

A Custom Cart for my AirVolution™ Solo Kayak, Version 1.4

By **R. G. Sparber**

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Given what I paid for this kayak, I did not want to make a cart out of PVC pipe. Sure, I could have bought a cart, but I enjoy designing and making my own.



My cart is designed to fit the contour of the hull near the bow of my AirVolution solo kayak. When the belt is tight, the two skids make full contact with the hull and do not slide around. When not under the kayak, the skids are never more than 30° from level. This makes it easy to position the cart under the kayak without having to look under there.

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The cart is made of architectural aluminum extrusions, which are easily cut with a hacksaw. The 12-inch long skids are expanded PVC trim board that is stiff, lightweight, yet will not mar the kayak.

The wheels are off of a discarded lawnmower, although plenty of stores sell them.

I will present shop drawings of the cart, followed by a suggested procedure for construction.

The design requires minimal skill with a hacksaw and drill.

Contents

Tools.....	3
Bill Of Materials	4
Shop Drawings.....	6
Axles	6
Cross Beam	7
Support Angle Type 1	8
Support Angle Type 2	9
Skids.....	10
Strap Bails	11
The Final Drilling and Assembly Process	12
Fitting the Axles to the Cross Beam	12
Installing the Skid Supports	14
Install The Skids.....	17
Prepare The Strap.....	18
Installing The Bails, Axles, and Wheels.....	18
Install the Skids	19
Operation.....	20
Update	21

Tools

1. Metal cutting saw – you will need to cut the aluminum, steel rod, and the bolts.
2. Drill – a drill press is best, but a hand-held drill will work if you are careful about drilling holes perpendicular to the surface.
3. Drill bits – you will need a 1/8”, “F” drill, and a “#9” drill. The goal is to have close-fitting holes for the bolts. You can substitute a 17/64” drill for the F drill. I don’t recommend it², but a 13/64” drill might be substituted for the #9 drill.
4. A countersink to match the 1/4-20 flat head screws.
5. A means of holding the bar stock to bend up the bails - I used a bench vise.
6. A hammer to persuade the bar stock to bend.
7. Wrenches and screwdrivers to fit the selected nuts and screws.
8. Three clamps able to accept 1½ -inches of material.

² The larger hole can make permit axle to slide around a little which is not good.

Bill Of Materials

<u>Description</u>	<u>size</u>	<u>Quantity</u>	<u>Total length</u>
architectural aluminum extrusion: channel	1/8" thick 3/4" x 3/4" x 16"	1	
architectural aluminum extrusion: angle	1/8" thick 1 1/2" x 1 1/2" x 3 1/2"	4	14"
aluminum bar	1/8" thick 1/2" x 4"	2	8"
expanded PVC trim board	3/4" x 3 1/2" x 12"	2	24"
A strip of slippery plastic	2" wide and 17" long	1	
10-24 round head bolt	1 1/4"	8	
10-24 nylon lined locking nut	n/a	8	
1/4-20 flat head bolt	1 1/4"	8	
1/4-20 nylon lined locking nut	n/a	8	
cotter pin	1" long, 1/8" in diameter	2	
washers	1/2" inside diameter, 1 1/4" outside diameter	2	
ratchet strap	1" wide and at least 3' long	1	
Light duty wheels	7" in diameter, 2" wide at the axle, 1/2" bore for axle	2	

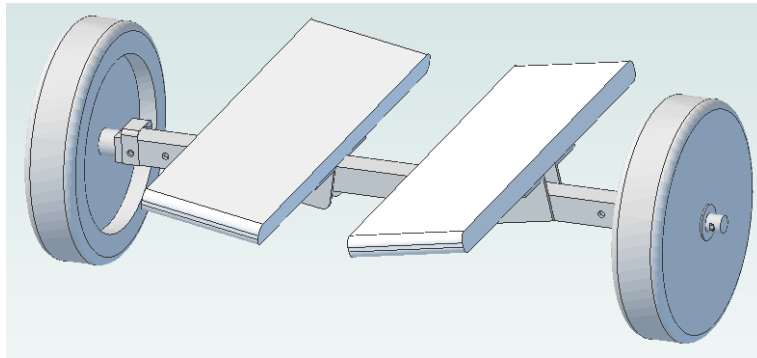
Notes:

1. Add 1/4" to all total lengths to allow for lost material due to sawing.
2. Architectural aluminum extrusions have a small fillet at each 90° inside corner. If you cannot find this style, structural aluminum extrusions should work, but it has a larger fillet. Verify that the 1/2" steel rod fits inside the channel such that it makes full contact with the bottom and sides and does not hit the fillets. Given the short lengths, I was able to buy leftover pieces of architectural aluminum at my local metal supply store.
3. After sawing all parts, file off all sharp corners.
4. I cut up a plastic file folder to make the strip of slippery plastic. Another option is to use nylon socks. Cut off the end, so you have a tube. You may find that this item is not needed.
5. The angle can be cut to the correct length by using one of the pieces of expanded PVC as a gage.

