the Layer Chair

by Jens Dyvik

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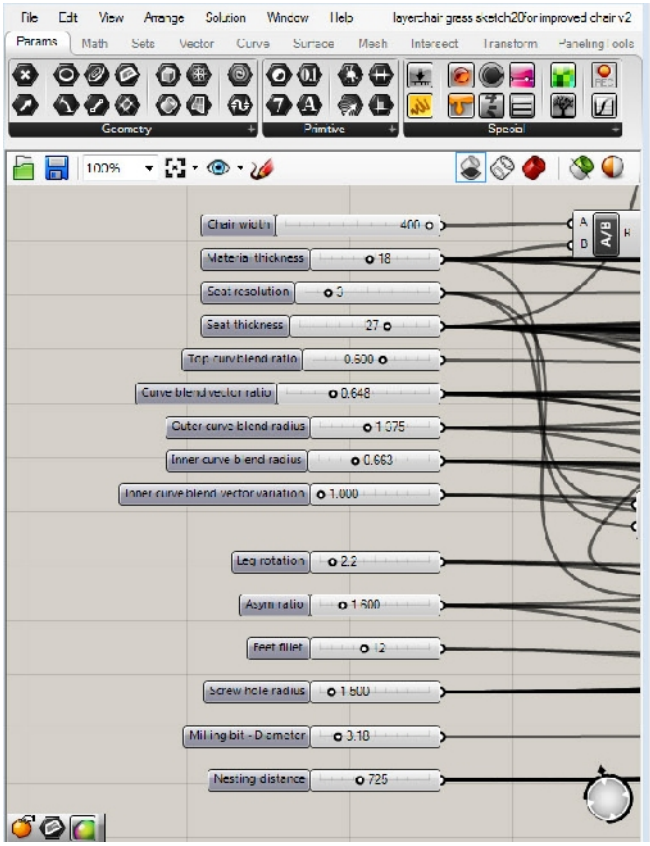
Alex Schaub (FabLab manager Amsterdam) liked the Layer Chair I made in the HONFablab Indonesia so much that we decided to make a few for his lab as well. We used one sheet of 18mm black MDF per chair. Colored MDF is a very interesting material for making large objects on the ShopBot. We are currently investigating different finishing processes like lacquering and waxing, so that the chair will be spill proof.

I originally designed the Layer Chair as an example of working with large organic surfaces on the ShopBot. The parametric Grasshopper definition enables you to input any profile curve you like, and the system outputs new milling curves. Download the design to make your own chair in a FabLab, and use the included Grasshopper definition to design the perfect personal chair for someone.

The parametric system lets you chance your material thickness, milling bit size, desired chair width and so on. It also possible to change the shape language of the chair by adjusting the size of the inside and outside fillets.

Points of improvement in the making:

- It is a complicated process to glue all the layers.
- The weak point of the structure is in the front part where the legs meet the seat. If someone sits down with sideways force, the layers can come apart.
- The back leg makes it hard to optimize the material usage. Next step will be a separate back leg with a connection joint
- Cut mdf is like a sponge, to make finished product you should apply some kind of surface coating.



Adjusting the design:
You can start by loading your own curves into the Grasshopper definition, or use the curves in the Rhino file included. If you just want to remake this exact model from 18mm material, you can skip ahead and open the included Partworks file and export the tool paths to your ShopBot.

Play around with the sliders and search for your optimal shape. You need to specify your milling bit diameter in order to get the “trim lines” to work properly. *(The trim lines creates the 3D surfaces on the inside of the surface by creating steps on the seating part of the surface. Since the rest of the surfaces has straight cuts, it is very fast to mill).*

Exporting your design for milling:
When you have found your perfect design you need to bake your lines to Rhino so you can export the vectors to you milling machine. All the way to right in the definition you can find components for baking the Cutting lines, Alignment holes and Trim lines. For the trim lines you need to use the “trim line selector” to export each depth pass independently. This is handy because when you export to different layers in rhino, the DXF you import in Partworks will have the same layers. By turning these layers on and off you can easily set the trim lines to be milled at different depths.

Once you have baked all the parts into their corresponding layers in Rhino, you need to nest then on a cut sheet manually. A smart trick is to group all the lines per part together. Than you easily drag and rotate the parts around for optimal material usage. Have a look at the include Rhino and Partworks file for reference. You also need to to mirror all the parts to get the second half of the chair and to draw circles to mark hold down holes.

Once your cutsheet is ready, make sure it laying flat on the XY plane of Rhino. If you curves are “standing” along the Z axis, Partworks will see your lines as single line (like in top view). So always work in the top view when nesting vector files for the ShopBot. Select everything and export as DXF. Use the default settings.

Programming your toolpaths:
Once in Partworks, turn all the layers off. Then turn on and off the different line types layers as you program them. I used a 1/8 inch 4 Straight flute milling bit at 100mm per second, pass depth 4.5mm and a plunge rate of 15mm p/s.

