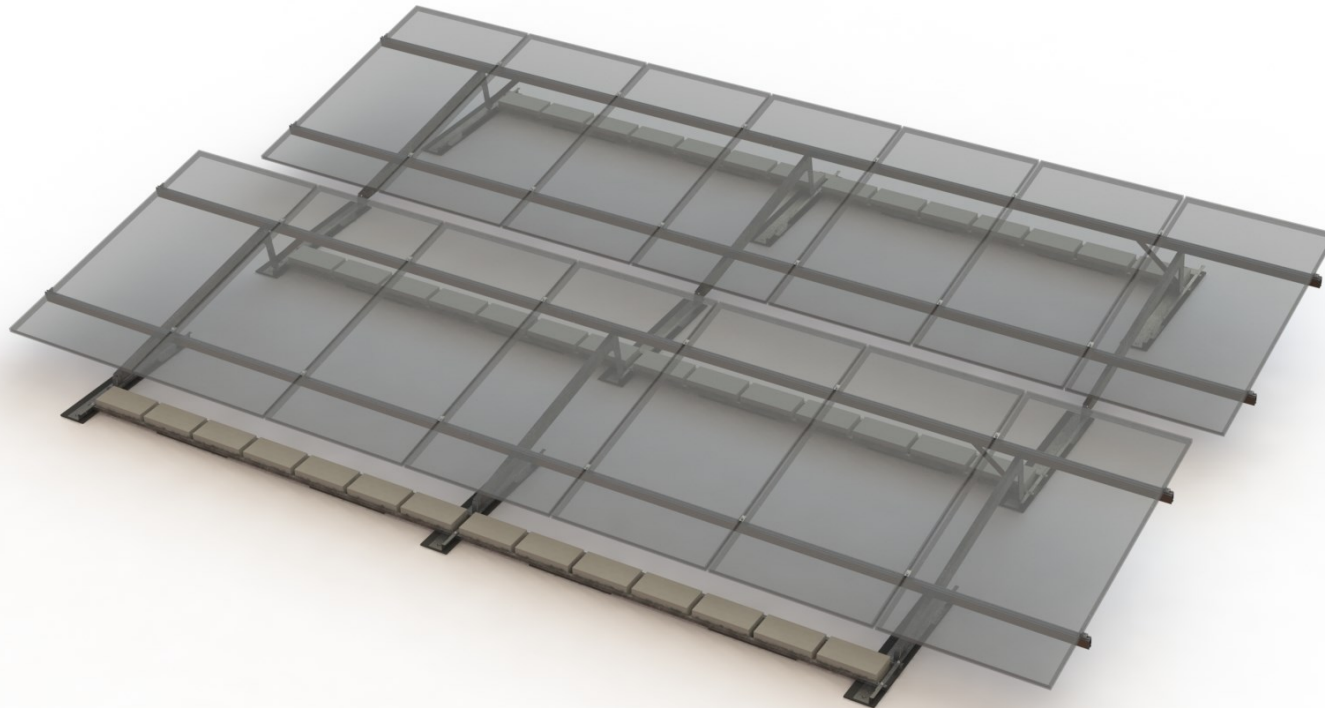


FR Avenue - Installation Manual

FLAT ROOF RACKING





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Introduction

This manual is an illustrated guide on how to install a Fast-Rack Avenue flat-roof racking system. It is meant to cover each individual step of the assembly process. Throughout the guide, references will be called to the parts list in order to assist in easily identifying the items required for a specific section. The guide is broken into several sections, each covering the milestone assembly steps, with sub assembly steps in-between where necessary. Each assembly step will include an illustrated list of hardware to be used during that assembly process. Where specified, some assembly sections include a preparation process. It is necessary to follow these preparations in order for the installation to continue smoothly, with no need for back tracking.

Throughout the guide there are reference markings for warnings, and recommendations, identified by these symbols:



Be sure to look for and read these markings. They will provide information such as guidelines to prevent damage to equipment, safety measures to prevent serious injury or bodily harm, and advice on how to make the assembly quicker.

General

Fast-Rack Avenue is a flat-roof racking system designed for ballasted or mechanically attached solar installations on flat or low slope roofs. This installation manual is to be followed for all projects and used in conjunction with project specific ballast plans approved by a professional engineer.

Liability

The installer, contractor, or developer of each project shall be responsible and liable for the safe and proper installation of each system. They are also required to initiate, maintain, and supervise all safety programs and precautions for each project and project site, providing all necessary protection to prevent damage, injury, loss, or death to any persons, property, or work present on the project site.

Charge Solar does not perform any portion of its mounting system installations. Therefore, Charge Solar does not have, and hereby explicitly disclaims, any duty or responsibility for the safe and proper installation of any mounting system or jobsite safety on any jobsite where its mounting systems are installed. Please follow the provided drawings and instructions, and report any issues or discrepancies to Charge Solar.

Receiving

Upon receipt of goods, make sure to check all packaging to ensure delivery of all parts required. Any damages or missing components are to be noted and communicated to Charge Solar within two business days. Damaged components are to be documented with pictures.

Compliance

The Fast-Rack Avenue photovoltaic mounting system has been certified and listed to the UL 2703, Ed. 1 and TIL No. A-40 standards (Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules). This standard includes fire testing for Type 1 and 2 modules, electrical bonding, and mechanical load testing and approval. The Fast-Rack Ultra system has additionally been designed and certified to the NBCC by professional engineers.





Personal Safety

Prior to starting installation it is important to identify all potential hazards and implement a safety plan denoting how to deal with these hazards.

Examples of some potential personal hazards which may be encountered during an installation are:

- Fall Hazards – Ensure compliance with local regulations for working at height. Use fall protection, or fall prevention equipment and practices as necessary.
- Electrical Hazards – Observe the location of overhead and rooftop conductors/electrical equipment. When possible disconnect/lockout circuits in the work area.
- Lifting Hazards – Use proper lifting techniques to prevent work place injuries when moving components on the ground, on the roof and lifting between the ground and roof.
- Environmental Hazards – Rain, snow, wind, sun and heat. All of these have the potential to injure personnel and property if not properly prepared for.

Once the hazards specific to the installation have been identified, it is critical to devise a plan should a workplace accident occur. Some things to have prepared and discussed prior to start of work are:

- Location of nearest hospital, emergency phone number
- Trained and certified on-site first-aid attendant and location of first-aid kit
- Devise method for extracting injured personnel
- Communication and awareness of potential hazards
- Trained and certified fall protection training for all personnel working at height

Site Safety

If necessary, obtain a structural analysis of the roof to determine it's capacity before installing solar PV modules. Failure to do so may result in overloading the roof and could lead to costly upgrades of the existing structure.

Familiarize yourself with local municipalities' building permit requirements. Commercial and industrial projects will typically require a structural assessment prior to the issue of a building permit.

In addition to determining the structural suitability of the building it is also important to protect the building when working on the roof. Adhere to best practices when working on different roof membranes to prevent damage to the roof and potential for water penetration.

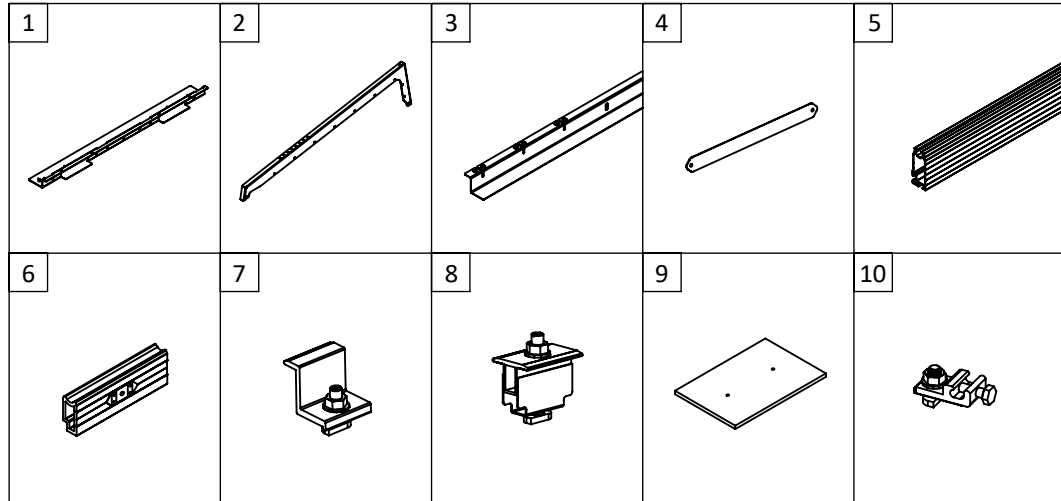
If necessary, work with an experienced roofer to install roof penetrations according to roof manufacturer's specifications. Ensure the solar installation does not void the warranty of the roofing.

It is the responsibility of the installer/owner to ensure the racking and solar system (including installation) meets local building and electrical codes along with requirements for local power distribution companies.



Components

ID	PART	CODE
1	Base	FR-AVE-BASE
2	Triangle	FR-AVE-TRI
3	Ballast Tray	FR-AVE-BT
4	Stabilizer	FR-AVE-STBL
5	Rail	FR-RAIL-RM-185
6	Rail Splice	FR-SPLICE-RM
7	End Clamp	FR-END
8	Mid Clamp	FR-MIGS
9	Rubber Mat	FR-AVE-MAT
10	Ground Lug	FR-GNDLUG-C

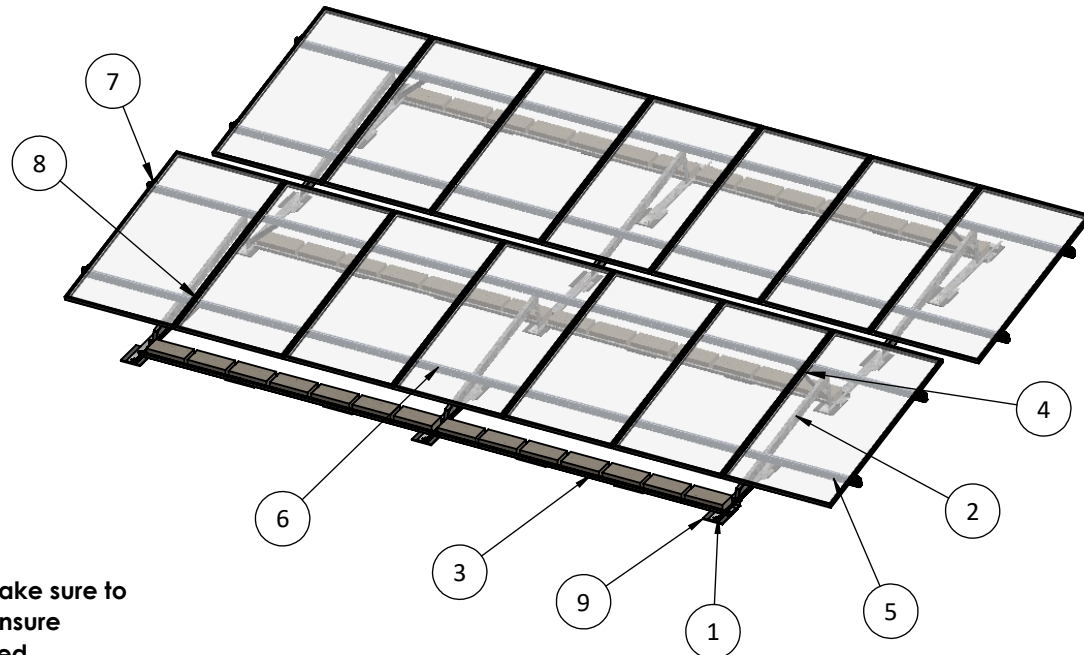


Hardware

ID	SIZE	TYPE
A	M8 x 25mm	T-Bolt
B	M8 x 20mm	Flanged Hex Bolt
C	M8	Flanged Hex Nut

