

Step-by-Step Instructions for Making the Wall-hung Bookcase

When a piece of furniture has an air and look of simplicity, you can be sure that it deftly conceals the complexity of its making. I wanted this piece to express that understated appearance in the following ways:

- its proportions were just right so you hardly gave them a second thought;
- the straight grain and color match came from

flawless boards from an extraordinary tree;

- the shadows cast by its simple rebates subtly framed and emphasized the parts;
- the exposed joinery clearly explained its purpose and sat comfortably within the proportion of the whole.

Also see *Harvesting the Parts*, *Woodworker's Journal*, April 2005.

Harvest the Parts



1. To get a feel for the log I put the 12 pieces back together in order on the bench.



2. With all the boards on display I could begin the selection process.



3. Shelf parts cut to length. The grain is straight and aligned with the edges. The remaining task is to make them into matching shelves 10" wide.



4. Begin selection with the longest boards. Here the sides are butt jointed and clamped together.



5. Here are some of the tapered cuts made in the quest for boards with the grain aligned with the edges.

Prepare the Stock

Prepare the Stock means get each part to width, thickness, and length.

Start by making a *face side* on each board, usually done on a jointer. Check with straightedge and winding sticks that it is:

- flat in length
- flat in width
- out of winding

The face side should be either the inside or underside face. Mark it with a face side mark.

Make a *face edge* on one edge of the board. Also done on a jointer with a fence square to the bed.

Check with straightedge, try square, and winding sticks that it is:

- flat in length
- flat in width
- out of winding
- at right angles to the face side

Mark it with a face edge mark.

Also see *Marking Up for Success: Prepare the Stock*, *Woodworker's Journal*, February 2001.

Mark the Joints: The Ends

On the inside face, knife across the shelf positions and the shelf thickness. The thickness should be marked $1/32$ " less than the thickness of the shelf stock. Try square goes only against the the back edge—the face edge. Pencil across the outside face to position the joints.

Also see *Marking Tools for Exacting Joints*, *Woodworkers Journal*, August 2001, and *Ian's Must-have Measuring Tools*, *Woodworker's Journal*, December 2004.

Mark the Joints: The Shelves

Select and number the shelves on the back edge. Knife the shoulder lines on the first shelf but do not knife the front edge and $3/4$ " from front edge top and

bottom. This is because of the “overhanging” shelf. Mark the shoulder lines of the remaining shelves, on the back edge from the first shelf.

Mark the Joints: Gauge the Mortises and Tenons



1. Mark the back edge mortise and tenons as normal and mark the front edge mortise.



2. Mark the front edge tenons by clamping the shelf accurately on the end piece and transferring the tenon line with a marking knife.



3. Set a mortise gauge to the knife marks and gauge the tenon. Then, with a marking gauge, gauge a line 1" from the front edge: the overhang will be marked accurately once the joint is entered.

On the shelf overhang area, knife a line 5/8" from the shelf shoulder line to the 1" gauge line you just made.

On the shelf, knife a line between the inside tenons 3/16" from the shoulder line. This will go into the housing between the mortises.

Cut the Joints: Chop the Mortises



1

1. An early difficulty posed by this parcel of English brown oak was that a normal mortise chisel, top, caused collapse and tearout of the tissue as it was driven. The solution was a bevel edge bench chisel with a low grinding and sharpening angle. However, the bench chisel's thin blade doesn't allow you to lever the handle back and accurately ream out the side of the mortise as you would with a mortise chisel. So, although the ends were cut square and free of tearout, the sidewalls had to be trimmed in a separate operation.



2

2. Given 3/4" material and a sharp chisel, you don't have to hit hard, but you have to make a lot of cuts to compensate for not being able to ream the sides (see photo 3). I made the joint sitting down—not a normal position for me, but it's a fussy time-consuming little joint that must be approached from both sides. Sometimes it's nice to be able to sit down on the job.



