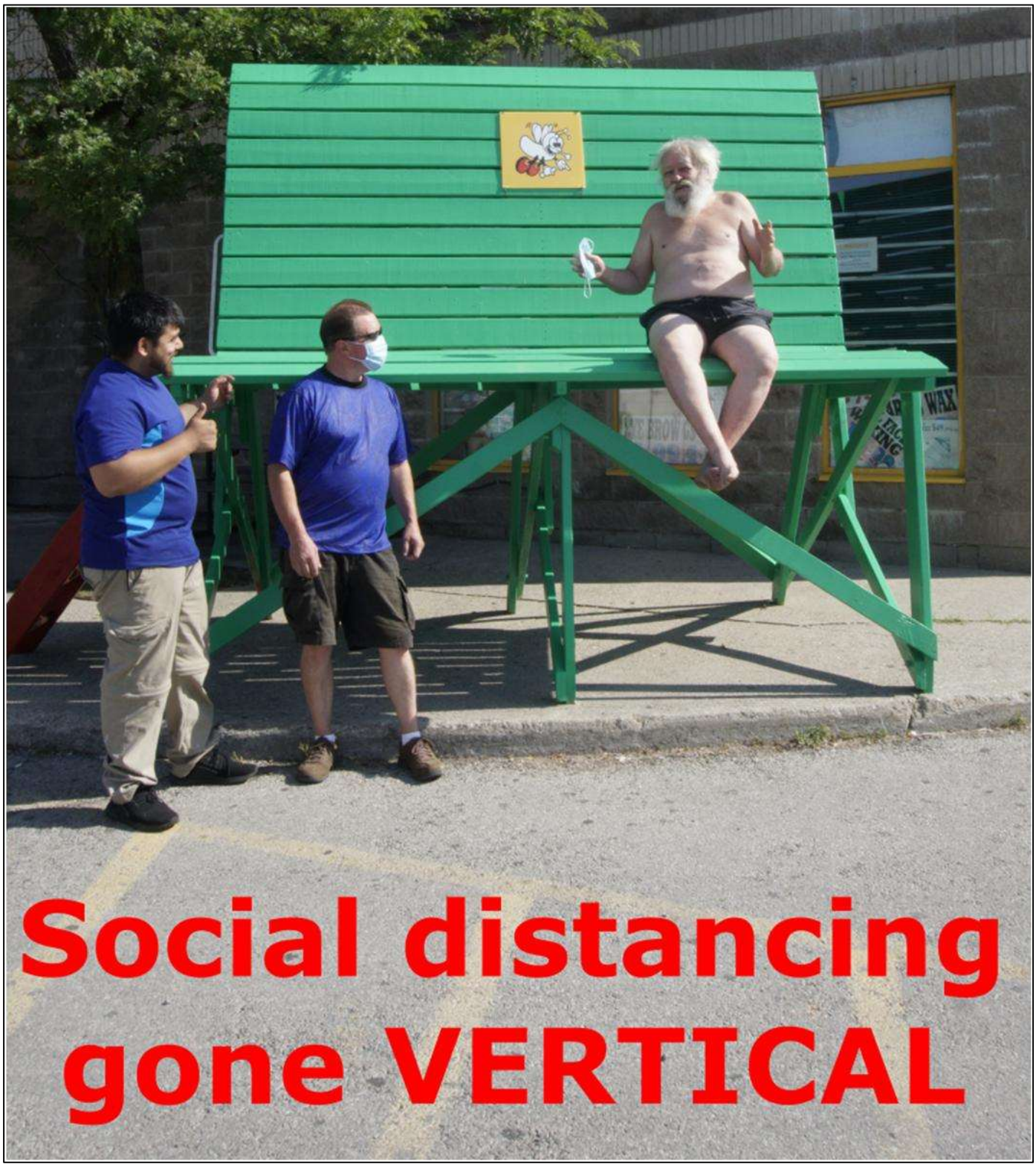
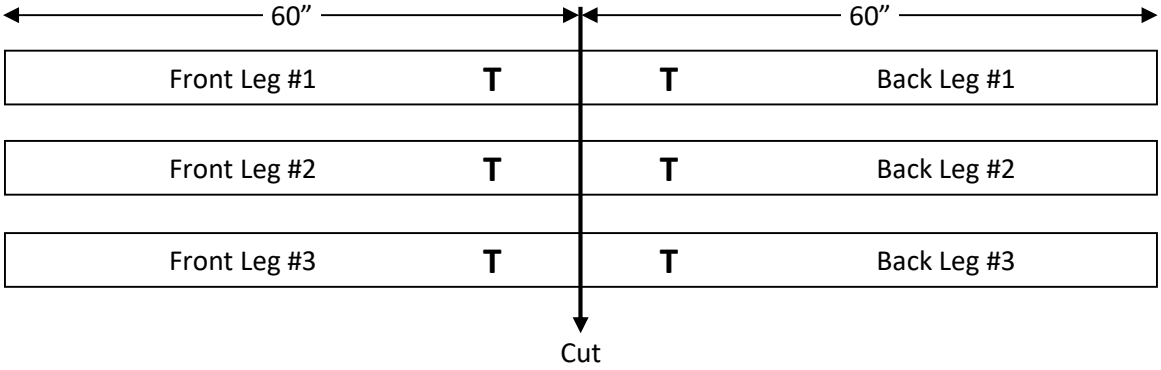
Step-by-step instructions on how to build a giant bench

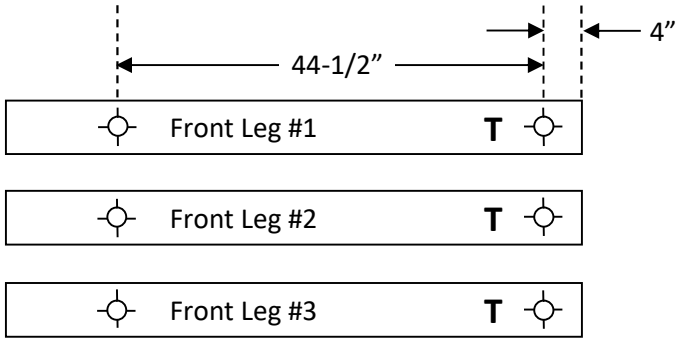


Wood required for the frame:
2” x 6” x ten feet (5 pieces)
2” x 6” x eight feet (3 pieces)
2” x 4” x ten feet (2 pieces)
2” x 4” x eight feet (3 pieces)

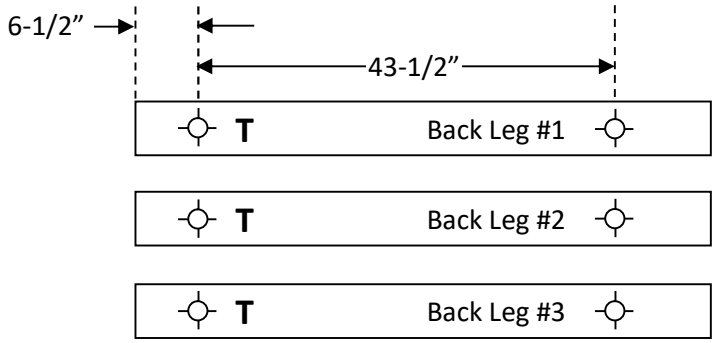
Step #1: Cut three pieces of 2” x 6” x ten feet in half, to prepare stock for three Front Legs and three Back Legs. Mark a “T” near the cut end. This end of each piece will be at the “top” when we assemble the frames. The scale in the following figure is 1” (on paper) = 20” (real world).



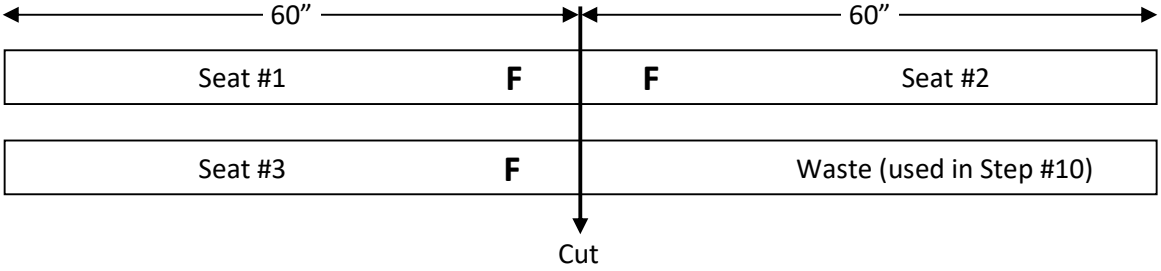
Step #2: Drill the following two holes (1/4-inch diameter) through the wide (6”) face of the three Front Legs. The holes are centered across the width of the piece. Scale 1” (paper) = 20” (real).



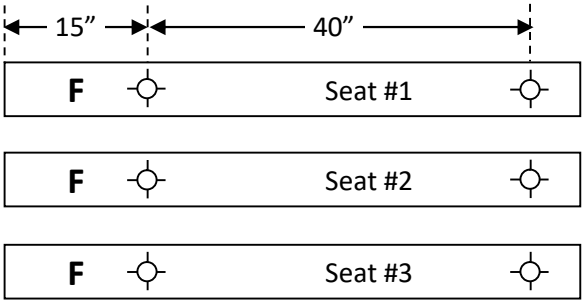
Step #3: Drill the following two holes (1/4-inch diameter) through the wide (6”) face of each of the three Back Legs. The holes are centered across the width of the piece. Scale 1” (paper) = 20” (real).



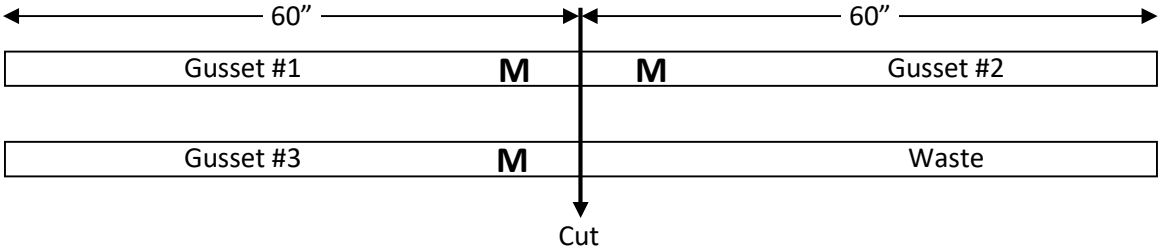
Step #4: Cut two pieces of 2” x 6” x ten feet in half, to prepare stock for three Seats. Mark an “F” near the cut end. This end of each piece will be at the “front” when we assemble the frames. The scale in the following figure is 1” (on paper) = 20” (real world).



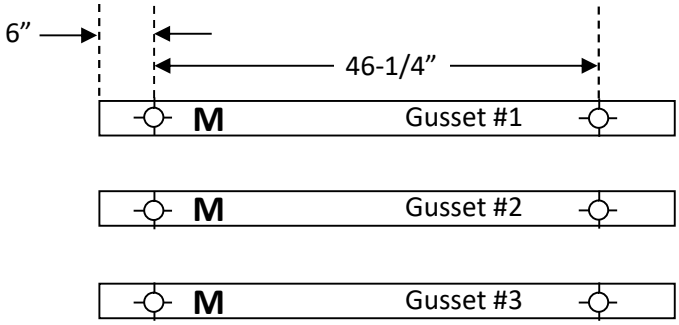
Step #5: Drill the following two holes (1/4-inch diameter) through the wide (6”) face of each of the three Seats. The holes are centered across the width of the piece. Scale 1” (paper) = 20” (real).



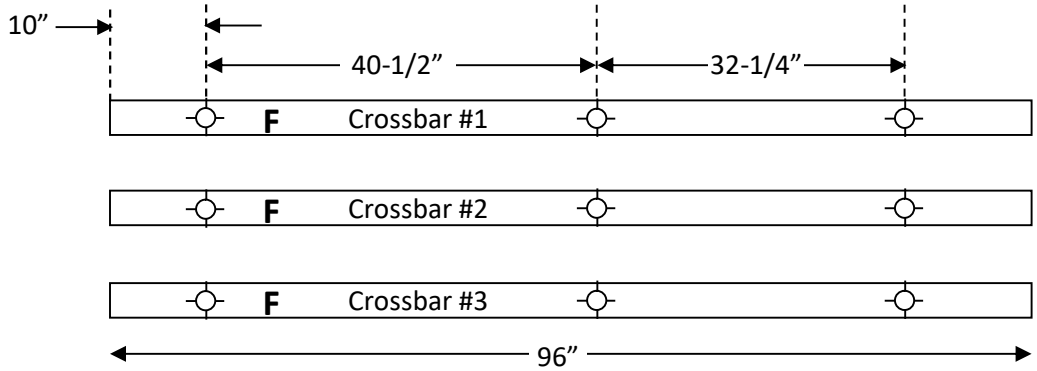
Step #6: Cut two pieces of 2” x 4” x ten feet in half, to prepare stock for three (front) Gussets. Mark an “M” near the cut end. This end of each piece will be at the “middle” when we assemble the frames. The scale in the following figure is 1” (on paper) = 20” (real world).



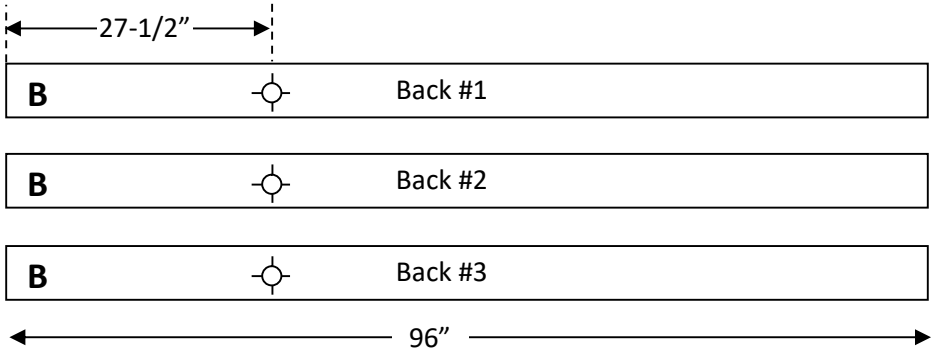
Step #7: Drill the following two holes (1/4-inch diameter) through the wide (4”) side of each of the three Gussets. The holes are centered across the width of the piece. Scale 1” (paper) = 20” (real).



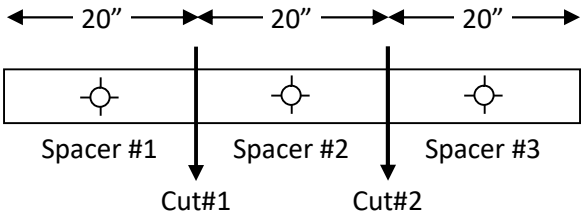
Step #8: Take three pieces of 2” x 4” x eight feet as stock for three Crossbars. No cutting is needed. Mark an “F” near the better of the two ends of each piece. This end of each piece will be at the “front” when we assemble the frames. Drill the following three holes (1/4-inch diameter) through the wide (4”) face of each Crossbar. The holes are centered across the width of the piece. Scale 1” (paper) = 20” (real).



Step #9: Take three pieces of 2” x 6” x eight feet as stock for three Backs. No cutting is needed. Mark a “B” near the better of the two ends of each piece. This end of each piece will be at the “bottom” when we assemble the frames. Drill the following hole (1/4-inch diameter) through the wide (6”) side of each Back. The hole is centered across the width of the piece. Scale 1” (paper) = 20” (real).

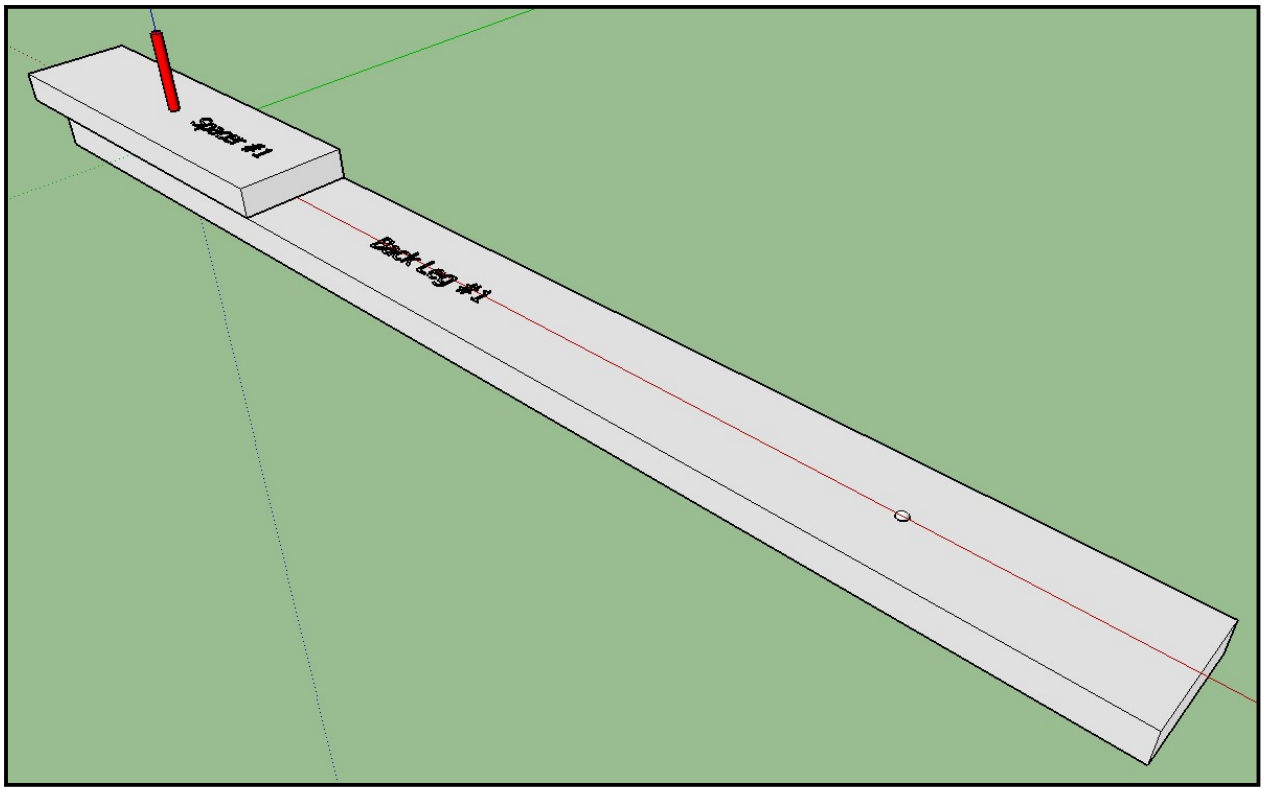


Step #10: Take the piece of Waste left over from Step #4. It is a piece 2” x 6” five feet long. Cut it into three equal lengths (each 20” long) and drill a 1/4-inch diameter hole through the wide (6”) face at the center of each length. These three Spacers are shown in the following figure. Scale 1” (paper) = 20” (real).



