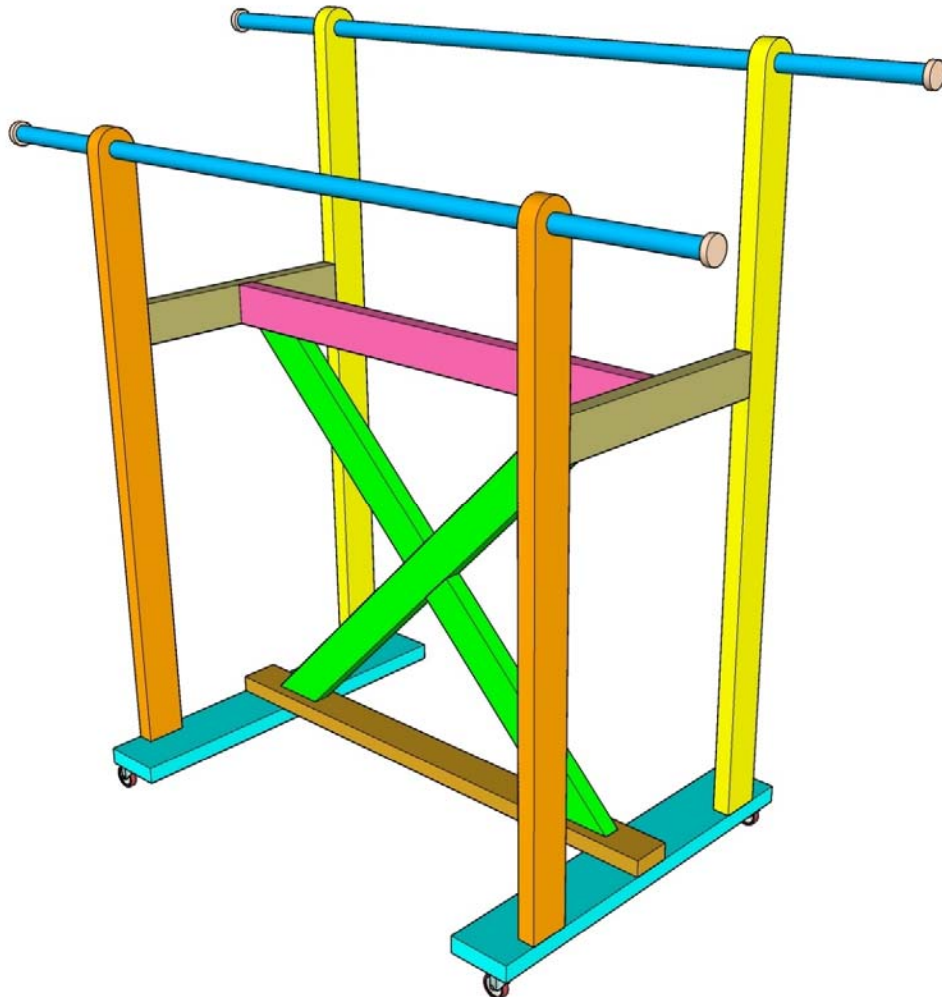


# INSTRUCTIONS

## for Building the 2x4 Clothes Rack

Rev. 1



# A Few Remarks About Making the 2x4 Clothes Rack

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## A WARNING - PLEASE READ

Woodworking can be dangerous! It's up to you to determine if you can safely use the tools and perform the tasks needed to complete this and any other woodworking project. If you are unsure, STOP! Get advice from someone knowledgeable or do some careful studying on your own. Be safe!

Always wear at least an appropriate N95 dust mask or respirator when sanding or spraying paint. For advice about dust masks and respirators, visit this link:  
<https://woodworkingtoolkit.com/best-dust-masks-respirators/>

**READ, UNDERSTAND, AND FOLLOW ALL OF THE  
INSTRUCTIONS AND WARNINGS THAT CAME  
WITH YOUR TOOLS. BE CAREFUL!**

## Why Build This Project?

The 2x4 Clothes Rack is useful and practical. It's designed to conveniently hang a large number of clothes in an informal location like a garage or storage room. It's constructed using inexpensive 2x4s, one 2x6, plus two standard closet rods and four swivel casters. Your total investment will be about \$100.

### Important Design Features of the 2x4 Clothes Rack

- Good project for an intermediate woodworker
- Rides on casters
- Each standard closet rod is 72" long
- The higher rod is about 65" off of the floor
- The lower rod is 8" lower
- The two closet rods have a horizontal separation of 24.5"
- Much of the construction is done using heavy duty pocket screws
- No finish is needed, but that option is up to you

### An Important Note About Pocket Screws

The 2x4 Clothes Rack uses a lot of pocket screw construction. Because all of the components are 2x4s, you should use a heavy-duty pocket screw system such as the "Kreg Jig® HD":

<https://www.kregtool.com/store/c13/kreg-jigsreg/p59/kreg-jigreg-hd/?source=1781>

This jig uses #14 x 2 1/2" pocket screws. Other vendors make heavy-duty pocket screw products, too. It doesn't matter which vendor's product you choose.

It would be unwise to use standard pocket screws instead of heavy-duty pocket screws for this beefy structure. **All references to pocket holes or pocket screws in this document assume heavy-duty pocket holes and screws.**

## Details of the SketchUp File and Equivalent PDF File

File *2x4\_Clothes\_Rack\_11.skp* is the SketchUp design for the 2x4 Clothes Rack. All of the dimensions and other necessary details are incorporated here. If you should find a dimension or other detail missing, it can be determined by examining this file. And, you can orbit and move the model around for a better look at everything.

File *2x4\_Clothes\_Rack\_11.pdf* contains all of the images and dimensions from the SketchUp file. Use this file if you're not familiar with, or don't use, SketchUp.

*The descriptions that follow will help to make clear the details of some of the components and construction so that possible misunderstandings might be avoided.*

### Use the Included SketchUp or PDF File to Follow Along with These Descriptions

There are 5 pages in this design. The heading of each section below corresponds to the name of a particular SketchUp/PDF page.

#### Assembly

This is a perspective view of the entire assembly. A limited number of dimensions are shown in this view.

Each unique component has been given a unique color. The color of a given component is the same in every view.

All structural components are 2x4s except the two Base pieces which are 2x6s.

#### Bracing

The Bracing forms the main structure of the 2x4 Clothes Rack. The half-lap Cross Braces provide a very rigid structure.

