



TV SHOW HANDBOOK
Celebrating **20** Seasons on Air!

Woodsmith[®] SHOP

**Projects
from
Season
20**

Step-by-Step Projects

Wall-Mounted Workbench

Shooting Board, Clamp Cart, Beam Compass

Double Porch Rocker

Japanese Hall Cabinet, Bathroom Vanity

Garden Arbor

Rolling Work Cart, Veneer Press



Season 20 Handbook

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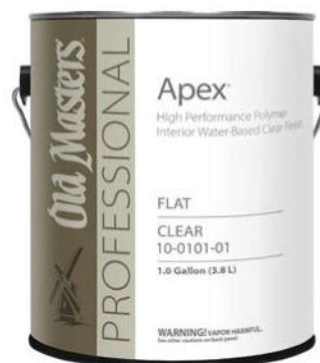
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Rolling Work Cart

This handy cart is loaded with storage options and provides a rock-solid worksurface no matter what the task.

If your shop is anything like mine, there are two things you can't get enough of — storage space and work surfaces. That's why this roll-around work cart is a welcome addition.

With eight heavy-duty drawers on full-extension slides and six easy-access

shelves, you'll have the tools and supplies you need for any project close at hand. And the beefy top means room to work isn't a problem either.

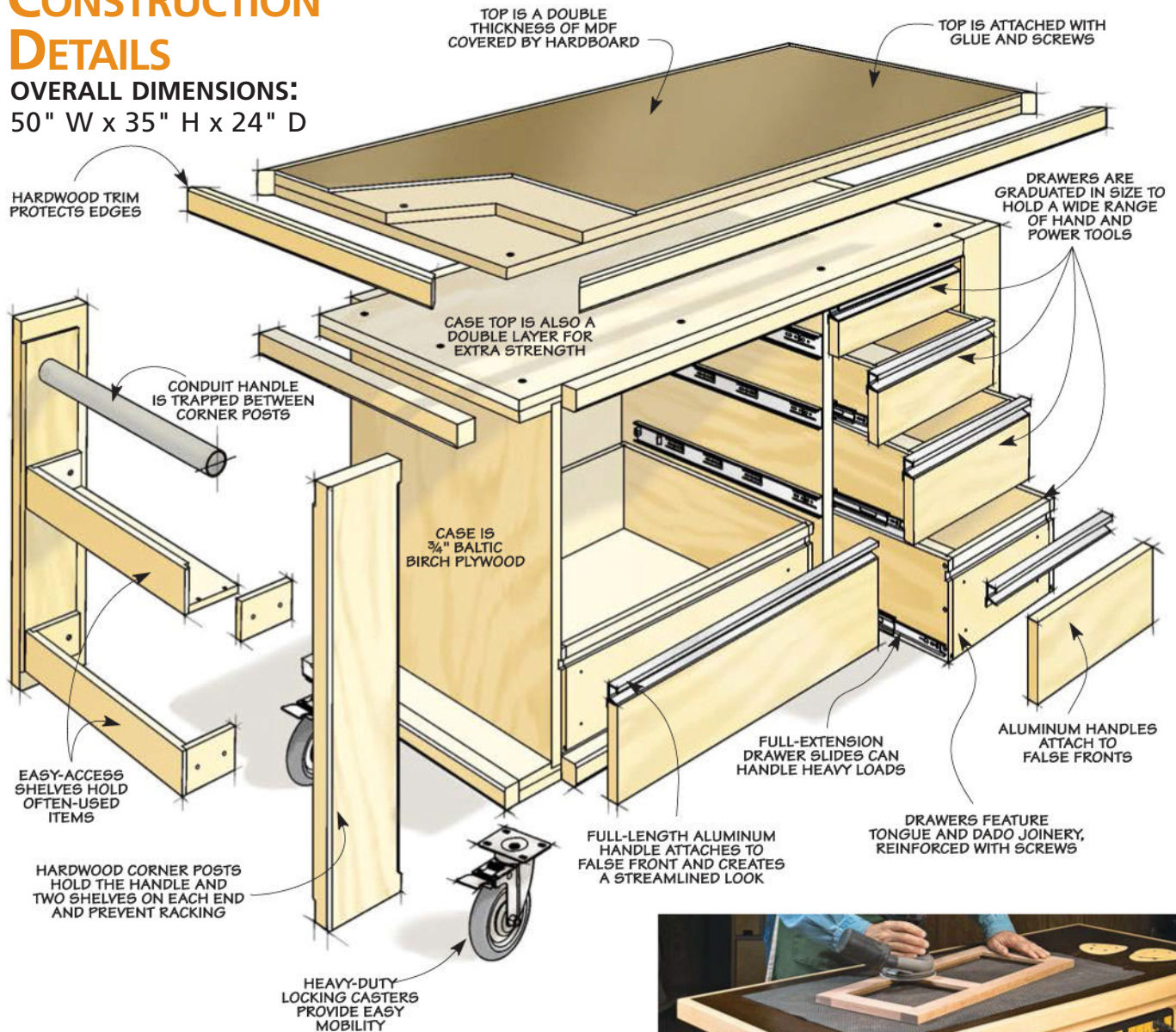
The case is made from $\frac{3}{4}$ " Baltic birch plywood, while the top is a double layer of MDF with a hardboard cover. It

won't have any trouble standing up to the demands of your shop. I also added hardwood trim to protect the MDF and plywood edges.

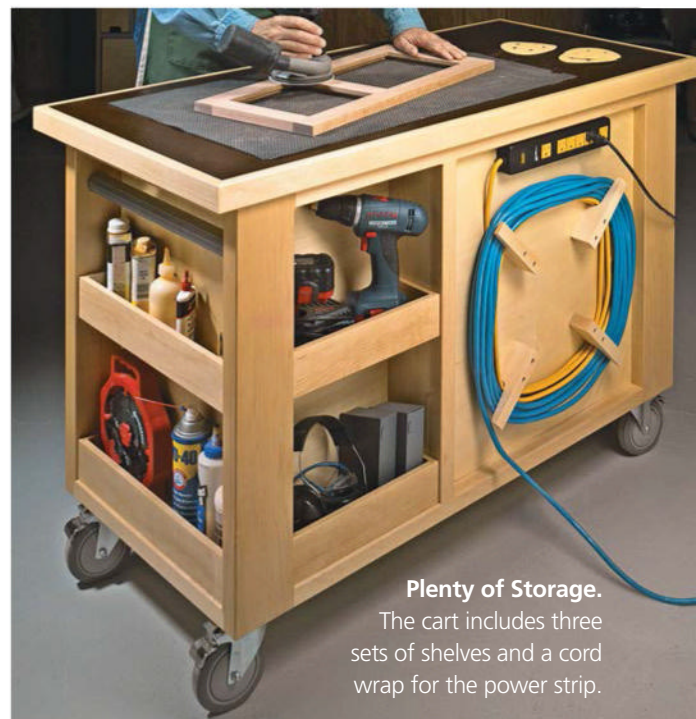
But the most eye-catching part of the project is the drawer handles. They give the cart a really "high-end" look.

CONSTRUCTION DETAILS

OVERALL DIMENSIONS:
50" W x 35" H x 24" D



Two Handles. Inexpensive conduit makes a great handle for the work cart. But the extruded aluminum drawer pulls turn it into a great-looking project. Best of all, they're easy to install.



Plenty of Storage.
The cart includes three sets of shelves and a cord wrap for the power strip.

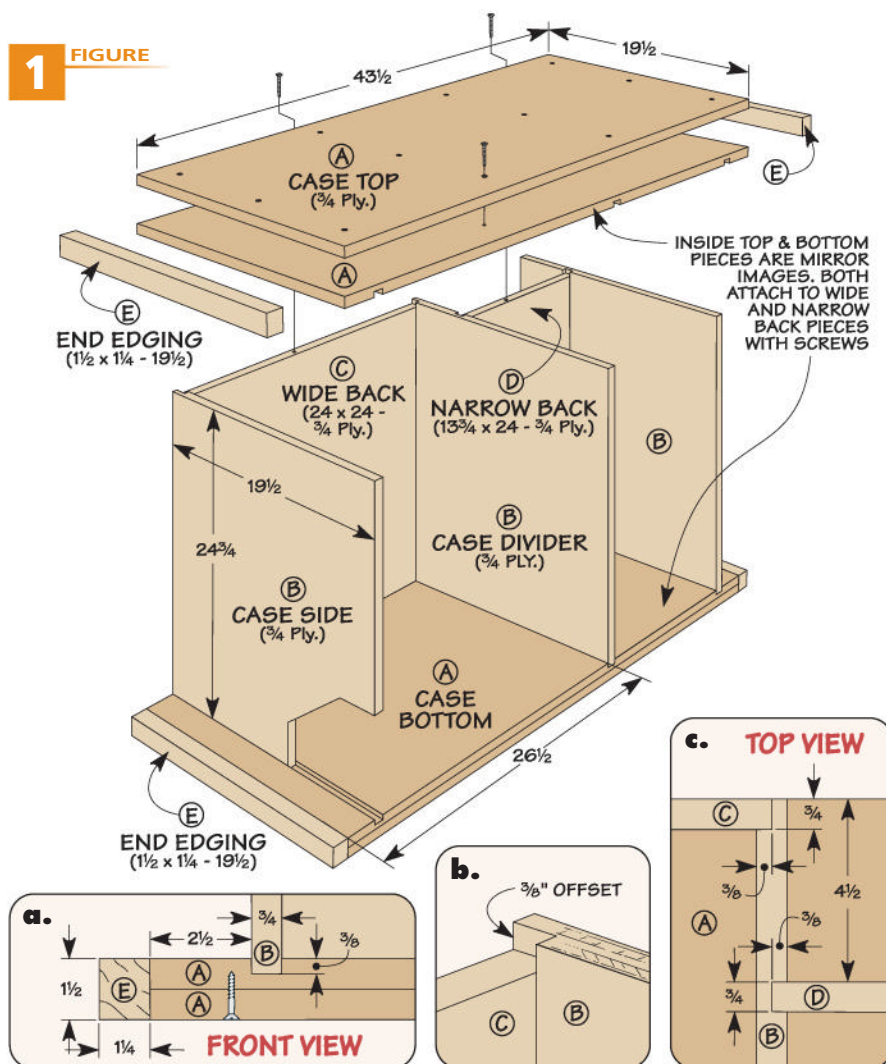
Building the Case

The foundation for this cart is a strong and sturdy case. So that's where I started. As you can see in the drawing at right, the case is built from $\frac{3}{4}$ " plywood, using dado joints throughout. To make the cart really solid, I used two layers for the top and bottom.

TOP & BOTTOM. I began by cutting the four top and bottom panels to size. You can set two of the panels aside since they'll be attached later. Then, with a dado blade on the table saw set to match the thickness of your plywood, you're ready to cut the dados that hold the case sides and divider. You can start with the dados on each end, since they're all cut with the same fence setting (Figure 1a). Then, simply reset the fence and cut the dados for the divider.

SIDES & DIVIDER. Now, turn your attention to the case sides and divider. They're identical in size, but they require different joinery. The right side and divider have grooves that hold the narrow back, creating a recess for the shelves that are added later (see Figure 1c). The left side and divider are rabbeted to hold the wide back, as in Figures 1b and 1c.

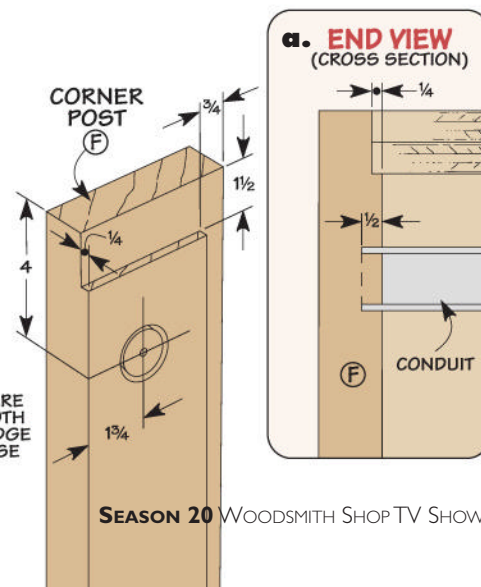
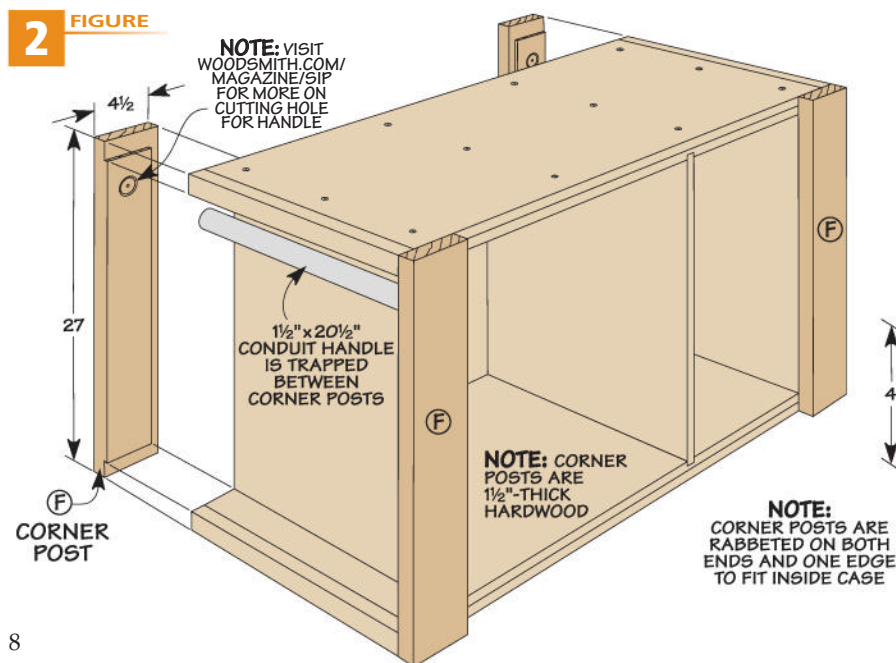
ASSEMBLY. This is a good time to predrill and countersink holes from the top and



bottom to fasten the two back pieces. Then you're ready to assemble the case. Beginning with the inside top panel, attach the sides and divider with glue,

then add screws to hold the back panels. Now you can flip the assembly over and do the same to attach the inside bottom piece.

The next step is to attach the two pieces you set aside earlier that complete the case top and bottom. The key thing to keep in mind for this task is making



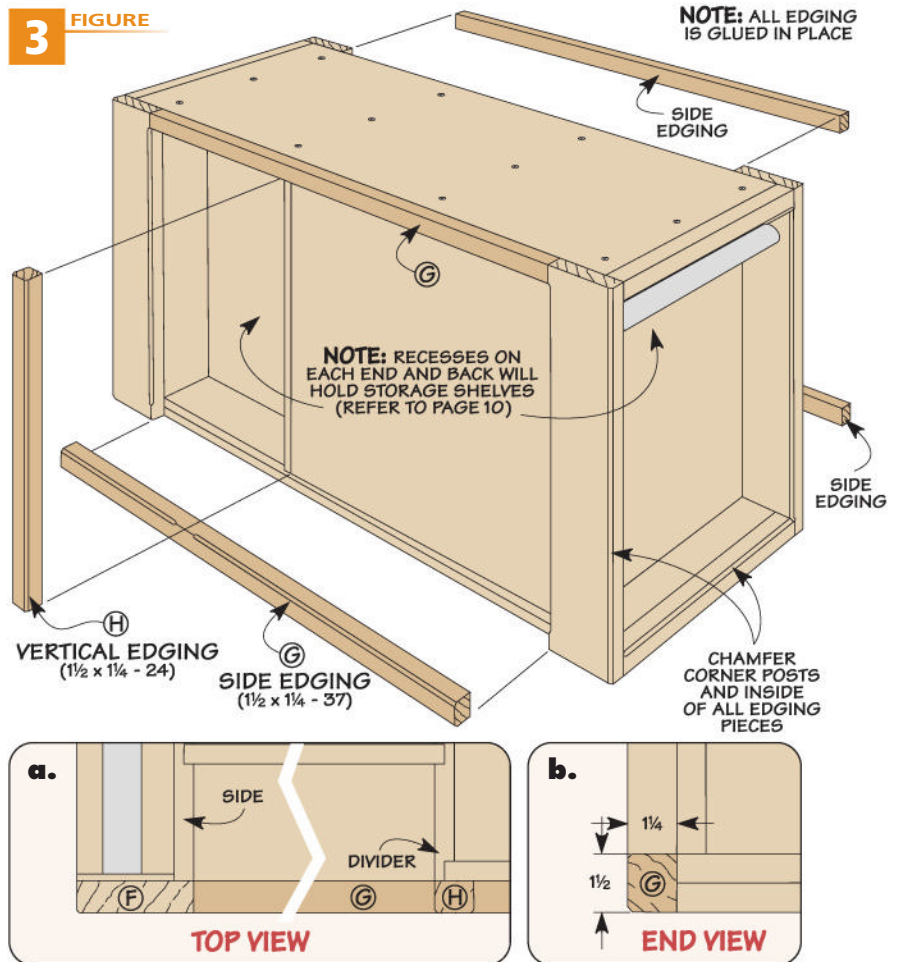
sure the edges of the workpieces stay flush all around.

EDGING. With the plywood case complete, you're ready to add some of the hardwood edging. The edging not only makes the cart look a lot nicer, but it also prevents wear and tear on the plywood corners.

I started with the end pieces on the top and bottom because they need to be in place before the other pieces can be added (Figure 1, previous page). They're simply cut to size, then glued in.

CORNER POSTS. The next step is to attach the corner posts. They add stability and hold the handles. To fit in the case, they're rabbeted along one edge and on both ends (Figure 2). I used a wing cutter to make sure the holes fit the handles perfectly. You can see more on this technique at woodsmith.com/magazine/sip. Then, slip the handle in each hole and glue the posts in place.

Adding the rest of the trim is pretty straightforward. You can start by attaching the top and bottom side pieces. Then just add the single vertical piece on the back of the cart. Once everything is in place, pull out your router and rout a $\frac{1}{4}$ " chamfer on the inside edges.



MATERIALS & SUPPLIES

CASE

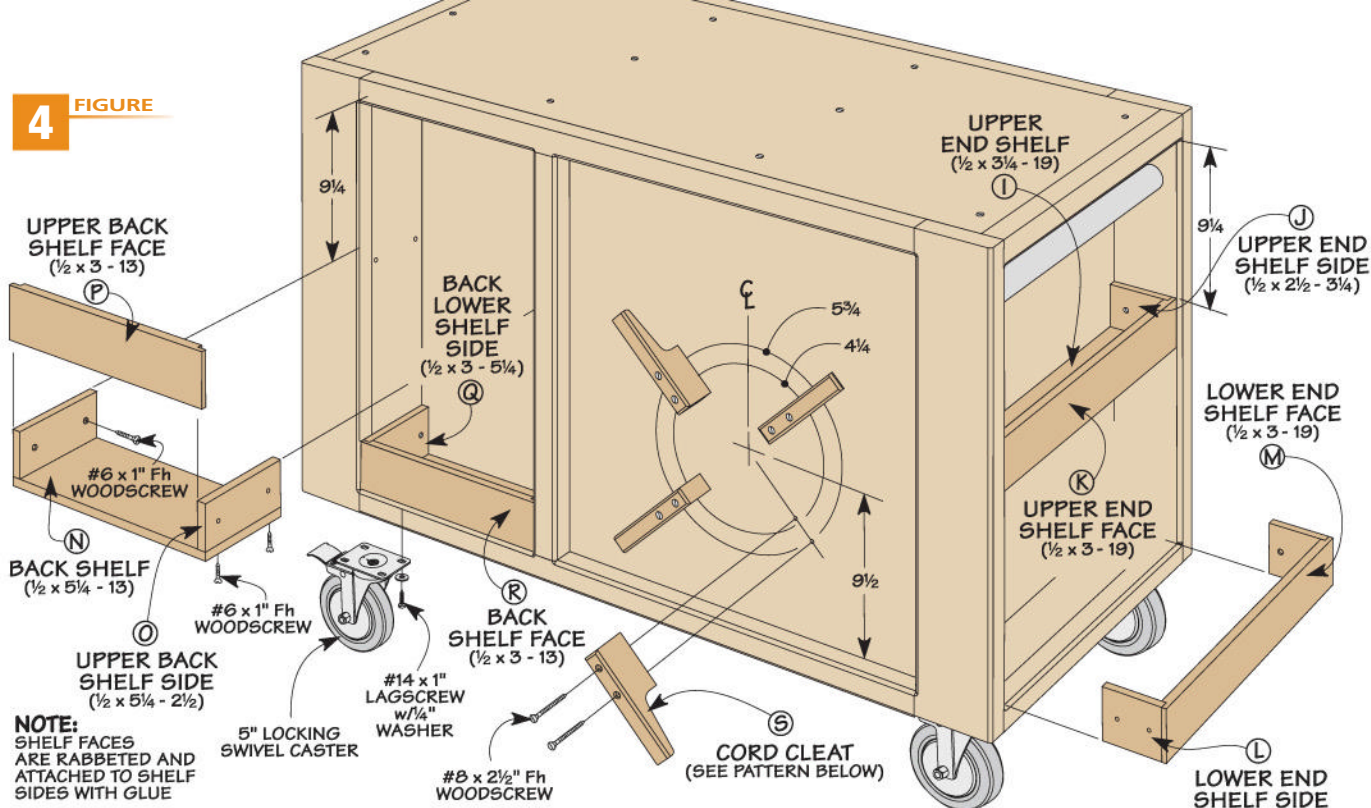
A	Case Tp./Btm.	(4) $19\frac{1}{2} \times 43\frac{1}{2}$ - $\frac{3}{4}$ Ply.
B	Case Sds./Dvdr.	(3) $19\frac{1}{2} \times 24\frac{3}{4}$ - $\frac{3}{4}$ Ply.
C	Wide Back (1)	24×24 - $\frac{3}{4}$ Ply.
D	Narrow Back (1)	$24 \times 13\frac{3}{4}$ - $\frac{3}{4}$ Ply.
E	End Edging (4)	$1\frac{1}{2} \times 1\frac{1}{4}$ - $19\frac{1}{2}$
F	Corner Posts (4)	$1\frac{1}{2} \times 4\frac{1}{2}$ - 27
G	Side Edging (4)	$1\frac{1}{2} \times 1\frac{1}{4}$ - 37
H	Vertical Edging (1)	$1\frac{1}{2} \times 1\frac{1}{4}$ - 24
SHELVES		
I	End Shelf (2)	$\frac{1}{2} \times 3\frac{3}{4}$ - 19
J	End Shelf Sides (4)	$\frac{1}{2} \times 2\frac{1}{2}$ - $3\frac{3}{4}$
K	Upper End Shelf Face (2)	$\frac{1}{2} \times 3$ - 19
L	Lower End Shelf Sides (4)	$\frac{1}{2} \times 3$ - $3\frac{3}{4}$
M	Lower End Shelf Face (2)	$\frac{1}{2} \times 3$ - 19
N	Back Shelf (1)	$\frac{1}{2} \times 5\frac{1}{4}$ - 13
O	Upr. Back Shelf Sides (2)	$\frac{1}{2} \times 5\frac{1}{4}$ - $2\frac{1}{2}$
P	Upr. Back Shelf Face (1)	$\frac{1}{2} \times 3$ - 13
Q	Lwr. Back Shelf Sides (2)	$\frac{1}{2} \times 5\frac{1}{4}$ - 3
R	Lwr. Back Shelf Face (1)	$\frac{1}{2} \times 3$ - 13
S	Cord Cleats (4)	1×2 - 6
TOP		
T	Top Support (2)	$22\frac{1}{2} \times 48\frac{1}{2}$ - $\frac{3}{4}$ MDF
U	Top (1)	$22\frac{1}{2} \times 48\frac{1}{2}$ - $\frac{1}{4}$ Hdbd.

V	Top Side Edging (2)	$\frac{3}{4} \times 13\frac{3}{4}$ - 50
W	Top End Edging (2)	$\frac{3}{4} \times 13\frac{3}{4}$ - 24
DRAWERS		
X	Drwr. 1 Frnt./Bck. (2)	$3\frac{3}{4} \times 21\frac{1}{2}$ - $\frac{1}{2}$ Ply.
Y	Drwr. 1 Sides (2)	$3\frac{3}{4} \times 18$ - $\frac{1}{2}$ Ply.
Z	Drwr. 2 Frnt./Bck. (2)	$3\frac{3}{4} \times 11\frac{1}{4}$ - $\frac{1}{2}$ Ply.
AA	Drwr. 2 Sides (2)	$3\frac{3}{4} \times 14$ - $\frac{1}{2}$ Ply.
BB	Drwr. 3 Frnt./Bck. (2)	$5 \times 21\frac{1}{2}$ - $\frac{1}{2}$ Ply.
CC	Drwr. 3 Sides (2)	5×18 - $\frac{1}{2}$ Ply.
DD	Drwr. 4 Frnt./Bck. (2)	$5 \times 11\frac{1}{4}$ - $\frac{1}{2}$ Ply.
EE	Drwr. 4 Sides (2)	5×14 - $\frac{1}{2}$ Ply.
FF	Drwr. 5 Frnt./Bck. (2)	$6\frac{1}{4} \times 21\frac{1}{2}$ - $\frac{1}{2}$ Ply.
GG	Drwr. 5 Sides (2)	$6\frac{1}{4} \times 18$ - $\frac{1}{2}$ Ply.
HH	Drwr. 6 Frnt./Bck. (2)	$6\frac{1}{4} \times 11\frac{1}{4}$ - $\frac{1}{2}$ Ply.
II	Drwr. 6 Sides (2)	$6\frac{1}{4} \times 14$ - $\frac{1}{2}$ Ply.
JJ	Drwr. 7 Frnt./Bck. (2)	$7\frac{3}{8} \times 21\frac{1}{2}$ - $\frac{1}{2}$ Ply.
KK	Drwr. 7 Sides (2)	$7\frac{3}{8} \times 18$ - $\frac{1}{2}$ Ply.
LL	Drwr. 8 Frnt./Bck. (2)	$7\frac{3}{8} \times 11\frac{1}{4}$ - $\frac{1}{2}$ Ply.
MM	Drwr. 8 Sides (2)	$7\frac{3}{8} \times 14$ - $\frac{1}{2}$ Ply.
NN	Lrg. Drwr. Bttms. (4)	$17\frac{1}{2} \times 21\frac{3}{4}$ - $\frac{1}{4}$ Ply.
OO	Sm. Drwr. Bttms. (4)	$13\frac{1}{2} \times 11\frac{1}{2}$ - $\frac{1}{4}$ Ply.
PP	Drwr. 1 False Frnt. (1)	$23\frac{3}{4} \times 23\frac{7}{16}$ - $\frac{3}{4}$ Ply.
QQ	Drwr. 2 False Frnt. (1)	$2\frac{3}{4} \times 13\frac{3}{16}$ - $\frac{3}{4}$ Ply.

RR	Drwr. 3 False Frnt. (1)	$4 \times 23\frac{7}{16}$ - $\frac{3}{4}$ Ply.
SS	Drawer 4 False Frnt. (1)	$4 \times 13\frac{3}{16}$ - $\frac{3}{4}$ Ply.
TT	Drwr. 5 False Frnt. (1)	$5\frac{1}{4} \times 23\frac{7}{16}$ - $\frac{3}{4}$ Ply.
UU	Drwr. 6 False Frnt. (1)	$5\frac{1}{4} \times 13\frac{3}{16}$ - $\frac{3}{4}$ Ply.
VV	Drwr. 7 False Frnt. (1)	$6\frac{3}{8} \times 23\frac{7}{16}$ - $\frac{3}{4}$ Ply.
WW	Drwr. 8 False Frnt. (1)	$6\frac{3}{8} \times 13\frac{3}{16}$ - $\frac{3}{4}$ Ply.

