Buddy’s Table

Raúl Vera

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Let me introduce you to Buddy. She belongs to my friends Rob and Renee, they live in Sydney.

I worked with Rob professionally for a number of years, in Sydney, and we both retired about the same time, so I suggested we do a fun project together.

I was thinking of computer software, but he knew I did woodworking so he suggested a table for Buddy's cage instead. That was about October of 2021.

This is the old table. The new table had to be tall, to make cleaning easy and to keep the bird happy. (They like to be up high.) It also had to look good because it would be with their other amazing furniture in their amazing apartment.

It has to roll around, it has to be somewhat impervious to bird poop, and it has to hold up the cage nicely.

My first idea was to use strongly tapered legs with pointy feet, sort of like bird legs, with castors at the bottom.

I wanted a good strong colour contrast between the red legs and rails on the one hand, and the lighter shelves and top on the other.

Rob and I went to a timber yard and showed the people this design and ended up buying the two woods. Red Grey Gum, which I think is a hilarious name, and Tasmanian Oak.

The circles at the top were requested by Rob when I first showed him the design. He thought it would be cool to have inlaid circles that reflected the circular tops of the cage.

Rob thought the original circles were too small, so I made them bigger.

These are 60mm in diameter. The legs are 90mm square at the top.

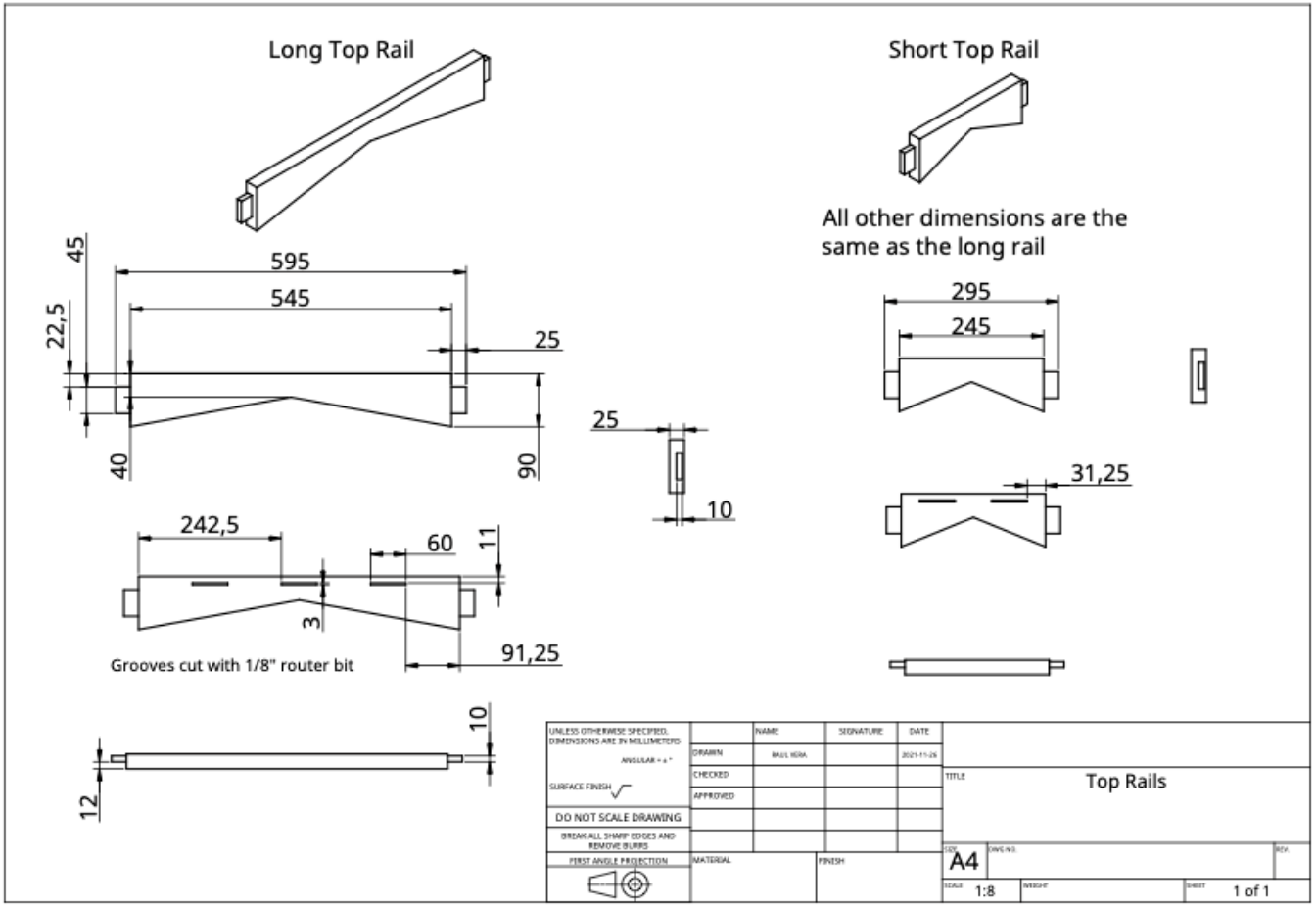
So here are examples of a few things about this project.

I didn’t know how to do an inlay, but obviously I knew it could be done, so I went ahead. In general, I like to design something without worrying too much about how I’m going to build it, and then figure out how to build it. If it turns out to be too hard or impossible, then and only then do I modify the design. I think that’s a good way to learn new skills and stretch the ones you have.

There were a few such situations in this project, as we’ll see. For example, I figured I would attach the top with screws from below, through those rails, and I’d attach the other two shelves by gluing them into cuts in the legs. Clearly, I didn’t know what I was doing. I looked at ways of attaching tops to tables and realised that wood movement would be a problem. The table is big enough that I might get a millimetre or two of movement, which could pull the table apart over time. So, the top clearly had to be attached to the rails some other way.

I decided to use zed clips screwed into the top and inserted into grooves in the rails. I gather this is a common way to attach tabletops.

The Zed clips



One of the benefits of using a CAD* system for design, is that you get good diagrams to work from, essentially for free.

This is a diagram of the top rails, giving all the dimensions and even the grooves for the clips.

*(CAD stands for computer-aided design)

Look at these tapered legs. These things are 1200mm long, minus the height of the castors and the thickness of the top. The whole thing is 1200 tall, and they are 90 square at the top. They are straight on the inside but tapered on both outside edges, and I had to do a 60mm diameter circular inlay on two of the legs, on the tapered sides

So, I looked at how to do the inlays - I'd never done an inlay before.

My first thought was to use my CNC router,
but mounting one of the legs securely onto the considerably smaller CNC bed (maybe 600 long) looked very difficult. I'm not even sure the bit could be raised 90mm off the bed. The CNC had collected so much dust that it was jammed up pretty badly and refused to work.

Next, I thought I'd use a Forster bit to cut the hole, then cut the inlay with a circle-cutting jig on the bandsaw, then smooth the piece to fit. I even bought an appropriately sized Forster bit like this one. But it was going to make a horrific hole in the leg that would interfere with the mortises, which I'll get to in a bit, and the circle-cutting jig on the bandsaw couldn't cut a circle that small.

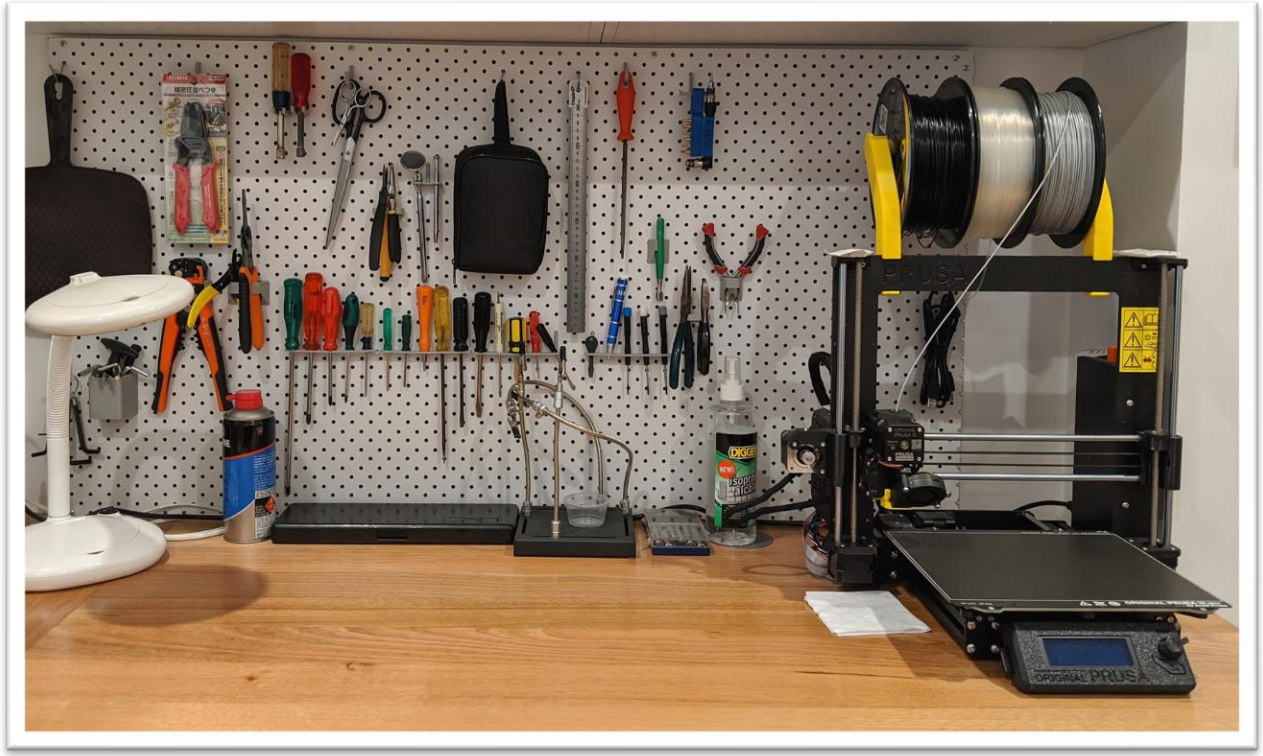
Instead, I bought an inlay kit for the router, a lot like this one, and used that. But even that required some jig making. As I'm sure many of you know, to do an inlay you need a template to ensure that the hole and the inlay match up. To use the inlay kit with the router, that template had to be an even thickness and be able to be clamped on to the workpiece so it didn't move.

