A Revolution in Chairmaking

When you separate the seat and back from the structure, it gets easier

BY MICHAEL C. FORTUNE

I have designed dozens of chairs during my career, and made several hundred. Whenever I design one, I strive to make it beautiful, comfortable, and strong. Meeting those goals often means the chairs are difficult to build, with parts meeting at compound angles. And then all those parts must be hand-shaped so they join seamlessly.

So, I began looking for a less complex way to make chairs, while remaining true to my design goals of beauty, comfort, and strength. In traditional chairmaking the legs, rails, seat, and back are part of a single unit, which complicates construction quickly. With this design, I borrowed from techniques developed in Scandinavia during the mid-20th century. By separating the seat and back from the legs and rails, you build the chair's base first and then

add the seat and back to it. As a result, the legs and rails can be square to one another, which simplifies the joinery. But the seat and back can be highly contoured for comfort, and then attached to the base with screws (I have a great technique for the shaping).
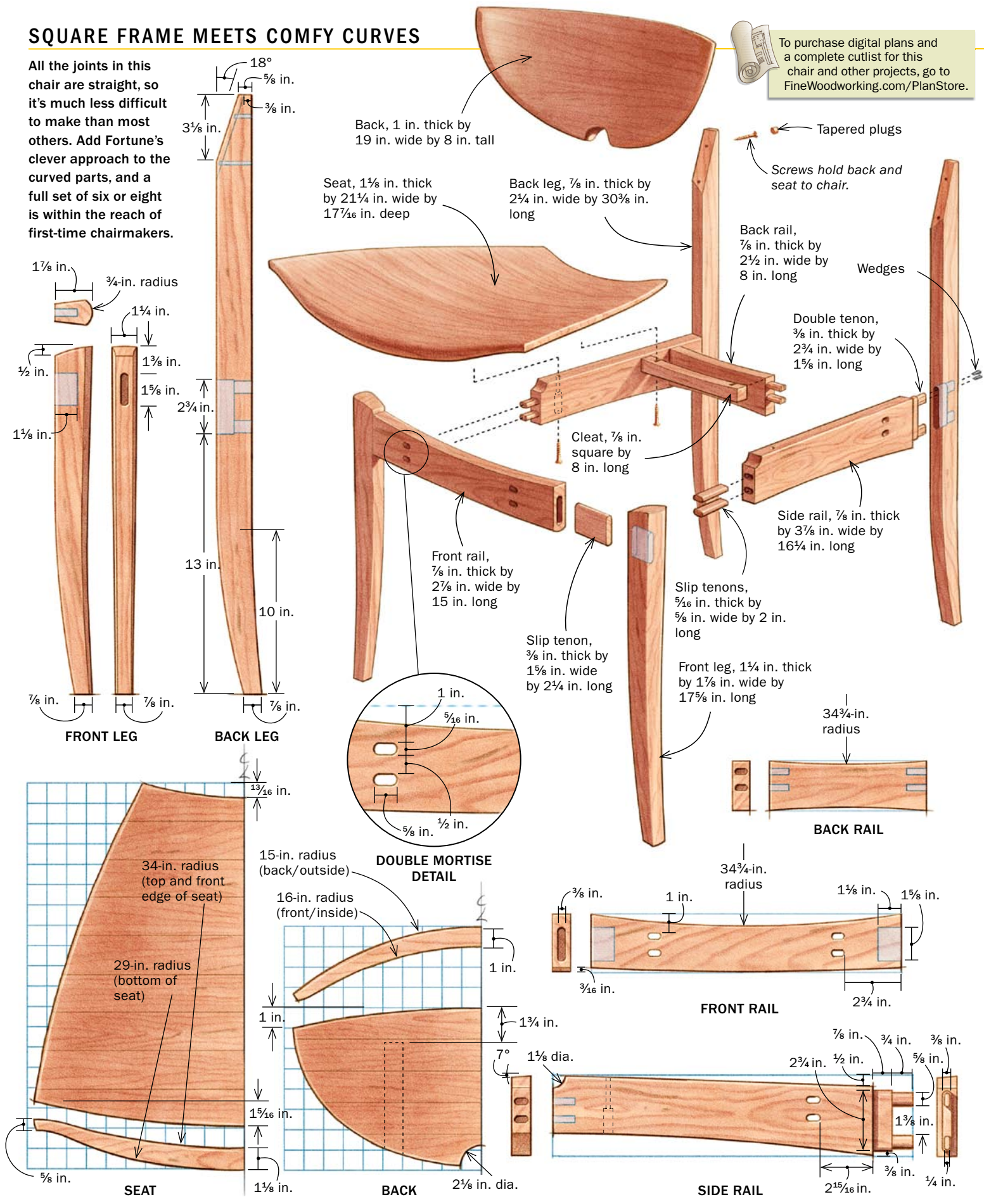
A chair like this is for a dining table, so you'll be planning to make at least four, but more likely six or eight. Since you're basically taking your woodworking into production mode, I'll show you some nifty jigs that will make the process go more smoothly and quickly.

