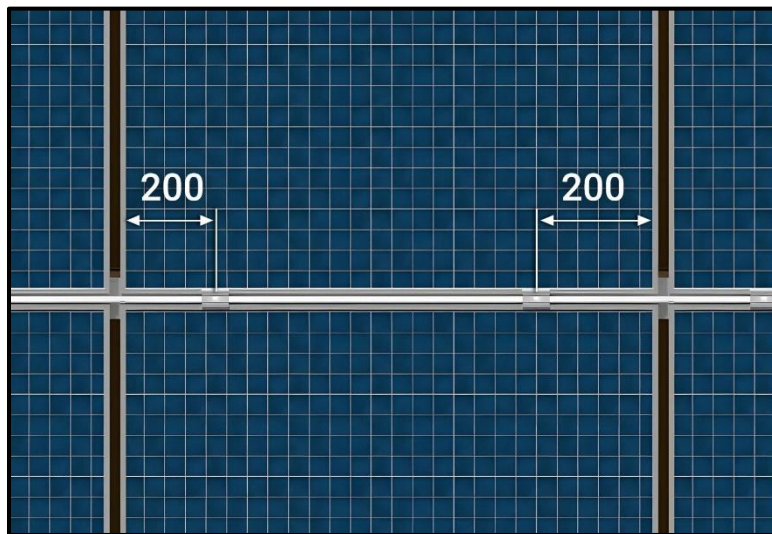
With the **M8 Hex Cap Screw** already protruding, insert the **Mid Clamp Click Fix** between adjacent panels by pushing the pegs into the rail slot. Ensure the clamp is securely seated in the rail before positioning the panels flush against the clamp. Tighten the **M8 Hex Cap Screw** to a torque of **18 N·m** to secure the panels in place. Avoid repeatedly inserting and removing the Click Fix components to prevent damage or wear.



Mid Clamps are installed between two adjacent PV modules to secure them, while End Clamps are used at the ends of each row of PV modules. Ensure all clamps are mounted flush against the sides of the PV modules for a secure and stable fit. Proper placement of clamps helps maintain alignment and structural integrity throughout the installation.



When installing Mid Clamps on the short sides of PV modules, ensure their centres are positioned ± 200 mm from the module's side edges.



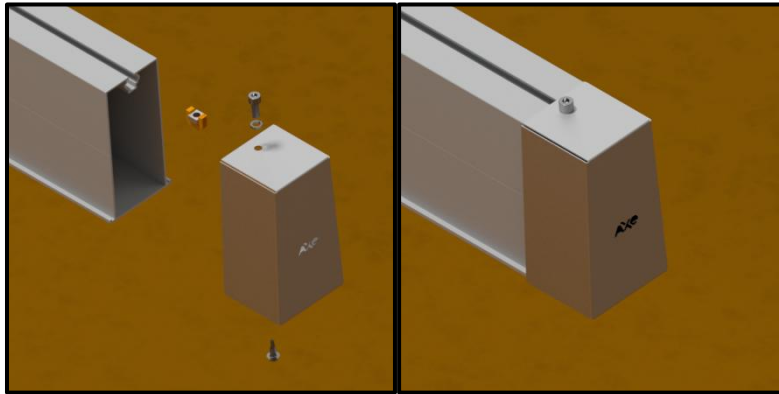
Clamps and Fasteners

It is essential to ensure that the appropriate clamps and fasteners are supplied according to the height of the PV module.

Module height (mm)	End Clamps	Fasteners (Mid & End Clamps)
30	AXE_CE_AP_30_AL	M8x25 Hex Cap Screws
35	AXE_CE_AP_35_AL	M8x30 Hex Cap Screws
40	AXE_CE_AP_40_AL	M8x35 Hex Cap Screws

⑪ End Caps

To achieve a neat finish, slide the End Caps over the ends of the rails. Position the Nut Stopper and Square Nut configuration near the end of the Rail. Then, slide the End Cap into place and tighten it using an M8x20 Hex Cap Screw. For added security, an M6.3 Self-Drilling Tek Screw can be installed at the bottom of the End Cap.



⑫ Maintenance

The products are to be inspected annually in the form of a visual inspection of the whole installation. Axe Struct must be notified of any first appearances of rust and abnormal deformations.

Annual spot checks are to be done on fasteners to ensure that the minimum required torque moment specified in this Manual is met.

Zinc paint touch-ups must be done where galvanising layers have been damaged.

Cleaning of the product must be done with water with a pH between 6 and 10, and without chemicals.

⑬ Liability

Axe Struct can accept no liability for damage arising due to improper use, installation, operation or maintenance. Liability is further excluded if Axe Struct is not at fault due to gross negligence or intent.

The text and images in this Installation Manual correspond to the state of the art upon printing. Subject to change.