Bowback Windsor Step by Step

Green woodworking lends its strength to this classic design

by Harriet Hodges

Strength belying its delicacy *is the hallmark of a Windsor chair, a trait it derives from the wet-dry joinery and the long, unbroken grain of the drawknifed, not sawn, pieces. The Windsor's classic good looks fit in almost anywhere.*

The rewards of building Windsor chairs are sweet indeed. From logs, I create objects of beauty and utility, strong but graceful, steeped in tradition and destined to last generations (see the photo at right). The process isn't difficult as long as you take it step by step.

Preparation

Before you start to make a bowback (or any other style) Windsor, you have to get green wood, preferably in whole log form. Split out, square and then round blanks for the back-bow, spindles, legs and stretchers. I use sugar maple for legs and spindles, pine or basswood for the seat and hickory for the back-bow.

You'll need to make a crude kiln to dry the tenons that go into wet mortises: Wet-dry joinery gives Windsors their characteristic strength. A cube of folded foil-faced insulation with a light bulb inside and plywood ends works well for me. Shape your spindles (see figure 6 on p. 96 for dimensions), and dry them for at least 24 hours. If you don't want to build a kiln, you can put the spindles in a gas oven with a pilot for 48 hours.

Drilling and shaping the seat

Using the seat pattern from figure 2 on p. 93, scale the pattern onto a piece of cardboard or heavy paper. Now set the blank on the bench, heart side down, and trace the pattern on it. Mark the centers of spindle, back-bow and depth holes. Mark leg centers on the top for reference in carving. You want to leave a lot of material around the legs for strength. Mark spindle sight lines (see figure 2). They will be used later to help drill the spindle mortises at the correct angles.

Cut the front profile of the seat, but leave the back waste intact so you'll have corners to clamp. Then set the pattern on the bottom, lining it up at the front and marking leg centers for drilling. Also, transfer the sight marks for the legs from the pattern (marks FL and RL in figure 2), and then draw sight lines, as shown. Next mark the centerline of the gutter, which defines where the seat carving begins and the plateau for the back ends.

Start drilling with the center spindle mortise. Set a bevel gauge to 8° back from perpendicular, and center its blade on the sight line. Use a ½-in. auger bit, and set a depth stop for 1½ in. Drill with a mirror set to the side of the bit and bevel gauge, so you can sight both angles at once (see the photo on p. 92). After the center spindle, drill in pairs, one mortise to each side of center. Change the bevel gauge's angle setting for each pair. Use a ⅜-in. bit to drill the back-bow mortises.

Turn test tapers now to match your reamer (see figure 5 on p. 95). The reamer tapers leg and back-bow mortises. Ream the back-bow holes from the top until the test taper protrudes below. Check angles repeatedly, aligning the center of the test taper, the blade of a try square and the sight line to get one angle right in one plane. Use the bevel gauge to check the angle in the other plane (see the bottom photo on p. 93).

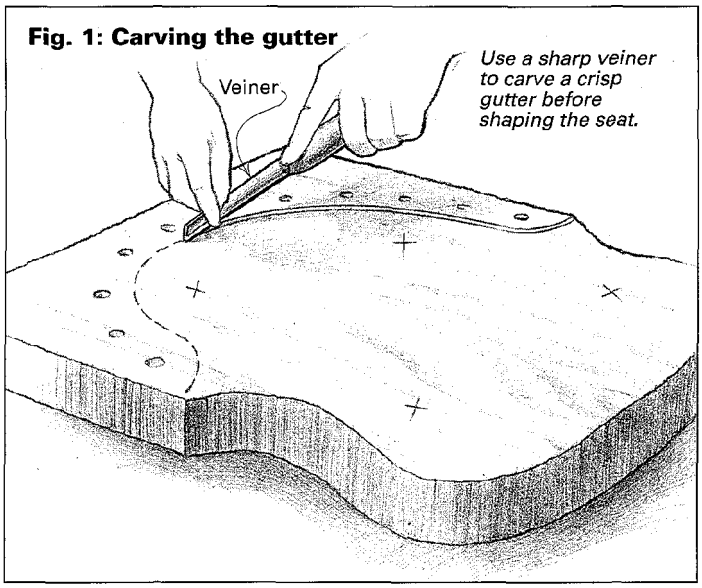
The first step in shaping the seat is to carve the gutter. Carving a crisp gutter requires a scalpel-sharp veiner (a carving tool that cuts a V-groove), see figure 1 on p. 92. Before you start removing more seat material, draw contour lines along the front of the seat and the forward part of the sides (see figure 2 on p. 93). Bore depth holes to ⅞ in. with a Forstner bit. Then have at it with an adze, inshave or large gouge. Proceed evenly, from the middle of the inner circle in figure 2, aiming for a shallow bowl that gradually deepens and widens. Bring in area A. Drawknife the front, spokeshaving when close to the line. Round the seat