3

3. Lots of cuts are required to make a mortise in this fragile material.

4. Because levering with a bench chisel is impractical, the walls have not been reamed clean.



4



5

5. Clean up the side walls with a chisel but start the cut below the surface.



6

6. A vertical position is preferable to working with the board horizontal on the bench. With the board upright in the vise, you can see through the joint to make the mortise end walls dead flat and accurate.

Cut the Joints: Saw the Tenons



1. You know how tight you made the mortise gauge spurs to the chisel. Now you have to decide where to make the sawcut relative to the gauge line. Start the sawcut on the far side of the board and watch it come towards you, splitting the line. Notice the grip on the saw. The index finger pointed forward gives you greater control.



2. Saw straight down the line, keeping the teeth parallel to the bench. Your sawcut should stop at the same distance from the shoulder line front and back.



3 & 4. Remove the waste with a coping saw. Grip the saw with two hands. Stand square to the work, feet apart, and bent into the work for good vision. Use steady saw strokes the length of the blade.



5. Remove the waste by horizontal paring. Place the chisel in the knife line and chisel upwards to the far edge.



6. Turn the workpiece around and and horizontal pare from the opposite side, leaving a roof-like shape in the middle.

Cut the Joints: Saw the Tenons *continued*



7. Remove the roof-like shape by horizontal paring.

8. You can now enter the tenons into the mortises at an angle to check for any inaccuracy.

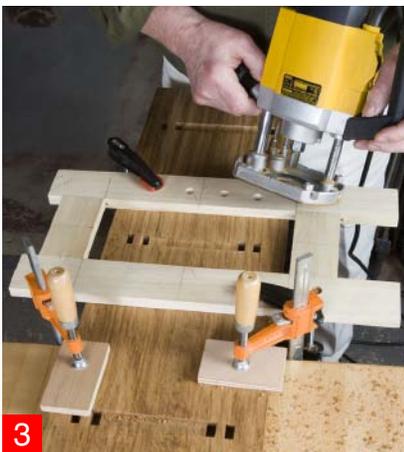


Cut the Joints: Rout the Housing



1. Cut the housing by hand or machine. If you use a hand router, make auxiliary lines just inside the shelf knife lines. The hand router will not sever the fibers free; you have to do that first with a knife.

2. Clamp the workpiece firmly in place. Position the router at the far side and pull it towards you. It doesn't take a lot of strength. It's a slow because you have to make new knife lines and reset the cutter depth after every cross-board travel. Chisel the sides clean and to width after you've made the housing to depth.



3. Make a router jig that will leave 1/16" of uncut material each side of the housing. It's quicker than making and positioning the jig absolutely accurately.

4. Clean the housing by vertical paring with a wide chisel whether you rout by machine or hand.



Fit the Shelves



1



2



3

1. Making the housing too narrow for the shelf thickness is the normal hand furniture technique. The shelf is then planed to fit. In this way you remove the machine planer marks, fit the shelf, and make it ready to polish in one operation.
2. Use a straightedge and a vernier to get the necessary accuracy.
3. The joints will enter only so far because the front overhang prevents closure.



4

4. You can knife the line exactly to mark the overhang with the shelf entered.



5

5. Set a marking gauge to the line and mark the overhang.



6

6. Saw the overhang line like a tenon.



7

7. Remove the waste.



8

8. Clean up the shoulder.

Fit the Shelves *continued*



9 If you make a tiny chamfer on the edges of the shelf, it will enter the housing without getting hung-up.



10 Confirm the fit of the overhang.



11



12

11. Enter the joint.

12. The joint completely fitted.

Shaping

Almost all shaping on this piece is done on the table saw: front edges of shelves, outside faces of ends, and back panels. Refer to article drawings for dimensions.

1. Shaping the front edge of a shelf on the table saw.

2. Cut the long rebates on the table saw. The short rebate are cut by hand as explained on the next page.



1



2

Handwork on the Front Edge of the Shelf



1



2

1 & 2. Knife around the shelf overhang at the correct length and angle.



