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MORTISE AND TENON



MORTISE & TENON

There are several good ways to make a mortise and tenon joint. The trick is determining which one is best for the task at hand.

I've always thought of mortise and tenons as the "bread and butter" of woodworking joints. Although they're not as showy as dovetails or box joints, they're often the backbone of a woodworking project. And the main reason for this is their incredible strength.

In a well-constructed joint, the tenon slips into the mortise like a sword in a sheath. This does two things. First, the close fit locks the two workpieces together to create a strong mechanical joint. In addition, there's a large glue surface where the cheeks of the tenon contact the sides of the mortise, so it provides a strong glue joint as well.

Maybe this explains why mortise and tenon joints have been around for so long, and why you'll find them just about everywhere, see the examples below.

MULTIPLE METHODS. You might think there's a single, proven method for making such a universal joint. This may have been the case back when mortise and tenon joints were made by hand. But with the power tools available today, there are several



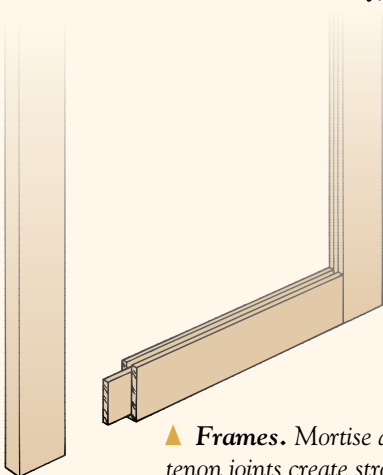
ways of creating both the mortise and the tenon. The trick is deciding on the best method in each situation.

In the *Woodsmith* shop, we use several different methods on a regular basis. But the technique we choose depends on the size and number of joints, the length of the workpieces, and the tools we have available.

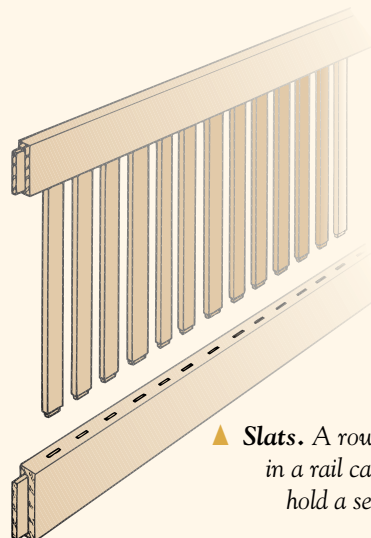
So I thought it might be worthwhile to take a look at some of the various

techniques for creating a mortise and tenon joint and explain how to go about selecting the best method.

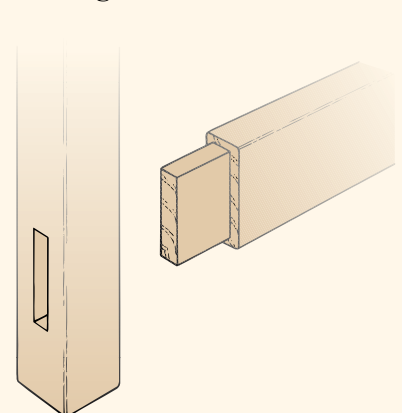
Regardless of the method, I almost always follow the same sequence when making a mortise and tenon joint. I make the mortise first and then cut the tenon to fit. The reason is simple — it's a lot easier to pare a little material off a tenon than it is to enlarge a mortise.



▲ **Frames.** Mortise and tenon joints create strong frames that resist twisting.



▲ **Slats.** A row of mortises in a rail can be used to hold a series of slats.



▲ **Leg & Rail.** A through mortise is both decorative and functional.

The Mortise

There's more to making a mortise than simply hacking out an opening in a workpiece. Anytime I'm making a mortise, I'm concerned with a couple of things — speed and accuracy.

I want a quick way to remove the material from the workpiece to create the mortise. But I also want to make sure the ends of the mortise are square with the sides, and the sides are square with the face of the workpiece. This is important if you want to get a good fit with the tenon.

