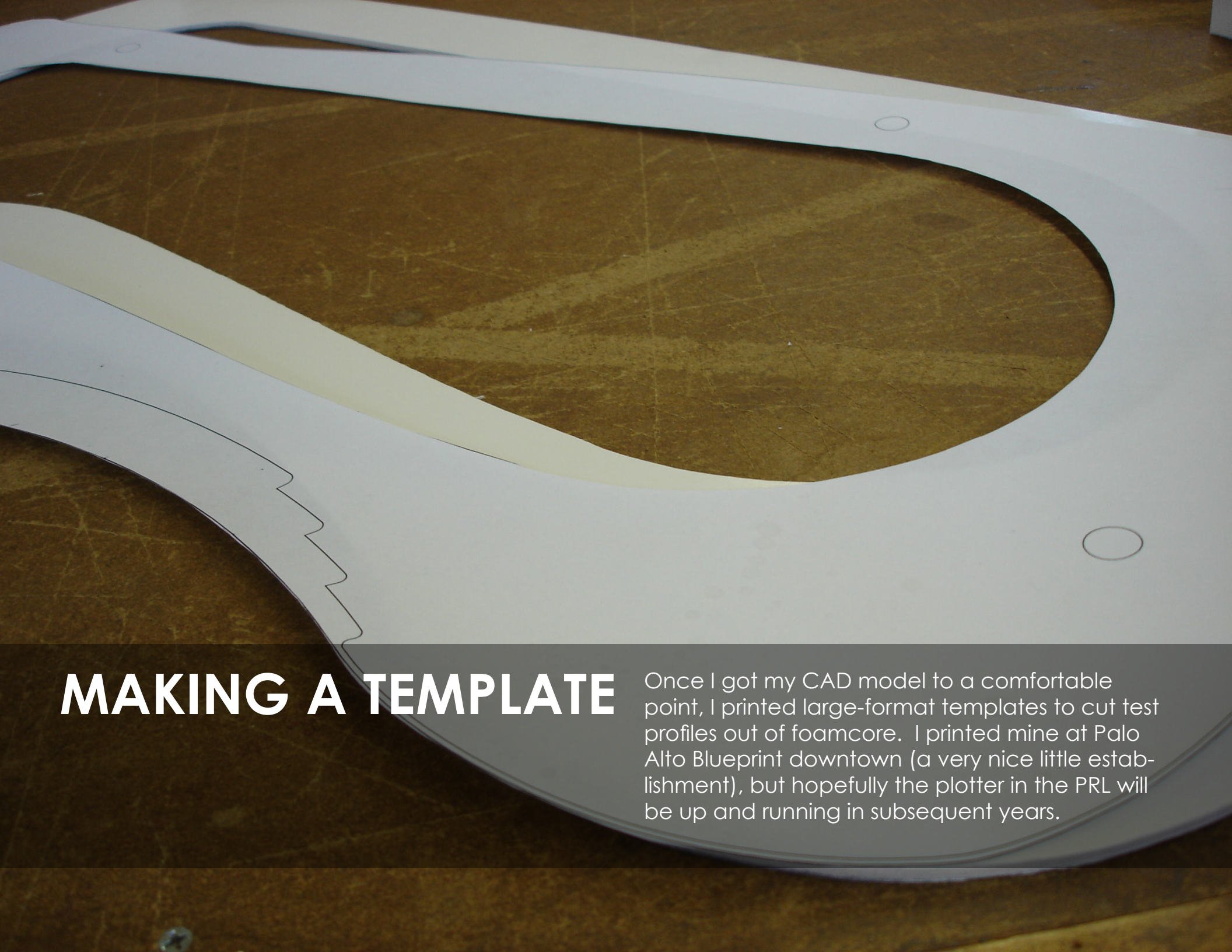
SLOSH CHAIR

CAMERON JUE SPRING 2011



MAKING A TEMPLATE

Once I got my CAD model to a comfortable point, I printed large-format templates to cut test profiles out of foamcore. I printed mine at Palo Alto Blueprint downtown (a very nice little establishment), but hopefully the plotter in the PRL will be up and running in subsequent years.

CUTTING PROFILES

Template in hand, the next step was to actually slice up some foamcore. Although my chair involved several different profiles, I was able to use only one template that I modified as I went (adjusting the depth of the feature below the seat).

