HANDYMAN'S BENCH PLAN

I should have been more suspicious when my neighbor with the skinflint reputation offered me some scrap lumber, "free for the hauling." But I was young and poor at that time and wanted to build a workbench in the worst way. Little did I realize how something free could be so costly.

My enthusiasm carried me through the hard work of pulling the nails from the lumber, and then patiently straightening them with hammer taps on the concrete garage floor. But when I was finally ready to start cutting, I realized why my neighbor had been eager to get rid of the lumber.

Simply using the word "warped" doesn't begin to explain the complete range of lumber defects I surveyed. But I figured that I could overcome the bad lumber with a strong arm and the coffee can full of salvaged nails.

After a weekend of hammering and sawing, I had assembled a workbench. Of course, I hadn't taken the time to draw any plans, so the only way I could tell that I was finished was when the lumber was used up. Then I kept hammering until the coffee can was empty. I stepped back for a look. Then I stepped back further.

I nicknamed that project "my 30-foot workbench," which had nothing to do with its actual length. It meant that it didn't look too bad from 30 feet away.

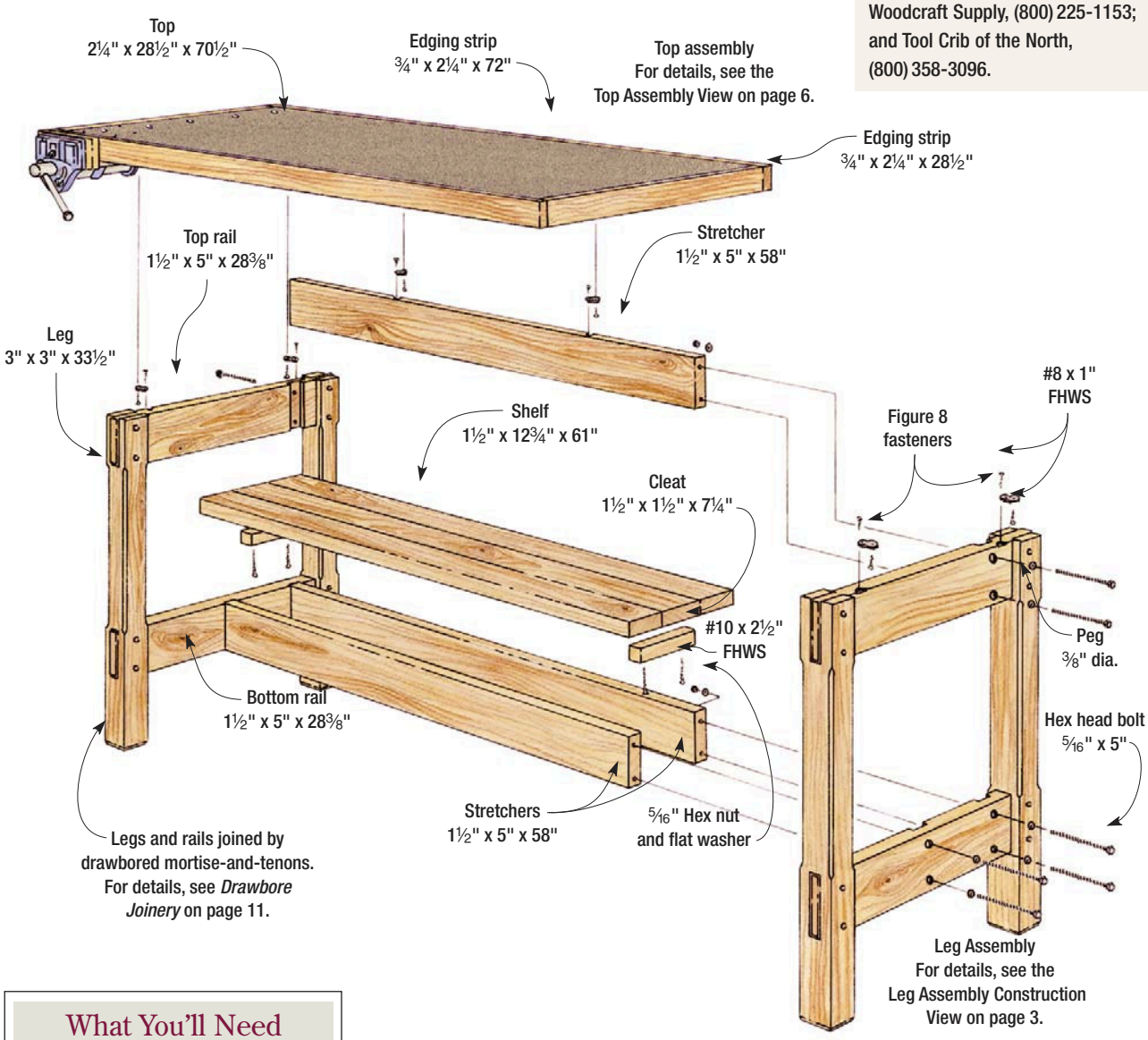
Built for Strength

By the time that first bench gave up its spirit, I had learned a few things about woodworking. So for its replacement, I designed a bench with unshakable joints, a dead-flat

Bench Construction View

OVERALL SIZE: 35¾" × 30" × 72"

Note: This workbench project calls for a Record 52ED vise, a model that's widely available. Three mail-order sources are: Woodsmith Store, (800) 835-5084; Woodcraft Supply, (800) 225-1153; and Tool Crib of the North, (800) 358-3096.



What You'll Need

Lumber

- (8) 8 ft. 2x6 Douglas fir
- (4) 8 ft. 2x4 Douglas fir
- (3) 8 ft. 1x4 Pine
- (2) ¾" × 4' × 8' MDF

Hardware

- (6) Figure-8 fasteners
- (12) ⅝" × 5" Hex-head bolts
- (24) ⅝" Flat washers
- (12) ⅝" Hex nuts
- (20) 6d Finish Nails
- (2) ⅜" × 3' Dowels
- (12) #8 × 1" FH wood screws
- (4) #10 × 2½" FH wood screws
- (1) ¾" × 2" hex-head bolt

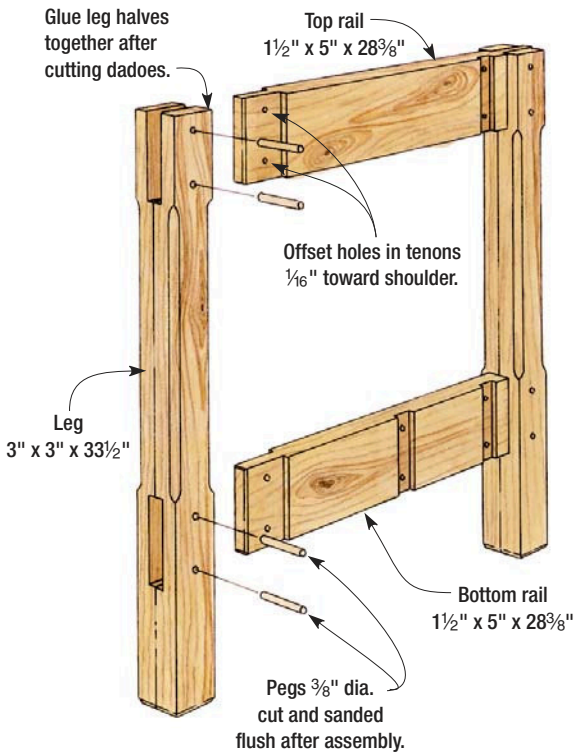
top, and enough mass to keep it firmly anchored during the most intense work sessions. Instead of nails, this bench has drawbored mortise-and-tenon joints and reliable nut-and-bolt connections **(Bench Construction View)**.

The top is laminated from three layers of medium-density fiberboard (MDF) for a flat working surface. This heavyweight material contributes enormously to the bench's solidity.