I've now made a lot chairs this way, and I couldn't be happier with the results. The basic structure and technique is flexible enough to accommodate a variety of designs. Best of all, even a

SQUARE FRAME MEETS COMFY CURVES

All the joints in this chair are straight, so it's much less difficult to make than most others. Add Fortune's clever approach to the curved parts, and a full set of six or eight is within the reach of first-time chairmakers.

Back, 1 in. thick by 19 in. wide by 8 in. tall

Tapered plugs

Screws hold back and seat to chair.

Seat, 1⅛ in. thick by 21¼ in. wide by 17⁷⁄₁₆ in. deep

Back leg, ⅞ in. thick by 2¼ in. wide by 30⅜ in. long

Back rail, ⅞ in. thick by 2½ in. wide by 8 in. long

Wedges

Double tenon, ⅜ in. thick by 2¾ in. wide by 1⅝ in. long

Cleat, ⅞ in. square by 8 in. long

Side rail, ⅞ in. thick by 3⅞ in. wide by 16¼ in. long

Front rail, ⅞ in. thick by 2⅞ in. wide by 15 in. long

Slip tenons, ⁵⁄₁₆ in. thick by ⅝ in. wide by 2 in. long

Slip tenon, ⅜ in. thick by 1⅝ in. wide by 2¼ in. long

Front leg, 1¼ in. thick by 1⅞ in. wide by 17⅝ in. long

FRONT LEG

1⅞ in.
¾-in. radius
½ in.
1¼ in.
1⅜ in.
1⅝ in.
2¾ in.
1⅛ in.
13 in.
⅞ in.

BACK LEG

18°
⅝ in.
⅜ in.
3⅛ in.
10 in.
⅞ in.
⅞ in.

DOUBLE MORTISE DETAIL

1 in.
⁵⁄₁₆ in.
⅝ in.
½ in.

SEAT

34-in. radius (top and front edge of seat)
29-in. radius (bottom of seat)
13⁄16 in.
1⁵⁄₁₆ in.
⅝ in.
1⅛ in.

BACK

15-in. radius (back/outside)
16-in. radius (front/inside)
1 in.
1 in.
1¾ in.
7°
1⅛ dia.
2⅛ in. dia.

BACK RAIL

34¾-in. radius

FRONT RAIL

34¾-in. radius
⅜ in.
1 in.
1⅛ in.
1⅝ in.
⅜ in.
3⁄16 in.
2¾ in.

SIDE RAIL

⅞ in.
¾ in.
⅜ in.
2¾ in.
½ in.
⅝ in.
1⅜ in.
⅜ in.
¼ in.
2¹⁵⁄₁₆ in.

Ultimate jig for slip tenons

This jig's usefulness goes far beyond this article. We first presented it in *FWW* #197, but we've included it here for those of you without access to that issue.

View port, ¾ in. wide by 6 in. long

Slot, ¼ in. wide by 2 in. long

Five-star knob

Guide rails, ½ in. thick by 1 in. wide by 12 in. long

Stop, plywood, ½ in. thick by 6 in. long, same width as router base

Guide rails and stops are rabbeted to avoid trapping sawdust while routing.

Guide, UHMW plastic, ¾ in. sq. by 3½ in. long

Dado, ¼ in. deep by ¾ in. wide

Top, plywood, ½ in. thick by 10 in. wide by 12 in. long

ROUT THE DOUBLE MORTISES

Mounting block, hardwood, 1⅞ in. thick by 3½ in. wide by 12 in. long

⁵⁄₁₆-in. holes, spaced 1½ in. apart

The holes on the back side are counterbored to leave T-nuts slightly below the surface.

Hold-down clamp

BOTTOM ONE FIRST

Set the jig for the mortise farthest from the top edge.

Router

Rail

Support block

Carriage bolt, ⁵⁄₁₆ in.

Support block, hardwood, varies by job. This one is sized to hold the rails against the top of the jig.