Of course, the hole in the template has to be larger than 60mm to make a 60mm diameter inlay, so there wasn't going to be much area on the leg left to support the template, and I had to do it on a tapered surface. I didn't like this.

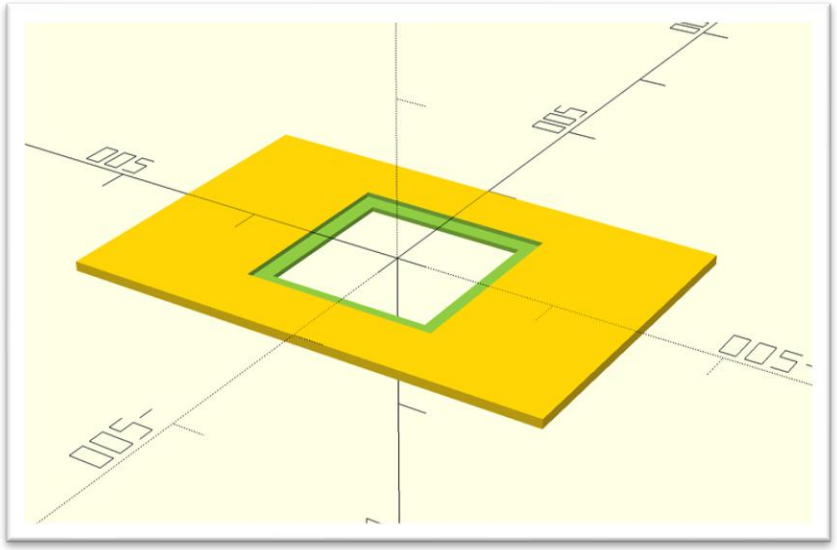
So, I had an idea: Flat tops. If we make the top part flat, as far as the top rails come down, there is a flat area for the circles, and the top rails are flat instead of tapered.
The flat top area means that we could do the inlay before cutting the taper, and we can support the template much more easily, using the other legs before cutting any tapers.

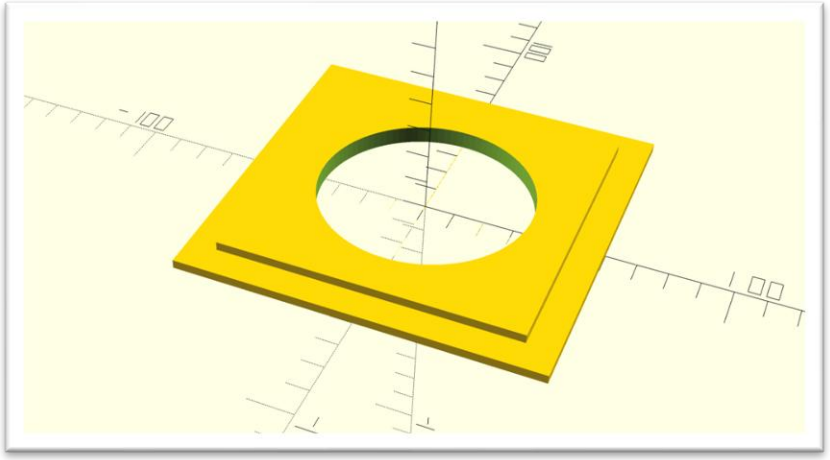
There is a bit of risk here in that we'll be doing the long taper cuts close to the inlaid parts, and we did run into some difficulties, but it was easier. And Rob also thought that the flat part at the top actually looked better, so this was again a place where a solution to a building constraint improved the design aesthetically.

Win-win!



So, I still had to get a perfect circle of the right size in a template, and the CNC is out of commission. How to do this? Rob suggested 3D printing. As we both have 3D printers (far right in the photo) and I did end up using a 3D printed template for the actual hole. But to secure it and hold it, I made a larger jig, with a square hole that could take any 100 x 100mm template.





It looked like this. I made it out of wood, using the router to make the lip a uniform thickness, and carefully sanded the inside edges until they were the exact dimensions I needed.

(Top picture) This is about 300 by 200mm, with plenty of area to clamp it down, and it takes inserts that rest snugly inside, exactly 120 by 120mm on the outside, and 100 by 100mm on the inside.

(Bottom picture) Here's the one I used for the circles. It's exactly 120 by 120mm on the outside, and the inner square is exactly 100 by 100mm. and it will fit snugly into the holder.

Here’s a close-up of the result.

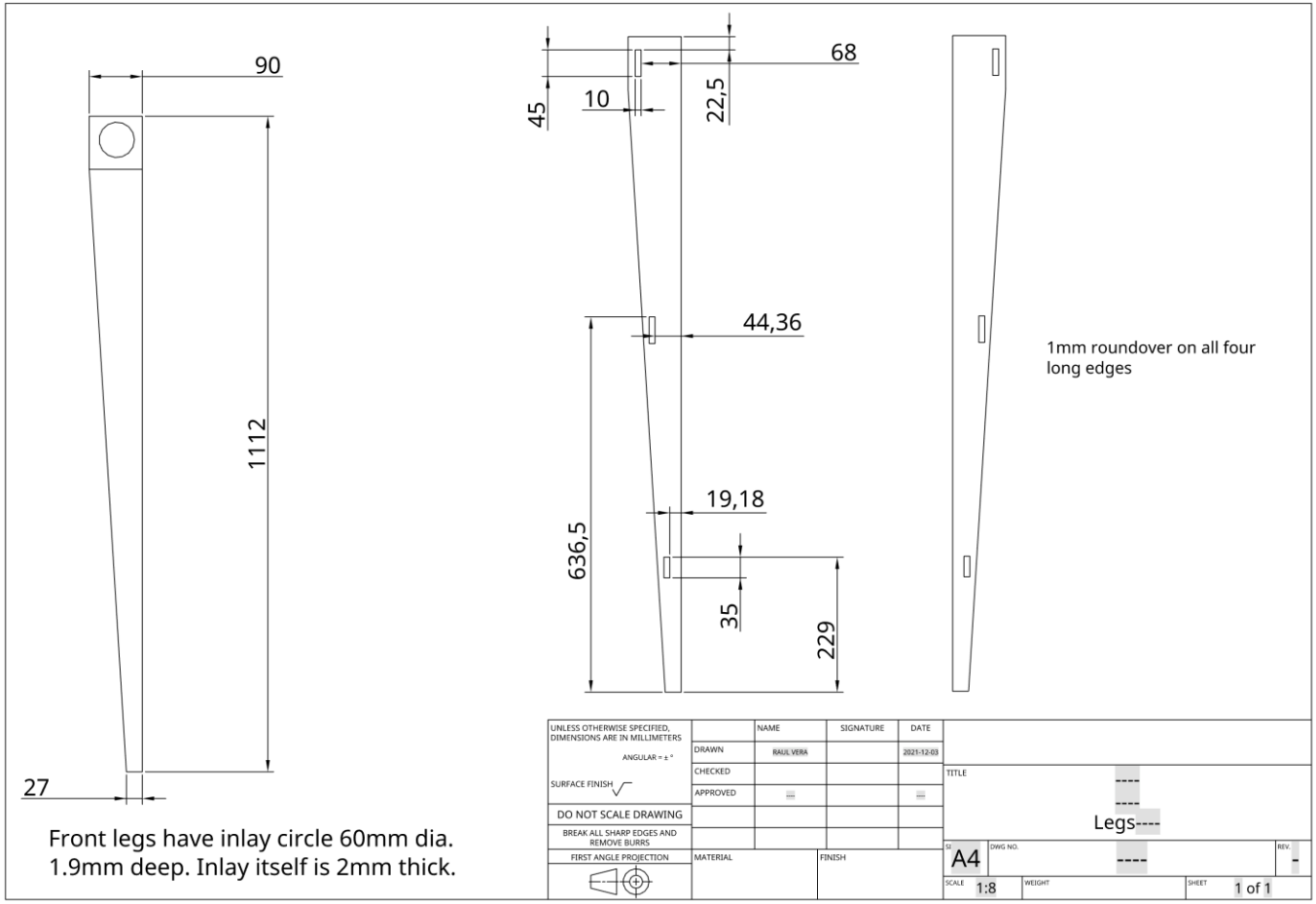
You can also see in the photo two mortises, and that brings me to how the rails were attached to the legs.

With mortise and tenon joints.

I had done some of these before, but not this many, and not on something this fine. In fact I’d never done anything this fine at all.

Fortunately, all the mortises were on the flat faces of the legs, on the inside, so I could do them while the legs were still square.

I really held off on doing those taper cuts as long as possible.