The method for constructing both the Cross Braces and the entire Bracing assembly will be described in detail later.

## Brace Frame

The Brace Frame not a part of the 2x4 Clothes Rack. Instead, it's a fixture that will be needed to help construct the Cross Braces. Those details will be provided later.

## Rod Support Assy

This is one of two Rod Support Assemblies used in the 2x4 Clothes Rack. **The two assemblies are mirror images of each other.**

## Cut List

All of the 2x4 and 2x6 components are shown here. It's clear to see that ten 2x4s are required and one 2x6 is required. You can also see the amount of waste material that will be generated.

**All of the 2x4s used in the construction of the 2x4 Clothes Rack should be kiln dried premium lumber.** *You need to use straight, stable lumber in order to get the best results.*

It's more difficult to find kiln dried 2x6s, so I used a piece of green lumber. Using green lumber runs the risk of shrinking, twisting, and cracking. However, the Bases are not glued into place, so they can be replaced if necessary.

## Building the 2x4 Clothes Rack



Figure 1. The 2x4 Clothes Rack

### Cut Most of the Components to Length

All of the cuts described in this section are right-angle cuts. Be careful to make all of the cuts square and smooth.

Refer to the *Assembly* view. Cut 2 pieces of 2x6 to the indicated length to form the 2 Bases. Cut 2 closet rods with a 1 3/8" diameter to the indicated length. Cut four 1/2" slices from a 2" diameter dowel rod to form the End Stops.

Refer to the *Bracing* view. Cut the Stretcher Top and Stretcher Bottom to the indicated lengths. **Cut each of the two Braces 9" longer than the specified length.** The excess length will be needed during construction.

Refer to the *Brace Frame* view. Cut each piece to its specified length. Square cuts are particularly important here, so cut carefully.

Refer to the *Rod Support Assy* view. Two of these assemblies are needed, so cut two of everything that you see in this view. Note that rounding will be applied to the top ends later. **Cut one extra Rail (the red piece referred to as the *Dummy Rail* in the Cut List view) which will be needed later during assembly.**

When all of the cuts are done, you should have:

- 2 pieces of 2x6
- 2 pieces of 1 3/8" dowel rod
- 4 pieces of 2"-diameter disks
- 15 pieces of 2x4

Some of the 2x4 scrap will be needed later.

### Sanding

After cutting all of the pieces to length, sand all surfaces of all of the 2x6s, 2x4s, and dowel rods using 80 grit paper, but **do not sand the ends of any of these pieces** so that the ends will remain clean, straight, and square. Sanding of the End Stops will be addressed later.

You might want to go to a finer grit sandpaper. The 2x4 Clothes Rack is constructed using construction grade lumber, so the 80-grit paper gives it some refinement, but you might want to do a little better to suit your taste.

### Form the Rounded Ends of the *Stile Short* and *Stile Long*

You'll need make a template for forming the rounded end of each Stile. Cut a piece of 1/4" or 1/2" MDF (Medium Density Fiberboard) or hardboard about 18" long and 3 1/2" wide. See Figure 2.

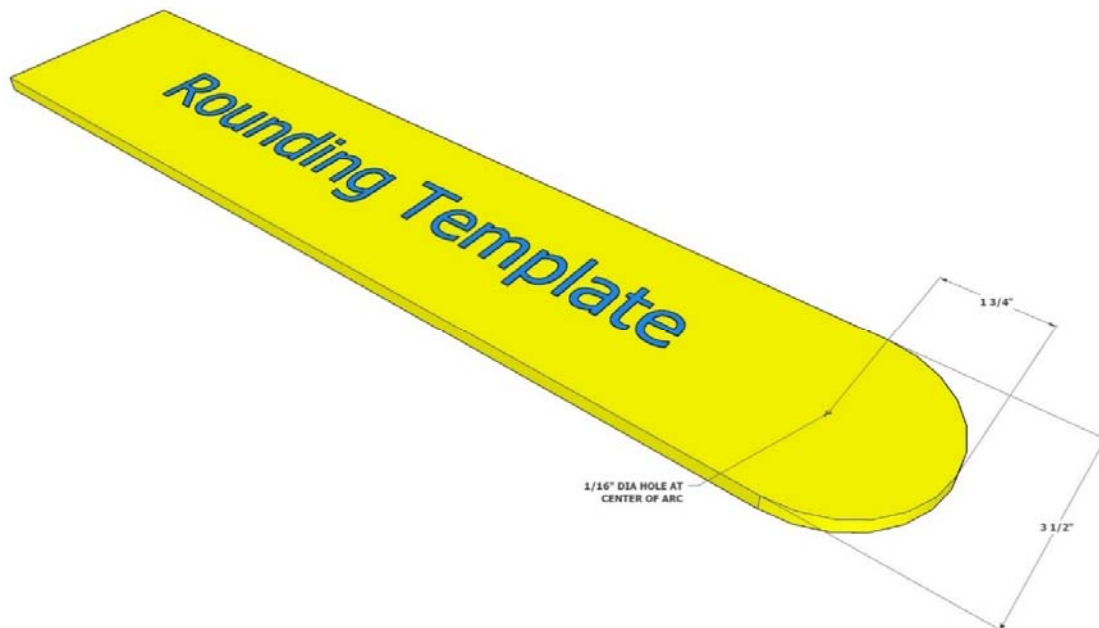


Figure 2. Rounding Template for Rounding the Ends of the Stiles

Mark a point 1 3/4" in from one end of the template and centered along its length. Carefully indent this point using an awl or a sharp nail. Place the pivot point of a compass into the indent and mark a semicircle with a radius of 1 3/4" across the end.

Use a jigsaw or bandsaw to cut along the semicircle, *staying slightly outside of the semicircle*. Carefully sand off the remaining material until you sand up to the marked semicircle. Be sure that you've formed a smooth semicircle at the end of the template.

Now drill a 1/16" perpendicular hole through the template at the indent.

