I took up a challenge this summer to return to my early days as a budding woodworker. "Design a good workbench," one of my students said, "that I can make in my basement shop." I well remembered what it was like in a home shop with only a few tools, very little money, and plenty of ambition. How do you get started without a bench to work on?

I made up a few rules to follow to satisfy that student's challenge. The total cost for the bench, not including the face vise, had to be less than $150. I could only use a few simple tools, like an electric drill and circular saw. All the parts and supplies had to come from one source, a large discount lumberyard. And I had to be able to build the bench in one weekend. Fair enough?

My new workbench is made from common material, plywood and pine construction lumber, put together in an uncommon way as torsion boxes. By gluing and screwing a framework of 2x4s between pieces of plywood I was able to create an incredibly strong and rigid structure. Torsion boxes resist twisting and racking, the problems most often found in workbench bases. The bench top is a torsion box, too, with a built in tool well.

Two sheets of 5/8" thick flooring underlayment plywood, about 120 linear feet of 2x4s, and a couple of 2x6s are the skin and bones of the bench. At the lumberyard I headed for the best looking pile and sorted out straight stock with smooth edges. It didn't much matter what length they were, for I was planning on cutting many different sizes.

Back at my workshop I made a temporary work table out of the materials I just bought. I nailed four of the 2x4s across a pair of sawhorses and covered them with one of the sheets of plywood. I nailed the plywood down, too. Now that I was ready to make the first torsion box, I decided it was going to be the center one of the base unit. The
plan was to finish this large box first and then use it as a better work table to make the other torsion boxes.

I cut the plywood skins for each box before cutting the framework pieces to size. For ripping up the plywood I used a circular saw but realized a jigsaw or hand saw would have worked just as well. The edges I cut didn't have to be perfect, and they sure weren't. I intended to use the factory made edges where it was important that they be straight and square.

I sorted through my pile of 2x4s and set aside the straightest for the bench top. Looking at what was left, I could have started sawing by hand in a wooden miter box. Again, the cuts didn't have to be perfect (the strength of a torsion box doesn't depend on tight framing joints) but my stamina isn't what it used to be. "Simple tools" aren't what they used to be, either, so I told myself I was still playing within the rules and used an electric chop saw.

Putting aside my tape measure I directly marked lengths from one piece to another as I went along. I wouldn't have done that years ago, but I've since

Tom Caspar's Torsion-Box Workbench
TOOLS REQUIRED

A pair of sawhorses.
Miter box and saw to cut 2x4s. An electric chop saw works best.
Saw to cut plywood. An electric circular saw is fast, but a jig saw or hand saw will work.

Straightedge. Can be a good 1x4 or a yardstick.
Drill. One with torque settings is best for driving screws.

Drill bits. Phillips head screwdriver; pilot bit with countersink for a #8 screw by 3/4" or 1" long; 1/4", 3/8", and 1-1/8" spade bits; 3/16" twist bit.
Hammer.

Tape measure.
Combination square and carpenter's framing square.

1/2" and 9/16" wrench or socket. For the lag screws.
A couple of clamps.
A nail set.

Paint scraper. For removing glue.

Hacksaw. To cut the threaded rod.

Jack plane. Optional. Grind a slight curve to the iron.

I learned that the best way to avoid making a mistake is to not use a ruler. Look at the order of the cut list. First I laid an uncut 2x4 across the plywood and ticked off two cuts. I cut the next end piece the same way. The following three pieces fit between them. I nested the two end pieces with the concave sides out, placed them together on one side of the plywood, and plunked down the next two by four to cut. I ticked off where to cut from the other edge of the plywood. Throughout building the bench I always made an effort to mark directly from one object to another.

All the short pieces needed generous holes 1 1/4" in diameter for the threaded rod that binds the base together. If the holes didn't line up in the finished box, well, I've been around the block enough times to see an embarrassing situation coming! Drawing an "X" from corner to corner, I centered the holes so that it didn't matter which way the shorts ended up in the framework. When you're in a hurry it's best to keep things simple, I drilled the same diameter holes through the end pieces.