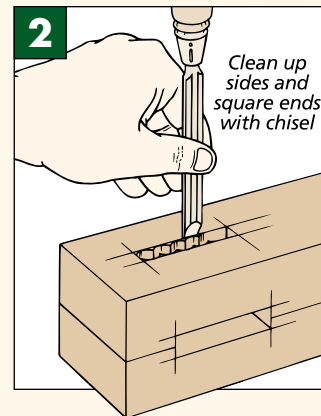
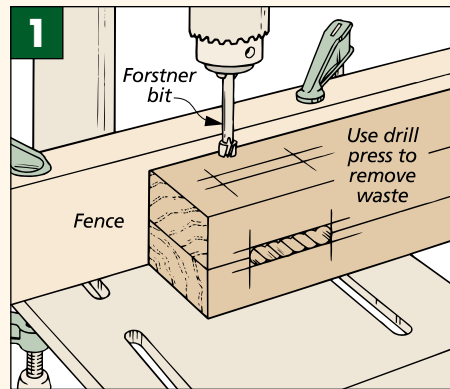
DRILL PRESS METHOD

One of the simplest methods available that satisfies both of these requirements is to use a drill press to remove most of the waste of the mortise (Fig. 1). Using a Forstner or brad point bit, I drill a series of overlapping holes to create a rough opening. Then I square up the ends and sides of the mortise with a chisel, (Fig. 2).

Shop Note: If your workpiece is too long or heavy to place on a drill press, try using a handheld drill with a dowel jig to guide the drill bit.

There are a couple of things I like about this method (which is probably why I use it more than any other). First, it doesn't require any lengthy setup of equipment. The width of the mortise is determined by the diameter of the drill bit and the depth by the depth stop on the drill press. All you need is a simple fence clamped to the drill press table to establish the position of the mortise in the workpiece.

Second, it allows me to see my work at all times. As I'm drilling the row of



holes, it's easy to tell if I'm wandering outside of my layout lines.

As useful as it is, drilling a series of holes and cleaning up the sides of each mortise with a chisel can be a time-consuming task, particularly if you have a lot of mortises to make. For some projects, it makes more sense to use a different technique.

ROUTER METHOD

Sometimes I need to make a series of identical mortises in a workpiece. For example, if I'm building a project with a row of slats or spindles, I use a router to cut the mortises.

Using an edge guide or a shop-made jig, it's possible to rout a series of mortises in less time than it would take to drill them on a drill press, see Fig. 3. It's simply a matter of setting up the edge guide and routing a slot for each mortise.

Shop Note: I don't like to take more than a 1/4"-deep cut on any single pass. If I need to make a mortise deeper than this, I'll take multiple

passes, lowering the bit in between. And to prevent the slot from filling up with shavings, I also prefer to use spiral end mill bits rather than ordinary straight bits for routing mortises, see photo at right.

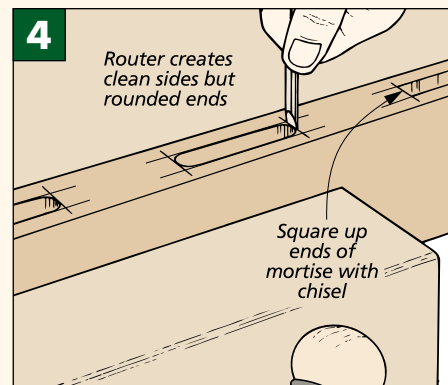
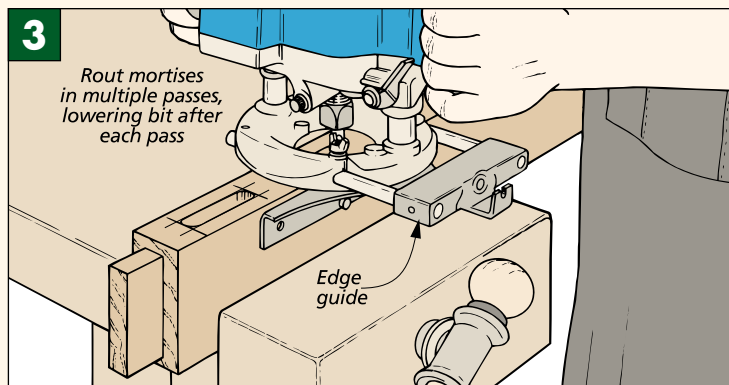
Aside from the speed, the nice thing about a mortise that's made with a router is the fact that it has perfectly smooth sides. The only handtool work that's required is to square up the ends of the mortise with a chisel, see Fig. 4.

DRAWBACKS. There are a couple of downsides to using a router for making mortises, though. First, although it's possible to get by with a standard router, routing mortises is really a job that calls for a more expensive plunge router.

But more importantly, I always feel like I'm sacrificing some control when I use a router. Since the router cuts a mortise so quickly (and you don't have a clear view of the mortise while you're routing), it only takes a split second to make a mistake.



▲ The deep flutes of a spiral end mill bit are designed to pull the shavings out of a mortise quickly.



Mortisers

Whether you use a drill press or a router to make mortises, either way you still have to square up the ends of the mortise by hand. But there's a tool that will drill out the waste of the mortise *and* neatly square up the ends all in one step — the hollow chisel mortising machine, see first photo at right.