6. I bought the expanded PVC trim board at Lowe's. You can substitute wood.
7. The wheels came off of a discarded lawnmower. New ones can be purchased online plus at Harbor Freight. They do not take a lot of weight, so being all plastic is fine. If you plan to roll on sand, wider tires would be prudent. You will need to increase the length of the steel axles.

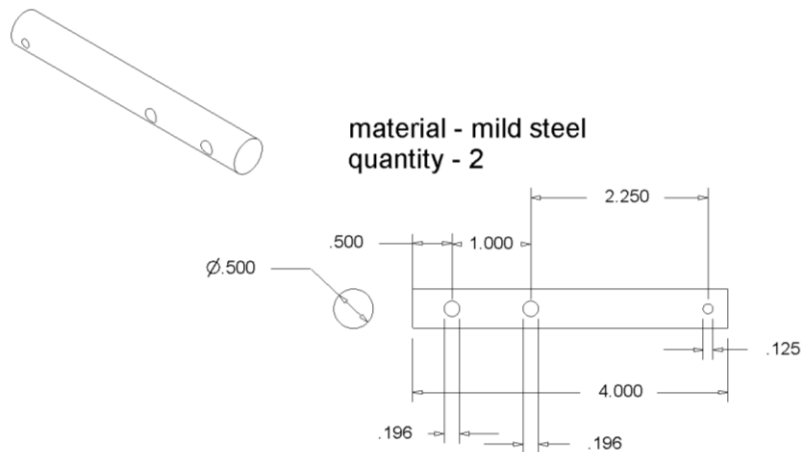
8.  A possible alternative to bending the Bails is to use two ½-inch long pieces of the angle stock and overlap them.

Shop Drawings

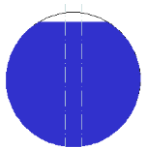


Axles

Note: drill the 1/8th inch hole but *not* the 0.196-inch holes.



Drill the 1/8th inch hole as close to center as possible. If on a drill press, clamp the bar in a vise such that 1/2" at the end of the bar is sticking out. Then balance one of the pieces of aluminum used to make the Bail over the end. Lower the drill down on the bar. When the bar is level, you are at the center of the bar. Clamp down the vise.

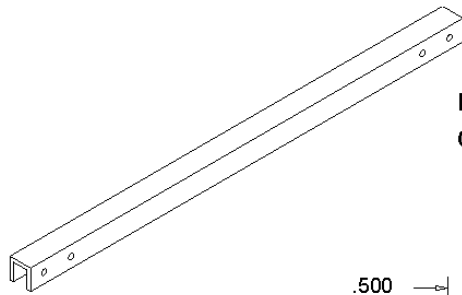


If drilling with a hand-held drill, file a flat on the bar around where the hole will go. It will help you see the center of the bar, plus the point of the drill will be less likely to walk its way off as you start.

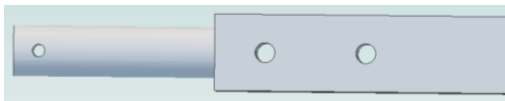
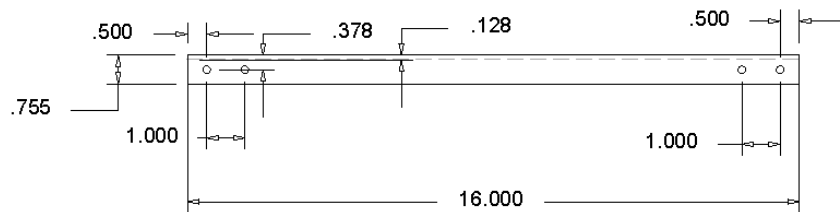
Use one of the large drills to start the hole and go in about 1/32". That will prevent the 1/8" drill from wandering off-center. Then switch to the 1/8" drill and drill through.

Cross Beam

Drill four holes 0.196 inches in diameter (#9 drill).



material: architectural aluminum extrusion
quantity: 1



One way to locate that 0.378-inch line on the Cross Beam is to place an axle inside of the channel with the cross hole exposed. Lay the channel on its side.

Put something inside the channel that presses on the axle. I call this packing.

Place the assembly in your drill press vise with a 1/4-inch thick piece of wood under it³. Put the 1/8" drill in the chuck. Feed the drill down while adjusting the position of the vise and axle until the rod enters the cross-drilled hole. Tighten the vise and re-check that the drill still smoothly passes through the hole. Clamp the vise down.

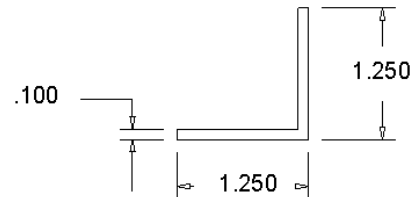
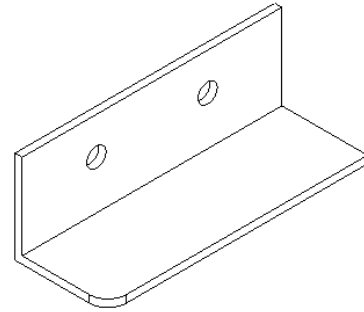
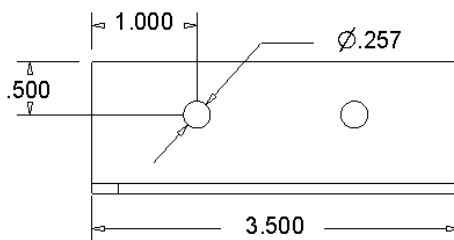
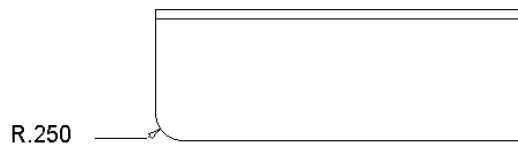
Remove the axle with its packing. Slide the channel over until the drill is at the first 0.196-inch hole. Tighten the vise and drill through only the top of the channel. Repeat for the second hole. Unclamp the vise and repeat this process for the holes at the other end of the Cross Beam.

