

Wooden Planes

A small investment in time and materials yields a tool that performs beautifully

by David Welter



Making planes is one of the first things we teach in the College of the Redwoods' furniture program. These tools are essential to cabinet-making, and making one or two of them is a good way to get started. Although construction requires care, making a plane is not a difficult process, and a wooden plane is not a fussy tool to adjust or maintain. Best of all, these planes are a delight to use.

The plane body can be made of any dense, stable wood. People like the romance of an exotic hardwood; its weight feels good in use. But it can be disappointing to experiment with a precious commodity. Maple is an excellent choice for a

first plane. Cherry, hickory, locust and black walnut are other suitable common materials. Look for stock that's fairly straight-grained. A plane built from stock with tension in it will be a perpetual aggravation.

Unless the wood you've chosen for the body of the plane is especially dense and hard, you will need a tougher wood for the sole, one that is fine-textured, dense and polishes up well. Lignum vitae is the best, but it can be hard to obtain. Gongalo alves has served our shop well for years. The thickness of these dense woods should be kept to under $\frac{3}{16}$ in.

We use the short, thick irons made by Ron Hock for the planes we make at the school

(Hock Handmade Knives; 707-964-2782). You can also use a standard plane iron.

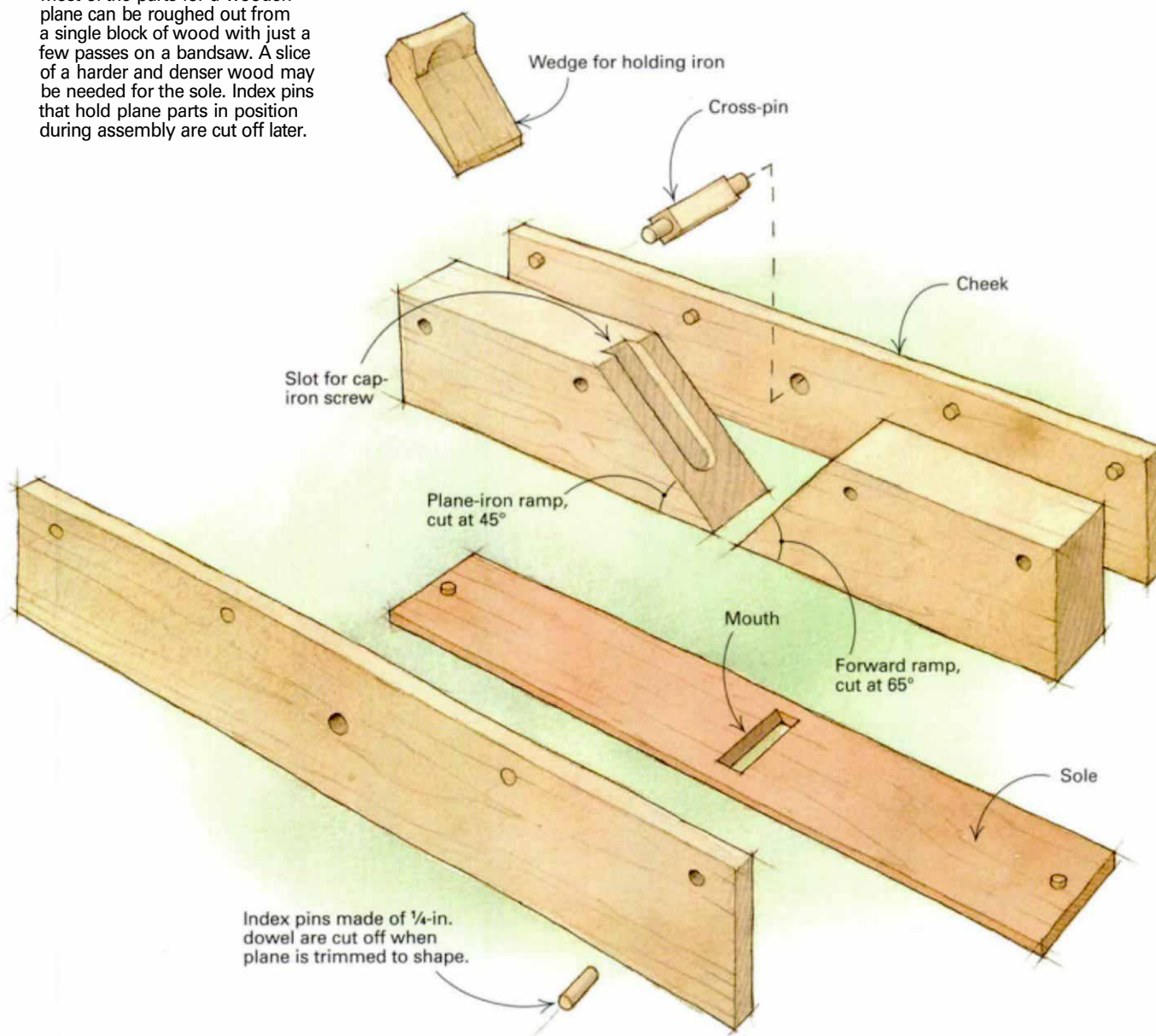
Start by squaring up the block

A wooden plane starts with a block of wood that will be sliced into three sections: the body and two cheeks. There's a certain appeal to having a plane constructed from a single block of wood, but the stock also may be built up from two or more pieces. Keep balance in mind if the stock needs to be built up. The thickness of two or more joined pieces should be the same.

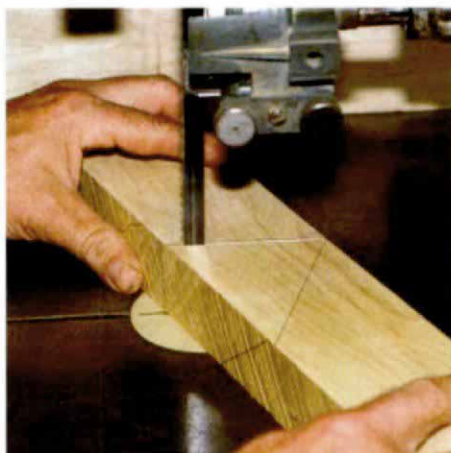
Minimum height for the plane blank is about 2 in. Its width is determined by the choice of plane iron, plus a finished di-

SAW A PLANE BODY FROM A SINGLE BLOCK OF WOOD

Most of the parts for a wooden plane can be roughed out from a single block of wood with just a few passes on a bandsaw. A slice of a harder and denser wood may be needed for the sole. Index pins that hold plane parts in position during assembly are cut off later.