Tools

- 13mm wrench, socket and ratchet
- Torque wrench
- Stringline
- Drill/driver
- Hand or chop saw
- Tape measure

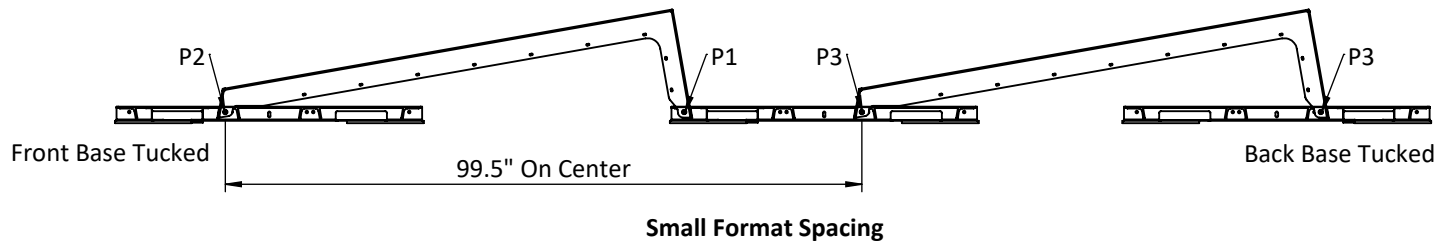
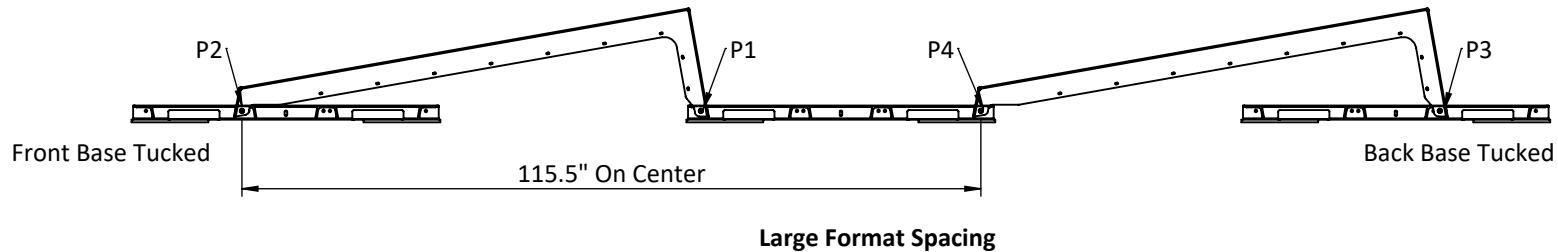
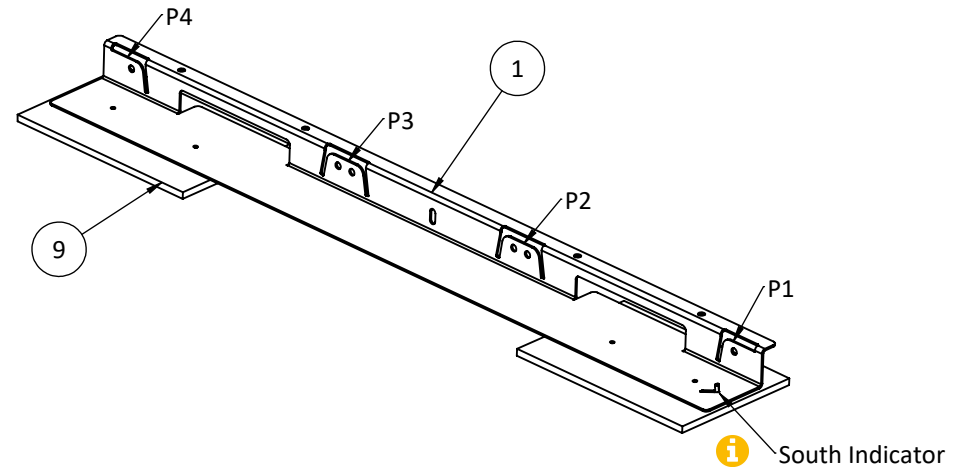


Upon receipt of goods, make sure to check all packaging to ensure delivery of all parts required.



4.0 Base Preparation

1. Install two rubber mats to the bottom of the Bases as shown to prepare them. Use the plastic tree clips to align the mats on the Base.
2. The Base is equipped with four mounting points designed for configuring the array.
3. To save space, the Bases may be tucked under the Triangles at the front and back of the array.
4. To optimize space usage and minimize shading, adjust the row spacing according to the length of the modules.
5. Refer to the following typical module lengths for guidance:
 - Large Format Spacing: module length > 75"
 - Small Format Spacing: module length < 75"





4.1 Base Spacing

1. Lay out the Bases on the roof while taking into account the specified roof edge setbacks and spans provided in the project ballast plan.
2. To ensure precision, it is advised to run a stringline. Use this stringline to establish a straight and square alignment for the leading edge of the array with the roof.
3. Bases on the front and back row are to be tucked. Refer to section 4.0 for illustration.

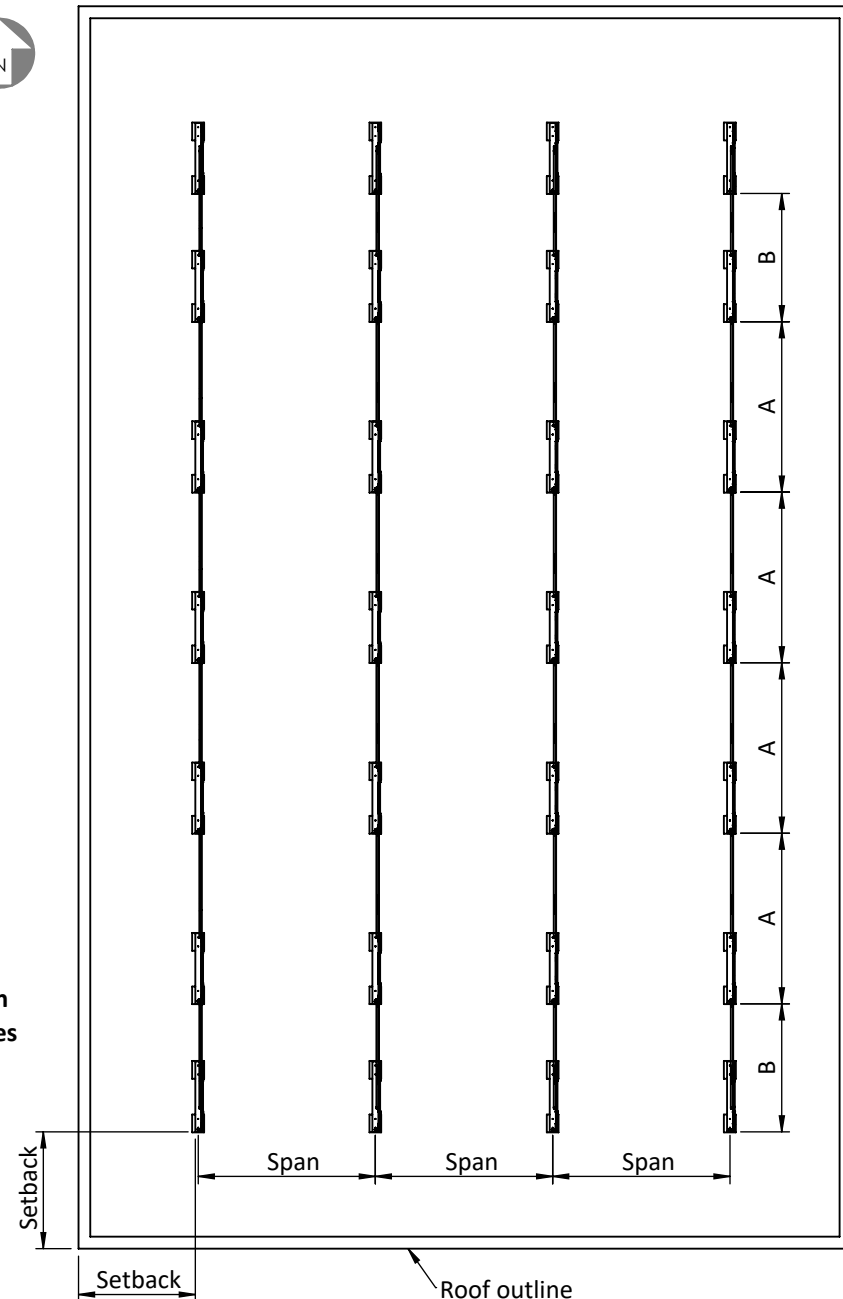
i Ensure marker arrow on Bases is facing South

i Using a storey pole/spacer jig is a quick method to space the Bases across the roof.

