PROJECT

There are many traditional construction techniques to this refined piece

PART 2

With the design brief in his back pocket and the sniff of walnut in his nostrils, **Gary Dingle** sets out to make this glazed display cabinet

This cabinet in English walnut (*Juglans spp*) is a traditionally framed construction and consists of an open leg frame base unit and a top display unit. As the components are fairly small, it's important they all play a role in the strength of the whole structure, including the glass. To help with this the cornice was designed as an enclosed box and made as an integral part of the top unit. Rigidity for the lower leg frame comes from the top rails being morticed and tenoned into the legs, plus the splay of the legs down to the floor and the stretcher rails.

CONSTRUCTION

Building the top display was a challenge. I eventually made the unit up from a series of pre-assembled components; base, front and side, door, back frame and the top/cornice box. I find it much easier to glue-up a series of flat frames than struggle to assemble the whole unit at once. You do, however, have to make sure the individual frames are measured accurately so they have a better chance of fitting together on final assembly.

ACCESS

Access to the display was an important part in the cabinet's construction. A door at the front would change the centre of gravity and could distract the eye from the piece's visual simplicity. A side door seemed a better solution. The doorframe had to be incorporated into the confines of the slender corner/leg posts, using bevelled rebates on the closing stile and square ones on the hinged side.

DILEMMAS

The first of many dilemmas soon appeared – both the outer faces of the legs and stiles were shaped and not in line with each other, although the inside edges of the frames were. I worked outwards from these so that the rail's shoulders would be identical. The stiles and rails were kept square and parallel and would be shaped at a later stage, thereby simplifying positioning of the mortices. The only problem was with the front left corner post, as it had to be square. In the end dummy flat stiles were used for rebating purposes and the post was machined on it's own.

A window on WALNUT

DRAWN ROD

When marking out the mortices, an accurately drawn rod is invaluable. The next problem is ensuring the mortices are the correct depth to prevent them breaking through to the outside faces of the closing stiles of the door and frame when machining the bevelled rebate.

Keep the size and position of the mortices the same through the job. This saves time in marking out, and, more importantly, reduces the chance of getting it wrong.

Marking out is made more complicated by having to allow for the rebate when positioning the mortices so as not to cut into them when routing out the rebate.

LEG FRAME

The rail joints are already cut and now need shaping. I thought of making jigs for the spindle, but the walnut cut so well that I just used the bandsaw and compass plane.

First make an accurate template from the softwood mock-up, place it on one side of the leg and cut 1mm (¾in) away from the line. Next, turn the leg through the 90° mark and cut the other curved face. After careful bandsawing, the legs are ready for shaping.

The compass plane is set up like any normal bench plane, just ensure the honing angle doesn't get wider than 2mm (¾in) and rub against the work.

Blending the curve into the flat of the leg was a slight problem. The flat on the convex side comes straight from the planer, whilst the concaved side is bandsaw cut. Marking with a gauge gave a line to work to, and a smoothing plane finished the job off. A combination of compass and smoothing plane was used to make sure the curve did not go under the line of the flat.

RAIL

Each rail has a shallow curve on its lower edge, mark this, cut on the bandsaw and finish off with the compass plane. With all the stretcher rails planed up to size and left square for machining, the position for the joints can be taken from the rod, and shoulder lengths checked against the top rails.

As all the rails are curved make sure they are in the right place before shaping. I used a router to produce the tenons and dovetail housing on the side rails. A push block and false bed were made for the router table to hold the cross stretcher rails whilst their ends were dovetailed.

To find the length of the shoulder line, dry cramp the whole leg frame together. Fix it in place with strips of MDF pinned on to the ends of the legs, to make sure it's parallel. The shoulder line can then be marked directly from the job.

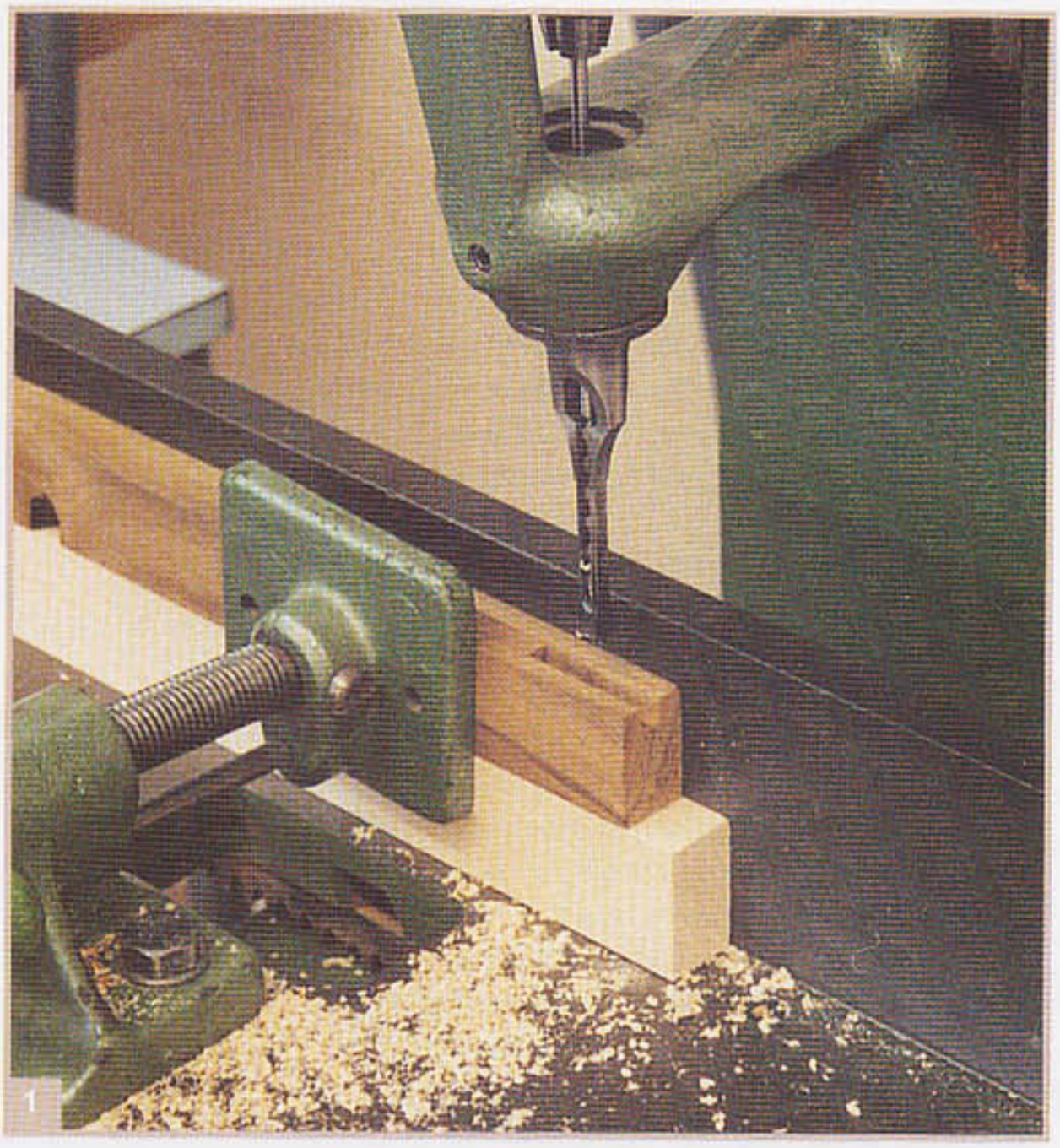
The tricky bit is ensuring the curves are accurately positioned on the stretcher rails to avoid cutting into and exposing any of the joints.

