

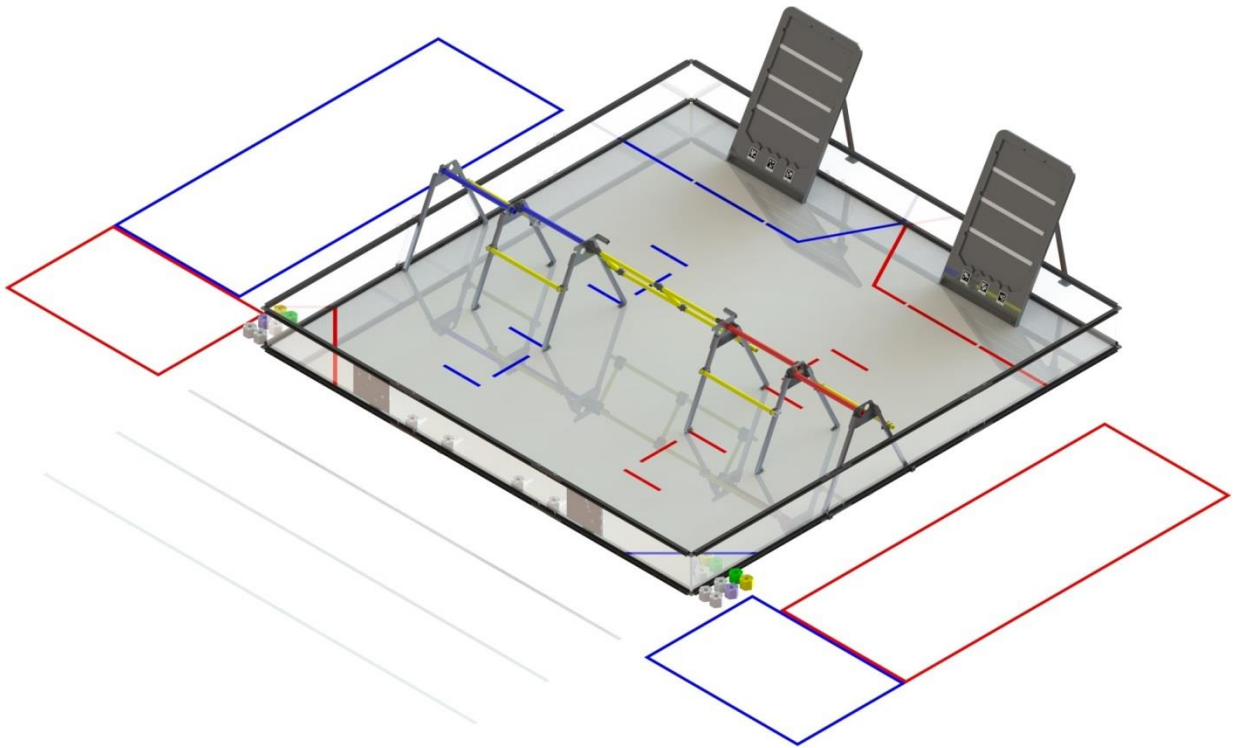


FIRST
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2023-2024 *FIRST*[®] Tech Challenge Field Setup Guide



Revision #	Date	Author	Purpose
0	8/21/2023	E. Scime	Initial Document
1	8/31/2023	E. Scime	Updated Text for Several Steps
2	9/15/2023	E. Scime	Allowed Use of Alternate Under Tile Disk
3	10/6/2023	E. Scime	Updated Definition for Landing Zone Tape
4	12/7/2023	E. Scime	Updated Instructions for Field Border Assembly
5	2/15/2024	E. Scime	Added Option for Washers Used in Truss Assembly



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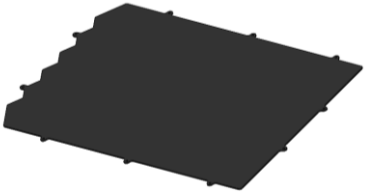
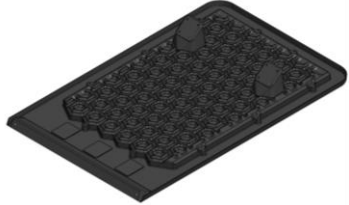

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Recommended Tools List

Component	Part #	Quantity	Photo
Utility Knife	N/A	1	
Tape Measure	am-4986	1	
5/32 Hex Driver	am-2751	1	
3/8 Nut Driver	am-3877	1	
Safety Gloves	N/A	1	
3/8 Combination Wrench	am-4961	1	

Backdrop Parts List

Component	Part #	Quantity		Photo
		Full	Part	
Backdrop Front	am-5118	2	1	
Backdrop Back	am-5117	2	1	
10-32 0.75" Socket Head Cap Screw	am-1047	16	8	

Component	Part #	Quantity		Photo
		Full	Part	
10-32 Nylock Nut	am-1042	36	18	
2ft Peanut Leg	am-3090a-2	4	2	
Backdrop Foot	am-3063a	8	4	
10-32 0.5" Socket Head Cap Screw	am-1002	20	10	
1/4-20 Elevator Bolt	am-1629	4	2	
1/4-20 Wing Nut	am-1705	4	2	
#10 Washer	am-1026	36	18	
Under Tile Bar	am-5119	2	1	
AprilTag 1	am-5120	1	1	





Truss Parts List

Component	Part #	Quantity		Photo
		Full	Part	
Apex Bracket	am-5106	4	2	
Apex Bracket (Blocker)	am-5116	2	2	
Stage Door Short Yellow Pipe, 11.5"	am-5108	3	3	
Truss Long Yellow Pipe, 24.5"	am-5107	8	6	
Truss Hanging Bar, Red, 24.5"	am-5109_red	2	2	
Truss Hanging Bar, Blue, 24.5"	am-5109_blue	2	2	
Pipe C-Clamp	am-5110_half	16	10	
Stage Door T-Clamp	am-5111_half	12	12	
Under Tile Peanut Mount Bracket	am-5112	8	8	
Under Border Peanut Mount Bracket (A)	am-5113_A	2	2	






Component	Part #	Quantity		Photo
		Full	Part	
Under Border Peanut Mount Bracket (B)	am-5113_B	2	2	
Truss Clamp Stop Bracket	am-5114	4	2	
Truss Clamp Passthrough Bracket	am-5115	12	6	
2 foot Peanut Extrusion	am-3090a-2	12	8	
4" Under Tile Disk OR 6" Under Tile Disk	am-3881 OR am-4804	8	6	
3.5" Peanut	am-4504a/ am-4504	2	2	
1/4-20 Elevator Bolt	am-1629	8	6	
1/4-20 Wing Nut	am-1705	12	8	
10-32 0.5" Socket Head Cap Screw	am-1002	32	20	


Component	Part #	Quantity		Photo
		Full	Part	
10-32 Nylock Nut	am-1042	102	76	
10-32 0.75" Socket Head Cap Screw	am-1047	52	46	
10-32 1.5" Socket Head Cap Screw	am-1014	18	10	
1/4-20 3.5" Hex Head Cap Screw	am-1605	4	2	
Rubber Stopper	am-4806	4	2	
1/4" Washer	am-1027	4	2	
10-32 Thumb Screw	am-4558	4	4	
1/4-20 Thread-forming Screw	am-1310	52	36	

Scoring Elements List

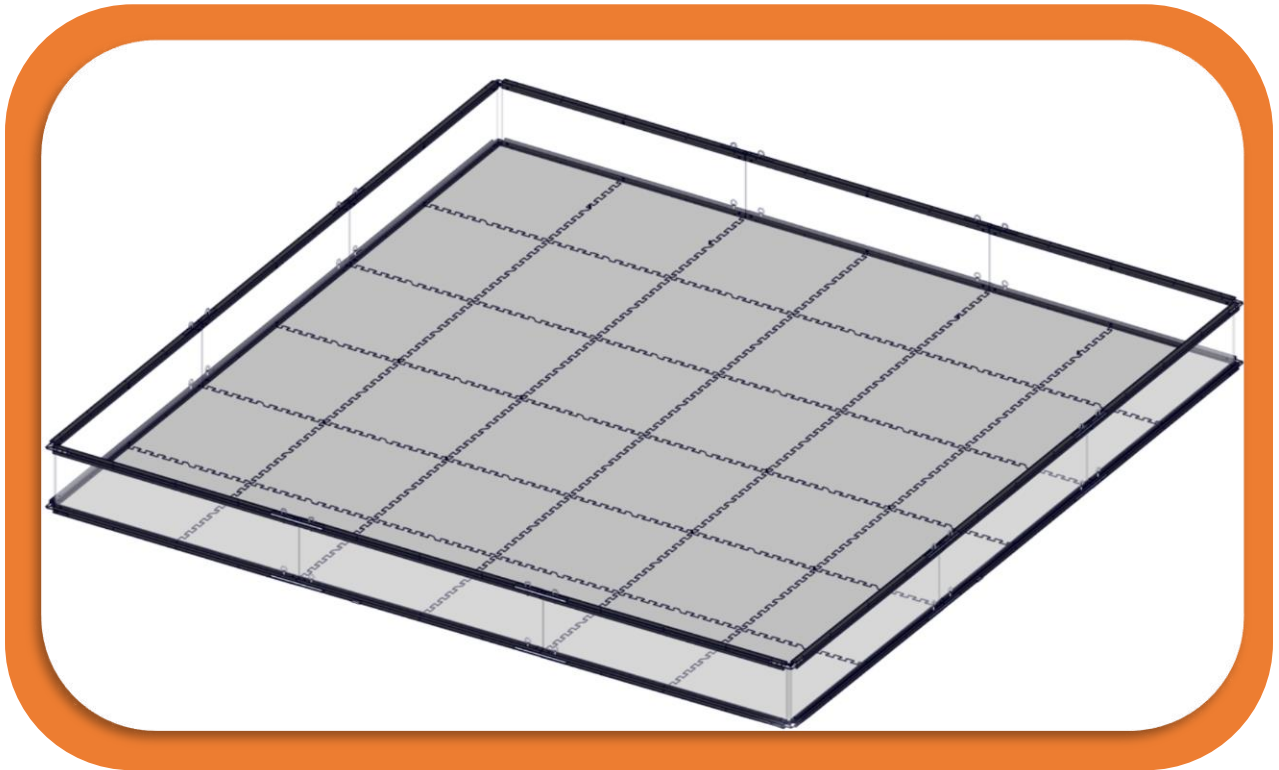
Component	Part #	Quantity		Photo
		Full	Part	
White Pixel	am-5101_white	64	32	
Green Pixel	am-5101_green	10	5	
Purple Pixel	am-5101_purple	10	5	
Yellow Pixel	am-5101_yellow	10	5	

Additional Materials List (Not Included)

Component	Part #	Quantity	Photo
1" White Gaffers Tape	am-4951	1	
1" Red Gaffers Tape	am-4952	1	
1" Blue Gaffers Tape	am-4953	1	
Black Permanent Marker	N/A	1	
Clear Plastic Sleeve, 8.5"x11"	N/A	2	

Color Printer	N/A	1	
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FIELD & PERIMETER ASSEMBLY



Field & Perimeter Assembly

Step 1

If using the AndyMark FTC Field Perimeter, follow the [FTC Field Perimeter Setup Guide](#) to construct your field border. Scan or tap this QR code to view.



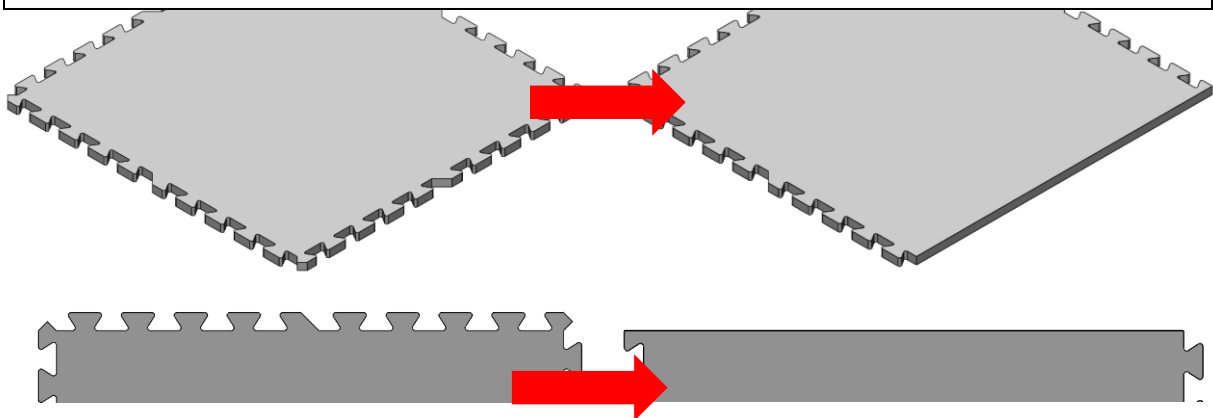
If using a different border, follow its associated assembly guide. Note that different borders will have varying heights, as listed in the table below.

Perimeter	Wall Design Categories	Wall Height
AndyMark (current)	Smooth on one side and an open cavity on the other side	12.125"
IFI Perimeter	Smooth on one side and an open cavity on the other side	11.5"
Logo Loc Perimeter	Symmetrical inside and outside surfaces	12.375"

Step 2

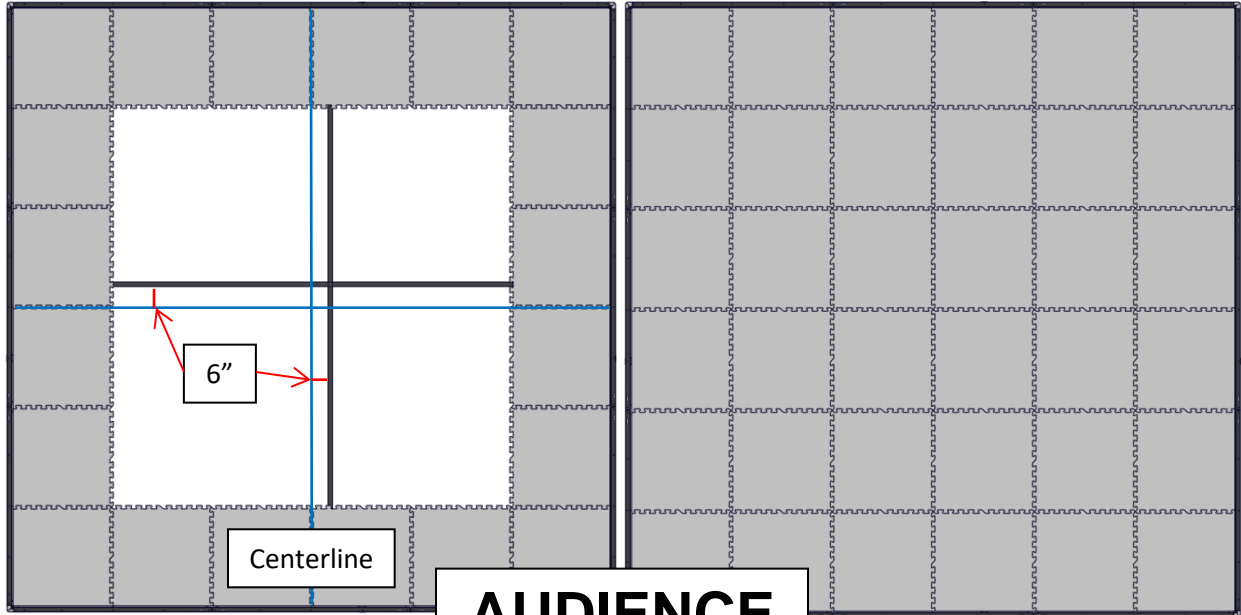
Remove material from one edge of 16 soft tiles until that edge is flat. For 4 additional tiles, do this on two adjacent edges, making the corners of the field.

NOTE: It is possible you may receive soft tiles that are smaller in size than expected. You may want to place your tiles in your perimeter (Step 3) before cutting off the edges (Step 2) to ensure you completely fill the perimeter by cutting less from each edge.



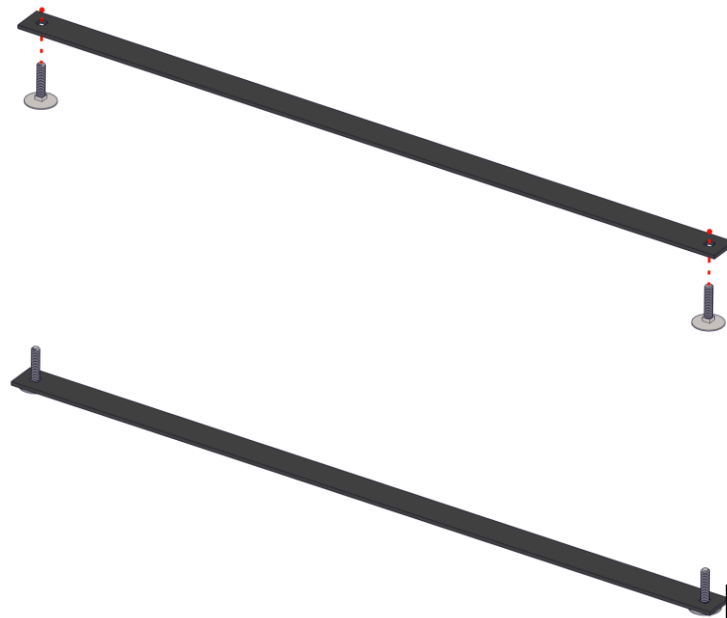
Step 3

Place the straps 6" from the centers of the field walls as shown. Use the cut tiles (16 with a single edge cut, 4 with two adjacent edges cut) to form the outer edge of the field floor inside the Field Border. Fill in the rest of the floor with uncut tiles. In total there should be 36 tiles placed.



Step 4

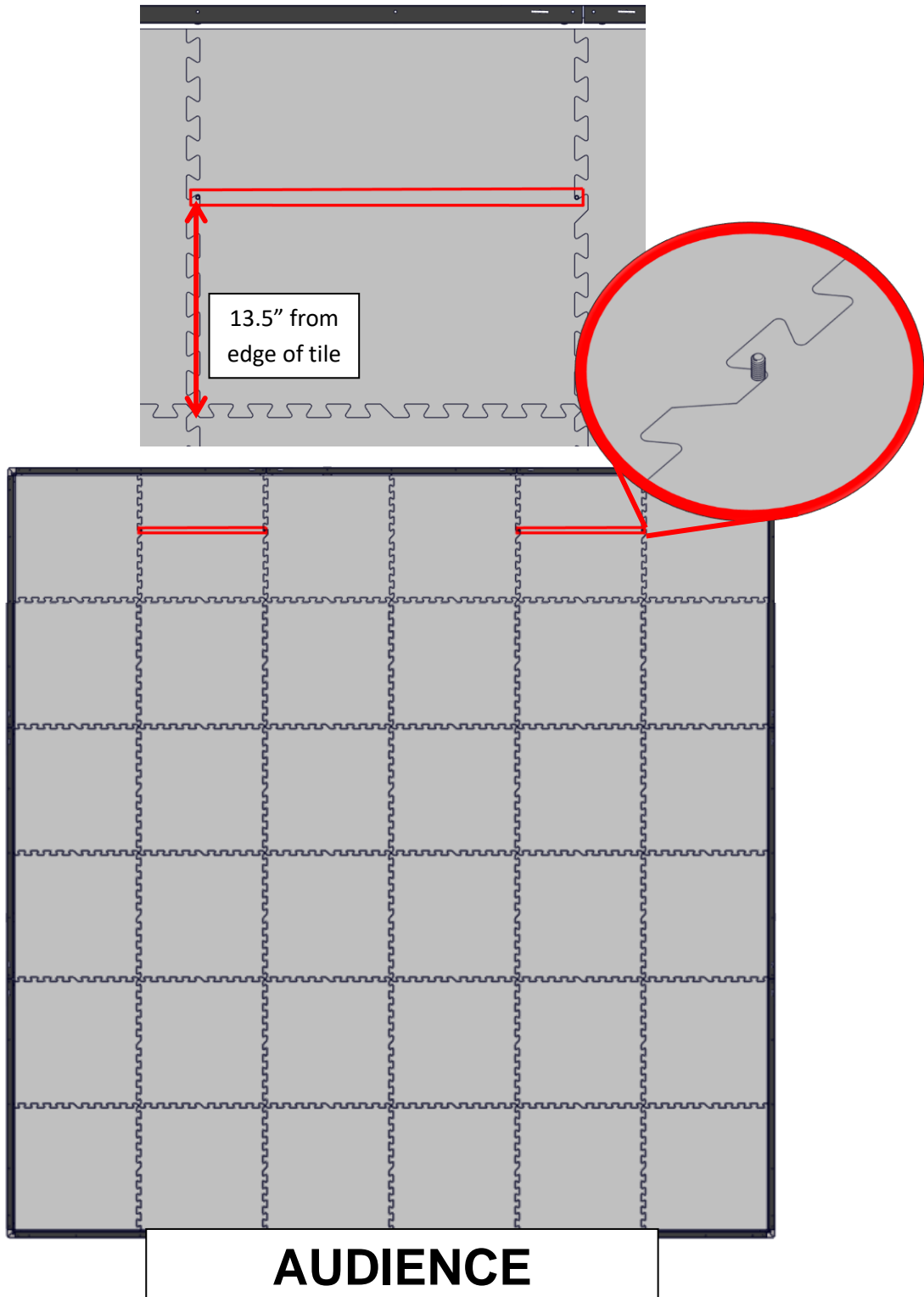
Prepare the Undertile Bar Assemblies by inserting 2 Elevator Bolts (am-1629) through the square holes in the Undertile Bars (am-5119). For a full field, prepare 2 of these assemblies. For a partial field, prepare only 1 assembly.



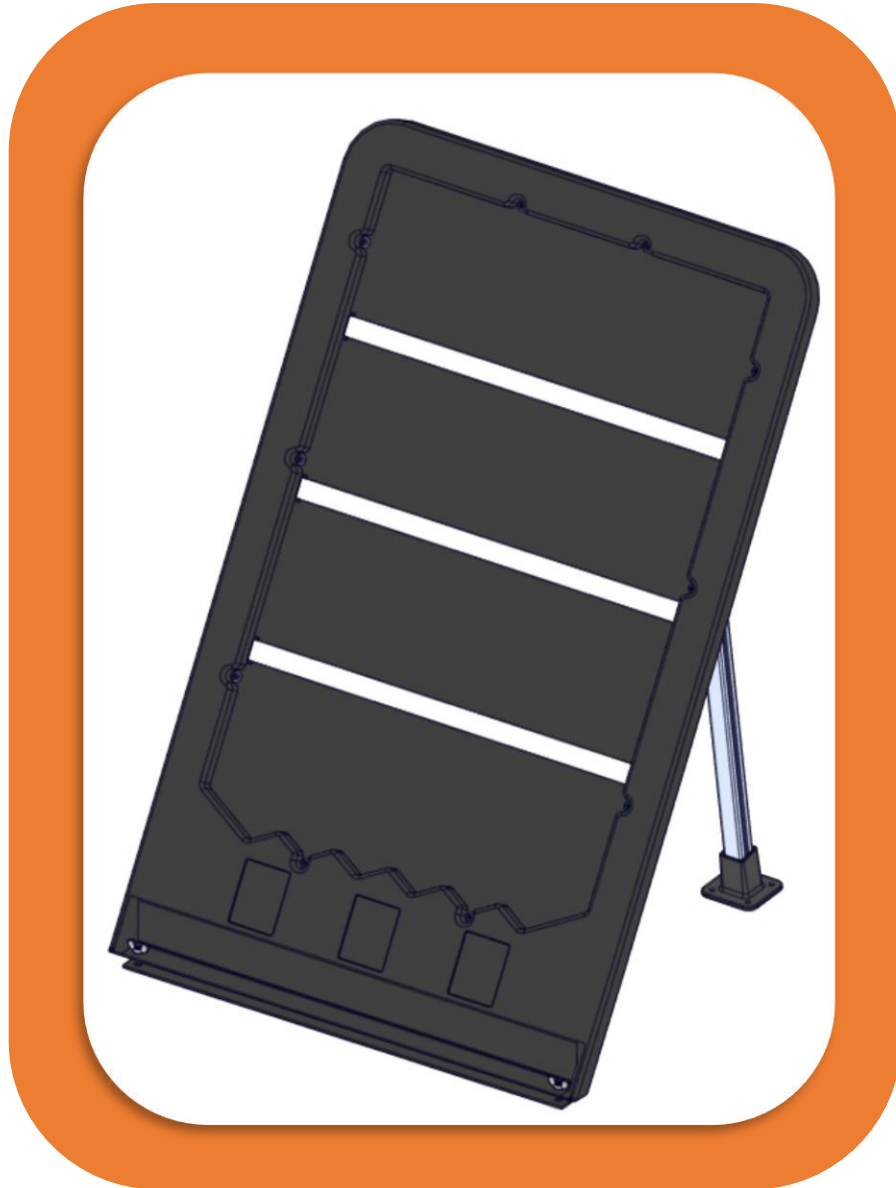
1X or 2X

Step 5

Slip the Undertile Bar assembly underneath the tiles second from the right and left and furthest from the audience. The elevator bolts should stick up through the tile roughly 13.5" from the edge of the tile as shown.



