P9L - Lounge Chair made with CNC Router

by **alepalan** on April 22, 2014

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Author:alepalan Portfolio

Alejandro is an industrial designer who focuses on creating impact through his designs. He has a broad background having worked at a graphic design agency, a furniture manufacturer, founded a successful furniture company, taught at universities and co-founded a medical device startup. Alejandro has applied his knowledge to design 100+ products in the market. His designs convey meaning and emotions keeping them simple and functional. He focuses on human-centered design and design thinking to create a deep connection with the users and to identify strategic opportunities. With solid foundation in mechanical engineering and design background, he is closely involved in all aspects of the design process, from ideation to production. Alejandro's work has received recognitions across the world. His latest product has been awarded the Core77 Design Award for Social Impact Student Category and published on Fast Company. He has been featured in the first book of Industrial Design in Argentina as well as in several design magazines. At AdaptAir, Alejandro's has focused on developing medical devices for pediatric patients with respiratory problems. He has travelled the world with his device to help fight the battle against pneumonia, the number one killer of babies under the age of five. Alejandro holds an MFA in Design from Stanford University, Masters in Furniture Design from Universidad de Buenos Aires (UBA) and Industrial Design also from UBA.

Intro: P9L - Lounge Chair made with CNC Router

CNC Furniture has been for a few years already but hasn't really taken off. I believe this is because designers haven't spend enough time designing with that technology in mind. Most of the CNC furniture I found online have the typical joinery exposed or had a rigid feel. I played around with the ShopBot Buddy (worktable 4' x 2') and made a family of chairs: Lounge Chair, Dinning Chair and Stool. I will be uploading each instructable separate.

CNC Routers have become affordable in the last couple of years and there are quite a lot of DIY CNC Routers out there. If you have a TechShop close by you can probably make it over there.

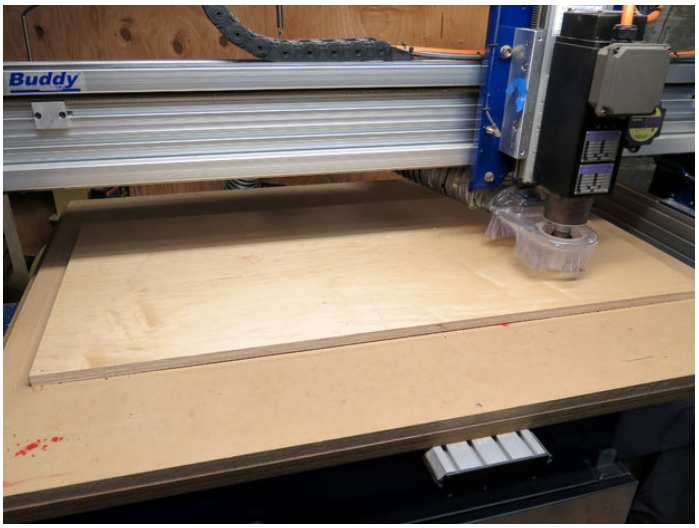
Design Concept: One of my favorite chair designs is Eames LCW molded plywood lounge chair. It's a design classic and the fine detailed surfacing work is incredible as well as comfortable. It has been a source of inspiration for quite a lot of my furniture and in this case while using a completely different technology I was able to resemble his masterpiece.

