GFT GROUND FIXED TILT

INSTALLATION GUIDE

NOTE:
Refer to construction drawings for project specific details. Construction drawings have precedence over these installation guidelines.

PUB2022APR18

Safety Note: Cold formed steel components may have sharp edges after fabrication. Appropriate PPE should be worn to avoid injury.

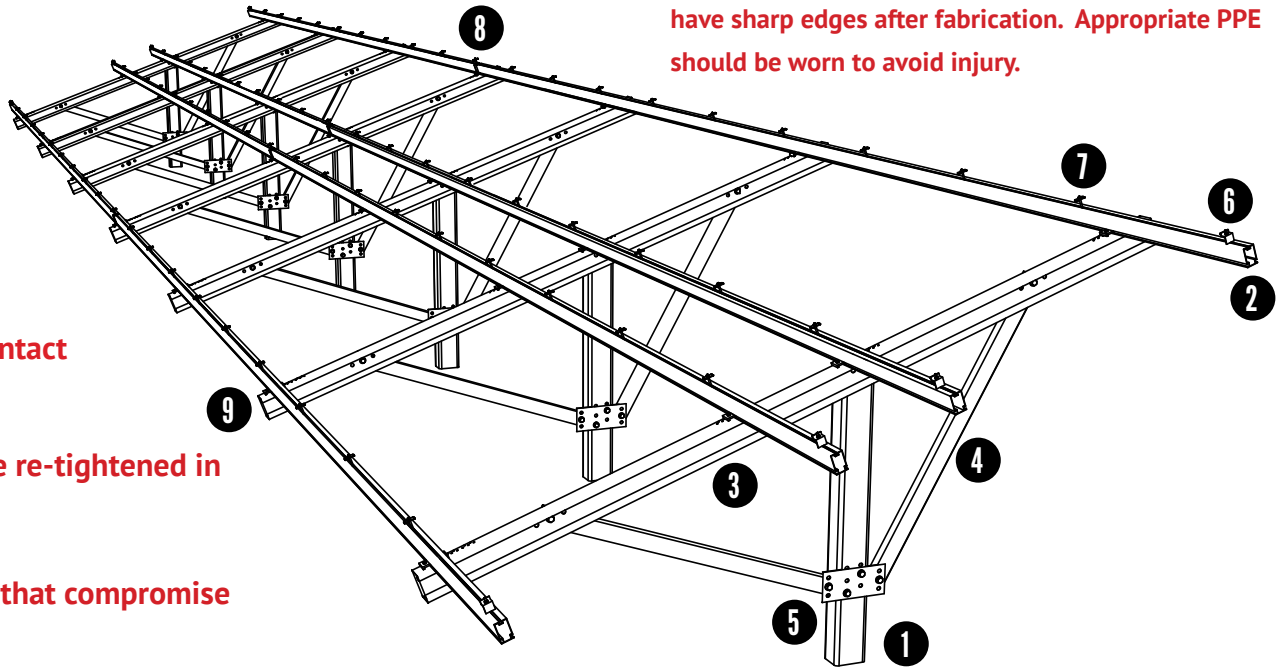
Safety Notes:

Cold formed steel components may have sharp edges after fabrication. Appropriate PPE should be worn to avoid injury.

Load ratings are project specific - please contact Unirac or refer to U-Builder.

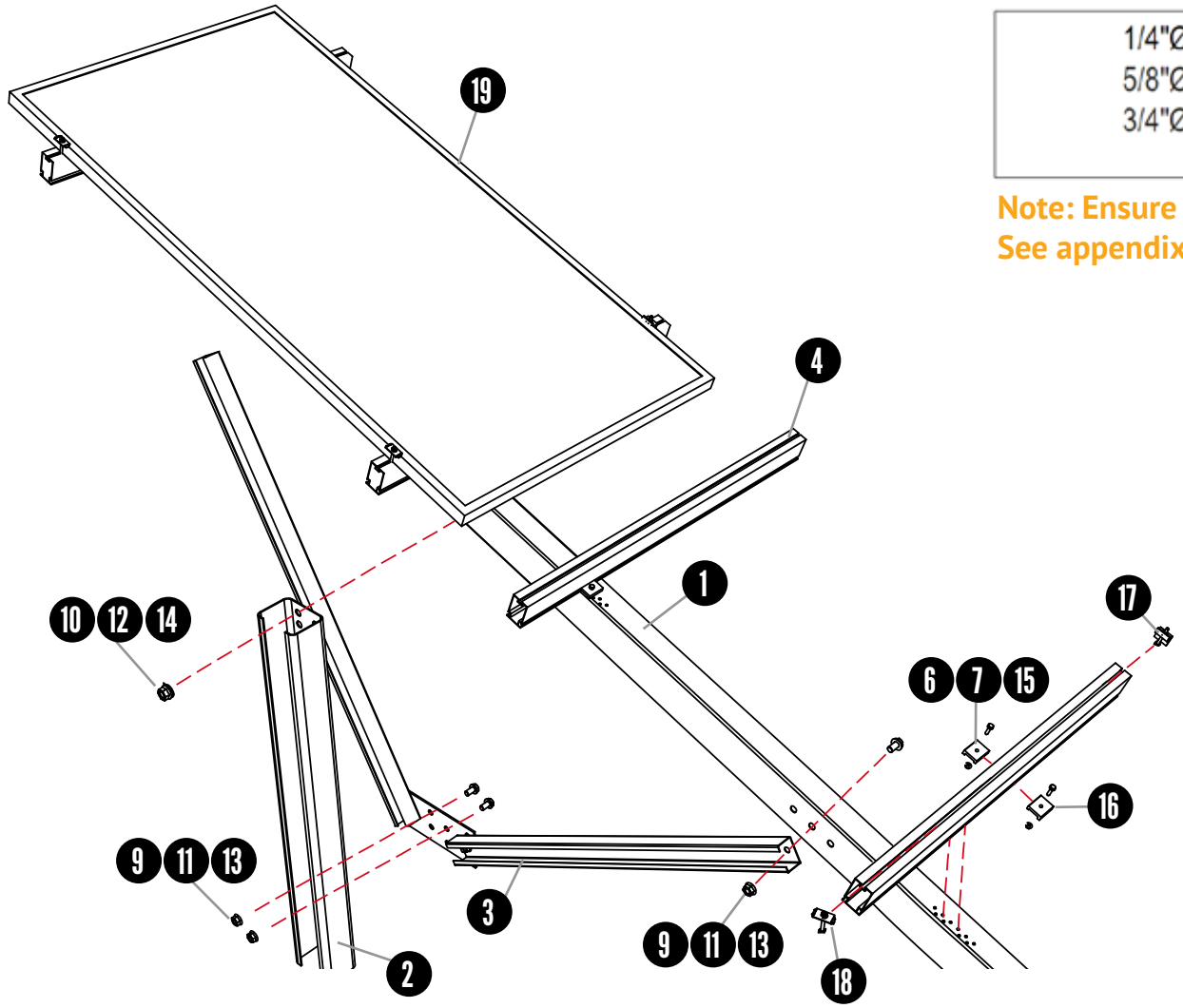
Any loose components or fasteners shall be re-tightened in accordance with these instructions.

Any components showing signs of damage that compromise safety shall be replaced immediately.



ITEM	COMPONENT	MATERIAL
1	Roll- Formed Steel Pile	4" or 4.5 " x 6" C Shape (Length Varies by Project)
2	Aluminum East-West Beam	Aluminum Beam with Continuous Slots for Adjustability
3	Roll-Formed Steel Top Chord	C Shape with Custom Hole Pattern for Adjustability
4	Roll-Formed Steel Diagonal Brace	C Shape
5	Steel Diagonal Brace Plate	Steel Plate with Custom Hole Pattern for Adjustability
6	End Clamp	End Clamp Assembly with T-Bolt
7	Mid Clamp	Mid Clamp Assembly with T-Bolt
8	Nested Splice Member	Internal Aluminum Splice Retained with Self-Tapping Screws
9	East-West Beam Clamp	Aluminum Extruded Clamp with Stainless Steel Hardware

OVERALL VIEW OF COMPONENTS



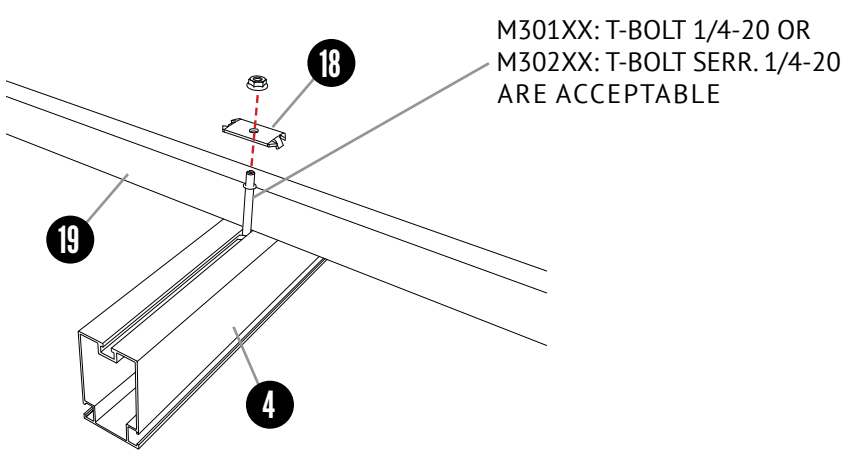
TORQUE REQUIREMENTS FOR THE GFT PRODUCT:

1/4"Ø HARDWARE =	9 - 11 FT-LBS
5/8"Ø HARDWARE =	54 - 66 FT-LBS
3/4"Ø HARDWARE =	99 - 121 FT-LBS

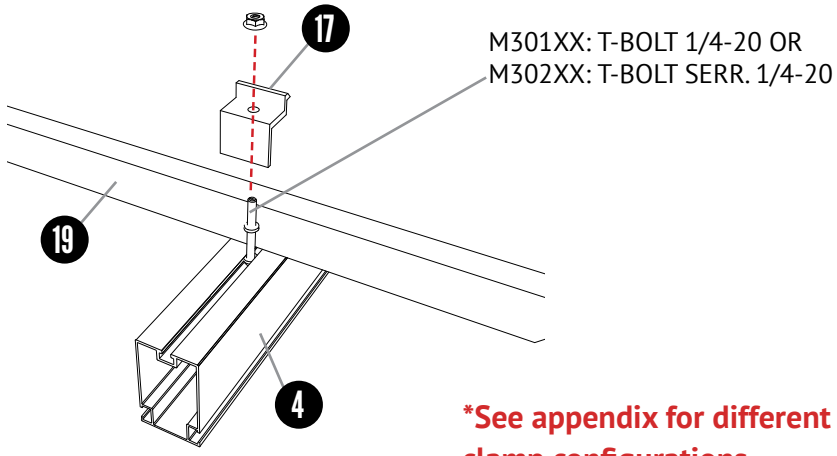
Note: Ensure Torque wrenches have been calibrated.
See appendix for different clamp configurations

ITEM	COMPONENT
1	4.1" Top Chord Channel
2	6" x 4" or 4.5" C-Shape Pile
3	Diagonal Brace Assembly
4	3.25" x 2" East-West Aluminum Beam
5	Rail Splice - See page 6
6	Flat Washer 1/4"
7	Hex Flange Nut 1/4-20 Serrated
8	Rail splice connection - See page 6
9	Flat Washer 5/8"
10	Flat Washer 3/4"
11	Hex Bolt 5/8-11" x 1-1/2"
12	Hex Bolt 3/4-10" x 1-1/2"
13	Hex Flange Nut 5/8-11 Serrated
14	Hex Flange Nut 3/4-10 Serrated
15	Hex Bolt 1/4-20 x 1"
16	East-West Rail Clip
17	Standard End Clamp Assembly
18	Standard Mid Clamp Assembly
19	PV Module (By Others)

Standard Mid Clamp Assembly with T-Bolt



Standard End Clamp Assembly with T-Bolt



***See appendix for different clamp configurations**

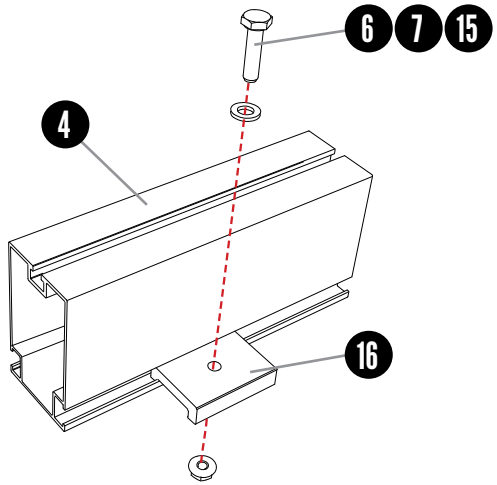
Mid Clamp Assembly With T-Bolt

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
18	Mid Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

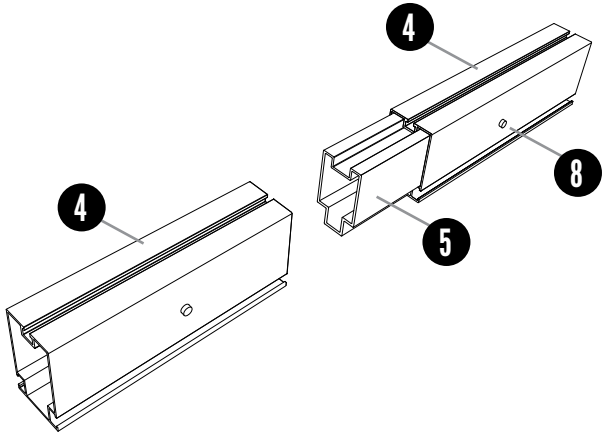
End Clamp Assembly With T-Bolt

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
17	End Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

East-West Rail Clip



East-West Beam Splice



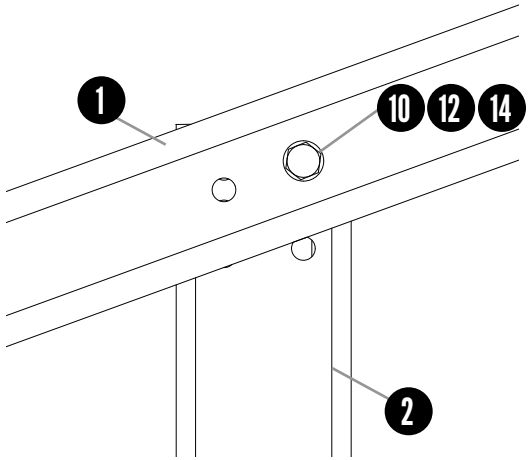
East-West Rail Clip

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
6	Flat Washer 1/4"	Stainless Steel ASTM F594
7	Hex Flange Nut 1/4-20 Serrated	302HQ 18/8 Stainless Steel Austenitic 300 Series
15	Hex Bolt 1/4-20 x 1"	302HQ 18/8 Stainless Steel Austenitic 300 Series
16	East-West Rail Clip	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6

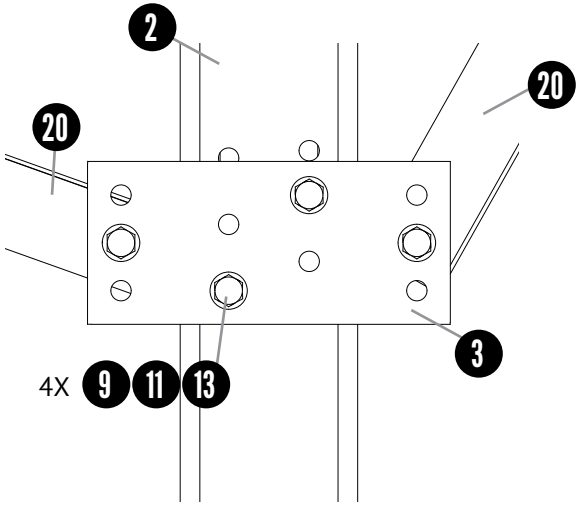
East-West Beam Splice

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
5	East-West Beam Splice Insert	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
8	1/4" x 20 Self Drilling Screw (Buildex)	ASTM A449/ SAE J429 (Similar Properties Confirmed by testing)

Top Chord to Pile Connection



Diagonal Brace Plate to Pile Connection

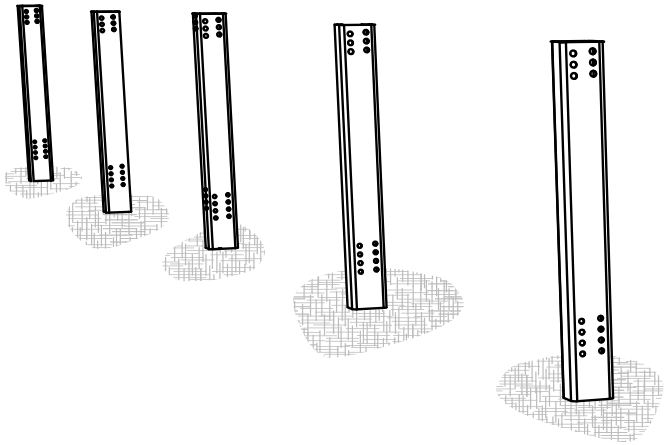


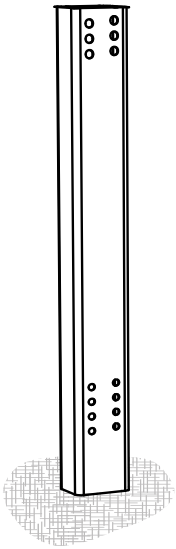
Top Chord to Pile Connection

ITEM	COMPONENT	MATERIAL
1	4.1" Top Chord Channel	Cold Rolled ASTM A653 HSLAS
2	6" x 4 or 4.5" C-Shape Pile	Cold Rolled ASTM A653 HSLAS
10	Flat Washer 3/4"	SAE Type A Narrow
12	Hex Bolt 3/4-10 x 1-1/2"	SAE J429
14	Hex Flange Nut 3/4-10 Serrated	SAE J429