Cut stock in three pieces. Two passes on the bandsaw divide dimensioned stock into two cheeks and a center block.



Divide body in two. Cut the center block to create the halves of the plane body—a forward and a rear block.



Save the wedge. The triangular offcut will be used later to make a wedge for the plane iron. Don't throw it out.

mension of $\frac{5}{16}$ in. for each cheek. To the width of the iron, add $\frac{1}{16}$ in. to get the finished width of the center block of the plane. The extra room allows the iron to be pivoted so it's parallel to the sole without binding. Safe margins for bandsawing a solid block require 1 in. in addition to the plane iron's width; make that $1\frac{1}{4}$ in. if tablesawing the block. After jointing and thickening the block, mark the top of the plane with a cabinetmaker's triangle to serve as a reference during assembly.

Cut the cheeks, and lay out the mouth

After cutting the cheeks on either a band-saw or tablesaw (see the far left photo on the facing page), lightly plane the mating faces of the center block and the cheeks. Plane only enough to remove the mill marks—you want the stock faces parallel.

The location for the mouth of the plane is laid out on the center block. The mouth opening should be somewhat forward of center. The exact location is not critical. Because you most often push a plane, the back absorbs most of the effort. But a somewhat longer than usual fore section helps get the plane started correctly.

A plane-iron ramp of 45° serves well for general purpose work (see the drawing on the facing page). Exactness of that angle is less important than ensuring that the ramp is flat and square to the sides. The forward ramp, cut at about 65° , may be mildly concave to allow a little more finger room for clearing shavings. If you take this extra step, leave the lower $\frac{1}{4}$ in. at the original 65° rather than running an arc to a feather-edge at the throat opening. We cut the ramps on a bandsaw and true them up with a plane (see the center photo on the facing page). You could also use a tablesaw or a power miter saw. Save the cutout. It will be useful later.

