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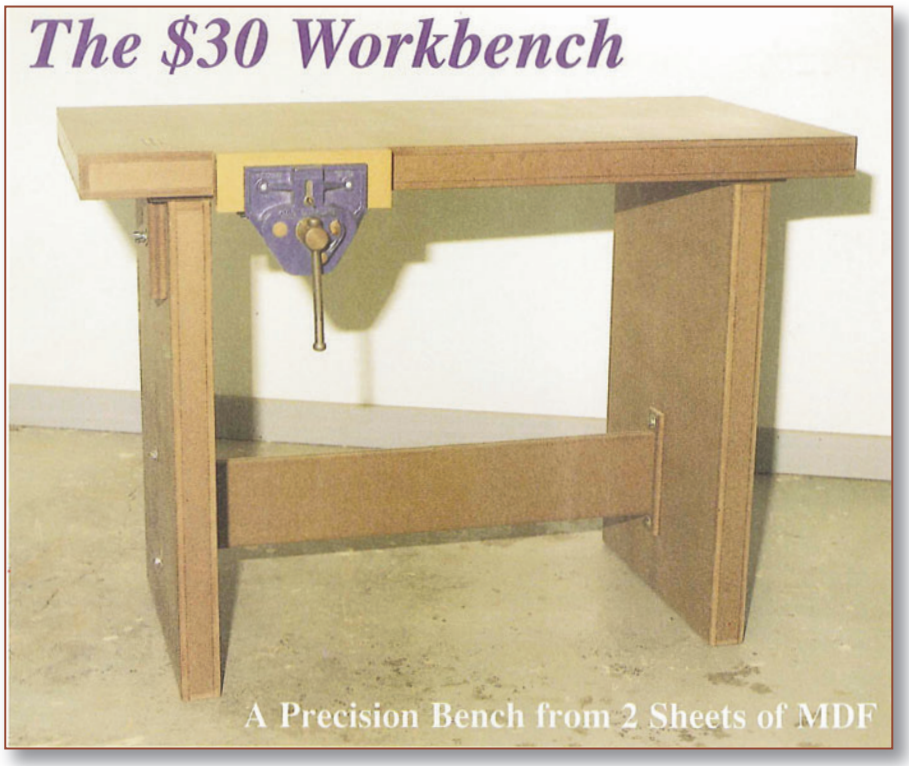
Classic Project

In this plan you'll find:

- Step-by-step construction instruction.
- A complete bill of materials.
- Construction drawings and related photos.
- Tips to help you complete the project and become a better woodworker.

The $30 Workbench



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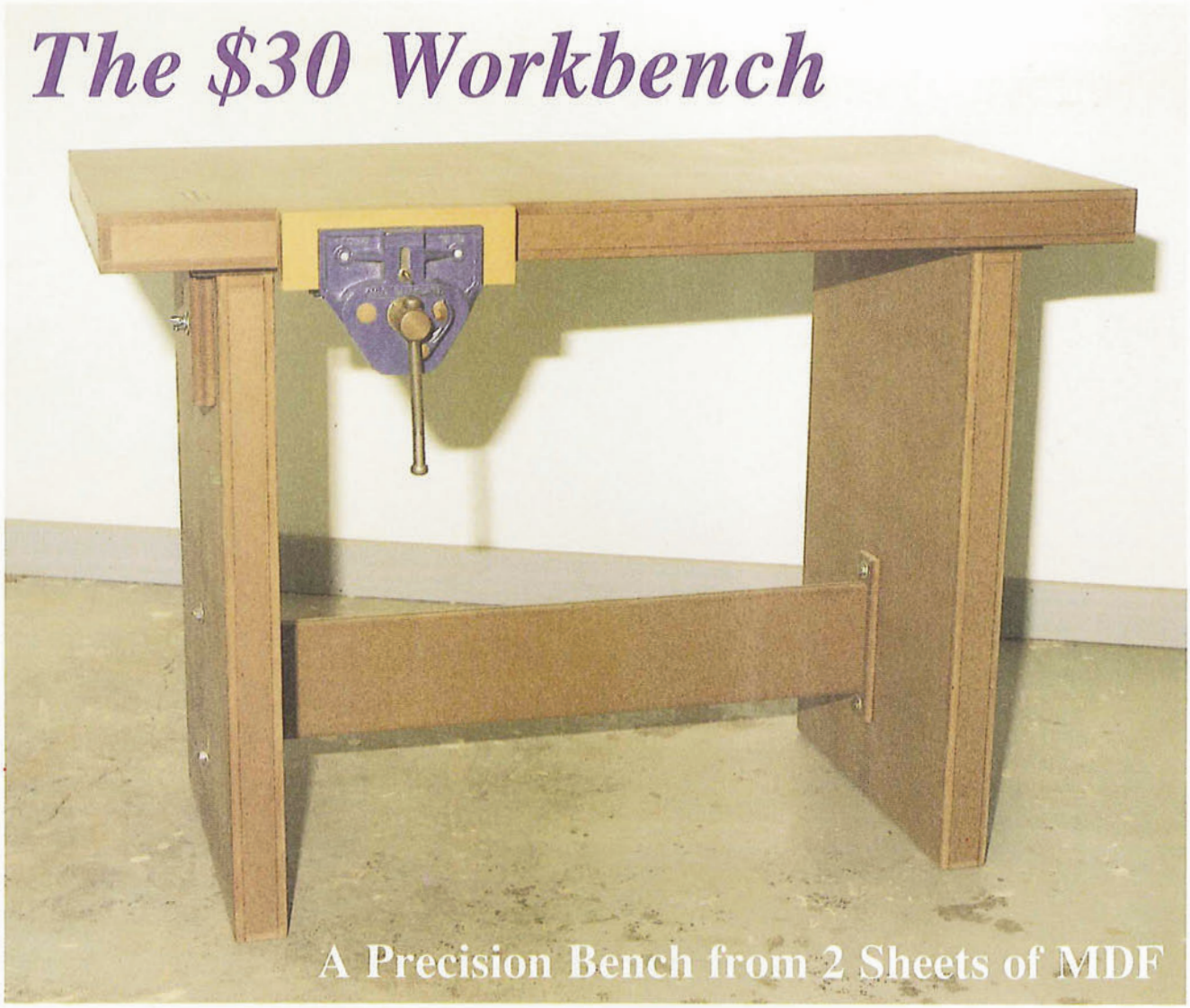
The $30 Workbench



