

BUILT TO TRAVEL. This bench can be knocked flat in about 10 minutes with a $\frac{3}{4}$ " ratchet set and a No. 3 Phillips screwdriver. I traveled all over the country with this workbench and became quite familiar with its assembly and disassembly. Finally, we gave the bench away to a reader of our magazine who won it in a contest. That guy made the moves on my managing editor, and so did the next reader who won one of my workbenches. So we stopped giving them away.

Chapter Nine: An Appendix



Knockdown Workbenches

On principle, I don't think it's a good idea to automatically build a bench that is designed to be disassembled and moved. It's quite a bit of extra effort to add all the engineering to create a workbench that is stable, yet can be broken down like an M-16 by a blindfolded woodworker to be moved at a moment's notice and under cover of darkness.

But whenever I get on my high horse about this topic, I remember the advice of the newspaper reporter who covered city hall at my first journalism job: "Anybody who does anything just for the principle of it, is a nutball – plain and simple."

Thank you Jo Fleischer.

Knockdown workbenches are a necessary evil in our mobile society. When I finished building the English Workbench in this book, I moved it from our shop in Cincinnati and into my basement workshop 20 miles away. It was a two-beer job, but nothing too nasty.

Later on, I decided to move that bench out of the basement and into the shop of a friend who lived a couple hours away. So we loaded the English chap into his mini-van and dumped it in his garage until we had some extra time to move it into his basement workshop.

That magic moment came a couple weeks later after a large lasagna dinner and a bottle of wine. We determined that the path of the workbench would be through the dining room, down the stairwell, around the corner of the playroom and into the workshop.

Now, before you peek back at the chapter on the English Workbench, I'll remind you that yes, it is indeed 8' long. And the bench's path? Well let's just say we now call it the Bataan Death March for Workbenches.

In the end, moving the bench into the basement workshop required my friend to destroy two walls of his lovely home after we wedged the bench in his stairwell like Augustus Gloop got jammed into the pipe to Willy Wonka's Fudge Room.

And that was when I decided to write an extra chapter for this book about knockdown benches.

You see, I'm no stranger to the concept of knockdown benches. The first seven benches or so that I built could be disassembled and loaded into a Honda Civic. And I've experimented with a fair number of novel and idiotic ways to create a knockdown workbench. And so this chapter will discuss those methods so you can pick the one that appeals to you and your budget.

How to Knock Down a Workbench

If you want to make a workbench that disassembles in any way, you basically want it to break down into five big pieces: the benchtop, two long stretchers and two end assemblies.

Some people will even build the base so the end assemblies can be knocked down, but I think this is a waste of hardware and effort. I think you should build your end assemblies with big,

beefy solid-wood joints and save the metal bits and precision drilling for the rest of the workbench.

So let's first talk about how you can join the base's long stretchers to the end assemblies of your workbench's base so you can take the thing apart. I think there are four major strategies:

1. Solid-wood tusks driven into large through-tenons that pass through mortises in the legs.
2. Drawbore pins
3. Lap joints secured with screws or lag bolts
4. Hex-head bolts, bench bolts or threaded rod.

Tusks: As Old as the Mammoth and Almost Extinct

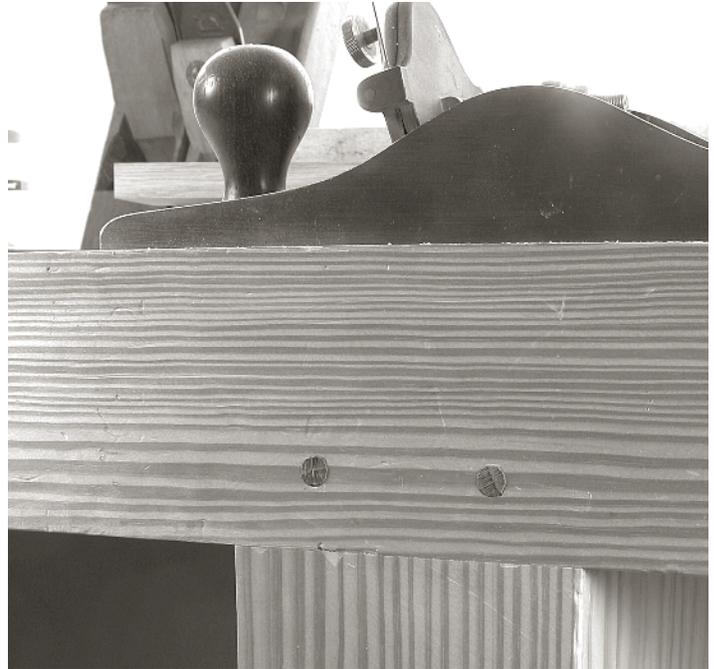
You don't have to have a scrap of metal in your workbench. Heck you can build your bench so you could get it through security on an airplane. Think: wooden vise screws, friction-fit dowels to attach the top to the base and tusk tenons to keep the base tight.

"The things we make show to the world what we are. The Furniture of a period is a sure index to the ideals and aspirations of that period – or to the lack of them."

— Elbert Hubbard (1856 - 1915)
author and teacher



TUSKS, IF YOU MUST. Using tusk tenons creates a bench that can be knocked down without metal hardware, but the joinery does complicate the construction of the base.



PERMANENT DRAWBORE. The base of my French workbench is joined to its top with a large drawbored tenon. It's stout, but makes moving the bench difficult.