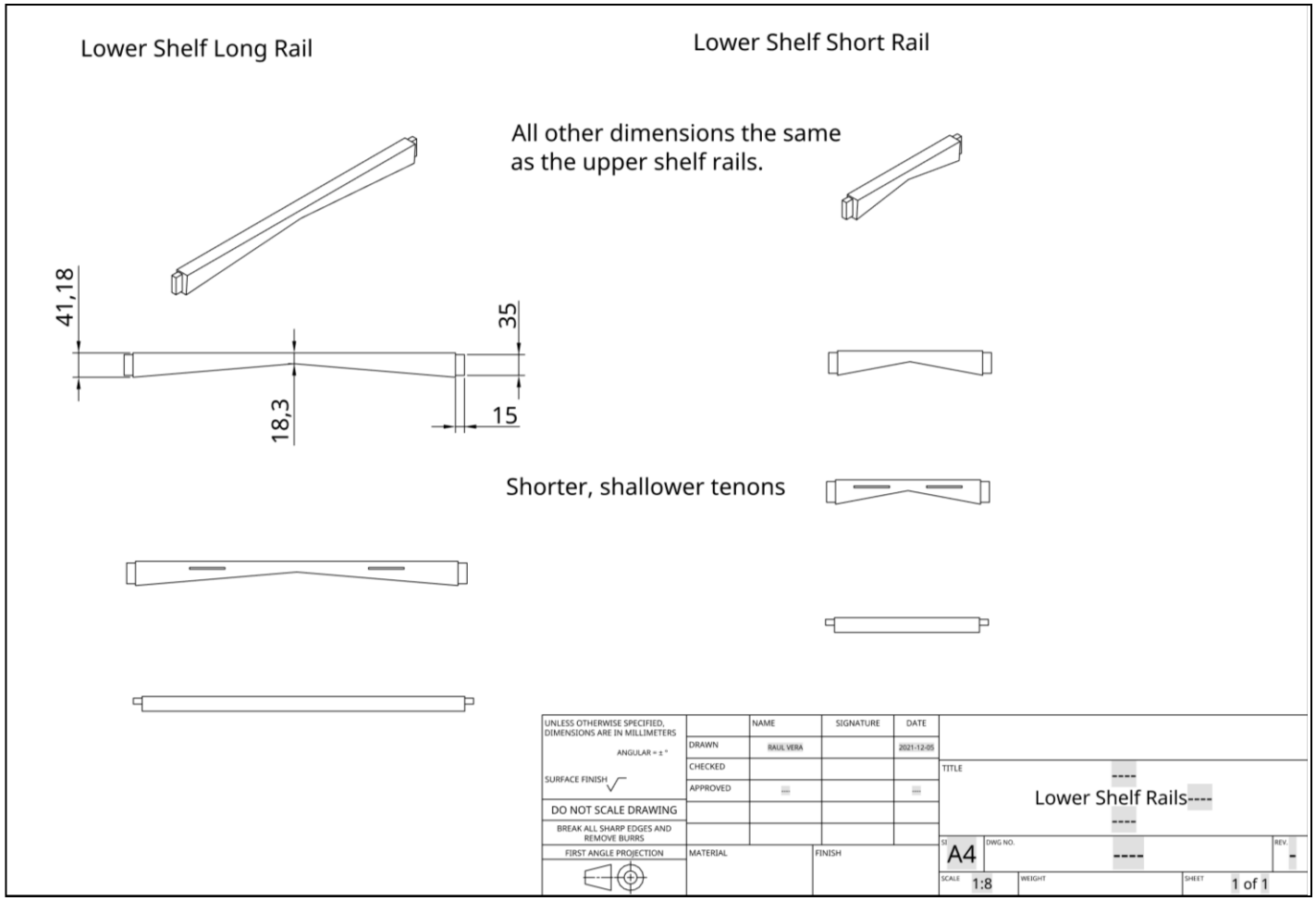
Here’s a drawing of the leg. You can see that the mortises have to be placed relative to the front, not the back, so the rails can be flush with the tapered side of the leg.

So, each mortise had to be placed a different distance from the edge of the uncut board. Also notice that the mortises for the lowest rail are somewhat smaller, 35mm instead of 45, so the tenon has to be smaller.

The leg is thin enough there that the mortises and tenons had to be shallower there, too, so they wouldn’t interfere with each other.

Cutting the mortises was relatively straightforward, because the boards had not yet been tapered. As you can see, I marked the outlines of the legs and mortises, then used the router. I decided to leave the mortises round, as rounding a tenon seemed easier than squaring the mortise.

One of the resources I used on YouTube recommended that. I'm not sure it really is that much easier. It did make me a bit nervous to do the work of cutting 6 mortises on each leg, before doing the very difficult long tapers. If I messed up the tapers, the work on the mortises would have been wasted. By leaving them round I was risking a little less work. By doing them before the taper cuts I was able to securely clamp a square untapered leg for routing.

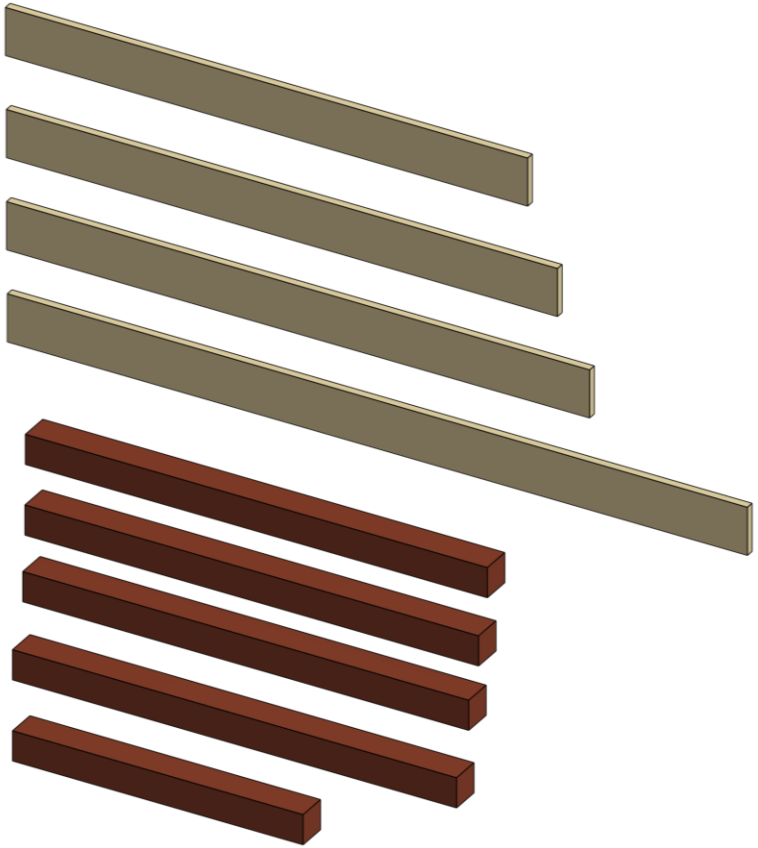


As you can see on this drawing; none of these drawings show that the front faces of the rails are tapered, to match the taper of the legs. They were, though it was subtle enough that I don't think I bothered to model it in the CAD.

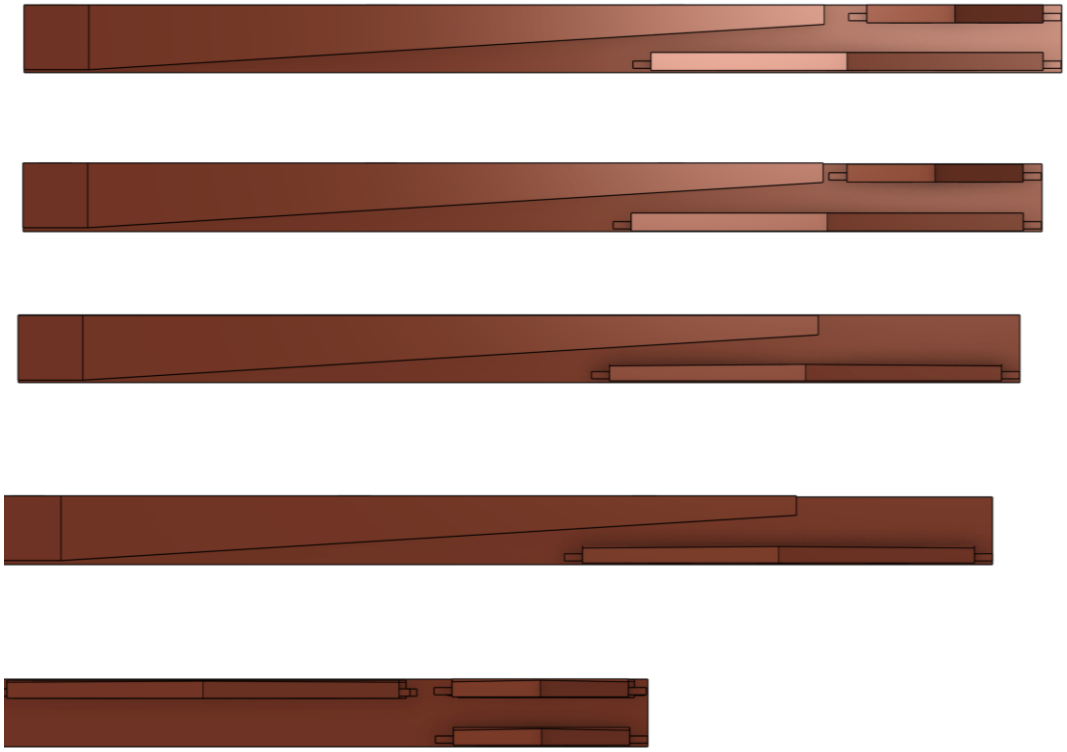
Unfortunately, this is the only photo I have showing a tenon, and you can't really see it very well. The tenons were done before the angled and tapered cuts, so I was working with just rectangular pieces of wood. But I did have to do 24 of them.

I cut them roughly on the table saw, then rounded and adjusted them by hand, with a chisel. This took a long time. Long enough that I thought I'd save some time by not clamping them in a vice.