Top edge of rail is against the jig's clamping surface.
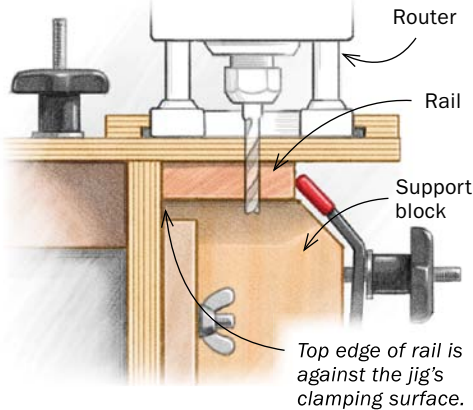
Lock the top of the jig. *Then clamp the workpiece in place and rout the bottom mortise.*

Vertical clamping surface, birch plywood, ¾ in. thick by 8½ in. wide by 12 in. long, glued to mounting block

Spacer block, ¹³⁄₁₆ in. thick in this case

NOW ADD A SPACER

This lets you cut the top mortise without changing your setup.

Bottom mortise

Add a ¹³⁄₁₆-in.-thick spacer between the jig and top edge of the rail.
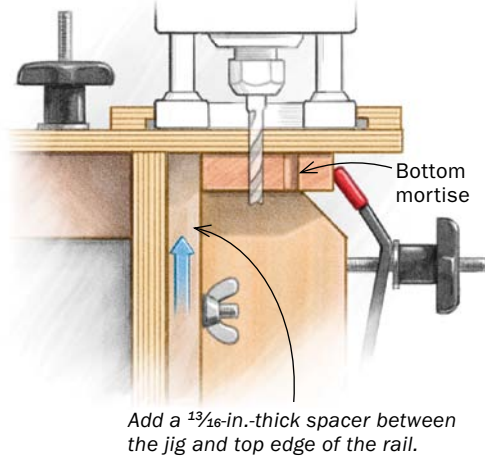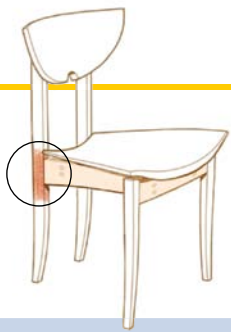
Space out for the second mortise. *The spacer lets you keep the overall setup locked in and ready for the next workpiece.*

END GRAIN MORTISES MOUNT VERTICALLY

Rout the ends of the rails with the workpiece clamped against the support block, which stays exactly where it was when you were routing the face-grain mortises.
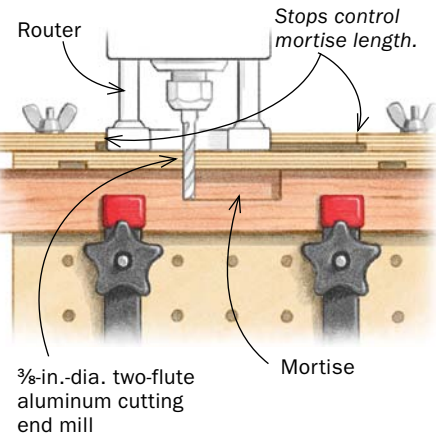
CUT THE STEPPED MORTISE AND TENON

Had Fortune used a slip tenon here, the mortise in the end grain of the rail would be too close to the double mortises for the back rail, weakening the side rail.
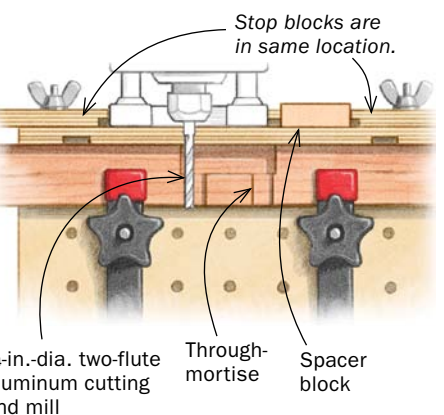

7/8 in.

2 3/4 in.

5/8 in.
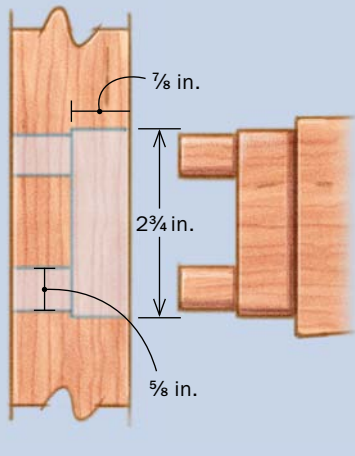
Mortise the back legs. Fortune adds a long piece of plywood behind the vertical clamping surface and notched to fit around the jig's mounting block, so he can use a stop block to quickly locate all of the legs (and that's a lot when you're making six or eight chairs).

Another spacer to the rescue. When routing the two through-mortises in the back leg, Fortune puts a small block in the jig to lock in their length. Switch it to the other end of the jig for the second mortise.

STEP 1: ROUT THE LONG MORTISE

Router

Stops control mortise length.

