ISYS™ GROUND 2.0

ISYS™ GROUND 2.0: IMAGINE BIG POSSIBILITIES.

Unirac engineering combined with economical, fast install speed, and scalability.

Designed to deliver the most cost effective systems with the most responsive and scalable supply chain, ISYS is optimized for commercial and utility projects ranging from 500 kilowatts to gigawatts and custom designed for each customer's module and site conditions.

ASSEMBLY **GUIDE**

UNIRAC®

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TABLE OF CONTENTS

DISCLAIMER 2

TABLE OF CONTENTS 3

COMPONENTS AND SHIPPING SPECIFICATIONS 4

- BEAM CLIP, MODULE CLIPS, FRICTION CLAMP, & WEEB 5
- TYPICAL BULK SHIPPING FOR CLIPS 6
- U-CLAMPS 7
- TYPICAL U-CLAMP PACKAGING 7
- TOP CHORD ASSEMBLY 8
- TYPICAL BULK SHIPPING FOR TOP CHORD ASSEMBLY 8
- BEAMS 9
- TYPICAL BEAM SHIPPING 9
- TYPICAL FASTENER PACKAGING 10
- TYPICAL JOB SITE DELIVERY 10
- OPTIONAL MODULE ASSEMBLY JIG (MAJ) 11

CONNECTIONS AND TOLERANCES 12

- BEAM CONNECTIONS 13
- DRIVEN PILE TOLERANCES 14

INSTALLATION GUIDELINES 15

- ASSEMBLE MODULE ASSEMBLY JIG: A. Layout All Main Sections 16
- ASSEMBLE MODULE ASSEMBLY JIG: B1. Attach Main Sections to Create an A-Frame 17
- ASSEMBLE MODULE ASSEMBLY JIG: B2. Attach Main Sections to Create an A-Frame 19
- ASSEMBLE MODULE ASSEMBLY JIG: C. Attach Horizontal Shelf Across Both Sides 19
- ASSEMBLE MODULE ASSEMBLY JIG: D. Attach L-shaped supports using provided strut nuts 20
- ASSEMBLE MODULE ASSEMBLY JIG: E. Use Jig to Hold Modules While Attaching NS Beams 21
- 1.0 INSTALL U-CLAMPS 22
- 2.0 INSTALL TOP CHORD ASSEMBLY 24
- 3.0 INSTALL FASTENERS AT BOTTOM U-CLAMP 25
- 4.0 INSTALL EAST-WEST BEAMS 26
- 5.0 INSTALL N-S BEAMS AND MODULES 27
- 6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS 31
- 7.0 MODULE COLUMN INSTALLATION PROCEDURE 40
- 8.0 INSTALL LATERAL BRACE (IF REQUIRED) 42
- 9.0 REPEAT UNTIL COMPLETE 43

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COMPONENTS AND SHIPPING SPECIFICATIONS

UNIRAC®

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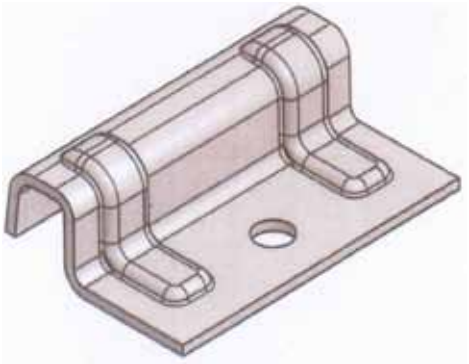
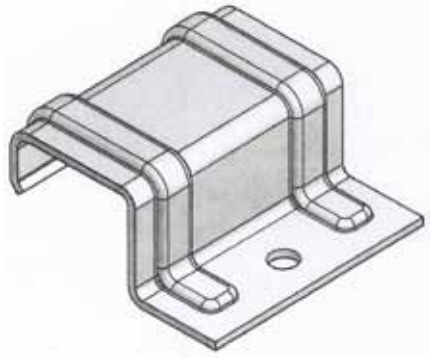
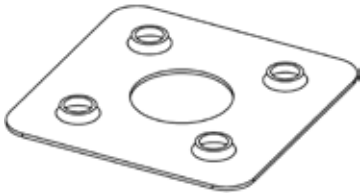
BEAM CLIP, MODULE CLIPS, FRICTION CLAMP, & WEEB



Small Beam Clip

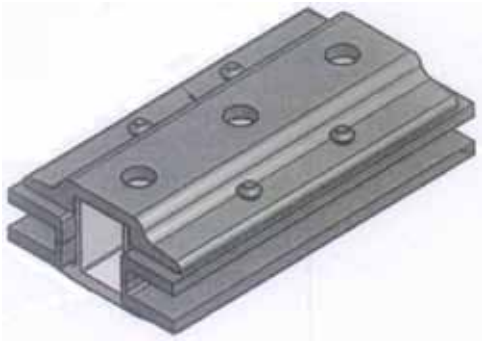


Large Beam Clip

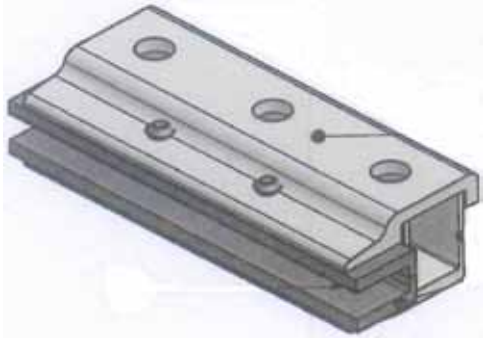


WEEB-uir

- Provides bonding between modules and NS beams.
- Not compatible with laminate clamps.
- WEEB-UIR is to be installed in accordance with Wiley installation guide: "Instructions for ISYS roof mount and ground mount (104-040000068-003)."



Mid Clamp
(Used with laminate modules)



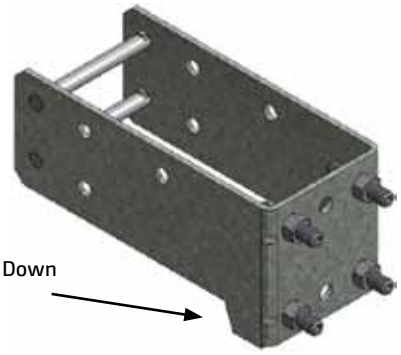
End Clamp
(Used with laminate modules)

Cast Friction Clamp
(Not used on every job)

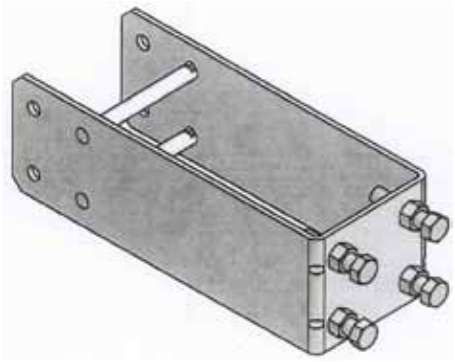
TYPICAL BULK SHIPPING FOR CLIPS

- Skidded boxes
- Typical size: 30” x 36”
- Typical weight: 2,000 lbs.