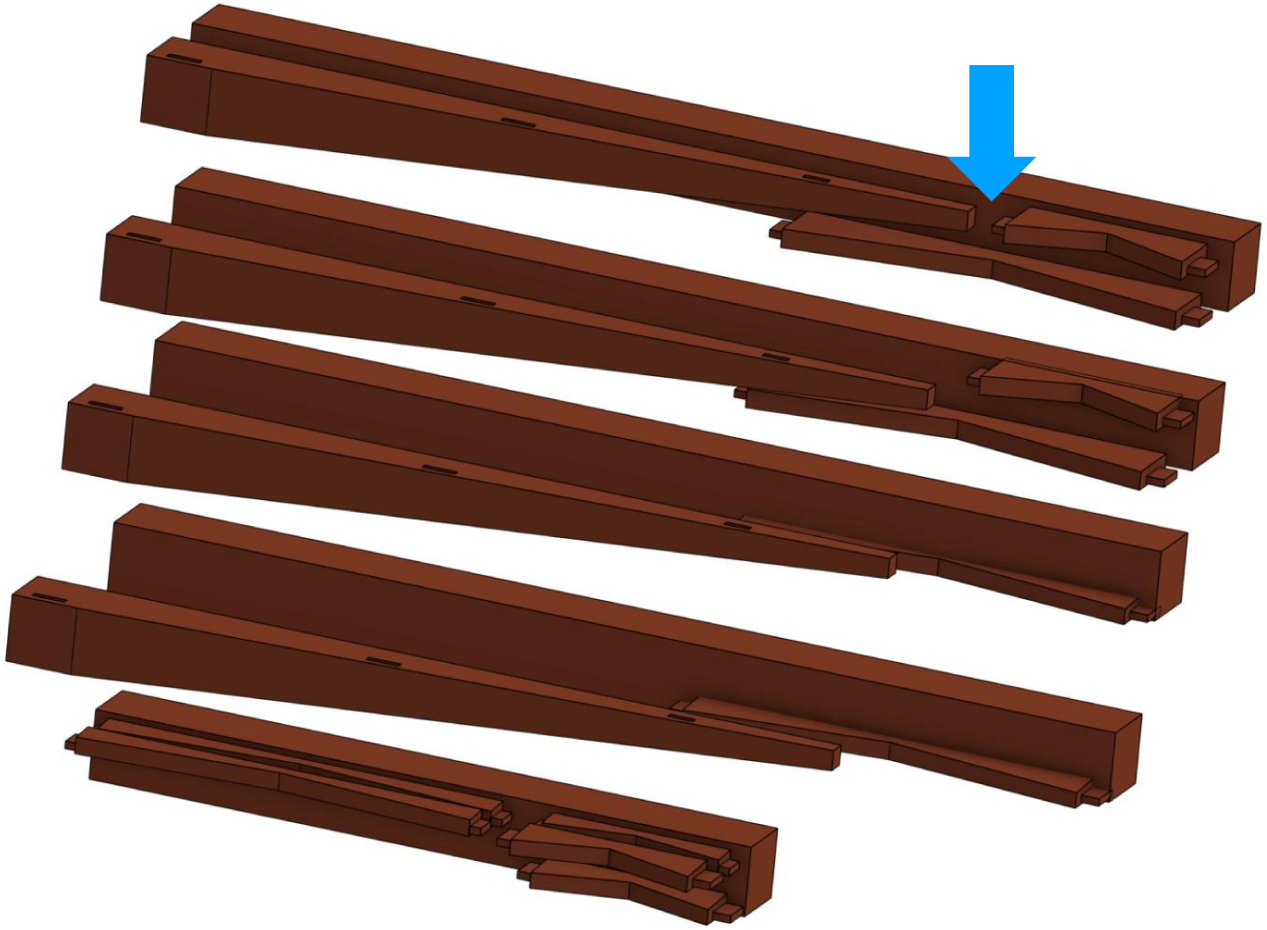
I just held the board with my left hand and worked away with the chisel in my right. Much quicker, and what could possibly go wrong? Well, that has to be THE stupidest thing I've ever done. I even remember thinking, "I really shouldn't be doing it this way. I'm cutting with a sharp chisel aimed straight at my other hand." But I did it anyway, at least until this happened. It wasn't too deep, so I managed to stop the bleeding myself and didn't go to A&E.



OK, so at this point I've got the mortises and tenons done. Next, I'd like to show you one of the other benefits of using a CAD system, at least for me. Here you can see the boards we bought, or really that Rob bought (left).
I modelled them directly into the CAD, with their correct dimensions.

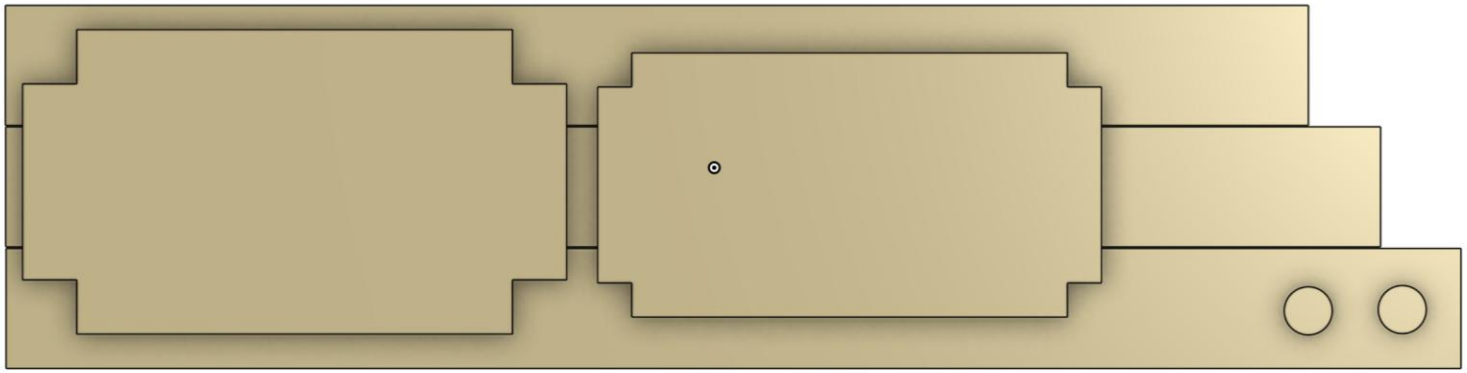


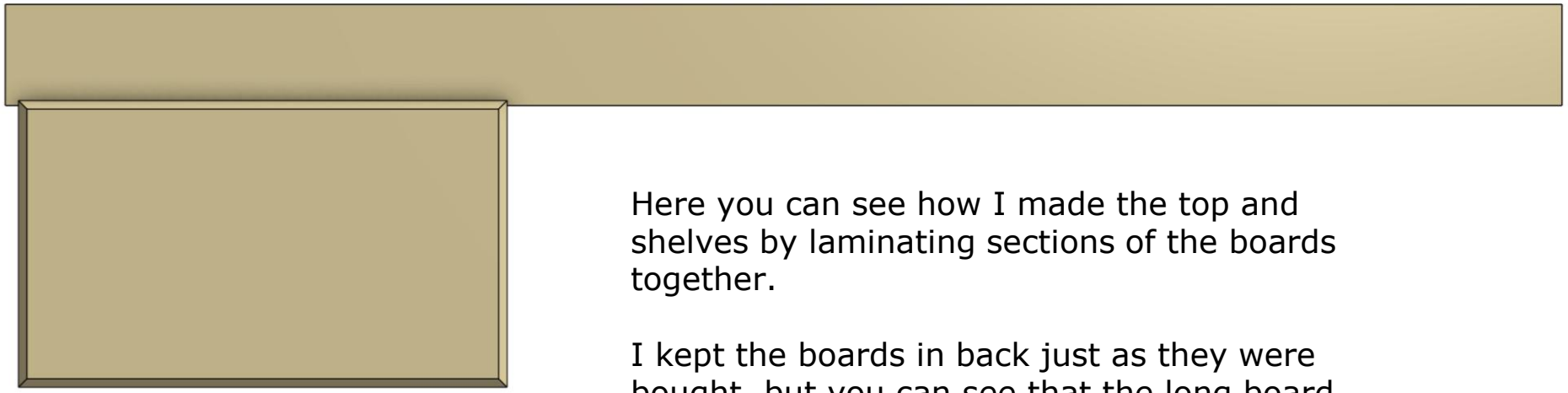
Here, I've put the legs and rails in front of the red boards, (right) again showing exactly where I'd cut out each apiece.



I found this useful to determine where not to cust, such as here, where you don’t want to cut all the way across.

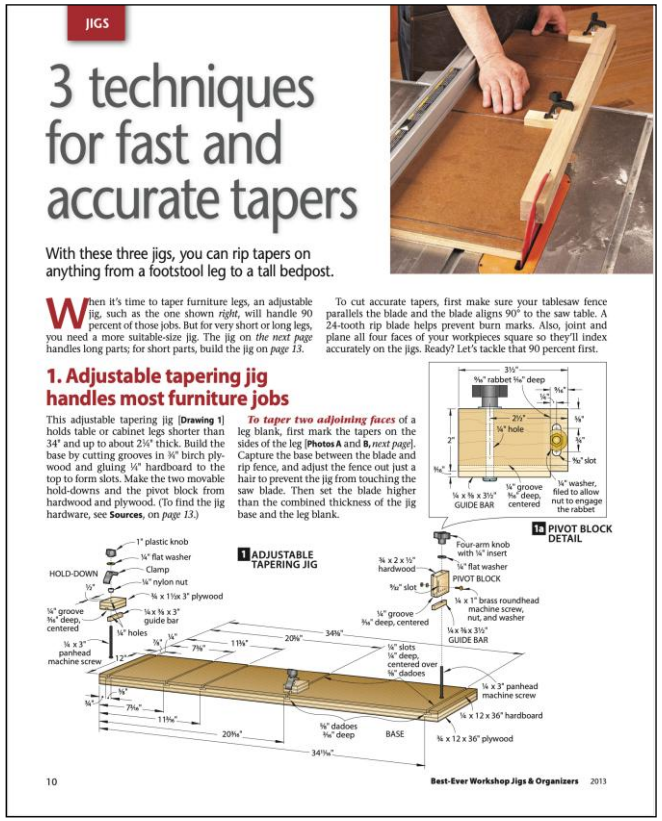
I guess this is usually done by marking on the boards themselves, and I did do that, but doing it in CAD let me move things around until I got it right, then mark the boards only once.





Here you can see how I made the top and shelves by laminating sections of the boards together.

I kept the boards in back just as they were bought, but you can see that the long board clearly has enough length to make the top.



JIGS

3 techniques for fast and accurate tapers

With these three jigs, you can rip tapers on anything from a footstool leg to a tall bedpost.

When it's time to taper furniture legs, an adjustable jig, such as the one shown *right*, will handle 90 percent of those jobs. But for very short or long legs, you need a more suitable-size jig. The jig on *the next page* handles long parts; for short parts, build the jig on *page 13*.

To cut accurate tapers, first make sure your tablesaw fence parallels the blade and the blade aligns 90° to the saw table. A 24-tooth rip blade helps prevent burn marks. Also, joint and plane all four faces of your workpieces square so they'll index accurately on the jigs. Ready? Let's tackle that 90 percent first.

1. Adjustable tapering jig handles most furniture jobs

This adjustable tapering jig [**Drawing 1**] holds table or cabinet legs shorter than 34" and up to about 2¼" thick. Build the base by cutting grooves in ¾" birch plywood and gluing ¼" hardboard to the top to form slots. Make the two movable hold-downs and the pivot block from hardwood and plywood. (To find the jig hardware, see **Sources**, on *page 13*.)

To taper two adjoining faces of a leg blank, first mark the tapers on the sides of the leg [**Photos A** and **B**, *next page*]. Capture the base between the blade and rip fence, and adjust the fence out just a hair to prevent the jig from touching the saw blade. Then set the blade higher than the combined thickness of the jig base and the leg blank.

