Router Joinery

Jigs expand the repertoire

by Bernie Maas

When I bought my first router in the mid-1960s, I thought that it might be useful for putting fancy edges on things. My attempts to do something more with it, like dado or rabbet, usually came to grief when the machine kicked out and gashed the piece. I kept at it though, and over the years, with the addition of a variety of sub-bases, jigs and templates, the limitless possibilities of the router became apparent to me. Today, I believe that the router is one of the more significant innovations in our craft in this century, particularly since the recent introduction of plunge routers.

The router is relatively safe, and it promises surety of performance without a lengthy apprenticeship—ideal qualities for the students in the shop that I run at a small Pennsylvania university. Shapers are expensive and they can be dangerous; I have neither the budget nor the inclination to buy one for our shop. The router can do much of what a shaper can do, and much that a shaper can't. The new generation of heavy-duty plunge routers can accept ½-in.-shank bits with the size and mass of some shaper cutters. Our 3-HP Hitachi TR12 plunge router, for example, comes with collets for ¼-in., ⅜-in. and ½-in. bits; it lists at about $300, although it can be found for half that price. Bits vary in price from a few dollars to over $100 apiece. Most of the jigs and fixtures I'll discuss here can also be used with much less expensive light-duty or medium-duty routers, and inexpensive cutters.

Perhaps the simplest router fixtures are auxiliary sub-bases. We commonly make two sub-bases for new routers, as shown at left and center in figure 1. We prefer to use ¼-in. Masonite or void-free plywood (such as Baltic birch), both of which are hard, slide easily, and wear well.

The first sub-base is similar to the router's original base, but we cut the center hole just large enough for the biggest bit we use to pass through. This reduces the chances of dipping or sniping when routing around corners or working small sections. Additional holes make it easier to see the cut in progress. The second base has a long, straight edge (12 in. or more) to guide the router against a fence for dadoing, rabbeting, or cutting grooves. The straight edge helps prevent loss of control when exiting a cut. The third sub-base shown in the drawing, which extends 6 in. either side of the router, is useful for spanning large templates. Make it as thick as possible while allowing the router's template guide to protrude.

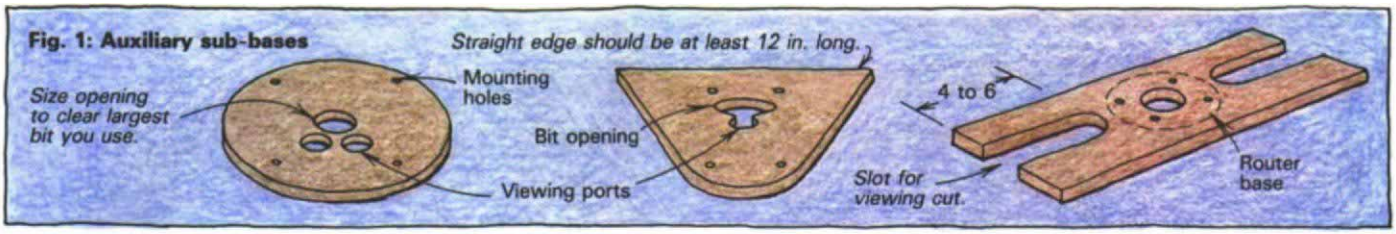
An excellent partner for the straightedge sub-base is the shop-made T-square fence shown in figure 2. The blade is 30 in. to 36 in. long, and extends 6 in. to 8 in. beyond the head, to steady the router as it exits the cut. We make our fences from stable, defect-free hardwood scrap. Usually one clamp is enough to secure the fence to the work. Clamp the fence on the side of the dado, groove or mortise that will be most visible. This limits wander or run-out to the "no show" side.

