

Build a traditional frame-and-panel door

PART 1:

HAUNCHED MORTISE-AND-TENON FRAME

BY BILL PAVLAK

A frame-and-panel is a timeless solution to wood movement. Wood panels are prone to cupping and warping, but a frame mitigates this by capturing the panel in a grooved frame made from narrow stock. This construction offers the stability of the frame along with the beauty and efficiency of wide panels.

The frame has mortise-and-tenon joints, typically with the mortises on full-length stiles and the tenons on the rails. Both mortises and tenons seem so simple; one is a small rectangle of wood at the end of a board, and the other is the rectangular opening for that rectangle. Yet both can pose some serious challenges when executed by hand. It's easy to spend a lot of time fussing the joint only to have it wind up twisted, out of square, sloppy, or loose—or all of the above. Here, I will lay out tips for chopping and sawing, but I will also explain what to do before and after those steps to allow for more efficient, accurate, and controllable results.



Because making mortise-and-tenon joints by hand is complex enough, I will tackle here the frame alone. In part 2, I will address the other half of the equation: raising a panel by hand.

Mortise first

Repeatedly beating a stout chisel into a block of wood with a hefty mallet is loud and violent. To the uninitiated, it also makes little sense. How could such brutality lead to the precision required for a well-fitting joint? To address that question, I have adopted two principles for working smarter, not harder.

LAYOUT



Set the pins on the mortise gauge to the width of your mortise chisel. Use this setting when scribing the mortises and the tenons, as well as the panel grooves.



Scribe the stile's entire inside edge. This piece gets mortised and grooved. The scribe lines are crucial layout for the mortises. For the groove, the lines' function is to cut the edge fibers, minimizing tearout from the plow plane.



Knife the top and bottom of the mortise. Register your knife against a square, and make these lines deeply in several passes. A deep knife wall not only is clear but also will help you register your mortise chisel.

MORTISING



Chop a large right triangle to depth. Start close to the near end. With the bevel away from you, chop straight down. Then slightly advance and angle the chisel to chop a triangular chip. Chop the vertical cut deeper, and then remove a larger chip. Repeat till you hit full depth.



Turn the chisel around, chop, and pry. With the bevel toward you, work toward the middle of the mortise by chopping straight down and levering away from you to remove waste.



The lengthening mortise will eventually guide your chisel. The growing side walls will steer the chisel very well, speeding up the work. The final chops are on your layout lines and should be perpendicular.

First, the bottom of a mortise doesn't need to be flat. Everybody knows that, but I suspect most folks assume that means the bottom can have slight undulations and a little overcut here or there. That's what I thought until I started studying antiques. By not flat, think of the Himalayas silhouetted by the setting sun. As long as you don't leave wood behind that will prevent the joint from closing, or chisel all the way through when you don't want to, you're good.

Second, a mortise doesn't need to be perfect right off the chisel. I beat myself up over this for a long time for no reason. Chop your joint as true as possible. I trust my sense of square for 90° and then sight against a bevel gauge for everything else. I'm rarely dead-on, but I'm usually off by only a few degrees. How do I check? As my colleague Brian Weldy showed me, the answer is dummy tenons—stock that fits snugly in the mortise and reveals its trajectory.

After sighting the angle, use a wide paring chisel to tweak the offending areas of the mortise wall to get the angle right. A beginner's mistake is to chop undersize mortises and then rely on paring. If you chop mortises the correct size first—I recommend matching the width of your mortise to the width of your chisel—you will still be able to pare a little away without opening the joint too much, and you will work much faster. Remember, you'll cut your tenons to fit your mortises, so you'll have a chance to account for any extrawide mortises later.

Before running the panel groove along the stiles, scribe the joint with the mortising gauge at the same setting you used to lay out the mortises. This scores the



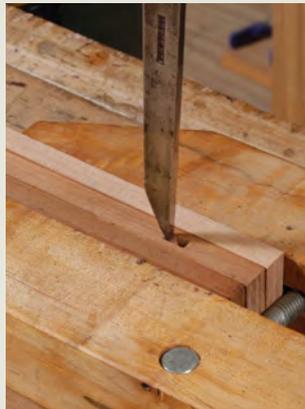
Dummy tenon is a smart gauge. The block, thickened to match the mortise chisel and press-fit into the mortise, lets you see if the mortise is square to the stile's edge and, if it isn't, where to adjust the mortise. This tester lets you perfect the mortise before cutting actual tenons, and avoid the risk of harming the actual tenons with multiple test assemblies.