Mortise

3/8-in.-dia. two-flute aluminum cutting end mill

STEP 2: ROUT THE THROUGH-MORTISES

Stop blocks are in same location.

1/4-in.-dia. two-flute aluminum cutting end mill

Through-mortise

Spacer block

novice chairmaker can use the technique and make great chairs right away.

One jig handles many mortises

The curved legs give the chair an air of complexity. But that's an illusion. The rails and legs meet at right angles and slip tenons hold them together, except for an integral tenon where the side rail joins the back leg. Making the joinery comes down to routing a bunch of straight mortises. The slip tenons are basically straight sticks planed to fit. As for the curves in the legs, don't sweat them. Use the drawings to get you close and trust your eyes when making templates.

While the legs and rails are still straight and square, but before routing the mortises, drill holes in the back legs and side rails for attaching the back and seat.

I rout all the mortises with the help of one shopmade jig, starting with the double mortises that join the side rails to the front rail. These are oriented horizontally, because vertical mortises cut across too much grain and weaken the rails. The double


CUT THE STEPPED TENON

Two-part cheeks. After cutting thinner cheeks at the end of the board, lower the dado set, adjust the rip fence, and cut the thicker base section of the tenon.
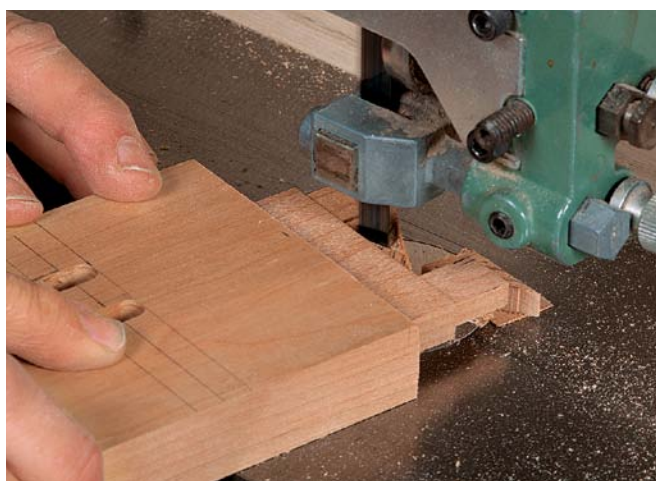
Form the double tenon. Fortune makes all of the cuts at the bandsaw, using diagonal cuts to clean out the waste between the tenons.
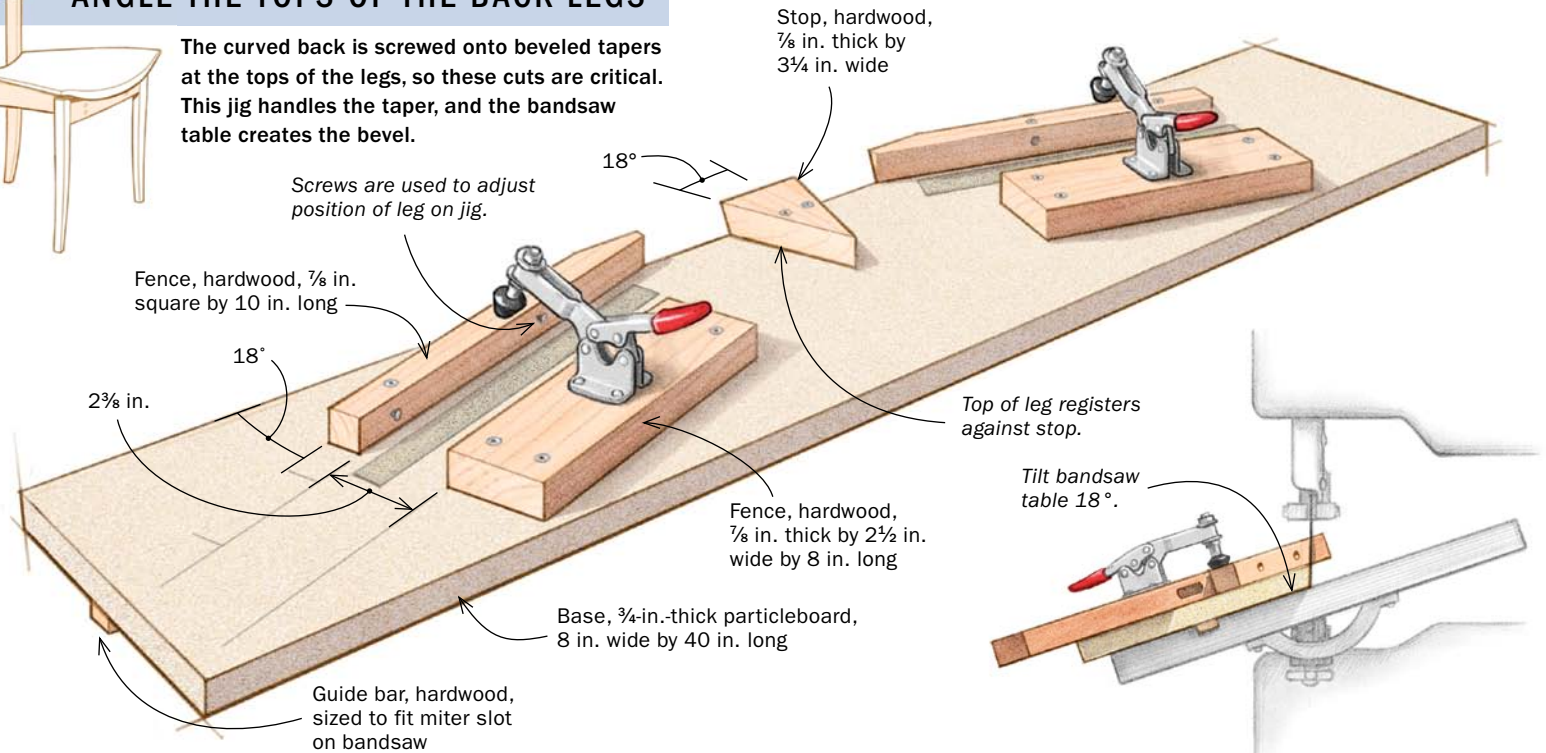
Jigs dial in the leg shapes, too