Part II – Assemble the left frame ("left" as seen when sitting on the bench)

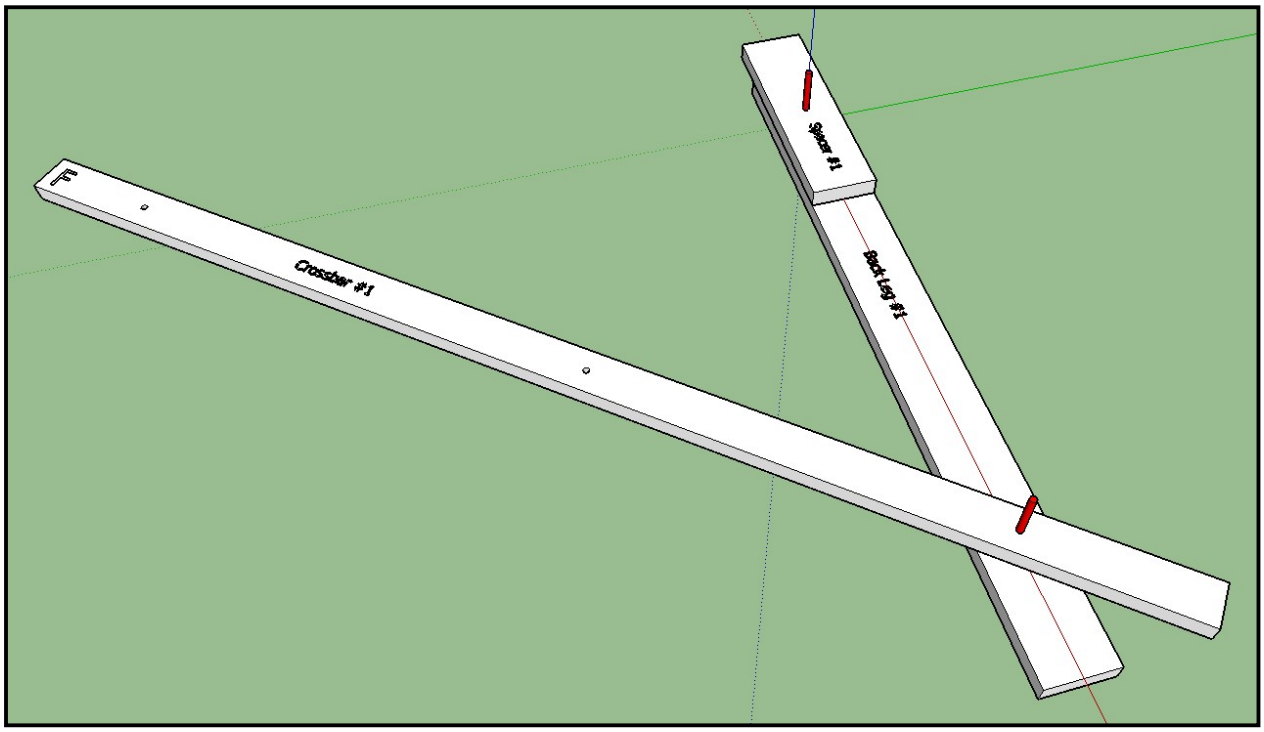
Place Back Leg #1 on the floor with the "T" end away from you. Place Spacer #1 on top of Back Leg #1, with the holes lined up as follows.



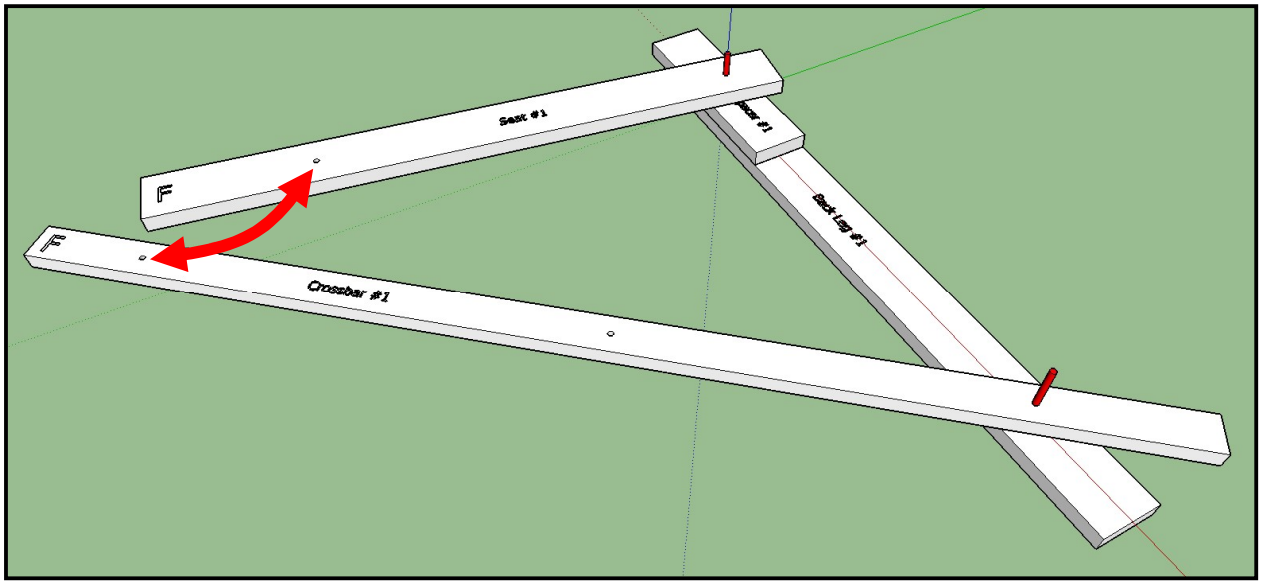
The red cylinder in the figure represents an eight-inch (or so) length of 1/4-inch threaded rod. Here, and again later, it is convenient to use such a rod to keep the holes lined up. If necessary, washers and nuts can be added to the ends to hold the assembly loosely together as it is moved around.

Incidentally, the "T" mark at the top of Back Leg #1 is not visible in the figure because it is hidden beneath Spacer #1.

The next step is to place another red cylinder (which I will start calling a "pin") up through the bottom hole of Back Leg #1, and to run it through the back hole of Crossbar #1. The following figure shows the new arrangement. Crossbar #1 will be oriented about 60° from Back Leg #1, but the exact angle does not matter just yet.

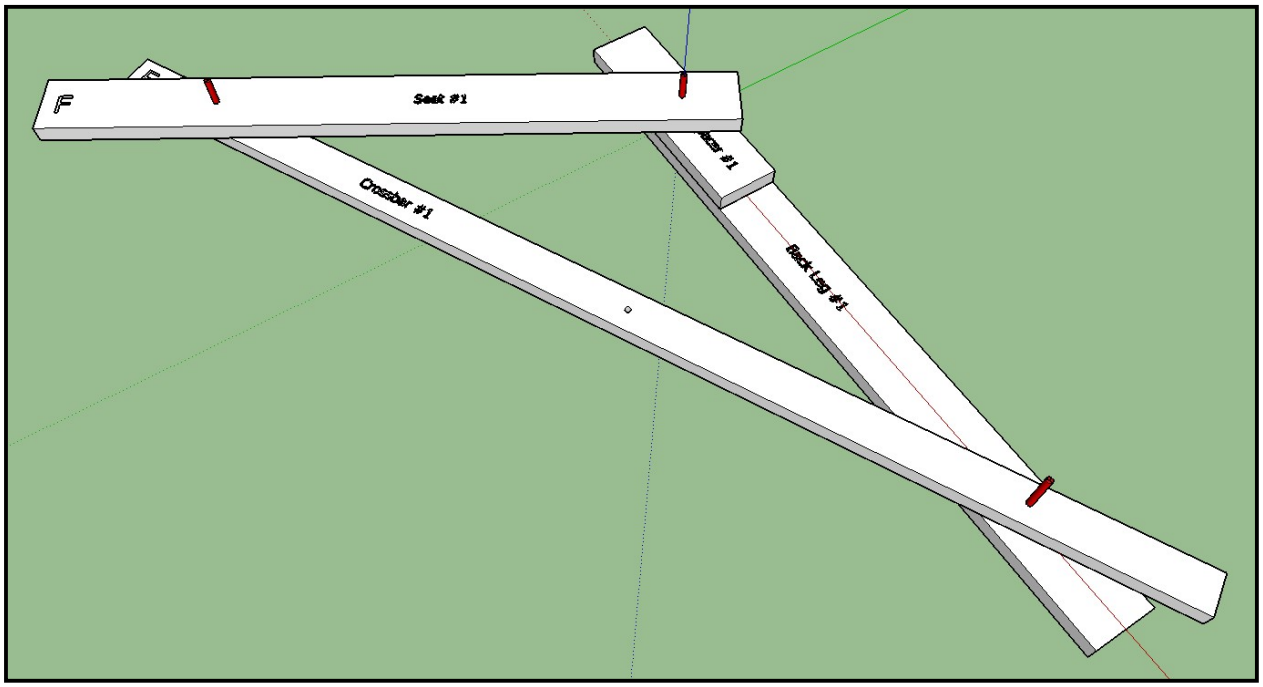


Now position Seat #1 so that its back hole slides down the top pin which comes up through Spacer #1. Note that Spacer #1 and Crossbar #1 are at the same vertical height (with respect to the surface of the page), so that Seat #1 will sit nice and flat on top of the two of them.

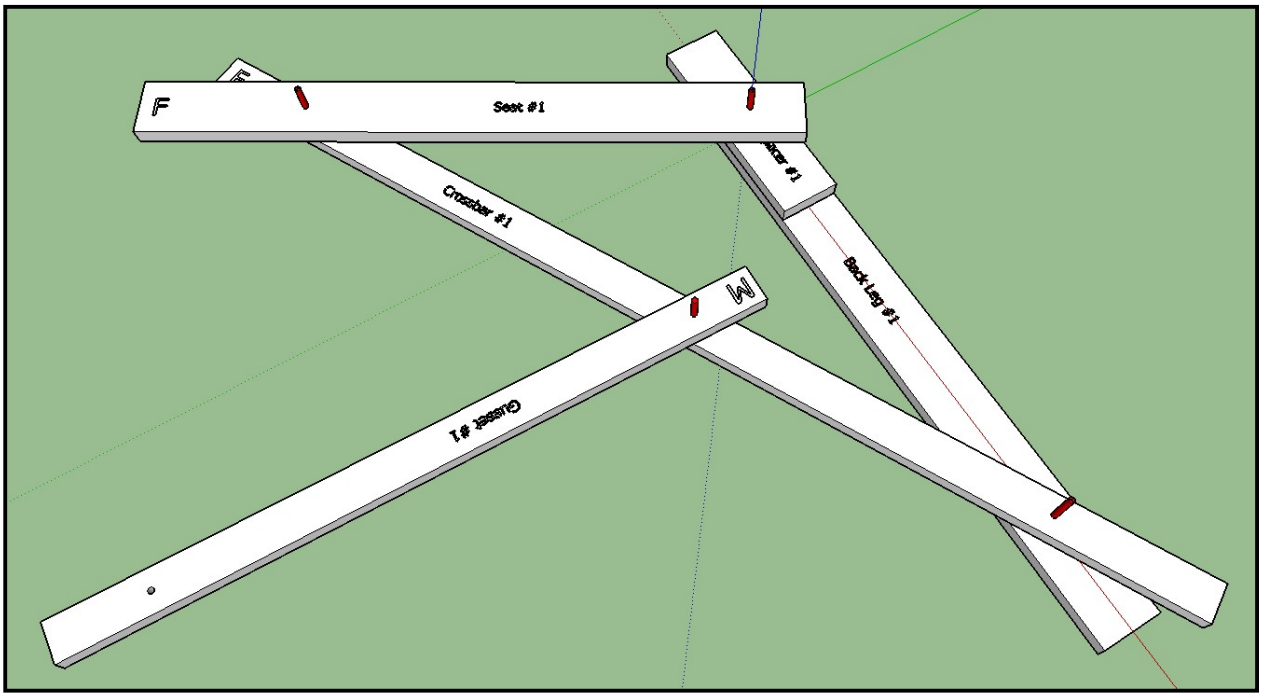


Now, pivot Seat #1 and Crossbar #1 around the two pins to bring their front holes into conjunction. The red arrow in the figure above shows the two holes to be

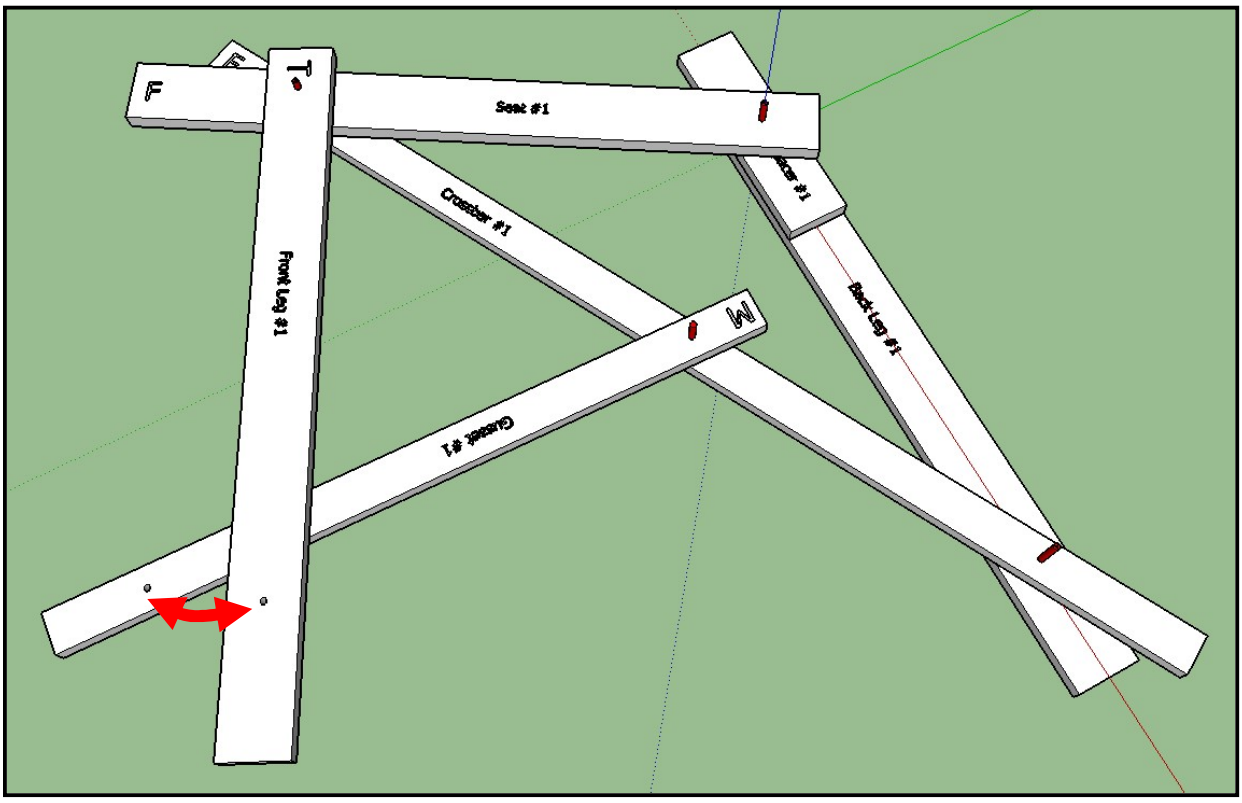
aligned. When the holes are aligned, run another pin through. This will result in the triangle (a strong shape) shown in the following figure.