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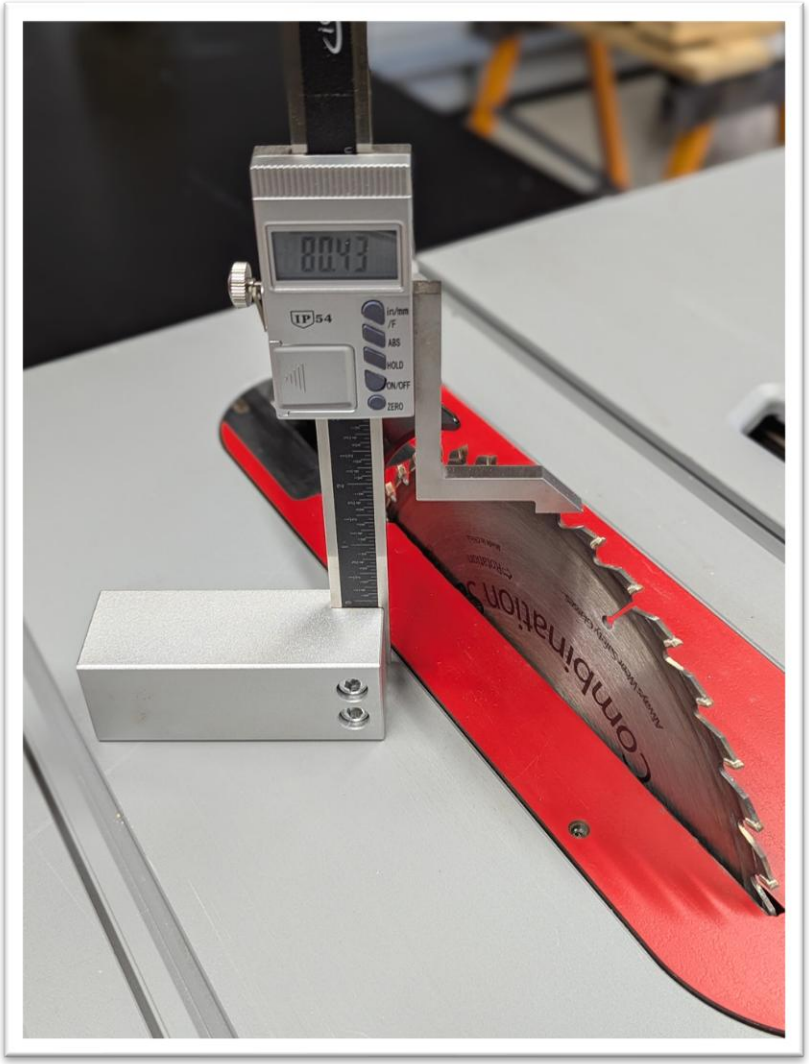
Now let's talk about those tapers.

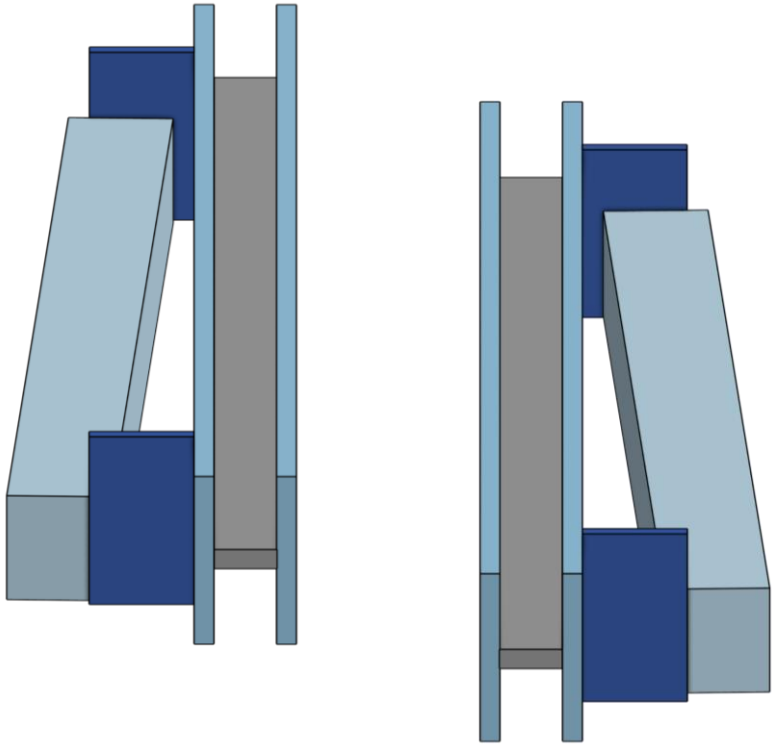
As you all know, cutting a taper isn't rocket science, nor a particularly new thing.

I clearly had to build a jig to hold the boards.

I did have one small problem, however.



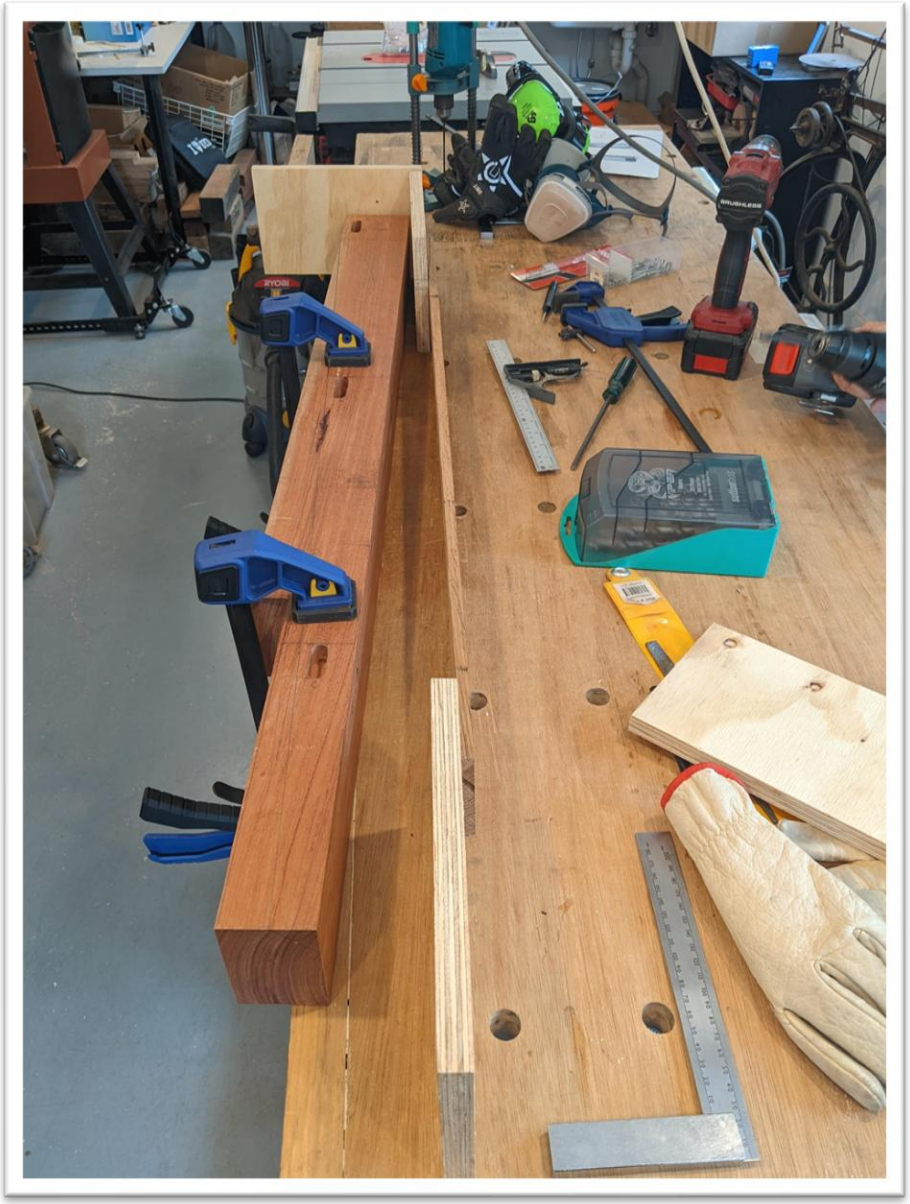
My table saw blade maxes out at a height of a little more than 80 millimetres. The legs of the table were 90 millimetres square.



I really didn’t want to make them thinner, partly because I liked the thick look, but also because I’m just plain stubborn sometimes.

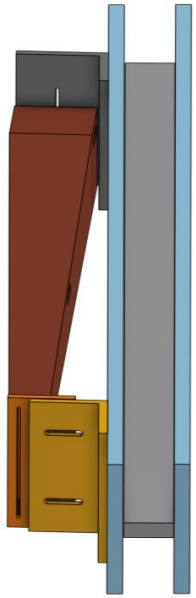
Here is a situation where I could have changed the design to make it easier to build, but I thought I’d try to figure out a way to do it as designed, and only change it if I had to. And I did in fact come up with a way. Here again playing with a CAD system paid off, as I could move these pieces around until I convinced myself that I had something that could work.

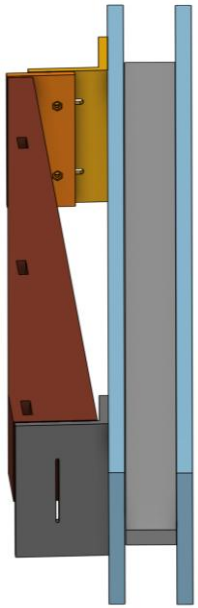
Here again playing with a CAD system paid off, as I could move these pieces around until I convinced myself that I had something that could work. I knew that I was going to have to make a cut, then somehow flip the board and make a similar
cut from the other side, lining up the two cuts as close as possible.
So, the idea I came up with was a jig that could straddle the table-saw fence on both the top and the bottom. I would make the first cut with the fence to the right of the blade, as you can see on the left side, then move the fence to the exact same distance from the blade on the other side, flip the jig and board over, somehow lower the piece exactly vertically, then make the cut on the other side.



Here’s a mockup we did to just check a few things out.