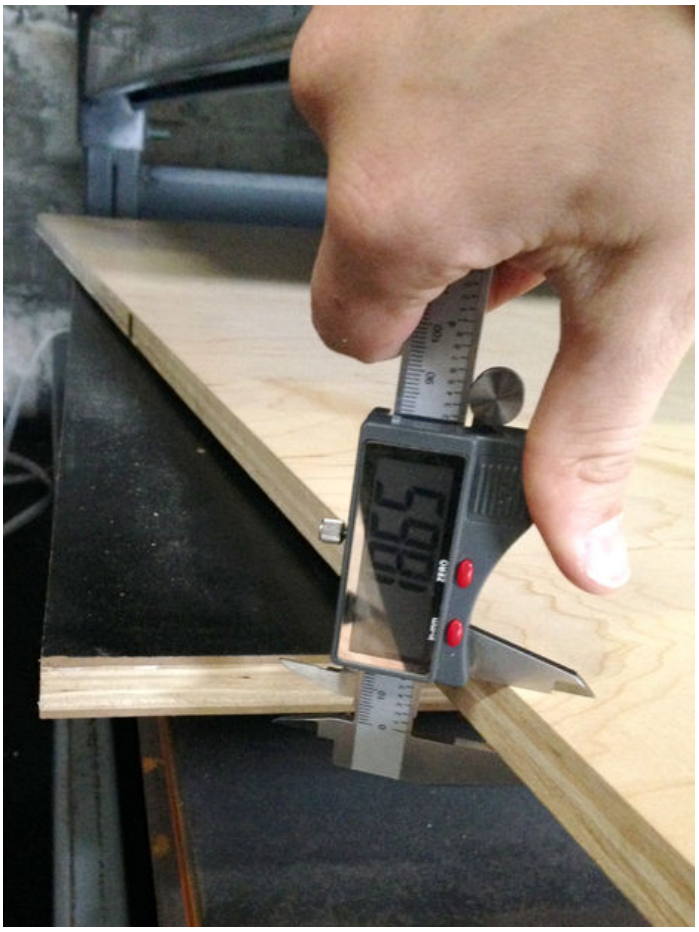
Step 1: Materials

Materials:

- ¾ inch pre-finished maple plywood (2 sheets 4'x2')
- Shopbot
- ¼ inch End Mill
- Table Router with round bit (optional)
- Wood Clamps
- Wood Glue

IMPORTANT: measure the thickness of your plywood! I purchased the 3/4 plywood in 0.75" thick (19.05 mm) but as you can see from the photo, it was 18.65 mm thick. This is really important to take note because the design has locking parts/pockets and we need to accommodate for a thinner/thicker material.





Step 2: Design and prepare vector work

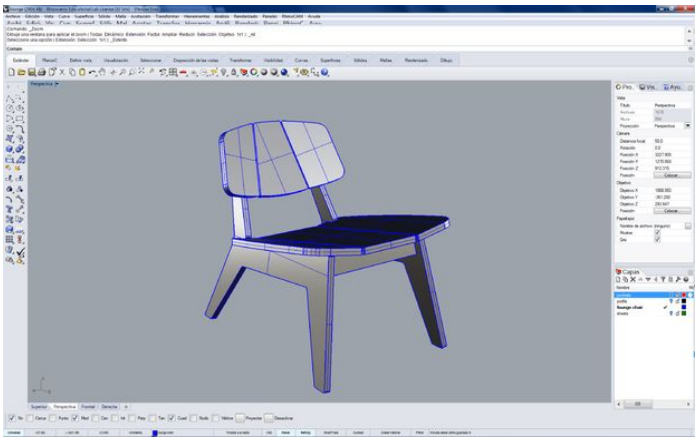
I used Rhino to design the lounge chair as I've been using it for the last 10 years. I took some measurements from other lounge chairs to have a sense of what the overall dimensions, specially the height, angle and width. You can edit the files as you wish and make a custom version for your own.

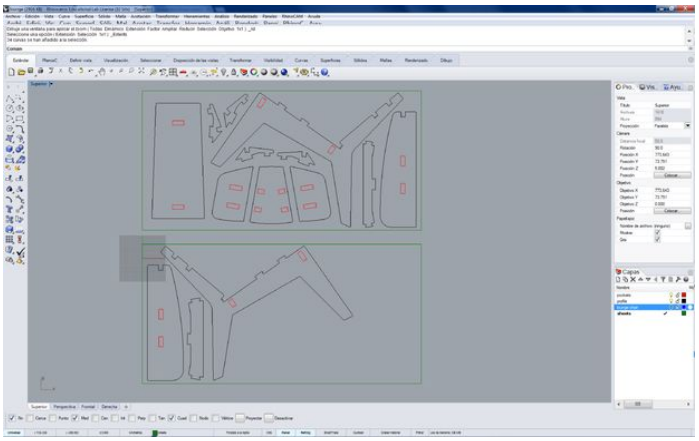
My biggest design constraint was that at least one leg had to fit in a 4' x 2' plywood sheet (that was how big my working table on the ShopBot is). I was able to make it fit on the sheet by rotating it a little, if you have a bigger working table you don't need to do this and probably have a more efficient use of material. You can download the Rhino file and STL to play around and edit the design. Once I had all the flat pieces I arranged them in 4' x 2' sheets. Download the illustrator or Autocad file that you will need to create the toolpaths.