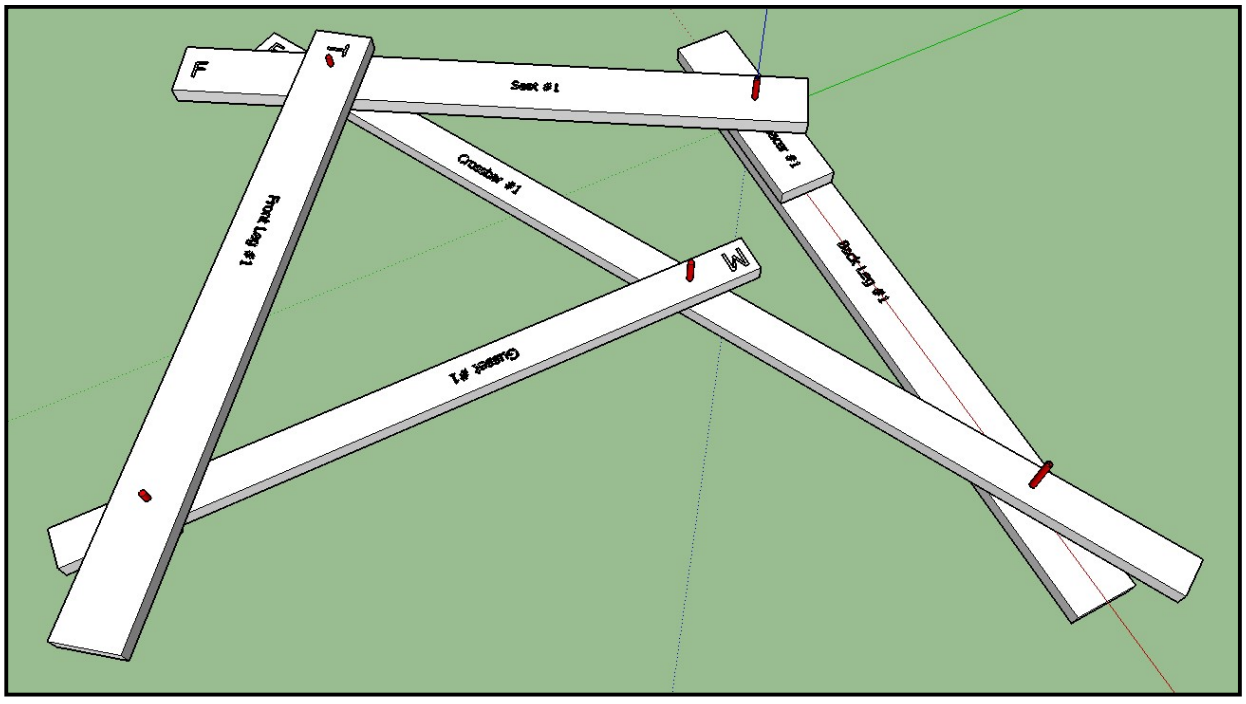
Gusset #1 can now be pinned to the middle hole in Crossbar #1, as shown in the following figure.



Next, Front Leg #1 is dropped onto the front pin as shown below, and the bottom holes of Front Leg #1 and Gusset #1 brought into alignment as shown by the red arrow.

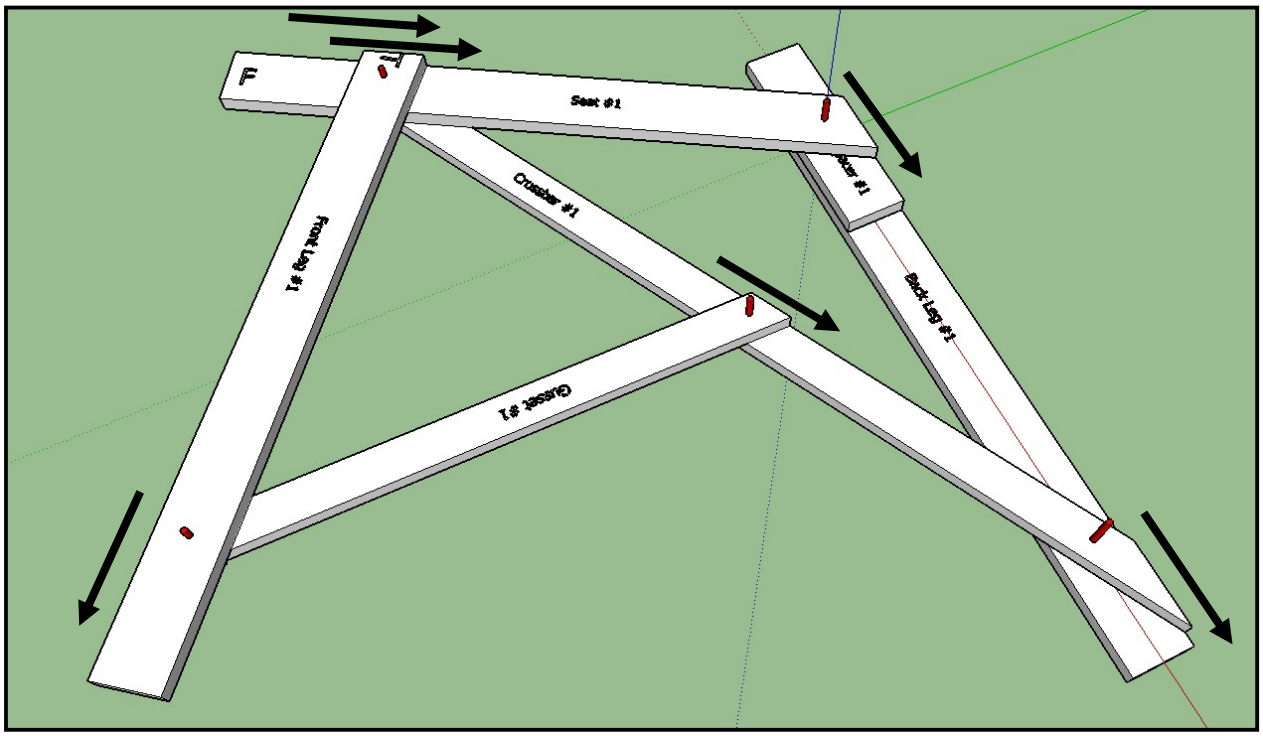


A final pin is driven through the aligned hole.



Since the frame is comprised of two independent triangles, it will fit together very nicely even if the holes were not drilled exactly where planned.

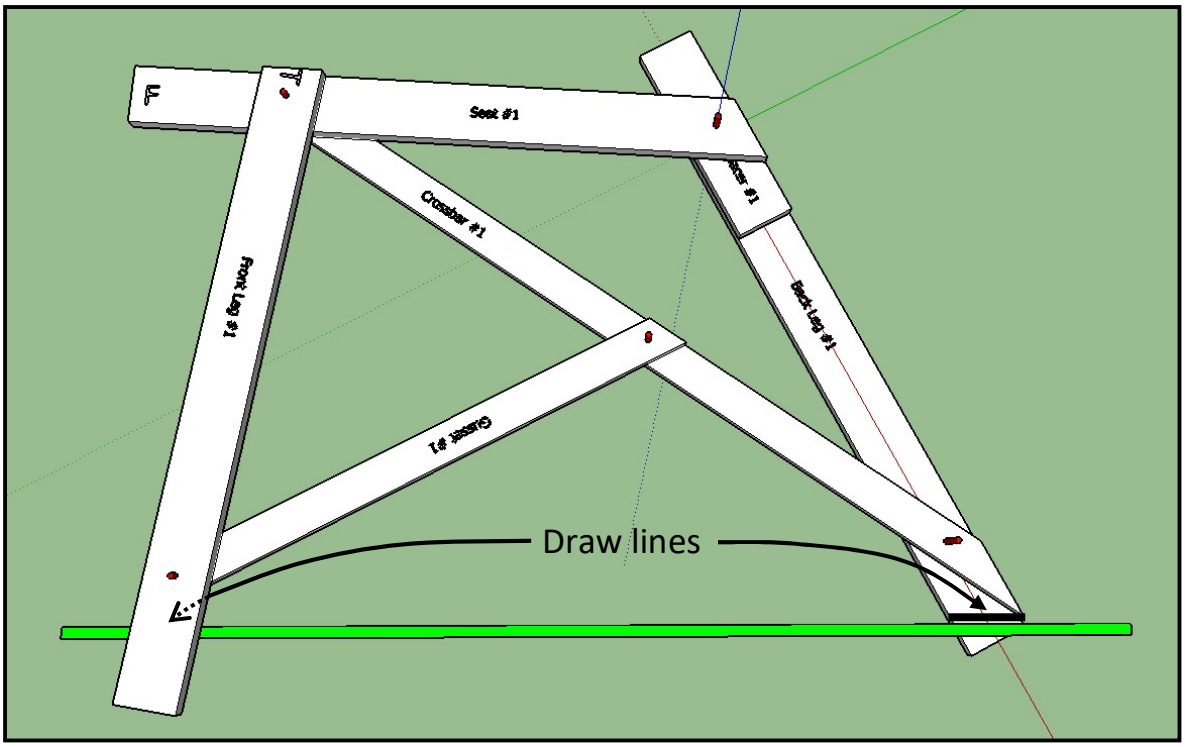
This is a good time to trim off the ends of some of the members. The easiest way is to draw lines where needed (using the crossing member as the straight edge), and then to temporarily disassemble the frame before making the cuts. The following figure shows where the cuts should be. Each of the six heavy black arrows is a cut through the cross-section of one 2" x 4" or one 2" x 6" piece. Note that the bottoms of the legs, the front of the seat, and the tops of the back leg and spacer are not trimmed just yet.



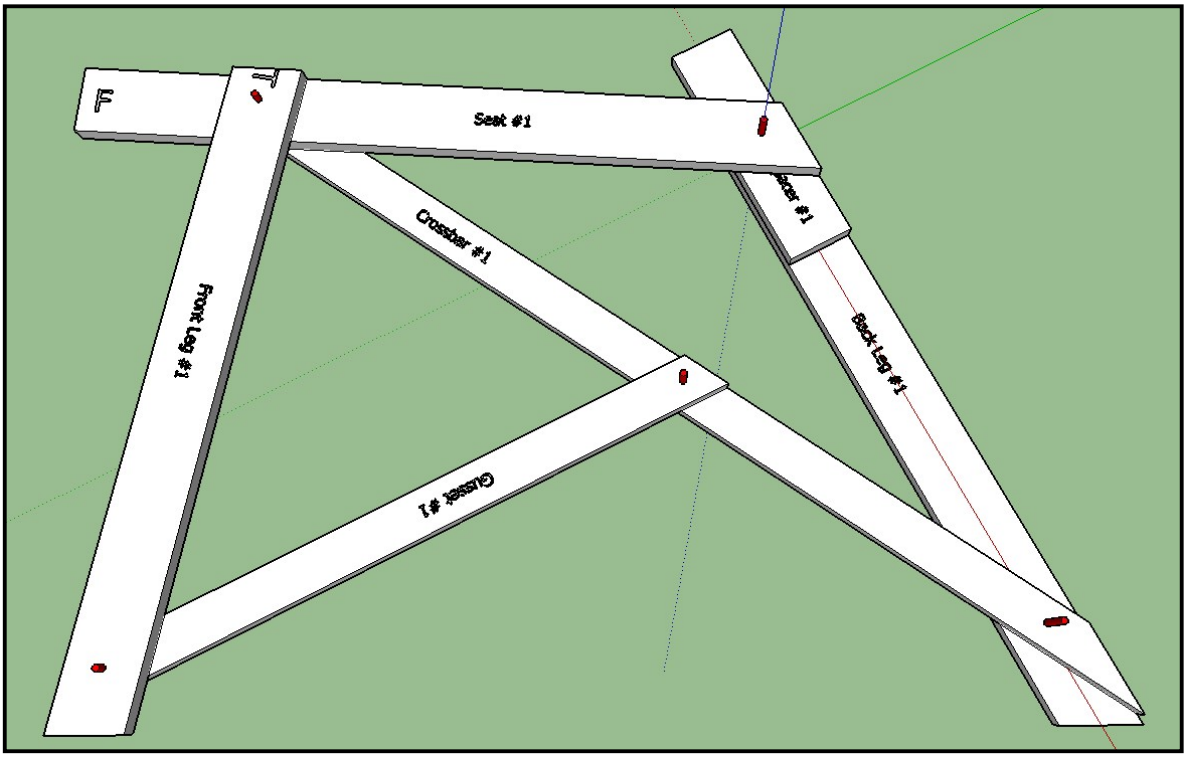
Next, we will trim the bottom of the legs. The following figure shows one way to do that. The green object represents a ruler, or even a scrap of wood with a reasonably straight edge. The one shown is eight feet long and easily spans the distance between the legs. Note that Front Leg #1 and Back Leg #1 are not in the same plane, so the "straight edge" will pass beneath the front leg and over the top of the back leg. Scribe a line along the top edge of the ruler and cut the ends off the legs along these lines.

The exact positioning of the straight edge is not that critical. Since the two scribed lines are colinear (meaning they are not just parallel in their directions, but share

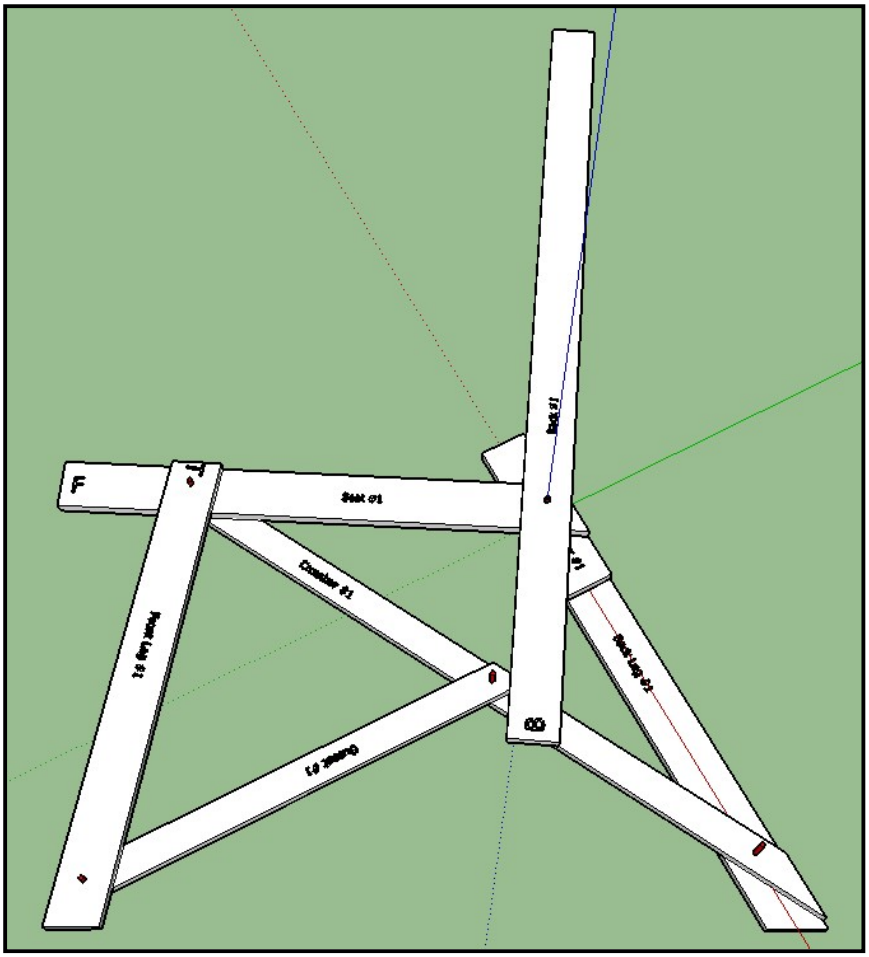
the same axis), the cut ends of the legs will both rest firmly on the floor or ground when the frame is upright.



I placed the straight edge so that the scribed line across back leg passed about one-half inch below the intersection with the bottom side of the crossbar, and the scribed line across the front leg passed about one-half inch below the intersection with the bottom side of the gusset. The following figure shows what the frame will look like after the legs have been trimmed.



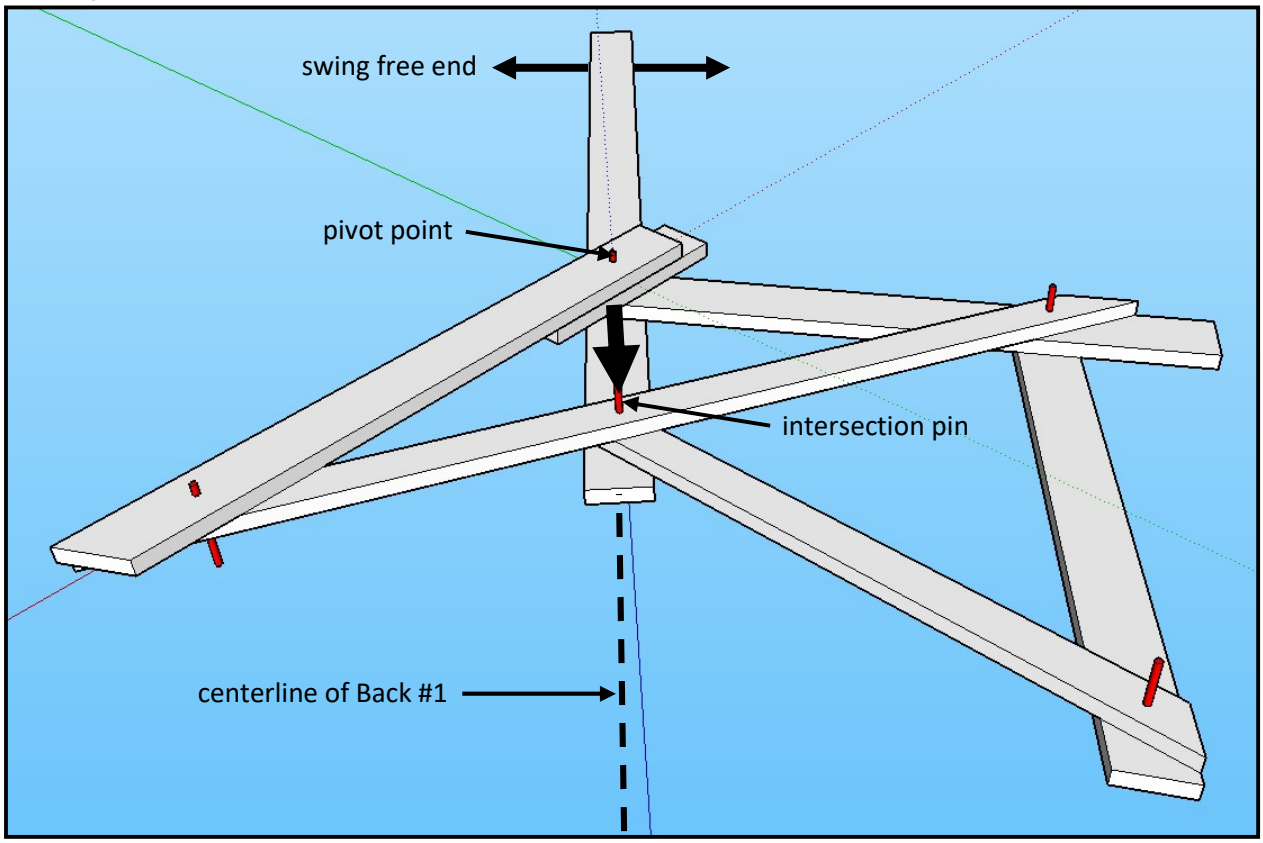
Now, let's begin the process of fitting Back #1. Start by sliding it down over the pin at the upper right, at the back of Seat #1.



