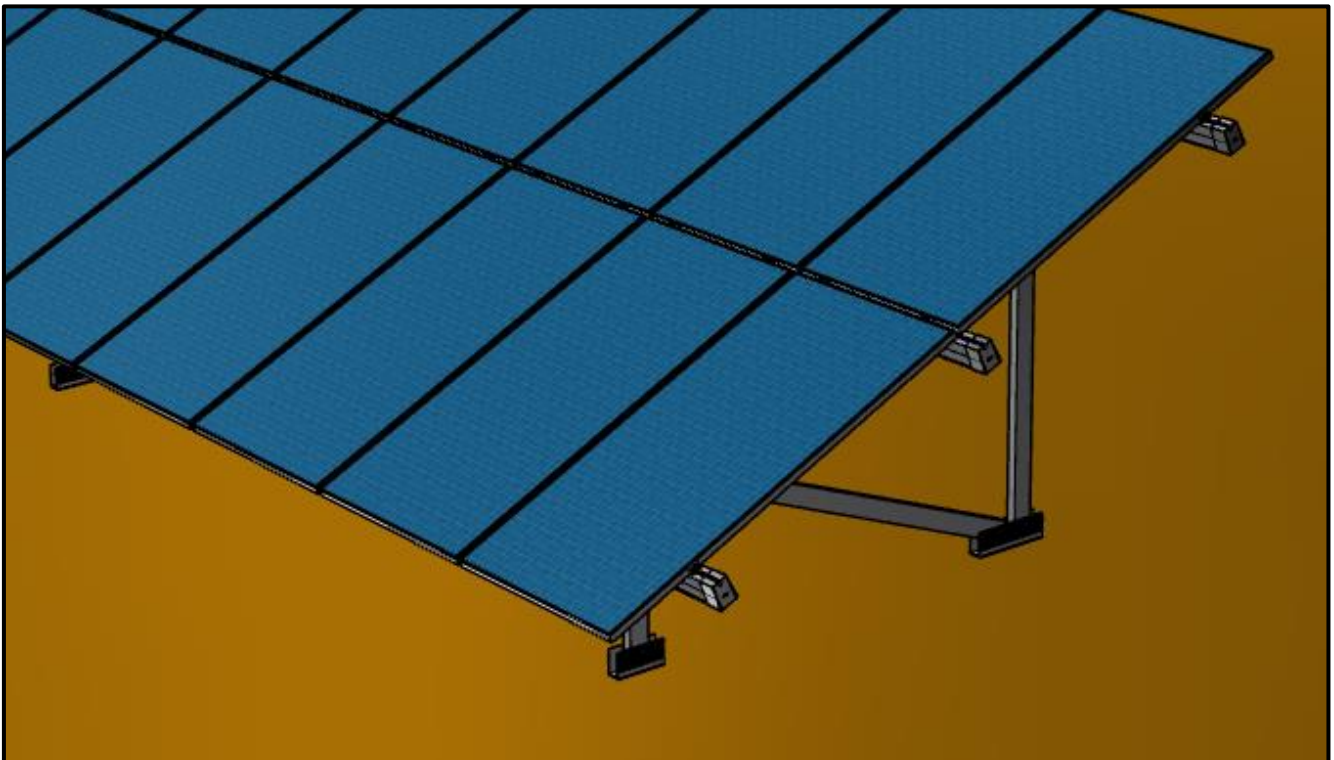


Installation Manual

IM_AXE_GM_EL

Elite Tilted Ground Mounting System

For framed PV modules in portrait orientation



Declaration

- ✘ Only the highest quality components are used in the mounting system in order to ensure trouble-free operation of your solar power system. The following information explains the proper setup of the Axe Struct Ground Mount Elite system.
- ✘ Any unique structural features must be documented so that the unique features of the terrain can be taken into account when planning the layout.
- ✘ Always fasten the bolted connection by turning the bolt head. Do not turn the nut, just hold it. Only Torque all connections once all relevant parts are aligned.

Contents

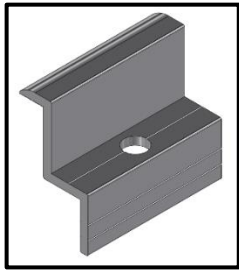
① Components	3
② Layout positioning	8
③ Foundations	9
④ Mounting Piles	12
⑤ Mounting Rafters	13
⑥ Mounting Rails	14
⑦ Joining Rails.....	15
⑧ PV module installation	16
⑨ End Caps.....	19
⑩ Bracing	20
⑪ Maintenance.....	21
⑪ Liability.....	22

① Components

End Clamp

AXE_AL_CE_AP

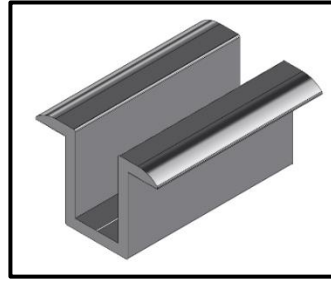
For PV modules with 30mm, 35mm and 40mm frame heights



Mid Clamp

AXE_AL_CM_AP

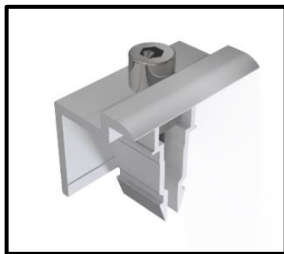
Clamping down any framed PV modules



End Clamp

AXE_AL_CE_CF

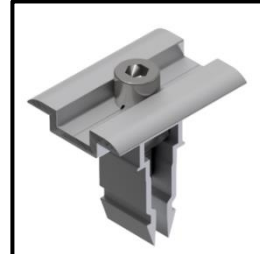
For PV modules with 30 and 35mm frame heights



Mid Clamp

AXE_AL_CM_CF

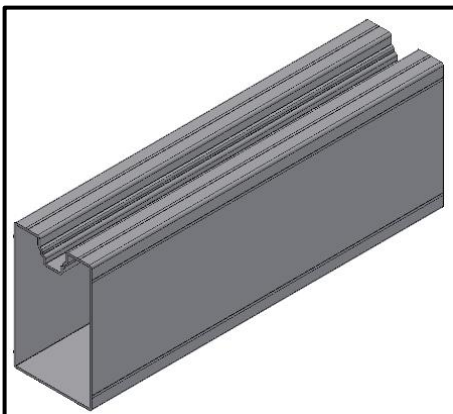
For PV modules with 30 or 35mm frame heights



Rail Splice

AXE_AL_EX_120_80

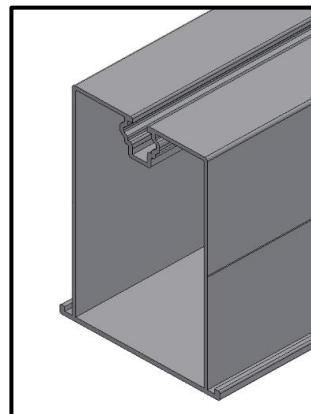
Extending Rails



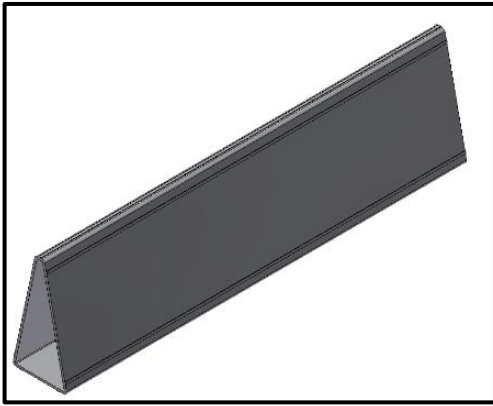
Rail

AXE_AL_L_R_120_80

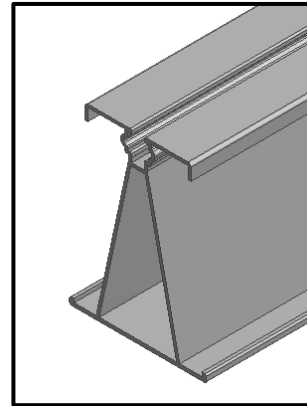
2.5; 4.5 or 6m lengths



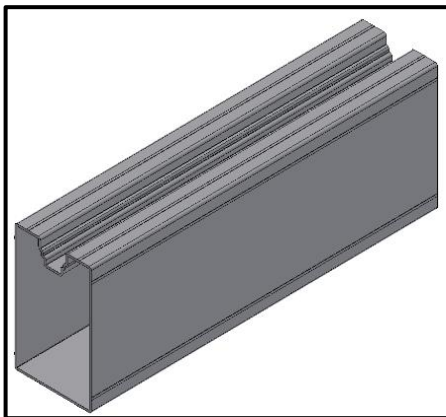
Rail Splice
AXE_AL_EX_120_70
Extending Rails



