Chair Making Simplified

Basic side chair won't compromise comfort, strength, or style

BY GARRETT HACK

Even the most basic chair must support a body comfortably and be strong enough to take lots of rocking and rolling. This likely involves angled joinery; add some grace to the design, and you're probably working with curved parts as well. A lot of woodworkers shy away from making chairs, but there are many good reasons for building them. Design a dining table or a desk, and it seems only fitting to complete the project by building the chairs, too. Dealing with angled joinery and curved parts exposes you to making patterns, full-scale drawings, mock-ups, and thinking in three dimensions. Also, chairs are great for improving hand skills such as fitting joints and smoothing curves.

By design, this chair is not overwhelming in its joinery or curves. Build one or two, and you'll soon be tweaking the design and construction to suit your own tastes and needs.

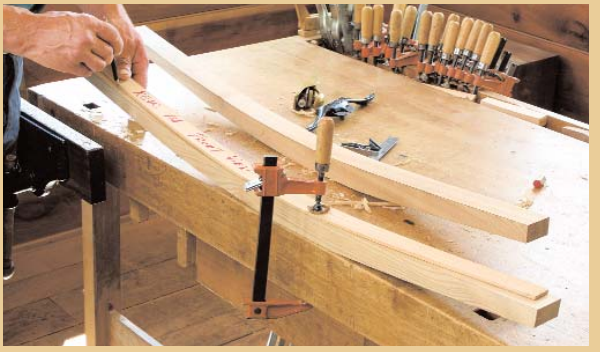
Rather than steam-bending or laminating parts, I designed all of the curves to be sawn from 8/4 stock. To give the back a dramatic splay toward the top, I used a design trick common to chair makers: rotating the curved rear legs inward by 4°. Also common to many chairs, the seat narrows toward the back to give it a graceful look and tilts slightly backward for comfort.

By carefully working out the curve of the rear legs, the tilt of the seat, and the taper and angle of the front legs, I was able to keep the joinery square in the side view, avoiding compound angles in most cases. This type of chair requires a slip seat, basically an upholstered platform that sits in a rabbet in the seat rails. You can make your own (go to www.finewoodworking.com or see *FWW* #163, pp. 54-58) or just cut out a plywood platform and bring it to an upholsterer.

Choose chair stock wisely

Strong and beautiful chairs can be made from a variety of woods. Mahogany and walnut have been high-style choices for centuries. Ash, maple, beech, cherry, and oak are equally good in terms of strength, although each has a unique color and