	A	B
Large Format Spacing	115.5"	86.7"
Small Format Spacing	99.5"	86.7"

	Span
Standard	120" (10')
High Load	108" (9')
Extra High Load	96" (8')
Extreme Load	Custom

Confirm with project specific ballast plan



! Refer to ballast plan for setback distances



5.0 Triangle Installation



B

M8 x 20mm
Flanged Hex Bolt



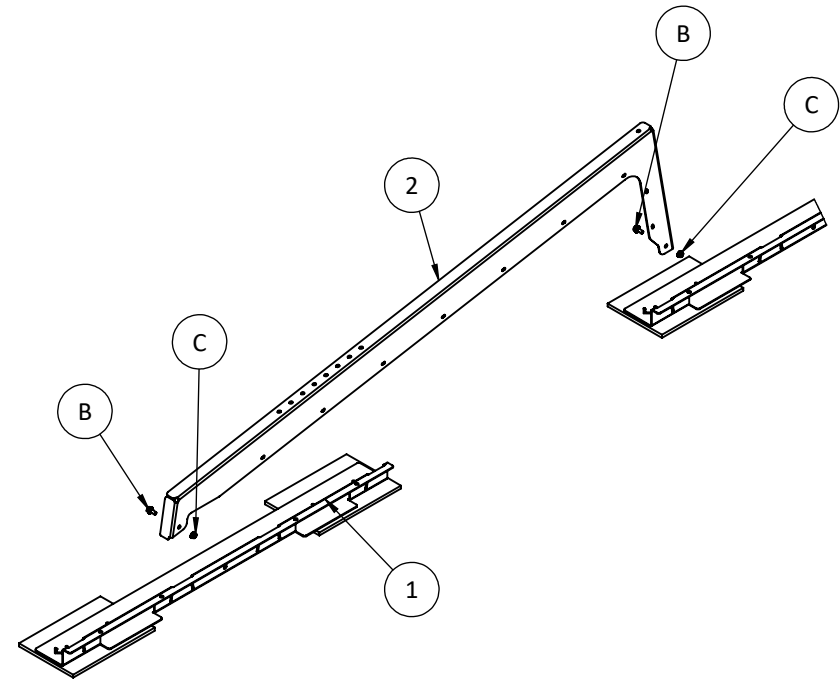
C

M8
Flanged Hex Nut

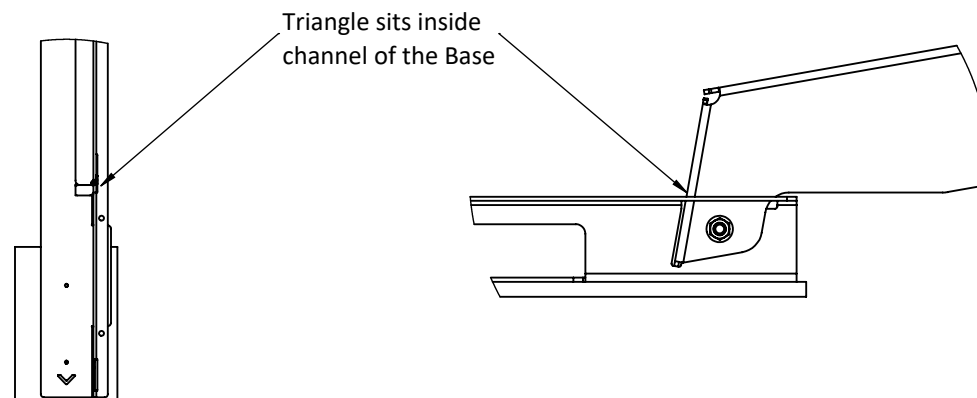
1. Begin installing the Triangles by inserting the legs of the Triangles into the cutouts on the Bases.
2. Ensure that the Triangles are seated securely inside the channel, so they stand in place.
3. Fasten the Triangles to the Bases using a single M8 bolt and nut.

i Confirm the Triangles are installed at the correct connection point on the Base

i Ensure the front and back Bases have been tucked underneath the Triangles



i Torque to 15 lbs.ft

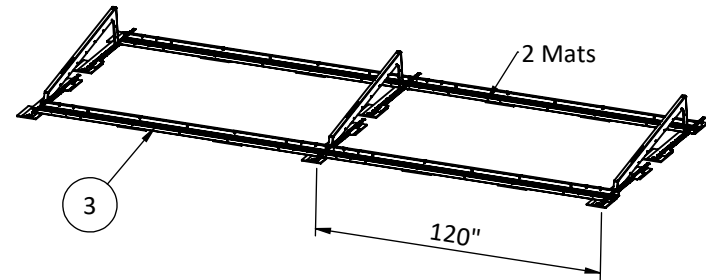




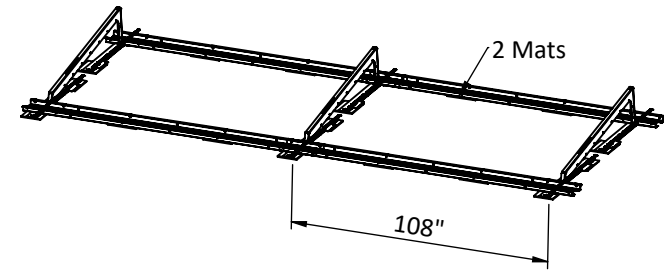
6.0 Bay Spacing

1. Prepare for the installation of the Ballast Trays by first confirming the required span for your specific project's array. Refer to the project-specific ballast plan for this information.
2. In most locations, a 10' span is the standard configuration. Locations with high climatic loads may require the 9' or 8' spans as indicated in the project plan.
3. The Ballast Trays are equipped with notches that automatically space the array as demonstrated below.
4. Select the appropriate set of attachment points based on the project's specified spans.
5. Note that the Ballast Trays are designed to overlap during installation.

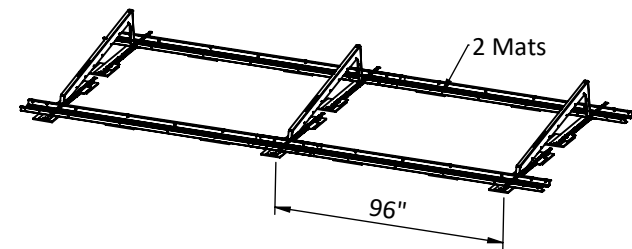
Refer to project specific ballast plan



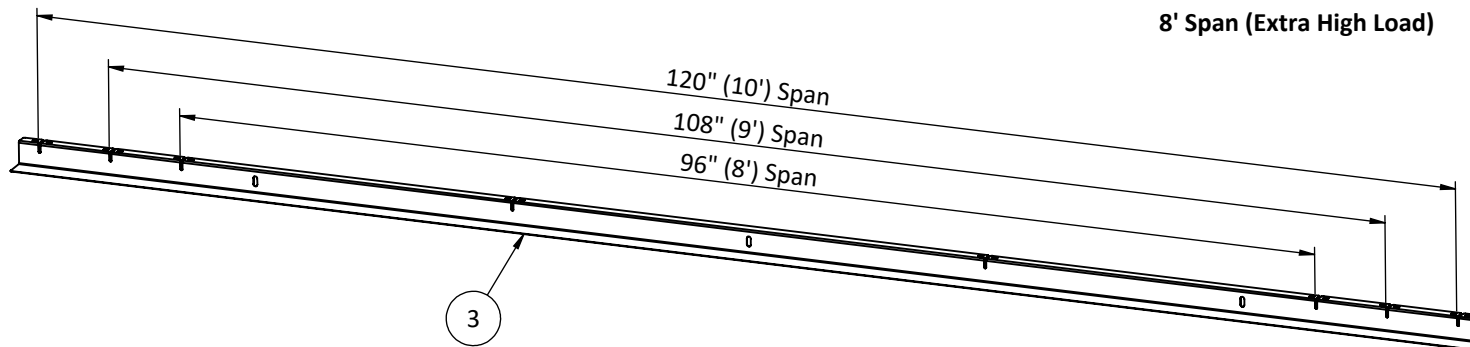
10' Span (Standard)



9' Span (High Load)



8' Span (Extra High Load)

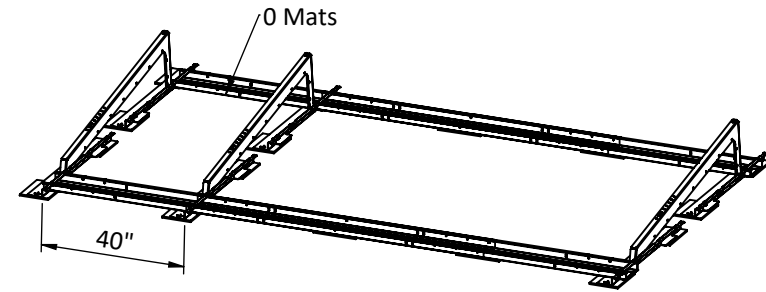




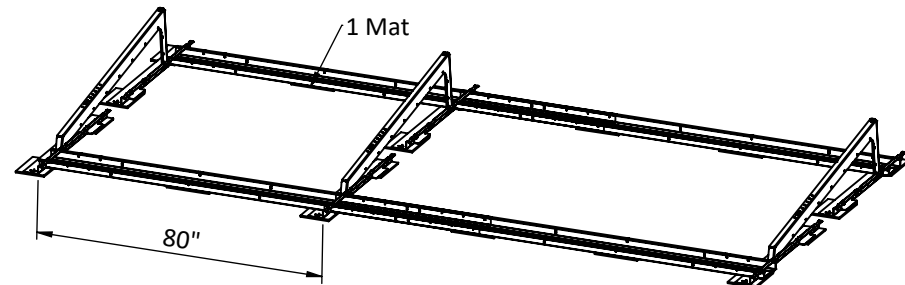
6.1 End Bays

1. The Ballast Tray features two intermediate attachment points, which are intended for use in end bay conditions. These allow the row length to be adjusted as needed to fit within the available roof space or to avoid obstructions.
2. To create a shorter end bay configuration, simply overlap the Ballast Trays and connect them at the desired attachment point.
3. These shorter end bay configurations are only necessary at the end of a row.

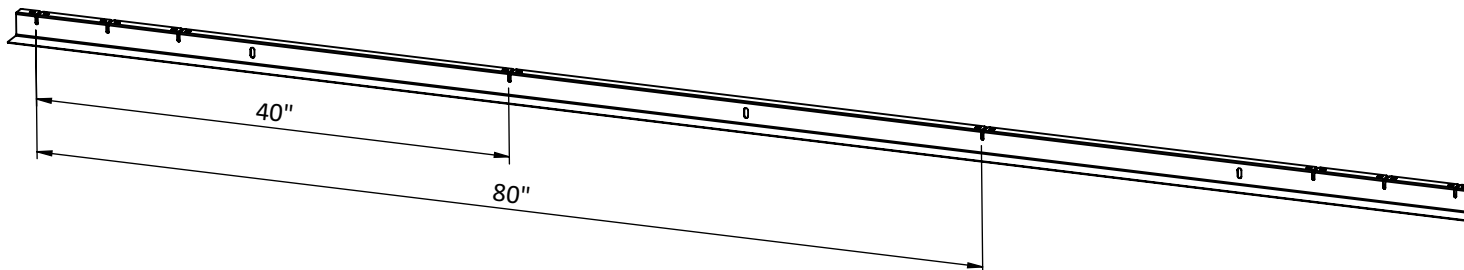
⚠ Refer to project specific ballast plan to identify end bay locations.