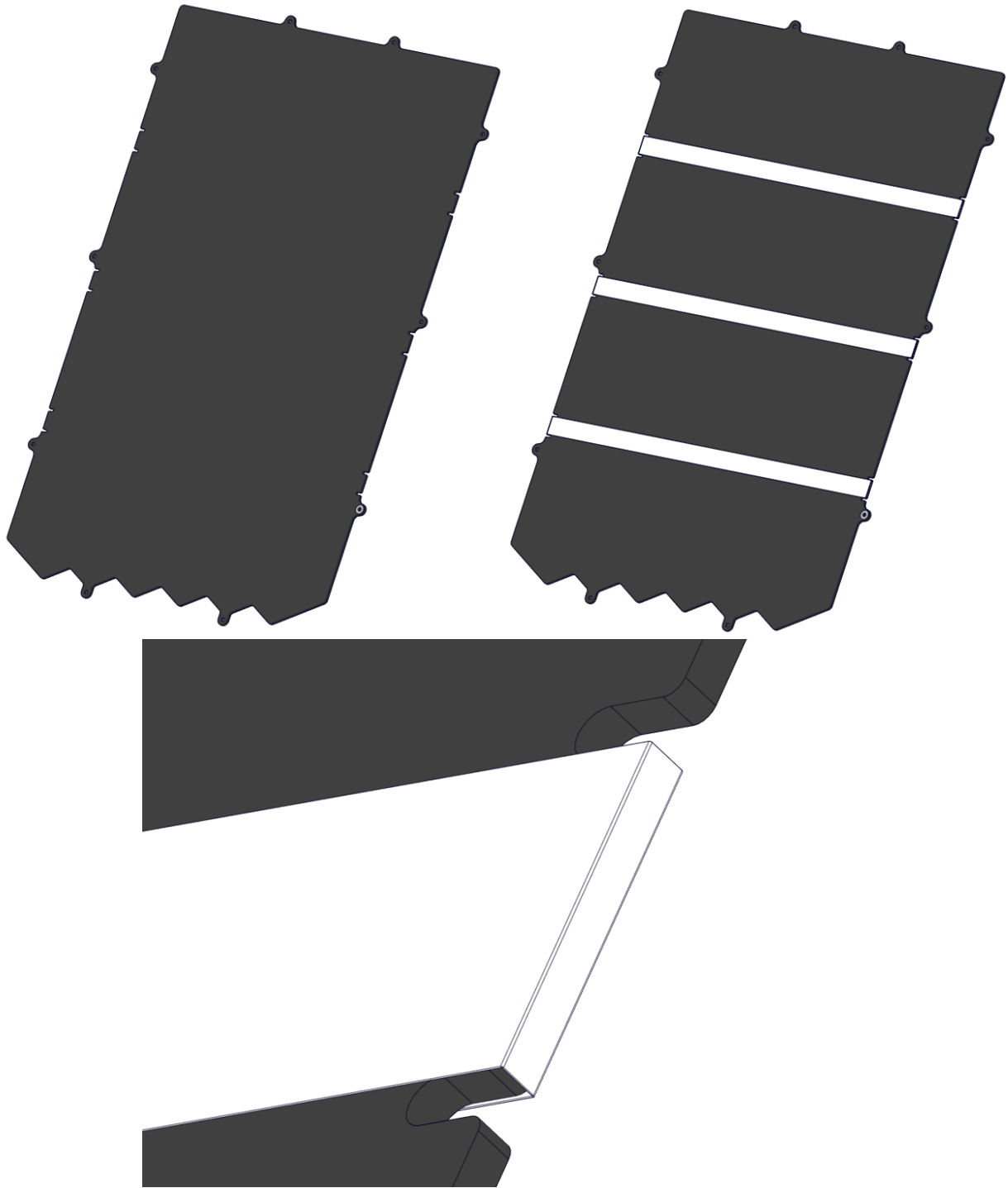
BACKDROP ASSEMBLY



Backdrop Assembly

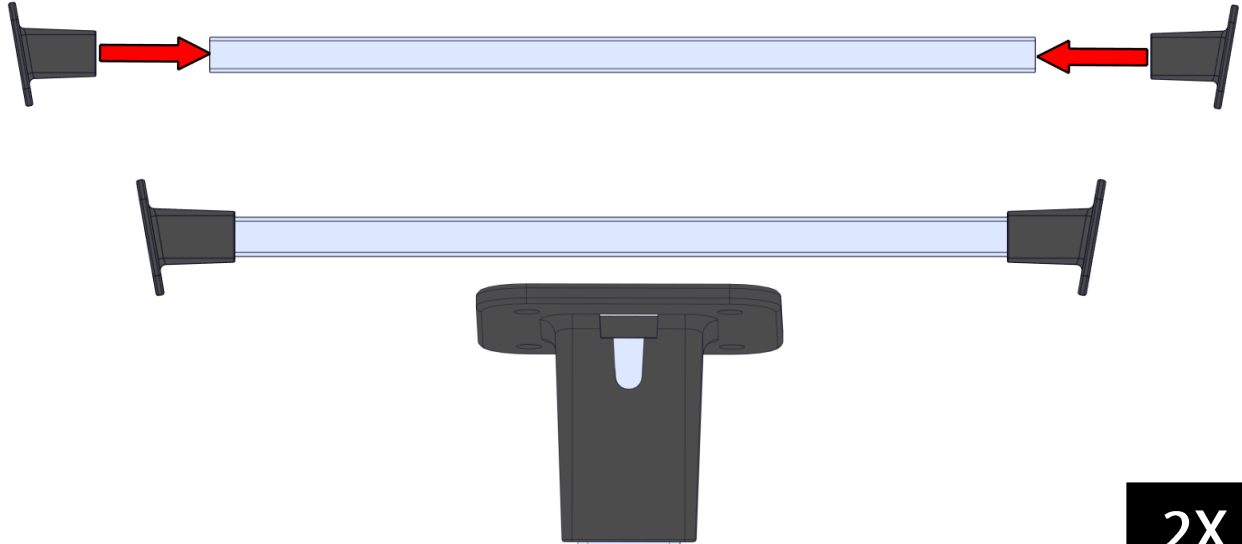
Step 1

Attach 1" White Gaffers Tape (am-4951) to the Backdrop Front (am-5118) by aligning it with the precut notches and taping across the foam component. Wrap each end around the edge to ensure good adherence to the part. The tape can be placed on either face.



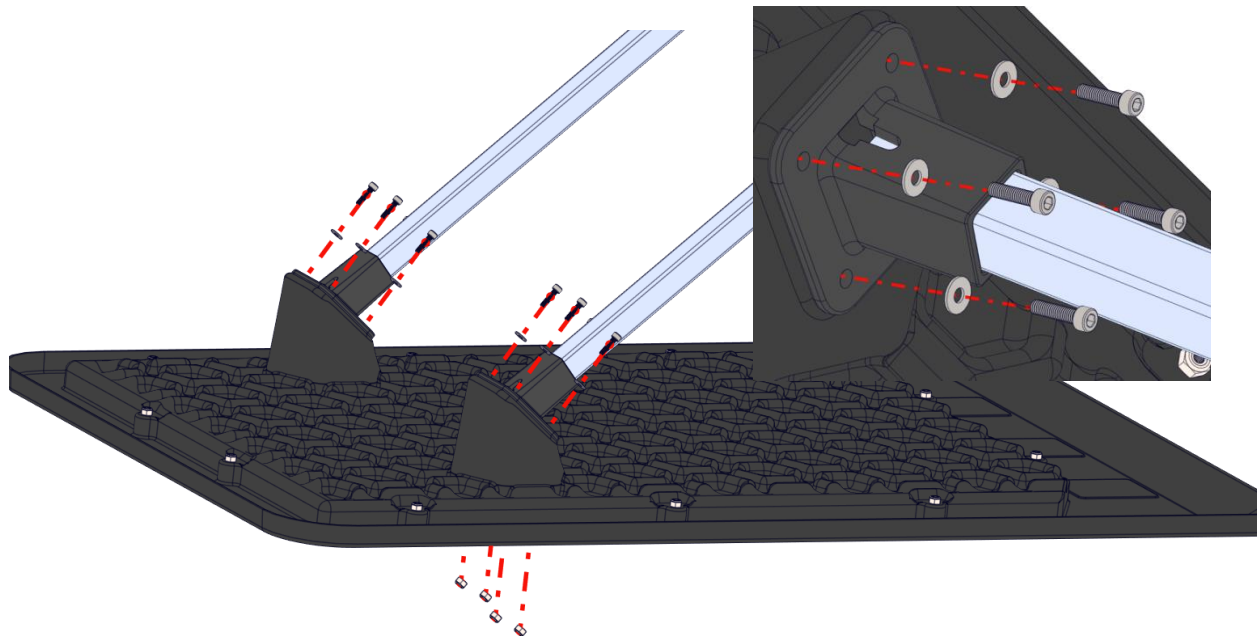
Step 2

Attach two Backdrop Feet (am-3063a) to two 2ft Peanut Extrusions (am-3090a-2) in the orientation shown. Do this twice. Ensure the feet are **COMPLETELY INSERTED**. This can be checked using the window shown in the diagram below – the edge of the Peanut should align with the edge of the window as shown.



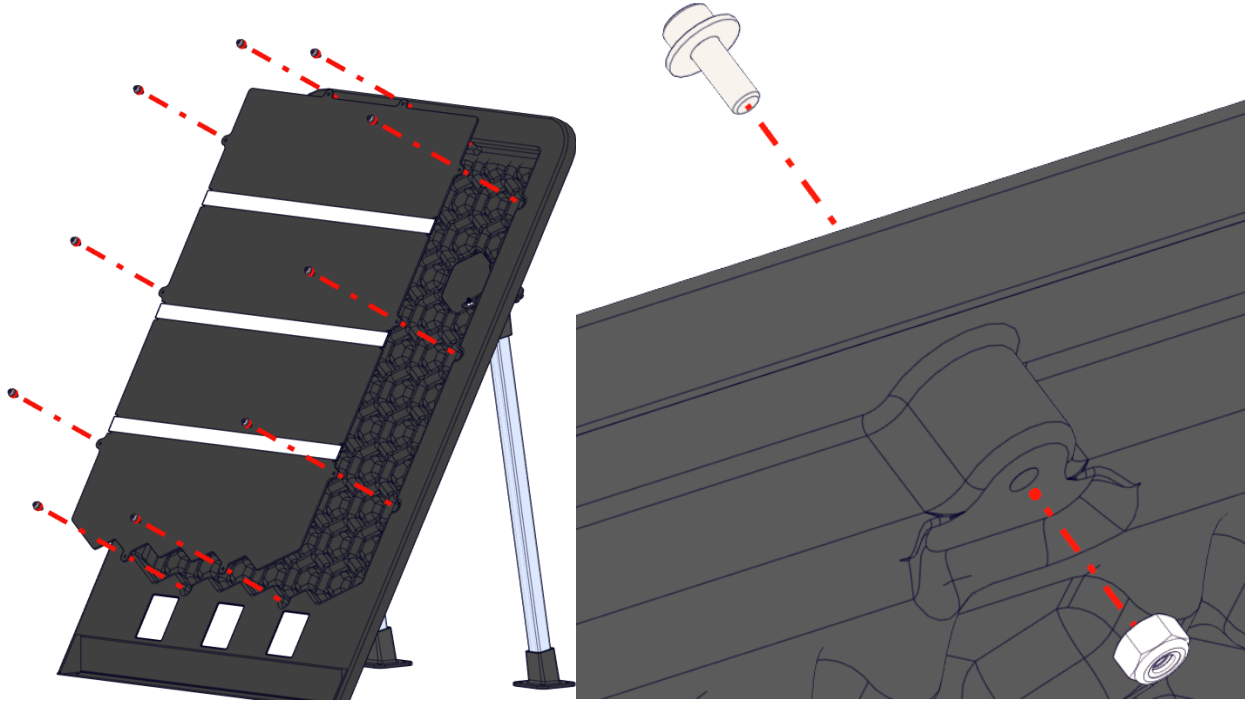
Step 3

Attach the assemblies created in Step 2 to the Backdrop Back (am-5117) using eight 3/4" long 10-32 socket head screws (am-1047), eight 10-32 washers (am-1026), and eight 10-32 nylock nuts (am-1042).



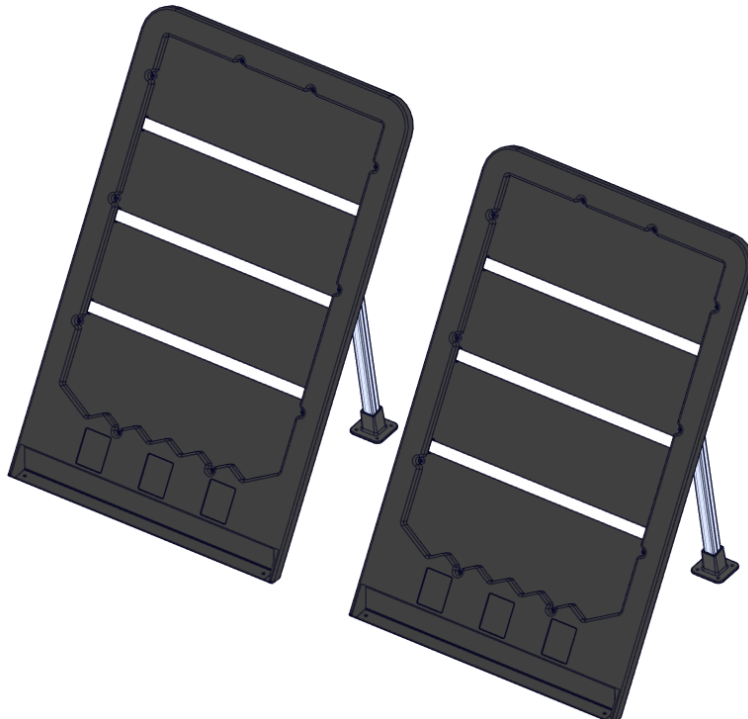
Step 4

Secure the Backdrop Front (am-5118) to the Backdrop Assembly using ten 0.5" long 10-32 socket head screws (am-1002) and ten 10-32 nylock nuts (am-1042). Each screw is inserted from the front of the Backdrop and secured on the back with a nut. Place a #10 washer on each screw, touching the head of the screw.



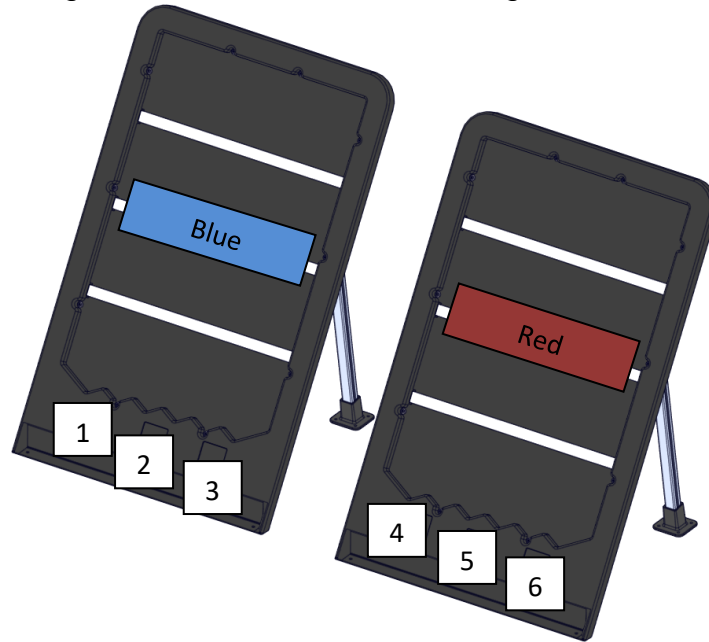
Step 5

Repeat steps 1 through 4 to build a second Backdrop if constructing a full field.



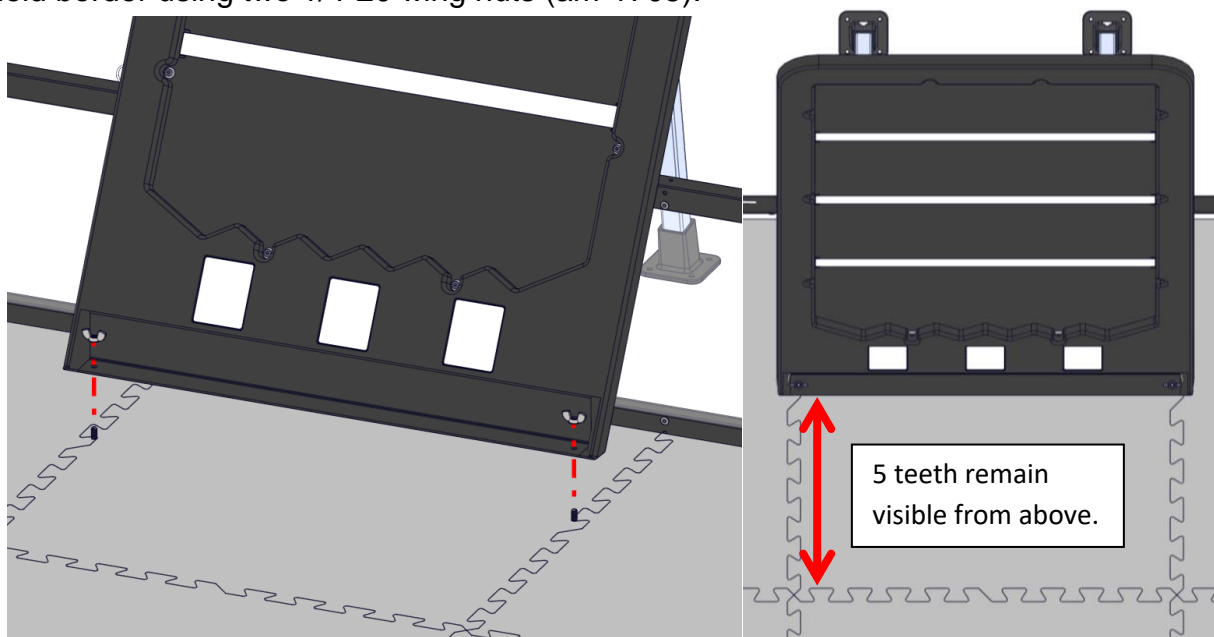
Step 6

Attach the AprilTags to the Backdrop Front by peeling off the sticker backing material and adhering them to the rectangular slots. If building the blue Backdrop, it should receive tag 1 in the left slot, 2 in the center, and 3 in the rightmost slot. If building the red Backdrop, it should receive tag 4 in the left slot, 5 in the center, and 6 in the rightmost slot. If building a full field, both of these configurations should be constructed.

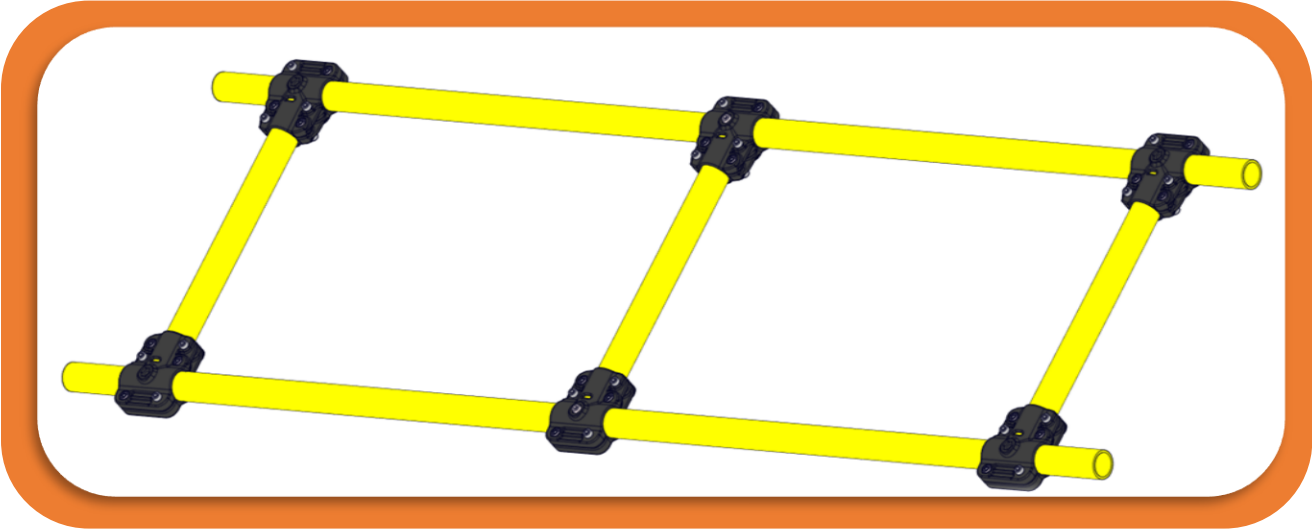


Step 7

Attach the Backdrop(s) to the elevator bolts sticking through the field tiles closest to the field border using two 1/4-20 wing nuts (am-1705).



STAGE DOOR ASSEMBLY

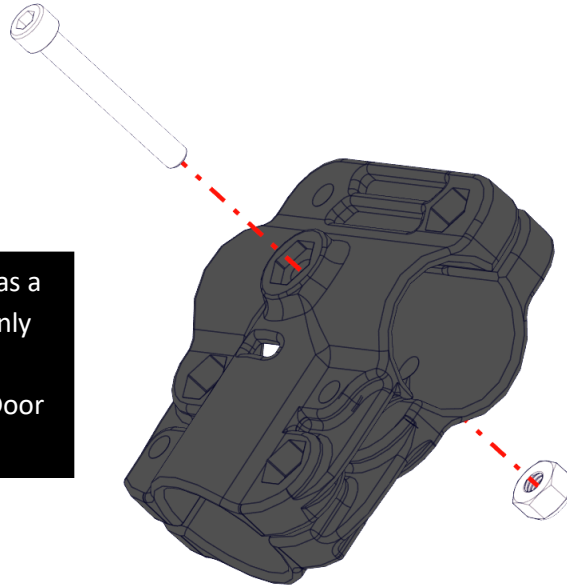


Stage Door Assembly

Step 1

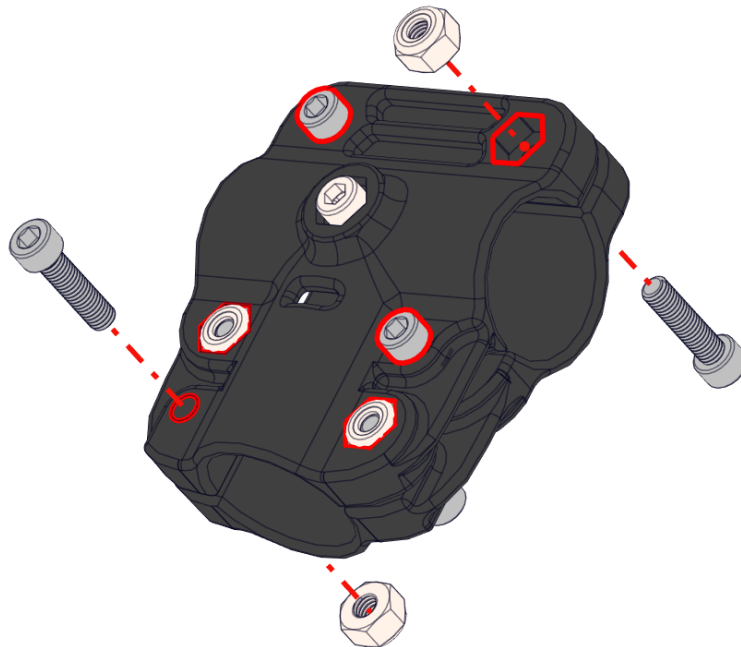
Insert a 1.5" long 10-32 socket head screw (am-1014) through two T-Clamps (am-5111_half) and a 10-32 nylock nut (am-1042). **Do NOT tighten this assembly.** It should be loosely attached at this stage.

