READYRACK™
GEOBALLAST FOUNDATION

APA SOLAR RACKING

INSTALLATION MANUAL

Updated: February 2023

TABLE OF CONTENTS

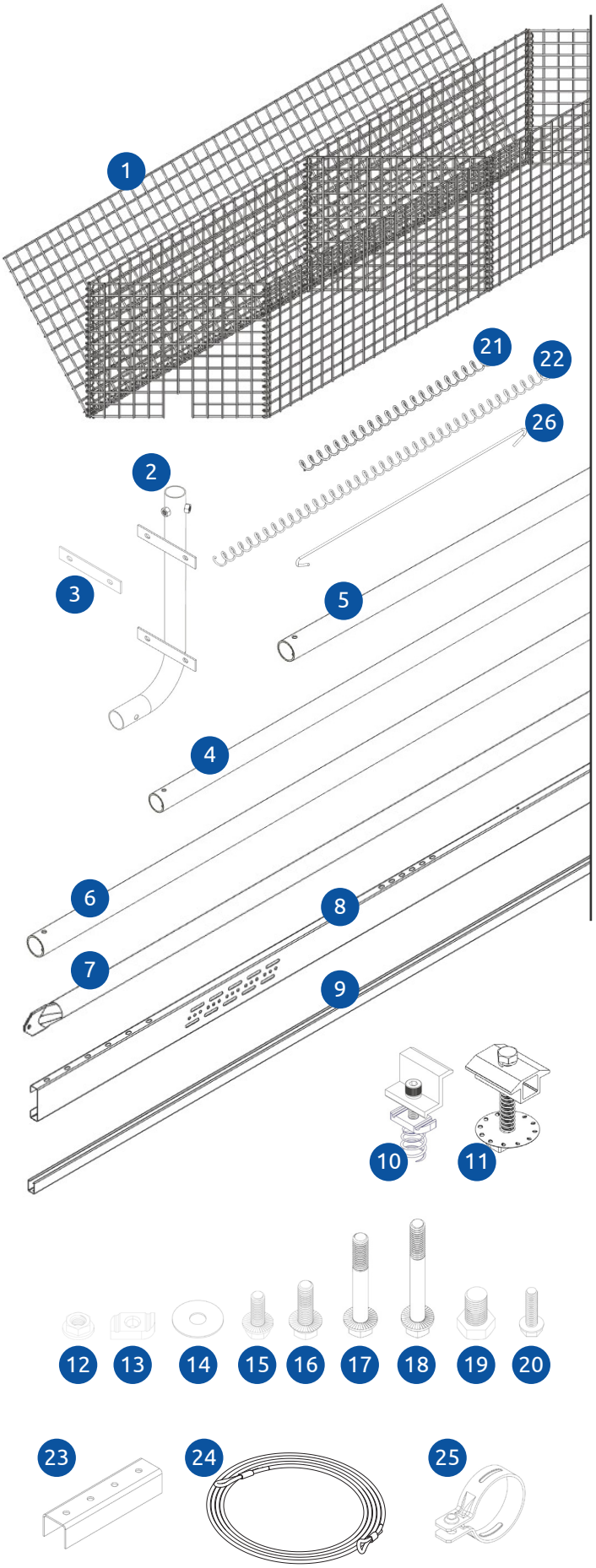
PARTS LIST

STRUCTURAL MEMBERS

[1] WIRE BASKET ASSEMBLY
FOLDED WIRE BASKET
SHORT SPIRAL RING [21]
LONG SPIRAL RING [22]
[2] ELBOW TUBE
[3] ELBOW CLAMP PLATE
[4] BASE TUBE
[5] FRONT (SOUTH) POST
[6] REAR (NORTH) POST
[7] CROSS BRACE TUBE
[8] N/S CHORD
[9] E/W STRUT PURLIN

HARDWARE

[10] END CLAMP ASSEMBLY
[11] MID CLAMP ASSEMBLY
[12] 3/8-16 SERRATED FLANGE NUT
[13] 3/8-16 CHANNEL NUT
[14] 3/8 FENDER WASHER
[15] 3/8-16X1.00” SERRATED FLANGE BOLT
[16] 3/8-16X1.25” SERRATED FLANGE BOLT
[17] 3/8-16X2.75” SERRATED FLANGE BOLT
[18] 3/8-16X3.00" SERRATED FLANGE BOLT
[19] M16-2.0X25 HEX SET BOLT
[20] TUBE CLAMP BOLT
[21] SHORT SPIRAL RING
[22] LONG SPIRAL RING
[23] STRUT SPLICE
[24] CABLE BRACING
[25] TUBE CLAMP
[26] BASKET STABILIZER



CONSTRUCTION 101

All structures, regardless of how complex, are built one step at a time. Each new step builds on the previous. In order for the final structure to be complete, it is best to ensure that each step is done correctly. It is far easier, faster, and cheaper to take your time to ensure each step is done correctly before moving on. There is no remedy for an error other than a correction. Time and effort will be put forth eventually to redo steps, reconstruct, and make adjustments, but far less effort is required to correct mistakes as they appear. If errors are fixed immediately, each subsequent step will begin correct and projects will run more efficiently.

It is recommended to completely install a test row from beginning-to-end of the row, and from beginning-to-end of all steps (from layout, to panel installation, and adjustments). This will help you understand not only how to install the product, but understand how tolerances stack up, how mistakes in one step cause errors in other steps, and how to make the adjustments required to keep everything in tolerance and looking good.

