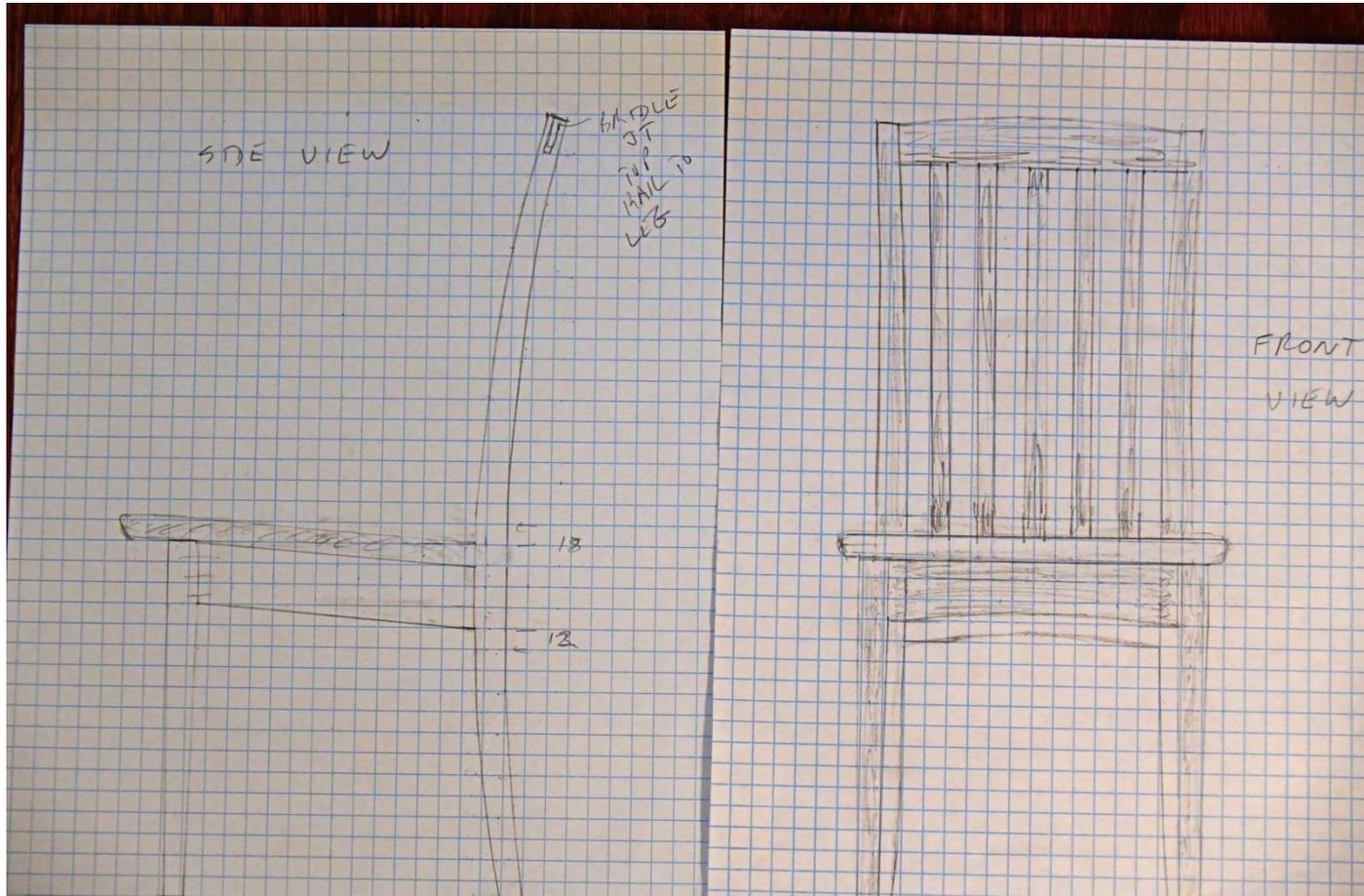
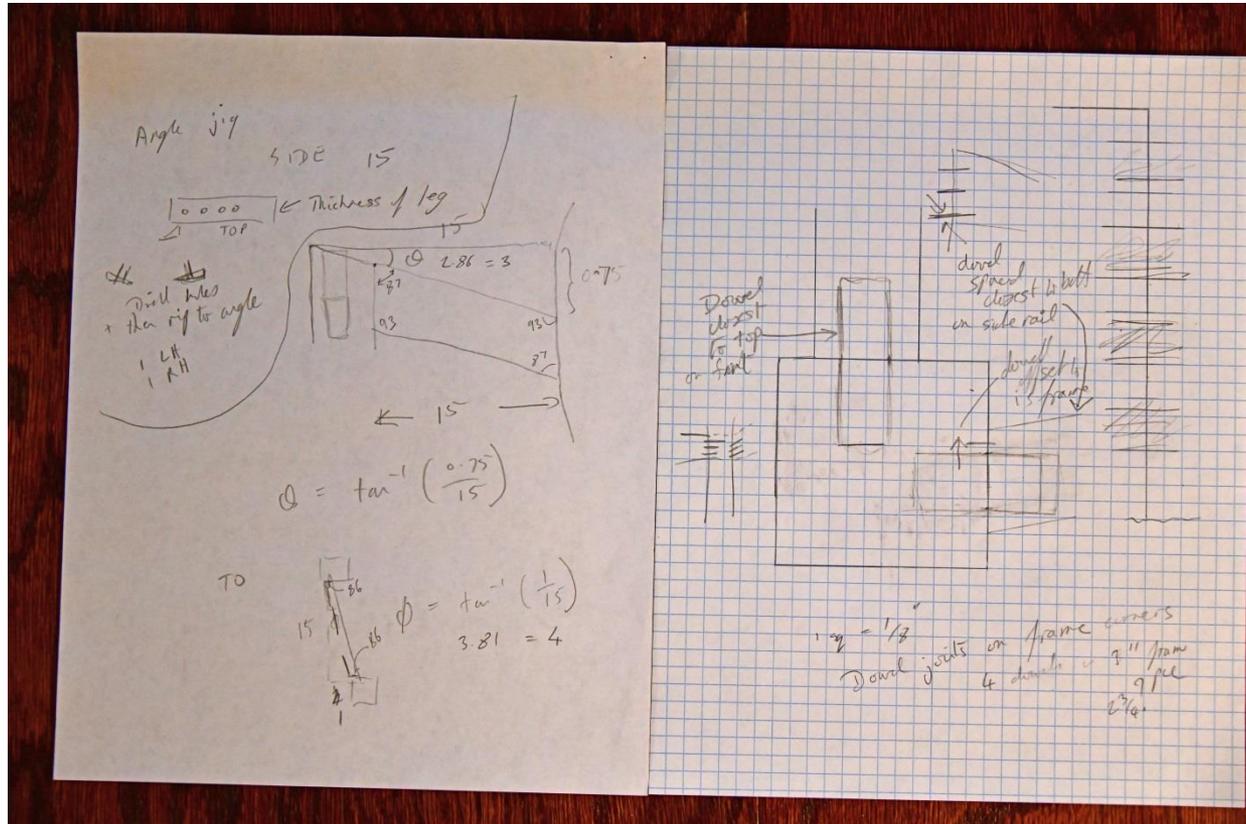


An Adventure in Chairbuilding



As with all my projects, I started with hand drawn scale plans to set basic dimensions and get it to look decently proportioned

Size & Geometry for Initial Joinery



The first construction step involved joinery on the chair legs and rails.