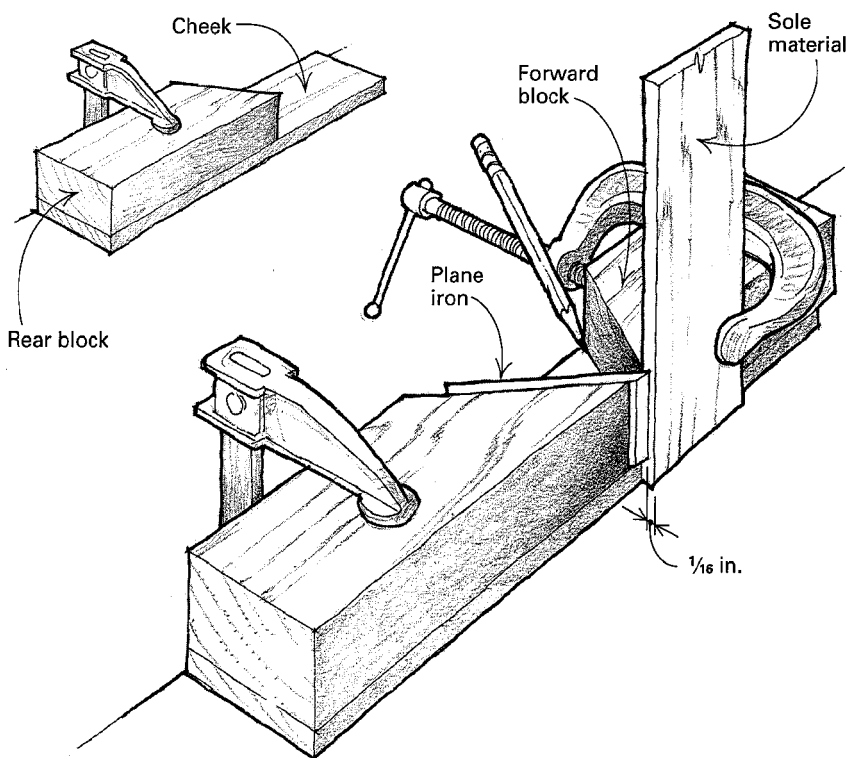
Fitting cheeks to plane body

To establish the positions of the forward and rear blocks, you will need the sole stock in hand. Sole stock about $\frac{1}{4}$ in. wider than the plane body will allow a margin of adjustment in alignment. Lay one of the cheeks on the bench with the inside facing up, and place the rear block on it (the back end of the block can protrude slightly beyond the end of the cheek). Clamp the block and cheek to the bench, and draw a pencil line along the 45° ramp on the cheek.

Clamp the sole onto the bottom of the forward block, aligning one edge of the sole

POSITION AND INDEX THE PLANE BODY

To locate the forward block correctly, start by clamping the rear block to one cheek on the bench and the forward block to the sole material. One edge of the sole should line up with the bottom edge of the forward ramp. The forward block is then shifted until the plane iron can come within $\frac{1}{16}$ in. of the outside surface of the sole. Mark the cheek here.



With blocks clamped, index the body. The author drills through the plane cheeks into the body to set the indexing pins.



Index pins made of $\frac{1}{4}$ in. dowel hold plane parts in position during assembly. They will be cut off after the plane is finished.

with the edge of the ramp (see the drawing above). Place the forward block and sole onto the cheek that's been clamped to the bench, and put the plane iron (bevel down) on its ramp. Set the iron to near cutting depth, and slide the forward block back until the sole contacts the cutting edge of the iron. Juggle the position of the blade and block until the blade touches the sole about $\frac{1}{16}$ in. below the outside surface. Now mark

the forward ramp's location on the cheek. When the plane is assembled with the center blocks in this position, the iron will not quite come all the way through—exact fitting will come later.

Using the lines marked on the cheek as a reference, position the center blocks between both cheeks, and clamp all three pieces together. To keep the relationship of the parts definite, index each cheek onto

both center blocks with 1/4-in. dowels (see the photos on p. 69). Place these index pins as near as possible to the ends or tops of the cheeks so they can be cut off when the plane is trimmed to shape.

Layout for cross-pin must be exact

Before the three pieces of the plane body can be glued together, you must cut a slot into the center of the rear block to accommodate the cap-iron screw, and you must make a cross-pin. The slot can be chopped, routed or sawn. Cut it a little deeper than the screw head is thick, about 1/8 in. wider than the screw head, and stopped about 3/4 in. from the bottom of the ramp (see the photo at right).

The center of the cross-pin falls at the intersection of two lines: one perpendicular to the bottom and the other parallel to the plane-iron ramp (see the drawing below). The pin should be high enough in the plane to allow your fingers to clear shavings from the throat and low enough for the wedge to exert pressure near the working edge of the iron.