LOTS OF SPACERS

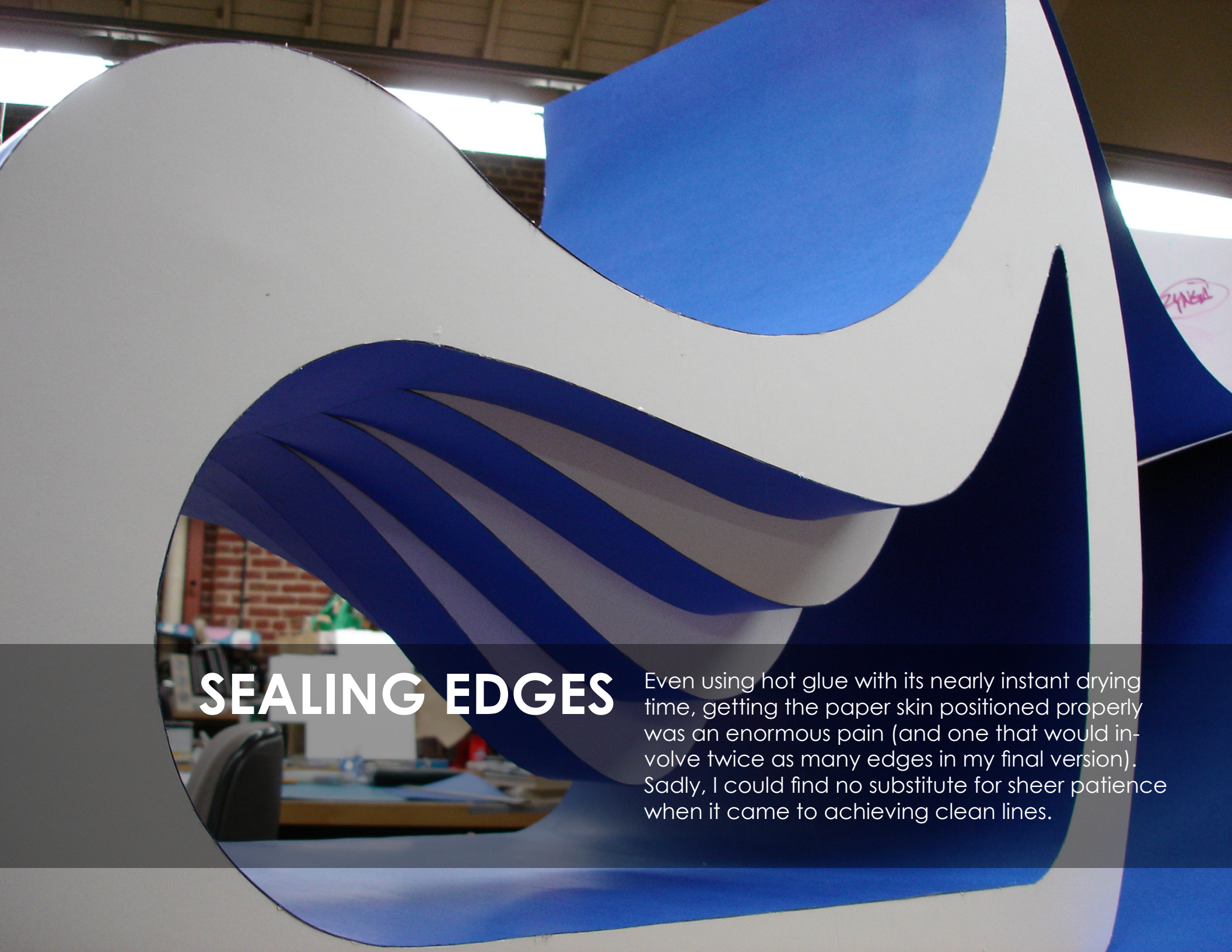
In order to keep the weight of my chair down, I opted to use thin profiles separated by spacers instead of solid sections. At the prototype stage, this meant many little triangular prisms cut out of foamcore. Keeping the profiles parallel required these spacers to be quite precise.

STACKING ‘EM UP

Here you can see some of the spacers assembled and providing the necessary distance between each profile. I discovered very quickly that alignment was going to be a problem and something to address in the final version. For the prototype, I used a level to ensure verticality.