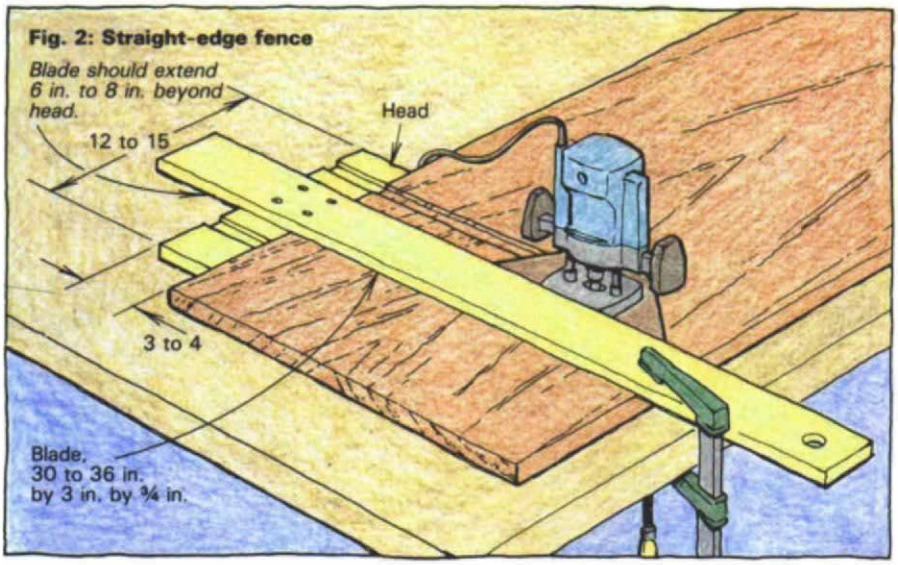
Trimming the ends of a wide panel square, smooth and true can be a stumbling block. A 40-in.-wide, 2-in.-thick tabletop can be a bear to wrestle through a tablesaw, a radial-arm saw doesn't have sufficient reach, and portable power saws leave rough surfaces at best. A router fitted with the straightedge sub-base will trim the ends dead square and glass smooth. We use a Freud 12-130 bit, a ½-in.-dia. straight, double-fluted carbide bit with 2½-in. working length, or a Freud 12-158, a similar ¾-in. bit with 2-in. working length. (Double-flute bits seem to cut cleaner than single-flute bits.) Both bits have ½-in. shanks.

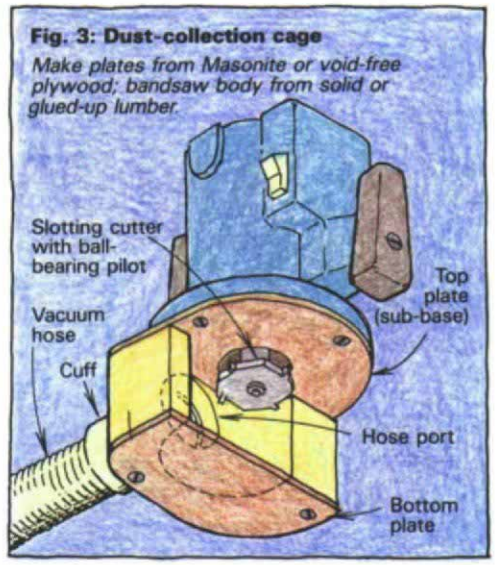
Trim the panel to within ¼ in. of finished length, clamp a straightedge or T-square fence in place, and rout away. Blocks clamped to each edge of the panel, flush with the end and top surface, will prevent splintering at the ends of the cuts. End grain is very hard on edge tools, so make several very light, full-depth passes rather than one heavy one. Remember to cut against the bit's rotation, moving the router left to right as you face the end—moving the other way causes the bit to grab and tear.