ASSEMBLY

The leg frame is glued-up in two assemblies. First assemble the end frames and then join them together. Make sure the legs are cramped square to the rails – a slight adjustment to the position of the sash cramps soon puts this right, and that the frame is flat.

Cramping the end frames together should be just as uneventful. I pinned strips of MDF on to the bottom of the legs to act as spacers and to fix the spacing of the bottom of the legs.

1 **Morticing legs**



Tenons

Cut the tenons on a bandsaw, router and tenoning jig. Use a cutter with a top bearing guide running against a template to rebate one face, then flip over, line up the shoulders and make the other rebate cut.

It doesn't take long to make the jig. The pieces of MDF are lipped in maple, and routing a shallow channel in the top for the vertical stand produces the required T shape. The bearing runs on the edge of the lipping, whilst the vertical piece is cramped into a bench vice.

This technique works well and produces accurate tenons. There were, however, a few teething problems. The ends of the jig had to be square as when the rails were flipped over, any inaccuracy was compounded with working from opposite edges. Planing the appropriate end of the lipping soon put things right.

The second problem concerned end grain breakout, and was a bit trickier. The basic principle of this technique uses the sides of a straight cutter to remove predominately end grain shavings – a small portion of the cutter has to do the vast majority of the work.

Axminster's large diameter profile cutter produced a superior finish, but there was still a problem with breakout on the back edge. This was reduced using a deep knife line, which also helped as a guide to line up the second shoulder line. The only way I found to successfully prevent any breakout was to 'back cut' the back edge – not a technique I like to use too often. The cutter tends to snatch when cutting in the direction of rotations, so use a series of light passes holding the router firmly down or rested against a guide.

With the tenons finished, cut the haunches and fit into the mortices. It's just as quick to set up a couple of marking gauges and finish off the job by hand.

2 **Tenoning jig set up**

3 **Remove waste in a series of passes, taking care not rock router**

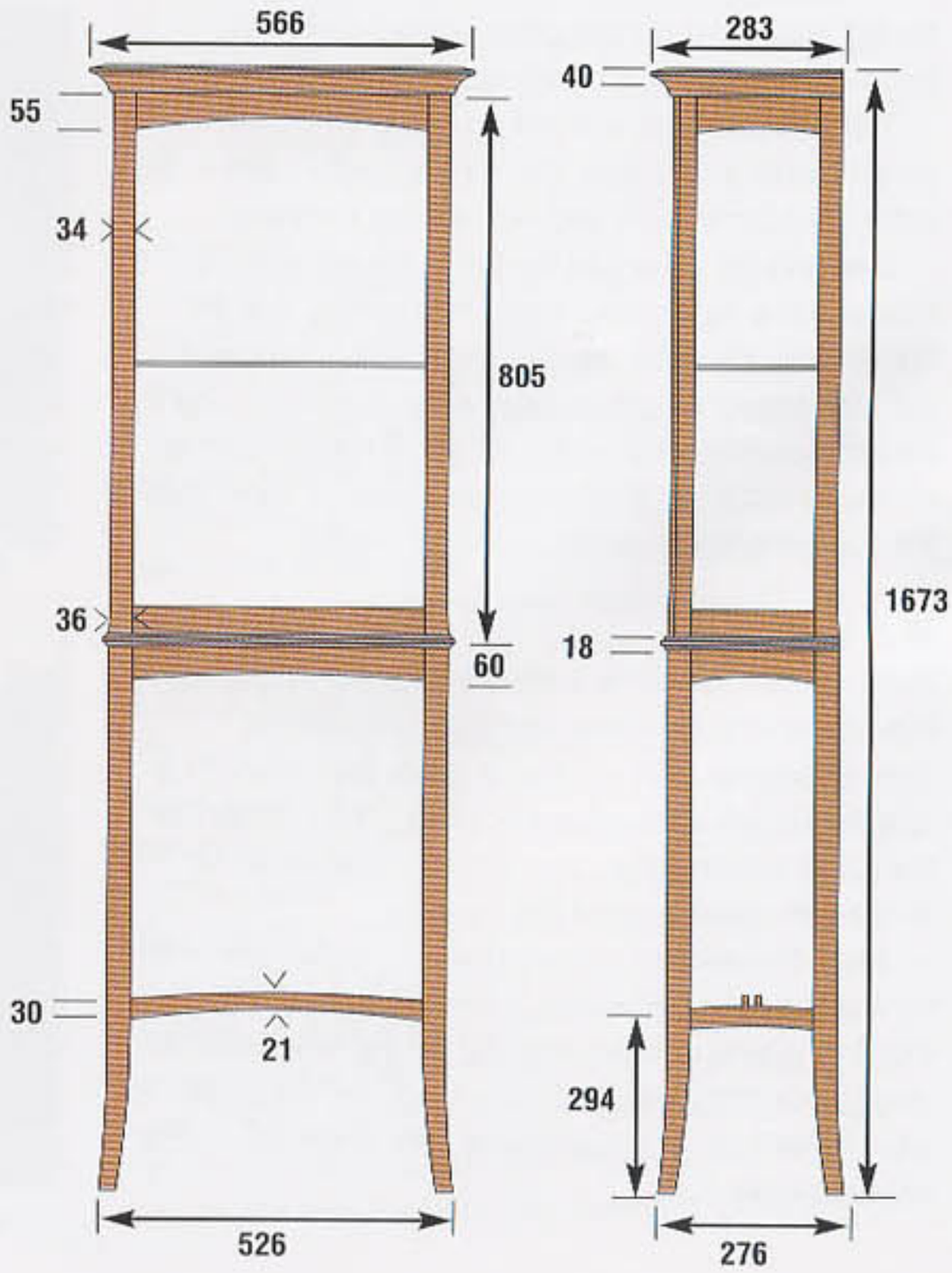
4 **With last cuts only remove small amounts to help prevent any breakout, if necessary tap rail along until cutter touches knife line**