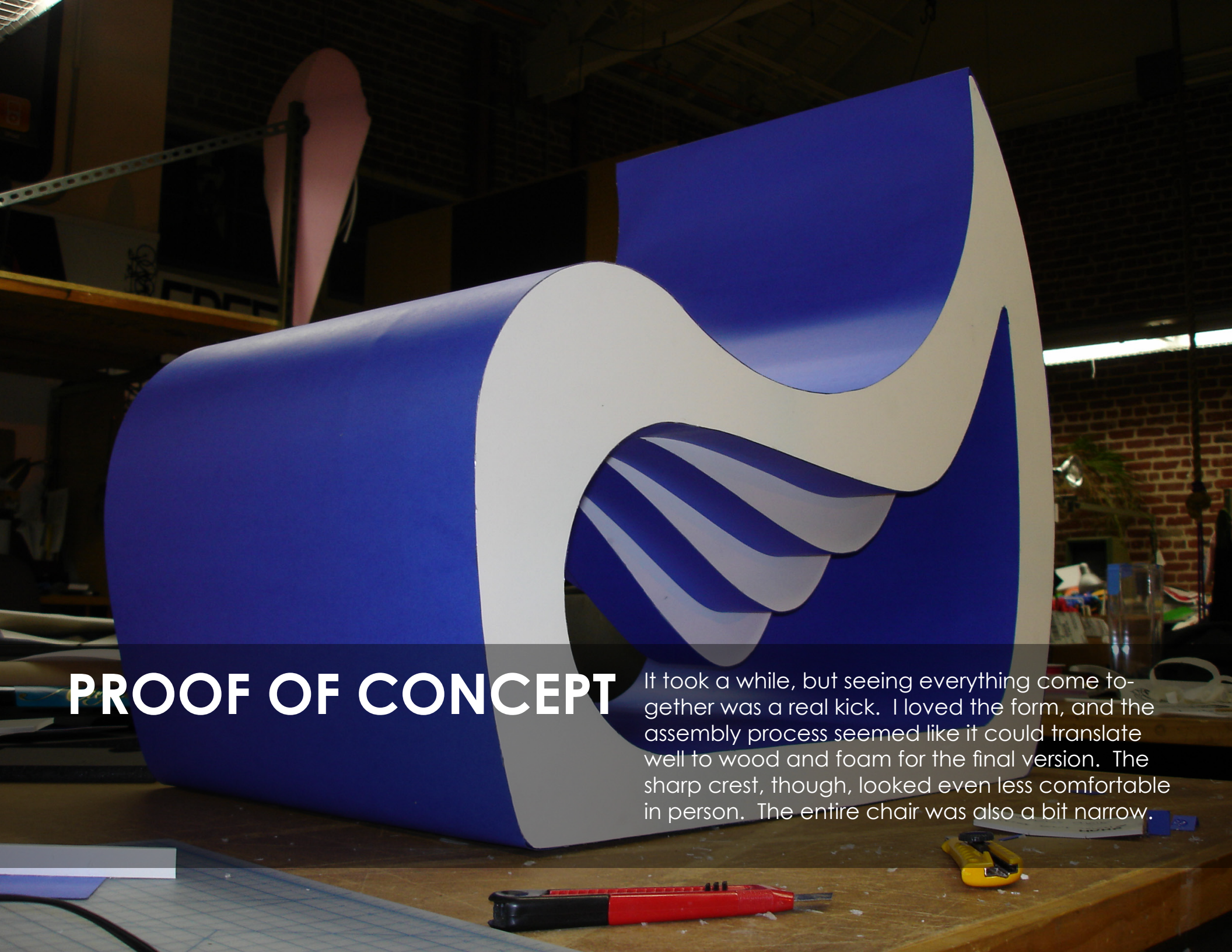
MAKING THE SKIN

I felt quite clever extracting the dimensions of the skin from my CAD model and using them to make a 2D drawing of what I needed to cut. This was tempered somewhat when none of the lengths lined up as expected—perhaps my hand-cut profiles were off? Luckily, they were on the long side.