Follow these steps to round the end of each Stile:

1. Carefully locate the Rounding Template of Figure 2 along one of the Stiles so that its edges are aligned with the edges of the 2x4 Stile. Its rounded end should be just slightly inside the end of the Stile. Using the Rounding Template as a guide, use a pencil to mark the arc on the Stile.
2. Put the Rounding Template aside but keep it nearby.
3. Use a jigsaw or bandsaw to cut along the pencil mark on the Stile staying about 1/8" outside of the pencil mark.
4. Now apply double-sided tape to key places on the Rounding Template. Then secure the Template to the Stile that you just cut. Be sure the edges of the Template and the edges of the Stile are aligned, and the curved end of the Template is aligned with the pencil mark.
5. Use a flush-cutting router bit with a bearing to remove the remainder of the material from the Stile. Align the bit so that its bearing is aligned with the Template and its cutting edges extend across the entire thickness of the 2x4.

NOTE: A handheld router can be used to remove the excess material but there's a chance that it could tip and damage the workpiece. I recommend cutting away the excess material by using a router table.

6. Once the rounded end of the Stile has been flush cut using the router—and before removing the Rounding Template from the Stile—use a pencil, thin nail, or thin awl to pass through the 1/16" hole in the Rounding Template and mark the center of the arc on the Stile. This mark will be used to center the drill when cutting the hole for the closet rod.
7. Remove the Rounding Template from the Stile.



Repeat Steps 1-7 for the other Stiles.

### **Round Over Some of the Unrounded Edges**

The edges of construction lumber are rounded. The edges of the rounded ends of the Stiles will not be rounded since they've just been cut.

Give your project a more consistent and attractive appearance by rounding some of the cut edges. Use a 3/16" radius round-over router bit to round both edges of the rounded end of each Stile.

Finally, round both edges of each end of both 2x6s.

### **Drill Holes for the Closet Rods**

Refer to the *Rod Support Assy* page to see the holes that are to be drilled.

I suggest using a hole saw to cut the holes for the closet rods. I think this is a better choice for this project than using a Forstner bit. It's certainly better than using a spade bit.

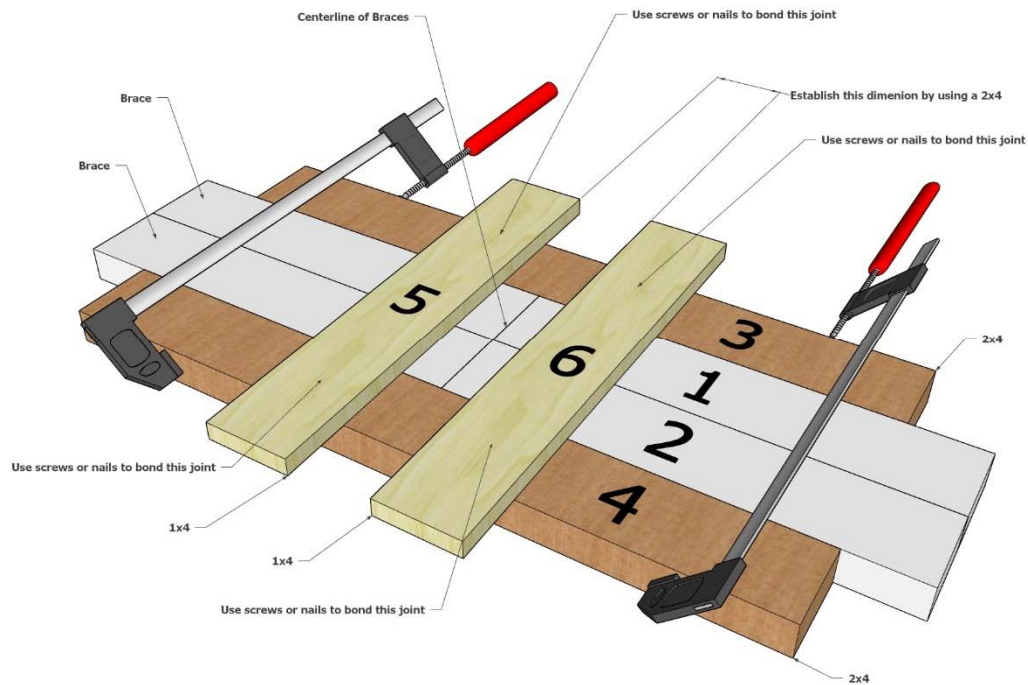
Center the hole saw or drill bit on the mark that you made in Step 6, above.

It's best to drill the holes on a drill press to ensure that they're perpendicular to the Stiles, but you can certainly use a handheld drill if you're careful. Cut the holes most of the way through, then flip the board over and cut the remainder of each hole from the other side. This will help to avoid tear-out.

Sand off any debris that forms around the holes.

### **Cut the Half-lap Mortises in the Braces**

Two of the most important cuts in this project are the half-lap mortises in the Braces. They must be perpendicular, clean, and cut to the correct depth. The way to accomplish this is to use a template. Look at Figure 3.



**Figure 3. Mortising Template**

Items 1 and 2 represent the Braces to be mortised. (You should have cut the Braces 9" longer than they're shown in the *Bracing* view.)

#### *Assemble the Template:*

- Find the center of each Brace and mark a line there across the Brace as shown in Figure 3
- Collect 2 scrap pieces of 2x4 to be used as Items 3 and 4 in Figure 3
- Collect 2 scrap pieces of 1x4 to be used as Items 5 and 6 in Figure 3
- Lay the 2 Braces on a flat surface and align their centerlines
- Place the scrap 2x4s, Items 3 and 4, on either side of the Braces as shown in Figure 3
- Use clamps as shown to *tightly* group Items 1, 2, 3, and 4
- Place 1x4 Item 5 across the group of 2x4s located about 1 3/4" to the left of the centerlines marked on the Braces. Ensure that it's exactly square with the 2x4s.
- Screw or nail Item 5 to Items 3 and 4. *The heads of the nails or screws must be below the surface so they won't interfere with the router.*
- Lay another scrap 2x4 against Item 5 and over the centerlines marked on the Braces.
- Lay 1x4 Item 6 *tightly* against the scrap 2x4
- While holding Item 6 *tightly* in place, screw or nail it to Items 3 and 4
- Remove the scrap 2x4 from between Items 5 and 6.