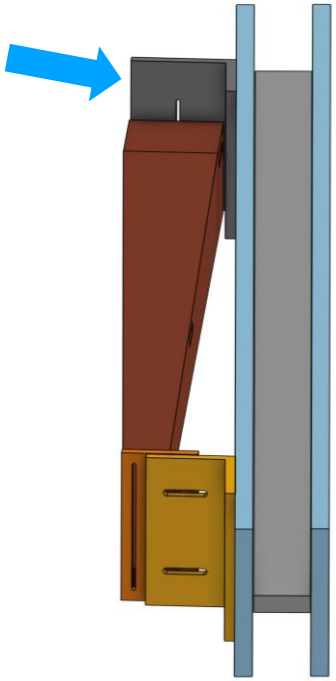
This could work, but moving the fence to the exact same distance on the other side, four times
for the four legs, didn’t seem like the best plan.
Then the solution dawned on me. Instead of moving the fence and flipping the jig and board horizontally, I could just flip the jig and board vertically

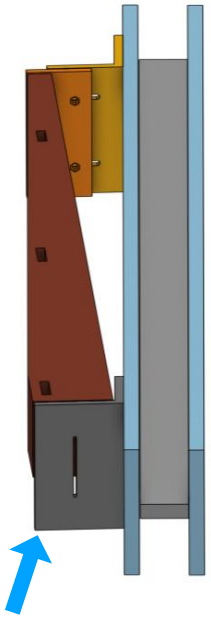


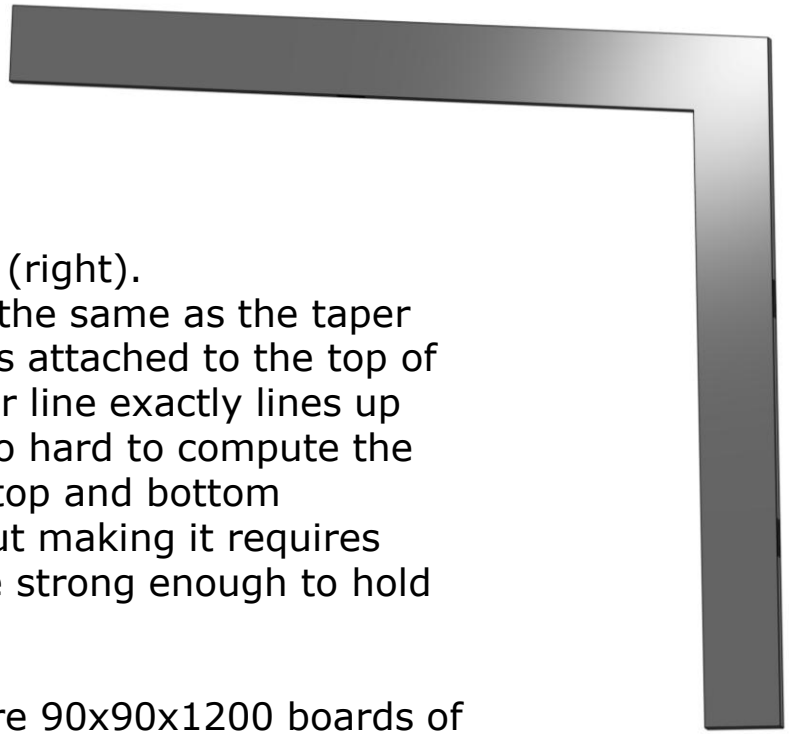


If the fence didn’t move, then the angle would be the same. But you do still have to move the board vertically, so it rests on the table, and that’s what the vertical slots in the clamp parts of the jig are for. But there is another thing the mockup showed us.

Here’s an image (left) of just the top clamp.





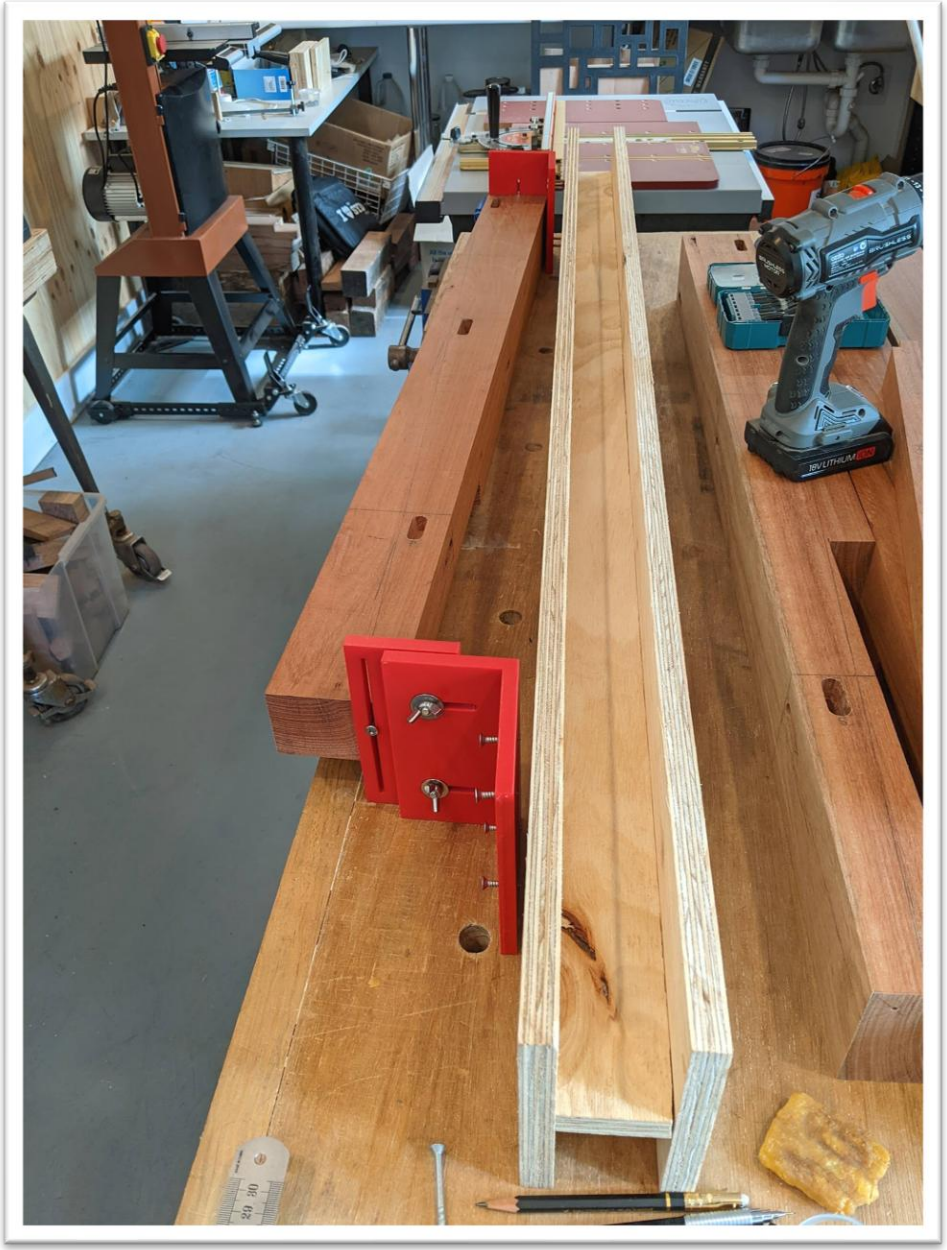


This is a view from above (right).
The angle here has to be the same as the taper angle, so that the clamp is attached to the top of the leg such that the taper line exactly lines up with the blade. It's not too hard to compute the angle you need from the top and bottom dimensions of the legs, but making it requires precision, and it has to be strong enough to hold the board securely.

Remember that these were 90x90x1200 boards of solid hardwood. They were pretty heavy.

That's why I put it all in CAD in this much detail.

To me it was clear that this called for 3D printing.



The clamps were 3D printed to make them as strong as possible. The bottom clamp also had horizontal adjusters so that the point where we screwed into the leg didn’t matter too much horizontally.

Using the vertical slots was straightforward, as in all cases the board had to be flat on the table. We just flipped it, loosened the screws, lowered the board till it was flat, then tightened the screws.

As you can imagine, this is a place where collaboration really came in handy, as the jig and board combination was very heavy, and had to be pushed across an unguarded table saw blade raised to about 50 millimetres.

This was a dangerous set of cuts. Having two pairs of hands to hold and guide things really helped. And we had to do it 16 times. Two cuts per taper, two tapers per leg, four legs.

This worked, but it wasn’t perfect. Nor did I expect it to be. There was still a ridge where the two cuts for a given taper met. I originally thought I’d just plane these down by hand, but they were long enough and big enough that I decided to run the pieces through the planer. Here is a photo of the planer. I have, a Carbatec 13” with a spiral head. It’s my favourite machine. You turners love your lathes. I love my planer. Anyway, the big tapered boards had to be supported so the tapered face was flat to the blades, but that wasn’t too hard.