A Precision Bench from 2 Sheets of MDF

Have you checked the prices of workbenches in any of those fancy woodworking catalogs that regularly fill your mailbox? Like most woodworkers, you probably lust after that luscious-looking bench of Burmese Teak or Rhodesian Muninga, but blanch at the price—typically well over $500. But then, are you buying the bench to admire or to work on? If your answer is the latter, then you may just decide to build this utilitarian bench, by Ed Speas. Ed, who hails from Ballground, Georgia, has been touting the advantages of—and selling plans for—this bench for some time now. If you've any doubt as to why this bench is—from a craftsman's standpoint—better than benches costing 10 times as much, then be sure to read Ed's "Is a Big Ticket Bench Better?" sidebar (page 47). Obviously, our $30 materials estimate covers only the sheet stock and the hardware, and does not include the vise.

Incredibly, the bench shown is made from just two 4 by 8 sheets of 1/2 in. thick Medium Density Fiberboard (MDF). The two sheets are cut (see Cutting Diagram) to yield parts for three torsion boxes—or T-boxes, for short. One T-box is the workbench top, the remaining two T-boxes serve as pedestals. If you've never tried T-box construction before, it's really quite easy. To help you, we've detailed the process in a series of step-by-step illustrations (see Make A Torsion Box, page 29).

Workbench How-To

Before you start: Make your decision regarding the workbench height before you lay out your parts on the two sheets of MDF. If you want a lower height, just reduce the length of the various pedestal parts. However, to increase the working height, don't increase the lengths of the pedestal parts, since there isn't much room to do this on the 4 by 8 MDF panels. Instead, just cut a few spacer strips from the scrap MDF and glue these under the pedestals to raise the height. Each layer of MDF will raise the benchtop height 1/2 in.

Lay out and cut parts: Using the Cutting Diagram as a visual guide, along with the dimensions listed in the Bill of Materials, lay out the various parts on the two sheets of MDF. As indicated, the various core parts (B, C, D, F, G, H) plus the plate parts (I, K) can be cut to exact length and width. However, both the bench top and the pedestal skins (A, E) and the stretcher and bench stop parts (J, L) must be cut oversize to start. The skins are trimmed flush with their respective T-box assemblies, and the

stretcher and bench stop are cut to final size after the glue on these sub-assemblies has dried.

Make benchtop and pedestal T-boxes: Make the benchtop T-box as described in the Special Techniques article: Make A Torsion Box (page 29). The two pedestal T-box assemblies are nearly identical to the top assembly, with the exception being the long core strips are doubled up in the center, and there's no area of solid core strips for a vise mounting. The doubled-up center core strips provides a solid area for the bolts (M) that are used to join the stretcher to the pedestals.

Make the stretcher and bench stop: The stretcher and bench stop are both laminations of two sections of 1/2 in. MDF. The sections should have been cut slightly oversize, as noted earlier, so the parts can be cut to final length and width after the glue has dried. Bore a 1/2 in. diameter hole in the bench stop as indicated, 2 3/4 in. up from the bottom end, then use your band saw or jig saw to cut the 1/2 in. wide slot up to the hole.

Add the end plates: Glue and screw the stretcher end plates on the stretcher ends, and the pedestal end plates onto the top ends of the two pedestals. Note that the left edge of the left side pedestal plate must be notched to allow clearance for the bench stop.

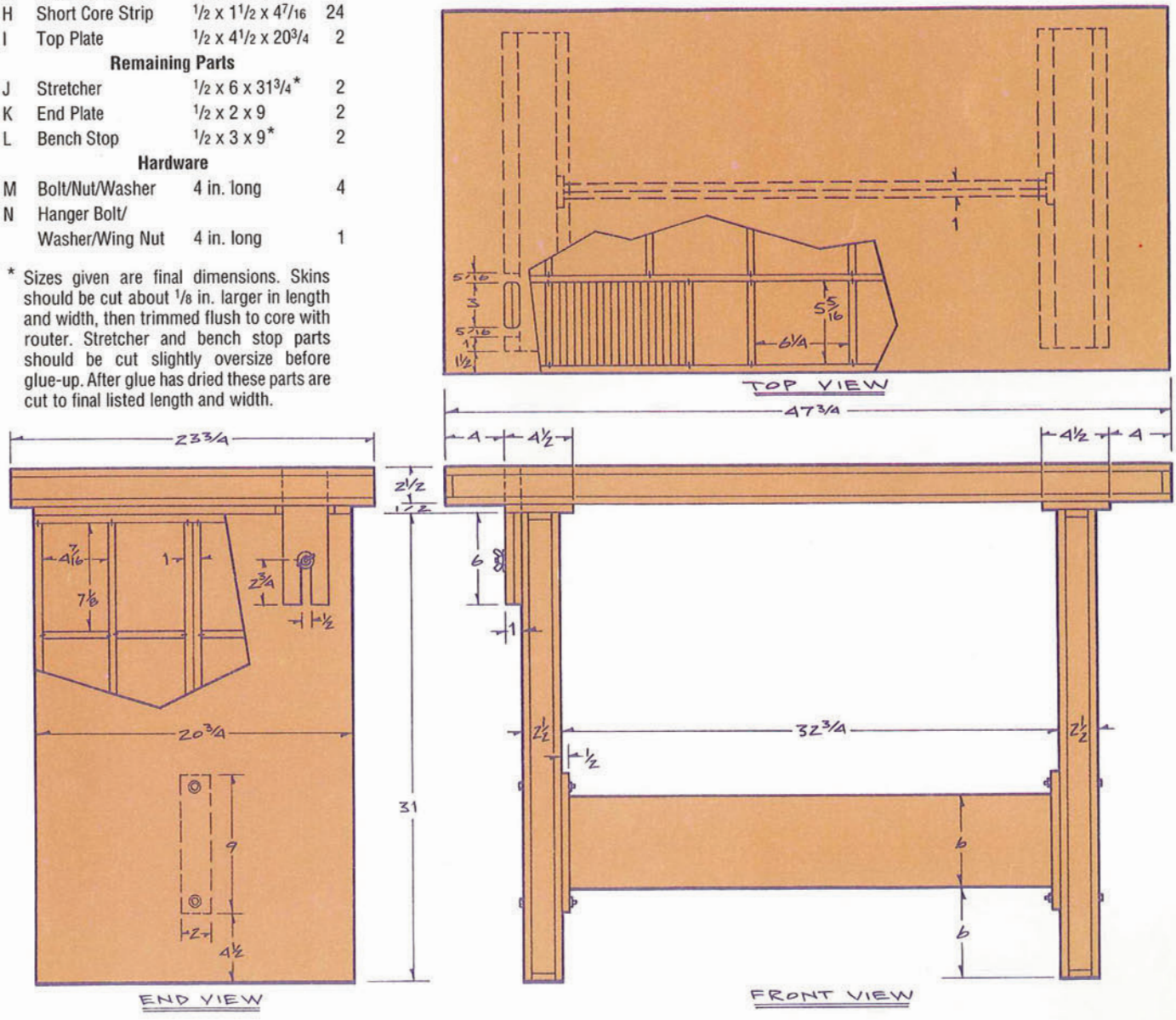
Rout out bench stop mortise in bench top: The best way to cut the hole in the bench top for the stop is using the router, a 1/2 in. diameter straight cutter, and a template. Size the template with respect to the guide bushing that you'll use with the 1/2 in. diameter straight cutter, so that you'll get a cutout that measures 1 in. wide by 3 in. long. The easiest way to index the template correctly (you'll need to make the cut on both sides of the benchtop T-box) is by cutting the template so its edges align with the bench top corner. That way, when you flip the benchtop over to make the cut on the bottom, you can be assured that the template will index perfectly. Once the bench stop mortise is complete, use a 1/4 in. radius rounding-over bit to round the edges of the bench stop to a 1/4 in. radius, matching the radius of the mortise corners.