3



4

3. Saw the overhang to length with a dozuki saw.

4. Clean up with a chisel.



5

5. Knife the end rebate.



6

6. Saw to line with dozuki saw: fine kerf and slow cut.



7

7. Chisel to finish lines.

Open the Mortises to Accept the Wedge



1

1. I calculated the amount by which I would typically open a mortise of this dimension—more details later!—then measured and marked it.



2

2. Knife these lines across only the mortise opening.



3

3. With the workpiece held upright in the vise, cut the gradient to within 1/8" of the inside edge.



4

4. Cutting the mortise gradients viewed from inside the bookcase.

Saw the Wedge Kerf in the Tenons



1

1. With a marking gauge make a deep mark in the ends of the tenons on each side. Pencil gauge a line down the edge.



2

2. Clamp the workpiece vertical in the vise. You can feel the gauge line. Start the cut with the teeth in contact with both tenons.



3

3. Saw down, keeping the teeth horizontal. End at the housing insert.

Resizing the Mortises with Veneer

At about this time—after I had once again calculated the wedge size by the full size drawing—I concluded that the tenon piece that would be bent over as the wedge was driven would, in most cases, break. The extent to which the wood had become brittle in places as a result of the *Fistulina hepatica* fungus was

worrying. I therefore decided to make the wedge opening in the mortise smaller. Serendipitously, my change of mind became a design detail feature. I glued a 1/32" thick pad of black dyed veneer into the mortise and reshaped the mortise gradient.



1 The “shooting board” is a piece of softwood with a rebate down the edge, about 1/16" narrower than the 3/8" wide veneer and a little more than half the thickness of the veneer deep.



2 The shooting board makes holding and planing the veneer a simple operation.



3 A caliper helps to get the width accurate.



4 A kerf across the end of the shooting board simplifies cutting the veneer pieces to length.



5 Sized blocks are fitted with a strip of blue tape.



6 Apply glue to the end grain using a shaped spatula.



7 Put the veneer tab in place.

Resizing the Mortises with Veneer *continued*



8 Position the clamping block and tape it down.



9 After the glue has dried the mortise must be reshaped.



10 Trim outer edge of veneer flush.

Make the Wedges

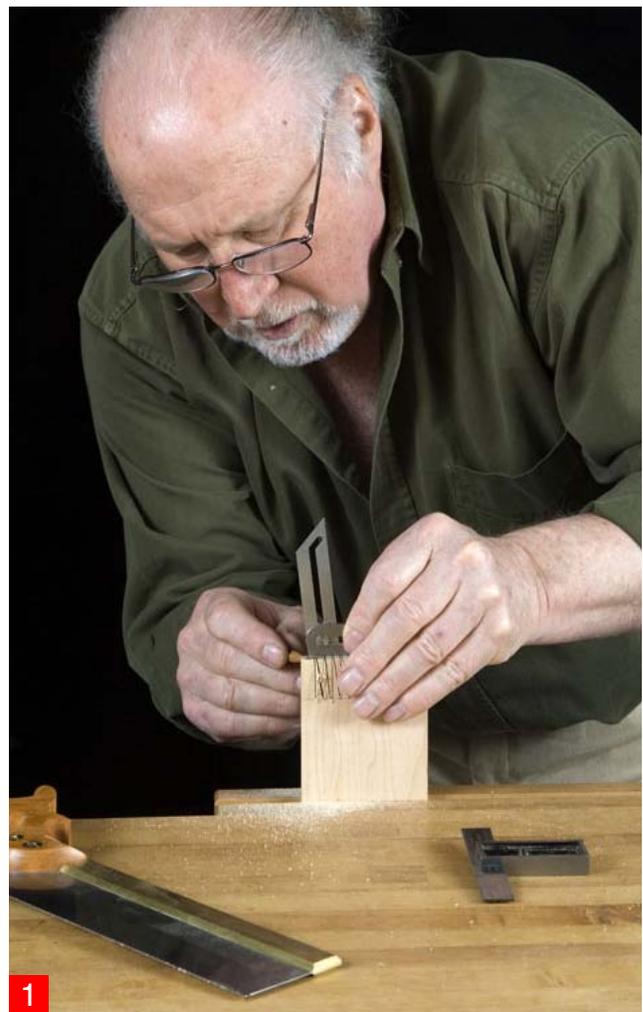
Make the wedges from a board about 5" wide and planed to the thickness of the tenon.

