

STUDENT PROJECT

Bench stool

Peter Sefton's students share the trials and tribulations of making a workshop stool project full of tapers and compound angles



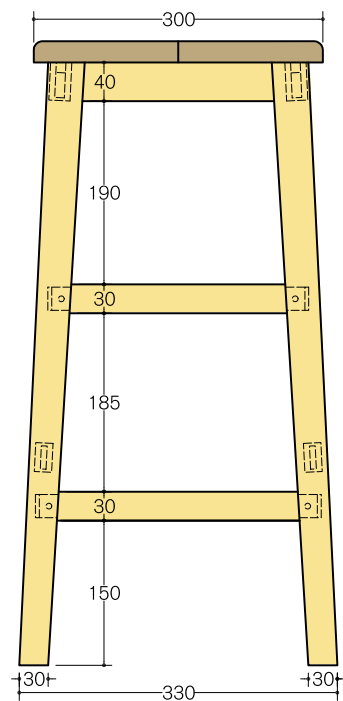
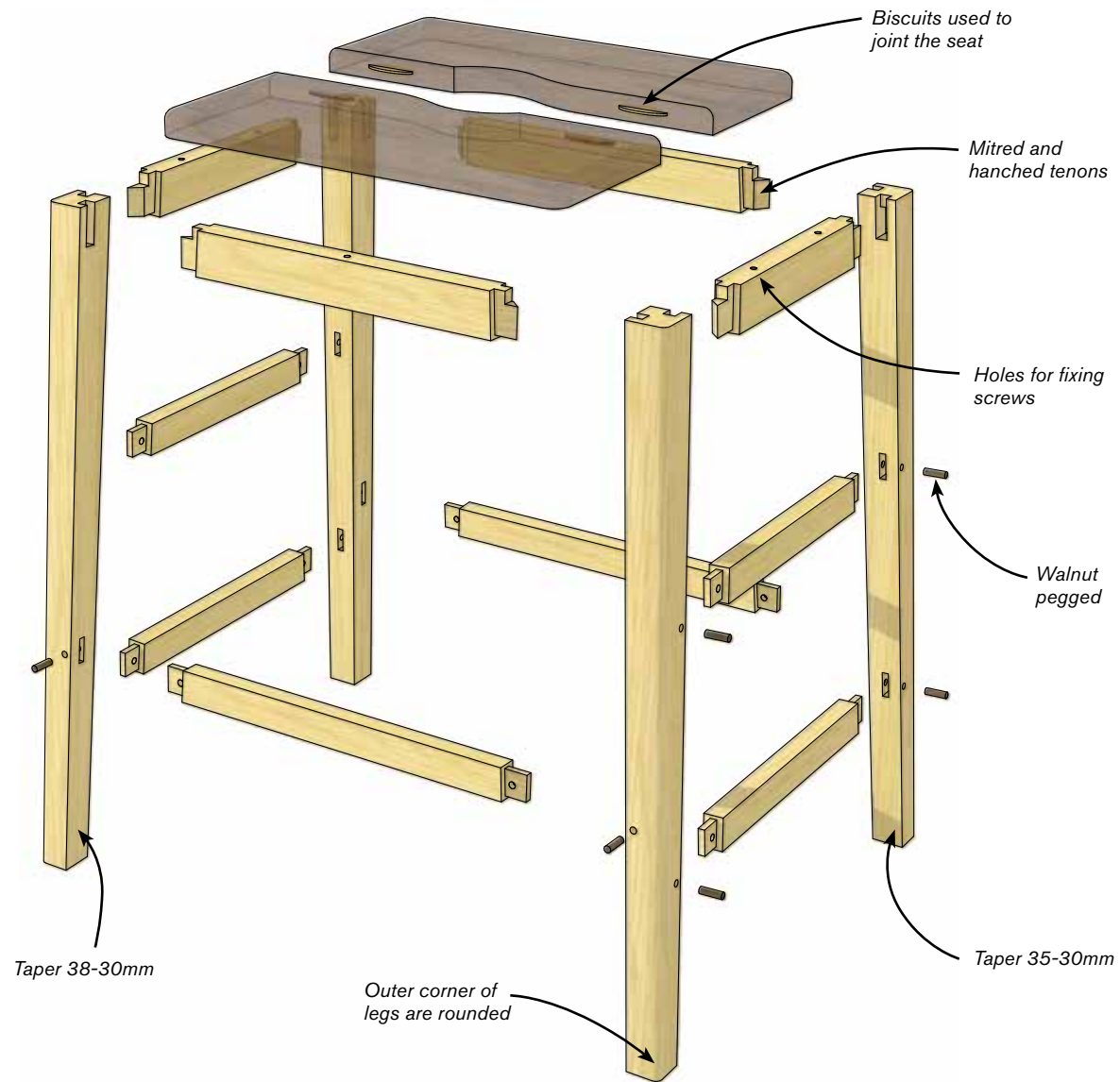
I'm Garry Rowberry, a full time student at Peter Sefton's Furniture School in Worcestershire and this is my account of constructing what at first looks like a simple workshop stool and how I deal with some of the issues and challenges along the way.