U-CLAMPS



Top U-Clamp
(8.5" or 10.5")
¼" Allen wrench cone point
set screws

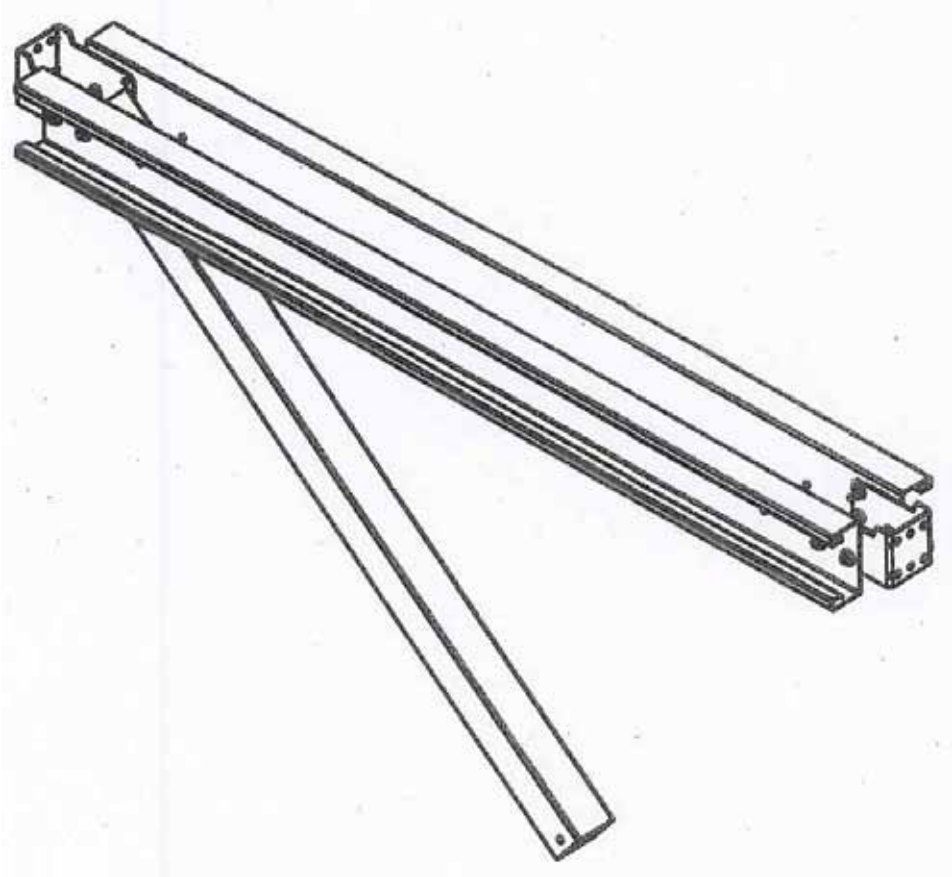


Bottom U-Clamp
(10.5" or 12.5")

TYPICAL U-CLAMP PACKAGING

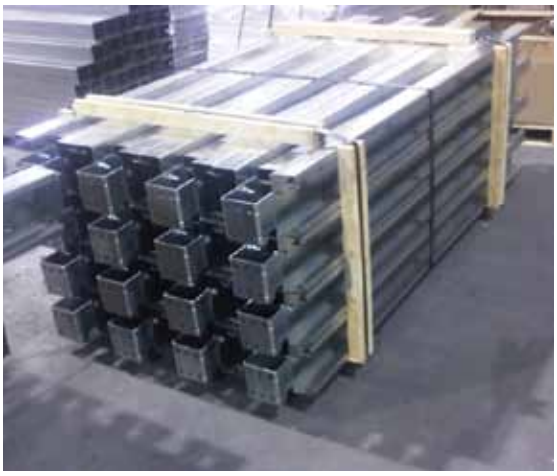
- Approx. 175 Clamps per box
- Typical size: 44" x 44"
- Typical weight: 2,000 lbs.

TOP CHORD ASSEMBLY



TYPICAL BULK SHIPPING FOR TOP CHORD ASSEMBLY

- Approx. 18-20 per bundle
- Typical bundle size:
  48” x length of top chord
- Typical weight: 2,300 lbs.



BEAMS

- Approx. 150 Hat Channel Beams per bundle
- Typical weight: 4,000 lbs.

Typical North-South (NS)
Hat Channel Beam
(Available in 3")

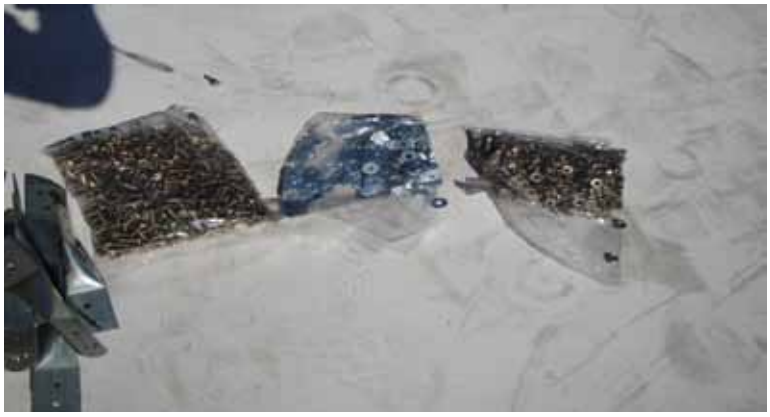
- Approx. 20 East-West Beams per bundle
- Typical weight: 4,000 lbs.

Typical East-West (EW) Beam
(Available in 8" and 10.75")

TYPICAL BEAM SHIPPING

- Typical length: varies by project requirements
- Unloadable by forklift

TYPICAL FASTENER PACKAGING



- Small boxes palletized together
- Typical pallet size:
  48” x 40”
- Typical pallet weight: 1,800 lbs.

TYPICAL JOB SITE DELIVERY

- Palletized boxes
- Bundled beams
- Shipped on
  flatbed
- Unloadable by fork lift
  (fork lift not provided)

OPTIONAL MODULE ASSEMBLY JIG (MAJ)

Used to preassemble modules on NS beams

Materials packaged with MAJ

Ships disassembled and palletized

Assembly instructions for jig on pages 16-21.

ISYS™ GROUND

CONNECTIONS **AND TOLERANCES**

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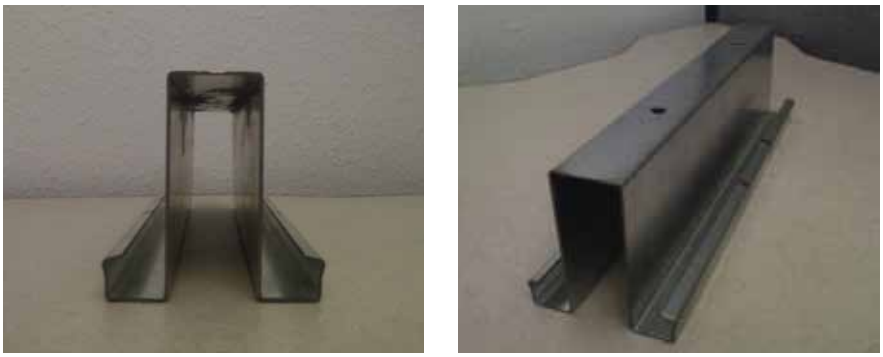
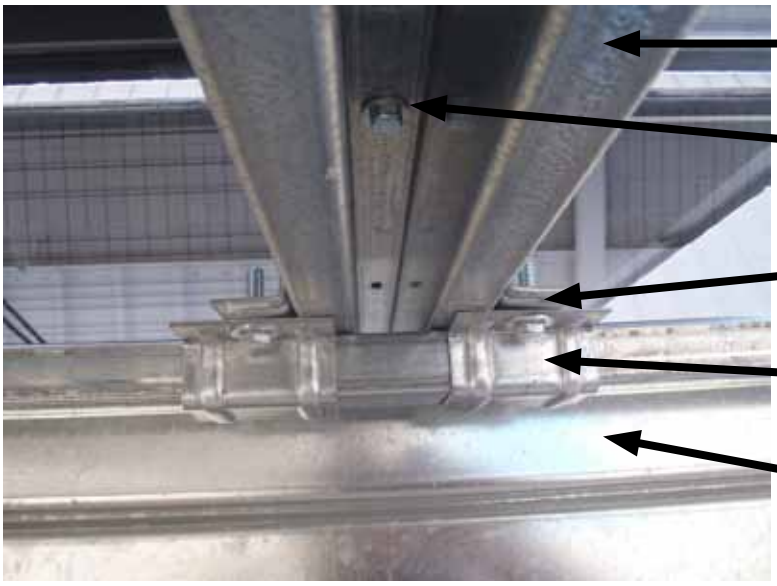
BEAM CONNECTIONS