40" End Bay



80" End Bay





7.0 Ballast Tray Installation



B

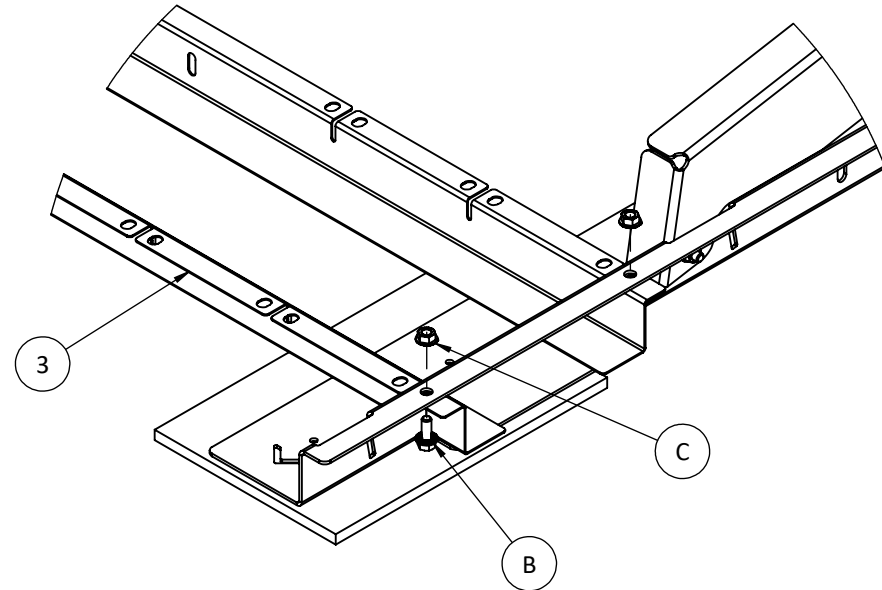
M8 x 20mm
Flanged Hex Bolt



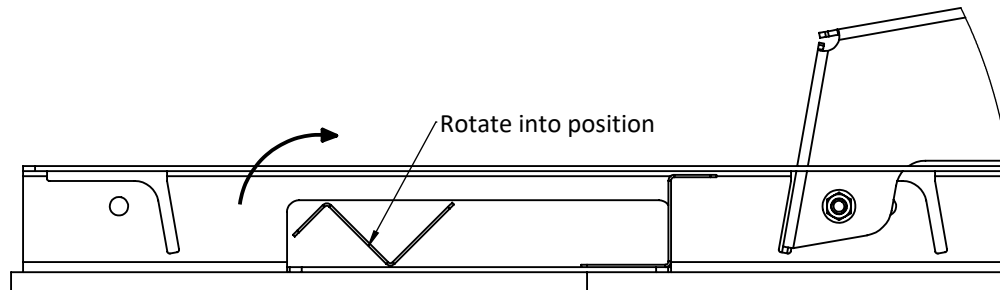
C

M8
Flanged Hex Nut

1. Insert the Ballast Trays through the cutout on the side of the Base. To fit through, position the Ballast Tray at a 45-degree angle.
2. Once the notches in the Ballast Tray align with those on the Base, rotate the Ballast Tray into its proper position.
3. Secure the Ballast Trays by bolting them at either end using an M8 bolt.
4. Note that adjacent Ballast Trays will overlap, and they will share the same bolted connection.



i Ensure adjacent Ballast Trays are installed before fastening





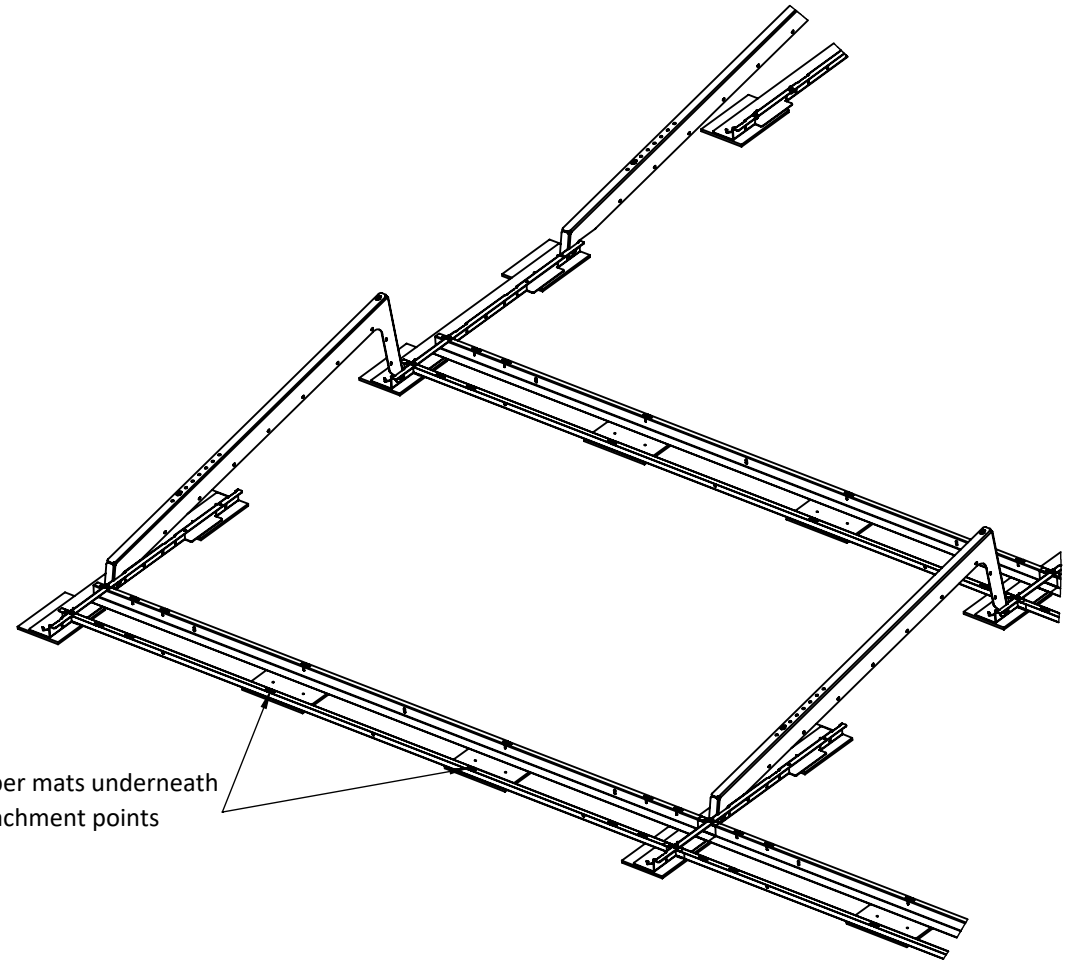
7.0 Ballast Tray Bays

1. Before installing any ballast blocks, start by placing rubber mats underneath the Ballast Trays.
2. Each set of Ballast Trays should have two rubber mats positioned beneath them, as illustrated.
3. In the case of 80" end bays, a single rubber mat is sufficient and should be centered under the Ballast Tray.
4. For 40" end bays, no rubber mat is needed.

i Locate the mats underneath the inner attachment points of the Ballast Tray

Bay Size	Mat Quantity
Full Bays (8', 9' & 10')	2 Mats
80" End Bay	1 Mat
40" End Bay	0 Mats

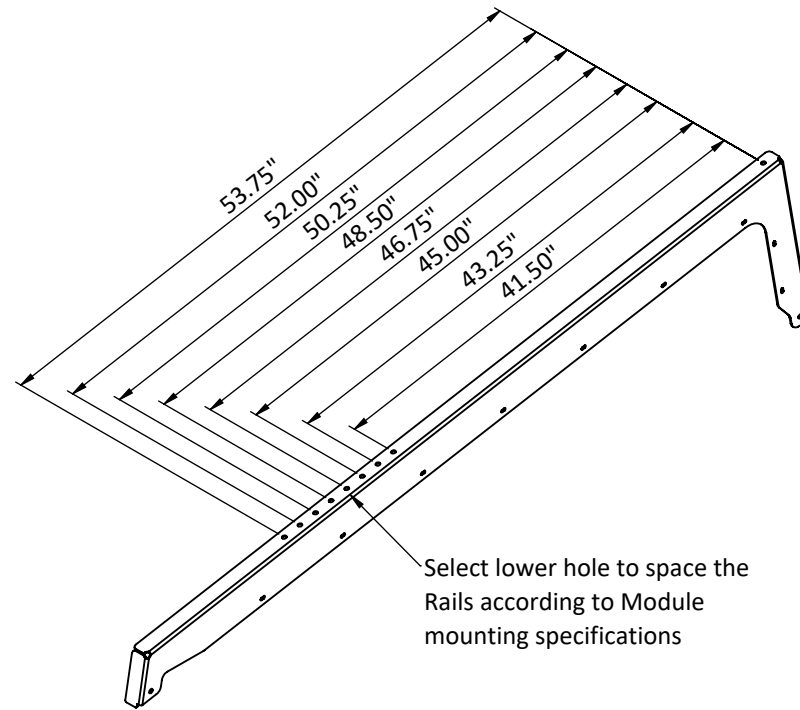
i Refer to section 6 & 6.1 for illustrations



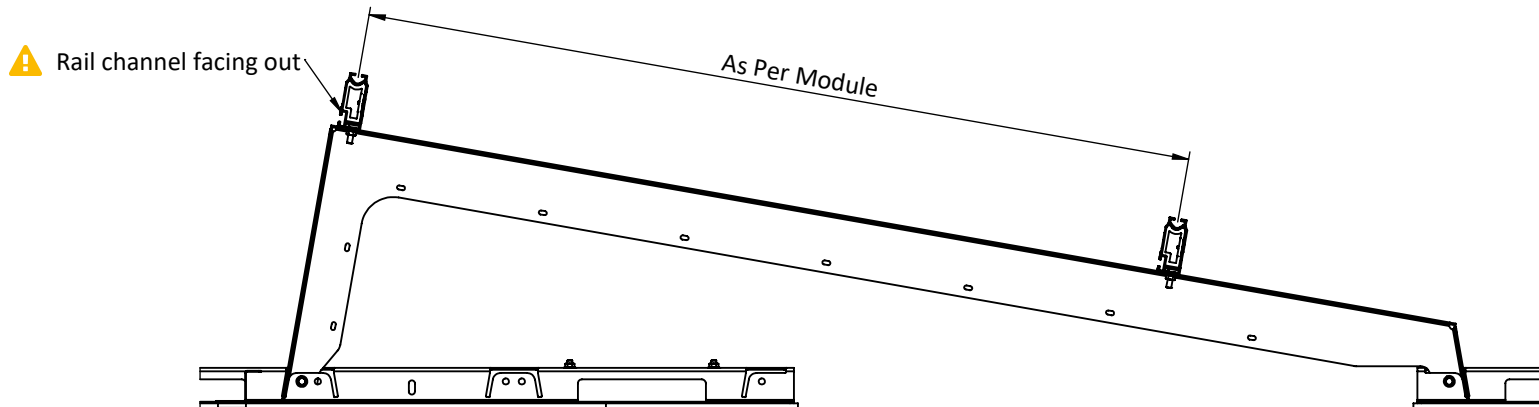


8.0 Rail Locations

1. The Triangle has a series of mounting points that allow for a wide range of Rail spacing. To ensure proper clamping within the "green zone," consult the module installation manual for the recommended spacing.
2. Begin by installing the upper rail, using the top hole on the Triangle. Make sure that the side channel of the Rail faces the high side (North).
3. Choose the lower connection point on the Triangle based on the PV module specifications.
4. It is advisable to pre-install the T-Bolt and nut into the holes before lifting the Rails into their designated positions.