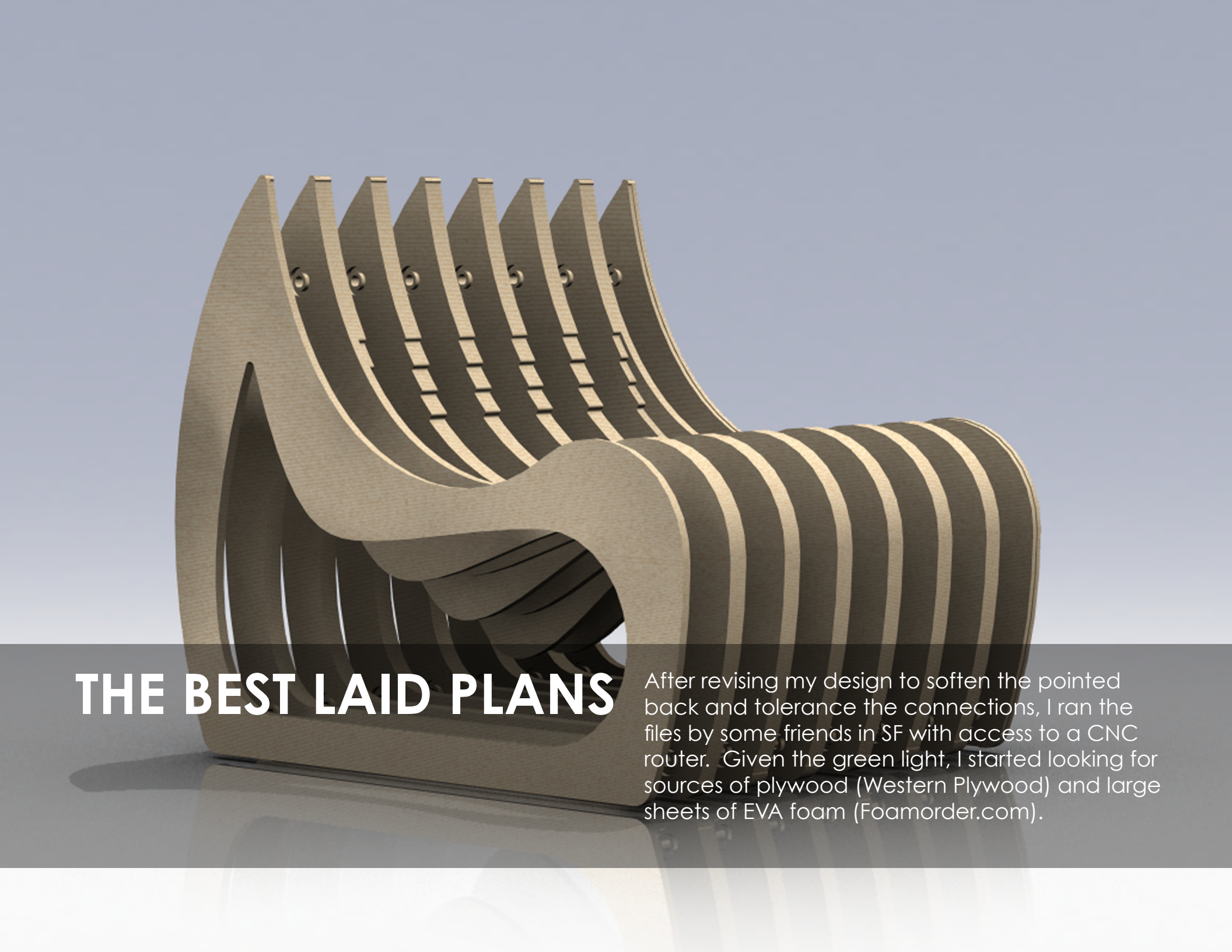
SEALING EDGES

Even using hot glue with its nearly instant drying time, getting the paper skin positioned properly was an enormous pain (and one that would involve twice as many edges in my final version). Sadly, I could find no substitute for sheer patience when it came to achieving clean lines.



PROOF OF CONCEPT

It took a while, but seeing everything come together was a real kick. I loved the form, and the assembly process seemed like it could translate well to wood and foam for the final version. The sharp crest, though, looked even less comfortable in person. The entire chair was also a bit narrow.