Centers determined the placement of parts in the framework as well. This made it easy to lay everything out without constantly referring to my napkin sketch. I nailed the framework together with one 8d nail in the center of each joint. Obviously I wasn't trying to make a rigid structure. The glue and screws would do that. The single nail allows enough movement in each joint so that all the two by fours would be pulled tight against the skin.
With the framework done, I drew lines on both skins that followed the centers of all the framework pieces. Each screw was supposed to hit the middle of a 2x4 edge. I set a combination square to 3/4" and gauged pencil lines all the way around the skins for the outer pieces. Then I laid the framework directly on the plywood and ticked off the other centers. Every eight inches or so I put slashes across the lines where screws were to go. The more the better of these cheap clamps.

Back to back went the two plywood skins and I drilled away. The holes had to be large enough for the sheetrock screws to slip through. I countersunk both sides of each hole. Using a bit that drills and countersinks at the same time made it go pretty quick. "One weekend," I kept reminding myself.

I positioned one of the skins over the framework and tacked it down with a few nails. This kept the framework square while I glued on the other side. Flipping the box over, I put it on the floor and ran a thick bead of glue from a plastic mustard bottle down all the edges. I laid the other skin on top and nailed it in a few places so it wouldn't shift. Like a farmer planting seeds I dropped screws in all the holes.

**MATERIALS**

**Wood**
- 2 sheets of 4' x 8', 5/8" thick B-B underlayment (for plywood with 5 layers)
- About 120 lineal feet of selected 2x4s. They should be straight, without twist, and both of the narrow edges should be smooth and full.
- One 8' 1x6, straight and flat, for the front of the bench.
- Some scraps of 1/4" thick softwood or plywood for feet.

**Fasteners**
- About 2 pounds of #8 by 1-5/8" coarse thread drywall screws.
- 1 box of 8d box or finishing nails for the torsion box frames.
- 1 box of 4d finishing nails for tacking down the plywood.
- Two 6' lengths of 3/8" threaded rod.
- Two 3/8" by 3" lag screws for fastening down the front of the bench top.
- Flat head wood screws or machine screws for fastening down the rear of the bench top. (Four 1-1/4" #12 wood screws or two 1-1/2" 5/16" machine screws.)
- Lag screws for the face vise: two 3/8" by 3" long.
- Washers and nuts for rods and lag screws.
- 1 gallon of yellow glue, like Titebond.

**FRAME CUT LIST**

To make four torsion box frames from 2x4s:

**Middle of Base**
- 2 ends at 29"
- 3 stretchers at 45"
- 6 shorts at 12-1/4"

**Two Ends**
- 4 tops and bottoms at 23-1/2"
- 6 stretchers at 26"
- 12 shorts at 5-1/2"

**Top**
- 2 ends at 24"
- 3 stretchers at 69"
- 8 shorts at 13"
For a cheap deep engagement clamp I used my own weight and stood on top of the box. That flattened out the plywood and helped squeeze everything together. With some fancy footwork I tried to put pressure right over each screw as I drove it in, starting in the middle of the box and working my way out to the edges. An electric drill with a screwdriver tip was essential to get the screws in before the glue set. Since I had been a good boy last Christmas I got to use a great gift: a cordless drill with torque settings. No screws stripped out.

Once I shot in all the screws on one side, I flipped the box over and pried off the other skin. Gluing it down right away, I noticed an awful lot of glue squeezing out and resolved to lay a thinner bead on the next boxes. You learn as you go. I removed the rubbery squeeze out with a large paint scraper and wiped the sides clean with hot water and a synthetic abrasive pad. Done.

Three more torsion boxes to go and I could put a usable bench together. Designing the bench as I worked, I jotted down a few things you'll want to note when you get around to making one of these benches yourself:

- Drill the ½" diameter holes in the end sections for the threaded rod after the boxes are glued together.
- Glue ⅛" feet onto the bottom of the end sections so your bench will be easier to level on an uneven floor.
- Buy a good face vise before making the bench top. You'll want to position the short pieces in the top according to the screw holes in your vise. The largest Jorgenson and Record vises are well worth the investment.
- Note the spacer piece in the tool well section of the bench top. This raises the back two by four to the same height as

### MATERIALS

Materials for the Dog Block and Tail Vise

Two lengths of 2x6. You will need about 6 feet of good wood from each one. Select boards that are flat across the grain and with a fairly flat ring pattern on the end. The side facing up of the outer board should be free of knots.