NOTE: This screw will act as a spacer in the assembly. Only two of the T-clamp assemblies on the Stage Door will include this screw.



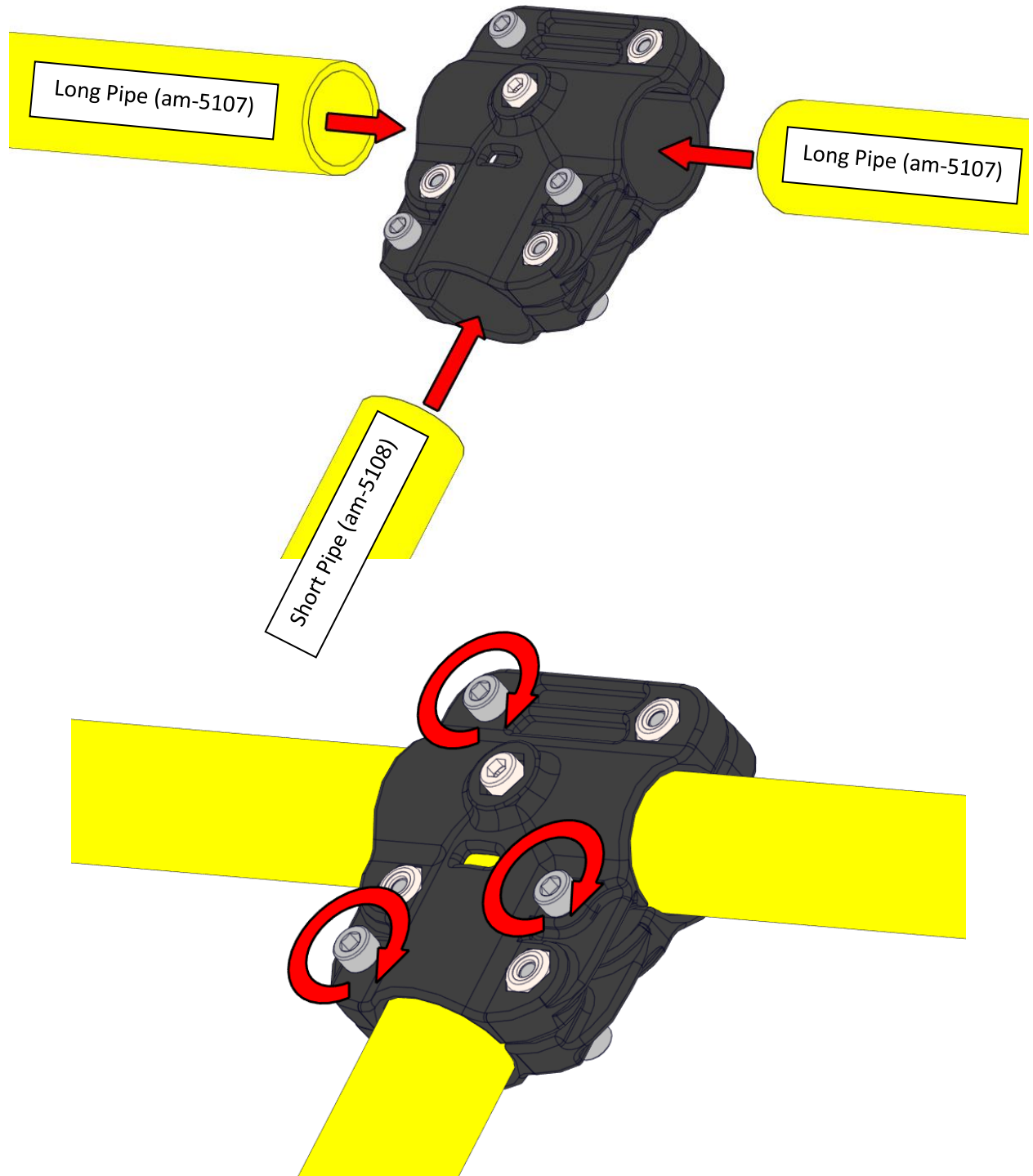
Step 2

Insert six 3/4" long 10-32 socket head screws (am-1047) through the assembly as shown into six 10-32 nylock nuts (am-1042). **Do NOT tighten this assembly.** It should be loosely attached at this stage. The side through which each screw is inserted alternates! Both the screw and nut should fit inside the pockets provided by the part.



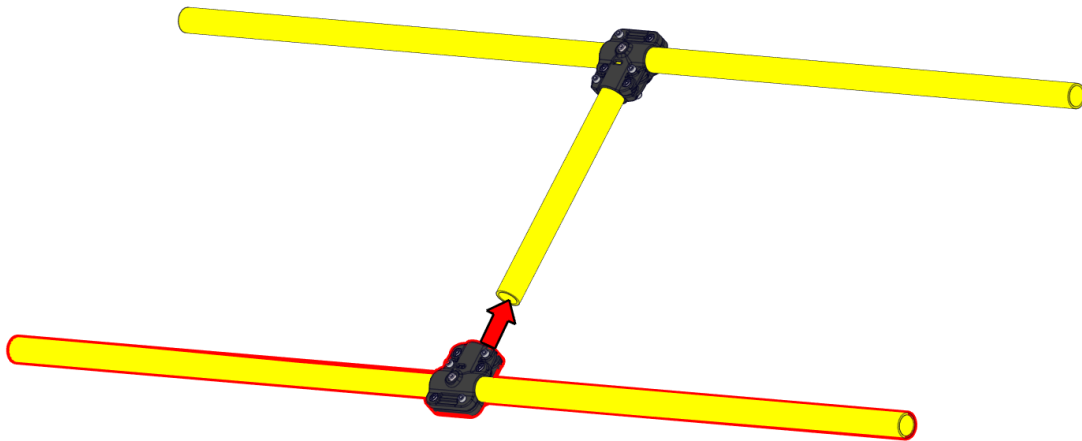
Step 3

Insert two long yellow pipes (am-5107) and one short yellow pipe (am-5108) into the assembly as shown. Tighten all screws in the assembly until the pipes are completely secure.



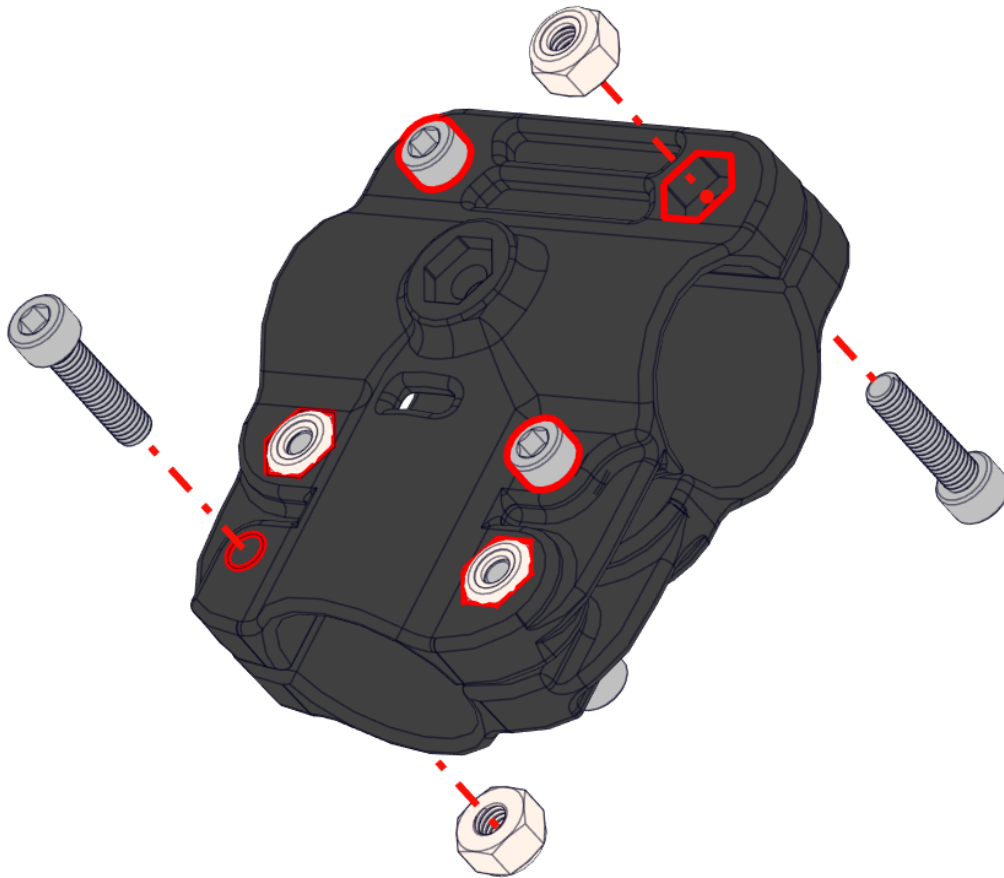
Step 4

Repeat steps 1 through 3 (with step 3 using the same short pipe used before) to complete the "H" assembly shown.



Step 5

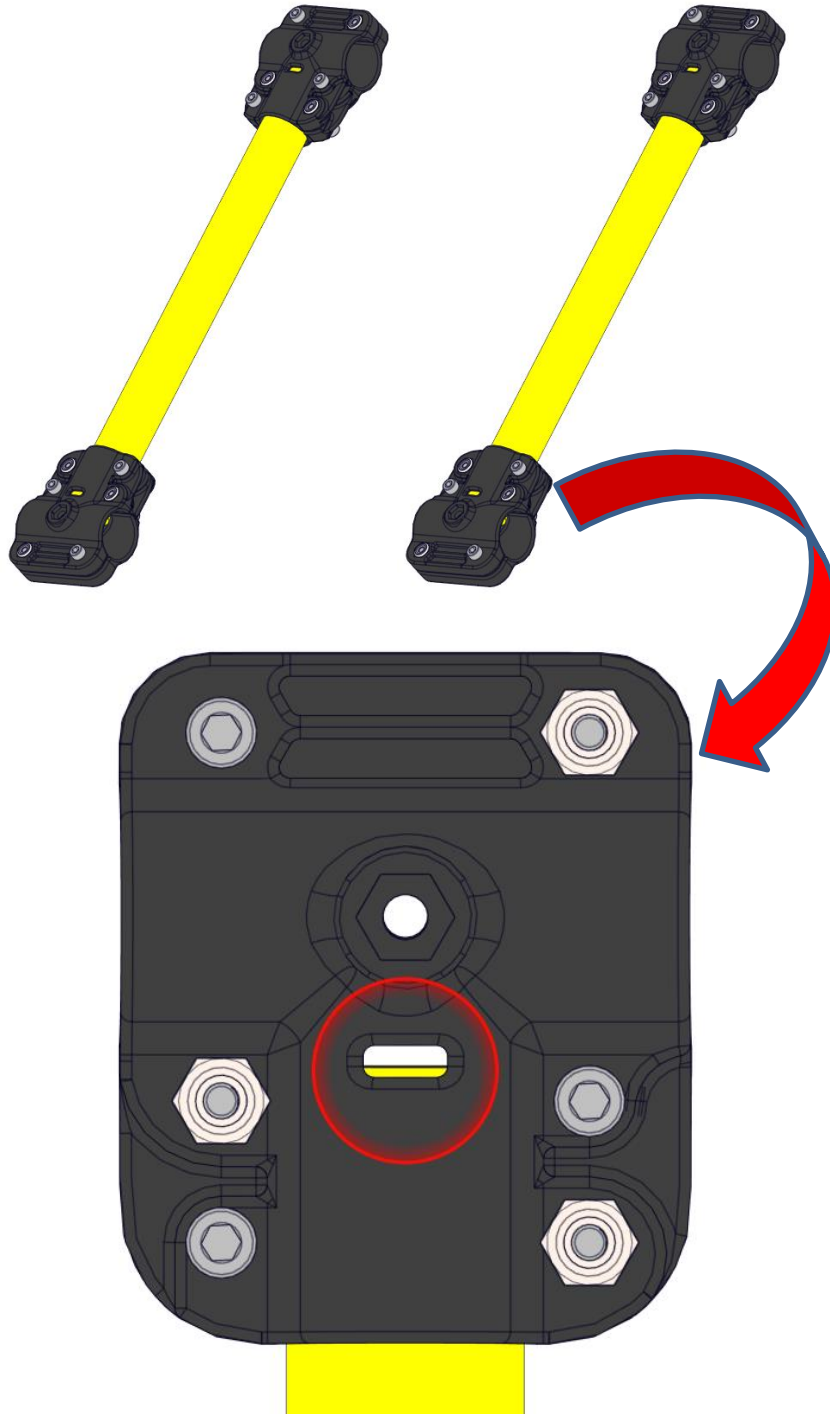
Build **FOUR** more T-Clamp assemblies, this time **WITHOUT** the 1.5" long screw in the center. **Do NOT tighten this assembly.** It should freely slip onto the yellow tubes.



4X

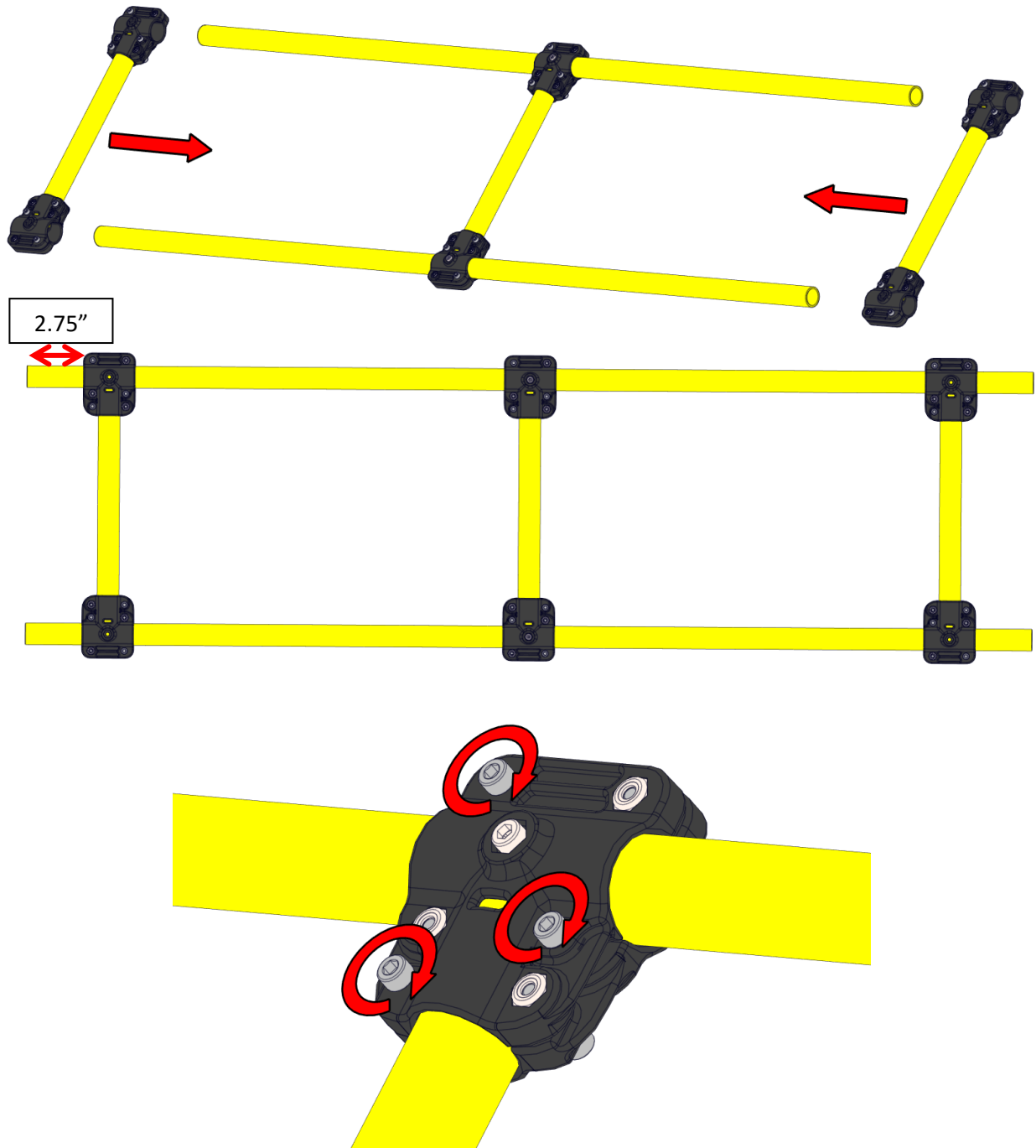
Step 6

Insert the short yellow pipes (am-5108) into the bottom of the T-clamp assemblies. There should be two T-clamp assemblies per pipe, assembled as shown. The pipe **SHOULD NOT BE PUSHED ALL THE WAY THROUGH THE ASSEMBLY**. Instead, it should be inserted up to the observation window as shown.

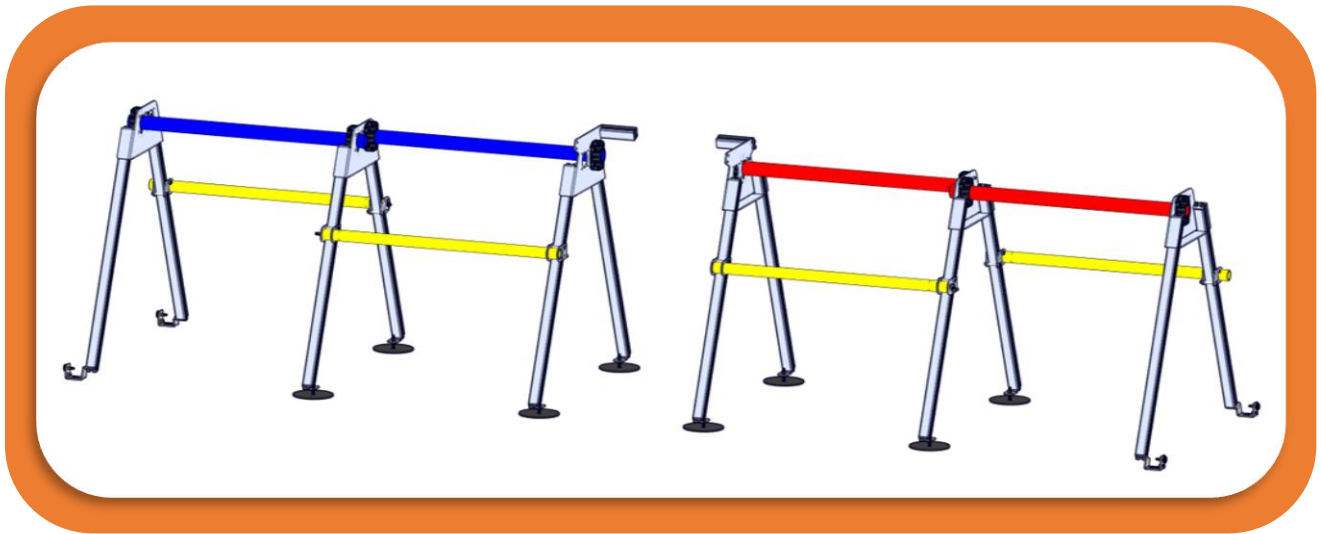


Step 7

Lay all the Stage Door components on the floor. Slip the pipe & T-clamp assemblies onto the “H” structure. The edge of the T-clamps should be 2.75” from the end of the perpendicular pipes. Push on the top and bottom of the Stage Door assembly until the short pipes are all pressed against the longer pipes inside the T-clamps. All of the “windows” in the T-clamps should be completely filled by yellow pipe. Tighten all screws in place. **Periodically push the assembly against the floor to ensure it remains as flat as possible once completely assembled.**



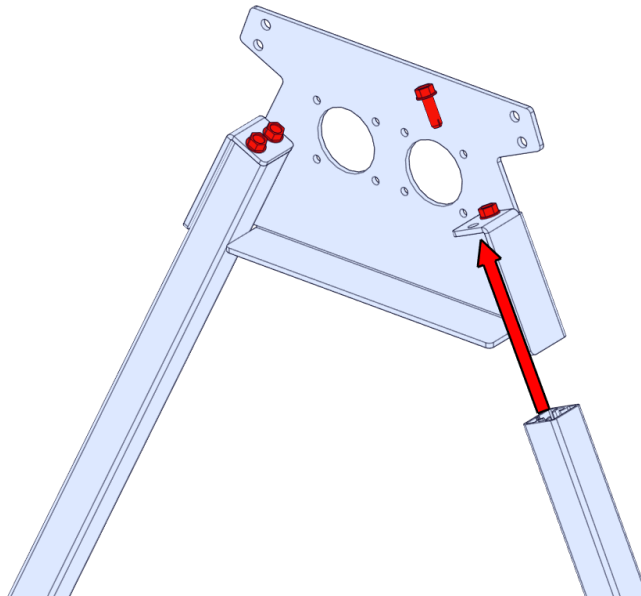
TRUSS ASSEMBLY



Truss Assembly

Step 1

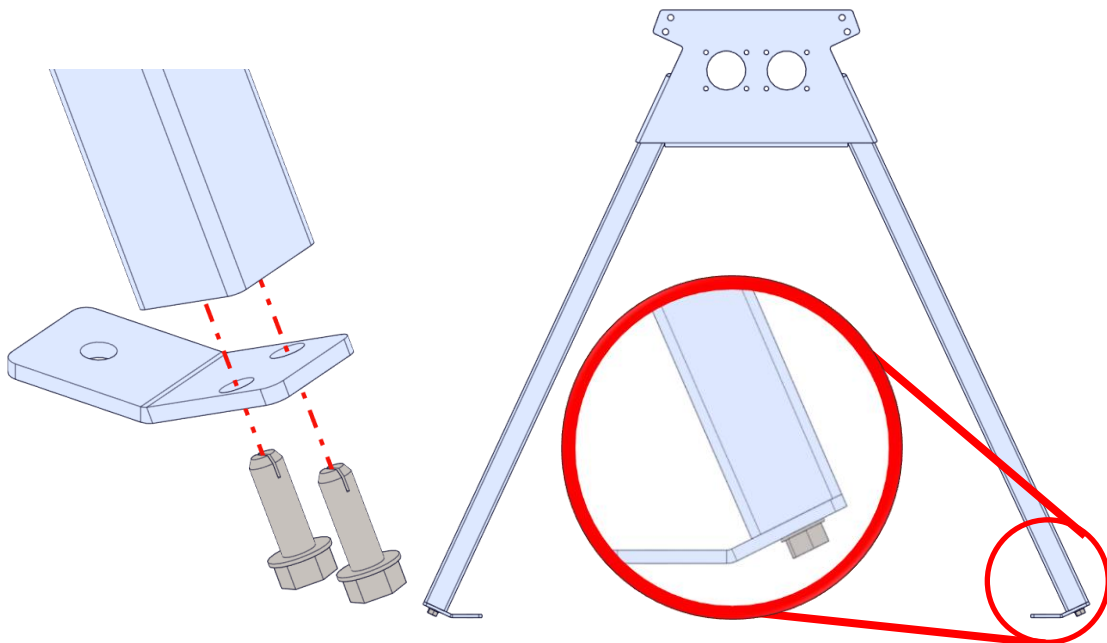
Attach two 2 foot long Peanut Legs (am-3090a-2) to the Apex Blocker Bracket (am-5116) using four 3/4" long thread-forming 1/4-20 screws (am-1310). **BUILD TWO OF THESE ASSEMBLIES.**



2X

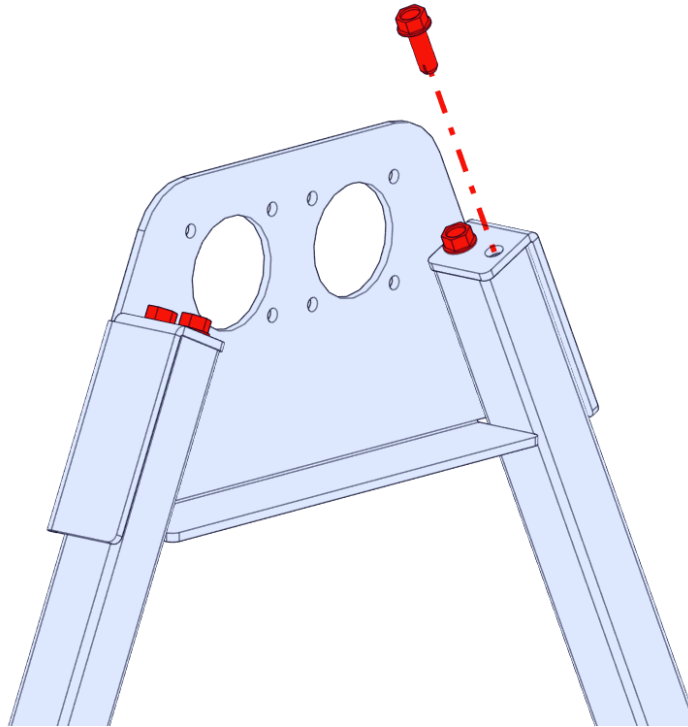
Step 2

On the other side of each peanut extrusion, attach one Under Tile Peanut Mount Bracket (am-5112) using two 3/4" long thread-forming screws (am-1310). The feet should face towards center of the A-Frame as shown below.