Photos: Vincent Laurence

DRILLING AND SHAPING THE SEAT

Aligning brace and bit in two planes isn't difficult, *but it takes practice. Hodges positions a bevel gauge, set at 8° off perpendicular, along the sight line she'd marked previously for each spindle mortise. By keeping her bit in line with the bevel gauge in front of it and checking the mirror to make sure the bit remains parallel to the gauge, she can bore all the spindle mortises in about 10 minutes.*

Fig. 1: Carving the gutter



over slightly below the gutter. Undercut the underside at the front deeply, tapering into the areas under the gutter edge. Finish up with scrapers on the top, leaving the bottom spokeshaved. Saw the waste off the back.

The side S-curves are difficult, undulating in two planes, perpendicular to the floor at the back and twisting subtly. Use rasps and files as necessary. Look for symmetry between the two sides and for fluidity (see the top photo on the facing page).

Once you've shaped the seat, turn it over and bore leg holes, using the same mirror technique as the spindle holes. Ream them from the bottom until the test taper protrudes slightly all the way around, testing frequently for angles with the test taper.

Preparing legs and stretchers

I chose simple bamboo-style turnings for this chair. Bamboo turnings can be done with a gouge and just the tip of a skew, which is good news if you haven't done much turning. Note the positions of the bamboo nodes in figure 3 on p. 94. Be sure to sand the legs while they're still on the lathe.

Once you've turned the legs, lap them to mate with their mortises. Mark a heavy line down the reamed hole with a soft pencil. Twist the leg in the hole, re-chuck it and remove high spots. The end of the tenon should protrude slightly all around. Mark and match legs and holes for a permanent match; they're *not* interchangeable. I use stick-on colored dots.