Here are some sketches of how I planned the dowel joints on the legs, and some calculations of angles

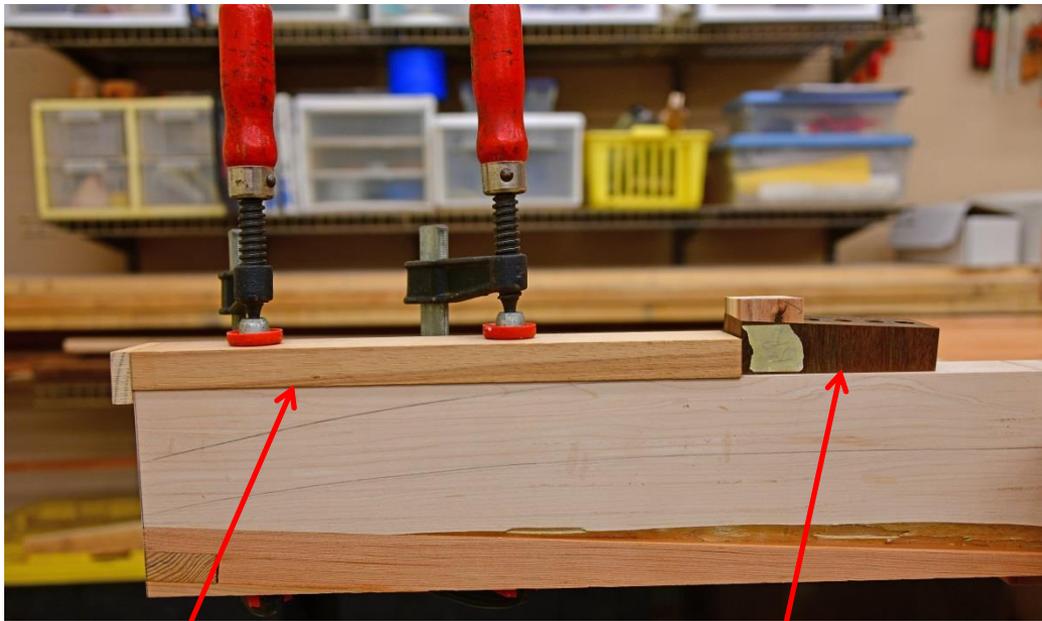
Layout of Back Legs



Tried to align grain to run along the curve of the legs

To make most efficient use of wood, this results in some odd shaped pieces. Need rectangular starting blanks to simplify joinery. Added patches from scrap as needed

Doweling for Back Legs



Spacer sets location of joint on the leg

Jig made from hardwood. Straight holes drilled first in long piece, then jig is cut off at correct compound angle. Jigs are indexed against the spacer and the *inside* of the back leg.



Test Clamp-up to Check Joinery



This picture gives a good view of the patched together back leg blanks.

A major objective at this point was to make sure all the joints pulled together fully under mild clamping pressure.

This was mostly a matter of getting the depth of the dowel holes correct, but some tweaking was needed.

Sizing the Back Rail

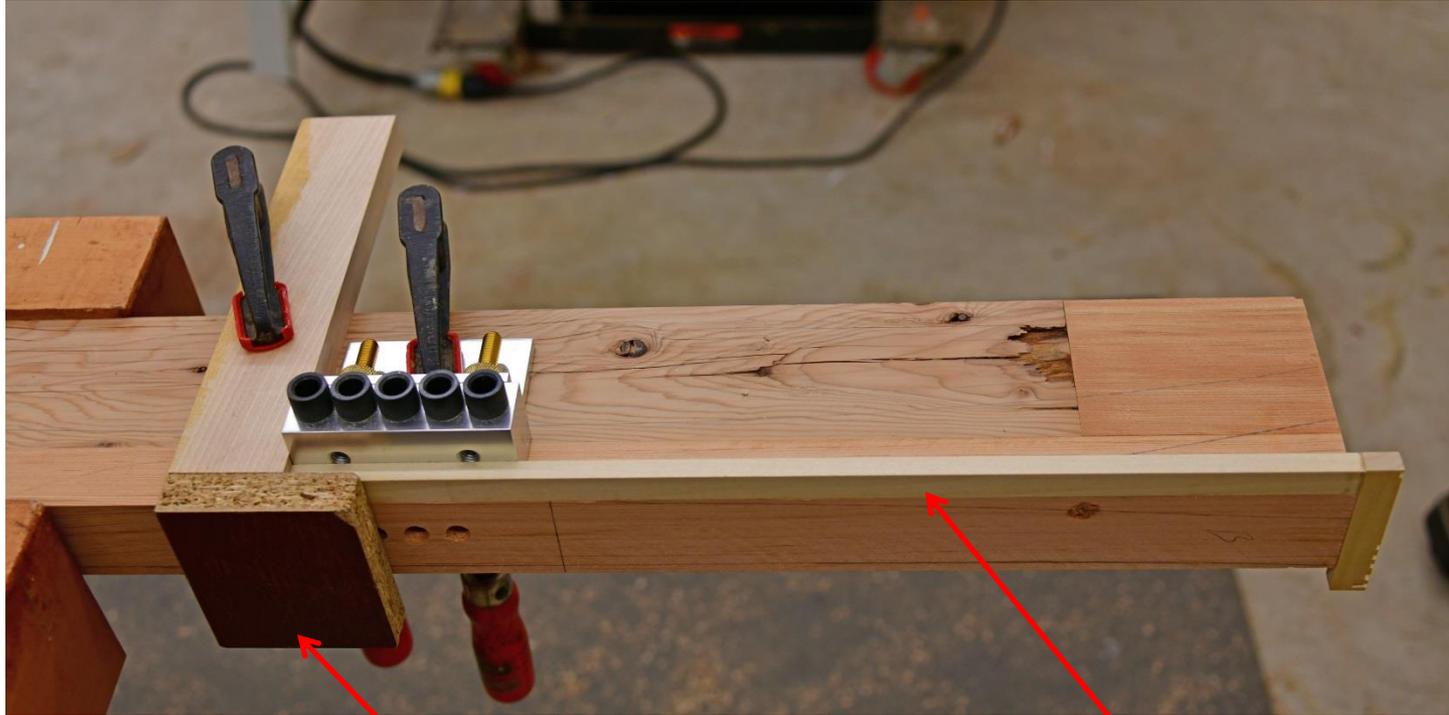


With the chair still clamped up, the exact size of the back rail can be measured.