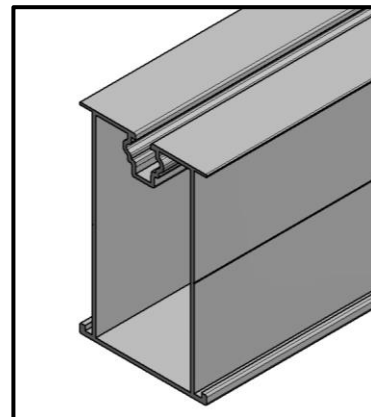
Rail
AXE_AL_L_R_120_70
2.5m, 4.5 or 6.0m



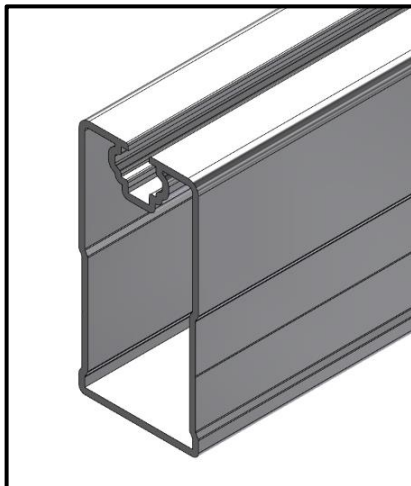
Rail Splice
AXE_AL_EX_110_60
Extending Rails



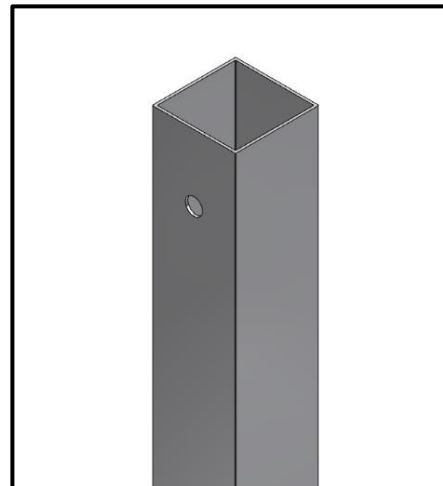
Rail
AXE_AL_L_R_110_60
2.5; 4.5 or 6m lengths



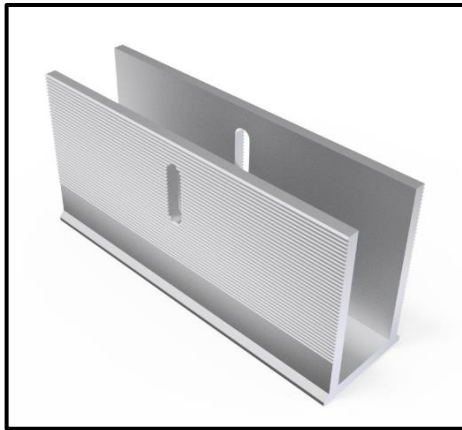
Rafter
AXE_AL_L_RF_120_60
Support for Rails, connection to Piles



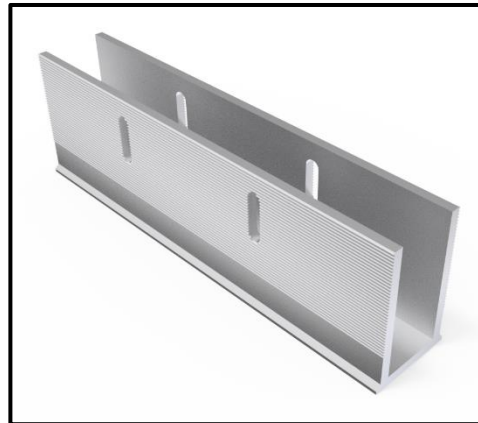
Pile
AXE_AL_L_SQR or AXE_AL_L_RHS
Profile for ground upright support



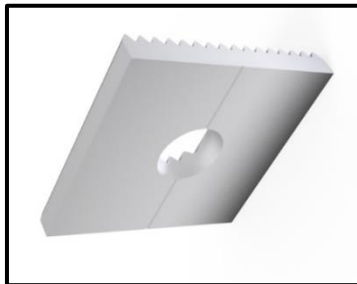
Base Slot Bracket
 AXE_AL_BR_BS_S_50
 Front pile base connection



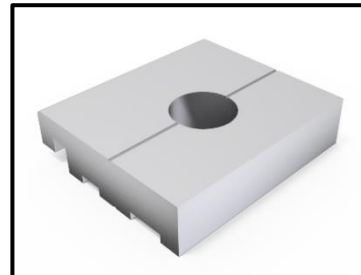
Base Slot Bracket
 AXE_AL_BR_BS_D_50
 Middle and Back pile base connection



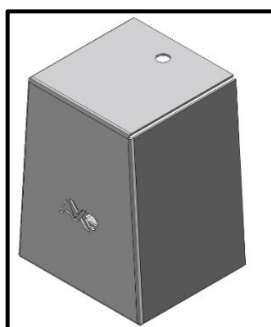
Base Slot Washer
 AXE_AL_WB_12
 Base connection washer



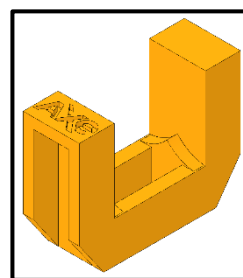
Rail Clip
 AXE_AL_CP_GM
 Holding Rail to Rafter



End Cap
 AXE_AL_EC
 Rounding of Rail ends



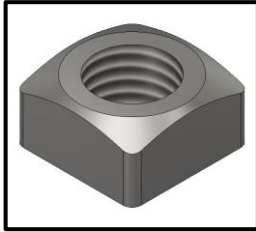
Nut Stopper
 AXE_PP_NST_8
 Guiding M8 Square nut into position



M8/10 Square Nut

AXE_SS_NSQ_8/10

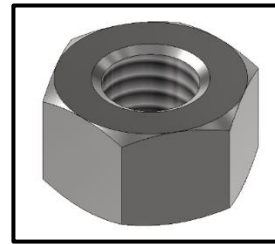
PV Module connection to Rails & Rail connection to
Rafter