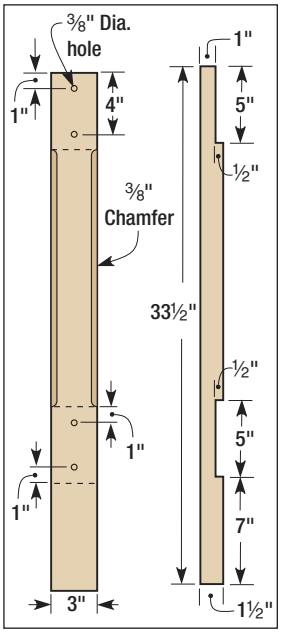
I've often wanted to work while sitting, but the design of my old bench made that awkward. In this bench, I located the lower stretchers toward the back. That way, I can pull a stool right up when I have detailed work to do or just need a break.

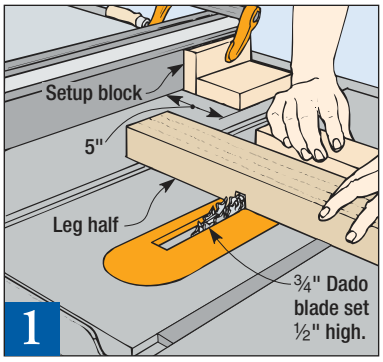
The bench also features several convenient options (See *Bench Accessories; Boxed Drawer and Shelf* beginning on page 9). You can build either or both of them now or add them later. The drawers keep frequently used tools and accessories within easy reach, and the shelf stores more tools and fasteners, so the bench top is always ready for your next project.

Leg Assembly Construction View

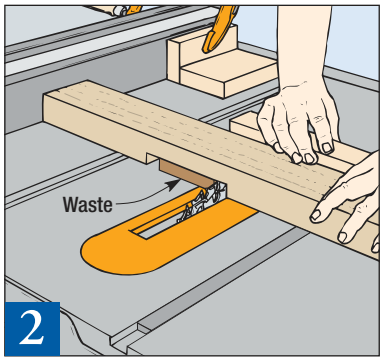


Leg Details



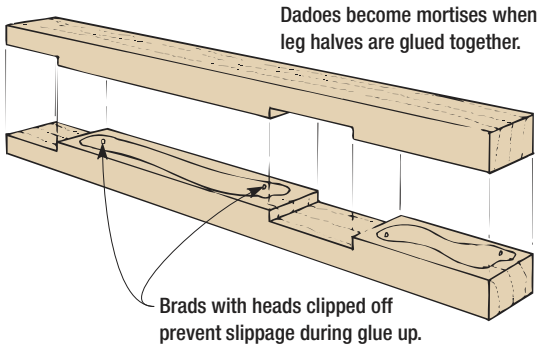


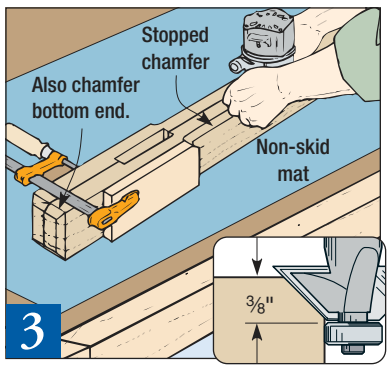
A setup block clamped to your table saw's rip fence helps you accurately position the leg half for the first dado cut.



To cut the top end of the dado, butt the leg half against your rip fence. Remove the waste (shaded area) to finish the joint.

Leg Glue-up Detail





Clamp scrap blocks to the legs to keep from routing chamfers too far. Make several light passes to prevent tearing out wood.

Start With the Legs

At the lumberyard, my past experience with poor quality material helped me pick out wood that I wouldn't have to struggle with. For strength, durability, and economy, I chose Douglas fir. If you want to make your bench from hardwood, birch and maple are traditional choices.

Once you get back to your shop, use your table saw to rip the 2x4s to width, removing the rounded corners from both edges **(Leg Details)**. Then crosscut the leg halves to identical length.

Next, set up your table saw to cut the dadoes for the bottom rails **(Figure 1)**. When the leg halves are glued together, these paired dadoes create the mortises **(Leg Assembly Construction View)**.

Screwing a wooden extension to your miter gauge helps prevent tearout when the dado blade exits the stock. This will give you clean, precise cuts. First, cut the lower end of each dado by butting the end of the leg half against a setup block clamped to the fence. Then, register the bottom end of the leg half against the rip fence and cut the top end of the dado **(Figure 2)**. After making both end cuts, make several passes to remove the waste between them.

Now you can turn your attention to the mortise at the top of the leg halves. Make certain that the dadoes making up this mortise are the same size as the lower dadoes. That way, all your rails can be identical in width.

Leg Halves Become Legs

After you've milled all the dadoes, glue the leg halves together in pairs **(Leg Glue-up Detail)**. To keep the parts from creeping, partially drive brads into one leg half in each pair, then clip their heads about 1/16" above the wood. When you apply clamping pressure, the brads will be buried into the other leg half for a non-slip glue up.

Align the leg halves with their

ends and edges flush to line up the mortises. I used a small piece of scrap wood to remove any glue that oozed into the mortises. After the glue joints cure, unclamp the legs and sand all their surfaces.

Chuck a chamfering bit into your router, and rout the chamfer at the bottom of each leg.

Next, make a light pencil mark all around each leg to define the limits of the stopped edge chamfers. Clamping blocks at the start and stop points of each chamfer will guarantee great results **(Figure 3)**. Rout the chamfer along each edge of the leg.

Drawboring Unites Legs

Maybe the memory of driving all the nails in the first bench — and the wobbly results — motivated me to to make extra strong joints in this bench. The mortise-and-tenon joints get additional muscle power from the time-honored technique of drawboring (see *Drawbore Joinery* on page 42).

This system has proven itself brawny enough to hold timber-frame houses and barns together for hundreds of years, so it certainly is more than adequate for a hard-working bench.

Carefully lay out the peg hole locations along the centerline of each leg, then drill them with a brad-point bit chucked into your drill press **(Leg Details)**.

Workin' on the Rails

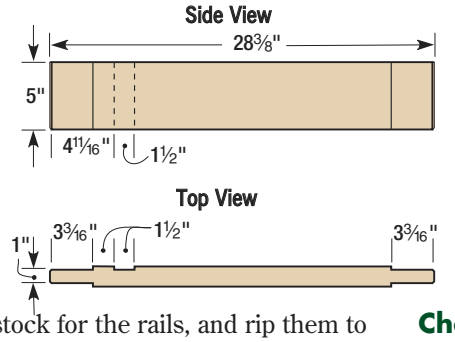
Cut the rounded corners off the stock for the rails, and rip them to width after double-checking the size of the upper and lower mortises in the legs **(Top and Bottom Rail Details)**.

Before you cut the tenons on the ends of the rails, double-check the width of the legs. I designed my tenons to protrude $^3/_{16}$" beyond the legs. To ensure tenons of consistent length, clamp a stop block to the wooden extension on your miter gauge **(Figure 4)**. Zero in on a perfect fit by cutting a test tenon in scrap lumber that is the exact thickness of your rails. Don't make the tenons so tight that you need to hammer them into the mortises. That would damage the hammered ends, and could split the legs.

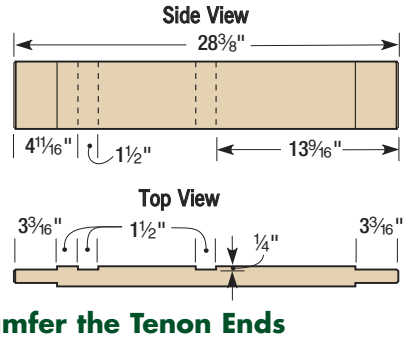
The rails have dadoes to seat the stretchers. Each top rail has one dado, and the bottom rails have two **(Top and Bottom Rail Details)**. After laying out the dado locations, cut them with the table saw **(Figure 5)**.

Mark the location of the bolt holes in the rails, carefully centering them in the dadoes you just cut. Use your drill press to bore holes square to the stock.