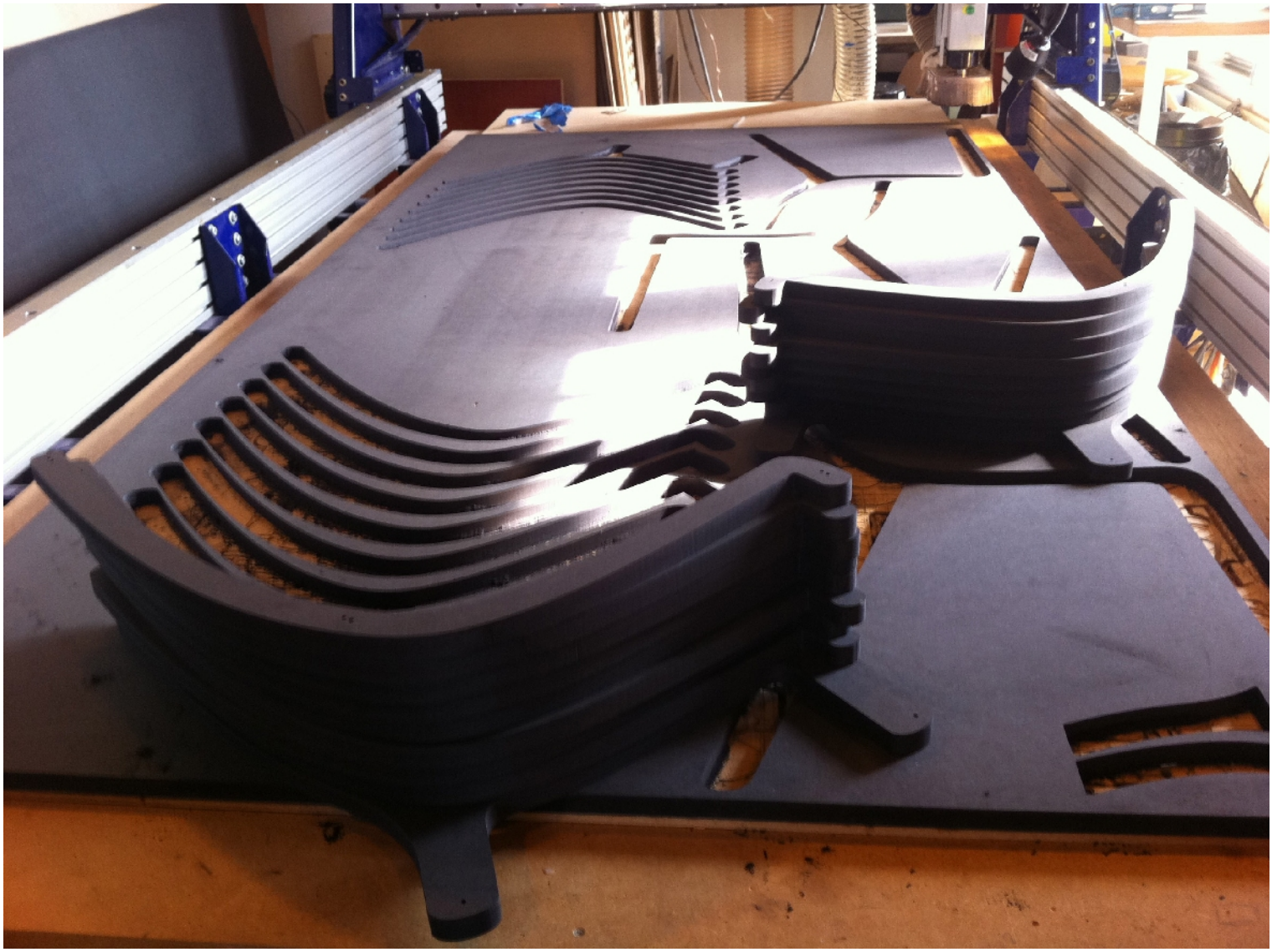
The alignment and hold down holes needs to be be “drilling toolpaths”. If you want be refined you can make sure the outer layers on left and right side are not drilled all the way through. This makes sure you have a clean surface on the sides. The trim lines are “profile toolpaths” set to one third and to thirds of your material thickness (make sure you set the “Machine Vectors to “On”, this is why you need to specify your milling bit diameter in the Grasshopper definition). The cutting lines are also “profile toolpaths”, but remember to switch the Machine vectors back to “Outside”.

Export the hold down toolpaths a separate file. Export all the part toolpaths as another file, make sure the the cutting lines is the last toolpath in the list.

Milling your parts:

Run the hold down drill job and attach the plate with screws through the hold down holes. You can mill out a small test piece if you want make sure you have the right settings. Then run the file with all the part toolpaths.

Assembling the design:



Before you get you parts of the machine, mark them with a pencil. This makes it easier to assemble them in the right order. You can also stack the two halves in in the correct order when you get them out of the plate.

Use wooden sticks of the same diameter as your milling bit and cut them in to a length a bit shorter than the double of your material thickness.

When gluing, use the alignment sticks to align the layers. It is smart to practice a bit before you start gluing.

Make sure you are well prepared before you apply the glue. Try to be as fast as possible between applying the glue, and clamping the structure. You can use normal wood glue. Better to have glue running over the edge, than using too little. If you wait about 4 hours, the excess glue is rubbery and easy to scrape of without smearing it into the mdf surface.

Leave the clamps for 24 hours. Sand the chair and apply some form of surface coating. And enjoy!

If you build this chair and would like to give a donation for my sharing of design and knowledge, my Paypal address is jens@dyvikdesign.com

And if you can, please send me a pic of your end result.

If you want to make manufacture this chair for commercial purposes you need to make written agreement with me. You can reach me at jens@dyvikdesign.com

best regards from Jens Dyvik