- (16) #14 x 1" Sheet Metal Screws
- (16) $\frac{1}{4}$ " Washers
- (20) #8 x $2\frac{1}{2}$ " Fh Woodscrews
- (44) #8 x $1\frac{1}{4}$ " Fh Woodscrews
- (72) #6 x $1\frac{1}{4}$ " Fh Woodscrews
- (72) #6 x 1" Fh Woodscrews
- (40) #6 x $\frac{5}{8}$ " Rh Woodscrews
- (2) $1\frac{1}{2}$ " x $20\frac{1}{2}$ " EMT Conduits
- (4) 5" x $1\frac{1}{4}$ " Swivel Casters w/Brake
- (4) $23\frac{7}{16}$ " Extruded Aluminum Drawer Pulls
- (4) $13\frac{3}{16}$ " Extruded Aluminum Drawer Pulls
- (4) 14" Full-Extension Drawer Slides
- (4) 18" Full-Extension Drawer Slides

4 FIGURE



Adding the Shelves & Top

With the case assembled, the cart is beginning to take shape. The next step is to add some organization. I started by adding shelves in the recesses on the ends and back.

SHELVES. I wanted the shelves to be big enough to hold a cordless drill and a few of my other more commonly used tools. And to build them I decided to use hardwood stock that matched the edging.

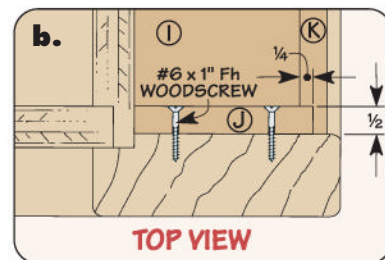
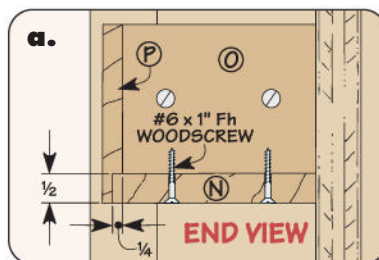
The construction is pretty simple. Each shelf is attached to two sides with

screws from the bottom. The face is rabbeted on the bottom and both ends to fit over the shelf and then assembled with just glue. Figures 4a and 4b, above, show how this works. I sized each of the shelf assemblies to fit the recesses and then attached them to the sides of the case with screws.

You'll also notice that the lower shelves are formed by the bottom of the case. So the face

is only rabbeted on the ends. Then just add the shelf sides to complete them.

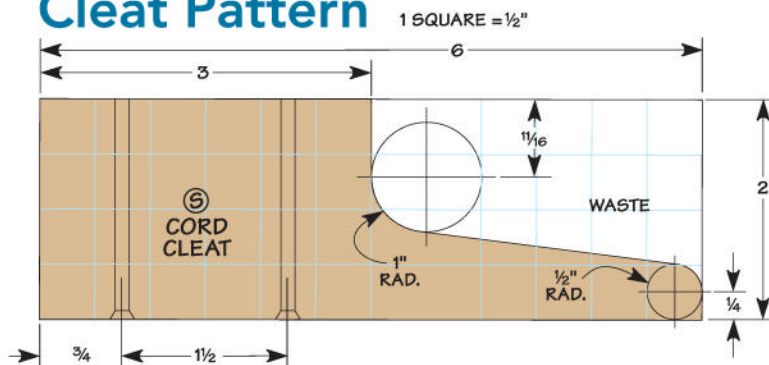
CORD CLEATS. I expected to do a lot of power tool work with the cart, so next I added a power strip and an extension cord. This way, you'll always have an outlet handy when you need to plug in a sander or any other corded tool to work on your projects. I didn't want the long extension cord to be in the way, though, so I also added a set of four cleats on the



Power strip. Adding a power strip guarantees you'll always have an outlet within easy reach.



Cleat Pattern

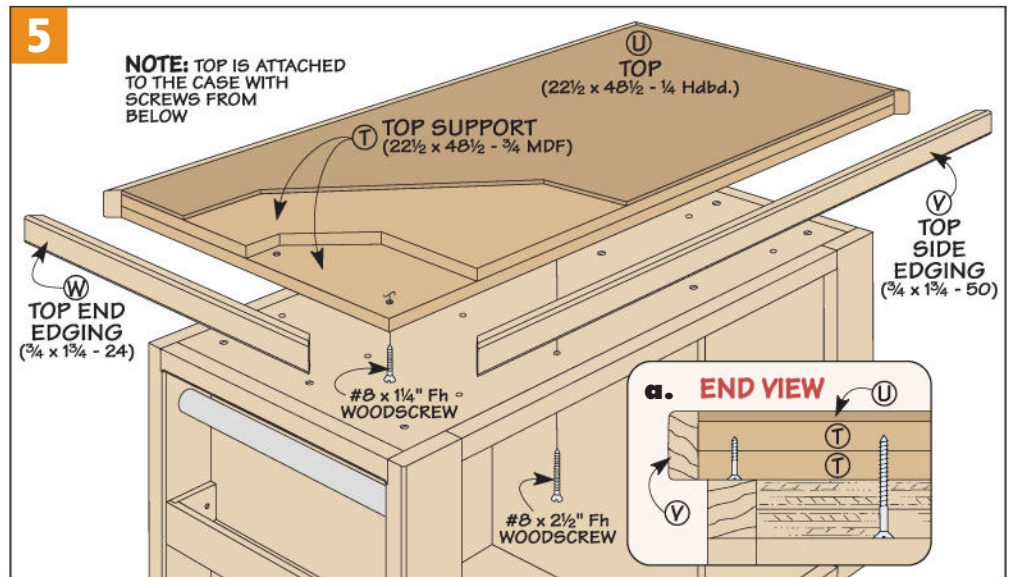


back to neatly wrap it around when not in use.

The cleats are just hardwood blocks that I cut to the shape shown on the opposite page and attached with screws. The easiest way to shape them is to drill the hole establishing the radius and remove the waste at the band saw.

ADD THE CASTERS. The cart weighs quite a bit on its own, but it'll be quite heavy once the drawers are loaded. So when it came time to choose casters, I made sure to use something that could handle the load. For the casters I used, refer to page 97.

To mount the casters, you first need to flip the cabinet on its top. Then you can predrill holes for the large lag screws needed to hold them in place. The photo at lower right gives you an idea of how this works. The thing to keep in mind here is to make sure you're mounting them in the plywood bottom and not the edging. Then just screw the casters in place.



THE TOP. Now you can turn your attention to the top. It's just two pieces of MDF glued and screwed together with a hardboard panel as a top. I cut both pieces of MDF and the hardboard panel at the table saw without changing the fence setting to make sure they all came out identical. Then, I lined up the MDF panels, clamped them together, and drilled the holes for the screws.

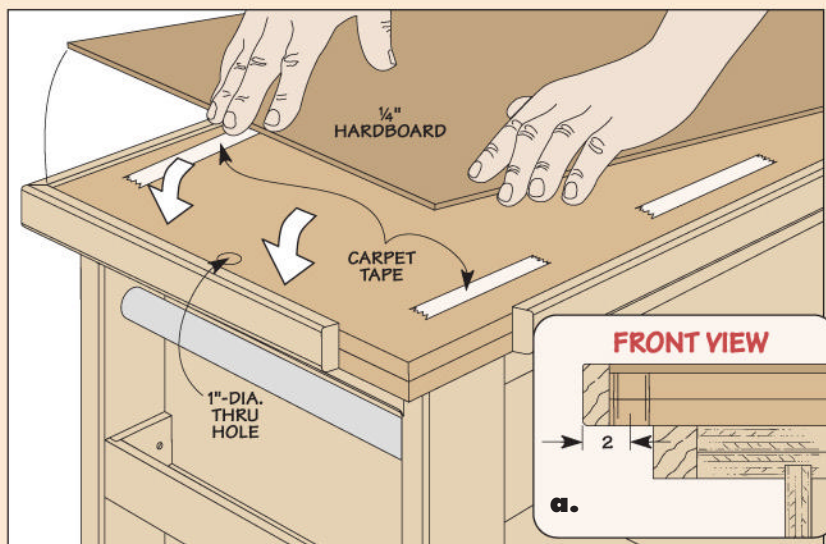
Finally, I added glue and fastened the pieces together.

You can glue the hardboard top on now, or you can just secure it with carpet tape and make it easier to replace if it gets damaged. The box below shows a simple option for making it replaceable.

MITERED EDGING. I added hardwood edging to match the case, mitering it to fit around the top. The edging protects the MDF from damage that can occur in the shop.

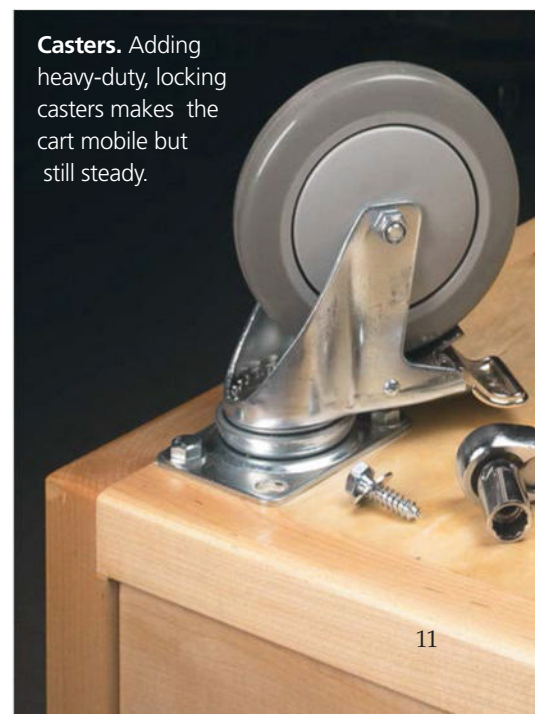
Finally, I attached the top to the case with screws from the inside. I predrilled the holes and used long screws through the double layers of plywood into the MDF to make sure the top stayed secure.

Replaceable Top Options



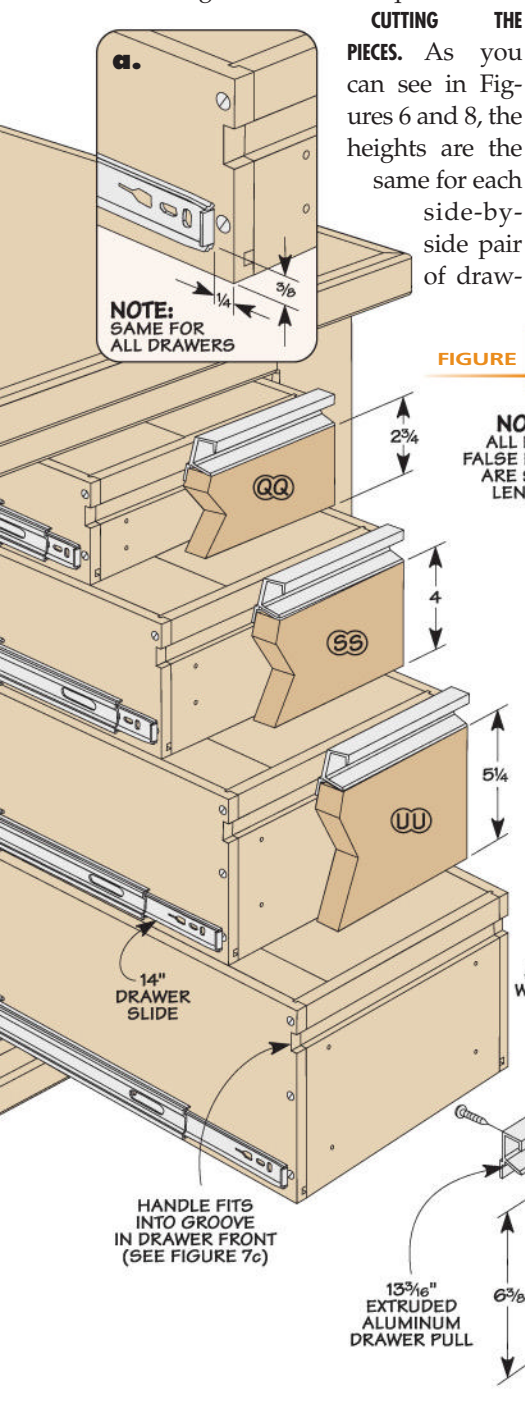
Replaceable Top. Since the top will see a lot of wear, you may want to replace the hardboard. A simple way to make this easier is to drill a hole through the MDF layers so you can pop out the old piece when it's time for a change. Just attach the top with carpet tape.

Castors. Adding heavy-duty, locking casters makes the cart mobile but still steady.

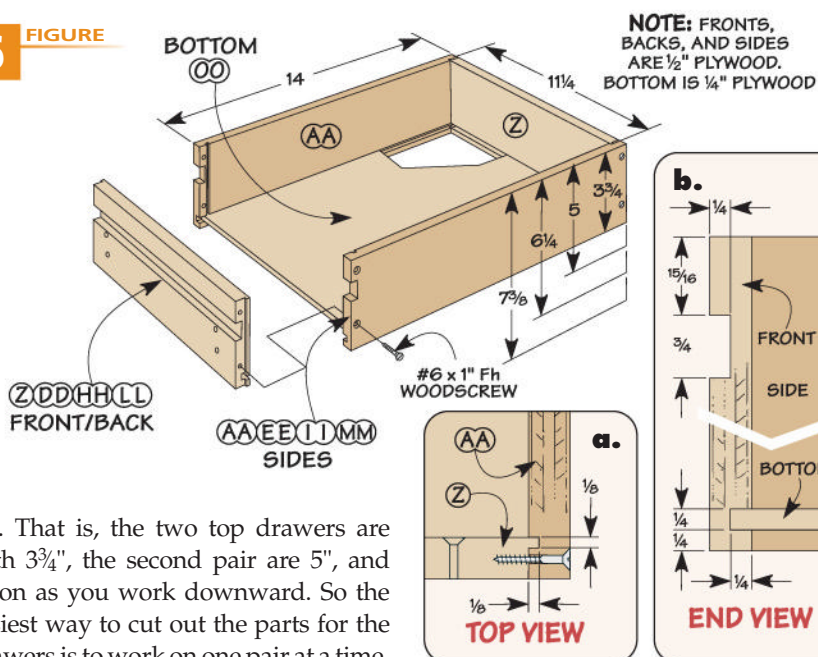


Simple, Sturdy Drawers

You can already see how useful the cart is going to be now that the top and wheels are attached. But the addition of the drawers is what really makes the cart a must-have item for your shop. And building the drawers isn't tough. They're different sizes, but they're all built using the same technique.



6 **FIGURE**



7 **FIGURE**

NOTE:
ALL FOUR
FALSE FRONTS
ARE SAME
LENGTH

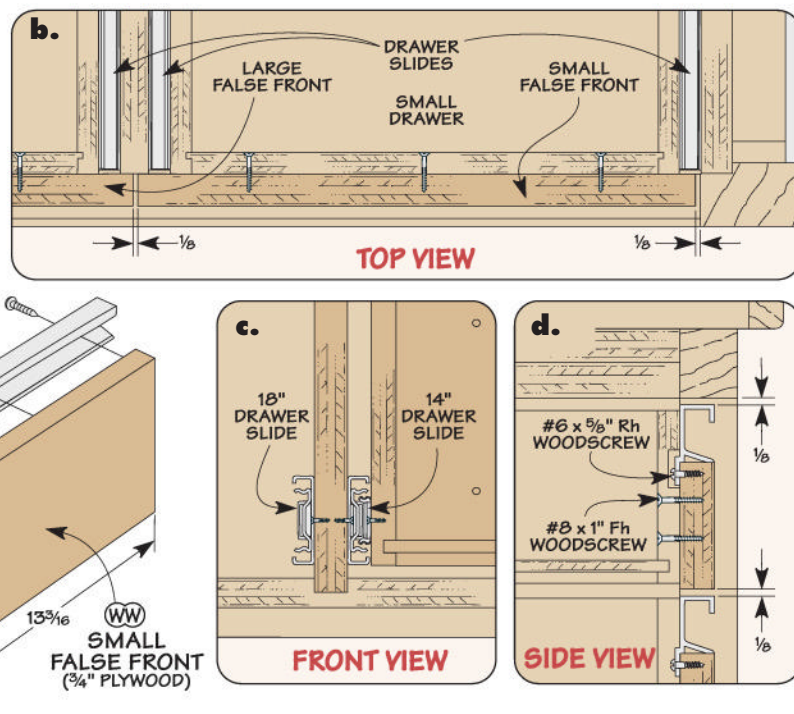
ers. That is, the two top drawers are both $3\frac{3}{4}$ ", the second pair are 5", and so on as you work downward. So the easiest way to cut out the parts for the drawers is to work on one pair at a time. This way, you can use the same table saw fence setting to make sure you get consistent results. To keep the parts from getting mixed up, I labeled each piece.

JOINERY. The next step is to cut the tongue and dado joint on each of the drawer pieces. Since the drawers will be holding a lot of weight, I decided to countersink the screws in the sides to reinforce the joint. The joinery here is mostly to help with alignment during assembly. You'll only need a $\frac{1}{8}$ "-square tongue

and matching dado, so you can cut them with a standard blade on the table saw. The technique for cutting this joint is shown in the box on the bottom of the opposite page.

Once you've completed the tongue and dado joinery, you can put a dado blade in the saw and cut the groove that will hold the $\frac{1}{4}$ " plywood drawer bottom. Then you can cut the bottoms to size.

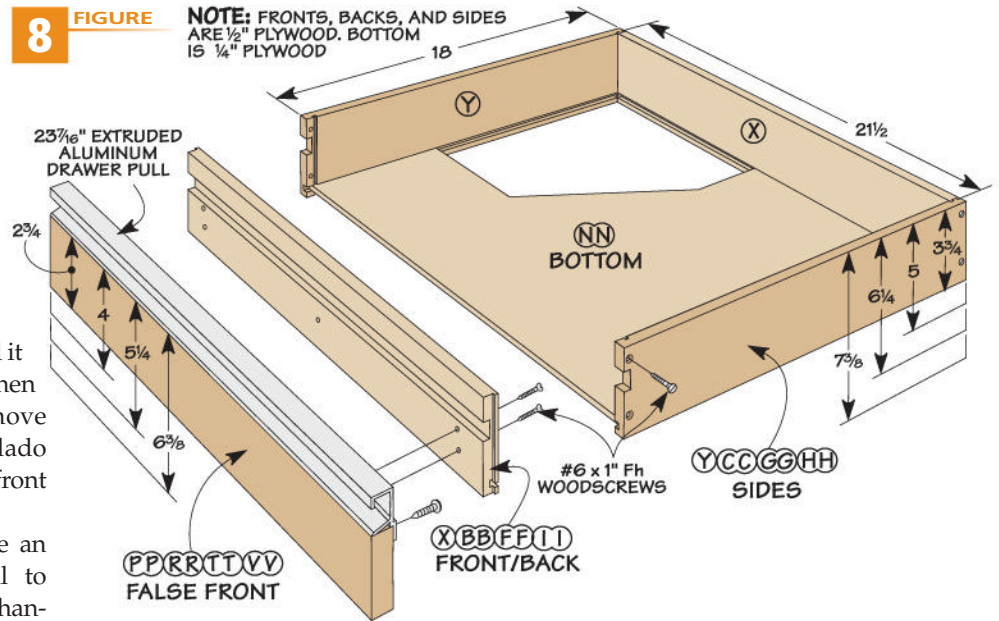
ASSEMBLY. Now that you've finished cutting all the pieces, you can begin assembling the drawers.



One thing to keep in mind here is to make sure the screws won't be in the way of the groove you'll cut to hold the handle. This groove will make room for the false front and handle assembly. And the groove goes through both the sides and the front, so the drawers need to be assembled before making this cut.

A little glue and the screws are all it takes to complete the drawers. When they're all assembled, you can move back to the table saw and use a dado blade to cut the $\frac{3}{4}$ " groove in the front of each drawer.

FALSE FRONTS & DRAWER PULLS. I chose an extruded aluminum drawer pull to give the drawers the look of a mechanic's tool chest. Since the aluminum stock comes in 8' lengths, you'll need to cut each piece to fit the drawer. Aluminum is easy to cut at the table saw with a carbide-tipped blade. After you've attached the handles, you can cut the false fronts. The false fronts are sized to keep an even, $\frac{1}{8}$ " gap around each drawer. The false front and handle assembly fits into the grooves you cut in the drawers earlier, and attaches with



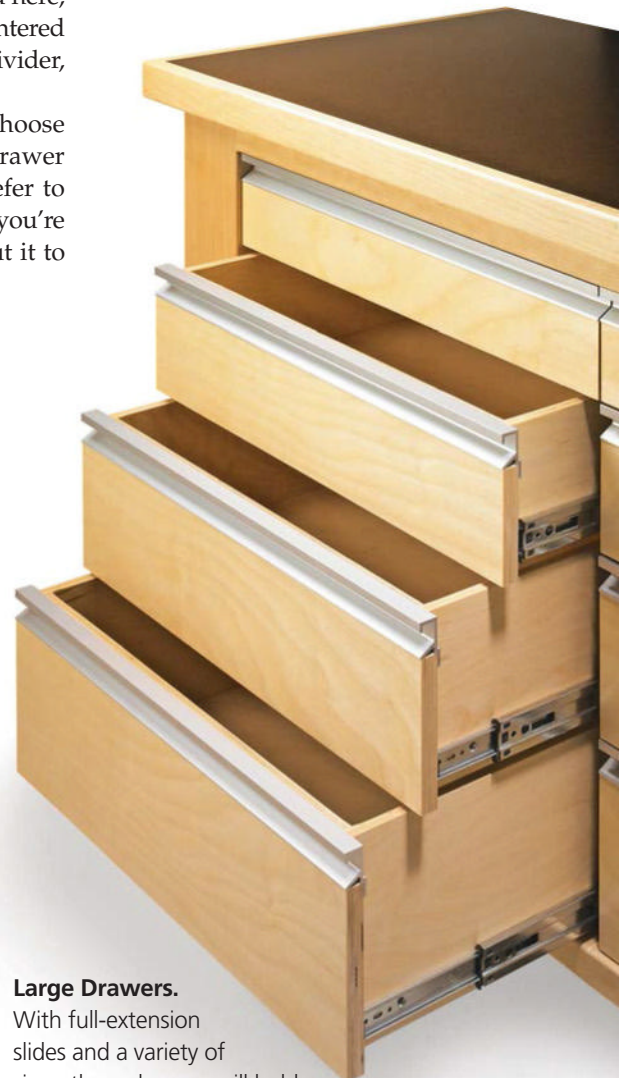
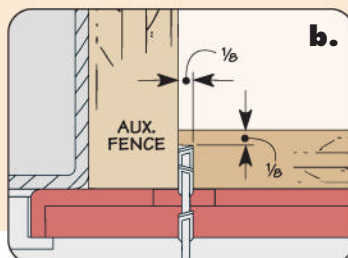
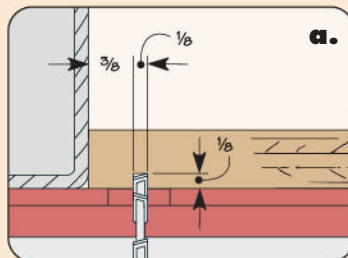
screws. The thing to keep in mind here, is that the false fronts are not centered on the drawers, but overlap the divider, as shown in Figure 7b

Now, all you need to do is choose which a finish and mount the drawer slides. For an easy technique, refer to woodsmith.com/magazine/sip. Then you're ready to load up the cart and put it to work in your shop.

Drawer Joinery

To beef up the strength of each drawer and make sure they could handle the weight of my heavier power tools, I assembled them with screws. A tongue and dado joint helps keep the drawer pieces aligned during assembly.

The nice thing about this joint is you can cut both parts at the table saw with a standard blade. Using the miter gauge, cut the shallow dadoses in the side pieces, as shown in detail 'a' at right. To form the tongue on the front and back, you'll need to add an auxiliary fence and slide it next to the blade. Use the miter gauge again to make the cuts on both ends of each piece (detail 'b'). Then just drill and countersink holes for the screws, add a little glue and assemble them.



Large Drawers.

With full-extension slides and a variety of sizes, these drawers will hold anything you need.



Double Porch Rocker

With its solid construction and elegant design, this double-wide rocker is sure to be the most relaxing project you have ever built.

I grew up in a rural area in a time when summer nights were spent relaxing on the porch. Those nights of long conversations about anything and everything, plus the occasional impromptu visit from a neighbor, are precious memories.

With this classic-style rocker, you too can spend time relaxing on your porch, deck, or patio. It has ample space for one person to stretch out while reading a good book. But it's just the right size to

cozy up to your significant other, kids, grandkids, or the family dog.

The woodworking presents enough of a challenge to make it an interesting build. Our designer spent a lot of time getting the shape of the rockers just right for easy, no-effort rocking.

The seat slats are curved for comfort. I'll show you how to make them using a pattern to lay out the shape before cutting them on a band saw using a jig.

Also, there's something unique about the way the seat slats are attached to the rails. Instead of screws, I used slotted dowels and secured them with thin wedges. This provides a durable and long-lasting connection that will stay strong for years to come.

I chose to use cypress because it's an attractive, durable wood that's easy to work with power and hand tools. Plus, it's suitable for outdoor use.