Typical NS Beam

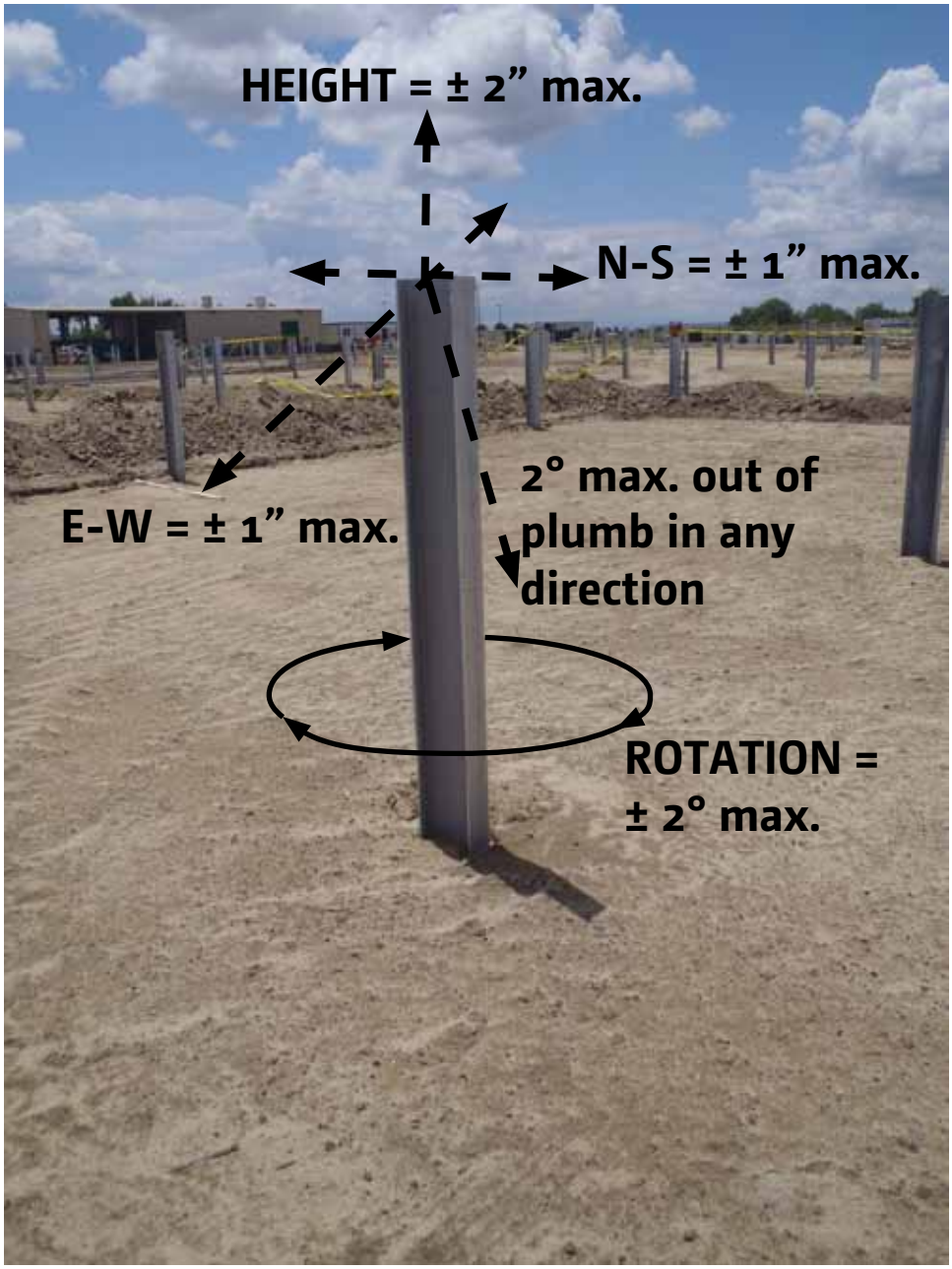


Typical NS to EW Beam Connection

(Using Small Beam Clip and Large Beam Clip)

DRIVEN PILE TOLERANCES

Tolerances given are measured from top of pile.



EAST-WEST = ± 1" maximum
NORTH-SOUTH = ± 1" maximum
HEIGHT = ± 2" maximum
ROTATION = ± 2° maximum
2° max. out of plumb in any direction

Note: The above pile tolerances are maximum tolerances for installed piles. Tighter pile tolerances may be required by the EPC or Developer's quality control specifications to better manage any of their visual and alignment concerns. Additionally, consistently maintaining tighter pile tolerances can result in installation savings by spending less time adjusting individual racking components.

ISYS™ GROUND

INSTALLATION **GUIDELINES**

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ASSEMBLE MODULE ASSEMBLY JIG:
A. Layout All Main Sections

There are two main sections with green strut attached. These sections are located at opposite ends of these two sections. They will be at opposite corners of the jig when completed.

ASSEMBLE MODULE ASSEMBLY JIG:
B1. Attach Main Sections to Create an A-Frame

Diagonal Brace
At both ends and midpoint

Horizontal Brace
At four locations

Horizontal Brace

Diagonal Brace

Horizontal and diagonal braces at alternating vertical members.

(Location of braces explained on next page)

ASSEMBLE MODULE ASSEMBLY JIG:
B1. Attach Main Sections to Create an A-Frame (CONT.)

Note: the two sections are held together by horizontal and diagonal braces. Locations listed above.

ASSEMBLE MODULE ASSEMBLY JIG:
B2. Attach Main Sections to Create an A-Frame

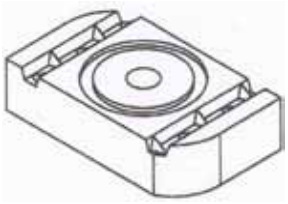
It may be helpful to build the jig in two pieces, and then attach them.

ASSEMBLE MODULE ASSEMBLY JIG:
C. Attach Horizontal Shelf Across Both Sides

Horizontal shelf is made of two pieces of 3" angle.

Horizontal Shelf

ASSEMBLE MODULE ASSEMBLY JIG:
D. Attach L-shaped supports using provided strut nuts



Strut Nut

L-shaped supports hold NS beam during pre-assembly.

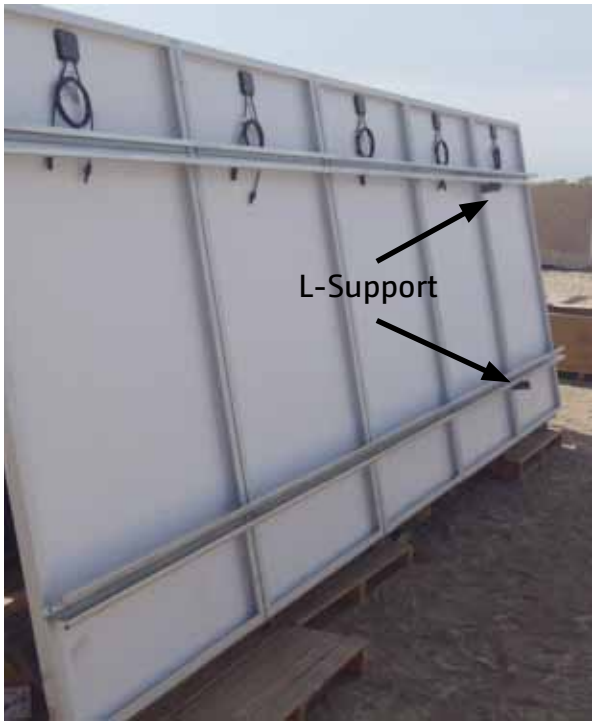
L-shaped support connection is made with supplied bolts and strut nuts (two for each support).

Shown with short leg pointing down, but can be installed facing up.

Height of supports is determined by spacing of the module's mount holes.

ASSEMBLE MODULE ASSEMBLY JIG:
E. Use Jig to Hold Modules While Attaching NS Beams

Note: It is essential that a flat and level area is established for the assembly of the Module Assembly Jig, as well as the pre-assembly process.