As the drawing shows, the center point is



A slot for the cap screw—The rear block is slotted with a 3/4-in. router bit to accommodate the cap screw on the plane-iron assembly.

established on the inside of one of the cheeks. That point will need to be transferred to the outside of the other cheek so that the cross-pin holes will be in line with each other. Square a line starting from the center point to the top of the cheek, across the top of the plane and then down the outside. Measure up that line, from

the bottom, the same distance.

The 5/16-in. holes for the cross-pin tenons can now be drilled. Drill through both cheeks from one side to guarantee that the holes will be in line (we use a horizontal boring machine, but you could use a drill press). Use the center block cutout to back up the hole while drilling to prevent blowout when the drill exits the stock. If the hole is drilled crookedly, the wedge won't grab the plane iron evenly.

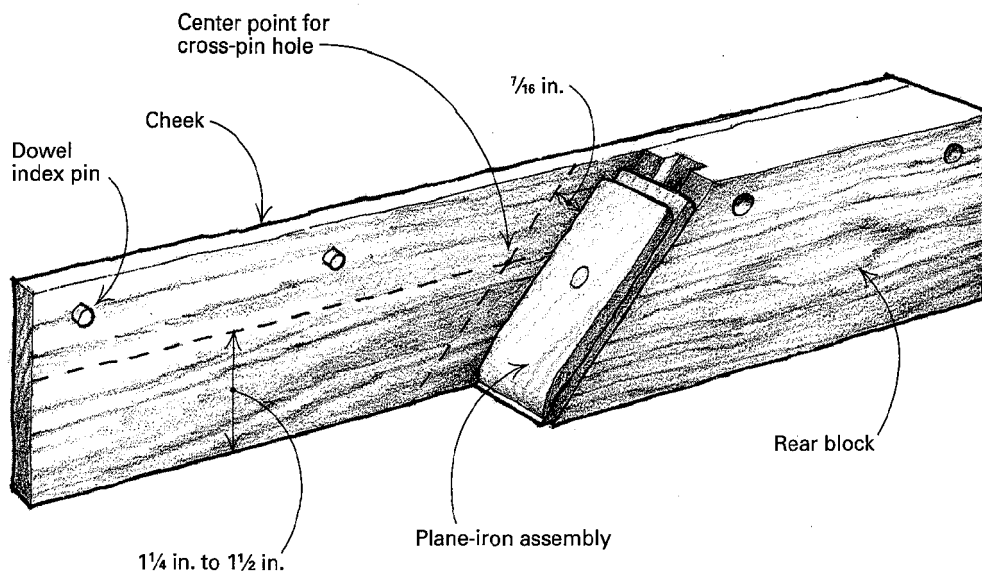
First a cross-pin, then a test-fit

To make the cross-pin, dimension a 12-in. length of stock to 1/2 in. sq., which is more than you need. With this extra length, your hands will be well out of the way when you rough out the tenons in a crosscut sled on the tablesaw. And as long as the saw is set up, cut an extra pin as a backup. The length of the pin between the tenons should be slightly less than the thickness of the center block (see the top photo below). Once the tenons have been cut, the pin can be separated from the stock.

Trim the square tenons to fit the round holes with a knife or chisel, fairing with a file if need be. Test the size of the tenon in

SHAPE AND LAYOUT CROSS-PIN

A 5/16-in. hole is bored in each cheek for the cross-pin. To find the center point of the hole, lay the rear block on one cheek, and place the plane-iron assembly on the ramp. The hole is drilled at the intersection of two lines: one 7/16 in. away from the plane-iron assembly and one 1 1/4 in. to 1 1/2 in. up from the bottom of the block.



Cheeks should not pinch the cross-pin. When cut correctly, the cross-pin can rotate freely in holes bored through the cheeks.



Spacing should be even. A thin strip of wood helps the author make sure the distance separating the cross-pin from the iron is uniform.

a hole drilled in scrap stock. The cross-pin should turn freely when in place.

All the parts are now made (see the photo at right), and when you assemble them, you'll get your first look at a nearly completed plane. You still need to check that the space between the plane-iron assembly and the wedge is uniform. One way to do this is to make a tapered gauge from a thin piece of wood (the gauge also will serve as a template for making the wedge). With the plane-iron assembly in place, push the gauge between it and one end of the cross-pin (see the bottom photo on the facing page). Mark the gauge at the point where it becomes snug. Move the gauge to the other end of the cross-pin, and compare the point of snugness to the mark. Make adjustments by planing the pin, ensuring that the surface is kept straight. Note left and right on the pin if an adjustment is made.