M12 Hex Nut

AXE_SS_NH_12

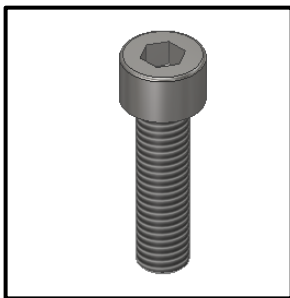
Pile-Rafter connection



M8 Hex-cap Screw

AXE_SS_CS_8

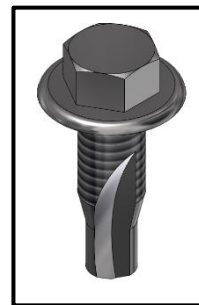
PV module connection



Self Drilling Tek Screw

AXE_GS_ST_6.3

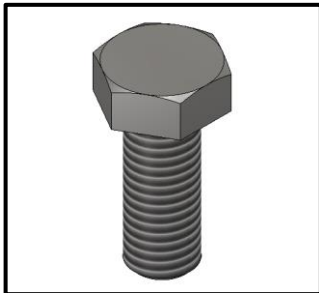
Splice connection



M10 Hex Bolt

AXE_GS_BH_10

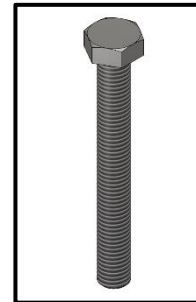
Rafter-Rail connection



M12 Hex Bolt

AXE_GS_BH_12

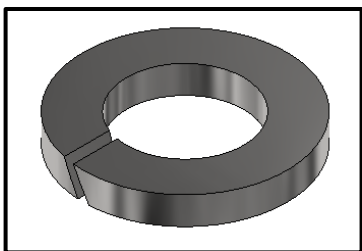
Pile-Rafter and Base connection



M8, M10 or M12 Spring Washer

AXE_GS_WS_8/10/12

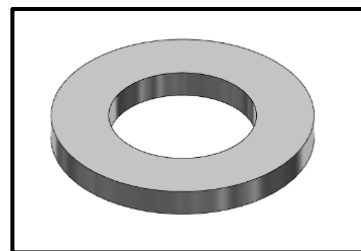
PV module, Bracket or Pile-Rafter connection



M12 Large Flat Washer

AXE_SS_WF_12

Pile-Rafter connection



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.

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

Fastening should be halted when aluminium sections start to visually deform.

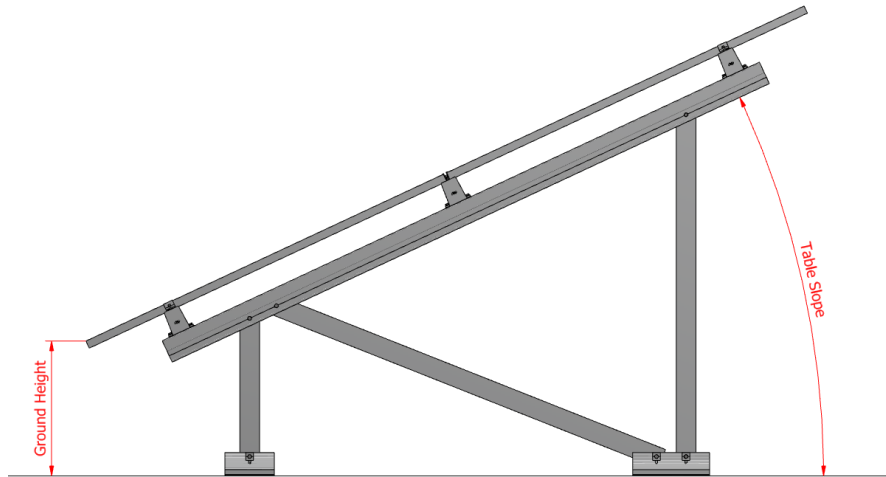
Only Torque all connections once parts are aligned.

Seizing (Galling) Prevention

It is recommended that Copper Slip paste is applied in all threaded connections, specifically Stainless-Steel fasteners. This will prevent fasteners from seizing and promotes good practice. A further step to prevent seizing is to tighten fasteners at low rpm's, without interruptions and apply steady pressure.

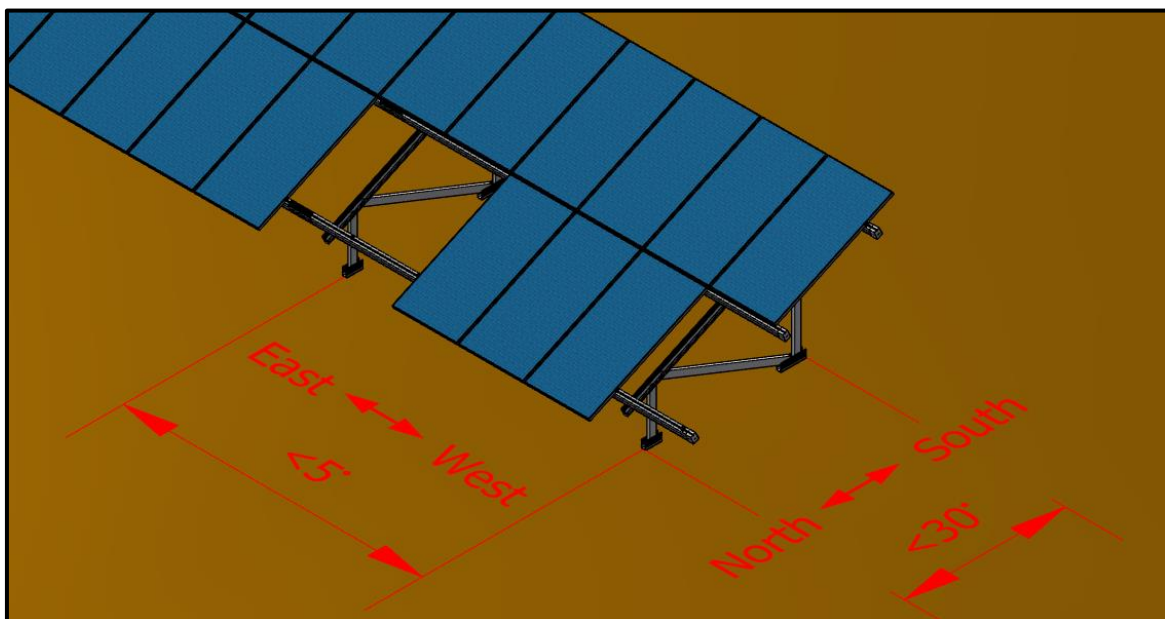
② Layout positioning

The spacing between Piles as well as the structural member size are determined by structural analysis. The outcome of the structural analysis is dependent on the Site location (Altitude and Wind Speed), Desired Layout (panel/string sizes or space), Table Slope, front panel edge Ground height and method of installation. Providing the incorrect information will result in the incorrect structure.



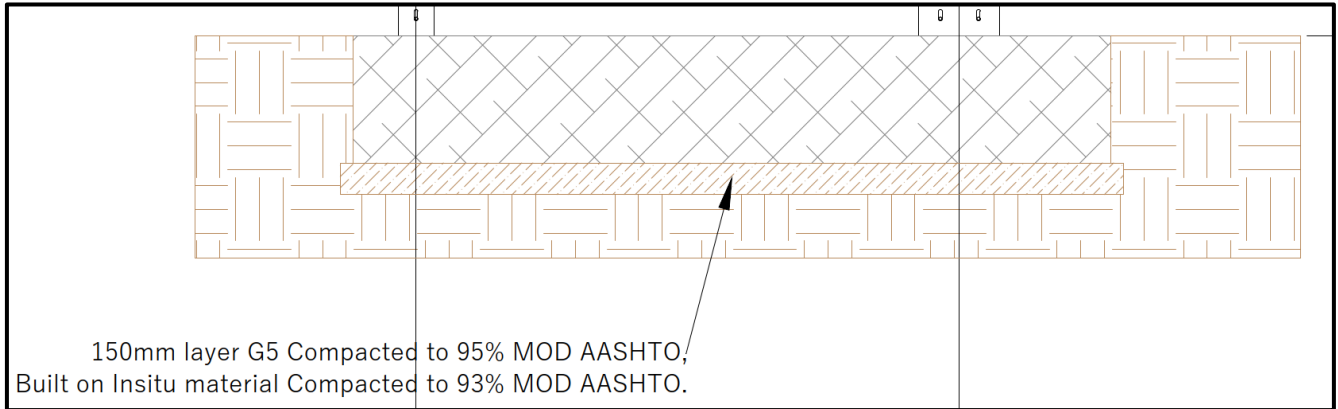
Ensure that the correct layout drawing is used for your site-specific structure provided by Axe Struct. The layout drawing illustrates the Reaction Forces, Side-, Back- and Top view of the table. These drawing also indicate the site conditions and the sections as determined by the structural analysis. Lengthening or shortening the tables, changing the panel type or the Tilt, without consultation can result in failure of the structure.