SQUARE HOLES. Although it may sound impossible, a mortising machine will actually drill a square hole. The secret behind these machines lies in the hollow chisel bits they use, which consist of a drill bit surrounded by a square, thin-walled chisel.

As the bit is lowered into the wood, it removes most of the waste while the chisel squares up the sides at the same time. By drilling a series of overlapping square holes, you can make a mortise of just about any



▲ **Mortising Machine.** Hollow chisels drill out the mortise and square up the ends all at once.



▲ **Mortising Attachment.** Mounted on a drill press, this attachment works like a mortising machine.

length or width you need.

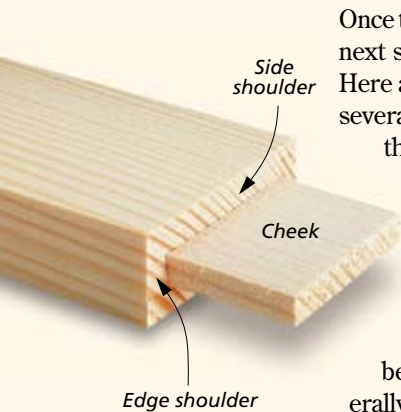
Hollow chisel mortising machines work great, but their biggest drawback is their cost — about \$250 or more for most models.

MORTISING ATTACHMENT. A less expensive alternative is a special mortising attachment that clamps around the quill of your drill press. It works in much the same way as

a dedicated machine and uses the same hollow chisel mortising bits, see right photo above. (Mortising attachments sell for about \$70, including the hollow chisel bits.)

The only problem with this type of attachment is that you have to take it on and off your drill press in order to go back and forth from mortising to regular drilling.

The Tenon



Once the mortise is complete, the next step is to cut a tenon to fit. Here again, you have a choice of several methods. But the goal is the same. You want to wind up with a tenon that has square shoulders and flat cheeks, see photo at left.

Although tenons can be made with a number of different tools, I generally prefer to use a table saw because of its speed and accuracy.

DADO BLADE METHOD

For most tenons, I install a dado blade in my table saw and remove the waste from the cheeks of the tenon by making multiple passes. I use

the rip fence as a stop to determine the length of the tenon and an auxiliary fence attached to the miter gauge to back up the cut (Figs. 1 and 1a).

Then after cutting the tenon, I slide the workpiece back and forth over the blade to clean up any saw marks left behind by the blade, see Fig. 2.

At first glance, you might think this method violates one of the cardinal rules of woodworking — never use the miter gauge and rip fence together. (The reason for this is that the cut-off piece can get trapped between the blade and the fence and kick back.) But when you're cutting a tenon with a dado blade, you're not making a *through* cut. So there isn't any cut-off piece to worry about.

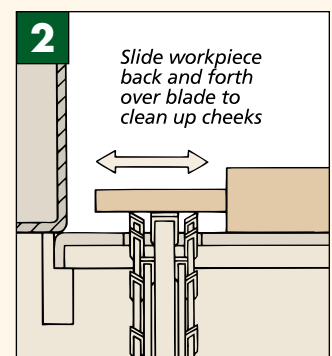
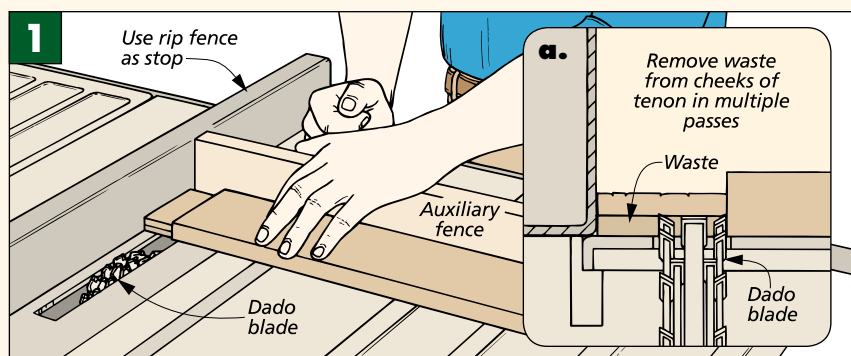
I prefer this method for a couple

of reasons. First, the dado blade removes a wide swath of material with each pass. So it's a simple matter to cut even a long tenon quickly.

But more importantly, I find it easy to "fine tune" the fit of the tenon by making some quick adjustments. If the tenon is too thick, I simply raise the dado blade a hair. If the tenon is too short, I just move my rip fence away from the blade.