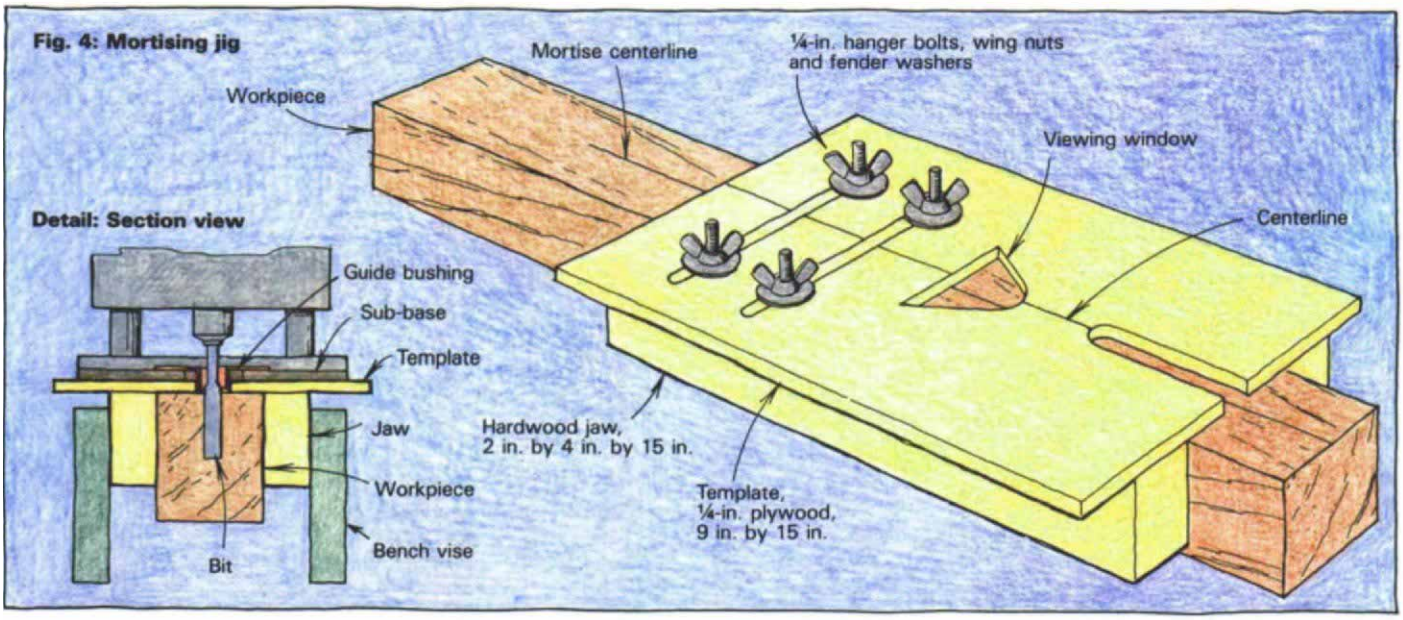
Aligning boards for edge gluing is easily and accurately done with splines in routed grooves. Shaper-cut edge-gluing profiles aren't an option for us, and doweling jigs have proved inaccurate and error prone. Stopped grooves, such a nuisance on a tablesaw, are a snap with the router. We cut the grooves with a slotting cutter consisting of an arbor, ball-bearing pilot, and the cutter itself. No fence is needed because the pilot bears on the edge to guide the cutter. Cutters commonly have either two, three or four wings and come in a range of diameters and kerf sizes. I like four-wing cutters because they cut more smoothly and put less strain on the router. Set the cutter at about the middle of the edge; exact centering isn't important as long as you run the router on the same face of each board to be joined.

The only drawback to a slotting cutter is the vast amount of dust and chips it generates. The chips shoot out of the machine in a trajectory that is usually painfully in line with your forearm. To handle the dust and chips created by this and other large bits, we connect a Shop-Vac to the dust collector shown in figure 3. The collector is basically a cage-like device attached to the router in place of the normal sub-base. We make the top and bottom plates of Masonite or void-free hardwood plywood, and bandsaw the body from a block of any available lumber. The hole in the top plate (the sub-base), should be just as large as the cutter, and the clearance between the collector body and









the cutter should also be kept to a minimum. These close tolerances maximize available suction. We bored the hose port in the body with a multi-spur bit. Shop-Vac hose cuffs are usually 2¼ in. in diameter, and tapered; jamming the cuff into the hole should be sufficient to hold it without an additional fastener. Position the port so that its center is in line with the trajectory of most of the chips.