THE BEST LAID PLANS

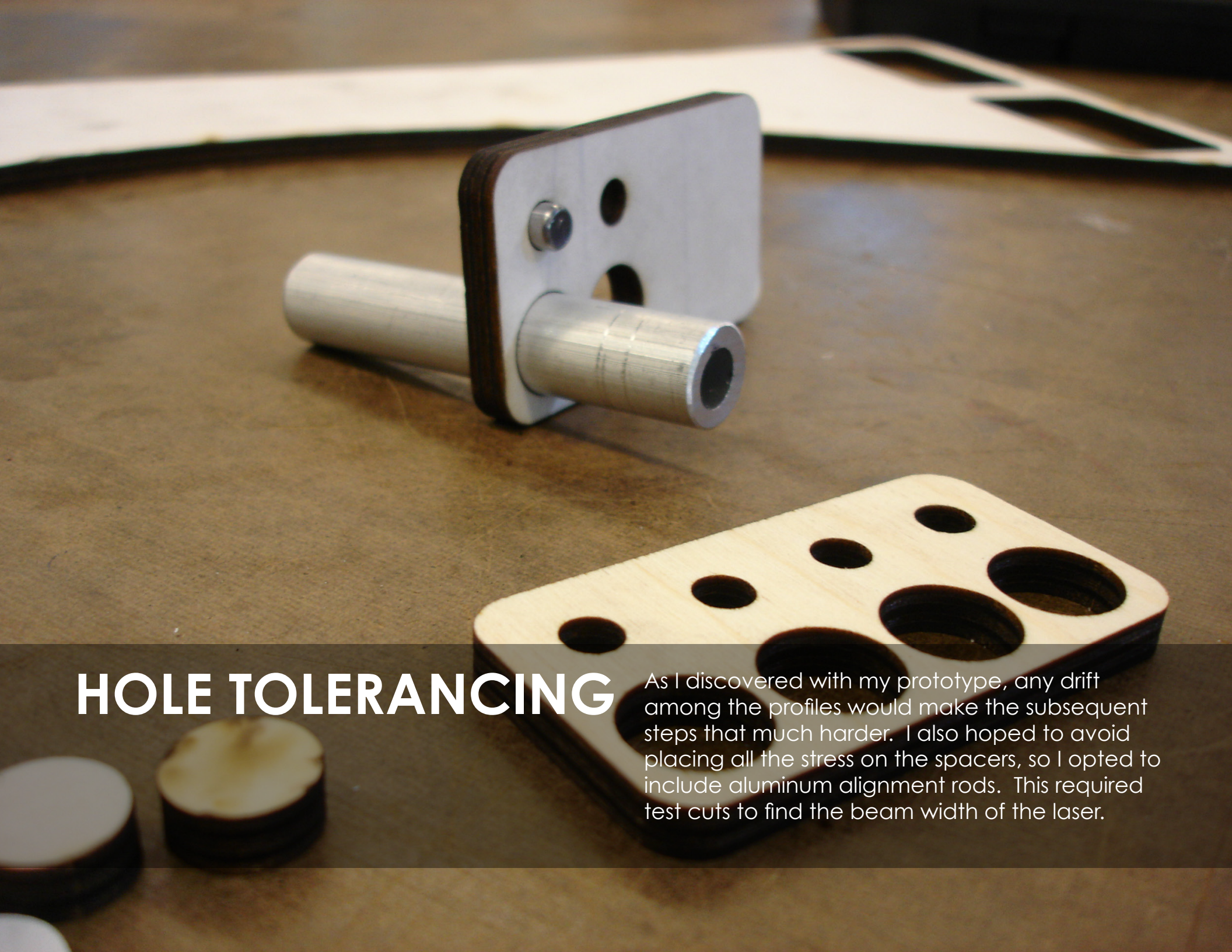
After revising my design to soften the pointed back and tolerance the connections, I ran the files by some friends in SF with access to a CNC router. Given the green light, I started looking for sources of plywood (Western Plywood) and large sheets of EVA foam (Foamorder.com).

COMPLICATIONS

With my foam in hand and plywood ready to cut, I thought I was set. This was until the router software broke, followed by the computer running it, and finally the motors themselves. The guys at Monkey Wrench were sympathetic and helped look for an alternative as I started to panic.

A LITTLE OFF THE TOP

After looking into other router and waterjet shops, I decided the best choice was the LaserCAMM in our very own PRL. In order to fit my profiles on the bed, I ended up rounding the crest at the back of the chair. Here's a test piece that I cut out of butcher paper to double-check the positioning.