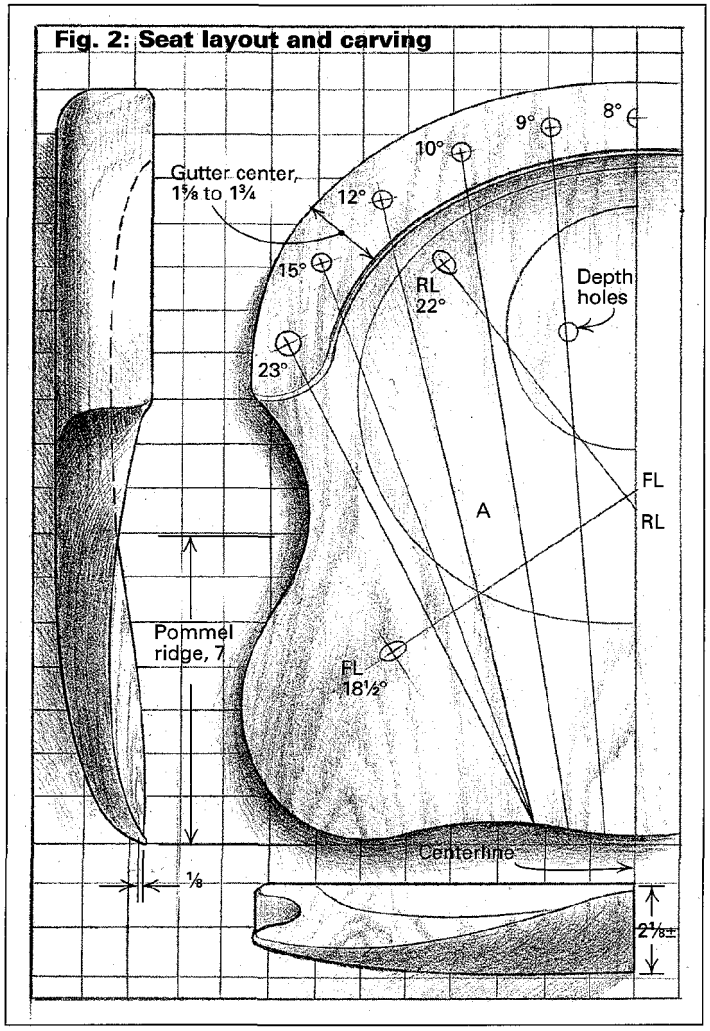
Insert all four legs in the seat with light mallet taps. You'll need to get the seat up on blocks, so the leg tenons will go to depth in their mortises. Orient the legs properly, turn the assembly upright and mark the top of the leg tenons for the direction of the sawkerf (note the orientation of legs and stretchers in figure 4 on p. 94). Kerfs must be perpendicular to seat grain.

Now flip the assembly back over, so the seat is back on blocks on your bench. Measure for stretchers at the centerline of the bottom node of the bamboo. To do this, choose a front-back pair, and mark the center of the mortise in one with an awl as you sight "through" its mate. Flip the assembly around and repeat. Now measure the distance between the two marks, add 2⅛ in. (for the tenons and chamfered shoulders) and you have the length of your stretcher. Repeat for the other side. It doesn't matter if the two stretchers are different lengths.

To get the length of the medial stretcher, first measure the distance between the front legs and the distance between the back legs. Use the same awl marks you made to drill for the side-stretcher mortises. Add those two lengths, divide by two and add ⅝ in. That's the length of your medial stretcher.

Cut stretcher stock to exact lengths and turn, making tenons exactly 1 in., chamfers ⅛ in., but leave the tenons slightly thick. Center the nodes on the side stretchers; space two equidistant from each other and the chamfers for the medial stretcher, Sand them on the lathe, and make sure to turn a couple of extras for test-fitting. Now wrap legs and stretchers tightly in aluminum foil, leaving just the tenons exposed, and dry them in your kiln for 48 hours—no more. Then re-chuck all legs and stretchers, and sand lightly to take down the grain raised by heating them in the kiln.

Drawings: Bob La Pointe



SEE ERRATA AT END OF ARTICLE

Much of a Windsor's alluring grace is found in the seat, *particularly in the S-curve on the side. The transition from a horizontal to nearly vertical surface over just a few inches requires a good eye and sharp tools to make it feel natural. Hodges uses a drawknife for starters, followed by rasp, file and spokeshave.*

A reamer (to the left, on the seat) is used to taper the chair-leg mortises. *Bore the mortises for the chair legs, using a mirror to get the angles right. Then use a bevel gauge, protractor, square and test taper to check the angles and mortise depth as you ream. A reamer in a tap wrench can be used to pare selectively within the mortise to get the angles just right.*

Assembling the undercarriage

Boring and assembly require concentration and speed. Assemble the chair upside down on the bench on blocks, orienting each leg properly in the correct mortise. Scribe around each leg at the seat.

To check the leg-stretcher angles, set a rule along each side pair of legs. Then set a bevel gauge against the rule, and adjust it so the blade is in line with the center of a leg, rear first, then front (see the photo on p. 94). Record these angles for boring the side-stretcher mortises.