Mortise-and-tenon joints are strong, dependable, and basic to much woodworking. However, they require a flair for hand tools or a retinue of expensive stationary power tools, both of which can be discouraging to novices. The plunge router presents a low-cost, quickly mastered alternative. It's possible to cut mortises and tenons using just the factory-supplied machine-mounted router fence, but we developed a simple pair of jigs (figures 4 and 5) to eliminate the possibilities of wander or run-out that can occur when guiding the router with only the fence.

The mortising jig consists of two hardwood jaws, about 15 in. long, fastened by hanger bolts and wing nuts to a ¼-in.-thick template of void-free plywood. Oversized fender washers prevent damage to the template. Mill a slot down the center of the template, 5 in. or 6 in. long and just wide enough for a snug, sliding fit on your router's template guide bushing. A window in the template helps when aligning the template and mortise centerlines.

To use the jig, mount it on the workpiece, template resting on the top surface, then clamp the jaw/workpiece sandwich in a

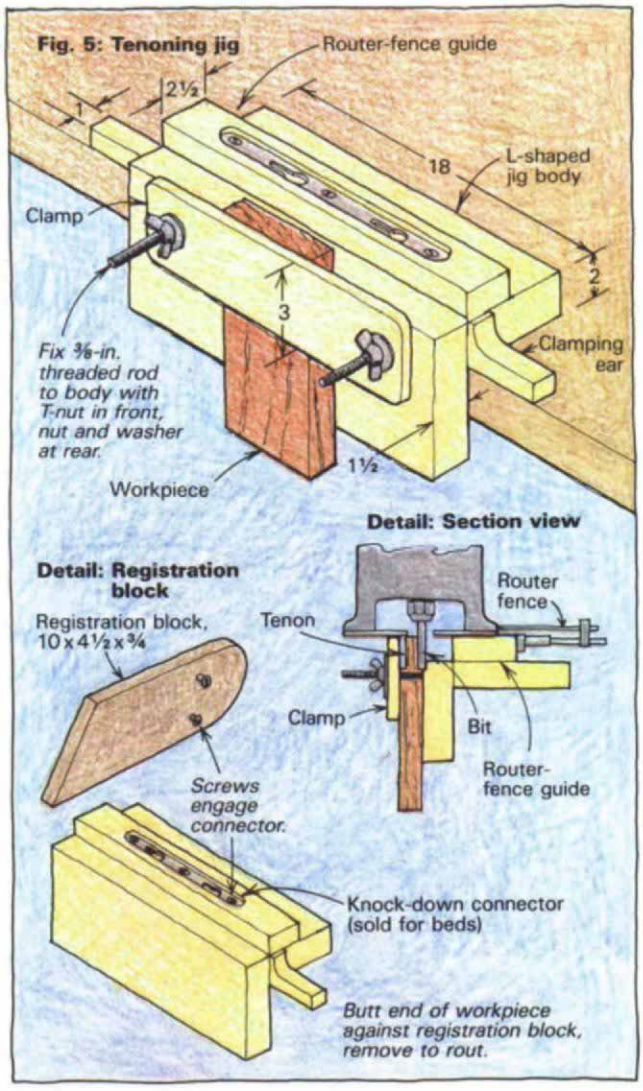


Fig. 5: Tenoning jig
Router-fence guide
1
2½
18
L-shaped jig body
Clamp
2
3
Clamping ear
Fix ⅜-in. threaded rod to body with T-nut in front, nut and washer at rear.
1½
Workpiece
Detail: Section view
Detail: Registration block
Router fence
Tenon
Registration block, 10 x 4½ x ¾
Clamp
Bit
Router-fence guide
Screws engage connector.
Knock-down connector (sold for beds)
Butt end of workpiece against registration block, remove to rout.