Terrain geography must be conveyed to the designer in order to maintain the requested table slope and PV module ground clearance height. The East – West terrain slope must be within 5° tolerance and for the North – South terrain slope it must be lower than 30° .

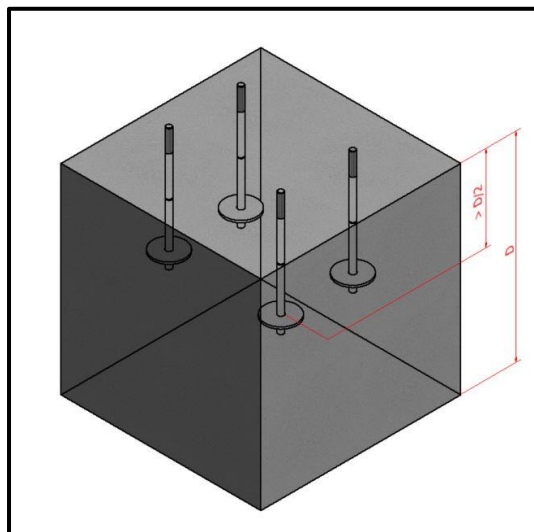


③ Foundations

Mark out positions of foundation locations from the layout drawings. Prepare designated areas for concrete bases, including compaction as per the image below. The concrete foundations are to be built on a 150mm thick layer of Class G5 material compacted to 95% MOD AASHTO. The previous mentioned material layer must be on an In-situ material of 93% MOD AASHTO.



Concrete foundations are designed for minimum of 30MPa. Before applying any tension to bolts, allow 7-days for curing. Use guide plate/Jig or dowel in threaded rods into the concrete bases at the correct positions. The threaded rods should be rated for the reaction forces indicated on the project specific layout drawings. The Threaded Rods should at least be embedded half the foundation depth in the concrete ($>D/2$).

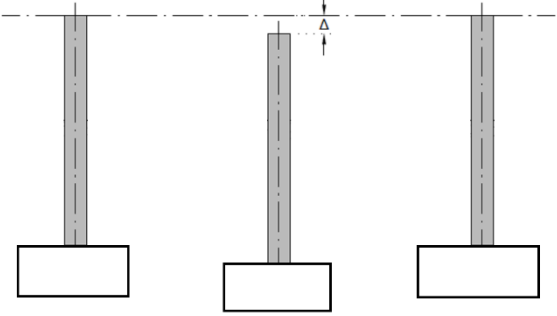


Foundation connection

We strongly advise to pre-cast the M12 Threaded rods in the concrete base with a bolted washer that has an OD of 80mm and a thickness of 4mm. This washer should sit lower than the midpoint of the base depth. At own risk, an alternative method can be pursued by utilizing chemical anchors. The specifications and installation methods of suppliers should be strictly adhered to.

Tolerances to consider when lining up threaded rods in concrete bases (measured at ground level):

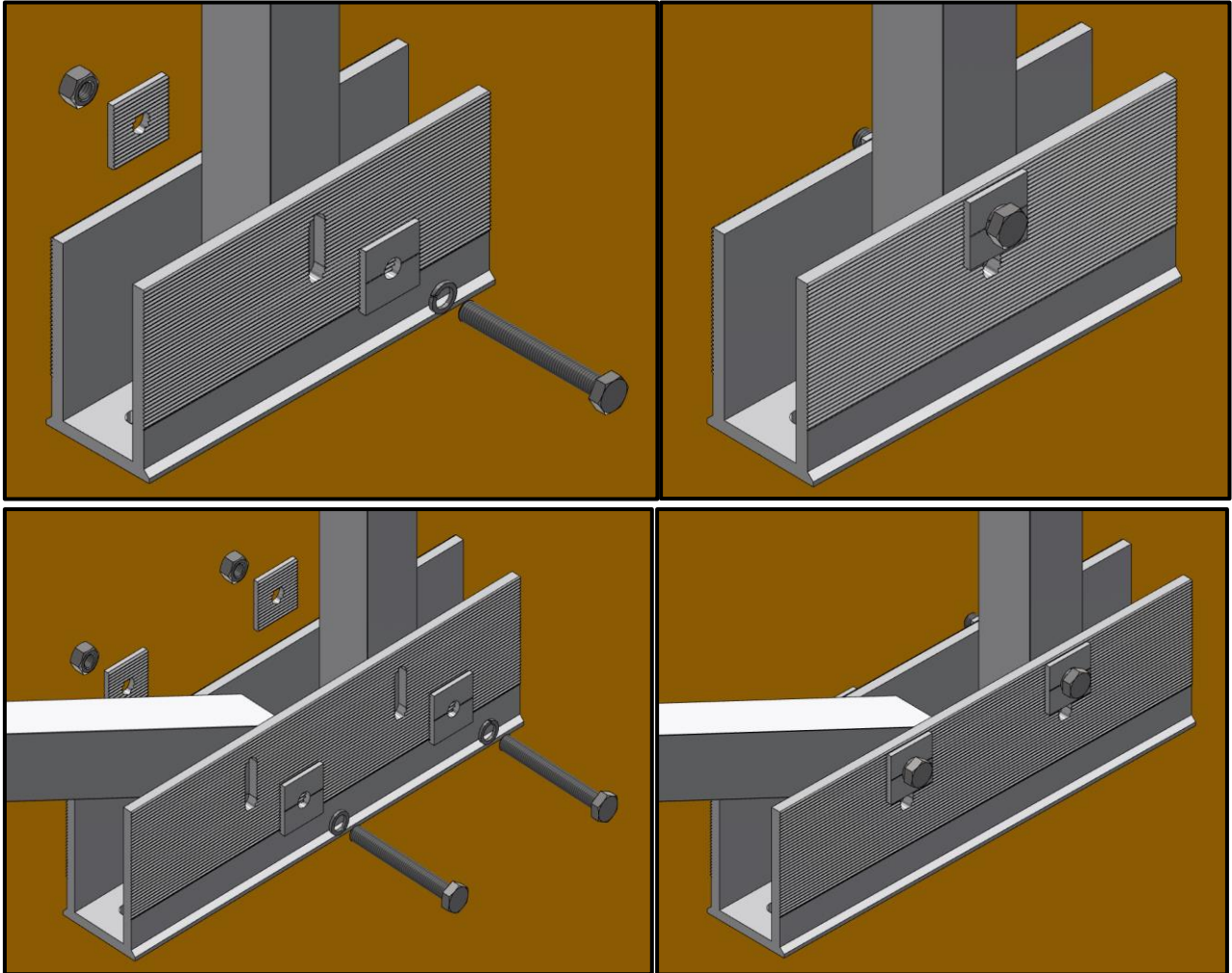
Description	Depiction	Tolerance
Individual 4 rod grouping position relative to the reference point (RP)		$\Delta 1 = \pm 10\text{mm}$
Individual 4 rod grouping spacing relative to adjacent 4 rod grouping		$\Delta = \pm 10\text{mm}$
General 4 rod grouping alignment relative to reference line (RL)		$\Delta = \pm 10\text{mm}$
Overall table length and North – South spacing		$\Delta 1 = \pm 20\text{mm}$ $\Delta 2 = \pm 10\text{mm}$
Individual post inclination		$\Delta = h/300$

Individual base level relevant to adjacent base		$\Delta = \pm 10\text{mm}$
---	--	----------------------------

Images in the above table are based on the use of base plates onto the posts, however these principles can also be applied to posts which are casted into the concrete.