Top Rail Details



Bottom Rail Details



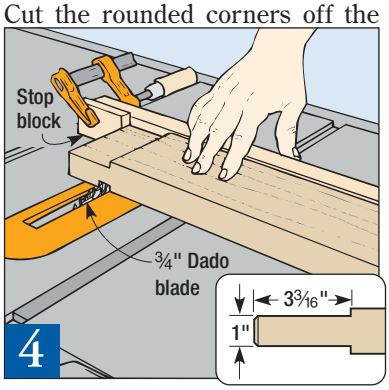
Chamfer the Tenon Ends

I scratched my head for a while trying to figure out how to machine the chamfers on the ends of the tenons. Then I realized that I was confusing myself by thinking only of power tools.

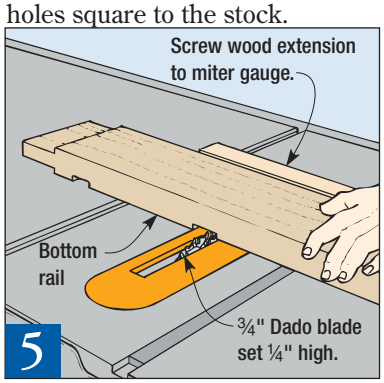
When I used my block plane, I had the chamfers done in a few minutes **(Figure 6)**. Chamfering the short edges first will help prevent tearout. If you're a stickler for subtle points, note that the top edge of the top rail tenon is not chamfered. When chamfering the cheek edges, I worked from both ends toward the center.

Sand the rails, then lay out the legs and rails in their assembled positions and mark them. I always take the time to do this when I'm working with mirror-image assemblies. It helps to prevent embarrassing mistakes.

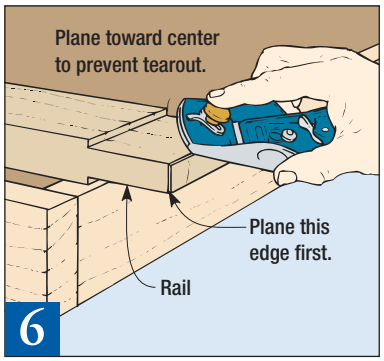
Join the rails and legs, using the procedure detailed in (*Drawbore Joinery* on page 42). Using a fine-toothed saw, cut off as much of the peg waste as you can. Then sand the end of the pegs flush with the surface of the legs.



When you cut tenons, clamp a stop block to your wood miter gauge extension. This guarantees that all tenons are identical.

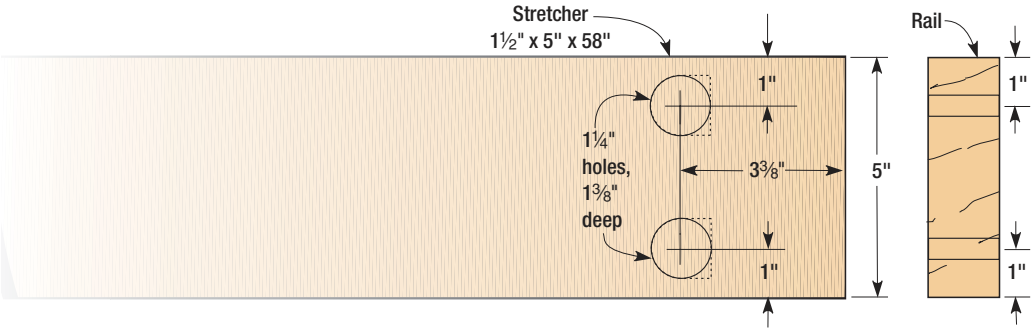


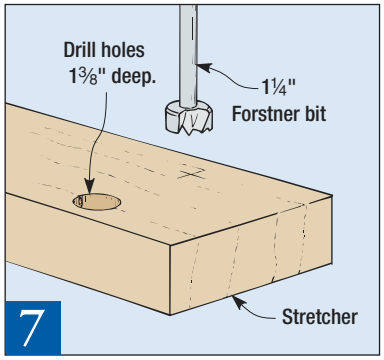
Use this table saw setup to cut dadoes for seating the stretchers. The bottom rails have two dadoes; the top rails have one.



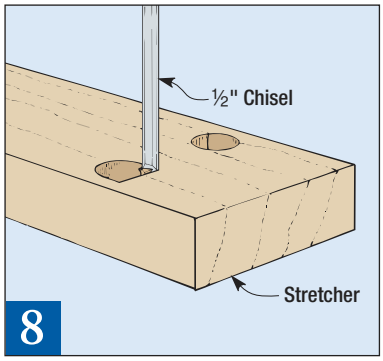
A sharp block plane is the perfect tool for chamfering the tenon ends. No plane? Use a sanding block held at a 45° angle.

Stretcher/Rail Detail





Nuts and bolts join the stretchers to the rails. Begin shaping the recesses for the nuts by drilling holes into the stretchers.



Complete the recesses by squaring one end of each hole. This creates a flat bearing surface for the washer and nut.

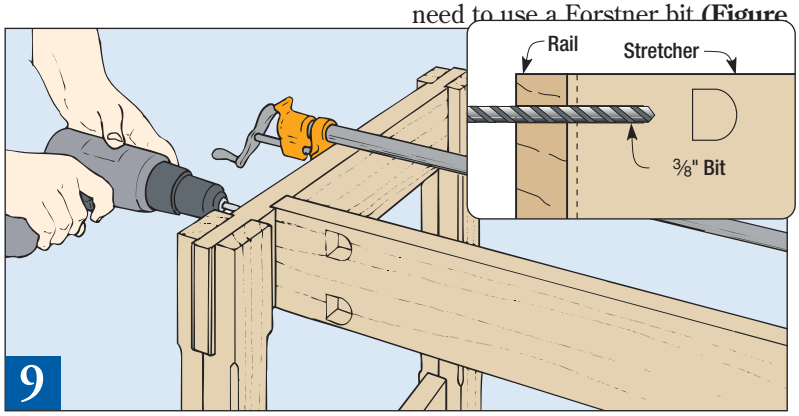
Stretchers

Use a rip cut at the table saw to square up one edge of your stock for the stretchers. Crosscut the stretchers to identical length, and rip them to final width.

Even though this workbench is designed as a permanent fixture for my garage, I wanted to be able to take it apart in case I move to a new house. I settled on a nuts and bolts system for both strength and straightforward construction.

At first, I was going to simply drill completely through the stretchers to create a home for the nut. But then I looked at the number of subtle design touches I had already built into the bench and decided to try something a bit more refined. To keep the nut concealed from the front of the bench, I chose to machine recesses into the back face of the stretchers.

Lay out the hole centerpoints on the stretchers **(Stretcher/Rail Detail)**. To avoid breaking through the front surface of the stretchers when you drill, you will need to use a Forstner bit **(Figure 7)**. Then grab a chisel and square one end of the recessed area **(Figure 8)**. This provides a flat bearing surface for the lock nut and flat washer.



Clamp the stretchers to the leg assemblies and drill the bolt holes into the stretchers. Drill the holes as deep as you can, then disassemble the base and complete the holes.

Drill Into Stretcher Ends

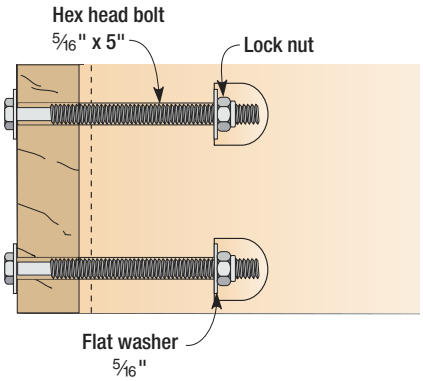
Now you can use the holes in the rails as guides for drilling into the ends of the stretchers. But to do this, you'll need to temporarily clamp the stretchers between the leg assemblies. Try to recruit an extra pair of hands to help you line up all of these parts. Clamp the leg assemblies to the stretchers, making sure to align the top edge of each stretcher with the top edge of the rails **(Figure 9)**. I used pipe clamps to hold the assembly together for drilling.