Reach into the mouth opening to make sure there is enough finger room to clear away shavings. The cross-pin can be whittled down or the forward ramp adjusted so that the throat is accessible. Ease the corners of the pin that face away from the plane iron. Those soft corners will be easy on your fingers.

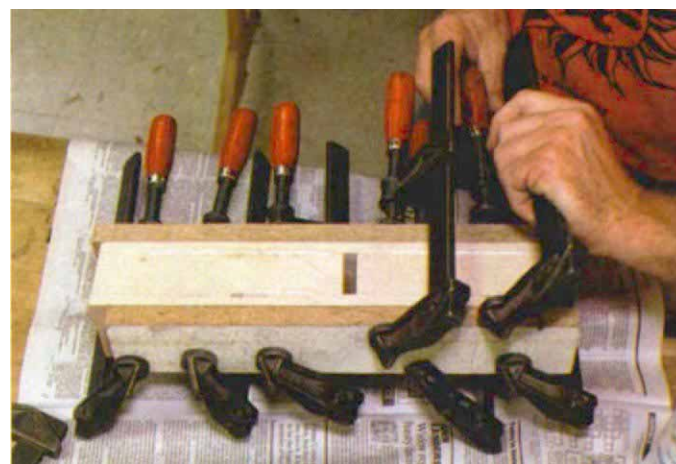
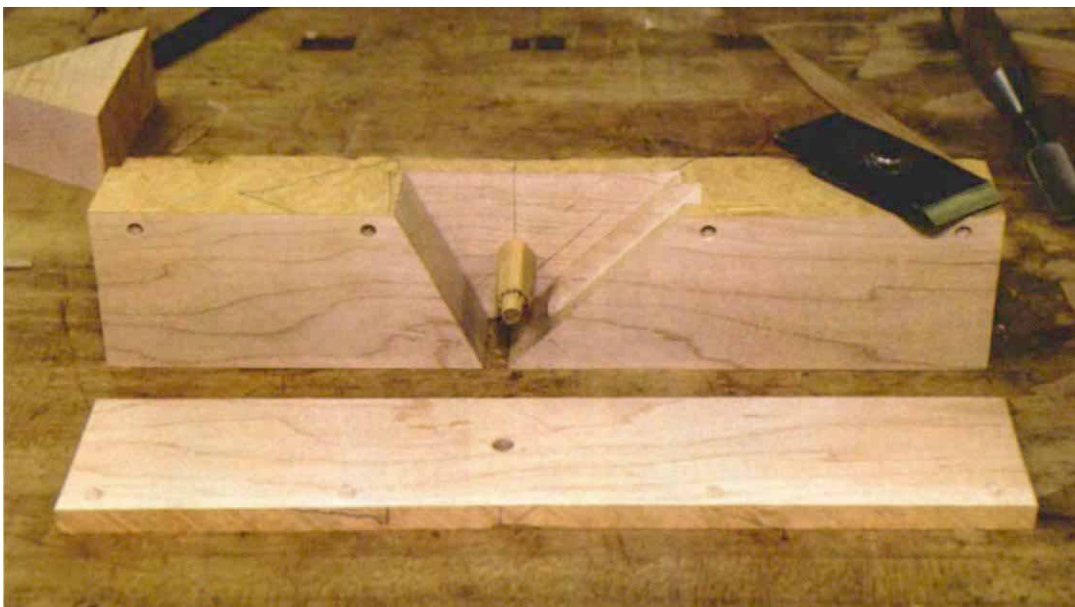
Don't skip the final dry-fit

A dry run of the glue-up greatly reduces the chance of disappointment. Make sure that neither the index pins nor the cross-pin tenons protrude beyond the cheeks (if so, they will interfere with the cauls used in glue-up). Use $\frac{3}{4}$ -in. cauls the same size as the cheeks both to protect the wood and to disperse clamp pressure.

Have enough clamps on hand to be able to place them 2 in. to 3 in. apart. When the clamps are in place, be sure the cross-pin rotates. If the shoulders are tight, they might prevent the cheeks from coming home. Alignment of the center blocks can be ensured by clamping them down to a block or bench before clamps are applied to the cheeks. Once a few clamps are in place, the first ones can be removed.