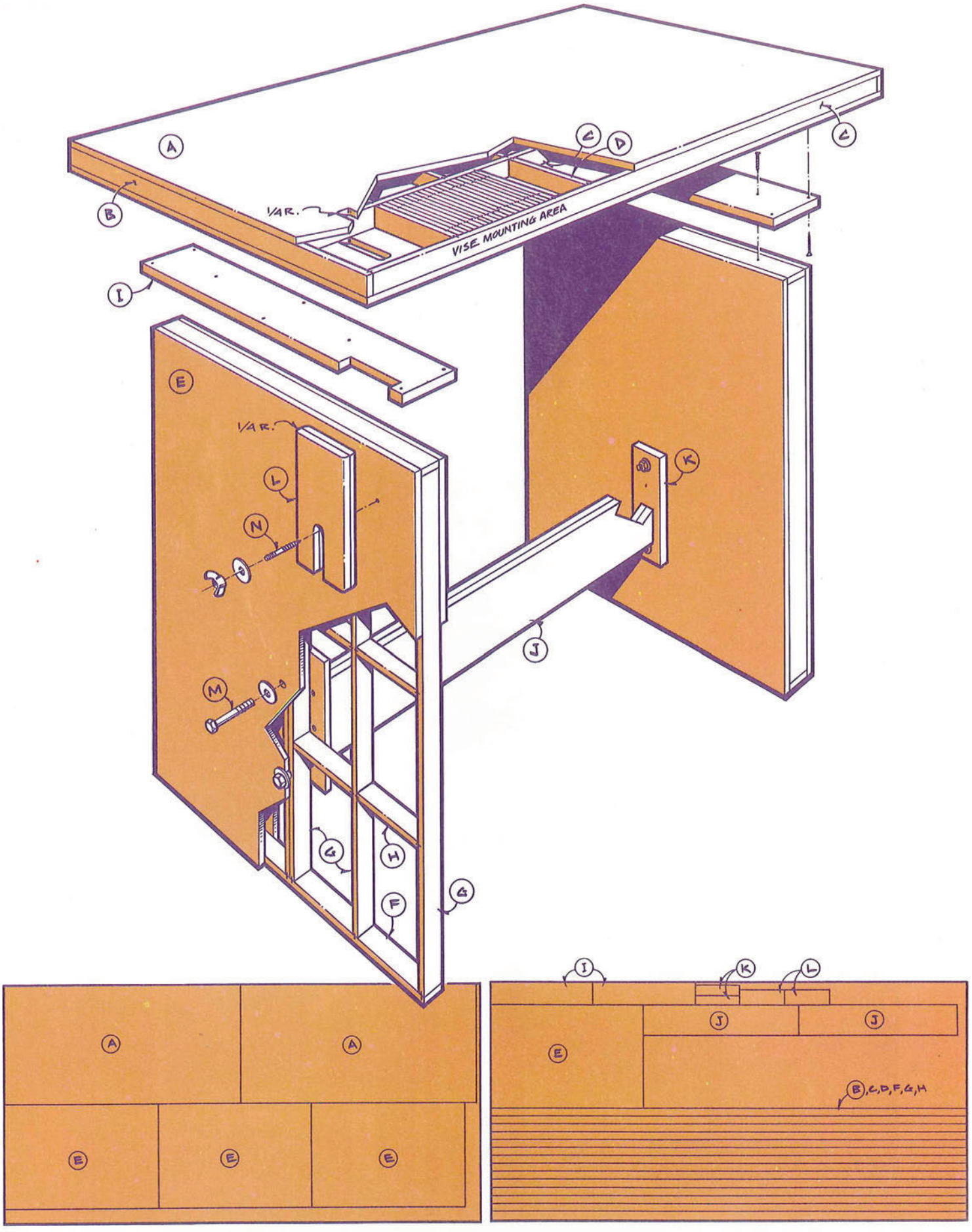
Assembly: Attach the left-side pedestal

Bill of Materials
(all dimensions actual)