HOLE TOLERANCING

As I discovered with my prototype, any drift among the profiles would make the subsequent steps that much harder. I also hoped to avoid placing all the stress on the spacers, so I opted to include aluminum alignment rods. This required test cuts to find the beam width of the laser.

NOW 50% THINNER

Of course, the LaserCAMM couldn't handle the 1/2" maple plywood I originally bought, requiring a trip to Southern Lumber for some thinner sheets. I chose 1/4" Russian birch, which has interior-grade glue and therefore doesn't burn as much as something like exterior-grade Baltic birch.

MAKING THE CUTS

With 16 profiles requiring about 15 minutes of cutting time each, this part of my project should have only taken around four hours. Between the finicky machine and needing to mask everything, this turned out to be a gross underestimate. Budget ample time if using the LaserCAMM extensively.

LAMINATING PAIRS

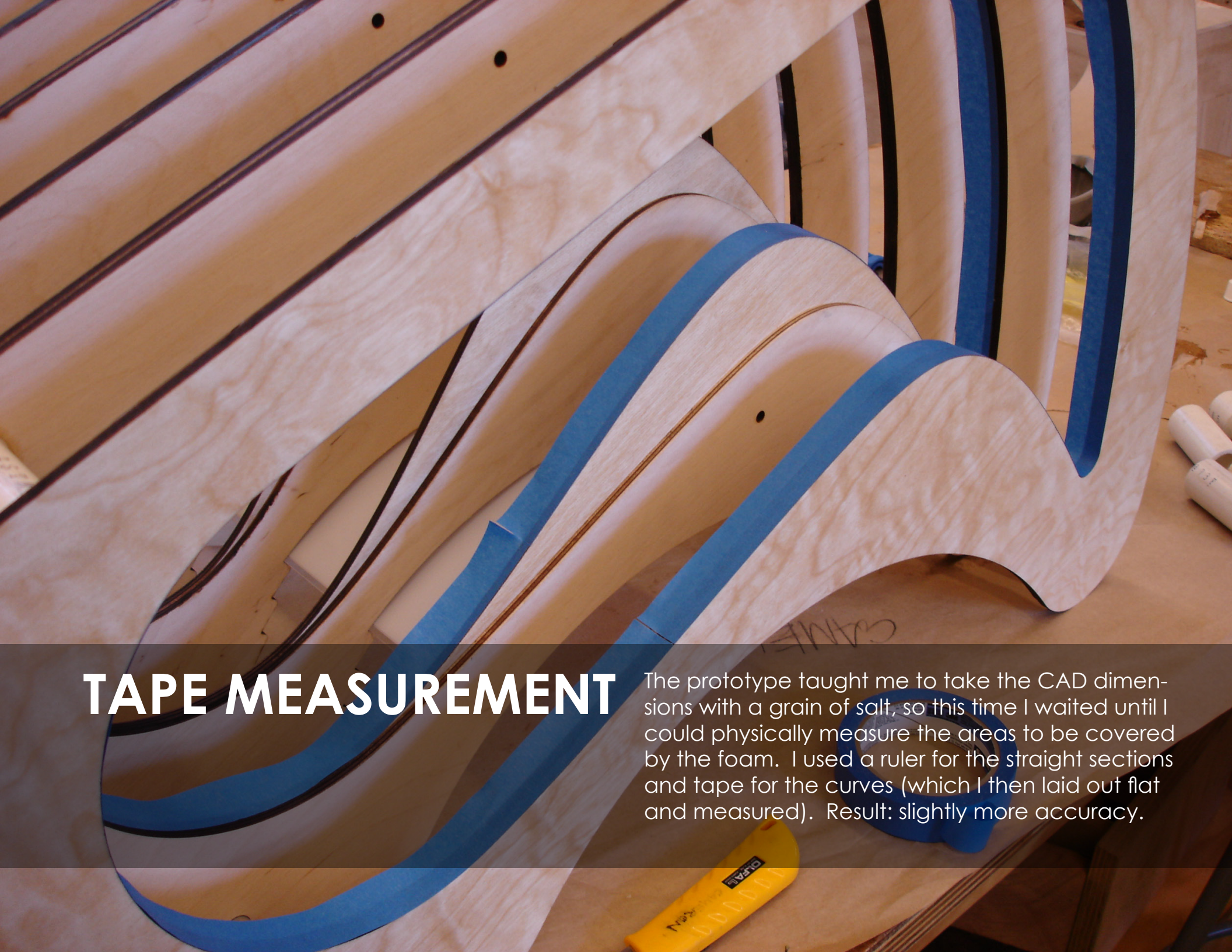
The 16 profiles next needed to become eight pairs. Laminating the pieces together with wood glue increased their overall strength and especially their resistance to bending. It also gave me two edges per section to support the foam on the stepped feature below the seat.