The wedges don't taper to a sharp or feather edge as you might expect. Instead they have a flat end which is equal to the width of the saw kerf. The wedge is sized to fill the saw kerf in the tenon and the opening in the mortise when its length is equal to the length of the kerf in the tenon. It's made about half as long again as the kerf length so that any damage incurred when driving it home won't matter.

I determined the size and shape of the wedge by making a full size drawing, then setting a sliding bevel to the angle needed. After marking the length of the wedges on the wedge stock, mark the first wedge on the end with the sliding bevel. (See photo 1.) After it's cut, mark the second wedge from the end of the stock using a try square. Leave a kerf thickness, square a line down, then cut the second wedge. Go across the stock in this way (see photo 3), then saw off all the wedges at once.

Refer to article drawing. Following is the step-by-step procedure for making wedges.

1. Prepare wedge stock to thickness.
2. Mark length lines.
3. Mark wedge #1.
4. Saw wedge. (The procedure is always the same: mark first, then saw—you can't mark more than one wedge at a time.)
5. Mark wedge #2.
6. Saw wedge.
7. Mark wedge #3.
8. Saw wedge.
9. Once you have cut to the width of the wedge stock, saw off all wedges at once. (See photo 4.)

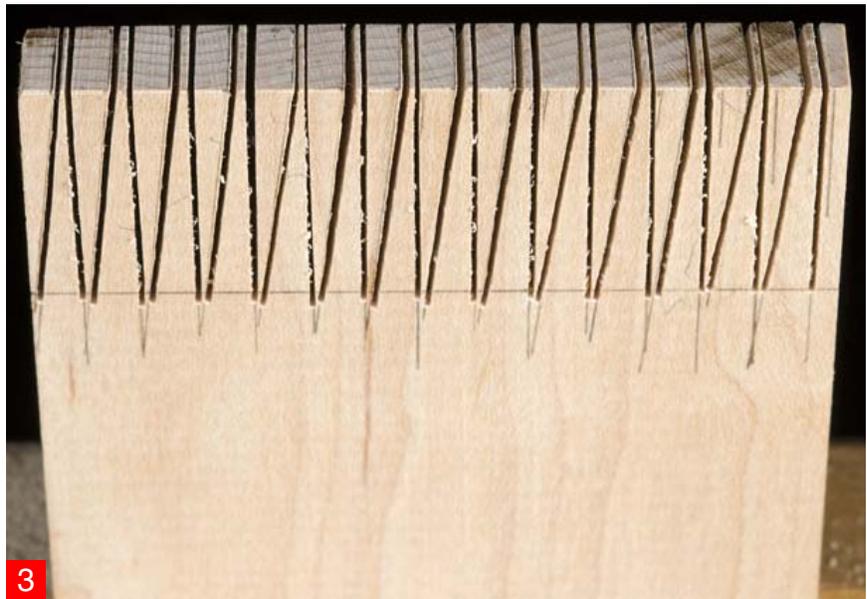


1 Mark wedge with sliding bevel.

Make the Wedges *continued*



2. Saw wedge.



3. Continue the mark-and-cut sequence until you have sawn the width of the wedge stock. In this case, the result is a total of 28 wedges ready to be sawn from the wedge stock.