³ When you drill through the Cross Beam, you do not want to hit the vise. Instead, you will drill into this bit of wood.

Support Angle Type 1

Holes are drilled with an "F" drill. Their position can be off by 1/16" but do try to get closer. The rounded corner is filed and does not have to be precise.

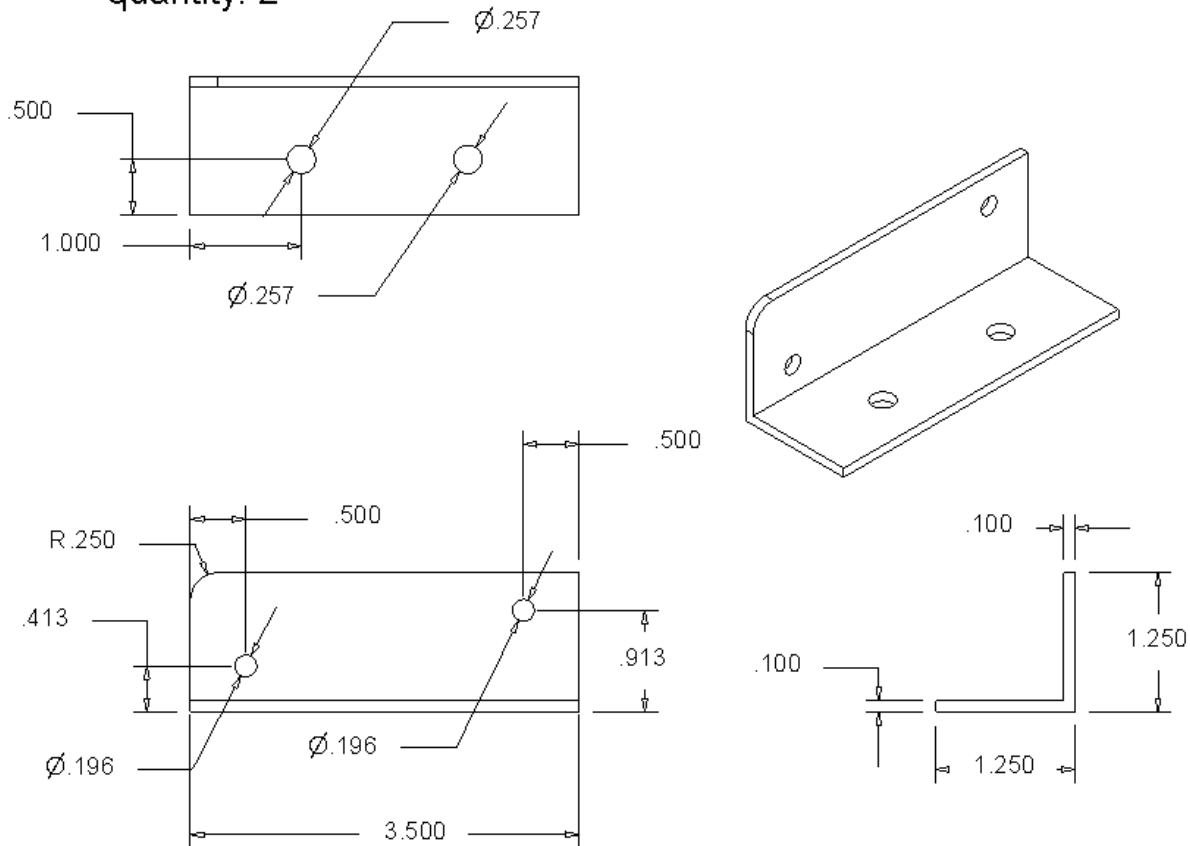
material: architectural extruded aluminum
quantity: 2



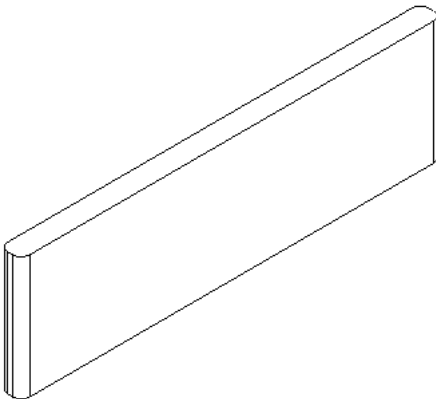
Support Angle Type 2

The 0.257-inch diameter holes are drilled with an “F” drill. The 0.196-inch diameter holes are drilled with an “#9” drill. Although the 0.196 hole positions are specified to three places, they don’t have to be that exact. The 0.413-inch dimension can be 7/16-inches. The 0.913-inch dimension can be 15/16-inch. The 0.250-inch radius was filed freehand. This corner is exposed, and I don’t want anything sharp near my kayak.