CUT OUT AND SHAPE THE LEGS

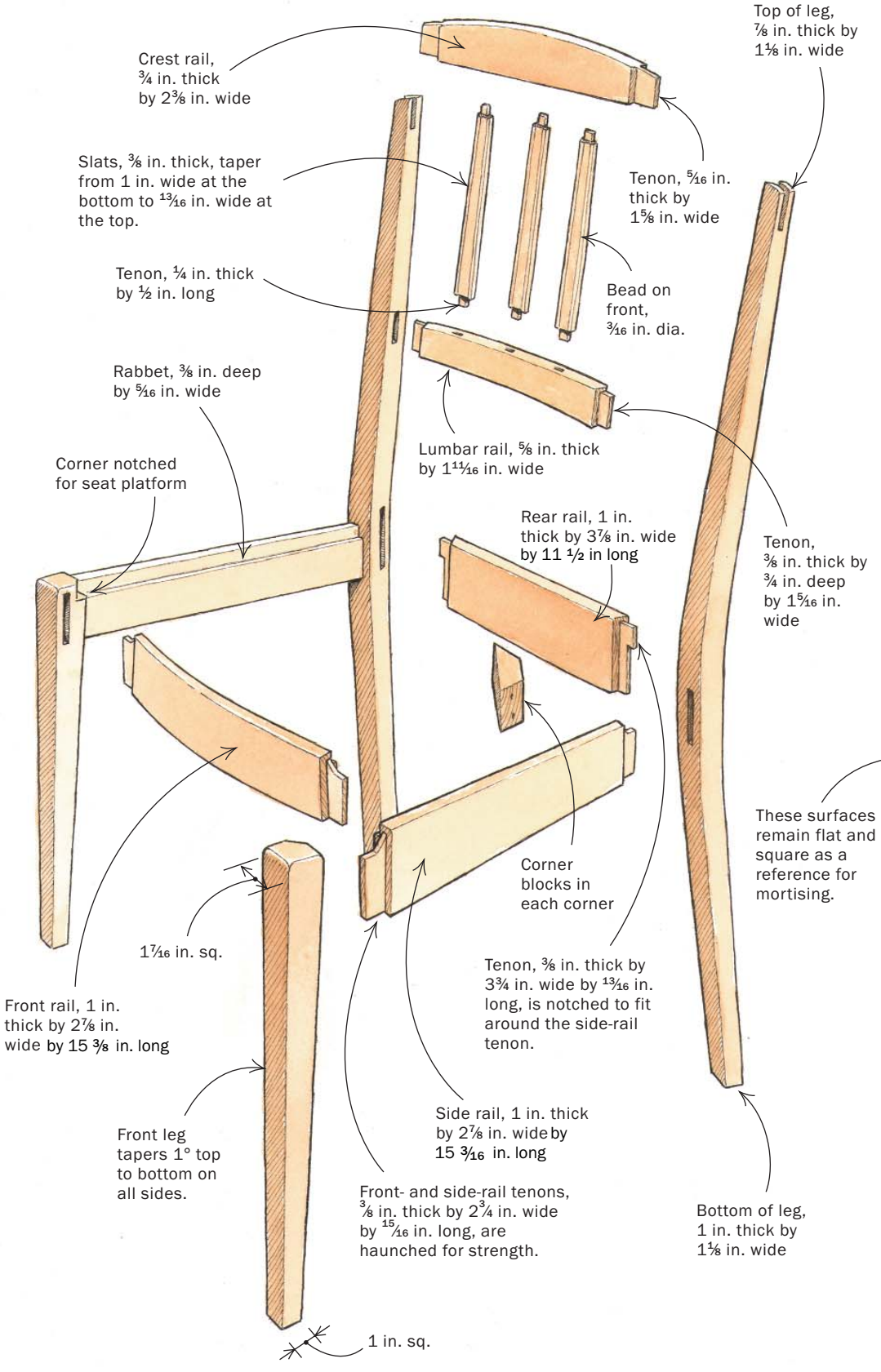


Using the side template, cut all of the legs from one wide 8/4 board to ensure uniform color (left). Lay out the legs for best grain orientation and strength (above).