④ Mounting Piles

Base Slots are connected to the Foundations using either threaded rods which are casted in or chemical anchors. With the Base Slot brackets in place the Piles can be fixed to the Base Slot Brackets. Use M12x100 Hex Bolts, M12 Spring Washers, M12 Base Slot Washer, and M12 Hex Nuts to line up the connection.



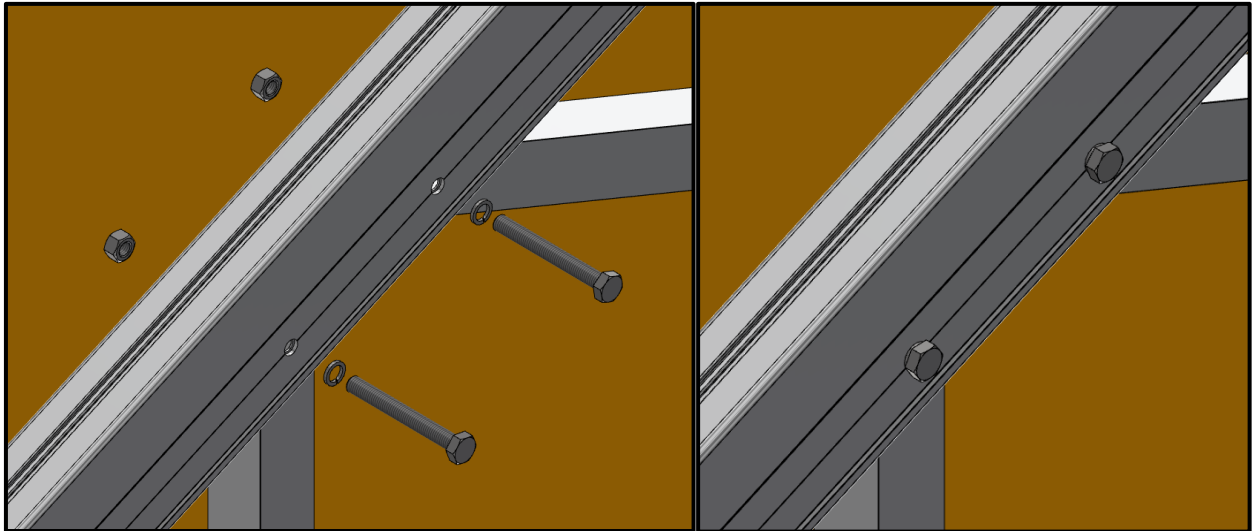
The slots on the Base Slot Brackets must be used for alignment of the Rafters. Wait until the all the Rafters align before torquing the Base Slot/Pile Connections.

⑤ Mounting Rafters

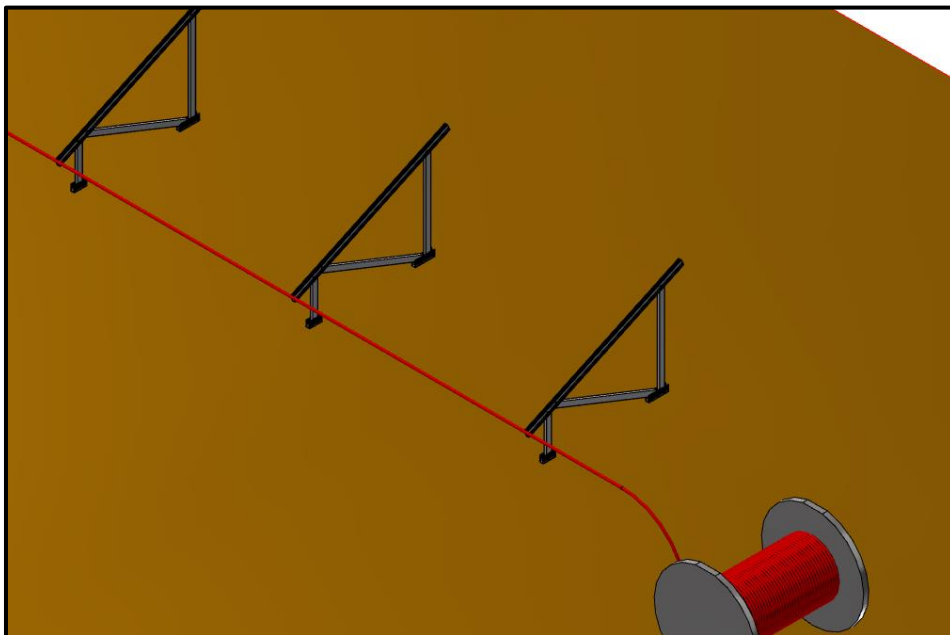
Rafters are connected to the Front short Pile and corresponding Back long Pile. Use M12x100 Hex Bolts, M12 Spring Washers, M12 Flat Washers and M12 Hex Nuts to line up the connection.

Recommendation

- ✘ Use the holes on the rafter and pile to connect the first rafter and last rafter on each table. Once each table's outer rafters are assembled, a gut line must be stretched between these rafters. Rafters in the middle of the table between the outer rafter assemblies can then be aligned with the gut line as a reference using the slots on the Base Slots.



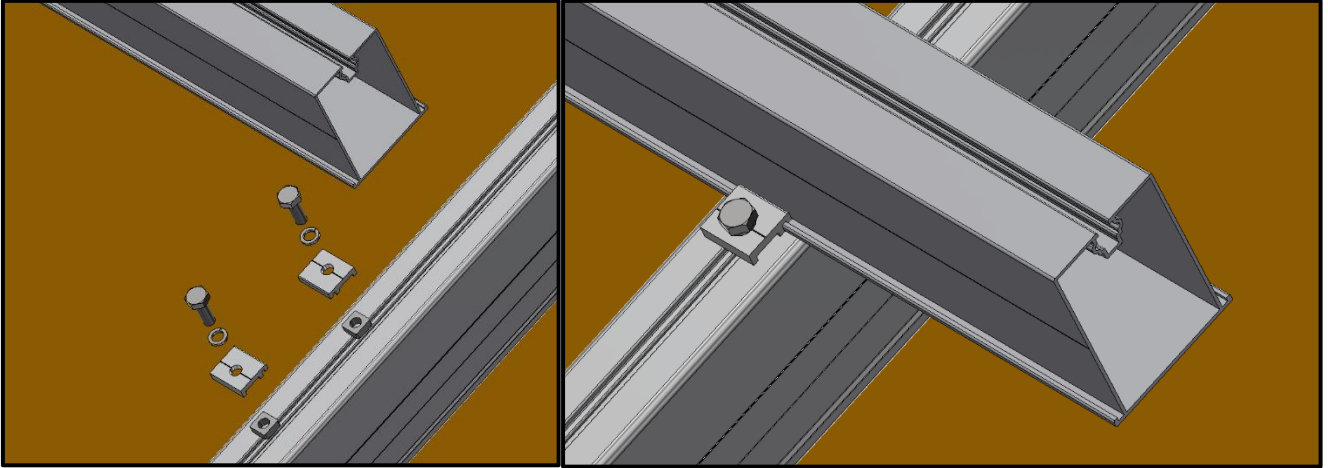
The M12 bolt and nut connections are torqued to 100 N.m. once all the Rafters have been aligned on a single table. This alignment must be done for both the bottom and top end of the Rafters in a vertical and horizontal plane.