i Green zone clamping means the rails are spaced within the acceptable clamping zones of the module





8.1 Rail Installation



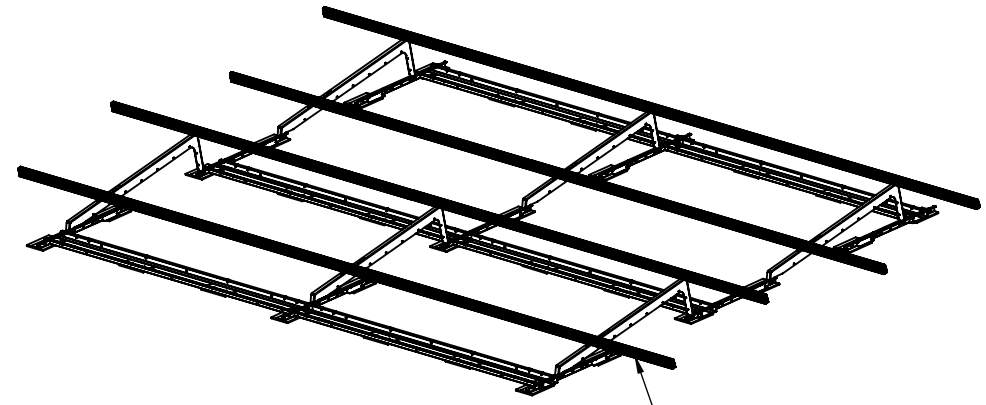
A

M8 x 25mm
T-Bolt



C

M8
Flanged Hex Nut

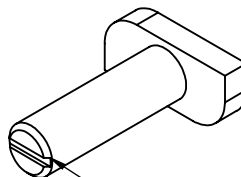


Max cantilever of 40"

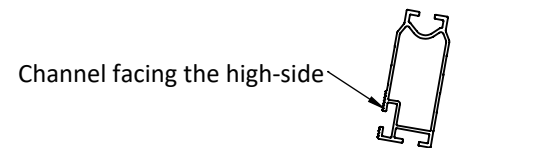
1. Start by pre-installing the T-bolt into the selected holes on the Triangle, ensuring that the "T" of the T-bolt is facing upward. Loosely fasten the nut, and position the T-Bolt at a 90-degree angle to facilitate Rail installation.
2. Place the Rail on top of the Triangles, making sure to align the bottom channel directly over the T-Bolt.
3. Once the Rail is in position, push the T-bolt into the channel and twist it into place. Hand-tighten the nut to secure the Rail in position.
4. Verify that the T-bolt is fully engaged in the channel to ensure a secure connection.
5. Note that the Rails can have a maximum cantilever of 40". Refer to the project-specific Ballast Layout for precise dimensions, as cantilever distances may vary depending on the array configuration.

When placing the Rails, they can be temporarily positioned just above the T-bolts prior to fastening, allowing the Rails to be quickly laid out across the racking.

Ensure the T-Bolt is turned 90° before torquing

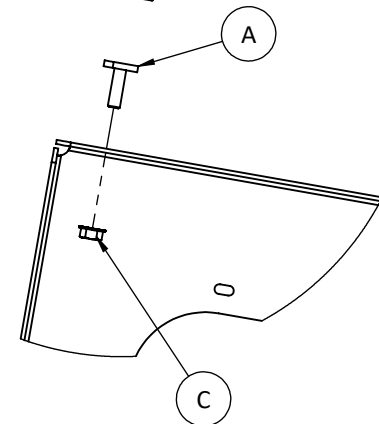


Marker line on T-Bolt to be perpendicular to Rail when properly engaged.



Channel facing the high-side

Torque to 15 lbs.ft





8.2 Slope Management



A

M8 x 25mm
T-Bolt



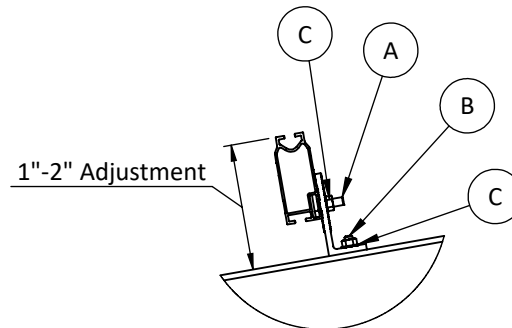
B

M8 x
Flanged Hex Bolt

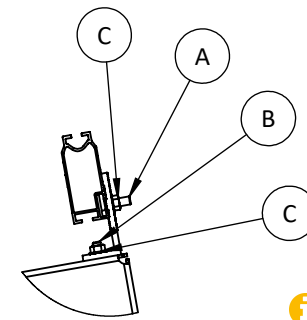


C

M8
Flanged Hex Nut



DETAIL A



DETAIL B

i Torque to 15 lbs.ft

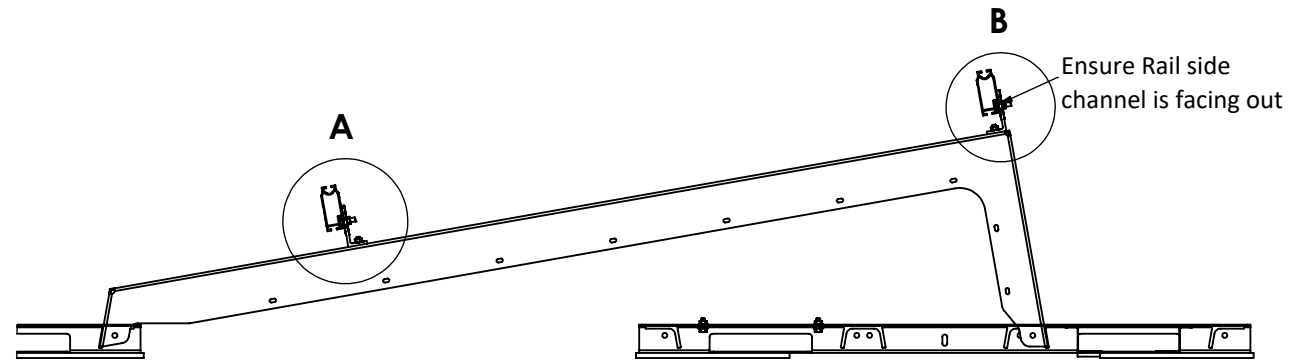
It is common for flat roofs to have gentle slopes for water drainage. This can result in mis-alignment of the Rails due to the height variation. There are two options to account for this.

Option 1:

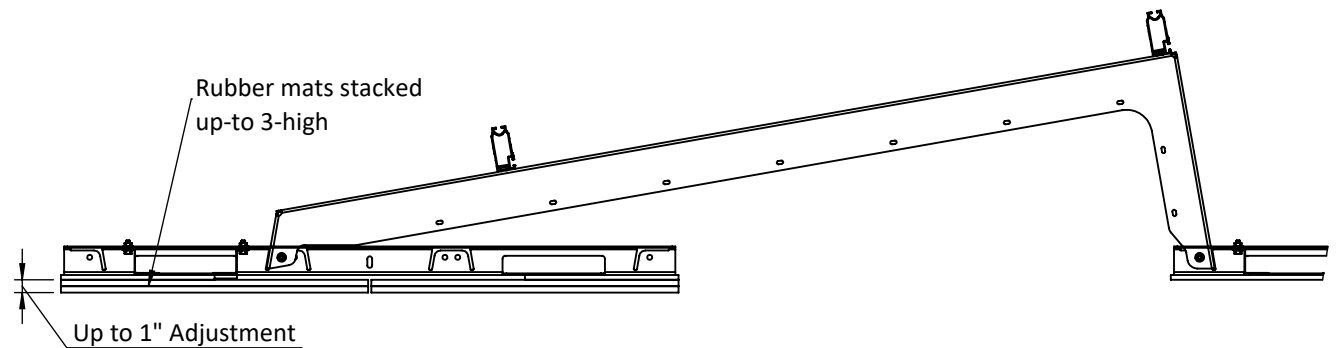
1. Install an FR-ROS L-Foot to the Triangle as shown. This allows for 1" to 2" of height adjustment.

Option 2:

1. The rubber mats may be stacked up to 3-high. This allows for the height to be adjusted in 1/2" increments.
2. Ensure both the Bases and Ballast Trays are shimmed accordingly if using this method.