SITE PREPARATION

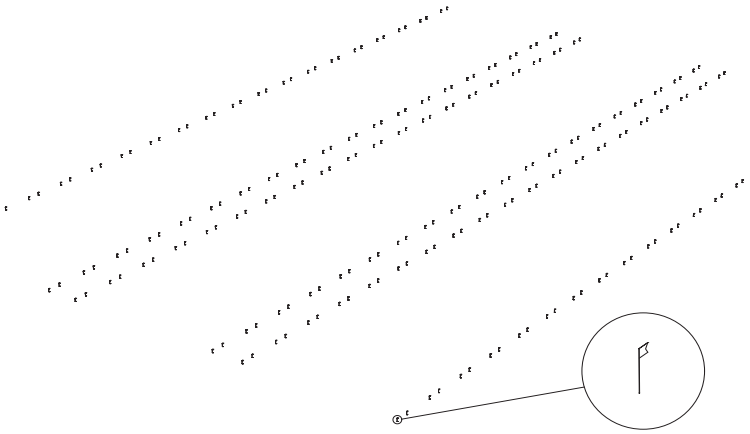
Site preparation should be conducted prior to construction. This will typically involve grubbing, rock and debris removal, and any other preparation that will facilitate swift and unhindered installation. For Geoballast systems, this means the preperation of level stone pads.

UTILITIES

All utilities should be marked before any construction begins.

SURVEYING

To ensure that the solar array is installed according to customer plans, the site should be surveyed according to the scope of work. This includes the North and South elbow tube locations for the Geoballast system. For projects with significant topography, survey points should be checked with a tape measure.



NOTE

Foundation locations should be surveyed by a professional surveyor, who can stake out row locations to the highest precision.

REVIEW & INSTALLATION PREPARATION

After site preparation has been completed and the site surveying is done, the foundations are ready to be installed. It is the responsibility of the site lead to review and understand the site foundation layout, surroundings, installation procedures, and to manage the installation to completion. Each project has different requirements.

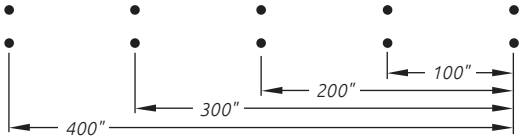
Dimensions in the East-West direction will change depending on row length, row location, and location within the row. Closely follow the construction plans and if there are any questions or discrepancies, bring them up to the site lead or project manager before installing any foundations.

UNEVEN GROUND

For sites with ungraded or rolling topography, it is important to ensure that the foundations are in the correct location. In cases where post locations can not be marked on the ground (uneven terrain), it is advised to check the survey points with a steel tape measure.

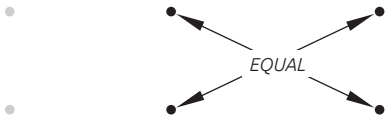
MEASURING

All measurements in the East-West direction must be made with a steel tape measure, and made from the start of the row, not foundation-to-foundation. For example, if the plans were to call for the first 4 spans to be 100” each, the tape should be staked to the ground, and the ground should be marked at 0”, 100”, 200”, 300”, 400”.



Measuring from foundation-to-foundation allows tolerances to stack up. In this case, a 2” tolerance would have stacked up to be 8” off by only the fifth foundation, and will cause major installation issues further down the road. If necessary, tape measures should be marked prior to use or prints should be marked up to indicate additive measurements (ie. 0”, 8’4”, 16’8”, 25’0”, 33’4”).

For Geoballast systems, the North and South points must remain in line with each other (one should not “chase” the other). Ensure the points are square every few sets by measuring diagonals. If marks are found to be out of square, make adjustments to correct.

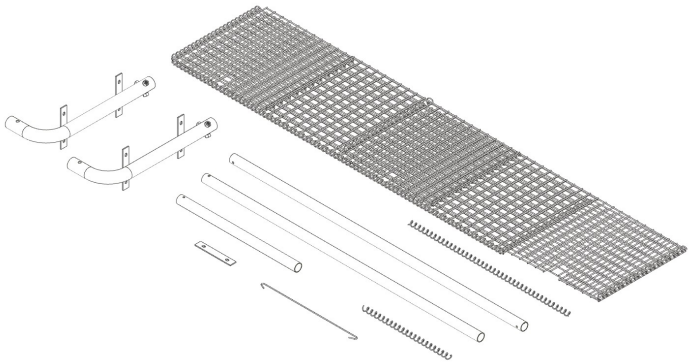


Measuring diagonals

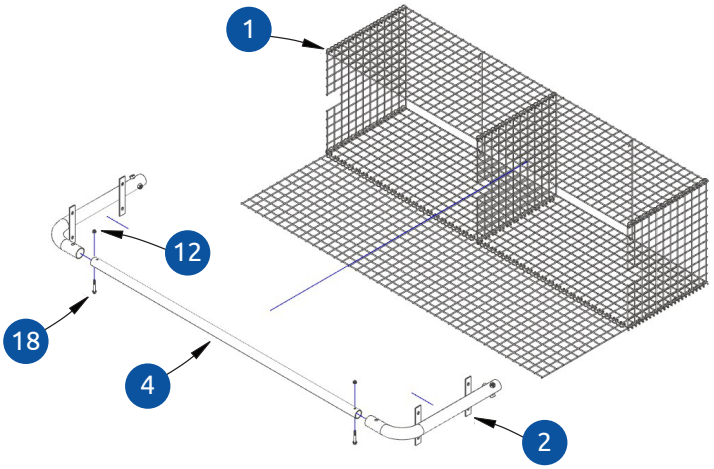
PRO TIP

BASKET ASSEMBLY

1. Unfold the semi-assembled wire basket assembly.



[1] WIRE BASKET ASSEMBLY
[2] ELBOW TUBE
[4] BASE TUBE
[12] 3/8-16 SERRATED FLANGE NUT
[16] 3/8-16X1.25" SERRATED FLANGE BOLT
[18] 3/8-16X3.00" SERRATED FLANGE BOLT
[21] SHORT SPIRAL RING
[22] LONG SPIRAL RING
[26] BASKET STABILIZER