- Securely clamp the new template to the flat surface in anticipation of cutting the half-lap mortise with a router.
- *Ensure that the heads of any nails or screws are below the surface.*

#### *Rout the Mortises:*

A plunge router is ideal for cutting the half-lap mortises in the Braces but a fixed-base router can be used. **Your router's base must be large enough to span the 3 1/2" gap between Items 5 and 6.**

- Insert a flush-cutting pattern bit (bearing on top) into the router. The bit must have a length suitable to cut about 1/4" deep into the Braces while its bearing is riding against Item 5 or 6.
- Use the router to hog out material about 1/4" deep in the Braces. You can start the cut by either plunging the bit into Item 3 or 4 if you have a plunge base, or simply run the bit through Item 3 or 4 if using a fixed-base router.
- Once about 1/4" of the material has been removed, increase the depth another 1/4" and make another cut. Change to a longer bit if needed.
- Increase the depth of the cut until you reach a total depth of about 5/8" (not 3/4")
- Remove the Braces from the template and place the template aside

#### *Check the Fit:*

Now try to fit one side of the half-lap joint into the other side of the half-lap joint. With any luck the two Braces will engage each other and not fit "too" loosely.

*It's important that the two mortises can engage each other at this time. You will have to pare the sides of one or both mortises using a chisel if they can't. Do this very carefully to ensure straight, clean sides in the mortises.*

Now lay one Brace on a flat surface with its mortise facing up. Lay the other Brace on top so that the mortises engage each other.

The top Brace will be high since you didn't cut the mortises to their required depth of approximately 3/4".

#### *Finish the Cut:*

Carefully measure the distance from the top of the bottom Brace to the top of the top Brace. This distance will be shared between the two mortises, so divide the

distance in half. The result is the additional depth that you'll need to cut into each mortise.

Use a flush-cutting pattern router bit (bearing on top) with a length such that the bearing can ride against the sides of the mortise while the bit cuts the remaining depth into each mortise.

Cut the additional depth into each mortise to complete the cuts.

The mortises in the two Braces should now engage such that each Brace is flush with the other. And, as a bonus, the joint should be snug enough that the Braces can't move very much relative to one another.

### **Temporarily Assemble the Braces**

If the half-lap joint is a little bit loose, move and rotate the Braces in relation to one another such that they are as centered and aligned as possible. Clamp them in this position.

Drill and countersink holes in the Braces for 4 screws as shown in Figure 4. The screws should be centered 5/8" away from each edge.



**Figure 4. Four Screws Hold the Braces Together**

Use four 1 1/4" flathead screws to secure the half-lap joint, as shown. **DO NOT USE GLUE.** Glue will be used on this joint in a later step.

Put the Brace assembly aside for now.

## Construct the Brace Frame

Refer to the *Brace Frame* page. Assemble the pieces as shown using pocket screws.

Be sure the final assembly is square by measuring across opposite corners and verifying that the two diagonals are the same length. If the assembly isn't square, do whatever is needed to make it square.

## Mark and Cut the Miters on the Braces

Retrieve the Brace assembly and place it on a flat surface. Lay the Brace Frame on top of it. Move the Brace assembly and Brace Frame relative to each other so that all of the gaps between the Braces and the 35" sides of the Brace Frame are equal as highlighted by the circles in Figure 5. Then apply clamps to prevent any movement.

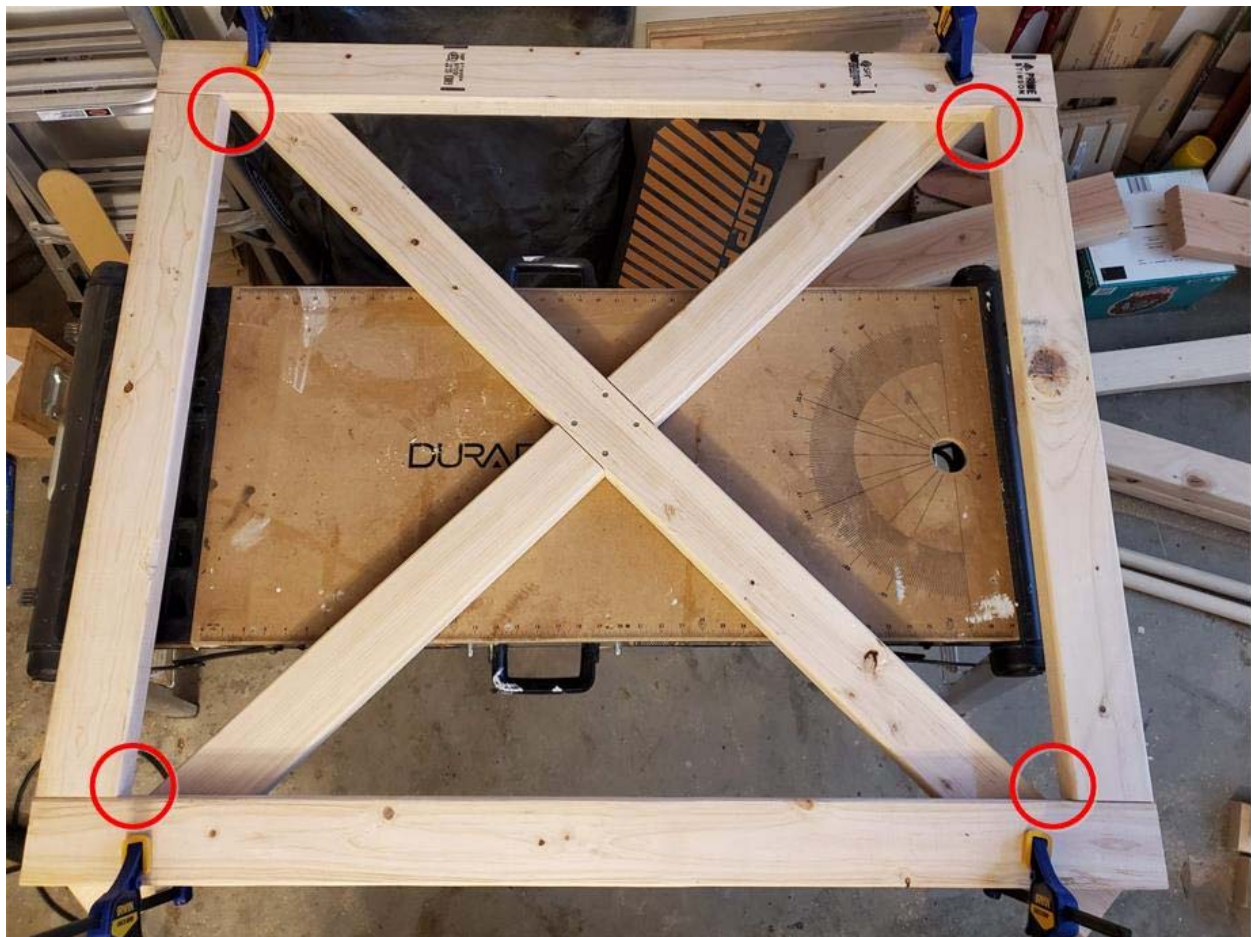


Figure 5. Aligning the Braces So That the Gaps are Equal



Figure 5 shows a condition in which the Cross Braces are aligned and centered. *That is, they appear in the Brace Frame exactly as you want them to appear in the 2x4 Clothes Rack.*

Now hold a pencil against the inside edge of the top of the Brace Frame and scribe a line across each Brace. Repeat with the pencil held against the inside edge of the bottom of the Brace Frame.