Option 1 - L-Foot

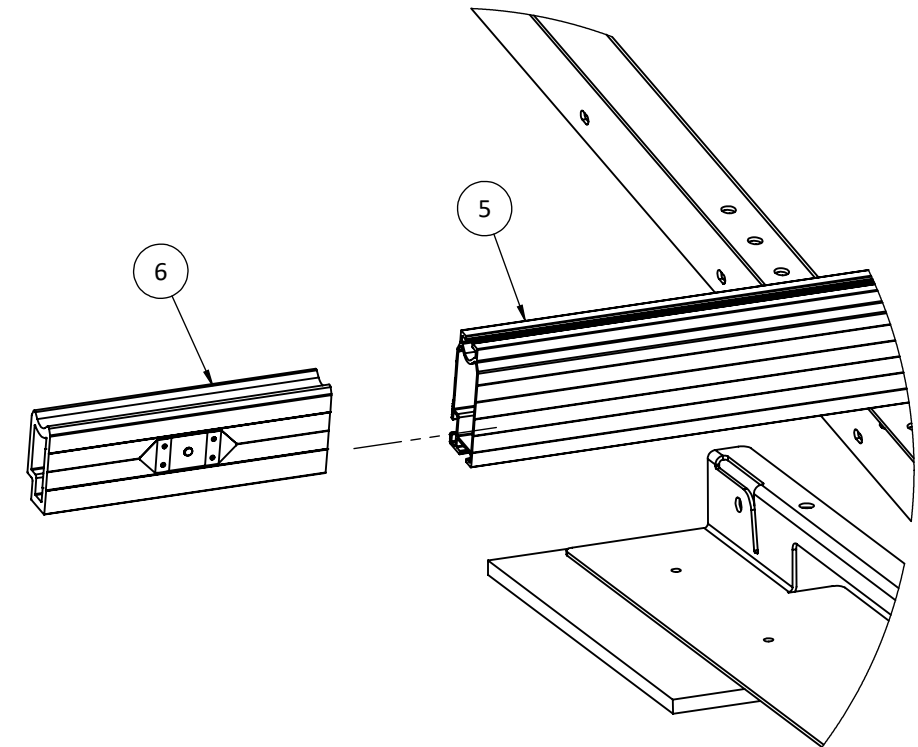


Option 2 - Stacked Mat



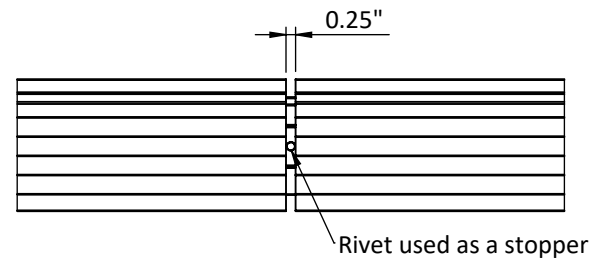
9.0 Rail Splice Installation

1. Install a Rail splice at all connections between adjacent Rails.
The Splice should slide into the end of the Rail until it clicks into place, with the pre-installed bonding washer.
2. Keep sliding the splice until the rivet contacts the end of the Rail. This action will automatically center the Splice.
3. Once the Splice is in place, proceed to install the second Rail. Make sure it is pushed all the way in, engaging the bonding washer on the Splice.
4. After both Rails are properly installed, there should be a 1/4" gap between them.
5. If the Rail joint falls under any of the following conditions, you will need to cut-back the Rail accordingly:
 - The joint lands directly over a Triangle T-bolt connection.
 - The joint lands on a cantilever.
 - The joint conflicts with a module clamp.



⚠ The Splice is for mid-span only and may NOT be installed on a Rail cantilever (ie. rail overhang at end)

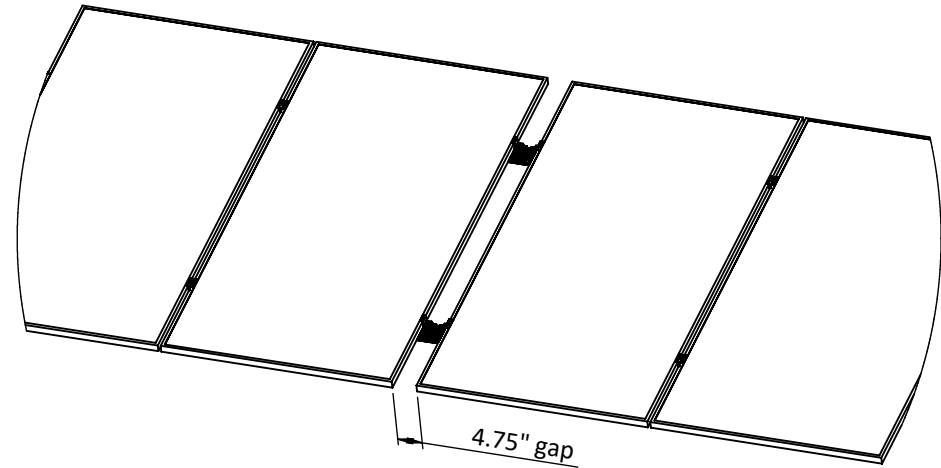
i Rails are to be cut-back as required to ensure Splices are not on a cantilever and do not conflict with T-Bolt or Module Clamp connections.



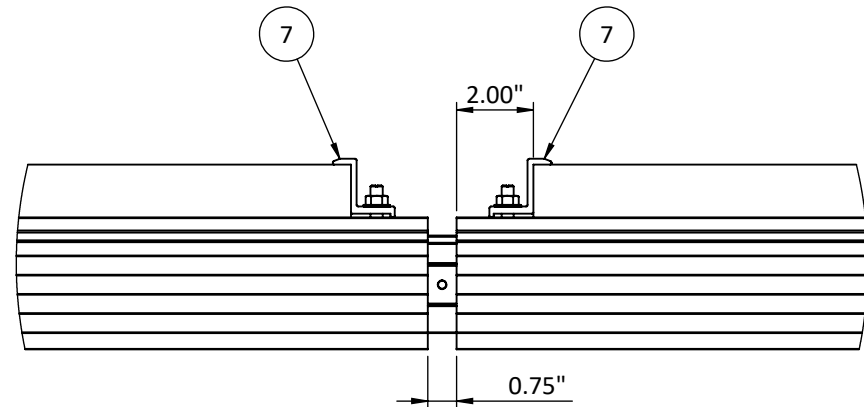


9.1 Expansion Joints

1. Install expansion joints throughout the array in accordance with the ballast plan.
2. Utilize Rail Splices to accommodate thermal expansion and contraction. Ensure that the modules are installed with a minimum 4.25" gap between them, as depicted.
3. To secure the modules at these joints, install end clamps. These end clamps should fasten the modules while leaving the Rail connection exposed, allowing it to expand and contract as needed.
4. Trim the Rails back to a distance of 2" from the module frame to facilitate the installation of End Clamps.
5. Remember that the bonding of the Rails is maintained by the Rail Splice at these joints. Larger gaps are acceptable if necessary, but the splice must be fully seated to maintain bonding.



- Expansion joint is typically required every 50'
- Refer to project specific ballast plan for joint locations
- Expansion joint may not land directly over a Triangle.





10.0 Stabilizer Installation



A

M8 x 25mm
T-Bolt



B

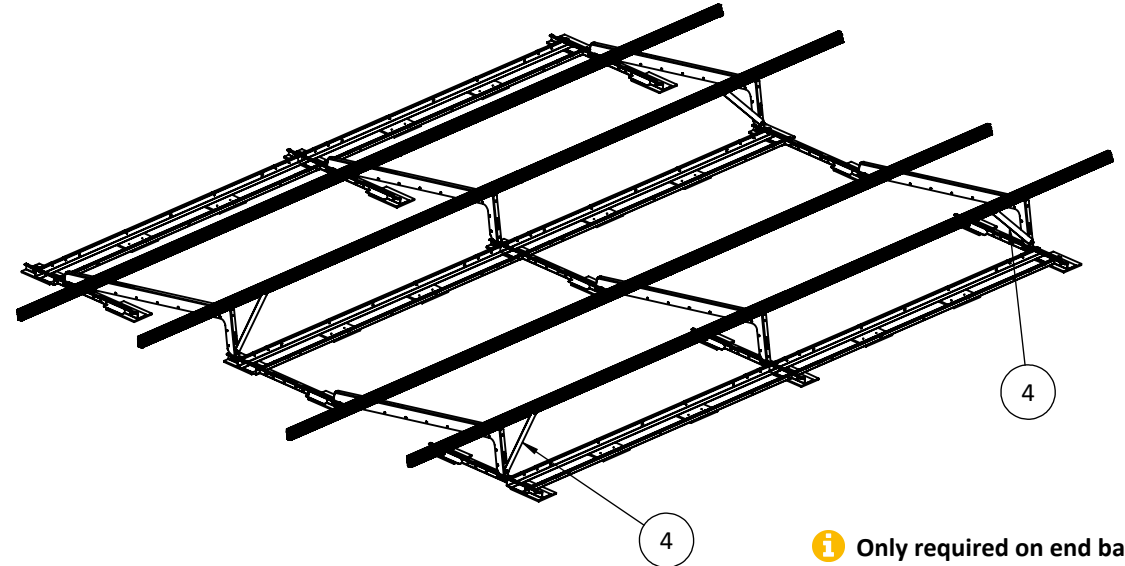
M8 x
Flanged Hex Bolt



C

M8
Flanged Hex Nut

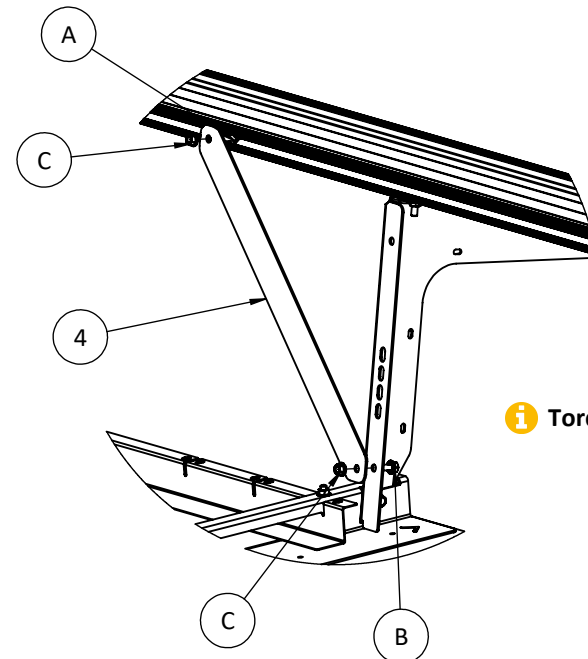
1. After the Rails are properly positioned, proceed to install the Stabilizers in all end bays of the racking system.
2. Connect the Stabilizer at the bottom of the back-leg of the Triangles, extending it up to the side channel of the Rail.
3. Secure the Stabilizer to the Triangle by bolting it in place as indicated.
4. Swing the Stabilizer into its designated position against the Rail.
5. Utilize a T-bolt to fasten the Stabilizer to the side channel of the Rail.
6. The Stabilizer is designed to tighten securely into place, sitting flush against the Rail and Triangle once all hardware is tightened.