2. Bolt the base tube to the elbow tubes.

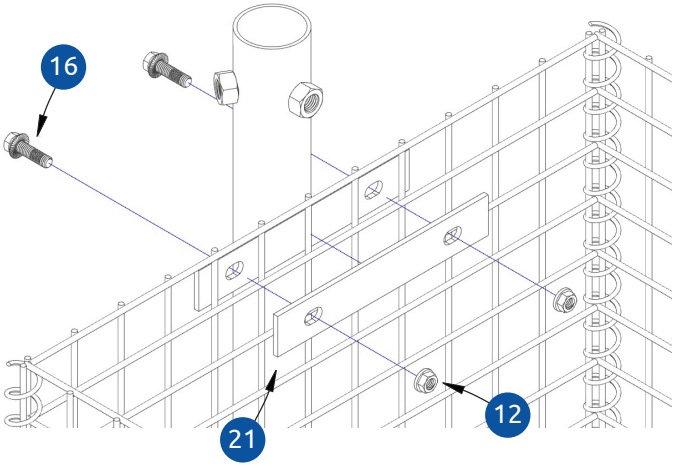
3. Place the wire basket assembly on its side and position the elbow and base tube assembly into the bottom of the wire basket assembly so that it is positioned within the cutouts of the mid and end panels of the basket.

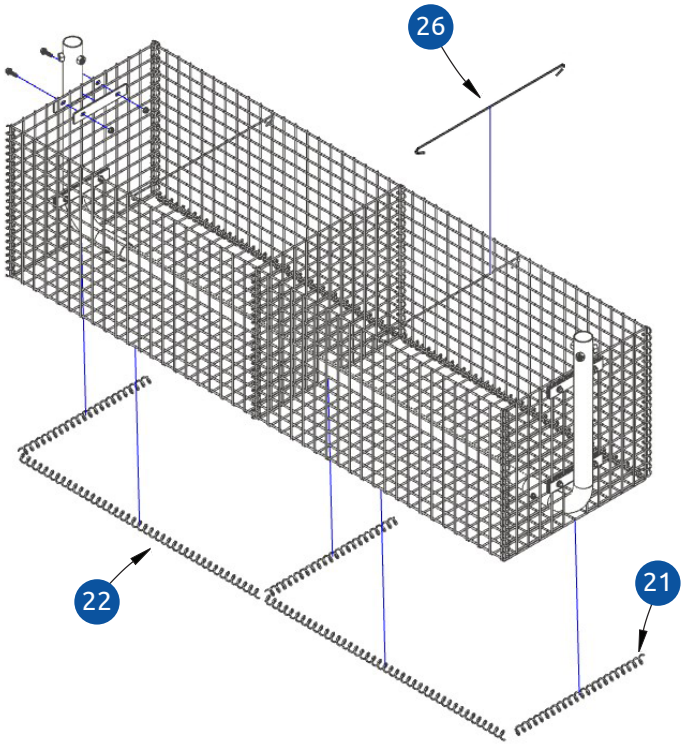
4. Fold the bottom panel of the basket back into place and insert the short spirals. Then proceed by inserting the long spirals.

5. Stand the assembly up and check elbow tube for plumbness.

6. Secure the elbow tubes to the basket assembly using the elbow clamp plate by placing it inside the basket and pinching the wire mesh of the basket between the two surfaces.

7. Install stabilizer to ensure basket integrity.



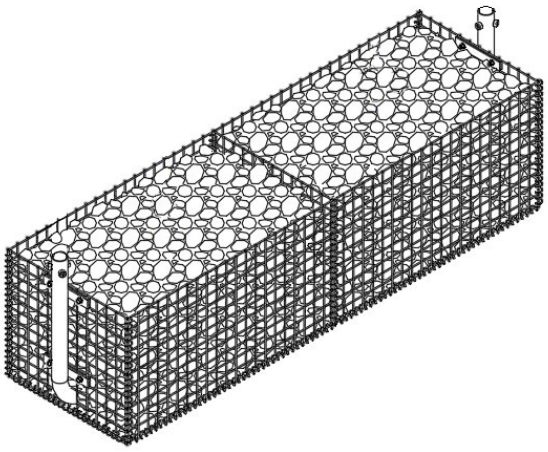


BALLAST STAGING & FILL WITH AGGREGATE

1. An equipment operator should carry the basket and tube assembly to each foundation location.

2. Positing the basket and tube assembly so that the North and South survey points align with the center of the elbow tube. Stage all ballast assemblies in the row.

3. Once the location has been confirmed, fill the ballast assemblies with aggregate as specified in the construction documents.



POST INSTALLATION

1. Insert the front (south) post at the first point on the south set of elbow tubes.

2. Measuring from the ground to the top of the post, ensure the post is at the correct height according to the construction plans. Also ensure the upper bolt holes are rotated to align in the East-West direction. Temporarily secure the post in place with a quick clamp or similar tool.

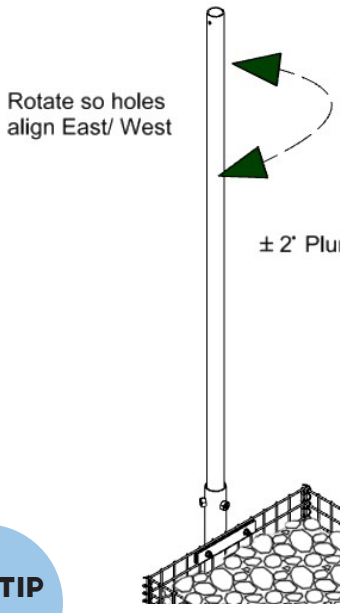
3. Repeat further down the front (south) side of the row with another foundation to create the next attachment point for the string line, once again measuring and ensuring plumbness. When topography is present, additional transition posts must be installed at transition points so that the string line can flow through hills and valleys at a moderate rate. Although the racking will follow terrain, it has limitations. Therefore, ensuring smooth flow will greatly aid the installation process.