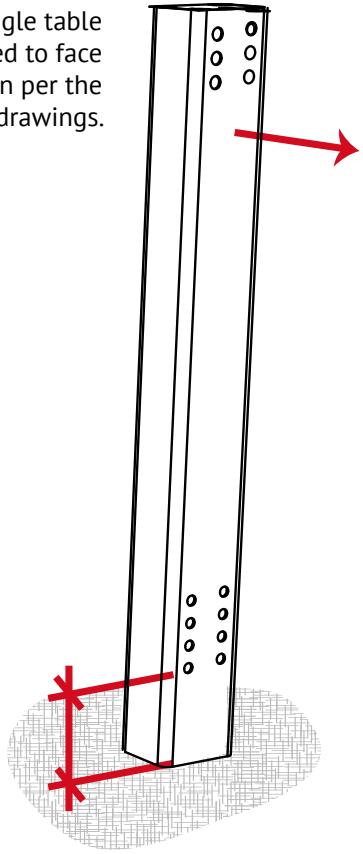
Diagonal Brace Plate to Pile Connection

ITEM	COMPONENT	MATERIAL
2	6" x 4 or 4.5" C Shape Pile	Cold Rolled ASTM A653 HSLAS
3	Diagonal Brace Plate	ASTM A36 or ASTM A653
9	Flat Washer 5/8"	SAE Type A Narrow
11	Hex Bolt 5/8-11 x1-1/2"	SAE J429
13	Hex Flange Nut 5/8-11 Serrated	SAE J429
20	Diagonal Brace	Cold Rolled ASTM A653 HSLAS



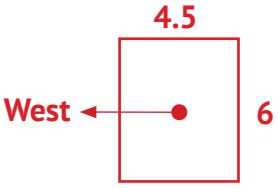


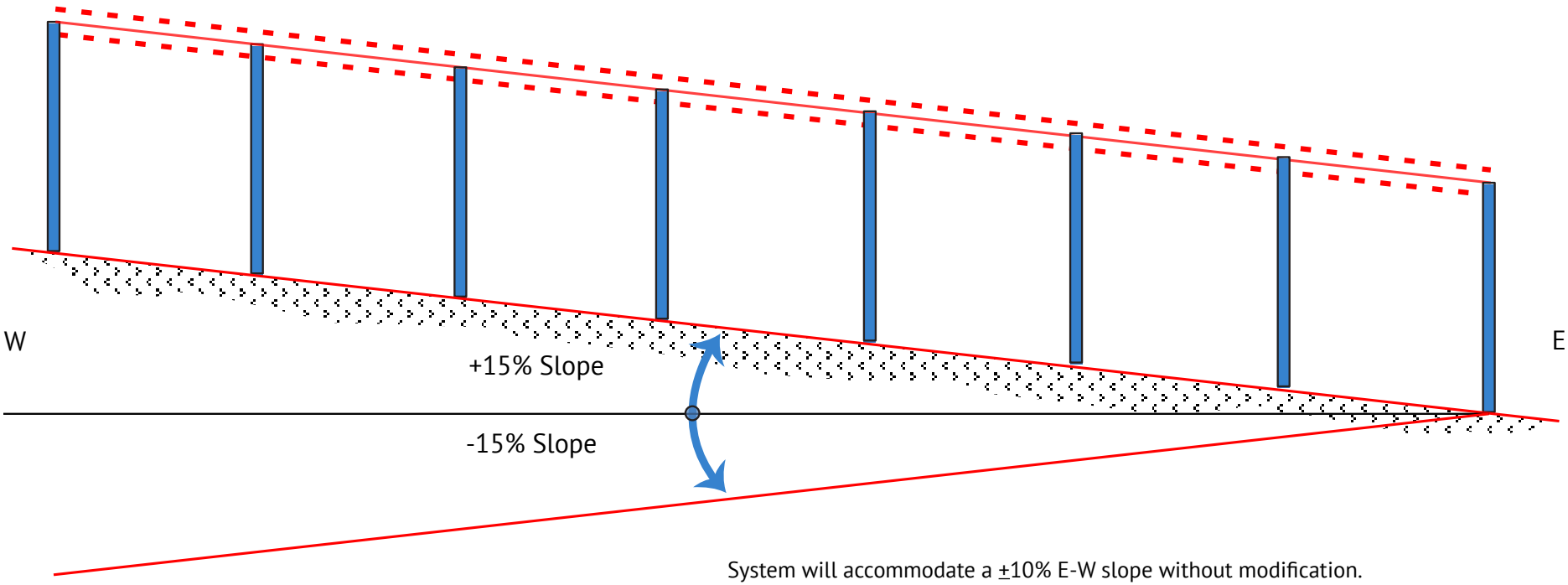
All piles within single table must be oriented to face the same direction per the construction drawings.



Hole height above grade per construction drawings.

Note:
C-Piles must be installed with C open to the West.

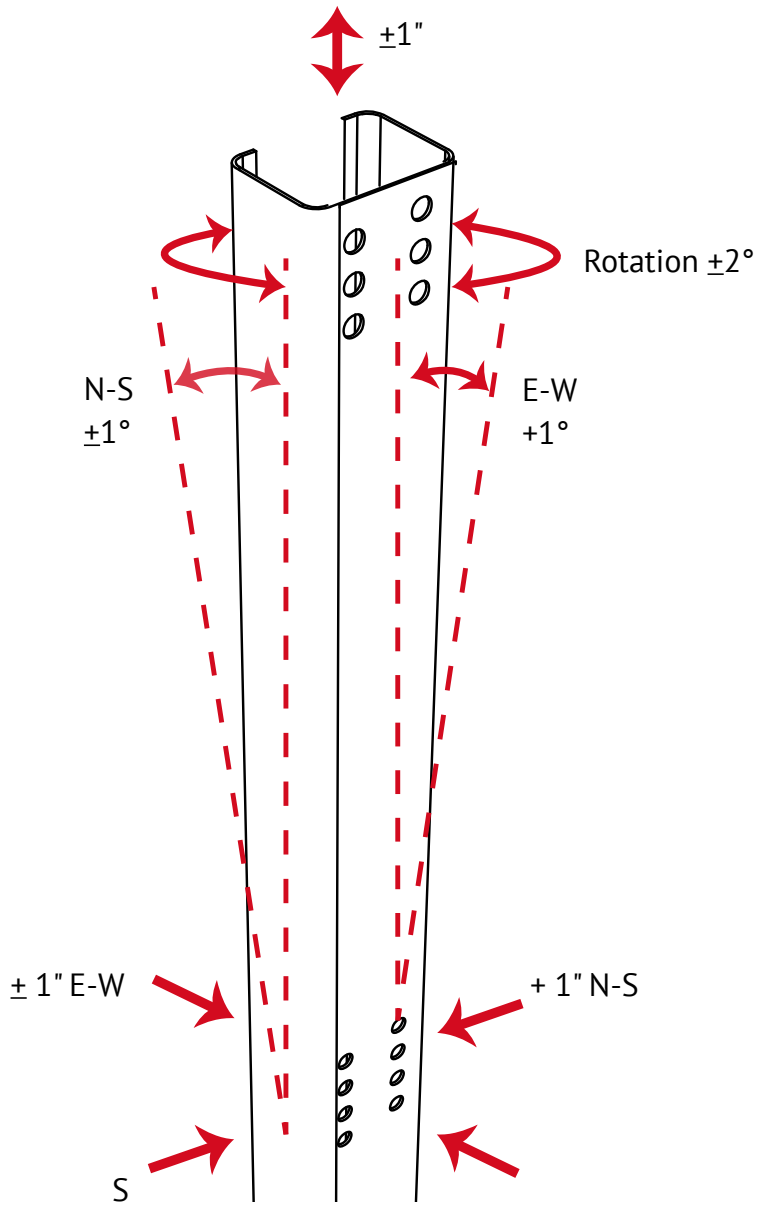




System will accommodate a ±10% E-W slope without modification.

- Plumb tolerances apply regardless of slope.
- Pile position tolerances apply relative to nominal finish grade line.

Note:
The GFT system has been installed at an E-W slope of 15%. This is achievable, but requires additional effort to ensure that holes align for bolted connection.

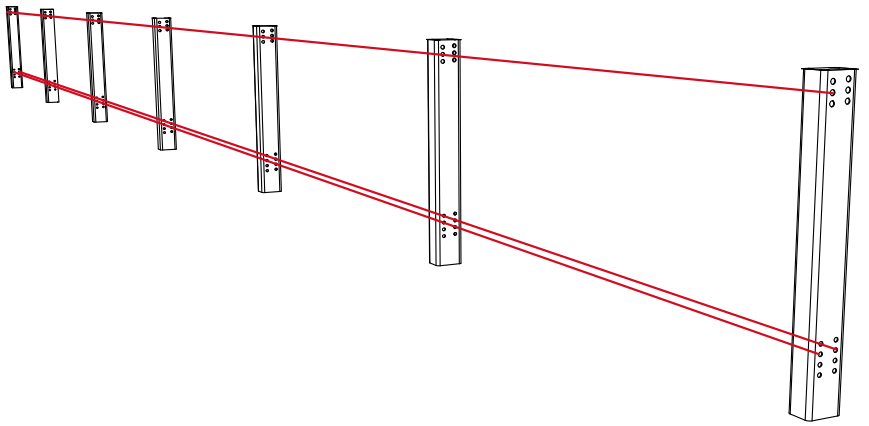

±1"
Rotation ±2°
N-S
±1°
E-W
+1°
± 1" E-W
+ 1" N-S
S

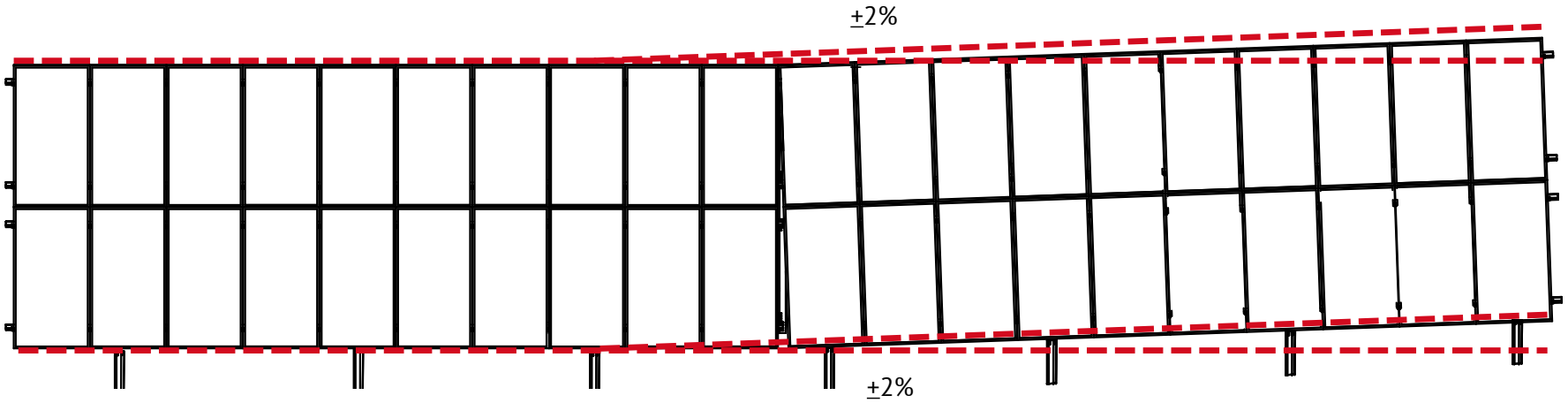
ALIGN ATTACHMENT HOLES ON PILES

1. Align target hole locations in all piles (within tables and table to table) using laser or string line.

2. Determine if adjustments are needed up or down (hole patterns allow for + 1-1/2" adjustments in 3/4" increments per instruction on following pages).

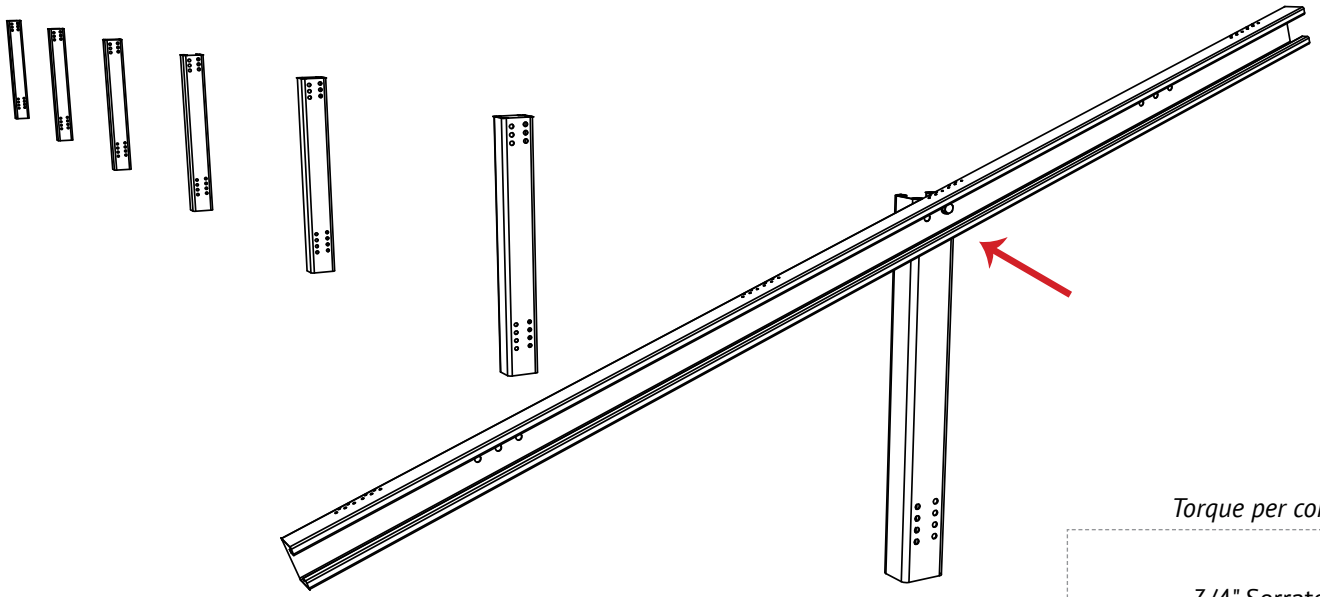
3. Mark holes to be used for top chord and diagonal brace plate attachments prior to installing.



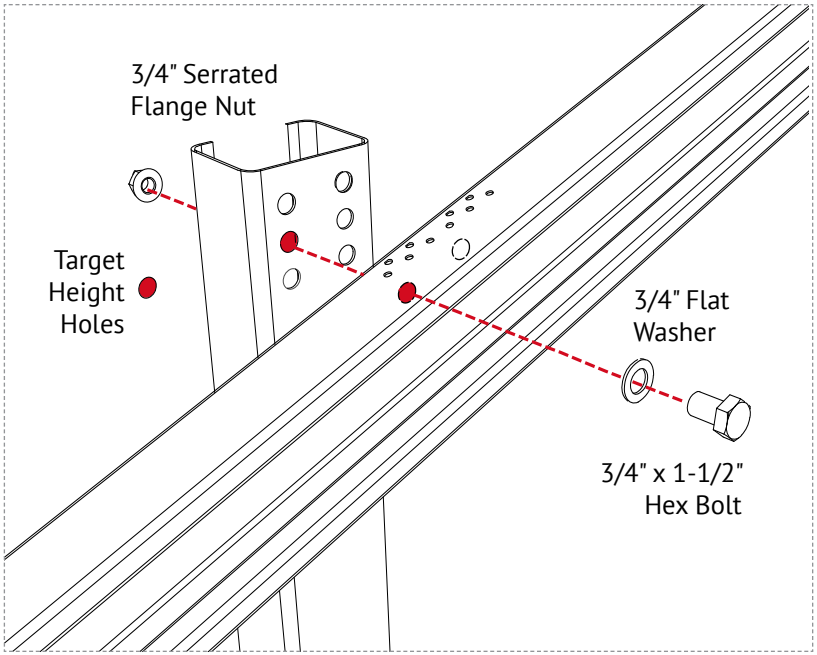


The system is capable of being aligned to the target string or laser line using the adjustment holes when piles are placed within allowable tolerances. Each table will however accommodate a 2% deviation from the target line as shown without impact to structural integrity.

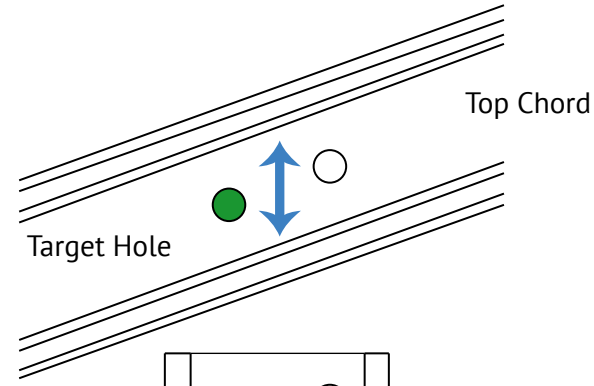
ATTACH TOP CHORD TO PILE

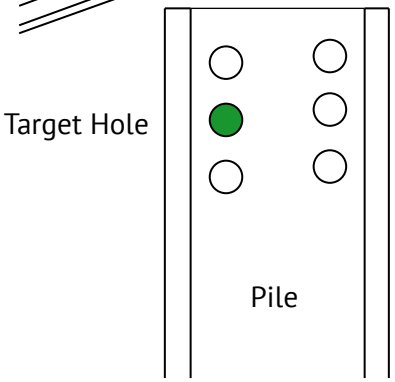


Install hardware snug tight.
Torque per construction drawings after final adjustments.



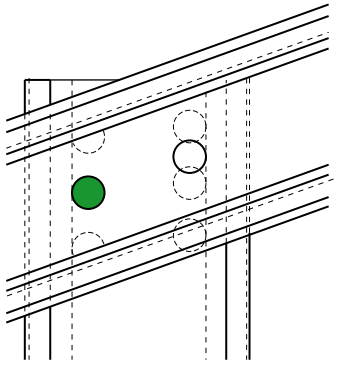
Target Height





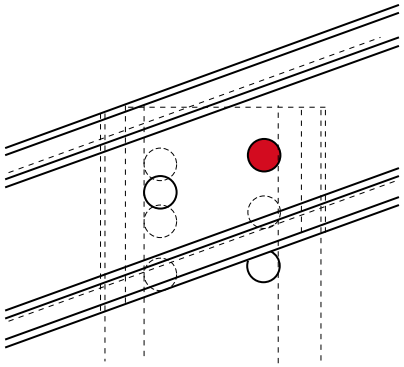
Move top chord up or down (not horizontally) as needed to adjust height in 3/4" increments.

Use single 3/4" bolt (nut and washer) at one of the locations shown.