Lay another rule across the first, snugging it against either both back or both front legs. With the bevel gauge, record the acute angle where the two rules meet. This is the medial-stretcher angle.

Place side stretchers on the seat with their tangential planes up. Put the medial stretcher between them, radial plane up. Pick up side stretchers with your thumb and middle finger opposing, each in the middle of an "ellipse," right at the center of the tangential face of the stretcher. Now prick a mark with an awl on the node ring halfway between your fingers, or right in the middle of the radial face, to locate the mortise for the medial stretcher.

The next step is to size tenons. Accuracy is a must. Use test pieces until you get a perfect fit, and *then* go for the real thing. File a test tenon very slightly in the radial planes, exaggerating the oval. Chamfer ends slightly, so they won't bind just as your tenon enters a test board. Use a piece of scrap maple with a ⅝-in. hole in it to test the fit. If the tenon slips right in, try a smaller bit. If it won't penetrate with moderate blows, it's too wide. A drive plate is wonderful for sizing tenons because it removes such a small amount at a time. Failing that, either file or re-chuck in your lathe. When you have a tenon that fits well, record its diameter with dial or vernier calipers. Then file flats on its radial planes, swab glue in the ⅝-in. hole in the maple test board and on the end of the tenon, and pound it home in the test mortise. Wait a minute. Try to pull it out or twist it. If you can't—and the mortise didn't split—that's your tenon dimension. Now size all tenons for real.

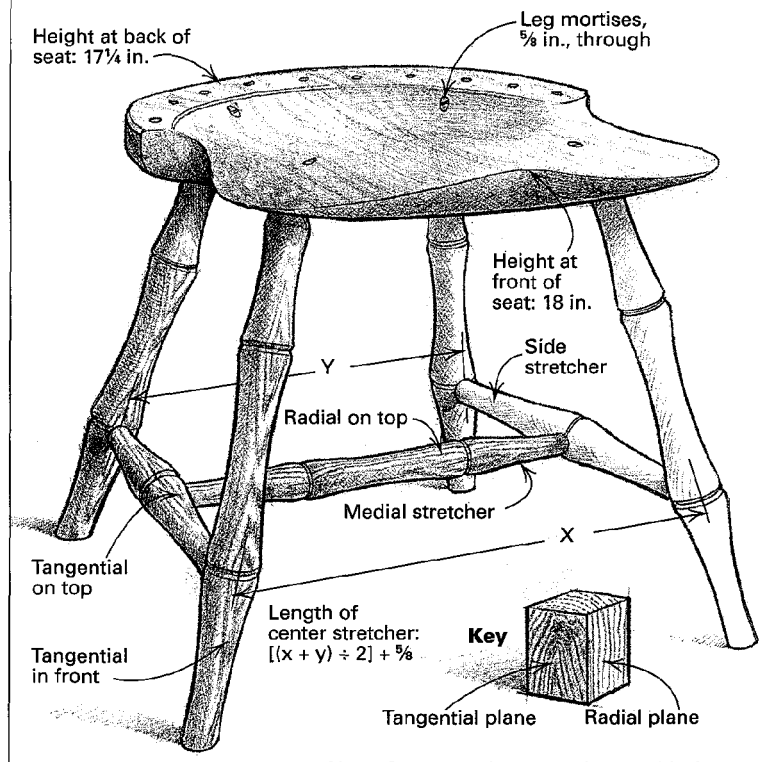
To avoid confusion in drilling, point the leg tenons toward you. For the two stretchers you'll mortise, draw arrows that will point toward you as you drill at an acute angle. You don't need jigs: Hands and eyes are capable of more than enough accuracy. Set the seat on blocks upside down on the bench for test fits. Do the stretcher assembly first. Pick up a side stretcher, note the angle you wrote down for the medial stretcher, set your bevel gauge and place the stretcher in a vise to hold it without rocking while you drill. I use a three-peg vise, which works well and takes only minutes to make (see the photo at left on p. 95). Place the bevel gauge alongside the stretcher, the acute angle pointing toward you. Set a mirror to the side, so you can see both bit and bevel gauge simultaneously while drilling. Don't worry about being a little off. This step is forgiving, too.