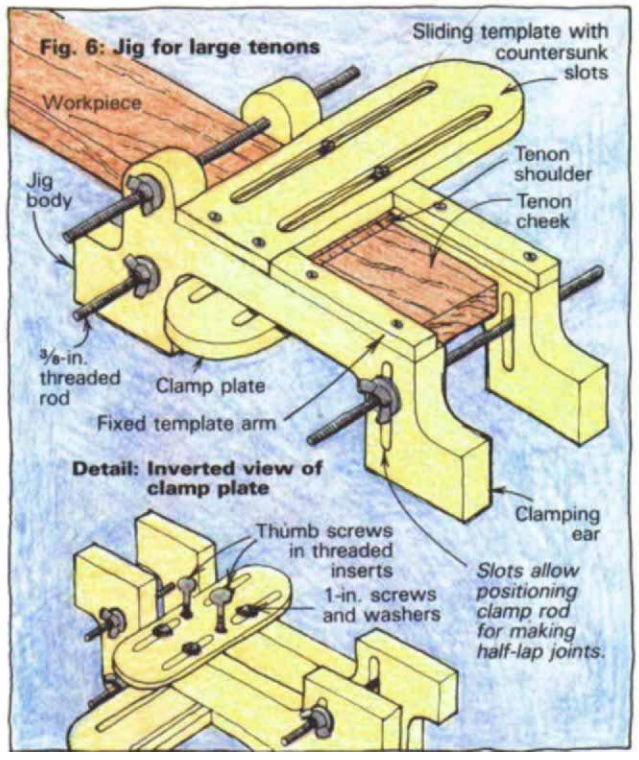


Fig. 6: Jig for large tenons
Sliding template with countersunk slots
Workpiece
Tenon shoulder
Jig body
Tenon cheek
⅜-in. threaded rod
Clamp plate
Fixed template arm
Detail: Inverted view of clamp plate
Clamping ear
Thumb screws in threaded inserts
1-in. screws and washers
Slots allow positioning clamp rod for making half-lap joints.