4. Continue to the end of the row as required to set a string line.

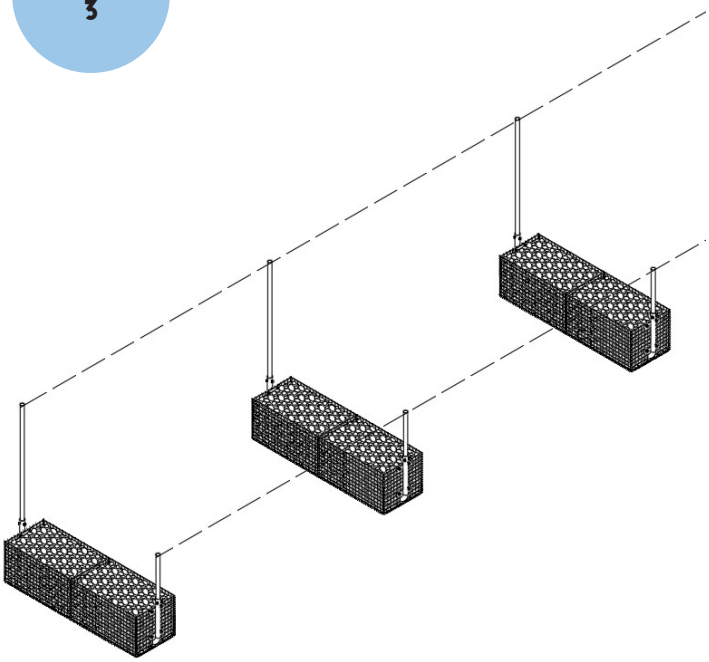
5. Run a string line between all foundations at the same height. For consistency, string line should run along the same side of the foundation for the entirety of the site. For example, always wrap counterclockwise, then install new posts on the south side of the string. This will help prevent zigzagging.

6. Ensure the heights of all posts are correct and flow with the terrain in the method indicated in the construction plans.

PRO TIP 2



PRO TIP 3



POST INSTALLATION (CONTINUED)

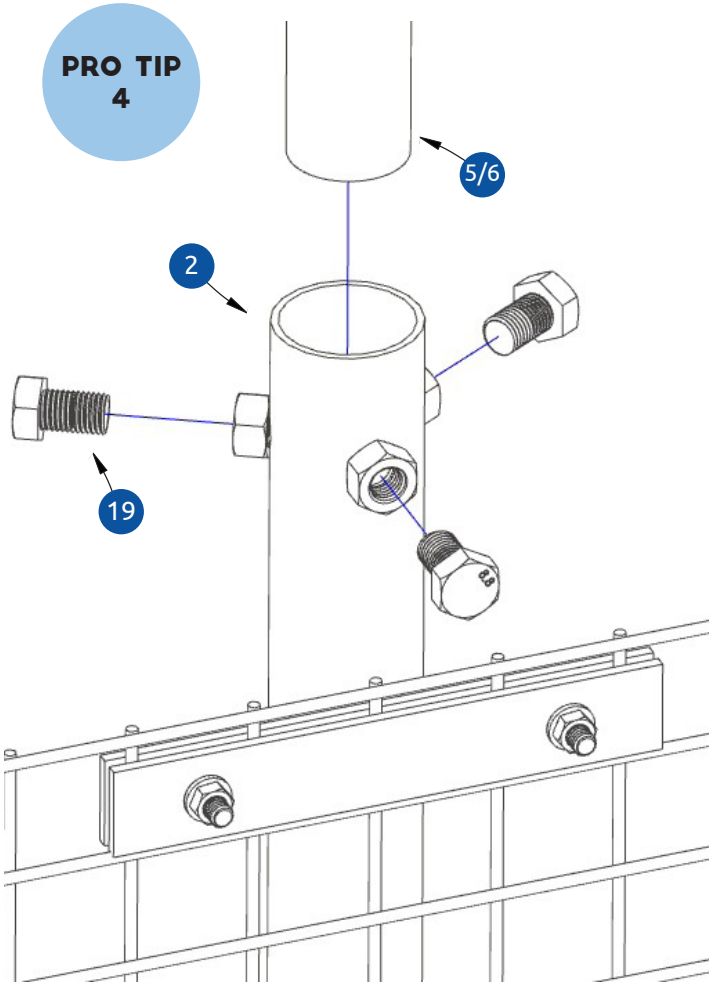
7. Secure the transition posts at the foundations with three (3) bolts and remove the temporary clamps.

[5/6] FRONT (SOUTH)/REAR (NORTH) POST
[2] ELBOW TUBE
[19] M16X2.0 25MM HEX BOLT

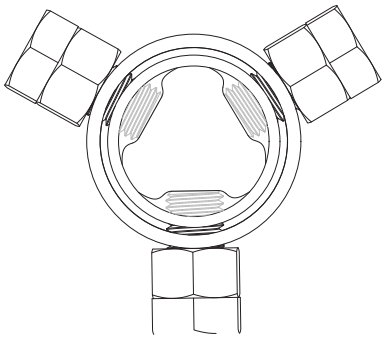
8. Once heights are verified correct and rotation is correct, bolts can be tightened. Every post should be checked to ensure the bolts are fully seated.

9. Once the front (south) posts are installed, set the rear (north) side posts by adjusting the height to the designed tilt angle per foundation set (check the build plans for the correct tilt angle). Set a steel guide on top of the front (south) and rear (north) posts and use an angle finder to determine the tilt. Repeat the string method for the rear (north) side posts.