i Only required on end bays

i Ensure the side channel of the Rail is facing North

i Stabilizer is only required on the outer Triangle of end bays

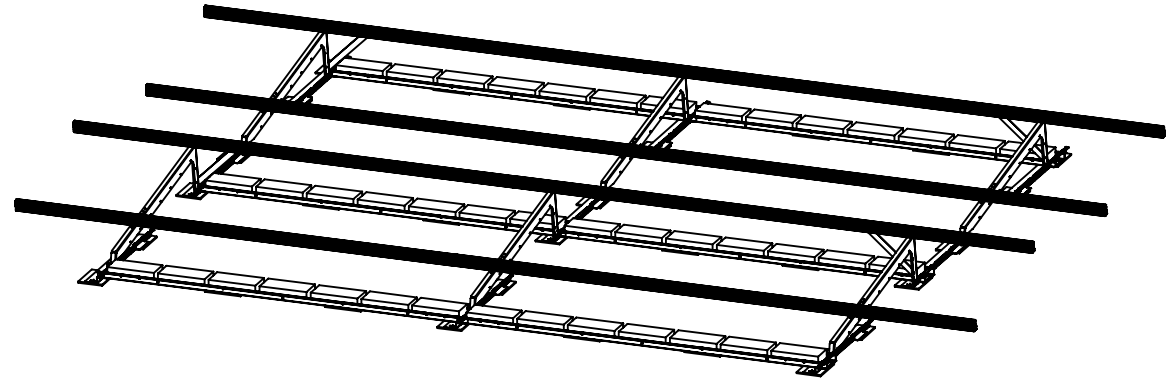


i Torque to 15 lbs.ft



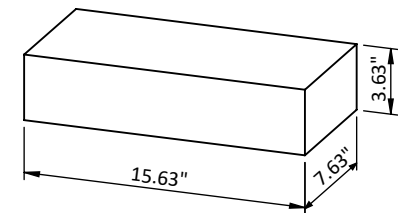
11.0 Ballast Block Layout

1. It is advisable to install the concrete ballast blocks before proceeding with the installation of the modules. This sequence allows for easier access and enables accurate verification. Be sure to reference the engineer-approved Ballast Layout specific to your project.
2. Each set of Ballast Trays is designed to accommodate up to fourteen ballast blocks. Install the ballast blocks following the guidelines outlined in the Ballast Layout for your project.
3. If your installation involves reduced bay spacing or shortened end bays, please note that the maximum block count will be adjusted accordingly. Consult the provided block counts in the engineered Ballast Layout for accurate guidance.

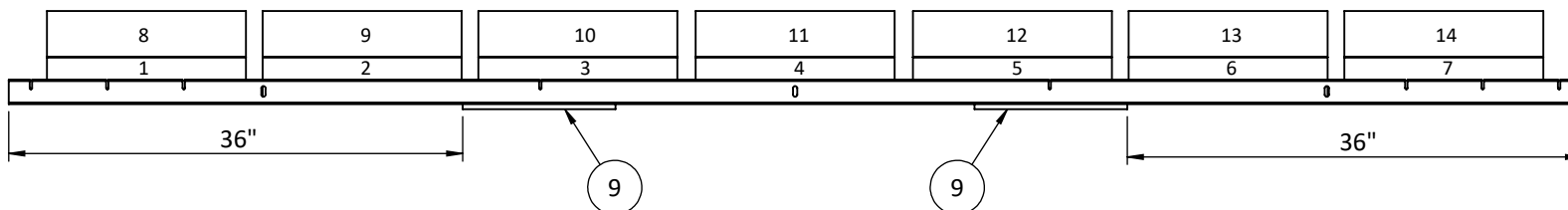


i Ballast blocks may be stacked a maximum of 2-high

! Ensure rubber mats are properly positioned prior to installing the ballast blocks



**4x8x16 Ballast Block
(33 lbs)**



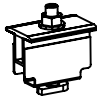


12.0 Module Installation



7

End Clamp



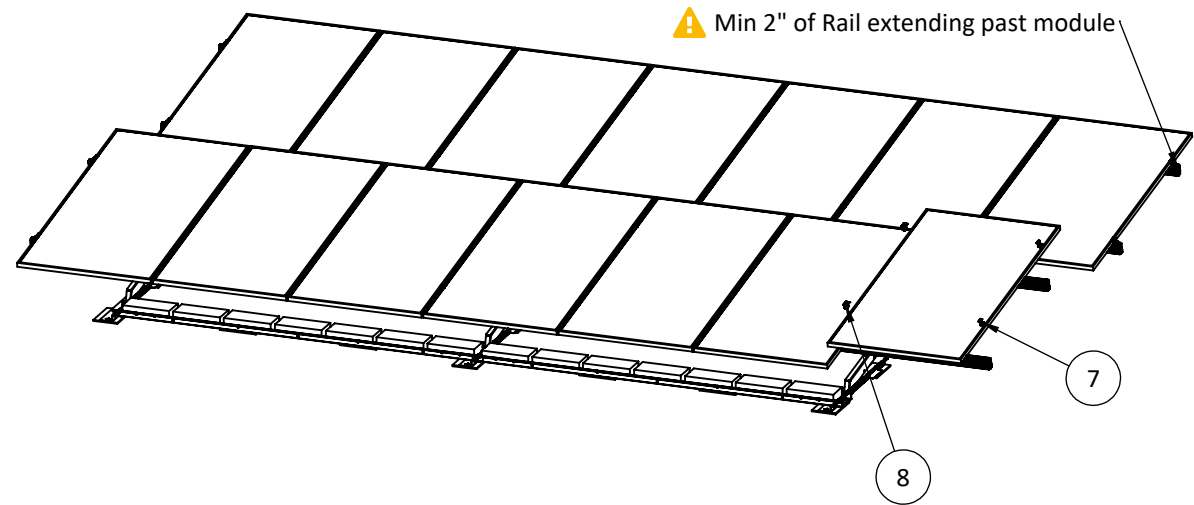
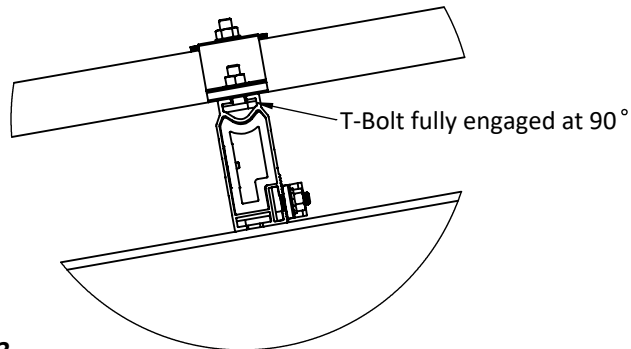
8

Mid Clamp

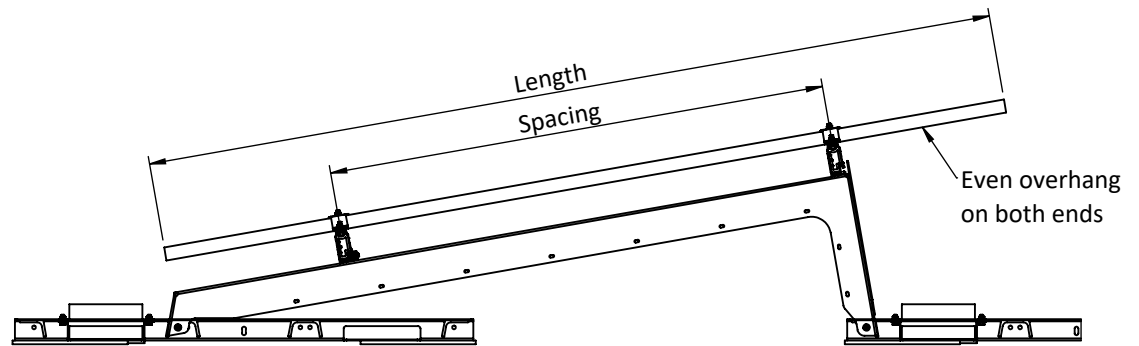
1. Position the PV modules onto the Rails, making sure there is an even overhang on both the top and bottom of the modules. Ensure that the Rails are situated within the "green zones" specified in the modules installation manual.
2. Pay careful attention to square up the first module as you place it. The Rails should extend at least 2" past the module to provide space for the End Clamps.
3. Once the first module is in place, proceed to install the End Clamps and the first set of Mid Clamps. Do not tighten the Mid Clamps at this stage; leave them loose until the adjacent module is installed.

i Ensure modules are square and that the top and bottom edges are aligned

i Use the Mid Clamps to set the spacing between adjacent modules



i Torque to 15 lbs.ft



$$\text{Overhang} = (\text{Length} - \text{Spacing})/2$$



13.0 Bonding

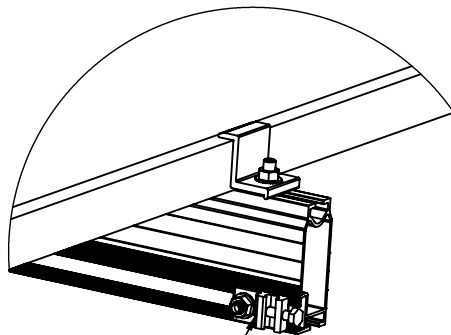


10

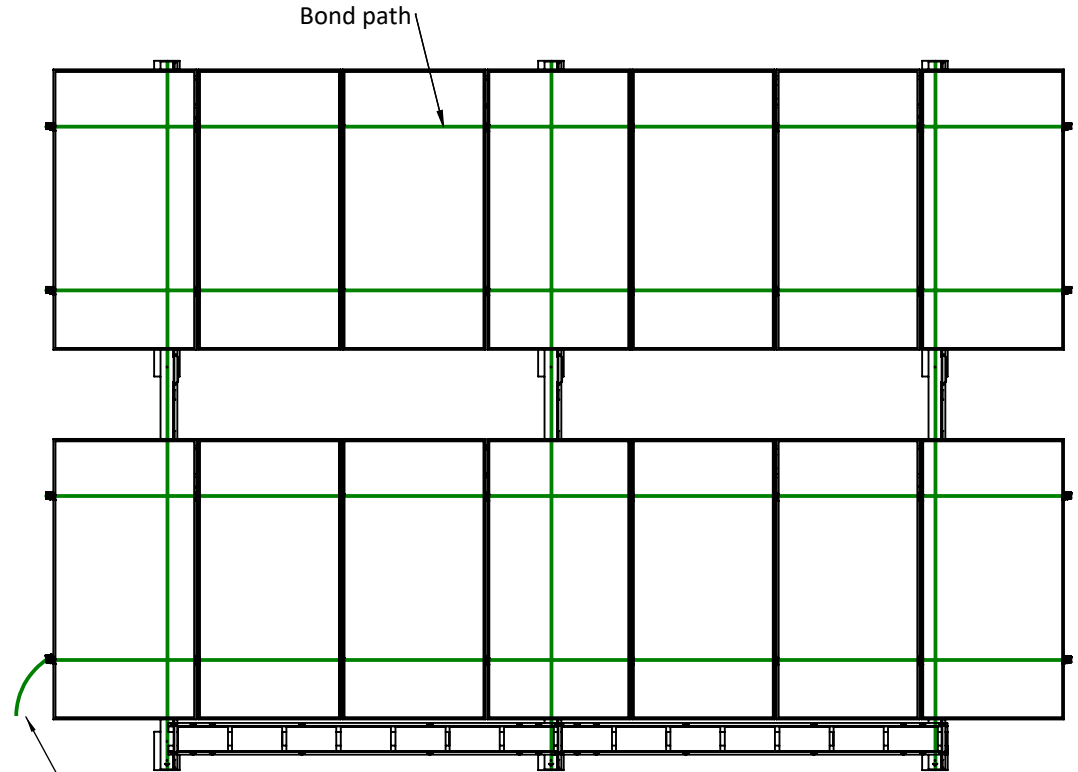
Ground Lug

1. The racking system features integrated bonding throughout. The module clamps establish a bond between the modules and the Rails using integrated bonding pins.
2. When bond-wire connections are required, install a bond lug on the racking system. It is advisable to install the bond lug on the side channel of the Rail, as illustrated in the provided reference.

i Sub-arrays or additional equipment to be bonded with #6 wire and bond lugs



10



One bond required for each continuous block of racking. Seperate or islanded portions of the array require bonds.