As always, though, the measurement is just a guide, and the final saw setting is determined by cutting and fitting a test piece made (in this case) from scrap plywood.

Back Rail Joinery

The joinery on the rail itself is just a standard use of the dowelling jig



The joinery on the back leg used two jigs.

One jig provides a square surface against which to reference the dowelling jig

The second jig sets the distance from the bottom of the leg and the offset from the inside of the leg

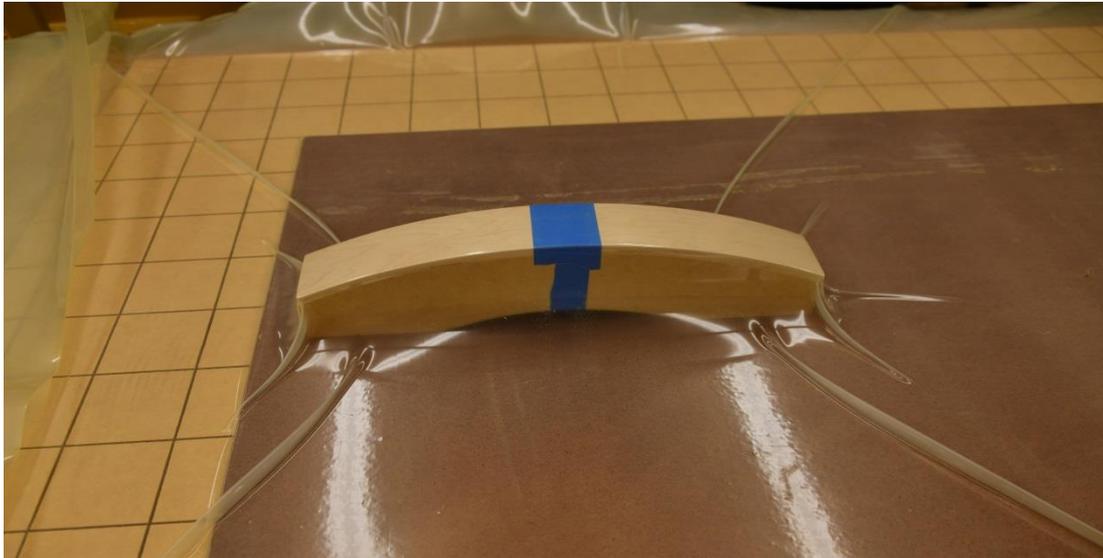
First Test



At this point, I couldn't resist trying it out.

It felt pretty solid, but it was NOT comfortable

Curved Laminations



The top and bottom rails for the chair back are curved laminations

I resawed the pieces to be laminated, and used a drum sander to remove the bandsaw marks

The final laminate thickness I ended up with meant I needed six laminations per piece

The vacuum press was not strong enough to bend all six at once, so each piece was glued up in two stages – 3 laminations at a time

Glue was urea-formaldehyde two part resin to minimize spring back

Joinery for Top Back Rail

First – Cut Reference Surfaces on Top of Back leg



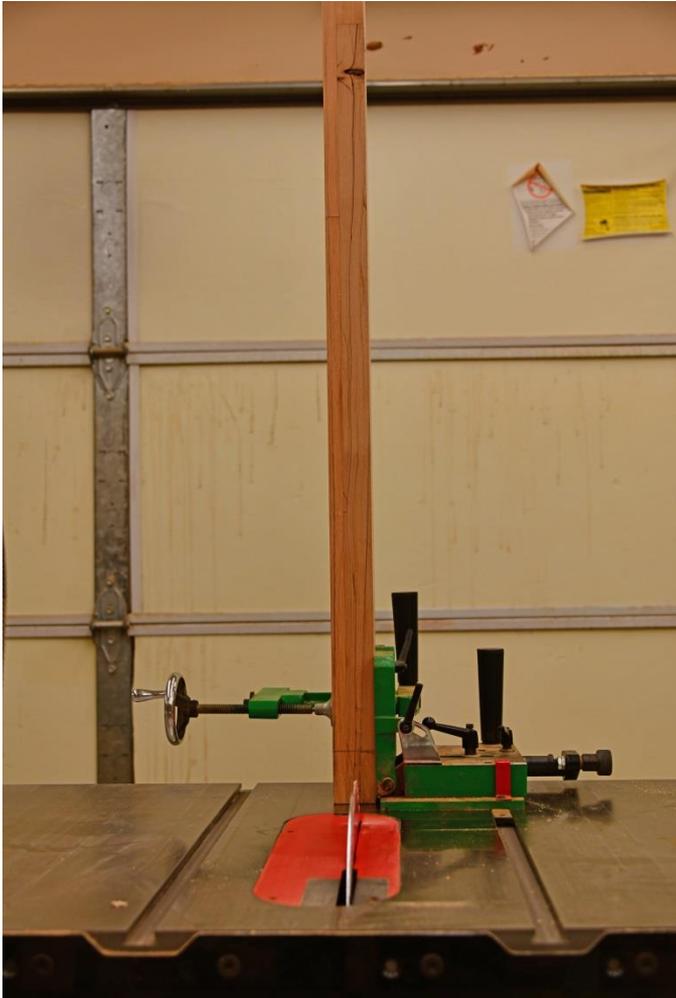
For comfort, the chair back is designed to lean backwards

The first cut sets the angle at which the top rail will lean and provides a reference surface for locating the eventual dowel joints that will attach the rail.

I built a long taper jig for making these cuts on the table saw

It's not important if these cuts end up too long, as they end up in waste that will eventually be cut away.