While tusk tenons are usually thought of as detail prevalent on Arts & Crafts furniture, it's actually a much older way of making knockdown furniture – the Conformat screw of the Dark Ages.

The most prevalent form of base I've seen with tusk tenons has the two end assemblies permanently joined. Then the two end assemblies are joined using long stretchers with through-tenons that piece the legs. Then those through tenons are pierced with tusks (wedges, essentially) that are knocked in place to tighten up the base. When you need to tighten up the base, knock the tusks in from the top. When you need to knock the base down when the Huns show up, you knock the tusks out from below.

It's an effective but imperfect joinery system. The effective part of the system is that you can assemble and disassemble things without any special hardware. A mallet (got one of those, right?) is all you need. The imperfection comes from the fact that the base can loosen up when you don't want it to. If the tusks aren't built skillfully, then seasonal expansion and contraction will work them loose – I've seen this happen in a lot of tusk-tenon furniture. I have a couple antique bookcases built this way. One day every year is "mallet day" when I go around the house beating all the tusks tight again.

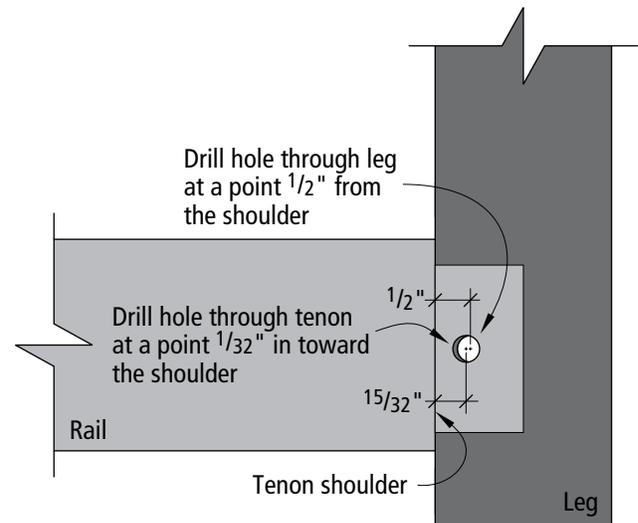
This ritual beating isn't a big deal, but it is the only knockdown system that has this problem. Also, you can work the tusks loose through the normal racking of the base caused by planing, chiseling and sawing. If you are going to build a workbench base with this system, you need to keep your tolerances tight and make sure all your parts for the base are at equilibrium. If the stretchers are wet, they can dry around a tusk and make it quite difficult to remove. If the tusk is wetter than the other components, it will shrink, the base will come loose and you'll have to make new tusks to make your base tight again.

One last piece of advice on joint design and we'll move on: When you make the hole in the stretcher that holds the tusk, you want to offset the hole so part of it is buried in the leg – about $\frac{1}{16}$ " will do in a beefy tusk. This slight offset will help pull all the components tight when you drive the tusk home.

Speaking of offsets, another way to make a knockdown bench is using drawbore joinery.

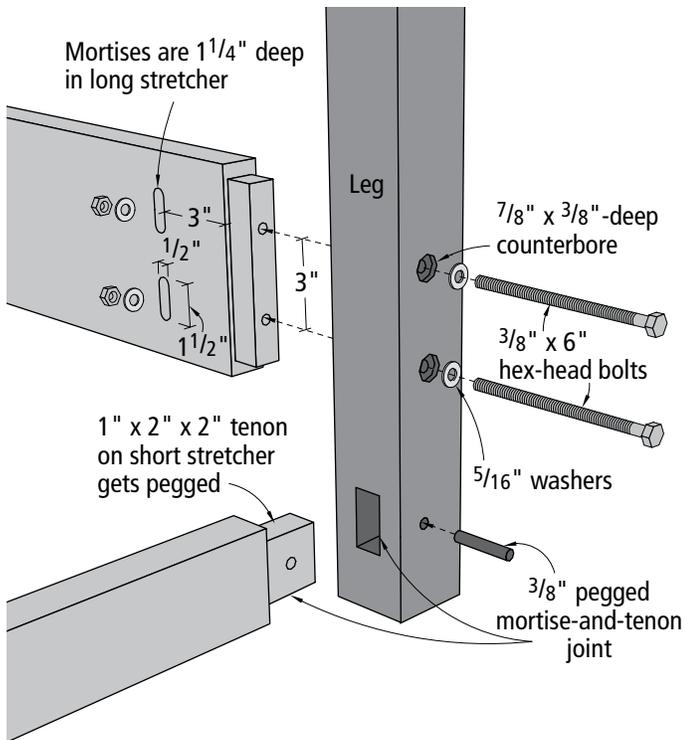
Drawboring: Don't Knock It

Traditional drawboring was done without glue (or without decent glue) and was done in wet wood (though the wooden pins work best if they are dry). You can use this system to put together your bench. The upside is that you won't need an metal hardware, the bond won't shake loose and it's unobtrusive.



The downside? The joint requires some finesse to do really well. And disassembly is not something you want to do if you are to be featured on the next episode of "Cops." It takes some time to disassemble things correctly.