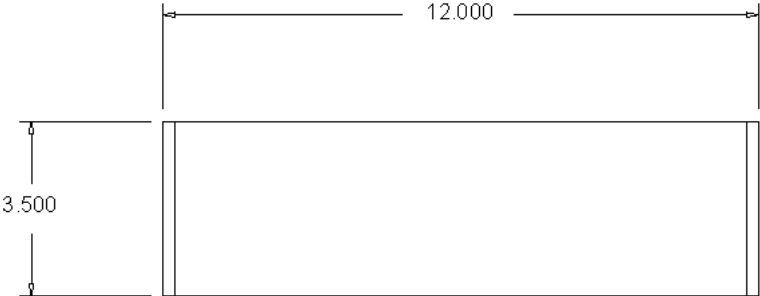
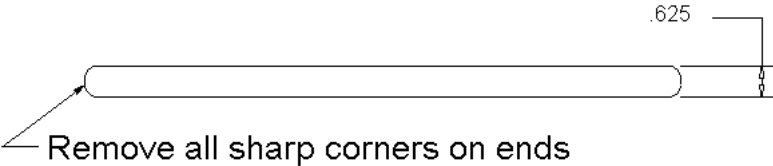
material: architectural extruded aluminum
quantity: 2



Skids

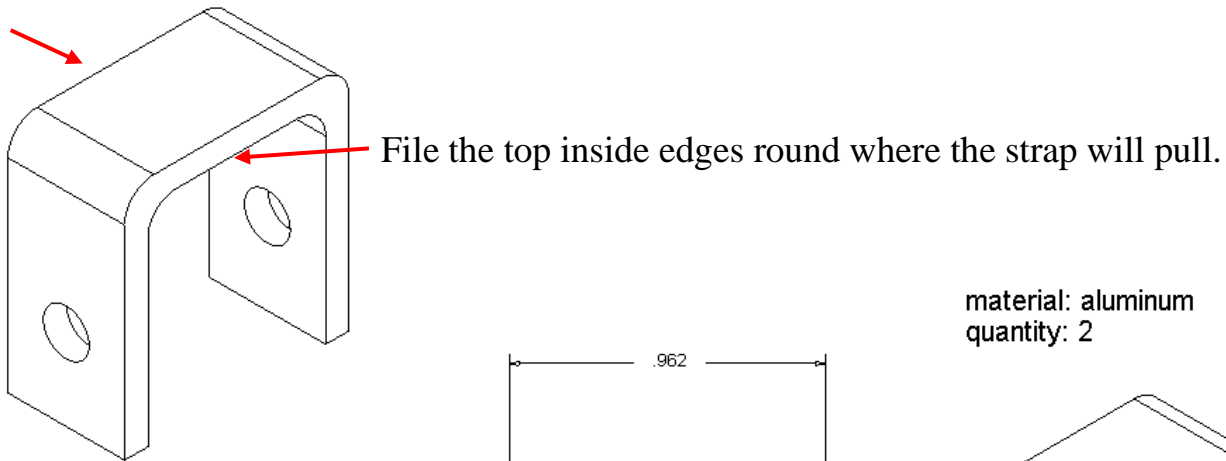


material: expanded PVC trim board
quantity: 2

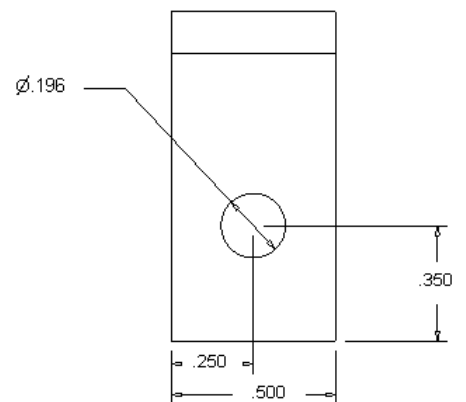
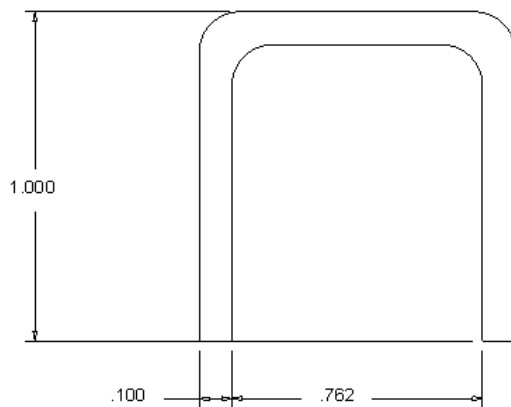
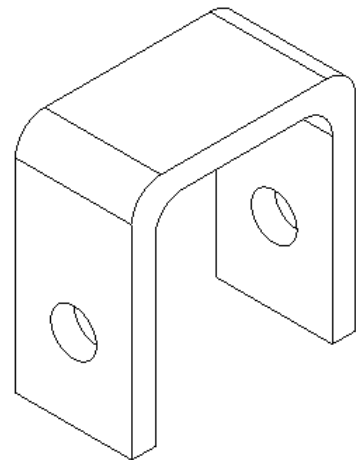
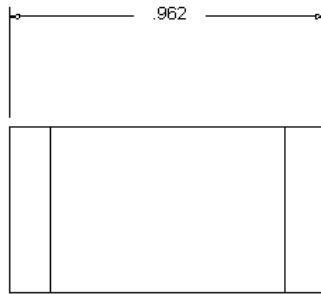