Chuck a ⅜" bit in a hand-held drill, and use the holes in the rails as guides to drill into the end grain of the stretchers. Unless you have a long bit, you'll need to disassemble the stretchers from the rails to complete the drilling. Drill all of the stretchers, then assemble the base with bolts, nuts, and washers **(Nuts and Bolts Detail)**.

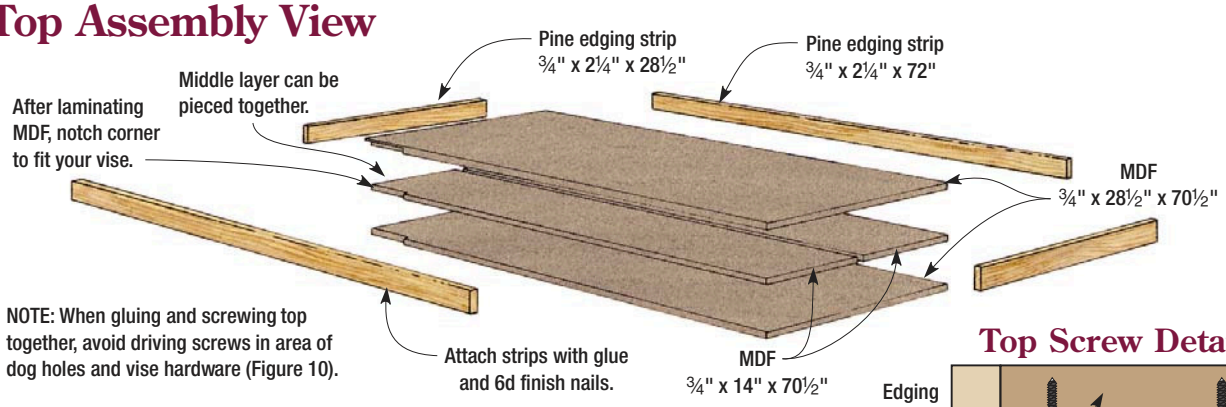
On To the Shelf

To make the shelf, joint and edge-glue 2x stock to get the necessary width, then rip and crosscut the panel to its final size **(Bench Construction View)**. Screw on two cleats to position the shelf and help keep it flat. The cleats and gravity hold the shelf in place.

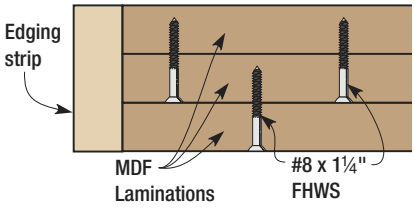
Nuts and Bolts Detail



Top Assembly View



Top Screw Detail



Learning From the Past

The uneven top on my first bench caused me nearly continuous frustration, and I always promised myself that my next bench would have a much better work surface. My first thought was a top like those on the European-style workbenches I had always admired.

But after thinking about it some more, I ended up ruling out a thick laminated solid-wood top. The wide swings in temperature and humidity in the garage would make it extremely difficult to keep any solid-wood top flat.

I finally decided to use medium-density fiberboard (MDF), a manufactured sheet that's consistent and tough. And MDF will give you a top that's flatter than a stretch of the Kansas Turnpike. That means you'll be able to count on your bench top as a dependable reference surface when you're assembling other projects on it.

MDF's weight also adds to the stability of the bench. Once you set the laminated top onto the base, this bench is not going anywhere. That's a far cry from my first bench and its habit of scooting around in the garage. With it, I sometimes felt I was chasing my work.