Part	Description	Size	No. Req'd.
	Bench Top		
A	Skin	1/2 x 23 3/4 x 47 3/4 *	2
B	End Core Strip	1/2 x 1 1/2 x 23 3/4	2
C	Long Core Strip	1/2 x 1 1/2 x 46 3/4	5
D	Short Core Strip	1/2 x 1 1/2 x 5 5/16	42
	Pedestal		
E	Skin	1/2 x 20 3/4 x 31 *	4
F	End Core Strip	1/2 x 1 1/2 x 20 3/4	4
G	Long Core Strip	1/2 x 1 1/2 x 30	12
H	Short Core Strip	1/2 x 1 1/2 x 4 7/16	24
I	Top Plate	1/2 x 4 1/2 x 20 3/4	2
	Remaining Parts		
J	Stretcher	1/2 x 6 x 31 3/4 *	2
K	End Plate	1/2 x 2 x 9	2
L	Bench Stop	1/2 x 3 x 9 *	2
	Hardware		
M	Bolt/Nut/Washer	4 in. long	4
N	Hanger Bolt/ Washer/Wing Nut	4 in. long	1

* Sizes given are final dimensions. Skins should be cut about 1/8 in. larger in length and width, then trimmed flush to core with router. Stretcher and bench stop parts should be cut slightly oversize before glue-up. After glue has dried these parts are cut to final listed length and width.





CUTTING DIAGRAM - FROM (2) 4 x 8' SHEETS MDF (½ INCH THICK)

to the vise end of the bench top, making sure the notch in the top plate is indexed properly to the bench stop cutout in the top. Although you could use both glue and screws, if you use only screws, then you'll be able to knock down the bench at some future date, for moving or whatever. If you plan on knocking the bench down on a frequent basis—such as for craft shows—then use threaded inserts (in the top) and bolts (through the top plates) instead.

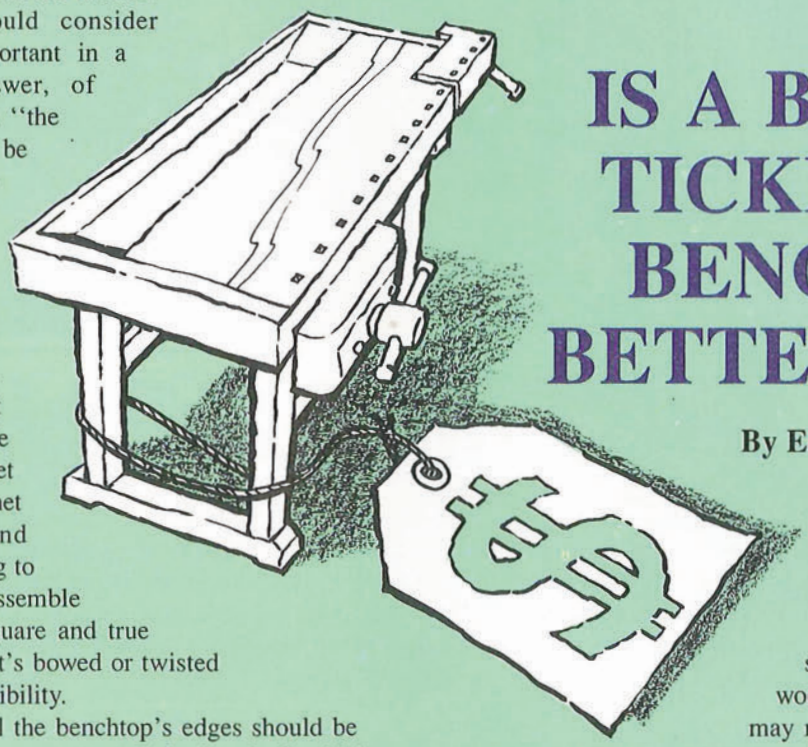
Next, drill the various bolt holes through the pedestals and stretcher end plates, bolt the stretcher assembly to both the left and right-side pedestals, and *then* mount the right-side pedestal to the bench top. Lastly, fit the bench stop through the mortise in the bench top, then insert the hanger bolt (N) that together with the wing nut and washer serves as a lock for the stop.

Finish: MDF should not be left unfinished. It's best to cover all surfaces with some type of protective coating, such as paint or polyurethane. By sealing all surfaces, even if the bench is placed in a moist area—such as a damp basement—it won't wick up the moisture. If there's one negative to using MDF, it's that you can't let MDF come into contact with moisture—the two just don't mix. One added bonus of a protective coating is that you won't need to worry about the inevitable spills—of finish, stain, honing oil or whatever—that all benches are subjected to, sooner or later.

Vise Mounting: The solid core area in the bench top will enable you to mount a vise by either lag bolting from the bottom, or countersinking for bolt heads in the top. Obviously, we've only layed out our core for a single vise. If you plan on adding a second vise at some later date, be sure to add solid core strips at the second vise mounting area. It's important to make these decisions before your make the T-box top, since it's impossible to add extra core strips later on, should you change your mind.

IS A BIG TICKET BENCH BETTER?

By Ed Speas



With so many different styles of workbenches out there, it's hard for the average woodworker to choose what's best. If money was no object, we'd probably all opt for the fanciest, prettiest bench available. But if we stopped and asked ourselves the question "Is the most expensive bench I can buy the best bench to work on?" we might be surprised at the answer.

First, we should consider what's most important in a bench. The answer, of course, should be "the top." It should be strong enough so there's no sag, durable enough to stand up to pounding, abuse and the pressure of clamping workpieces to it, and it must be flat. We work hard to get furniture and cabinet parts flat and straight, and trying to do work and assemble furniture that's square and true on a benchtop that's bowed or twisted is a virtual impossibility.

Furthermore, all the benchtop's edges should be straight, all corners square, and the bench should have a stop to keep pieces from sliding off as we plane or sand. The underframe—the purpose of which is to support the top securely at a given height—should be open enough to allow for getting bar clamps under the top, which makes it easy to clamp pieces to the side of the bench. Finally, the bench should have at least one—or better yet two—good vises.