ENTER SANDMAN...

It was now time to sand the exposed surfaces in anticipation of finishing. Although I worked my way up from 80 to 400 grit, the lower grits seemed like overkill in retrospect (and actually left some deep scratches in my pieces). I'd suggest starting with 180 or 220 grit for this kind of plywood.

COMING TOGETHER

After finishing the exposed surfaces with two coats of boiled linseed oil, I threaded the eight pieces onto the aluminum rods. I glued the spacers (PVC pipe cut on the cold saw) in place with marine-grade epoxy. The 15-minute cure time allowed me to position the pieces, then glue it all at once.



TAPE MEASUREMENT

The prototype taught me to take the CAD dimensions with a grain of salt, so this time I waited until I could physically measure the areas to be covered by the foam. I used a ruler for the straight sections and tape for the curves (which I then laid out flat and measured). Result: slightly more accuracy.

FOAM OPERATIONS

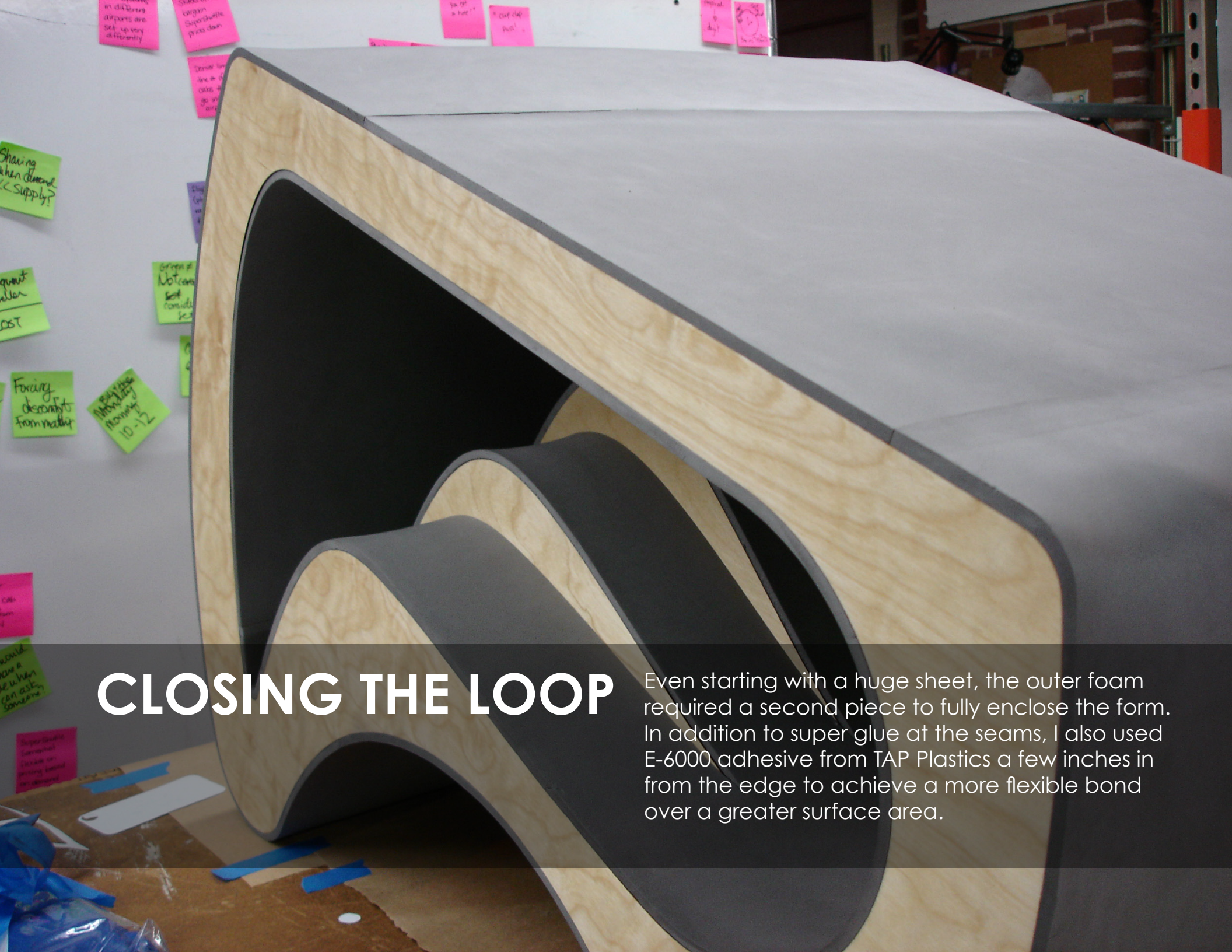
Cutting the foam was an interesting challenge, both due to its size and the fact that I couldn't risk leaving any marks on it. I used a combination of blue masking tape and butcher paper to guide my cuts. A gigantic piece of aluminum bar stock served as an eight-foot straight edge.