Note on woodgrain direction: This is an aesthetics warning. The orientation you give to every piece will matter once they are put together. For example, it is nice to have the seat or the seat rest match in orientation because the wood grain will be continuos. The seat is composed by 3 pieces and it will look inelegant if each one has the wood grain going in different directions.

Files included:

- lounge.3dm - Rhino CAD drawing
- lounge.stl - for a 3D preview
- lounge.dwg - Autocad vector in mm.
- lounge.ai - Illustrator vectors in mm.





File Downloads

lounge.stl (113 MB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'lounge.stl']

lounge.3dm (3 MB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'lounge.3dm']

lounge.AI (49 KB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'lounge.AI']

lounge.dwg (80 KB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'lounge.dwg']

Step 3: PartWorks: Creating Toolpaths

Create a **New File**.

Now in Job Setup: We will create a file with the size of our material: 4' x 2' x 1/4" (or how thick your true material is). **Zero on the top**.

Import Vectors files and your vectors will appear on your sheet. Sometimes your vectors might be outside the sheet so will need to zoom out.

Another thing you need to do is actually **joining open vectors**, under the section Edit Vectors. Control+A will select all of the vectors and then hit the Join button. Hit the Join button again.

If you need to correct or move some objects around the sheet now is the time to do it. You might want to do this to optimize material.

Control + A (select all), click on the right tab: **Toolpaths (pin it** so you have it open for the rest of your session).

POCKET TOOLPATH:

Under the Toolpath Operations you will see a few options. We will begin with Pocket Toolpath that will clear an area as deep as we want. You should always start with pockets because all of your material will be in place - for example, if you start with a Profile cut and your piece moved because you didn't have tabs (or they were too thin) you will have a loose part and your pocket will be made in the wrong place.

Select your vectors that we want to pocket. These are all the small closed vectors that look like a dogbone and they are inside the cut pieces.

Click on “Toolpath” tab on right side of screen. Under “Toolpath Operations” select “Create Pocket toolpath.”

Start Depth: 0” (starting on top of material)

Cut depth: Choose a finished depth of cut which will be less than 3/4 ". I used 0.551" but if you want to change it you will also need to change the dimensions of the part that fits inside.

Now you need to select the Toolbit you will be cutting with. Under Tool, click on Select and use a 1/4 inch End Mill

We are going to select Offset that will follows the contour of the design. Select Climb.

PROFILE TOOLPATH:

The 3rd icon is for Profile cut and a fill in sheet will appear with options. The first set of values will determine how deep you want to make the cut. Our start depth will be zero since we zeroed on the top of the surface. You want to cut all the material and a tiny bit of the sacrificial board so add a little depth to your Cut Depth (C).

Now you need to select the Toolbit you will be cutting with. Click on Select and use a 1/4 inch End Mill

Since we are cutting the pieces mark on Machine Vectors: Outside/Right.

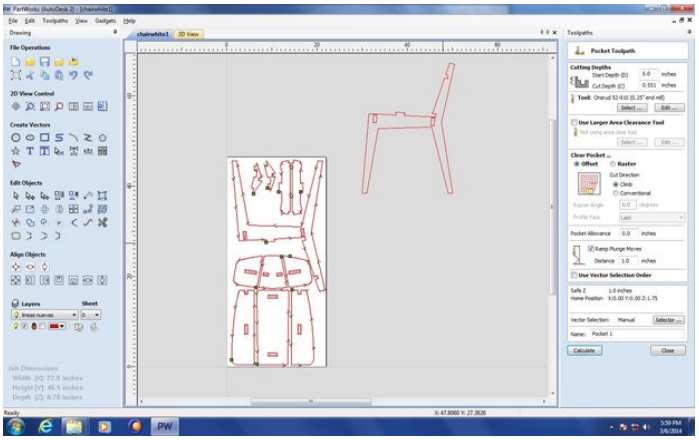
Add Ramps to Toolpath, Smooth, pick a Distance (4-6 inches works well).