Joinery for Top Back Rail

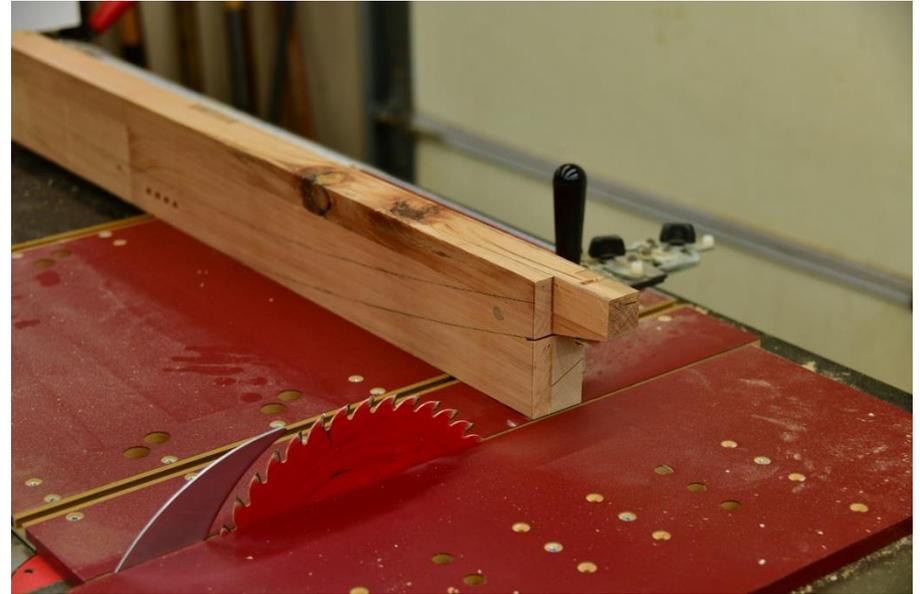
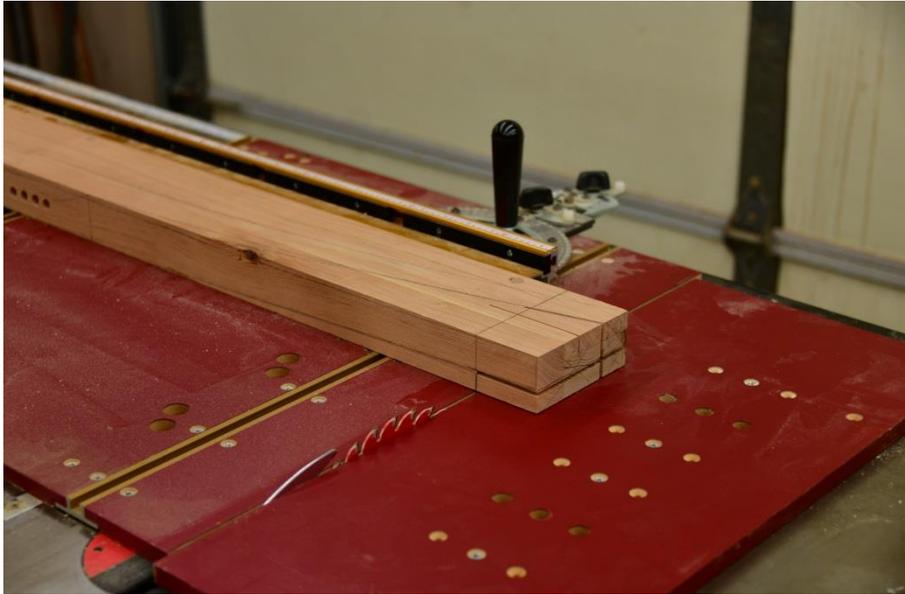


The second cut was made with the leg mounted vertically in a tenoning jig

I almost never use this jig anymore, but it was just the right tool for this job.

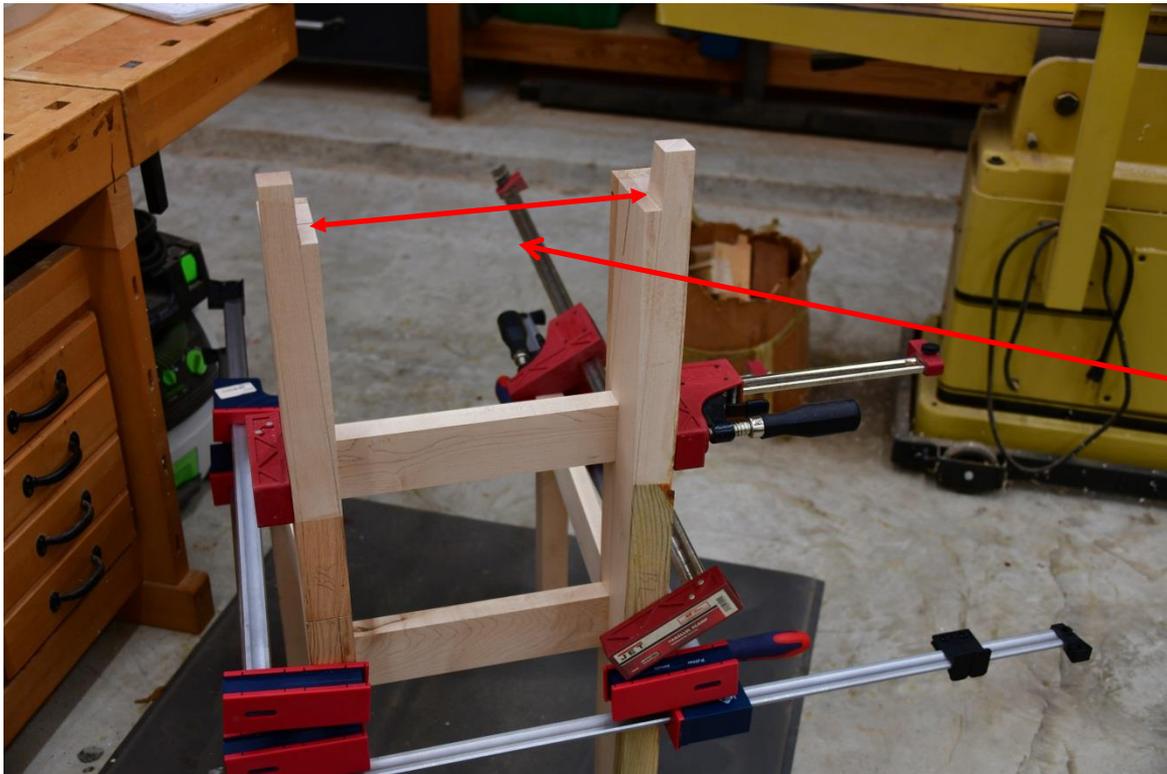
In principle, this cut *does* have to be made to the correct depth, although a mm or so error just locates the rail that much higher or lower on the leg, so not a critical issue.