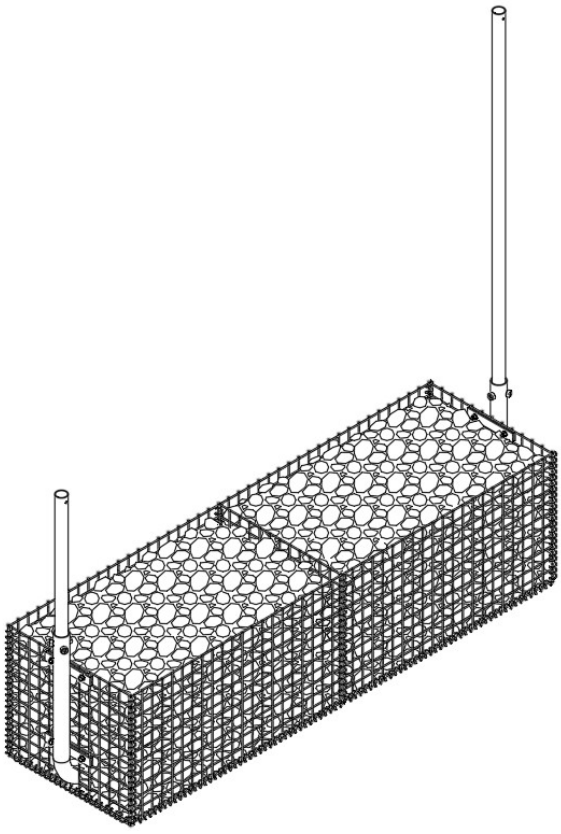
PRO TIP 4



PRO TIP 5



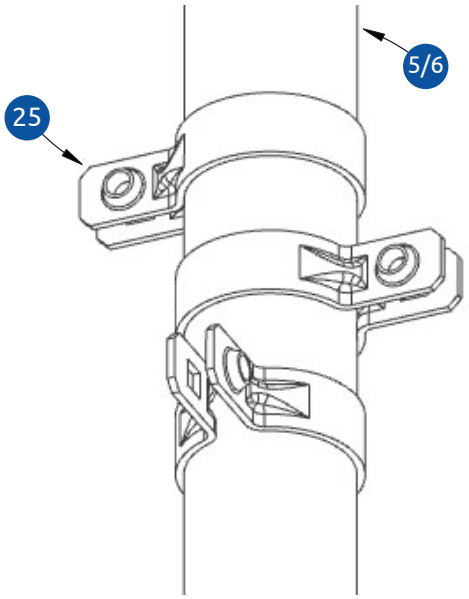
Top view of post and fully tightened bolts



TUBE CLAMP STAGING

1. Slide the tube clamp over the rear (north) post prior to attaching the N/S chord or stretch the clamp apart, fit it around the post, and squeeze it back to its original shape. Refer to the construction prints for the bracing requirements and locations.

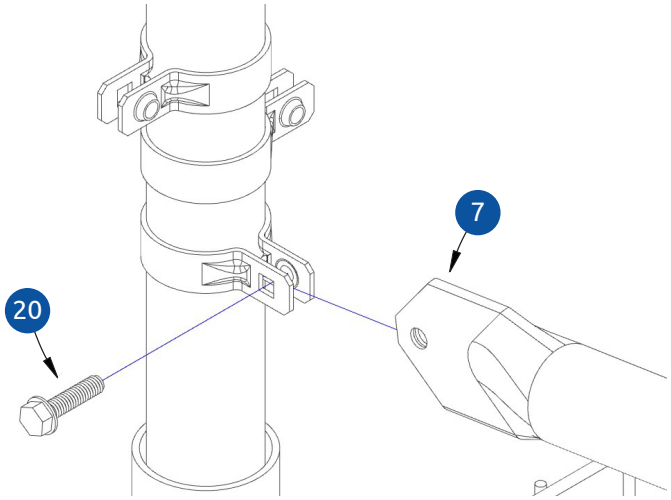
[25] TUBE CLAMP
[5/6] FRONT (SOUTH)/REAR (NORTH) POST

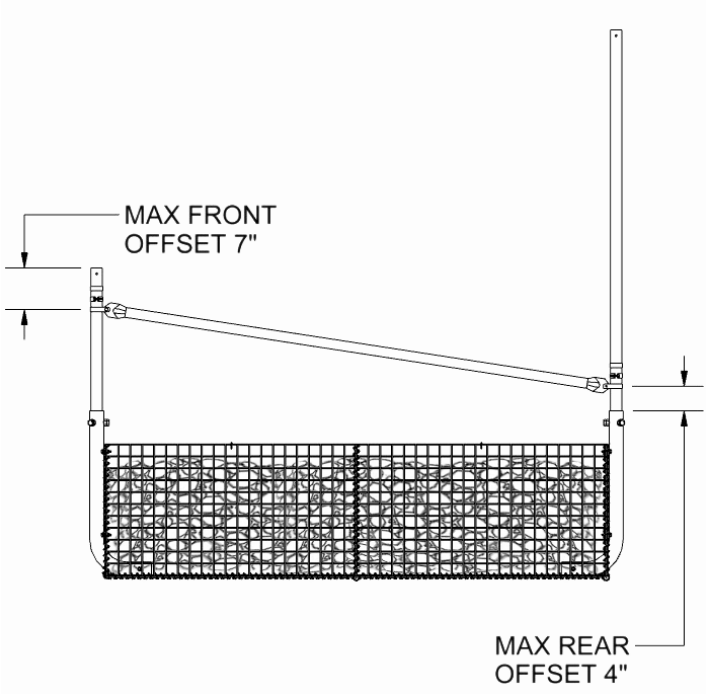


CROSS BRACE TUBE INSTALLATION

1. Install the cross brace tube at the lower location on the rear (north) post and at the upper location on the front (south) post.