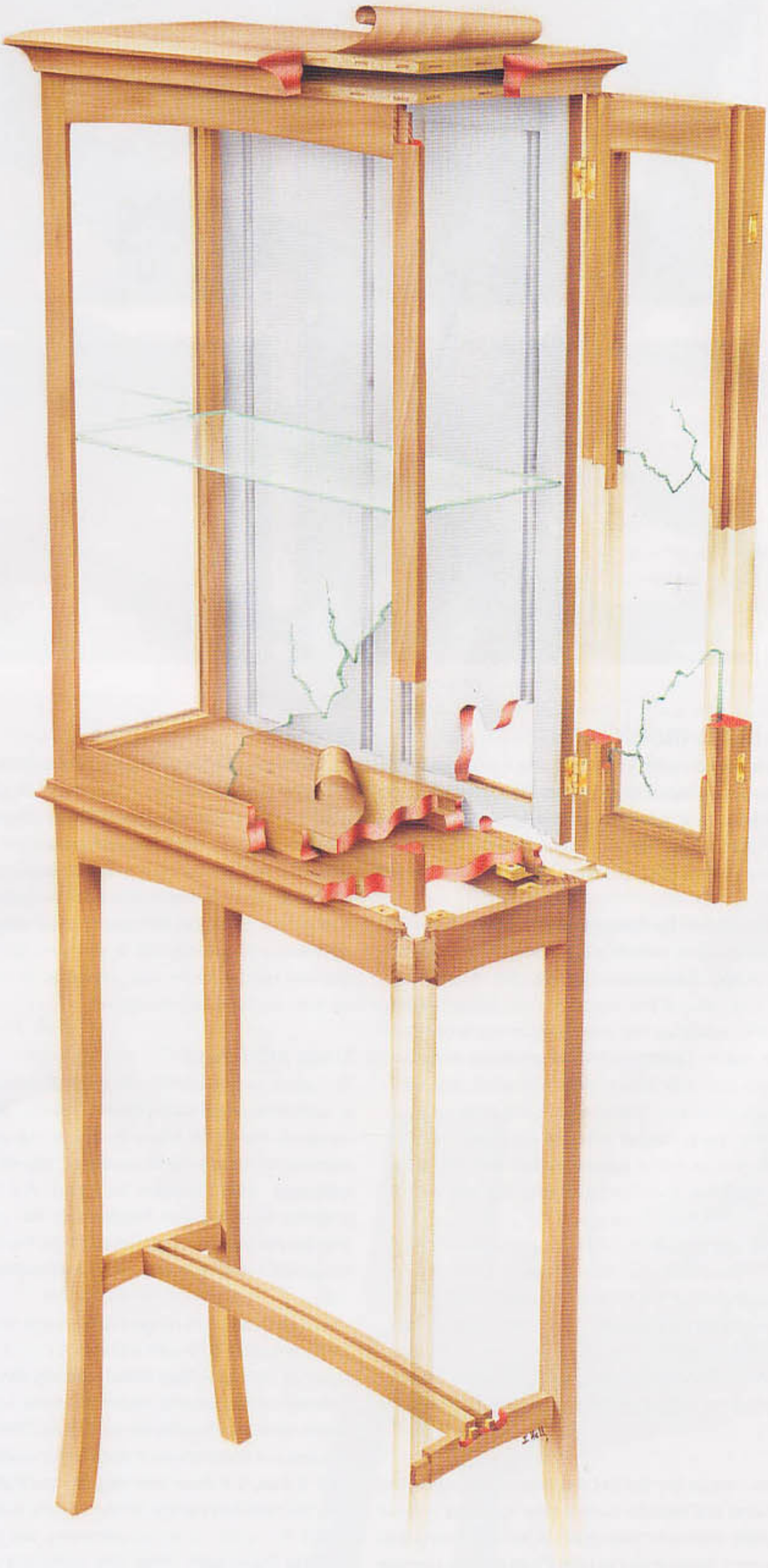
Use a router with a bearing guided grooving cutting to make the necessary slot for the buttons and it's ready to fix to the top display unit.

DISPLAY CARCASS

I started on the display carcass frames as the leg frames dried. These are fairly straightforward to make. Already morticed and tenoned together, they need the haunches cut and fitted. The top rails need curving, before gluing up. Front and side frames are glued up separately; one with the real corner post and the other with a dummy one.

Once dry, the frames are placed in a jig and the rebates routed with a bearing guided cutter – a cutting gauge line will prevent breakout. Machining the corner post can be a bit troublesome. There are three rebates; two stopped ones for the glass and one 20mm (25/32in) square to remove the inside corner. For me, the spindle moulder is the best way to do this. Firstly, I made a simple jig consisting of a piece of 18mm (23/32in) MDF slotted to take the corner post, and a back fence. The cutter is broken through a new false fence, which made locating the start and stop position of the cutters easier. Having marked these positions, the jig can be accurately lined up and substantial stops cramped to the spindle's fence.