Strap Bails

These straps are formed by bending the bar stock in a vise using a soft-faced hammer. Take care not to make too sharp a bend, or the material will crack. Drill through only one side at this time. Although dimensions are specified to 3 places, the strap just has to fit around the cross beam and have enough room on top to pass the strap.



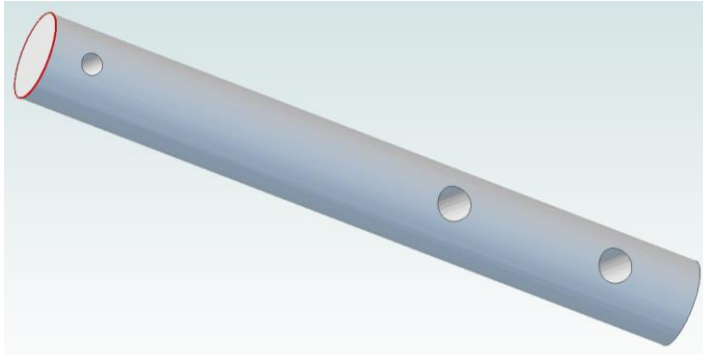
material: aluminum
quantity: 2



The Final Drilling and Assembly Process

This process will ensure that all holes perfectly line up without having to do any precise measuring. I recommend that all holes be drilled on a drill press, so they are perpendicular to the surface. A hand-held drill can be used, but care must be taken to align the drill bit.

Fitting the Axles to the Cross Beam

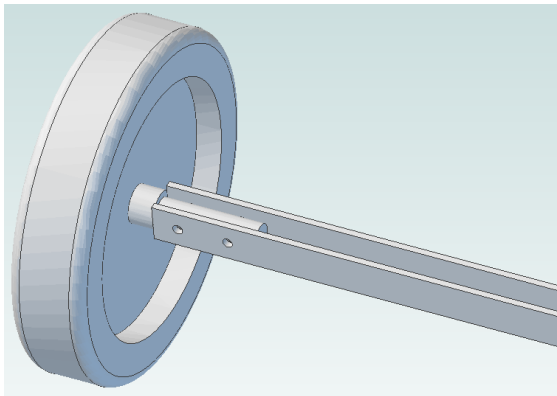


Note: the two larger holes have not been drilled yet.



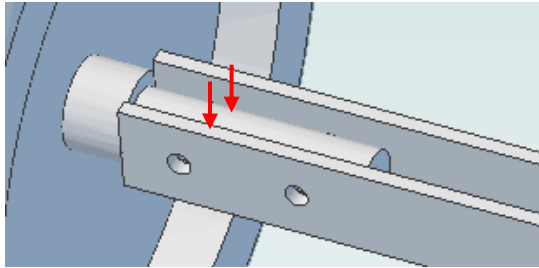
Slide a cotter pin through the 1/8-inch hole and bend the end around the axle.

Slide the washer onto the axle. Then slide on the wheel.



Push the axle into the channel such that it is pressing on the inside bottom surface. The end of the channel should barely touch the wheel. Place a piece of scrap metal or wood in the channel to press on the axle. Secure tightly with a clamp positioned, so it does not block the hole nearest the wheel. Then use a #9 drill to drill through the existing hole in the channel, through the steel axle, and through the other side of the channel. Run a 10-24 bolt through the hole and

secure tightly it with a nut. Move the clamp so it does not block the second hole. Repeat the process, including adding the bolt.



With the channel's open side facing up, place it on a solid surface. Using a punch or nail and a hammer, make a dimple on the axle. Make a second dimple adjacent to it on the channel. These marks identify which axle goes with which end of the channel plus the proper orientation of the axle.

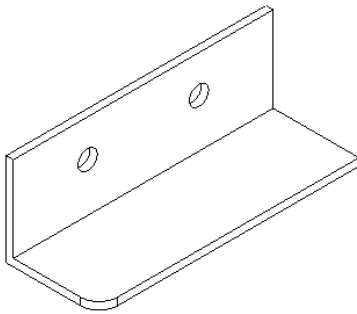
Repeat the entire process for the second wheel. Make two punch marks in that axle and channel.

Unbolt both axles. Deburr around all holes.