You should now have a straight line marking the miter cut on each Brace as shown in Figure 6.



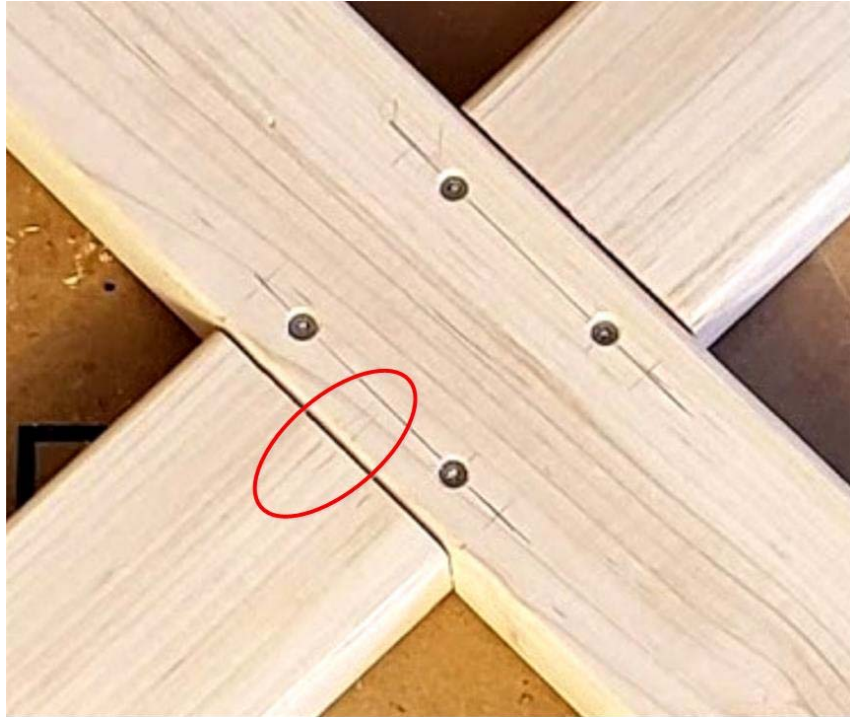
**Figure 6. Marked Miter at the End of a Brace**

Remove the clamps and put the Brace Frame aside.

You're done with the Brace frame, so it can be disassembled if you wish.

## Cutting the Miters on the Braces

With the Braces still screwed together, use a pencil to draw a "witness mark," a line or mark that crosses from one Brace to the other Brace *across only one side of the half-lap joint*. That is, any mark on one Brace should match and be next to a similar mark on the other Brace. See Figure 7 for an example of a witness mark.



**Figure 7. A Witness Marks Has Been Applied Across One Edge of the Joint**

The witness mark will be used to ensure that the Braces are reassembled exactly as they were when the pencil lines were scribed against inside of the Brace Frame. The witness mark will be used to prevent one of the Braces from being rotated relative to the other piece. If that happened, it could upset all of the aligning that was achieved when using the Brace Frame.

After applying the witness mark, remove the four screws holding the Braces together. Put the screws aside but be prepared to use the same screws again.

## Making the Miter Cuts on the Braces

Use a T-bevel to measure the angle of the pencil marks near the end of one of the Braces. Use the T-bevel to transfer the angle to your miter saw. *Being absolutely sure that the miter saw has been set correctly*, carefully cut the miter on the Brace. Repeat for the remaining miter cuts on the Braces.

## Reassemble the Braces with Glue

- Gather the four screws that you removed from the Braces
- Apply glue to the inside of the mortises in both Braces
- Join the mortises together in a half-lap joint
- **Be sure** that the witness marks are aligned with each other
- Carefully screw the joint together using the four recovered screws
- Wipe away any glue squeeze out