When you're making a set of chairs, it pays to make jigs for the repetitive tasks, especially shaping. Your parts are guaranteed to be exactly the same and you'll get them done much quicker.
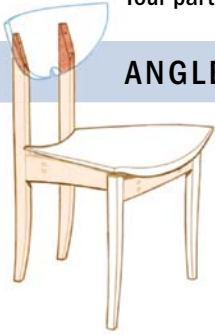
ANGLE THE TOPS OF THE BACK LEGS

The curved back is screwed onto beveled tapers at the tops of the legs, so these cuts are critical. This jig handles the taper, and the bandsaw table creates the bevel.

Stop, hardwood, 7/8 in. thick by 3¼ in. wide

Screws are used to adjust position of leg on jig.

18°

Fence, hardwood, 7/8 in. square by 10 in. long

18°

2⅜ in.

Top of leg registers against stop.

Tilt bandsaw table 18°.

Fence, hardwood, 7/8 in. thick by 2½ in. wide by 8 in. long

Base, ¾-in.-thick particleboard, 8 in. wide by 40 in. long

Guide bar, hardwood, sized to fit miter slot on bandsaw

One jig, two legs, two angles. *The angled table (18°) and jig combine to cut a compound angle on both legs in one shot. A wooden guide bar on the bottom rides in the table's miter slot.*

mortises are laid out so that the ones in the face grain and the ones in the end grain can be routed with a single setup on the jig (and a 5/16-in.-dia., two-flute aluminum-cutting end mill). The secret is a spacer.

Rout the bottom mortises on the front rail. Then put the spacer between the rail and vertical clamping surface on the jig. This moves the rail out so you can rout the top mortises. I rout the entire through-mortise from one side of the rail, taking shallow cuts (about ⅛ in.). I don't use a backer block, because I've never experienced tearout with this type of end mill (it is an upcutting bit). Just don't take too big of a cut.

Now rout the mortises in the side rail's end grain, adjust the jig's stop block, and rout the double mortises that join the back rail to the side rails. Then set up to rout the vertical mortises in the front legs. Put a ⅜-in.-dia., two-flute aluminum-cutting end mill in the router and adjust the jig to center the mortises on 1¼-in.-thick material. Once that's done, adjust the jig to center the bit on 7/8-in.-thick material and rout the matching

CURVE THE FRONT LEGS

Fortune bandsaws all the curves on these chairs, cleaning up with hand tools where possible. For concave surfaces, he uses router templates.

Clean up with a router. A flush-trimming bit leaves a clean, fair surface.

Roundovers on the router table, too. Fortune uses part of a ¾-in. radius roundover bit to put a softer edge on these front legs. The pin at rear helps him enter the cut safely.

mortises in the end grain of the front rail.

Finally, rout the mortise in the back leg for the integral tenon on the side rail. The tenon is stepped, with a large base section that carries the weight, and a pair of smaller wedged through-tenons that lock the joint. Rout the mortise for the tenon's base first and then the two through-mortises.

