Double Mortise and Tenon Improves Joint Strength

Add structural integrity to delicate furniture parts

BY CRAIG VANDALL STEVENS

The mortise-and-tenon joint and its many variations have long been a preferred method for joining two pieces of wood at a right angle or close to it. One of my favorite versions is the double mortise and tenon. I use it to increase the strength of a joint on relatively small furniture parts, such as those on the free-standing room screen I built last year (see *FWW*#141, pp. 70-73). I knew the screen frame would be subject to some flexing in daily use, and I wanted to be certain that it would hold up to the stresses.

You'll often find the double mortise-and-tenon joint on chairs and window sashes-projects in which structural integrity on visually delicate pieces of wood is essential. By doubling the surface within a wood joint, you can greatly improve the joint's strength without increasing the size of its parts. What follows is an account of how I design and execute this joint. To cut the mortises I use a simple plywood jig and a plunge router equipped with an end-mill bit. For the tenons I use a combination of tablesaw, bandsaw and chisels. Others may prefer another technique, such as doing the job entirely by hand or using a mortiser or drill-press setup. Any way you choose to cut it, the benefits of employing a double mortise and tenon in your work are worth the extra effort required.

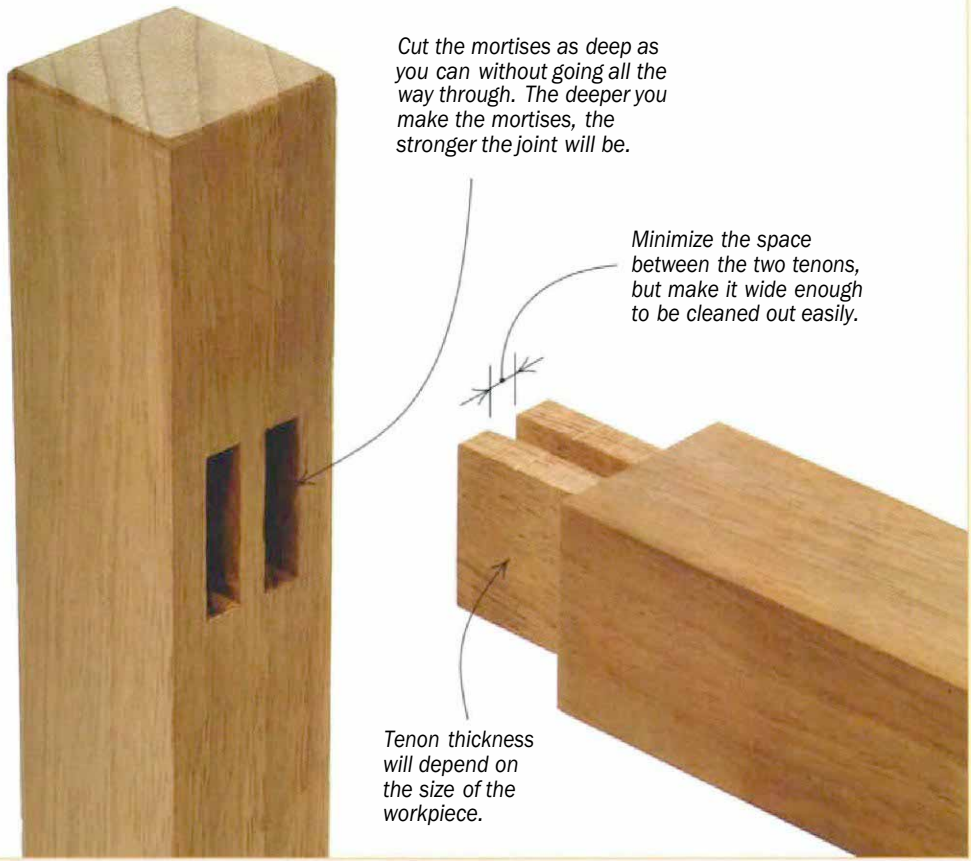
Prepare the stock with the end use in mind

I always start milling the lumber for a project several days ahead of time, then set it aside to stabilize. Initially, I flatten stock with a jointer and rip the individual pieces a bit oversized with the bandsaw. (I use a bandsaw rather than a tablesaw most of the

Photos, except where noted: Jonathan Binzen

Use a double mortise-and-tenon joint when strength is an issue, as it is in the freestanding room screen shown above. By doubling the surface area of a glue joint, you can greatly improve its ability to hold together and to withstand stress.

DESIGNING WITH DOUBLE-TENON JOINERY



time because it's a safer and quieter machine, and it produces less waste.) When the wood has stabilized, all of the pieces can be rejointed on two adjoining faces to flatten out any springback that has occurred and then brought down to their final thicknesses with a planer. It's always a good idea to mill some extra stock for setting up the joinery and to use as backups if you make a mistake along the way.

With furniture parts that will eventually be sized differently, I prefer to mill all of the stock to the same thickness, complete the joinery and then bring the thinner pieces down to their final sizes with the thickness planer or a handplane. For example, on a conventional table, you can mill the legs and rails first to an equal thickness, then cut your mortises and tenons. After that, send the rail pieces through the planer again to make them thinner and provide a step-back from the surface of the legs when they're joined together.