The workshop stool project introduces us to compound angles, using full size drawings and we work as a group to make a small production run. We get involved with setting up machines and jigs for repeated tasks, and all the students use the same settings to mill and construct their own workshop stools. The brief gives us latitude in the selection of timber and the final finish.

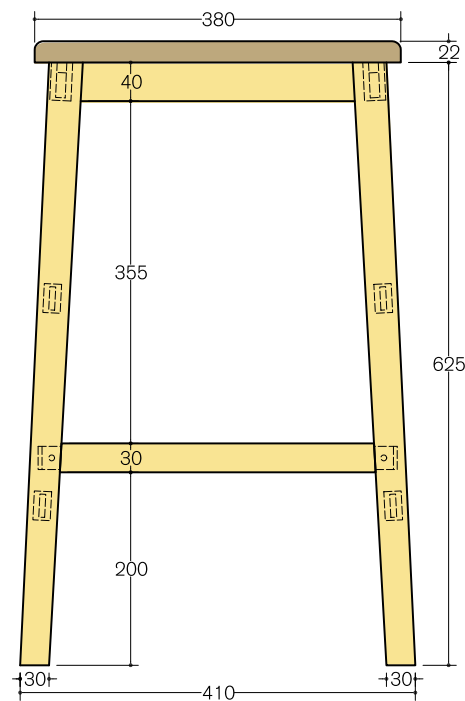


PHOTOGRAPHS BY PETER SEFTON

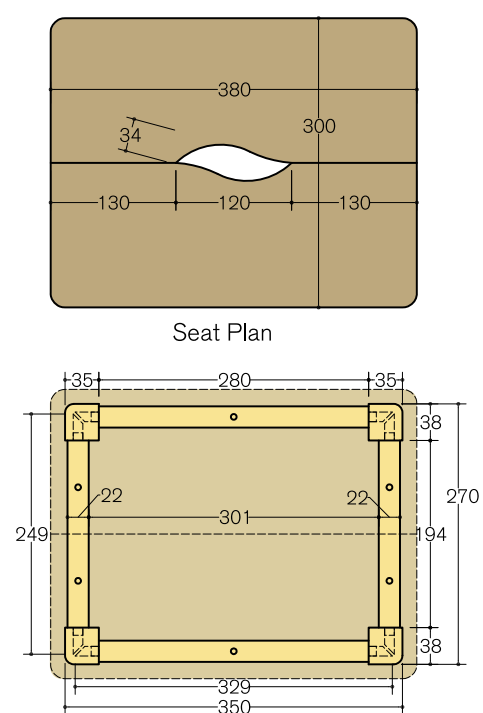
► In detail



Side Elevation



Front Elevation



Plan / Section



Students Paul and Harry selecting previously machined ash (*Fraxinus excelsior*) to match grain and colour



Garry checking the dimensions whilst drawing the rod

Selecting and roughing out timber

We started by working out a rough sawn cutting list so that we could select and mill the timber oversize. We skimmed the surface of the walnut (*Juglans regia*) using the thicknesser to see the extent of the defects to establish the workable timber. We only ended up with three defect-free walnut tops; the other two came from some nice cherry (*Prunus spp.*) from the timber store.

The ash (*Fraxinus excelsior*) legs proved far easier; when milling the timber we worked in pairs either cutting boards over-length, removing splits, knots and end seal paint or squaring up a face side and face edge and ripping the timber 4mm over the final size.

Drawing a rod

The stool had compound angles and tapered legs so it was drawn out full size on a piece of MDF board known as a rod. We then took measurements directly off the rod to confirm angles and shoulder lengths.