4. Lay the wedge stock on a sawing board and saw off all the wedges.



5. Collect and select the wedges. There will be size variations: just right, too big, and the odd one too small. Discard the too small. The too big are quickly corrected by putting the wedge against the end stop of a sawing board and removing the excess with a chisel.

Make the Back

Refer to article drawings. The back slats are loose in the groove, about 1/32" between pieces, and screwed into shelves #2 and #3.

Prepare the slats to size: thickness is 9/16"; length is the opening between the top and bottom shelf plus 1/2"; width depends on how you decide to fill the distance between shoulder lines of the shelves.

Groove shelves #1 and #4 to drawing dimensions.
Saw 9/16" off the backs of shelves #2 and #3.



1. I made two bookcases: one had four back slats and the other had five.



3 & 4. I used a small shoulder plane to clean up the rebates.

Knife the end shoulder lines on the back slats.
Gauge the "tenon."
Saw the tenon on the table saw. Fit the tenon. See photo 2

Saw the edge rebate.
Saw the end rebate. Clean up rebates with a shoulder plane. See photos 3 & 4.

After the glue-up, screw back slats to shelves. See photo 5.



2. Check that the back slats fit easily into their grooves.



5. After the glue-up, equally space back slats with business cards and screw to shelves #2 and #3.

Clean up and Polish the Parts

All the parts except the outsides of the two ends were cleaned up and polished before assembly. The

ends had been planed to finish prior to sawing the rebates. I used shellac and beeswax as the finish.



1 & 3. The piece is clamped firmly to the bench, making it easy to cut off the excess on the joints and plane them clean. This procedure is only possible if the bench is rigid and the edge is square.

2. The back of a dozuki makes an ideal guide to saw parallel to the surface of the workpiece without damaging it.

In truth I left more length on the tenon that I should have—about $\frac{3}{32}$ ". However, don't be tempted to make the length of the tenon exactly the depth of the mortise. If you do, when the edge piece of the tenon is bent over by the wedge, it will describe an arc and sit below the surface.

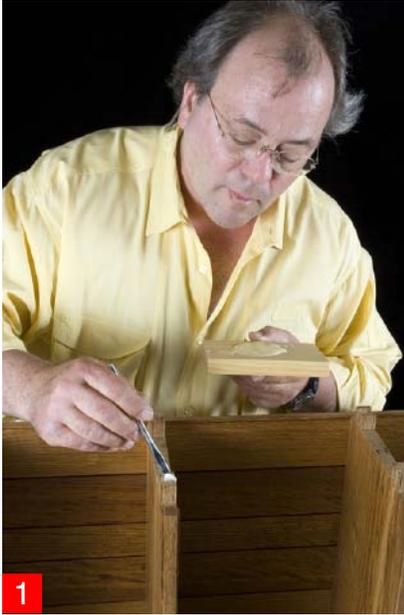


Glue Up

The joints on one side and down one edge of each shelf were glued up one at a time. The four glue-ups went along much quicker than you might imagine because there is no need to wait for glue to cure once

the wedges are driven.

Gluing the second side is a one-shot exercise. Don't forget to insert the back slats.



1 & 2. One person applies glue to the mortise parts while the other applies glue to the tenon pieces.



3. Having two pairs of hands at work to align the four shelves is definitely a big help.



4 & 5. Setting up the clamps and clamping blocks requires working together as a team.



6 & 7. One person glues the wedges a pair at a time. Scrape glue on one wedge, then transfer by wetting the second from the first.

Glue Up *continued*



8. The wedges can be pushed in by hand about half way...



9. ...and driven home with an 8 oz Warrington cross-peen hammer.

Hang the Bookcase



2. Detail of the inserted softwood pad required to screw the right side of the bookcase.

1. The bookcase was screwed to the wall. A stud was conveniently located on the left side but on the right I had to open the wall and insert a softwood pad. The blue tape marks the position of the bookcase.