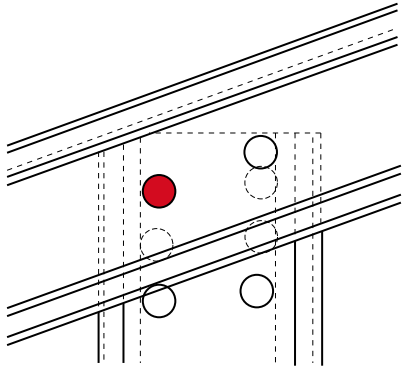


Target Height

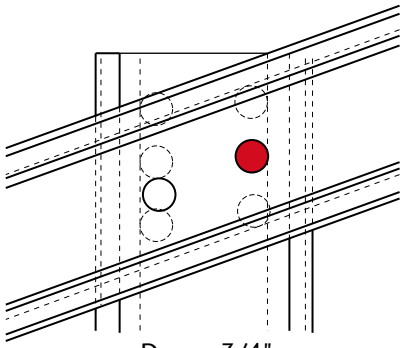
Adjustment Locations (Single 3/4" Bolt)



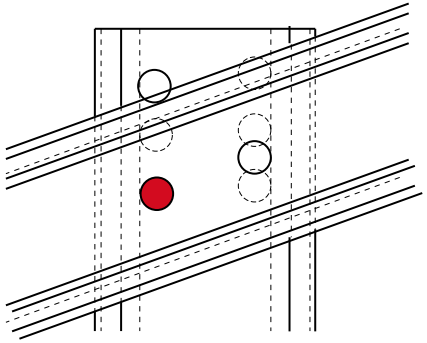
Up 3/4"



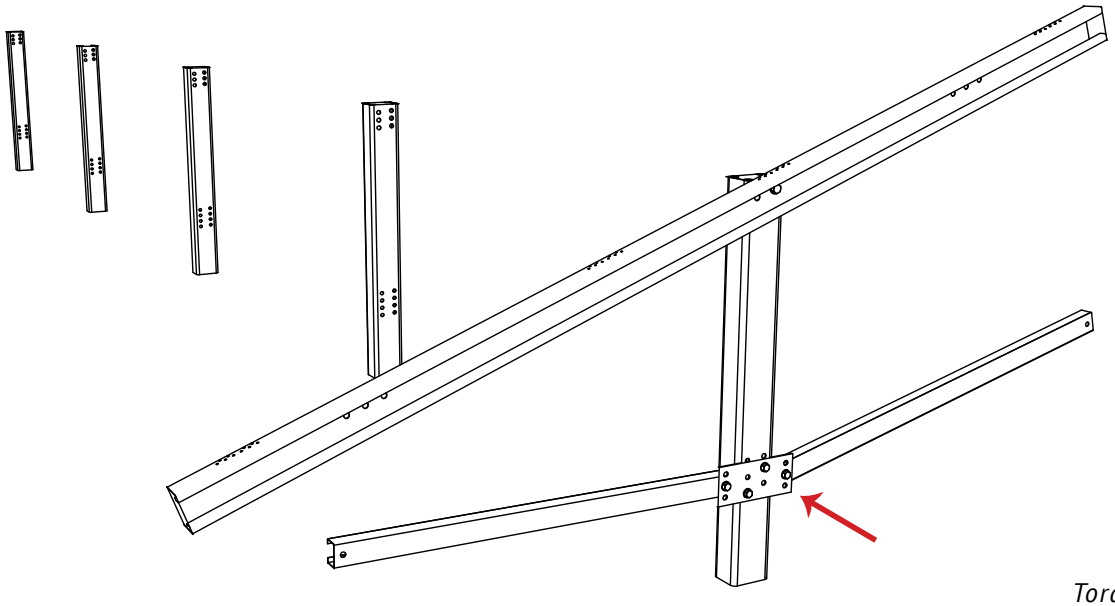
Up 1-1/2"



Down 3/4"



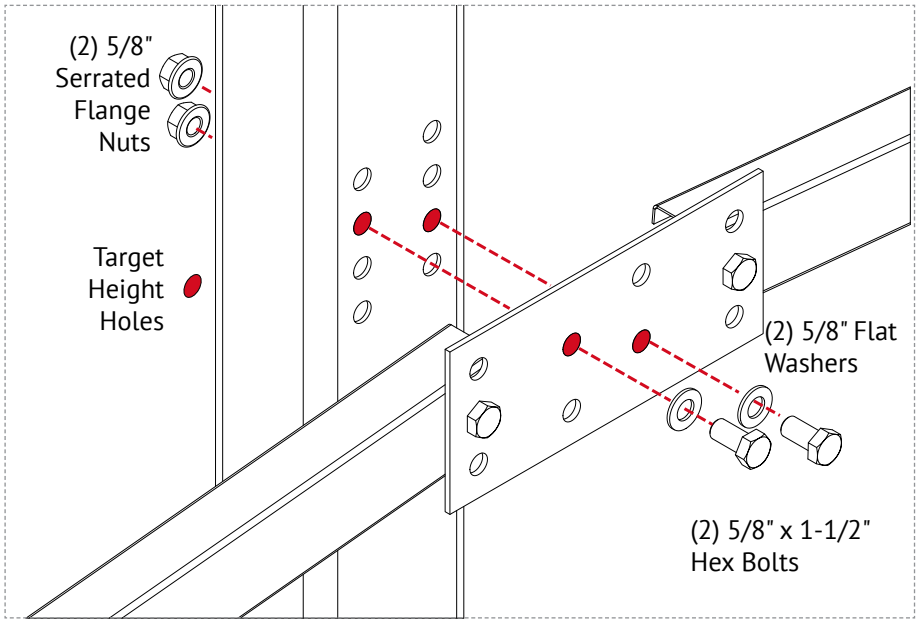
Down 1-1/2"



Diagonal Brace Assembly

Install hardware snug tight.

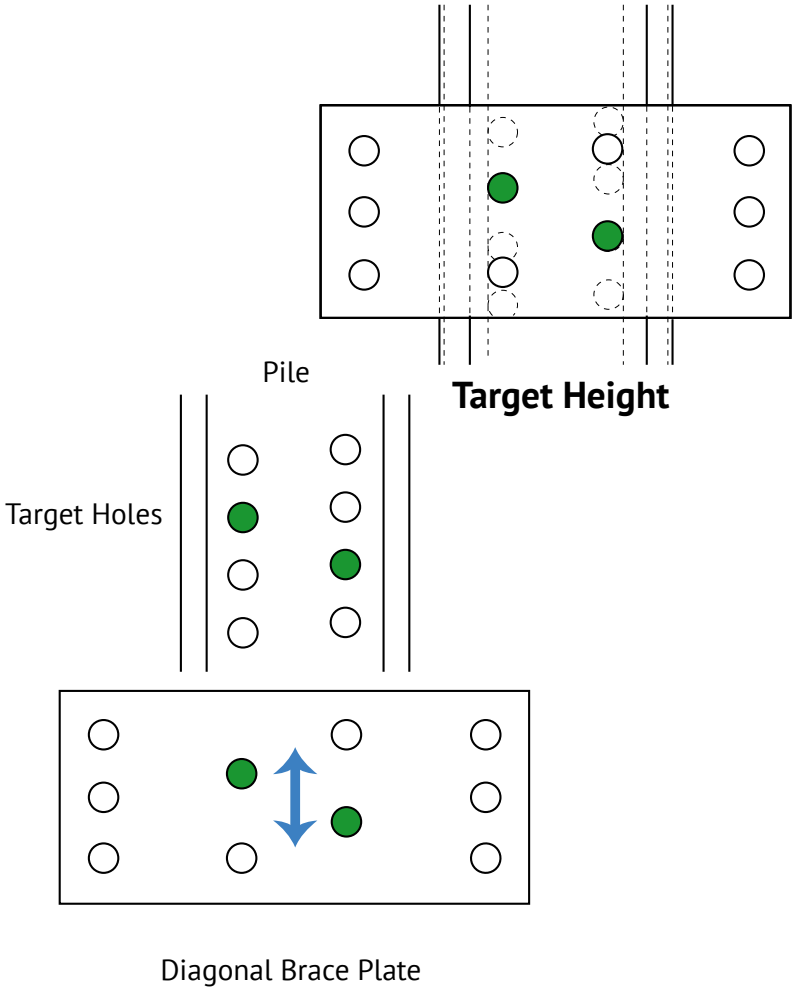
Torque per construction drawings after final adjustments.



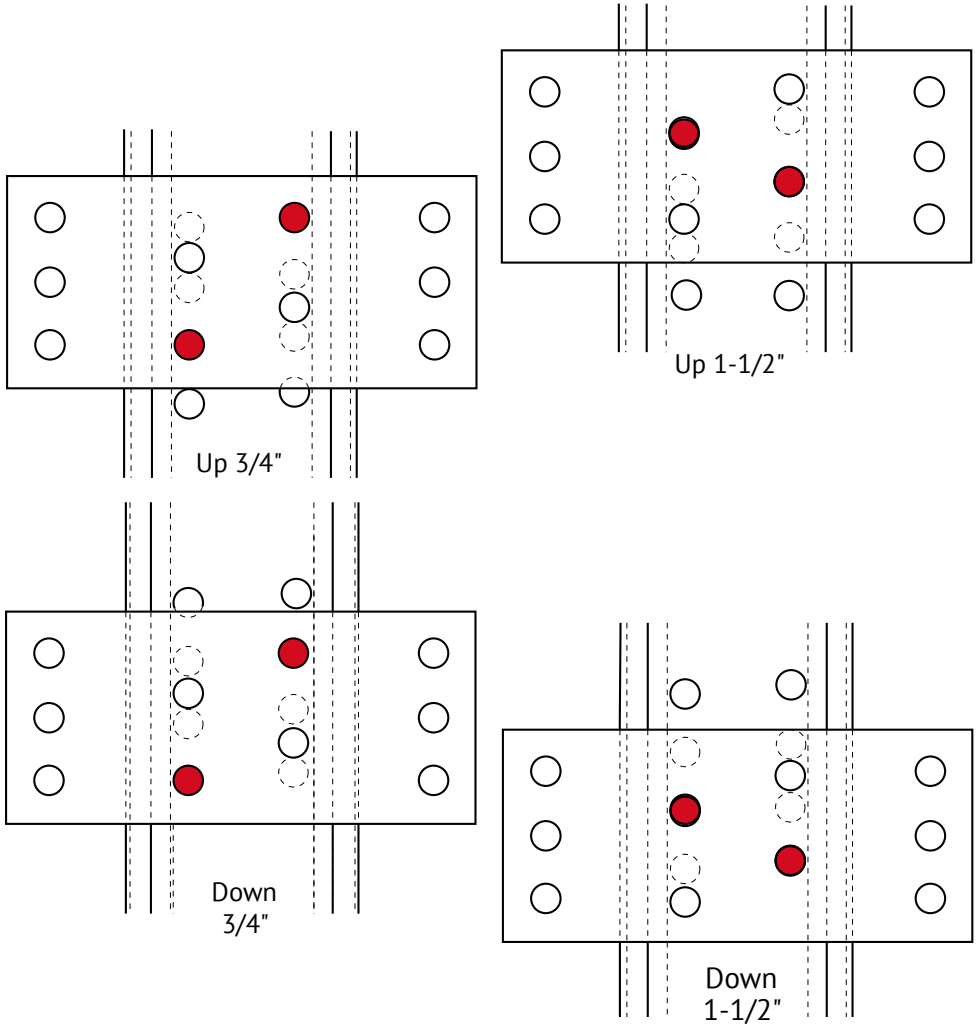
Target Height

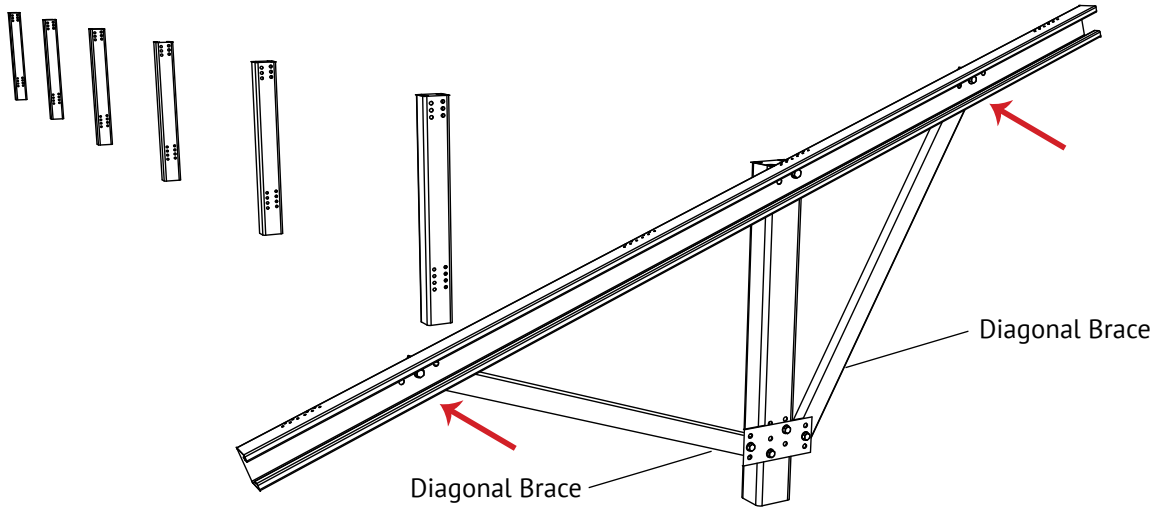
Move diagonal brace plate up or down (not horizontally) as needed to adjust height in 3/4" increments.

Use pair of 5/8" bolts (nuts and washers) at location shown.

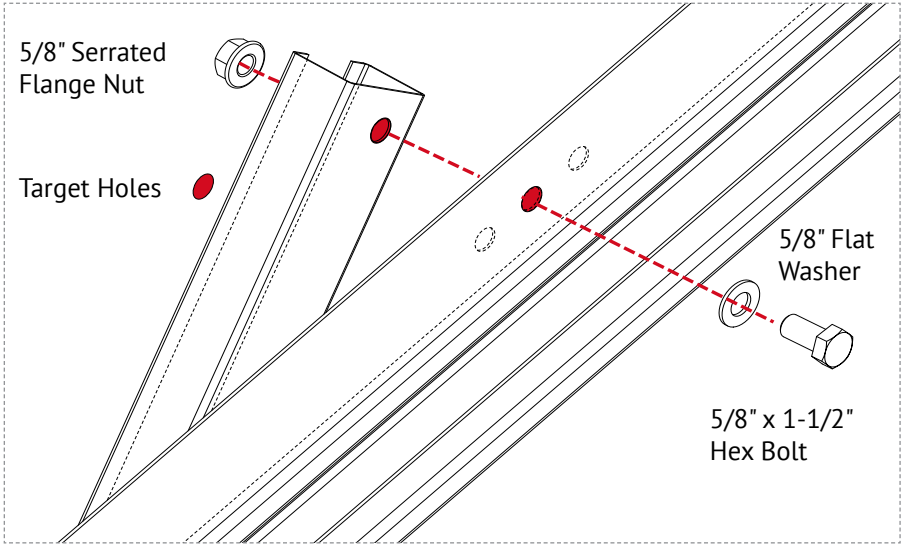


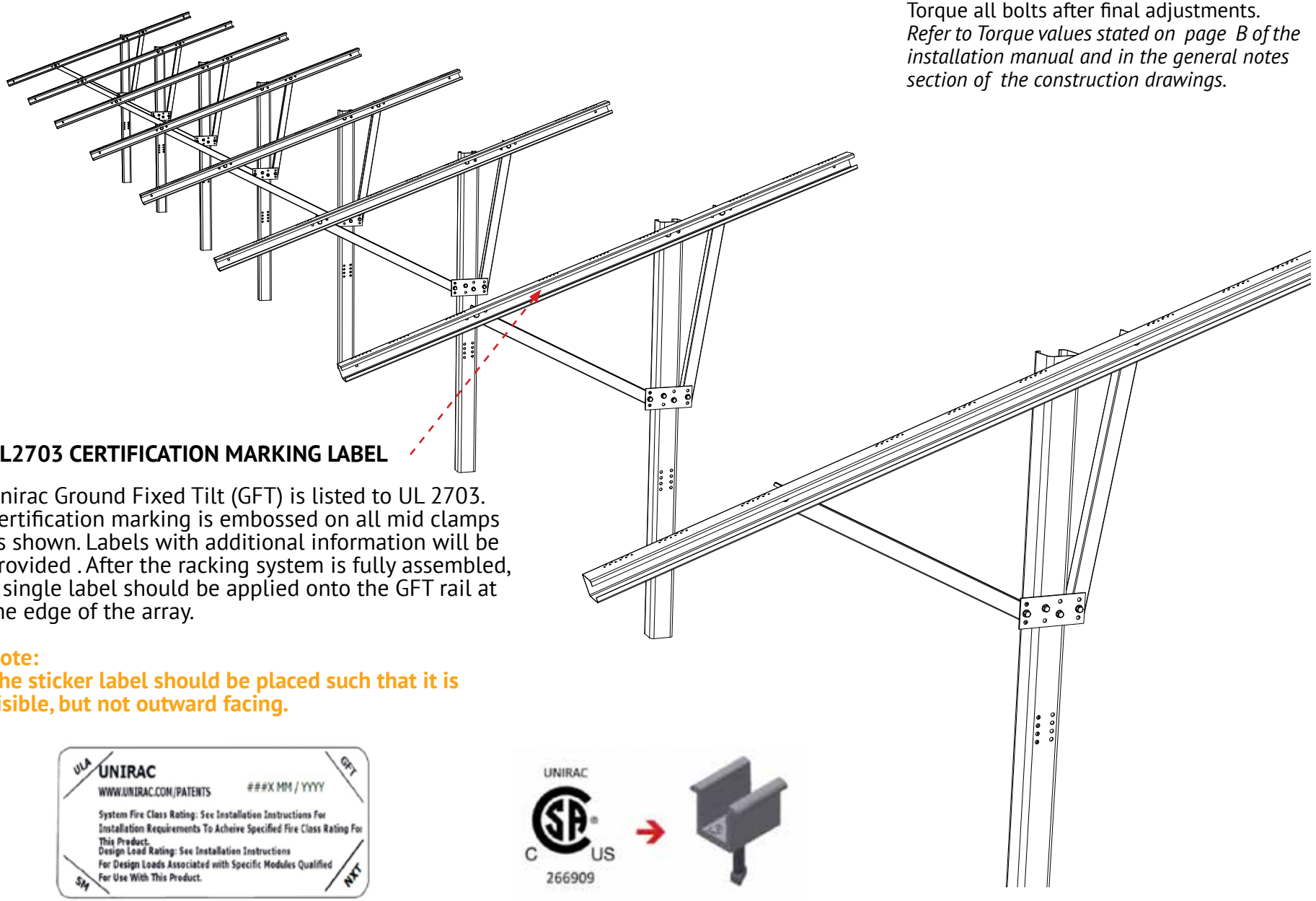
Adjustment Locations (Pair of 5/8" Bolts)





Install hardware snug tight.
Torque per construction drawings after final adjustments.