[7] CROSS BRACE TUBE
[20] TUBE CLAMP BOLT

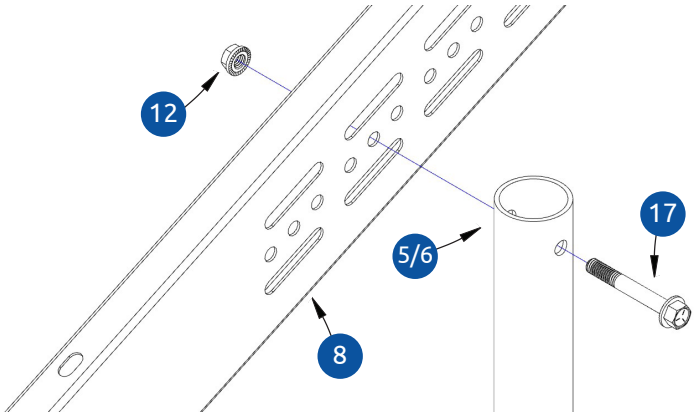




N/S CHORD-TO-POST

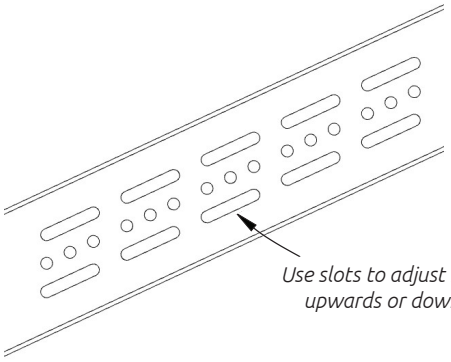
1. Attach the N/S chord to the West side of the posts. Refer to the construction documents for the correct hole locations.

[8] N/S CHORD
[5/6] FRONT (SOUTH)/REAR (NORTH) POST
[17] 3/8-16X2.75" SERRATED FLANGE BOLT
[12] 3/8-16 SERRATED FLANGE NUT



FINE HEIGHT ADJUSTMENT

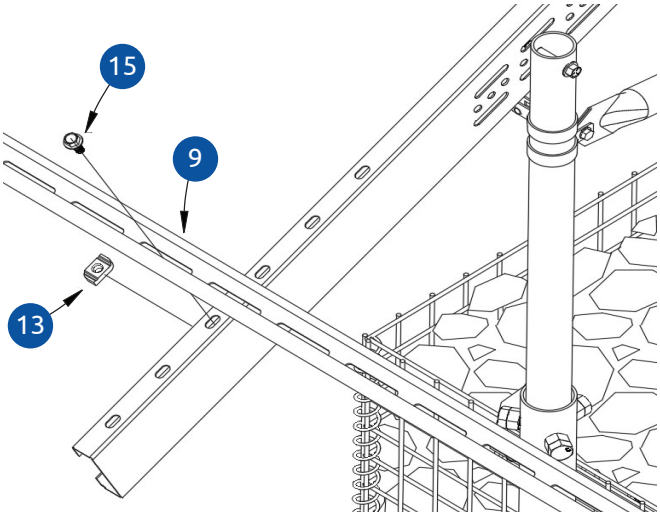
1. Sighting down a row, looking from East or West, look for inconsistencies in the heights of the racking. Adjust the height by removing the N/S chord hardware and adjusting the height using the adjustment holes before re-attaching the hardware.



E/W STRUT PURLIN-TO-N/S CHORD

1. Bolt the E/W strut purlin to the N/S chord using the correct hole location per the construction documents.

[9] E/W STRUT PURLIN
[15] 3/8-16X1.00" SERRATED FLANGE BOLT
[13] 3/8-16 CHANNEL NUT

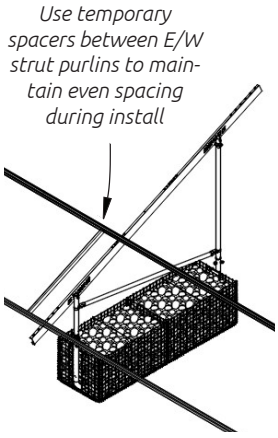


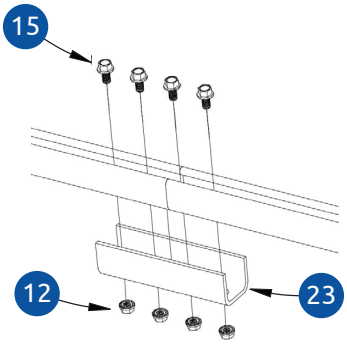
E/W STRUT PURLIN SPLICE

1. Connect two E/W strut purlins by using the splice to make a continuous rail. Stagger the location of the splices between foundations to reduce sagging.

[23] STRUT SPLICE
[12] 3/8-16 SERRATED FLANGE NUT
[15] 3/8-16X1.00" SERRATED FLANGE BOLT

2. Ensure the bottom or southern most E/W strut purlin is straight by adjusting it in the slot or by moving the N/S chord. Once visually straight, fasten down. Use spacers (scrap wood, scrap metal, etc.) to set the remaining E/W strut purlins to keep even spacing per the construction documents.





PANEL INSTALLATION

1. Beginning at one end, start setting the panels by squaring the first panel to the bottom E/W strut purlin. Refer to the construction documentation to determine the correct orientation of the panel.

2. Place the top panel after squaring the bottom panel. Make sure the spacing between the top and bottom panel is correct. Note: Use a fixture to create the proper gap, such as a piece of wood and spare clamp from the site.

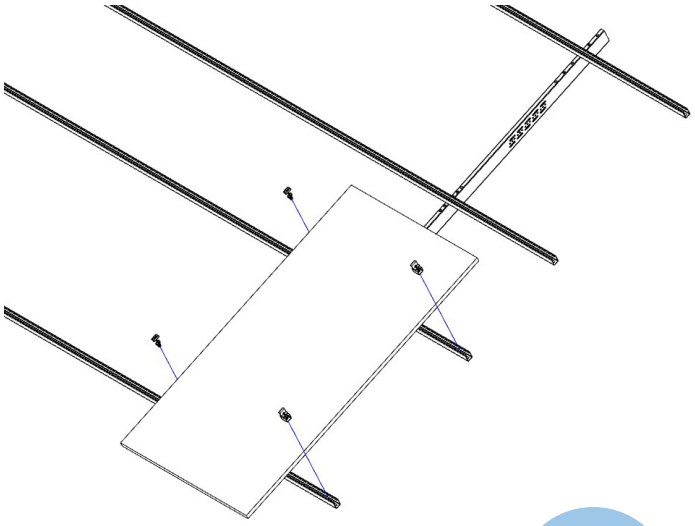
3. Place transition panels periodically throughout the row, squaring them to the rack as you go. Once these transition panels have been placed, run a string across them to create your leading edge for the row. This is done to provide the best aesthetics while keeping the panel placement within specification.