Step 3

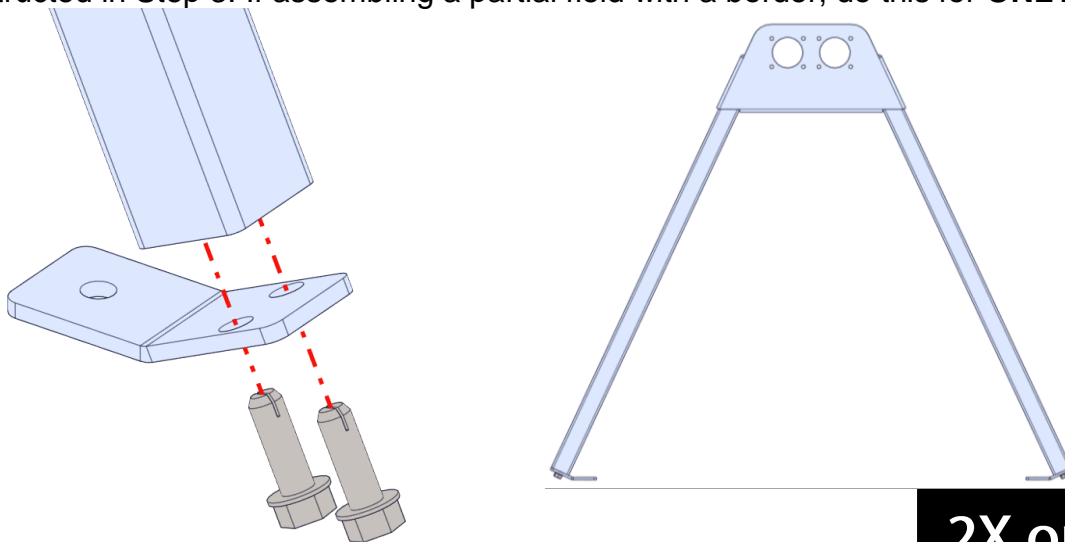
Attach two 2 foot long Peanut Legs (am-3090a-2) to the Apex Bracket (am-5106) using four 3/4" long thread-forming 1/4-20 screws (am-1310). If constructing a full field, you should complete **FOUR** of these assemblies. If constructing a partial field, you should complete only two of these assemblies.



4X or 2X

Step 4

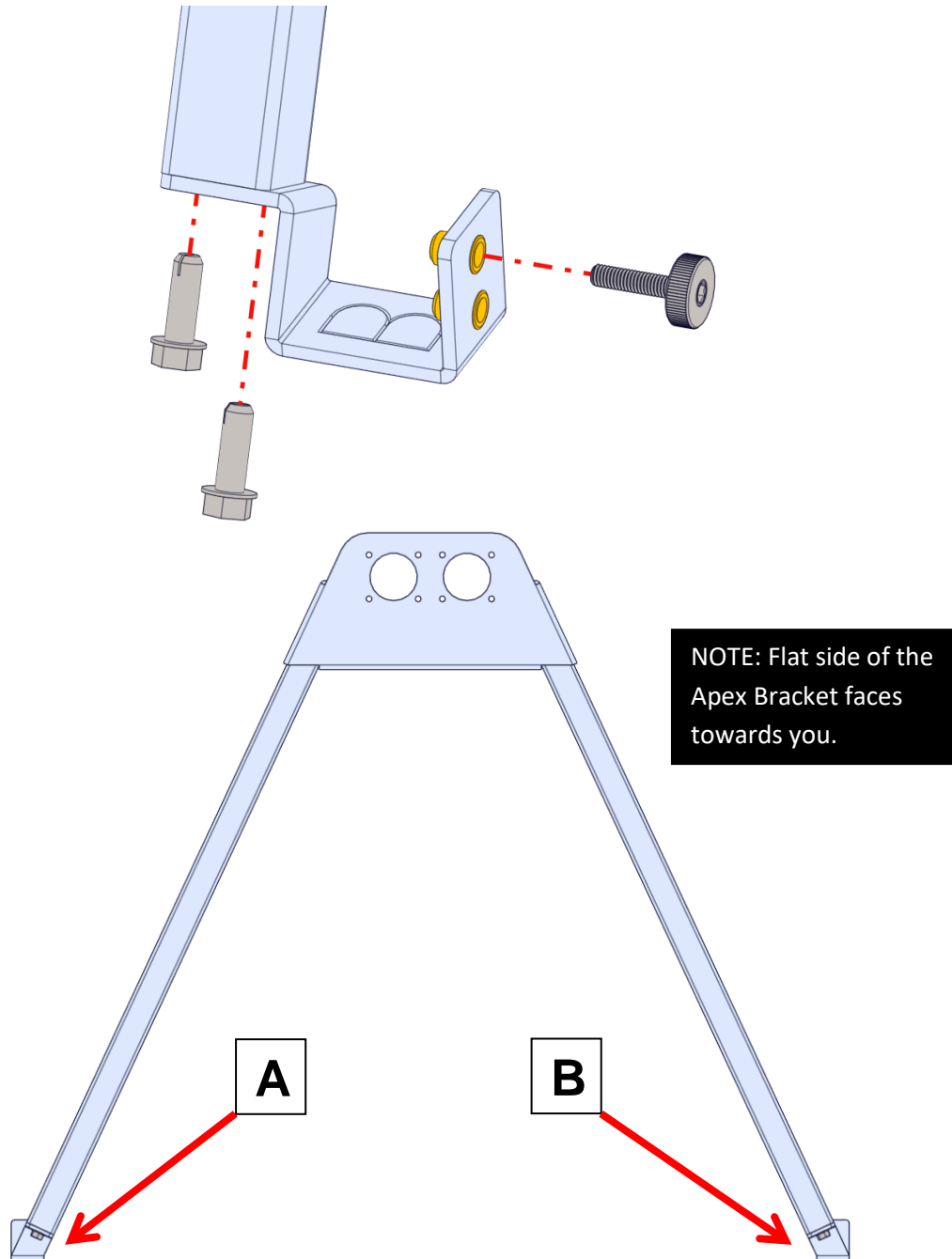
On the other side of a peanut extrusion, attach one Under Tile Peanut Mount Bracket (am-5112) using two 3/4" long thread-forming screws (am-1310). The feet should face in towards the A-Frame as shown below. Do this for **ONLY TWO** of the assemblies you constructed in Step 3. If assembling a partial field with a border, do this for **ONLY ONE**.



2X or 1X

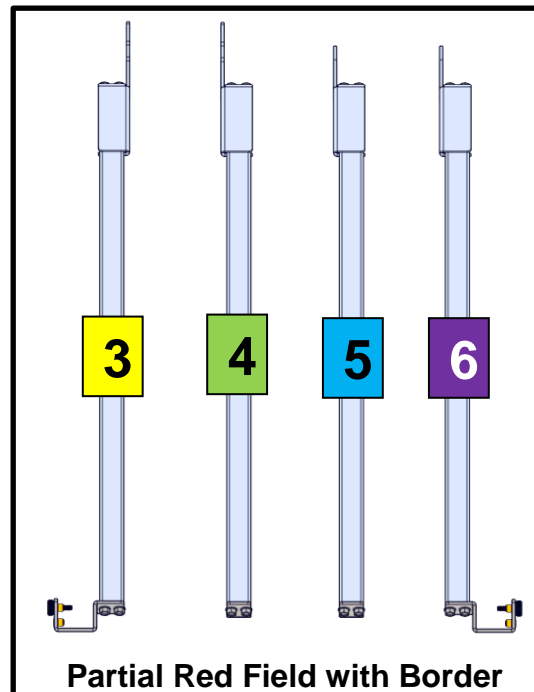
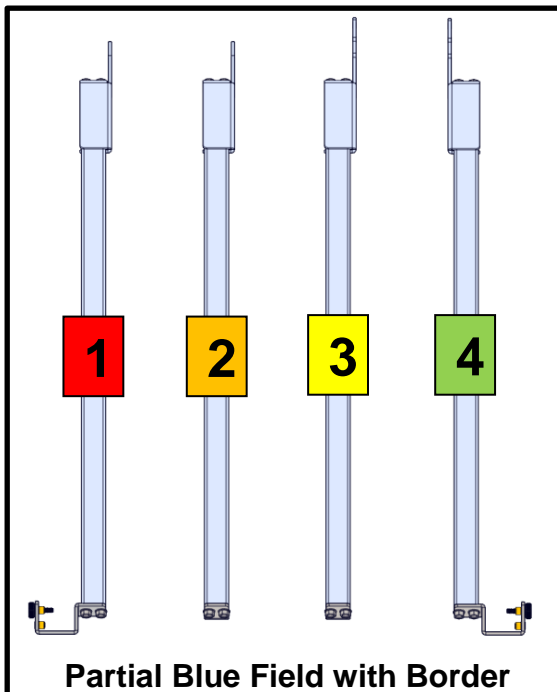
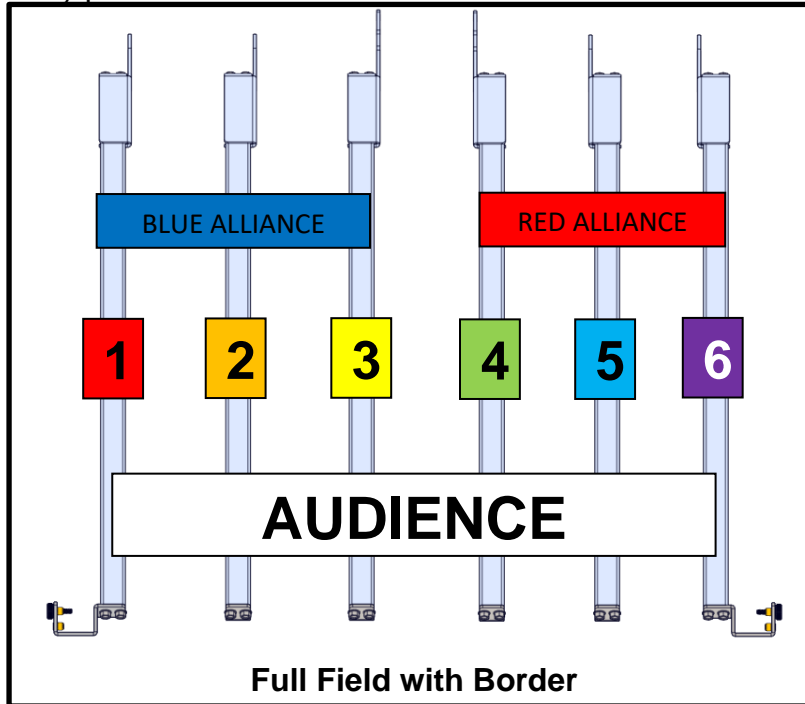
Step 5 – SKIP THIS STEP IF ASSEMBLING A FIELD WITH NO BORDER

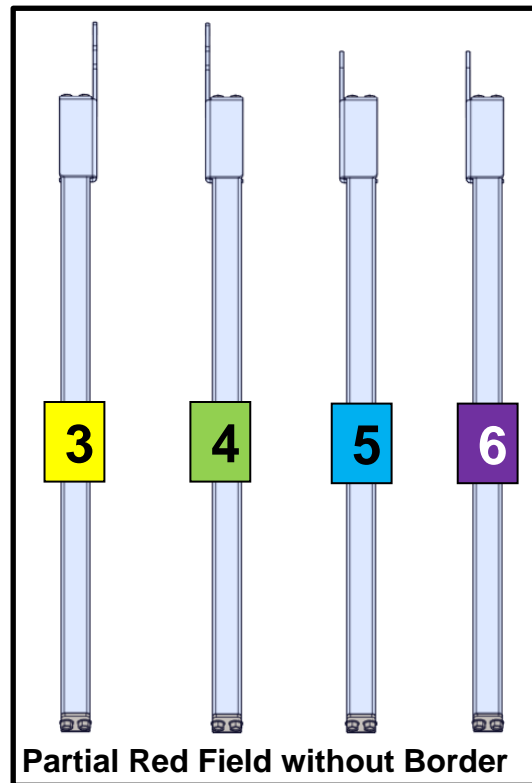
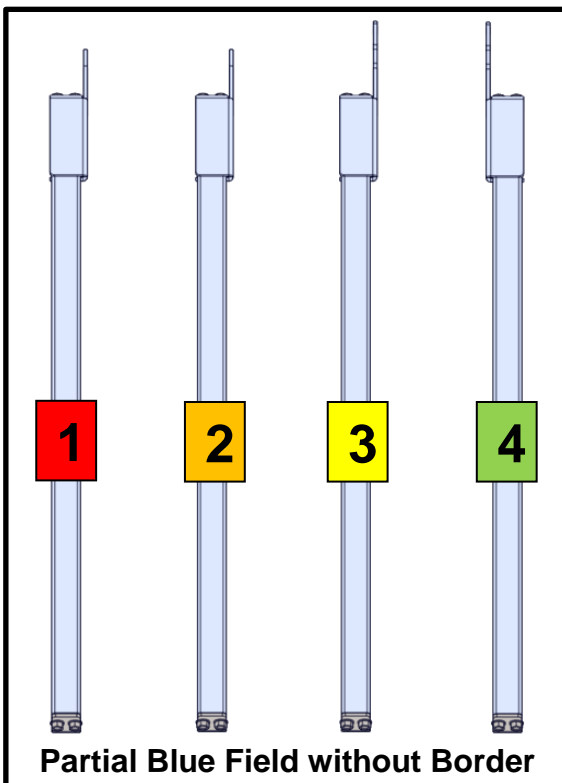
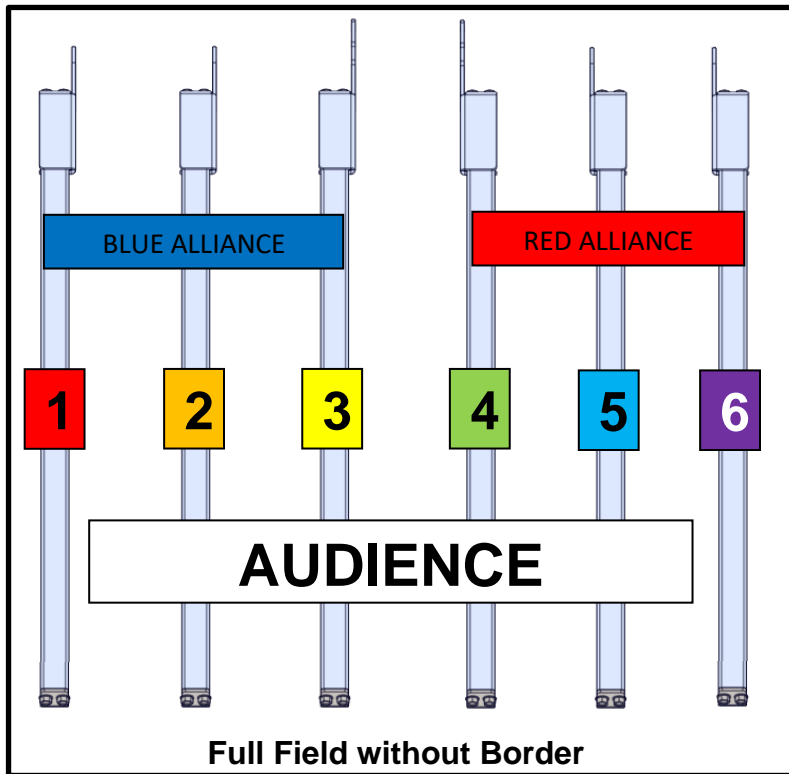
On the remaining A-Frame assemblies, attach one Under Border Peanut Mount Bracket (am-5113) to each peanut leg with two 3/4" long thread-forming screws (am-1310). The brackets are labeled with an A or B letter. When looking at the A-Frame in the orientation in which no bends are visible on the Apex Bracket (am-5106), the bracket labeled A goes on the left, and the bracket labeled B goes on the right. Both brackets are oriented so that the bent portions of the part are on the same side as the bend portions of the Apex Bracket. Loosely insert the 3/4" long thumb screw (am-4558) into the upper rivnut if building using an AndyMark field perimeter. For an IFI field perimeter, insert the screw into the lower rivnut.



STOP

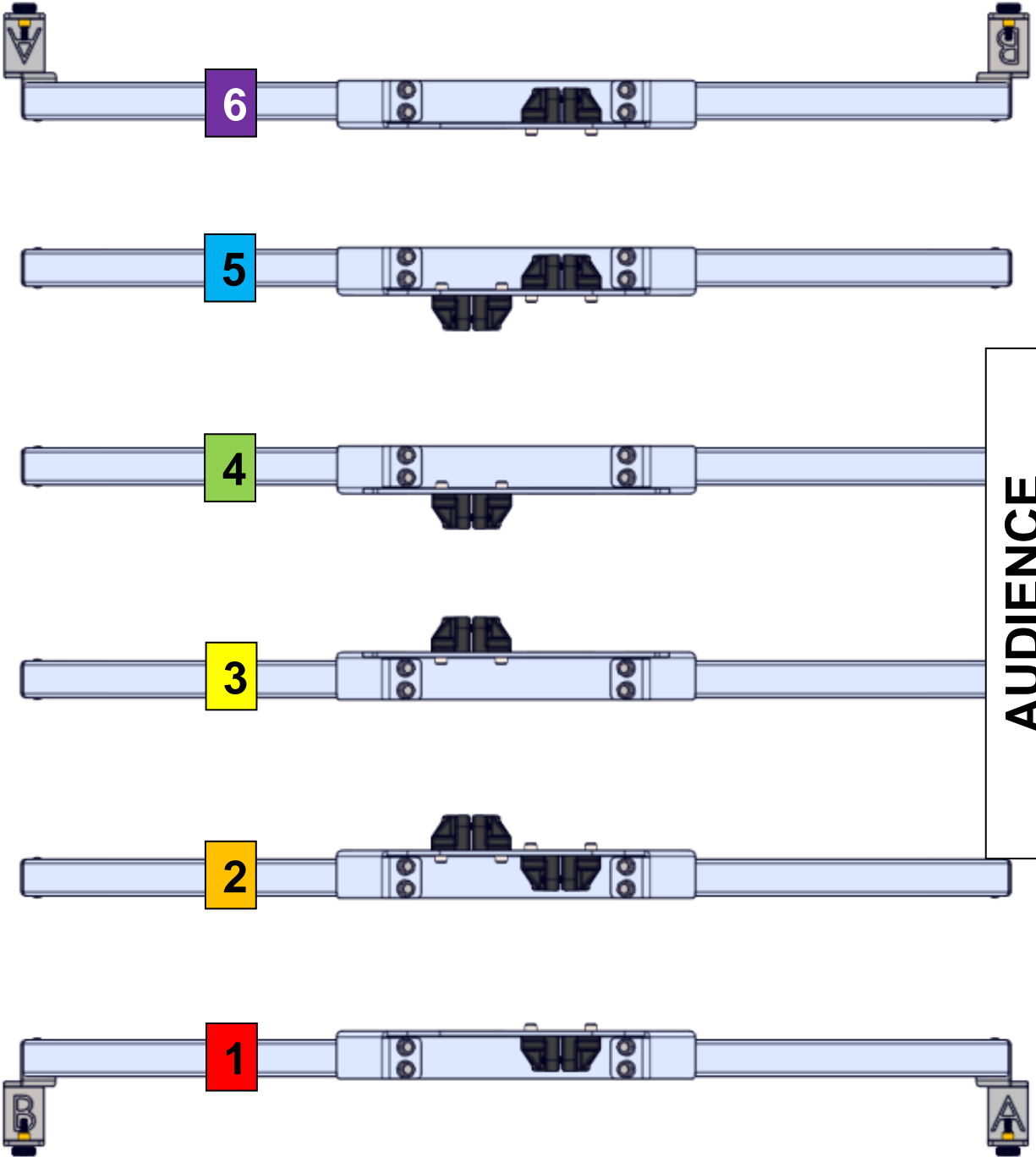
At this point, you should have either four or six completed A-Frame assemblies. The assemblies you should have completed are shown below for each field configuration. Each frame in this diagram is labeled with a number that will be used to identify it for the rest of the assembly process.





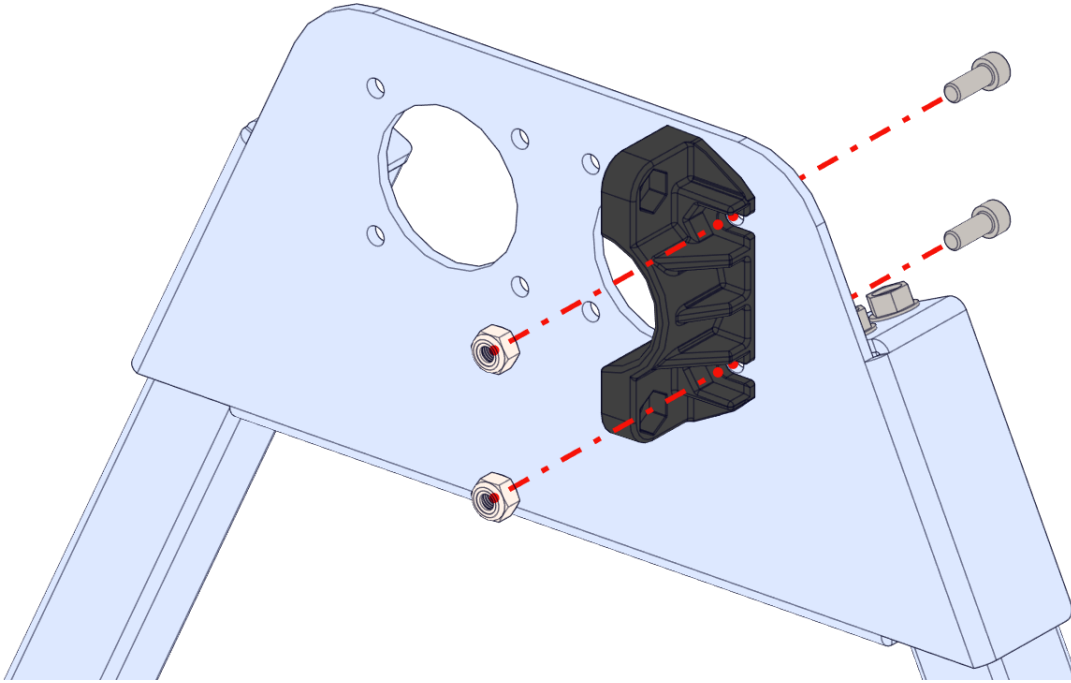
Step 6

Using the instructions in steps 6a and 6b on the next page, install C-clamps on each of the A-Frames as shown. Pay close attention the orientations of the C-clamps on each A-Frame, and note that only two A-Frames (frames 2 and 5) receive two C-clamp pairs.