Joinery for Top Back Rail



Two more cuts complete the creation of the reference surfaces for the next step

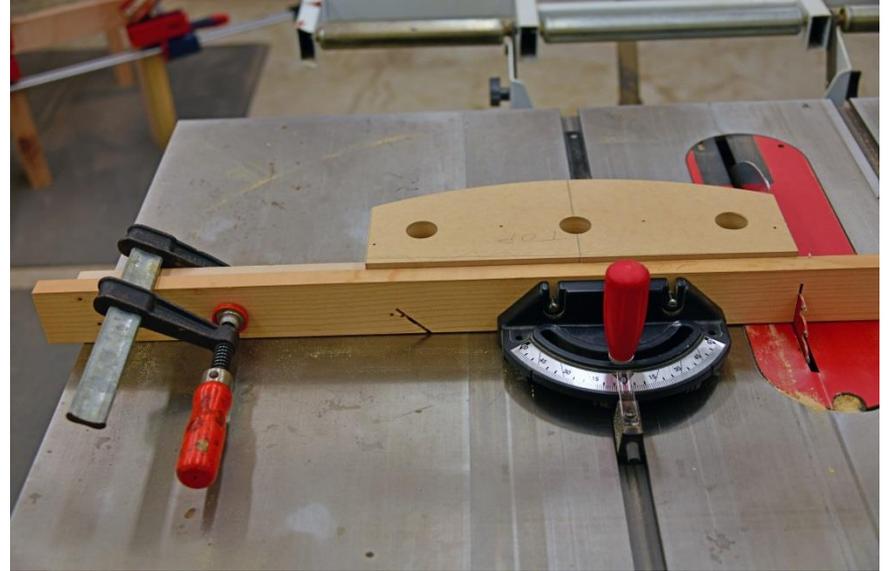
Ready to Fit the Top Back Rail



Here's the chair, clamped back together, with the reference surfaces cut on the back legs

The next step is to fit the top rail in here

Fitting the Top Back Rail



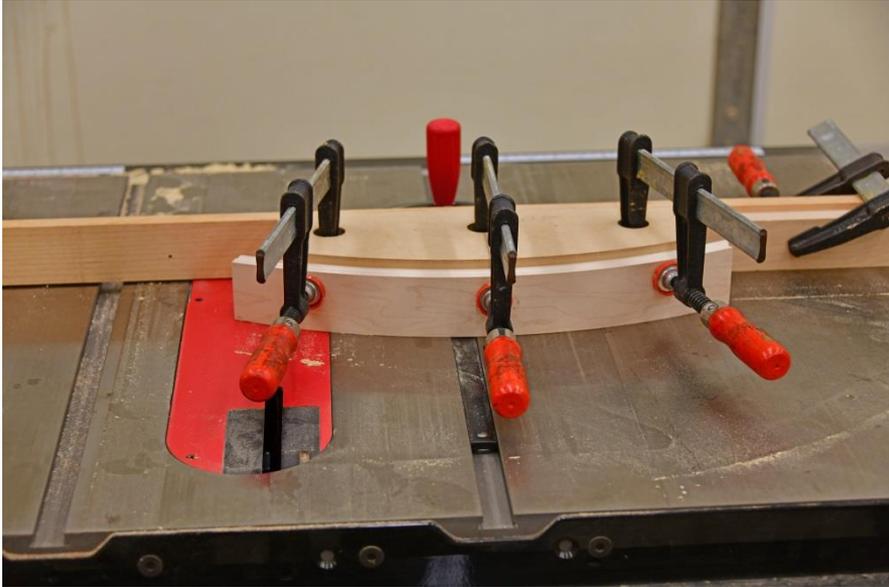
I built another jig to hold the curved rails for cutting to final size and for drilling the dowel holes.

The curve on the jig is the same radius as the curve of the rail, and the jig is sized to fit exactly against the reference surfaces that were cut on the top of the back legs. The holes in the jig allow the rails to be clamped to the jig

An auxiliary fence attached to the miter gauge, and a stop block, are used to size the jig

Once the fit is correct, the stop block is left in position on the fence

Cutting the Top Back Rail to Size



The rail was clamped to the jig, one end of the jig set against the stop block, and the first end trimmed.

To trim the second end, the clamps were repositioned on the other side of the jig so the jig could rest securely on the saw table

The tricky part of this was that the clamps got in the way of the saw blade, so the cuts were made by raising the blade into the work, not pushing the work into the blade

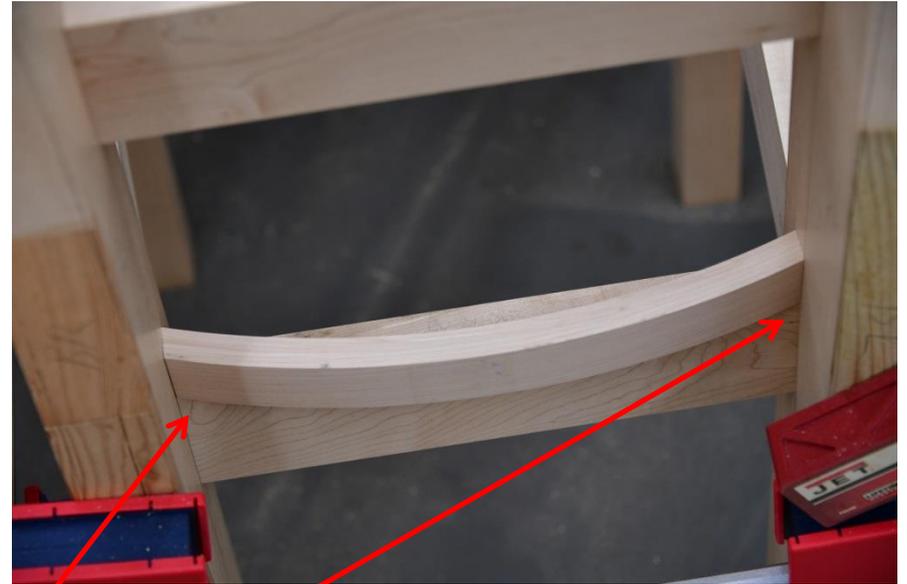
Fitted Top Rail



Looks pretty good.

Note the extra back rail clamped between the legs to help keep them parallel during the fitting

Bottom Back Rail

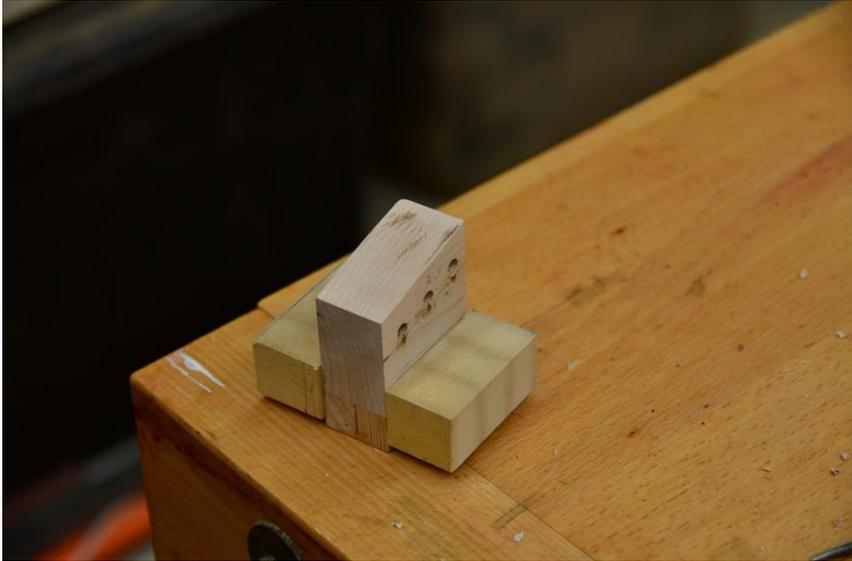


Similar procedure used to size bottom rail

No joinery planned – just glue joints here

I did plan on adding a shaped glue block below the rail to smooth the contours and add strength