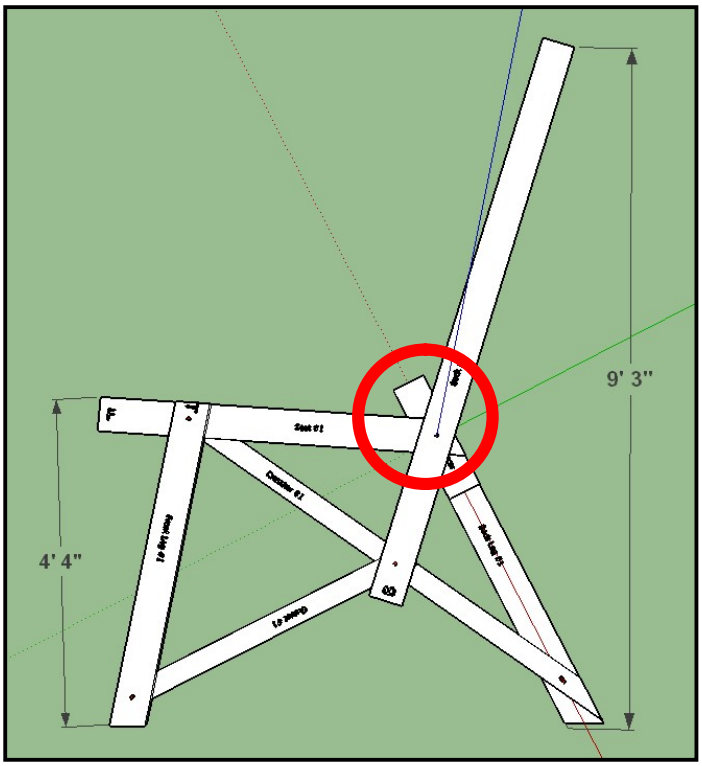
We are going to have to drill a hole near the bottom end of Back #1 so it can be pinned where the crossbar and gusset meet. To find out where to drill that hole, do the following. First, use a hammer or block of wood to tap down on the pin at the intersection of Crossbar #1 and Gusset #1. Tap the pin down so that its top is level with the surface of Gusset #1. Then, turn the entire assembly over.

Refer to the following figure. Swing the free end of Back #1 around the pin at the back of Seat #1, where it connects to the back leg. The goal is to orient the back so that its centerline passes right below the pin at the intersection of the crossbar and the gusset. When the back is positioned (so that the hole to be drilled passes through the centerline of Back #1), then give the the top of the pin a sharp tap with a hammer or block of wood, as shown by the heavy arrow in the figure. This will make a dent in the wood marking where the hole should be. Drill a 1/4" diameter hole through Back #1 right here.

Once this hole is drilled, it will be possible to run the intersection pin all the way through.



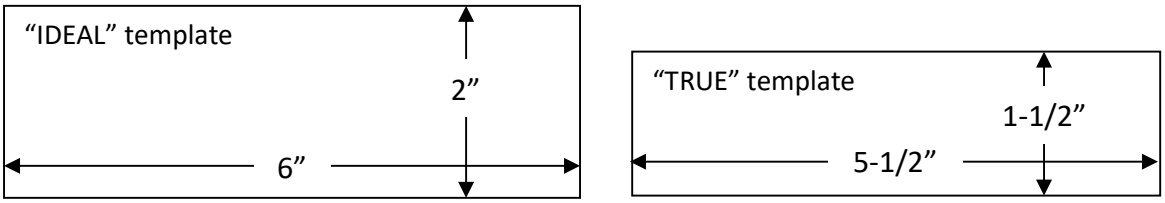
When the assembly is turned back over, and stood upright, the ultimate size and shape of the bench will become clear.



In the next Part, we are going to lay out the positions of the horizontal 2” x 6” planks that will be the seat and back of the bench. The purpose of this exercise is to determine how to trim the front end of Seat #1 and the top end of Back #1 for the best visual appeal. We will start the exercise by looking more closely at the junction shown inside the red circle shown to the left.

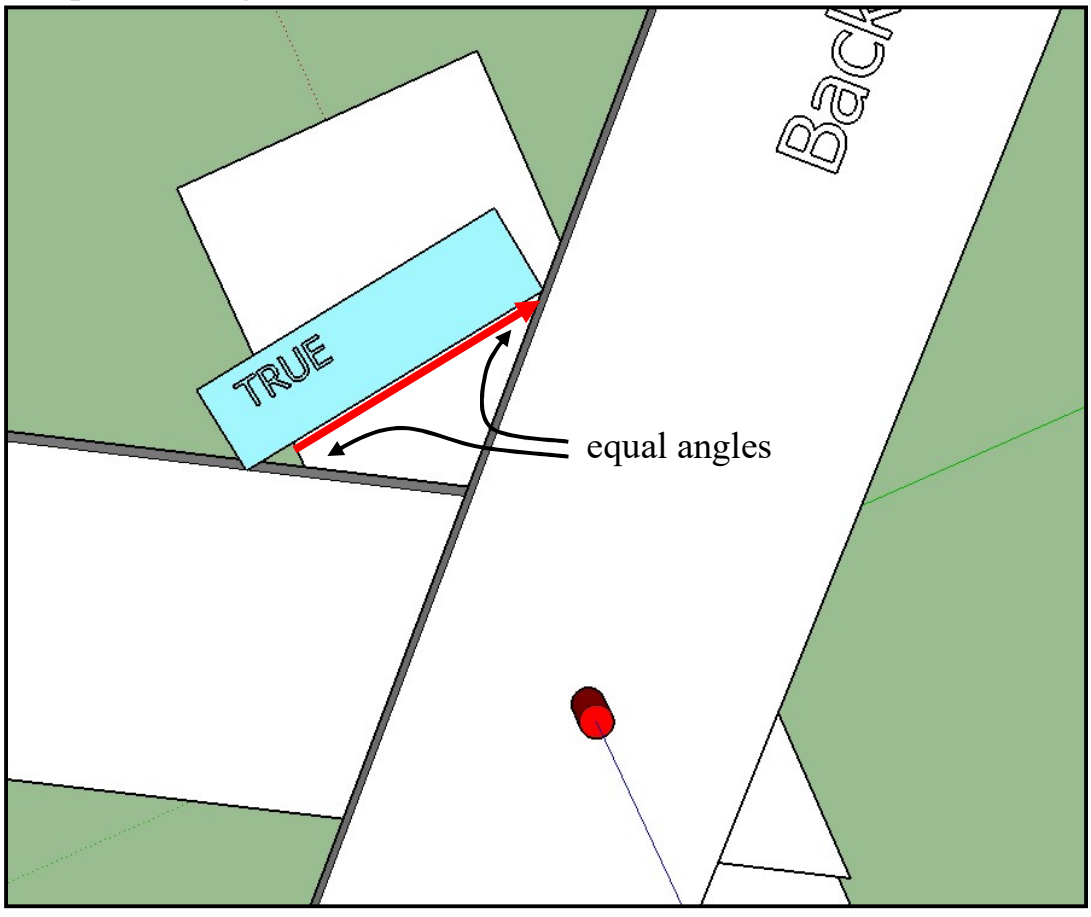
Part III – Layout of the planks which will be the seat and back of the bench

I decided to use 2” x 6” planks to make the seat and back of the bench. From a piece of cardboard or thin plywood, cut out the following two templates.

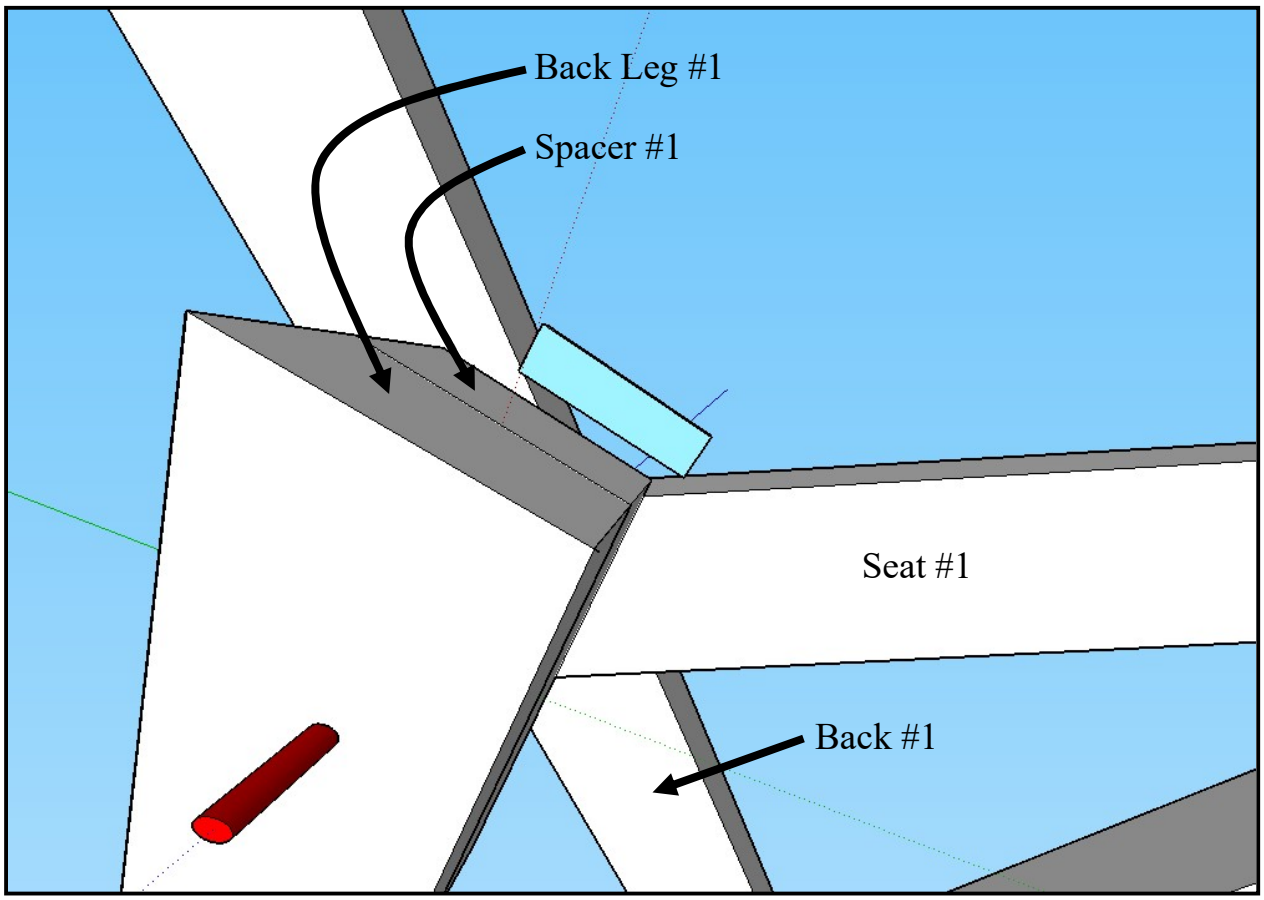


The two templates represent cross-sections of 2” x 6” planks. The IDEAL template is, of course, two inches high and six inches wide. But that is not the size of a “two-by-six” plank at the local Home Depot or lumber store. The ”true” dimensions are one-half inch shy of the ideal, so the TRUE template is 5-1/2” wide and 1-1/2” high.

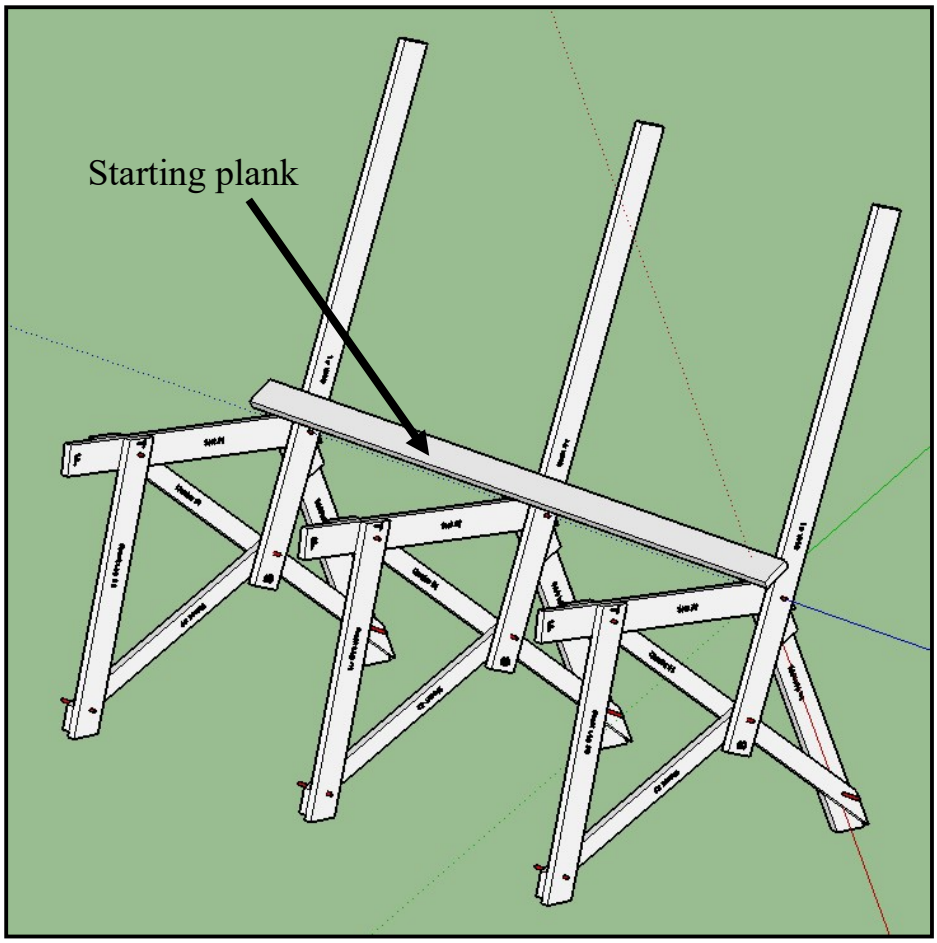
Place the TRUE template inside the junction circled in the previous figure, at an angle which bisects the obtuse angle between Seat #1 and Back #1. It is not necessary to be exact – “eye balling” is adequate. Scribe a line across Back Leg #1 and Spacer #1 along the bottom of the template, as shown by the red arrow, and cut these two pieces along this line.



In fact, eye-balling will be necessary. The picture above makes it look like the TRUE template is actually lying on the face of Spacer #1. But it is not. That this is the case is obvious if the intersection shown above is viewed from the other side. The view from the other side – after Back Leg #1 and Spacer #1 have been cut off – is shown in the following figure. The TRUE template touches Back #1 and Seat #1, but Spacer #1 and Back Leg #1 are on the far side of Seat #1, an inch-and-a-half away. To be on the safe side, it would be better to cut Back Leg #1 and Spacer #1 a little too long than a little too short.

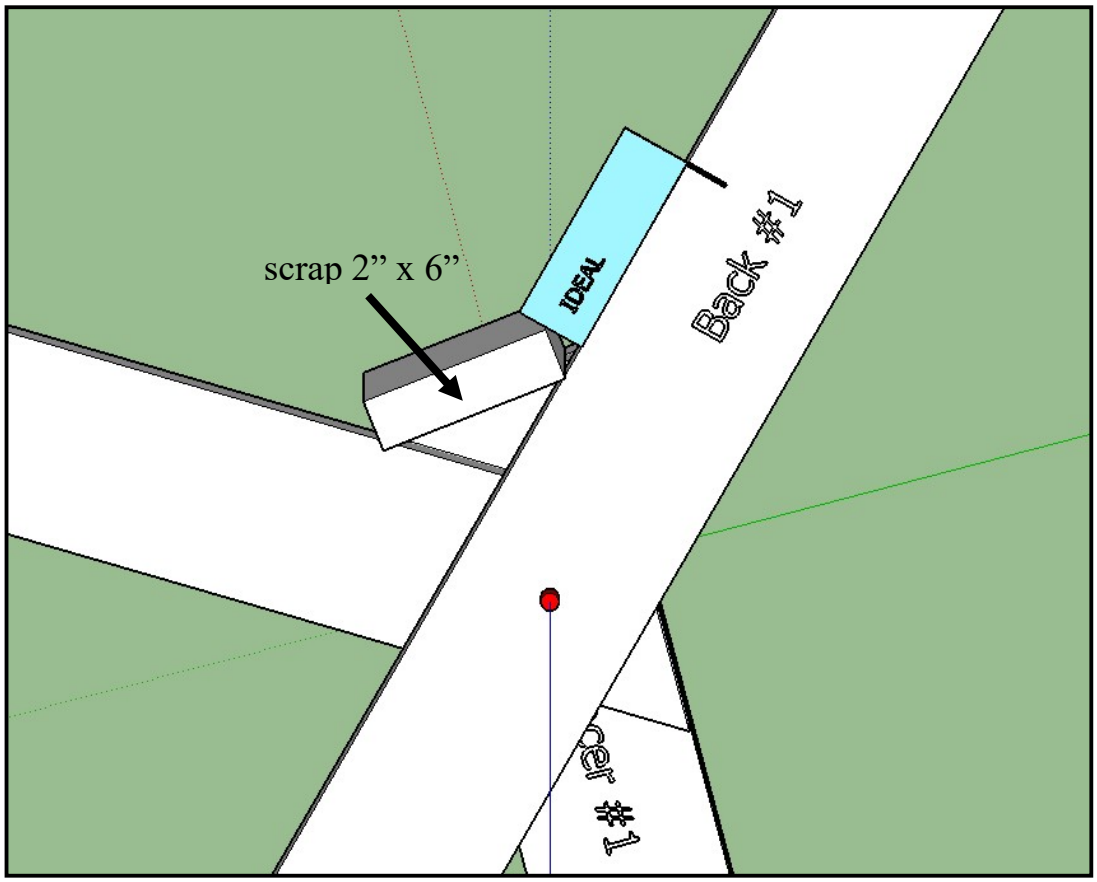


Let me explain why I went to such pains to cut the back and seat in this way. When we start to assemble the bench into its final three-dimensional form, we will place the first horizontal plank across these cut ends, and sscrew the plank to these cut ends. The result will look something like the following figure. We will use this plank as the starting point, or reference line, for laying more planks upwards along the back and frontwards along the seat. It is better if this first plank rests firmly on top of the ends we just cut, rather than being supported by its two bottom edges – hence my suggestion that the cut be made a little too long instead of a little too short.