## Assemble the Stretcher Bottom to the Cross Braces

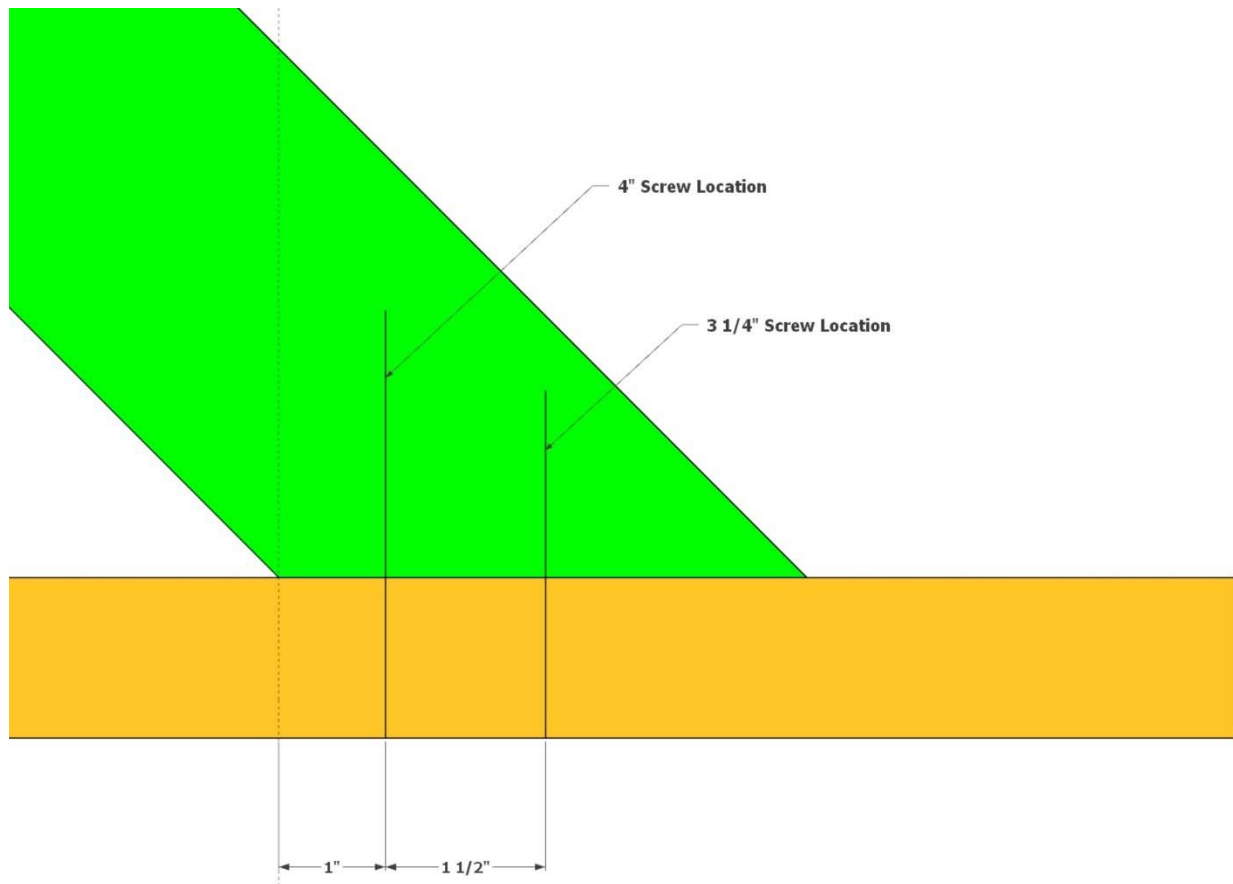
Refer to the *Bracing* view. The Stretcher Top and Stretcher Bottom will now be attached to the Brace assembly. We'll begin with the Stretcher Bottom.

The Braces will be centered along the centerline of the Stretcher Bottom. Thus, with the 1 1/2" thickness of the Braces and the 3 1/2" width of the Stretcher Bottom, each side of the Brace will be about 1" from the edge of the Stretcher Bottom.

Clamp the Brace assembly to the Stretcher Bottom with the tip of one Brace located 4 1/32" from the end of the Stretcher Bottom.

Drive two flathead screws, one 4" long and the other 3 1/4" long, in through the bottom of the Stretcher Bottom and into the bottom of each Brace as shown in Figure 8.





**Figure 8. Stretcher Bottom Screw Locations**

With the Stretcher Bottom secured to the Brace assembly, it's time to move on to attaching the Stretcher Top.

### **Assemble the Stretcher Top to the Cross Braces**

The 2x4s might not be straight and the Brace assembly might not be aligned exactly correctly, so a special method is needed to attach the Stretcher Top to the Brace assembly. You'll need a plumb bob.

A plumb bob will act as a very large try square.

#### ***Aligning the Stretcher Top:***

Clamp the new assembly vertically on a flat, horizontal surface with the Stretcher Bottom resting on the surface. Clamp the Stretcher Bottom to the surface so the assembly won't fall.

Place a level on top of the Stretcher Bottom. Use shims at one end of the Stretcher Bottom as needed to bring the Stretcher Bottom exactly into level.

Referring to the *Bracing* view and the  $2\frac{17}{32}$ " dimension, draw a pencil line across one edge of the Stretcher Top located  $2\frac{17}{32}$ " from each end. This is the design distance from the ends of the Stretcher Top to the tips of the Brace assembly.

Place the Stretcher Top on top of the Brace assembly with the pencil lines toward the bottom. Center the Stretcher Top on the Brace assembly so that each pencil line is positioned the same distance from the respective tip of the Brace assembly. Lightly clamp the Stretcher Top in place so that it won't fall.

The Stretcher Top is 3" shorter than the Stretcher Bottom. Mark lines across the Stretcher Bottom such that they're half this distance, or  $1\frac{1}{2}$ " from each end.

The ends of the Stretcher Top should be located, ideally, exactly above these lines. Let's see if they are.

Lower a plumb bob over one end of the Stretcher Top and check the distance from the plumb bob's tip to the pencil line on the Stretcher Bottom. Now do the same thing at the other end.

If the plumb bob is away from the respective pencil lines by unequal distances, then unclamp the Stretcher Top, slide it in the direction and distance needed to equalize the distances, and re-clamp it. Check again using the plumb bob.

Repeat this process until the plumb bob falls at equal offsets from both pencil lines on the Stretcher Bottom. Then clamp the Stretcher Top tightly in place on the Brace assembly.

#### *Attaching the Stretcher Top:*

With the Stretcher Top tightly clamped, drive two 4" screws through the bottom of the end of each Brace and into the Stretcher Top. Figure 9 shows the locations and orientations of the screws.