Time for tenons

To make the slip tenons, start with two blanks milled to the final thickness and width. Rip a groove down both faces of one blank. The grooves give the glue a place to go. Next, round over the edges of both blanks to match the ends of the mortises. Finally, cut individual slip tenons
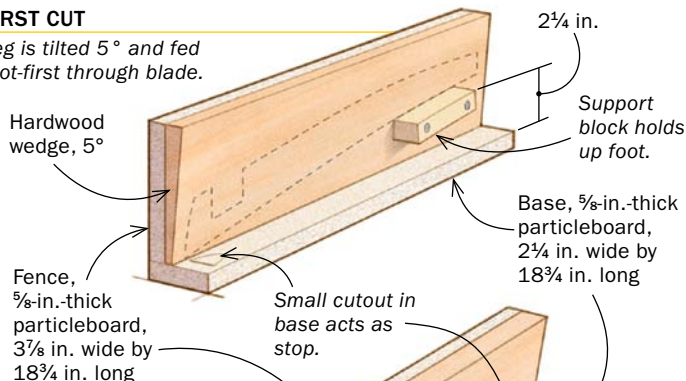
from the blanks. For the tenons that fit a stopped mortise on one end only, use a handsaw to cut a small kerf (with the grain) on that end. Now cut the integral tenon into the side rail. Start at the tablesaw, cutting the cheeks with a dado set. Then head to the bandsaw and cut the two small through-tenons. Finally, cut slots

NOW TAPER THEM

With their curves cut, Fortune bevels and tapers the legs with sleds. He holds them in place by hand, reaching past the blade when necessary.
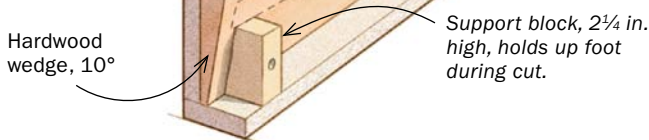
FIRST CUT

Leg is tilted 5° and fed foot-first through blade.

Hardwood wedge, 5°

2¼ in.

Support block holds up foot.

Base, ⅝-in.-thick particleboard, 2¼ in. wide by 18¾ in. long

Fence, ⅝-in.-thick particleboard, 3⅞ in. wide by 18¾ in. long

Small cutout in base acts as stop.

SECOND CUT

Leg is tilted 10° and fed top-first through blade.

Hardwood wedge, 10°

Support block, 2¼ in. high, holds up foot during cut.

Wedge-shaped fence is the key. *Tilting the leg into the blade creates an angle on the side and raising the foot (pushing it farther out than the leg's top) cuts a taper along the leg's length.*

Second jig for the second side. *The wedge's angle is double that on the first jig, and the leg is fed through the blade top-first, so it's raised on the trailing end.*
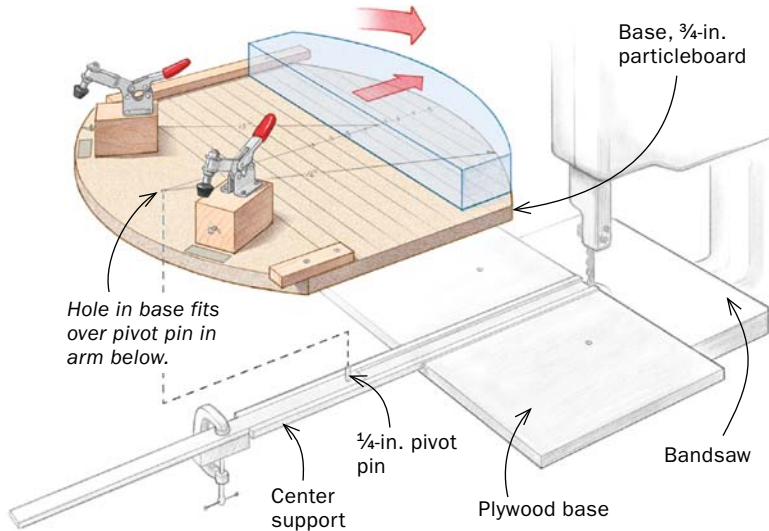
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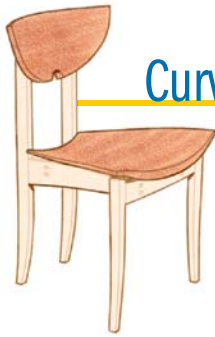
Curved seat and back: Stack and conquer