Beyond the above criteria, there are two more things to consider—size and height. As for size, most of us tend to use the Texas theory: The bigger the better. But, experience shows that the typical Texas-sized bench gets crowded with tools that should have been put away, or scraps that should have been thrown away, and when the time comes to get busy, there we are clearing off a little work area around the vise. For this reason, I prefer a smaller bench.

With respect to height, keep in mind that it's next to impossible to work comfortably on a bench that's too high. We can always bend our knees a bit or lean over a lower bench, but most of us are done growing. For the average person, the 34 in. height shown should be just fine, but you should make adjustments accordingly if you are tall or short.

Now that we've looked at what makes a good bench, let's compare the T-box workbench to a solid wood bench, Initially, both tops can be made equally flat, but by virtue of its solid wood nature (remember, wood moves) the solid wood top may not long remain flat. The T-box top, on the other hand, remains forever stable. If you make it flat, it will stay that way.

But let's not be blind to beauty. That luscious teak or muninga bench will make your workshop look just great. Visitors will swoon. Surely, a master craftsman must be at work here, they'll sigh.

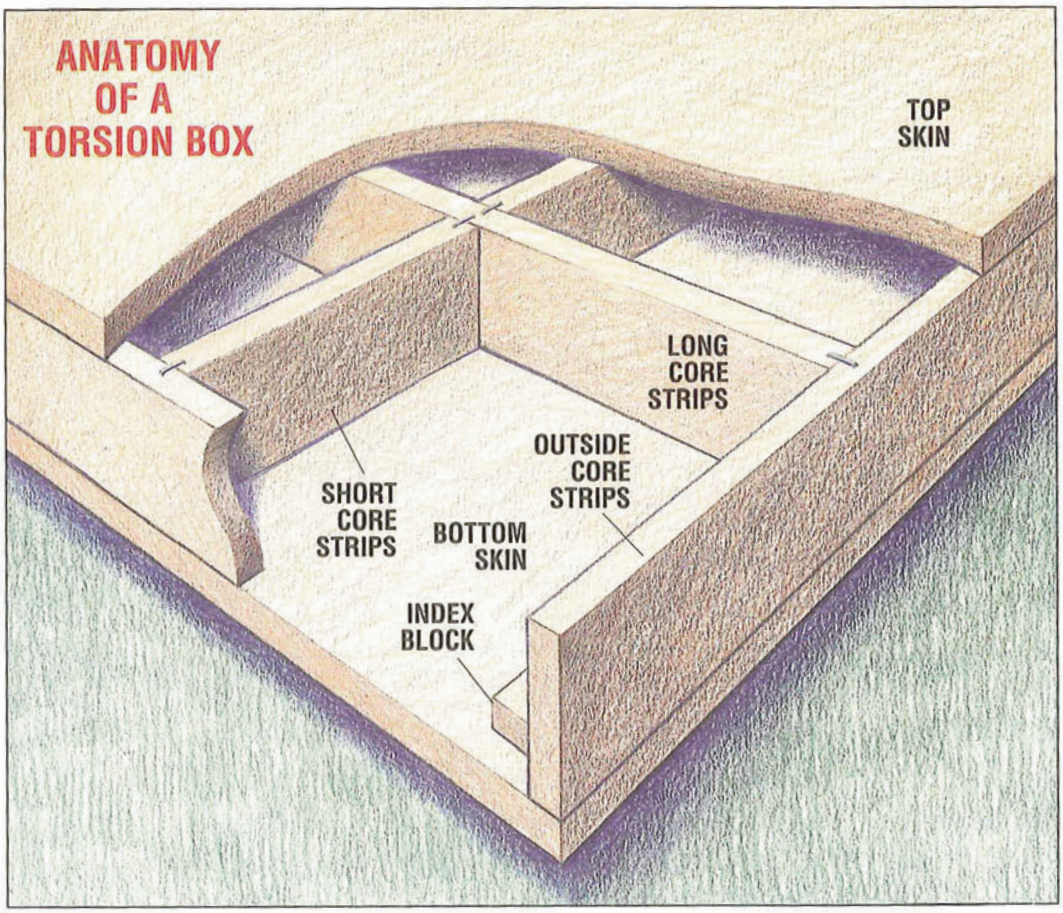
In the end, it all comes down to one simple question. Ask yourself: "Would I rather build pretty furniture on an accurate bench, or build inaccurate furniture on a pretty bench?" Believe me...the more you work on a T-box bench, the prettier it gets.

Make a Torsion Box

The High Strength/Lightweight Alternative to Solid Wood

by Ed Speas

When most woodworkers think of woodworking materials and construction methods, they think of solid wood or plywood, using terms like mortise-and-tenon, frame-and-panel, apron, rail, or carcass. But solid wood isn't always the best choice, and even with adequate supporting framework, table or workbench tops made from solid wood can twist and bow. For some applications, there is another choice: The torsion box; "T-box" for short. The T-box is ideal for surfaces where stability is important, and contrary to what you may at first think, they aren't really complicated or difficult to build. The T-box that we show being constructed here is the bench top for the T-box workbench project on page 44. The entire workbench is constructed from just two 4 by 8 sheets of medium density fiberboard (MDF).



A T-Box is a mostly hollow-core structure that has a skin material attached to each side. A hollow core door, and an airplane wing are two good examples. The T-Box gives you a strong and stable panel, as thick as you like, without adding excess weight or expense to the project.

A T-Box can be used for any vertical or horizontal panel where extra strength and stability are required. A few of its many uses include doors, shelving, desk and table tops, cabinets, benches, and work surfaces.

For furniture, the core is usually made of a man-made sheet material (MSM). Plywood, or medium density fiberboard (MDF), are the best choice. The skins are also made of MSM. Plywood, MDF, or particleboard all work well. The choice is determined by what type of finish covering you will be applying to the skins; veneer, leather, plastic laminate, paint, etc. In most cases, your best choice for the skins is also MDF. It is the best substrate for veneer, and also accepts paint very well.