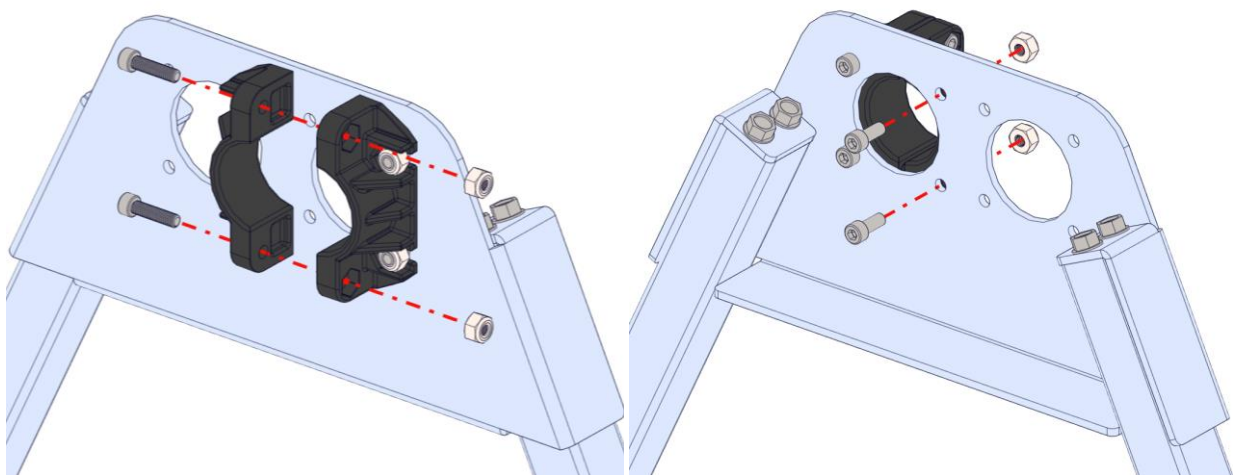
Step 6a

To install a C-Clamp (am-5110_half), use two 1/2" long 10-32 screws (am-1002) and 10-32 nylock nuts (am-1042). Put the nut in first for the easiest experience. **DO NOT** completely tighten this assembly! Leave it loose enough to slide along the slot.



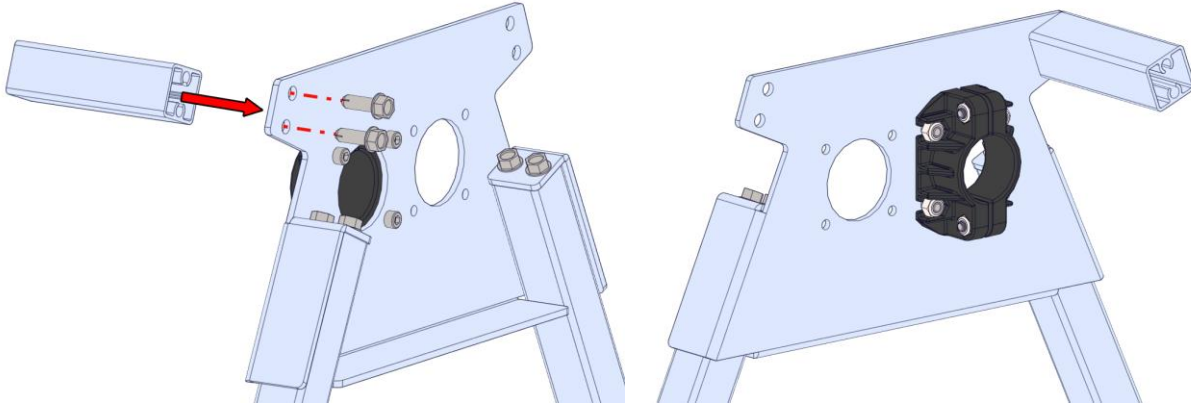
Step 6b

Attach the other half of the C-Clamp (am-5110_half) to the first half using two 3/4" long 10-32 screws (am-1047). **DO NOT** tighten these all the way down. Leave the two halves very loosely connected. Attach the second C-Clamp with two 1/2" long 10-32 screws (am-1002) and 10-32 nylock nuts (am-1042).



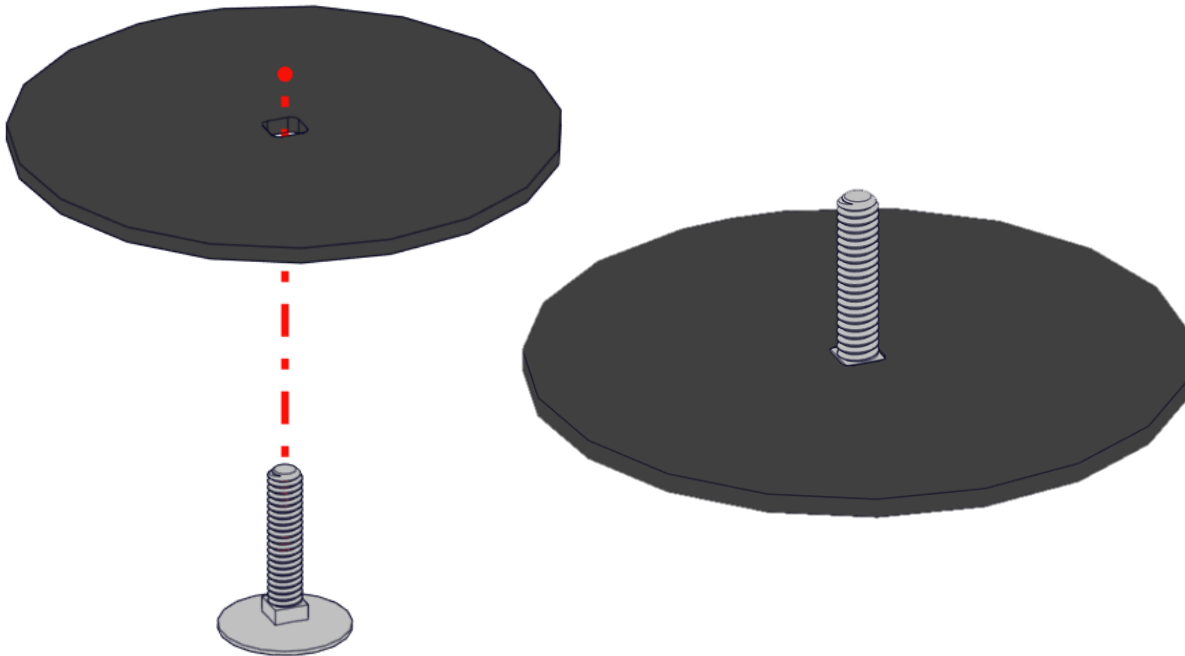
Step 7

Attach the 3.5" long peanut extrusion (am-4504a) to the Apex Blocker Brackets using the set of holes closest to the C-Clamps attached in Step 6 and two 3/4" long thread-forming screws as shown.



Step 8

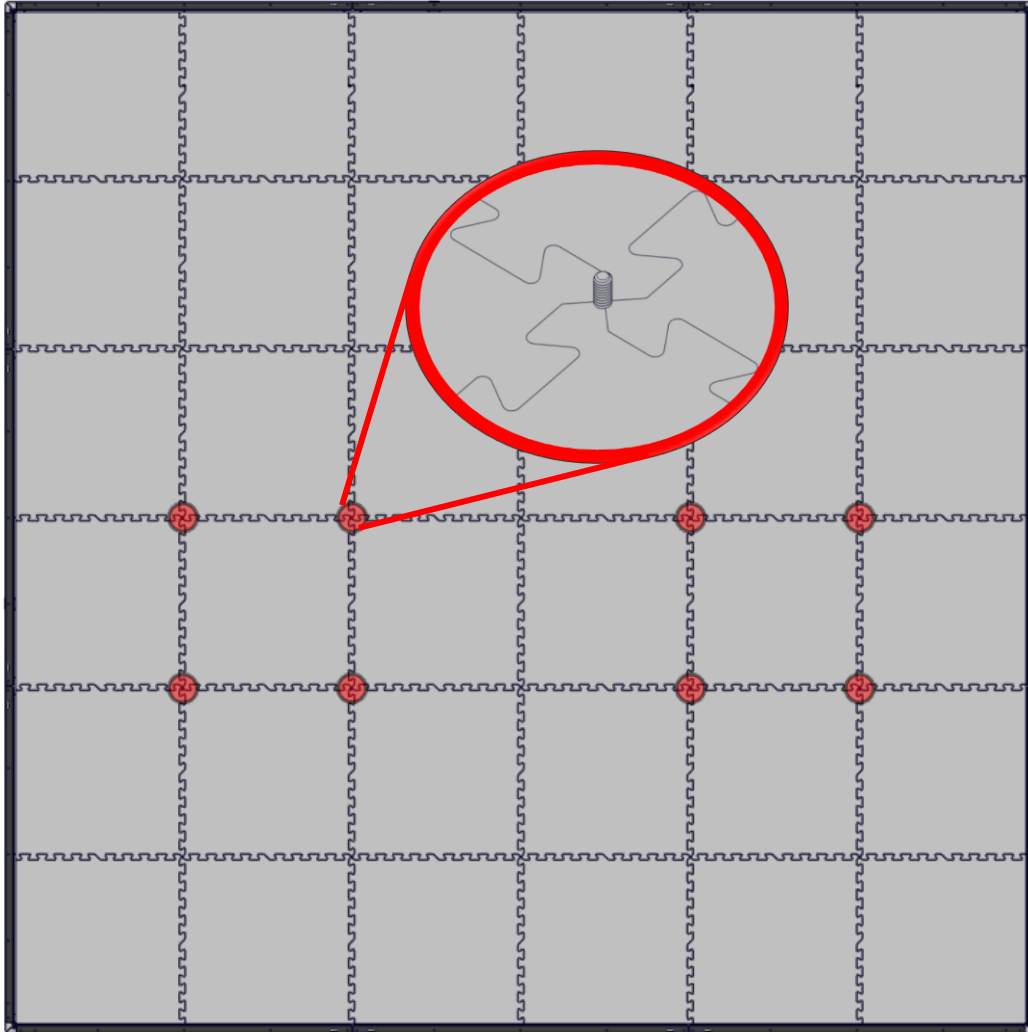
Prepare the Under Tile Disk Assemblies by inserting an elevator bolt (am-1629) through the square hole in an Under Tile Disk (am-3881). For a full field, prepare 8 of these assemblies. For a partial field, prepare 4 of these assemblies.



8X or 4X

Step 9

At each of the highlighted locations, gently lift up the tiles and slip one of the assemblies from Step 8 underneath so that the elevator bolt sticks up through the intersection of four tiles.



AUDIENCE

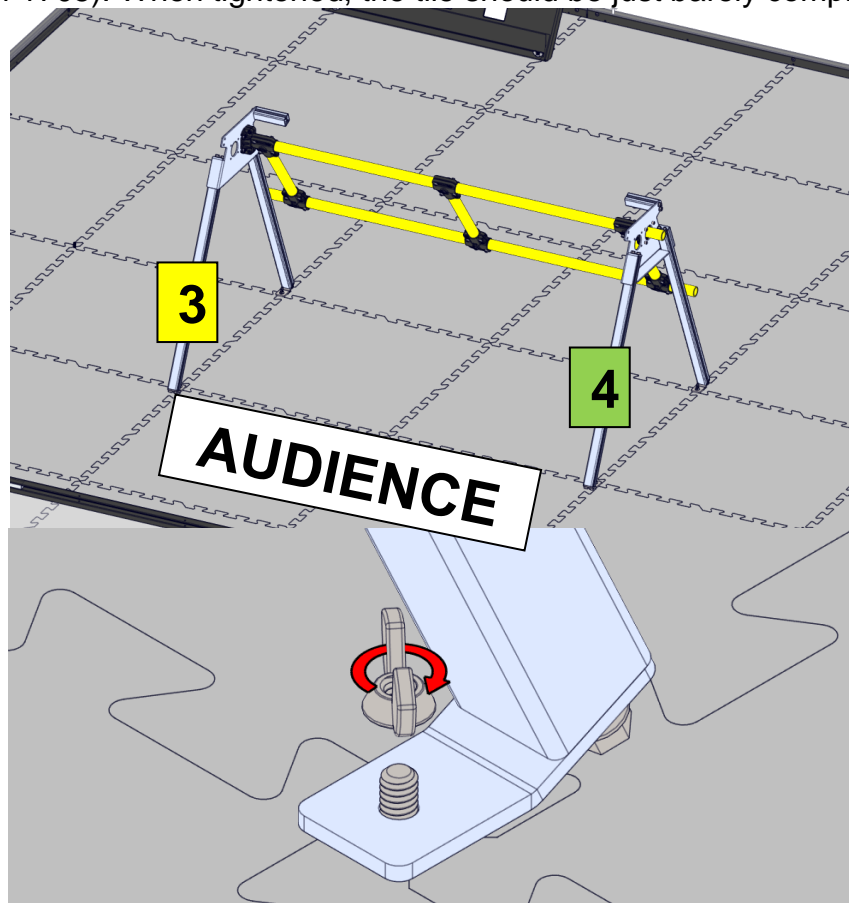


Optional Step: During Gameplay, robot interaction with the trusses may cause slight shifting of the trusses and elevator bolts between the tile. To alleviate shifting, [3" washers \(am-1628\)](#) may be added on top of the tile teeth and through the elevator bolt prior to placing the A-Frames onto the elevator bolt.



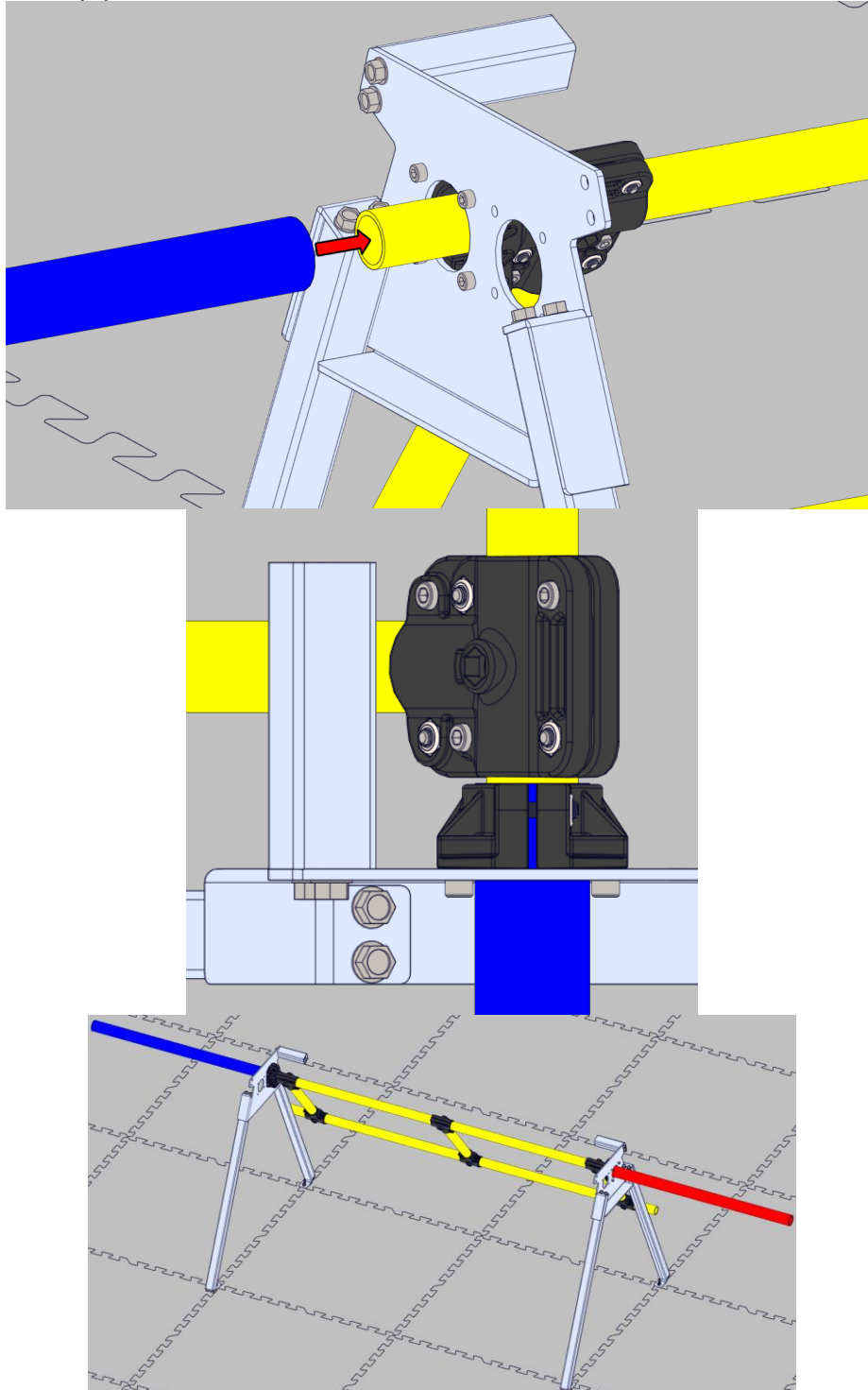
Step 10

It is now time to start attaching the frames to the field. Begin by placing A-Frames 3 & 4 onto the Under Tile Disk Assemblies sticking up through the tiles at the center of the field. The Stage Door Blocker Peanut should be closest to the Backdrops, away from the Audience. Slip the Stage Door Assembly into the C-Clamps on the A-Frames. **DO NOT TIGHTEN THE CLAMPS.** Secure the A-Frames in place by screwing on 1/4-20 wing nuts (am-1705). When tightened, the tile should be just barely compressed.



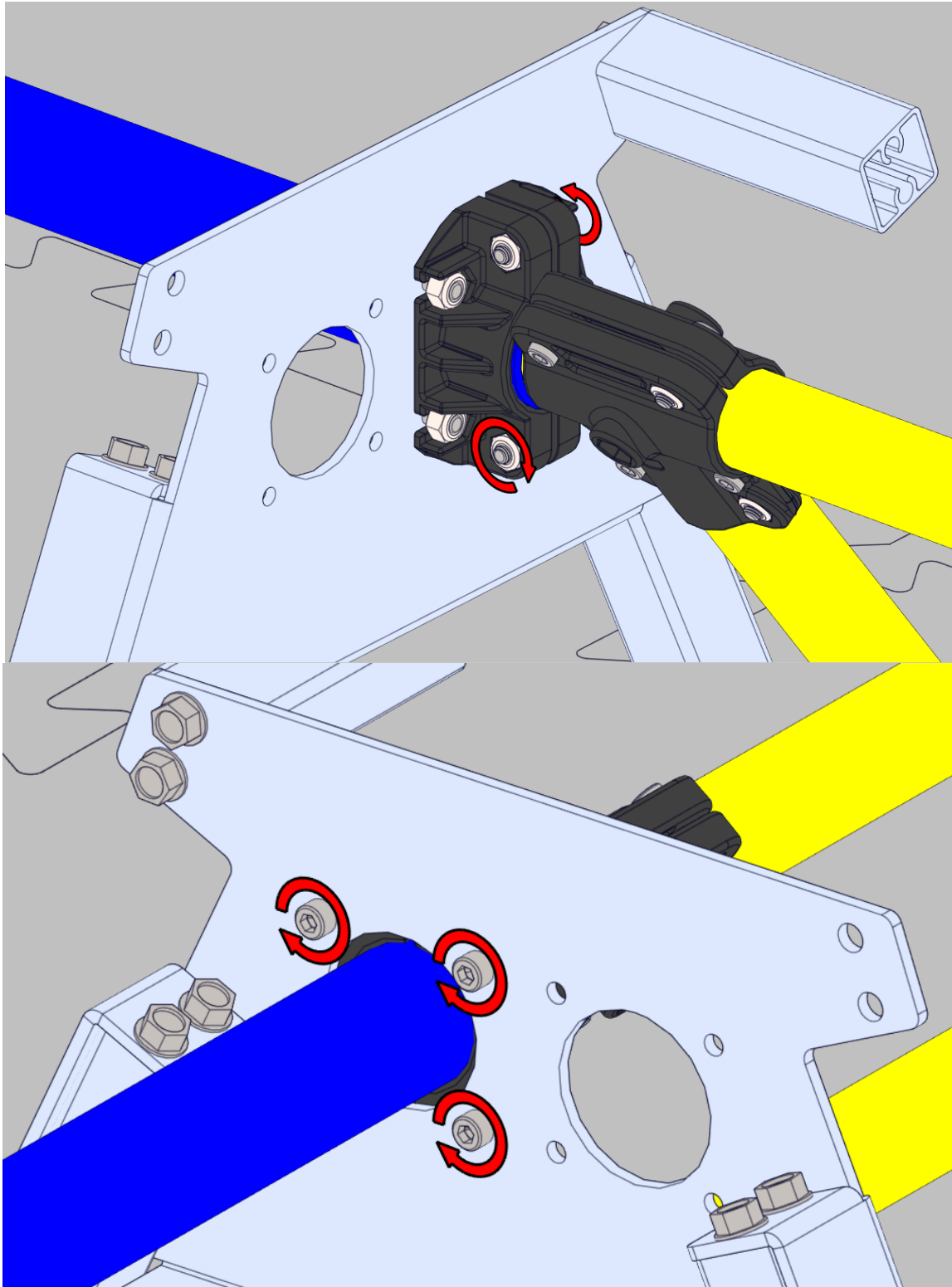
Step 11

Slip hanging bars (am-5109) through the C-Clamps on each frame until they are flush with the Stage Door Assembly. The red hanging bar should be placed on the right side of the Stage Door (when viewed from the audience). The blue hanging bar should be placed on the opposite side. The yellow pipe of the Stage Door Assembly slips inside the blue and red pipes.



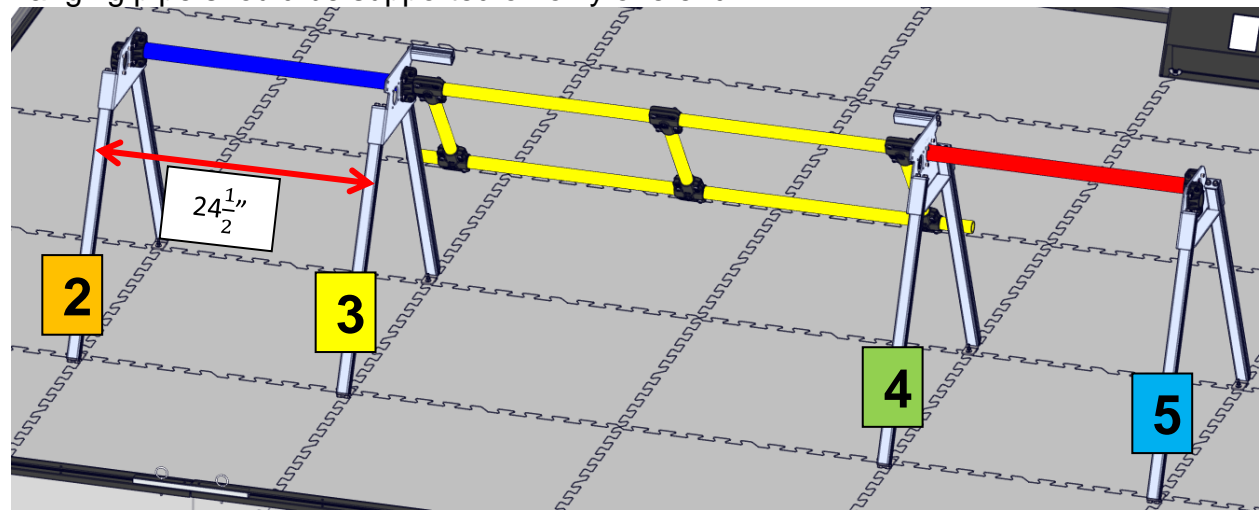
Step 12

Tighten the clamps closest to the Stage Door. **DO NOT** over-tighten! Make sure the Stage Door still freely moves after tightening. If it doesn't, loosen the clamps until it does.

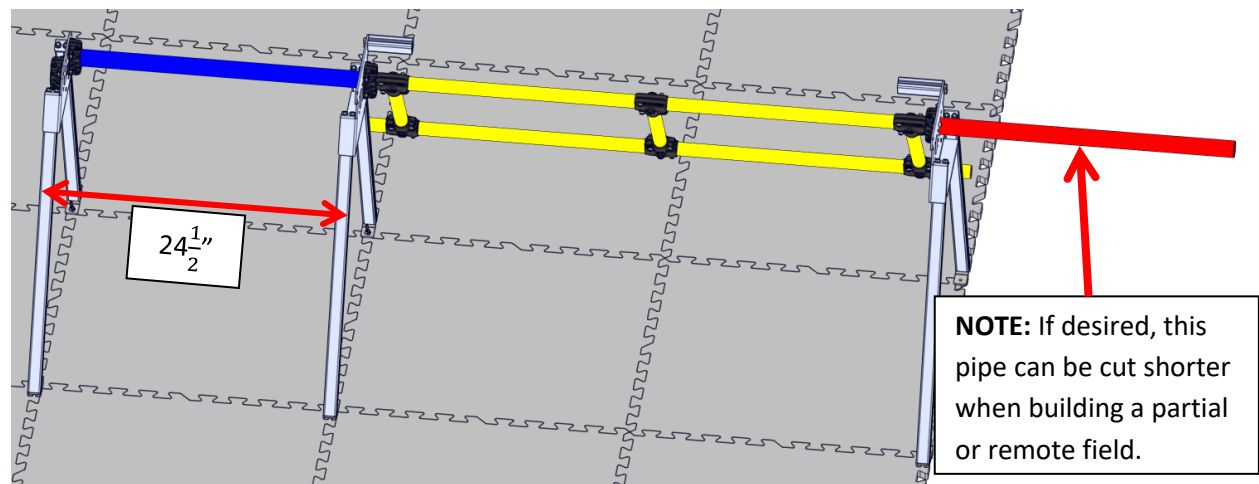


Step 13

Place A-Frames 2 and/or 5 onto the field in the same manner as in Step 10. Secure to the tiles with Wing Nuts (am-1705). Slide the hanging bars placed in Step 12 through the clamps on each frame. Tighten the clamps onto the pipe as in Step 12, making sure that the outside edges of the A-Frame peanut are 24.5" apart. If building a partial field, you should be placing only one A-Frame down in this step. For a red partial field, the blue hanging pipe should be supported on only one end. For a blue partial field, the red hanging pipe should be supported on only one end.