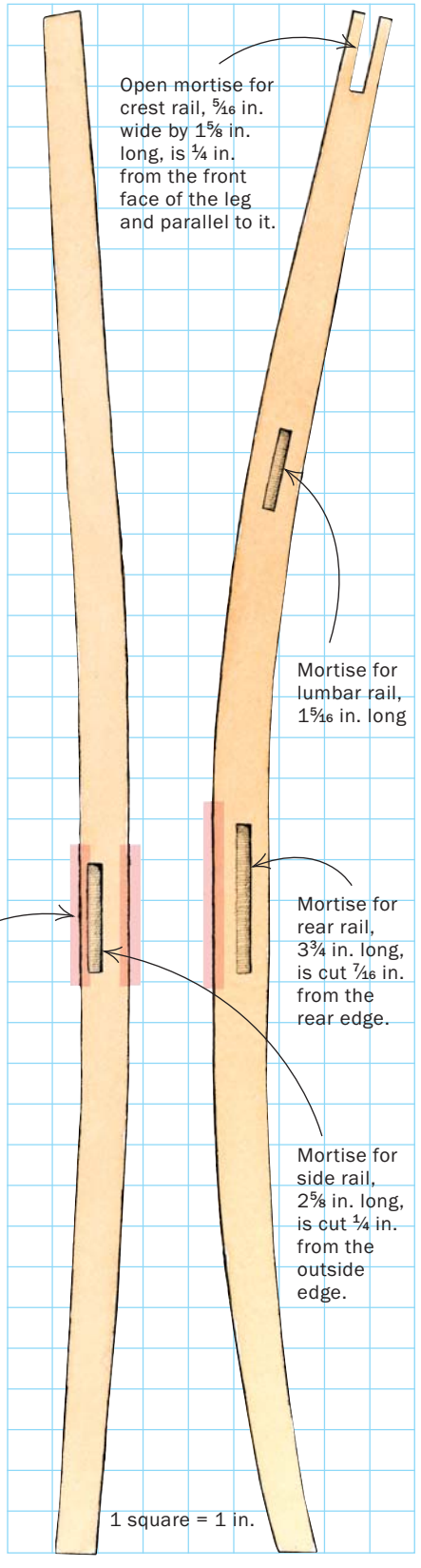
Photos: Asa Christiana

FULL-SIZE DRAWINGS AND TEMPLATES AID CONSTRUCTION

Building a comfortable, attractive chair is never easy, but these joints have been simplified as much as possible. Most are angled in only one direction. In the front seat rail, the curve is cut after the joinery has been laid out and cut. Make a full-size drawing and templates for each part to keep track of lengths, curves, and joinery. The lengths of the upper rails and slats are determined after the base of the chair has been built and dry-fitted.



LEFT REAR LEG
1 7/16 in. thick by 1 5/16 in. wide at seat rails, 37⅞ in. long



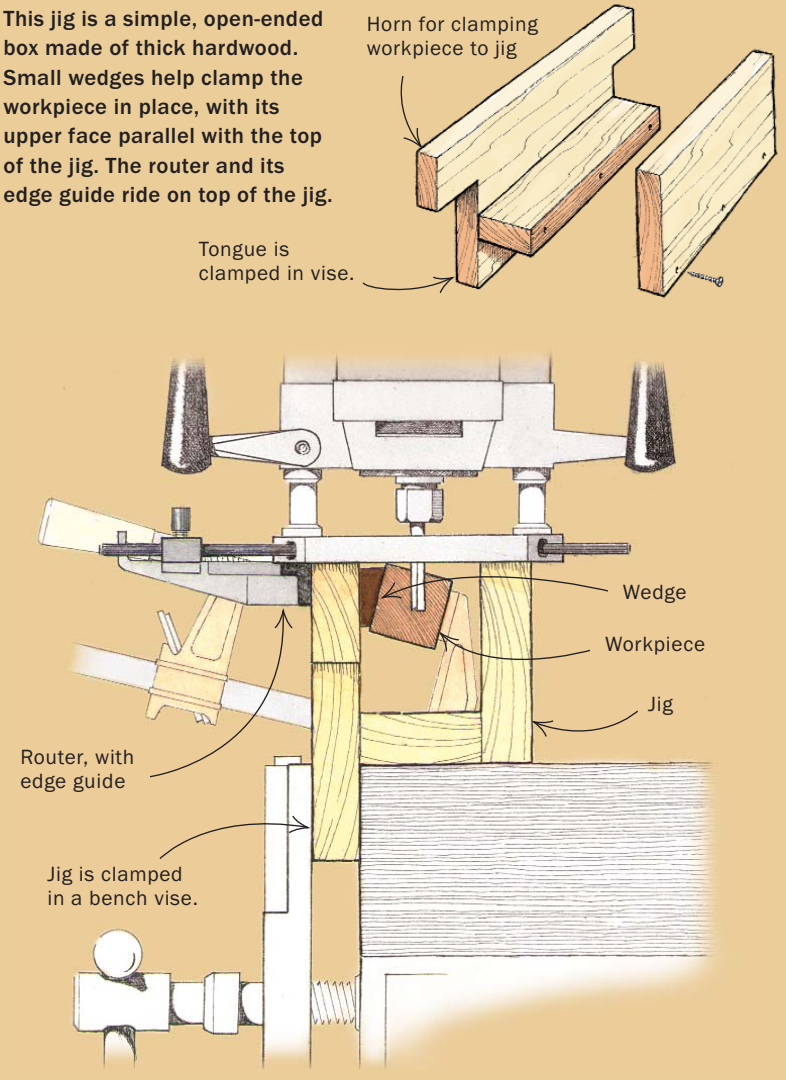
Drawings: Heather Lambert

ANGLED MORTISES ARE CUT WITH A ROUTER JIG

Aside from the crest rail, the mortises in this chair are angled, and the tenons are straight. Most of the mortises are cut with a plunge router, with the legs wedged at the appropriate angle in a box-type jig. The mortises are squared up by hand.