Mortising tips



Clamping scrap stock to a thin workpiece prevents damage. Thin boards are prone to blowout during mortising. Clamping stock to both sides fools them into thinking they're thicker and therefore better supported to endure chopping's forceful blows.



Drill before chopping and paring when a mortise is over ½ in. wide. Removing this much waste with a chisel and mallet alone is incredibly strenuous; drilling out much of the waste saves energy. For anything ½ in. and under, Pavlak prefers simply chopping with a mortise chisel. He finds it easier and more accurate at this scale than drilling by hand first.

fibers to limit tearout from the plow plane. I repeat this step on the rails for the same reason. However, I mortise before grooving to maintain my mortise's layout lines. Plus, an unsquare groove would tip my chisel off 90°.

Size the tenon to the mortise

For tenons, I've learned to work systematically to make sure they fit tight and square to their mortises.

When you're working by hand, there is no need to square the ends of your tenon stock. If the bottoms of mortises don't need to be flat, then the ends of tenons don't need to be square. Save your time. Simply get your shoulder-to-shoulder measurements right, and leave enough wood beyond for a suitably sized tenon. At layout, use a square and a marking knife to mark the shoulder rather than a gauge registered off the end.

A quick note about tenons on chairs and aprons: Often, period versions were not shouldered on the bottom edge. This spares work but leaves the area exposed. Usually the area winds up out of sight, so I omit this shoulder, too. If I want a cleaner look, I add a little shoulder, maybe ⅛ in.

When cutting a tenon, I use this order of operations: (1) saw the cheeks, (2) saw the shoulders, (3) pare the shoulders, (4) pare the cheeks, and (5) cut the tenon to width. I used to do all of the sawing at once, but keeping the tenon the full width of your stock as long as possible has some serious benefits. Sawing to width early removes any remnants of your layout lines, and that puts a lot of guesswork into paring. These lines describe the relationship of your tenon to your stock's reference surface; that's a crucial relationship, so keep it visible as long as you can. The extra width also maximizes the bearing surface for your chisels and planes to ride as you pare.

GROOVES



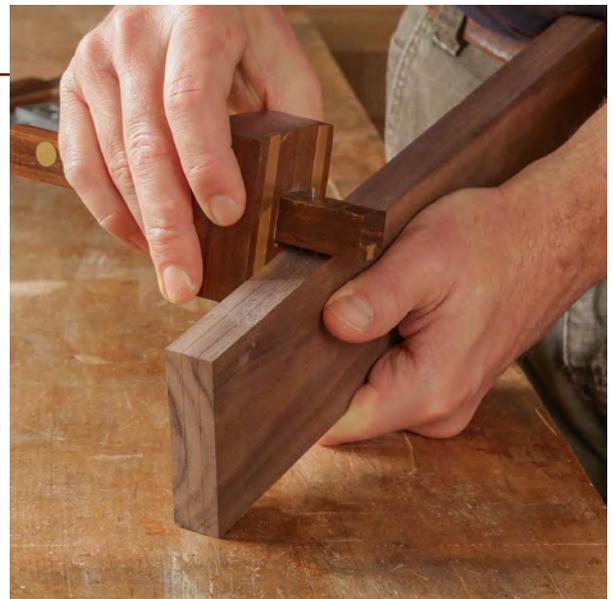
Fit the plow plane's iron in the mortise to set the plane's fence. You want the groove to be in line with the mortise. It's worth finding a plane iron that's the same width as the mortise.



Plow a through-groove. When you're working by hand, a through-groove is far more convenient than a stopped one. A haunch on the rail is easy to form and will fill the short length of groove beyond the mortise.