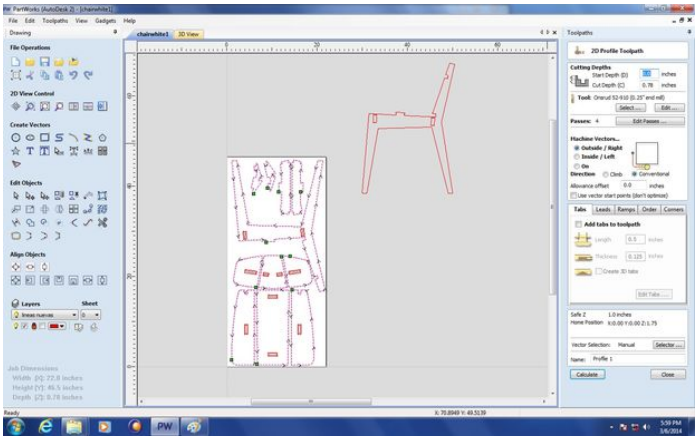
Save Toolpaths: You will be prompted a "WARNING - Tool will cut through material" but you know that already because you did that on purpose when you selected the cutting depth. Once you succesfully created the toolpaths you will see a preview. Once you are satisfied with what you see, hit Close.

Make sure you select Pocket1 and Profile1 and hit Save Toolpaths, it will have an extension SBP.

NOTE ON CREATING TABS: Tabs are pieces of your material that won't be cut to hold the parts in place. Since I had quite a lot of parts to cut and I didn't want to do a lot of post-processing work I decided NOT TO MAKE TABS. If you have a worktable with vacuum then this is great because you won't need tabs anyway.

The screenshots are from the chair and not the lounge chair. I will get the screenshots updated in a few days. Nevertheless, it is the same step-by-step procedure.





Step 4: Zero X, Y and Z Axis

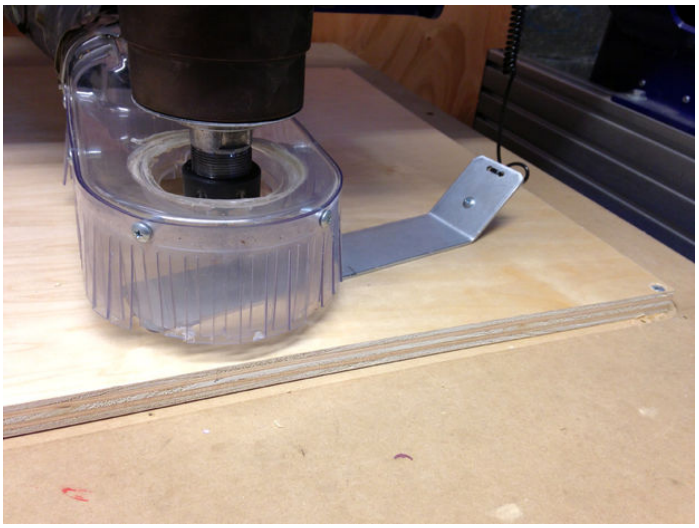
Now you are ready to cut the pieces for your table. Place your 4' x 2' sheet of ¾ plywood on the worktable of the Shopbot. Use screws to get the sheet down to the table.

Turn on the Shopbot and the Computer. Open the Shopbot manager. Put the ¼ inch End Mill on the Collet and you are ready to Zero the machine in 3 axis.

Use the proxy switches to Zero both X and Y Axis. Now use the Z plate to zero the Z axis of the Machine.

Zero Z Axis with Z Plate:

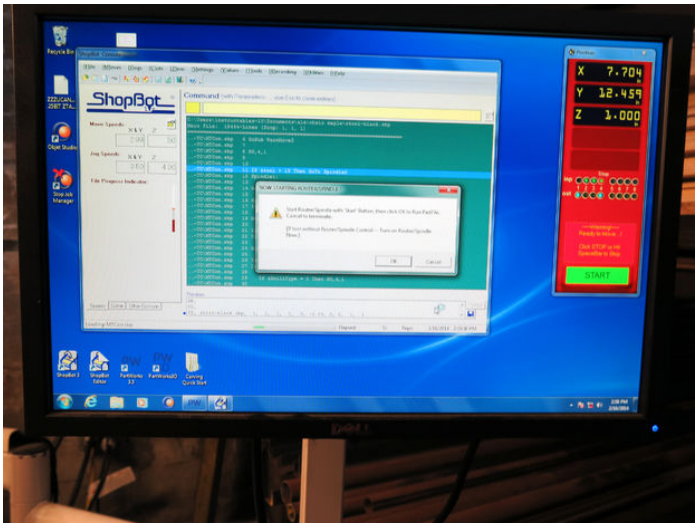
- Cuts - C2: Zero Z Axis w/Zero Plate
- It will prompt if we have the Zero Plate bellow our bit. Hit Enter when ready.
- It will now go down, touch the plate, go up and then slowly go down again to touch the plate one more time.
- It will prompt that it has been zeroed. Awesome, now you are ready to begin the cuts!