Bore the mortise so it's at least 1⅛ in. deep. Relieve the acute-angle side of the mortise, so the chamfer on the medial stretcher doesn't get hung up. Clean any chips or sawdust out of the mortise. Orient the medial stretcher correctly, and coat its tenon thinly with glue, particularly the end. White glue's a good idea until you're confident you can deal with the quicker set-up time of yel-

MAKING THE UNDERCARRIAGE

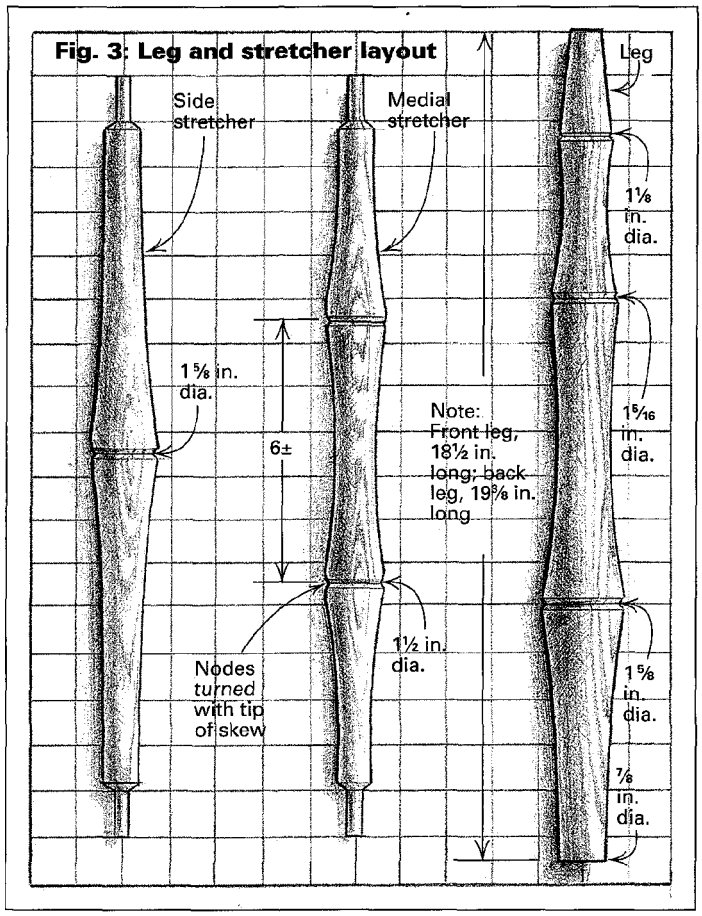
Double-check the leg angles before boring the stretcher mortises. *Using a straightedge to establish a plane between the front and back legs, the author checks the leg-to-seat angles to make sure that the stretchers will be parallel to the seat.*

Fig. 4: Seat and undercarriage assembly



Note: Correct grain orientation is critical to the strength of Windsor chairs.

Fig. 3: Leg and stretcher layout



low glue. Pound the tenon home with a mallet. Now bore the other stretcher, and pound in the other tenon in the same plane. If it needs correction, twist as you pound.

Take up a rear leg, bore the side-stretcher mortise, glue its tenon and pound it into the leg mortise a little. Seat the leg (dry) in its hole with the stretcher assembly attached. The medial stretcher should be parallel with the seat. It probably won't be, so correct it by pounding at the other end of the stretcher assembly while twisting it (see the photo at right on the facing page). Check again. Remove the leg from the seat, and pound the stretcher home. Be quick because the kiln-dried tenon is swelling from the moisture reintroduced by the glue. Bore the other rear leg, and keeping both legs in the same plane, pound the glued stretcher tenon home.