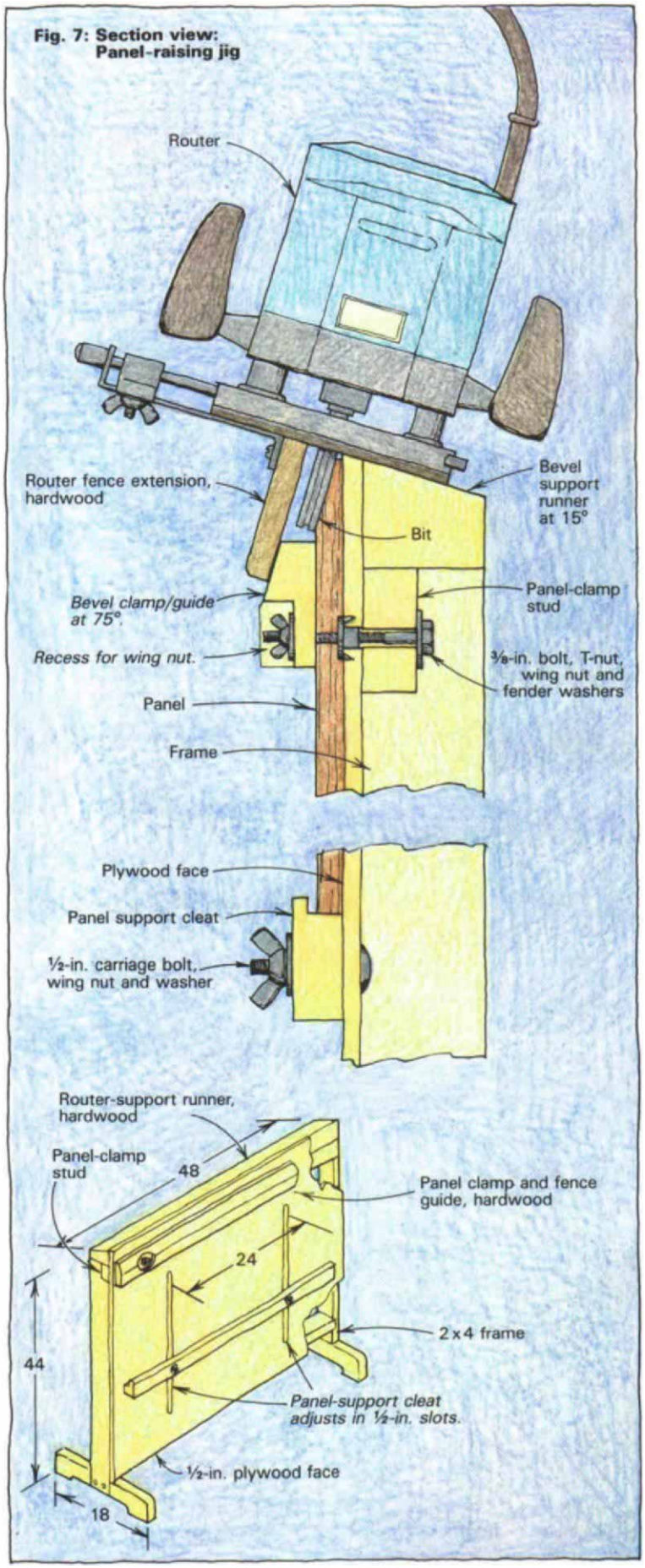


Fig. 7: Section view: Panel-raising jig
Router
Router fence extension, hardwood
Bevel support runner at 15°
Bit
Bevel clamp/guide at 75°.
Panel-clamp stud
Recess for wing nut.
⅜-in. bolt, T-nut, wing nut and fender washers
Panel
Frame
Plywood face
Panel support cleat
½-in. carriage bolt, wing nut and washer
Router-support runner, hardwood
Panel-clamp stud
48
Panel clamp and fence guide, hardwood
24
2 x 4 frame
44
Panel-support cleat adjusts in ½-in. slots.
½-in. plywood face
18

bench vise. Adjust the template to align the centerlines, then tighten the wing nuts. If you're cutting an open mortise on the end of a piece, as for a bridle joint, the template should extend an inch or so beyond the end so that the guide bushing is fully engaged before cutting starts. If you wish, clamp stop blocks for the mortise length. Cut the mortise in several passes. The same jig works for dovetail slots. Hog most of the waste with a straight bit, then rout the dovetail slot in one full-depth pass.

The tenoning jig (figure 5) is equally simple, and can be used with regular routers as well as plunge routers, though deep mortising is much easier with a plunge router. Built of 2-in. stock (any stable wood will do), it has an 18-in.-long L-shaped body that hooks over the edge of a workbench, where it is clamped by its two ears. Glued to the body's top surface is a precisely milled router-fence guide, about 1 in. thick by 2½ in. wide—make sure that it's thicker than the depth of your router fence. The guide is parallel to the front edge of the body and set back 1½ in. from it. The router's fence runs against the rear of the guide, making it impossible for the bit to wander or kick into the tenon. Two lengths of ⅜-in. threaded rod pass through the body to support the clamp that holds the workpiece. T-nuts at the front, and nuts and washers at the rear, lock the rod to the body. The top edge of the clamp should be level with, or slightly below, the upper face of the fence guide so it won't interfere with the router base. The detachable registration fixture positions the workpiece end at the correct height, although you could do this with a straightedge.

The tenon is cut vertically, the waste wood peeled away on the cheeks by the length of the bit, the shoulders cut square by the end of the bit. Adjusting the position of the fence varies the width of the shoulder and, therefore, the thickness of the tenon. Two setups are needed, one to cut each cheek. To register properly, the end of the workpiece must be square to its edges. Position the end of the workpiece with the fixture or straightedge, then tighten the wing nuts securely. Set the bit depth (or plunge depth stop) to the tenon's final length and adjust the router fence for the shoulder width. It's a good idea to cut a trial tenon in scrap to check the settings. Standing so the work is to your right, cut into the far edge of the workpiece slightly, pulling the router toward you. This prevents tear out when the cut is completed from the other direction. The bit will pull itself into the wood, so hold the router securely. Now, pushing the router, take several shallow passes to complete the cheek; for the last cut, push the fence firmly against the guide. Turn the piece around, re-register it, and cut the second cheek. You can trim the edges of the tenon in the same way, but for wide pieces it's just as easy to cut them on the tablesaw after routing the wide cheeks.