Step 5: Run Toolpath File

Open your Toolpath file and hit Start. You will be prompted a Warning message to start your Router/Spindle. Make sure you actually start the spindle before hitting OK on the Warning message.

The Shopbot will now begin to make the cuts on your material.



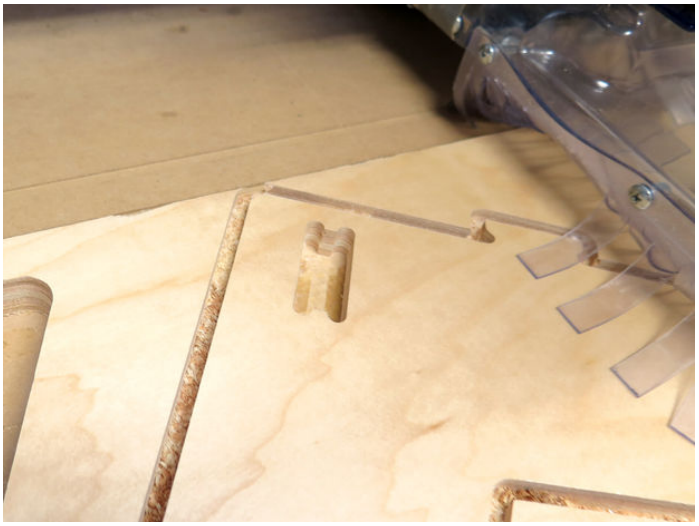
Step 6: Watch and remove parts

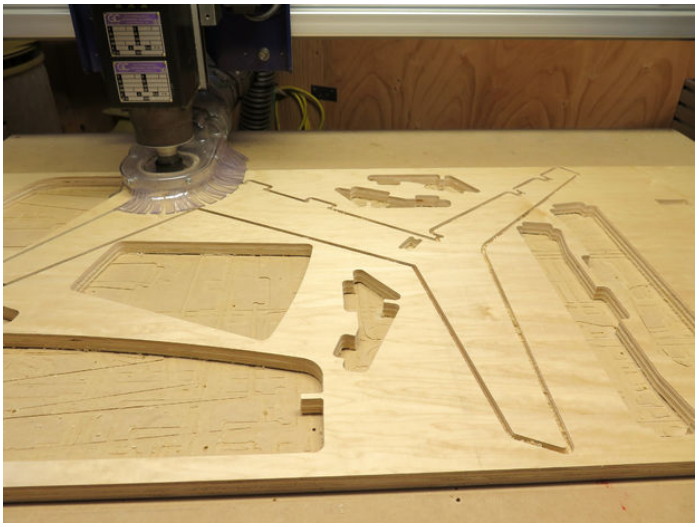
Now this is the easy and fun part. You sit down next to the router and watch how the machine cuts all of your pieces. Since I was using a ¼ inch End Mill it will make 3 passes before it actually cuts loose each single part. It will start by doing the pockets and then the profile cut.