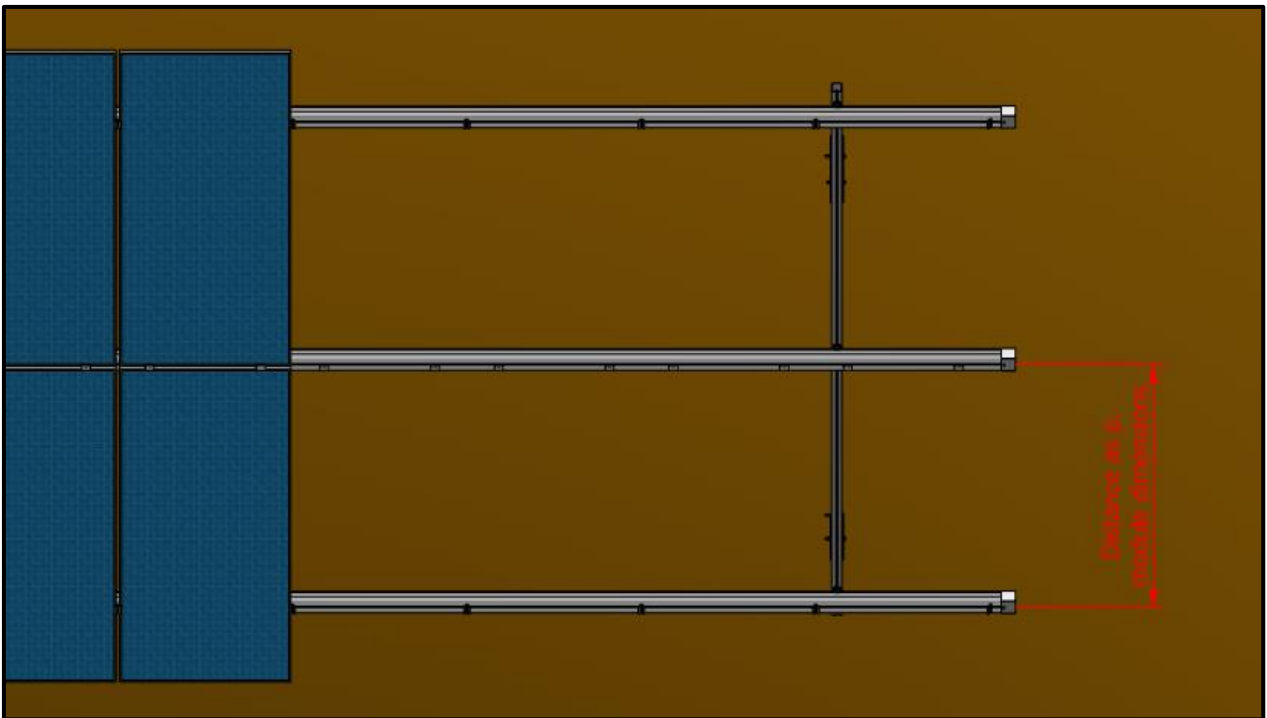
The Rafters must be aligned so that there will be no stresses in the PV module upon installation.

⑥ Mounting Rails

Position Rails on top of the Rafters. Connect Rail Clips to rail by inserting M10 Square Nuts into Rafters cavity. Use M10x30 Hex Bolts, M10 Spring washers and M10 Square Nuts to tighten connection. Spring washers are added to each connection configuration to ensure connection will not loosen over time.

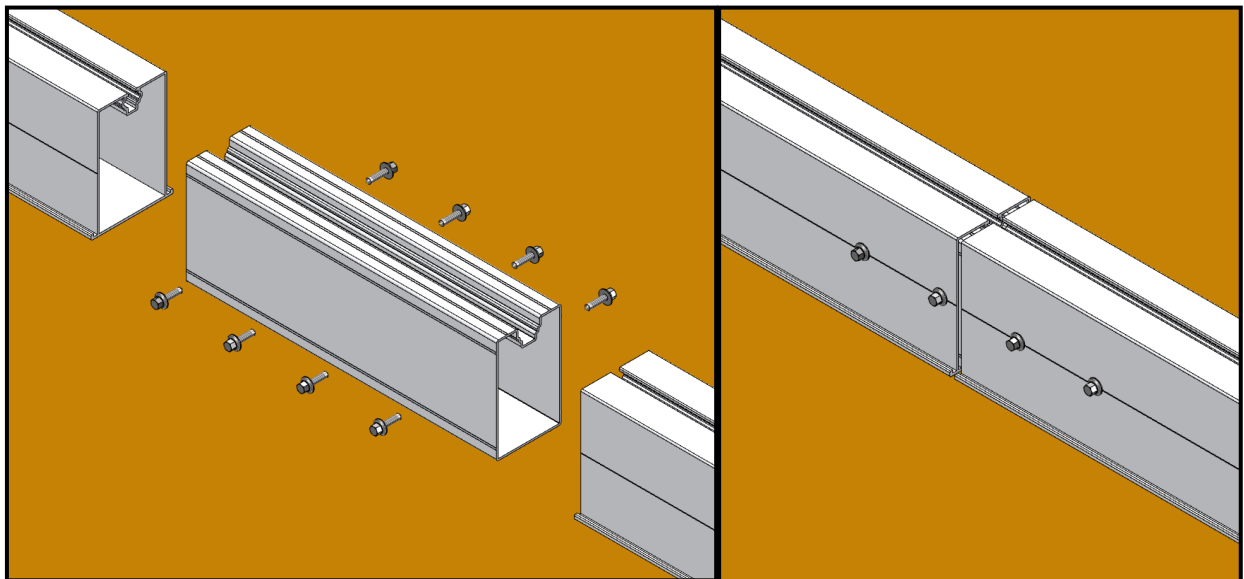
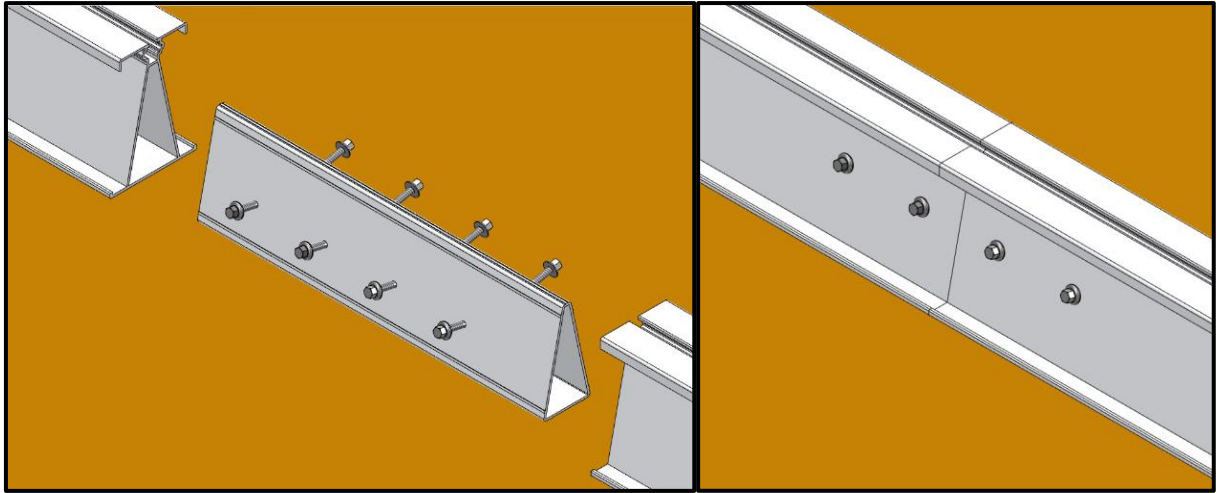


The rail spacings are dependent on the dimensions of the PV module used. PV module installation manuals indicate supporting requirements.