CONSTRUCTION DETAILS

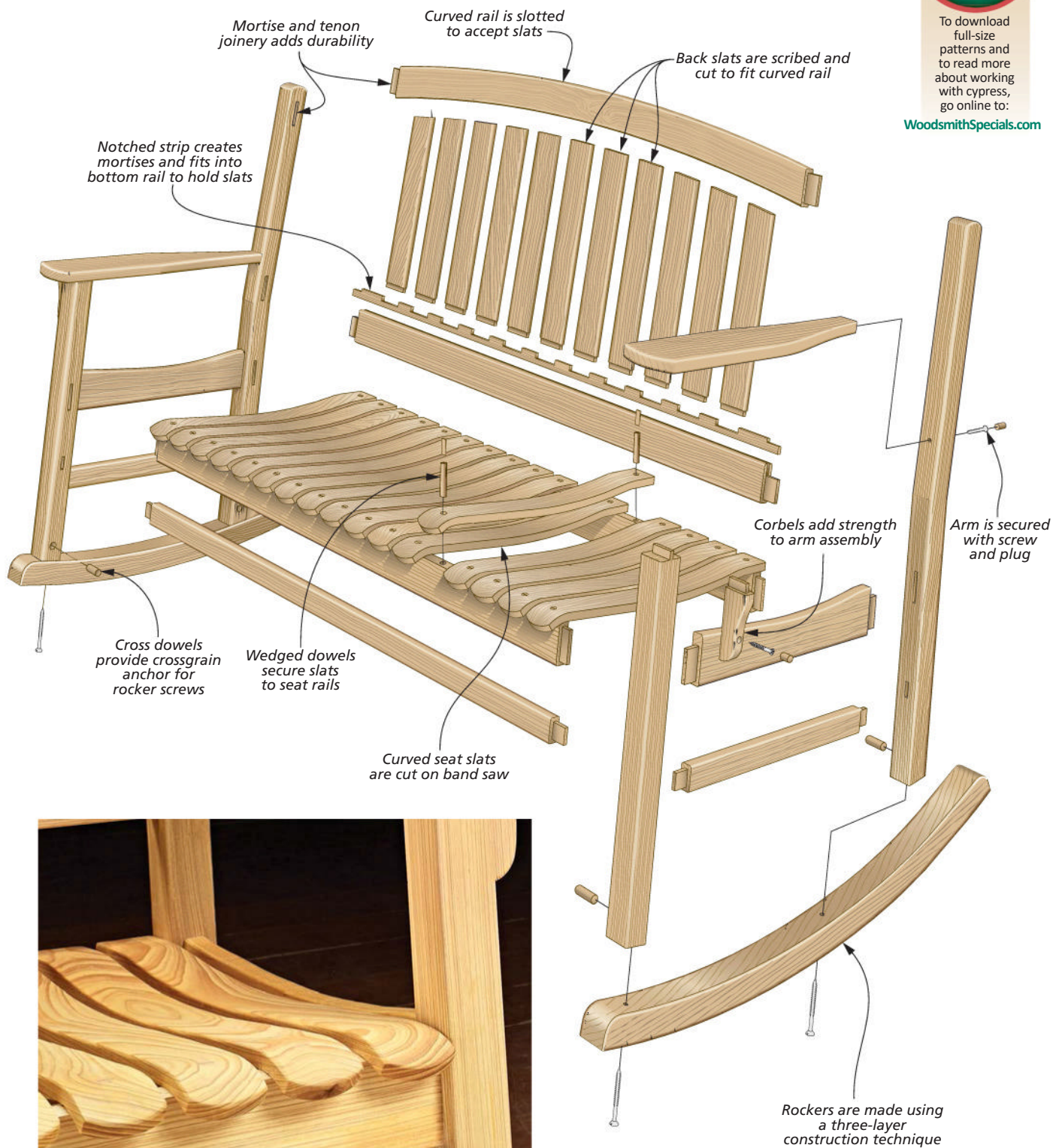
OVERALL DIMENSIONS:

48 $\frac{7}{8}$ " W x 36 $\frac{5}{8}$ " H x 35 $\frac{1}{2}$ " D

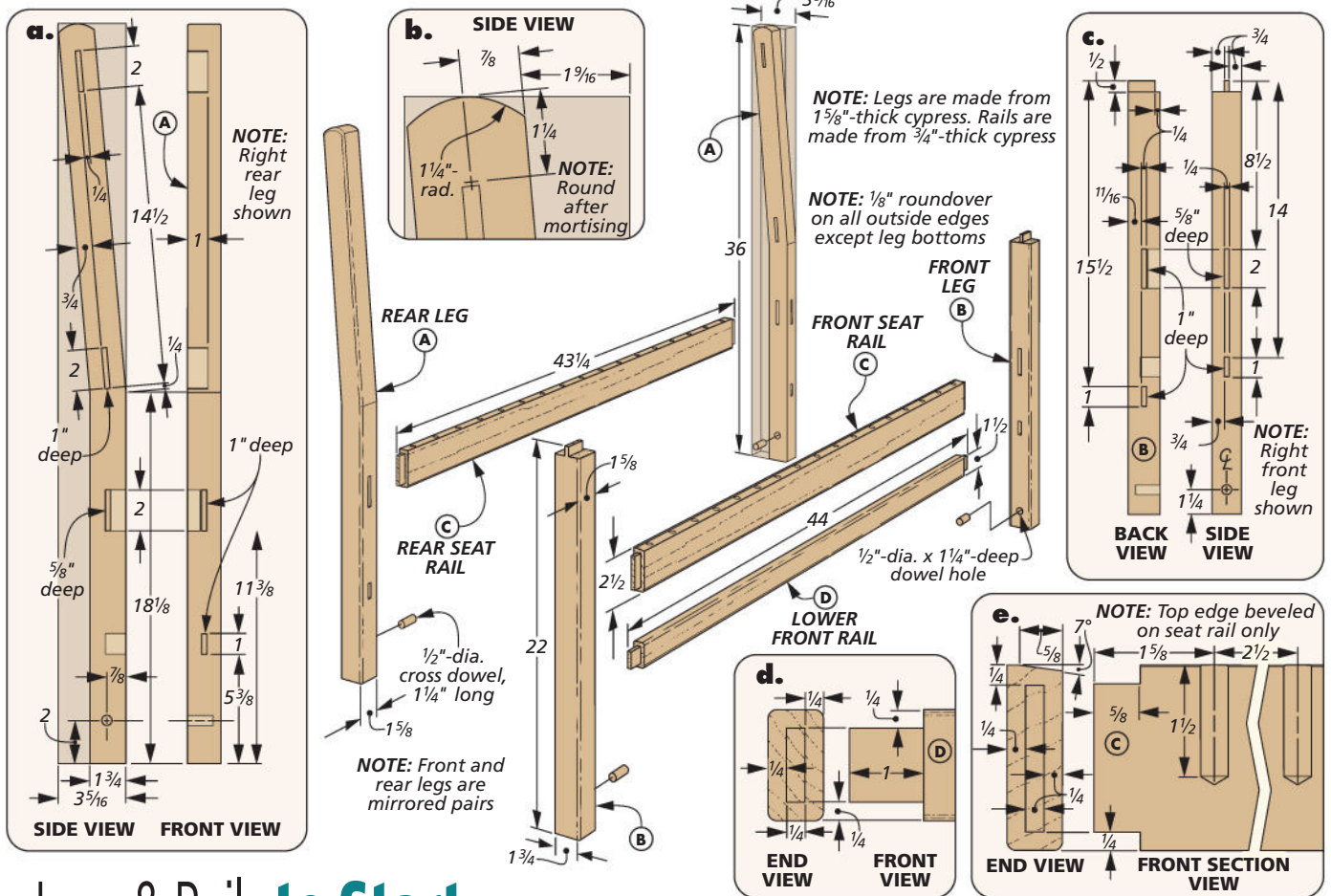


To download full-size patterns and to read more about working with cypress, go online to:

WoodsmithSpecials.com



Easy-To-Make Slats. Shaped slats make for a comfortable seat. The ends are curved to avoid digging into the back of your legs as you rock. The slats are easy to form at the band saw.



Legs & Rails to Start

The construction of the rocker starts with the legs, seat rails, and lower front rail. But there's one thing I want to point out before you start: You won't assemble these components until after the seat and back are completed. For now, you'll just dry assemble all of the parts to ensure a good fit.

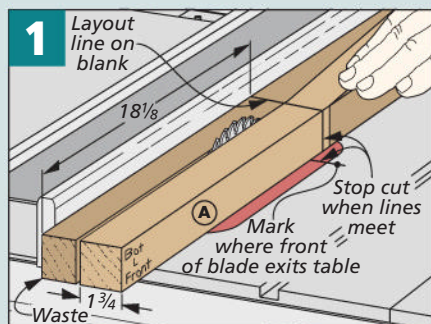
REAR LEGS. All four legs are cut from stock planed to $1\frac{5}{8}$ " thick. The upper portion of the rear legs is angled. This tilts the back of the rocker for comfort.

Detail 'a' above shows how the rear legs are cut from wide blanks. Some careful layout is in order here. You'll want to mark the top and bottom to

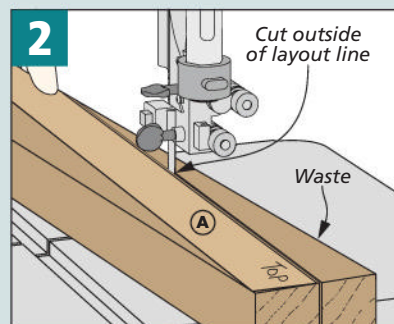
keep the orientation correct as you cut the parts and lay out the mortises.

The box below shows the technique I used to ensure straight cuts. It starts by making a stopped cut at the table saw to define the width of the lower portion of the leg. The second cut takes place at the band saw to cut the inside face of

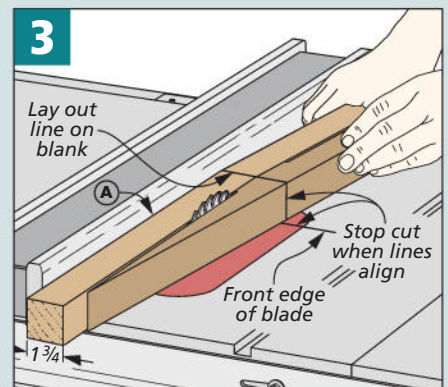
Cut Leg to Shape from Blank



First Cut. Mark where the blade exits the saw table. Then make a stopped cut to define the lower, straight portion.



Second Cut. Cut the inside face of the upper, angled portion at the band saw and then joint the face smooth.



Third Cut. Make another stopped cut to define the width of the top of the leg. Finish the cuts at the band saw.

the upper, angled portion. After running this face across the jointer, head back to the table saw to make another stopped cut to define the final width of the upper portion of the leg. Complete both stopped cuts at the band saw to remove the waste. A little sanding creates a smooth transition.

FRONT LEGS. The front legs are easy to make. Cut them to width and form the tenon at the top end that will fit into a mortise in the arm of the rocker, as in Figure 1 at right. Be careful of the orientation here — the leg is $1\frac{5}{8}$ " wide across the front and $1\frac{3}{4}$ " thick.

MORTISES. The legs require mortises to hold the rails, seat, and back. These are detailed in the drawings on the previous page and Figure 2 at right. Depending on the size of your drill press table, you may need to elevate the rear legs with a spacer to hold them level while drilling the front mortises.

CROSS DOWELS. The rockers are attached to the bottom ends of the legs. Screws don't hold well in end grain, so I added cross dowels for the screws to grab. Figure 3 shows how the holes are drilled.

Before moving on to the rails, round over the top end of the rear legs, as you can see in Figure 4. Then head to the router table to ease the edges.

A SET OF RAILS

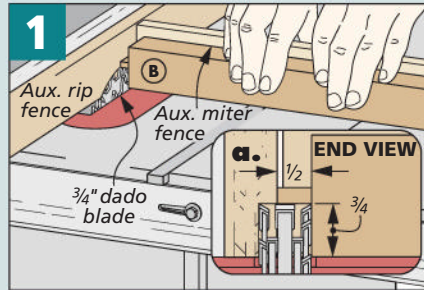
The two rails that hold the seat slats and the lower front rail follow a similar construction procedure at first. They all require a tenon on each end (Figures 5 and 6). Note that the overall size of the rails and tenon size differ between the lower front rail and the two seat rails.

DOWEL HOLES. Now focus your attention on the pair of seat rails. Each of the slats is held in place with a wedged dowel. You'll need 17 holes along the top edge of each seat rail (Figure 7). I placed the two rails side-by-side to lay out the hole locations.

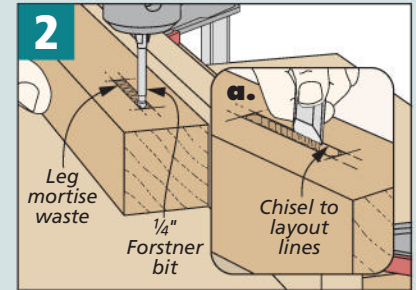
At the drill press, take time to adjust the fence to center the bit on the rail edges. A trick I use to do this is to lower the bit until it makes a dimple, then rotate the workpiece 180° and repeat the process until the dimples align.

BEVEL RIP. The final step is to slightly bevel the top edge of the front rail (Figure 8). This allows the curve on the seat slats to fit tightly against the rail.

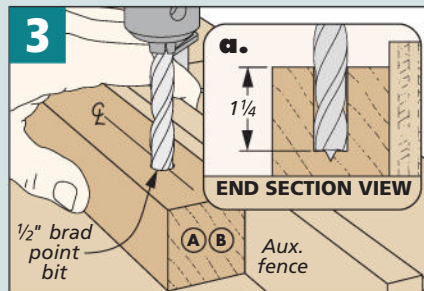
Tenons, Mortises & Dowel Holes



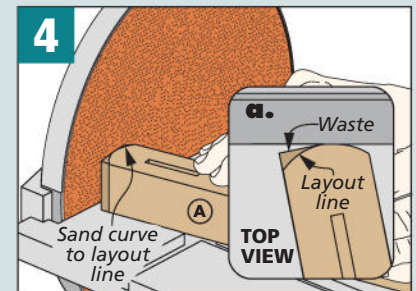
Short Tenon. The tenon at the top of each front leg helps to secure the arms of the rocker that you'll add later.



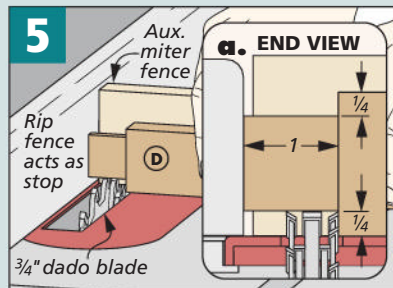
Making Mortises. Drill overlapping holes and then cleanly define the mortise with sharp chisels.



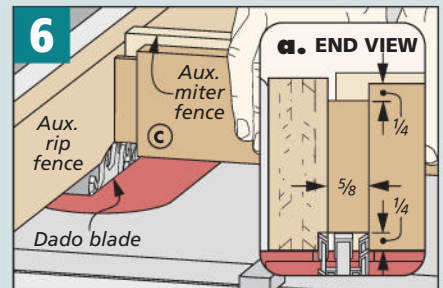
Cross Dowels. Each of the legs requires a hole for a dowel on the inside face. After drilling, glue the dowel in place.



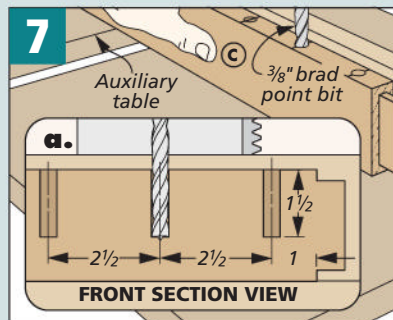
Smooth Shape. Lay out the curve at the top of the rear legs, then use the disk sander to shape them.



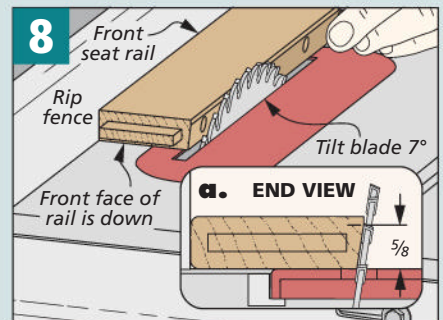
Lower Rail Tenons. The tenons on the lower front rail help add strength to the rocker assembly.



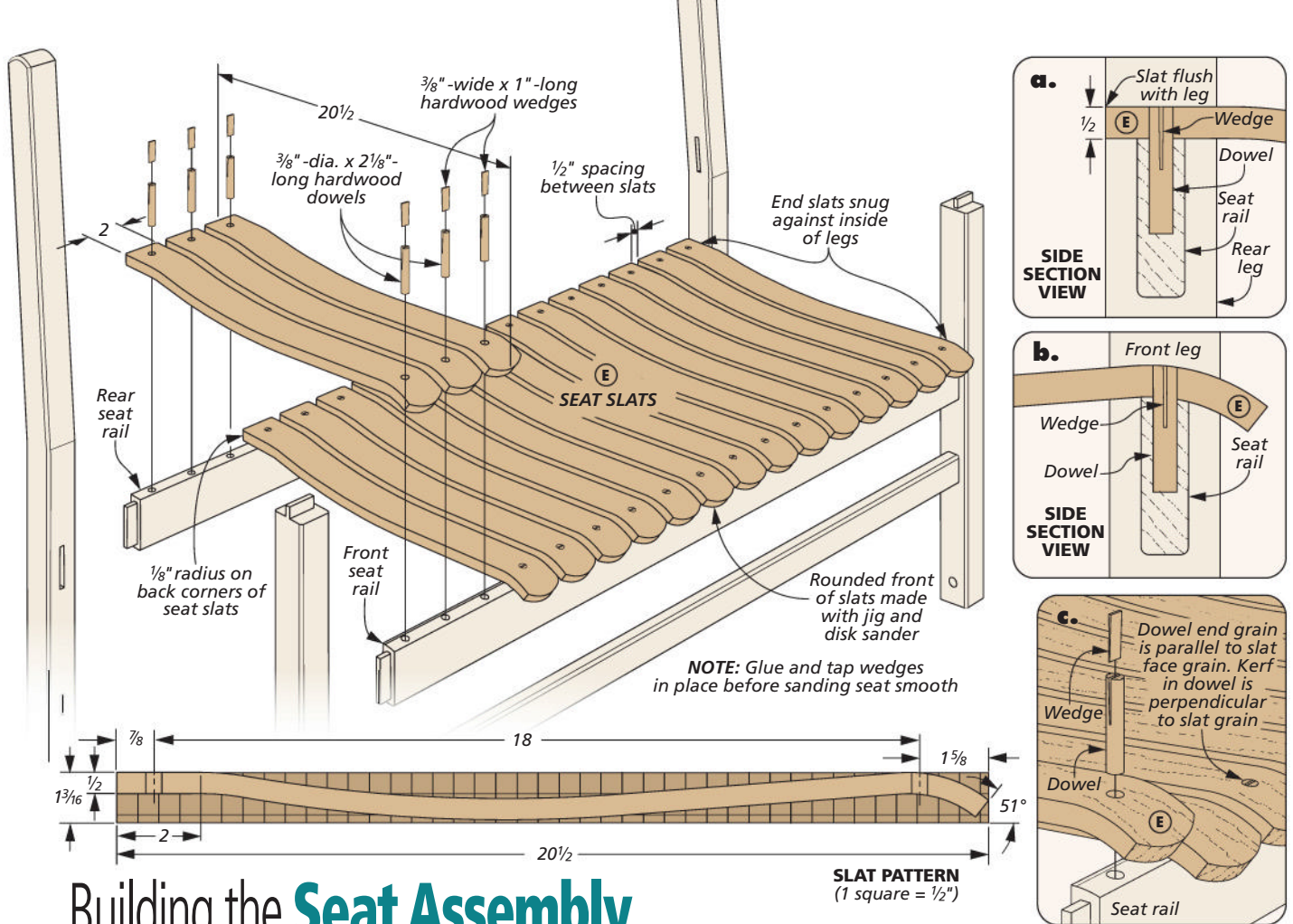
Tenons on Seat Rails. The tenons on the seat rails provide a strong connection to the legs of the rocker.



Dowel Holes. Carefully lay out and drill holes for dowels centered along the top edge of each seat rail.



Beveled Edge. To allow the curved seat slats to fit tightly to the front seat rail, rip a slight bevel along the top edge.



Building the Seat Assembly

So far, you've made all of the parts that form the frame for the rocker. But before you can glue them up, you'll need to add a seat and back assembly. Most of this work happens at the band saw.

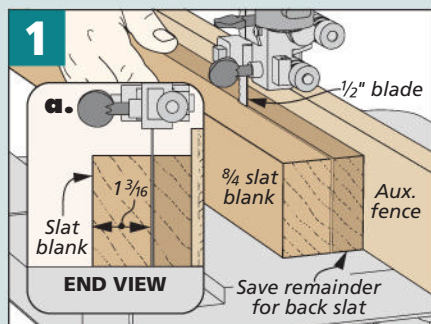
BAND SAW WORK. To make the seat slats, I started with 8/4 cypress blanks a little

over 2 1/4" wide. From these, resaw strips roughly 13/16" thick for the curved seat slats (Figure 1 below). What's left over will be used later to make the slats for the back. Set those aside for now.

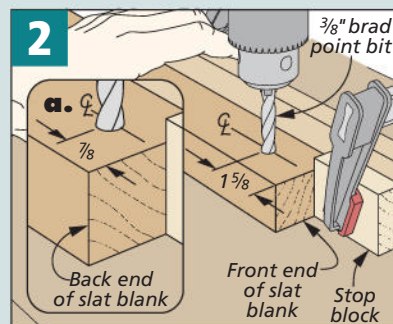
Rip each of the seat slats to their final width and then lay out the hole locations

at each end of the blank (details 'a' and 'b' and slat pattern above). Each of the slats will be secured to the rails with a pair of wedged dowels. It's important that the holes for these dowels be drilled accurately so everything fits well during glueup. For this reason, I used stop

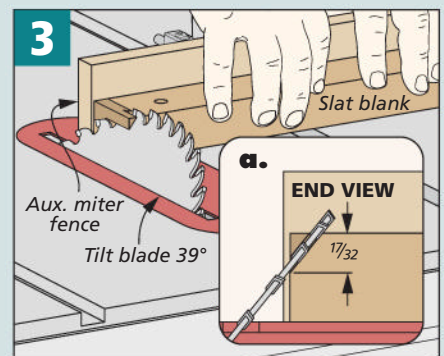
Prepare Seat Slat Blank



Resaw the Slat Blank. After resawing to create the blank for the seat slat, save the remainder for the back slat.



Drill Dowel Holes. Dowels secure the slat to the seat rails and also hold the blanks on the jigs used to form the slat.



Bevel One End. To make it easier to sand the rounded end of the slat later, cut a small bevel on each blank.

blocks on the fence to accurately position the holes on each of the blanks, as shown in Figure 2 on the previous page.

The next step is to cut a bevel on one end of each blank, as in Figure 3, previous page. This makes it easier to round over the end of the slat after it's cut to shape.

SHAPING JIGS. Shaping the seat slats comes next. Figures 1 through 3 at right show a couple of jigs I made to lend a hand with this task.

Before you can do any shaping, make a $\frac{1}{4}$ "-thick hardboard template to trace the side profile onto the blank. The slat pattern is illustrated on the previous page. A full-size pattern can be downloaded online from woodsmith.com/magazine/sip.

Figure 1 illustrates how a two-sided holding jig secures the slat blank on a pair of dowels. After cutting what will become the top side of the slat, move the blank to the opposite side of the jig. Cut the bottom profile of the slat before sanding it smooth with the same jig (Figure 2).

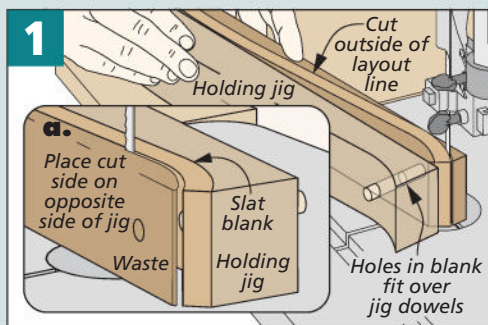
SANDING JIG. Another handy jig is one that helps hold the slat at the proper angle to shape the front end (Figure 3). The slat is held in place with dowels. After marking the curved profile using a posterboard pattern, I used a disc sander to sand to the line (learn more about the pattern and jig online).

DOWELS & WEDGES. To secure the slats to the seat rails, I used dowels with wedges. The jig shown in Figure 4 is used to both cut the dowels to length and create the slots for the wedges (Figure 5). Take care to orient the dowel to cut the slot perpendicular to the grain. This helps to avoid splitting the dowel when inserting the wedge.

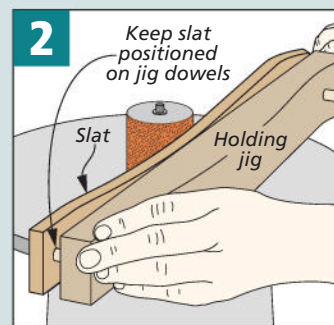
To make the wedges, I cut angled slots in a piece of maple with the grain oriented vertically, as illustrated in Figure 6. After cutting the strips, score the cut lines with a knife and snap the wedges free.

SLAT ASSEMBLY. Finally, you're ready to install the slats onto the seat rails. I used a jig to hold the rails secure during the process. You can find out more details about the jig at WoodsmithSpecials.com. When gluing the dowels, orient the slot parallel to the rails to avoid splitting the slats (Figure 7 and detail 'c'). Then glue and tap the wedges in place before sanding the entire surface of the seat smooth.

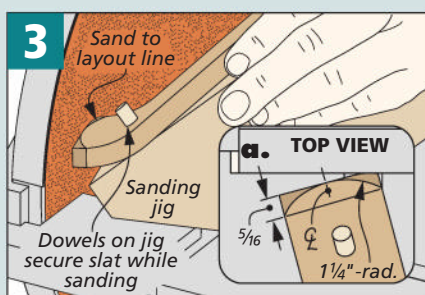
Profile Slats & Assemble the Seat



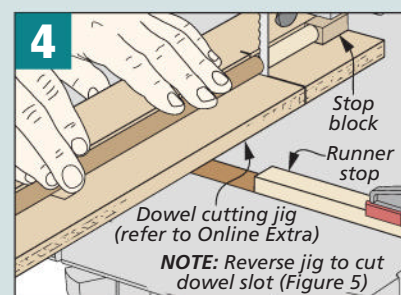
Band Saw Work. Use a holding jig to guide the slat blank when cutting each side of the slat to the profile lines that define the shape.



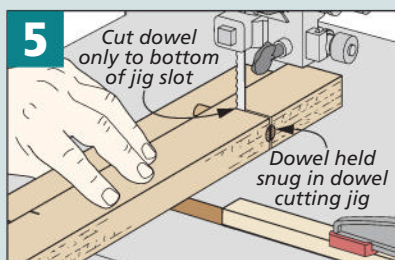
Smoothing. A spindle sander is ideal for smoothing the top and bottom of each slat.



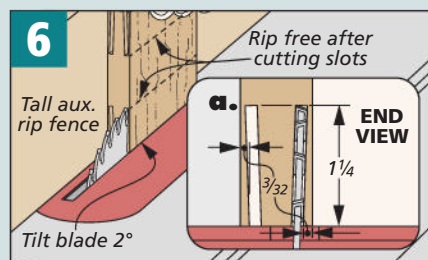
Rounded Ends. Use a jig to hold the slat at the proper angle to round over the end at the disc sander.



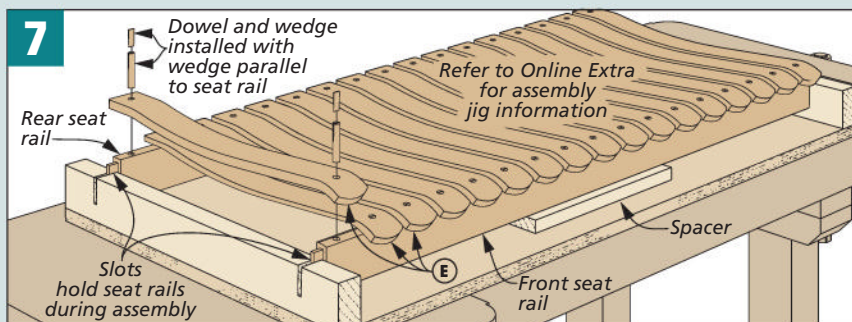
Cut & Slot Dowels. One jig takes care of cutting dowels to length and creating a slot for the wedges.



Grain Orientation. Cut the slot perpendicular to the grain direction on the end of the dowel.



Wedge Blanks. Cut angled slots in a blank first, then rip the strips free before trimming the wedges to width.



Seat Assembly. A simple assembly jig cradles the seat rails as you install the slats. Add glue to the hole in the seat rail and orient the slot on the wedges parallel to the rail while tapping them in place. Secure the wedges with glue.

LOWER SIDE RAIL. The lower side rail is simple by comparison. All you do here is cut the tenons on each end and round over the edges.

LEG ASSEMBLIES. At this point, you can glue the side rails to their respective front and rear legs. This creates two end assemblies.

SEAT BACK ASSEMBLY

The How-To box on the right provides the details on creating the seat back for the rocker. The lower rail has a groove along the top edge that houses a mortise strip (Figure 1). This strip is simply notched to form mortises that secure the bottom end of the back slats (Figure 2). I cut the tenons on the ends of the rail after the mortise strip was glued in place.

CURVED RAIL. The curved upper back rail starts out as a wide blank. The first step is to cut a tenon on each end, as in Figure 3. I used a strip of hardboard to lay out the curves before cutting the rail to shape at the band saw (Figures 4 and 5).