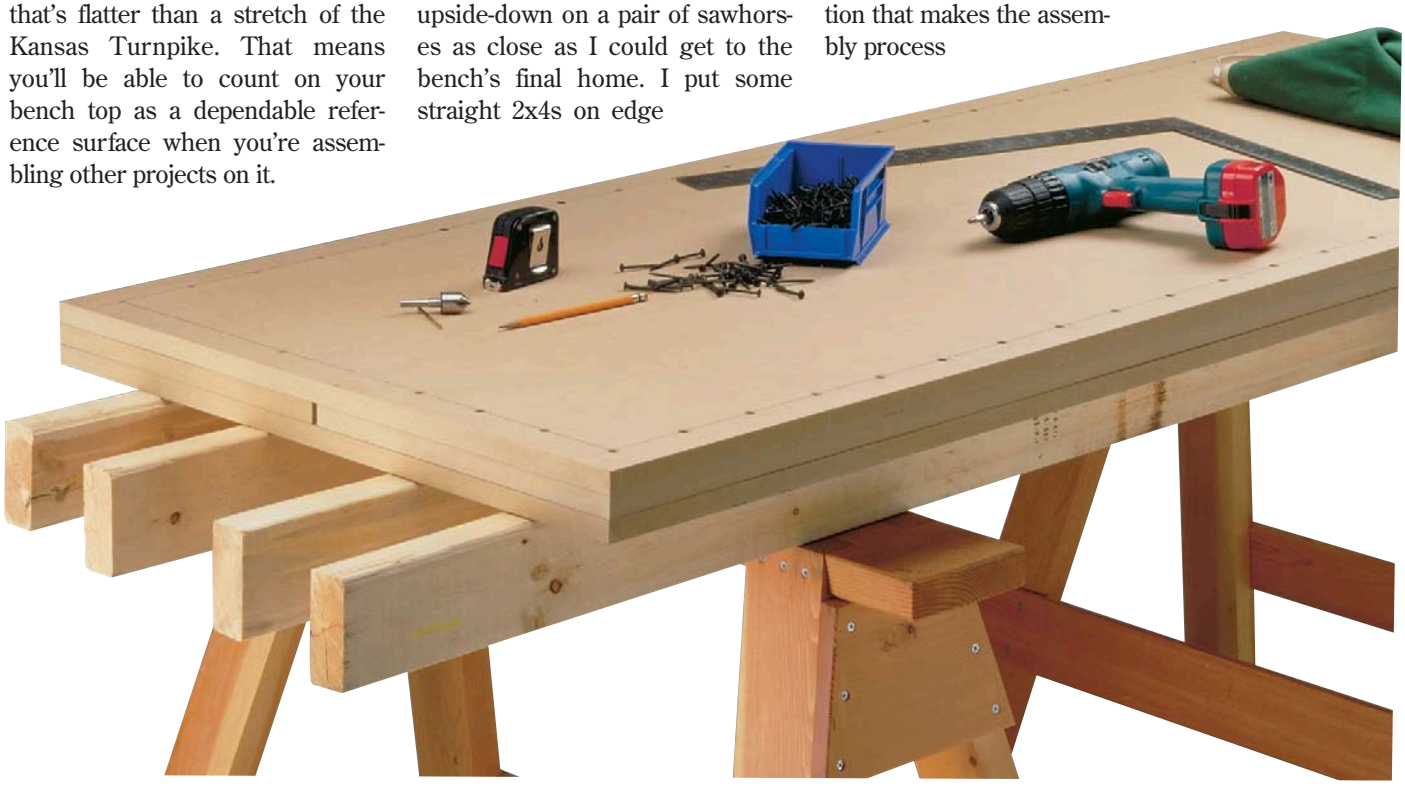
Move To the Top

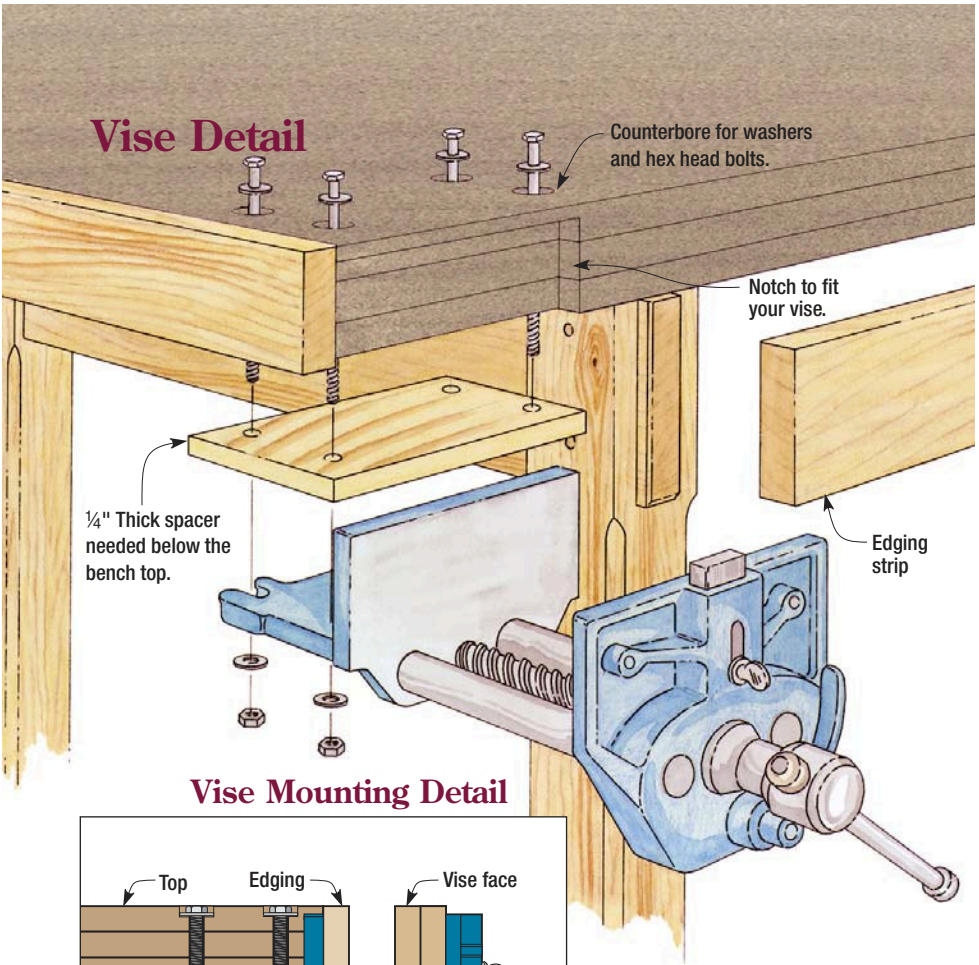
Cut the upper and lower laminations of the top from separate sheets of MDF **(Top Assembly View)**. For economy, use the leftover material to piece together the middle layer.

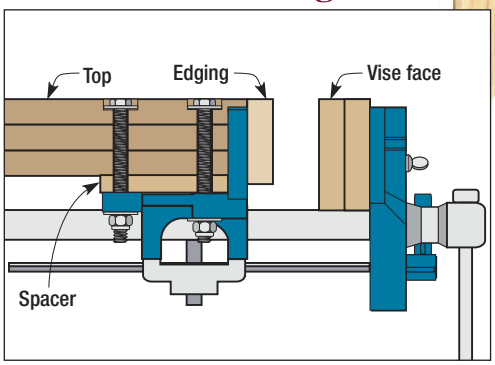
By the time you have the three layers of MDF laminated together, you won't want to carry it far. That's why I assembled the top upside-down on a pair of sawhorses as close as I could get to the bench's final home. I put some straight 2x4s on edge between the sawhorses to keep the MDF from sagging under its own weight as I worked on it. I didn't want to discover a crown in the assembly when I turned it over.

Carefully align the edges and ends of each layer, then drill countersunk pilot holes to attach them together with glue and screws **(Top Screw Detail)**.

A couple of tips: first, be sure to stagger the screw locations so they don't run into each other. And don't go overboard on the amount of glue — that will create a slippery situation that makes the assembly process







more difficult. Be careful not to drive screws into the area where you will later drill the bench dog holes **(Figure 10)**.

Everybody Needs a Vise

I installed a Record 52ED woodworking vise on my bench, and to do that I had to notch into the corner of the laminated workbench top **(Vise Detail)**. The vise you choose may require a similar notch, so it's a good idea to have your vise on hand to verify the exact size of the notch you need to cut.

Once you have the vise, lay the top upside-down and mark the vise mounting bolt locations. Drill the holes, then make a spacer block like I did to make the upper edge of the vise lower than the top **(Vise Mounting Detail)**.

You may want to recruit a brawny neighbor to help you flip the top over. In fact, if you don't happen to live next door to Arnold Schwarzenegger, you may need to invite two or three friends. Finish the vise installation by counterboring the holes and cinching the bolts tight.

Make a vise face to fit your vise **(Figure 11)**. I made mine from a leftover piece of 2x stock, but you could make yours from hardwood to gain a little more durability. One trick I learned is to leave the vise face a bit rough. A slightly textured surface will give the vise face a stronger grip on wood workpieces.

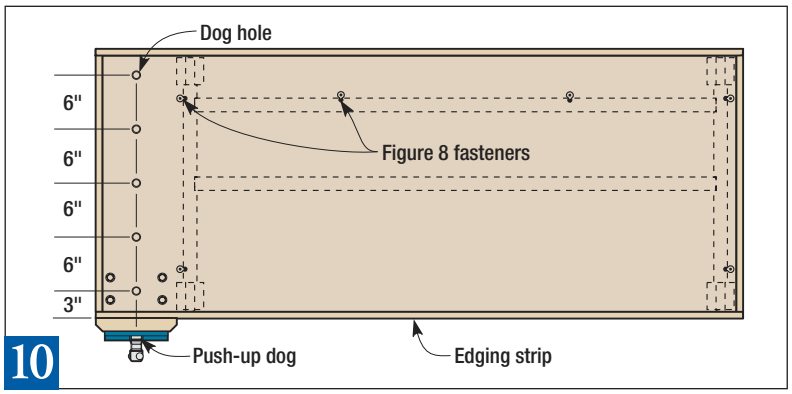
Screw the vise face to the vise jaw so its upper edge is flush with the MDF bench top. This is easy to do — you simply tighten the vise to hold the face in position.

On the Edge

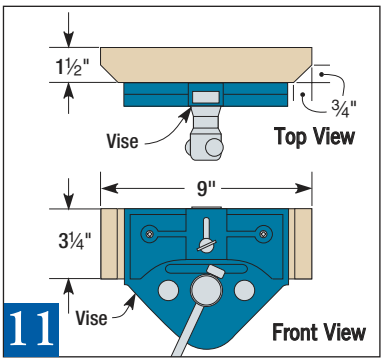
Attaching edging strips to the laminated top is the next step, so rip your stock to width. You could miter the corners, if you want, but they are difficult to install with quality corners. Instead, I used simple butt joints. I attached the end pieces first, then the strips on the front and back of the bench.

Driving a few 6d (2"-long) finishing nails through the edging strips is the most direct method of attaching them. Glue is not absolutely necessary, but I added some for good measure.

If you can position the top edges of the strips perfectly flush with the MDF top, you'll save yourself some work. But if you have to settle for less than perfect, try to posi-



After installing the vise, lay out the dog hole locations. The centerline of this row of holes is aligned with the middle of the push-up dog built into the body of the vise.



Size the wood face to suit the vise you choose. Clamp the face into position with the vise, then drive the mounting screws.

tion them slightly proud of the top surface, then plane, scrape, or sand them flush with the MDF. Also sand the faces of the strips. As a finishing detail on the edging strips, I routed a 1/4" chamfer along their top and bottom edges.

A Pilot Makes Drilling Fly

After I marked the row of holes for the bench dog, I realized that getting the top to the drill press was out of the question. But I wanted to make sure that the holes were perpendicular to the top.

To accomplish that, I devised a multi-step process. If I drilled an accurate pilot hole through the top, I reasoned, I could then use it to guide a 3/4" spade bit.