Particular attention was made to ensure the MDF boards were perfectly square as the stool was to be drawn and referenced against the bottom and left hand edges. From the technical drawing we knew that the legs angled by 30mm from vertical to form the outside frame of the legs. We also drew the legs tapering from 30mm at the bottom to 35mm at the

top; we did the same on the side elevation paying particular attention to the leg sizes as they differed; tapering from 30mm to 38mm. The rest of the rod drawing was completed including the rails, stretchers, tenons and mortises.

Checking the individual rods for accuracy

The measurements for the cutting list would come from our rods which also held all the constructional notes for each component. When filling in a cutting list, these notes help us remember why we make decisions. For instance the overall finished length of the rail can often be broken down to give us the critical shoulder length and therefore length of tenons.

Milling and tapering the legs

Using a common cutting list we re-face side, edge and thicknessed our solid timber leaving the legs 1mm over thickness as the process of milling a taper would finish the legs in readiness for hand planing. A sled for the thicknesser was used for the tapering face of the leg. The jig was fed through the thicknesser with the leg on a taper raising it by the desired amount.

There was some slippage of the leg in the sled; this was overcome by placing a wedge between the sled wall and the leg, effectively jamming the leg against the sled wall. ►



Pushing the taper jig through the saw with legs secured with toggle clamps



Re-tapping and cleaning the saw fence's threaded locking mechanism

Peter's tips on...

... pre-machining over size

We always pre-machine our timber over size and leave it. This gives the timber time to acclimatise to the workshop conditions and release any inbuilt stresses before final machining to size. The grading of American black walnut 'First and Seconds' (FAS) should provide boards of over 84% 'clear' faces – free of knots but only means one face and edge need to be clear of sap. For free-standing furniture this can be problematic as we require it to be clean on all four sides for consistent colour. It is getting more and more difficult to source clean walnut that is a deep colour.

... when to use a rod

At the Furniture School we tend to use a full sized drawing – also known as a rod – when we know we are going to have a project which involves a lot of curves or angles, as taking these from a scaled drawing doesn't give you enough accurate information. I know from experience with this project that although all the students will try to work accurately, the rods will throw up various anomalies for the students to overcome.

... three ways to machine tapers

We use three main ways of machining tapers at the school, all with pros and cons:

1. Using a taper jig on the bandsaw is safe for newcomers and large timbers can be produced; the down side is that they require a fair amount of hand planing afterwards to clean away the bandsaw marks
2. Tapers on the tablesaw are quick to cut and may require very little hand planing afterwards. However, care has to be taken to ensure that the off-cut wedge does not get trapped between the saw blade and the table mouthpiece
3. The thickness planer gives the cleanest finish when a full length taper is required but unlike the other two methods this may require several passes through the machine. Very wide boards can be tapered – as wide as your planer – but you may suffer from heal and snipe or imprinting from the infeed roller if the taper is not produced over the full length of the piece.

Peter's tip for...

... why we cut the legs to finished length

Traditionally legs would be left over length and then cut off by hand and planed down to the apron rails. We do the complete opposite ... why? We use the table or chop saw to cut the legs to finished length and angle as it is so accurate and clean cutting; it is much easier to leave the apron rails over wide and plane them down to the legs, saving all that end grain breakout.

... chopping your mortises first

We always mark and cut our mortises first and then make the tenon to fit; this is because the mortise chisels come in set sizes and should produce repeatable thickness mortises. The tenons are then cut to fit. For this project all the mortises are marked and cut referencing from the outside of the leg, as again the internal tapers would throw the mortises out of square.

... why cut these tenons on the spindle moulder?

We have previously cut tenons by hand, on the bandsaw and using the tablesaw with appropriate guarding, but for this project the spindle moulder was used as although the set up time is longer, once set up it was easy to cut all of the angled shoulders on this machine to keep the shoulders in line and constant.

... making wedges for the spindle moulder

We needed to make two wedges to produce the shoulder angles of 2.75 and 3.2° to match the different internal leg angles. So to make the wedges we lay timber on the rod to mark the angles, bandsawed them and finished them with a hand plane.

If you are interested in enrolling on one of Peter's courses then further details can be found by visiting the website: www.peterseftonfurniture.com. The Peter Sefton Furniture School offers a range of furniture making and woodworking courses, suitable for all ages and abilities at its purpose built workshops in Worcestershire



A taper jig on the thicknesser gives a clean finish but requires several passes to reach the finished size



Cutting legs to length on the tablesaw with compound angles

▶ **Cutting the legs to length**

The legs had been machined over length so we could cut off any heel and snipe that the thicknesser may have left. But we needed to know the angle of cut for the legs referencing from the outside faces, as the internal faces had different angles, because the tapers varied.