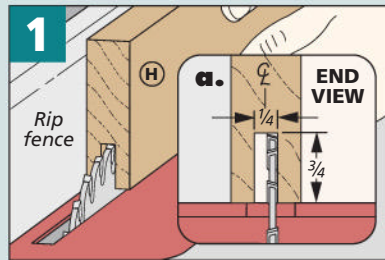
I cut a groove in the bottom edge of the upper rail to secure the upper end of the back slats. Figure 6 shows how a slot cutter in the router table is ideal for this task. Rout the slot in two passes, flipping the workpiece between passes to center the slot.

BACK SLATS. The slats for the seat back are made from $\frac{3}{8}$ "-thick stock. They're cut extra long so you can trim them later to match the curve in the upper rail. Cut a tenon on one end of each slat to fit the mortises in the bottom rail (detail 'e').

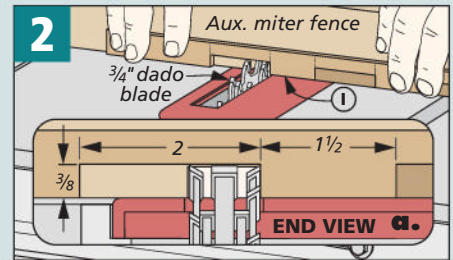
ONE MORE ASSEMBLY JIG. To help align the slats and rails during glue-up, I made a simple assembly jig (Figure 7). You can see in Figure 7a how a $\frac{7}{16}$ "-thick spacer positions the upper rail to serve as a guide to mark the curved cut lines at the top of each of the slats. This accounts for the extra length needed to glue the slats into the groove in the upper rail. Then you can step over to the band saw to cut each slat to length.

Before gluing up the back assembly, remove the spacers from the jig. Add glue in each mortise in the lower rail and at the top of the slats before clamping. Once the glue dries, dry-fit the seat and back assemblies to the leg assemblies to check the fit before applying glue and clamps.

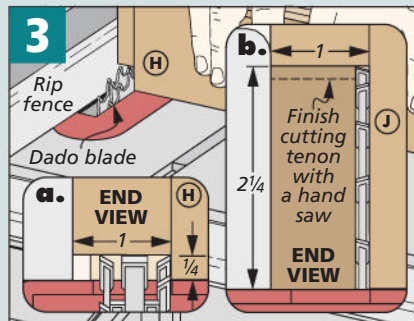
Create the Seat Back Assembly



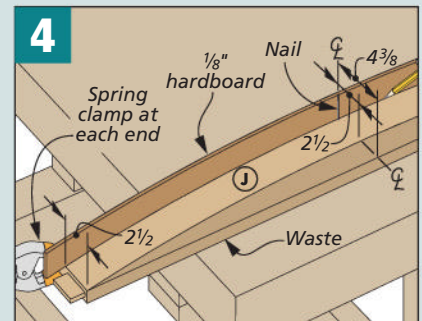
Centered Groove. To center the groove, make two passes, flipping the workpiece between passes.



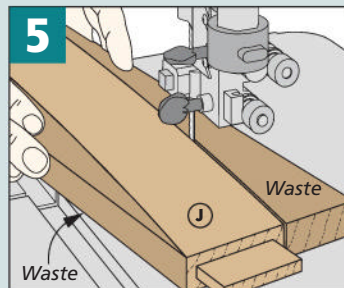
Notched Mortise Strip. Carefully lay out the notches before removing the waste with a wide dado blade.



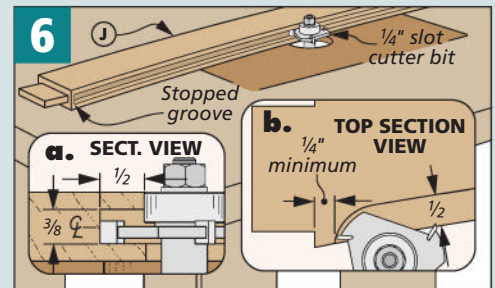
Tenons. Cut the tenons on the upper and lower back rails. Finish the tenon on the upper rail with a hand saw.



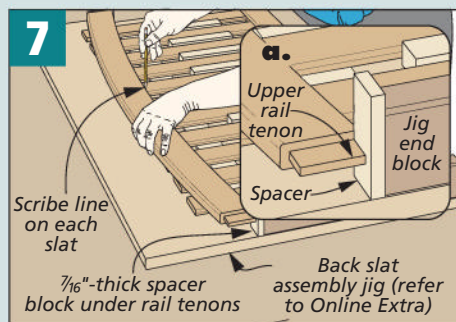
Curved Rail. Use a strip of hardboard to lay out the curves at the top and bottom edges of the upper rail.



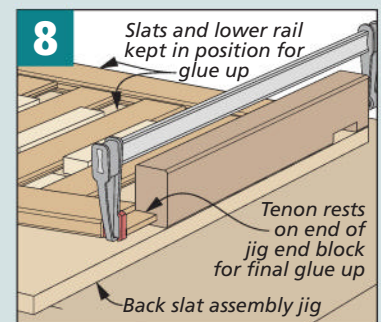
Cut & Sand. Cut the upper rail to shape at the band saw and then sand the curves smooth.



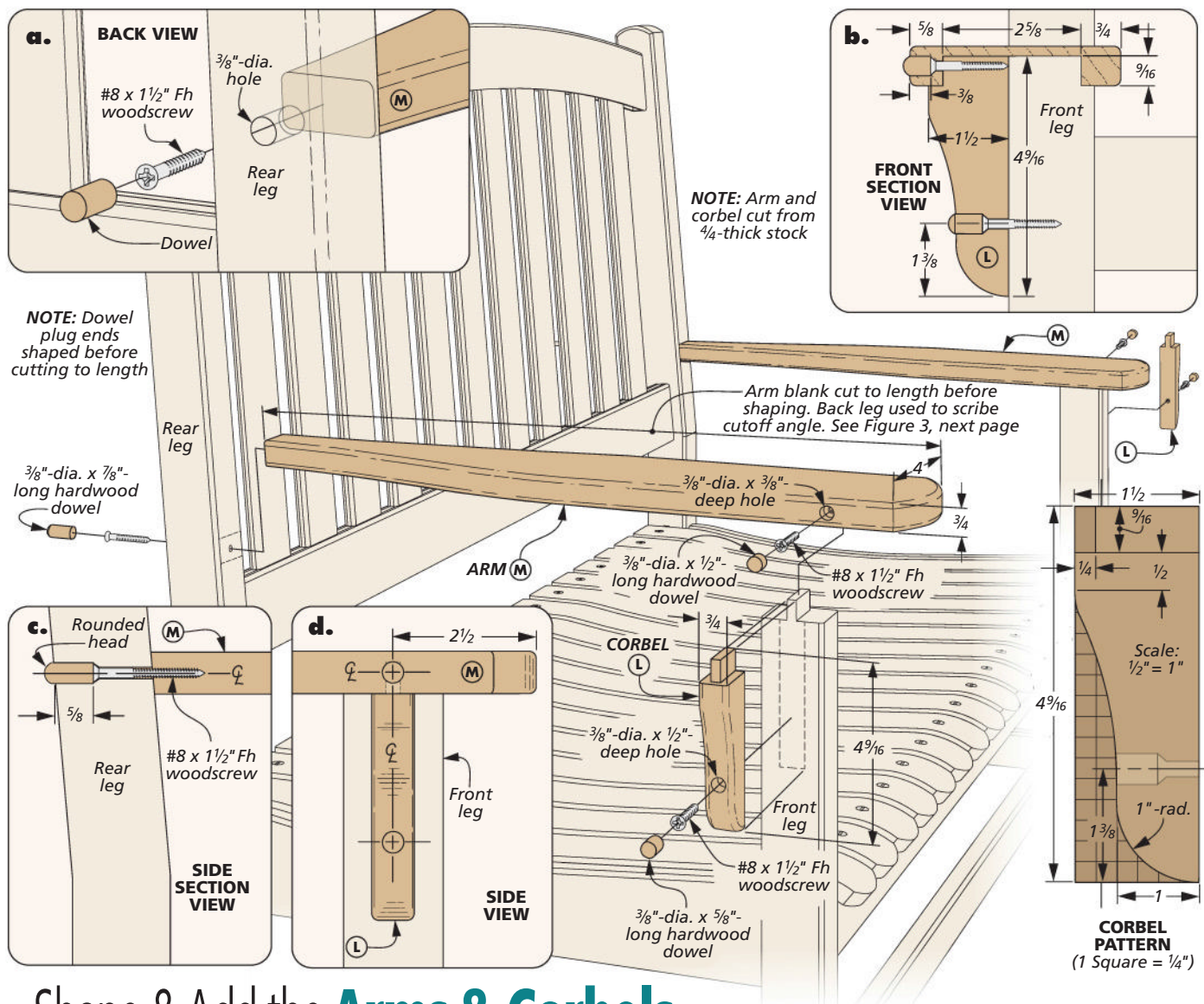
Cutting a Curved Groove. Make two passes with a slot cutter to create a centered groove. Flip the workpiece between passes.



Scribing. Use the upper rail as a guide to mark the cut lines on the back slats. Use a spacer to correctly position the rail.



Assembly. The assembly jig properly spaces the rails and slats to aid glueup and clamping.



Shape & Add the Arms & Corbels

The main structure of the rocker is complete. Now you're ready to finish up by adding the arms, corbels, and rockers.

WIDE, SHAPED ARMS. The arms for the rocker are extra wide. But cutting them to shape is done after the joinery is cut. You'll also need to cut the blanks to length to fit the rocker before heading over to the band saw.

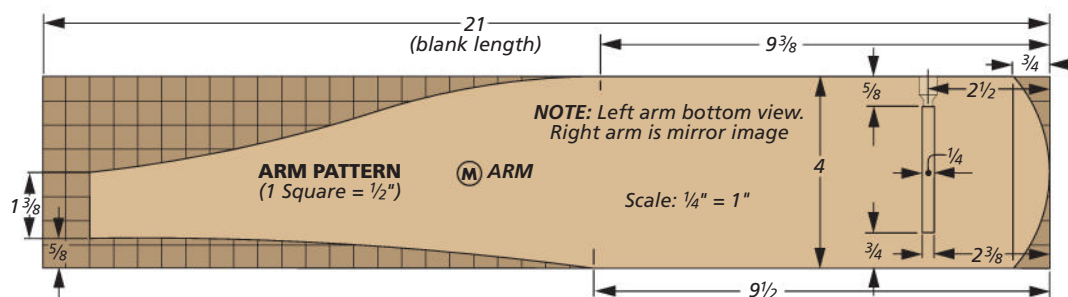
The pattern below shows how the

blank is cut to width but left a little long. This is so you can scribe the cut line at the seat back for a perfect fit.

REINFORCED MORTISES. Figure 1 on the next page shows how to cut a mortise on the bottom face of each arm blank. This matches up with the tenon on the top of the front leg. A tenon on the corbel also fits into this mortise to provide additional strength. Then, to reinforce this

connection, drill a counterbored hole on the outer edge of the arm for a screw and plug you'll add when installing the finished arm on the rocker (Figure 2).

CUTTING & SHAPING THE ARM. Figure 3 gives you an idea on how to cut the back end of the arm to fit the angle of the seat back. The important things to keep in mind are that the mortise should align with the tenon on the leg and the arm should be square to the leg. To accomplish this last goal, I used a couple of spacers to support the front and back ends of the arm. Then it's a simple matter of scribing the line where the arm and seat back intersect. Use this line as a guide to set the angle of the saw blade before cutting each



of the blanks to length. You can see this illustrated in Figure 4 on the next page.

While you have the arm positioned, project a centerline from the edge of the arm around the back of the seat back. Drill a counterbored hole for the screw and plug used to secure the arm, as shown in detail 'c' on the previous page. Keep the bit parallel with the arm as you drill through the seat back.

SHAPING AT THE BAND SAW. A little band saw work is required to cut the arms to the final shape shown in the pattern at the bottom of the previous page. The technique I used was to stack the parts with the mortises facing out. Double-sided tape keeps the blanks from slipping as you cut out the shape.

All that's left to do on the arms is sand and round over the edges. You don't need to round the edges where the arm connects to the seat back. I waited to attach the arms until the corbels were made and in place.

CORBELS. A corbel on the outside face of each front leg provides additional bearing surface for the wide arms. Figure 6 provides the details for cutting the tenon on the blank.

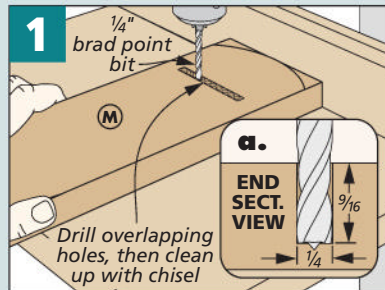
Shaping the corbels follows along the same lines as the arms: Drill a counterbored hole for a screw and plug, stack the parts, and cut them to shape (Figure 7). Sand them smooth before rounding over the outside edges.

ARM ASSEMBLY. With the arms and corbels in hand, now is a good time to dry-fit the parts. This will be your last chance to make sure the arms seat all the way on the tenons made in the legs and corbels. After making any necessary adjustments, attach the corbels to the front legs using glue and screws. Use the arm to help locate and hold the corbel in position as you drive the screw through the edge.

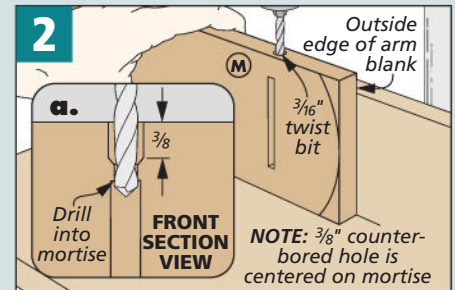
Secure the arm to the front leg and corbel with glue and drive the screw through the outside edge to secure it. And you can fasten the back of the arm with a screw through the seat back.

The last step is to plug the screw holes. Figure 8 at right shows how I rounded over the plug ends with a sanding block before cutting them to length. This rounded end makes fitting the plugs in place much easier.

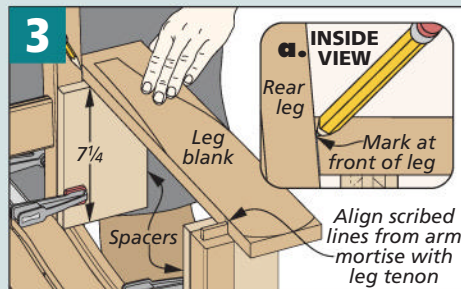
Shape the Arms, Corbels & Dowels



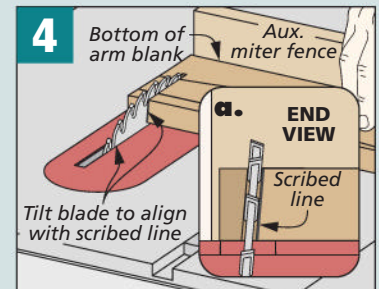
Mortises. Cut mortises in the bottom face of each arm to fit over the tenon on the legs and corbels.



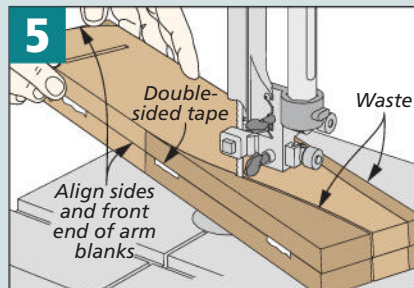
Reinforcement. A screw adds strength to the joint. Drill a counterbored hole in the edge for the screw and plug.



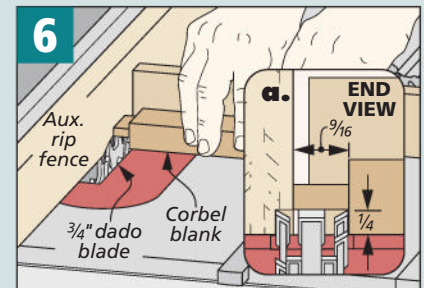
Scribing the Length. Support the arm on a couple of spacers before scribing the cut line at the back of the arm.



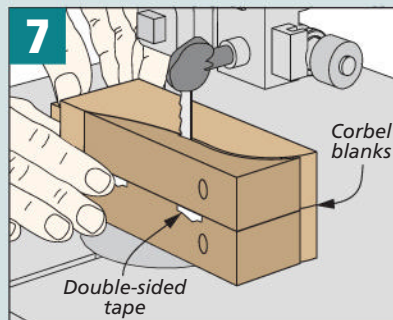
Cut to Length. Use the scribed lines as a guide to cut the arm to final length at the table saw.



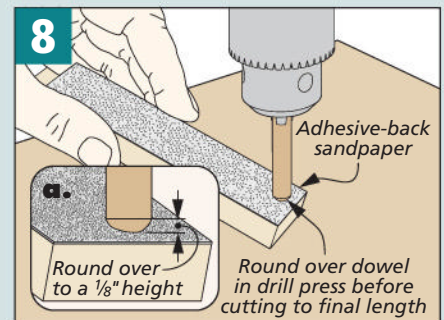
Shaping. Fasten the parts together with double-sided tape (with mortises facing out), and then cut to shape.



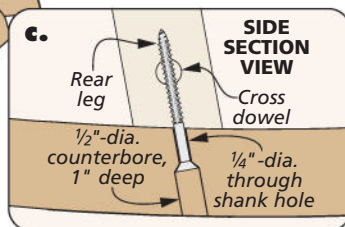
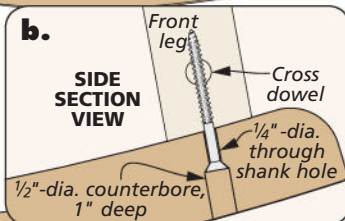
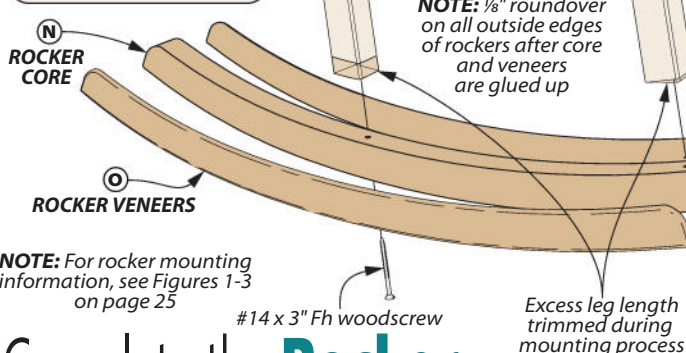
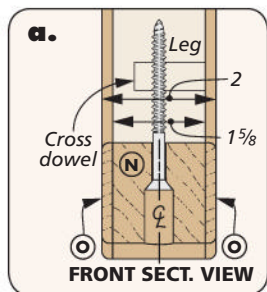
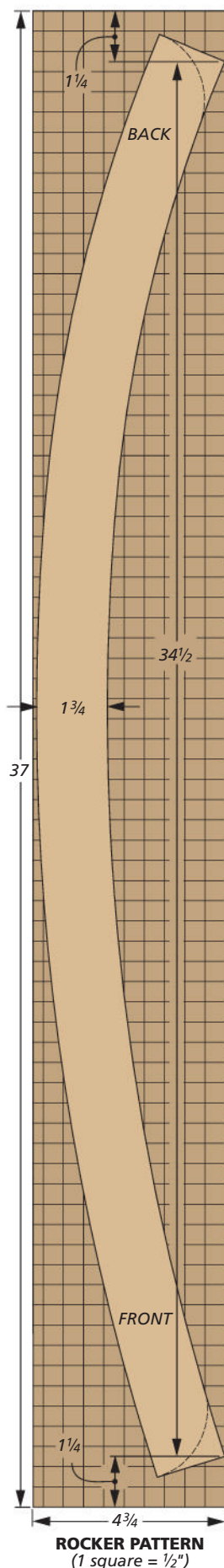
Corbel Tenons. Cut the corbel blanks to final size then cut the tenon on the end to fit the mortise in the arm.



Shaping the Corbels. After drilling the counterbored screw holes, stack the parts to cut them to shape.



Rounded Plugs. Chuck an extra-long piece of dowel in the drill press to shape the end with files and sandpaper.



Complete the Rocker

If building this rocker were a race, you'd be rounding the final curve, so to speak. All that's left to do is add the most important parts — a pair of rockers.

LAYERED CONSTRUCTION. The first thing you'll notice in the drawing above is that each rocker is made up of a core layer and two outside veneer layers. Adding the veneer layers helps strengthen the rocker. I purposely cut the veneers with a slightly different grain direction than the main rocker core. This, plus the glue, reinforces the rocker "sandwich."

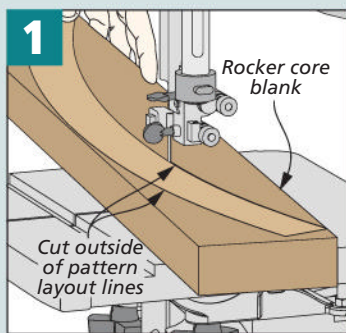
CUTTING & ASSEMBLING THE PARTS. The rocker core and veneers are both cut from wide blanks using the pattern at left. But there's one thing I need to point out. The shape of the rocker isn't a sym-

metrical curve. There is a front and back, so it's helpful to mark the ends so you'll be sure to install them in the proper orientation later.

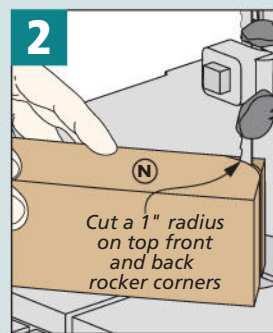
Figures 1 through 3 below illustrate the basics of the rocker construction. After cutting the core to shape and sanding it smooth, I resawn the veneers about 1/4" thick. You'll joint them to their final 3/16" thickness after they're glued to the rocker core. When cutting the veneers to shape, leave a generous amount outside the cut line. This allows you some wiggle room when gluing the veneer to the core. The excess will be trimmed at the router table after they're glued to the core.

I glued the two veneer layers to the core with the rough, band-sawn face out. A couple passes over the jointer smooths the faces of the veneers before

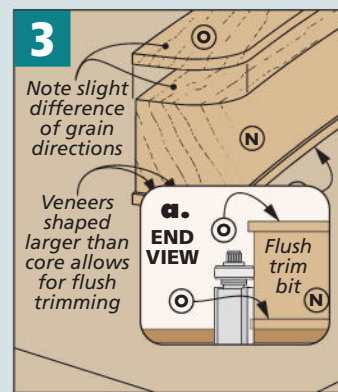
Build the Rockers



Rocker Shaping. Cut the rocker core and veneer to shape at the band saw.



Rounded Ends. Cut a 1" radius at each end and then sand the core smooth.



Apply Veneer. Glue the veneer with the rough side out then joint and trim smooth.

you trim them flush at the router table. The next task is to form the $\frac{1}{8}$ " roundover on all the edges.

ROCKER INSTALLATION. Attaching the rockers to the legs involves some hand work to get a good fit. The How-To box at right provides some guidelines to help you out along the way.

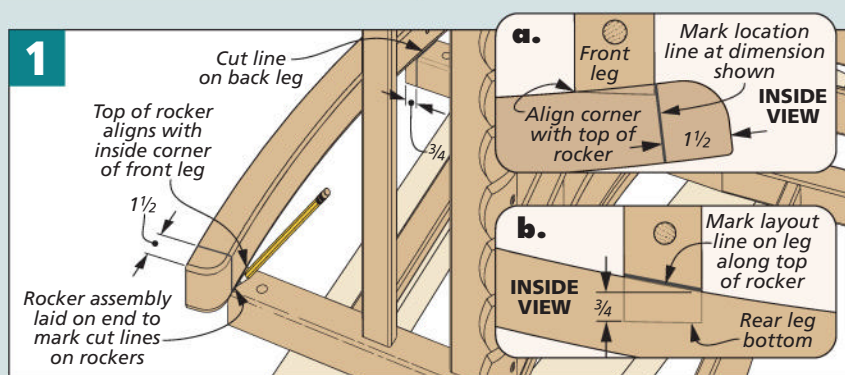
DEFINING THE CUT LINES. The end of each of the legs will be cut to conform to the shape of the rocker. In order to establish the guidelines, turn the rocker assembly on end and lay the rocker on the legs, as shown in Figure 1. It's important to position the rockers identically and according to the dimensions shown so that the rocking motion is smooth and consistent.

Shaping the legs is your next task. For this, I used a combination of hand saws, files, rasps, and sandpaper. As you work, use the rocker to check the fit with the legs occasionally. Once you're satisfied, you can move on to marking the locations for the screws.

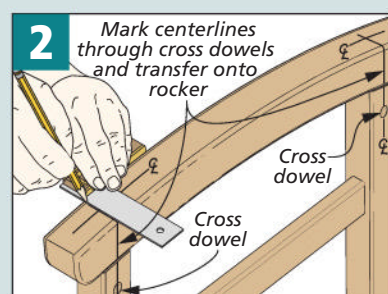
ATTACHING THE ROCKERS. Figures 2 and 3 at right show how I marked the locations for the screws. Project a centerline from the cross dowel to the bottom of the leg. Continue this line across the side and bottom of the rocker. Then strike a line to locate the midline of the rocker.

Use a hand drill to create a pilot hole through the rocker into the end of the leg. Try to keep the bit aligned with the leg's centerline. This ensures the screw engages the cross dowel to provide additional strength to the joint, as illustrated in Figure 3 above.

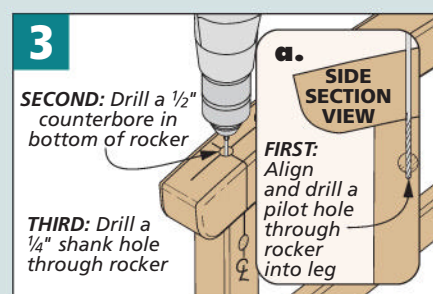
Install the Rockers



Positioning the Rockers. Using the dimensions shown, place the rockers on the legs to serve as a template for marking cut lines. Cut and shape the legs to the lines to conform to the rocker's curve, using the rockers to check your progress.



Locating Screw Holes. Mark the centerlines along the leg and rocker to find the centerpoint for drilling.



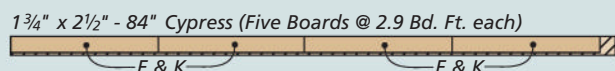
Drilling. Keep the drill bit aligned with the centerline of the leg to ensure the screw fully engages the dowel.

Now you can remove the rockers and drill the pilot holes to final depth. Replace the bit to drill the counterbores in the bottom of the rockers. Then you drill shank holes in the rockers for the screws.

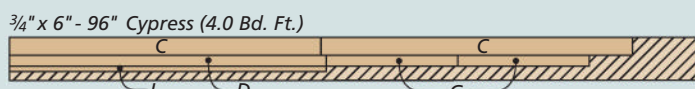
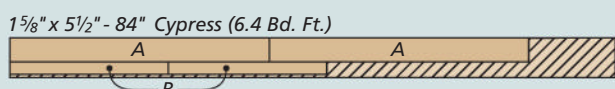
I applied a couple coats of oil (refer to Sources, page 98). Once that's done, you can enlist some help to carry the rocker to the front porch and relax with a cold beverage.