Using this jig, tenon length is restricted by the length of the router bit. In practice, we seldom cut them longer than 1¼ in. with this jig. For larger tenons, we use the jig shown in figure 6. The two halves of the jig slip over the workpiece, the sliding part of the template aligned with the shoulder line. The router rides on the template, the end of the bit milling the" waste from the cheek. (Thumbscrews fitted in a plate under the jig push the workpiece tight to the sliding template.) For wide tenons, the extended router sub-base is helpful to span the jig. The guide bushing runs against the sliding template to cut the shoulder. (If your bit and guide bushing aren't the same diameter, be sure to allow for this when positioning the sliding template.) Repeat the process for the other cheek, and to remove the waste on the edges for the narrow cheeks, if you wish. By sliding the front bolt down in its slots, the jig can also be used to mill half-lap joints anywhere on the length of a board.

In frame-and-panel construction, beveling (also called "raising") the panel edges allows the panel to remain snug in the frame grooves as it expands and contracts with changing moisture content; raising also gives the panel a pleasing appearance. A century or *so* ago, panels were beveled with hand tools—saws and panel-raising planes and a good deal of expertise. Today, the job can be done by machine, as well as by hand.

The shaper, tablesaw, jointer, and radial-arm saw all offer methods for panel raising, but they share two drawbacks. First, panels, often bulky and unwieldy, must be moved over a stationary cutter, presenting control problems that can result in sniping, blade burns, runout and kickback. Second, the panels must be dead flat or the beveled surfaces will be irregular.

Figure 7 shows the router panel-raising setup we developed in the school shop. The panel is fixed securely to the stand; any cup or bow is forced out by the stout clamp, which also guides the router fence. The router slides on the angled support runner that forms the top of the stand's frame. We use the Freud 12-130, ½-in. carbide bit to cut the bevel. Adjusting the router fence determines the depth of cut and, therefore, the final thickness of the tapered panel edge.

We used dressed 2x4s for the stand frame, hardwood elsewhere. The face of the stand is a 4-ft. square of plywood, glued and screwed to the frame—recess the screws to prevent marring the panels. Plunge-rout the ½-in. slots in the plywood face for the panel-support cleat. Oversized holes in the cleat will prevent the carriage bolts from binding. The support runner, angled 15° from the horizontal, can be mortised or screwed to the uprights. The 75° bevel on the clamp/guide combines with the angle of the top support runner to create a right angle—if you alter the angles, make sure they add up to 90°. The router fence extension should be at least 1 ft. long, and deep enough to provide good support and contact with the clamp/guide.

To use the jig, set the panel on the support cleat, adjusted to place the panel's top edge flush with the support runner, then tighten the clamp. Set the router fence and the bit depth, then hold the router base firmly on the runner, turn on the machine and slowly engage the panel. Make several passes, gradually easing the fence extension onto the clamp/guide. Make the final pass with the router held firmly against the guide. Set up for the next edge or end, and repeat. Because the unusually long bit is fully exposed, be extra careful to keep clear of it. The resulting panel should be uniformly raised, without burn marks, and with miters meeting precisely at the corners. Light rippling on the surfaces vanishes with normal sanding.

Much as I like routers, they do have drawbacks. They're terrific generators of noise and dust, so be sure to wear ear protection and a dust mask or respirator. When chucking a bit, especially a large one, slide it into the collet until it bottoms out, then back it off about 1/16 in. before tightening down. Bits seated against the bottom can vibrate loose, no matter how much torque you apply when tightening. Routers need very little maintenance—my 25-year-old Stanley still has its original brushes and bearings. Plunge mechanisms, though, need periodic cleaning and some type of dry lubrication, such as silicone spray. Dust in a switch can cause arcing at the contacts and failure of the switch. We've found that packing the switch cover housing in non-conductive Plasticine (children's modeling clay) seals out the dust. □

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