Joinery for Top Rail

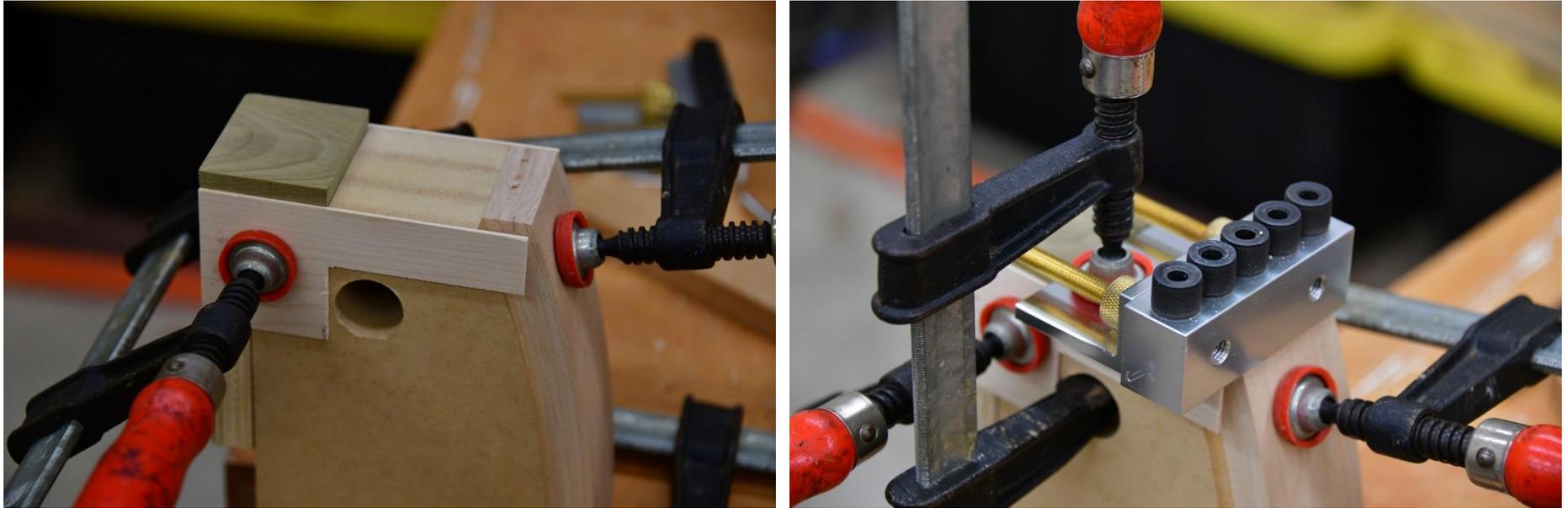


Yet another jig for positioning the holes in the legs

Jig indexes flush to angled reference surface and butts against the step previously cut in the leg

Jig is small, so clamps get in the way. I drilled first hole and inserted dowel to preserve jig position before moving clamps

Joinery for Top Rail 2



To drill the dowel holes in the top rail, I used the regular dowelling jig, with a second jig to position it correctly with respect to the rail.

To hold it in position, and allow secure clamping in the bench vise, the rail was re-attached to the jig used in cutting it to size

Finally – the back legs can be shaped



Here is what it looked like with the back legs shaped and the top and bottom rails of the back fitted in position

Fitting the Back Slats



Back slats have 3 different lengths and most have compound angles at both ends

To keep track of which was which, slats were numbered 1 through 5

A dummy slat was first cut from scrap poplar, angles and length adjusted if necessary, and then the real slats were cut without changing the saw setting.

In this picture, they have been cut, but are just wedged in place

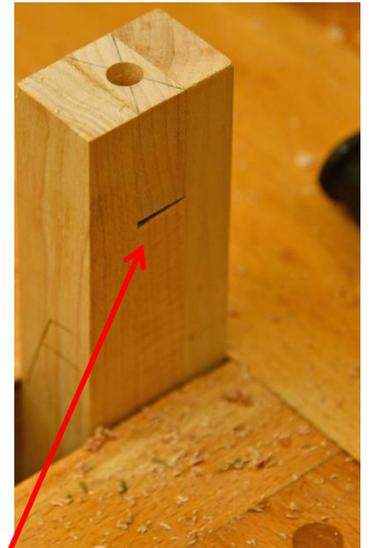
Dowel Joints for Slats



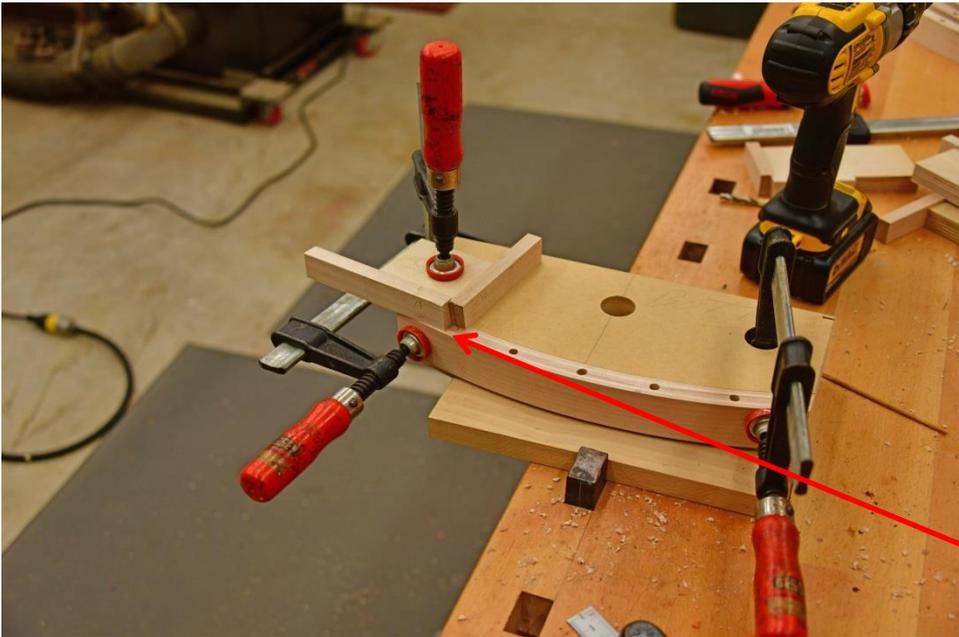
I made a jig for
dowelling the slats
using offcuts from the
slats themselves