FULL FIELD

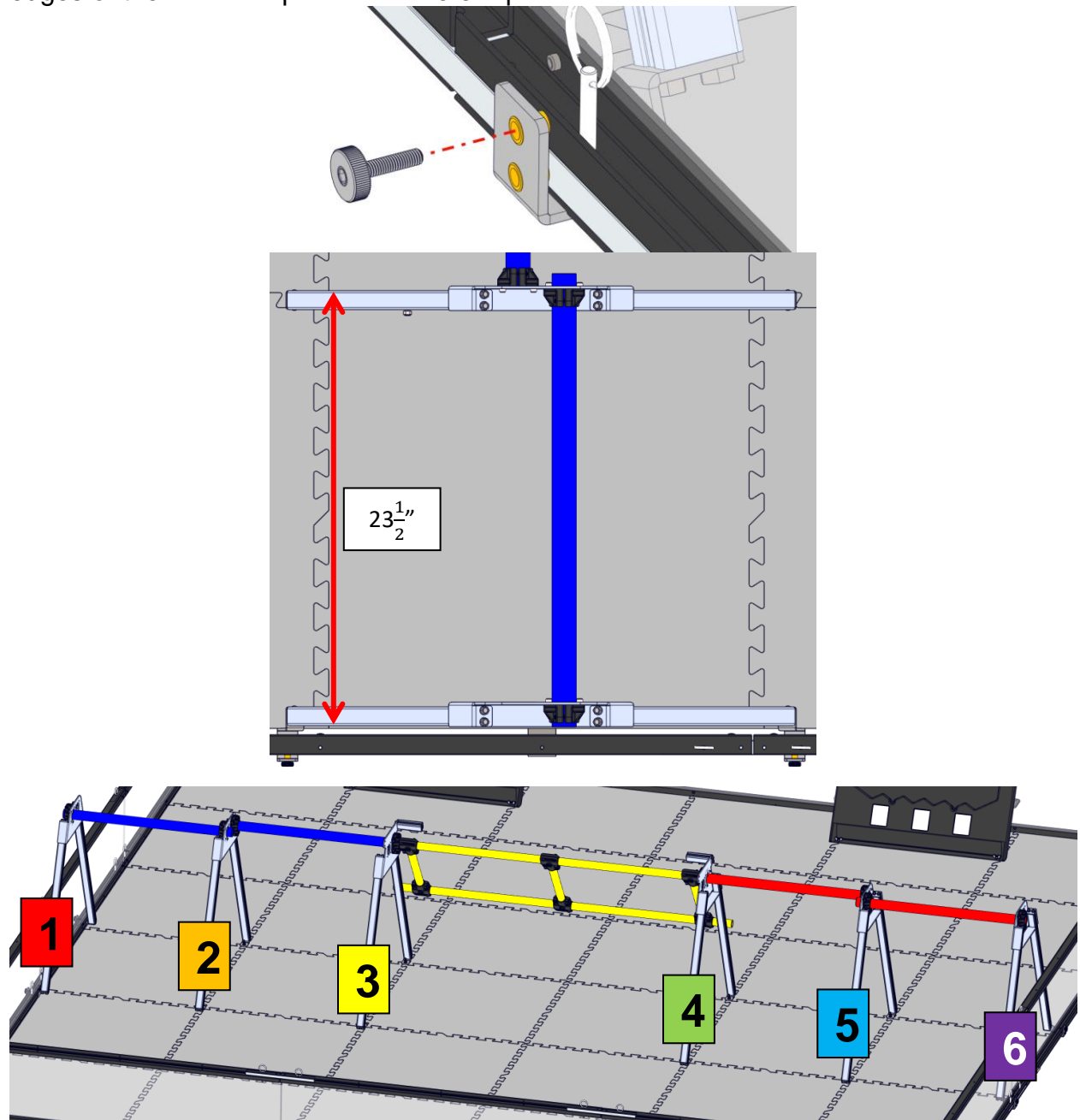


NOTE: If desired, this pipe can be cut shorter when building a partial or remote field.

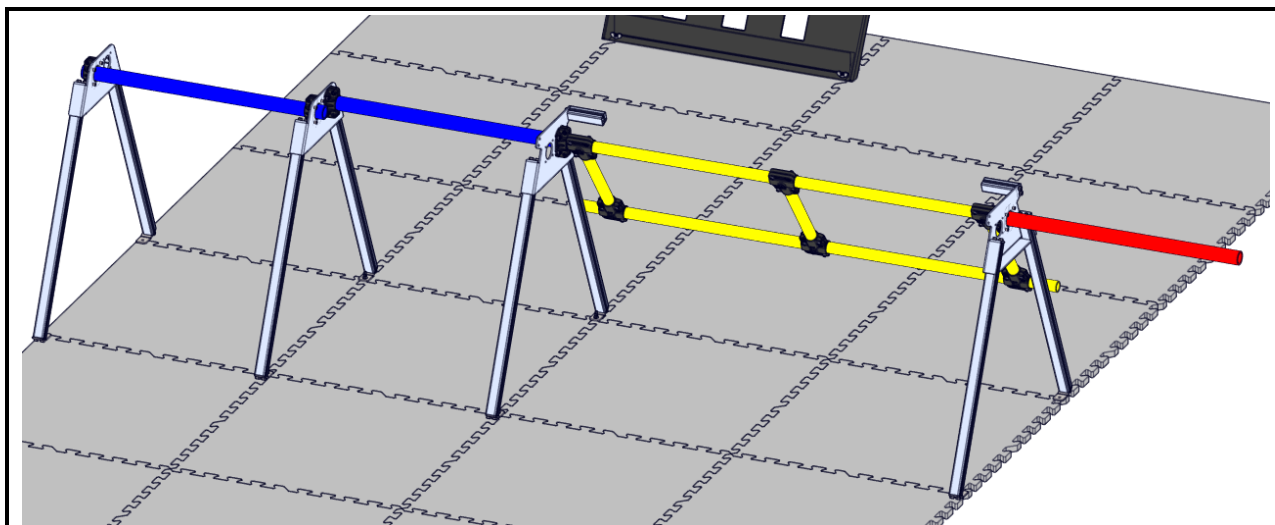
PARTIAL FIELD

Step 12

Place the remaining A-Frame(s) (Frames 1 and/or 6) onto the field. If assembling a Field with a border, slip the bottom of the A-Frame under the field border as shown. Align the A-Frame with the others in the row and then tighten the Under Border brackets to the field border using the Thumb Screws (am-4558). Slide another Hanging Bar through the C-clamps until the edge of the bar is flush with the second C-Clamp placed as shown. Tighten the clamps onto the pipe as in Step 10, making sure that the outside edges of the A-Frame peanut are 23.5" apart.



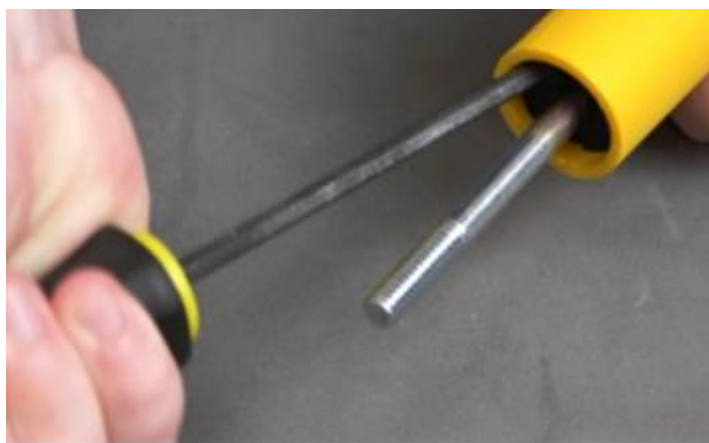
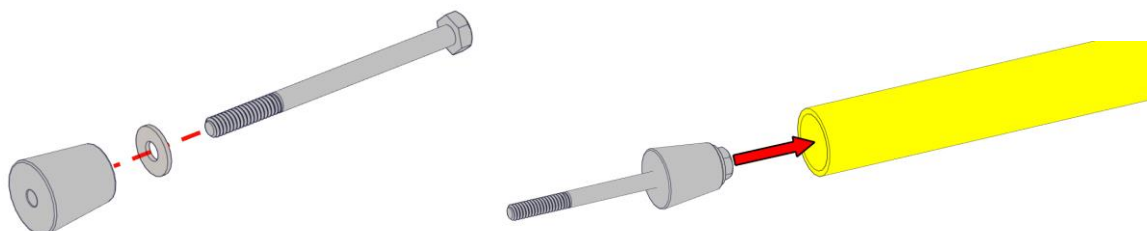
Full Field



Partial Field with No Border

Step 13

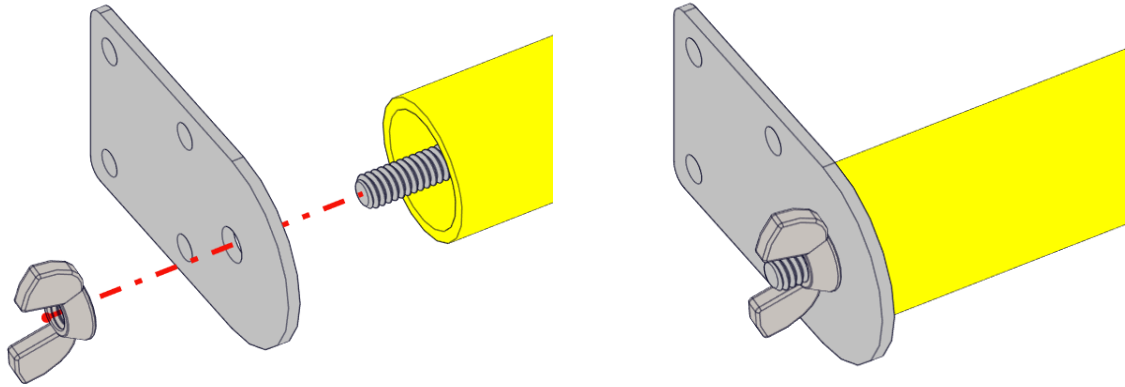
Insert 3.5" long 1/4-20 hex head screws (am-1605) through 1/4" washers (am-1027) and rubber stoppers (am-4806). Push the small end of the rubber stopper completely into a Long Yellow Pipe (am-5107) using a ball end driver or similar tool. Press around the edges of the rubber stopper to ensure that it is inserted straight and the screw exits parallel to the pole. Four assemblies should be created for a full field, and two for a partial field. The bolt should stick out from the tube about as much as the head of the bolt is wide.



4X or 2X

Step 14

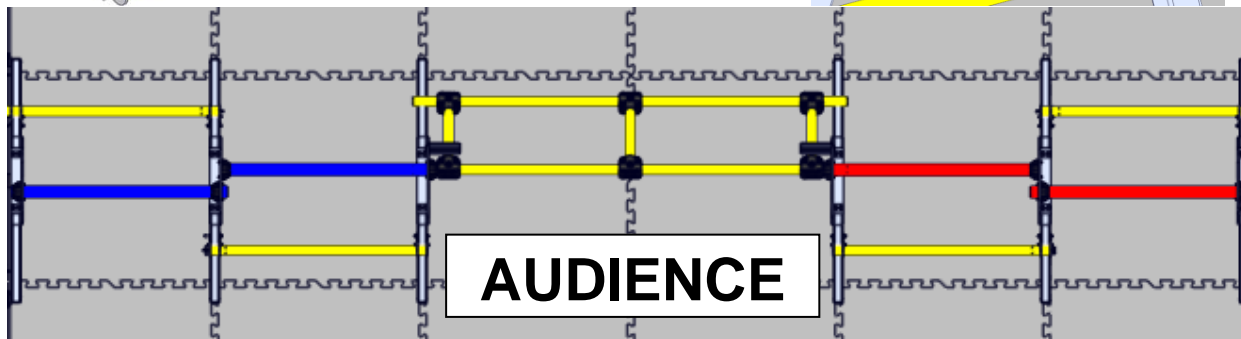
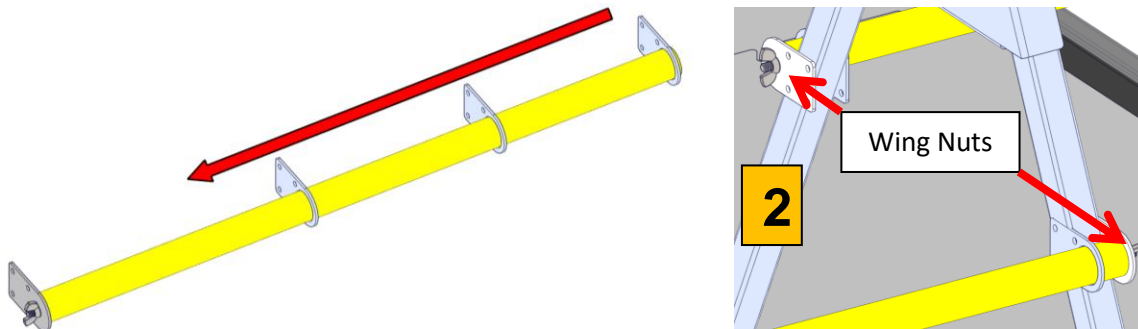
Insert the 1/4-20 screw end of a Height Limiter Assembly into a Truss Clamp Stop Bracket (am-5114). Tighten the Height Limiter Assembly to the bracket using a 1/4-20 Wing Nut (am-1705). Do this twice for a partial field, and four times for a full field.



4X or 2X

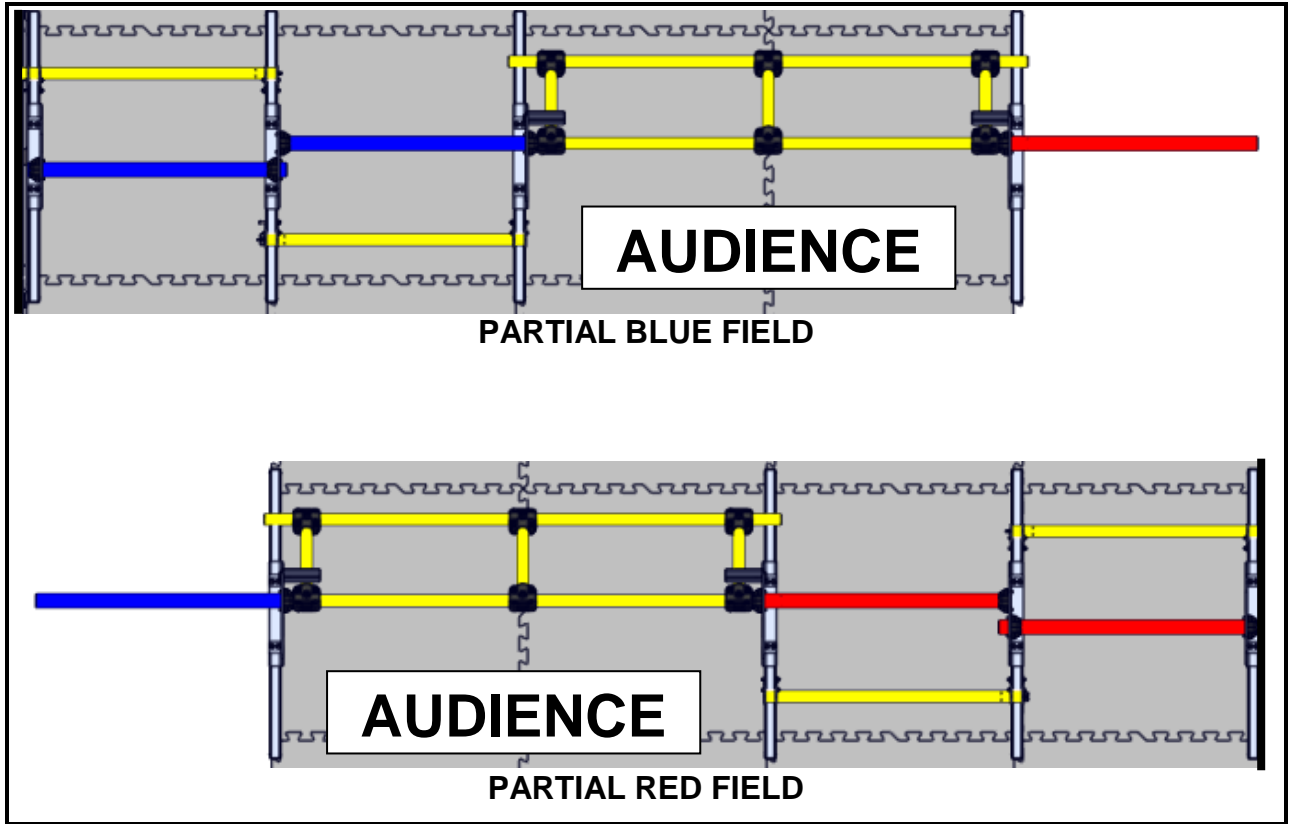
Step 15

Slide three Truss Clamp Passthrough Brackets (am-5115) onto the assemblies in Step 14. Position the assemblies between the A-Frames in the configuration shown below. Note that the Truss Clamp Stop Brackets (the bracket closest to the wing nut) should only ever touch A-Frames 2 and/or 5.



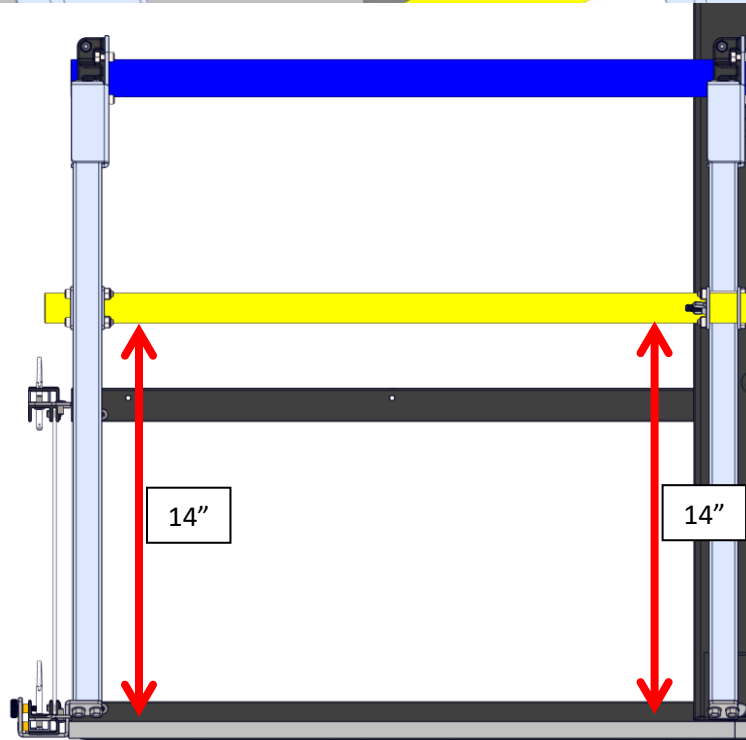
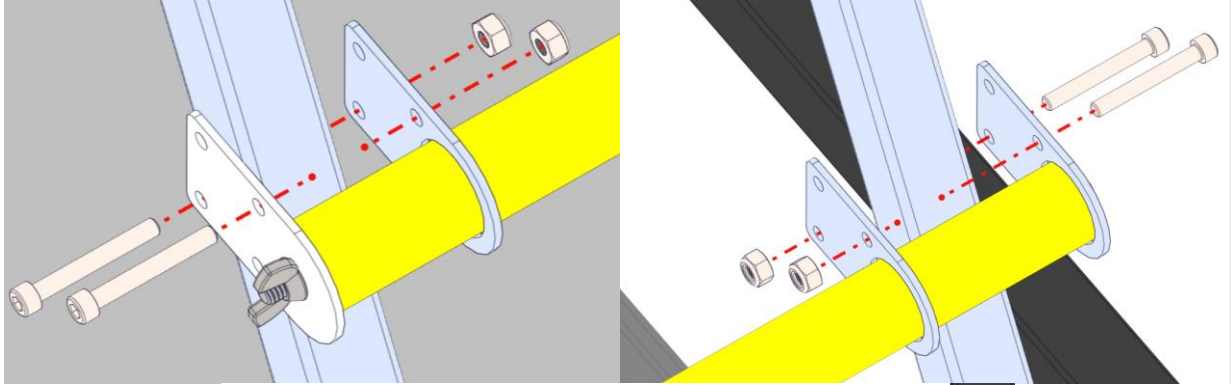
FULL FIELD





Step 16

Use 1.5" long 10-32 screws (am-1014) and 10-32 nylock nuts (am-1042) to clamp the pipe assemblies into position. Using a measuring tape, measure from the bottommost part of the pipe to the top face of the tile. Tighten the clamps so that this measurement is 14" on both sides of the pipe.