All the basic rules of drawboring apply (see the appendix on drawboring in this book for complete details). You don't want to make the drawbore hole blind – obviously – or the thing will never come apart. Nor should you introduce glue to the joint. Make the drawbore pin from the toughest wood you can. I like white oak for drawbore pins whenever possible. My gut says that hickory would be an awesome species for drawbore pins because it can take a beating like the Cincinnati Bengals. But other bench builders (people who have built



THE VERITAS BENCH BOLT SYSTEM. A few well-placed holes is all it takes to hold your bench together with the Veritas system. And tightening the bolts in the system is simple with a ratchet set – though mine have needed it only once in five years.

more benches than I have) report that the hickory is hard to rive and work into a nice pin and just doesn't do as nice a job as white oak. So take that hearsay for what you will.

I don't recommend using a wood that splits easily: cherry and walnut are not the best choices. After you drive the drawbore pins, how do you get them apart? I like to use a metal rod that is a slightly smaller diameter than the drawbore pin – a $\frac{1}{16}$ " smaller in diameter is ideal. Place the metal pin on the head of the wooden pin and hit the metal one with a hammer. A couple good strikes should loosen things up. And if the drawbore joint is well made, you should be able to reassemble the bench.

When re-assembling the bench, I recommend making new drawbore pins. When I remove pins that have resided in a joint for a long time, they have taken a set and become permanently bent. So for best results, drive a new wooden pin in.

How About a Knockdown Dovetail?

When I visited tool collector John Sindelar in southwestern Michigan a few years ago, I spent a few hours poring over the old 19th century workbenches in his collection. Though he has more vintage workbenches in one room than I've ever seen, I don't think Sindelar actually collects workbenches; I think he actually uses them more to display his tools.

But he does have a wide variety of them and a couple of them have an interesting way of securing the base so it can be knocked down. In essence, the base was made with lap-dovetail joints that were then secured by nuts and bolts running through the assemblies.

It's a fairly clever idea (though I admit I've never tried it). The tail shape on the stretcher fits snugly into the female socket in the leg

without glue. The shoulder of the joint keeps the base assembly from racking. Then you bore a counterbore and clearance hole through the joint and bolt it tight.

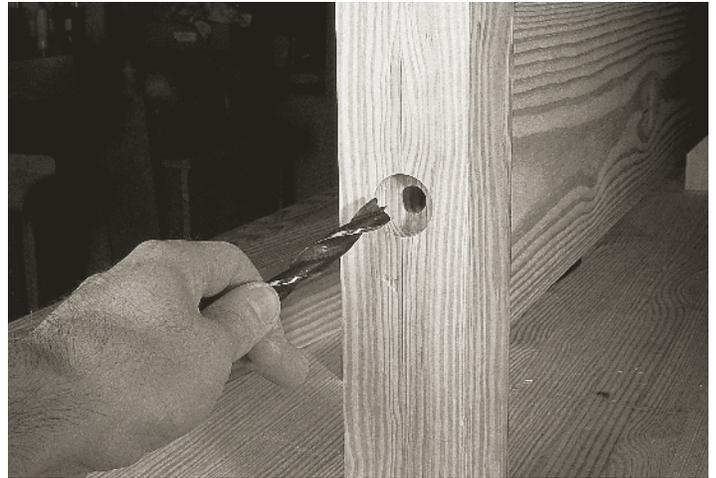
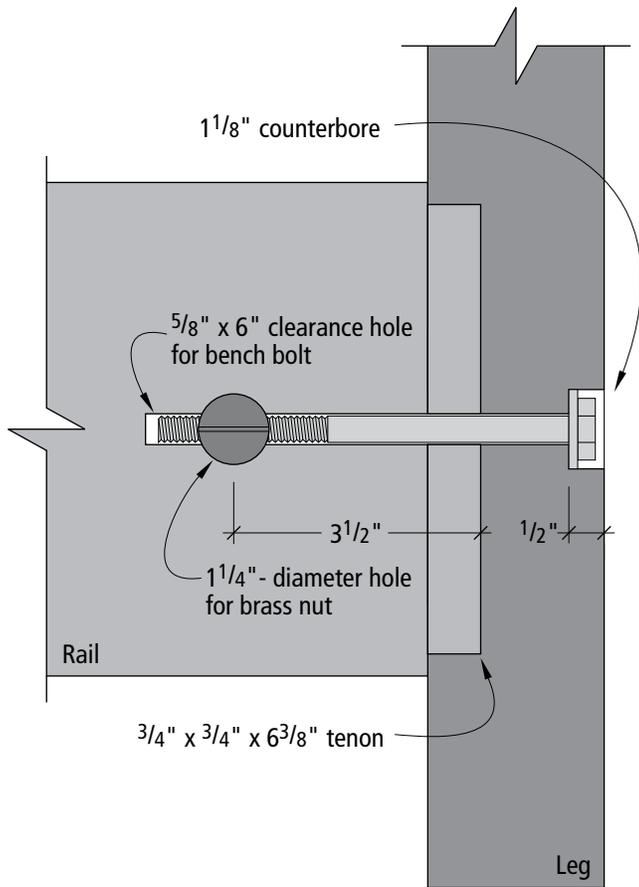
Perhaps the only disadvantage is that you cannot cinch the base tight if you ever rack the base so much that the shoulders of the dovetail get worn out. (You can cinch tight a typical bench bolt system that has become loose or damaged, as you'll learn below.)

Bolt Your Bench Like a Bed

I think the best way to make a knockdown bench is to use a bolt system like that found on traditional knockdown beds. This system uses a long bolt that passes through the leg and into the stretcher. Inside the stretcher, the bolt encounters a captured nut buried in the stretcher. The two bits of metal thread together and lock the leg to the stretcher. You can tighten the bolt until the joint is tighter than anything you can build with traditional joints – heck you can compress the wood to failure in some soft softwoods.