JIG SIMPLIFIES ANGLED MORTISES

This jig is a simple, open-ended box made of thick hardwood. Small wedges help clamp the workpiece in place, with its upper face parallel with the top of the jig. The router and its edge guide ride on top of the jig.



The side-rail-to-front-leg mortise. *Wedge the leg at 9° in the jig and place a block under the leg for extra support. Note where the entire box is being squeezed to hold the leg in position.*

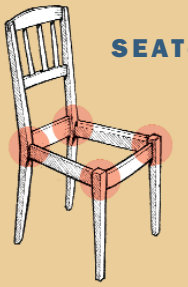
grain that impact the design. Softer woods are to be avoided. For this chair, I chose white ash because of its exceptional strength along the grain and its pronounced grain pattern. However, white ash is tough to work. Cherry or walnut are more forgiving with more subtle grain patterns.

Both 8/4 and 5/4 stock are required, ideally from the same tree for harmonious color and grain. Wide stock will yield more parts with less waste if you stack the curved rear legs side by side and cut the front legs from the odd shapes in between. Plan on cutting extra legs for trial setups and for backup in case of miscuts. Grain that follows the outline of the leg is ideal. Avoid wild grain that angles sharply off edges and defects that might weaken parts.

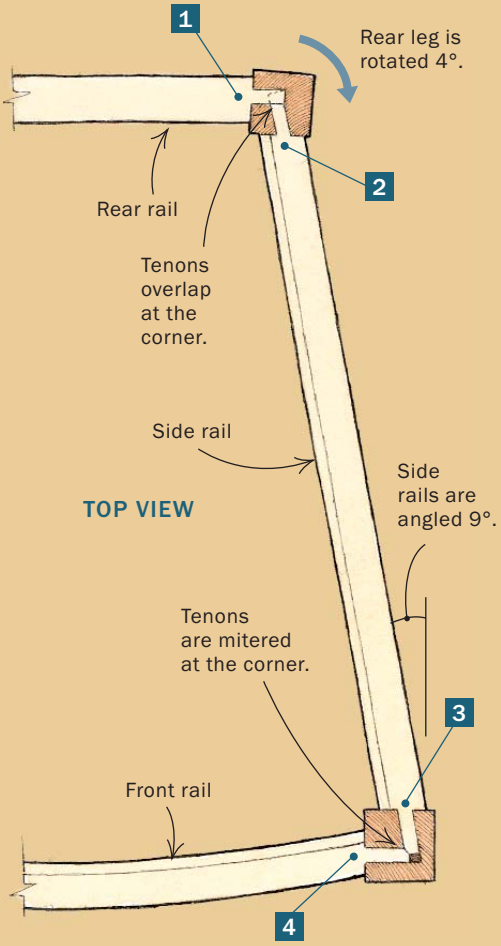
Make full-scale drawings, then patterns

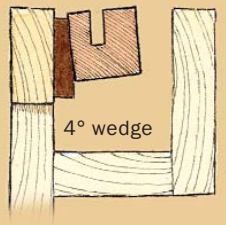
To help manage all of the parts and joinery in a chair, a full-scale drawing that includes front, side, and seat views is invaluable. It's

SEAT-RAIL MORTISES

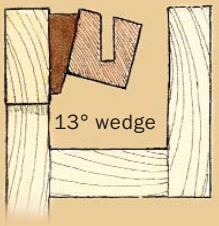


Wedges position the workpiece for the proper mortise angle. The outside face of the leg is placed against the wedge, and the top face is parallel to the top of the jig, lengthwise.