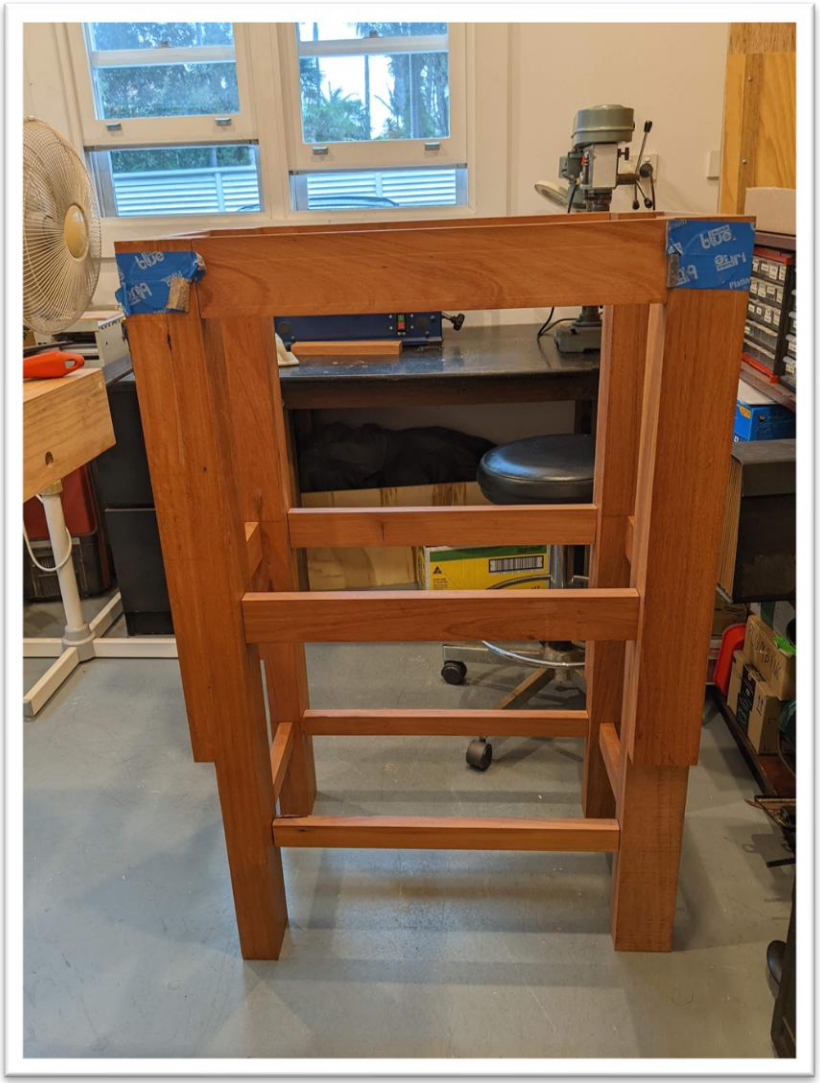
I’d done this before when I was trying to get boards square without a jointer. You just mount them onto a flat board that’s longer, with supports hot-glued underneath to make the top surface flat. Unlike the CNC, the size of the thicknesser bed isn’t an issue.

However, at one point the ridge was big enough that we had to run the board through quite a few times, to the point where we ate up a part of one of the inlaid circles.

The inlay template came to the rescue, and we were able to redo that inlay surprisingly easily.

One of the woodworker YouTubers I watch once said that the difference between a beginner and a master isn't that the master doesn't make mistakes, because everyone makes mistakes and even every project has its mistakes. The difference is that the master knows how to fix their mistakes. I've found this to be true. Every project I've ever done had some mistake which I had to figure out a way to fix. But I always did, and it almost never meant throwing away the workpiece and starting over. Here's an image with the fixed area.

It wasn't so much a mistake as a fairly bad bit of rot that was deep inside the board, so we didn't see it until we'd cut the taper. Rather than just fill it with epoxy, I cut out a rectangle and put in a piece with the grain lined up as best I could. I hoped that once finished it wouldn't be particularly visible, and following what another YouTuber I like says: we put it on the back toward the wall.



I had already done some provisional assemblies like this, before cutting the tapers, just to verify that all the mortise and tenon joints would work together.

In software we test components as we build them, and those are called unit tests. Here that would have been testing each joint as I cut the tenon, testing for the fit into the mortise. But in software you also need to do system tests that ensure that all the components work together, and that’s what I was doing here.

You can only check whether the whole thing will be square and not warped by putting it together and checking. In fact I did have to adjust some of the joints, just to get the whole thing to stand right.

Here is a view, again of a system test, no glue yet, with the tapered legs.

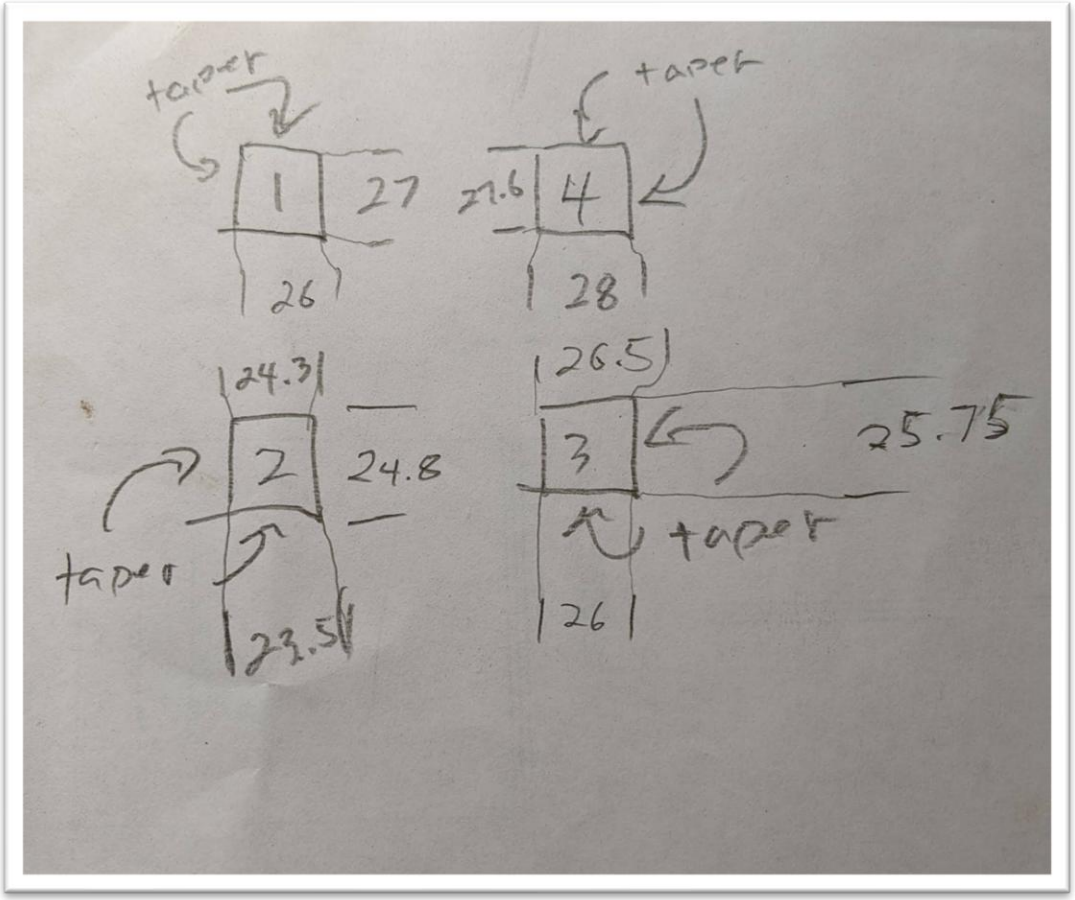
Note that the rails don’t yet have their final shape.

This view now has the rails fully cut and shaped, but there is still no glue.

This showed me where I needed to adjust some of the rails that didn’t line up perfectly with the tapered sides.

I must have put the thing together like this and pulled it apart a dozen times before I was satisfied that I couldn’t get it any better.

Now those feet are pretty narrow. Furthermore, because of all the planing we had to do to get the tapered faces smooth, the legs weren’t actually all the same.



Here is a little drawing I did of the exact dimensions of the bottoms of the legs.

We were going to drill holes in these to put castors on. There wasn't much space for that.

So, Rob once again suggested 3D printing, and it worked well.

He designed, printed, and painted these little boots, using the dimensions I gave him in that diagram. Each one is different and matches one of the feet.

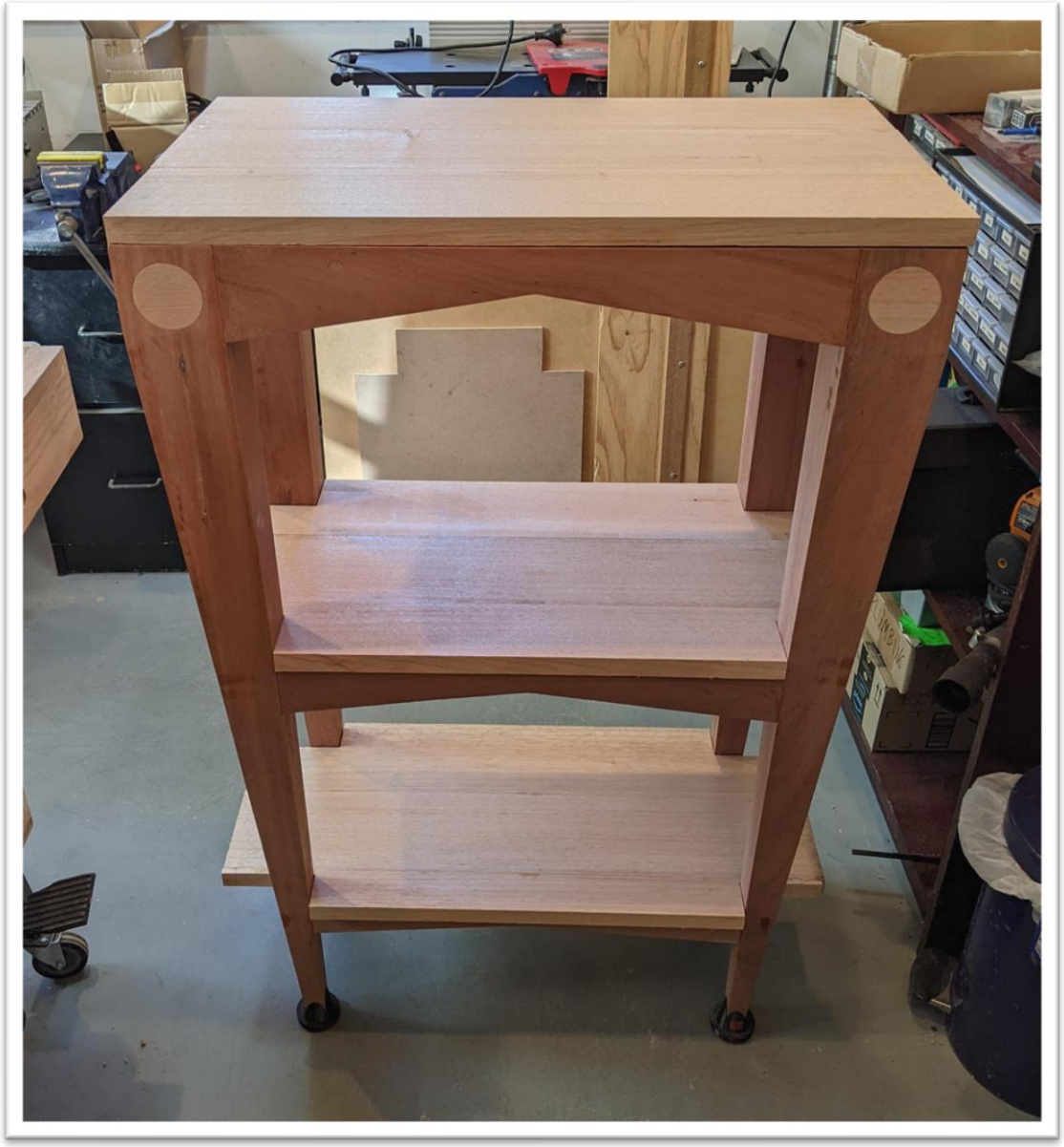
If you look closely, you can see labels on the back ones indicating which leg they were for. This was before they were painted, by the way.