With this sort of system each leg has a bolt, some sort of washer and a captured nut. However, there is another system you can use that uses two long threaded rods. Each threaded rod passes through a leg, then the entire stretcher (usually in a groove in the stretcher and then out the other leg). Then you put washers and bolts on both ends of the rod and cinch the sucker tight.

I haven't used this system in a workbench, but I have built furniture this way (one of my family's first pieces of handmade furniture was a coffee table built using that system, and it survived four kids, a divorce and being dumped at our farmhouse).



THIS IS A DOWELING JIG. The clearance hole in the leg works like a doweling jig to make the clearance hole in the stretcher. The hole in the leg guides the bit as you begin the hole in the stretcher.

need to be sized like a traditional tenon. Instead, make it short and squat. I'll usually make the tenon $\frac{3}{4}$ " long and at least $\frac{3}{4}$ " thick. The extra thickness is to accommodate the $\frac{5}{8}$ "-diameter clearance holes for the bench bolts. If you make your tenon any thinner you won't be able to install the bolts. If you make it even thicker than $\frac{3}{4}$ " you'll be in high cotton – $\frac{7}{8}$ " thick or 1" thick is great if you can manage it.

The mortise needs to house the tenon. I like to make my mortises just a shade deeper than necessary ($\frac{1}{8}$ " is fine) to ensure any junk at the bottom of the mortise doesn't interfere with the fit of the tenon. Plus, as you will soon see, bolting the tenon will compress the wood in the leg a little, so a bit of space at the bottom of your mortise helps ensure tight, tight tenon shoulders for years to come.

Installing the Bolts

The No. 1 mistake people make when they drill all the holes for their bolts, nuts and washers is that they make their tolerances too tight. For example, they'll buy $\frac{3}{8}$ "-diameter hex-head bolts and bore a $\frac{3}{8}$ "-diameter clearance hole for the bolt. Same goes with the counterbore for the washers. The washer is $\frac{7}{8}$ " so they drill a $\frac{7}{8}$ "-diameter counterbore.

These tight tolerances will ensure that you will have a hard time getting everything lined up so all the bolts and nuts and washers will work in tandem. You will make it far easier on yourself if you make all your holes for all your hardware $\frac{1}{8}$ " oversized in diameter. Drill a $\frac{1}{2}$ "-diameter hole for $\frac{3}{8}$ " bolts. Drill a 1"-diameter counterbore for a $\frac{7}{8}$ " washer. The bolts will get some wiggle room and assembly will be a breeze.

So here's the drill (pun intended): First you bore the counterbores and clearance holes in the leg for the bolts. Then you assemble the stretcher and leg and use the hole in the leg like a doweling jig to bore as much of the clearance hole as you can in the stretcher. Your drill bit will bottom out before you make it all the way.

So you then disassemble the leg and stretcher and finish boring the hole in the stretcher freehand.

All the boring begins with the counterbore in the leg for the

By far, the most popular way to bolt a bench together is to use a bed bolt system. You can, in fact, use bed bolts from a reproduction hardware company. Or you can use hex-head bolts from the home center. Use two bolts in each joint – eight bolts total per bench. Cheaper, yes. Classy, no.

After building a few benches with the hardware above, I broke down and started using the Veritas bench bolts – currently priced at less than \$30 for a set. I like the Veritas bench bolts because they are beefier than a bed bolt, and the installation process is a little simpler. With a bed-bolt system, the nuts are housed in a rectangular mortise you excavate in the stretcher. The mortise isn't difficult to make, but once you use the Veritas system, it sure seems that way.

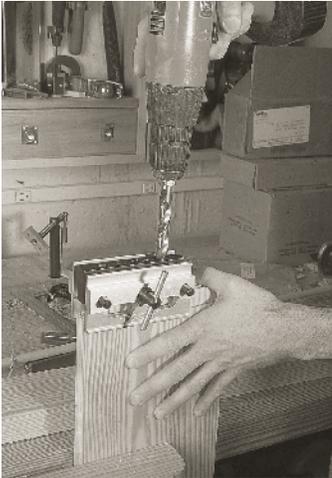
With the Veritas system, the nuts are housed in a blind hole you bore with a Forstner bit. It's simple and fast to do. Plunge. Done.

But I'll let you decide which is best. Let's walk through installing both systems: The hex-head bolts (total cost: \$7 in hardware) and the Veritas Special Bench Bolts (\$26.50 in puny 2007 dollars).