Reset the bevel gauge for a front leg, bore the mortise, glue its tenon and insert it in a little way. The top of the front leg should fall slightly to the outside of the line described by the back leg as you look across the pair. Treat the last leg in the same way—except now you can use its mate for alignment.

Kerf the leg tenons almost to the scribe line you marked showing their depth in the seat. Turn the seat upside down on blocks, swab the mortises with glue and work glue into the sawkerfs. Set the lower assembly in place, each leg tenon in its mortise. Pound legs down alternately, listening for the thunk that says it's done. Turn what is now half a chair over. Hammer in glue-smeared wedges.

Back assembly

The next step is to bend the back-bow. I steam the piece for about 45 minutes in a length of 4-in., schedule 40 PVC pipe with a cap glued on one end and a couple of rags in the other end. My steam generator is a tea kettle on a hot plate. The steamed back-bow goes into a plywood bending form the shape of the interior of the bow.

Holding parts securely is more than half the battle. *Hodges uses three pegs and a wedge in her shaving horse, but a shoulder vise with wooden jaws also could be used. Either way, blocks should be used to keep the workpiece from rocking while you're drilling.*

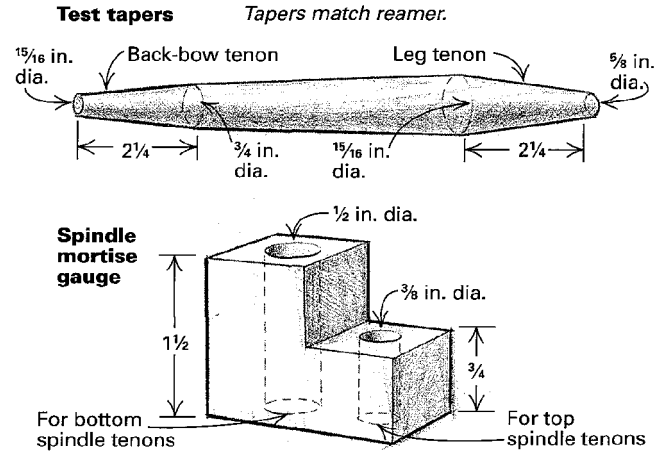
Work quickly once you've started attaching the legs to the stretcher assembly *because glue in the leg joint will cause it to swell in no time, freezing the joint in place. Once you've adjusted the stretcher assembly so that it's parallel with the bottom of the chair, pound the tenon home.*

After drying the back-bow in the bending form for about a week, stick its tenons into hot sand or under a light bulb in an aluminum reflector for at least four hours. Sand can be heated easily in a cake pan or skillet on an electric range top. After four (or five or six) hours, test-fit the back-bow tenons in the seat mortises. Pare the tenons until they protrude below the seat at least 3/16 in. Mark tenons left and right, scribe around them at seat level and mark kerf lines, perpendicular to the seat grain. Chamfer the tenon ends.

While the tenons are drying, make a simple support fixture to steady the back while you drill for spindles (see figure 7 on p. 96), but wait to notch the top until after you've fitted the bow. Set the back-support fixture in place 90° to the seat in the center-spindle mortise. If the top of the back's arc doesn't coincide with the center of the seat, mark the true center. The center spindle must be perpendicular. Mark off spindle locations with dividers and pencil using the measurements in figure 2 on p. 93. Fix each line with your eye over its respective spindle mortise in the seat, and without moving your head or your gaze, use an awl to mark on the line at its center on the bow. This center is important because there's not much wood to spare.

Bore the spindle holes with a 3/8-in. auger bit. In addition to the back-support fixture, I sometimes use a 1/2-in. dowel or a pair of all-thread rods connected with washers to steady the bow further and to drill true (see the photo on p. 96). I also use the mirror to stay true in the other plane. What you're trying to do is to sight "through" the bow to the spindle mortise in the seat, even though the bow's obscuring it. Begin perpendicularly to an imaginary tangent at the bow's surface, and then bring the bit gradually up to the correct angle within 10 turns. Bore until you can just feel the tip of the drill. Repeat for the rest of the spindle mortises in the bow, and then remove the back and finish the holes from the other side.