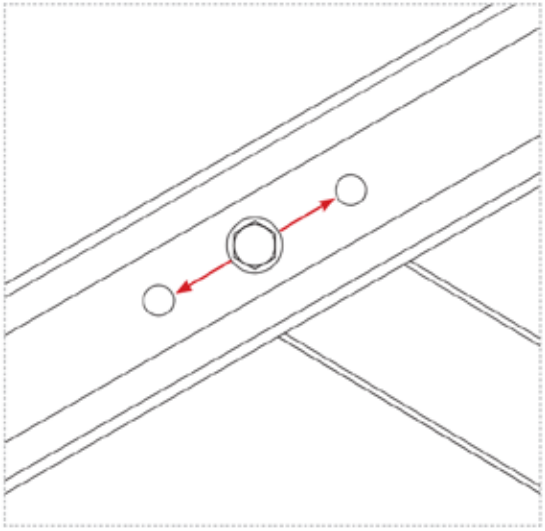


Torque all bolts after final adjustments.
Refer to Torque values stated on page B of the installation manual and in the general notes section of the construction drawings.

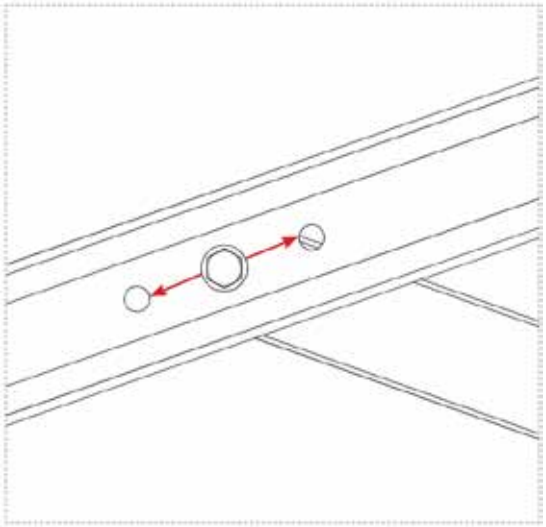
UL2703 CERTIFICATION MARKING LABEL

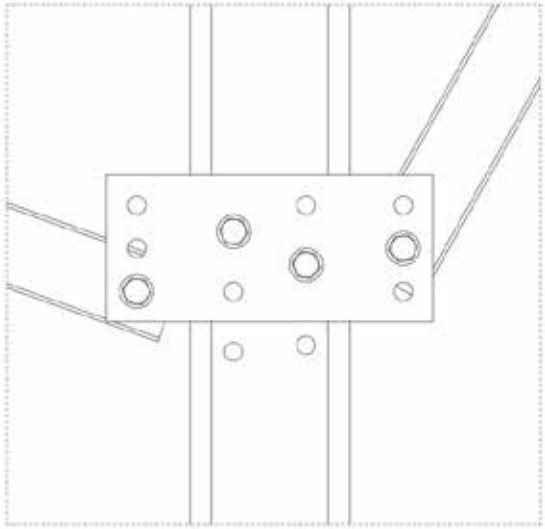
Unirac Ground Fixed Tilt (GFT) is listed to UL 2703. Certification marking is embossed on all mid clamps as shown. Labels with additional information will be provided . After the racking system is fully assembled, a single label should be applied onto the GFT rail at the edge of the array.

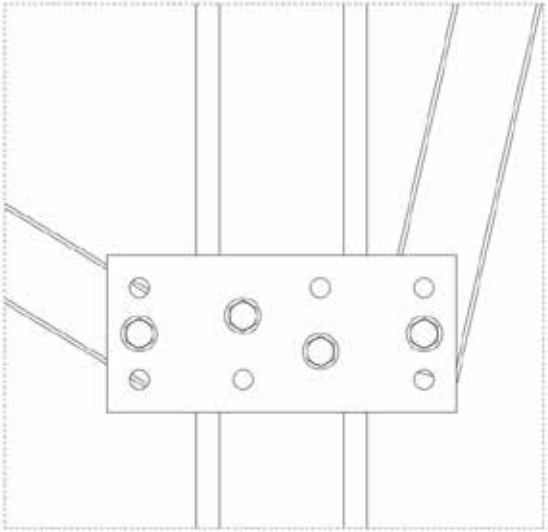
Note:
The sticker label should be placed such that it is visible, but not outward facing.

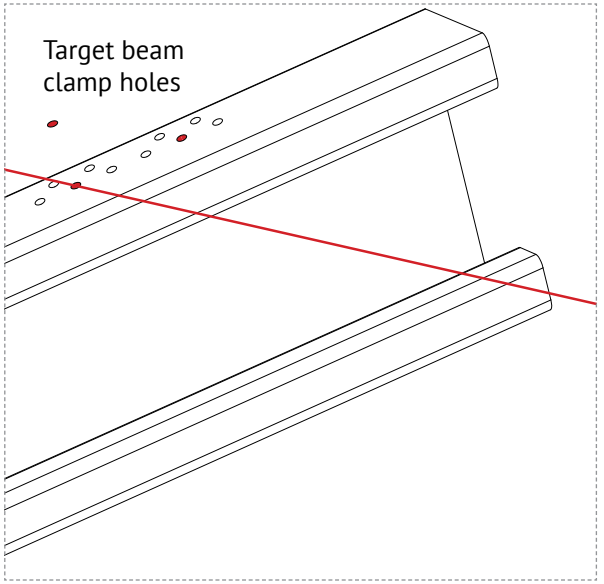


If required, additional minor adjustment of top chord angle may be achieved by a combined repositioning of diagonal braces to adjacent holes in top chord and diagonal brace plate.





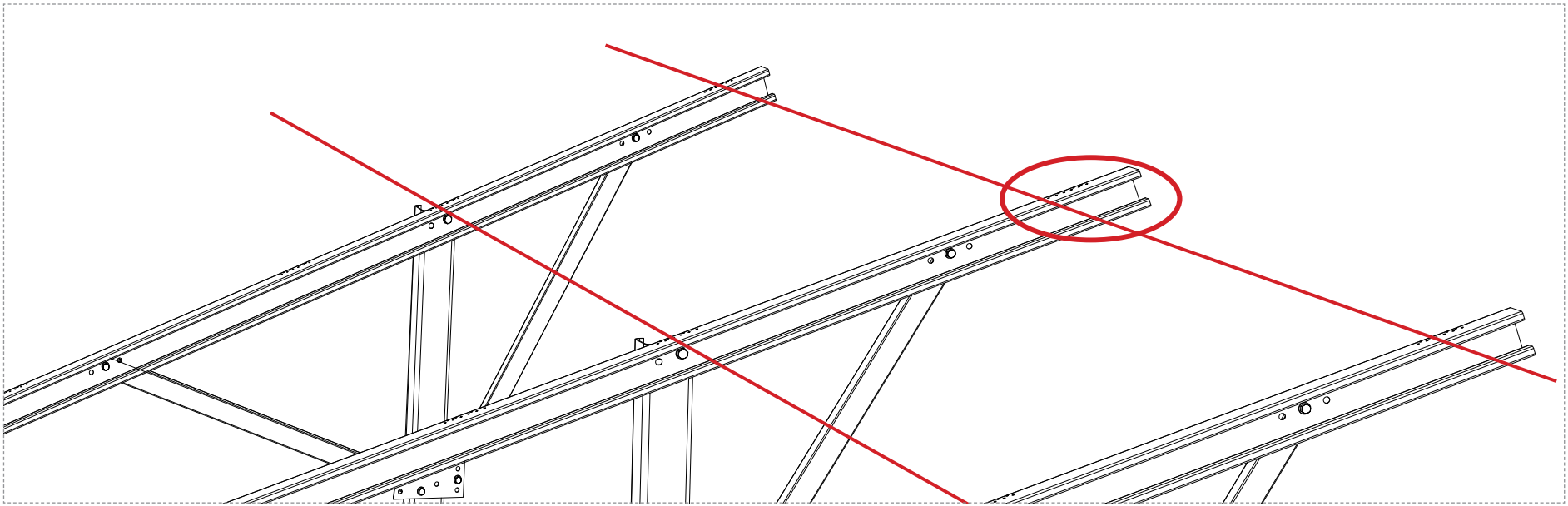




1. Align target hole locations using laser or string line.

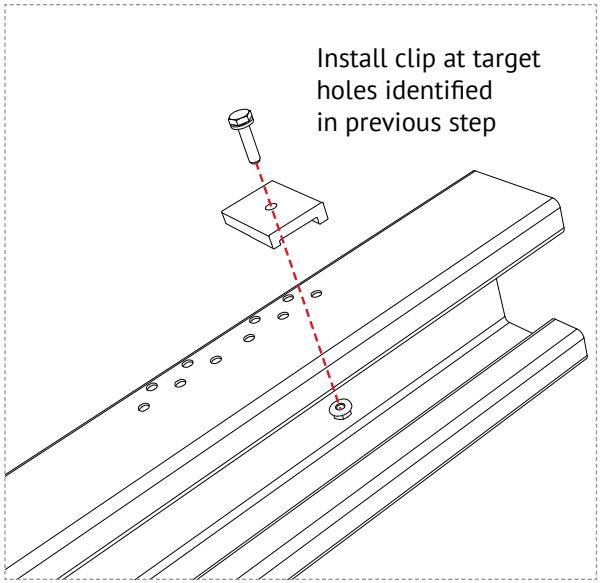
2. Determine if adjustments are needed up or down. (hole patterns allow for +1" adjustment in 1/2" increments per instruction on following pages).

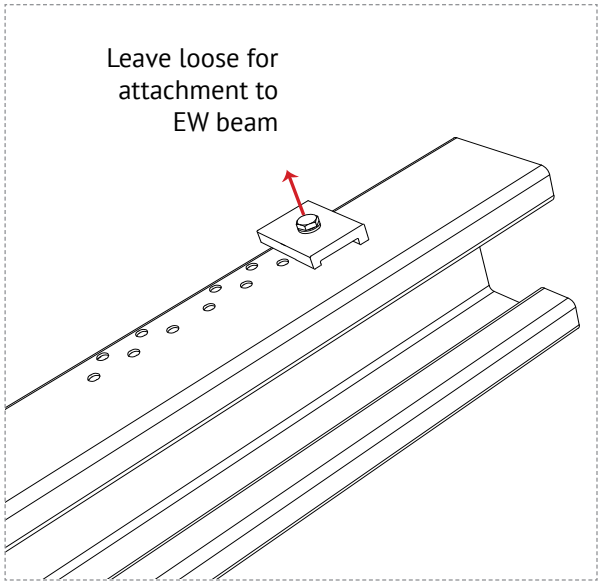
3. Mark holes to be used for attaching E-W beams prior to installing.

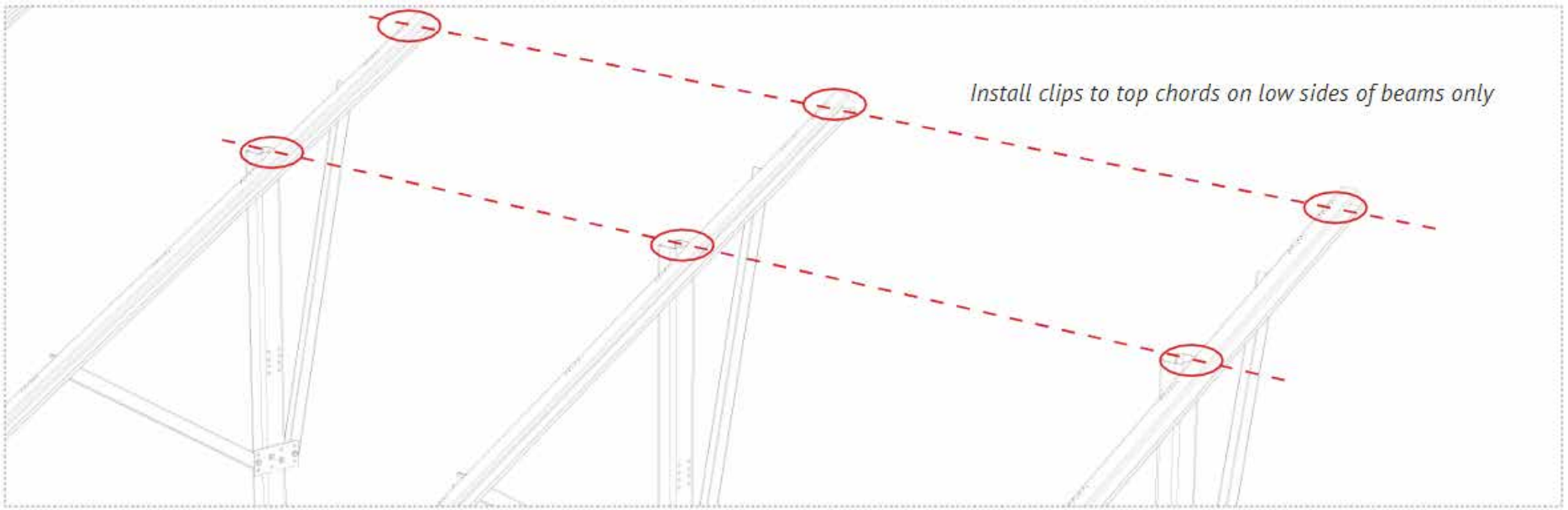


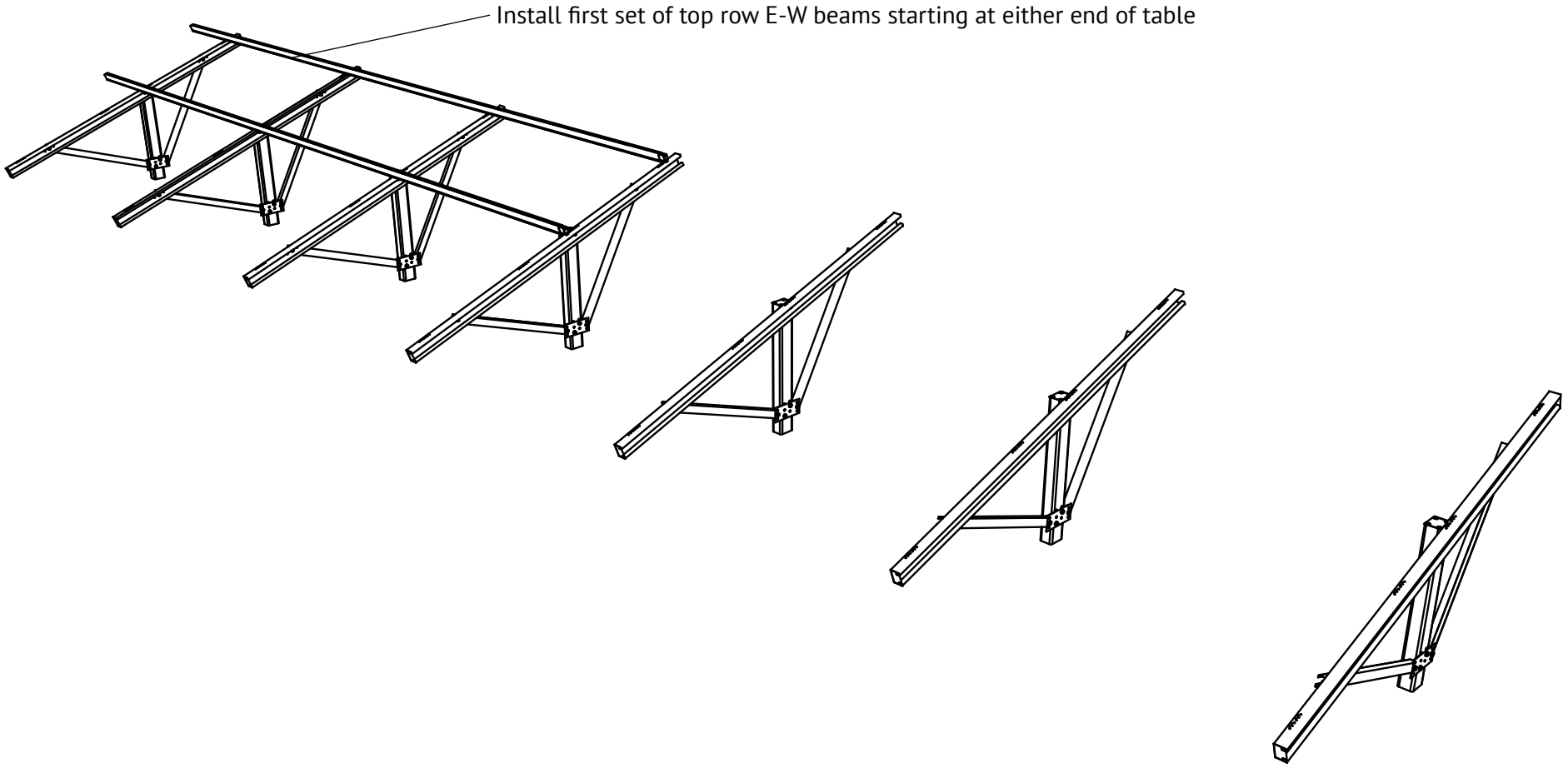
Anti-Seize

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood: 1. Apply minimal lubricant to bolts only where indicated in installation process, preferably Anti-Seize commonly found at auto parts stores (Anti-seize has been factory applied to mid clamp bolts) 2. Shade hardware prior to installation, and 3. Avoid spinning stainless nuts onto bolts at high speed.