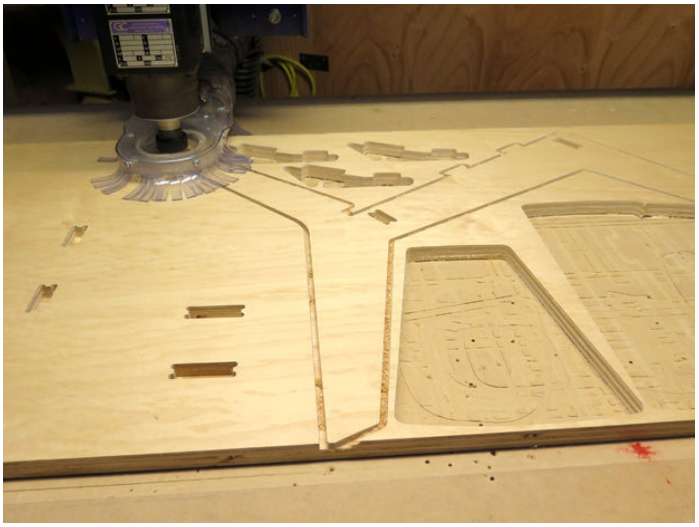
Remember that we didn't add tabs so if your pieces are really close to each other it might be a good thing to take your recently cut piece out of the table. I did this easily without stopping the machine.

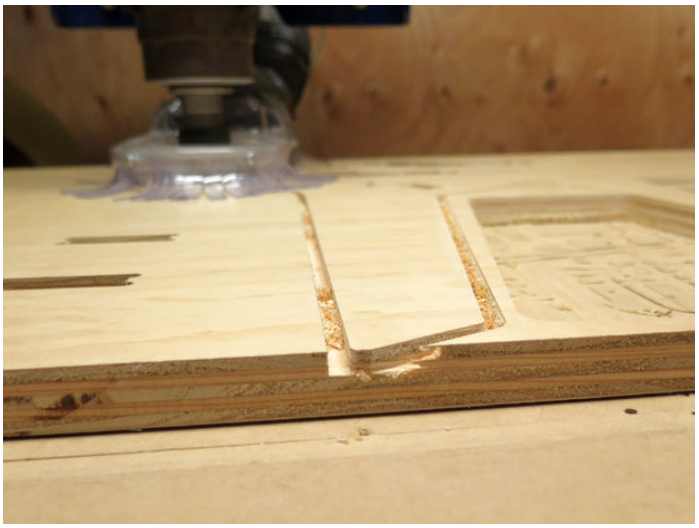
Once the job is done the Spindle will turn off automatically and you can unscrew your material off the worktable. For a single lounge chair 2 sheets of 4' x 2' is needed so now go ahead and repeat the process for the 2nd sheet.

Note how tight it fits on the sheet: By rotating the leg on the layout I was able to make the leg barely fit on the sheet. I know this will not look great because the woodgrain will be facing in diagonal but overall it wasn't as bad as I thought.





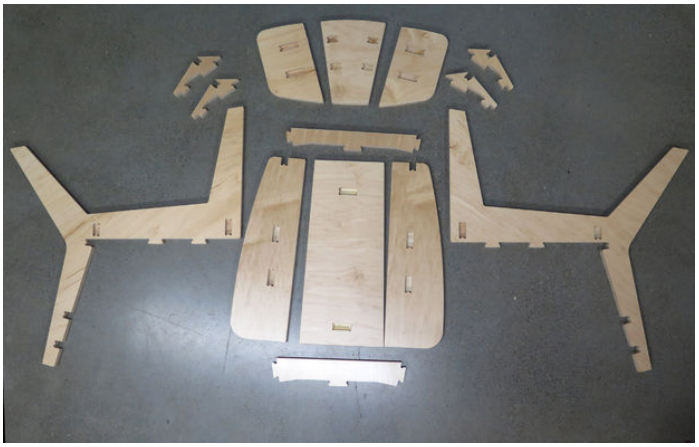




Step 7: Organize Parts

We have a bunch of pieces and it is a good idea to organize them before we begin to assemble. We should have:

- 2 legs
- 2 supports between each leg
- 3 seat parts
- 3 backrest parts
- 4 joinery parts



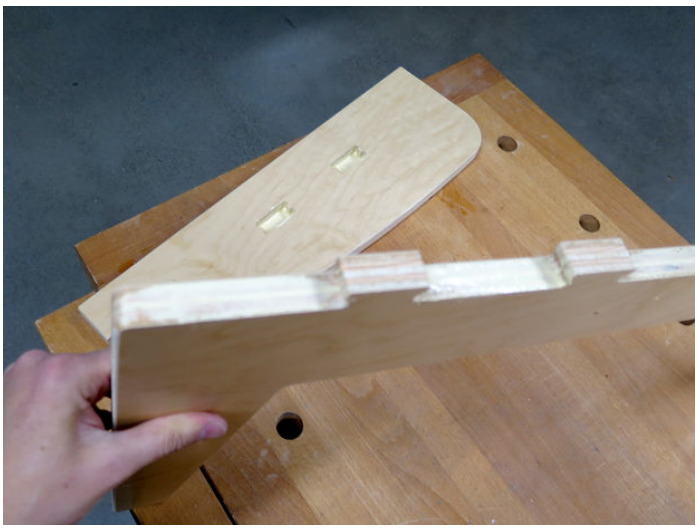
Step 8: Rounding edges with Table Router