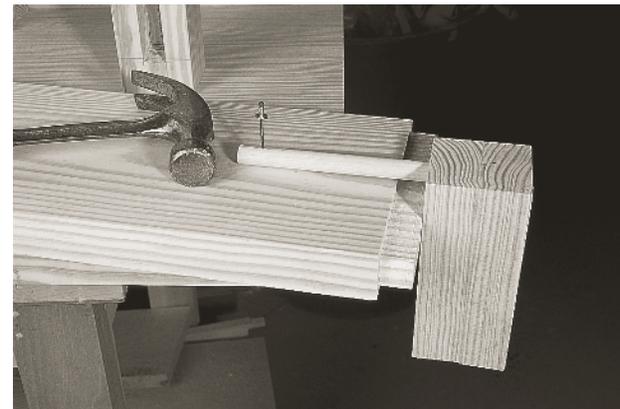
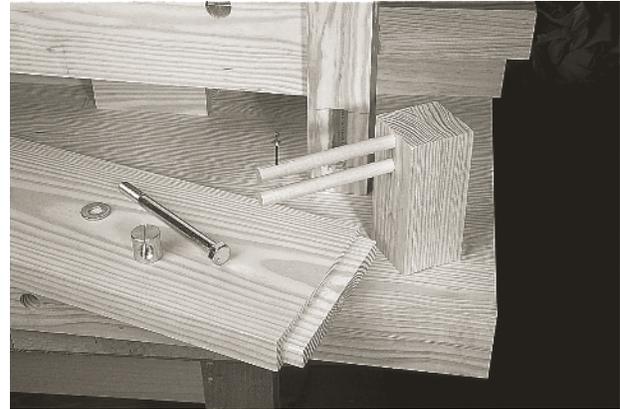
A Bit About Joint Design

For both systems, there still is some wood-to-wood joinery involved before you can get to the bolting fun. The wood component of the joint might indeed supply a little strength, but the wood joinery's primary job is to hold all the parts of your bench's base in place as you install the bolts, nuts and washers.

So you need a tenon on the end of your stretcher, but it doesn't



BORE UNTIL YOU CAN'T BORE ANY MORE. I like to do this operation vertically because I can poke my head all around the bit to see if I'm plumb with little effort. You can do this operation horizontally if you don't have a vise (yet).



A DOWEL SHOWS THE WAY. Here you can see the jig that indicates where the nut will be located on my stretcher (top). The bottom dowel goes into the bolt hole. The top dowel mirrors the direction of the bottom dowel. The nail pricks the stretcher. That is where your nut will go.

Making a Nut Hole

Putting the hole for the nut in exactly the right place can be a bit tricky. It needs to intersect the hole you just bored for the bolt and leave room for the nut. Plus, if you are using home-center nuts and washers, each hole needs to be able to have enough room for the washer and your fingers – plus the mortise needs to have one flat surface for the washers and nuts to press against. If you are using the Veritas Bench Bolts, you just need to find the centerpoint for your round hole.

The solution for both systems is the same, and it doesn't involve measuring. Trying to figure out where the nut hole should go by using math will get you in trouble because chances are that your hole for your bolt is off by a degree or two – that's enough to throw a monkey wrench in the works.

So you build a simple jig that can find the perfect location for your hole, no matter how poorly you bored the holes for the bolts. I got the idea for this jig from the installation instructions for the Veritas Twin-Screw Vise. It uses a similar but smaller captured bolt system to hold the rear jaw in place.

The jig is easy to make – takes five minutes. Get an offcut from building your base – I typically use a chunk left over from the leg. Then get two lengths of dowel that are the same diameter as the hole

washer. If you are using hex-head bolts, go nuts and spend the extra six cents to get large fender washers for your bench. These bigger washers will spread out the clamping force of your bolt head, reducing the chance that you'll crush the wood in the leg when you cinch everything up.

Measure the diameter of the washer and bore a counterbore that's $\frac{1}{8}$ " larger in diameter using a Forstner bit. I recommend the Forstner here (instead of a spade bit) because its center tip is smaller. The smaller tip will make it easier for you to find the center of the counterbore to follow up with your clearance hole for the shaft of the bolt.

Make the counterbore deep enough to accommodate the thickness of the washer and the thickness of the bolt head – usually $\frac{3}{8}$ " deep is enough for off-the-rack hex-heads (the Veritas Special Bench Bolts need a $\frac{1}{2}$ "-deep counterbore). I do this operation on the drill press so it's more likely to be dead-on.

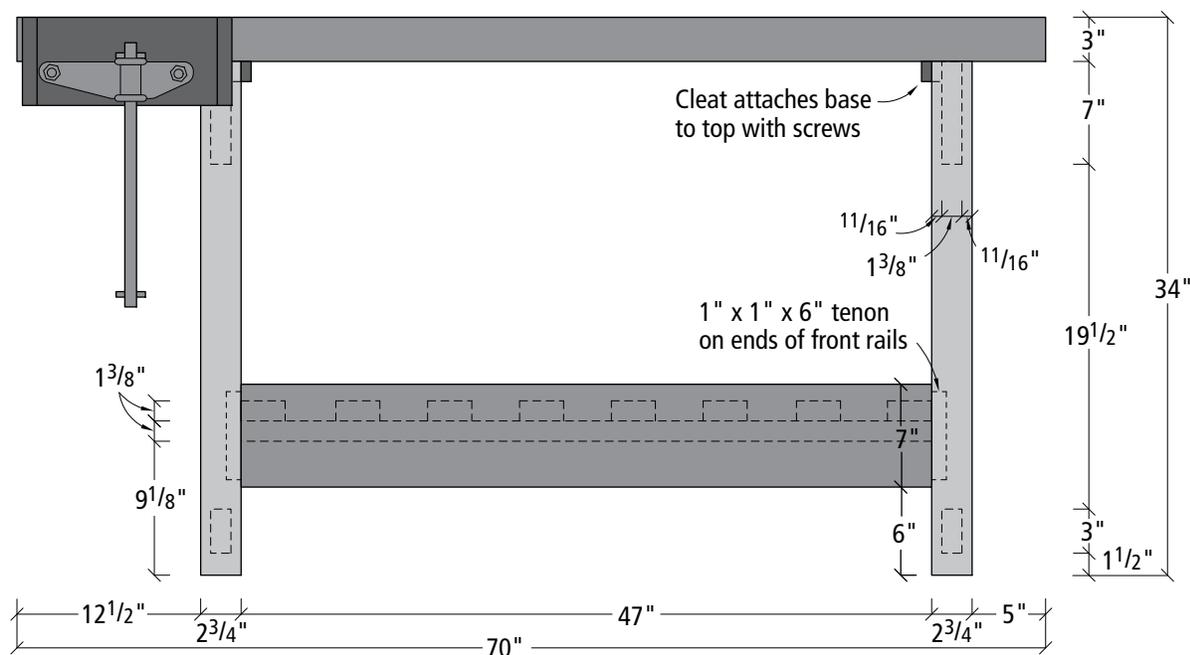
After you drill all your counterbores, get a drill bit for your bolt's clearance hole. You can use a Forstner, twist bit or a brad-point here. If you have all three kinds of bits to choose from, pick the one that will make it easiest for you to find the centerpoint of the counterbore.