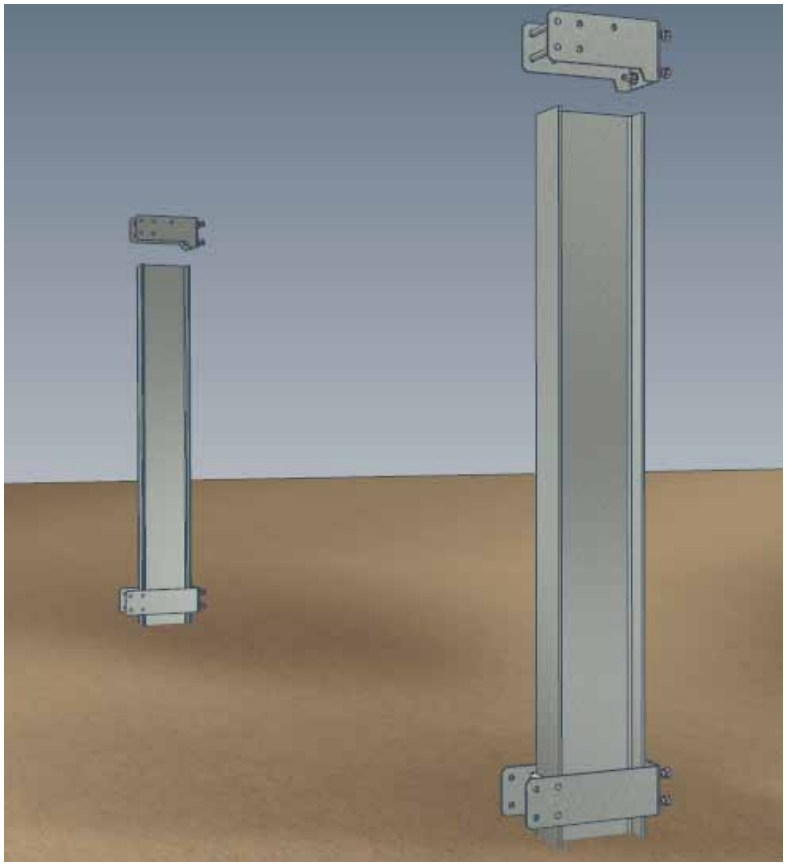


NS Beams are supported at one end by L-Support. Start installing fasteners at opposite end.

The blue spacers and L-Support provide the ¼" spacing between modules.

1.0 INSTALL U-CLAMPS

- Assuming vertical members (post/pile) already installed by others.
- ISYS Ground Mount can be installed on a ballast block.
- **Note**: Once a U-clamp has been installed and torqued to its final torque value it cannot be removed and reused. A U-clamp that has been installed and removed must be discarded and replaced with one from provided overage



Top U-Clamp

Bottom U-Clamp

- Bottom U-Clamps first.
- Top U-Clamp with tab towards ground
- Position as per construction documents
- DO NOT fully torque bottom U-Clamp at this point.

Note: Lock nuts need to be installed snug tight, not to the torque value of the set screws listed in the construction documents.

1.0 INSTALL U-CLAMPS (CONT.)

1.1 Install cast friction clamp (not required on all jobs)

A. Installed U-Clamp.

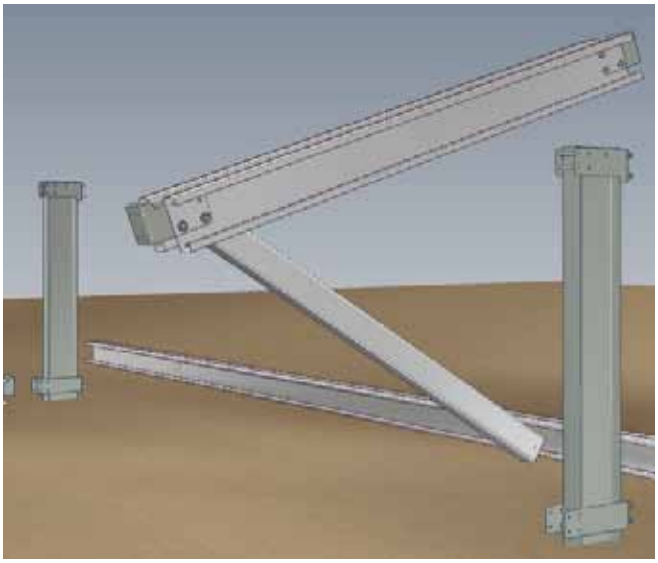
B. Pre-assemble the viper clamps onto the supplied bolt.

C. Install viper clamp assembly snuggly against the bottom of the top U-clamp.

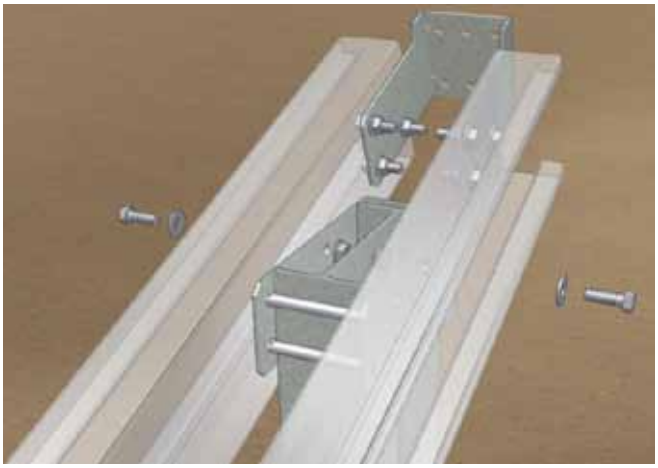
D. Torque as per construction documents.

(Shown with all-thread and flange nuts. Assembly may be built with washer and bolt.)

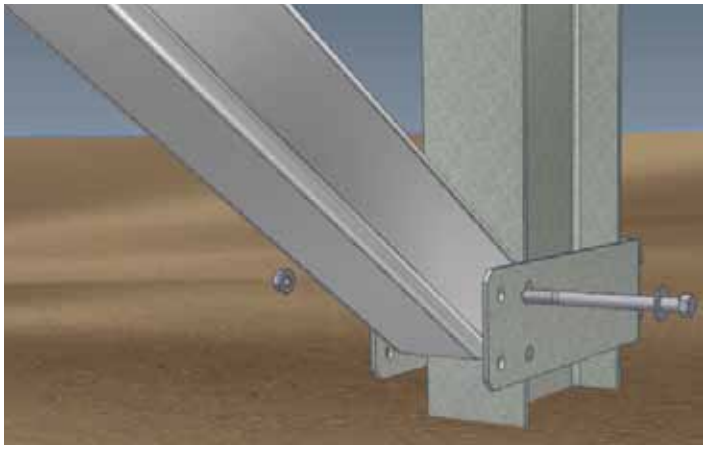
2.0 INSTALL TOP CHORD ASSEMBLY



2.1 Install fasteners at top U-Clamp per construction documents.



3.0 INSTALL FASTENERS AT BOTTOM U-CLAMP



- Install fasteners at bottom U-Clamp per construction documents.

3.1 Verify tilt angle of Top Chord by positioning bottom U-Clamp as per construction documents.

3.2 Torque bottom U-Clamp as per construction documents.

4.0 INSTALL EAST-WEST BEAMS

EW Beams hang off the lower and upper ends of the top chord.

4.1 Install fasteners as per construction documents.

5.0 INSTALL N-S BEAMS AND MODULES

Installation of NS Beams and modules will vary depending on module type, framed modules vs. laminate modules.

Framed Modules

- Pre-assemble modules to the NS Beams – Section 5.1 (below) and 5.1.1 (next page).
- Place the pre-assembled module columns on the array structure – Section 6.0

Laminate Modules

When working with laminate modules there are two options for installing the NS Beams and modules:

Option 1:

- Install NS Beams onto the array structure – Section 7.0
- Then place modules onto NS Beams one at a time – Section 5.2.1 (page 30).