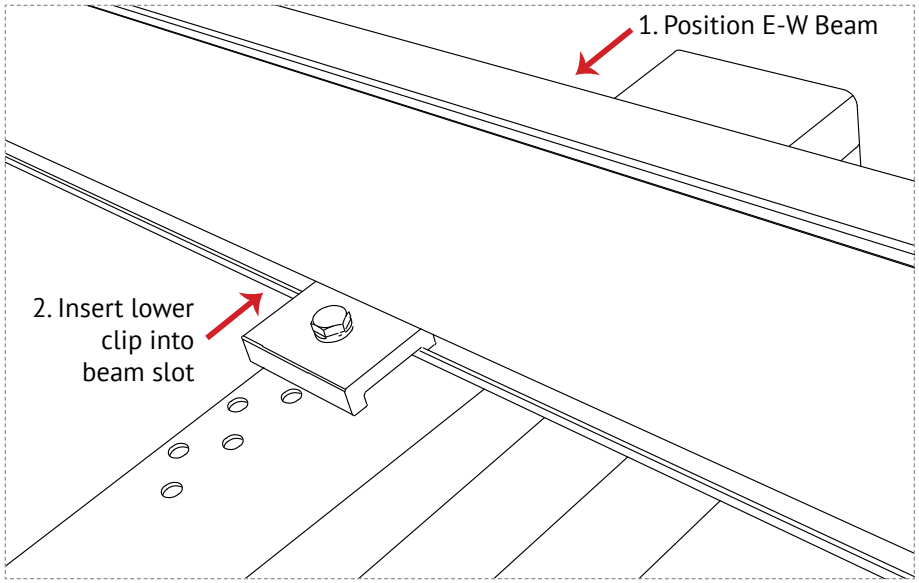


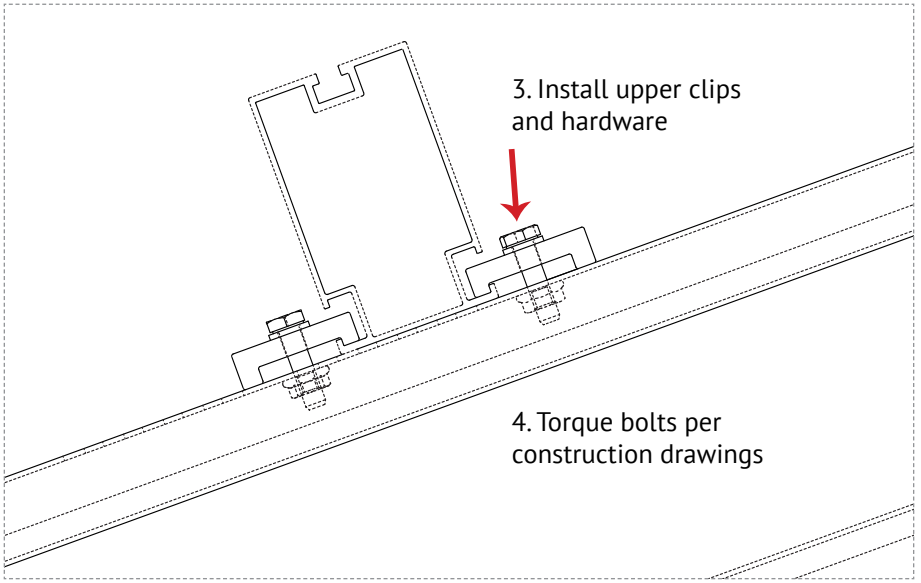


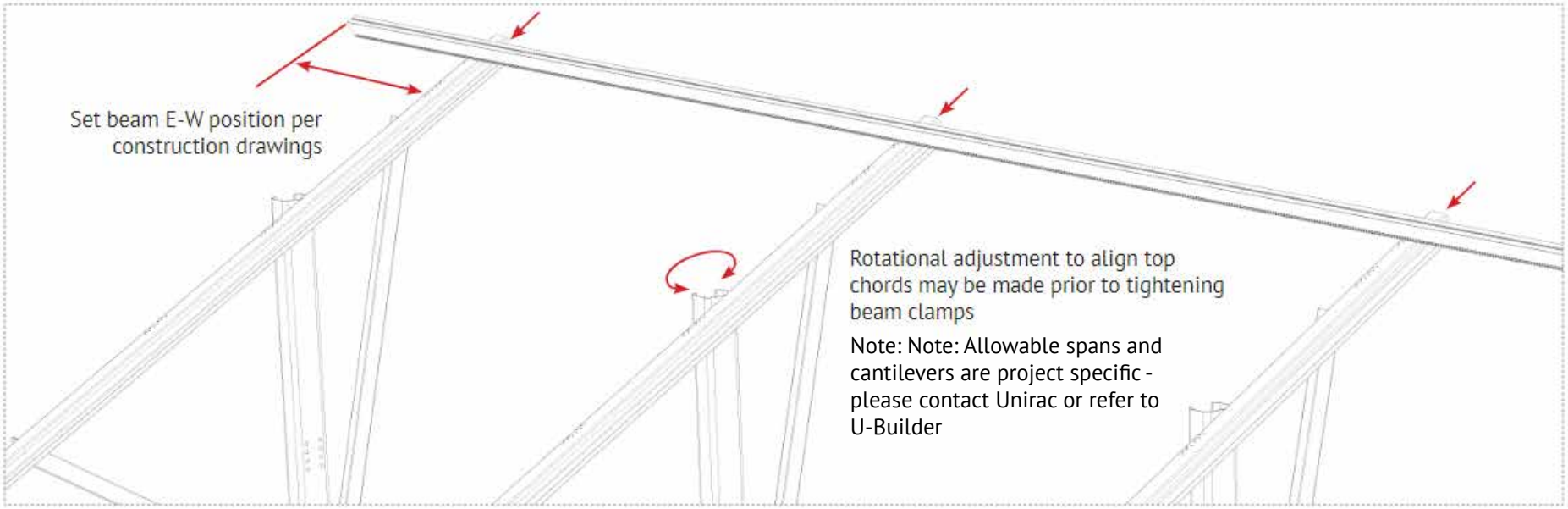


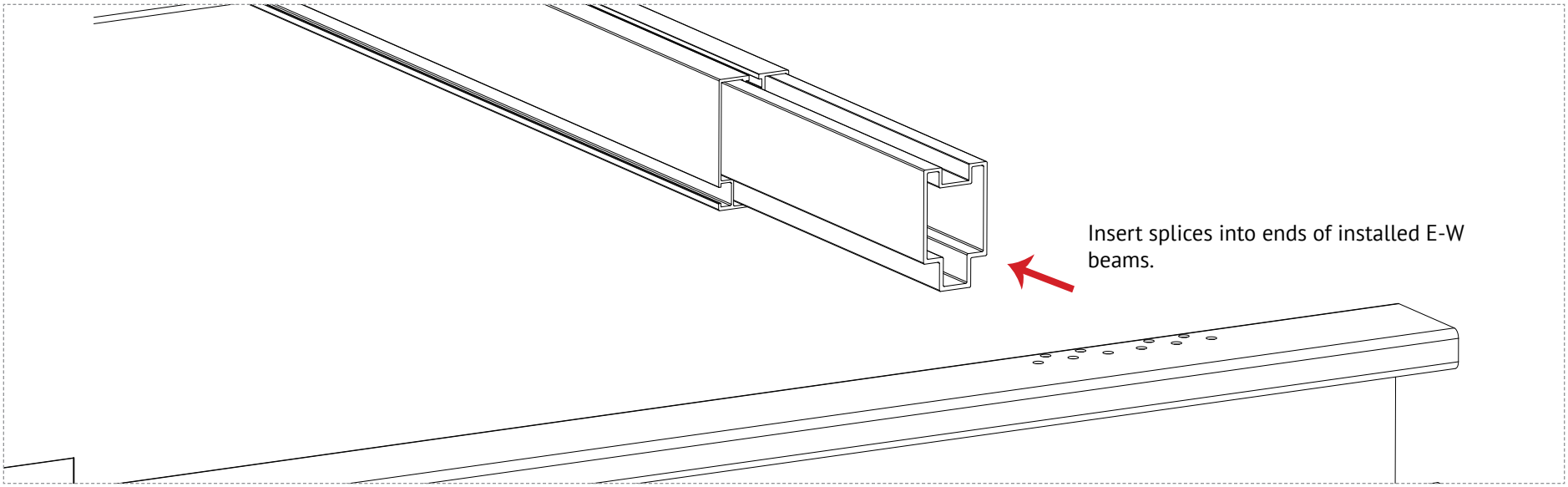

Install first set of top row E-W beams starting at either end of table

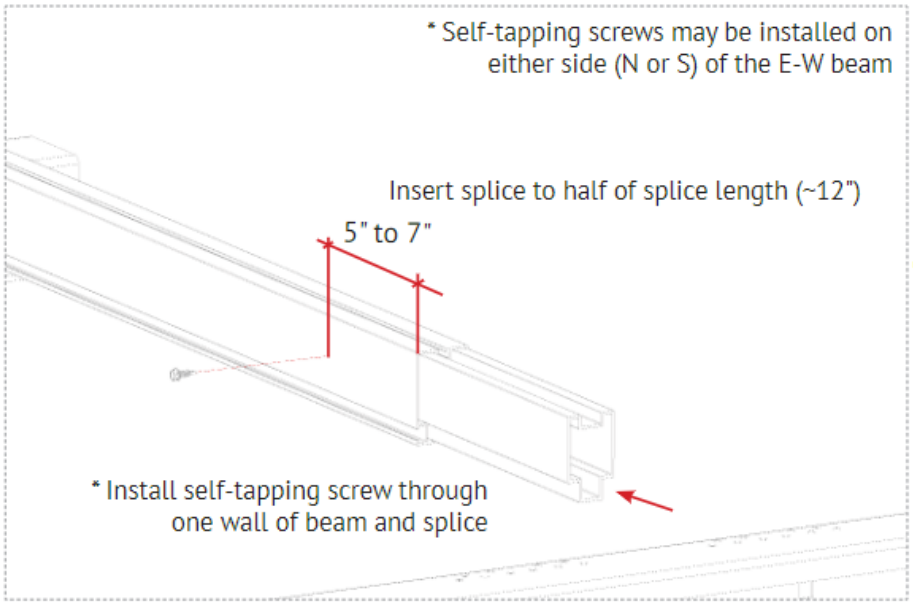
ATTACH E-W BEAMS TO TOP CHORDS

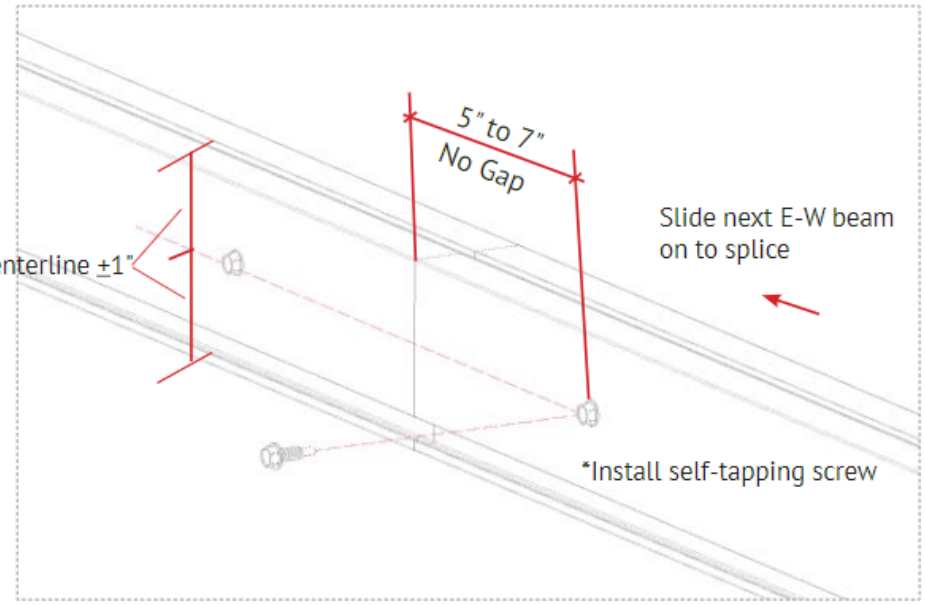


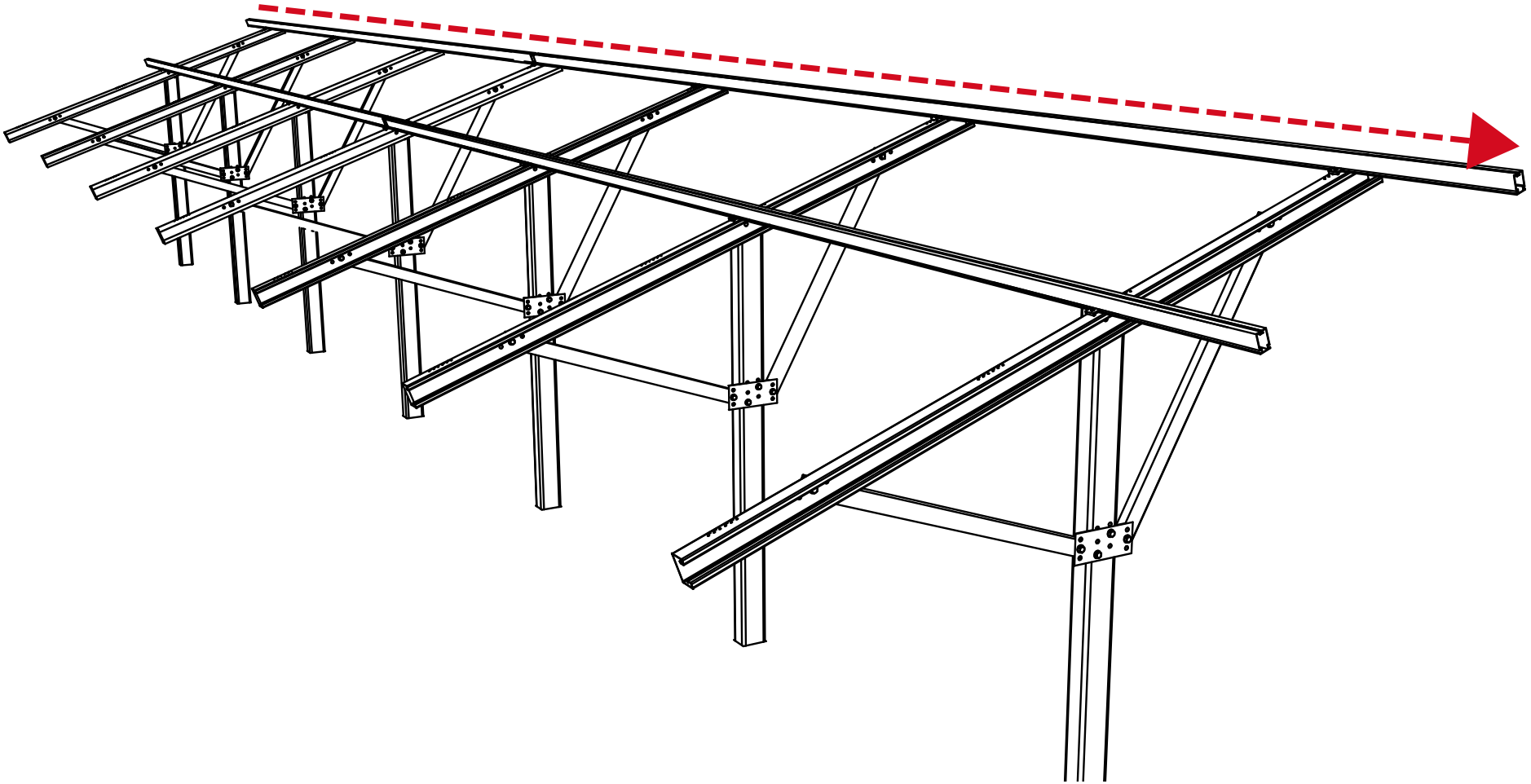




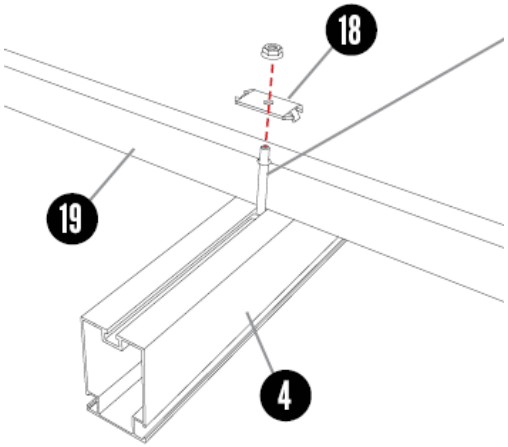

Insert splices into ends of installed E-W beams.


* Self-tapping screws may be installed on either side (N or S) of the E-W beam
Insert splice to half of splice length (~12")
5" to 7"
* Install self-tapping screw through one wall of beam and splice


5" to 7"
No Gap
Centerline ±1"
Slide next E-W beam on to splice
*Install self-tapping screw

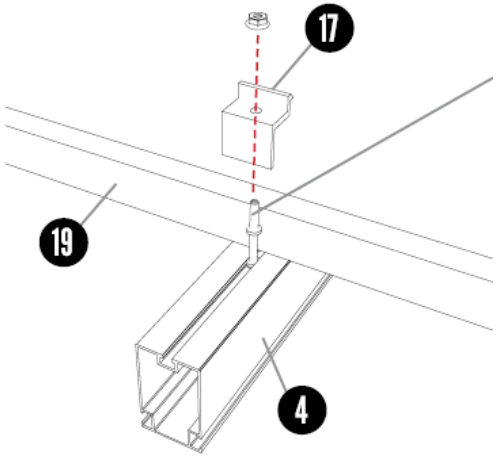


Mid Clamp Assembly with T-Bolt



M301XX: T-BOLT 1/4-20 OR
M302XX: T-BOLT SERR. 1/4-20
ARE ACCEPTABLE

End Clamp Assembly with T-Bolt



M301XX: T-BOLT 1/4-20 OR
M302XX: T-BOLT SERR. 1/4-20

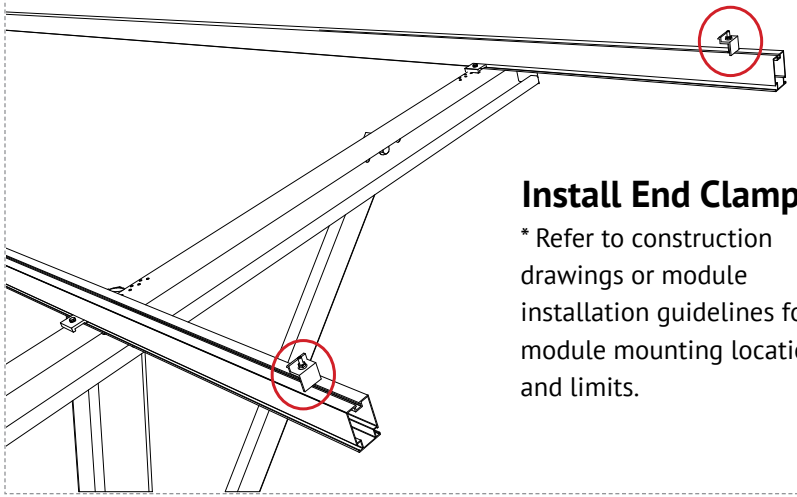
Mid Clamp Assembly With T-Bolt

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
18	Mid Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

End Clamp Assembly With T-Bolt

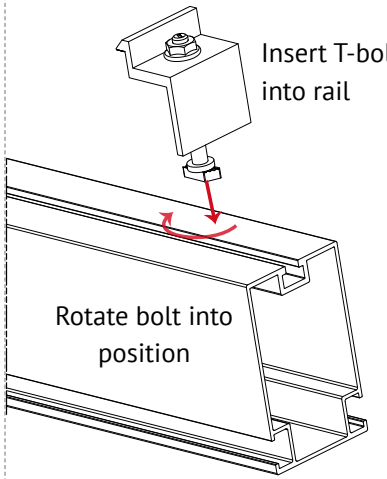
ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
17	End Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

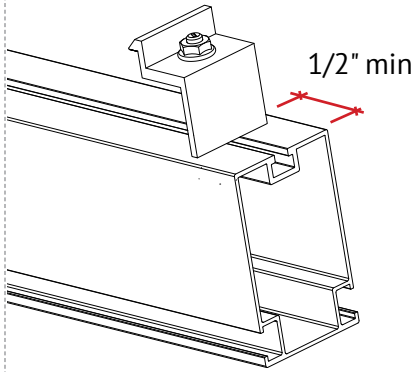
INSTALL MODULE W/STANDARD CLAMPS

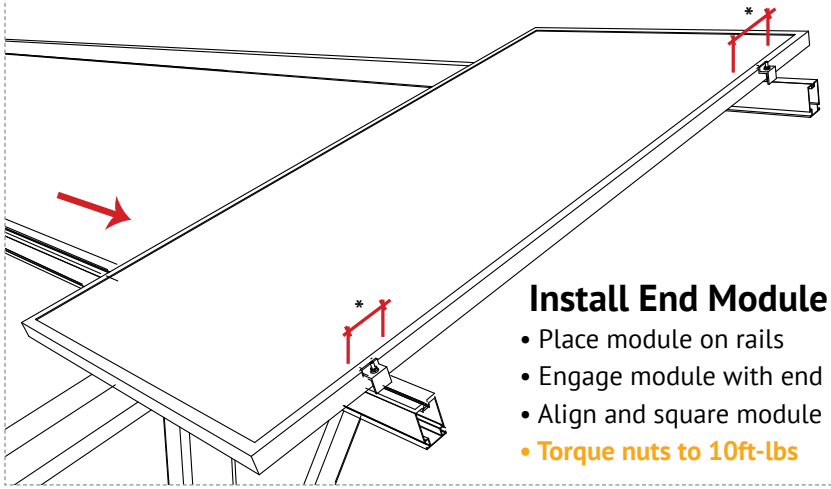


Install End Clamps

* Refer to construction drawings or module installation guidelines for module mounting locations and limits.