If all your Forstners use a center tip that is similar in size, it will be easy for you to just drop the tip for the bolt's hole into the depression left in the middle of the counterbore. A twist bit can easily find the center of a large depression. A brad-point that has a long point can find the center of an average-sized hole with ease.

Chuck the bit in your drill press and bore the bolt's clearance hole all the way through the leg and into the mortise on the other side. You'll get some blow-out on the exit side, but don't sweat it.

Now comes the fun part. Assemble the leg and stretcher and clamp it up tight – put a clamp at the top and the bottom of the stretcher and leave yourself some room for your drill's chuck. Take the drill bit out of your drill press and chuck it into your brace or your electric drill. Put the bit in the hole in your leg and bore down all the way until you run out of bit.

Unclamp the joint and pull the stretcher out of its mortise. Now continue to bore into the stretcher until you run out of bit again. Take it slow at first, and do your best to stay straight on.



you bored for the bolts. These need to be long enough to reach the entire distance you bored in the stretcher – usually 6" is long enough.

Now bore two blind holes in your offcut to house the dowels. Where you put the holes is determined by the thickness of your stretcher. One of the dowels in your jig will go into the hole. The other dowel will sit on top of your stretcher so you can see the direction of the hole in the stretcher. Usually there's an 1" of space between the two holes or so.

So glue the dowels into the jig and then drill a slender hole in the dowel that will be on the outside of the stretcher. The hole needs to accommodate a finish nail and it needs to be centered on the dowel's diameter. The finish nail will mark on your stretcher exactly where you want your nut to go.

Insert the jig into the stretcher and use the nail to mark the stretcher. If you are using the Veritas Bench Bolts, you are almost done – just bore a 1¹/₄"-diameter hole right on that location (I know that it seems like you should use a 1"-diameter hole, but the 1¹/₄" hole will give you some wiggle room and be just as strong).

If you are using the hex-head bolts, then you need to make a mortise at that location that will accommodate the washer and nut. You can make this mortise many ways: You can chop it out by hand, bore it out and clean up the walls with a chisel, or rout it out using a template (be careful because the mortise is deep and can snap your bit if you plunge too deeply).

The router jig is the cleanest and most accurate way to do this operation, but building one jig for just a handful of holes is a bit of overkill. If you're going to make benches or beds for a living, however, the jig is definitely the way to go here.

When sizing your nut hole, make sure you make the mortise large enough to get the washer in there. Don't use the big fender washers

here – you'll have to clip their corners to fit them in these tight mortises. Use standard washers. And make sure you can get a wrench in there to hold the nut as you cinch the bolt.

After you get your nuts and washers tightened up, you're done. Some woodworkers fill the mortises with hot-melt glue or thick epoxy to hold the nuts in place. This is supposed to make the bench easier to re-assemble because the nuts will stay in place. The downside is that if you ever strip out the threads on the nut, you're going to have to go all Howard Carter on your nut hole and excavate the ruins of your spoiled nut. (However, I'm sure no one has ever stripped out the threads on a home-center nut).

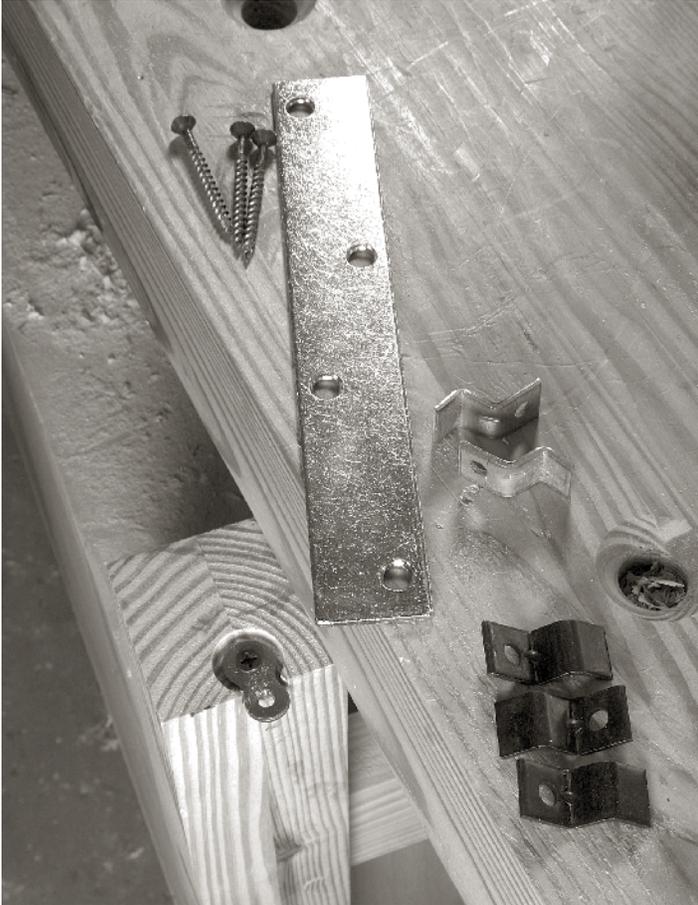
If you're using the Veritas Special Bench Bolt system, you just drop the brass nut in your hole and use a straight-bladed screwdriver to roughly line up the nut with the bolt. Cinch the head of the nut with a ratchet and you're done.