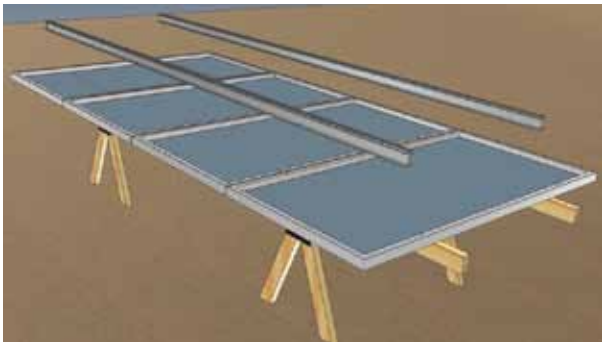
Option 2:

- Pre-assemble modules to the NS Beams - Section 5.2 (page 29).
- Then install pre-assembled module columns – Section 6.0

Note: If pre-assembling laminate modules, movement of the pre-assembled column needs to be kept to a minimum.

5.1 Pre-assembly of Framed Modules Using MAJ

Install fasteners as per construction documents.



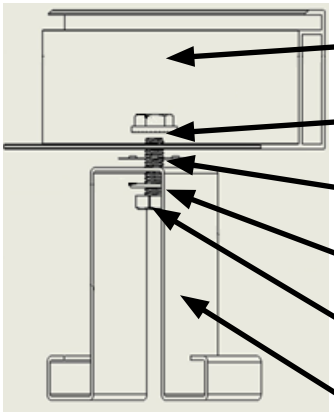
Pre-assembly on saw-horses is possible when MAJ is not available.

5.0 INSTALL N-S BEAMS AND MODULES (CONT.)

5.1.1 Connection from NS Beam to Framed Module

Shown loose and with optional WEEB-UIR – torque as per construction documents

Slotted hole in NS Beam used for connection to modules



5.0 INSTALL N-S BEAMS AND MODULES (CONT.)

5.2 Pre-assembly of Laminate Modules to NS Beams

- Supporting one end of the NS Beams with the lower EW Beam minimizes the distance the pre-assembled columns have to be moved
- Support the other end of the NS Beam to get a level work surface
- Wood spacers keep NS Beam evenly spaced
- Once columns are assembled, safely lift the North end over upper EW Beam
- For sequencing of module column installation see Section 6.0

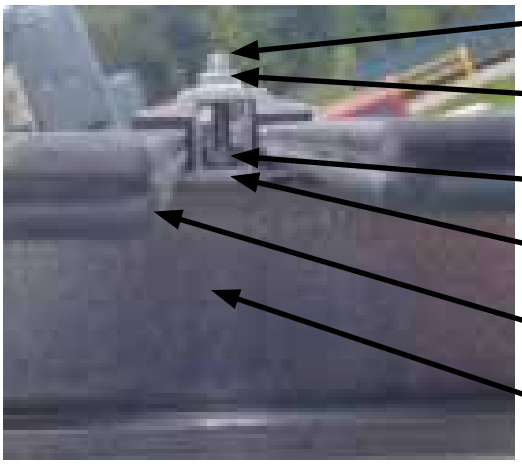
5.0 INSTALL N-S BEAMS AND MODULES (CONT.)

5.2.1 Connection from NS Beam to Laminate Module

Bottom half of mid-clamp shown

Complete mid-clamp shown

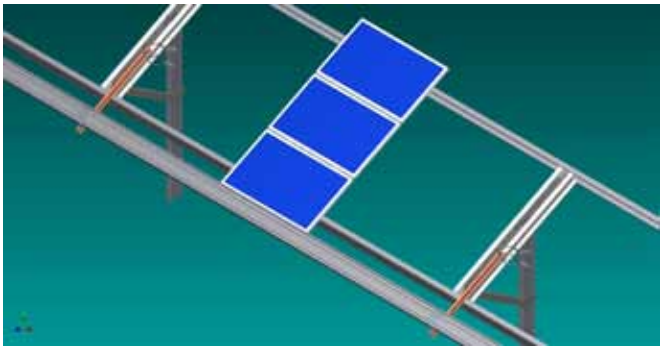
Slotted hole in NS Beam used for connection to modules



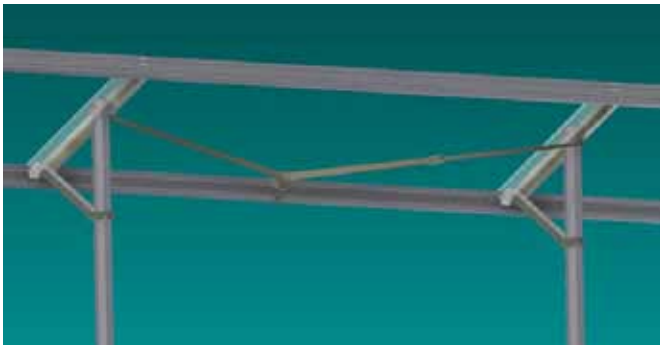
6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS

This section lists three different options to support the lower EW Beam during the installation of the pre-assembled module columns:

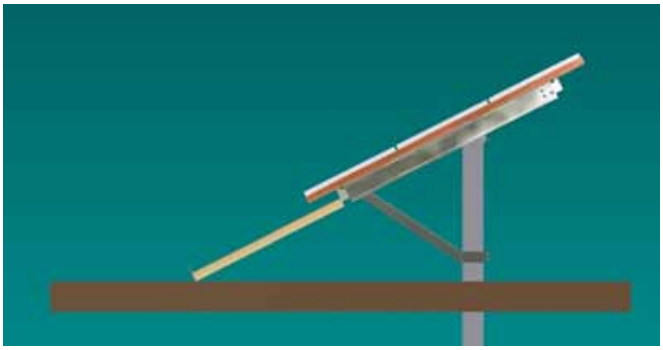
Option 1: Alignment Jig Method - See page 32.



Option 2: Strap Method - See page 36.



Option 3: Kicker Method - See page 38.



6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 1: ALIGNMENT JIG METHOD

The advantage of the Alignment Jig Method is that all the module columns can be quickly and easily placed onto the EW Beams of the array structure in a repeatable process that aligns the leading edges of the module columns.

Once the jig is in place the module columns can have their leading edges and expansion gaps efficiently aligned and set. Attachment of the jig to the structure is achieved with Vice-Grips type 11R (or equal). Attachment of the End Stop to the L-Foot is accomplished with supplied ¼-20 fasteners (see Figure 1 on next page).

The required materials needed to create the End Stop and Outriggers of the alignment jig are supplied by Unirac as overage materials. This overage material is identified in the project specific Bill of Materials (BOM). Visa Grip clamps needed to make the connections are not supplied by Unirac.

Note: Material overage quantities are supplied to replace lost or damaged materials. Effective on-site material management will provide more unused overage material that can be used for Alignment Jigs.

Specifically, each jig will require the following materials (see Figure 1 on next page):

- 1 ea. - EW Beam (End-Stop) : Part # A22000xxxG1
  String line or similar alignment is required to establish a straight end stop and ensure consistent module column alignment
- 1 ea. - NS Beam (Outrigger) Part # A20000xxxG1
  Note: this NS Beam is required to be field cut in half
- 2 ea. - Aluminum L-Foot
  These are not part of overage and are typically shipped with Module Assembly Jig.

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 1: ALIGNMENT JIG METHOD (CONT.)