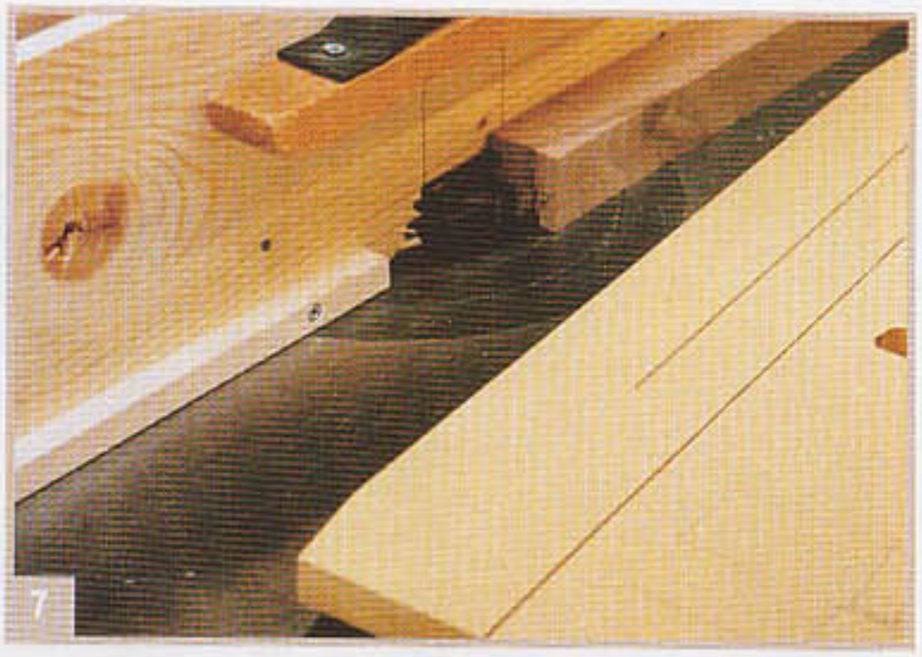


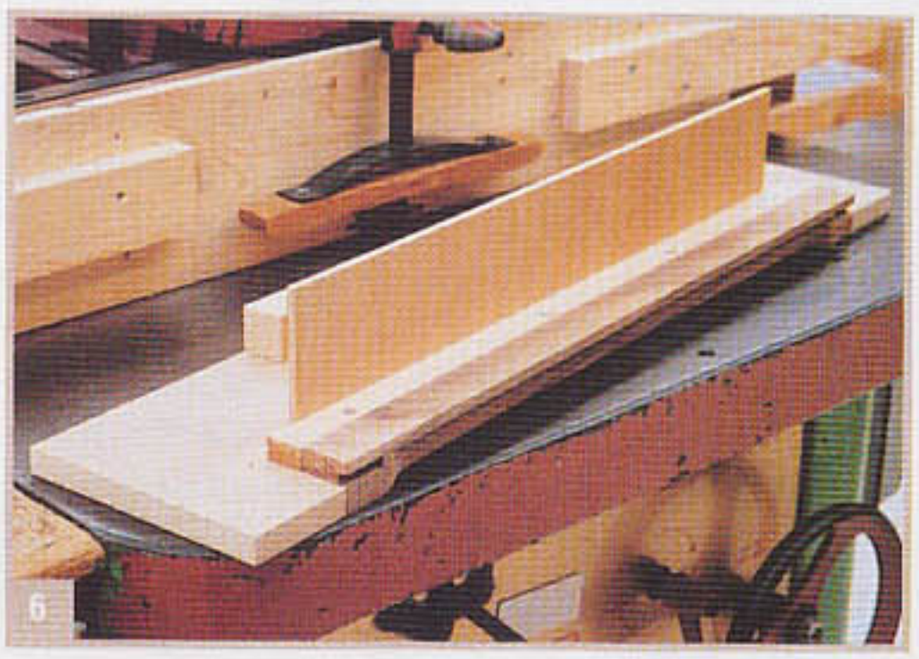
5 Compass plane used to shape curved faces

6 Spindle set to machine stopped rebates in the corner post. The post is secured in a 'simple' jig, and end-stops used to accurately locate both ends of cut. A Shaw's guard provides downward pressure on the jig

7 Spindle re-set for through rebate. A 'spacer' is screwed to the back fence to prevent post twisting during machining

8 Corner post complete with stopped rebates





Cornice/sub-base mouldings

Essentially these are constructed of lipped and veneered MDF. The cornice for strength consists of a sealed six-sided box, and the lippings are tongued and grooved to the MDF panels. The construction is complicated by having sycamore on the inside and walnut on the outside so the panels are veneered before the lippings are applied.

The two are jointed together by biscuits. The front mitres need adjustment when gluing-up to ensure they close up and are in the right place. Once dry, the cornice box can be cleaned up and moulded. Normally I like to pre-shape the moulding before it's applied, but in this case, as the moulding is so large and difficult to cramp in place, I machined it. When machining the moulding I start with the right hand side and work my way around in a clock-wise direction. There wasn't any break-out – I put that down to nice sharp cutters and the mild grain of the walnut. The same technique works just as well for the sub-base moulding. In both cases the chamfer/bevel was marked with a pencil gauge and removed with a jackplane.

The sub-assemblies can be jointed together once assembled. To mark the position of the biscuits, cut a piece of 18mm (²³⁄₃₂in) MDF to the inside dimension of the cabinet, this was set in by the thickness of the back and centralised. The base plate of the biscuit jointer is rested against this edge and the slots cut. Another piece of MDF is cramped to the inside face of the carcass, the position of the biscuits marked and the slots cut.

Assembly

The top carcass frame can be dry assembled together to make sure everything fitted. I found the biscuits were a little tight, but a quick plane soon put this right. The back was glued to the side frame with the cornice and sub-base, and left dry to help to square the carcass up. These were then glued in place once they had dried.

Muntin

The frame is constructed as an outer frame of stiles and rails with a central vertical muntin. A bead and a quirk on the long edges of the solid flush panels give a subtle degree of interest, and also distracts the eye from any movement.

The top display carcass has an upward taper all the way round, including the back frame. The back is made to the thick dimension and before gluing-up the taper on the stiles the muntin is planed by hand and the top rail is run through the thicknesser. Once cleaned up the frame was planed to fit the side frames and the tongue machined on the spindle.

Locks and hinges

The door needs careful fitting, and needs to be tight up against a combination of incorporated rebates in the carcass. With the taper on the outer faces it means the only truly vertical edges were on the inside of the cabinet. Working from these the hinge positions were marked out and cut. To further complicate matters, they are also 'feathered'. The recesses are tapered so that on the outer face of the cabinet, the line is not broken by the hinge. To me this looks much better than recessing it half-and-half.

Having fixed each hinge with a single screw, the door can now be tried to see how well it pivots. I found this was critical as the taper of the outer face meant the top hinge protruded from the cabinet more than the lower ones. As I set out the recesses, I made sure they would err on the shallow side on the door, just in case I marked them in the wrong place.

As it was, the door was slightly too tight a fit. As there was a double bevelled rebate on the closing stile it would be easier to shunt the door over by widening the recesses, rather than planing the rebate. With this complete and a 0.5mm closing gap I was satisfied.

The size of the rebate means it has to be machined in several stages, for accuracy and safety. I like to make two or three passes. The first takes a 2mm (5/64in) cut to define the position of the second cut and helps to prevent further break-out. In all cases a spacer is screwed to the out-feed fence to prevent the work from twisting into the cutter.

GLUING UP

Before gluing up, the corners of the rebates are carefully squared out – the front frame is glued to the corner post followed by the side frame. In both cases it's important to ensure the post is square to the frames. Once dry the bevelled rebate on the closing stiles needs to be machined on the spindle moulder, as the frames had some give. MDF panels were secured in the rebates to ease machining. I then placed the frames on top of the leg frame to ensure they were the right size.

MORTICE LOCKS

For the mortice locks, make a shallow recess for the fore plate and a deeper mortice for the main body. The router is the obvious choice for this; the only problem being that the closing stile has the double bevelled rebate, thereby cramping the door vertically to the side of the bench. The slots are then cut with the aid of a side fence. I remembered to leave the bolts sticking out of the locks so that I could easily remove them from the mortices. Next. you need to carefully mark out the position for the keyholes.

THE GLASS

Glass in any piece of furniture should conform to safety legislation, so the type of glass, finish and thickness are important. For this cabinet I used 4mm toughened glass. I could have selected 6mm plate or 6mm laminated but these would have added too much weight.