TENONS

Scribe the tenon shoulders and cheeks. Lay the shoulders out using a reference edge and face rather than the end of the stock. Then, with the same marking gauge setting used when mortising, scribe the tenon thickness.



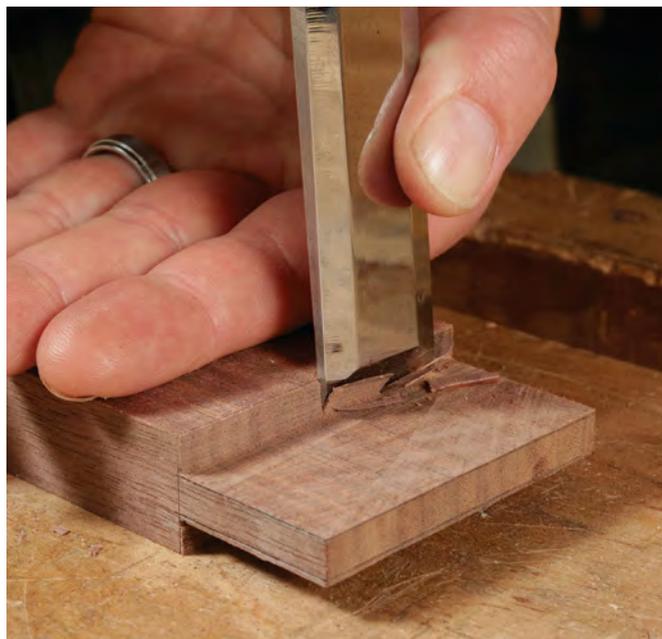
Saw the cheeks, then the shoulders. When sawing tenons, get close to your lines. Leaving a little waste to pare away later can be a good idea. Pavlak aims to leave his gauge line and about $\frac{1}{32}$ in. more.



When you pare, think of the tenon as a tiny board that you must check for cup, bow, and twist. For 90° tenons, verify that their faces are parallel to the board's faces, too, or at least its reference face. Check the entirety of each shoulder for square, since any bump can keep the joint from closing and throw it out of alignment.

The second phase of checking your work is the one that arises when you first test-fit the joint. The back and forth of this phase is what gives a lot of woodworkers the most trouble. By following the aforementioned checks while creating the tenon, you should find this second phase far easier—but there are a few matters to keep in mind.

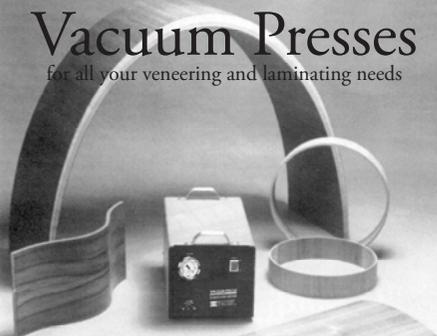
When you start sliding a tenon into its mortise, look for two things: a snug fit and a square entry. You want a tenon that requires a good amount of hand pressure



Pare the shoulders. To create a clean, square shoulder, register a wide chisel in your line and pare down. As you advance across the shoulder, engage only half of the chisel in cutting; use the other half to ride against the last cut you made.