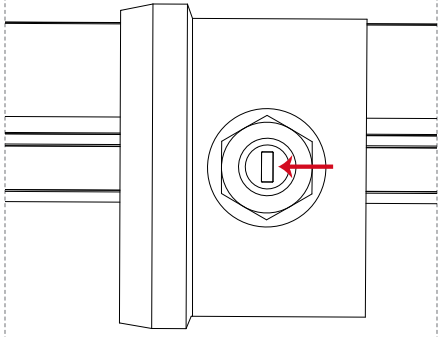




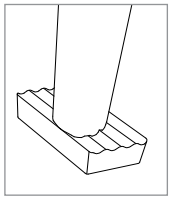
Install End Module

- Place module on rails
- Engage module with end clamps
- Align and square module
- **Torque nuts to 10ft-lbs**

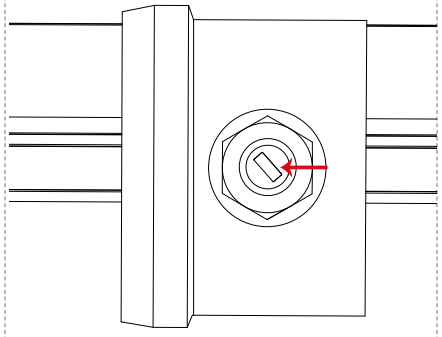
Serrated T- Bolts



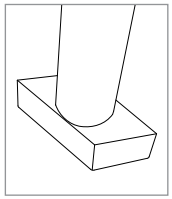
Verify that bolt position indicator is perpendicular to E-W beam



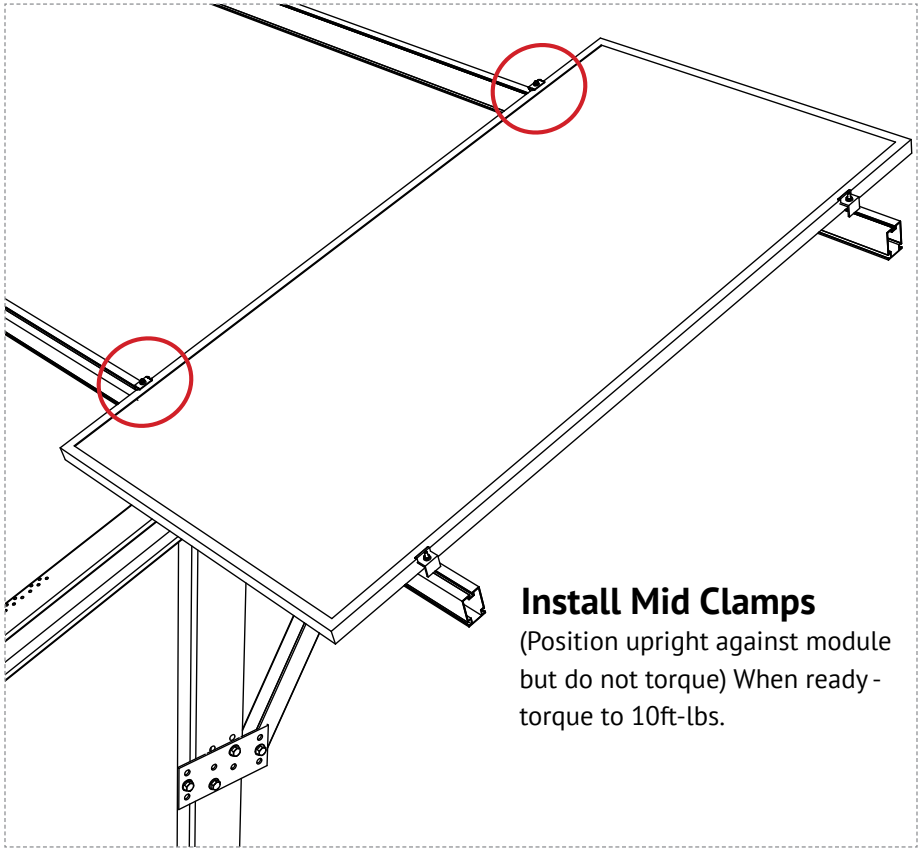
Non-Serrated T- Bolts



Verify that bolt position indicator is as shown

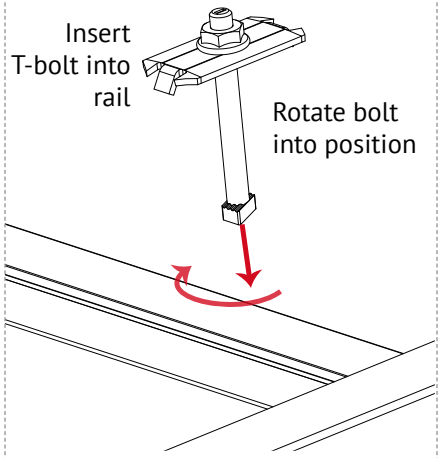


NOTE: *See appendix for different clamp configurations.

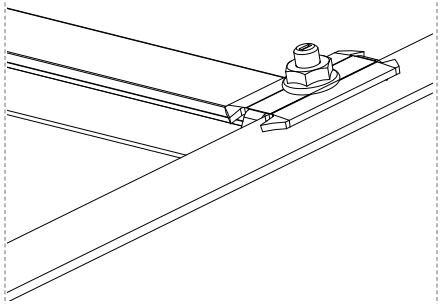


Install Mid Clamps
(Position upright against module but do not torque) When ready - torque to 10ft-lbs.

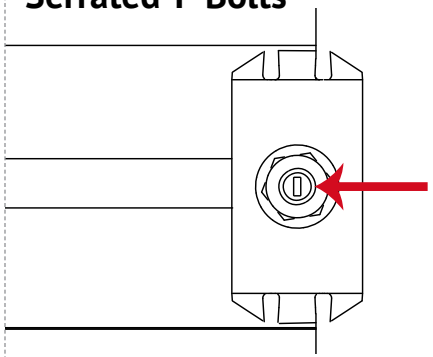
NOTE: *See appendix for different clamp configurations.



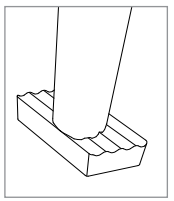
Position clamp on module.
Do not tighten nut until next module is in place.



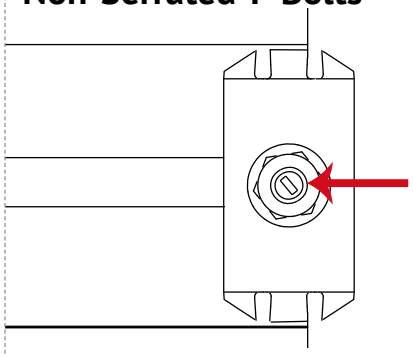
Serrated T- Bolts



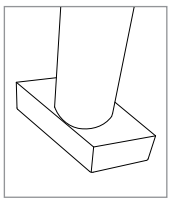
Verify that bolt position indicator is perpendicular to E-W beam