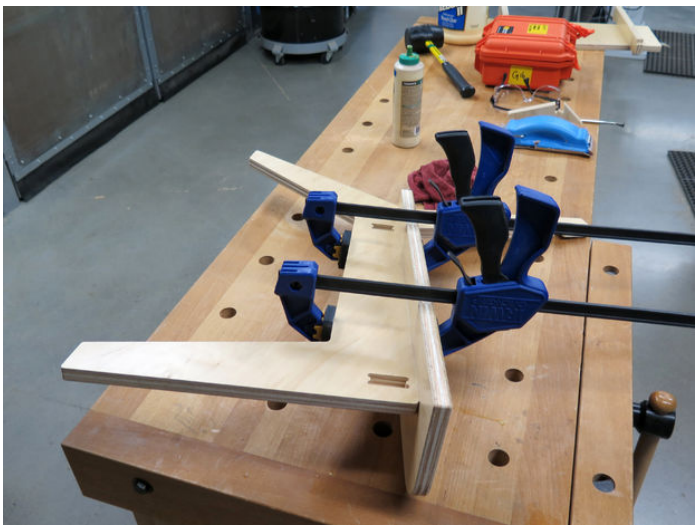
Before we actually assemble the parts I decided to round the edges of all the pieces except for the Legs and Supports (if you actually round those edges the pieces joined won't look as nice).

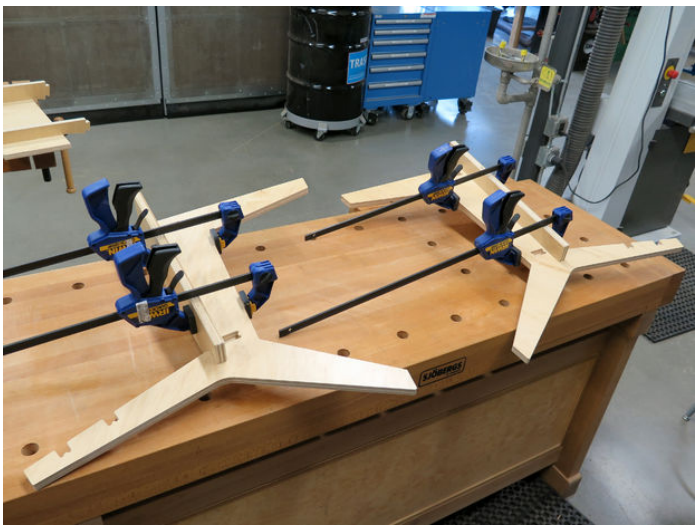
The setup I had was really great: I used a table router and a small radius router bit. If you don't have access to a router you can sand the edges away with sand paper. It is good to practice with a test piece first to make sure the height of router bit is in the ideal location.

Step 9: Assemble legs

Now it is time to start assembling the pieces together. I started by gluing the left leg to the left seat. I used 2 clamps to hold it firm in place and then did the same with the right leg. Leave the clamps for 30-60 minutes.