FINISHING

Walnut's fine tight grain will show any small mark or scratch. When sanding I go through the grits and finish with 400grit silicon carbide, making sure I have removed any scratching from the previous paper. The best way to prevent rounding over surfaces and edges is to glue the sandpaper on to a piece of MDF and sand as little as possible. Bare unfinished walnut is beautiful but once polished it is something special. I have no spraying facilities at home so a linseed/teak oil finish was applied and gave the finish I was looking for. Oil soaks into the grain leaving a thinner layer on the surface and a greater depth of shine. On paler woods I prefer Danish/tung oil, but with oak and walnut teak oil gives a much warmer colour.

In two days the cabinet received six coats, two de-nibbs and a buff. The sycamore back needed three coats of white shellac polish, which were applied between coats of oil. Try not to get the oil to bleed on to the sycamore, I got a few spots but a wipe and a sand and all was well again.

The cabinet then had a day to dry before it was given two coats of clear wax and a generous buffing up. **F&C**

9 **Final leg frame sub-assemblies being glued up**

10 **Buttons are used to fix leg frame to the display cabinet carcass**

THE BOARD is sitting

With the completion of his eight zebrano boardroom chairs in the offing, **Kevin Ley** was looking forward to a bit of a sit-down himself. Alas, some re-upholstery was called for...

Main photo
Sizing round tenons with a dowel plate

Top right
Chairs fully upholstered

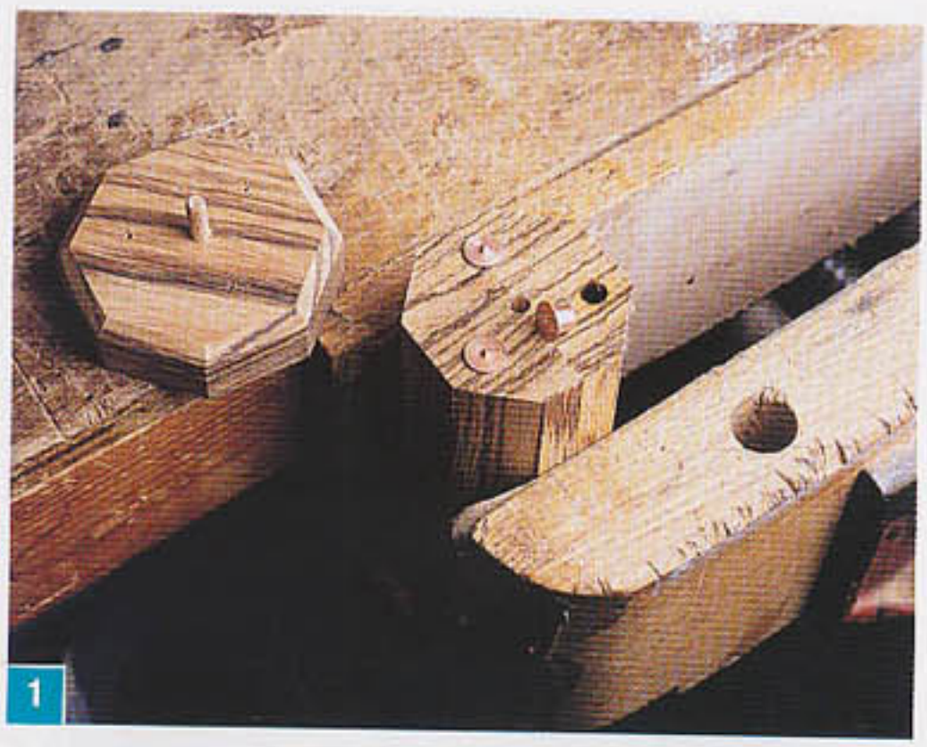
Last month I outlined the design, timber selection and preparation, and the beginning of the construction of these zebrano boardroom chairs which go with the table that I made earlier. This month I will complete the project, including re-upholstering the seats with denser foam, after a bit of confusion with the upholsterer!

LEGS

With the legs dimensioned, made into octagonal cross section and the mortices and dowel holes made for the seat rails and back frame, all that was left to do to the chairs was to cut the top bevels, drill the dowel holes for the feet, and hand finish the faces and bevels.

TOP BEVELS

The leg ends were fine-sanded lightly on the radial arm saw disc sander attachment to ensure they were flat and true. Then the saw blade was replaced and raised, set to a suitable angle and a stop set to locate on the centre of the leg. This allowed all eight cuts to be made in rotation, to form the bevels, with the legs held against the fence.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1 Dowel points in leg holes with foot about to be offered


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2 Fitting foot to leg


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3 Half-lap joints on back frame pieces and shoulder cuts on ends for dowels

I chose the angle by eye, keeping it quite shallow. Needless to say, several trial runs were made first, using the offcuts from cutting the legs to length, until I was satisfied with the look. I used a fine, sharp, TCT blade to minimise finishing. The leg top now had eight bevels and a centre flat.

DOWEL HOLES FOR FEET

I had decided to dowel the feet to the legs with 3 x 10mm dowels, but had to add a fourth centre dowel to help line up the octagonal faces of the legs and feet. The holes had to be drilled accurately at right angles and the legs were too long to go under my drill press, so I fitted a brad-point 10mm drill into the slot morticer chuck, marked the centre and perimeter holes on the leg ends, and drilled the dowel holes on the morticer.

The back legs were supported on a roller stand to avoid any strain on the relatively small morticer table.

FINISHING LEGS

With the leg work done, the faces were finished with a fine-set jack plane, cabinet scraper and sanding blocks. I had decided not to use the belt sander for fear of losing the definition and/or line on the eight narrow faces.

It took a lot longer but was worth it for the result. There was some tearout which took a bit of removing, but the scraper did the trick. Sanding was as light as possible, achieved by using a hard block, again to protect the edges of the narrow faces.

Next, the bevels were finished very carefully with a hand scraper to preserve their definition. Again, this called for a very light and careful sanding with 320grit on a hard block – it was very easy to lose the line and shape of the shallow bevels because the sanding block was bigger than the area of the bevel, and it was difficult to keep the reference.

It all took a long time but was eventually completed to my satisfaction. The finished legs were stacked carefully out of the way.