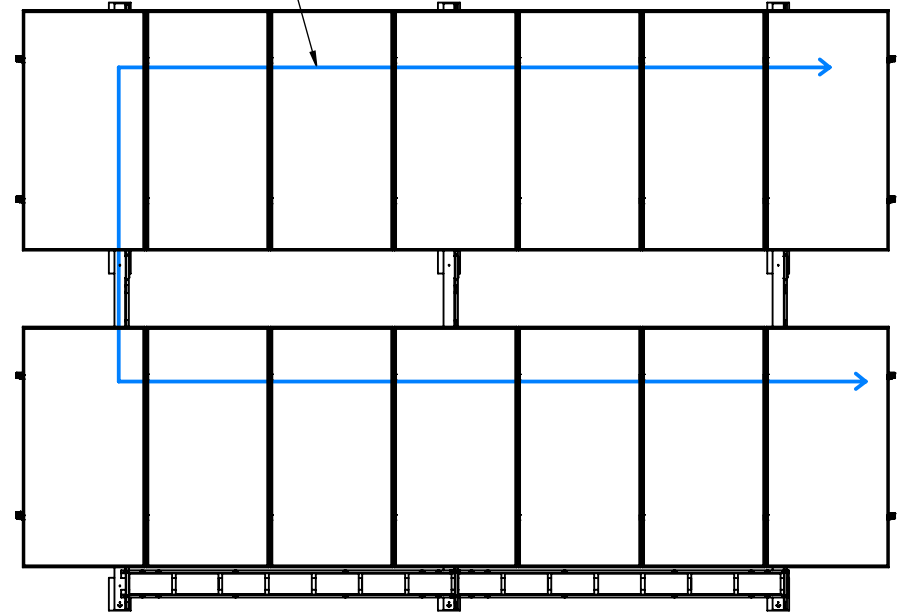


14.0 Cable Management

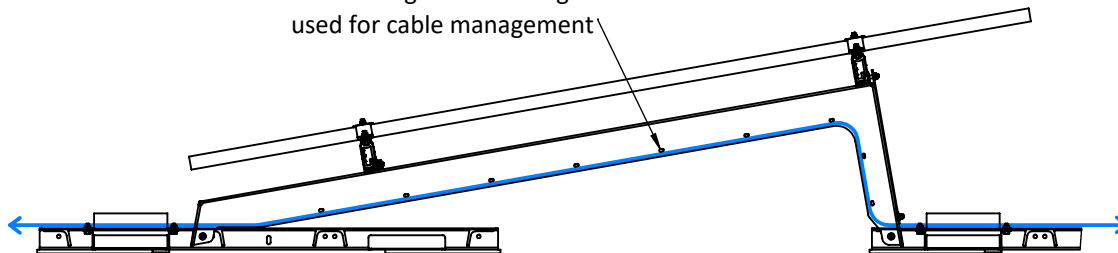
1. Ensure that PV wires are organized neatly underneath the modules, following the regulations outlined in local electrical codes.
2. To manage PV wires, you can use cable ties to secure them along both the top and bottom Rails.
3. For North-South wiring, consider fastening the wires to the sides of the Triangle and along the Bases. There are a series of holes conveniently located along the side of the Triangle that can be used with cable ties or cable clips for this purpose.

⚠ It is the responsibility of the installer to ensure all wiring is installed in accordance with the applicable electrical codes.

PV Wiring cable-tied to rails



Holes along side of Triangle are used for cable management





14.1 Accessories



A

M8 x 25mm
T-Bolt



B

M8 x 20mm
Flanged Hex Bolt



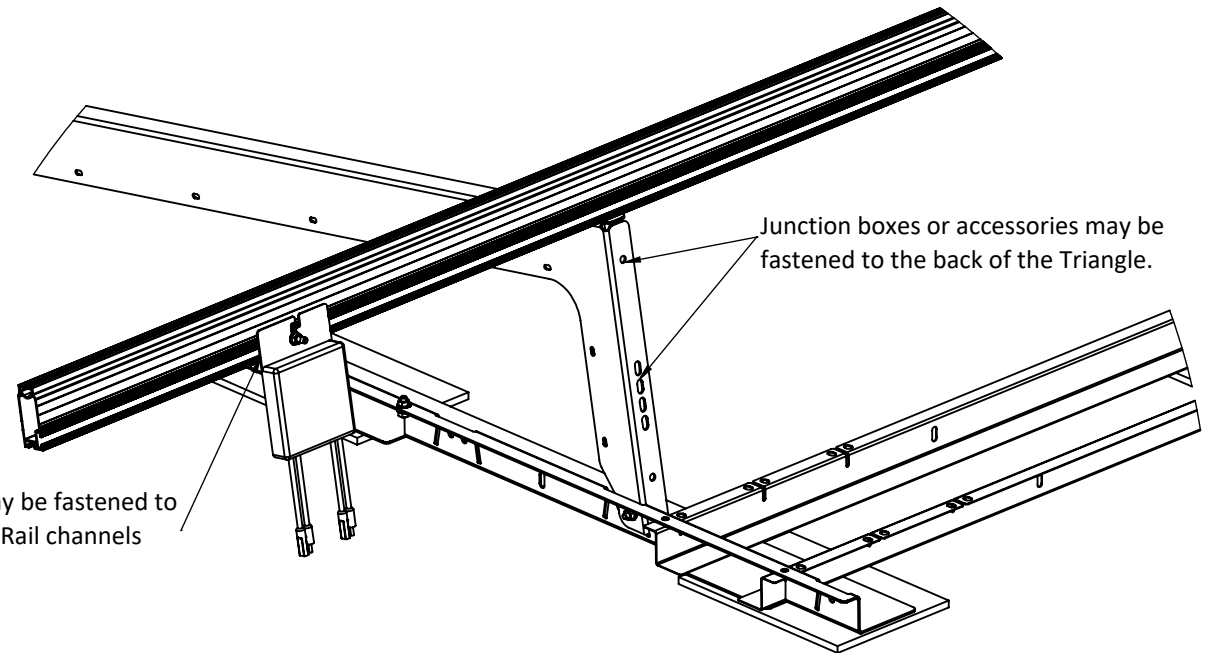
C

M8
Flanged Hex Nut

1. You have the option to mount module-level power electronics (MLPE's) and electrical accessories on the racking system. Use a T-Bolt to secure these components to either the top channel or the side channel of the Rail. This provides a convenient location near the module junction boxes.
2. For junction boxes, such as 6"x6" or 8"x8" sizes, they can be installed on the back leg of the Triangle. There is a hole and a set of slots provided to accommodate a range of bolting patterns for secure attachment.

⚠ Ensure equipment location does not conflict with the PV modules, Clamps, or Stabilizers

i MLPE's may be fastened to any of the Rail channels





15.0 Inspection & Maintenance

Introduction

The primary purpose of regular inspection and maintenance is to ensure the safe and efficient operation of your ballasted solar racking system. By following these guidelines, you can identify and address issues before they lead to performance degradation or safety concerns.

Safety Precautions

Before conducting any inspection or maintenance activities, adhere to the following safety precautions:

- **Safety Gear:** Wear appropriate personal protective equipment (PPE), including safety glasses, gloves, and a hard hat.
- **Secure Access:** Ensure you have safe and secure access to the solar racking system. Use ladders or scaffolding when necessary, and be aware of potential fall hazards.
- **Electrical Safety:** If inspecting electrical components, follow electrical safety procedures. Always de-energize and lockout/tagout electrical systems before inspection.
- **Teamwork:** Whenever possible, work with a partner who can assist with safety measures and procedures.

Corrosion Prevention

Inspecting Steel Components

Steel components are susceptible to rust, so it's crucial to monitor them:

- Regularly inspect steel components for any signs of excessive rust, including flaking or discoloration.
- Pay close attention to areas where galvanized finish may have chipped or scratched, as these areas are more vulnerable to corrosion.

Rust Treatment

Rust along the cut edges of steel components is normal and acceptable. If you notice excessive rust on steel components, take appropriate action:

- Remove loose rust and corrosion using a wire brush or sandpaper.
- Apply an appropriate rust inhibitor or primer to prevent further corrosion.
- Spray the affected area with a cold galvanizing compound to maintain protection.

Regular Inspection

Visual Inspection

Perform visual inspections on a regular basis to identify any visible issues:

- Check for loose or missing bolts, nuts, or fasteners.
- Inspect for signs of corrosion or rust on steel components.
- Examine the overall condition of the racking structure for any damage.
- Ensure that the solar panels are securely fastened and not damaged.

Torque Check

Regularly check the torque of bolts and nuts to maintain the structural integrity of the system:

- Use a torque wrench to verify that all fasteners are tightened to the manufacturer's specifications.

Electrical Inspection

Inspect electrical components to ensure safe and efficient operation:

- Examine electrical connections for signs of wear, corrosion, or loose wires.
- Check the condition of junction boxes, wiring, and connectors.
- Monitor the performance of inverters and other electrical equipment as per the manufacturer's recommendations.

Structural Integrity

Ensure the structural integrity of the racking system:

- Check for any signs of settling or shifting of ballast blocks or anchors.
- Inspect for any signs of stress or damage to the mounting rails and supports.

Frequency

Regular inspection intervals are essential to maintain the reliability of your solar racking system. Consider the following recommended inspection frequencies:

- **Quarterly:** Electrical inspections, structural integrity checks, and a comprehensive visual inspection should be conducted every three months.
- **Annually:** A more thorough inspection, including rust prevention measures, should be performed at least once a year.

However, it's essential to adapt the inspection frequency to your specific environmental conditions. If your system is exposed to harsh weather or other challenging factors, more frequent inspections may be necessary.