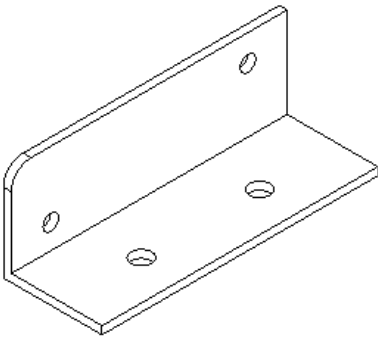
Installing the Skid Supports



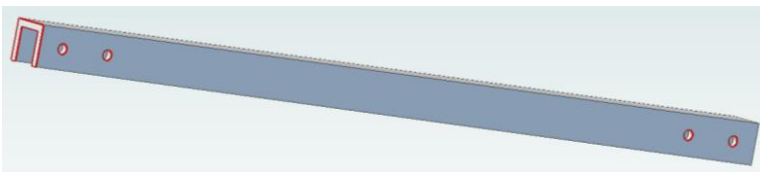
The four pieces of angle form the skid supports. All supports have two holes on one side that accept 1/4-20 bolts. They will be used to secure the skids.



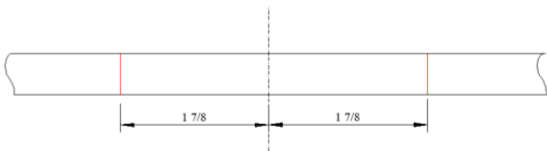
Support Angle Type 1 has holes on only one side.



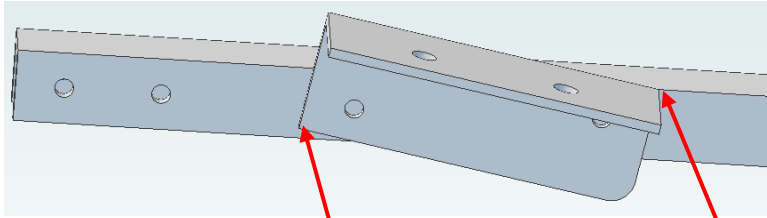
Support Angle Type 2 has holes on both sides.



Measure the length of your Cross Beam and divide that number by 2. Mark a pencil line this far from one end to define the centerline. Draw this line on all three outside surfaces.



Mark two lines that are each $1\frac{7}{8}$ inches from the centerline. Extend each line over the top of the Cross Beam.



Place one of the Support Angle Type 2 pieces against the side of the cross beam.

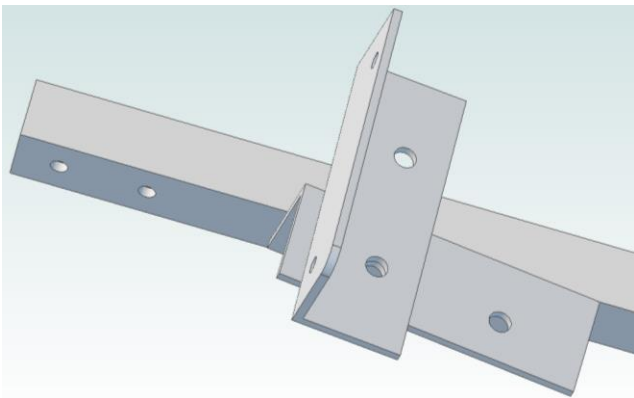
This corner must be on the line you drew.

This corner must be 1/8 inch from the bottom edge.

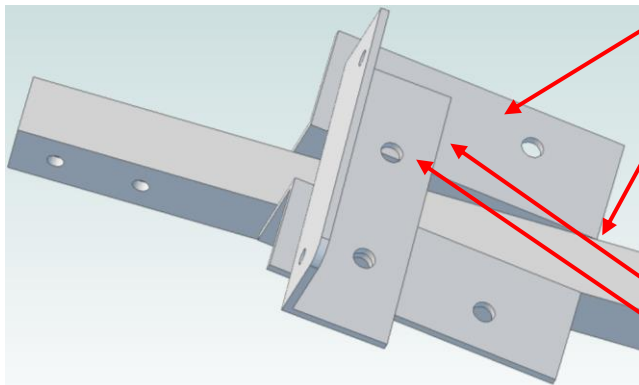


Clamp the angle support to the cross beam. Drill both holes using an “F” drill through both faces of the Cross Beam.

Thread a nut onto one of the 10-24 bolts going in about 3/8 inch. Slide the assembly into one of the holes. Reach inside the Cross Beam and spin a second nut on the end of the bolt. Turn the outside nut until the fastener is snug. Repeat for the second hole. Tighten both outside nuts.



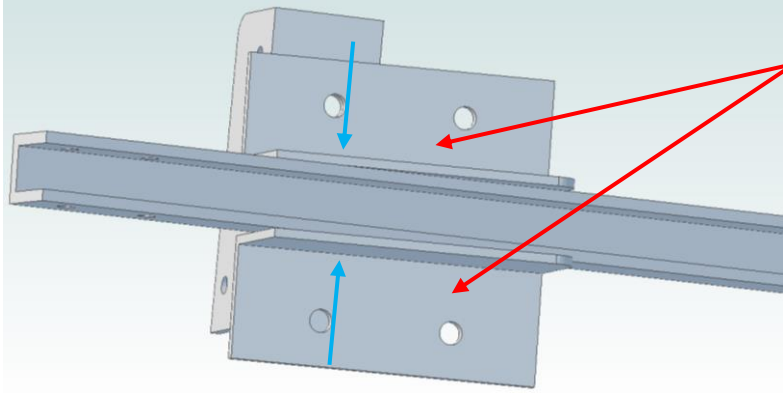
Using a 1/4-20 bolt and nut, secure the other Support Angle Type 2 part to the one bolted to the Cross Beam. Angle the part as shown and tighten the bolt.