Fig. 5: Test tapers and spindle gauges



Make a spindle-tenon test gauge (see figure 5), and size all the bottom ends of spindles to fit snugly. Insert them in the spindle mortises in the seat, place the back just behind the spindles and arrange the spindles, so they're lined up with their corresponding back-bow mortises. Mark spindles with a pencil where they intersect the back-bow bottom and again 1/2 in. above the back-bow top. Cut them at this top mark. Now mark them, L1, R1 and so on, and scribe a line around each at its penetration into the seat.

Remove the back-bow. Remove the spindles and shave their tops, so they will slide easily into the spindle mortises in the back-bow down to the lower intersection. Chamfer the spindles heavi-

ASSEMBLING THE BACK

A wooden back-support fixture keeps the back-bow steady *as Hodges drills spindle mortises in it. Two pieces of metal rod connected with nuts serve as a visual guide to keep her bit aligned with the spindle mortise in the seat.*

Fig. 7: Back support fixture

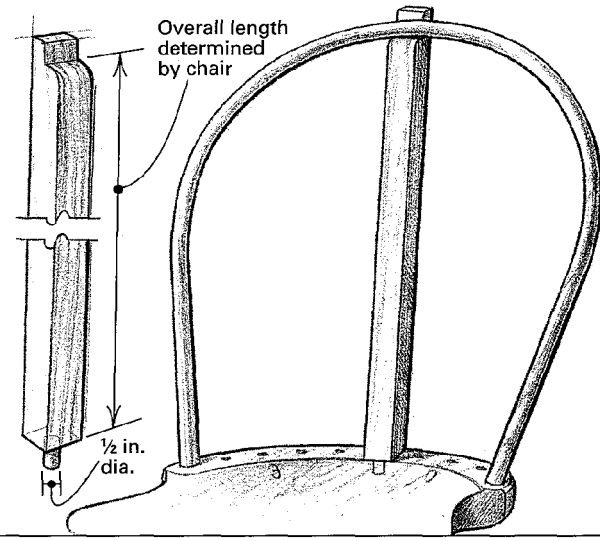
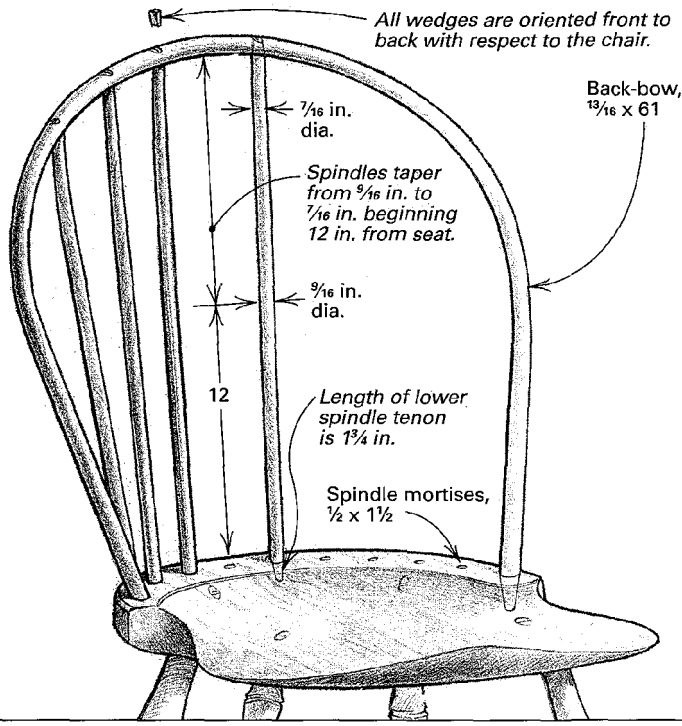


Fig. 6: Back assembly

Thickness dimensions are green and will shrink.