It is very important to understand that a T-Box is simply a building block. Like a frame and panel, or a chair leg, it isn't much without the addition of other T-Boxes, or other parts.

How a T-Box Works

Individually, the parts of a T-Box can be easily bent or broken. Yet when assembled into a single, unified structure, they create a box or panel with great strength and stability. The strength comes from the glue.

We tend to think of glue as that yellow or white liquid in the bottle. But when glue has cured in our project, it is a very thin, very hard layer of material, with incredibly strong sheer strength properties. No matter how you try to bend, twist, or destroy a T-Box, you are trying to sheer a glue line somewhere.

Glues that bond by mechanical adhesion, such as contact adhesive, do not have this property. You must use a specific adhesion glue such as polyvinyl acetate (white glue), or alaphatic resin, (yellow glue).

The Core

The core consists of several core strips attached to form a grid that the skins will be attached to. There we're using 1/2 in.

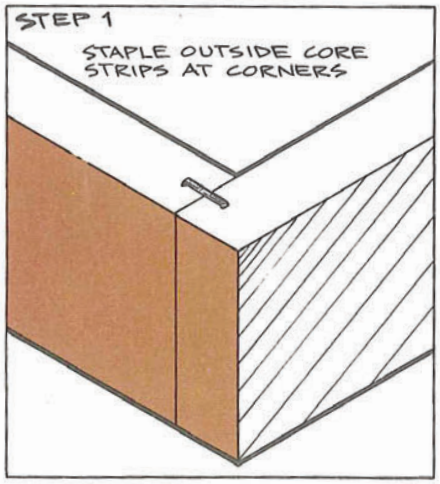
material for the core strips, although 3/4 in. material is also fine.

A basic core layout would consist of the core strips spaced approximately 4 in. to 6 in. apart. This is not a hard and fast rule, just a place to start. The closer the core strips are, the stronger and heavier the T-Box will be, and the less chance that the skin will depress in the voids.

The width of the core strips is determined by the final intended thickness of the T-Box. That is, the thickness of the T-Box, minus the thickness of the two skins. All core strip parts can come straight from the table saw.

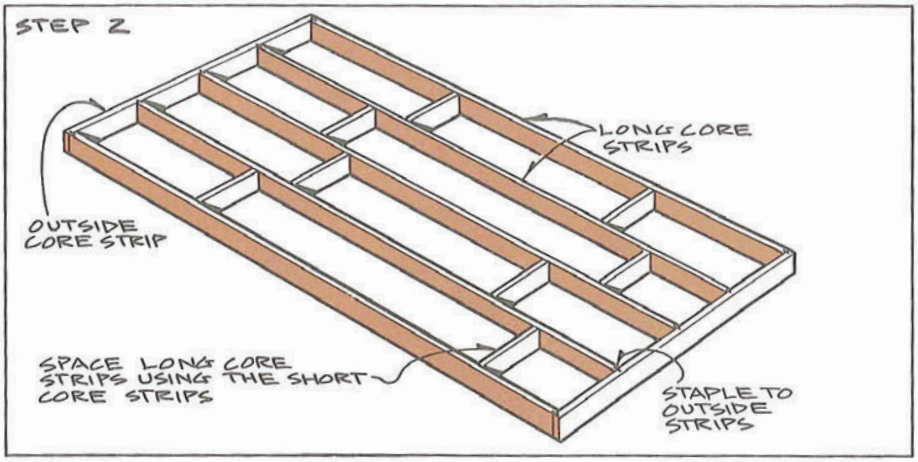
Designing the Core

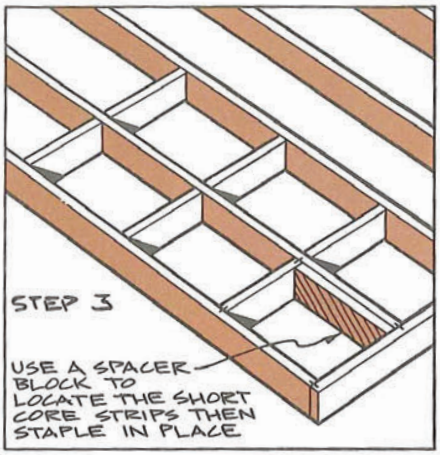
The core layout must be designed specifically for each individual T-Box. After you determine the basic spacing of the core, you must then consider everything that is subsequently attached to the T-Box. A good example of this is the mounting of the vise to the workbench project. At every point where there will

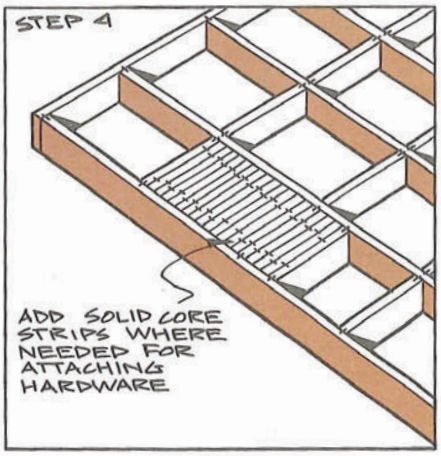


be a screw, dowel, bolt, etc., you must have solid core strips to support the attachment. You don't want a screw to be holding only to a 1/2 in. skin. So, at every location where something will be mounted, add extra core strips to the basic layout. Remember, keep it as simple as you can.

You can see the importance of good planning before you start construction. Once a T-Box has been glued up, you can't go back and add more core strips.







Constructing the Core

The core construction should also be kept as simple as possible. There is no gluing or joinery involved. At each attachment point of the core strips, just staple across the butt joint on both sides of the core.

To start, hold the outside corners together, and staple the joint on the top (Step 1). Do this to all outside corners to finish the perimeter of the core.