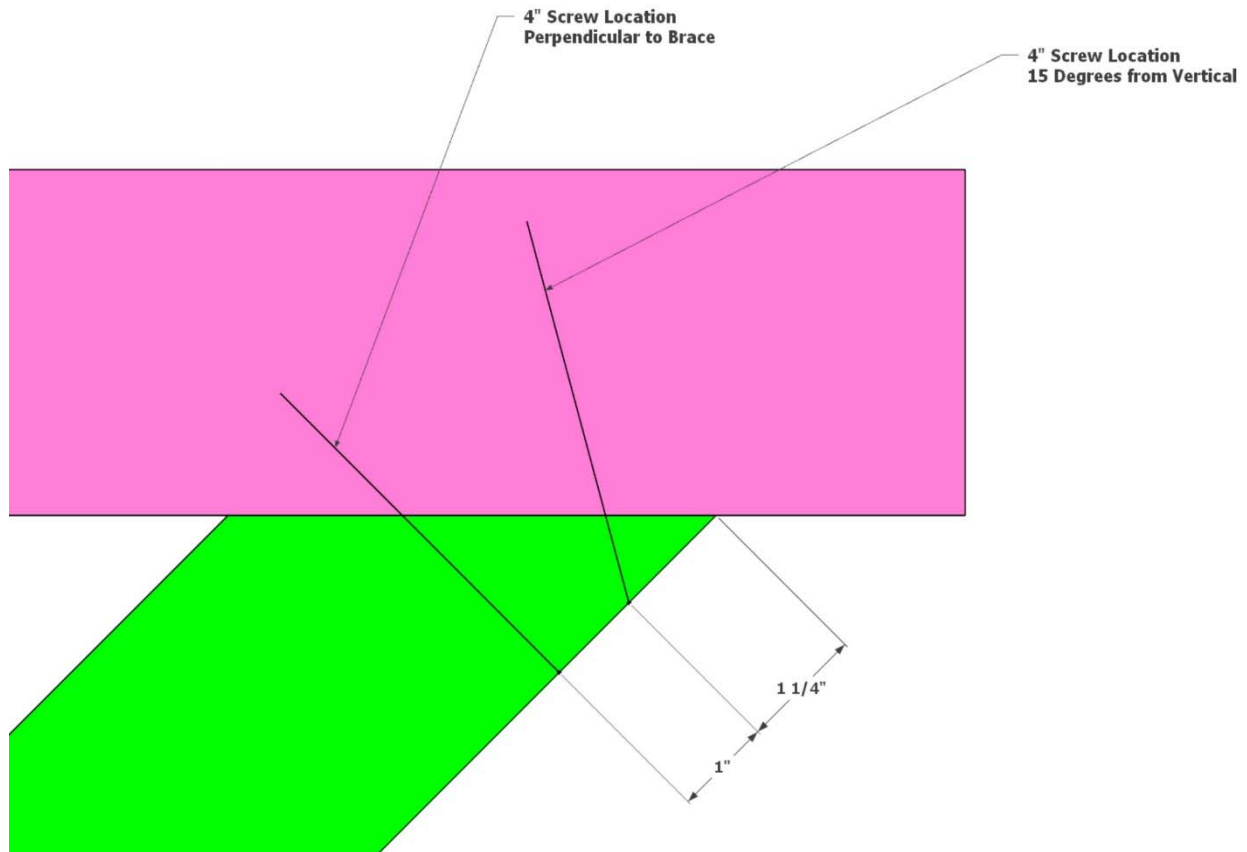


Figure 9. Stretcher Top Screw Orientations

### Attach the 2x6 Bases to the Cross Brace Assembly

Figure 10 shows 2 rows of 5 screws each that secure the Base to the Stretcher Bottom.



Figure 10. Screws Attaching Each Base to the Stretcher Bottom

Refer to the *Assembly* page. Mark a line across the top of each Base (the 2x6 pieces) that's located 15 1/4" from the front edge as shown by the dimension on the *Assembly* page.

Mark a centerline across the bottom of each Base so that the line is located 17" from each end. Now mark parallel lines 1" on either side of the centerline. These last two lines identify the locations of the rows of screws.

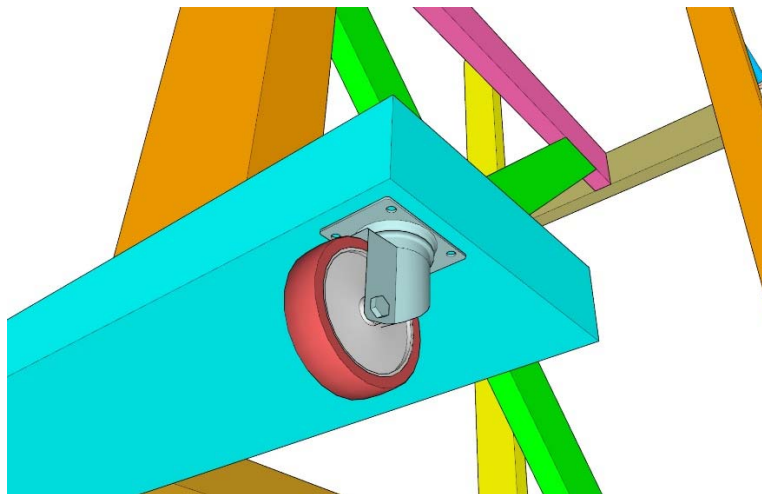
Observe the 15 1/4" line on the top of each Base. Clamp each Base to the Stretcher Bottom so that the front edge of the Stretcher Bottom is on the line. The end of the Stretcher Bottom should be flush with the outside edge of the Base. **Be absolutely sure that each Base is perpendicular to the Stretcher Bottom.**

Drill and countersink pilot holes into the bottom of each Base and into the Stretcher Bottom. The holes should be spaced evenly along each of the lines on the bottom of the Base.

Drive a 2 1/2" flathead screw into each hole.

### **Attach the Casters**

I used casters with 2" diameter rubber wheels. All are swivel casters. Two of the casters are locking. Two are not locking. The caster location is illustrated in Figure 11.



**Figure 11. Caster Location**

Each caster is mounted about 1/4" from each end of each Brace and 1/4" from the outside edge of the Brace. This gives the 2x4 Clothes Rack maximum stability

while also giving the screws enough meat to bite into. I used #12 x 1 1/4" screws driven into 1/8" pilot holes.

The locking casters are located at the front of the 2x4 Clothes Rack to provide easy access to the locking levers.

Place the entire assembly on the floor once the casters have been mounted. The assembly should roll easily along the floor if everything is straight and square.

### **Let's Drill Some Pocket Holes**

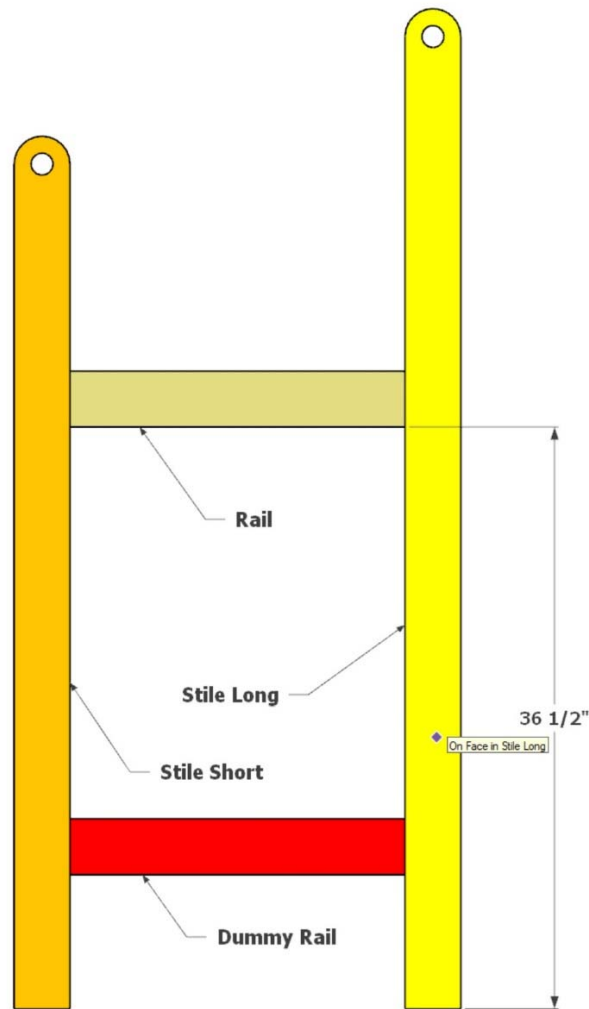
Drill 2 pocket holes at the ends of all stiles, rails, and stretchers.