Here it is clamped in
the vise with one of
the slats. Note the
angled end of the slat



Dowelling the Back Rails



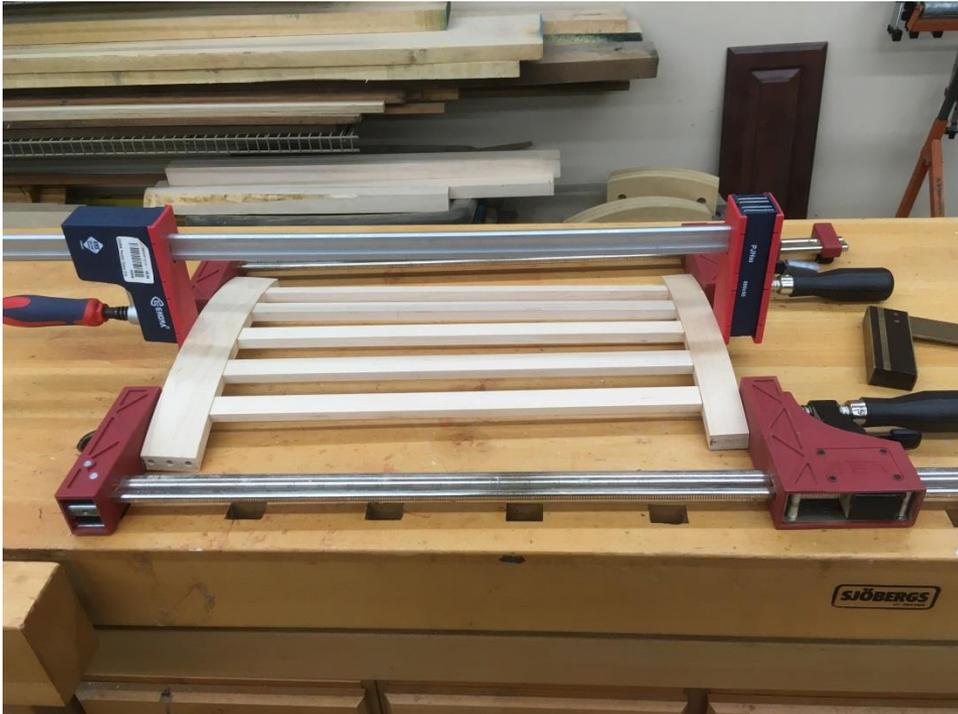
The holes in the slats were drilled along the axis of the slat. This meant that the holes into the rails themselves had to be drilled at the correct compound angle.

I used a hand held drill for this, and made a series of jigs to guide the angles. Each jig consisted of two cutoff slat ends glued to a plywood base. The angles on the ends of the slat pieces guide the angle of the drill

Hand drilling combined with aligning the drill visually to the correct angle made this a bit imprecise. Quite a few holes had to be plugged and re-drilled

Note that the rails are again clamped to their respective curved jigs for this step

Testing the Fit

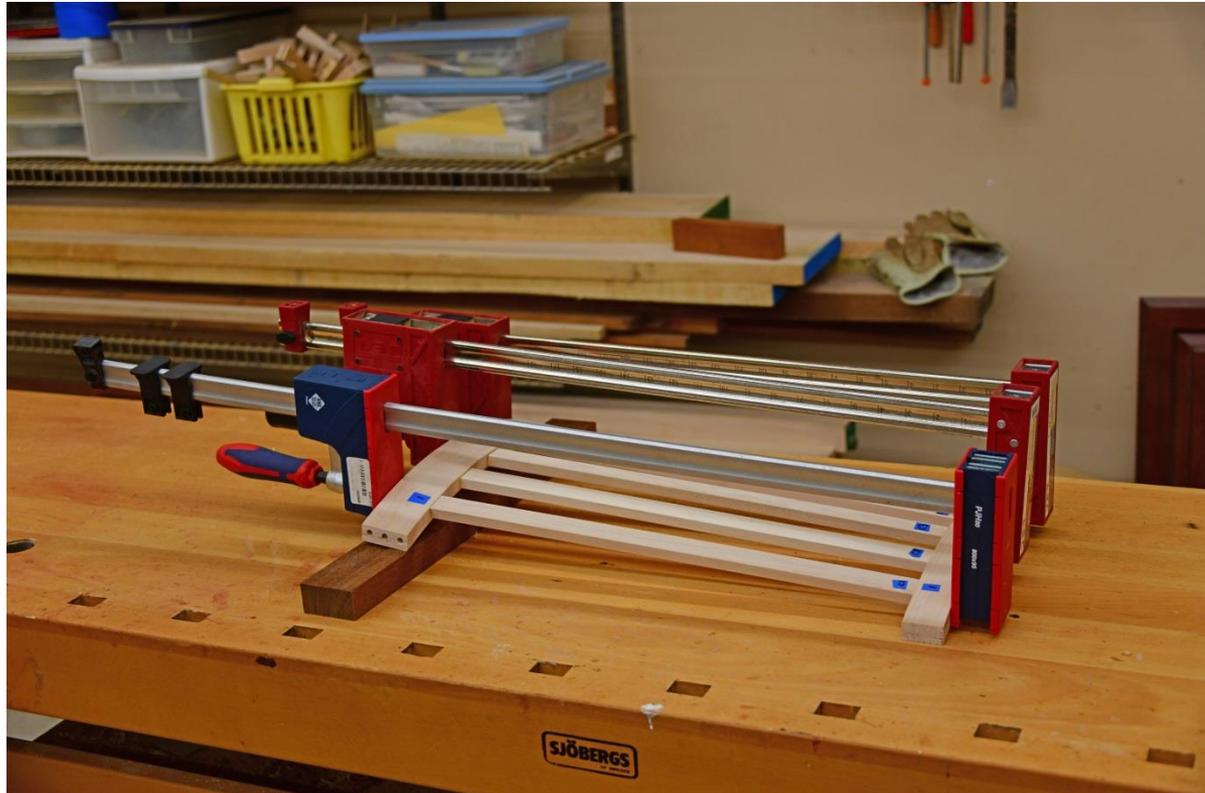


With the dowelling done, the back could be fitted together to test how it looked

The joints didn't all close up correctly, and I had to re-trim some lengths and angles to get everything to look better

That had some consequences which required adjustments at later stages

Finally, Some Glue



At this point, I had been working on this project for 6+ months, and hadn't glued a single piece of the chair together, except for the curved laminations

Glue-up started with the backs. Note the block under the top rail to help hold the correct angle.