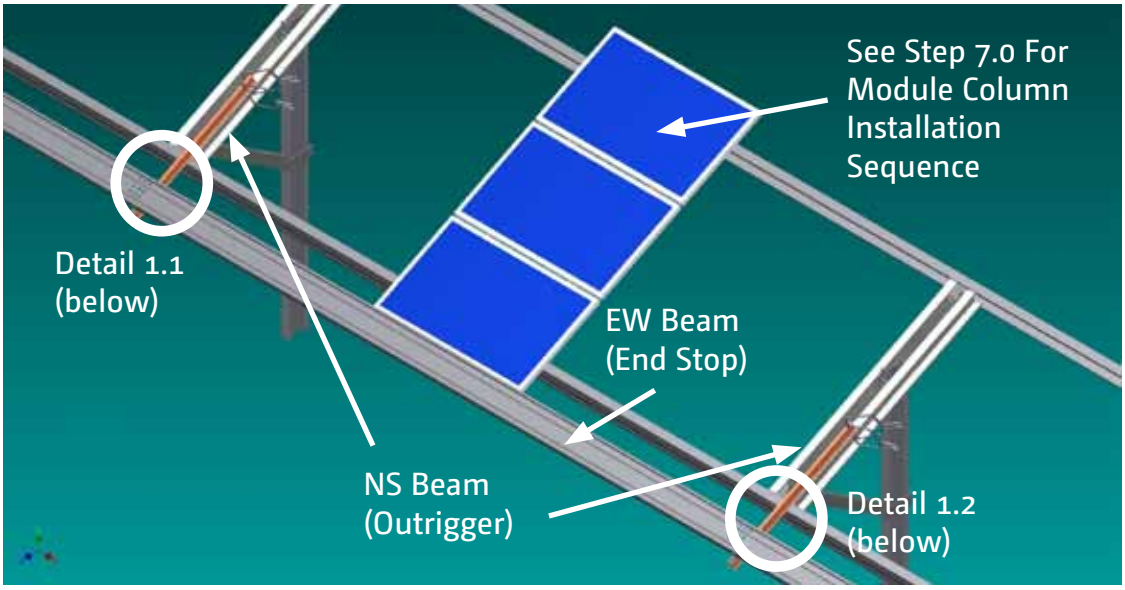
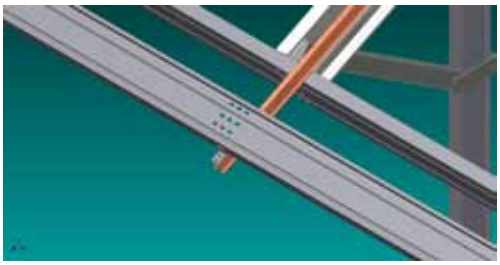
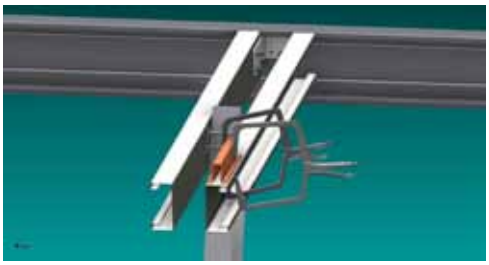


Figure 1.



Detail 1.1: Outrigger to End Stop Connection



Detail 1.2: Outrigger to Top Chord Connection

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 1: ALIGNMENT JIG METHOD (CONT.)

Jig Installation Procedure:

- Cut a NS Beam (Part # A20000xxxG1) in half - these two sections become the "Outriggers" that support the End-Stop
- Place the Outriggers over each Top Chord as shown in figure 1 and detail 2 on previous page.
- Check the construction document's typical plan view to ensure that the Outriggers will not interfere with a system NS Beams. If a NS Beam is directly over a channel of the top chord assembly, the opposite channel of the top chord assembly will have to be used to make the connection with the Outrigger (See Typical Plan View illustration on the following page).

  Note: A single job site may have multiple array sizes. Ensure there is no interference for each array size used on a job.
- The Outriggers must extend far enough out to permit the End-Stop to sit at the front of the leading edge of the modules. The section view of a typical array from the construction documents will help determine this length.
- Clamp each Outrigger to a Top Chord channel once its position is finalized. Vise Grip type 11R is one type of clamp that has the required size and head shape to meet these clamping needs.

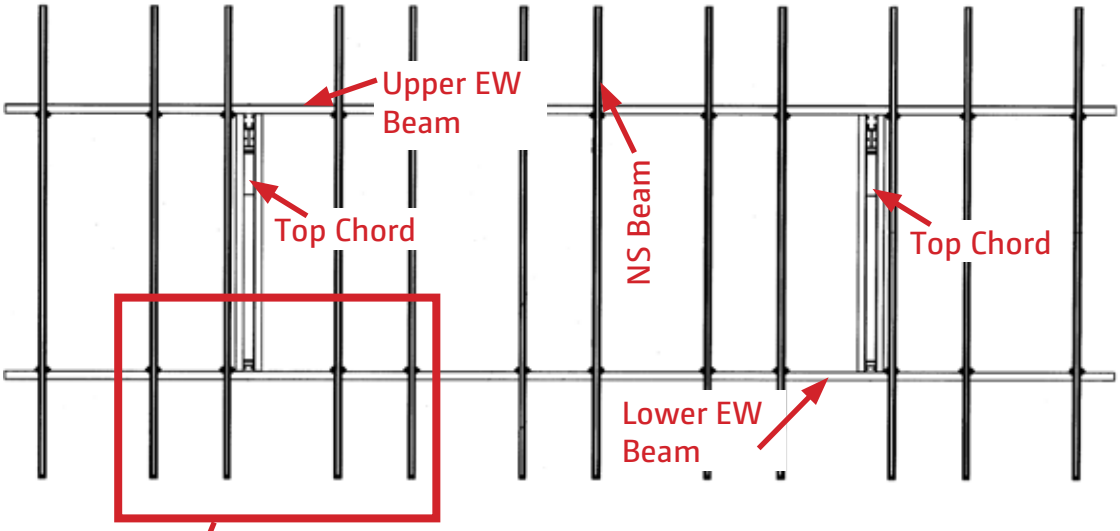
  Warning: Ensure the release handle of the clamp is facing away from the modules so modules are not damaged when clamp is released.
- The End-Stop sits on top of the Outriggers and acts as a shelf for the leading edge of the module columns.
- Attach the End-Stop to the Outriggers as shown in figure 1 and detail 1 on previous page.

  Because the weight of the module columns are supported by the End-Stop there is no need to temporarily support the lower EW Beam as required by options two and three.

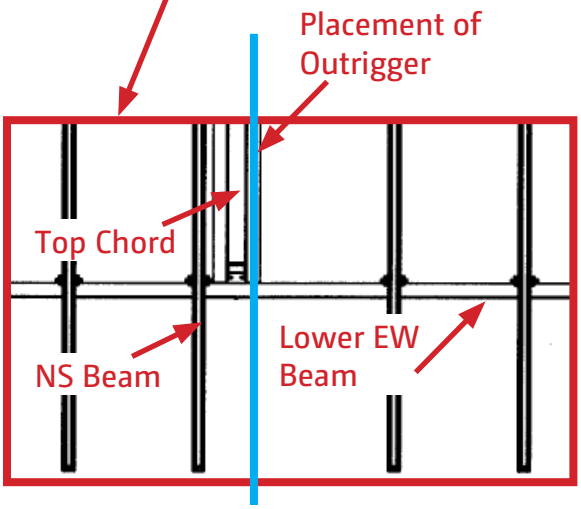
  See Step 7.0 on page 40 for module column installation sequence and EW Beam tolerance.

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 1: ALIGNMENT JIG METHOD (CONT.)



Typical Plan View



Detail of Typical Plan View

Because the closest NS Beam is left of the Top Chord, place the Outrigger on the right side of the Top Chord.

If the closest NS Beam is right of the Top Chord, place the Outrigger to the left side of the Top Chord

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 2: STRAP METHOD

The advantage of the Strap Method is that you can adequately support the lower EW Beam during the installation of the module columns and the straps are very fast and easy to install and uninstall.

Two nylon straps are needed (not supplied). First strap: minimum of two inches in width, must be approximately three feet long and have loops on both ends. Second strap: minimum of two inches in width, approximately 25 feet long, and has the ability to hook to the piles and be tightened. See illustrations below.