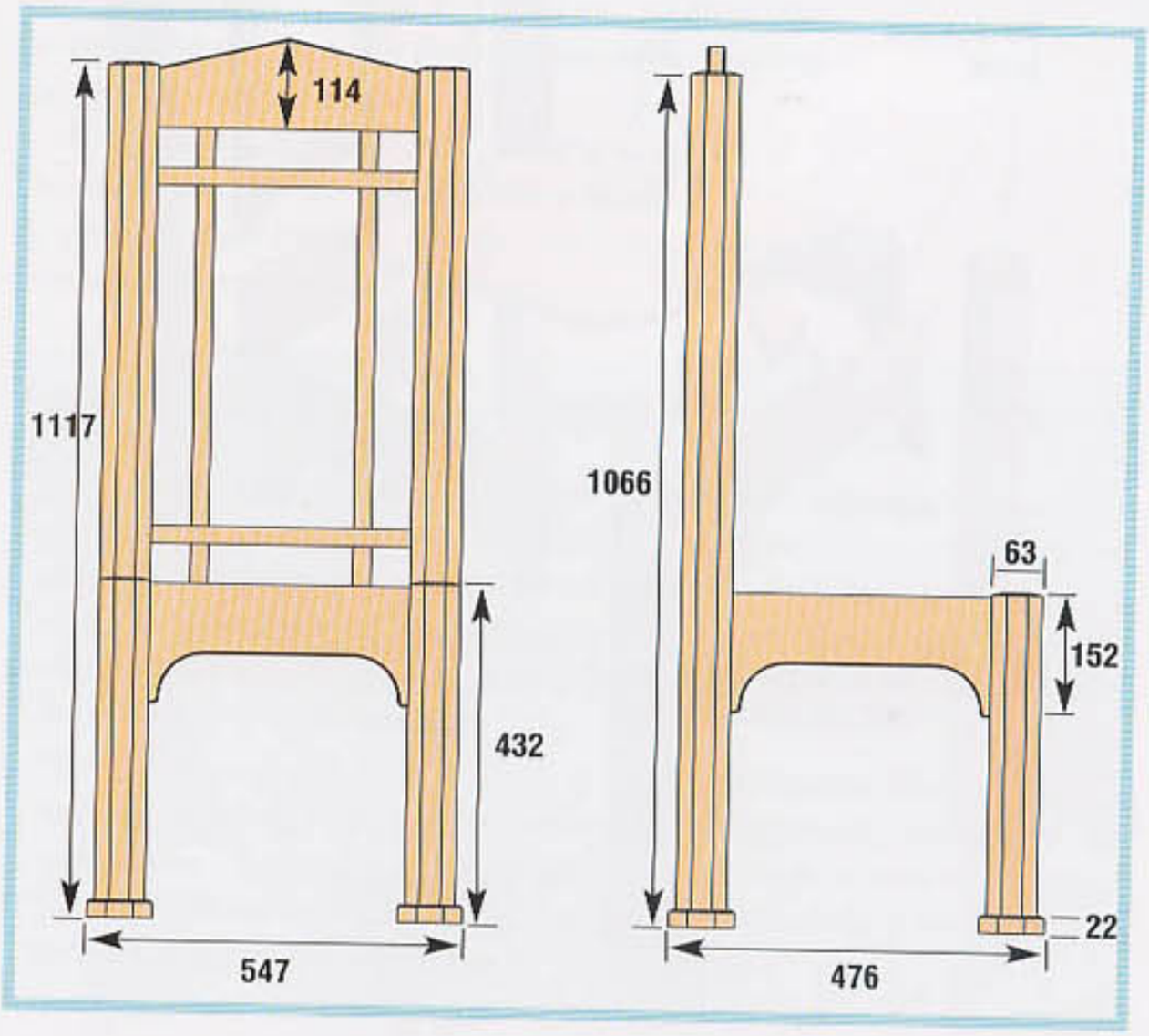
FEET

The octagonal feet were 10mm (⅜in) wider than the legs, 22mm (⅞in) thick with a chamfer on the edges. They were initially cut square and the corners cut off on the radial arm saw to form the octagonal.

The resulting faces were finished on the sanding disc attachment, then the bevel cut on the router table using a 45° cutter with a guide bearing. All the faces were finished by hand with a scraper and sanding block.

The centres of the feet were marked and a hole drilled on the pillar drill fitted with a 10mm brad-point bit to take a loose dowel. The legs were held, end up, in the vice and dowel points fitted in the pre-drilled holes.

A dry dowel was fitted in the centre hole and the feet offered up to the legs, centred on the dry dowel. They were lined up carefully by eye with the leg faces and



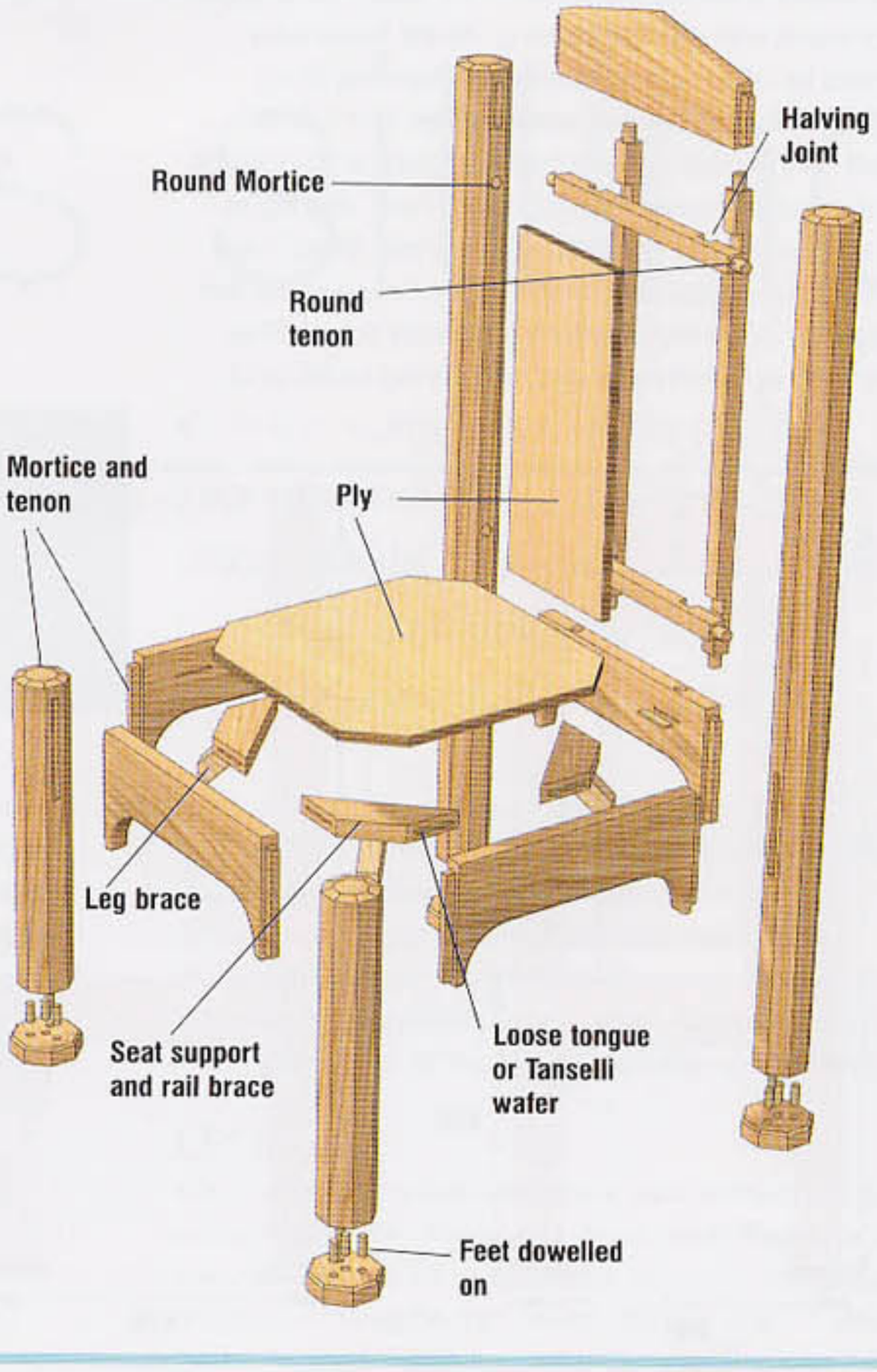
pressed on to the dowel points to leave a marked centre for the purpose of drilling the dowel holes in the feet. The dowel holes were drilled, again on the pillar drill.