Rather than cooper the curved seat and back or sculpt them from solid slabs, both tedious techniques, Fortune cuts curved sections on the bandsaw and then simply stacks them. Little cleanup is required.
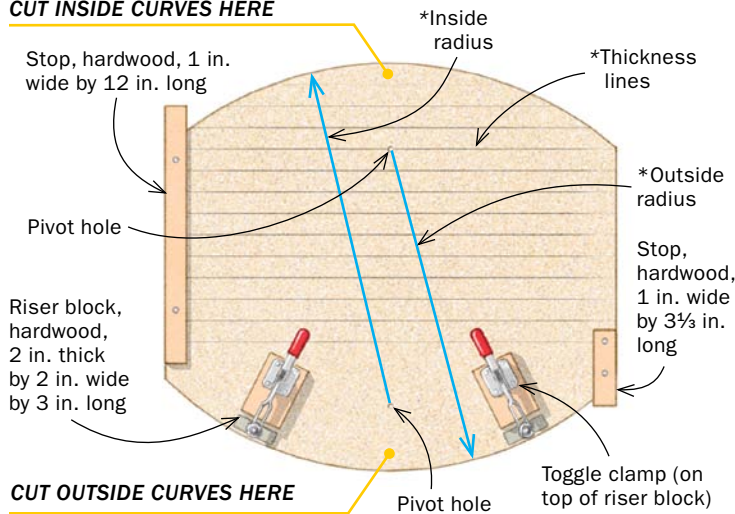
ANOTHER INGENIOUS JIG

*You'll need two of these, one to form the curved sections for the seat, and the other to handle the slightly different curve of the back. Both jigs work the same. The seat jig is 24 in. wide by 36 in. deep with reference lines 1⅛ in. apart. The one for the back is 21 in. wide by 19 in. deep, with reference lines 1 in. apart. *See plan (p. 65) for radii.*

CUT THE SECTIONS

Base, ¾-in. particleboard

Hole in base fits over pivot pin in arm below.

¼-in. pivot pin

Center support

Plywood base

Bandsaw

Cut the inside curve first. *No clamps are needed, because the force of the cut pushes the blank against the stop. But as the blank gets narrower, use a bit of hot-melt glue on the leading end.*

CUT INSIDE CURVES HERE

Stop, hardwood, 1 in. wide by 12 in. long

*Inside radius

*Thickness lines

Pivot hole

*Outside radius

Stop, hardwood, 1 in. wide by 3⅓ in. long

Riser block, hardwood, 2 in. thick by 2 in. wide by 3 in. long

CUT OUTSIDE CURVES HERE

Pivot hole

Toggle clamp (on top of riser block)

Other side now. *The other side of the jig has a smaller radius, so the blank ends up thinner at the edges than in the center, eliminating the need to taper it by hand.*

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in the tenons for the wedges and make the wedges.

Shape the parts and assemble the base

Now shape the legs and rails. Start with the side rails, which have a beveled taper on their top edges to accommodate the curved seat. (The beveled edge sits higher than the front legs and rail so that the seat clears

them.) Then cut the compound taper at the top of the back legs to fit the curved back. Clean it up with a block plane.

Next, cut the curves on the legs. Trace the profile from a full-size template, rough out the shape at the bandsaw, and then clean up the curves. Convex curves are easily smoothed with a handplane, but concave curves are trickier. For those, I

use a template and rout the parts flush to it at the router table—making sure to always rout down the curve and with the grain.

The front legs are also tapered along their length and across their width. Both tapers can be done at once at the bandsaw. I use an L-shaped jig that has a tapered shim added to its vertical side.

The rails are much easier to shape. Just

Cut it out at the bandsaw. *Use hot-melt glue to hold the blank in place. Fortune puts the blank in the cradle first and then adds a few drops of glue along the seams.*

USE A CRADLE FOR CONTROLLED CUTS
Again, you need one for the seat and one for the back.

Support, ½-in. particleboard,
4 in. wide by 19 in. long,
curve on top edge matches
outside radius of back

Base, ½-in.
particleboard,
9 in. wide by
19 in. long

5 in.

1½ in.

Clamp it up in sections. *Fortune starts by gluing up pairs of ribs and then glues those together into a single blank. Cauls across the blank's width keep the ribs aligned, which makes it much easier to smooth it.*
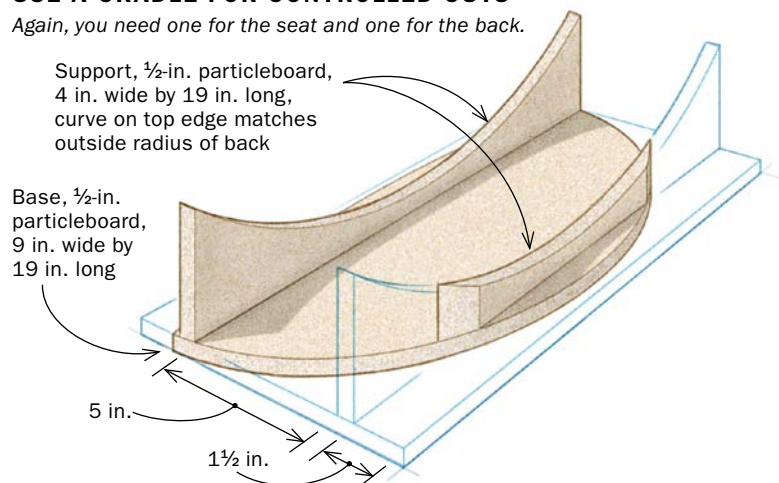
trace the curve onto the bottom edge, cut it out at the bandsaw, and rout it flush to a template at the router table.