I drilled a hardwood block at the drill press to create a pilot hole jig, and then used this jig to guide th bit in my hand-held drill **(Figure 12)**. Because of the top's thickness, I had to complete the pilot holes without the jig. But by that time, the holes were already deep enough into the top to control the pilot bit accurately.

After you drill all the pilot holes, use them to guide the spade bit that enlarges the holes to final size **(Figure 13)**. Although you still do have to exercise some care to keep the drill square to the top, the pilot hole creates a path of least resistance that guides the point of the spade bit. As a finishing touch, rout a chamfer around the perimeter of each hole **(Figure 14)**. The bench dog is simply a 2"-long hex-head bolt with a 3/4" shank.

Attach the Top

I selected figure-8 fasteners to attach the laminated bench top because they are easy to install and are nearly invisible. The fastener placement is not critical — I used two on each rail and two on the upper stretcher (refer again to **Figure 10)**. Drill the counterbores and pilot holes into the rails and stretcher, then screw on the fasteners **(Figure-8 Detail)**.

To slide the top into position, you may want to call in the same crew that helped you turn it over. Secure it with screws through the figure-8 fasteners.

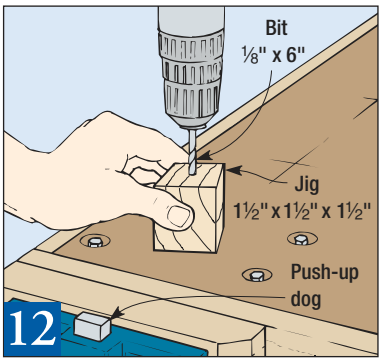
To keep grime from grinding into the wood and the MDF top, I wiped on three coats of Watco, a penetrating oil finish. Glue has a tough time sticking to a surface finished with Watco, so any squeeze-out from project assemblies will wipe up easily. To prevent spontaneous combustion from oil-soaked rags, don't leave them wadded up — spread them out to dry in a well-ventilated area or soak them in water.

Expanding the Uses

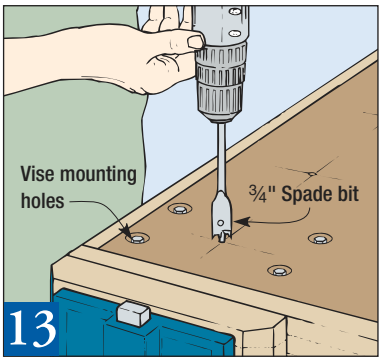
As I mentioned earlier, I'm realistic enough to know that this bench will be used for much more than cabinetmaking and detailed woodworking. I figure that this is where I will sharpen my lawnmower blade, clean up parts while I'm working on my car, and repair everything from gardening equipment to bicycles. Actually, "repair" may not be the right word. At least this is where I take those things apart.

To help me handle those utility chores, I added a machinist's vise to the right front corner of the workbench. I chose a Record model 5VSB, but you may already have a vise on hand that will work well.

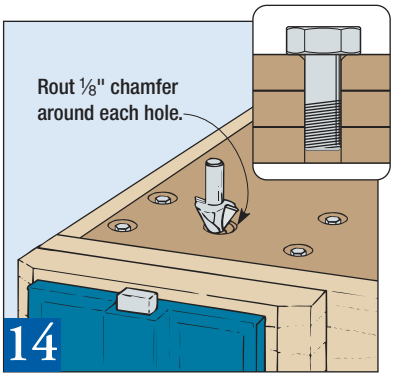
And to keep the top clean during even the dirtiest of those chores, I keep a piece of cardboard handy. It took me a long time to get a bench with an inviting work surface. I'm not going to mess it up now.



Use a pilot hole jig (made at the drill press) to drill accurate starter holes at each bench dog hole location.



Hold your drill as square to the top as possible, and let the pilot hole steer the point of your spade bit into the MDF top.



Complete the bench dog holes by routing a chamfer around the rim. Make dogs by cutting off 3/4"-dia. hex-head bolts (see inset).

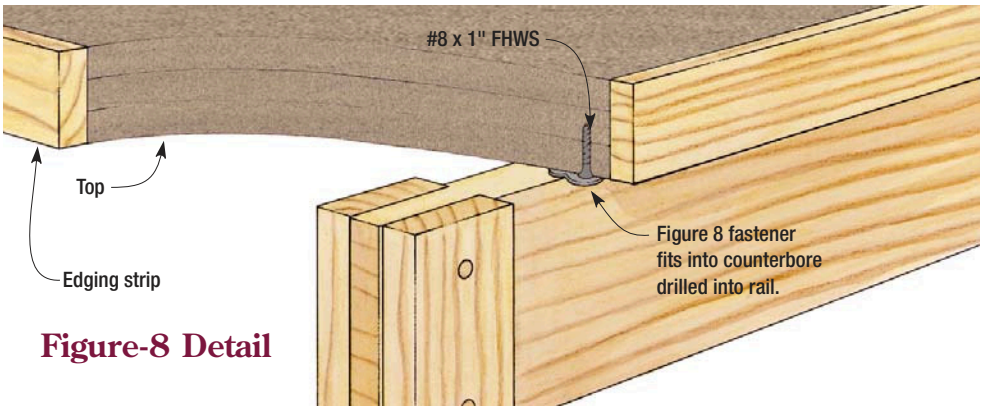
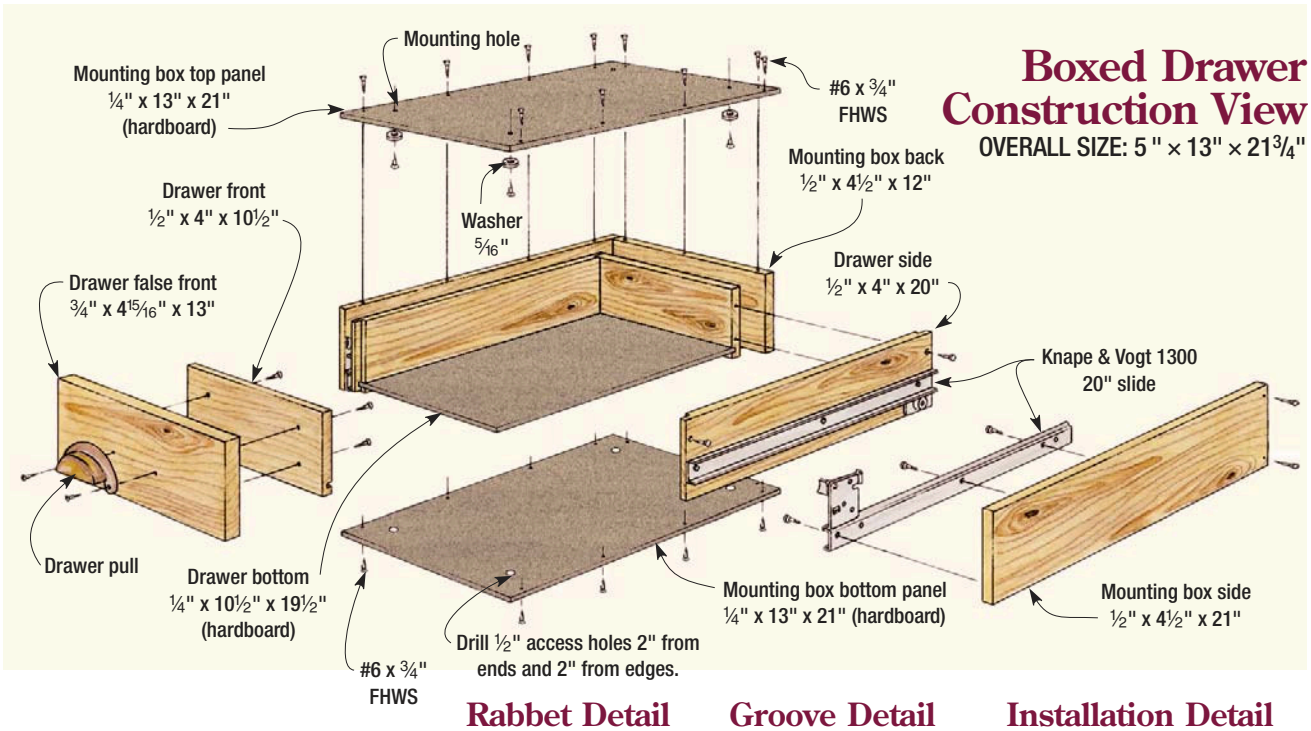
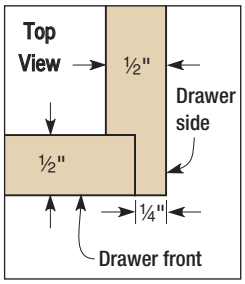
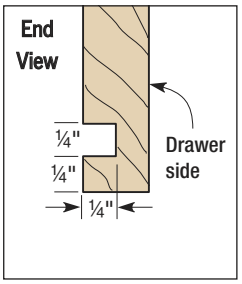
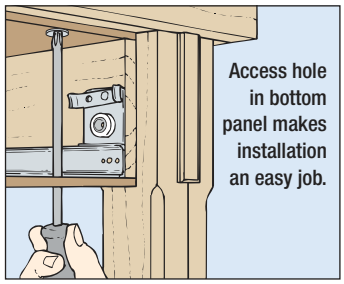