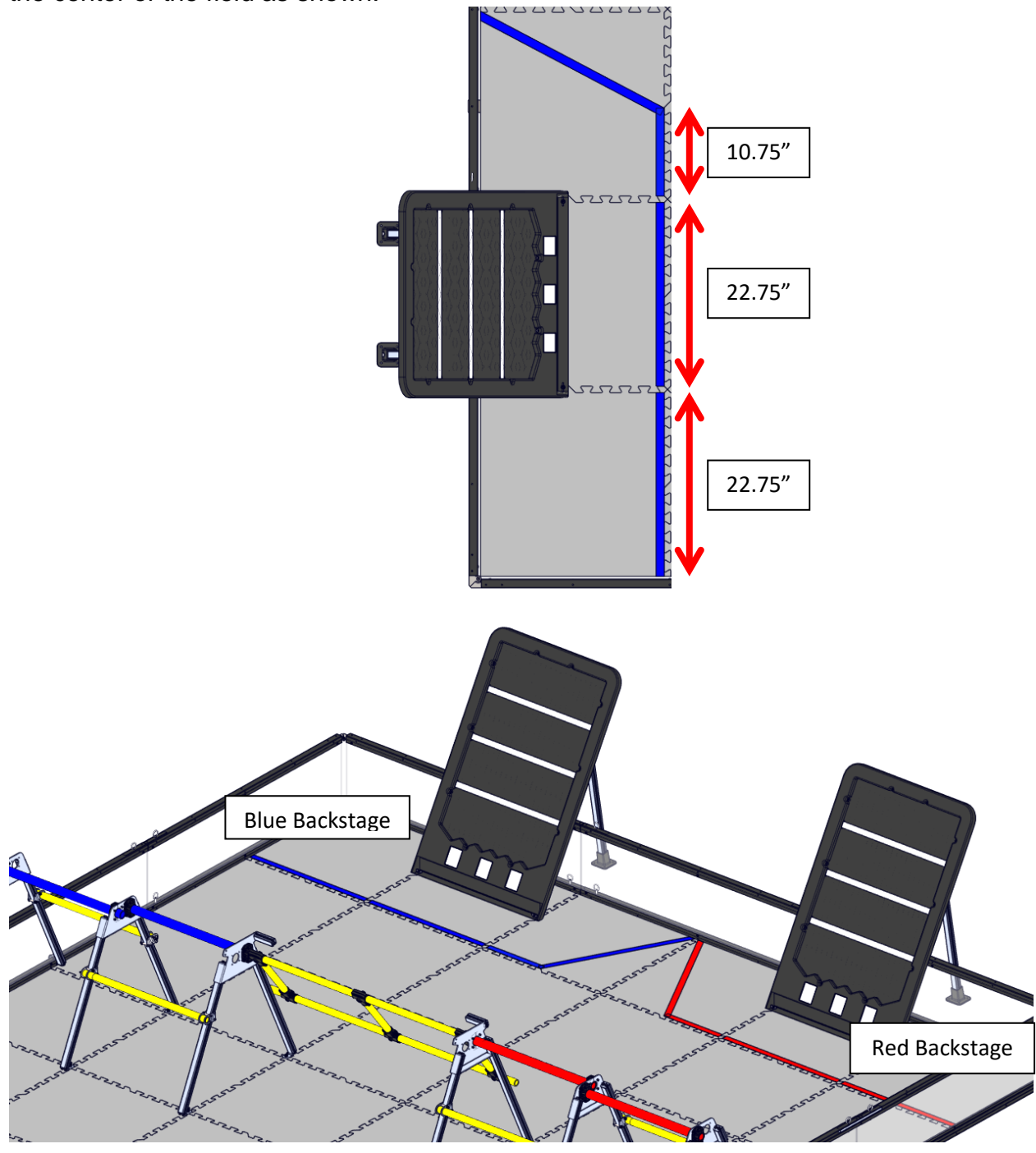
TAPE LINES



Tape Lines

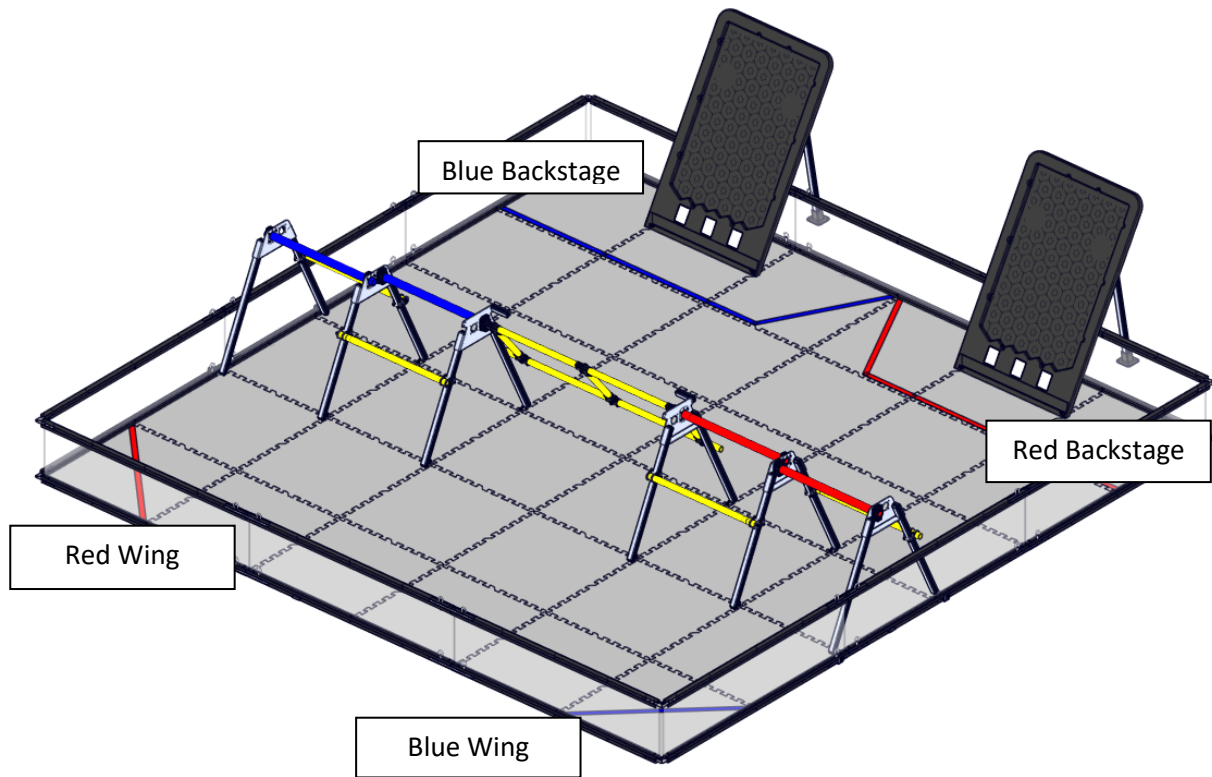
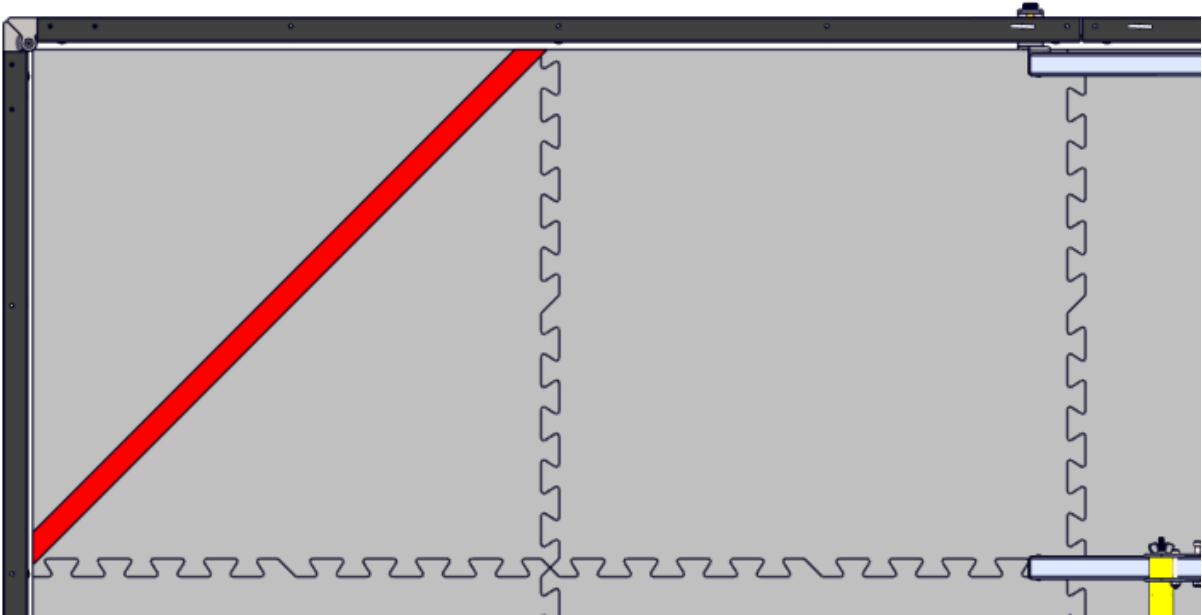
Backstage

One line (made of three 1" Gaffers tape strips, each contained to only one tile) extends from the field border side that is connected to the Truss, 58" towards the center of the field, along the edge of the tiles closest to the Backdrop as shown. An additional tape line connects the end of the first line and proceeds diagonally towards the field border to end at the seam between the center tiles. The red and blue sides are mirrored across the center of the field as shown.



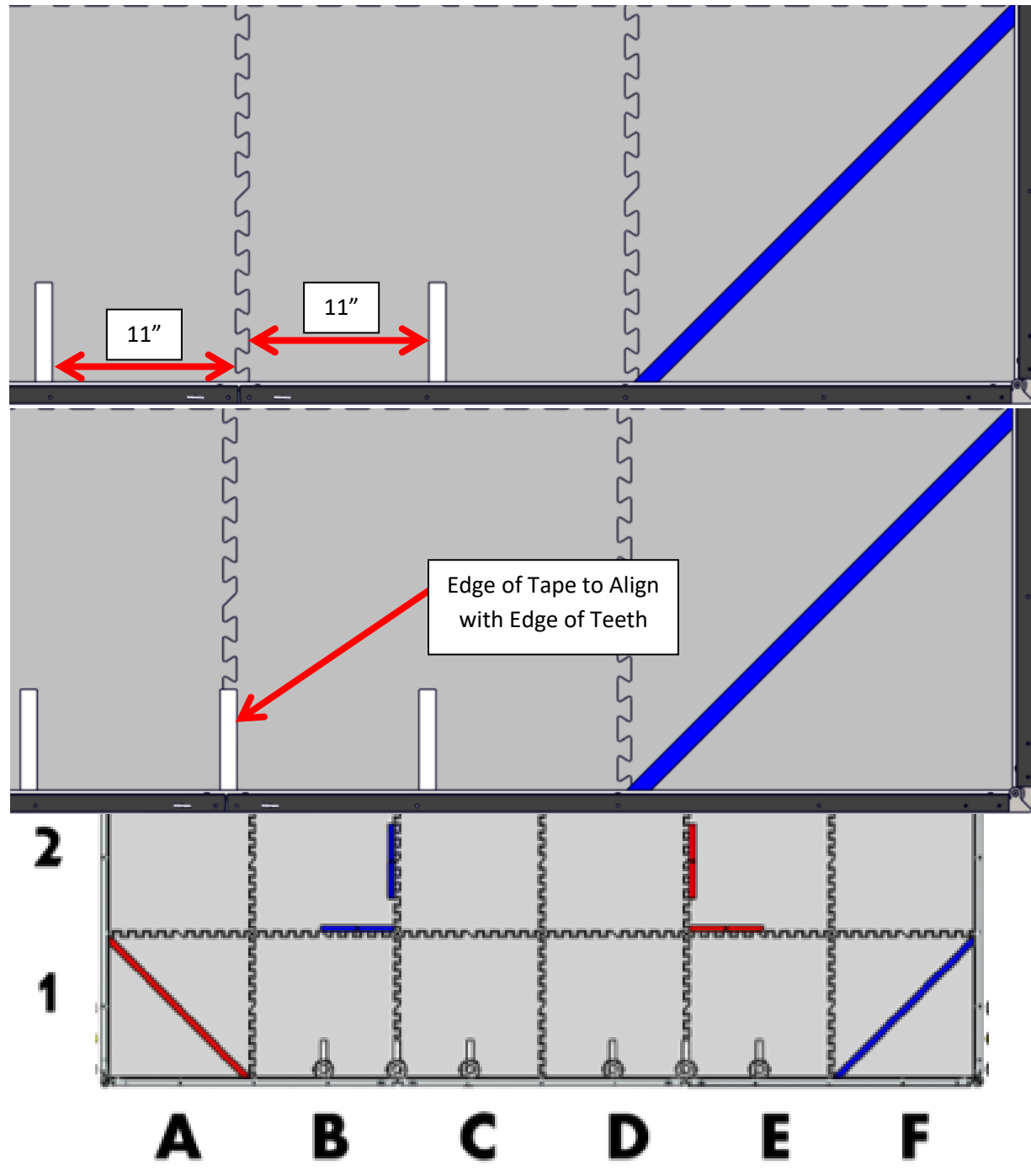
Wings

In the corners opposite the Backdrops, diagonal red and blue lines (both 1" Gaffers tape) are positioned so that they connect the field border walls and only touch one tile as shown. The blue line should be in the corner opposite the blue Backdrop (on the side of the field with the red Truss and Backstage). Mirror this for the red Wing.



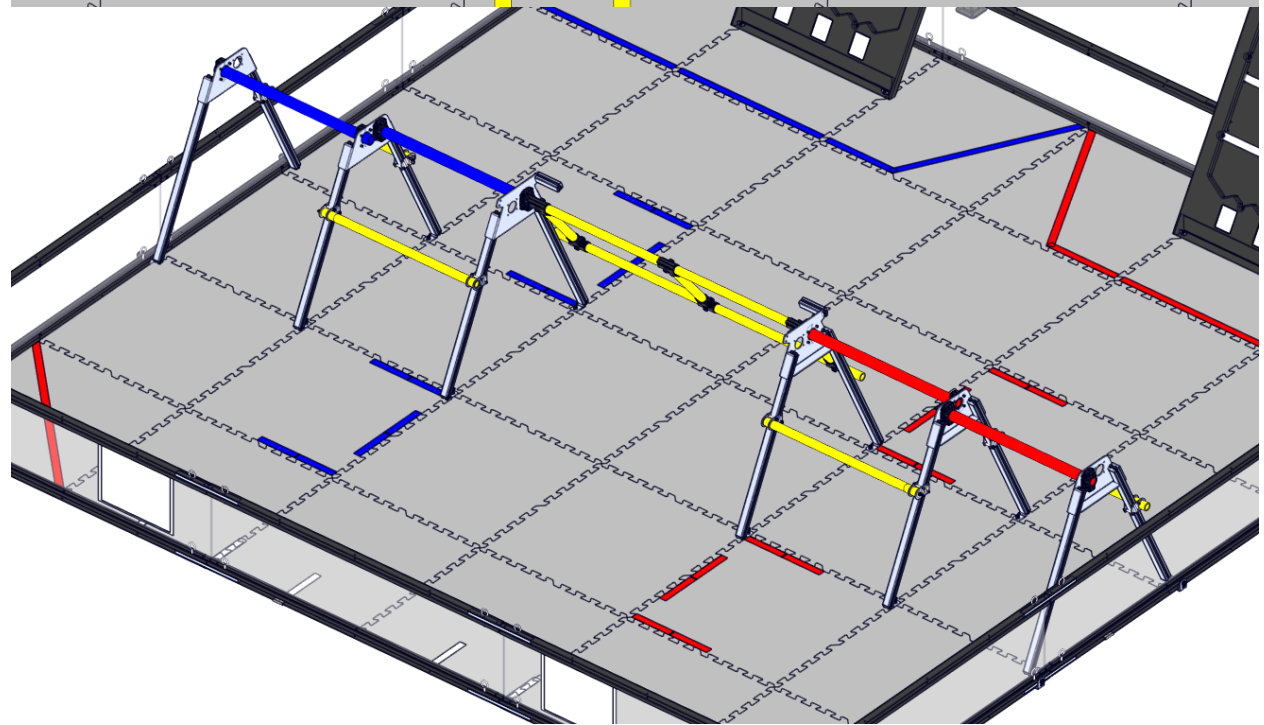
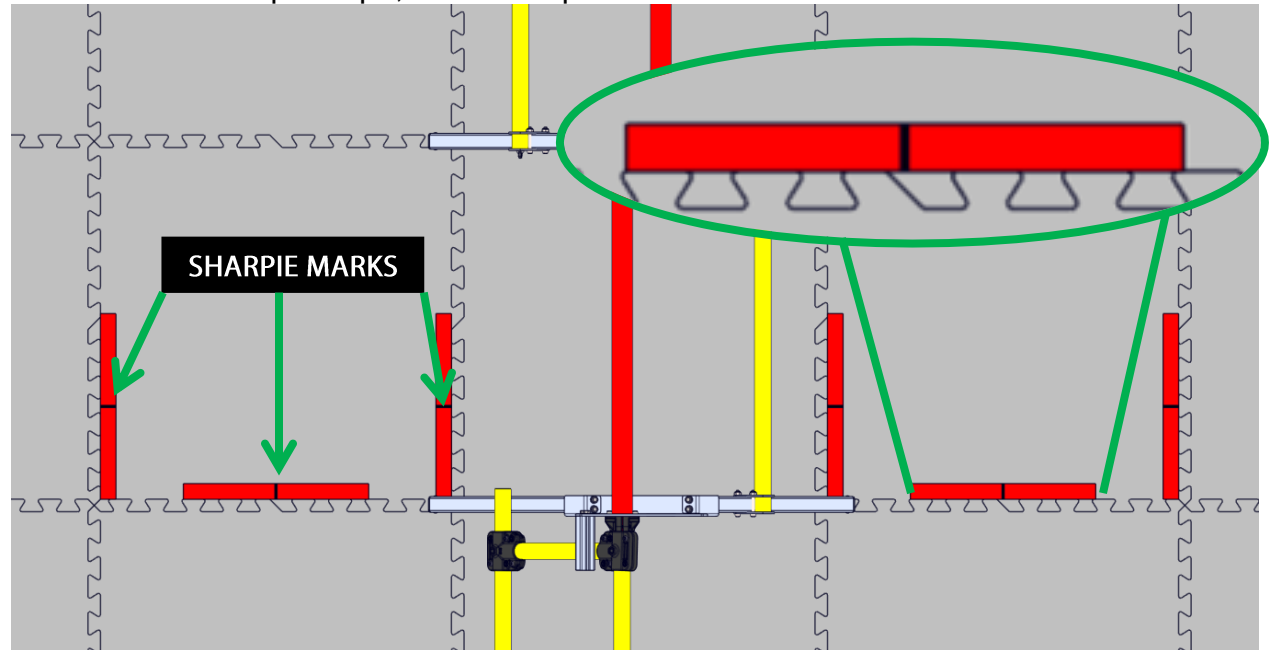
Pixel Stack Locators

On the side of the field opposite the Backdrops, six 6" long white lines (1" Gaffers tape) are placed against the wall. Measuring from the portion of the seam between tiles D & E furthest from the Blue Wing, set the close edge of a tape line 11" away from the edge. Measuring from the edge closest to the Blue Wing of the same seam, set another tape line 11" closer to the Blue Wing. Place a third tape line aligned to the edge of the seam between D & E closest to the blue Wing. Mirror this process for the red side to place all six lines.



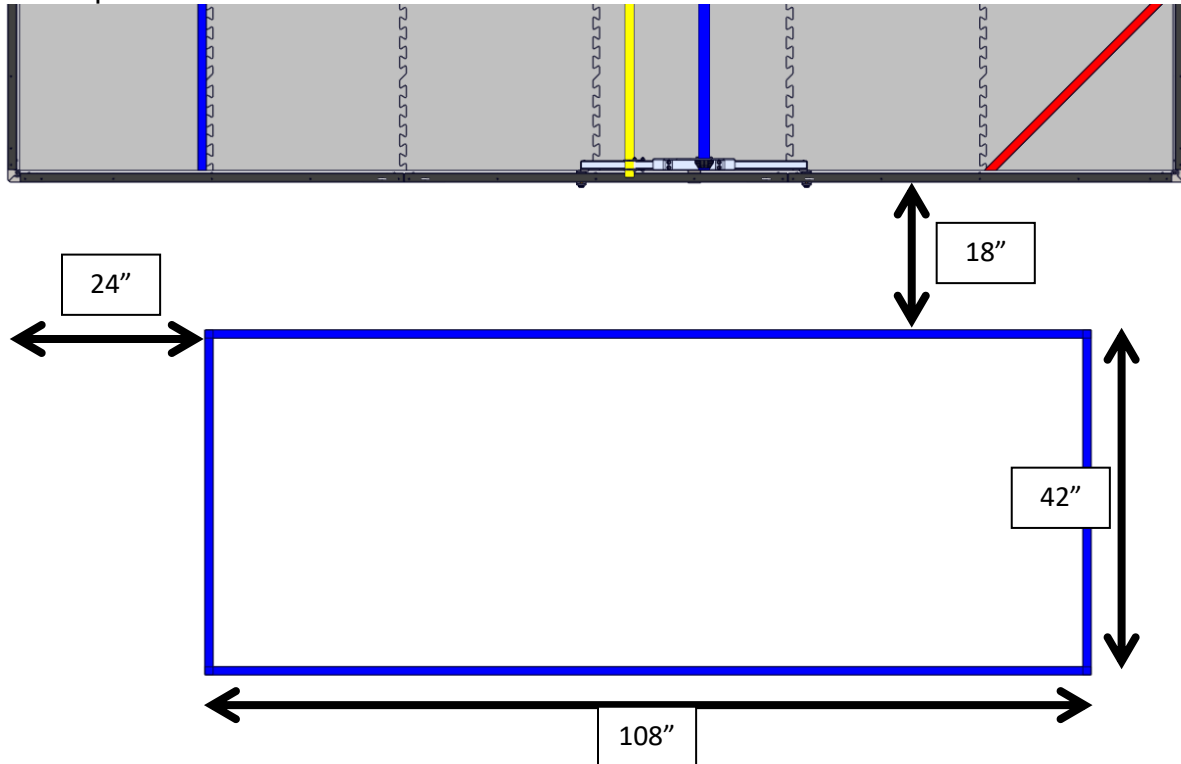
Spike Marks

On both sides of the truss between the innermost A-Frames, tape three 12" long lines. One line is centered in the tile and up against the edge closest to the Stage Door. The remaining two are placed along the perpendicular edges of the tile to that line. Repeat this process three more times to create all 12 randomizer lines. The lines on the blue side of the Truss are blue, and the lines on the red side of the Truss are red. In the middle of each strip of tape, use a sharpie to create a line across the middle as shown.



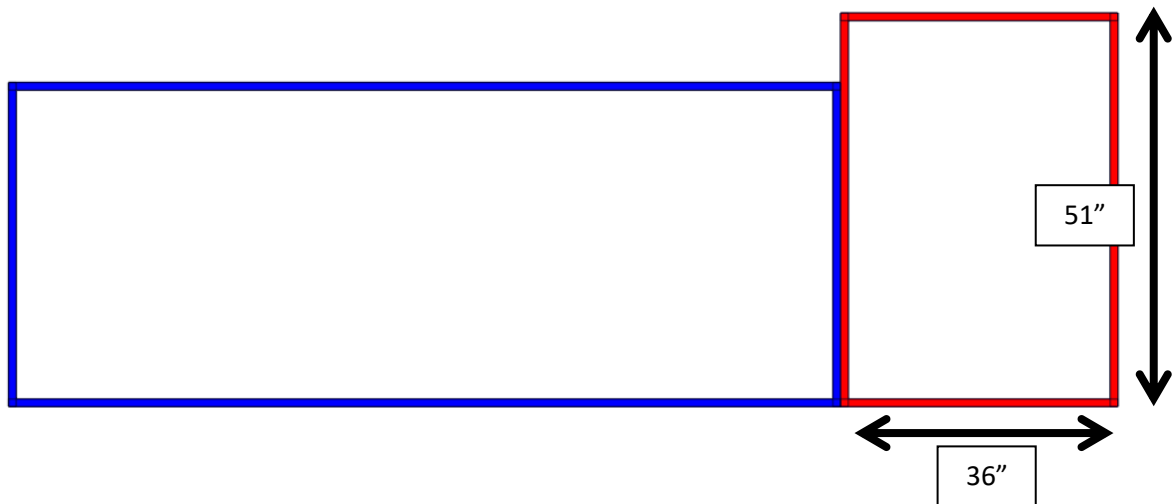
Driver Station

The driver station box is 108" long by 42" wide and placed 18" away from the field border and 24" from the edge where the Backdrops sit. These markings can use 1" or 2" Gaffers tape.



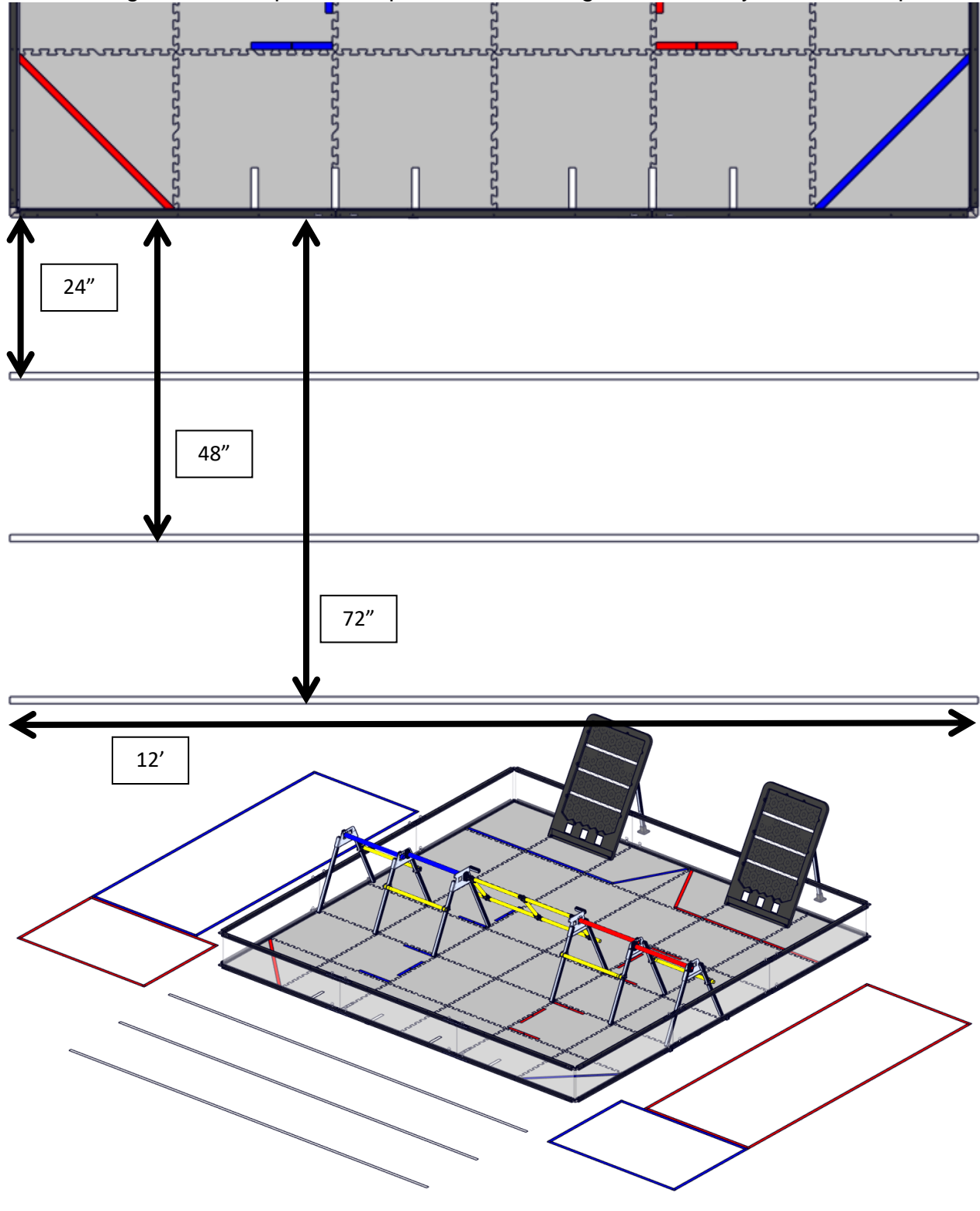
Human Player Station

The human player station is adjacent to the driver station box of the opposite color. It is 51" wide by 36" long and its furthest edge from the field border is in line with the furthest edge of the driver station.