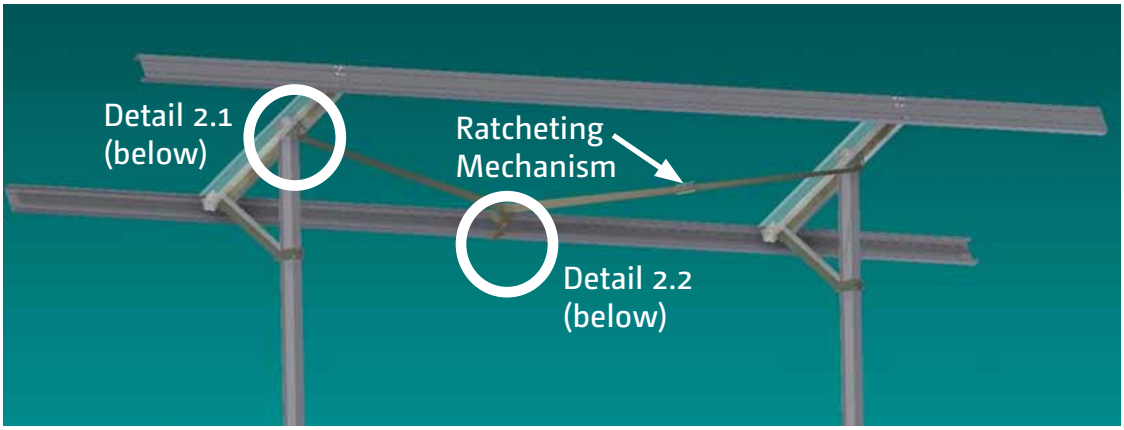
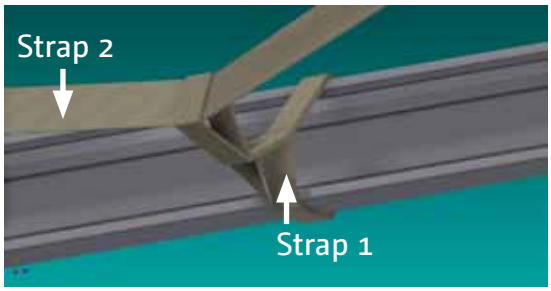


Figure 2.

Detail 2.1: In this picture part of the array structure is translucent to illustrate the connection between strap #2 and the pile



Detail 2.2

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 2: STRAP METHOD (CONT.)

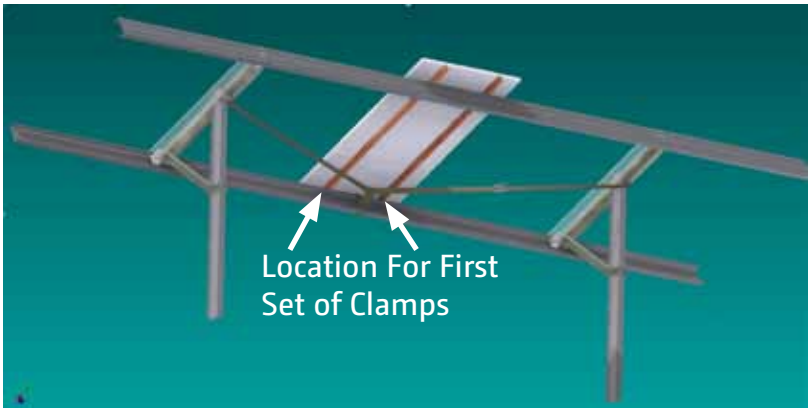


Figure 3.

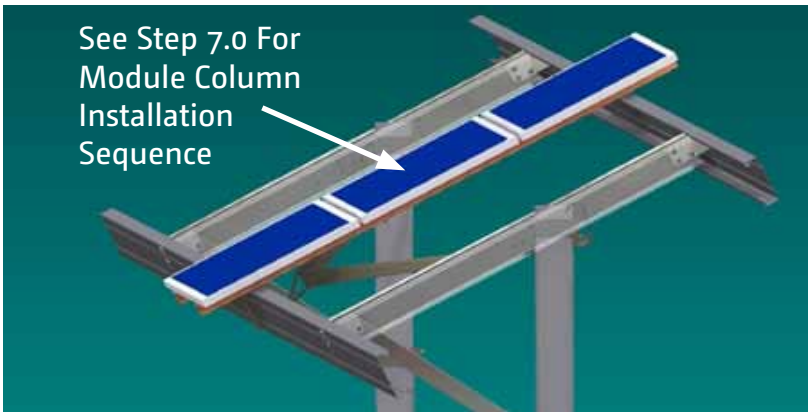


Figure 4.

Procedure:

- Using strap 1 and 2, connect the lower EW Beam to the piles as shown on previous page.
- Tighten the strap until taught and ensure the Lower EW Beam has no outward bow in it. It is essential that this Beam is visually straight prior to and after the module columns are installed.
- During installation, the module column's weight adds a temporary lateral load to the lower EW Beam that needs to be offset by installing the short term bracing option described above.

See Step 7.0 on page 40 for module column installation sequence and EW Beam tolerance.

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 3: KICKER METHOD

The advantage of the Kicker Method is that it maybe the simplest method of the 3 methods to achieve a straight lower E-W Beam by using readily available construction materials. This method is illustrated below.

The Kicker shall be a minimum of 2" x 4", and made of wood. The length will be determined by leading edge height and tilt angle of the individual array. The Kicker should be installed at the same angle as the module tilt angle (see next page).

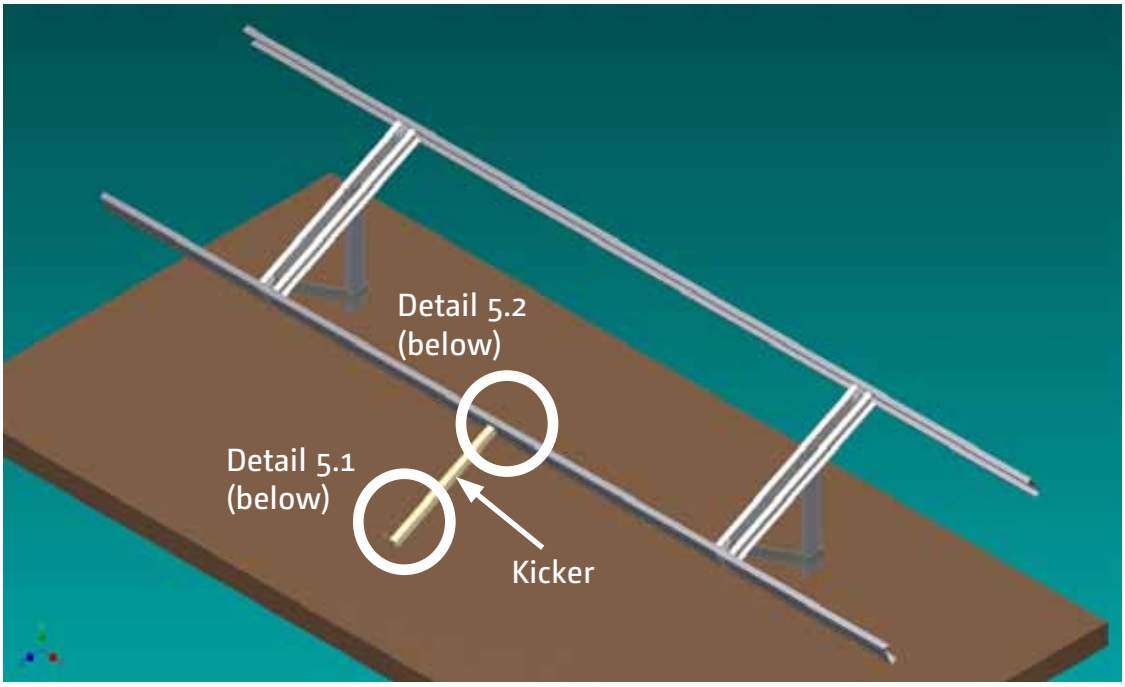
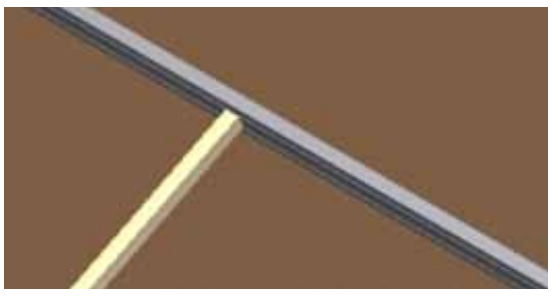


Figure 5.