Figure-8 Detail









Bench Accessory: Boxed Drawer

If you want to get organized in a hurry, build a pair of these simple drawer units and hang them under your workbench, below a shelf, or anywhere you need additional storage space.

I designed the drawer for easy construction and installation. It features no-nonsense corner joints — glued rabbets reinforced with screws. Joinery of the mounting box is even easier. And when you're ready to install the mounting box, access holes through the bottom panel let you easily screw the unit into position.

The ball-bearing drawer slides I chose for this project require 1/2" clearance between each side of the drawer and the mounting box. I've found that you can oversize this side clearance by a little bit (up to about 1/16"), but you can't make it even a hair smaller than 1/2". To be on the safe side, I decided to make the drawers first. I could easily adjust the size of the mounting box, if necessary.

After ripping and crosscutting the drawer sides, front, and back, cut the rabbets in the sides **(Rabbet Detail)**. Then cut the groove for the drawer bottom **(Groove Detail)**. Double-check the size of the drawer bottom during a dry assembly, and cut it to size.

Now you can assemble the drawer with glue and two screws in each corner. Cut the false front to size, but don't attach it yet.

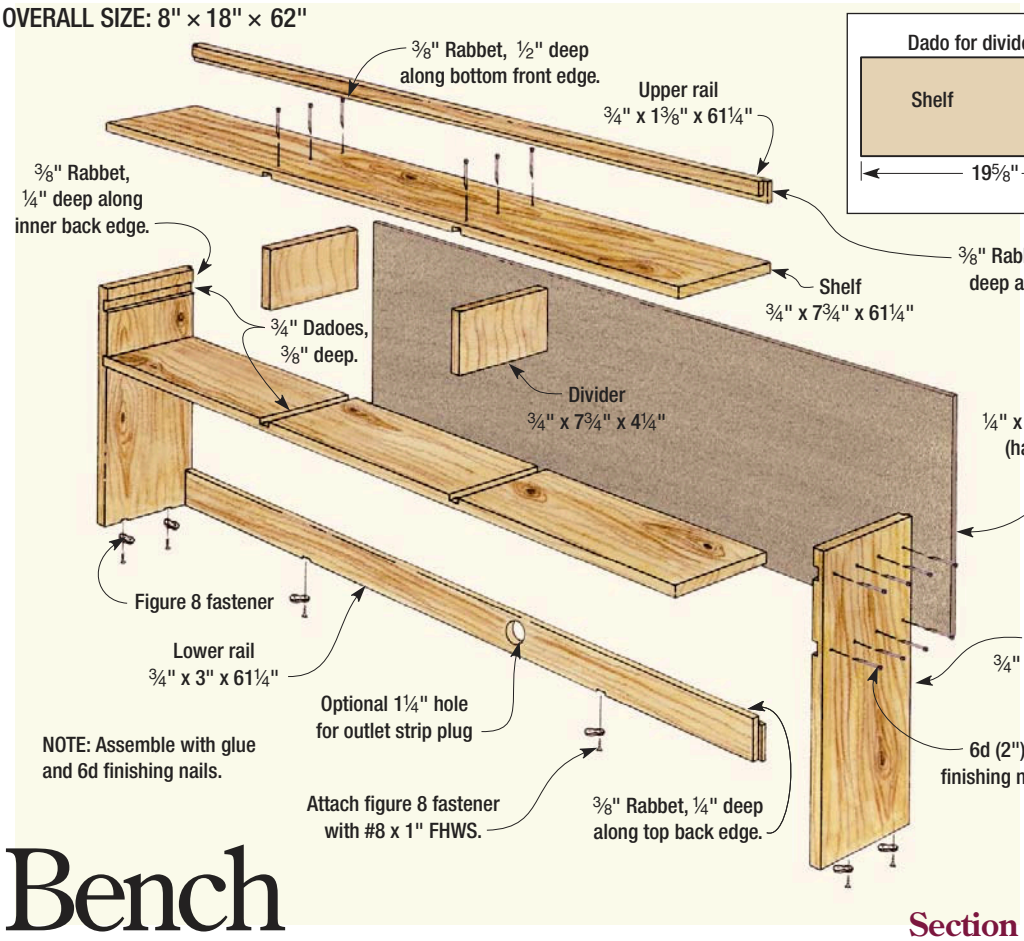
To make the mounting box, start by ripping and crosscutting the sides and back. Next, cut the top and bottom hardboard panels. Drill access holes through the bottom panel, and mounting holes in identical locations through the top panel. Assemble the mounting box with glue and screws. I installed the drawer slides inside the mounting box before adding its top panel.

Position the false front so its lower edge is flush with the bottom of the mounting box. Attach the false front with screws driven from inside the drawer. Adding the pull completes the drawer.

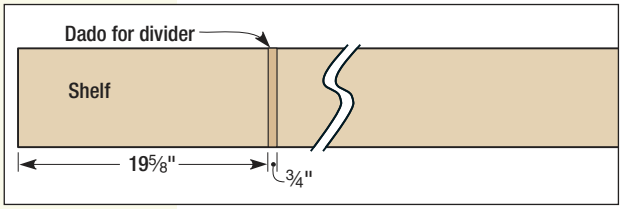
Install the mounting box with screws **(Installation Detail)**. This is easy enough to do by hand, but a long bit in a power screwdriver makes it even easier.

Shelf Construction View

OVERALL SIZE: 8" × 18" × 62"



Shelf Detail



Bench Accessory: Shelf

If the right place to put away a tool is closer than the wrong place, you're much more likely to put it in the right place. And that means you'll have a much better chance of finding it the next time you need it. I designed and built this accessory shelf for the workbench to create a wealth of right places — all within arm's length — to store tools, fasteners, and accessories

I purchased some plastic storage bins at a home center to organize the screws and nails I use most often. If you're also going to do that, buy the containers before building in case their size forces you to change the shelf dimensions.

Start construction with the sides. Rip them to width and crosscut to length, then use a dado blade to cut the rabbet along the back edge of each side **(Section View)**. Next, cut the shelf dadoes into the sides.

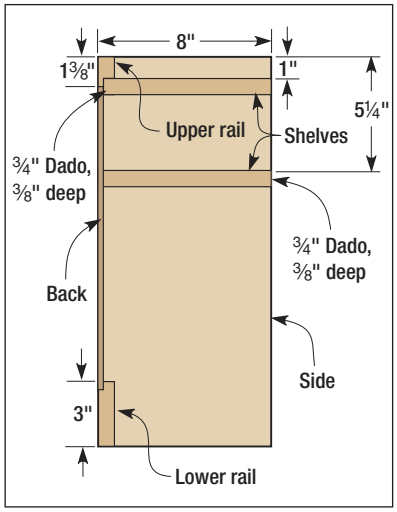
Double-check the width for the shelves by measuring from the front edge of the side to the rabbet along its back edge. Once you've done that, you can rip the shelves to width, crosscut them to length, and mill the dadoes for the dividers **(Shelf Detail)**.