I like to have newspapers and a damp rag on hand for the glue-up. Leave the cross-pin in one of the cheeks. Spread glue on the first cheek, staying about $\frac{1}{2}$ in. away from the mouth opening. Position the center blocks onto the glued surface, and apply glue to the dry sides. Then place the second cheek, and start clamping. Remove any glue squeeze-out from the mouth opening with a stick and a damp rag.

The clamps may be removed after sever-



***Test-fit**—With a cross-pin fitted in one cheek (above), the plane parts are brought together for a dry-fit before the author reaches for the glue bottle.*

***Glue at last.** Cauls should be about the same size as the plane cheeks to ensure that clamping pressure is spread evenly. The author uses ordinary white PVA glue to bond the parts.*

al hours, but the glue should cure at least overnight before doing further work. When the assembly has dried, the bottom of the plane may be trued with light passes on the jointer.

True up the plane body with a wedge installed

The pressure of the wedge against the iron can cause distortion in the bottom of the plane. That condition can be taken care of in this truing process. Cut one scrap of wood that represents the plane-iron assembly in width and thickness and another for a temporary wedge. Place the faux iron in the plane, and seat the wedge firmly, but not aggressively. Resist the temptation to skip making the stand-in iron from wood. An iron that vibrates loose while jointing will most likely lead to disaster.

Care must be taken that jointing is done parallel to the bottom of the center blocks. Check as the work progresses that the throat opening appears squarely across the bottom. When the surface has been

cleaned up, check the trueness on the jointer table by pushing on each corner of the plane body in turn. If the opposite corner lifts off the table, there is still an inaccuracy to deal with. If squareness of the sides is an issue, square them in reference to the bottom after it has been trued.

Adding the sole and wedge

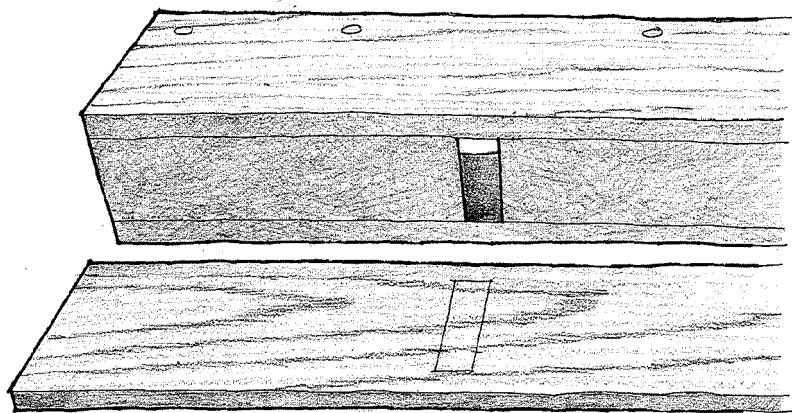
The opening for the plane iron in the sole must now be laid out and cut. Before you do, though, determine which end of the sole piece should be at the front of the plane. Run your fingertips lightly from one end to the other. A sensitive touch will reveal that one direction is smoother than the other. Orient the sole so the fur runs from front to back. The drawings on p. 72 show how the slot is laid out and cut in the sole.

When you do the glue-up, use cauls on the top and the bottom. The top caul should span the mouth opening to allow the clamps to be placed uniformly along the plane's length.

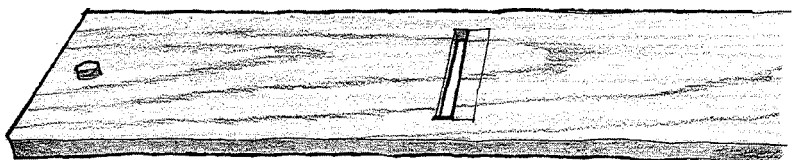
While the glue is drying, the wedge can

LOCATE AND CUT THE MOUTH

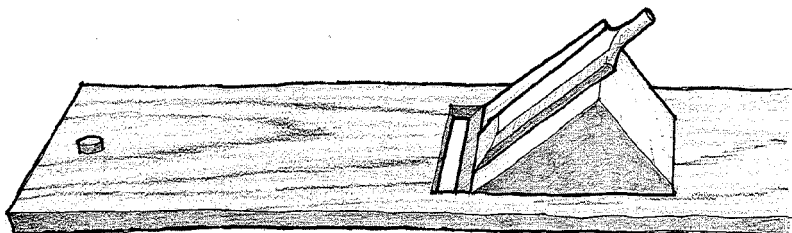
The best time to cut a mouth, or opening, for the plane iron is before the sole is attached to the body of the plane.