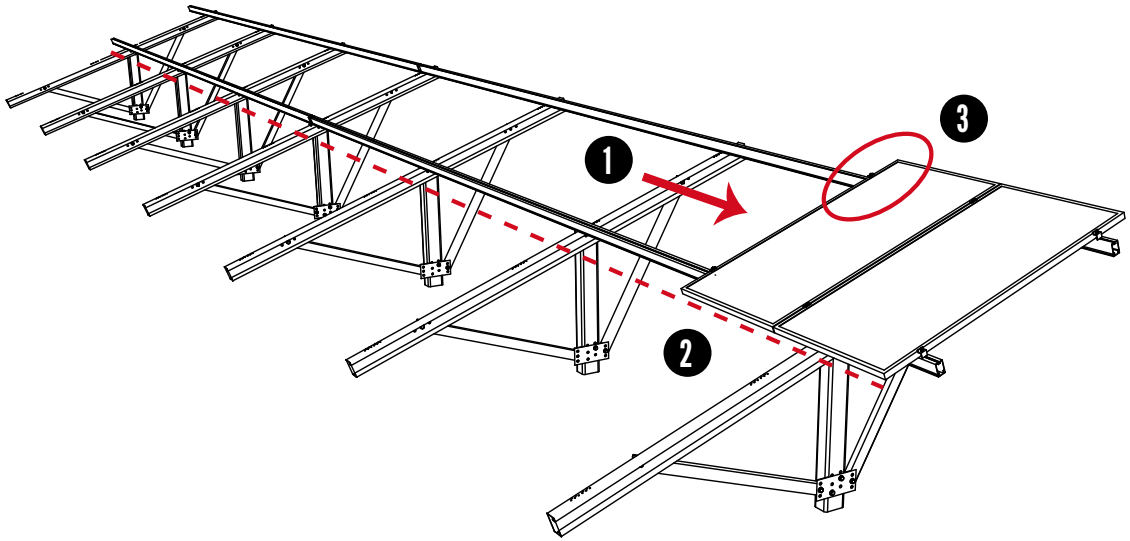


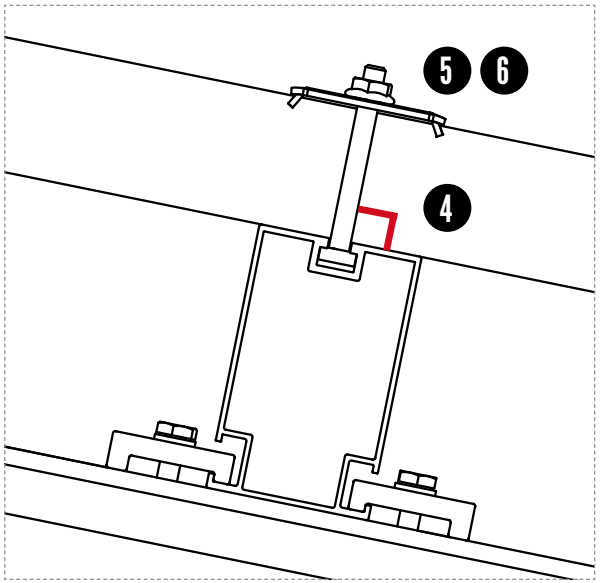
Non-Serrated T- Bolts

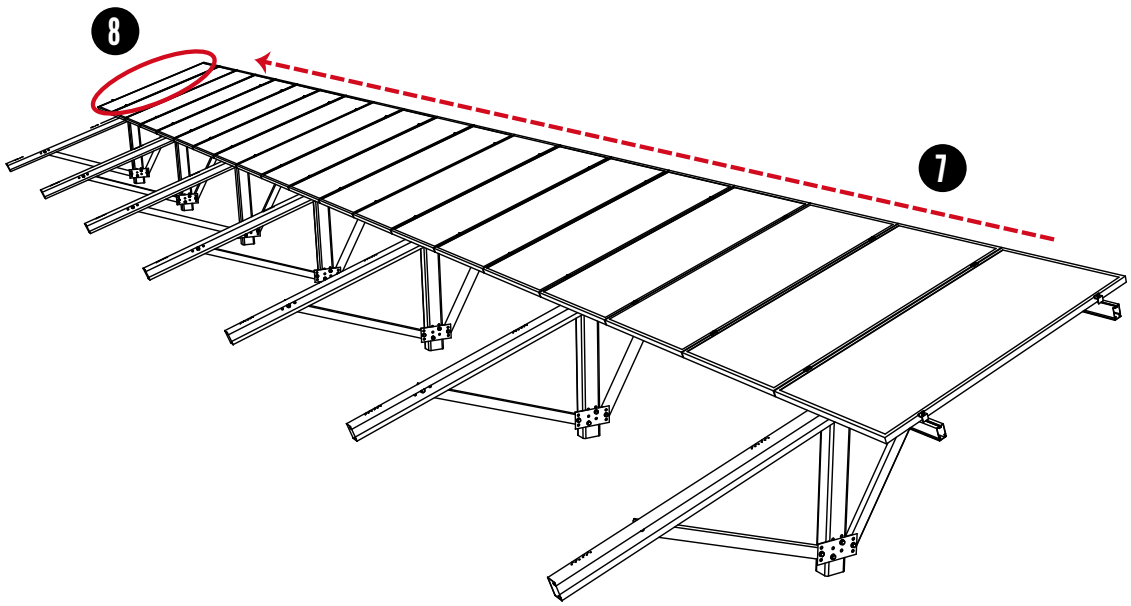


Verify that bolt position indicator is as shown



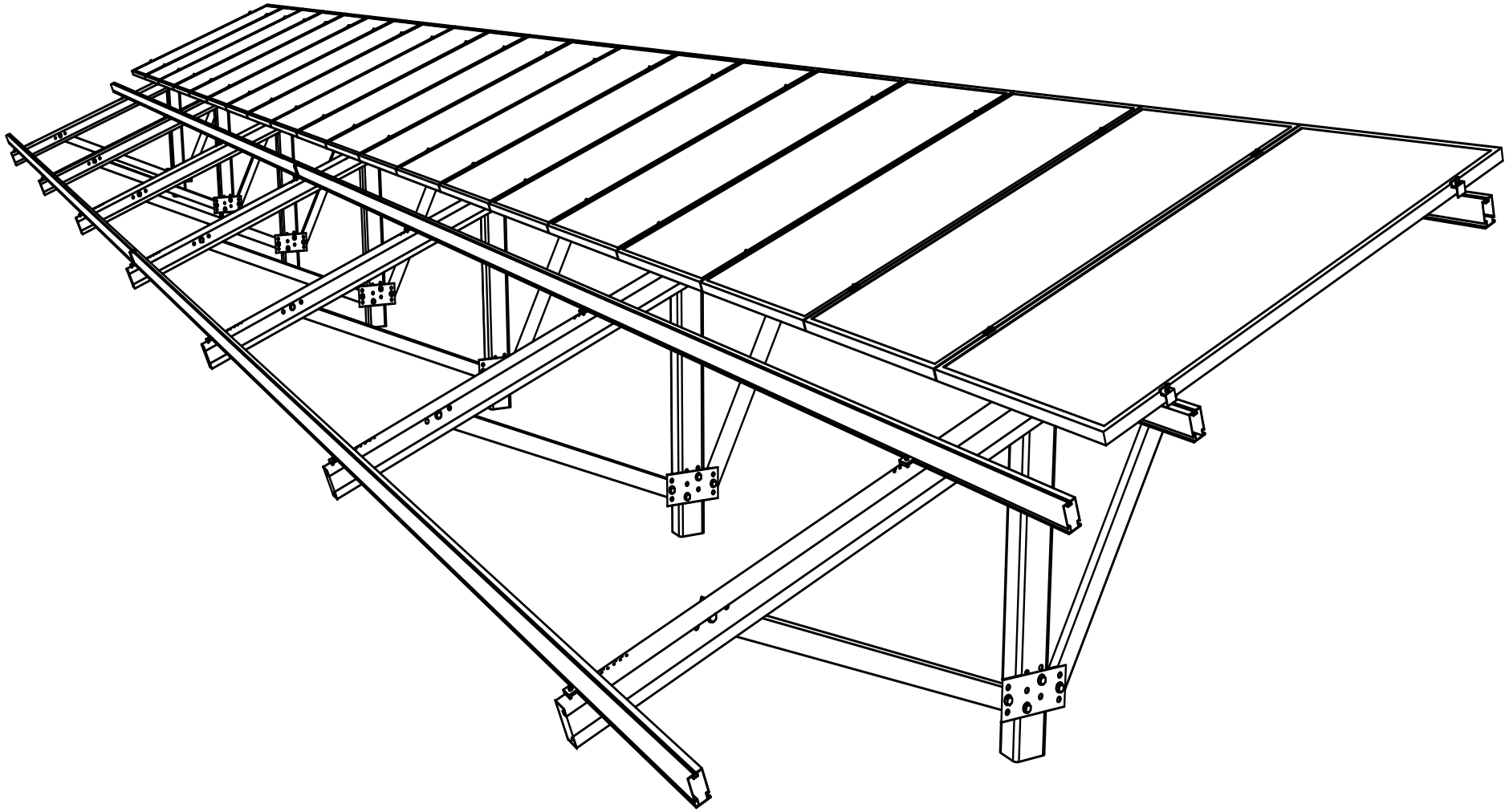


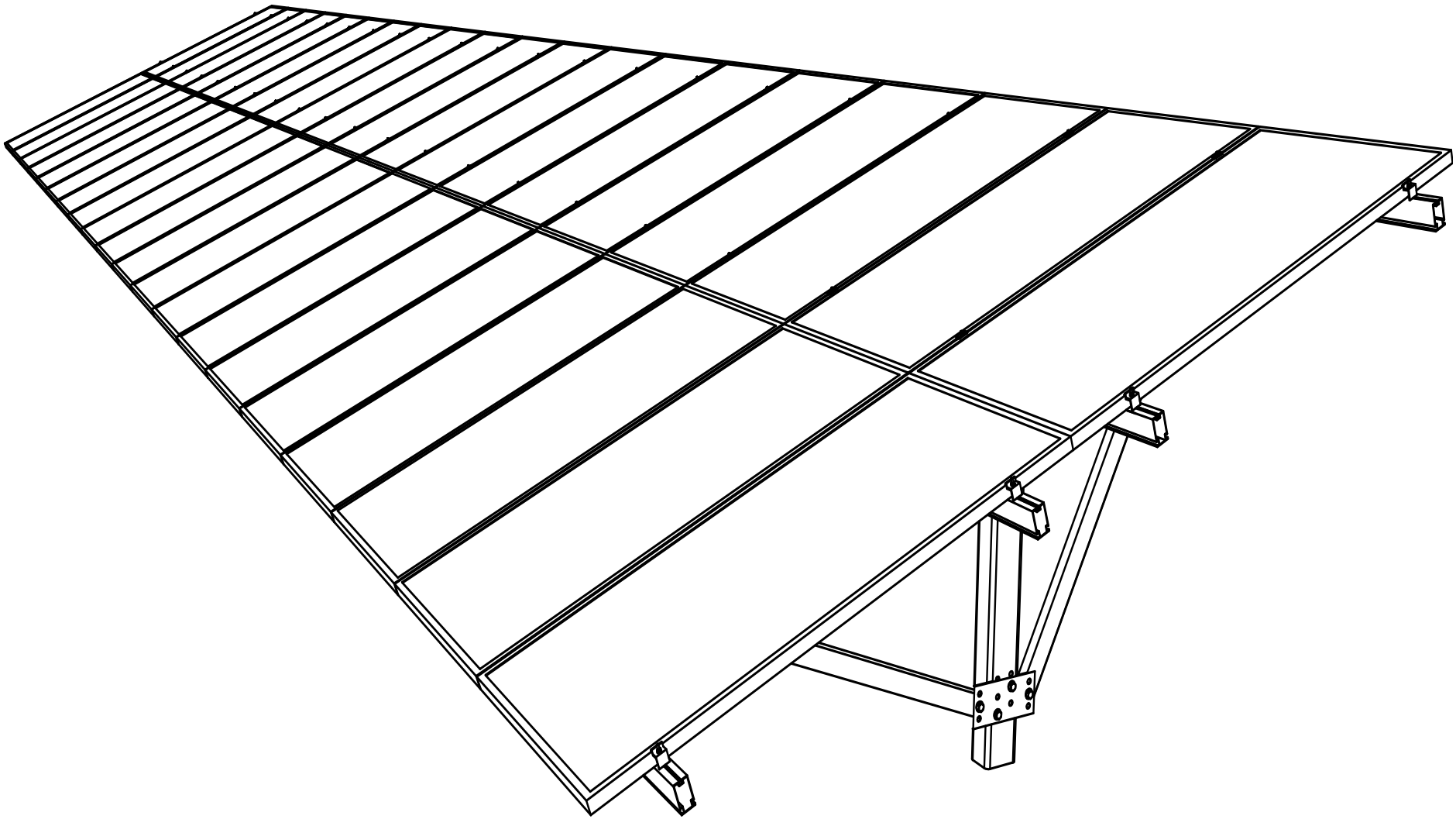


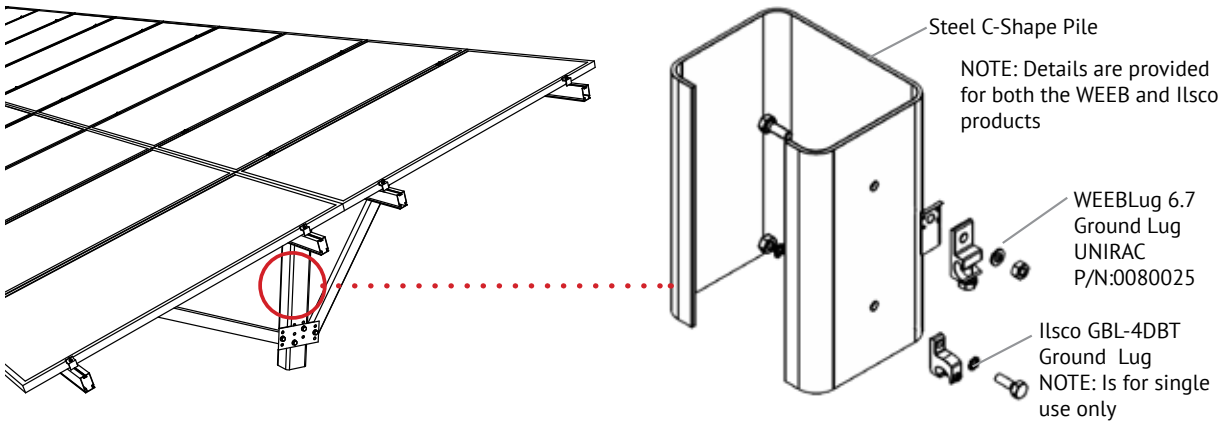


1. Place module on rails and engage with Mid Clamps
2. Align and square modules
3. Verify module gap (1/4")
4. Verify Mid Clamp bolt shafts are perpendicular to rail
5. Verify position of indicator mark on bolt
6. **Torque nuts to 10 ft-lbs**
7. Repeat installation of clamps and modules to complete top row
8. Install End Clamps on last module

NOTE: The GFT system must be periodically re-inspected for loose components, loose fasteners and any corrosion, such that if found, the aff ected compo-nents are to be immediately replaced.







The following grounding & bonding components have been certified to be compatible with Unirac GFT:

- Wiley WEEBLug (P/N 0080025) Torque 1/4" mounting hardware to 10ft-lbs. See product data sheet for conductor size and conductor fastener torque.
- Ilsco Lay-in Lug (P/N GBL-4DBT) Torque 10-32 mounting hardware to 5ft-lbs. See product data sheet for conductor size and conductor fastener torque.

Ground Lug	Bolt size	Drill size
WEEBLug	1/4"-20	17/64"
Ilsco	#10-32	7/31"

The entire Unirac GFT table has been classified for grounding & bonding to UL2703. The bonding path has been evaluated from the PV module frame all the way through to the pile. The following are suggestions to aid in grounding The entire Unirac GFT table has been classifi ed for grounding & bonding to UL2703. The bonding path has been evaluated from the PV module frame all the way through to the pile. The following are suggestions to aid in grounding of the table for the project electrical engineer of record, and by the local authority having jurisdiction.This racking system may be used to ground and/or mount a PV module complying with UL1703 only when the specifi c module has been evaluated for grounding and/or mounting in compliance with the included instructions.

GROUND LUG MOUNTING DETAILS

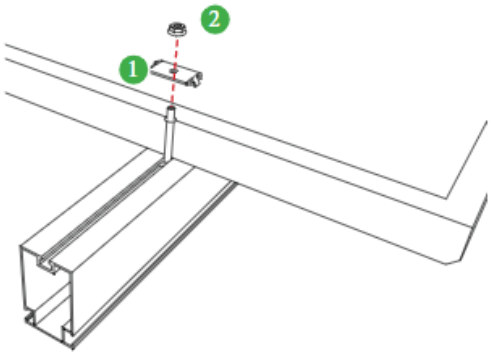
Details are provided for both the WEEB and Ilsco products. The WEEBLug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. One lug is recommended per GFT table. Installation must be in accordance with NFPA NEC70, however the electrical designer of record should refer to the latest revision of National Electrical Code (NEC) for actual grounding conductor cable size. Unirac GFT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. A minimum 10AWG, 105°C copper grounding conductor should be used to ground the system according to the (NEC) and the authority having jurisdiction. It is the installers responsibility to check local codes, which may vary. NOTE: Any holes drilled to attach the ground lugs should be de-burred before use. **NOTE: All Unirac module clamps and the Ilsco GBL-4DBT ground lug are single use. All other GFT components are multiple use.**

TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding mid-clamp will be properly grounded. If a module adjacent to the end of a row is removed, or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as follows:

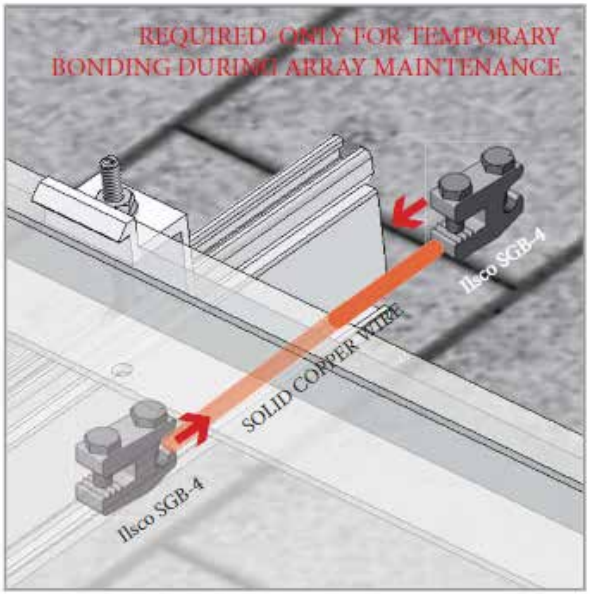
• Attach Ilsco GBL-4DBT or WeebLug 6.7 to both modules on either side of the module that has been removed. Note: The lug should be attached to the manufacturers designated grounding point on the frame.

• Install a solid #6 Awg copper wire to both grounding lugs. **NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION.**



BONDING MIDCLAMP ASSEMBLY

1. Stainless steel Midclamp points, 2 per module, pierce module frame anodization to bond module to GFT rail through clamp.
2. Serrated flange nut bonds stainless steel clamp to stainless steel T-bolt



TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of GFT rail(Rail shown in picture is not a GFT rail but a representative rail for demonstration only)
- Attach Ilsco SGB4 to module frame
- Install solid #6 AWG copper wire jumper to Ilsco lugs

NOTE: All Unirac mid clamps and the UAF end clamp shown in this install guide are bonding clamps

ELECTRICAL CONSIDERATIONS

GFT is intended to be used with PV modules that have a system voltage less than or equal to 1000 VDC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to National Electric Code (NEC). according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

INTERCONNECTION INFORMATION

There is no size limit on how many GFT & PV modules can be mechanically interconnected for any given confi guration, provided that the installation meets the requirements of applicable building and fi re codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

Mid clamps do not need to be repositioned for re-use.

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
Aptos Solar	DNA-120-MF10 DNA-120-(MF/BF)23 DNA-144-(MF/BF)23 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26
Astronergy	CHSM6612 M, M/HV CHSM6612P Series CHSM6612P/HV Series CHSM72M-HC CHSM72M(DG)/F-BH
Auxin	AXN6M610T AXN6P610T AXN6M612T AXN6P612T
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxP/156-60S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB)
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P) CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS3W-(MS/P/P-PB-AG)

Manufacture	Module Model / Series
Canadian Solar (cont.)	CS5A-M CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6U-(M/P/P HE) CS6X-P CSX-P ELPS CS6(A/P)-MM
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04
Eco Solargy	Orion 1000 & Apollo 1000
ET Solar	ET AC Module, ET Module
First Solar	FS-6XXX(A) FS-6XXX(A)-P, FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series
Hanwha SolarOne	HSL 60
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 144HC M6
HT Solar	HT72-156(M/P) HT72-156P-C, HT72-156P(V)-C HT72-156M(PDV)-BF, HT72-156M(PD)-BF

Manufacture	Module Model / Series
HT Solar (cont.)	HT60-156M-C HT60-156M(V)-C
Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiS-S400PI
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAM72D30 xxx/MB, JAM78D10 xxx/MB JAP6 60-xxx JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAP72S##-xxx/** JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology
Jinko	JKM & JKMS Series JKMxxxM-72HL-V JKMxxxM-72HL4-(T)V JKMxxxM-7RL3-V
Kyocera	KD-F & KU Series
LA Solar	LSxxxHC(166)
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxxN2W-B3

The modules selected for UL 2703 bonding and grounding testing represent the broadest possible range of modules on the market. The tests were performed for each specific bonding location using representative module frame profile sections. The tests performed cover the following basic module parameters:

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
LG Electronics (cont.)	LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(M1C/N1C/Q1C/Q1K)-N5 LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5 LGxxxN3K-V6
LONGi	LR4-60(HPB/HPH) LR4-72(HBD/HPH) LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HBD/HV/PB/PE/PH) RealBlack LR4-60HPB RealBlack LR6-60HPB
Meyer Burger	Meyer Burger Black, Meyer Burger White
Mission Solar Energy	MSE Mono, MSE Perc
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M Series
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04, EVPVxxx EVPVxxx(H/K/PK)

Manufacture	Module Model / Series
Peimar	SGxxxM (FB/BF) SMxxxM
Phono Solar	PSxxxM1-20/U PSxxxM1H-20/U PSxxxM1-20UH PSxxxM1H-20UH PSxxxM1-20/UH PSxxxM1H-20/UH PSxxxM-24/T PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series
Q.Cells	Plus, Pro, Peak, G3, G4, Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+) Plus, Pro, Peak L-G2, L-G4, L-G5 Peak L-G5, L-G6, L-G7, L-G8(BFF) Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G7 Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G8.3 BFG/BGT Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G9.3 BFG Q.PEAK DUO G10+ Q.PEAK DUO BLK G10(+)

Manufacture	Module Model / Series
Q.Cells (cont.)	Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-G11.3/BFG
REC	RECxxxAA (BLK/Pure) RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Renesola	All 60-cell modules
Risen	RSM Series
S-Energy	SN72 & SN60 Series
SEG Solar	SEG-xxx-BMD-HV
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11) SRP-(6QA/6QB) SRP-xxx-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-450-BMA-HV, SRP-xxx-BMZ-HV, SRP-390-405-BMD-HV
Sharp	NU-SA & NU-SC Series

The modules selected for UL 2703 bonding and grounding testing represent the broadest possible range of modules on the market. The tests were performed for each specific bonding location using representative module frame profile sections. The tests performed cover the following basic module parameters:

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID

Electrical Bonding and Grounding Test Modules

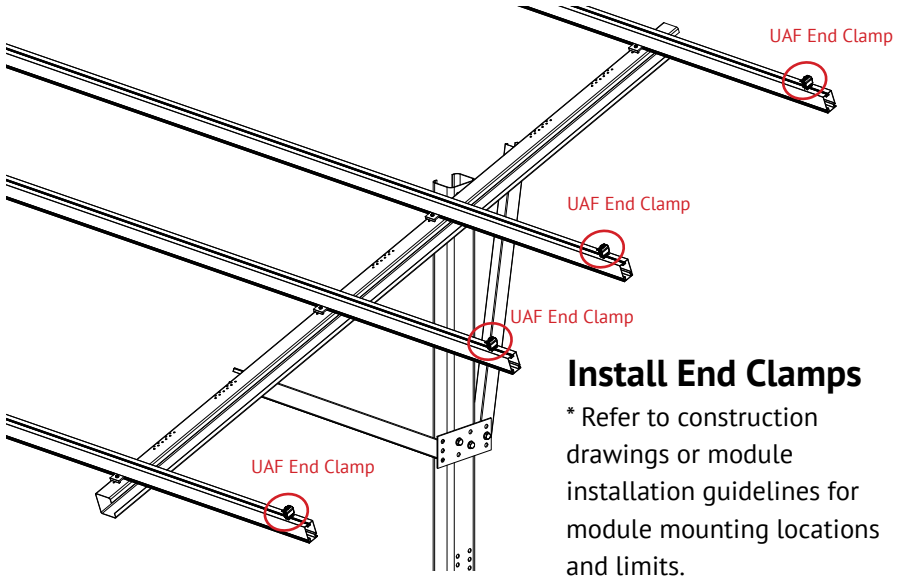
The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SILxxx(BL/NL/NT/HL/ML/BK/NX/NU/HC)
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC)
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Suniva	MV Series & Optimus Series (35mm)
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC
Suntech	STP, STPXXXS - B60/Wnhb
Sun Edison	F-Series, R-Series
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart
Tesla	SC, SC B, SC B1, SC B2, TxxxS, TxxxH
Trina	PA05, PD05, DD05, DD06, DE06, DE09.05 PD14, PE14, DD14, DE14, DE15, DE15V(II) DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20
TSMC	TS-150C2 CIGSw
Upsolar	UP-MxxxP, UP-MxxxM(-B)

Manufacture	Module Model / Series
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB), FBKxxxM8G
Vikram	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05
Vina	VNS-72M1-5-xxxW-1.5 VNS-72M3-5-xxxW-1.5 VNS-144M1-5-xxxW-1.5 VNS-144M3-5-xxxW-1.5 VNS-120M3-5-xxxW-1.0
VSUN	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN4xx-144BMH
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
ZNShine Solar	ZXM6-72 Series ZXM6-NH144 ZXM6-NHLDD144

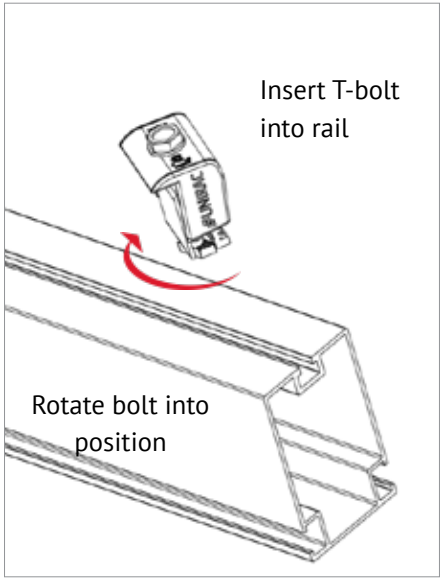
The modules selected for UL 2703 bonding and grounding testing represent the broadest possible range of modules on the market. The tests were performed for each specific bonding location using representative module frame profile sections. The tests performed cover the following basic module parameters:

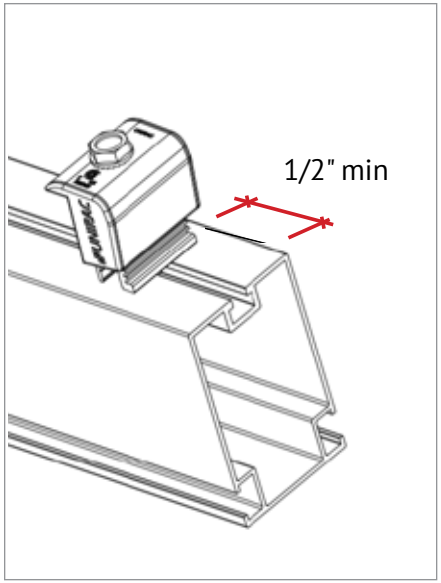
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID

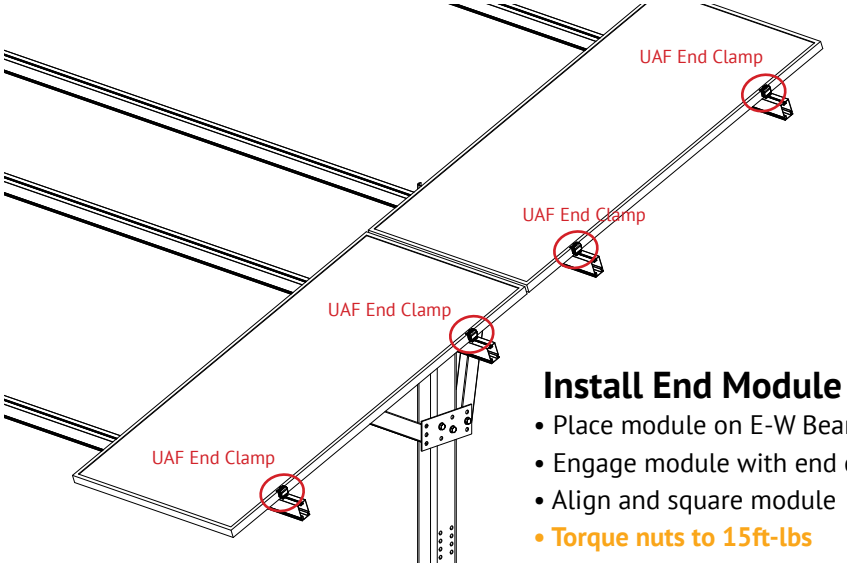


Install End Clamps

* Refer to construction drawings or module installation guidelines for module mounting locations and limits.