ly on top, and replace them in the seat. Test-fit the back, reaming spindle holes very lightly or shaving from a spindle as necessary. Draw a line down the spindle fronts and onto the seat, so you can replace them in the same orientations. Now cut them off level ¼ in. (on the short side) above the chair, and mark for a kerf across their tops—perpendicular to the grain of the back-bow. Make sure the line at the intersection of the underside of the bow and the spindles is well-marked. Now disassemble the back; re-chamfer the spindle tops; kerf all spindles at the top, nearly to the line below the bow; and kerf the back-bow tenons nearly to the seat-depth scribed lines.

Lightly brush glue in seat holes, two at a time. Insert spindles. Brush glue in the back-bow holes, and with a mechanic's feeler gauge (or anything else that's thin, flexible and won't self-destruct with glue on it), work glue into all the wedge kerfs. Start spindles into their mortises in the back-bow, and then start the back-bow into its mortises in the seat. Pick up the mallet and a scrap of wood, and moving from side to center to alternate side, hammer the back down. Wiggle recalcitrant spindles. Sometimes the sharp points of the bow tenons hang up in their holes. If they do, pull forward on the bow while hitting it. When the bow tenons reach their depth mark, that's it.

Smear glue on the spindle wedges, and hammer them home. Turn the chair upside down, and insert wedges in the bow tenons. Look for gaps in the fit, inserting little wedges wherever you can get them. When the glue has set, saw the spindle, back-bow and leg tenons almost flush; then chisel, scrape and file to finish. Level the legs, and chamfer their bottom edges so they won't split when great-grandchildren skate the chair over a floor. Finally, sand, raise the grain, sand again (to 180-grit) and fill small gaps.

Finish

Paint makes the chair read as sculpture. I use milk paint, which is not like other paints. Practice with it. Penetrating-oil topcoats will make a chair water resistant. This finish gives off a soft glow and is extremely durable. Virtually unchippable, it is only burnished by the years. □

In addition to building Windsor chairs and settees, Harriet Hodges raises sheep and harvests chair wood on a Craig County, Va., farm. She is also the indexer for Fine Woodworking.

Further reading

Magazine articles

"Working Green Wood" by Harriet Hodges, *Fine Woodworking* #108, pp. 90-93

"Steam-Bending Basics" by Andrew K. Weegar, *FWW#*107, pp. 62-66

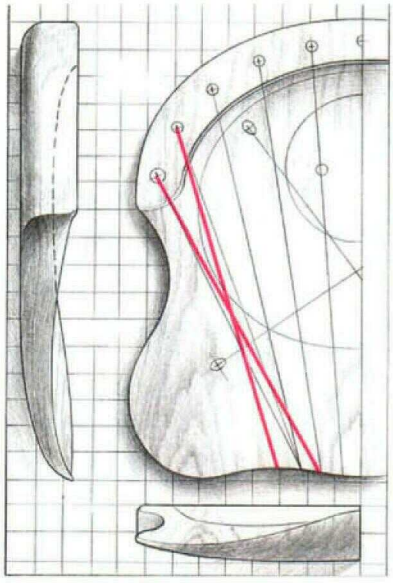
"Milk Paint" by A. Richard Fitch, *FWW*#91, pp. 62-65

Books

Make a Chair from a Tree by John D. Alexander Jr., Astragal Press, Mendham, N.J., 1994

Make a Windsor Chair with Michael Dunbar, The Taunton Press, Newtown, Conn., 1984

Errata—There was an error in one of the drawings that accompanied an article by Harriet Hodges on making a Windsor chair in *FWW* #109, pp. 91-96.



Two of the sight lines you would use to align your bit when boring holes in the seat were shown incorrectly in the drawing. The correct lines are shown in color on the drawing at left.

Hodges would like to acknowledge Curtis Buchanan, Tennessee Windsor chairmaker, and David Sawyer, a Vermont maker, as the sources of the design for the chair shown in the article.