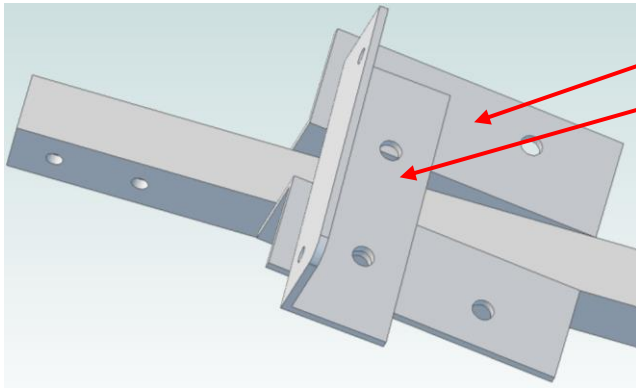
Place one of the Support Angle Type 1 parts on the opposite side of the Cross Beam.

Line up the right corner with the line on the top of the Cross Beam

while pressing the top face against the Support Angle Type 2 that is above it.



Apply a clamp (blue arrows) to the Support Angle parts, so they don't move on the Cross Beam. Position the clamp as far away from one of the holes in the Support Angle Type 2 as possible because you are going to drill through the other hole.



Apply a second clamp such that the Support Angle Type 1 is secured to the Support Angle Type 2 that is above it.

Remove one of the bolts hold that first Support Angle Type 2 in place. It must not move relative to the Cross Beam.

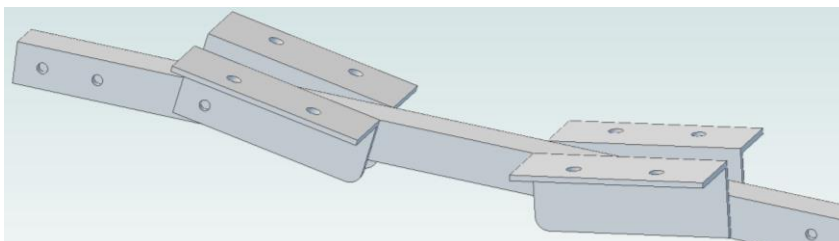
Drill through the existing hole and through the Support Angle Type 1 on the other side.

Feed a 10-24 bolt through the assembly. The head will contact the Support Angle Type 2, and the end of the bolt will poke out the hole in the Support Angle Type 1. Spin on a nut and tighten.

Reposition the clamp, so it is clear of the second hole in the Support Angle Type 2.

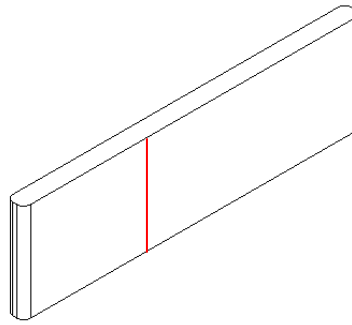
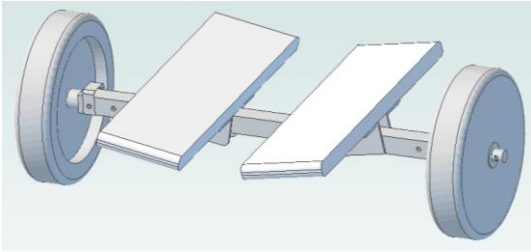
Remove the bolt with the two nuts on it. Then, again drill through the assembly. Install a second 10-24 bolt and secure with a nut.

Remove the Support Angle Type 2 that was temporarily bolted across the top.

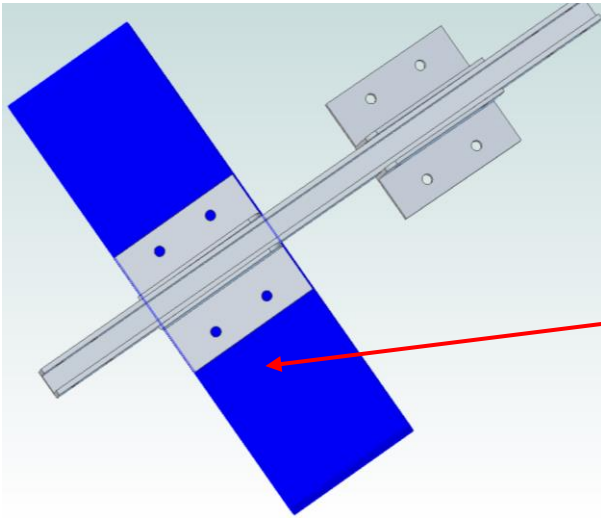


Repeat the process for the other pair of Support Angles. You will need to find something else to clamp over the top for alignment.

Install The Skids



Draw a line across each Skid
4 3/8-inches from the end.



Place one of the skids on a table. Place one of the pair of support angles on top of it. You may need to move the assembly around, so the other pair of supports doesn't hit the table.