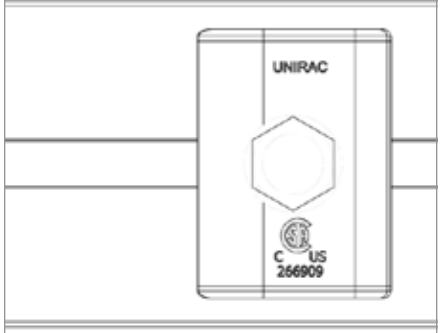




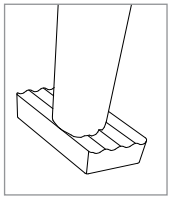
Install End Module

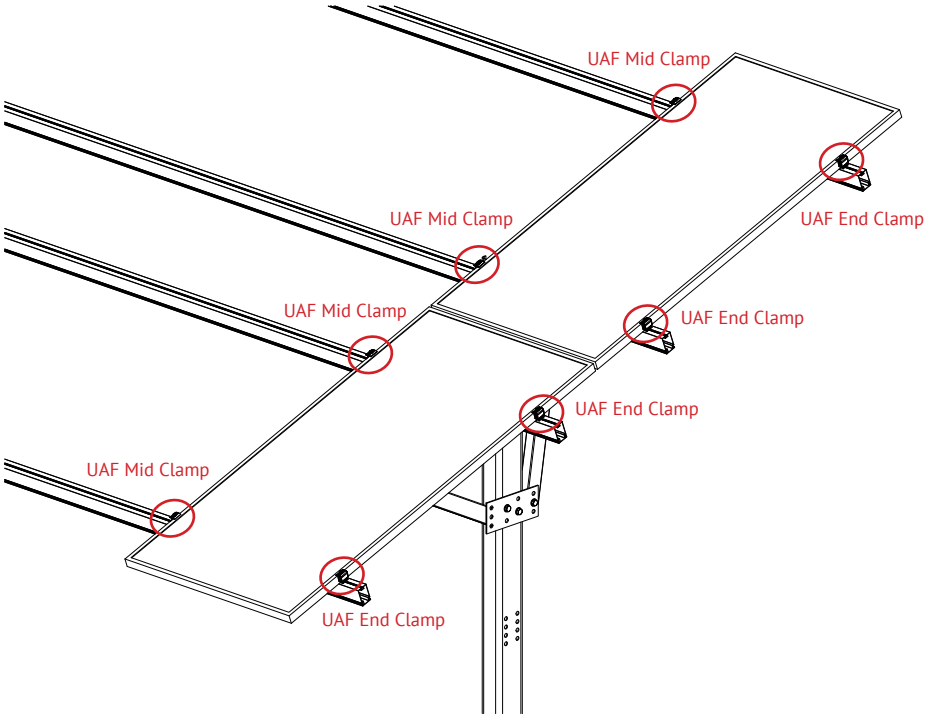
- Place module on E-W Beams
- Engage module with end clamps
- Align and square module
- **Torque nuts to 15ft-lbs**

Serrated T- Bolts



Verify that bolt position indicator is perpendicular to E-W beam

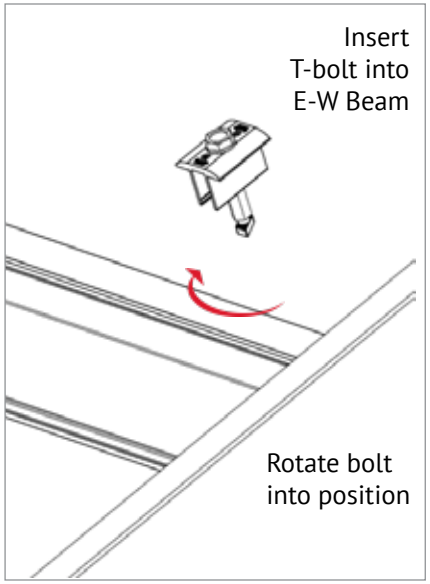


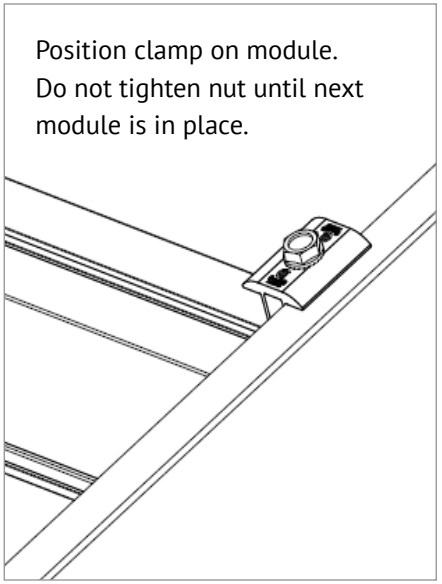


Install Mid Clamps

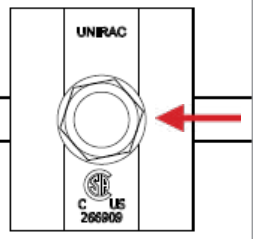
(Position upright against module but do not torque.) When ready - **torque to 15ft-lbs.**

NOTE: Please refer to the GFT Shared rail install manual when using a shared rail.

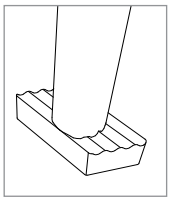




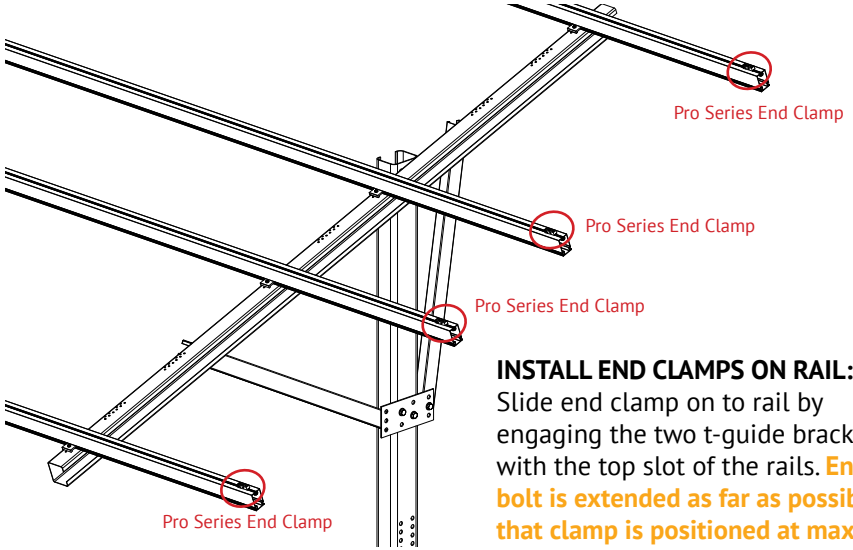
Serrated T- Bolts



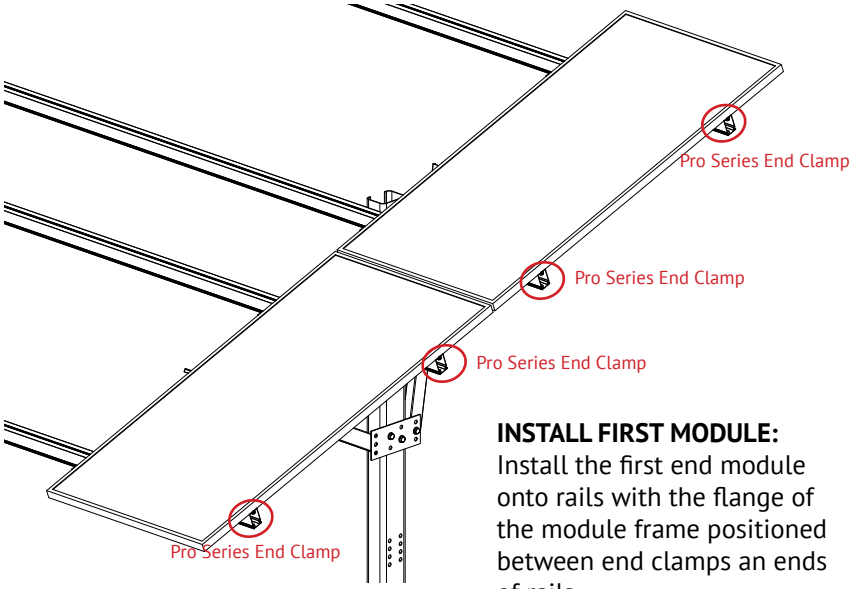
Verify that bolt position indicator is perpendicular to E-W beam



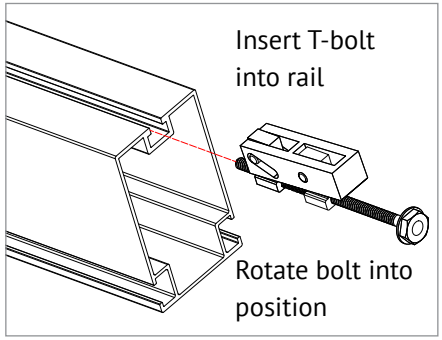
PRO SERIES CLAMPS INSTALL MODULE W/PRO SERIES CLAMPS



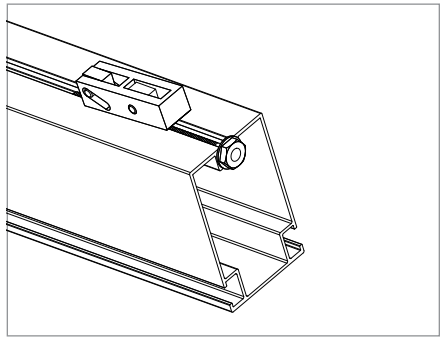
INSTALL END CLAMPS ON RAIL:
Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**



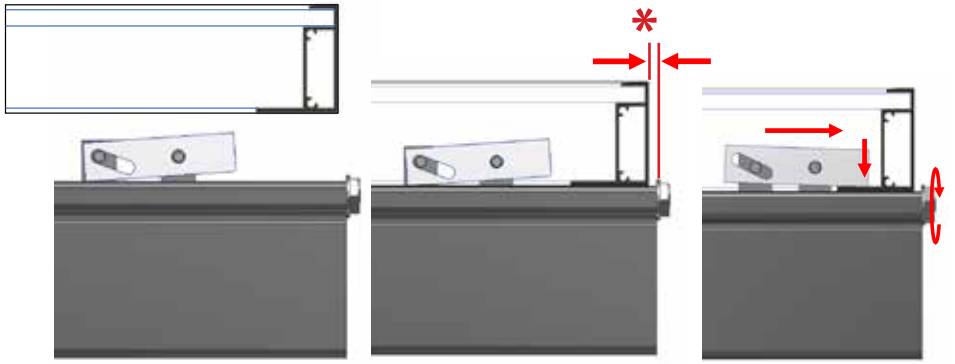
INSTALL FIRST MODULE:
Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.



POSITION END CLAMPS:
Slide end clamp assembly on to rail until bolt head engages with end of rail. **End clamps are positioned on rails prior to the first end module and prior to the last end module.**

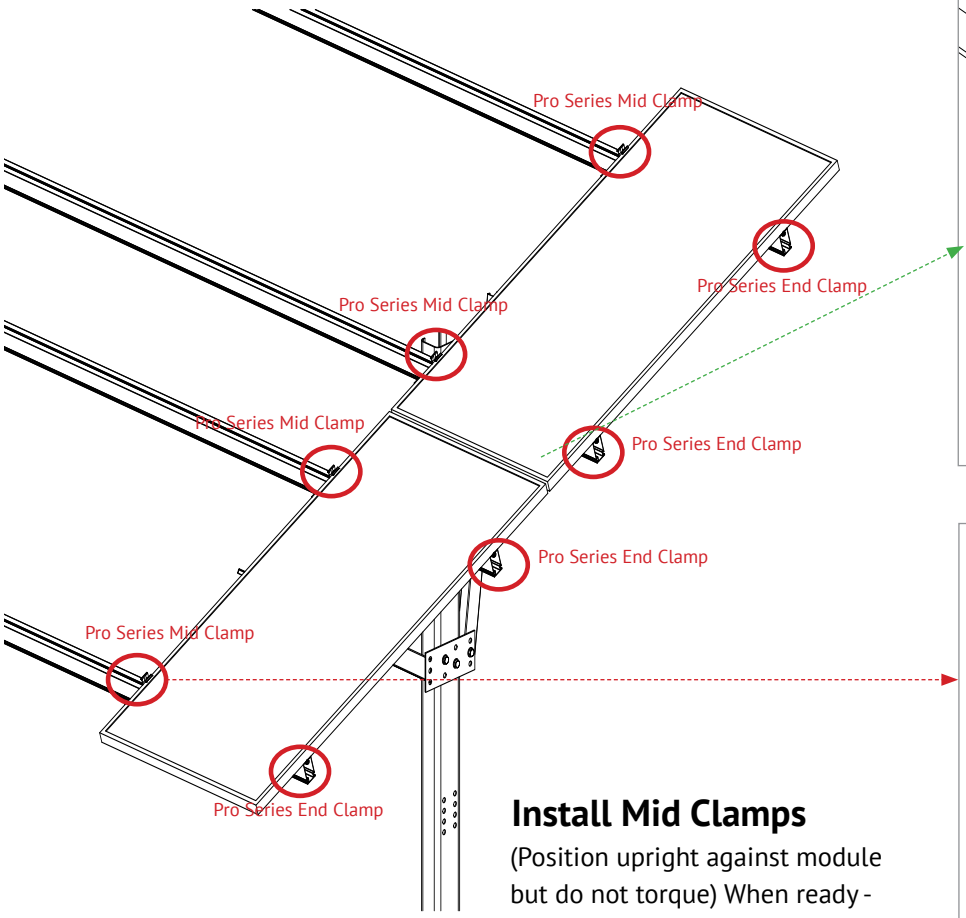


NOTE:
To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.



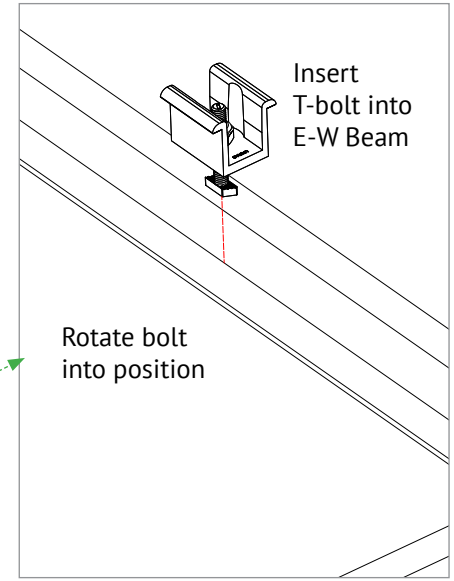
ENGAGE CLAMP:
While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force. **To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.** TORQUE VALUE (See table and notes on PG. 1) End clamp bolt to **5 ft-lbs**, No anti-seize

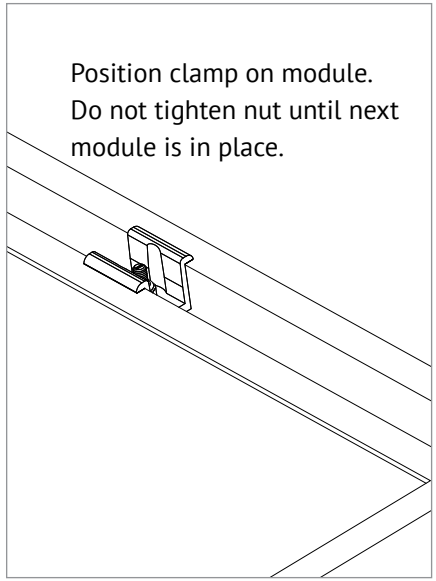
* Position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.

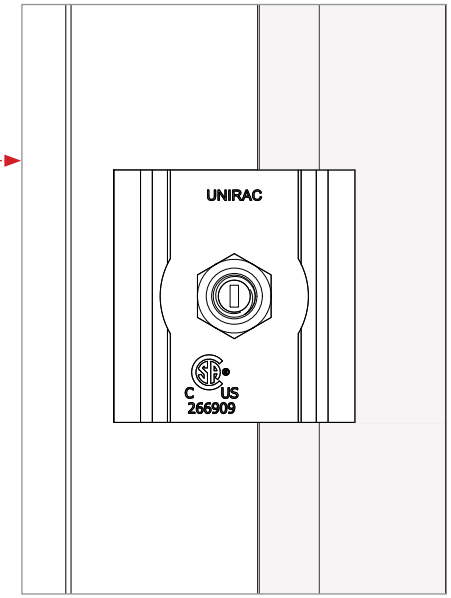


Install Mid Clamps

(Position upright against module but do not torque) When ready - **torque to 11ft-lbs.**







Verify that bolt position indicator is perpendicular to E-W beam once nut is torqued