1. Lay the plane body on the sole, and mark the outline of the opening.



2. Cut the slot with a chisel or router, $\frac{1}{8}$ in. wide for a standard iron and $\frac{1}{4}$ in. wide for a thick iron. Position the sole on the bottom of the plane body so the iron comes within $\frac{1}{32}$ in. of the bottom surface of the sole. Ideally, the forward edge of the slot will line up with the forward ramp. Clamp and index the sole.



3. Take the sole off the plane, and carry the 45° angle through the sole, using the offcut of the center block as a guide. Now glue the sole to the body.



Cleanup—The author uses a chisel to make sure the plane iron ramp and the bevel in the slot are in line.



Square up the throat. A file fine-tunes the throat opening. To avoid tearout, cut on the push stroke only.



Center block offcut becomes the wedge. The author details the plane's wedge, which should be cut to a slope of 6° to 8° . A flat at the back presents a good surface for the hammer.

be roughed out. Its slope is critical. It should allow for a short range of tightness. If the slope is too slight, the wedge can be driven to an excessive degree; if the slope is too great, the wedge will be either loose or tight and tend to pop out. A slope of about 1:10, or 6° to 8° , is just about right.

The offcut from the center block has enough stock to provide for the wedge. (You do still have it, don't you?) Lay it out so the grain runs along the length of the wedge. The top end should be broad enough to present a good target for tapping with a hammer and rise away from the iron so you can tap either the iron or the wedge, but not both at the same time (see the photo above). Bandsawing is the safest way to work with such small stock. The wedge should be at least $\frac{1}{16}$ in. narrower than the thickness of the center block so it can be wiggled out when you want to remove the iron.

After you've removed the clamps from the sole, make sure the bevel in the sole is truly in line with the plane-iron ramp. Any protrusion here will give a false reading when fitting the throat opening and will create a bump on the bottom of the sole. Lay a sharp chisel on the ramp, raise it slightly, and pare away excess sole material.

The remaining truing of the plane may be accomplished by lightly sanding the sole on a strip of 120-grit sandpaper clamped to a tablesaw (see the top photo on the facing page). Place the plane iron in the body so it nearly comes through the sole, and seat the wedge firmly. Check for inaccuracies with a straightedge both along the plane's



Easy does it. The author uses 120-grit sandpaper clamped to a flat surface to true up the sole of the plane. Using very light pressure, he sands only until the surface is uniformly abraded.

length and across its width. The tension exerted by the wedge tends to create a bump behind the iron. With gentle pressure in the problem area, make a light pass on the sandpaper, and make sure that material is indeed being removed from where it ought to be. Don't use too much force. This task is complete when the entire surface has been uniformly abraded.