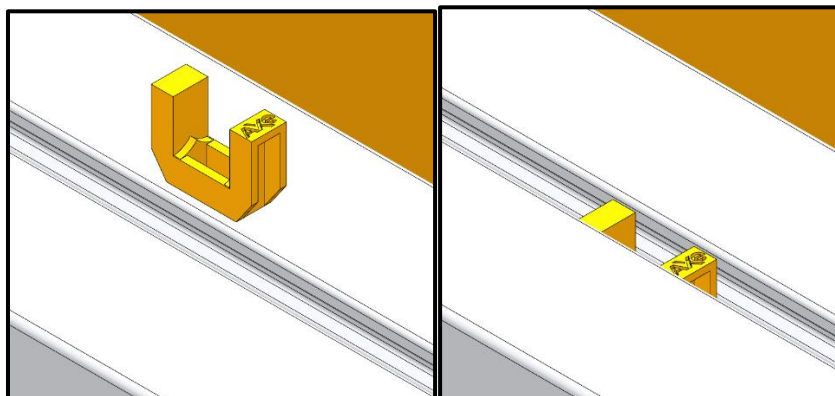
⑦ Joining Rails

Slide Rail Splice halfway, indicated on Rail Splice with a marker, into each adjoining Rail. Use 8 x Self Drilling Tek Screws to tighten the connection.

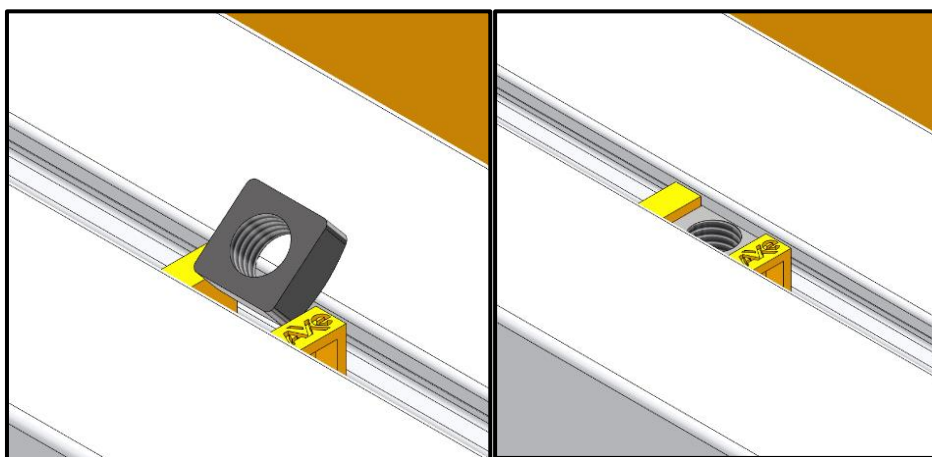


⑧ PV module installation

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

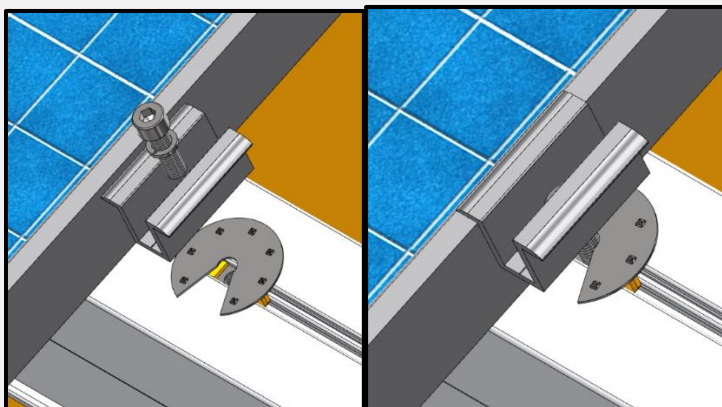


Position a M8 Square Nut at each Nut Stopper. Slide M8 Square Nut at an angle into Rail cavity so that it falls vertically with flat side facing upwards.

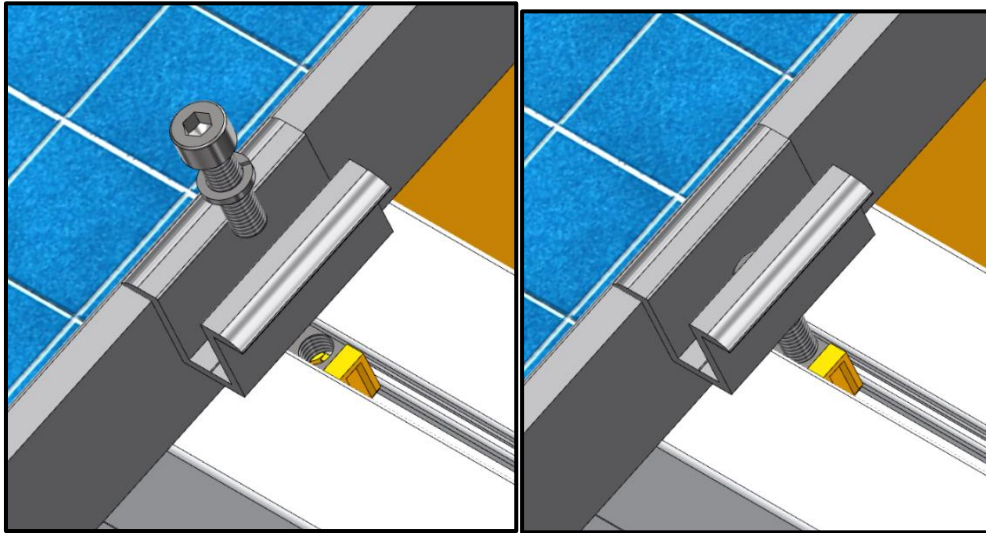


Earthing insurance

As a standard, Axe Struct Mid Clamps have earthing pins. In cases where earthing plates are required, please specify. In order to ensure continuity for conduction of the earth system the anodizing layer on the PV module frames must be broken by installing Earth Plates.

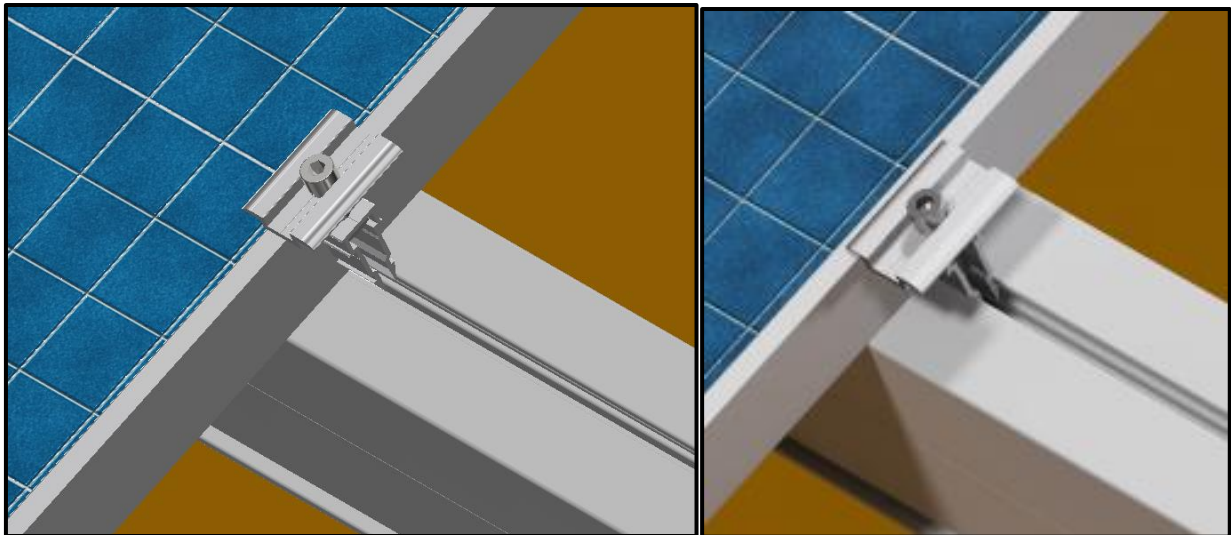


PV modules are laid onto Rails in portrait view so that each PV module is supported by 2x rail lengths. Install PV module Clamps on the sides of the PV module so that each PV module is fixed on 4x locations. 1x clamp per opposing long side and 2x clamps on short side will hold each PV module down to the Rails. Torque M8 Hex-Cap Screws at 18 N.m.