After shaping the legs and rails, assemble the base. Glue the front rail to the front legs. Next, glue the side rails to the back legs. Wedge the tenons. Then glue the back rail between the two side rails and wedge those tenons. This creates an assembly made up of the back legs, back rail, and side rails. Let the glue dry. Finally, glue and wedge the side rails into the front rail. After the glue has dried, trim all of the wedges and tenons, cutting them close with a handsaw and handplaning them flush.

The secret to a comfortable seat

A chair is either made or broken by how comfortable it is. With traditional methods,

Soften the edges. *Fortune hogs off most of the waste with a Shinto saw rasp and then follows up with files (left) and sandpaper. To smooth the curves, use a sanding block that's been shaped to match the radius (right). Wrap the sandpaper around the ends of the block and staple it in place.*

Assemble in stages

To avoid making an unintentional rocking chair, glue up a single joint or subassembly at a time. Then add subassemblies together for a square, solid chair.

Slope the walls. *Use a rat-tail file with a diameter that matches the bit used to rout the mortise—5⁄16 in. for all but those mortises on the back legs (use a 1⁄4-in.-dia. file there). An angled guide block ensures that the shape is correct.*

Put glue in the mortises. *Spread some on the area around the joint, too, but not on the tenons. They'll swell and the joint will be much harder to get together. Assemble the front legs first. Fortune elevates the parts and uses shaped cauls to create a flat surface for clamping and protect the legs from the clamp heads.*

Then glue the side rails to the back legs. *Don't use a caul over the through-tenons. They need to stick out a bit for the joint to be pulled tight. Hammer in the wedges right away. After the glue is dry, the tenon won't spread for them. Also, sink them all the same amount so that after being flushed to the leg they are same thickness (looks better than wedges that vary in thickness).*

shaping the seat and back for comfort is difficult, but the technique I use on this chair makes it easy.

Both the back and seat are made by cutting curved ribs from large blanks and then stacking them on edge and gluing them together to create a curved blank. The concave side becomes the scoop that your back and backside rest against.

Because both the back and seat are made in the same way, I'll show you how to make only the back. Start with a flatsawn board. The grain exposed by the bandsaw cuts will complement the curve. Also, the board should be wide enough to

make all of the ribs (use a second board for the seat).

To cut the curves, I use my bandsaw and a modified circle-cutting jig. It has a large base that pivots on a center point. The blank sits on top of the base as I feed it through the blade. I then advance the blank 1 in. closer to the blade and make a second cut to free another rib. Repeat until you've cut out all of the ribs. The outside curve is cut from the other end of the base, so rotate it, adjust the centerpoint, and cut the curve on all of the ribs.

Next, edge-glue the ribs together to make the curved back blank. I do this in steps, first gluing up the ribs in pairs. Then glue all

Finish the base and attach the back. *When gluing the back rail between the side rails, Fortune dry-fits the front leg assembly to keep things square (left). Then, when gluing on the front legs, he clamps a board to the back rail (center), providing a large, flat clamping surface so that he can get a clamp on both sides of the two joints. Finally, the back gets pilot holes for the screws, making it easier to get the screw in (right) and preventing splits along the grain.*

the pairs together. After the glue is dry, I smooth the inside and outside curves using shopmade sanding blocks. I start with P120-grit sandpaper and work up to P220-grit.

Now shape the perimeter of the back. Because it's curved, you need a cradle to hold it: a piece of MDF for the base and two supports, both curved on the top edge to match the curve of the seat back. Draw the perimeter shape on the back and cut it at the bandsaw, with the table square to the blade. Sand the cuts smooth.

Finish the base, the seat, and the back. For a chair like this, I use Watco Danish Oil. Then screw the seat and back in place. ☐

Michael C. Fortune is a contributing editor.

Smart comfort. *Reminiscent of the classic chairs found at cafés, Fortune's design combines a welcoming seat and back with straightforward joinery. It's a chair you can build and that everyone will want to sit in.*

EASY TO CHANGE THE LOOK

A café-style chair isn't right for every dining table, but by adding 1⅛ in. to the height of the back legs and adjusting the back's dimensions, you get a more traditional dining chair.

17 in.

10 in.

Original back profile