There's no need for pocket holes in the Dummy Rail, seen in the *Cut List* view.

### **Assemble the First Rod Support Assy**

Refer to Figure 12. Lay a Stile Short, a Stile Long, and two Rails on a flat surface, as shown in the figure, with all of their pocket holes facing upward. One of the Rails is the *red Dummy Rail* on the *Cut List* page.

The Dummy Rail should be located at least several inches above the bottom ends of the Stiles.



**Figure 12. Assembling the Rod Support Assy**

Place a clamp across the assembly where each Rail meets the Stiles. Use a framing square to *ensure that the bottom ends of both Stiles are even with each other.*

Use a pencil to mark a vertical centerline on the Rail. Add parallel lines on both sides of the centerline spaced 3/4" from it. These last two lines mark where the edges of the Stretcher Top will be located.

### **Mount the First Rod Support Assy**

Look at the *Assembly* view. Notice that the Rod Support Assy on each Brace is positioned 3" from the front end of each 2x6 Base.

Identify the Base that is to be the left Base. Place a pencil mark 3" from its front edge. Stand the clamped Rod Support Assy on top of the Base so that its front edge is on the line and the outside edges of both Stiles are flush with the outside edge of the Base.

Clamp the Rail to the Stretcher Top to stabilize everything. Use pocket screws to attach the bottom of each Stile to the Base.

Remove the bottom clamp and the Dummy Rail from the Rod Support Assy.

### **Assemble the Second Rod Support Assy**

To assemble the second Rod Support Assy, refer to Figure 12 again. Follow all of the same clamping procedure **but this time layout all of the pieces as a mirror image of the figure, again with all of their pocket holes facing upward.**

Use a framing square to be sure the bottom ends of the Stiles are even, as before.

Again, as before, use a pencil to mark a vertical centerline on the Rail. Add parallel lines on both sides of the centerline spaced 3/4" from it. These last two lines mark where the edges of the Stretcher Top will be located.

### **Mount the Second Rod Support Assy**

As before, place a pencil mark 3" from the front edge of the right Base. Stand the clamped Rod Support Assy on top of the Base so that its front edge is on the line and the outside edges of both Stiles are flush with the outside edge of the Base.

Clamp the Rail to the Stretcher Top to stabilize everything. Use pocket screws to attach the bottom of each Stile to the Base.

Remove the bottom clamp and the Dummy Rail from the Rod Support Assy.

### **Align and Attach Both Rails to the Stretcher Top**

Even if you were careful to follow all of the dimensioning in the design drawing, the height of the Rails might not match the height of the Stretcher Top exactly. If this is what you've found, carefully loosen the clamp across one Rail and adjust its height to align with the top edge of the Stretcher Top.

NOTE: The end of the Stretcher Top might not line up with the two pencil lines marked on the Rail. You might have to force the Stretcher Top into alignment.

When the height of the Rail is correct, use pocket screws to attach it to the Stiles.

Adjust and attach the other Rail following the same process.

Now force one end of the Stretcher Top into alignment with the pencil marks on the Rail and use two pocket screws to secure it against the Rail. Do the same for the opposite end of the Stretcher Top.

### **Inserting and Securing the Closet Rods**

The project is almost complete.

Use a 1/2" Forstner bit or brad point bit to drill a 1/4" deep counterbore at the top of the curve on each Stile. Then drill a 1/8" pilot hole into the center of each counterbore, all the way into the 1 3/8" hole. Just drill from the top and into the larger hole. Don't drill past the larger hole.

Slide the closet rods through the large holes in the Stiles. Allow for equal lengths of each rod to extend beyond the outside edges of the Stiles. The ideal distance is 12" but just make sure that the extension is the same at both ends.

Rotate each closet rod so that its grain is oriented vertically so that it's as stiff and strong as possible.

Once the closet rods are turned in the correct direction and the ends extend equal distances from the Stiles, drive a #12 x 1 1/4" wood screw down through the pilot hole in the Stiles and into the closet rods. The screws will prevent the closet rods from turning or moving. The counterbores and screws should look like Figure 13.



**Figure 13. A Screw in Counterbore Secures the Closet Rod**



### **Prepare the End Stops**

Find and mark the center of each End Stop. Mark the center with an awl or sharp nail. Drill a 1/4" hole through the center of each End Stop.

Put a 1/4" bolt through the hole of one of the End Stops and thread a 1/4" nut onto the other side. Hand tighten or tighten mildly with a pair of pliers.

Put the threads of the 1/4" bolt into a drill. Rotate the drill *counterclockwise* and use sandpaper to provide a mild round-over to both edges of the End Stop. The results should look like Figure 14.



**Figure 14. The Edges of Each End Stop are Rounded**

Do the same to the other End Stops.

### **Add the End Stops to the Ends of the Closet Rods**

Find and mark the centers of the ends of the closet rods. Mark the centers with an awl or sharp nail. Drill a 1/8" pilot hole into each rod end.

Apply glue to the end of one of the closet rods and to the same area on one side of an End Stop. Drive a #12 x 1 1/4" pan head or round head screw through the End Stop and into the closet rod. Repeat for the other End Stops.

## **Applying a Finish**

I chose to leave the 2x4 Clothes Rack unfinished. You might want to apply a clear or even a painted finish.

Even if you choose to apply a finish, you might not want to apply a finish to the closet rods. The hangers could wear the finish off or discolor it if you use paint.

Good luck! Make good use of the 2x4 Clothes Rack.