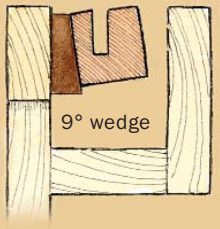




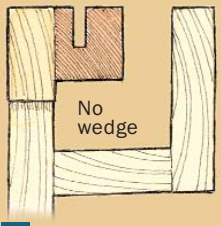
1 REAR RAIL TO REAR LEG



2 SIDE RAIL TO REAR LEG

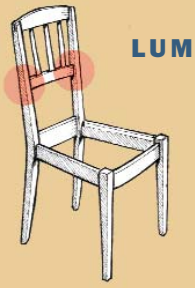


3 SIDE RAIL TO FRONT LEG



4 FRONT RAIL TO FRONT LEG

LUMBAR-RAIL MORTISES



The curved, angled block (foreground) is necessary for firmly clamping the curved rear leg in the jig and setting the mortise angle at 4½°.

CREST-RAIL MORTISES

The open mortise for the crest rail must be parallel to the front face of the leg. Cut it on the tablesaw using a tenoning jig and a dado set. An extra block prevents tearout at the back of the cut.

on the full-size drawing that I work out all of the curves, the dimensions of parts, and the joinery. I then make patterns and lift dimensions directly from the drawing, making fewer errors than I would by measuring alone.

Thin wooden patterns are useful for more than just helping to cut out the parts with pleasing grain. They also allow me to refine the shape of each part before cutting into my stock. And it is on the pattern where I mark out the locations of the joinery for transfer to the actual legs. Later, when fitting the crest and lumbar rails to the rear legs, I use other, simpler patterns to get the angles of the shoulders and tenons right. In the end, the stack of patterns becomes a record to refer to if I build this chair again.

Cut out and shape the rear legs

Cutting out the rear legs requires two patterns: one for the side view and another for the front view. Both include reference surfaces (see the leg templates on p. 81), which are flats where joints are cut and flats that help orient the leg when mortising.

On 8/4 stock, lay out and cut the side view first. I cut each of the legs from the rough plank to yield parts as thick as possible and to avoid the labor of milling what will be waste. Bandsaw the legs about ¼ in. oversize in width and about 1 in. extra in length. Joint and thickness the rear legs to 1¾ in., retrace the pattern (which you can shift a little to improve the grain), and bandsaw, just leaving the layout line.