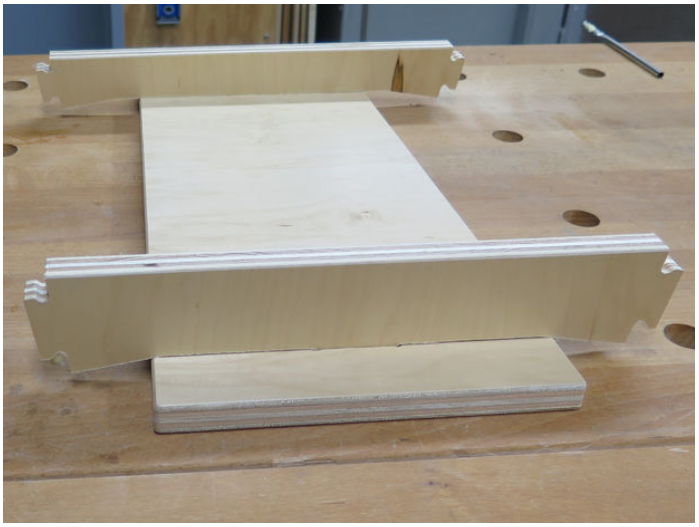


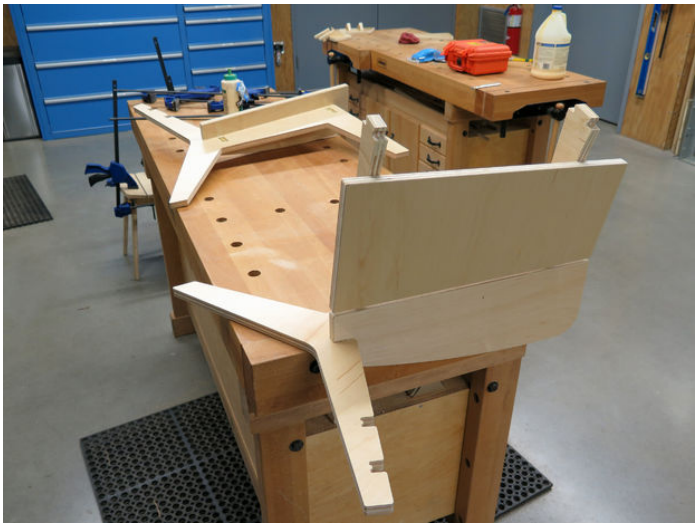




Step 10: Assemble seat + legs

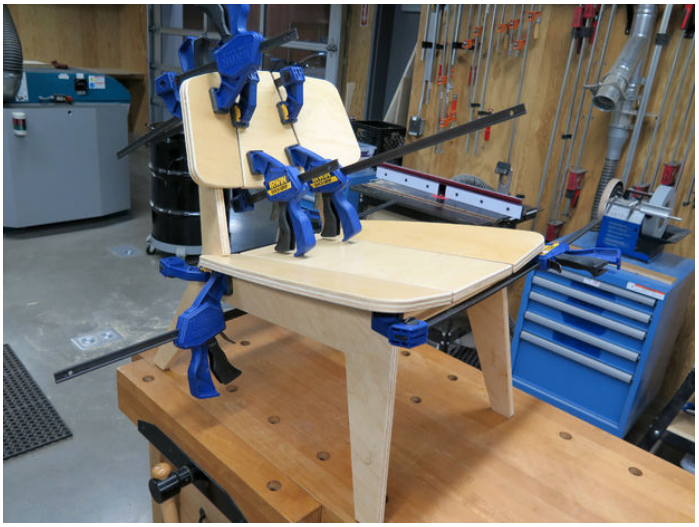
While the legs are drying up you can assemble other parts such as the seat. Assemble the seat with the 2 supports. You can also use clamps and leave them to dry. Once the you have the first pieces assembled you can combine the legs with the seat and glue them together.





Step 11: Finish Assembly

Once you have the seat and legs together you need to assemble the seat rest and you are done. Put some glue in the pockets and use clamps to have a firm attachment.



Step 12: Enjoy!

Now it's time to sit down, relax and enjoy your P9L Chair! Follow me to check out the Chair and Stool that I will be uploading over the next couple of weeks.

Step 13: Back Details

OK, one more photo-shoot with the details of the back. Hope you enjoyed the process!

Related Instructables

Bamboo Chaise Lounge Chair by M.O.T.H.

Free-form curved furniture without molds / Part 1 by pseaton

Shopping Cart Furniture - Part 2 - The Lounge Chair by JFabor

Piggy Coffee Table - CNC Router by alepalan

Pallet garden loungers by shoestringpavilion

Open chair by James Tooze (Photos) by Jamestooze

Comments

1 comments **Add Comment**

SGutshall says: Apr 29, 2014. 3:26 PM **REPLY**

Wow this is a beautiful chair! I'm thinking about adapting it for a laser cutter.

Awesome work!