Attaching the Top to the Base

Attaching a benchtop to a base vexes a lot of woodworkers. They want to do it right and make it stout so that the result will withstand racking forces. This is one part of bench-building where you can go a little overboard and make it hard on yourself.

Perhaps the most traditional way to attach a benchtop to the base is to not attach it. Instead, you bore a hole in the top of each leg and drive a stout 1" dowel (or stouter) into the hole. Shape the proud end of the dowel like a bullet. Then bore four matching holes in the underside of the top and drop the top onto the dowels. No glue. No metal. Just a press-fit and good old gravity (still free of charge – 4.54 billion years and counting).

I've used these benches. They're great. The stretchers in the base do most of the work in preventing racking. The top just sits there and



INEXPENSIVE AND FAST. You can use hardware designed for attaching dining tables (shown in leg and at right), or beefy steel-plated stuff designed to reinforce garden gates and barn doors.

does all the workholding. And that's true with most workbenches: The mechanical connection of the top to the base is a minor player in the overall structure of the workbench.

The following are some of the common knockdown methods for attaching the top, along with a discussion of their pros and cons.

1. Old-school, press-fit joinery
2. Wooden cleats and screws
3. Metal plates: Mending plates, figure-8s, Z-clips, L-brackets
4. Metal bolts: Hex-head bolts, lag bolts, threaded inserts, T-nuts

Old-school Wood Joinery

The French Workbench in this book as built by A.J. Roubo could be a knockdown design. The top is secured to the base using a through-tenon and a through-dovetail. I doubt you would need a drop of glue in this joint to make it sound. But you could knock it apart if you wanted to. You also could make this joint with two through-tenons and achieve the same result.

When Roy Underhill built his Roubo-style workbench for the 2007 season of "The Woodwright's Shop," he used a tapered dovetail joint that he called a "rising dovetail." In essence, the joint goes together loosely; as you pound the components together, the joint tightens up. It's easier to see than to explain. Check it out at the PBS



TOUGH ENOUGH. Here I attached the top to the base with a figure-8 fastener. The bench's rigidity is maintained by the stretchers below. So the method of attaching the base to the top is more about shear forces than racking forces. So the steel screws do the job quite well.

web site: <http://www.pbs.org/wws/schedule/video.html>.

The easiest and most common way to join the top and base with wood, however, is the "wooden bullet" described above. Unless I were building a Roubo repro, I'd probably use the wooden bullet if I didn't feel like using little bits of metal. But I do like the metal stuff because it makes the installation process much easier.

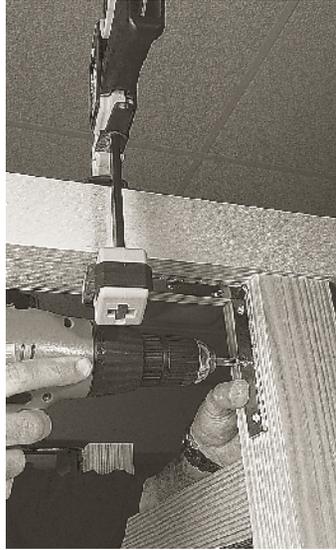
Wooden Cleats and Screws

The simplest way to secure a top to the base is probably to use a 1³/₈" x 1³/₈" wooden cleat that is screwed to the base and then screwed to the top. This is how I secured the top of the \$175 workbench I built in 2000 and it has not complained a bit after many years of planing and sawing.

I used #10 screws and designed the cleats to accommodate seasonal wood movement in the top. Here's how: A couple years after I built the bench I decided to move the top backwards on the base so the front edge of the benchtop was in line with the front of the legs (surprise). So I replaced the cleats and drilled the holes so that I could keep the front surface of the workbench flush and push all the wood movement to the rear of the bench.

So I drilled all the clearance holes to attach the cleats to the base straight on and tight – I didn't ream them out at all. When I drilled the clearance holes in the cleat to attach the cleat to the top, I drilled the two front-most holes straight on as well. That ensured the front edge of the top and base would stay in line. With the remaining three holes I reamed them out to accommodate the benchtop's movement.

FAST AND SECURE. These 6" L-brackets are inexpensive (about \$3 each) and install quickly – no mortising. And they are stout enough to resist wood movement forces.



Now, some people will make router jigs to make the oversized holes. Or they'll make them on the drill press by connecting two holes to make an oval-shaped clearance hole. This isn't really necessary. After I drill the clearance holes I just tip the drill forward and back about 20°. This produces an hourglass-shape that reflects exactly what the screw is going to do during its life in that hole – it's going to tip forward and back.