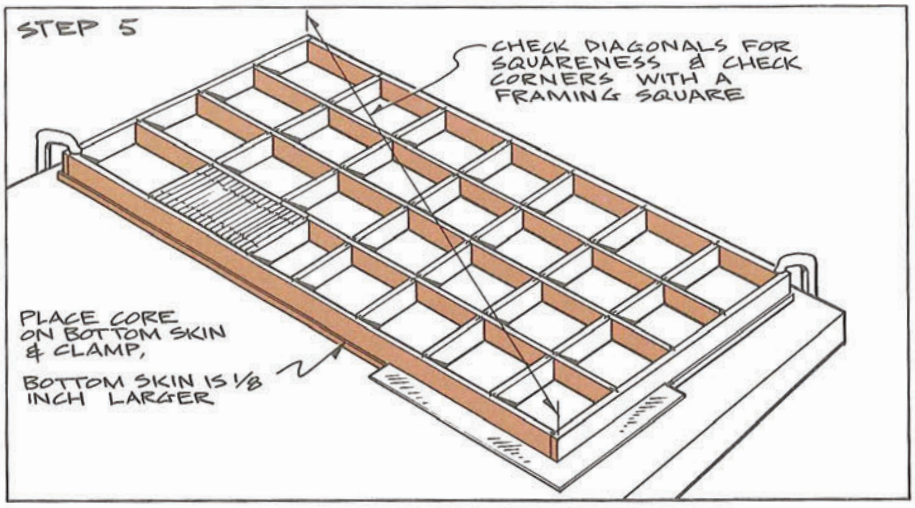
Next, take the remaining long core strips and position them by using the appropriate short core strips as spacers (Step 2). Then staple the long strips into position. Now you will need to cut a couple of spacers to position the short core strips (Step 3). Add the remaining core strips as needed to fill out these areas that must be solid to accept hardware mountings (Step 4). Then turn the core over and staple the other side of the core in the same way.

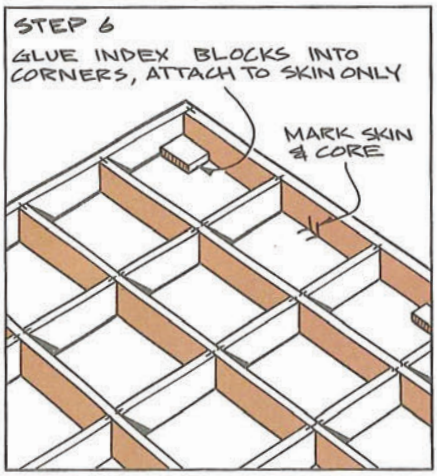
The Skins

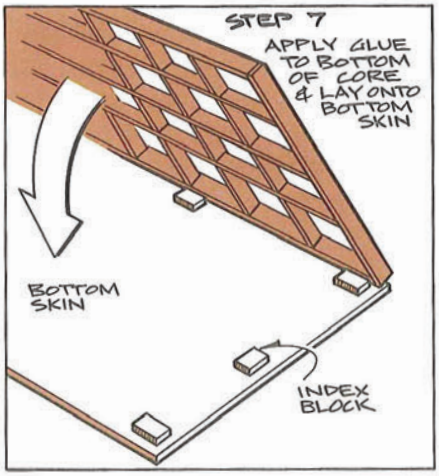
The thickness of the skins can be anything from 1/8 in. to 3/4 in. It depends on what the T-Box will be used for. In most furniture application, you will use a thin skin to keep the weight down. For work surfaces, you will probably want a thicker skin to reduce deflection over the voids of the core.

Make the core the size that you want the T-Box to be, but cut the skins a little oversize, about 1/8 in. all around. It's important to cut the skins slightly oversize, since it's all but impossible to get the assembled core to exactly match a predetermined dimension. Then, after assembly, the skins can be trimmed flush with a router.

If you are going to apply veneer to the skins, they must be veneered before they are assembled to the core. Otherwise, the glue will cause the skins to depress over the voids, forcing an excess of glue into







these areas. Such a situation would cause the veneer to bubble and lift. Try applying veneer to an already constructed sample T-Box, and you'll discover this for yourself.

Assembly

Now that the core is assembled and the skins are complete, we are ready to attach the skins to the core. But before this is done we need some way to keep the core square and straight as the skins are being applied.

A good way to do this is to first take one of the skins and lay it on a bench or table with the side to be glued facing up. Lay the assembled core structure on the skin as it will be in the final glue up. Then, square the core by measuring the diagonals and clamp it to the skin at the corners (Step 5).

Next, you'll need a way to index the core to the skin, so that after the core is removed (so glue can be applied to the edges), it will be automatically indexed to the skin when repositioned for the final glue-up.

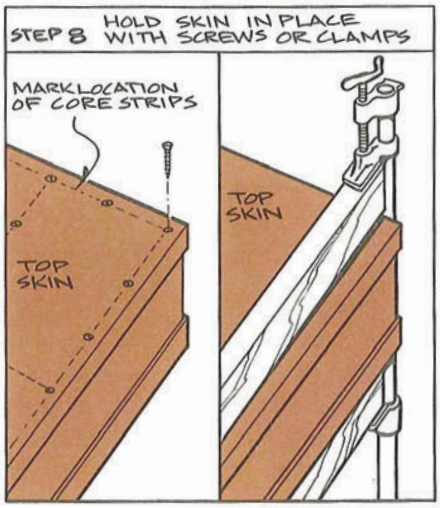
You will need several small blocks, about 1/4 in. thick by 1 in. square. With hot melt glue, fasten one block to the skin at each of the four corners, tight against the core (Step 6). Now glue as many additional blocks as needed around the perimeter of the core to keep it straight. After the clamps are removed, the blocks will hold the core square and in proper registration to the skin.

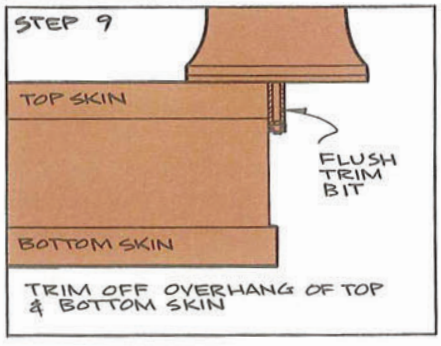
The core can now be removed for gluing. When the core is repositioned down on the skin, the blocks will hold the core in perfect registration (Step 7). Be sure to mark both the core and skin (as shown in Step 6) so that you get the core back on the same way it was when you attached the blocks.