I decided that it would be easier to varnish the feet and legs separately. That way, too, the varnish would not contaminate any joints. For these reasons they were not joined at this point.This method of joining the feet to the legs was very time-consuming and the joint was probably over engineered for possible future stresses. For the table legs and feet I decided to use three countersunk screws in a dovetail pattern, with the feet positioned and located using No Nails glue. That method was very satisfactory and, if doing this again, I would use it on these feet, rather than on the dowels.

4 **Back frame clamped up**

Finishing considerations

Assembled chairs are a pain to finish, there being very few opportunities to 'run off' a brush or pad, resulting in build up at joins, uneven finishing, and difficult denibbing and rubbing down. I prefer to finish the individual pieces and assemble carefully afterwards. Chair joints are relatively easy to protect from varnish contamination that would weaken glue joints – which should be wood to wood. All the joints were check-fitted dry and any final adjustments made.



SEAT RAILS

The seat rails and tops were cut to length and the dowel holes for the back frame's turned dowel ends were drilled in the under edge of the tops and the top face of the back seat rails. The pieces were held in the bench vice and the holes cut with a plunge router; a stop was used on the side fence to locate the holes.

The seat rail tenons were formed on the Trend M+T jig. A slightly undersized cutter was used to give a 'fat' tenon which I could tailor with a shoulder plane to fit each mortice – oversize tenons are easy to adjust but undersize are not!

A 4mm (5/32in) slot was cut in each rail; the seat braces, used with Tanselli wafers, would fit into these. These braces would also support the seat panel.

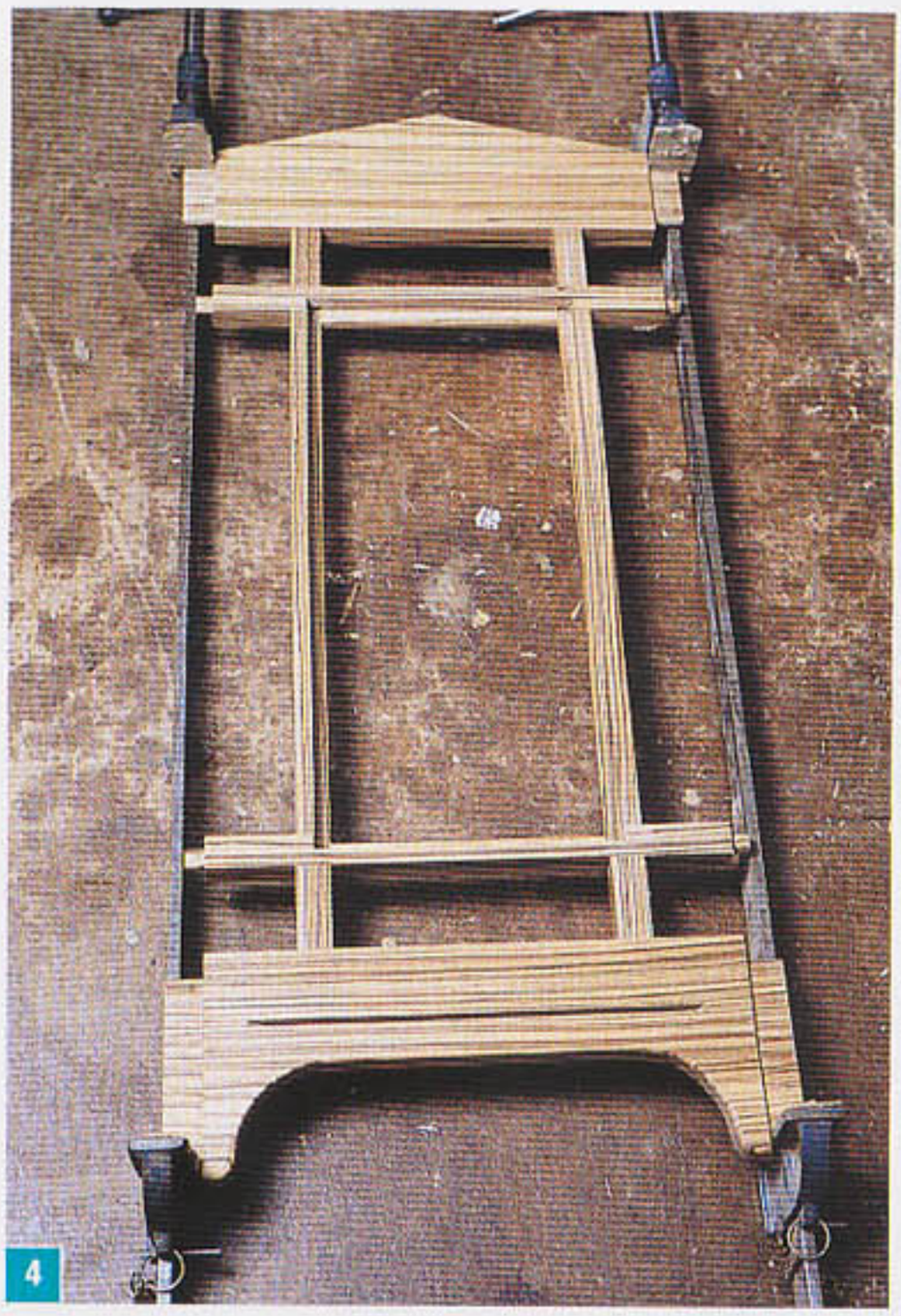
Next, the undersides of the rails were shaped on the bandsaw, and finished on the drum sander attachment on the radial arm saw. The underside edges and topside outer edge were rounded over on the router table with a radius cutter with a guide bearing.

TOPS

The tops were shaped on the bandsaw and the tenons cut on the Trend jig after the seat rails so that only the length of the tenon needed to be adjusted. The top edges were finished with a jack plane and sanding block.