MATERIALS, SUPPLIES & CUTTING DIAGRAM

A Rear Legs (2)	$1\frac{5}{8} \times 3\frac{5}{16}$ - 36	H Back Lower Rail (1)	$\frac{3}{4} \times 2\frac{1}{2}$ - 44	O Rocker Veneer (4)	$\frac{3}{16} \times 4\frac{3}{4}$ - 37 rgh.
B Front Legs (2)	$1\frac{5}{8} \times 1\frac{3}{4}$ - 22	I Mortise Strip (1)	$\frac{1}{4} \times \frac{3}{4}$ - 44		
C Seat Rails (2)	$\frac{3}{4} \times 2\frac{1}{2}$ - 43 $\frac{1}{4}$	J Back Upper Rail (1)	$\frac{3}{4} \times 4\frac{1}{2}$ - 44		
D Lower Front Rail (1)	$\frac{3}{4} \times 1\frac{1}{2}$ - 44	K Back Slats (11)	$\frac{3}{8} \times 2\frac{1}{4}$ - 16 $\frac{3}{8}$		
E Seat Slats (17)	$1\frac{3}{16} - 2 \times 20\frac{1}{2}$	L Corbels (2)	$\frac{3}{4} \times 1\frac{1}{2}$ - 49 $\frac{1}{16}$		
F Upper Side Rails (2)	$\frac{3}{4} \times 3$ - 18 $\frac{1}{4}$	M Arms (2)	$\frac{3}{4} \times 4$ - 21 rgh.		
G Lower Side Rails (2)	$\frac{3}{4} \times 1\frac{1}{2}$ - 18 $\frac{1}{4}$	N Rocker Cores (2)	$1\frac{5}{8} \times 4\frac{3}{4}$ - 37 rgh.		



NOTE: Part E resawn from 8/4 stock, remainder is used for part K



NOTE: Part O resawn from 3/4 inch stock



Micro-adjustable Shooting Board

Fine-tuning joinery is a cinch with this precision bench accessory.

Shooting boards used to be a staple in most woodworking shops, and for good reason — there's no better tool for trimming workpieces to ensure gap-free joinery. All you need is a sharp hand plane.

With the design of the shooting board you see here, you gain the ability to “tweak” the angle of the workpiece as you trim it. This is made possible with the two micro-adjusters. There's one each for 45° and 90° cuts. You can make very small adjustments within a range of a few degrees. And this makes it easier to improve your craftsmanship.

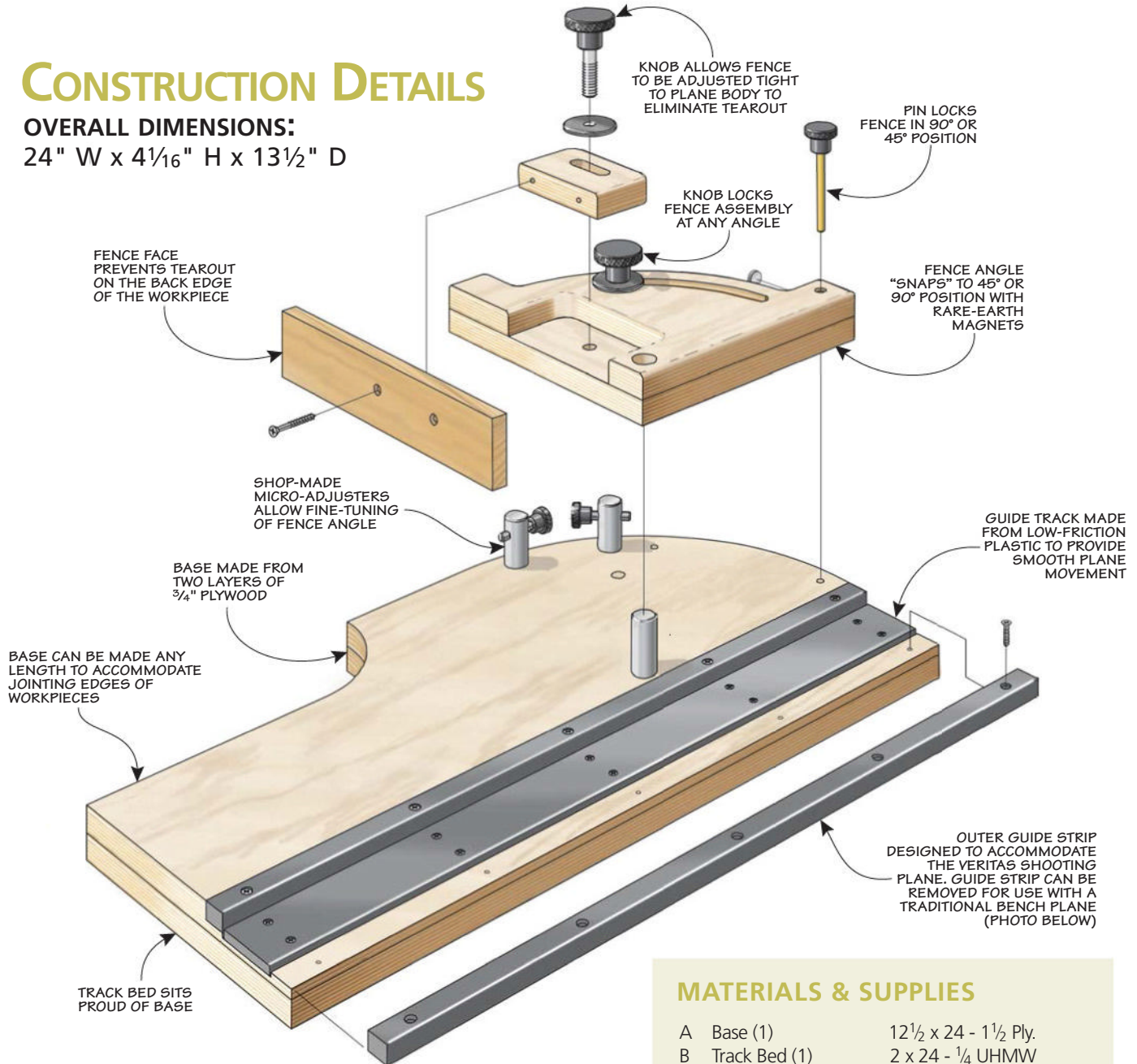


Adjustable. When trimming miters or squaring up a workpiece, the built-in micro-adjusters allow you to fine-tune the angle for a precise fit.

CONSTRUCTION DETAILS

OVERALL DIMENSIONS:

24" W x 4 1/16" H x 13 1/2" D



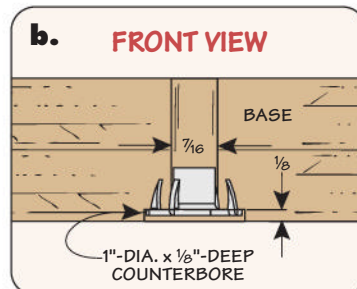
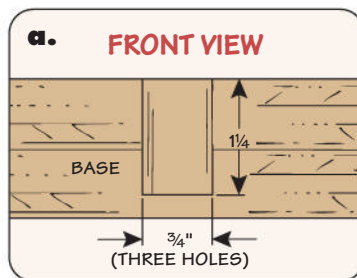
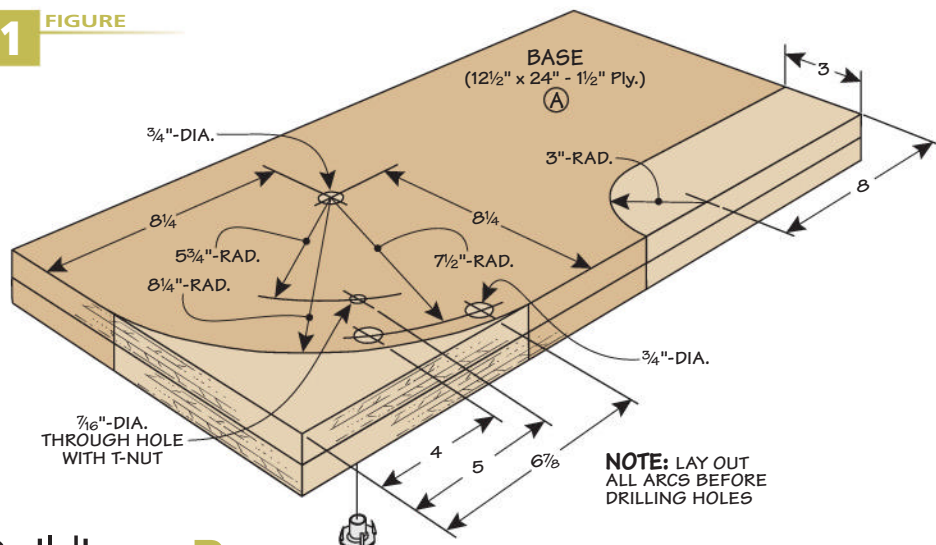
MATERIALS & SUPPLIES

- | | | |
|---|------------------|--------------------------|
| A | Base (1) | 12 1/2 x 24 - 1 1/2 Ply. |
| B | Track Bed (1) | 2 x 24 - 1/4 UHMW |
| C | Guide Strips (2) | 3/4 x 24 - 1/2 UHMW |
| D | Steel Pins (3) | 3/4-dia. x 3 Steel Rod |
| E | Fence Base (1) | 9 x 9 - 1 1/2 Ply. |
| F | Fence Mount (1) | 2 1/4 - 35/8 - 3/4 Ply. |
| G | Fence (1) | 1/2 x 2 - 10 |
- (2) 3/4"-dia. Knurled Knobs w/ 1/4"-20 x 1 1/4" Stud
 - (2) 1 1/2"-dia. Knurled Knobs w/ 3/8"-16 x 3" Stud
 - (1) 1"-dia. Knurled Knob w/ 1/4"-dia. Hole
 - (2) 3/8"-16 T-Nuts
 - (2) 1/4"-dia. x 3" Brass Rod
 - (1) 3/4"-dia. x 12" Steel Rod
 - (2) 3/8"-dia. Rare-Earth Magnets w/Cups & Screws
 - (2) 3/8" x 1 1/4" O.D. Black Oxide Washers
 - (2) #8 x 1 1/2" Fh Woodscrews
 - (5) #6 x 1 1/4" Fh Woodscrews
 - (10) #6 x 3/4" Fh Woodscrews
 - (5) #6 x 1 1/4" Rh Woodscrews
 - (5) #6 Washers



Use Any Plane. You can use a specialized shooting plane, like the one in the main photo, or any standard bench plane such as a low-angle smoothing plane or the No. 5 shown here.

1 FIGURE



Building a Base

The base of the shooting board forms the foundation for all of the working components, so it's important to take your time in building it. It's made from two layers of Baltic birch plywood.

GLUE FIRST. To start on the base, I cut a piece of plywood for one of the layers to the final overall size. You can cut the other layer slightly oversized, glue the two layers together, then trim the layers flush (Figure 1). It's a good idea to lay out all of the hole locations while the blank is still square. And you can draw

the outside shape of the base so you can cut it to final shape later.

DRILLING. There's a T-nut on the bottom of the base that's used for the locking knob on the pivoting fence base. After drilling a shallow counterbore and through hole, tap the T-nut in place (Figures 1 and 1b).

There are three holes for $\frac{3}{4}$ "-dia. steel pins. One pin serves as the pivot for the fence base. The other two pins are for the micro-adjusters. A Forstner bit is ideal for drilling these holes since it creates smooth sides and a flat bottom to seat the pins.

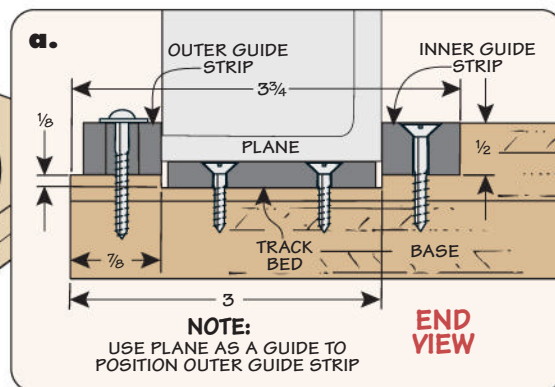
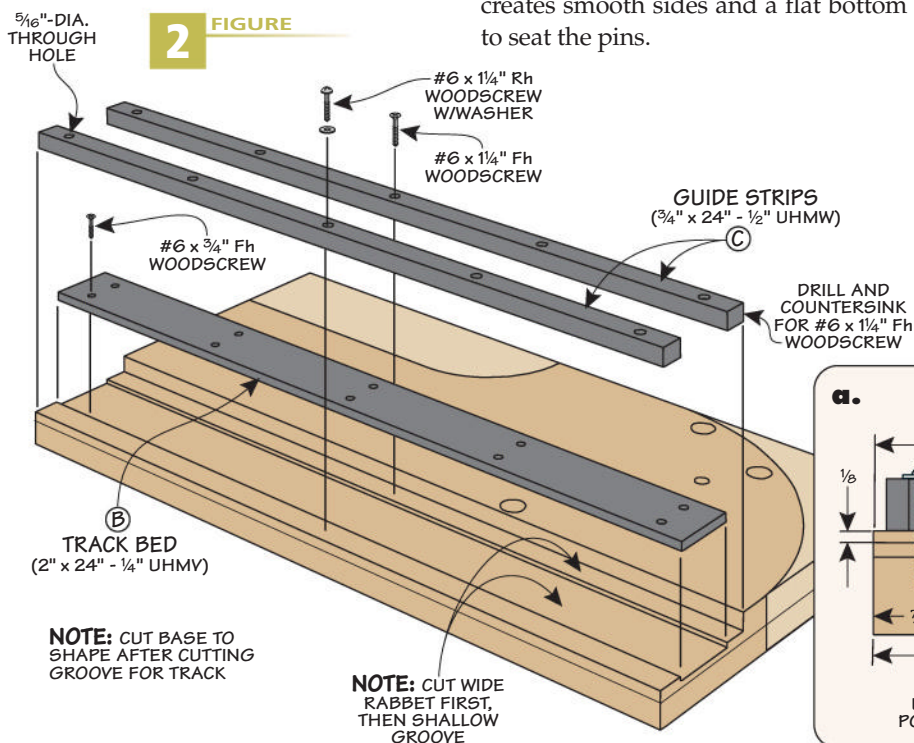
RABBIT & GROOVE. There's another task you can complete before cutting the base to its final shape. And that's to cut a stepped groove along one edge of the base blank. This groove holds the strips of UHMW for the guide track. Take a look at how these all fit together in Figure 2.

I started by cutting a wide rabbet first (Figure 2a). Then lay out the narrower groove, reset the height of the dado blade, and cut the shallow groove.

CUT TO SHAPE. Before moving on, now is the time to cut the base to shape and sand it smooth. I applied a clear finish to the base.

PLASTIC STRIPS. As you can see in Figure 2, there are three plastic strips to install. The wide strip serves as a smooth-gliding surface for the hand plane. The inner strip guides the sole of the plane during use. The outer strip is used to create a track for the Veritas shooting plane. If you wish to use another bench

2 FIGURE



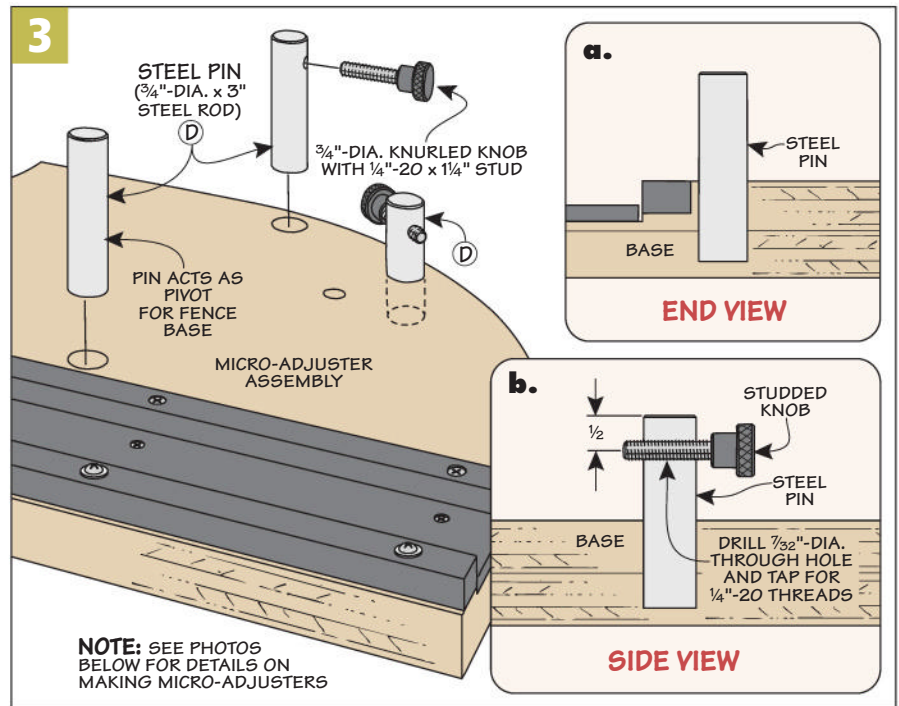
plane on the shooting board, simply leave the outer guide strip off.

To install the plastic strips, I drilled countersunk screw holes. You'll want to make sure that the screws on the wide strip for the track bed are recessed below the surface to avoid the heads protruding and scratching up the sides of the plane.

MICRO-ADJUSTERS. The unique and most useful parts of the shooting board are the micro-adjusters. They allow fine movements of the fence angle to sneak up on the fit of a workpiece. As shown in Figure 3 and the photos below, they're easy to make.

You start by cutting the steel rod to length. Then step over to the drill press to drill the clearance hole for tapping threads all the way through the rod, as illustrated in Figure 3b.

To make it easier to cut the rod square with a hack saw and hold it in position for drilling, I made a small holding jig. You can see how it works in the box below. It's simply a wood block with a $\frac{3}{4}$ "-dia. hole drilled 3" deep in the end and split down the middle by a saw kerf. The saw kerf allows the two halves to tighten together, securely clamping the rod for cutting. The end of the block serves as a guide for your hack saw to get a square cut.

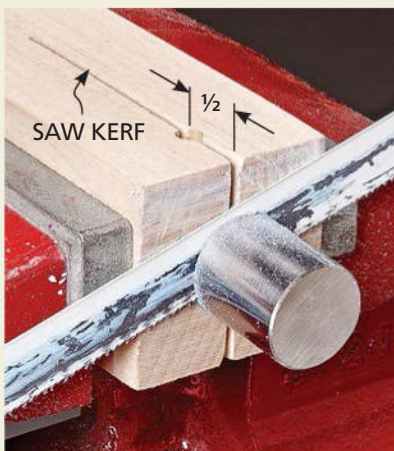


The holding jig also provides a convenient way to drill and tap the threaded through hole. Drill a $\frac{7}{32}$ "-dia. hole through the kerf in the block, $\frac{1}{2}$ " from the end of it. Use a punch before drilling through the rod. At that point, pull the rod out just enough to clamp it in a vise and use a tap. Applying a few drops of oil or cutting lubricant will make drilling and tapping a little easier.

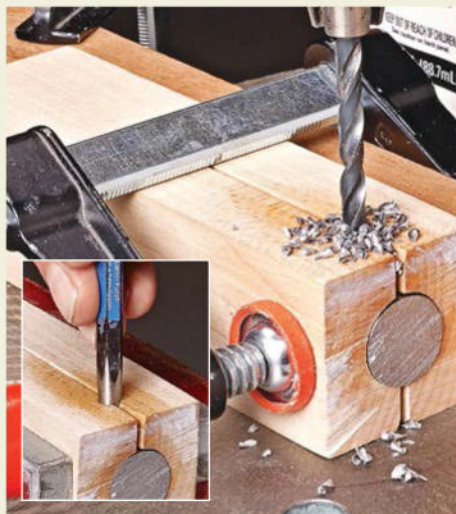
Once you have the pins made for the micro-adjusters, cut a third pin to serve as a pivot for the fence base. File or grind a small chamfer on the ends of each pin. I used epoxy to secure the pivot pin into the base.

You can thread a studded knob into each micro-adjuster and slip them into their holes. You don't need to glue them in place yet.

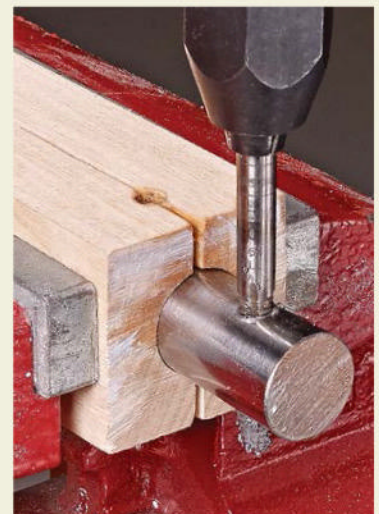
Cut, Drill & Tap



Cutting. A block of wood can be made into a jig for holding the steel rod while cutting and drilling.



Punch, Then Drill. A punch helps to keep the bit centered (inset). Then use a gentle touch to keep the bit from wandering.



Tapping. Use the block and a vise to secure the steel pin while tapping the threads of the hole.

4



The pivoting fence base teams up with the pair of micro-adjusters and a locking pin to provide precise angle settings. A sliding fence helps to minimize tearout when using the shooting board.

FENCE BASE. The pivoting fence base is also made up of two layers of plywood.

I started by cutting two square blanks to size (Figure 4). It's important to make sure the edges are square to each other since the accuracy of the shooting board depends on this.

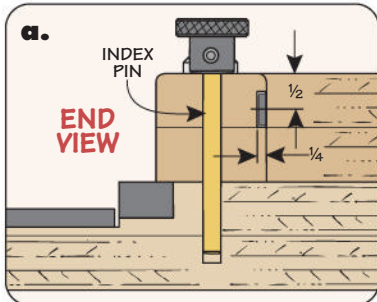
Before gluing the two layers together, the top layer needs a little work. I cut out a pocket for the adjustable fence.

both directions will help.

After cleaning up the edges, you can drill the hole for the index pin, as shown in Figure 5a. And there's a counterbored through hole on the underside for a T-nut (Figure 4a).

Now you're ready to start shaping the fence base. I drilled the pivot hole and

5



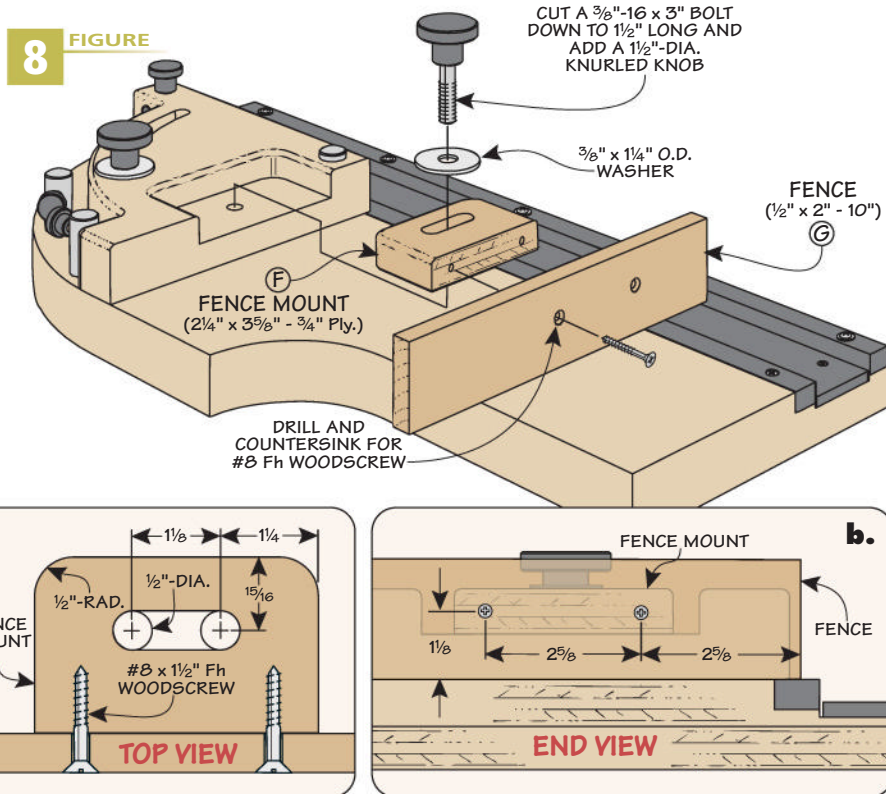
then used a router with a trammel base to cut the outer arc and curved slot. Visit woodsmith.com/magazine/sip for details on how to do this.

To create clean starting and stopping points for the arcs, I first drilled holes at the ends. After routing the shape, the band saw makes quick work of cutting the “tabs” on the two corners to remove the waste. Follow that up by rounding over the top edges and sanding everything smooth.

I installed the fence base on the pivot pin to determine where to drill holes for the rare-earth magnets (Figure 5). Pivot the fence in each direction to butt each tab against the end of the threaded stud on the micro-adjuster. Mark the vertical centerline of the stud on the tab, remove the fence base, and drill the shallow counterbores for the magnet cups.

INDEXING. To align the fence base onto the base of the jig, use a combination square, as in Figures 6 and 7. Once you have the fence base rotated to both the 45° and 90° positions, use the hole for the locking pin as a guide to drill into the base.

INDEX PIN. The next logical step is to make the index pin, which you can see in Figure 5a on the previous page. I used a length of brass rod and a knob. The knob has a set screw for holding the rod in place.



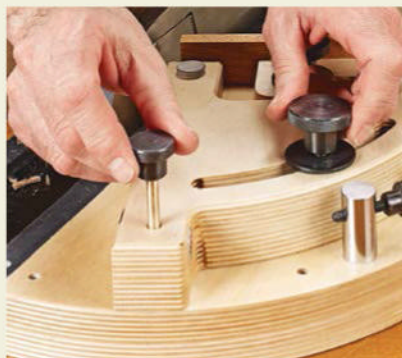
SLIDING FENCE. All that’s left to do now is make the sliding fence assembly (Figure 8). It’s made up of a slotted fence mount and a simple fence. The slot allows it to be adjusted tight to the plane body to eliminate tearout as the plane iron exits the workpiece.

The fence face is a piece of hardwood, and it’s meant to be replaceable. It’s fastened to the fence mount with a couple of screws (Figure 8a).

USING THE SHOOTING BOARD. The photos below show the setup the shooting board. The key is to set your plane for a thin shaving. And since you’ll usually be shaving end grain, it’s important to make sure the blade is very sharp.

After making a few swipes with the plane, you’ll immediately see the benefits of using a shooting board. And you’re well on your way to making gap-free joints on all your projects.

Using the Shooting Board



Coarse Adjustment. Loosen locking knob and lift the index pin to pivot the fence base to the desired position.

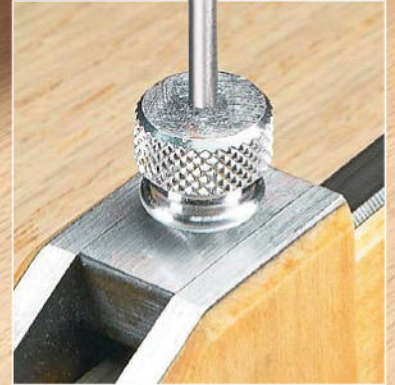


Fine Adjustment. With the locking knob loosened, fine-tune the angle of the fence by turning the micro-adjuster knob.



Adjust the Fence. Loosen the knob to butt the adjustable fence up against the sole of the plane.

Shop-Made Beam Compass



Aluminum and figured wood come together in this practical layout tool you can build in a weekend.

When it comes to laying out large arcs and circles for a project, nothing beats a beam compass. The beauty of this tool is that you're not limited by the distance between points as you would be with a standard compass. For larger circles, you just use a longer beam.

For the beam compass shown here, anodized aluminum gives it a unique look and durability. Alongside it, the wood veneer adds the look and feel of an heirloom tool. After spending a little time in the shop, you'll have a handy tool you'll reach for often.