Think through the layout first—I lay out the joinery dimensions for the tenons first. The tenons need to be as long as possible to maintain a strong joint. At this stage, having in hand a good sketch of the joinery detail is especially helpful.

Estimate the amount that each face will be stepped down and then experiment with different tenon sizes until you have a layout that will be strong without creating any weak areas in the joint. I leave the space between the tenons at least a little wider than the narrow ⅛-in. chisel that I use to clean up that area. On the outside of both tenons, I'll often leave only a narrow shoulder, about ⅛ in. wide, which allows some leeway in deciding the thickness and spacing of the tenons.

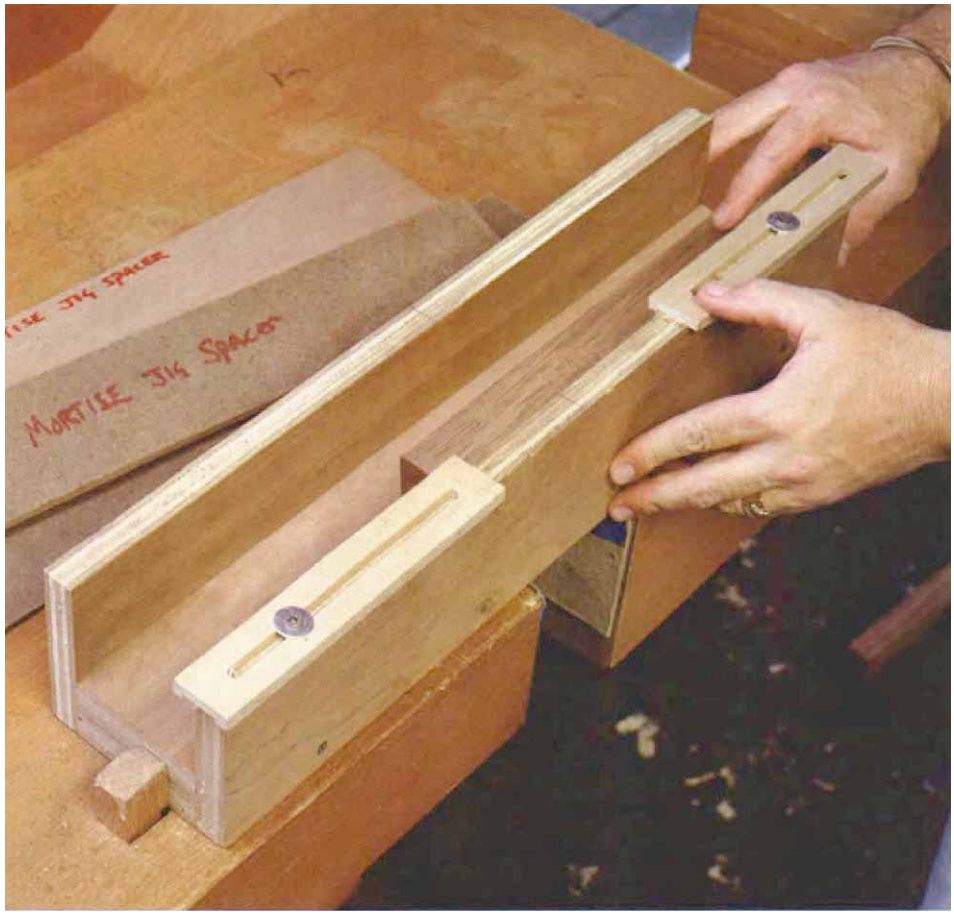
Mark and cut the joinery, starting with the mortises

After layout, transfer the width and length of the tenons to the mortise workpieces using a marking knife. If you have to cut more than a few mortises, make a story

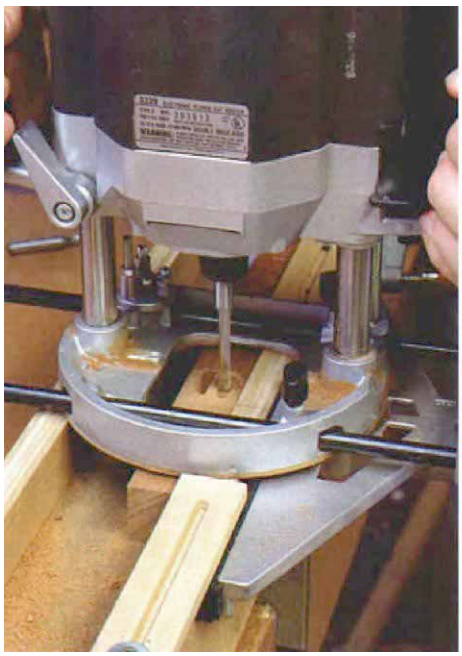
Tools for multiple marking. *A story stick and a marking knife add accuracy and reliability to a repetitive process.*

Photos, this page: Stephen Webster (top left); Michael Pekovich (top right)

A SIMPLE JIG FOR ROUTING MORTISES



This jig has an important feature. *Adjustable stops on this mortising jig limit the distance the router can travel and keep the length of all of the mortises consistent.*



Steady as she goes. *The router base sits firmly on the top of this jig as the router fence indexes the location of the mortise.*

Help with the handwork. *A thick block of wood clamped firmly to the workpiece serves as a guide to chisel the ends of the mortises true and square.*

stick from a straight scrap of wood and tack a cleat onto one end. Hook the cleat over the appropriate end of each workpiece, then transfer the mortise locations with the marking knife.