A STICKY WICKET

With the inner foam positioned loosely, it was time to glue it into place along all the edges. Contact cement—my original plan—proved far too messy and dried slowly. TAP RP2000 worked well in general, while brush-on Krazy Glue was absolutely unparalleled in terms of achieving a clean edge.

SUPPORT STRUCTURE

While the inner foam would see little handling, the outside of the chair required something beneath the foam to make the wooden profiles less apparent to the user. I chose thin sheets of polycarbonate, held to the wood with staples. They also kept the padding concealed below the seat in place.



CLOSING THE LOOP

Even starting with a huge sheet, the outer foam required a second piece to fully enclose the form. In addition to super glue at the seams, I also used E-6000 adhesive from TAP Plastics a few inches in from the edge to achieve a more flexible bond over a greater surface area.

MAPLE PLYWOOD

$40 per sheet (4' x 8' x 1/2") from Western Plywood. Great price, but definitely with some drawbacks. I went to the trouble of hand-selecting sheets, only to find three random ones waiting for me when I went to cut. Chosen for price and aesthetics, but not used in the end due to the router.

RUSSIAN BIRCH PLYWOOD

$24 per sheet (5' x 5' x 1/4") from Southern Lumber and cut to car-friendly sizes for $2 dollars per sheet. Somewhat expensive, but worth it considering the strength and ease of cutting. Definitely go with interior-grade (versus exterior-grade) glue if using the LaserCAMM to minimize burning.

POLYCARBONATE

Various prices per sheet, depending on thickness, size, and source. I originally planned to use pieces 1/16" thick, but discovered that they stopped staples dead in their tracks with any kind of curvature applied. Thinner sheets (~1/32") worked better, but the staples still often required hammering.

EVA FOAM

$24.75 per sheet (40" x 80" x 1/4") from Foamorder.com. Was surprisingly difficult to find large sheets of EVA foam, let alone specific colors. EVA offers great softness (better than neoprene, FloTex, Volara, etc.), both in terms of aesthetics and touch. It also dents easily, so handle with care.

ADHESIVES

Brush-on Krazy Glue provides a great aesthetic seal between wood and EVA foam, while E-6000 offers more strength. Contact cement also works, but is messy and releases some seriously noxious fumes. 15-minute marine epoxy was great for bonding both PVC and polycarbonate to wood.

REFLECTIONS

Looking back, a huge amount of the time invested in my chair was spent tweaking and refining my model in SolidWorks. Although this paid dividends in the end—router difficulties aside, the chair came together with few hiccups—I could have iterated much more efficiently with a better structured CAD model (relationships, dimensions, etc.). As it was, I ended up rebuilding most of the assembly every time I wanted to make a change.

And proper iteration is key. The chair that I ended up building is very different from my earlier designs, and I feel that the piece is much stronger because of it. With only one major project, this class is a rarity in the opportunity it provides for revision and refinement. So take advantage of it.

That said, one of the most satisfying aspects of the class is having a highly polished chair at the end. Enjoy the process, but also budget enough time to achieve a result that you're proud to show.

Final dimensions: 24" (W) x 23" (H) x 30" (D)