After much head scratching and various combinations of wedge positions, we arrived at a suitable cut using a 2.75° wedge fitted against the cross cut fence and the saw blade tilted over by 2.75°. Keeping the longest corner against the bed of the saw and the fence we were able to cut legs to length at 628mm.

It's not easy keeping track of pieces with all these compound angles and tapers, a slight lapse in concentration and you make mistakes. On trimming a test leg piece to length it became apparent that the angled cut was not parallel to the previous cuts. We had to reset the angles by re-jigging the tablesaw's cross cut fence to 2.75° in the opposite direction and adding a 2.75° wedge under the leg.

Marking out mortises

Next to make sure all the mortises are cut in the correct internal leg faces, the legs were bundled together in the correct orientation, with the previously marked outer edges facing outwards. Also a square was marked on the end of the legs encompassing the inner

faces and – for belt and braces! – each joining face was marked 1:1, 2:2, 3:3 and 4:4. Marking out the exact upper and lower extents of the mortise holes was not all that straightforward; it was back to the rod to work out the positions before transferring these markings onto the legs.

Setting up the mortise gauge was easy enough and we marked the gauge lines parallel to the outside face of each leg. Finally, the upper and lower extents of the mortise and the haunches were knifed in with a square and scalpel.

Cutting the mortises and tenons

A 0-30mm taper over 625mm was used on the hollow chisel mortiser to lift the leg to the correct angle. With the mortises cut it was time to set up the spindle moulder as a tenoner. We fitted two sets of straight cutters and limiters to a pair of Whitehill tenoning blocks. The blocks had a series of spacers between them to produce a 10mm tenon.

Cutting the angled shoulders on the rails

The first wedge was screwed onto the spindle moulder's square fence on the sliding table and a series of test cuts made slowly raising the cutter heads into position to form a centralised tenon. Then a sacrificial piece of timber the same thickness as the rail,



Final sanding of the handle hole after gluing up



Student Harry using the dust-free Abranet from Mirka

was added to prevent breakout.

Next, a stop block was fixed to ensure the shoulder was the correct – and repeatable – length, remembering to flip the rails end-for-end to ensure the angled shoulders matched. The lower stretcher rails had 6mm tenons as opposed to 10mm on the apron rails so the cutter stack was adjusted to give us the required 6mm tenon.

Bandsawing haunches

With all the stretchers and apron rails cut with tenons it was time to notch out the haunches on the apron rails and the top and bottom 3mm shoulders on the stretchers.

The bandsaw was set up to cut the haunches top and bottom, with a length stop fitted to prevent us cutting into the shoulders. The stop had to be carefully cut and positioned to register on the angled/sloping shoulders. The haunch cut on the top of the apron rails was a combination of two cuts and had to be referenced to the bottom edge of the rails as the top was deliberately oversized to allow for planing in later and couldn't be used as a reference.

The sequence in which the band sawn haunches are cut is important. We need to cut across the grain first and then lengthways, so the waste falls away from the blade and doesn't get trapped between the blade and fence.

Drilling holes to fix the stool seat

With the milling work completed it was back into the hand tool workshop to drill and counterbore the apron rails so that the seat could be screwed in place from underneath. Allowance needed to be made for expansion and contraction of the solid seat top. Unlike metalwork, in woodworking we drill our largest holes first and then drill the smaller hole.

Making the handle hole in the seat top

Peter had a template/jig for this and it was used to draw around prior to bandsawing away the waste, before reinserting the pieces in the jig and running the whole assembly around a template profile router bit in the router table. With this all done, it was back to the bench to hand plane and joint the two boards together with biscuits. The seat tops were then marked for centre and trimmed to size on the tablesaw – taking a cut off each side to ensure the hand hole cut-out was central.

The tops had radiused corners marked out using a two pence piece before bandsawing and shaping with the disc sander. The stool top was then moulded on the router table with a round-over bit. The cutter height was set but we took the profile in a couple of passes to improve the quality of cut. ▶



Mortising with the leg set on the 0-30mm taper



Tenoning on the spindle moulder gives clean and repeatable sloping shoulders



Gluing up the side frame with tapered glue blocks using three cramps to stop the legs twisting



Final glue up after checking for twist and square

Peter's tip for...