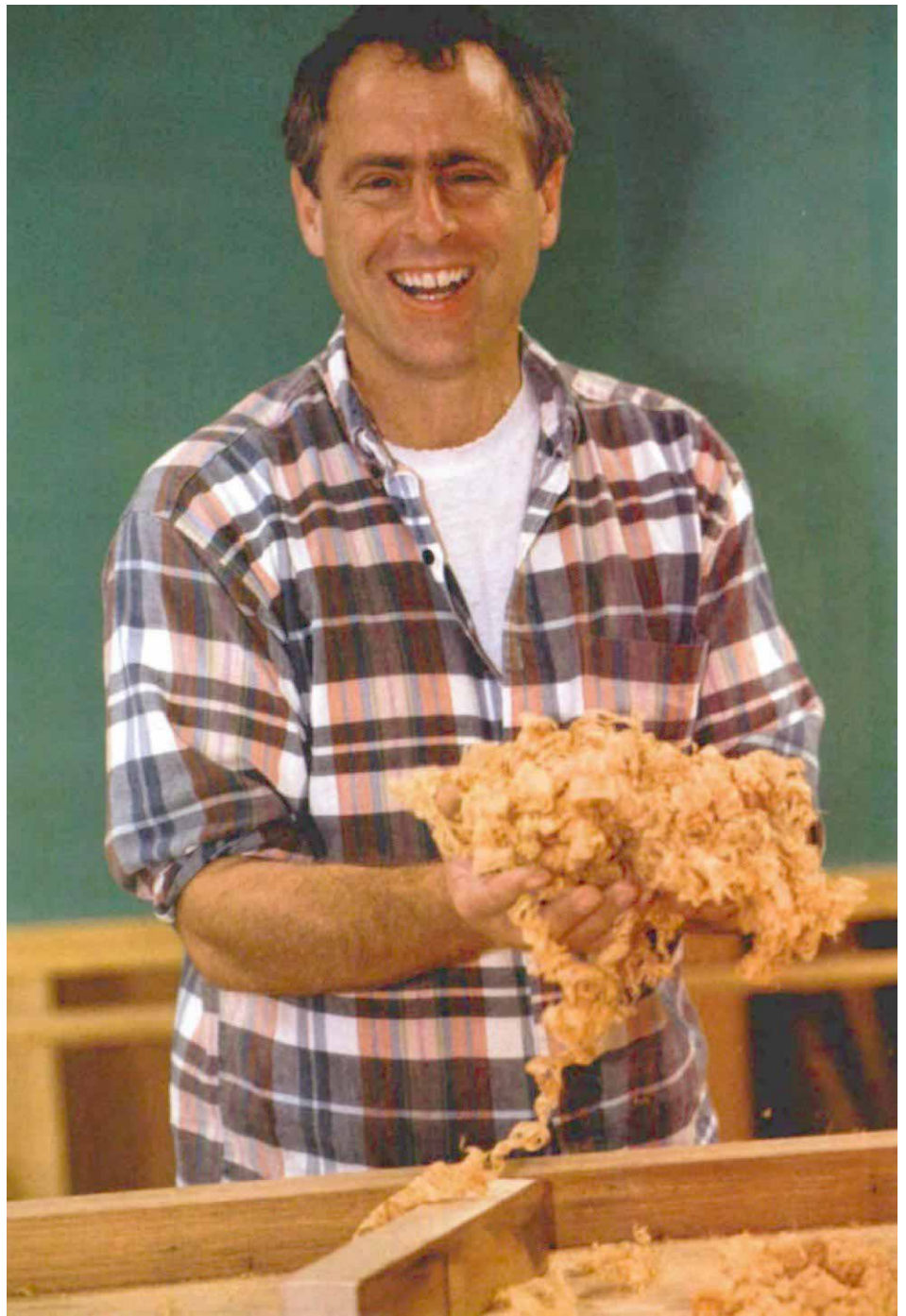
I aim for a final throat opening of about $\frac{1}{16}$ in. Work from the outside in with a file, angling slightly toward the front to provide shaving clearance (see the bottom right photo on the facing page). Remember that a file cuts only on the forward stroke. Pressure on the backstroke will likely produce chipout at the opening.

Making your first shavings

You are now at the point you have been anticipating: making shavings (see the photo at right). Place the iron assembly in the body at a height above where it would begin to cut, and lightly tap in the wedge.

We have all been taught in our early years to gauge the depth of the iron by sighting along the bottom of the plane from the front. A sharp, finely set iron's edge is difficult to see in that manner. I find it much easier to adjust the iron while sighting from the back of the plane. The iron should barely present itself above the sole. It's important to get the blade parallel to the sole. If the iron is set too deeply, rap the back of the plane to back it out, set the wedge and begin again.

Two problems often show up with a new plane that can be attributed to a bump on



Using a new plane is a delight. After it's adjusted with a few taps of a light hammer, the plane can get right to work. It will need very little maintenance.

the sole behind the iron: The plane seems to dig in at the beginning of the cut and then skate, or one of the corners of the iron constantly digs in. To correct those problems, flatten the bump with a hand scraper. It is acceptable to create a slight hollow when doing this. The plane will then sit flat when re-truing on sandpaper.

Difficulties in adjustment of the iron generally involve the wedge. Drive it in only as much as is necessary to hold the iron. A burr from the cap-iron screw may catch on the wedge. A swiveling iron may indicate that the wedge is not making uniform con-

tact with the cross-pin. Look for burnish marks on the wedge that indicate the nature of the fit. Ease the edges of the plane, and start using it before committing to the shape of the body. An advantage to the lack of knobs and handles is that the hand's position may be shifted around in use.

David Welter has been a staff member at the College of the Redwoods in Fort Bragg, Calif. for 11 years. During seven years of teaching summer classes, he and colleague James Budlong have helped students build some 500 planes.