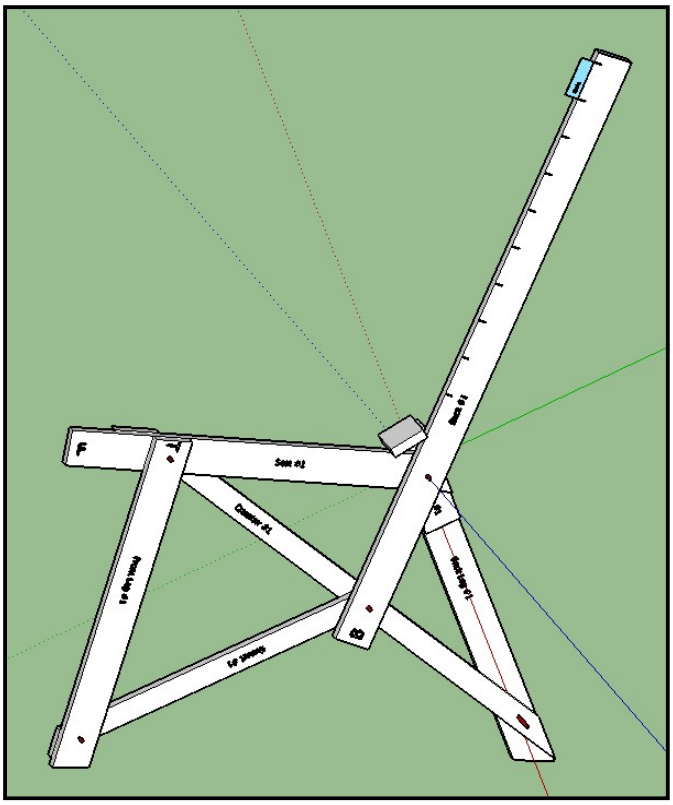


Just to be clear, though, I am not suggesting that this plank be mounted just yet. I provided the previous figure simply to give an idea of where it will end up.

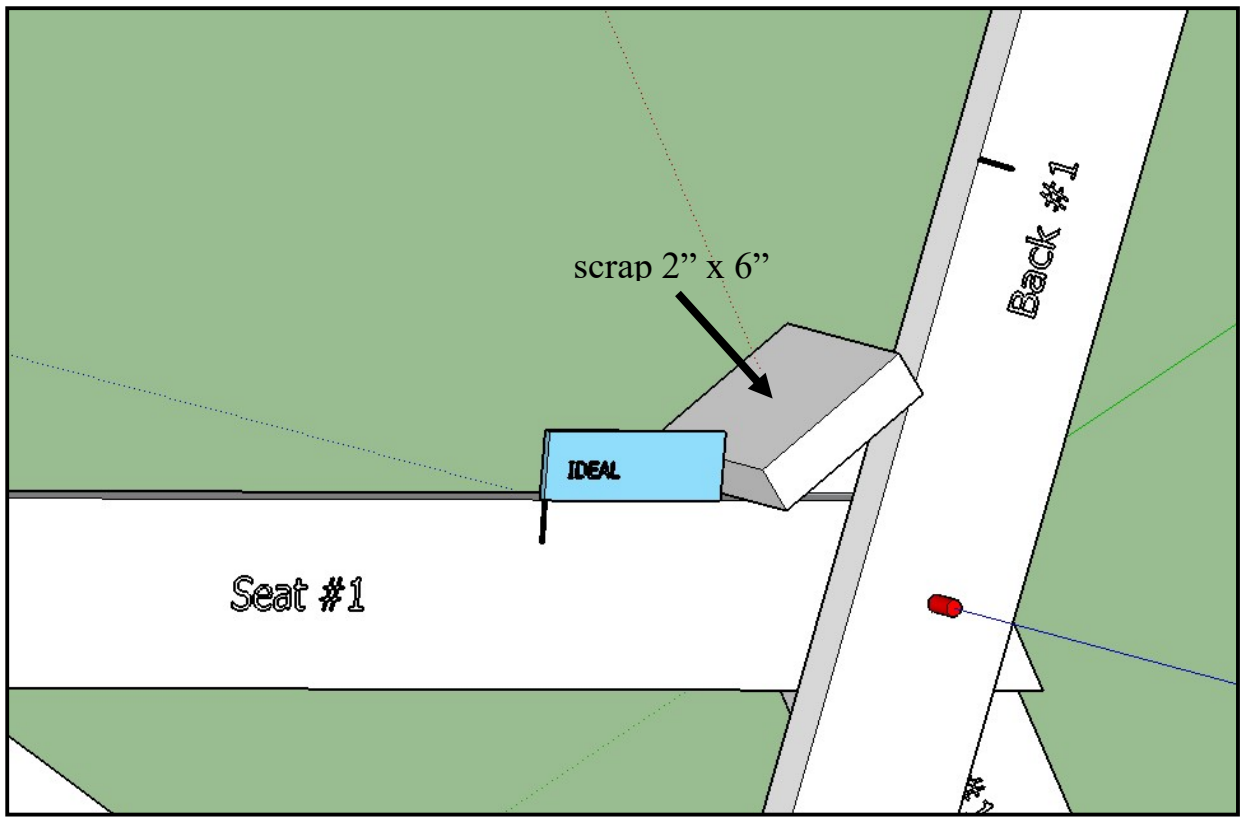
The next step is to lay out the locations at which we want to attach the planks along the back. This is easiest to do if the TRUE template shown in one of the previous figures is replaced with a short piece of scrap 2" x 6", and the IDEAL template placed above and against it. This arrangement is shown in the next figure. Make a mark at the "upper" end of the template.



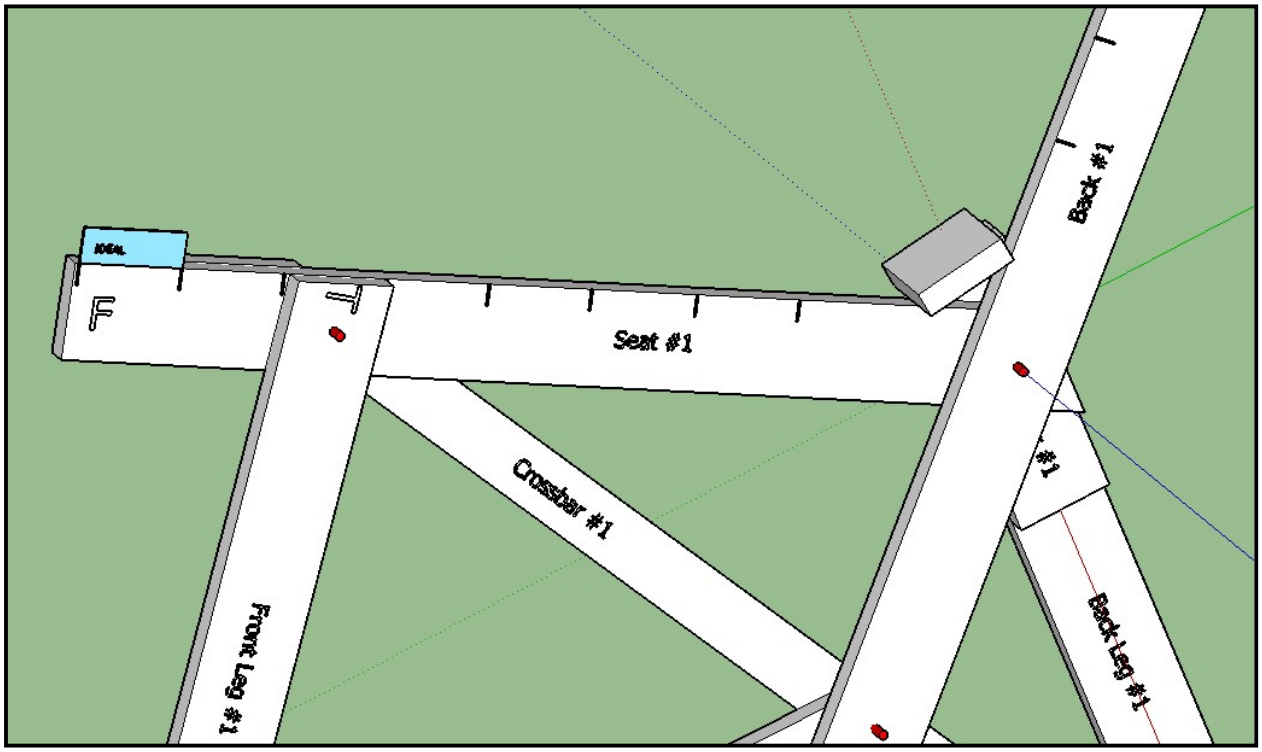
Now, continue using the IDEAL template to make marks six inches apart all the way up Back #1.



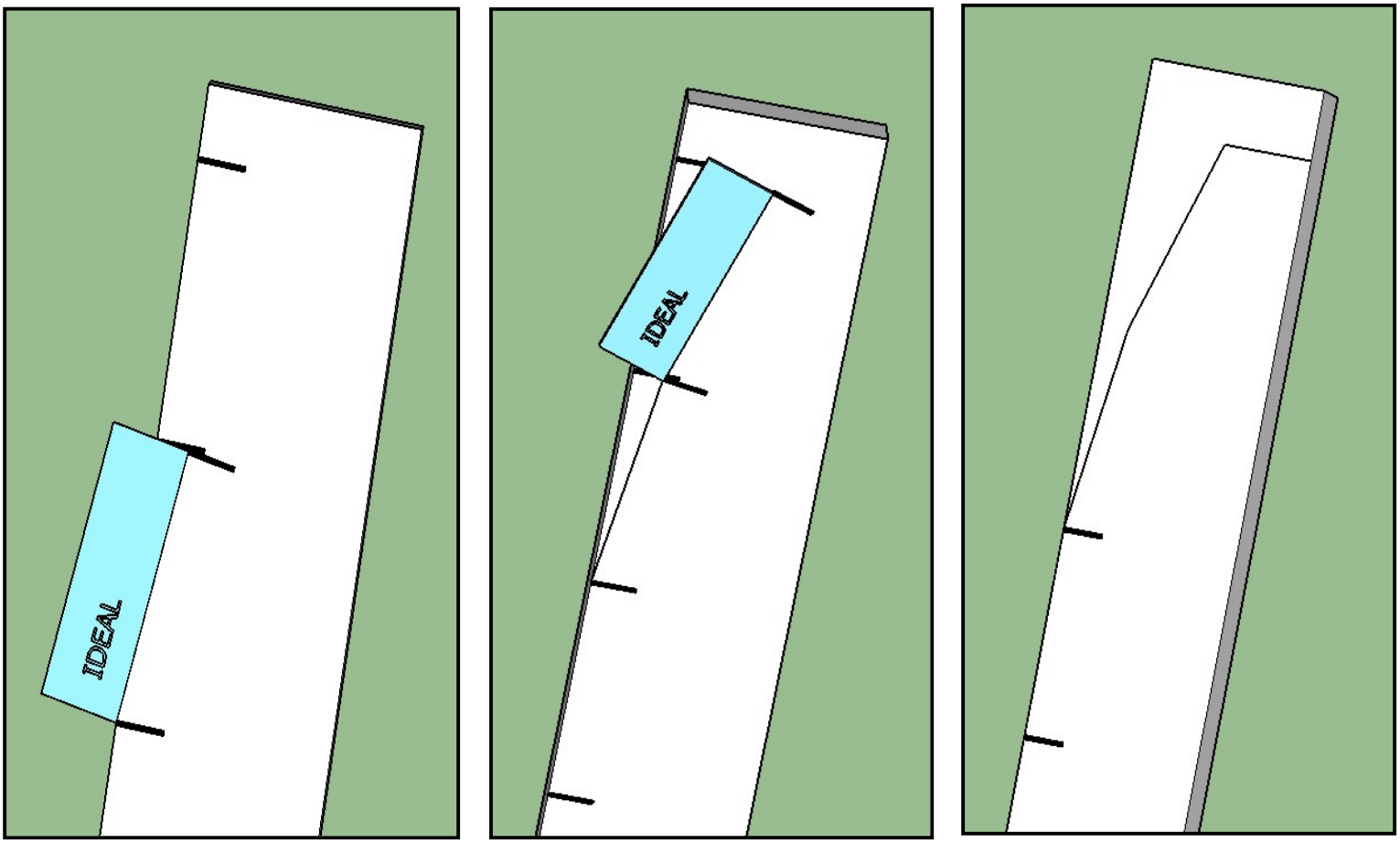
In the same way, make marks for the planks of the seat, starting with the IDEAL template snug against the scrap piece of 2” x 6”.



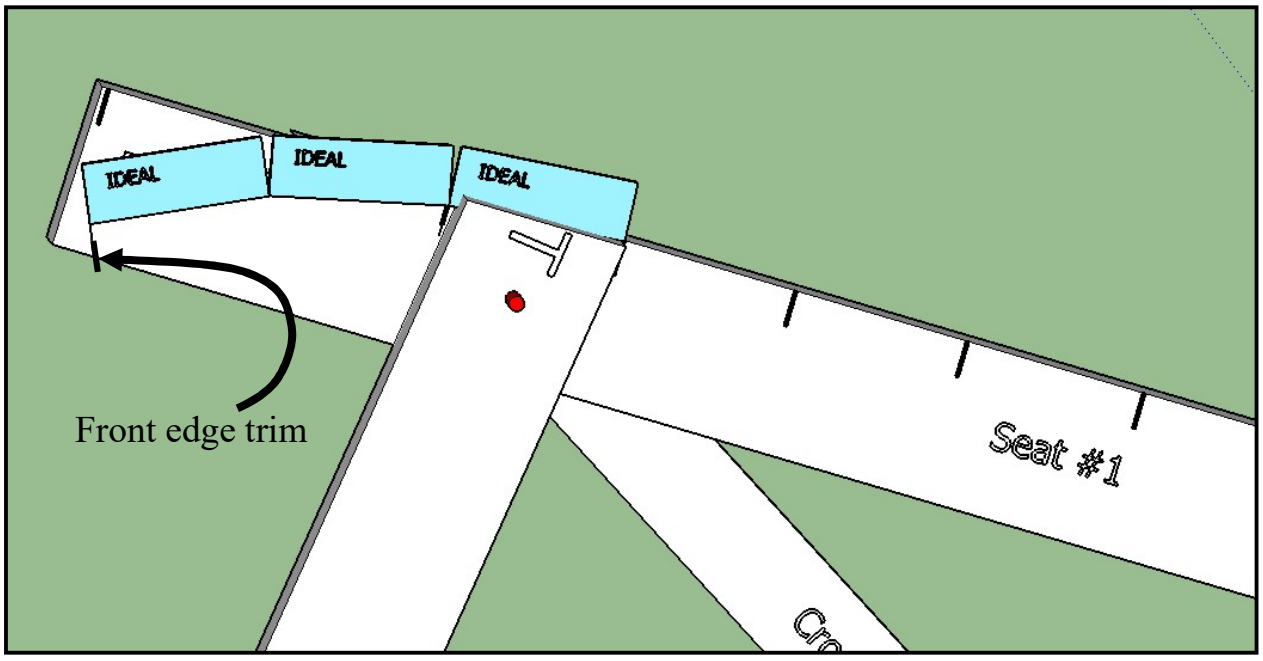
Work your way out to the front of Seat #1, making a mark every six inches.



Although one could nail planks on to the back and seat at the locations now marked, the bench will be much more pleasing visually if the top of the back and the front of the seat are rounded off, and not left square. The following figure shows how the IDEAL 2" x 6" template can be used to round off Back #1.