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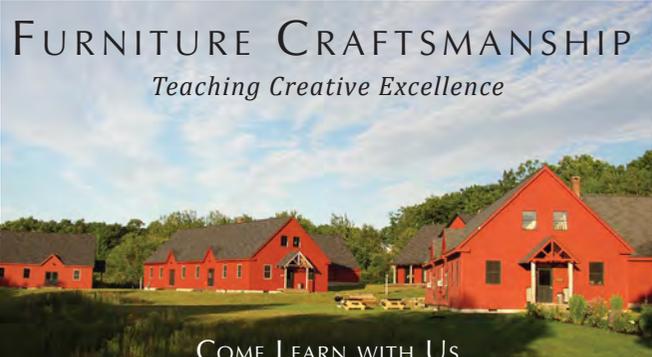
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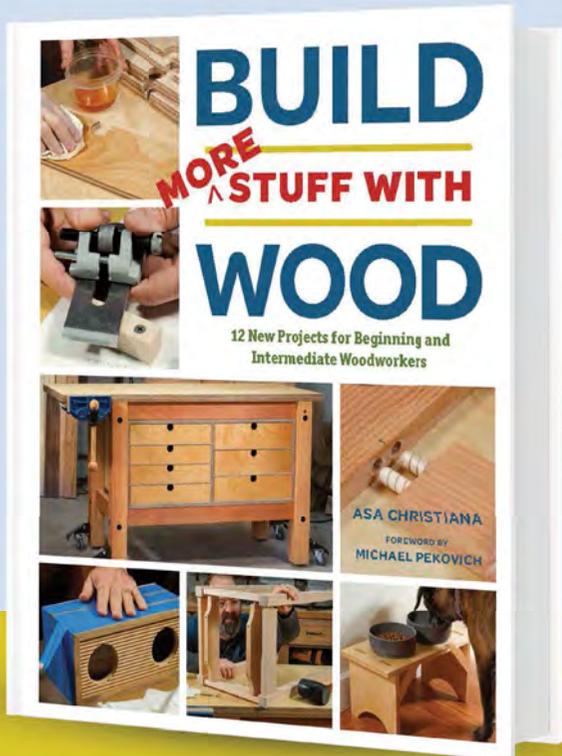
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FIT THE TENONS

Refine the cheeks to thickness. Use the layout lines to guide your work as you pare carefully across the grain. Again, use previous cuts to register subsequent ones.



Save the shoulder plane for wide tenons. For the shoulders and cheeks of larger tenons and breadboard ends, a shoulder plane is a godsend. On smaller tenons, however, it sometimes creates more problems than it solves because of the decreased reference surface and the potential of blowing out a shoulder.

Check the tenon's accuracy with a small straightedge. Move a small straightedge along the cheek to look for high spots. To look for twist, use the straightedge like a winding stick and sight it against the top of the shoulder. Finally, use the straightedge to ensure that the tenon's cheeks are parallel with the board's faces. If you milled the stock by hand and your nonreference face is unreliable, use the reference face to sight both cheeks.



A fix for thin tenons



Patch a too-thin tenon with a thick shim, then recut. Sometimes for a tenon it's death by a thousand cuts; it's been pared and adjusted so much that it becomes too loose. To fix it, glue on a flat, oversize block and recut it. This works better than trying to glue on a thin veneer.

CUT THE HAUNCH

Rip the tenon to width, and cut the haunch. Keeping the tenons wide till now has distinct advantages. For one, it maintains the mortise gauge's critical layout lines, which help direct paring. The extra width also creates a better bearing surface for chisels and planes to ride as you pare.



with the shoulders themselves—either that they are not square or that one protrudes further than the other—square them by knifing a new shoulder line about $\frac{1}{32}$ in. away from the current shoulder, and then pare with a chisel or shoulder plane. In these situations, a new line is far superior to guessing by removing a little wood here or there.

Little discrepancies often reveal themselves when you fit the whole frame. Before gluing, check the assembly for square, twist, and coplanarity. Repeat with clamping pressure. Repeat the above steps to remedy any slight problems that might still be present.

Bill Pavlak is the supervisor at the Anthony Hay Cabinet Shop at Colonial Williamsburg in Virginia.



Leave the haunch long at first before paring to a perfect fit. The gap where the haunch bottoms out is the amount you need to pare back the haunch.

to fit. It shouldn't just drop in (or out), and you shouldn't have to beat it in with a mallet, although a few light hammer blows are acceptable. When I can fit a tenon at least a third of the way into the mortise, I check for square like I did with the dummy tenon. This tells me where I should pare the too-tight tenon.

If the shoulders don't close, look for debris in the mortise or along the shoulder, sloping walls in the mortise, or a too-long tenon. Confirm that the shoulder is 90°. A slightly angled mortise or tenon will keep a shoulder from closing. To fix this, pare a little off the lower half of the mortise wall opposite the gap. A light shaving or two should correct the problem without loosening the joint. In the rare cases when this fails to solve the problem, double-check the squareness of the mortised edge and plane accordingly. If you determine there is a problem



Plow the groove. Reference the fence off the same face as when you grooved the stiles, ensuring that the grooves will line up around the frame.