About 1 lb. of 2-1/2" #8 coarse thread deck screws.

Five 3/8" by 6" lag screws and washers.

Two 3/8" by 3-1/2" lag screws and washers.

One 8" (#0) wooden Jorgenson hand screw, the kind with two threaded rods.

One 2" #12 flat head wood screw to hold the hand screw in place.

### CUT LIST

For the Dog Block

From 2x6s

1 outer face at 72" minus vise opening

2 dog blocks at 3"

12 dog blocks at 2-3/4" long

1 dog block 18" or so long
the work surface. Glue up the torsion box without these pieces in place. Glue and screw the plywood spacer to the 2x4, then screw both in place through the bottom skin.

At the end of a good weekend’s work I rewarded myself by bolting the four torsion boxes together and installing the face vise. “Man, is this thing heavy and sturdy,” I remember thinking. Having finished the first stage of bench building I realized that I had a substantial work surface for making the dog block next weekend. Hearing from the critics in my shop I removed the screws from the bench top, drilled deeper holes with the countersink and glued in wood plugs.

Flat-black paint on the base’s plywood faces unified the structure. The black screw heads blended right in. I left the 2x4s unpainted. Nailing on the 1x6 facing board to the bench top made it look a whole lot better, even though I knew I’d be removing it later for the dog block. I got inspired and put three narrow shelves from 2x4s along the front of the base to hold my set of Keen Kutter planes. (I think they’re the best users out there.) A 1x2 facing strip on each shelf keeps them in place.

I had a heck of a time figuring out what to do about a tail vise for this bench. It had to be easy to make and yet as versatile as the sliding box of a traditional bench. I listened to a lot of suggestions but they all sounded too cumbersome, too time consuming, or too expensive. The solution was sitting right in front of me all the time, clamped to the antique chair I was repairing: a Jorgenson handscrew. Eureka! In its new place as a tail vise a handscrew gives plenty of pressure, can be adjusted up and down, and is ready to be installed right from the store.

With the handscrew at one end the rest of the dog block was easy to figure out: short blocks get squeezed between two boards. Spaces between the blocks would become dog holes. I planed the outer 2x6 smooth and straight to make a better glue surface. I left the middle board alone, for this had to remain a full 1½” thick to match the thickness of the hand screw. I cut off the snipped ends to get a consistent thickness for each block.

I ran the edge grain of all three boards in the same direction to make them easy to even up later. Anticipating their future cupping, I placed their heart sides out. As the boards dry the top and bottom edges should remain tight to the bench.

Note in the drawing how the handscrew is wedged between two short pieces. It’s not glued, though. I drew the taper of the second block directly from width of my combination square blade. After gluing each block down I put the square alongside it and butted up the next block. This kept every block square and maintained a consistent dog hole size. Using an object rather than a ruler was the way to go. I screwed and glued the inner ½” board on top of all the short dog blocks and counterbored the lag screw holes with a 1½” spade bit. One lag screw goes right through the center of the short piece behind the handscrew.

Mounting the dog block in place was a pleasure. It’s a bench! I had to shave my handscrew down a bit so it would easily slide in and out of place. I can remove it whenever it’s needed as a clamp again. One flat head wood screw holds it fast. Playing with the tail vise I decided to make the handle more comfortable to turn by wrapping a long length of split bicycle inner tube around it.

I retired my turn-of-the-century cabinetmaker’s bench to try this new one out. Made with an economy of means, it feels like an everyday tool rather than an untouchable altar to woodworking. It is a great workbench, inspiring not in it’s beauty but in it’s down-to-earth practicality. I thanked the guy who dared me to do it. Returning to my youthful days has given me a fresh start.

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