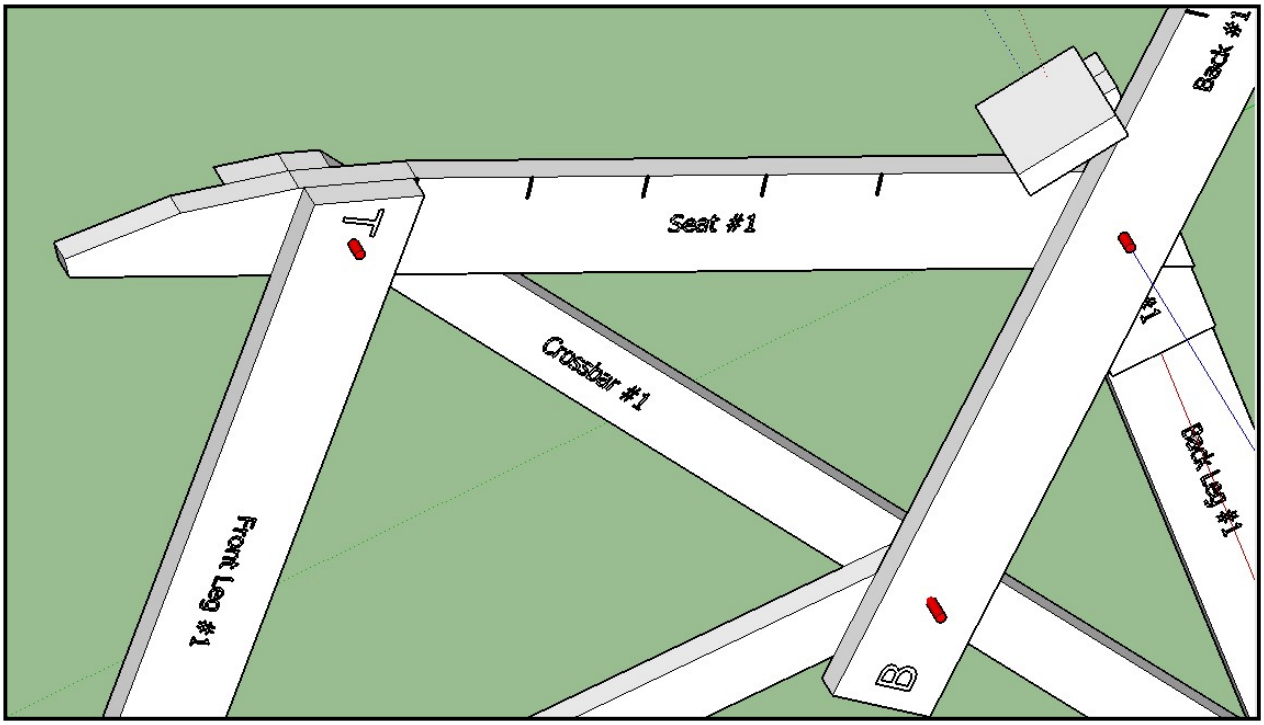
Three straight cuts will trim the top of Back #1 to a suitable shape. Do the same at the front of Seat #1, as shown next.



The previous figure should not be taken too literally. Three IDEAL templates are shown, but they represent the single template in three successive locations. In the first position, the template appears to be physically inside of the top of Front Leg #1. This is not really the case. Instead, the template will rest of the flat surface of the front leg, and the cut-line will be drawn across the front leg. When the saw is used to cut along this line, it will cut off the top of Front Leg #1 and the top of Crossbar #1, as well as the bit of Seat #1 which produces the shape.

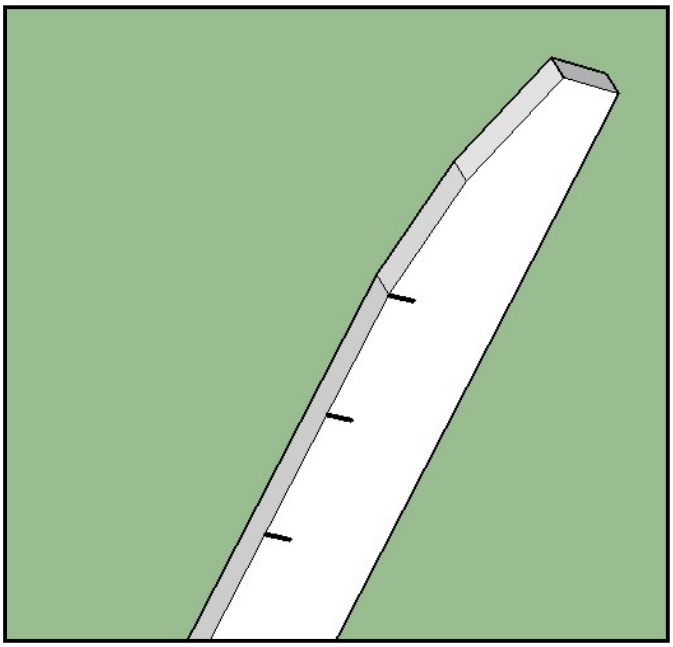
For my bench, I drew a line down from the bottom-front corner of the IDEAL template (labelled as the front edge trim line in the previous figure). The line is parallel to the front edge of the template. This will mean that the front edge of the bench will be slightly undercut when it is finished.

When all the cuts are made to the front of the seat, it will look like this.



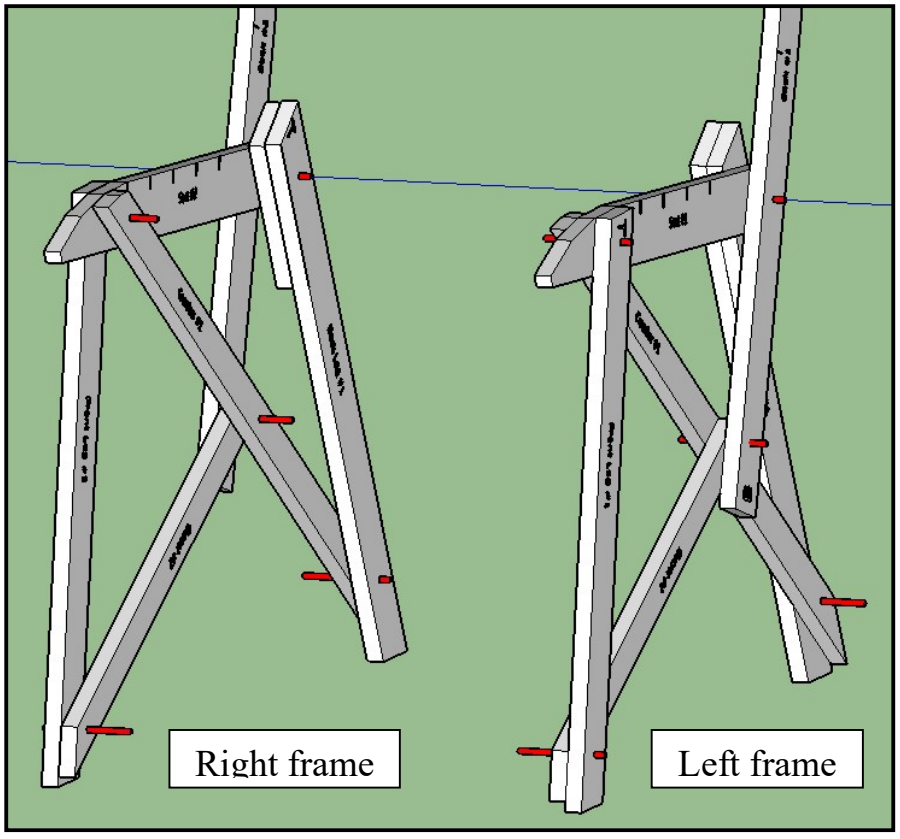
The figure at the top of the next page shows what the top of the back will look like after the cuts are made there.

This completes the left-side frame, which is to say, the one at the left-hand-side when seated on the bench. There are two other frames, one for the right-side and one in the middle. For those who are interested, I have attached as Appendix “A” a cross-section of the frame showing the layout and dimensions I used to figure out the required length and orientation of the pieces.



Part IV – Making the other two frames

The frame we have been working on was constructed using the wooden pieces I labelled "#1". I mentioned above that this was the frame for the left end of the bench (from the point-of-view of a person sitting on the bench).



Let's make the right-end frame using the wooden pieces labelled "#2". Each such piece is identical to the corresponding "#1" piece, but they

need to be assembled in a different order. It can be convenient to use a "#1" piece as a template to draw cut-lines on the corresponding "#2" piece.

The third frame is assembled from the wooden pieces labelled "#3". It will be in the middle of the bench, and thus not exposed to view, so it can be made like either end-frame.

Part V – Final assembly of the frames

Up to this point, the frame(s) have been held together temporarily using pieces of one-quarter inch diameter threaded rod about eight inches long. If the bench is to be left exposed to the weather, and subject to heavy use (think a group of 25-year old youths), then heavier bolts should be used.

I chose to use one-half inch diameter bolts. Carriage bolts, which have a nicely-round head, would be ideal but are quite expensive. I therefore used a one-half inch diameter threaded rod, cut into the following appropriate lengths. The total length required is 93", or 7'9", so an eight-foot length of threaded rod should suffice.

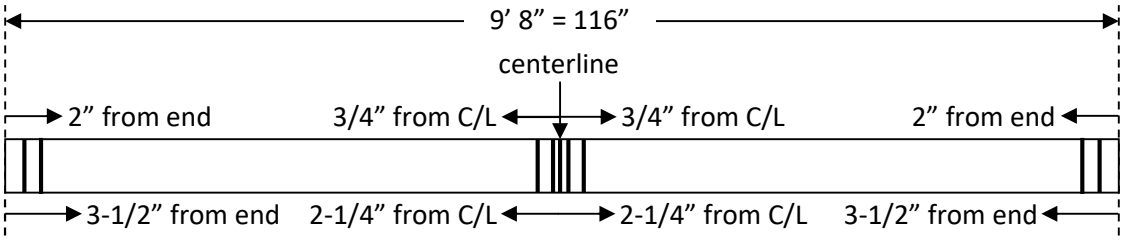
Length of rod	Number required	Purpose
Five inches (5")	Six (6)	Ties two pieces of 2" x 6" or 2" x 4"
Six and one-half inches (6-1/2")	Six (6)	Ties three pieces of 2" x 6" or 2" x 4"
Eight inches (8")	Three (3)	Ties three pieces of 2" x 6" or 2" x 4"

These lengths leave room on each end for a heavy-duty washer, a lock washer and a nut. Once all three frames are bolted together, the protruding ends of the rod should be ground down using an angle grinder. It is a good idea to use the angle grinder to round off all sharp corners of the nuts as well.

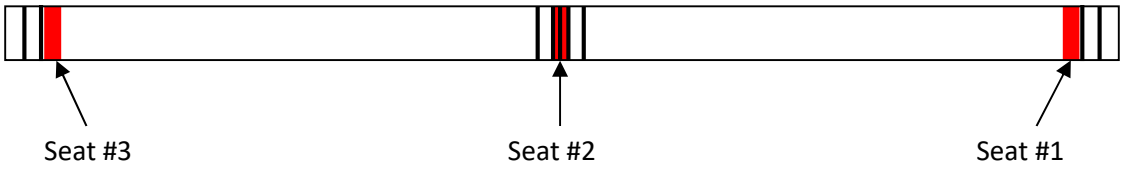
Part VI – Cutting planks for the seat and back

I chose to make the seat and back using 2" x 6" planks, of the same type used for the frames. I used planks ten feet long, but one could use twelve-foot long planks if desired. Nineteen (19) planks are needed.

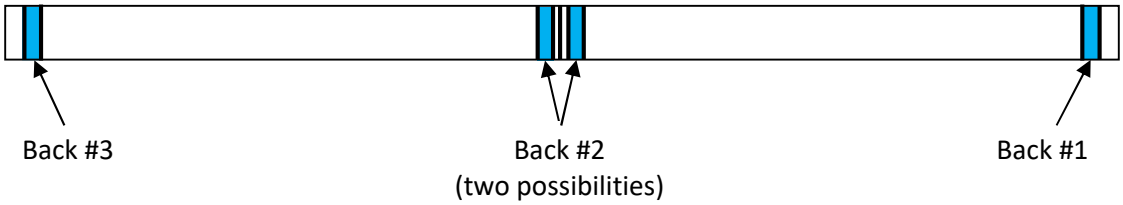
I cut two inches off both ends of each plank to remove some roughness and cracking. Then, I marked the following nine lines squarely across the wide (6") face each plank. If a plank has one face that is cleaner or better than the other face, then draw the line on the worse side. Scale 1" (paper) = 20" (real).



These nine lines are not intended to be guidelines for cutting. Instead, they will be used for aligning the planks when they are to be screwed to the frames. If a particular plank is to be mounted on the bench’s seat, it should be aligned so that the three frames lie flat on the following red areas:



On the other hand, if a particular plank is to be mounted on the bench’s back, it should be aligned so that the three frames lie flat on the following blue areas:

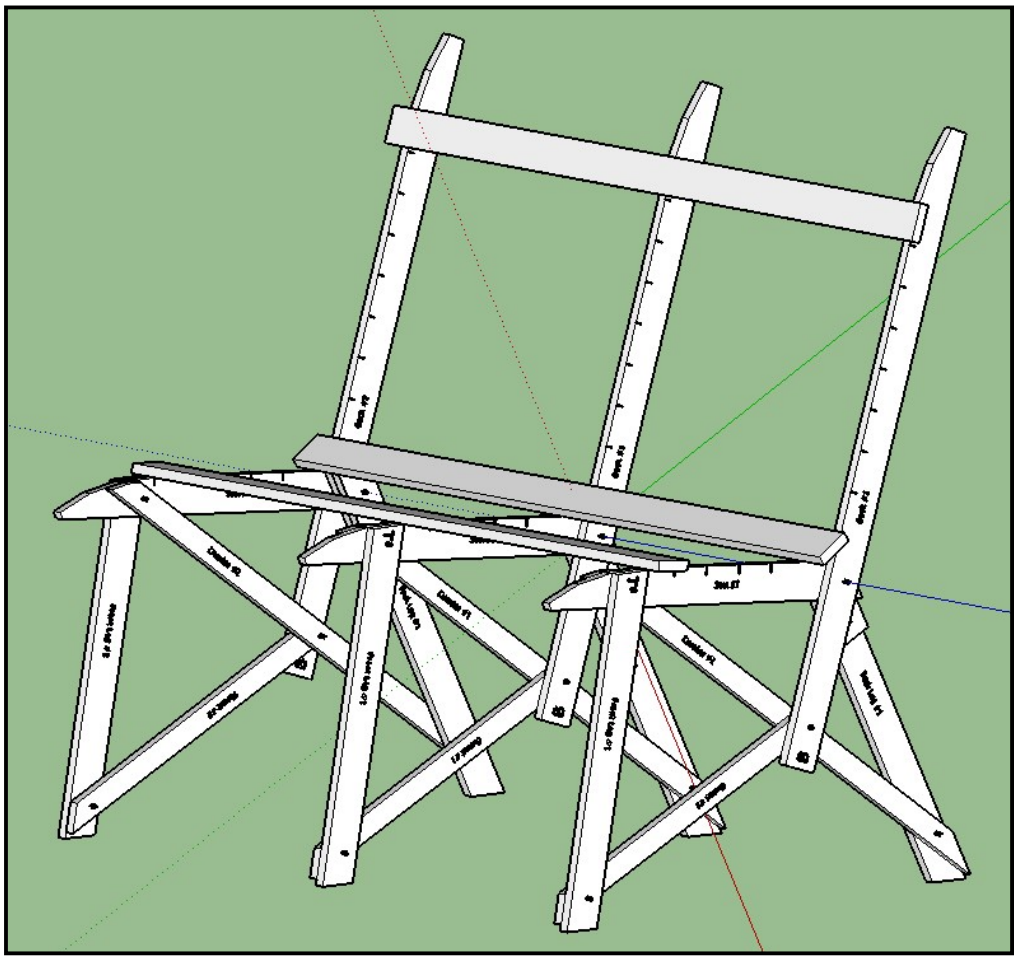


At the left and right ends, the Back members lie outisde of the Seat members. Note that the Back member of the middle frame can be on either side of the middle Seat member, depending on whether one constructed the middle frame to be like the #1 frame or the #2 frame.

In any event, drawing a multiplicity of lines (which is to say, nine lines) across each plank will help to keep everything square when the planks are screwed to the frames.

Part VII – Initial assembly in three dimensions

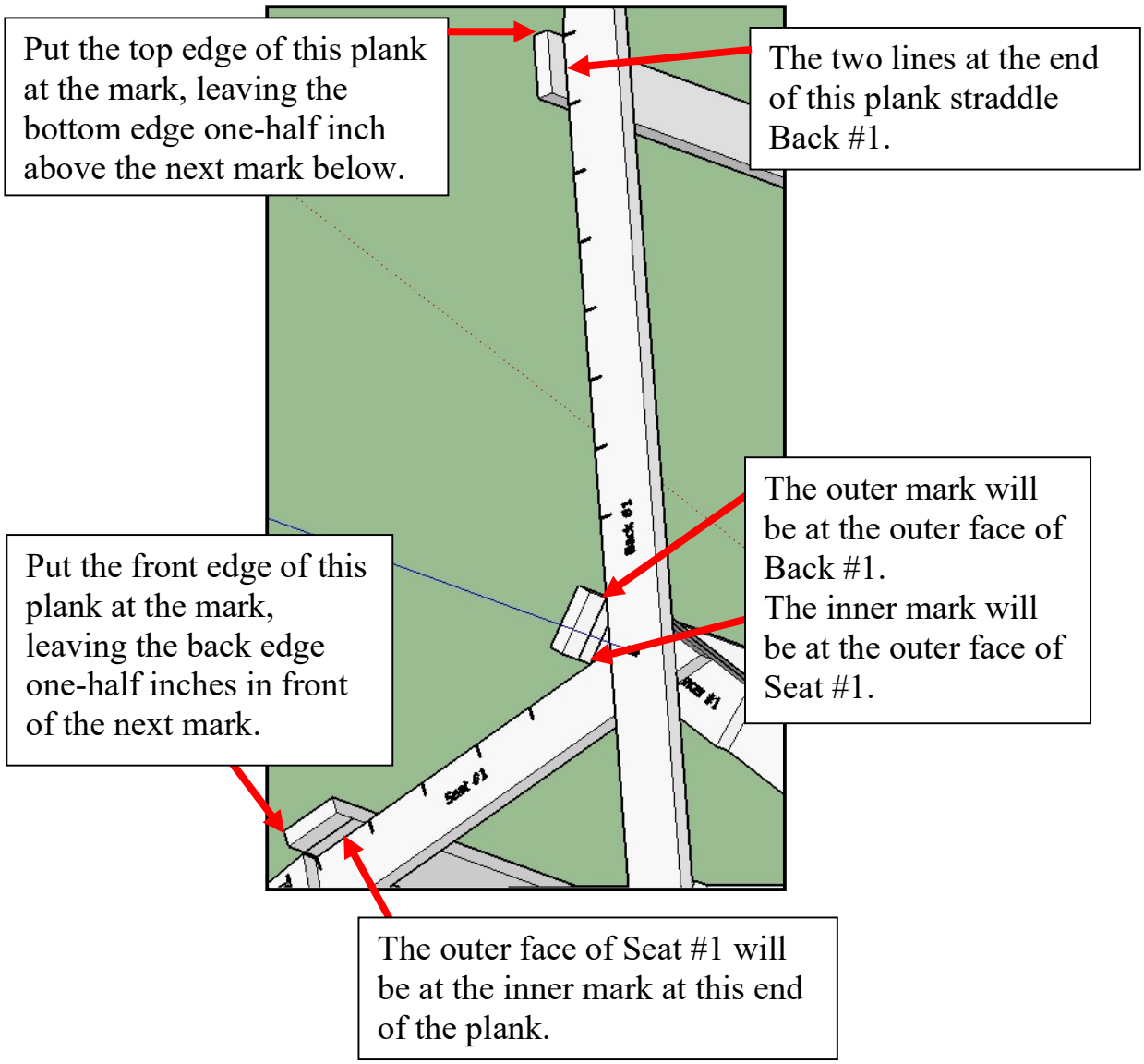
The next step is to screw three planks across the three frames, to produce the following structure.