Landing Zones

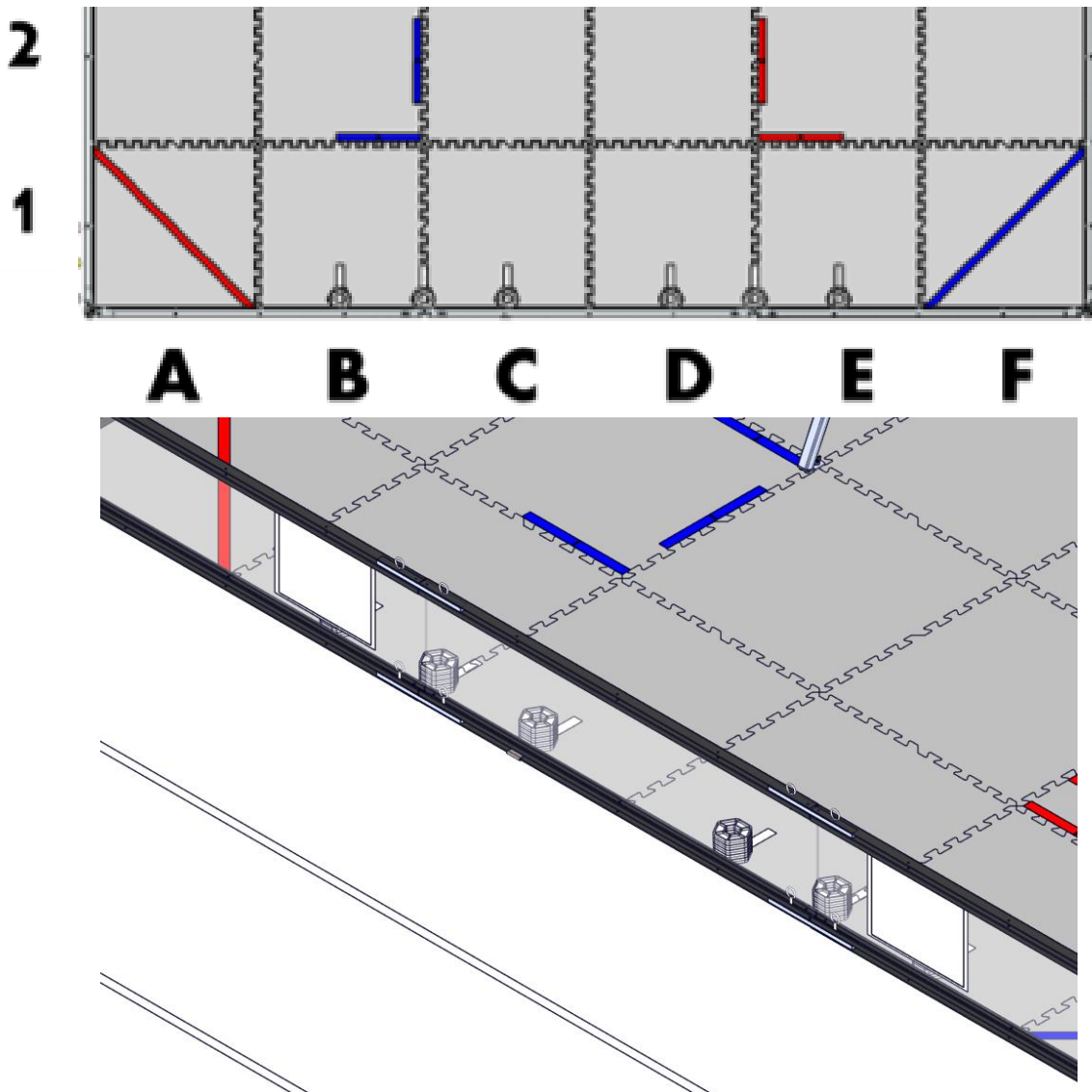
Three white lines, each twelve feet long, are placed outside the field border. The furthest edge of the tape from the field is 24" from either the field border or from the furthest edge of the last piece of tape. These markings can use only 1" Gaffers tape.



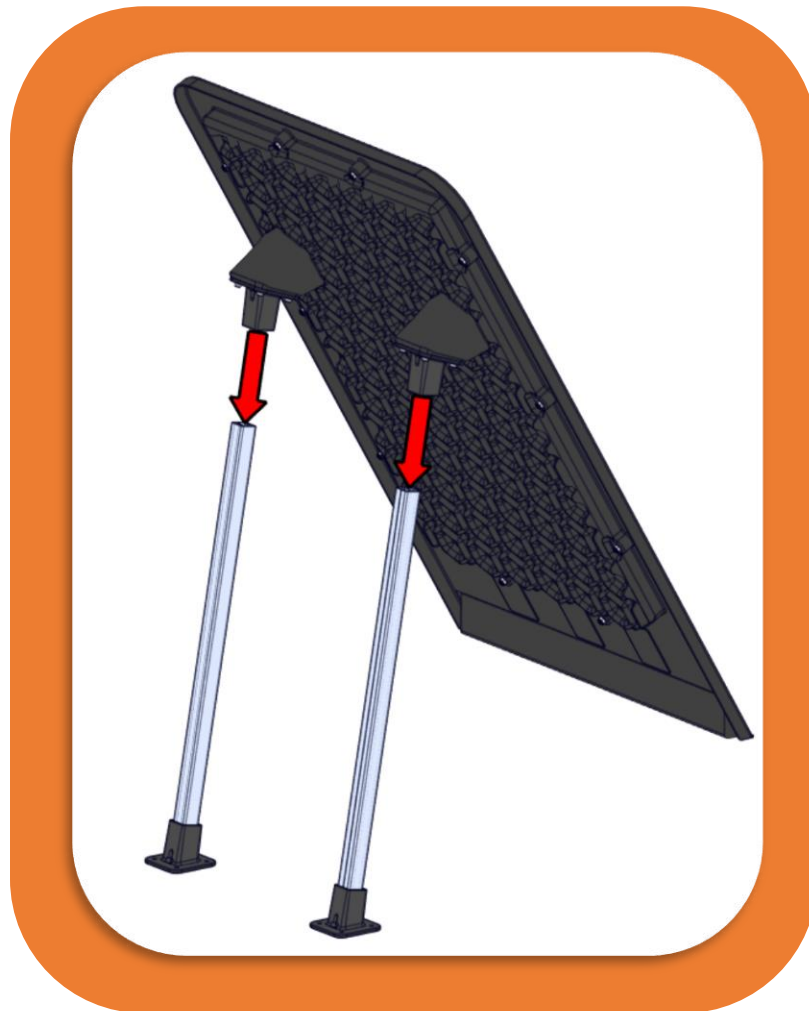
AprilTag Sleeves

Print out the AprilTag documents (1 for Blue Alliance and 1 for Red Alliance) using the “Actual Size” setting or a “Custom Scale” at 100%. To verify the printed document, compare the black square area of each AprilTag to the measurements listed on the document (2” and 5” square.) Slip the two documents into plastic sheets. Use white Gaffers Tape (or equivalent adherence method, excluding black tape) to attach the sheet to the outside of the field perimeter (the side NOT touching the soft tiles) as follows:

- For the red alliance document, align the vertical black line with the center of the Pixel Stack tape line closest to Tile F1. Then, adjust the document vertically until the horizontal black line is 4” above the surface of the playing field.
- For the blue alliance document, align the vertical black line with the center of the Pixel Stack tape line closest to Tile A1. Then, adjust the document vertically until the horizontal black line is 4” above the surface of the playing field.



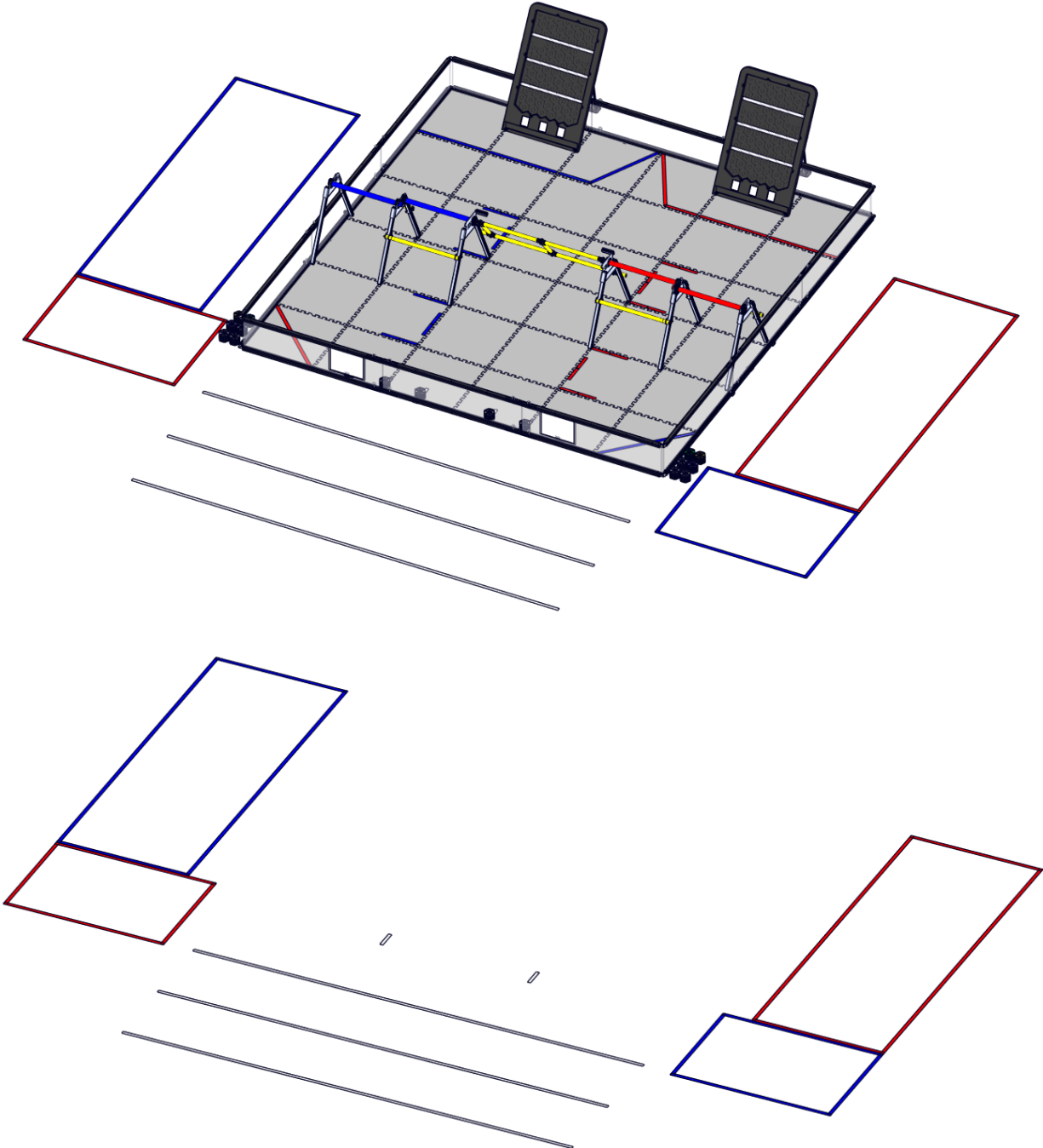
GAME-SPECIFIC TEARDOWN



Game-Specific Teardown

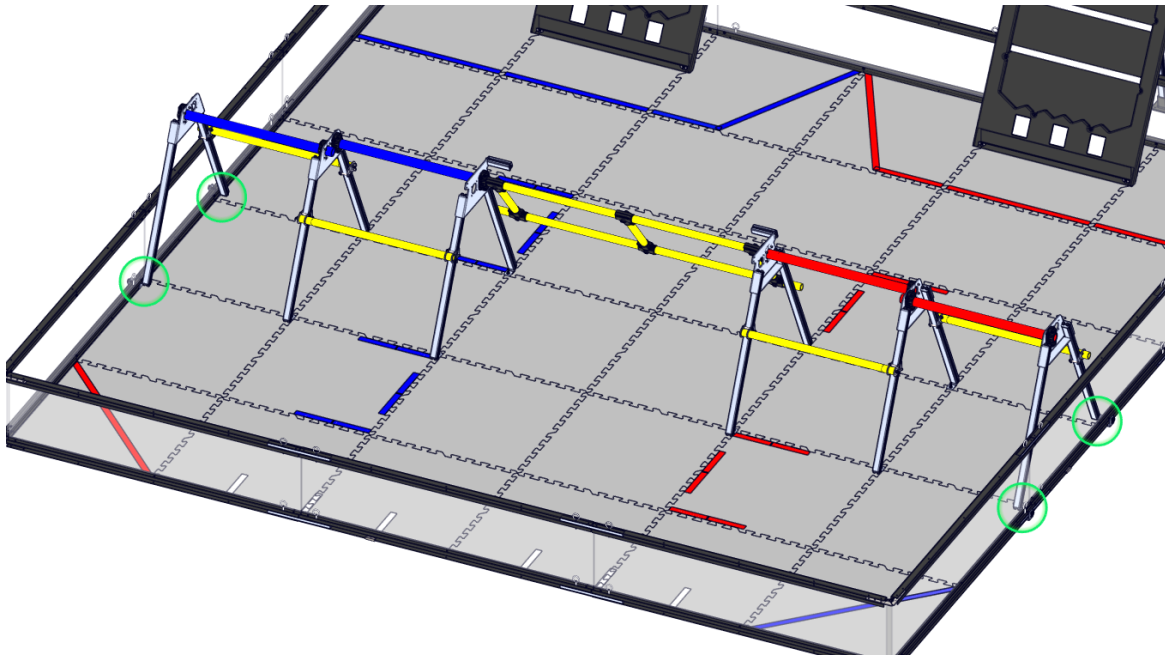
Step 1

Remove any tape line that is not contained to a single tile. The tape lines to remove are shown by themselves below.



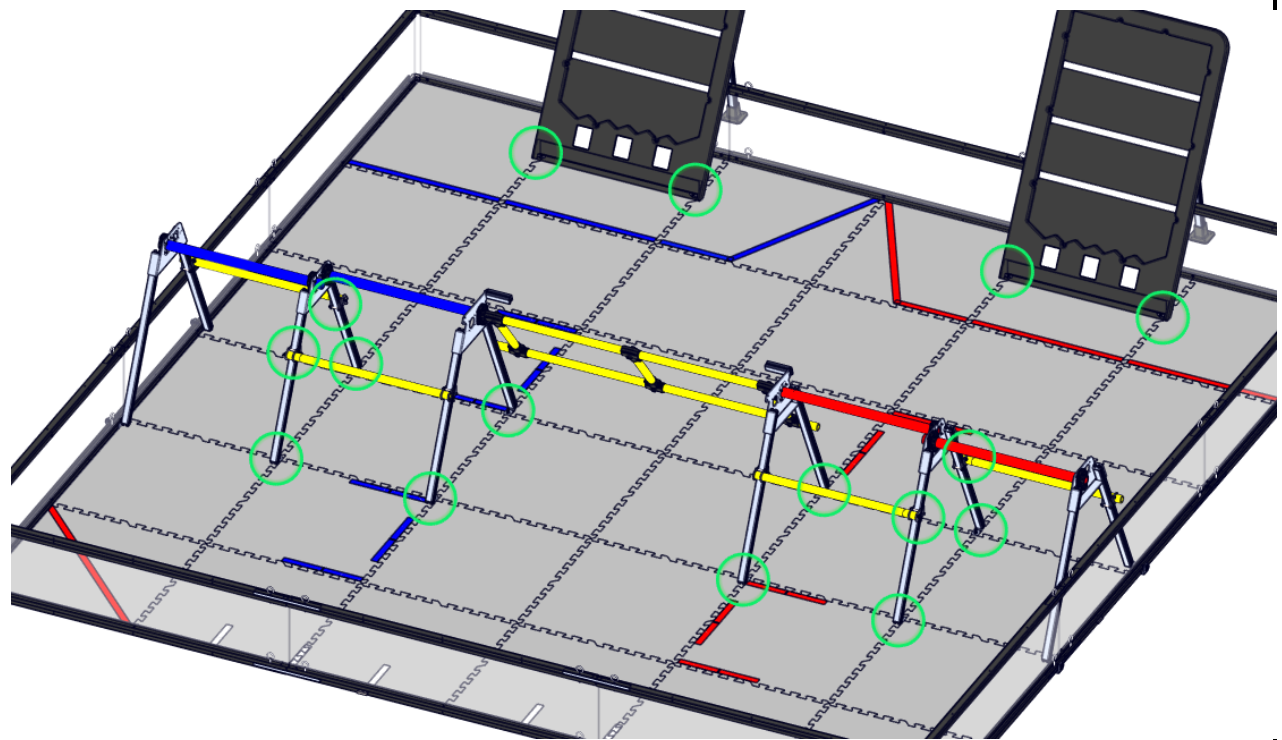
Step 2

Loosen the thumb screws located at both ends of the Truss until the Truss can freely move.



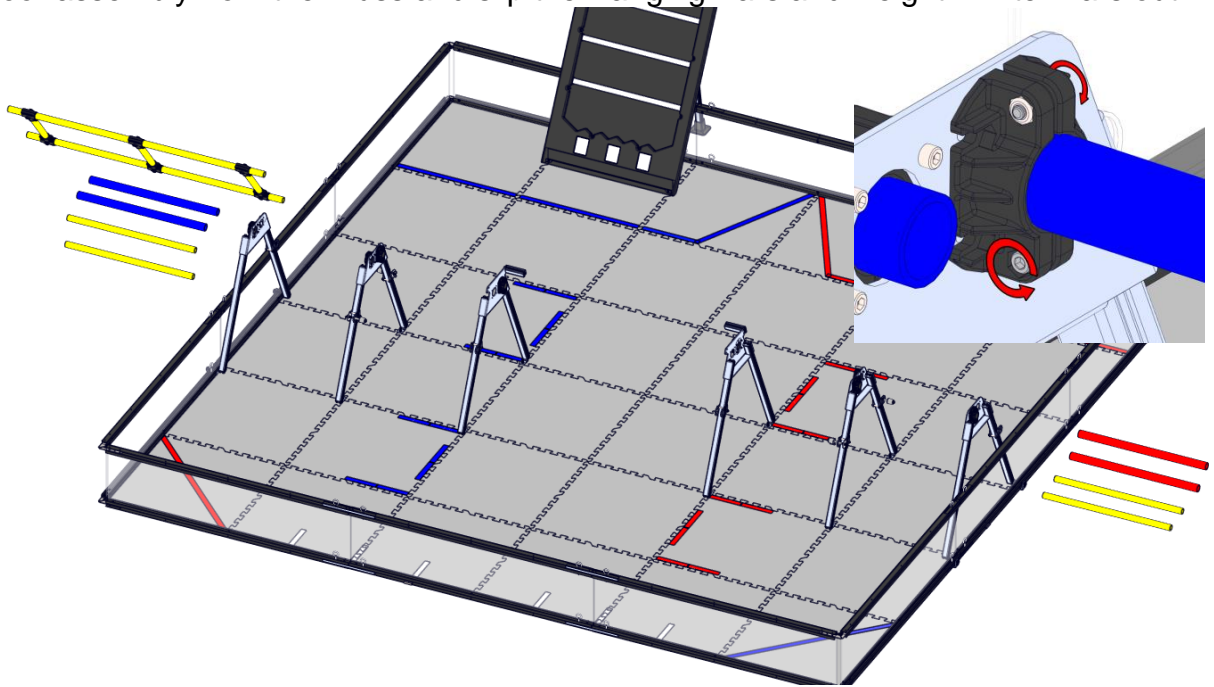
Step 3

Remove the wing nuts at each of the locations on the field shown. Once complete, there should be no wing nuts left on the field.



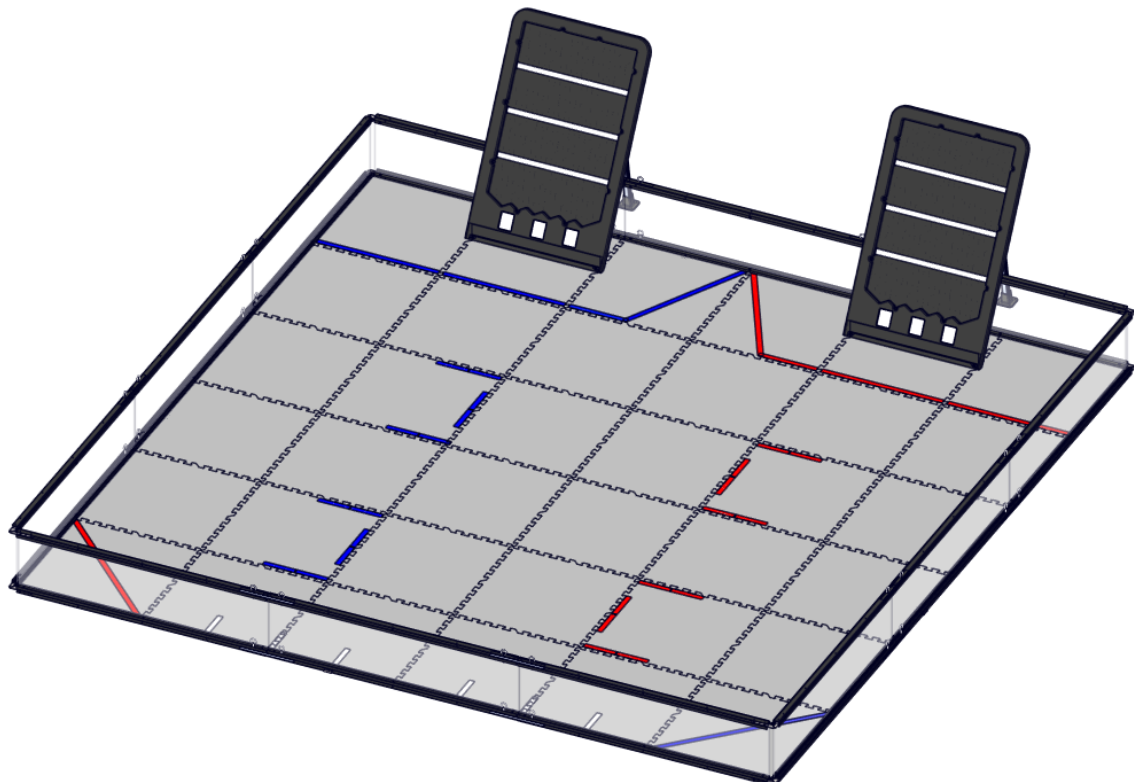
Step 4

Loosen the C-Clamps holding the Hanging Bars onto the Truss. Remove the Stage Door assembly from the Truss and slip the Hanging Bars and Height Limiter Bars out.



Step 5

Leave the A-Frames assembled and remove them from the field. These can be stacked on top of each other to save space.



Step 6

Remove the Backdrops from the field and disconnect the legs from the back of the larger Backdrop Assembly with a firm tug and/or wiggle. These can be stacked on top of each other to save space.