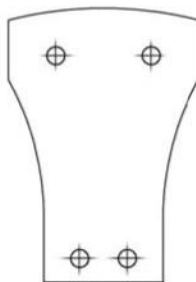
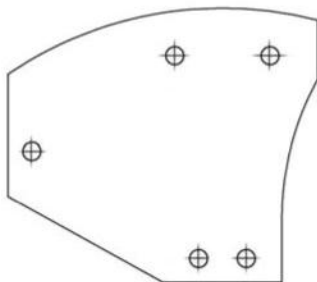
CONSTRUCTION DETAILS

BEAM CAN BE MADE ANY LENGTH TO SUIT A VARIETY OF TASKS

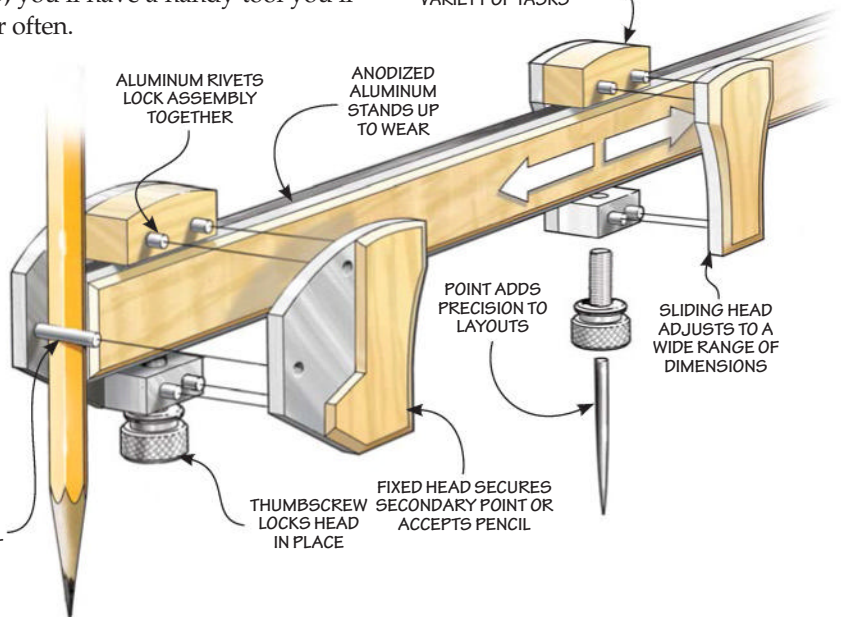
PATTERNS (SHOWN 100%)

FIXED HEAD

SLIDING HEAD



RIVET HOLDS PENCIL SECURELY AGAINST BEAM



One look at the Exploded View will tell you that there's not much to building the beam compass. The two heads are just wood infill and aluminum "sandwiches" riveted together with a solid wood face on each side. And the beam is nothing more than an aluminum bar with wood veneer faces.

ANODIZED. I used anodized aluminum for this project. Not only does it add some color, but the anodizing makes the surface of the aluminum tougher (box below).

MAKING A SANDWICH. Since most of the detail work will be spent building the two heads, that's the place to start. Figure 1 and the photos below will step you through the process. The full-size patterns at the bottom of the previous page will be a big help when it comes time for shaping and drilling later on.

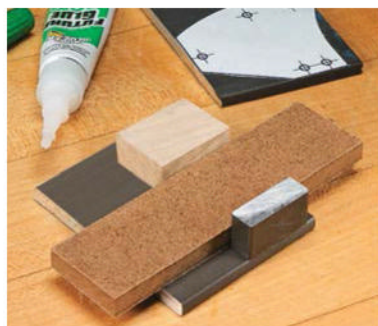
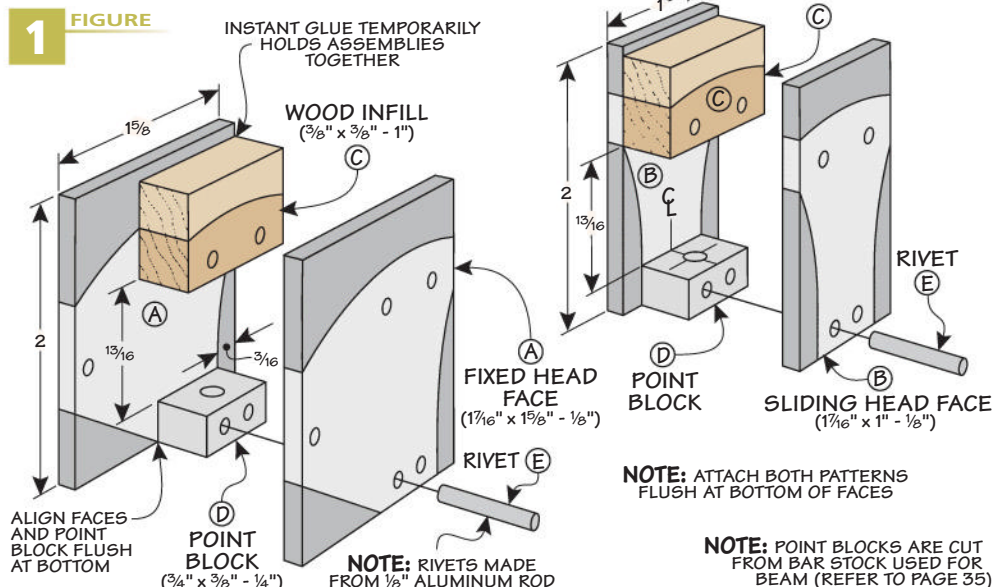
I started by cutting the face blanks to rough size. After attaching the patterns

to one face with spray adhesive, you can put the pieces together.

INSTANT GLUE. These small parts, especially the wood infill and point block, are hard to clamp and hold in place while drilling for the rivets. So I used instant glue to hold everything together temporarily. Then, after using the pattern as a guide for drilling, you can add

the rivets to secure the assembly.

DRILL & TAP. Before drilling the holes for the knurled screws in the point blocks, go ahead and sand the rivets flush on the side without the pattern. This creates a flat reference surface you'll use to sand the assemblies to shape. Finally, after sanding the bottom edge flush, drill and tap the holes.



Glue. Use a spacer to locate the parts on the face blank and a quick-setting glue to attach them..



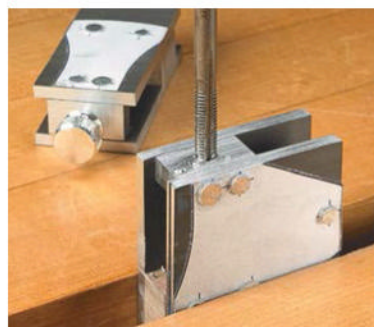
Center Punch. A punch is an easy way to locate points to drill and countersink holes for rivets.



Drill & Rivet. Peening the aluminum rivets is an easy task and locks the assembly together.



Sanding Smooth. Smooth the bottom square after sanding the rivets flush on one side.



Drill & Tap. Finally, after drilling, use a hand tap to cut the threads for the thumbscrew.

Anodizing

Aluminum is a relatively soft metal. But anodized aluminum has a hard, protective coating of aluminum oxide that is created during the anodizing process. As a matter of fact, this coating is so tough that I had a hard time scratching it with my awl. The anodized surface stands up to the pressure of the thumbscrews and makes the heads slide more smoothly. Refer to Sources on page 97.

Shaping & Final Details

Once you have the head assemblies riveted together, shaping them and adding the veneer is the next step. Later, you'll add a steel point to the sliding head and work on making the beam.

SHAPING TOOLS. When it comes to shaping the heads, the pattern will help you out. A band saw makes quick work of removing the excess waste. Just remember to stay a little to the outside of the line so you can do the final sanding and smoothing up to the line.

A coping saw with a standard 15-TPI blade works fine, too (left photo below). It just takes some effort and a little extra time.

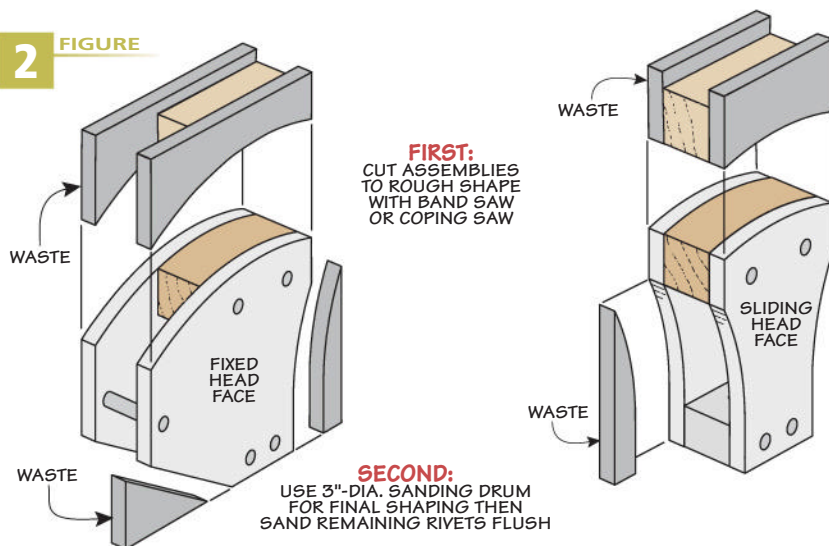
SANDING. For the inside curves on the heads, a 3"-dia. sanding drum works perfectly to smooth the edges to their final shape. It works great on the outside curves, too. Just be sure to keep the blank moving to avoid flat spots.

Once you're satisfied with the overall shape, go ahead and remove the pattern and sand the remaining rivets flush.

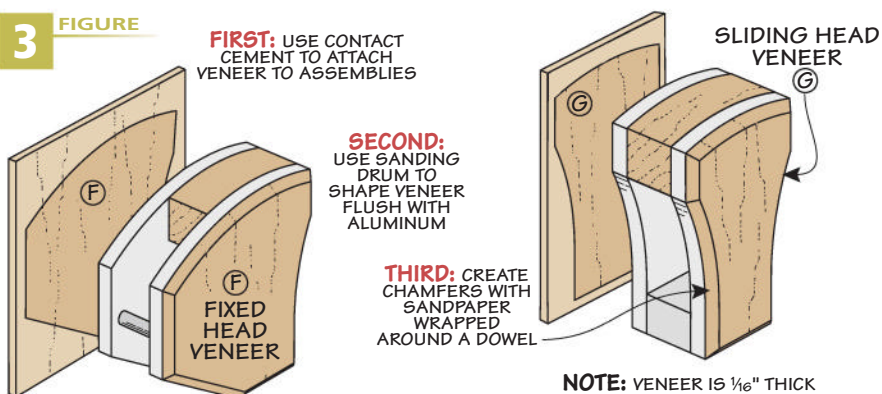
VENEER FACES. Gluing the veneer to the outside faces is easy. Simply cut the veneer a bit oversize and use contact cement to attach it.

Because the veneer is so thin, it won't take much work to sand it to shape with the sanding drum — you only need to sand it flush with the aluminum. To add a little visual interest, I created a small

2 FIGURE



3 FIGURE



chamfer around the edges using a piece of sandpaper wrapped around a block and a dowel.

ADDING A POINT

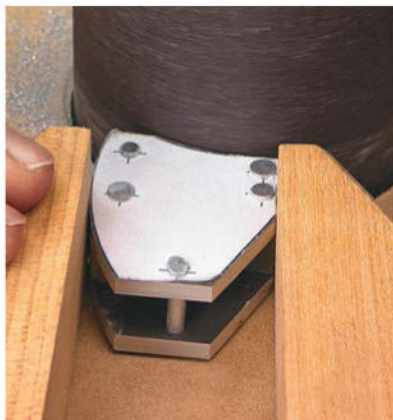
With the head assemblies complete, the next thing to do is add a steel point to the sliding head. For the point, you'll be drilling a hole in the head of the

knurled thumbscrew and filing a nail to a sharp point. I found that a 6d finish nail was just the right size, plus it was soft enough to file easily. However, you can use anything that you can make work. For instance, an old drill bit could be filed down for the point as well.

DRILLING THE THUMBSCREW. The important thing here is to make sure the hole in



Cut To Shape. Begin by rough-cutting out the shape of the head assemblies. I found a coping saw works well to make these cuts.



Sand It Smooth. To achieve the proper radius, use a 3"-dia. sanding drum to do the final shaping and smoothing.



Shaping the Veneer. After gluing on the veneer, the sanding drum quickly trims it flush.

the head of the thumbscrew is perfectly centered. To do that, there's a simple trick I used that you can see below.

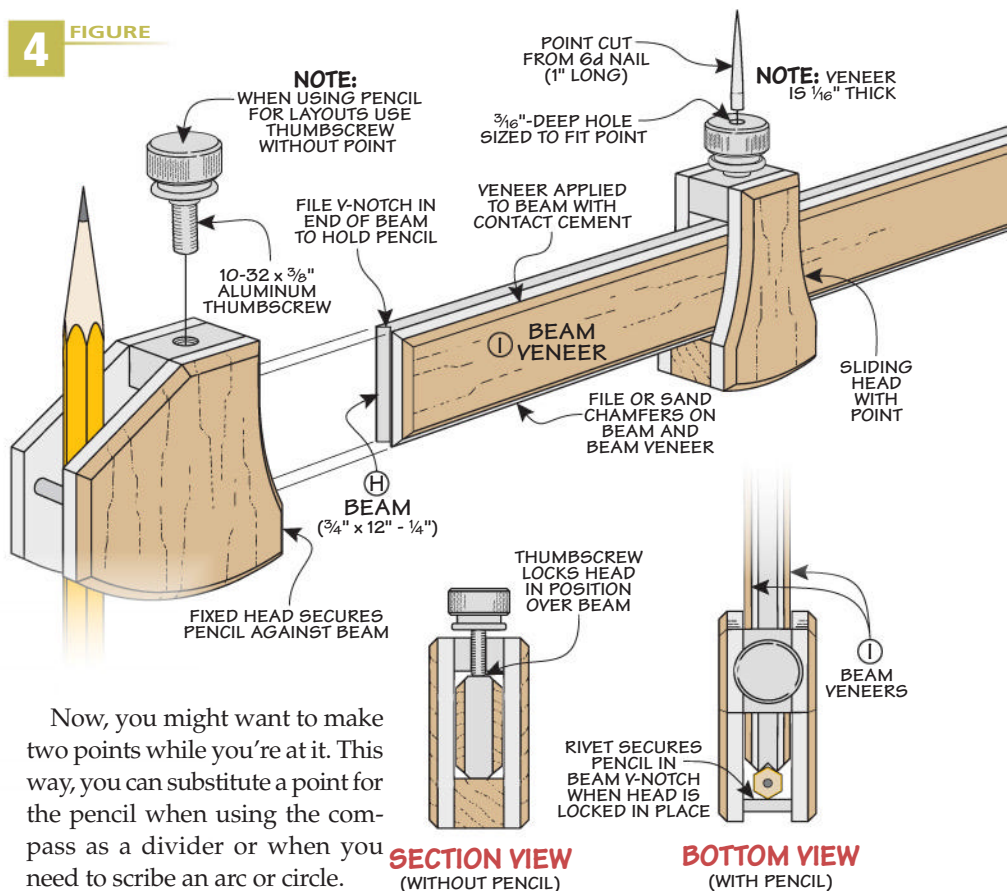
First, I clamped a piece of plywood to the drill press table. Then it's just a matter of drilling a hole the same diameter as the threads on the thumbscrew. Without moving the plywood block, insert the threaded portion of the thumbscrew into the hole.

Next, drill a hole in the head of the thumbscrew for the nail. You'll want the diameter of the drill bit to match the diameter of the nail. If you find the thumbscrew starts spinning as you're drilling, use a pair of pliers or vice grips to safely hold it in place.

FILE & POLISH. When it comes to shaping the nail to a sharp point, you can use the drill press and a metal file. All you need to do is chuck the nail in the drill press and file it while it's spinning, as shown in the lower left photo below.

Once I had a sharp point, I used progressively finer grits of wet/dry sandpaper to polish it smooth. Finally, I used a dab of epoxy to secure the nail inside the thumbscrew.

4 FIGURE



Now, you might want to make two points while you're at it. This way, you can substitute a point for the pencil when using the compass as a divider or when you need to scribe an arc or circle.

BEAM

The beam of the compass is made from the same bar stock used for the point blocks. I started with a 3'-long piece, so I made two beams: one 12" long and another (about 2') from the leftover.

You can make the beam any length you wish, depending on the layout task at hand. For an extra-long beam, you can simply use a length of 3/4"-thick hardwood ripped and sanded to fit inside the heads.

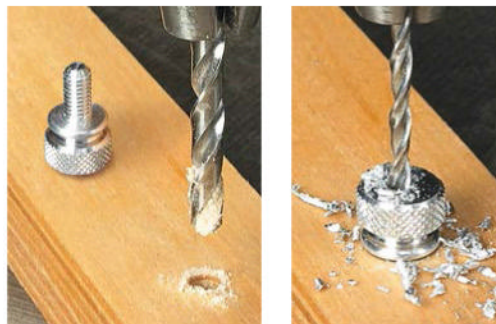
To make the beam, start by gluing the veneers to the aluminum bar. Then it's just a matter of sanding them for a smooth sliding fit in the head assemblies. A light chamfer eases the edges. Finally, file a shallow V-notch in one end to help hold a pencil in place, like you see illustrated in Figure 4.

After spending just a few hours in the shop, you have a classic tool that grabs attention. And the best thing is, it comes in handy for a lot of layout tasks.

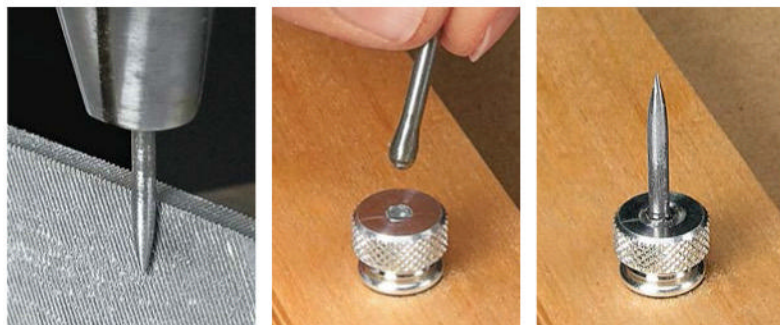
MATERIALS & SUPPLIES

A	Fixed Head Faces (2)	1 7/16 x 1 5/8 - 1/8 Alum.
B	Sliding Head Faces (2)	1 7/16 x 1 - 1/8 Alum.
C	Wood Infill (2)	3/8 x 3/8 - 1
D	Point Blocks (2)	3/4 x 3/8 - 1/4 Alum.
E	Rivets (9)	1/8 x 1 1/16 rgh. Alum. Rod
F	Fixed Head Veneers (2)	1/16 x 2 - 1 1/2 rgh.
G	Sliding Head Veneers (2)	1/16 x 1 1/2 - 1 1/2 rgh.
H	Beam (1)	3/4 x 12 - 1/4 Alum.
I	Beam Veneers (2)	1/16 x 3/4 - 12

- (3) 10-32 x 3/8" Aluminum Knurled Thumbscrews
- (2) 6d Finish Nails (cut to 1" long)



A Centered Hole. Drill a hole in a scrap to fit the threads of the thumbscrew. Then drill a 3/16"-deep hole sized to fit the point.



Making a Point. Cut a nail to length and chuck it in the drill press. With the drill press on, file it to a point and polish it with sandpaper. Then use epoxy to glue the point into the hole in the thumbscrew.

Japanese Hall Cabinet

The artful Asian influence that haunts this cabinet will grace your home. While building it will let you flex a wide variety of woodworking skills.

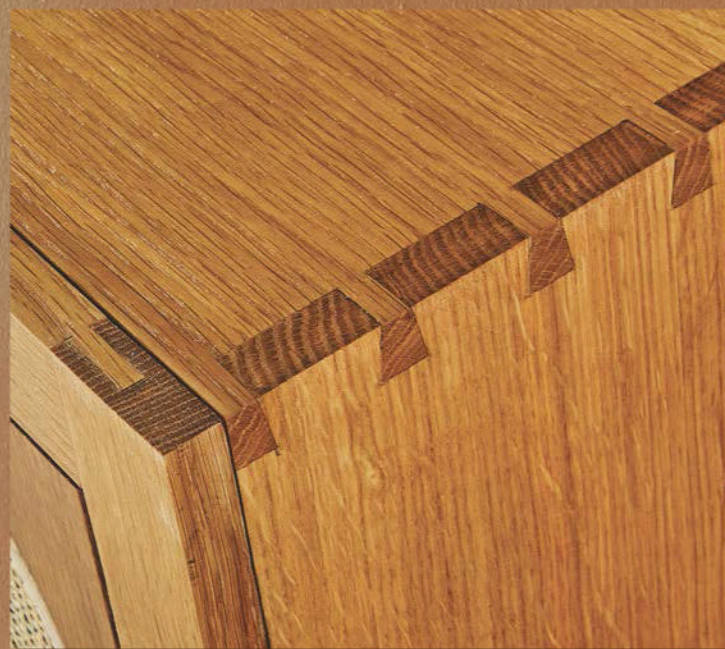
Woodworking is always a fun endeavor, and when you come across a project like you see here, there are bonus points for variety. Which reminds me of another old saying, “variety is the spice of life.” That adage came to mind often when dealing with and thinking of this cabinet.

THE DESIGN. For instance, the big square that is the case and the overlay doors are soothed and supported by the curvilinear base. While the rattan tondo in the door agrees with the base, it does so in a more exotic way.

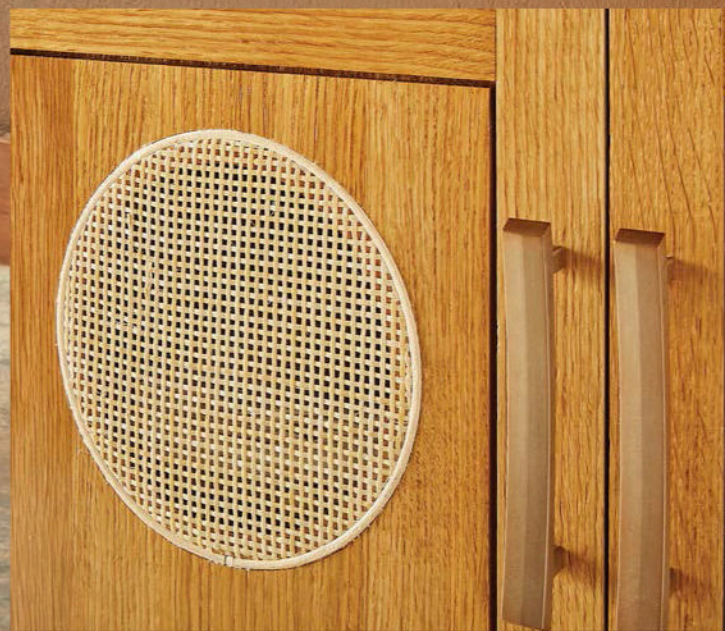
Speaking of the door, the term “frame and panel” door doesn’t speak to the beauty you see here. That’s because the hardwood panel has been brought flush to the frame and given a little separation as well. This slight of hand adds a graphic charm to the cabinet.

THE MATERIAL. Although white oak is the predominant wood used on the cabinet, the walnut feet on the legs add a mellow touch. And rattan always kicks things up a notch.

THE TECHNIQUES & TOOLS. Let’s see — some dovetail joinery at the bench, the ever-present table saw and drill press are on board, a little time at the lathe, routers cutting circles and mortising cylinders — toss in some rattan and hot water. There’s plenty to do here, so let’s head to the shop.

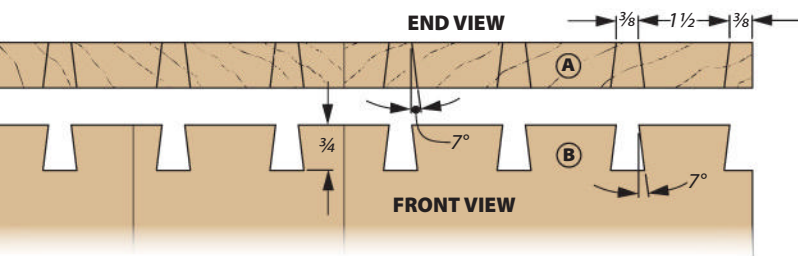


Dovetailed Case. The visual gift of simple geometry and the contrasting grain patterns of dovetail joinery mean the strength and beauty of these joints will last a long time.



Woven Windows. The graphite-like shadow line between the door panel and frame encourages the rattan-covered opening to glow a little in its surroundings.





A Sturdy Dovetailed Case

The heart of this cabinet is the case. As you see in the drawings here, the joinery du jour that brings the case parts together is dovetails — they're fabulously strong and a delight to look at. After gluing up the panels and cutting them to their final length, you're ready to jump in.

The box below walks you through the process, but I'll add a few details here. You must have all the panels flat, smooth, and square. When you're happy with that, arrange the panels with the best faces forward and mark each adjoining corner to keep things in order.

PINS. Figure 1 shows how to layout the pins. The baseline represents the thickness of the panels. The drawing above shows the spacing of the pins.

When cutting the sides of the pins, be sure to stay on the waste side of the line. Stop cutting when you've reached the baseline on both sides of the panel.

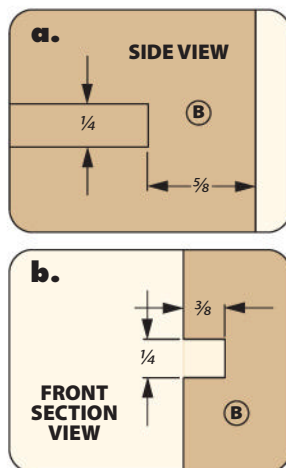
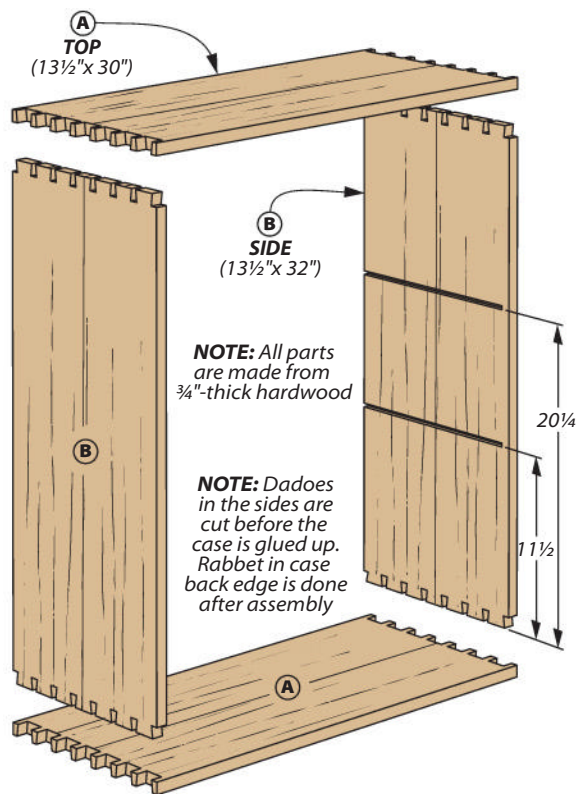


Figure 2 shows using a backer board to make an accurate baseline incision. Then chop away half of the waste before flipping the panel to do the other side.

When the pins are done, you'll use them to lay out the location of the tails on the mating panels. Figure 3 shows using the backer board to hold the panel in place while tracing the tail locations. Figure 4 shows removing the waste from

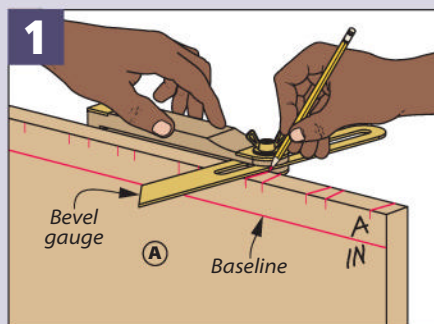


the tails (like you did on the pins). Before you glue up the case, there are a couple of things to do.