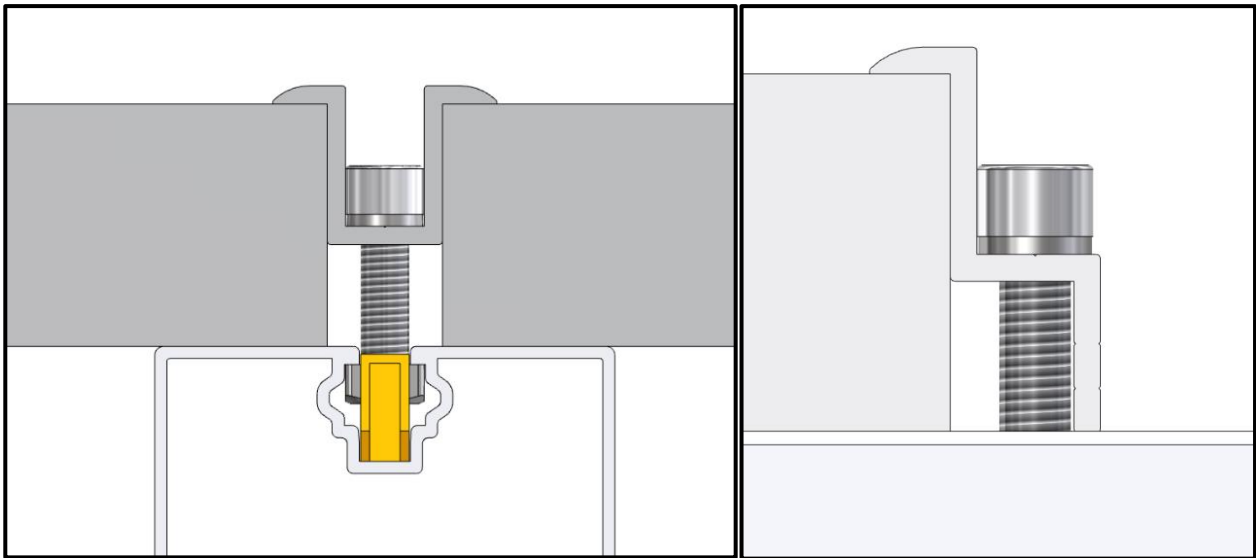


Click Fix

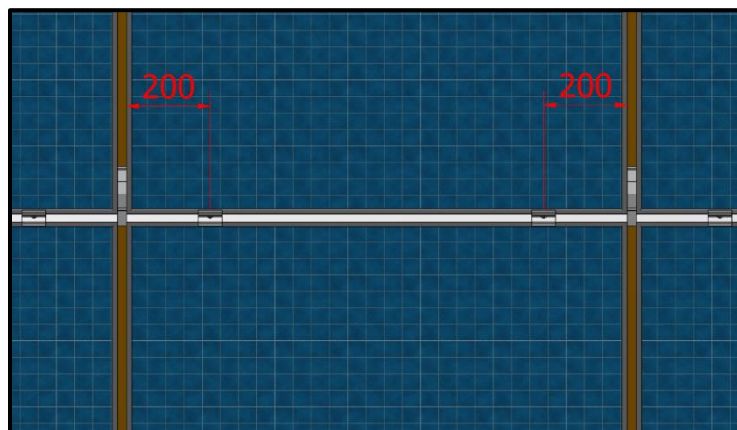
With the M8 Hex Cap Screw protruding, Insert Mid Clamp Click Fix between panels by simply pushing the pegs in to the slot in the rail. With the Click Fix Clamp firmly in the rail, position the panels flush with the clamp and Torque the M8 Hex Screw to 18N.m. Do not repeatedly insert and remove the Click Fix Parts.



Mid Clamps are used in between 2x PV modules and End Clamps are used at the end of a row of PV Modules. Make sure to mount Clamps flush against PV module sides.

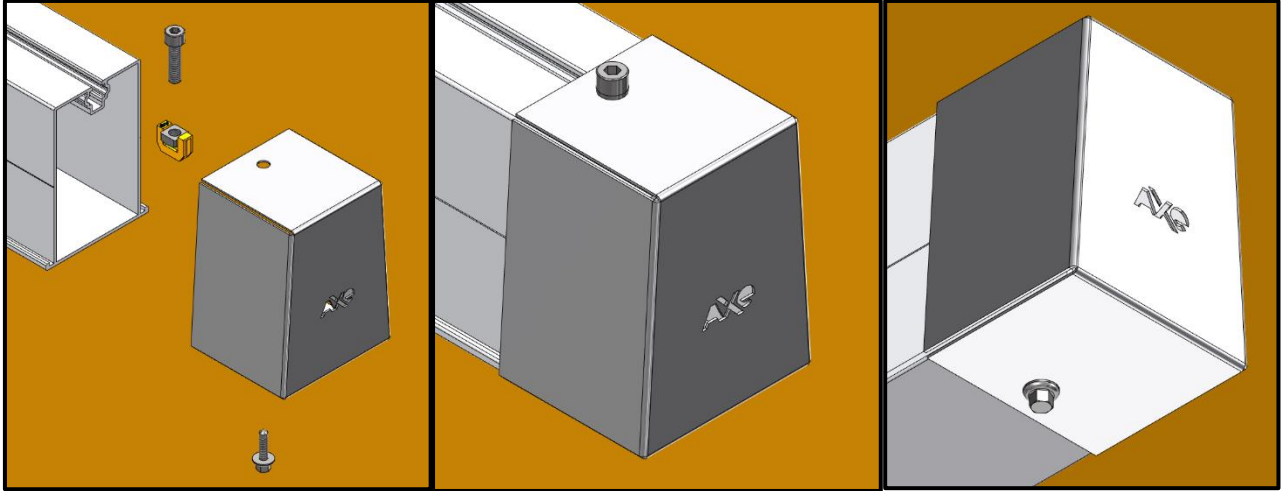


The centre of Mid Clamps used on the PV modules' short sides must be installed $\pm 200\text{mm}$ from the PV module's side edges.



⑨ End Caps

Slide End Caps over the end of Rails for neat aesthetics. Position Nut Stopper and Square Nut configuration close to the end of a Rail. Slide End Cap over and tighten with M8x20 Hex Cap Screw. An M6.3 Self Drilling Tek Screw can be installed at the bottom of the End Cap for additional security.



⑩ Bracing

The bracing of a structure is only to prevent movement or swaying in one direction. Bracing member only work in tension to prevent movement in the length of the table (direction of rails). Axe Struct offers two types of Bracing for the Ground Mount Elite, either Aluminium Angles or SS Cables with Turnbuckles. Bracing is only applied between two back Piles, as it is the longest. The position of the bracing can be found on the Layout Drawings.

The end result will look like an “X”. The holes for the braces should be drilled on site.

1. Aluminium Angles:

These angles come in a standard 6.0m length and should be cut to fit on site. With the shape of the angles, one brace/angle will be installed on the inside and one on the outside. A good position for fixing the brace is 100-200mm from the ground on back Pile 1 and 100-200mm from the top of back Pile 2. And vice versa on from Pile 2 back to Pile 1.

Holes should be drilled through the Back Pile/Post in a straight line to ensure the M12x100 Hex bolt fits. Slide the M12 Spring Washer followed by the M12 Plain Washer over the M12x100 Hex bolt. Slide the above mentioned assembled M12x100 Hex Bolt through the hole in the angle then through the Pile. The protruding bolt must be fixed with an M12 Plain Washer and a M12 Hex Nut.

2. Cables with Turnbuckles:

The cables also come in a standard length and should be cut once the fitment is completed. The M12 Eye-nuts will be used to fix the bracing cables. The M12 Eye-nuts will replace the M12 Hex Nuts on the Rafter/Post and the Post/Base slot connection.

⑪ 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.

⑪ 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.