I placed one of these planks across the frames near the top of the back, just below the two cuts which were made to trim the shape of the back. I placed another plank across the frames near the front of the seat, just behind the three cuts which were made to trim the shape of the seat. I placed the third plank across the frames at the intersection between the seat and back. It should be understood that the planks are laid on the frames so that the nine lines drawn in the previous section are on the bottom side or the back side, where they can be used to adjust the relative position before driving screws.

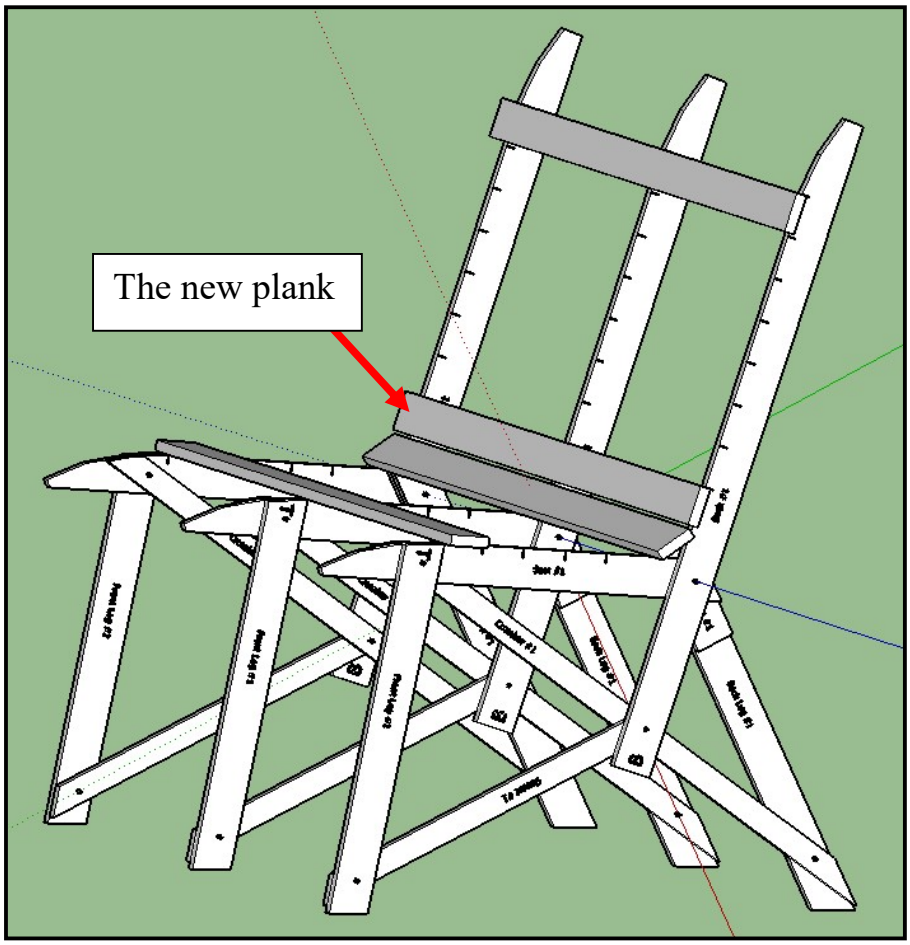
Each plank is secured to each frame using two screws, so a total of 2 x 3 x 3 = 18 screws will be needed for this step. “Deck” screws about 3-1/2 inches long are ideal. It is important that the structure be “square”. Any misalignment at this stage will not fix itself later on.

The following figure shows the left-side frame, from underneath, once the first three planks have been screwed into place.



Part VIII – Strengthening the back with two crossbars

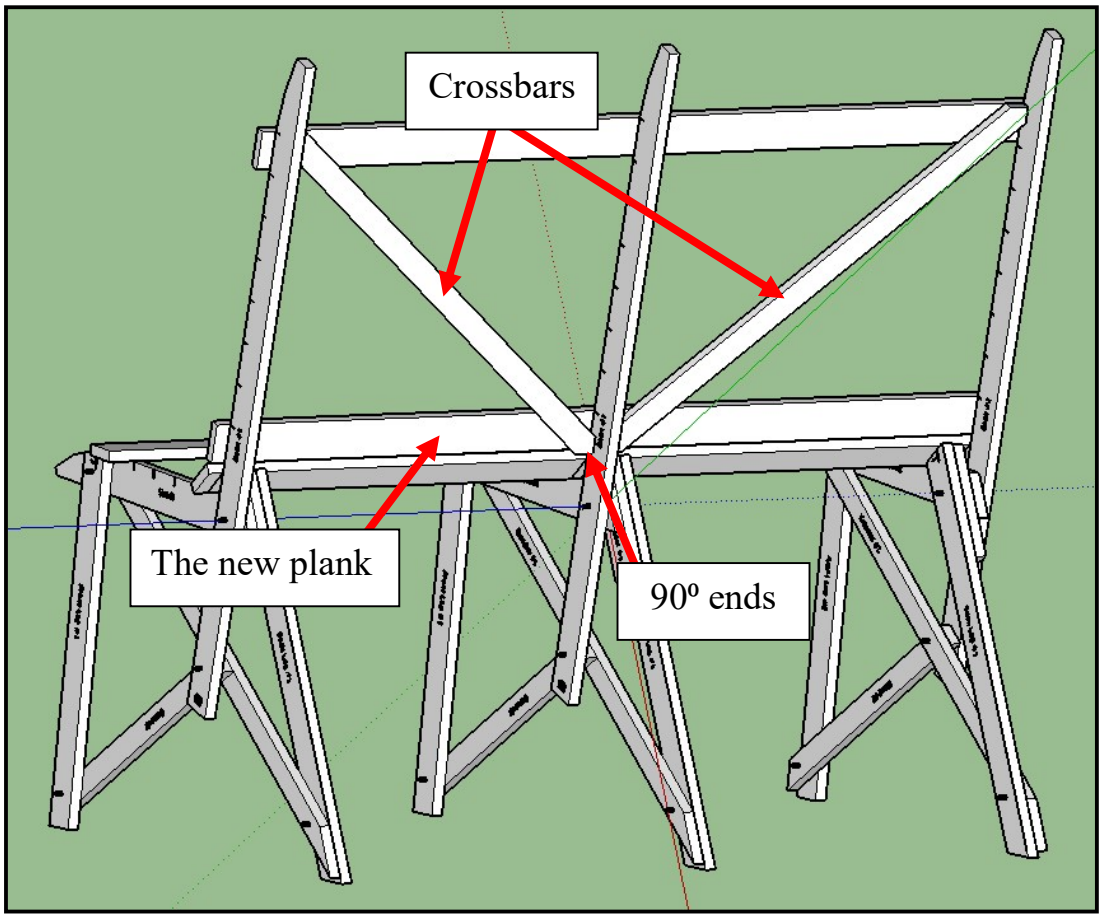
Start by installing the plank that is at the bottom of the bench's back. This plank should be mounted with its top edge against the mark we made earlier on the Back members. This new plank is identified in the following figure. In due course, the other eight planks of the back will be mounted with their top edges against the marks (or against the top edges of the cuts, in the case of the topmost two planks), which will leave a nice one-half inch gap between planks.



What we will do now is add two crossbars, oblique across the back, to help the bench resist “racking”. The two planks already in place at the top and bottom of the bench’s back lie in the same geometric plane, so attaching crossbars across them is not too hard.

The following figure shows the result. Fitting the crossbars is most easily done by placing the uncut pieces of wood against the front side of the bench’s back, drawing lines where appropriate and then cutting. Notes:

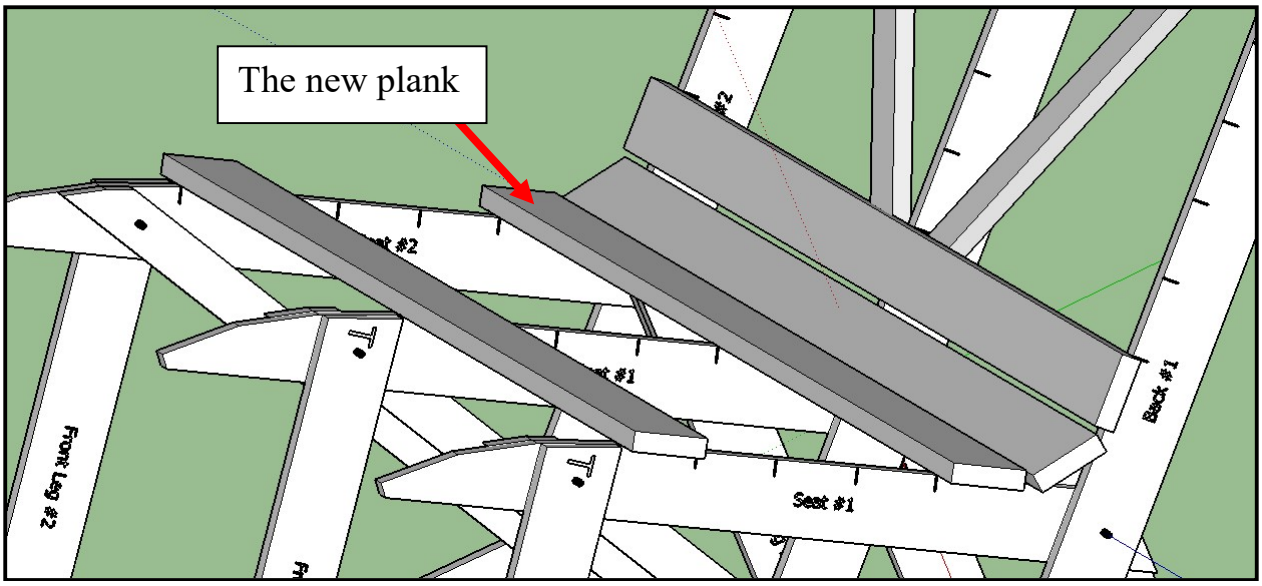
1. The crossbars can be made from 2” x 4” lumber.
2. The two crossbars will not have the same length because the middle frame is not symmetrical. One crossbar will be about 6’1” long and the other about 5’11” long, so the two can be cut from one 12’ length of 2” x 4”.
3. The crossbars will be stronger (more contact area through which to drive screws) if the ends are made with two cuts at roughly 90°, as shown, rather than with a single horizontal or vertical cut.



Part IX – Strengthening the seat with two crossbars

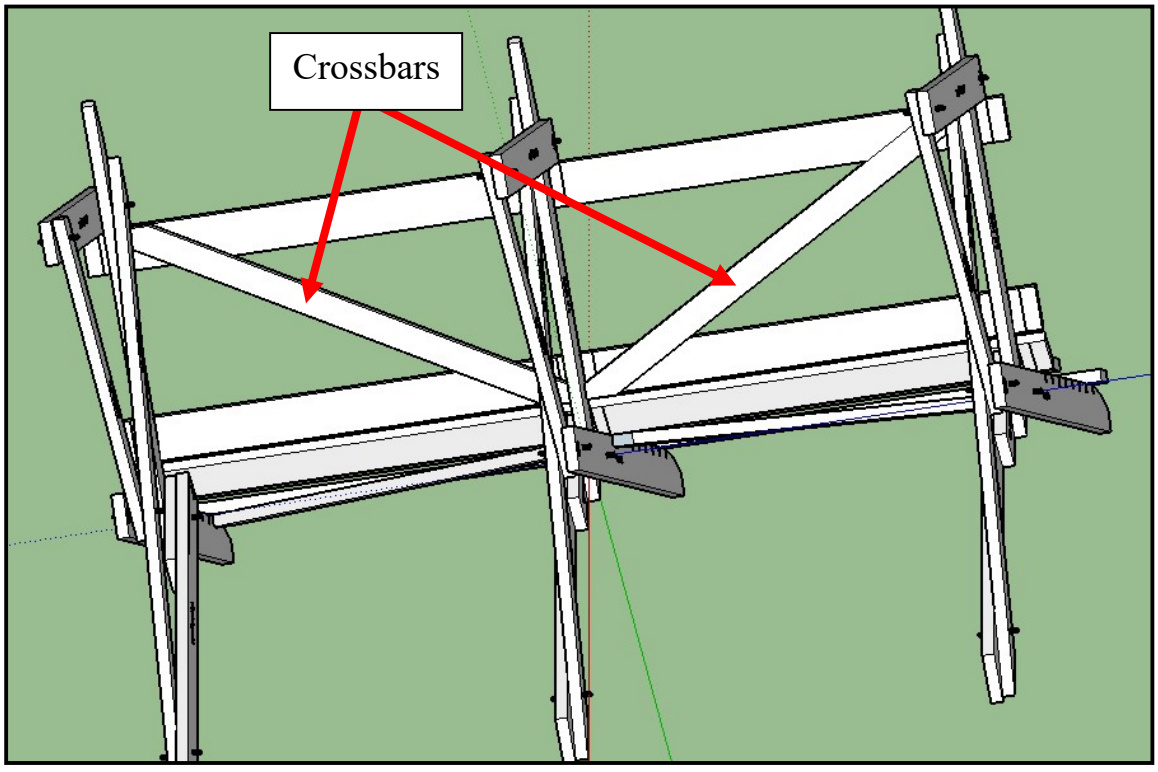
In a similar way, we will install two crossbars underneath the seat. Start by installing the plank that is at the rear of the bench's seat. The plank should be mounted with its front edge against the mark we made earlier on the Seat members. In due course, the other six planks of the seat will be mounted with their front edges against the marks (or against the front edges of the cuts, in the case of the frontmost three planks), which will leave a nice one-half inch gap between planks.

I have identified this new plank in the following figure. This new plank and the plank which we previously placed along the front of the seat lie in the same geometric plane, so attaching crossbars beneath them is not too hard.



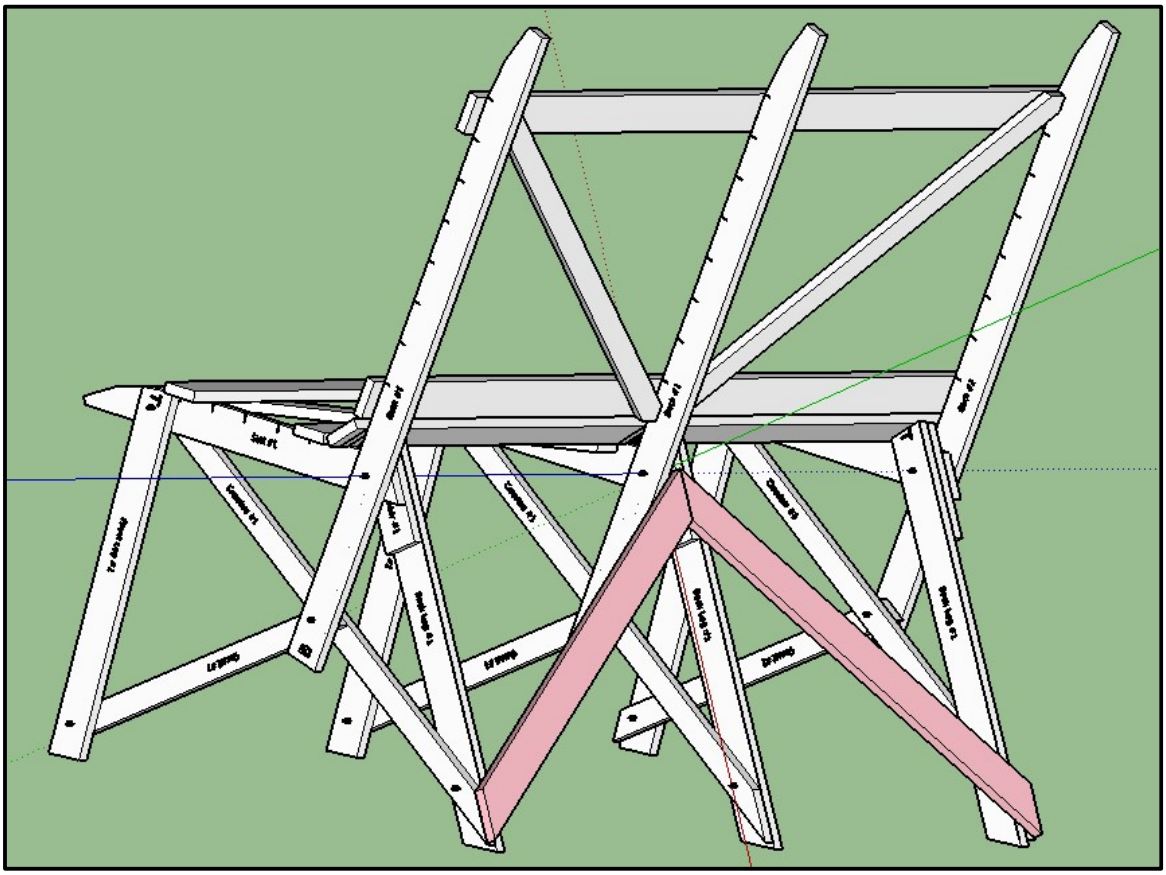
The following figure shows the bench from below, with the two crossbars identified. Notes:

1. Like the crossbars for the back, the crossbars for the seat can be made from 2” x 4” lumber.
2. The two crossbars will be the same length, since member Seat #2 is centered. They will be about 4’11” long, so the two can be cut from one 10’ length of 2” x 4”.