One final note: Eagle-eyed readers will also ask why I even reamed the holes out at all. After all, the French Workbench uses wood movement to pull the entire Franco-thing into an A-frame shape. Why not do this with a cleat?

Well, you can do it with a cleat, but it's a bit risky. Because you are pushing all the wood-movement forces into the cleat, you risk the screws splitting the cleat. Replacing the cleat isn't a big deal, of course, but it's not a very tidy, workman-like task to saddle on future generations.

Metal Plates: Think Agricultural

You can easily get away with using hardware for attaching tabletops in many cases, as long as it isn't the flimsiest sort. If you can bend it with your hands, it's not suited for the job.

I've attached benchtops to their bases using the figure-8 fasteners for tabletops that you can buy at hardware stores with great results. Installation is a snap: You drill a shallow recess in the top of the leg and screw the fastener to the top of the leg with the biggest screw you can manage.

Then you position the top on the base and screw the top in place through the other hole in the fastener. Again, use the largest-diameter screw you can because this area will be subjected to shear forces. The figure-8s will rotate to accommodate wood movement. They are quite clever.

In a similar vein, I think you could use the common Z-clips to attach the benchtop and base. Be cautious of the quality of the hardware however; some of these Z-clips have been confused with aluminum foil.

If I were installing a top with these clips, I try to put two in each



QUICK OR COMPLEX. You can use a simple lag bolt (right) to attach the top. Or you can use a through-bolting system that is typically used to attach the ends to the stretchers in the base.

leg. Or, if I had a stretcher running between the legs up at the top, I'd put a couple more in there as well. Whenever I install these, I use a biscuit joiner to cut the slot for the clip. A slot with that shape allows the Z-clip to move side-to-side to accommodate wood movement.

What if you don't want to accommodate wood movement and want a bench that casts into an A-frame but you don't want to make beefy French tenons? That's when you can turn to using mending plates and L-brackets. I've used both, and both are up to the task.

When you use the mending plates, you install them much like the figure-8 fasteners. You make a shallow mortise in the top of each leg and screw the plates down with honkin' big screws (you'll usually get two screws in there). Then you put the top in place and screw the top to the plates.

The plates are fairly invisible in the finished bench, and they are stout enough to resist typical wood movement in a top. The plates I encounter are $\frac{3}{32}$ "-thick zinc-plated steel. They'll hold things together as the benchtop shrinks and expands a $\frac{1}{4}$ " or so during the course of a year.

Even simpler than a mending plate is installing an L-bracket in the corner created by the benchtop and leg. A typical \$3 L-bracket is a remarkable chunk of hardware. Each leg is 6" long, has three screw holes and is a whopping $\frac{3}{16}$ " thick.



BOLTED THROUGH THE TOP.

Here I've used a hex-head bolt to attach the nut for a vise, but the idea is exactly the same if you wanted to attach the top to the bottom. The cleaner look is to have the head of the bolt showing in the topside – not the nut.

Installation is easy. Clamp one leg of the L-bracket to the underside of top (you did leave room under your top for clamps did you not?). Screw the bracket to the leg. Repeat this process on the other three brackets and then screw all the brackets to the underside of the benchtop. Done.

Bolting it On

Many commercial benches use a simple lag screw to attach the base to the top. The usual arrangement is that the two end assemblies of the base are a trestle shape. The top rail of the trestle might be 2" thick. Then you drill a clearance hole in the trestle's rail and drive a lag screw into the underside of the top.

The first time I encountered this years ago I was surprised at how flimsy the arrangement looked. The bench-building company used only two skinny bolts in each trestle. It did the job at the time, but I do wonder about the long-term with just a couple screws. If I were to go the lag-screw route, I'd use some beefy 1/2"-diameter ones and use three on each end (six total). I'd ream out the two rearmost holes to accommodate wood movement.

The more permanent method of joining the base and top involves some metal threads on the female side of the equation – usually something embedded in the benchtop.

There are a few ways to go about this. Without doubt, the most stout is to use 1/2" hex-head bolts, washers and nuts – just like when installing hex-head bolts in the base as detailed above. The cleanest way to do this is to put the counterbore for the washer in the top of the benchtop.

Then you put a washer and nut on the underside of the stretcher of the base. Cinch it up and you are done. You can do this with four

bolts total in a workbench and you will be set for life. It's up to you whether you ream out the clearance holes at the rear to accommodate the seasonal movement of the top. It depends on what you are trying to accomplish with your bench.

There are a couple other ways to go about this that I've discussed with other bench builders. I haven't tried these, so I cannot vouch for them. But they are worth considering. The first is to install bolts through the top as described above. But instead of using a nut and washer on the underside of the bench, you install a T-nut in the underside of the stretcher. This works on the same principle as a hex-head bolt; the only real advantage is that you won't have as much hardware to misplace when you move the bench because the T-nut will be embedded in the base.

The other option is invisible – some people don't want to see a shiny bolt head in the top of their workbench. (I'm indifferent to that. I see it as a reminder of how stout the sucker is.) In this scheme, you embed a 3/8" threaded insert in the underside of the top. Then you bolt the base to the top through a stretcher in the base.

Though this hardware setup does keep the hardware from sight, it's a bit fussy. In fact, when faced with that task, I might just pull out the tenon saw and start cutting massive through dovetails and tenons and go Roubo-style.

— Christopher Schwarz
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