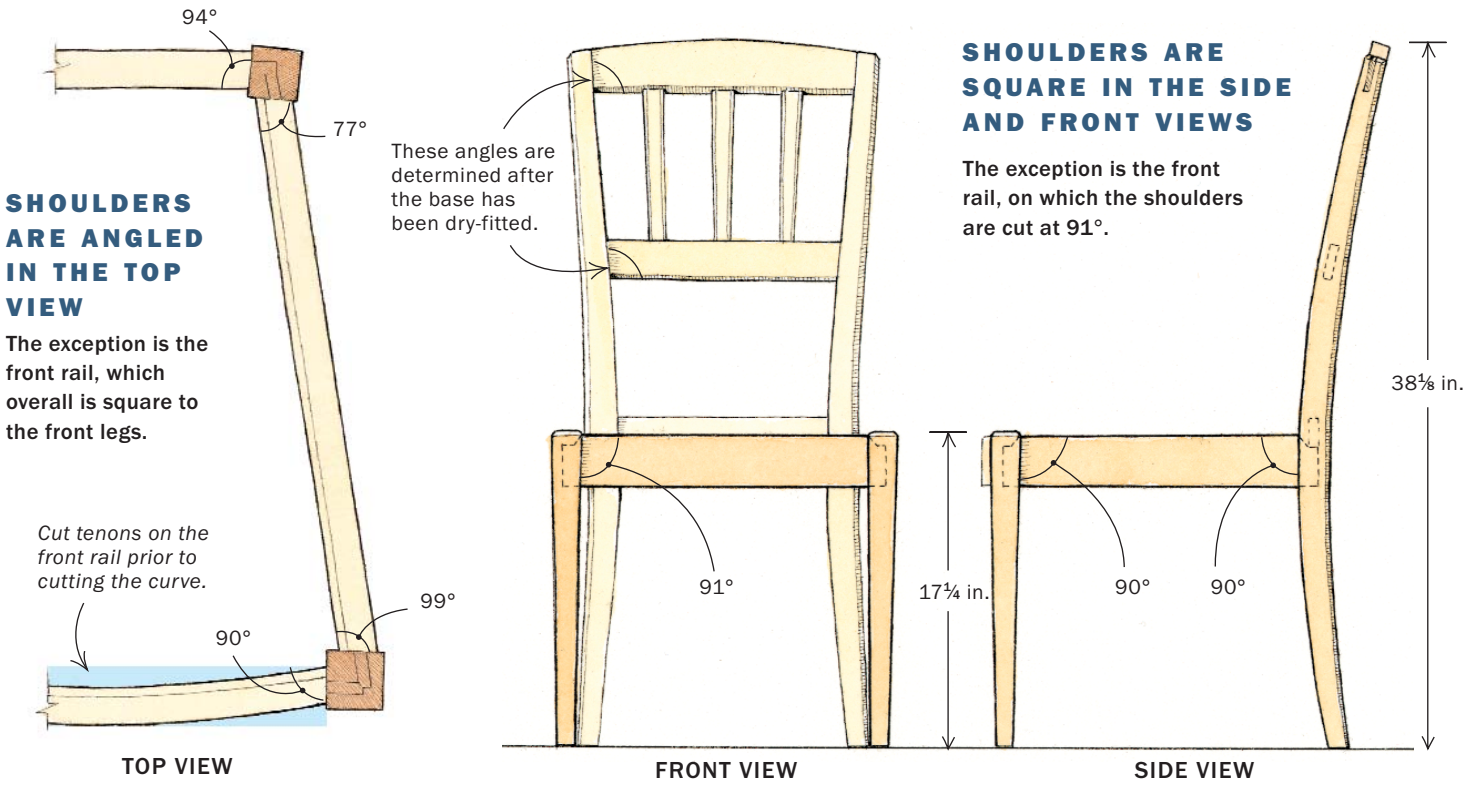
There are no tricks to shaping the rear legs; just compare the pattern and leg, and plane and spokeshave off the high spots. Use the bandsaw marks to guide you, taking them off evenly, as they should be square across the surface. Pay particular attention to the reference surfaces, keeping them flat, square, and precisely aligned with the pattern. Before cutting the rear legs in the front-view profile, lay them face up and choose the best right and left

TENONS ARE SHAPED ON THE TABLESAW

The tenons are straight on every piece except the crest rail, but all of the shoulders are angled in one direction or another to mate with the mortised pieces. Lay out every joint clearly to avoid mistakes when setting up and orienting parts on the tablesaw.

Lay out the angled shoulders. *On the front rail, the shoulders are square in one direction (left). But a bevel gauge set to the angle of the leg taper (1°) is necessary for laying out the vertical shoulders (right).*

Cut the cheeks first. *Use a tenoning jig on the tablesaw and stay shy of the shoulder lines.*



legs from the pair. Then trace the front-view pattern, bandsaw, and smooth the shape with a plane and a spokeshave.

Now, cut and taper the front legs

The front legs on this chair are tapered on all four sides from the top to the bottom, unlike some other chairs that have flat areas at the top for a simpler joint with the rails. One advantage of the unbroken taper on all sides is that the best-looking faces can be chosen after tapering the leg. Plus, I believe the unbroken taper gives a more refined look to the chair.

On the front rail, cut the tenon shoulders at an angle (1°) that will make the centerline of the front legs plumb.

Join the seat rails to the legs

To add strength to this chair, the side rails should be 1 in. thick. The extra thickness will be hidden beneath the seat, but it allows for large and strong tenon shoulders. Cut the front rail out of 8/4 stock so that it can be shaped into a pleasing outward curve after cutting and fitting the joinery.

The key to a good chair is tight-fitting joints. Sloppy or under-

Now cut the shoulders. *Set the miter gauge to 1°, being careful not to angle the cut in the wrong direction. The curve is cut after the joinery has been completed.*

size joints are going to fail eventually. I've repaired lots of those chairs. It's not too much trouble to haunch the tenons that go into the front legs for maximum resistance to racking forces. On the other hand, the rear tenons can be nearly full height with only small shoulders on the top and bottom to hide any slight defects in the mortise. The tenons on the front and side rails are mitered together inside the legs for maximum length and strength. To strengthen the mortises, I made the front legs a bit higher than the rails, and then rounded their tops. In the rear, the side-rail tenons, which are the most critical joints in the chair, are cut to the full depth of the mortises. The wider rear-rail tenons are notched around them.