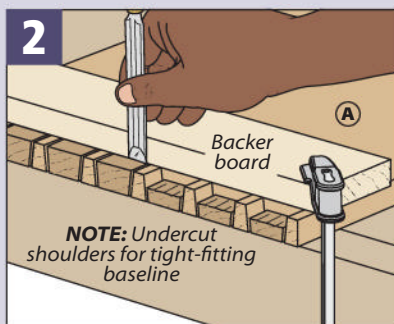
MORE JOINERY. Now that you've finished the jazzy joinery, you have some dadoes and tongues to contend with. Let's start with the stopped dadoes for the horizontal dividers.

The main drawing and both details on the previous page show you all you need

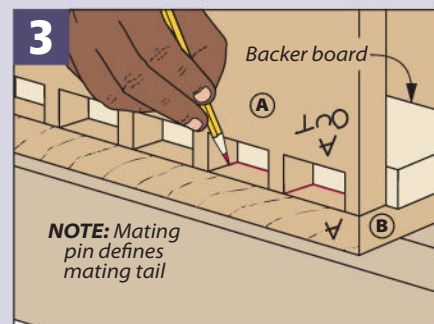
Hand-Cut Dovetails



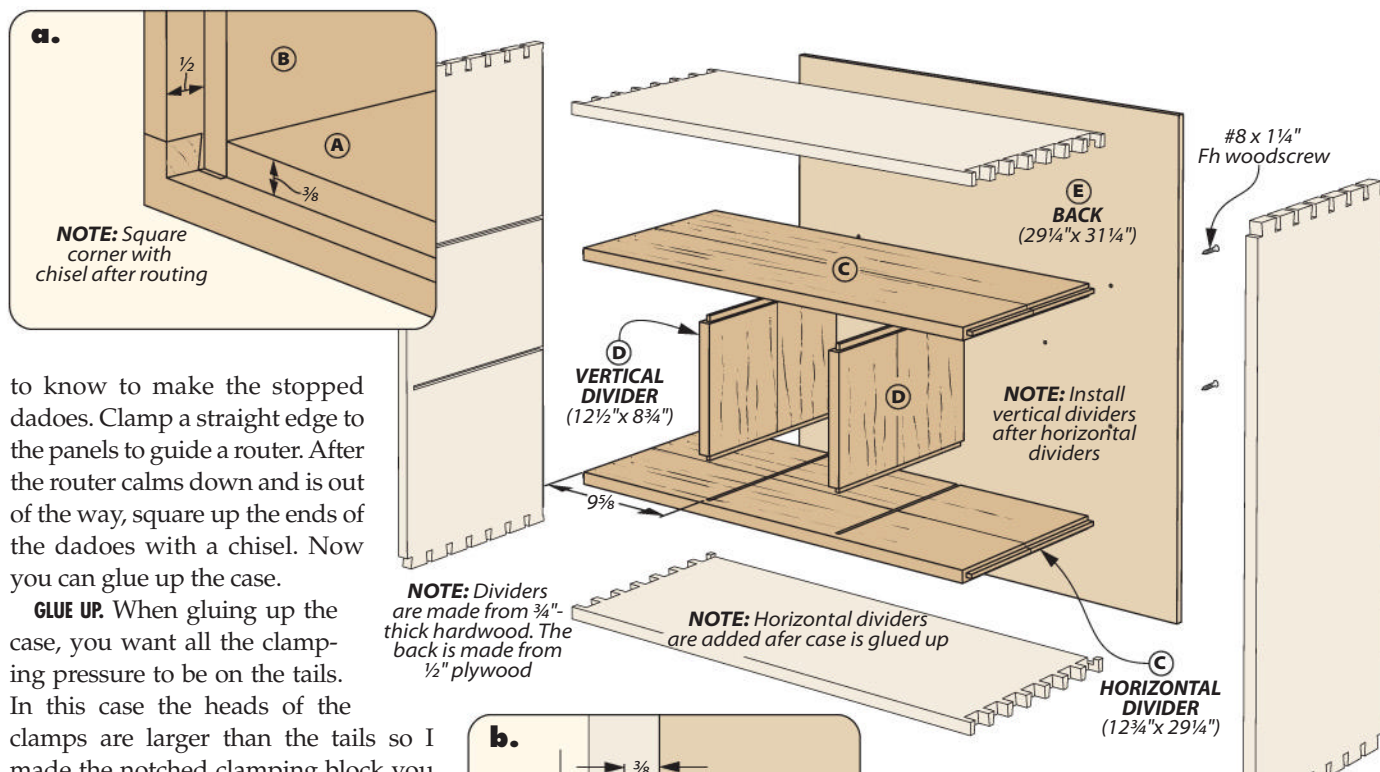
Layout the Pins. First, draw the baseline and pin location, then use a bevel gauge to draw the angled lines.



Chop-chop. After you've cut the pins with a hand saw, clamp a board to the baseline and remove the waste.



Transfer to Tails. A sharp pencil transfers the pin location to the tails. Use a backer board to steady the panel.



to know to make the stopped dadoes. Clamp a straight edge to the panels to guide a router. After the router calms down and is out of the way, square up the ends of the dadoes with a chisel. Now you can glue up the case.

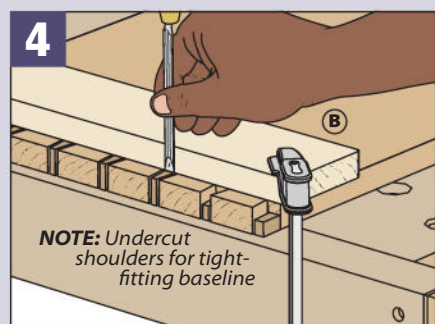
GLUE UP. When gluing up the case, you want all the clamping pressure to be on the tails. In this case the heads of the clamps are larger than the tails so I made the notched clamping block you see in Figure 5. After the clamps are stowed away, rout a rabbet on the rear edge of the case like you see in detail 'a' above for the plywood back.

DIVIDERS

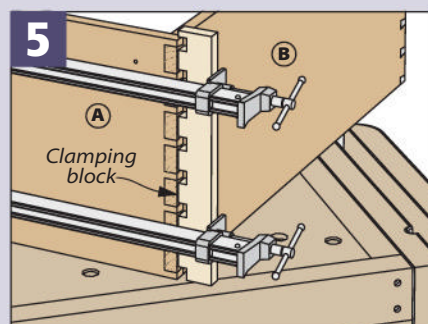
While considering the joinery you may have glued up the panels for all the dividers. If not, glue up the panels now. In the spirit of measuring twice and cutting once, check the distance between the dadoes in the case and then cut the horizontal dividers to length.

As you see in the main drawing and detail 'c,' there are more stopped dadoes on the inside faces of the horizontal dividers to hold the vertical dividers. When those are done, you can tackle the tongues that are on the ends of the

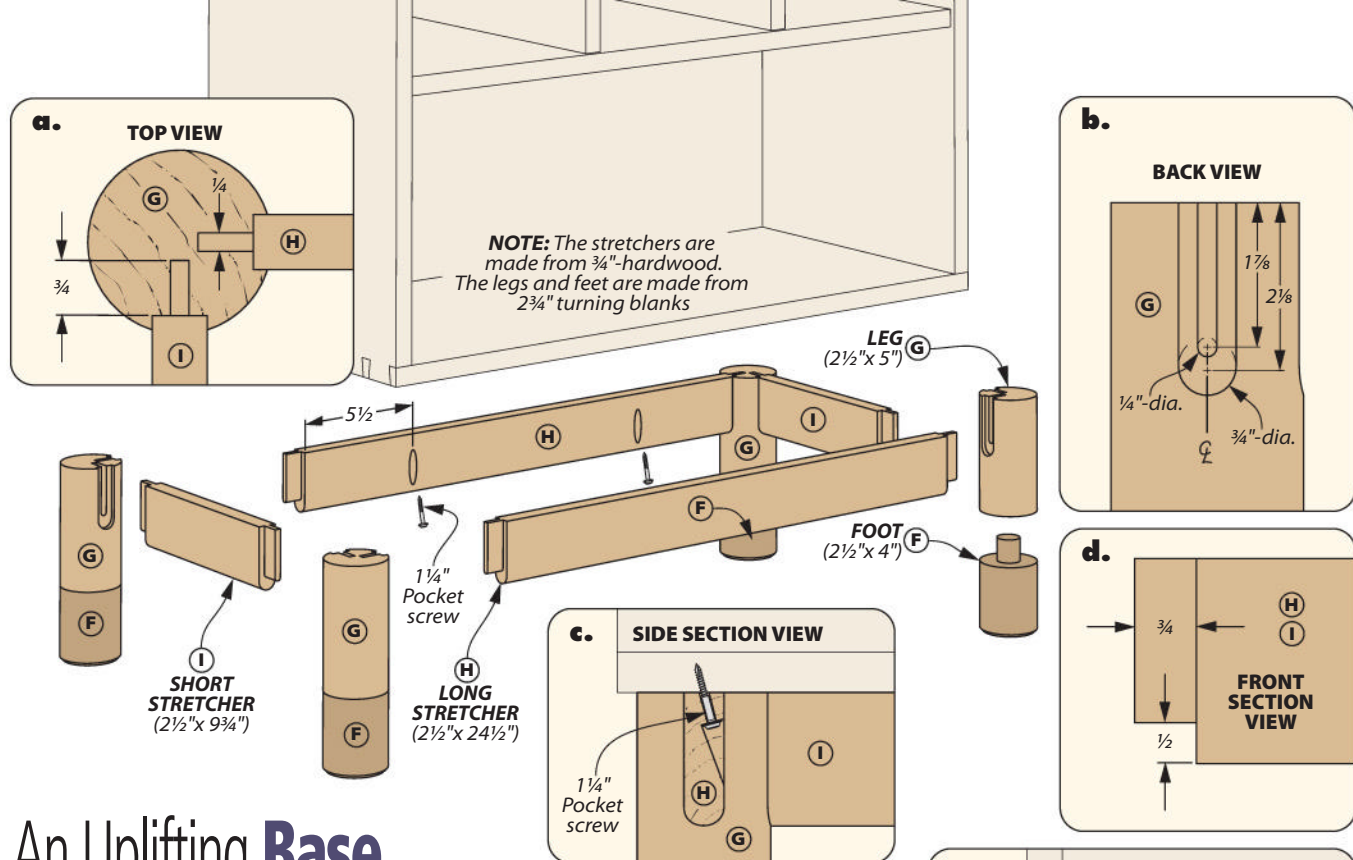
dividers (detail 'b'). Install the horizontal dividers first, then follow up with the vertical dividers, and finally the plywood back.



Shape the Tails. Remove half the waste in the tails, then flip the panel over and repeat the process.



Glue Up. I used shop-made clamping block cut from a scrap piece to apply pressure directly on the tails of the sides.



An Uplifting Base

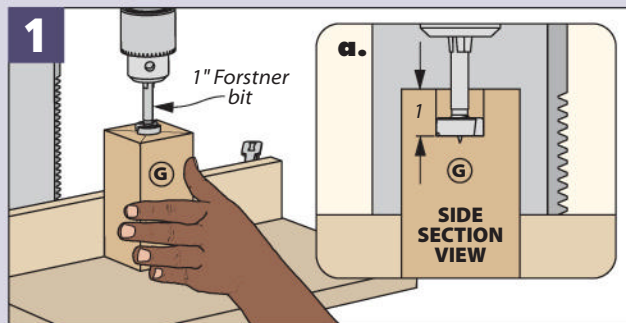
As wonderful as the case of the cabinet is, it does come up short in one area — height. Well, height from the floor anyway. The base solves that problem while complementing the imposing square geometry of the cabinet with circular patterns.

The legs you see in the main drawing above are two-part cylinders that add visual punch to the cabinet while lifting it off the floor. They're tied together with stretchers that echo the circular motif with a large roundover on the

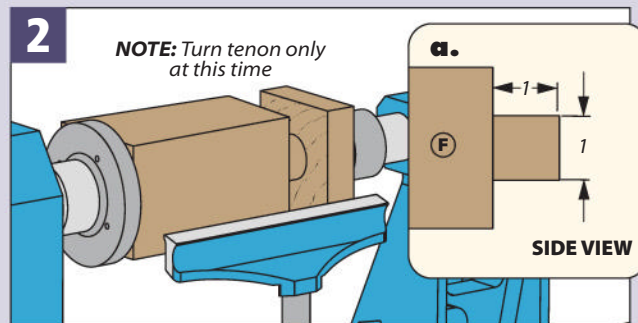
bottom edge. (Later, when you make the door, you'll add a circular opening to the panel that completes the trifecta.) The journey of making the leg starts at the lathe with the foot.

TURNING A TENON. Gluing end grain together does not make a good joint. So to address that problem you'll join the two turning blanks with a mortise and tenon. The box below will guide you. First, drill the holes in the leg blanks (Figure 1). Then make the tenons on the ends of

Mortise & Tenon



Drill a Hole. Drill a hole in the bottom of the leg to join with the foot. A Forstner bit is the ideal bet for this job.



Turn the Tenon. The foot has a tenon turned on the top to mate with the hole in the leg. For now just turn the tenon.

the feet (Figure 2, previous page). Afterwards, you can glue the two parts together.

TURNING THE ASSEMBLY. Now it's back to the lathe to turn the final leg shape. You can add the chamfer on the bottom now, or with a router bit later. Otherwise, it's time to make some mortises in the legs.

DOUBLE MORTISES. Detail 'b' on the previous page shows the two mortises you need to cut into the legs. To do this safely and accurately you'll need to add temporary blocks that match the diameter of the legs to the ends of each leg assembly to hold the leg in place at the router table.

The first pass creates the large mortises that hold the shoulder profile of the stretchers (Figure 1). The second, smaller mortise (Figure 2) is for the tenon (it would be best to make this mortise in multiple passes).

STRETCHERS

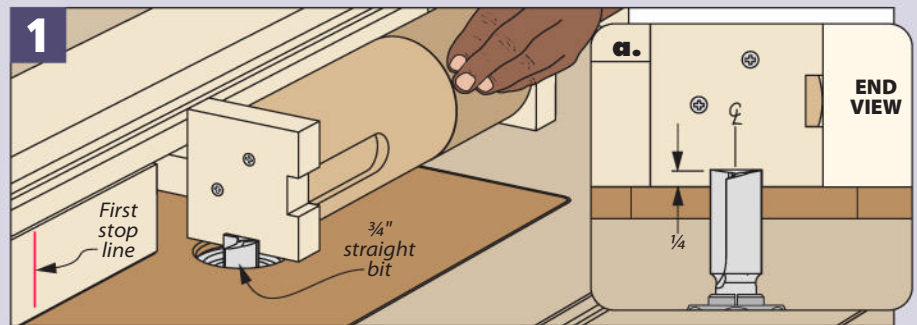
The four stretchers (two long, two short) that bring the legs together (main drawing, previous page) are straightforward workpieces. And the work starts at the table saw making tenons on the ends (Figure 3).

The same dado stack buried in an auxiliary rip fence will shape the tenon cheeks (Figure 3a) as well as the shoulder cut (Figure 3b), just raise the blade.

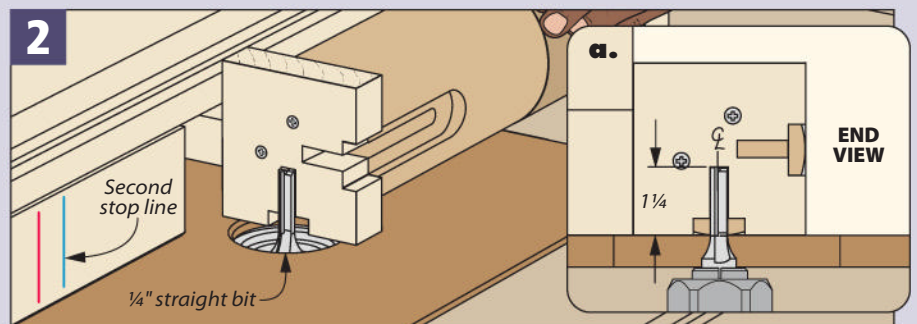
BIG EASY. To say you need to "ease" the bottom edge of the stretchers would be an understatement. A large roundover bit chucked into your router table (Figure 4) is what's called for to dress the stretcher's profile.

Before gluing up the base there are pocket holes that you need to drill on the interior face of the front and back stretchers (detail 'c,' previous page). As you glue up the base, (with band clamps) confirm that the tops of the legs and stretchers are flush, and the frame is square.

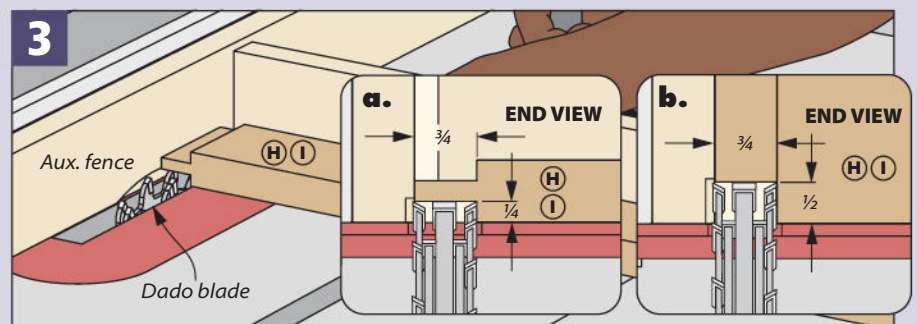
Connecting the Parts



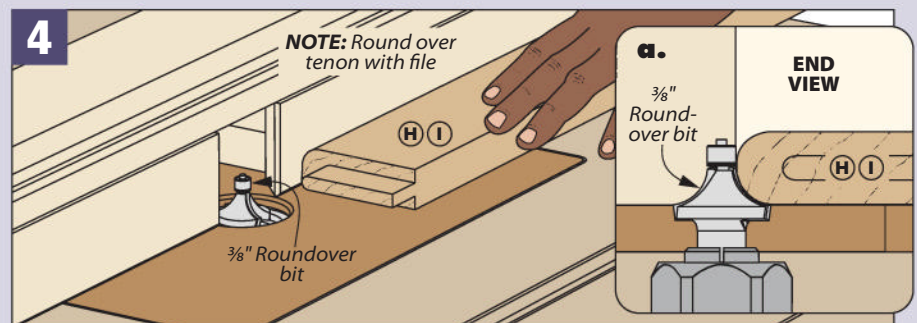
A Jig for Mortises. Attaching blocks to the ends of the leg assembly will hold it steady while you rout the first mortise. Then turn the blank 90° and rout the other mortise.



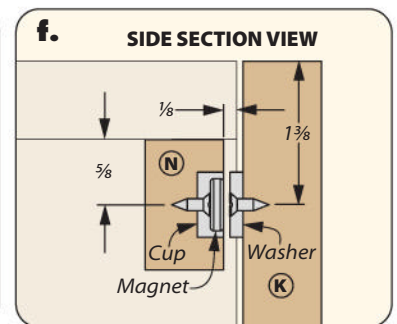
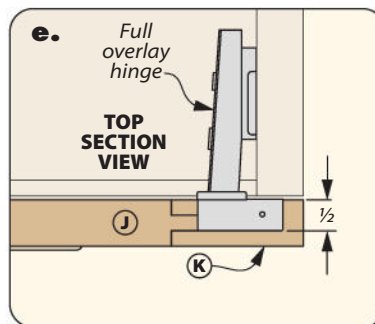
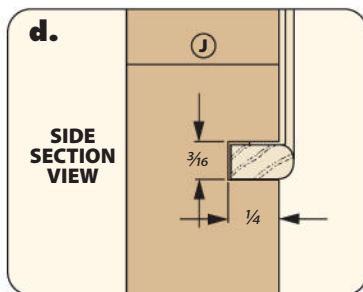
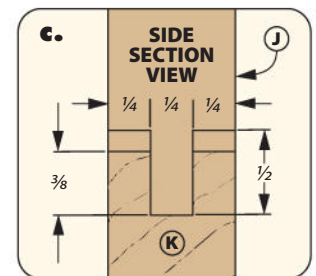
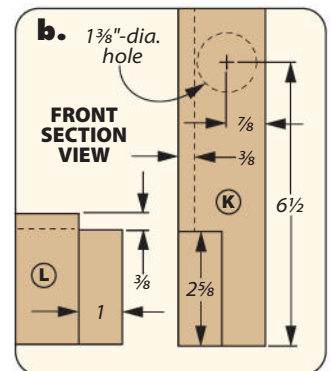
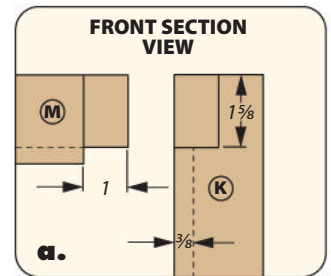
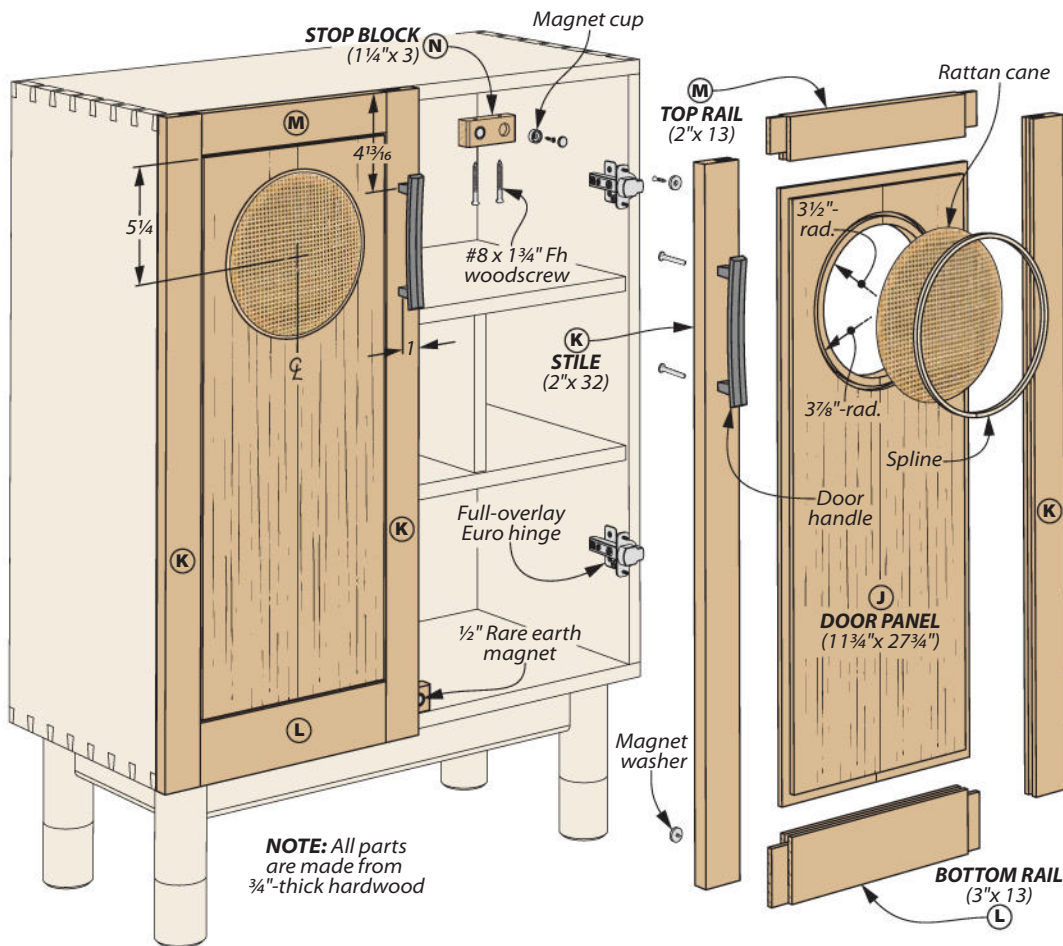
Smaller but Deeper. All you have to do for the second mortise is change out the bit and mark the second stop line on the router table fence.



Stretchers are Next. Over at the table saw you'll cut the tenons on the ends of the stretchers. Cut the cheeks first, then remove the material for the shoulders.



Roundover. A roundover bit chucked into the router table makes short work of the roundovers needed on the bottom edge of the stretchers.



A Pair of Doors

The doors for this cabinet, like the design and materials on the rest of the project, are a notch above the standard fare. At first glance it may seem like just a frame and panel door with a decorative opening in the upper center. But on closer inspection you'll find some subtle features that sing in the same key as the rest of the cabinet.

SOLID DOORS. You won't find any plywood here. These solid white oak panels are graced with an extra-wide tongue that creates a nice shadow line

between the surrounding frame. And that circle laced in cane rattan — we'll get to that shortly. You've got some panels to glue up first.

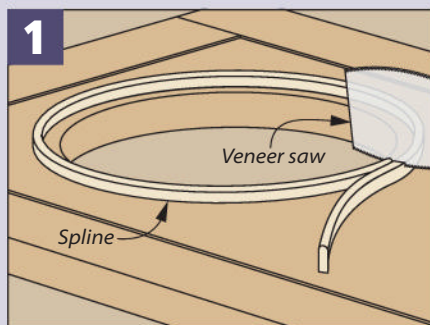
While the glue is curing on the panels, it's time to tackle the stiles and rails. A solid-wood panel needs to be able to move with seasonal changes. This means the frame surrounding it has to be the muscle holding the door together.

After you cut the centered grooves in the stiles and rails (shown in detail 'c') you'll need to drill mortises in the end of the stiles to accommodate some beefy tenons (detail 'a') that you'll cut on the

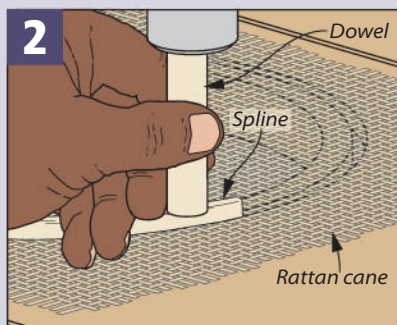
ends of the rails. Before we can put the doors together we've got to gussy up those panels. Start by trimming the glued-up panels to size.

TRAMMEL TIME. The hole in the door panel (main drawing above) and the surrounding groove are begging to be made with your router and trammel. Using double-sided tape, attach the panel to a sacrificial board and rout the outer ring first (detail 'd,' previous page). Once that's done, adjust the position of the router on the trammel and make the opening in the panel. Finally, head back

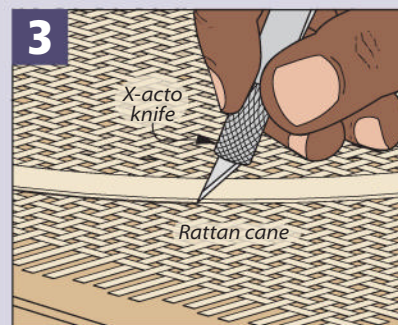
Installing the Cane Screen



Fit the Spline. After soaking the binding cane (spline) in hot water, fit it in the groove and trim it to length.



Install the Screen. Place the softened sheet of rattan over the opening and use a wood dowel to set the spline.



Trim & Lock the Screen. First, trim the excess cane around the spline. Then lock it in place with hide glue.

at the table saw and cut the tongues on the edges of the panels (detail 'c').

Now you can glue up the doors. Remember to let the panels float. Detail 'b' shows where to drill the holes for the full-overlay hinges (detail 'e'). The main drawing shows the screw hole locations for the handles. This is a good time to install the stop blocks in the case (detail 'f').