... producing a shaped handle hole in the seat

The stool seat has an 'S' shaped handle hole in the top and traditionally this may have been made by bow sawing out the waste and then cleaning up inside with rasps and abrasive paper – difficult to achieve a clean finish into the blind corners. So, we find it gives a much cleaner cut and finish to make it in two halves on a bandsaw and routing jig, then sand the internal faces before gluing the pair together to form the seat.

... making timber dowels for constructional decorative purposes

1. Use straight grained timber
2. Work them quite accurately through the tablesaw or thicknesser
3. Pass them over the router table or use a hand plane to remove the corners before you attempt to knock them through the dowel plate.

... selecting a finish

Two of our favourite hand applied finishes are Blanchon hard wax oil which is a quick drying alternative to Osmo Polyx oil. Being an oil-based finish, this gives depth of colour to the walnut and cherry stool seats. We use Blanchon Original Wood Environment – natural – which is a water-based finish for the ash frames as it keeps them clean and doesn't darken the ash. See the website – www.agwoodcare.co.uk – for further details. The ash leg frame on the centre stool of these three was finished with Chestnut finishing oil which has given the ash a completely different tone.

PROJECTS & TECHNIQUES

Student project – bench stool



Garry flushing down his walnut dowels, pinning the tenons

► Sanding

The seat tops were then sanded before a small pilot hole was drilled on the underside of the top in each corner using the battery drill. The holes were located above each leg position so that they would not show when assembled. Later a screw would be fitted to the holes, raising the top off the bench to aid applying finish. With the router table still set up with a round-over bit, the top edges of the stretcher rails were moulded.

The apron rails were intentionally made to overhang the top of the legs and would need to be flushed in after assembly, 0.5mm was left to hand plane later after gluing up.

The apron rail tenons needed to be mitred so that they didn't interfere with each other on assembly. This was done on the chop saw by lining up the rail shoulders against a scribed line on the chop saw fence. Two lines had to be marked on the fence due to the differing tenon lengths – for the 35mm and 38mm legs.

With all the components machined, it was time for sanding the inside faces – the outer ones could be tackled later after assembly was complete. We tend to use Mirka's Abranet plugged into a vacuum cleaner to keep dust levels to a minimum in the workshop.

Gluing up the side frames

The glue up was done in stages starting with the side frames. Due to the tapered leg frames we needed to use wedges between the frames and sash cramps to stop the cramps from slipping up the slopes. The wedges used on the hollow chisel mortiser were re-used.

Gluing up always seems to throw up a few issues and this time was no exception. A few of the guys in the

heat of the moment forgot a couple of steps. They didn't check their work for racking or twist with the winding sticks, but relied on the joints to bring the work square and true and didn't measure the diagonals either. After the frames were removed from the clamps the following day some of the pieces were in twist.

One student used only two cramps not adding a cramp across the middle of the piece to pull up the middle stretcher rail, and this left a slightly open joint.

The final glue up

Once the side frames had been glued overnight the outside corners of the legs were rounded-over on the router table, before the top apron rails were flushed in with the hand plane. The final machining task was to drill holes in the legs for some walnut or cherry dowels, to lock the tenons.

With both side frames assembled it was time to assemble the front and

back frames and join the two sides together. A quick measure across the diagonals and a spy with the winding sticks is always needed to ensure the frame is nice and square and not in twist.

Flushing in and a final clean up

With the holes drilled, glue was applied to both the dowel holes and the dowels before knocking them home. Once the glue had set they were flushed in with a flush cut saw, planed or pared with a chisel and sanded smooth. Before sanding and applying finish we needed to flush in the last two apron rails and level both the top and bottoms of the frame. Before any finish was applied to our work all pieces were sanded and any blemishes, etc. dealt with before wetting the pieces to raise the grain and show any glue squeeze out. With the surplus glue removed and a final sand it was time for finishing. This is where the group did their own thing and various types of finish were used.

Applying finish

Personally I used hard wax oil for my cherry seat and a water-based finish for the legs. After a couple of coats of each, the work was lightly sanded before a couple more finish coats applied. Then a general waxing applied with '0000' steel wool and a buff completed the finish.

Some of the group used the same hard wax oil but all over the stool, some used finishing oil, whilst others used two-part brush on lacquer.

I enjoyed making the project, it was a twist on the normal individual set pieces we had done and a departure from hand skills; it focused on group working and was more production biased. It was the last of our set projects and now I feel ready to start my own design-led projects for the remainder of the year. *F&C*



Student Sambhi's stool in the centre has finishing oil which has darkened the ash legs