Set the edge of the nearest Support Angle on the line. The Skid should be centered over the Cross Beam. Clamp the Skid to one of the Support Angles.

Lift up the assembly and apply another clamp around the Skid and the other Support Angle.

Using an "F" drill, drill as many of the holes as possible through the Support Angles and through the Skid. Run 1/4-20 bolts through the holes, spin on nuts, and tighten them snugly.

Remove the two clamps and drill the remaining holes. Notice the punch marks near the end of the Cross Beam that were placed there to align the axle. Use a marker to put a dot on the Skid. This dot will let you set the correct Skid back in place with the proper orientation. This is the only way you can guarantee all four holes will line up.

Remove the Skid.

Install the other Skid using the same procedure.



Countersink all holes on the faces of the Skids that do not have dots on them. The flat head bolts must be below the surface of the Skid, so there is no chance of them contacting the hull.

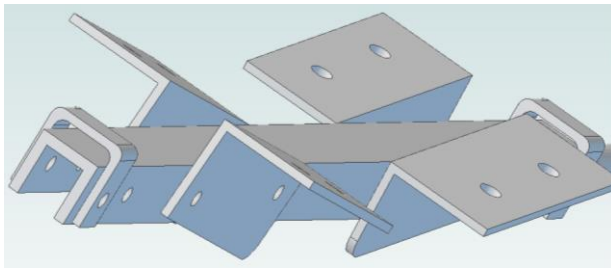
Prepare The Strap



Saw the hooks off of each end of the ratchet strap, being careful not to damage the strap.

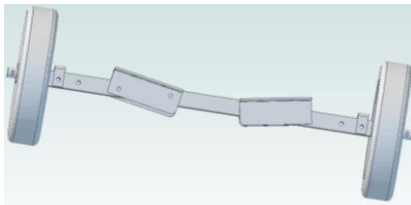
Installing The Bails, Axles, and Wheels

Feed a bail through the loop at the end of the strap that does not have the take-up machine attached.



Place the Bail over the Cross Beam such that its holes line up with the holes at the end of the Cross Beam.

Slide a washer onto one of the axles, followed by a wheel. Repeat for the other axle, washer, and wheel.



Install the axle assembly that is marked for the end of the Cross Beam with the Bail being sure that the punch mark is visible. Run a 10-24 bolt through the Bail, through the flank of the Cross Beam, through the axle, through the other flank, and out the other side of the Bail. If the bolt does not easily push through, check that you have the right axle in place with the correct orientation.



Slide the second Bail through the loop in the strap that has the take-up machine. Orient the Bail so the take-up machine's handle faces away from the cart. When wrapped around the kayak, you want the machine facing up so the handle can swing away from the deck.

Secure the Bail with a 10-24 bolt and locking nut.

Install the remaining 10-24 bolts on the axles.

Inspect the nuts on all 10-24 bolts and replace plane nuts with locking nuts. Tighten all of these bolts.

Install the Skids



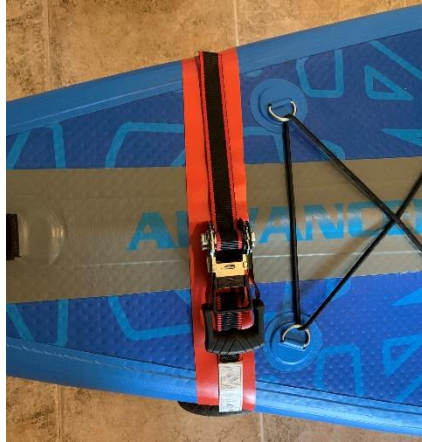
Use four flat head 1/4-20 bolts with locking nuts on each Skid. Tighten each nut, so it is just snug. If too tight, the plastic can distort or even crack.

This completes the cart.

Operation



Lift up the bow and place the cart under it such that the axle is even with the first set of D-rings.



Lay down a strip of slippery plastic and dress the strap on top of it. This plastic permits the strap to adjust without pulling on the gunnels or deck. You may find that it is not necessary.

Ratchet the strap until it is just tight enough that the cart does not move relative to the hull.

I'm still working out the best time to install the skeg. One way is to install it in the staging area. As long as I'm lifting up on the stern handle, the skeg won't touch the ground. Down at the water, I wade in until the skeg doesn't touch bottom. I can then start to wheel the kayak into the water. Before the cart reaches the water, I release the strap and lift it out of the way.



I store the cart on the forward deck. That way, I can keep an eye on it.

Where am I? This is Tempe Town Lake in Arizona. Here in the desert, we do have a lot of constructed lakes.

Update



There is one launch spot with a sandy beach. My wheels just sink in. My solution was to first replace remove the cotter pins and install hitch pins. I clipped on a second hitch pin on each side. They provide a good handle for pin removal plus are a back-up for the the opposite wheel.



With the wheel removed, I can install skis.



It is about twice as hard to pull the kayak compared to the wheels but at least it is possible.



I welcome your comments and questions.

If you want me to contact you each time I publish an article related to my AirVolution kayak, email me with “Subscribe kayak” in the subject line.

If you are on the list and have had enough, email me “Unsubscribe kayak” in the subject line.

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