Angle the mortise, not the tenon—For the most part, both angled and straight tenons are equally strong, except for an extremely angled tenon with weak short grain. That said, I chose straight tenons rather than angled ones for this chair because I knew I would make fewer mistakes laying out, cutting, and fitting them. Basically, every tenon is in line with its workpiece. Also, it is just as easy to cut angled mortises with a plunge router and a box-type jig as it is to cut angled tenons on the tablesaw.

However, there is one part that must have angled tenons: the crest rail. For the best appearance, the open mortises in this bridle joint must be square to the tops of the legs, an angle that requires angled tenons. But I have a neat way for laying out these tricky tenons.

Cut the mortises first with a router jig—The router jig for the mortises is a simple, open-ended box made of thick hardwood (see pp. 82-83). The parts are clamped inside with their upper face parallel with the top of the jig. Various wedges and angled blocks are used to locate and clamp the legs in the proper positions. Then the plunge router rides along the top of the box, with its edge guide riding the outside edge. Afterward, the ends of the mortises are squared by hand to accommodate square tenons.

Cut all of the chair's mortises before any of the tenons. Use the

Dry-clamp the seat frame. *After hand-fitting all of joinery in the seat frame, clamp it together and fit the upper crosspieces to the actual chair.*

leg patterns to lay out the top and bottom of each leg and the location of each mortise, including the ones for the lumbar rail. Each mortise has a face that it is cut into and an adjacent reference face that is clamped against the mortising jig. At the top, leave the front legs long by at least ¼ in. to strengthen the mortise while fitting the rails (when a little extra twisting could split it).

One important tip: Because most of these mortises meet another mortise inside the leg, the bottom of one mortise is the side of its neighbor. Thus, cutting a mortise too deep weakens the adjacent joint by cutting into some of its cheek glue surface. To keep the joints strong, set the router depth to come up a bit short for both mortises, then chisel away by hand the small step left at the bottom.

Tenons on the tablesaw—A ⅜-in.-thick tenon on a 1-in.-thick rail is a good compromise between tenon strength and ample

DRY-FIT THE BASE, THEN BUILD THE BACK

The rails and slats in the upper part of the chair (the chair back) are fitted to the rear legs after the base of the chair has been assembled and dry-fitted. The rails go in first, then the slats are arranged by eye and fitted to the rails.

1 FIT THE LUMBAR RAIL

Make a pattern for fitting the lumbar rail. *Plane the ends of the template until it rests perfectly at the base of the lumbar mortises. This is now a record of the shoulder angle and the location of the tenons.*

Determine the vertical angle of the shoulders. *With the pattern resting at the base of the mortises, use a bevel gauge to record the angle. Align the gauge's fence with the opposite mortise to keep it in line with the workpiece.*

Lay out the tenons. *Use the pattern to lay out both the tenon shoulders and the beginning of the cheeks. These tenons are straight. Then use the bevel gauge to lay out the vertical shoulders.*

2 FIT THE CREST RAIL

An added twist for the crest-rail template. *These tenons are angled, so after fitting the pattern between the legs to find the shoulder angle, fit mock tenons into the mortises and glue them to the pattern.*

Lay out the crest-rail tenons. *Use the pattern to lay out the cheeks and shoulders. Flatten one side of a pencil to ensure an accurate transfer.*

shoulders. Cut only the seat-rail tenons at this time; hold off on the upper crossmembers. There is no telling exactly what the dimensions and angles will be in the upper part of the chair until the bottom has been joined and dry-fitted.

Before cutting the tenon cheeks on the tablesaw, clearly mark the shoulder angles with a pencil. Also, remember that the front rail's tenons will be set back from its front face to allow for later shaping. Cut the cheeks with a tenoning jig on the tablesaw and cut the shoulders using a miter gauge, with the blade and miter gauge angled as necessary. Cut very close to the layout lines but leave a little extra for fitting by hand.