4. Stage panels throughout the row in preparation to be set to the string line.

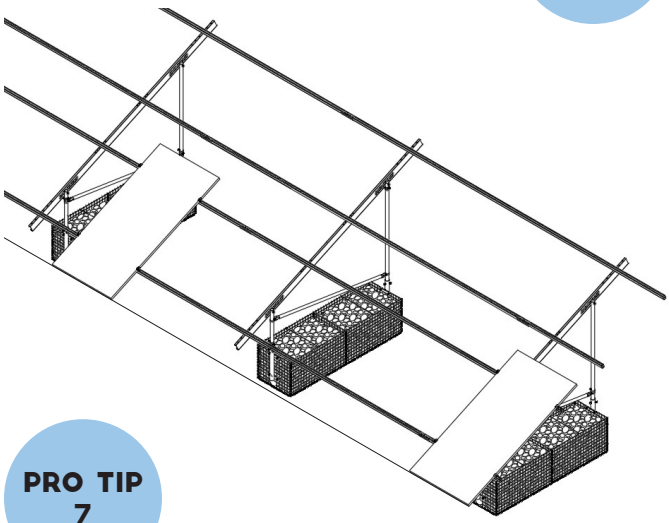
5. When starting panels, mid clamps can be placed in any area of the E/W strut purlin, except for splice locations.

6. Tighten the clamps square to the panels and ensure the grounding teeth are coming into contact with the panel frame.

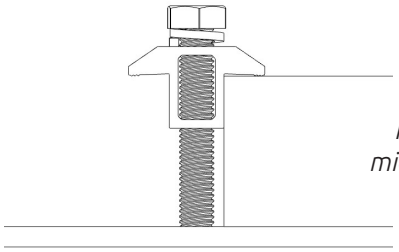
7. Repeat steps down the row, moving transition panels as you reach them if necessary.



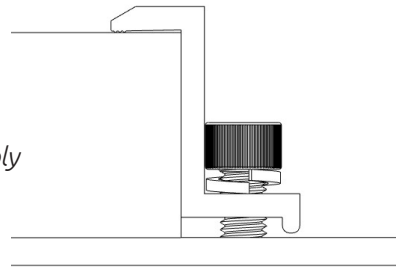
PRO TIP 6



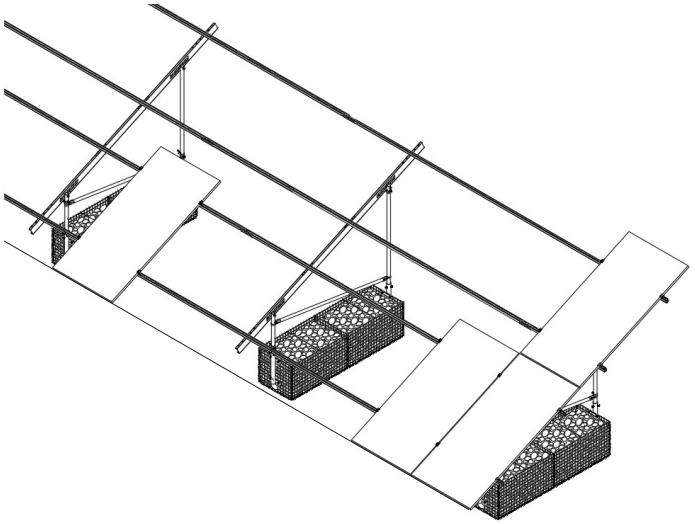
PRO TIP 7



Properly seated mid clamp assembly

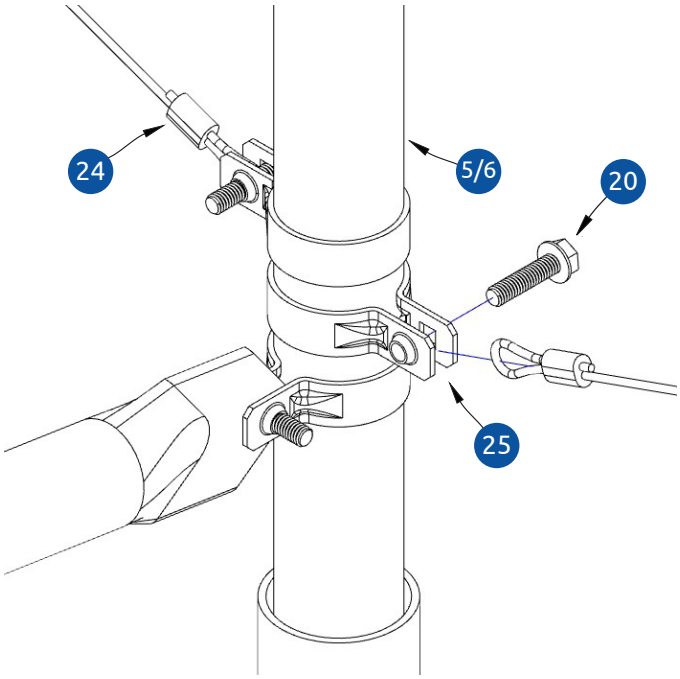


Properly seated end clamp assembly



CABLE BRACE-TO-POST

Depending on the array and project parameters, a set of posts may get multiple sets of cable braces to limit movement and reduce fatigue. Refer to the construction documentation for locations and frequency of cable bracing.