Part X – Braces across the back legs

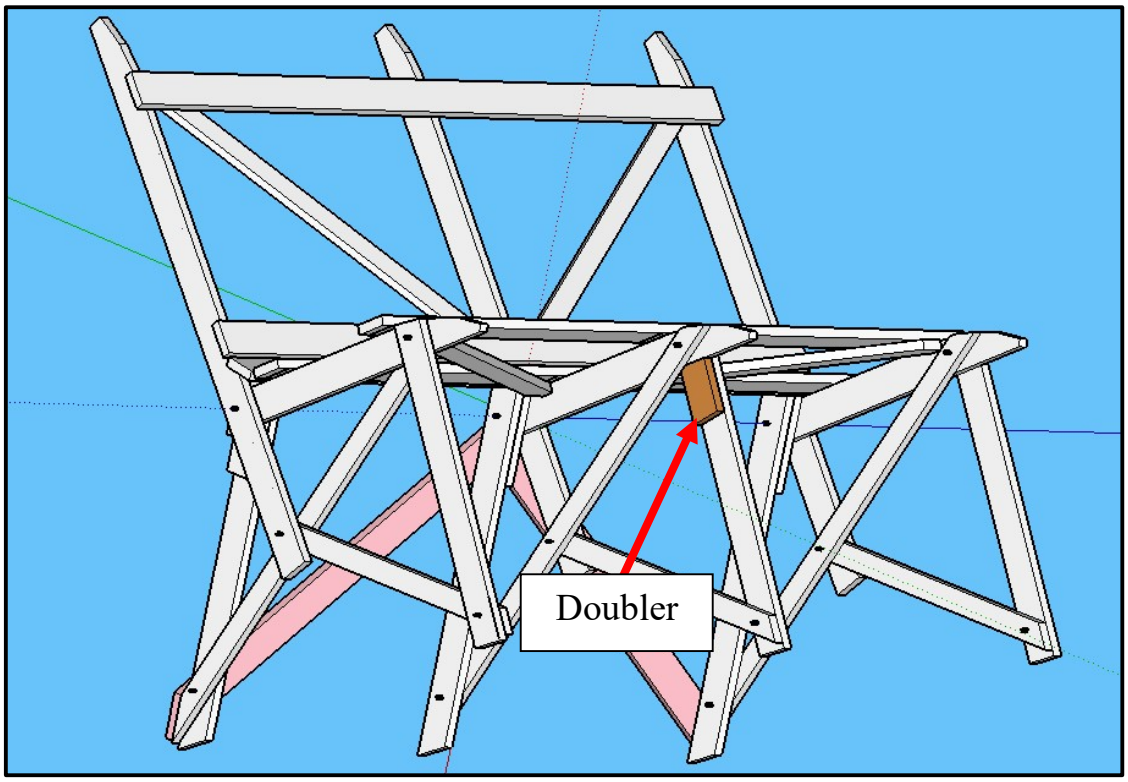
Completing the bench from this point onwards is a real delight. The two pink braces in the following figure brace the outside legs. They are made from 2" x 4" pieces. Use a couple of clamps to hold them in place while scribing lines for cutting. Dealing with the "V" joint where the two braces meet is simple. Back Leg #3 and Spacer #3 are bolted together – face-to-face – right along this joint. The left brace is screwed into Spacer #3; the right brace is screwed into Back Leg #3. There is plenty of room for screws.



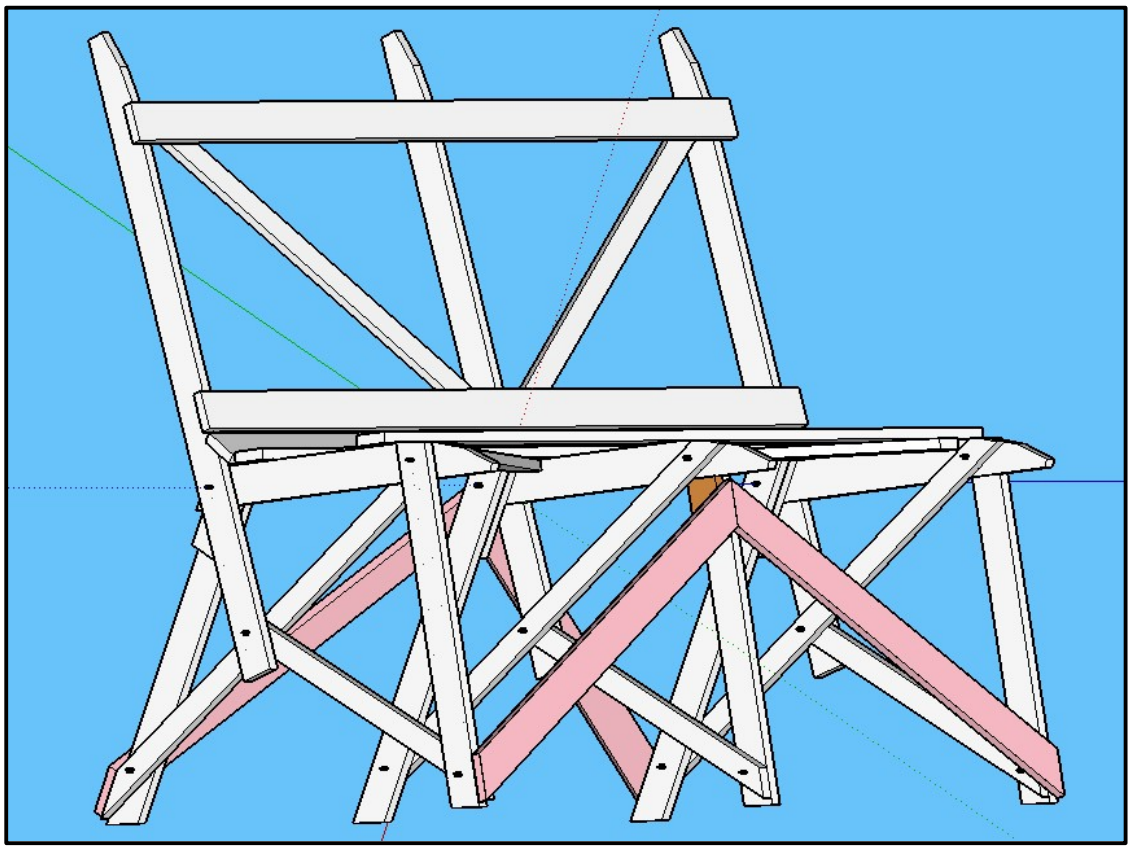
Part XI – Braces across the front legs

We want to install a similar pair of braces across the front legs. There is a bit of a snag -- the Front Legs do not have doublers. (The back braces were easy to install because the Spacers at the top of the Back Legs served as doublers.)

The solution is to explcitly add a doubler to the top of the middle Front Leg. The doubler is an eight-inch long piece of 2" x 6". It is the brown piece shown in the following figure.



With this doubler in place, it is a simple matter to add the front braces, shown in pink in the following figure.



Part XII – Completing the bench

Screw the rest of the seat and back planks to the frames. I also screwed each plank to any crossbars which passed behind it. Depending on the look you want, you can drive the screws in from the back side or the under-side, or down through the plank into the crossbars. I did the latter, but used a couple of cardboard templates to center the screws accurately into the points of intersection between the planks and the crossbars.

I used a handheld belt sander to remove any obvious splinters from the edges and ends of the planks.

I tack-welded a few of the nuts onto the ends of their threaded rods. I did this to prevent the bench from collapsing if it was attacked by vandals.

I gave the whole a couple of good thick coats of exterior paint.

Part XIII – Access

How does one climb up onto the beanch? At its lowest point, the top of the planks of the seat are 4’3-1/2” above ground. That is too high for many people to hoist themselves up.

If the bench is placed in a rural setting – overlooking a stream, for example – it may be possible to build up a pile of local rocks one can use to clamber up onto the bench.

I built a short flight of stairs from extra pieces of 2” x 6” lumber. The SketchUp views in Appendix “B” set out the dimensions. The photograph shown here is a detail from the photograph shown at the start of this paper. I painted the stairs red. Also note the handrail. It is the kind found in handicapped washrooms and makes a great support while climbing up or down the stairs.

As I said above, making this bench was really a satisfying project. I bought everything I needed – lumber, threaded rod, screws, paint, and so on -- from the local Home Depot. The lumber was pretty good quality but, like many things, more expensive than it used to be.

It's also a great eye catcher. I have never seen a kid pass by and not go out of his way to climb up. Lots of big kids climb up, too.

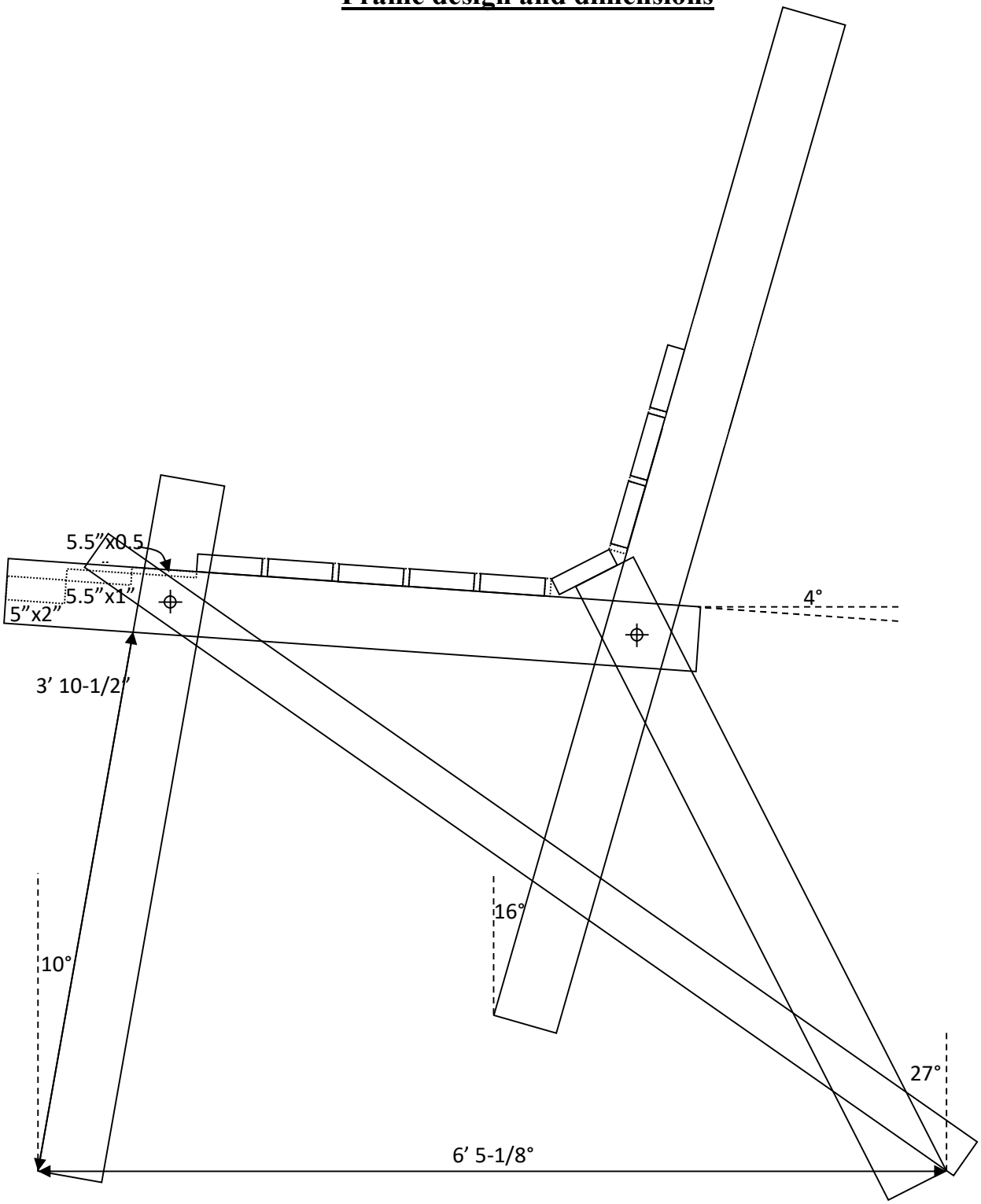
If you end up making a bench for yourself (or your business), please send me a picture. I would also love to hear about any modifications you make.

Jim Hawley
April 2021

(As always, I welcome e-mails setting out errors or omissions.)

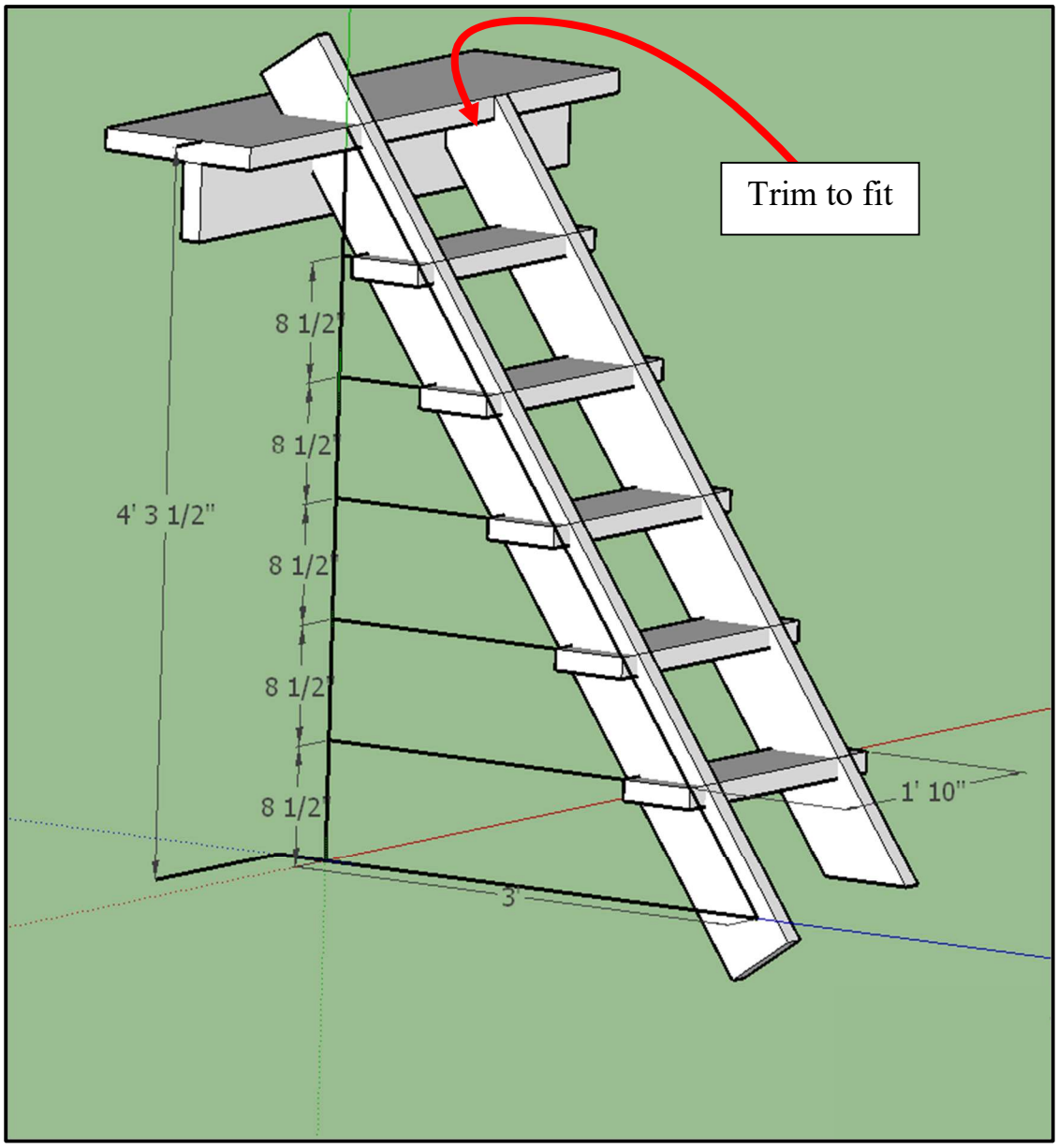
Appendix "A"

Frame design and dimensions



Appendix "B"

Stairs



The stairs have an overall height of 4'3-1/2" from the ground to the top face of the seat planks. The stairs extend out 3' from the ends of the seat planks. The sides and treads are made from 2" x 6" planks. I have chosen the length and angle of the stairs so that each side can be cut from a six-foot length of 2" x 6" plank.

The stairs are 1'10" wide from the outside of one side to the outside of the other. Since the thickness of a standard 2" x 6" is 1-1/2", it follows that the width of the tread between the sides is 1'7".

To ensure that the stairs are as robust as possible, I cut grooves on the inside faces of the sides into which the ends of the treads are inserted. It was not necessary to use a router. I simply used a Skill saw to cut grooves 1-1/2" wide (the true thickness of the treads) and one-half inch deep. A few blows of a hammer on a large chisel smoothed out the bottom and sides of the grooves. When the ends of the treads are inserted into the grooves, the screws which one drives through the sides and into the ends of the treads do not bear any heavy loads.

The following figure shows the layout ot the side planks. Trimming the bottoms of the planks is not difficult. Trimming the tops is more challenging. What worked for me was to defer trimming the tops until everything else was finished. Then, I positioned the stairs temporarily against the side of the bench and started trimming. It took three iterations of measuring and cutting until things fit together nicely. The cause of the difficulty is that the member of the frame which is the bottom of the seats is not horizontal. Instead, the seat rises towards the front at a four degree angle above the horizontal. Therefore, the side of the stairs which faces the front of the beanch must be a little longer than the side which faces the rear. It was easier for me to cut the tops to fit rather than carry out a lot of trigonometry.