TENON JIG

The dado blade method works well in most cases, but it does have one drawback. The dado blade has a tendency to leave ridges on the face of the cheeks. If you're cutting a through tenon or an open mortise and tenon (where part of

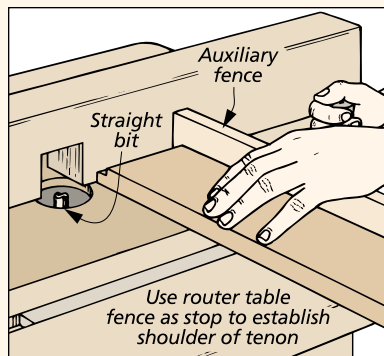
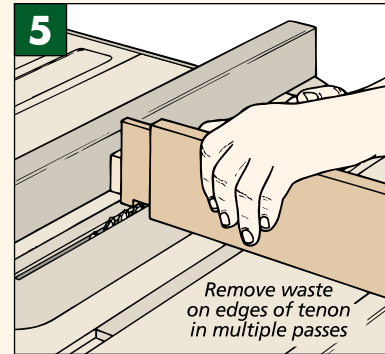
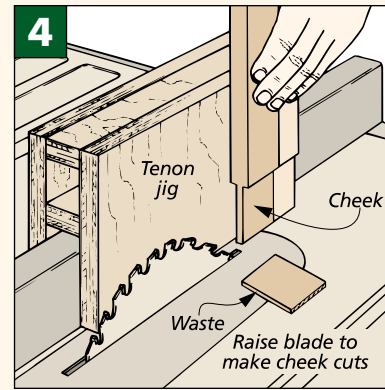
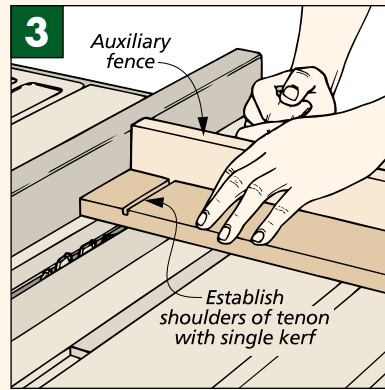


the tenon will be exposed), you want all the tenons to have smooth-faced cheeks. That's where a tenon jig comes in handy.

A tenon jig (you can buy a commercial jig or make your own) allows you to cut each cheek of a tenon in just two passes, using a single blade. This eliminates the ridges that most dado blades leave behind.

To start, you simply raise the blade slightly to make the shoulder cuts, as shown in Fig 3. Then, riding in the miter gauge slot or straddling the rip fence, the tenon jig holds a workpiece upright so you can cut each cheek, see Fig. 4.

Although this method gives you a



▲ For cutting stub tenons quickly and cleanly, I like to use a router table and a straight bit.

tenon with nice, smooth cheeks, there are a couple of reasons I don't use it for all my tenons. For one, it doesn't work well with long pieces, since it's necessary to stand the workpiece on end while using the jig.

Second, there's no way to cut edge shoulders on a workpiece with a tenon jig. So if you're making a tenon with edge shoulders, you have to come back and nibble away the waste with the saw blade, see Fig. 5.

ROUTER

There's one other method I use to make tenons that's worth mentioning. A router table and a router equipped with a straight bit is a great way to cut tenons on small workpieces, see drawing at left. A fence controls the length of the tenon and a miter gauge helps guide

the workpiece past the router bit.

A router table combines the best of both worlds — the speed and control of the dado blade method and the smooth results you get when using a tenon jig. But it works best with short, shallow tenons that can be cut on a single pass (like stub tenons for a door or for tenons on the ends of small spindles). **W**

FITTING A MORTISE AND TENON JOINT

No matter what method you use for making a mortise and tenon joint, there's still a good chance that you will have to do some "fine tuning" to get a perfect-fitting joint.

LOOSE FIT. One of the most common problems encountered in mortise and tenon joinery is a gap between the shoulder of the tenon and the mortised workpiece. This is caused by a shoulder that isn't perfectly square or cut cleanly.

To avoid this problem, I like to undercut the shoulders of the tenon slightly with a chisel. This pulls the tenoned workpiece up tight to the mating workpiece when the joint is

assembled, see left photo below.

STEPPED SHOULDERS. A common problem when cutting a four-shouldered tenon is stepped shoulders. But instead of trying to get all four shoulders flush

when cutting them on the table saw, I leave the edge shoulders intentionally high. Then I come back with a chisel and pare them flush with the side shoulders, see right photo below.



▲ **Perfect Fit.** To get a tight joint-line, undercut the shoulders of the tenon with a chisel.



▲ **Stepped Shoulders.** Cut shoulders on edges of tenon slightly proud, then trim flush.