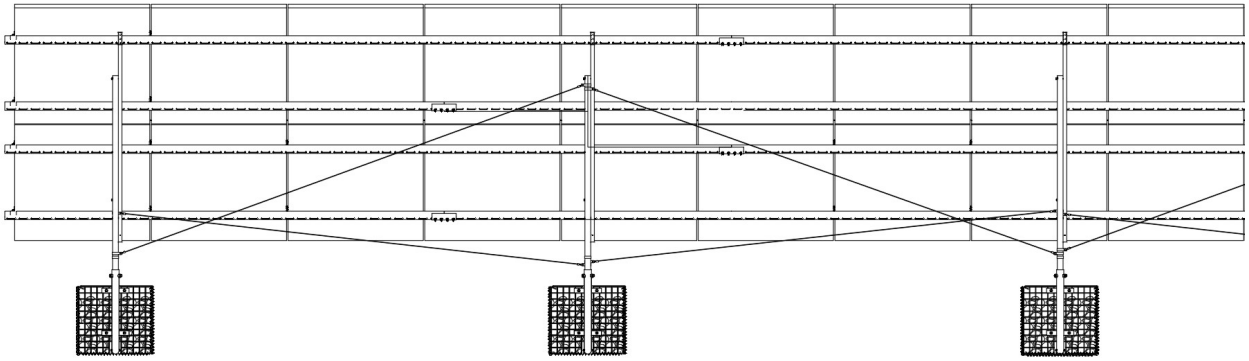


1. If clamps were not installed prior to installing the N/S chord (highly recommended), spread the clamp apart, slide around the post, and re-compress it. Install clamps on the North and South posts as required.
2. Once clamps are installed, string a cable between the two clamps. Note: There may be multiple lengths of cables on one job; refer to construction documentation to use the correct one.
3. Secure cable with bolts, loosely. Ensure that the bolts are pointing to the interior of the rack.
4. Install all cables as indicated in the construction documents. Cables should be taut and have no noticeable slack or sag.

[5/6] FRONT (SOUTH)/REAR (NORTH) POST
[20] TUBE CLAMP BOLT
[24] CABLE BRACING
[25] TUBE CLAMP

Note: In areas involving terrain, custom bracing may be needed. This is achieved by cutting a piece to the correct length off of a spool. It will then be crimped by a swagging tool.

NOTE
Cable braces are not used to induce static tension, like trusses of a bridge, but instead only to keep the posts from spreading or shifting.



PRO TIPS

PRO TIPS are pieces of advice from installation experts. They are intended to provide practical solutions to real-world problems that you may encounter. But before implementing any of the below tips, make sure to request approval from APA's Engineering team, as not all solutions are allowed on every site.

[1] Use a STEEL tape rather than a fiberglass tape to measure distances over the length of the row. Fiberglass can stretch over time and affect layout and installation lengths.

[2] When dealing with extreme topography, additional transitions will have to be added to make the racking flow with the terrain.

[3] With extreme topography, every foundation must be marked and the string line must be attached to every post, in order to ensure that the racking will flow at every high and low point.

[4] While it is very difficult to make every post perfectly plumb and at the correct height, care should be taken to keep them within the tolerances specified in the plans in order to ensure that the system fits and functions as intended.

[5] Use grip clamps when setting post transitions . This is the best technique to use so that no improper dimpling is done to the posts if adjustments are needed. Once desired flow is reached, then tighten the set bolts.

[6] When staging panel clamps, tighten the bolt until the spring is slightly compressed. This will help the panel installer free up one hand. If the spring is not compressed prior to staging, the clamp will spin and another installer will have to hold the panel.

[7] To square the panel, measure the distance from the edge of the panel to the flat part of the E/W strut purlin on both sides, ensuring equal distance.

OPERATION & MAINTENANCE

Regular inspections and proper maintenance are essential to maintain the design life and warranty of the Geoballast solar racking system. Solar racking is exposed to many elements from initial construction to seasonal changes and can even be susceptible to severe weather conditions. The following Operation and Maintenance procedures should be followed and performed on an annual basis to ensure the warranty for the racking system remains active. The procedures below highlight the critical points to be examined and maintained for a properly functioning solar racking system.

BOLTED CONNECTIONS

Annually, bolted connections need to be visually inspected to ensure the components are properly joined together. At the beginning, middle, and end of each row, there are torque marked nuts/bolts per the APA QA/QC process. These marked locations should be visually inspected to confirm no movement of the bolted connections has occurred. If loose hardware is found, re-tighten to the specifications noted in the plan set for the racking system.

SOLAR PANEL CLAMPS

Clamps need to be visually inspected annually to ensure modules are properly secured. If loose clamps are found, retighten to the specifications noted in the plan set for the racking system.

GALVANIZE COATING

The galvanized coating ensures that the steel components are protected from corrosion and that the solar racking system will last for the entire project life. Annually, the solar racking system should be inspected for any areas of corrosion or rust. If areas are found, they should be repaired in a timely manner by cleaning the area and then generously applying cold galvanizing compound.

The cut, slit and sheared edges of the racking system are exposed steel that are expected to show corrosion or rust. This is normal and should be expected, but does not affect the structural integrity of the system.

Copper should be isolated and cannot touch the galvanized coating, as it will expedite corrosion.

CROSS BRACING CABLE WIRE

If applicable to your project, the bracing needs to be visually inspected on an annual basis to ensure that it has not become loose. Cables are required to be taut for motion limiting, but do not need to be tensioned.

SYSTEM DAMAGE

The solar racking system should be visually inspected for other types of damage. Examples include damage from mowing equipment, maintenance equipment, falling trees or branches, storm damage, system lean, soil erosion, etc. Any components that are damaged or deformed should be replaced as they may be weaker or corrode faster than intended. Some components may be able to be repaired onsite if replacement is not practical. For assistance with replacement parts or instructions on repairing a component, contact APA.

GENERAL OPERATION

It is important to maintain the solar racking system to ensure the design lifespan.

Keep all vegetation managed and off of the racking system and solar modules.

Check that module cleaner solution, weed killer, or other chemicals used on or around the solar racking system are not corrosive to galvanized or stainless steels.

Check electrical wiring to ensure it is managed properly and protected.

Take note and log when inspections were performed and if any corrective actions were taken or need to be taken in the future.