The upper and lower rails are the same length as the shelves, but these parts have rabbets cut into their ends and along one edge.

Clamp the shelf unit together to check the fit of the parts. Cut the back to fit into the rabbet, and trim the dividers to fit between the shelves. After making any adjustments, you're ready to glue the assembly together. I reinforced the glued joints with 6d (2"-long) finishing nails.

I routed a chamfer along all edges and ends (except the bottom), and mounted the shelf to my bench with figure-8 fasteners.

Section View



Drawbore Joinery

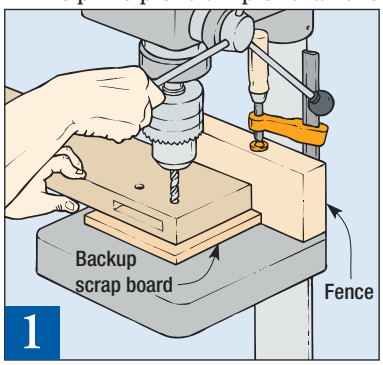
Anyone who frequents woodworking tool shows knows how many new gadgets arrive every year, each promising accuracy, speed, and better results. Some aim at improving our skills,

others at making skill irrelevant, and a few will surely gather more dust than they generate.

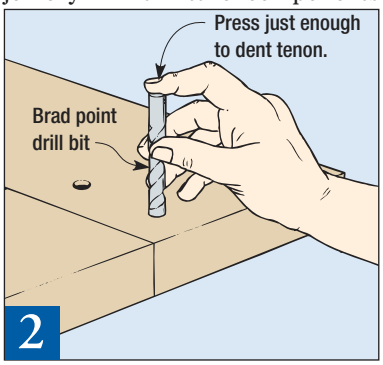
I like watching the constant stream of new ideas, but the more I see the more I appreciate the ingenuity of the early woodworkers, craftsmen who made do with simple tools and techniques.

Drawboring is one of those great techniques, relying on nothing more than wooden pegs and several holes drilled through a mortise-and-tenon joint. The hole positions are shifted slightly to create a permanent tension in the joint, almost like building a clamp right into the assembly.

The principle is simpler than the recipe for ice cubes. A straight peg driven into the slightly offset holes draws the tenon into the mortise, forcing the shoulder tight against the mortised piece. The amount of offset varies with the scale of the joinery — furniture components

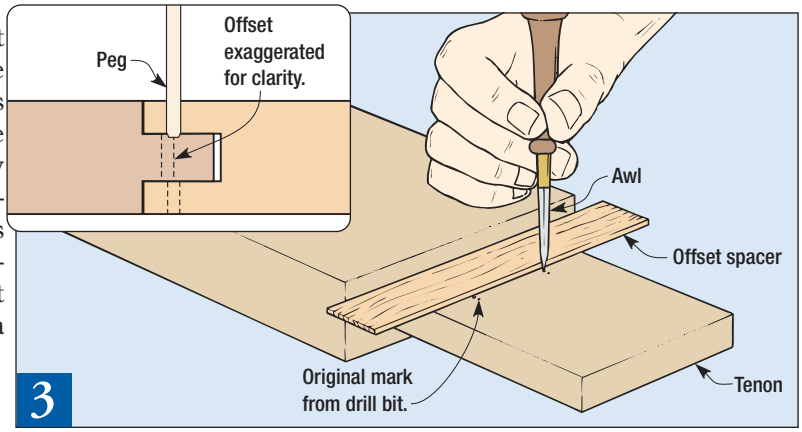


Determine the best peg hole locations and drill through the mortise. The holes can be drilled through or stopped blind.



Dry-fit the joint together and use a brad-point drill to mark the tenon. Press lightly to leave a small, fine dimple.

may require no more than 1/32", but for a joint in a large timber-frame structure, you can stagger the holes by as much as 1/4", especially if the lumber is green enough to give way as the peg is driven. One caution — too much of an offset will overstress the joint during assembly and literally break the wood apart. If you're not sure, cut some extra parts and do a few trial runs first.



Disassemble the joint and mark the tenon holes at the appropriate offset. When drilled accurately and pegged, the staggered holes pull the joint tight (see inset detail).

Measure Twice, Drill Twice

After you test-fit the tenon in the mortise, disassemble the joint and bore the peg holes through the mortise **(Figure 1)**.

Like the offset, the peg position should be scaled to the joinery. Going more than halfway down the length of the tenon leaves it weak and prone to splitting; too close to the shoulder weakens the sides of the mortise. This varies with the wood species and the proportions of the joint, but as a general guideline, the distance from the center of the hole to any edge or corner should be no less than twice the peg diameter. Within these limits, though, I usually try to stay close to the shoulders. That way, a gap won't open up in the joint if the wood shrinks — the movement will stay to the outside of the pegs.

After you drill the first holes, dry-fit the joint again and use a brad-point drill to mark the face of the tenon **(Figure 2)**. Press the bit just enough to leave a small, sharp dimple. If you create a large dent there, chances are you're deforming the very spot where the offset mark needs to go. Finesse this step and save your muscle for disassembling the joint. Then figure the offset you want and mark the new hole locations on the tenon **(Figure 3)**.

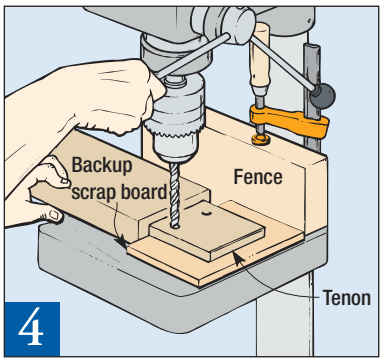
When you drill these holes, use a block underneath to support the back of the tenon **(Figure 4)**.

Prior to the final assembly, you'll also need to customize your pegs. I cut short lengths of hardwood dowel rod (fluted dowel pins create gaps at the hole edges) and sand a chamfer on the leading ends so each peg can maneuver through the offset holes **(Figure 5)**.

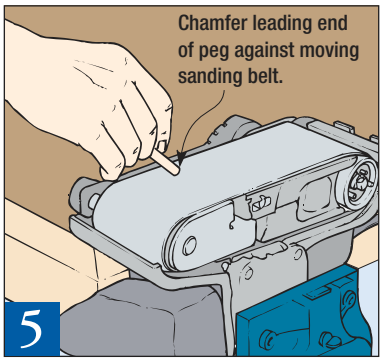
Attention to Detail

I also ease the leading edges of the tenon slightly so it will enter the mortise more easily and give the excess glue a little room. When you're ready for final assembly, spread glue inside the mortise and (lightly) on the tenon, then force the joint closed with clamps. Check the assembly for square, then drive the pegs **(Figure 6)**.

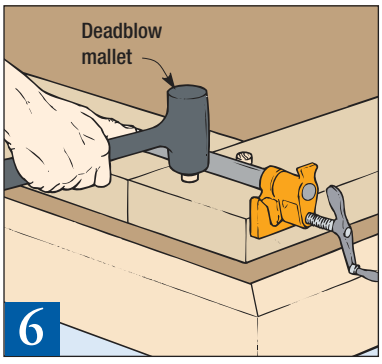
You can vary some details if you want — the pegs can be left proud or pared flush with the wood surface. Also, they can stop shy of the back of the joint or continue through the assembly. And the tenon itself can be "blind" (concealed inside a closed mortise) or "through" (extending to or past the far side of an open mortise).



Using your drill press (if possible), bore the peg holes through the tenon. A backup block helps prevent tearout.



A belt sander makes quick work of the end chamfer on each peg. Don't skimp here — that "nose" is your navigator.



Use a clamp to close the joint, then check the assembly for square. Drive the pegs with a deadblow or wooden mallet.