As I mentioned before, I lay out the tenons first, but when it comes time to cut the joints, the mortises come before the tenons. It's important that the two mortises line up with each other and be cut squarely. To cut mortises, I use a simple plywood-jig design based on one that Tage Frid used (see *FWW*#82, pp. 52-55).

The jig holds the workpiece in place while a four-flute center-cutting end mill mounted in a plunge router accurately cuts the mortise. The router fence simply rides against the outside of the jig. Clamp stop blocks to the jig to create mortises of identical length, and use a chisel to square up the ends of the mortises.

To fit a double mortise-and-tenon joint successfully, focus on properly fitting the outside cheeks of the tenons before dealing with the inner cheeks. Think of the first setup as fitting an extrathick tenon into an extrawide mortise. Chop away the wood separating the two mortises on one of the practice pieces and use this practice mortise later when you're setting up the tablesaw to cut the tenons.

Two tenons are not twice the work—A tablesaw will cut the two tenons very accurately, and you can use a test piece with the tenons marked and drawn on the end of it to set up the cut.

A sliding cutoff box really helps achieve consistent results in crosscut work, and a shoulder cut along the cheeks is a good place to start. Raise the blade so that it's slightly below the pencil line representing the tenon cheek. A marking-knife tick on the side of the workpiece indicates the length of the tenon, based on the depth of the mortise. The length of the tenon should be 1/16 in. or so shorter than the depth of the mortise to ensure a snug fit and to allow room for excess glue that gets pushed into the mortise during assembly.

A stop block keeps the shoulder cut consistent as you rotate the workpiece. After you cut the first two cheek shoulders, the blade height will probably need to be changed to cut the other two sides. And here's another secret: Before cutting these two adjacent faces, put a piece of masking tape on the end of the stop block to bump

away the workpiece slightly. This will keep the sawblade from nicking the previously cut shoulders.

With all four shoulders cut, clamp a straight piece of wood to the tablesaw fence. This auxiliary fence should be around 5 in. high or higher; check it with a square to ensure that it is 90° to the saw table. With this setup, one hand slides along the top of the auxiliary fence, holding the workpiece firmly in position, while the other hand helps push the workpiece through the cut. Both hands are kept safely away from the blade. Set up a clean, sharp, ripping blade to cut just below the shoulder cuts. Adjust the fence to ait the practice workpiece a little proud of the outside of the tenons.

When you use this method, the waste piece falls away from the action rather than being trapped against the fence. Use a steady feed rate to move the workpiece through the cut, then rotate and cut the opposite side. Ideally, with the first pass, the tenon will be too fat to fit into the practice mortise you prepared earlier. Readjust the fence and repeat the cuts until the practice pieces go together with no sloppiness, using only hand pressure.

By fitting the outer cheeks first, there's no guessing whether it's the outer or inner cheeks that are preventing a nice fit. After you cut all the outer tenon cheeks, you can reset the fence to cut away the space between the double tenons. Sneak up on the final fit, readjusting the fence until the tenons fit nicely into a pair of mortises.

The bandsaw makes short work of cutting the tenons to their proper width. Again, use the layout marks on your set-up pieces to determine the location of the bandsaw fence, and clamp a stop block to the fence to prevent the blade from cutting into the shoulders. Start a little wide, bumping the fence until the tenon is the same width as the squared-off mortises. Use a chisel to clean up the corners of the shoulders, and take care to avoid damaging the adjacent shoulders. You'll need a narrow chisel to fit between the tenons and pare away the waste. To make the final assembly go more smoothly, you can use a file or a knife to cut a slight chamfer on the ends of the tenons. □

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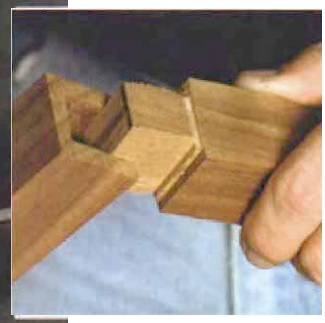

A higher fence for safety and stability. *The extra height of the auxiliary fence provides a firm surface to press the workpiece against and helps keep hands away from the blade. Using scraps for testing the fit, make sure the two outside cheeks fit snugly into a mortise before proceeding with the cuts for the inside cheeks.*

Almost there. *Tweaking the final fit requires frequent checks with the set-up scraps before you can complete the final cuts on the workpieces. A snugly fit joint will go together smoothly with moderate hand pressure.*