It's a Chair!



After glue-up, I finally had some chairs

There is one problem, though – the backs ended up a little bit shorter than the plan

You can see the gap between the chair back and the back rail of the chair. This wasn't supposed to be there

Notice that the front legs have been tapered since the last time you saw them. I can't remember exactly when I did that

Fixing the Gap Problem



I added a curved reinforcement that is glued to the chair back and the back chair rail

I had always planned to add something here to smooth the look. It just turned out to be more structurally significant than in the original plan



The bottom picture shows what it looks like from the inside

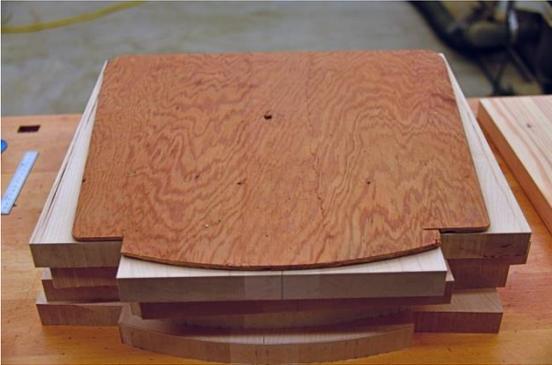
Starting on the Seats



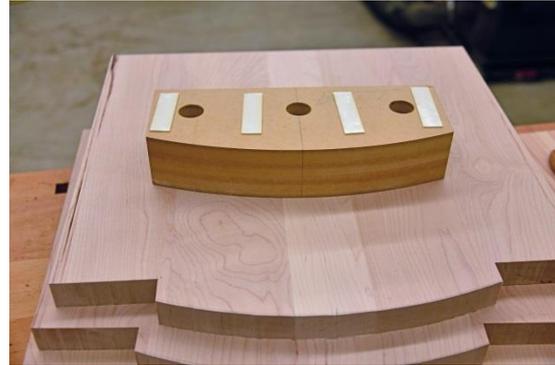
To decide on the final shape of the seats, I made a template from scrap plywood. This also let me practice the sequence of operations

1. Cut a rectangular blank the correct width and depth
2. Notch to fit around the back legs
3. Rout the curve on the back
4. Cut the angled sides
5. Round the corners and edges

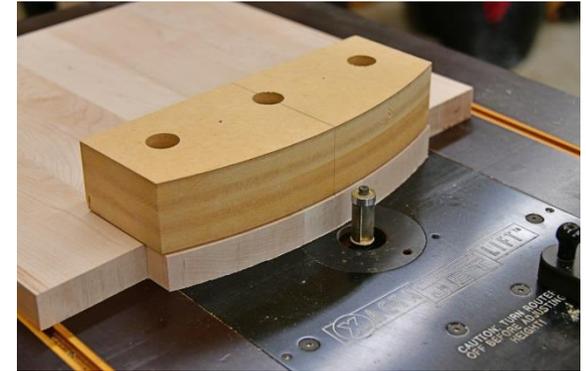
Making the Curved Back



Seat blanks are trimmed to final width, front is cut square and notches are cut. Start on the curved section by marking the position using the plywood template.



Bandsaw the curve close to the line. Take the jig used for trimming the bottom back rail and attach it to the chair seat with double-sided tape



Rout to the final line with a flush trimming bit

Cutting the Angled Sides



Cutting the angled sides to the seats was straightforward using the table saw and Incra miter gauge

Since the seat blank is already at the final front width, both sides can be cut with one setting by just flipping the blank

Contouring the Seat - Practicing

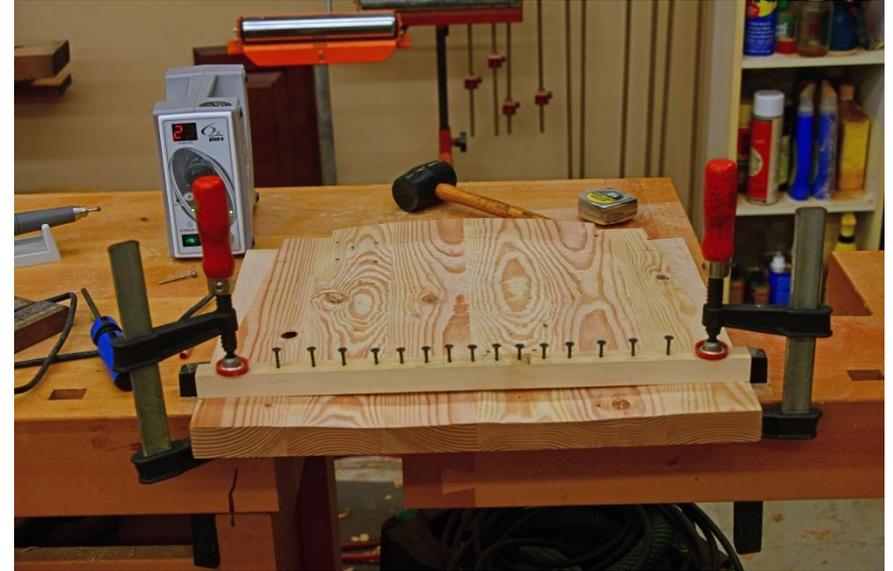


We have a set of breakfast room chairs that sit comfortably, so I used them as a model for carving the seat

I started by using rulers and straightedges to build a matrix of depths to carve to

I then transferred these to a scrap seat blank and carved by hand

Contouring the Seats – Refinement



The first method worked, but seemed a little crude (and slow), so I built a jig that allowed for more accurate transfer of the seat contours

I then refined the contours on the dummy seat blank, checked that it sat comfortably, and used this as the model when carving the real seats

I also switched to a micromotor rotary carving tool – does not produce smooth contours, but is much faster. I tried a variety of approaches to smoothing off the marks left by the rotary carving. I finally settled on the Festool Rotex random orbit sander, which did the job very quickly.

Carving the Real Seats



Drill a matrix of holes to mark the depth contours and rout out most of the waste



Then smooth the contours with a rotary carver and a spherical burr, followed by random orbit sander until carving marks are gone, then final scraping to even out a few bumps

The End



Seats were clamped to the chair to locate attachment screws

The final picture is just to prove I really did make four of these things

Finish is Minwax wipe-on poly. Five coats on the seats, three everywhere else, rubbed out with paste wax and steel wool