BACK FRAMES

The back frame pieces were cut to length, and the ends shouldered on the radial arm saw. Using a sizing tool, the ends were turned on the lathe to form dowels. The dowels were left slightly over size and adjusted at the time of fitting with a dowel pop – a



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piece of 6mm (¼in) mild steel with accurate holes cut in it for dowels to be tapped, pushed, or 'popped' through for accurate sizing. They can be used to make your own dowels from scrap wood pieces.

Next, the pieces were half lapped to form a centre rectangle to take the upholstered back panel. The half laps were cut on the radial arm saw using multiple passes, with the blade set to the correct depth, and stops set on the fence to ensure that the female halvings were cut tight. The male halvings could be adjusted slightly with a plane, scraper or sanding block, and tapped in for a perfect fit.

Using the router table and a straight cutter, stopped rebates were cut in the forward edges for the back panel. Glue was applied to the half laps, the frames assembled and clamped and, when set, the rebates were finished square with a paring chisel. The frames were then hand scraped and block sanded to a finish.

FINISHING

The workshop was cleaned and tidied and all the pieces were laid out carefully, checked over, dents and marks removed, and finally hand-sanded down to 320grit.

I use Barfords Aquacote acrylic finish, which dries fast, enabling several coats to be applied in one day; it hardens quickly to a tough finish. In this case, a matt finish was required.

The first coat can dry quite quickly and get tacky while it is still being worked, adding 10% water, but dampening the piece first can cure this.

As usual, the first coat raised the grain and all was sanded back with 320grit to a smooth surface. Zebrano has an open grain and this coat was sanded back quite hard to act as a grain filler. After curing, a second coat was applied and also rubbed back to a smooth surface with 320grit abrasive. A third coat was applied and treated in the same way.

ASSEMBLY

First, the feet were fitted to the legs. Titebond was applied to the dowel holes and the loose dowels tapped into the legs. Then the feet were pushed onto the dowels and a jet clamp, with its greater reach, was used from the centre of the leg top to the centre of the underside of the foot. The leg top was protected with carpet pads.

Next, the backs were assembled. Titebond glue was painted on the insides of the mortices of the tops and back seat rails, and the back frame dowel holes, so that the glue would be pushed into the joint when it was assembled, giving as little glue ooze as possible. The backs were assembled and clamped, and diagonals checked for square and left to set.

Pads of carpet pieces were again put under wooden blocks to prevent marking of the finish by the clamp jaws.

The front legs and seat rail were assembled in a similar manner.

SEAT AND LEG BRACES

At this point, a front was offered up to a back and a chair assembled using dry joints on the side rails. I measured the seat braces and cut them all from the pieces I had cut out from the seat rails when forming the under-curved shape.

A 4mm (5/32in) slot was cut in each end to take a Tanselli wafer; this will join it to the seat rails. When I dry fitted the seat braces I realised I could add a further brace from the underside of the seat

5 Showing extra braces from leg to seat brace

6 Easing oversize tenons with shoulder plane to fit mortices

10 'Tapping' the corner seat braces in with a 2 ½lb club hammer

Batch work

Chairs are ideal projects for batch production, with a high ratio of joints on small pieces and repeat cuts at the same machine settings. The argument is even stronger for a set of eight chairs. It can be a bit boring doing 60 plus repeat cuts but the setting-up time is minimised and, providing the cut is accurate, time is saved and costs are cut.

The essence of batch production is care and organisation. Accurate cutting lists, careful preparation, sequencing of actions, and use of rods and jigs for repeat measurements and actions are essential. Machines should be checked for accuracy of settings, fences, adjustment locks, blade sharpness etc.

8 Components of chairs curing after finishing

Roll on the finish

I applied the acrylic finish using a Harris varnish roller, which allows a much longer working period without lifting the layer, and I found it very successful. As the varnish is water based, the roller is easily washed and reused.

rails to the legs. These braces were cut from scrap and drilled and countersunk for the screws which would fit them to the legs just under the seat, and the underside of the seat braces.

Gluing the side rail mortices and clamping up in a similar way to the fronts and backs saw each chair assembled. While the glue was soft, the seat braces were tapped home with a club hammer. There was little swing room and the heavy hammer did the trick far better than a lighter hammer would have done.

The chair was stood on my flat, true, reference surface and, where necessary, my trusty white rubber mallet was applied to ensure all the legs were touching the floor. A small Jet clamp, with the jaws reversed to make it into a 'spreader', was applied against the relevant leg braces to correct the diagonal while the chair set, should this prove necessary. The leg braces were now glued and screwed into position.

FINAL FINISHING

The chairs were checked very carefully all over for any marking and rubbed down with a Scotchbrite red pad as necessary.

A final very thin coat of varnish was applied over all with a cloth-covered pad to ensure an even finish. To prevent runs and build up at the joints, the pad was damp rather than wet with varnish.To matt it down, this coat was in turn cut back with a Scotchbrite grey pad.

SEAT AND BACK PANELS

The seat panels were cut from beech faced ¼in five ply. As they were to be a drop-in fit, due allowance was made for the thickness of the velvet with which they would be upholstered. The back panels were to be a push fit from the front and were cut to fit much tighter. **F&C**

Upholstery

The seat and back panels and the velvet my client had chosen were sent to my usual upholsterer with instructions on what was required. They were returned and fitted and the client came down to see the finished chairs. He was delighted and the chairs were delivered. However, after they had been in use for a short time he was not happy with the foam seats, which he felt were too soft and 'bottomed' onto the seat panel. This was uncomfortable and effectively also reduced the height of the seats.

The seats were returned and I went to the foam supplier to discuss the problem. He told me the foam that had been used was covering foam, to go over hard foam in a layer construction, and that my seats needed a denser foam.

I ordered the foam, cut to the exact size using a set panel as a pattern, and it was a relatively simple matter to remove the top covers carefully, change the foam, and re-staple the top covers into position. They were a definite improvement and I confidently returned the seats to my client.

Conclusion

I hate it when something goes wrong, especially for such an important client, on such a big project, in to which I had put so much effort into. But the problem over the seats taught me a lesson – I should have been more closely involved in the choice of foam rather than leaving it to the upholsterer. However, the problem was dealt with quickly and to my client's satisfaction, and he is very pleased with the final result.

Contacts

Timber - Craft Supplies
Tel: 0800 146417
Website: www.craft-supplies.co.uk

Aqua Cote acrylic varnish – Barfords
Tel: 01277 622050

References

All titles available from GMC publications
Tel: 01273 488005

Planer blade preparation:

David Charlesworth's Furniture-making Techniques

General techniques and standard dimensions:
The Technique of Furniture Making by Ernest Joyce

Also:
Kevin Ley's Furniture Projects
Furniture Projects with the Router by Kevin Ley
Furniture Workshop by Kevin Ley (out now)