Here everything has been glued, and only the top, shelves and the castors are left.

There isn’t all that much to say about the top and shelves. They were fairly straightforward laminations like you would do for any straightforward.

The top had bevelled edges, which were easy to do on the table saw, and the lower shelves had rectangular notches at the corners that were easy to do on the bandsaw.

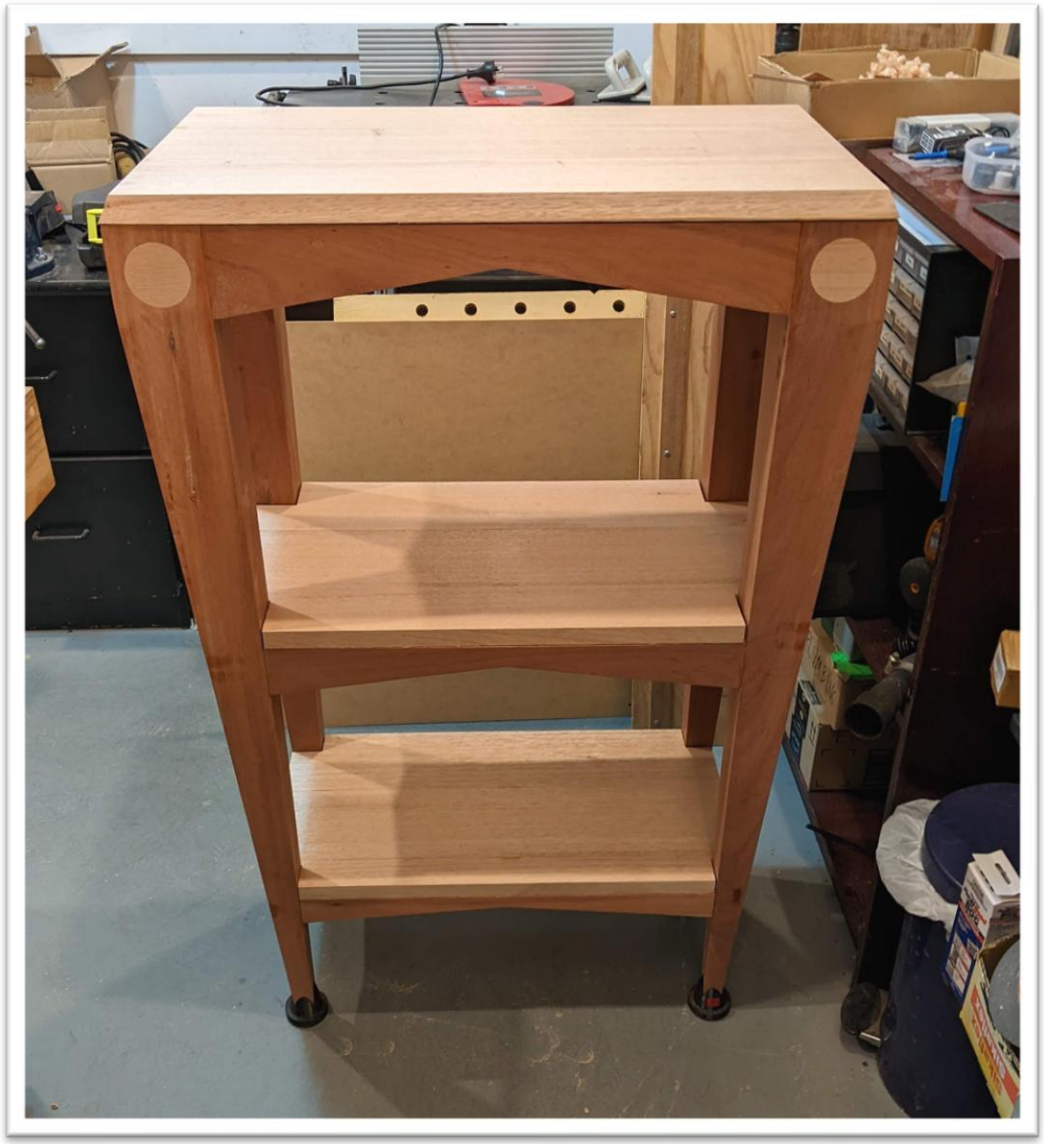
I did make it a point to not rely on the design at this point, but to mark the boards against the actual glued legs. At this point any deviation from perfectly square was just part of the table. It was well within what I considered acceptable, so this wasn’t a problem.



You can see that I did the notches first, then cut off the extra length.

The legs weren't perfectly square, so the shelves weren't either. I marked a line between the actual edges of the legs and cut to that.

This was a bit of a pain because I couldn't just cut them square on the cross-cut sled, but the sled I have has a very nice mitre, so it worked out fine



So this is it!

Or at least it’s fully assembled.

The shelves are cut to fit, and the top is bevelled.

At this point Rob took the whole thing to his workshop, where he did the final sanding and finishing, attached the castors, painted the boots, and mounted the top and shelves with the zed clips.

I played no further part.

Here is a shot of one of the shelves that’s been sanded and finished.

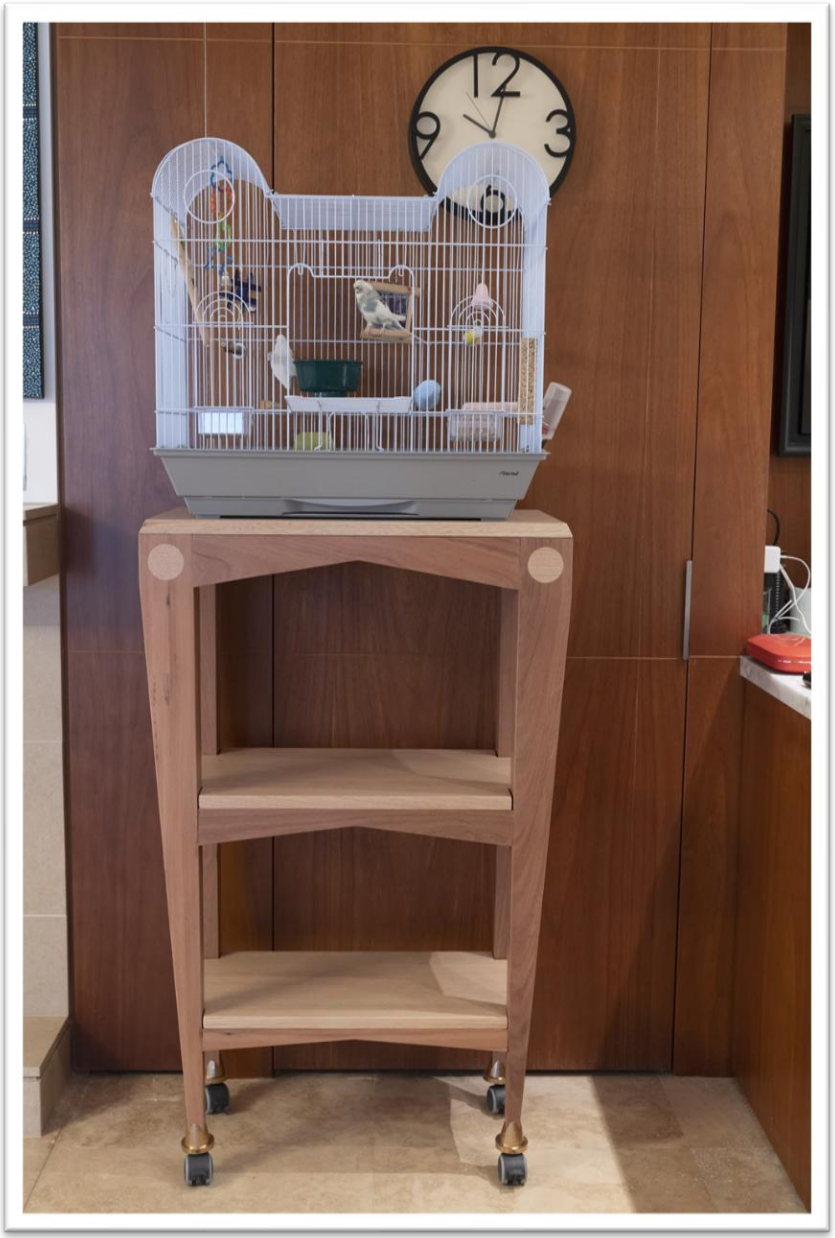
He did a pretty good job.

In the background you can see that he’s working high up in his penthouse apartment, where he has a pretty decent workshop.

Here is the first photo of the fully completed table.

My original intention was that the red be finished to bring out the colour more, much like the panelling behind it, especially the bit on the left, but I didn’t know much about finishing (I still don’t).

Rob did the finishing, it’s his table, and he’s happy.



…and here’s Buddy, happy on her new perch.

This was taken in June 2022, over 8 months after we started.

The door looks open because it is. They let the bird fly around the apartment at times, where she’s learned to use iPads, with her beak.

So, that’s the story of Buddy’s table.

Raul Vera December 14th 2024

Resources

Google Search - I usually start just by looking up a topic on Google. Often this leads to YouTube videos, but sometimes just good text descriptions, like the article on taper jigs I showed.

Stumpy Nubs: https://www.youtube.com/@StumpyNubs\
One of the best. Very clear, very knowledgable.

Matt Estlea: https://www.youtube.com/@MattEstlea
Excellent presenter. Very good at explaining techniques.

Woodworking for Mere Mortals: https://www.youtube.com/@steveramsey
Most down to earth. Often quite funny.

The Wood Whisperer: https://www.youtube.com/@woodwhisperer
Good videos, also author of Hybrid Woodworking, a good book about mixing machine and hand techniques

Jonathan Katz-Moses: https://www.youtube.com/@katzmosestools
Very professional. Good advice about mistakes.