Another important tip: There are a lot of angles to deal with and a lot of parts to flip around in various positions on the tablesaw. To avoid mistakes and to be sure the cut is going in the right direction, make an intermediate cut well shy of your layout line when you get each part into position.

To miter the tenons within the front-leg mortises, assemble a rail and leg. Then reach in through the opposite mortise and mark the beginning of the miter. Next, take apart the joint and hand-cut the miter from this line to the tip of the tenon so that there is no chance of the miters meeting inside and keeping the shoulders from coming up tight. Do the same thing in the rear legs, where the rear-rail tenons must be notched out to butt against the side-rail tenons.

Fitting and sculpting the seat frame—After the joinery has been fitted on the seat rails, the front rail can be shaped into its curve. Make a pattern from the drawing, checking that it is symmetrical around a centerline. Trace the outside curve on the rail, bandsaw close to the line, and smooth it into a fair curve. Then bandsaw the inside of the rail parallel with the outside curve, leaving it the same

3 FIT THE SLATS

Clamp on the slats to find a pleasing array. *Then mark their angles and tenon locations on the lumbar and crest rails.*

Drill out the waste and chop the mortises in the lumbar and crest rails by hand. *Fitting the slats and the crest rail is the most challenging part of the construction, as all must seat simultaneously in their mortises.*

thickness as the other seat rails. To accommodate a slip seat, cut a rabbet around the front and side seat rails. This can be done on a router table with a small curved fence or a bearing-guided rabbeting bit. To see where the rabbets hit the front legs, dry-fit the seat frame. This is where the front legs must be notched to accommodate the seat platform. Do not glue up the seat frame yet.

Fit the back in steps

The next job is to cut and fit the lumbar rail, the crest rail, and the three small slats. One of the advantages of the bridle joint on the crest rail is that the slats can be fit last, after the rest of the chair has been glued up.

First, cut the open mortises for the crest rail on the tablesaw with a tenon jig and dado blade. These deep slots are cut parallel to the front faces of the legs. Clear layout lines will help prevent mistakes.

Cut and fit the crossmembers—Because of the curve of the rear legs and the splay between them, the length of the lumbar rail and crest rail and the angles of their tenon shoulders can't be read easily from a drawing. I use patterns to determine these. The crest rail is the only part with angled tenons. These require a new twist on the template technique to record the angles and location of the tenon cheeks. The crest rail is exposed, so it is critical to get a good fit. Last, cut the curves in the crest and lumbar rails using a pattern.

Cut and fit the three slats—Make the slats and form their delicate beads, leaving them a bit long. Then clamp them in front of the crest and lumbar rails. When you have their positions right, make lines on the slats for the shoulder angles and tenon locations; then lay out the mortises and the overall angle of each slat on the lumbar and crest rails. A router setup is cumbersome, so lay out the mortises, drill out the waste, and chop them by hand.

Now you can assemble and glue everything but the crest rail and slats. Place glue to get no squeeze-out, as this is easier than trying to clean up dried glue later. Glue up the chair sides first, then connect them with the front- and rear-seat rails and the lumbar rail. Measure the diagonals between the lumbar rail and seat rail to check that the assembly is true.

Fit the shoulders and length of the slats between the crest and lumbar rails. This is tricky because the crest rail must bottom out in its mortises at the same time the shoulders of the slats are butting up tight to the lumbar rail and crest rail. If you cut one of the slats too short, you can drop the entire crest rail by deepening its mortises in the rear legs.

Now glue up the crest joints and slats. Glue blocks, fitted carefully into each corner of the seat frame, will stiffen the chair considerably and offer a convenient place to secure the slip seat. Finish and wax the chair. Finally, make the slip-seat platform slightly smaller than the space within the rabbets to accommodate two layers of fabric wrapped around each edge.

Building this chair will not be as hard as you think. If you tackle it in steps—with drawings, patterns, and patience—the joinery will come together fine. Build one chair, and you'll build another. □

Garrett Hack is a contributing editor.