Glue Up

There are two choices when it comes to clamping the skins to the core (Step 8). If you plan on doing a lot of T-Box work, a clamping press, such as a veneer press, is the best choice. But for occasional T-Box construction, fasteners, such as nails, staples, or screws are fine to hold the skins in place while the glue cures. If you use a mechanical fastener, first mark on the skins where every core strip is. Be sure to use plenty of fasteners.

Apply glue to the edges of the core, making sure to use enough. There is no need to apply glue to the skin. The core can now be repositioned to the skin with the positioning blocks (as shown in Step 7). Next, apply glue to the edges of the other side of the core. Position the opposite side skin and attach it to the core using the same fastening method—either glue or glue plus mechanical fasteners—as you used on the first side. If you are using a clamping press, you'll





need to add a few brads through the opposite side skin and into the core, so the skin doesn't slip out of registration as clamp pressure is applied.

Trim Edges

Once the T-Box has been clamped, trim the overhanging skins with a router and flush-trim bit (Step 9), and clean up any excess glue. If your project requires an edging, add it now. Treat a T-Box edge the same way you would an edge on a sheet of pre-veneered plywood.

Attachment

Now that you have built a T-Box, you need to know how to attach one to another. There are several ways of doing this. You can attach them the same way that you would join two pieces of plywood, such as with screws, glue, splines, dowels, or a plate jointer. These all work quite well. Or you can use the pocket and ledger (see Another Option side bar).

T-Box Construction Summary

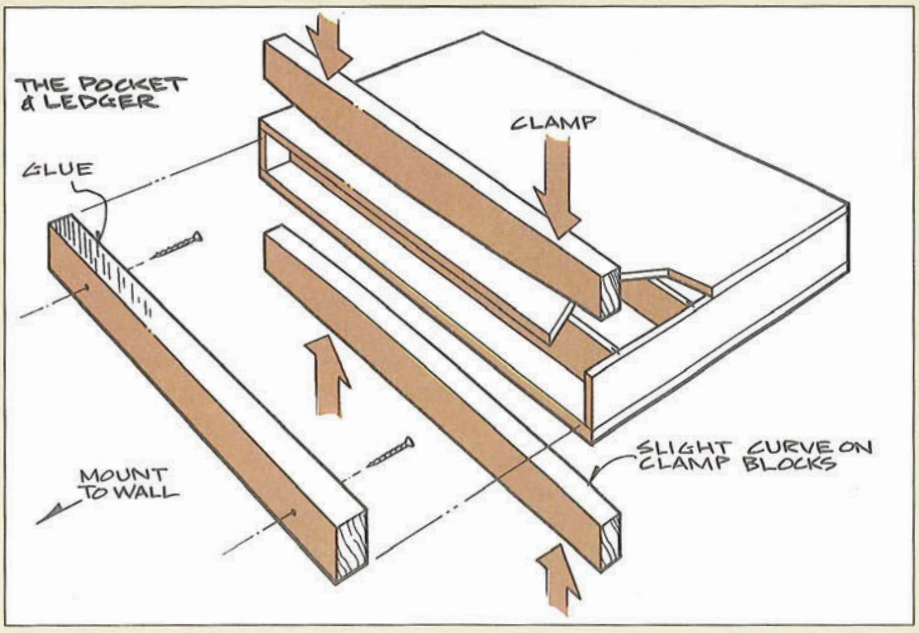
1. **Design:** Make as many sketches and drawings as you need to visualize the finished project.
2. **Working Drawings & Mock-ups:** Now is the time to make decisions regarding size, proportion, type of material, mountings, etc.
3. **Cutting List:** From your final working drawings, make a parts cutting list that includes the thickness, width, length and number required of each different part.
4. **Cut Parts:** Using your cutting list as a guide, cut all the parts. Be sure to cut your skins slightly oversize.
5. **Add Veneer** (if needed)**:** Now is the time to apply veneer to the skins, if your project requires it.
6. **Assemble The Cores:** Assemble the core structures according to your working drawings.
7. **Assemble The T-Boxes:** Square up the core of each T-box to the skin with the positioning blocks, add glue, and assemble the skins to the core. If mechanical fasteners are being used, both glue and nail (or screw) the skins to the core.
8. **Clean Up Edges:** Flush-trim the overhanging skins with your router and a flush-trim bit, and scrape off any excess glue. If your project requires veneer or solid wood edgings, now's the time to apply them.
9. **Final Assembly & Finish:** Where possible, apply finish to each separate T-box before final assembly. If your project is comprised of several T-boxes, join them together using your chosen method of attachment.

Another Option

Depending on what you are planning to make, the pocket and ledger is a version of T-box construction you may want to consider. It's nearly identical to standard T-box construction, with one minor exception: By extending the core strips out on one side, when the skins are applied, a pocket—or mortise—is formed in the T-box. The ledger—or tenon—is a piece that's then cut to fit within this pocket. The pocket and ledger can be employed as a method of joinery when you are mounting one T-box to another (be sure to add extra core strips in that area of the T-box onto which the ledger will be screwed), but its most common application is probably as a way to make a shelf seem to hang invisibly on a wall.

If you are making a T-box that employs the pocket and ledger, keep in mind that the ledger is the same width as the core strips, and for consistency should be cut on the table saw at the same time as the core strips. The ledger is usually about square in cross-section, but when making the T-box it's a good idea to make the pocket just a hair deeper than the ledger thickness. As with any mortise and tenon, this little extra space allows a place for the excess glue to go as the ledger and pocket are assembled.

The standard assembly proceedure is to first screw (or glue and screw if you are assembling one T-box to another) the ledger to the surface on which it is to be mounted. Apply glue, then slide the T-box with the pocket into place over the ledger. Use cambered clamp blocks to apply pressure so the skins of the pocket are firmly fixed to the ledger, as illustrated.



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