Detail 5.1: Kicker to ground connection



Detail 5.2: Friction connection between EW Beam and kicker

6.0 MODULE COLUMN SEQUENCING OPTIONS & LOAD BALANCING EW BEAMS (CONT.)

OPTION 3: KICKER METHOD (CONT.)

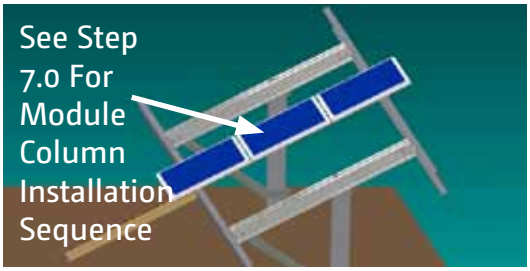


Figure 6.

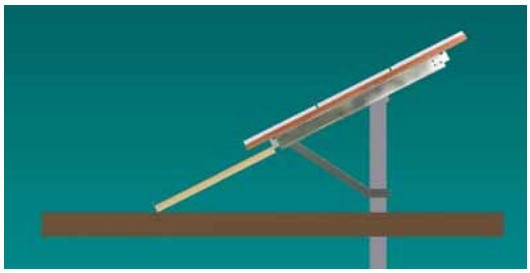


Figure 7.

Procedure:

- Create a "Kicker" brace similar to the brace shown above and as described on previous page.
- Install the Kicker brace at the mid span of the Lower EW Beam and ensure the EW Beam has no outward bow in it. It is essential that the EW Beam is visually straight prior to and after the module columns are installed.
- During installation, the module column's weight adds a temporary lateral load to the lower EW Beam that needs to be offset by installing the short term beam bracing option described above.
- Connection to the ground is made with:
  - — ½" round steel form stake thru 5/8" hole drilled in kicker
  - — ½" round steel form stake secured to the side of the kicker
- Connection to the EW Beam is a friction connection

See Step 7.0 on page 40 for module column installation sequence and EW Beam tolerance.

7.0 MODULE COLUMN INSTALLATION PROCEDURE

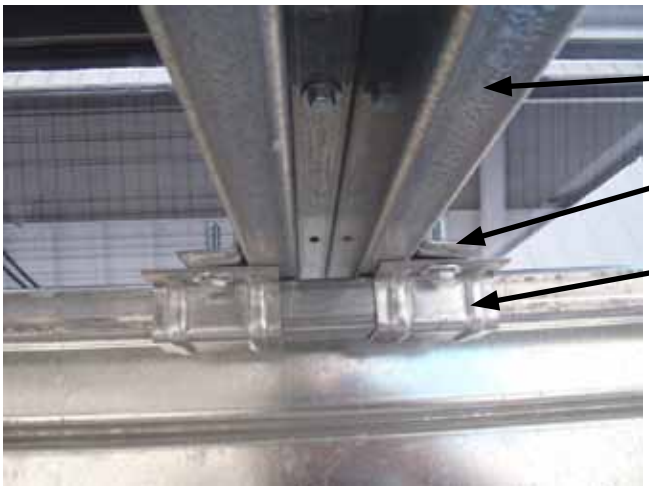
This section provides the critical installation sequence that the installation of the module columns must follow to balance the dead load on the EW Beams during installation.

1. Position the center module column on the system's EW Beams and clamp with supplied Large and Small Beam Clips to the lower EW Beam first
   - Details on EW Beam to NS Beam connect in Step 7.1.
   - If required, push the upper EW Beam out (northward) to remove any visual bow in the beam.
   - Clamp the center module column to the upper EW Beam.
2. Safely install in any sequence all remaining pre-assembled module columns and connect to array's lower EW Beam first.
   Note: Clamping to the bottom EW Beam prior to clamping to the top EW Beam is essential to ensure balanced loading of the array structure
3. Ensure the proper design gap on all remaining module columns is maintained.
   - Clamp each module-column to the upper EW Beam using the supplied Large and Small Beam Clips.
4. If required by construction documents connect one end of the lateral braces (Part #A62139-1) to the upper and lower EW Beams (See Step 8.0 on page 42 for more information).
   - If required, rotate by hand the upper EW Beam so that it is perpendicular to the NS Beams and clamp in place.
   - Once module column adjustment is complete Tek screw the other end of the lateral braces to the NS Beam and remove the bracing and alignment aids for use on the following array.

Note: Once all module columns are installed the EW Beams are within tolerance if their respective bows are +/- ½".

7.0 MODULE COLUMN INSTALLATION PROCEDURE (CONT.)

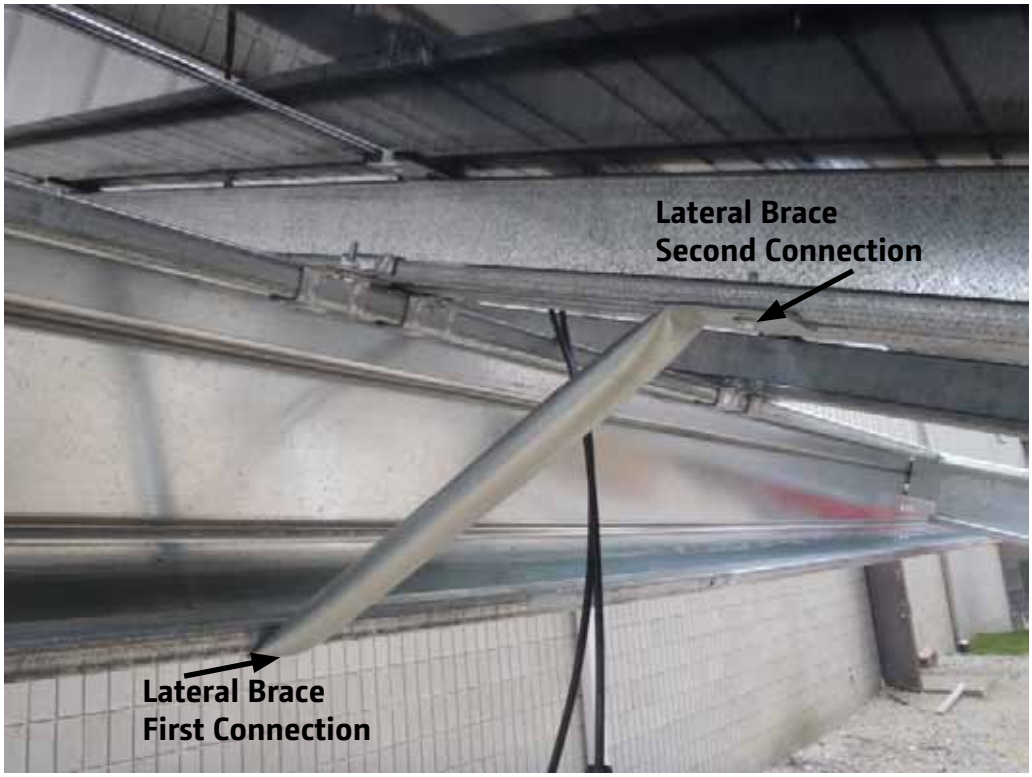
7.1 Install Large and Small Beam Clips to Make EW to NS Beam Connection



Hat-Channel Beam Connections

Option to pre-assemble Small Beam and Large Beam Clips in the field

8.0 INSTALL LATERAL BRACE
(IF REQUIRED)



Lateral Brace not required on all jobs. Attach with Tek Screws per construction documents.

Connection to NS Beam

Connection to EW Beam

9.0 REPEAT UNTIL COMPLETE

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