SPLINES & RATTAN

To decorate the hole you made in the door you're going to use the same two durable ingredients that make up the

skins of wicker furniture. Open weave rattan cane comes in sheets and is often used to cover large openings in chairs. Binding cane (or spline) is the long strips of material that holds the rattan in place and wraps the rest of the chair.

HOT WATER. When you first unpackage the cane, you'll find the pieces are quite stiff. The only way you can work with these materials is to first soak them in hot water. In about 20 to 25 minutes the binding cane will be pliable enough that you can fit the material into the groove in the door. Figure 1 above shows how to do this.

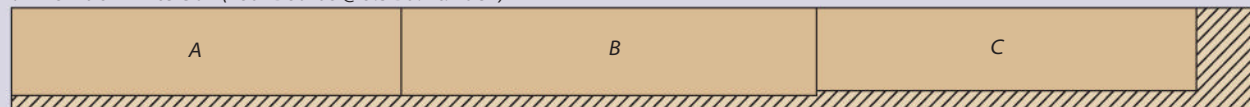
The next step is shown in Figure 2. Here we've laid the rattan sheet in place over the opening. We then embed the spline with a wood dowel to secure the rattan. Let the cane dry overnight and use the dowel to confirm the spline is still seated, then trim away the excess (Figure 3). Applying some hide glue in the groove will lock the spline and rattan in place.

Now all that remains is the finish. The cabinet will glow nicely sprayed with lacquer after a coat of wipe-on oil dries. With that, your cabinet is ready for home.

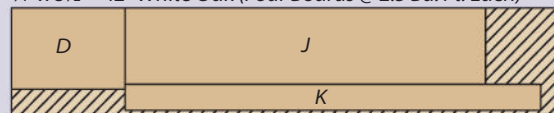
MATERIALS, SUPPLIES & CUTTING DIAGRAM

A Top/Bottom (2)	$\frac{3}{4}$ x 13 $\frac{1}{2}$ - 30	I Short Stretchers (2)	$\frac{3}{4}$ x 2 $\frac{1}{2}$ - 9 $\frac{3}{4}$	• (4) #8 x 1 $\frac{3}{4}$ " Fh Woodscrews
B Sides (2)	$\frac{3}{4}$ x 13 $\frac{1}{2}$ - 32	J Door Panels (2)	$\frac{3}{4}$ x 11 $\frac{3}{4}$ - 27 $\frac{3}{4}$	• (1) 18" x 24" Open Weave Rattan Cane
C Hrz. Dividers (2)	$\frac{3}{4}$ x 12 $\frac{3}{4}$ - 29 $\frac{1}{4}$	K Stiles (4)	$\frac{3}{4}$ x 2 - 32	• (1) $\frac{3}{8}$ " x 20' Binding Cane
D Vert. Dividers (2)	$\frac{3}{4}$ x 12 $\frac{1}{2}$ - 8 $\frac{3}{4}$	L Bottom Rails (2)	$\frac{3}{4}$ x 3 - 13	• (2pr.) 110° Full Overlay Hinges
E Back (1)	$\frac{1}{2}$ ply. - 29 $\frac{1}{4}$ x 31 $\frac{1}{4}$	M Top Rails (2)	$\frac{3}{4}$ x 2 - 13	• (2) Door Handles
F Feet (4)	2 $\frac{1}{2}$ x 2 $\frac{1}{2}$ - 4	N Stop Blocks (2)	$\frac{3}{4}$ x 1 $\frac{1}{4}$ - 3	• (4) $\frac{1}{2}$ " Rare-Earth Magnets
G Legs (4)	2 $\frac{1}{2}$ x 2 $\frac{1}{2}$ - 5	• (6) #8 x 1 $\frac{1}{4}$ " Fh Woodscrews		• (4) $\frac{1}{2}$ " Magnet Cups
H Long Stretchers (2)	$\frac{3}{4}$ x 2 $\frac{1}{2}$ - 24 $\frac{1}{2}$	• (4) #8 x 1 $\frac{1}{4}$ " Pocket Screws		• (4) $\frac{1}{2}$ " Magnet Washers

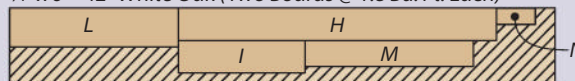
$\frac{3}{4}$ " x 8" - 96" White Oak (Four Boards @ 5.3 Bd. Ft. Each)



$\frac{3}{4}$ " x 8 $\frac{1}{2}$ " - 42" White Oak (Four Boards @ 2.5 Bd. Ft. Each)



$\frac{3}{4}$ " x 6" - 42" White Oak (Two Boards @ 1.8 Bd. Ft. Each)



ALSO NEEDED: One 48" x 48" Sheet of $\frac{1}{2}$ " Oak Plywood, One 2 $\frac{3}{4}$ " x 2 $\frac{3}{4}$ " - 29" Walnut Turning Blank, One 2 $\frac{3}{4}$ " x 2 $\frac{3}{4}$ " - 29" White Oak Turning Blank

Wall-mounted Workbench

Transform a few feet of wall space into a workshop with these three simple projects.



A few key ingredients are required for setting up a workshop. Two important ones are a worksurface and some storage for tools and supplies. The three projects shown here prove that all it takes is a few feet of wall space to create a comfortable shop.

The thick, rugged workbench can withstand heavy use. A simple rack keeps your tools close at hand and off the benchtop. And a wall shelf holds supplies and small tools overhead.

Bevels and chamfers give the three projects a classic look. And they're built from common, low-cost construction lumber.

CONSTRUCTION DETAILS

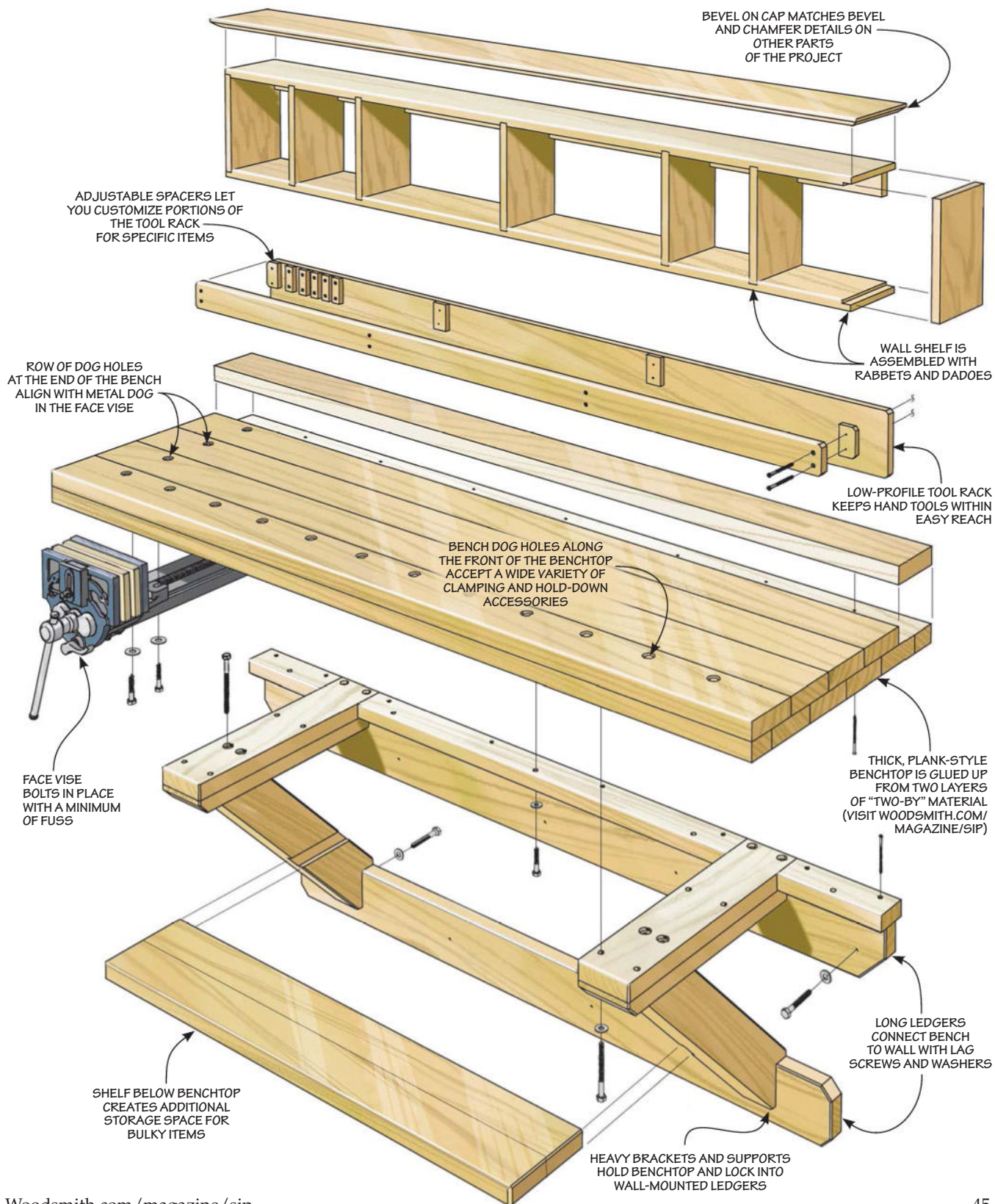
OVERALL DIMENSIONS:

72¾" W x 11¼" H x 7½" D (wall shelf)

70¾" W x 5½" H x 2" D (tool rack)

78" W x 25¾" H x 29" D (workbench)

NOTE: WALL SHELF
AND TOOL RACK ARE
MADE FROM "ONE-BY"
CONSTRUCTION LUMBER



Low-cost, Rugged Workbench

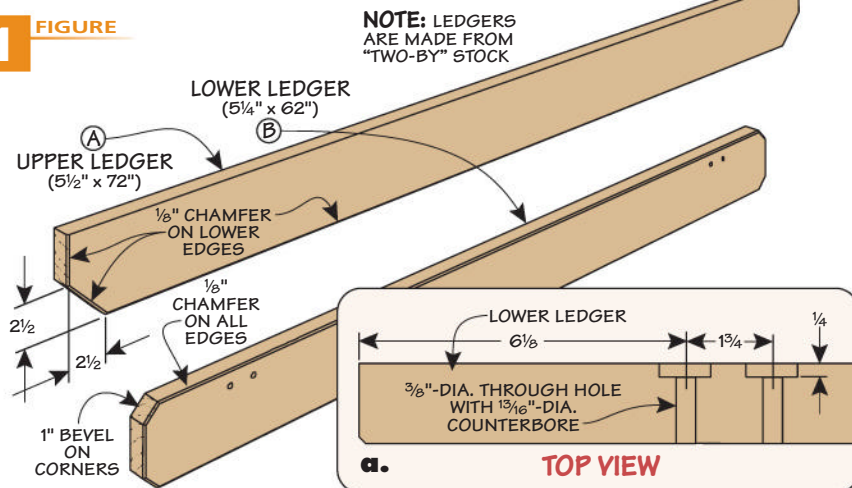
Building a wall-mounted workbench like this one offers a few advantages. Perhaps the biggest is that you “borrow” strength from the wall to create a more sturdy worksurface.

STRONG SUPPORT. In order to make the most of that benefit (and stand up to heavy use), the benchtop and its support structure need to be stout. The bench is attached to the wall with two large ledger strips, as shown in Figure 1. These allow you to connect the whole assembly to a number of wall studs.

The upper ledger has the lower corners beveled. Then the ends and lower edges receive a small chamfer. (I used these bevel and chamfer details throughout the project to tie the components together visually.)

The lower ledger is slightly narrower. All four corners are beveled and all edges are chamfered. In addition, the lower ledger has a set of counterbores on the back face for attaching the brackets that support the top, as in Figure 1a.

1 **FIGURE**



NOTE: LEDGERS ARE MADE FROM “TWO-BY” STOCK

BRACKETS. Two angled brackets rest on the lower ledger. The brackets are made by gluing up two layers of “two-by” stock, as you can see in Figure 2. Each bracket has a miter cut on both ends. The lower end has a notch cut in it to

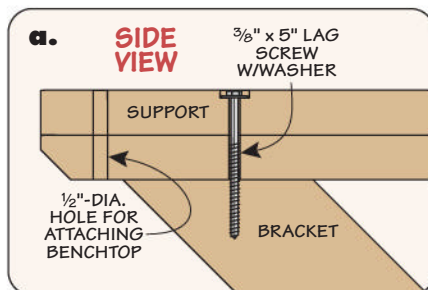
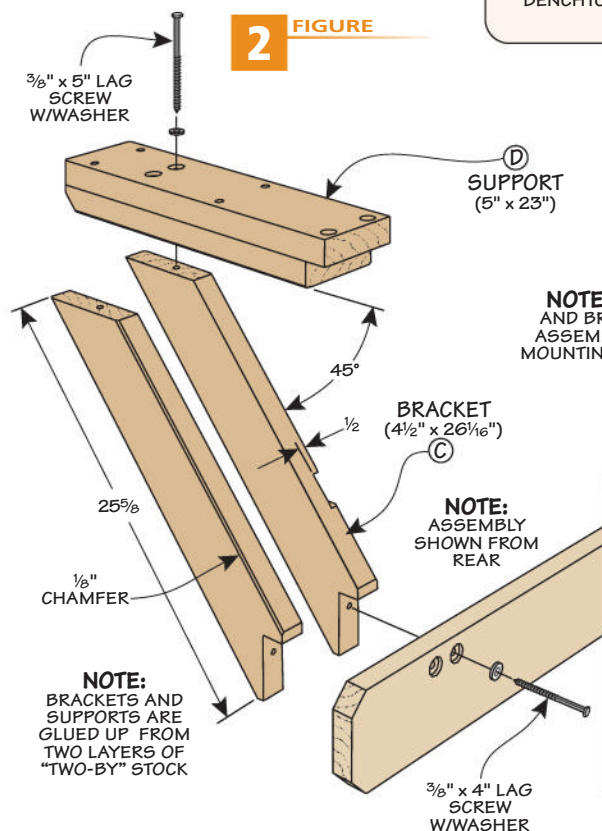
catch the lower ledger (Figure 2b). The depth of the notch matches the thickness of the lower ledger.

The real trick is cutting identical notches on the large pieces. The solution is an auxiliary miter gauge fence that has a pair of angled cleats. You find how I make and use this online at woodsmith.com/magazine/sip.

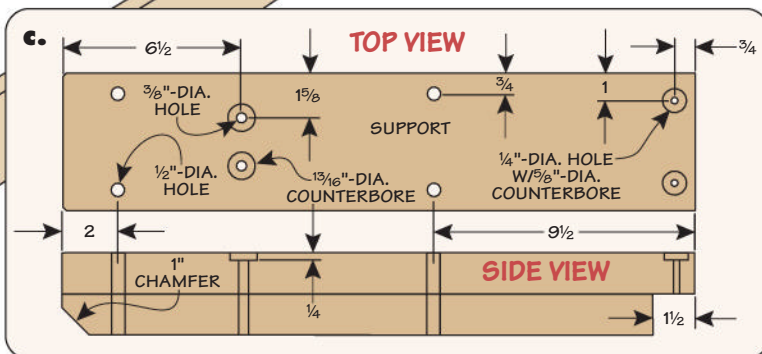
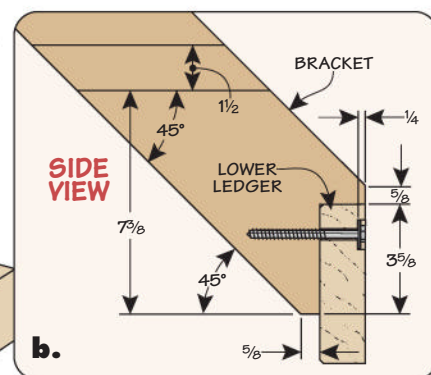
The final detail on the brackets is an angled dado cut on the inside faces. It’s sized to accept a shelf.

THE SUPPORTS. The benchtop mounts to a thick support on top of each bracket. A rabbet at the back end allows the support to rest on the upper ledger.

2 **FIGURE**



NOTE: SUPPORTS AND BRACKETS ARE ASSEMBLED BEFORE MOUNTING TO THE WALL



The width of the rabbet matches the thickness of the ledger, as in Figure 2c.

In the same drawing, you can see the mounting holes in each support. These serve to connect the support to the bracket, the upper ledger, and the benchtop.

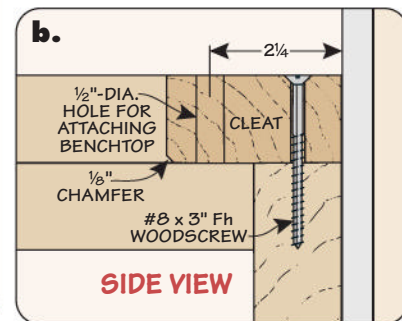
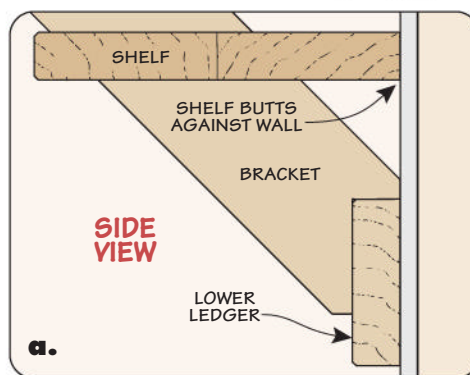
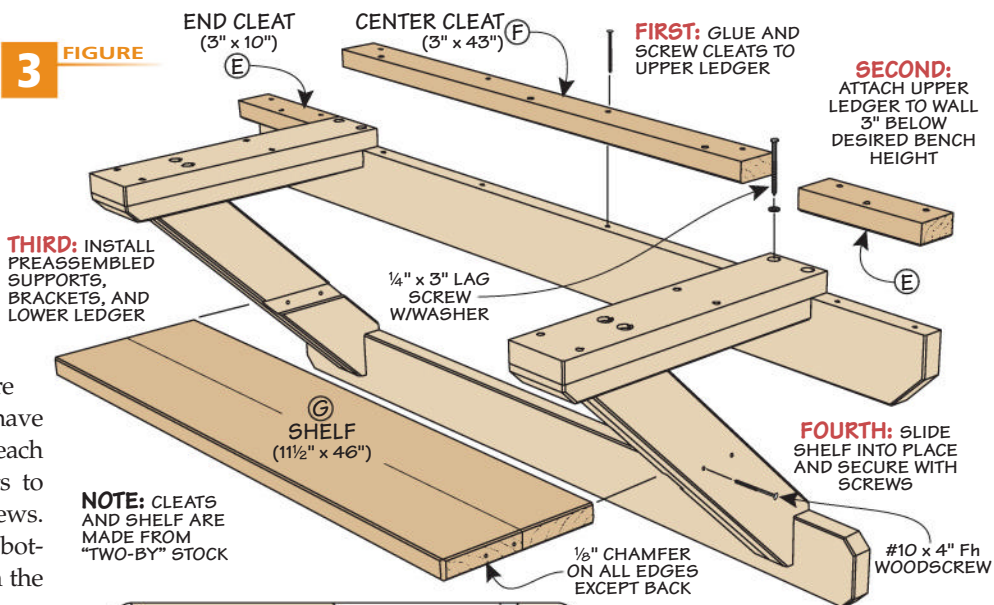
CLEATS. I also added a set of cleats to the upper ledger to secure the back edge of the top. They have mounting holes drilled from each face. One set attaches the cleats to the ledger with glue and screws. An outer row of holes (from the bottom face) makes it easy to attach the benchtop (Figure 3b).

ASSEMBLY. At this point, you can do a little assembly. The steps in Figure 3 guide the way.

SHELF. The final part of the support structure is the shelf. It's sized to slide into the dadoes in the brackets. Long screws hold it in place, as in Figures 3 and 3a.

BENCHTOP. The workbench top is made in a laminated, plank-style to match the simple, rugged look of the support system below. Two layers of "two-by" lumber create a thick, solid work surface, as you can see in Figure 4 below. The two layers are glued and screwed together, but the individual boards aren't edge glued. Once the individual boards are cut to their final sizes, the actual assembly of the top goes quickly. You can read more about the process I used to make the benchtop online at woodsmith.com/magazine/sip.

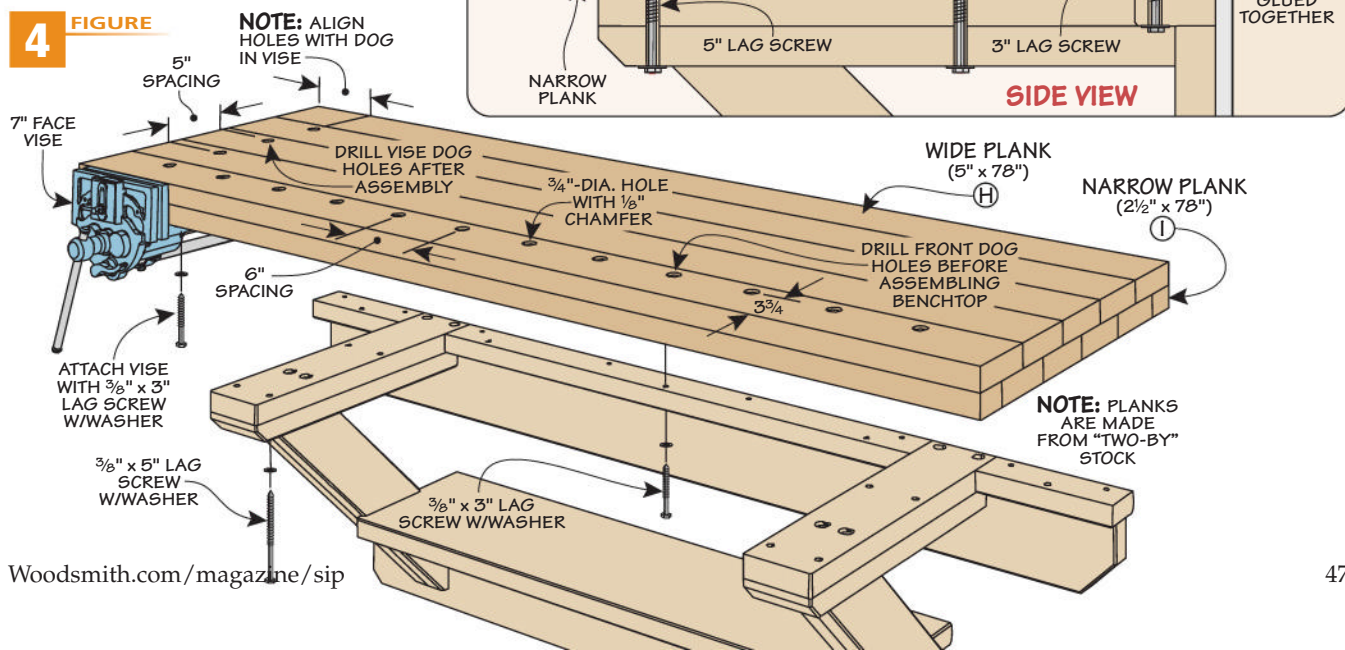
3 FIGURE



DOG HOLES. Before gluing up the top, I drilled the dog holes in the front board of the upper layer. This way, I could drill accurate holes at the drill press. Once the top is assembled, the holes then serve as

guides to drill through the lower layer. There's another row of dog holes that aligns with the vise. These are drilled after cutting the top to length so they would be accurate.

4 FIGURE



Options for Tool Storage

A solid bench gives you a great place to work. But to do that effectively, you also need easy access to your tools and supplies. That's where the other two parts of this project come into play. Like the workbench, both the tool rack and shelf are wall-mounted.

The tool rack is a versatile solution for holding hand tools within easy reach. The simple design makes organizing your tools nearly foolproof.

For larger tools and other supplies, the wall shelf provides six cubbies. The shelf isn't very deep, so don't worry — items can't get lost in the back.

While I sized the tool rack and shelf to go with the bench, the designs are flexible enough to alter the length to suit your needs.

TOOL RACK. Simplicity is the name of the game when it comes to making the tool rack. In Figure 5, you can see there are just a few parts necessary to build it.

There are two long rails and a handful of spacers. The gap between the spacers is where the tools go. What's surprising is how just a basic design like this can hold such a wide range of tools without



Tool Rack. Spacers between front and back rails make for a flexible storage solution.



Wall Shelf. Rabbits and dados make building this shelf a quick and easy task.

making a lot of intricate, custom holders.

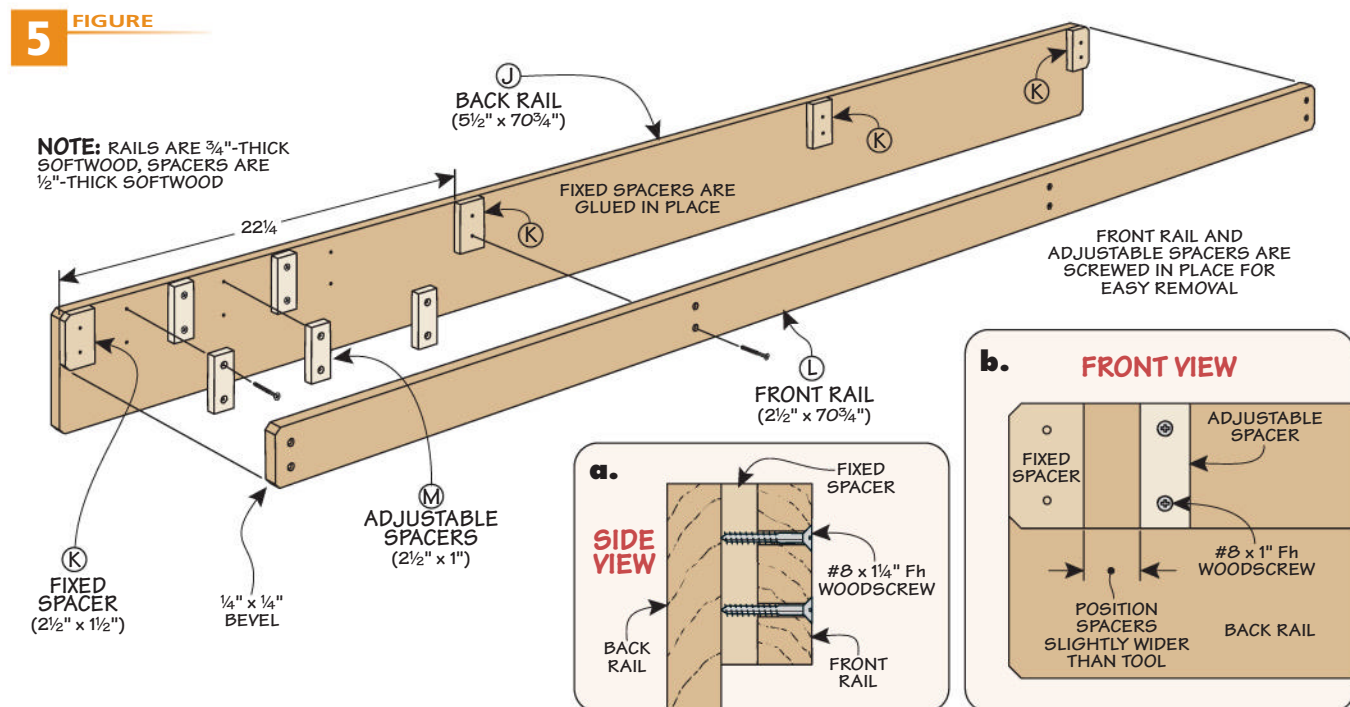
The wide back of the tool rack is cut to size with the corners "dog-eared" to match the details in the bench. A set of wide, fixed spacers are glued to the back, as shown in Figure 5a. The back can then be mounted to the wall. The front of the tool rack is a narrow rail that's just screwed to the spacers.

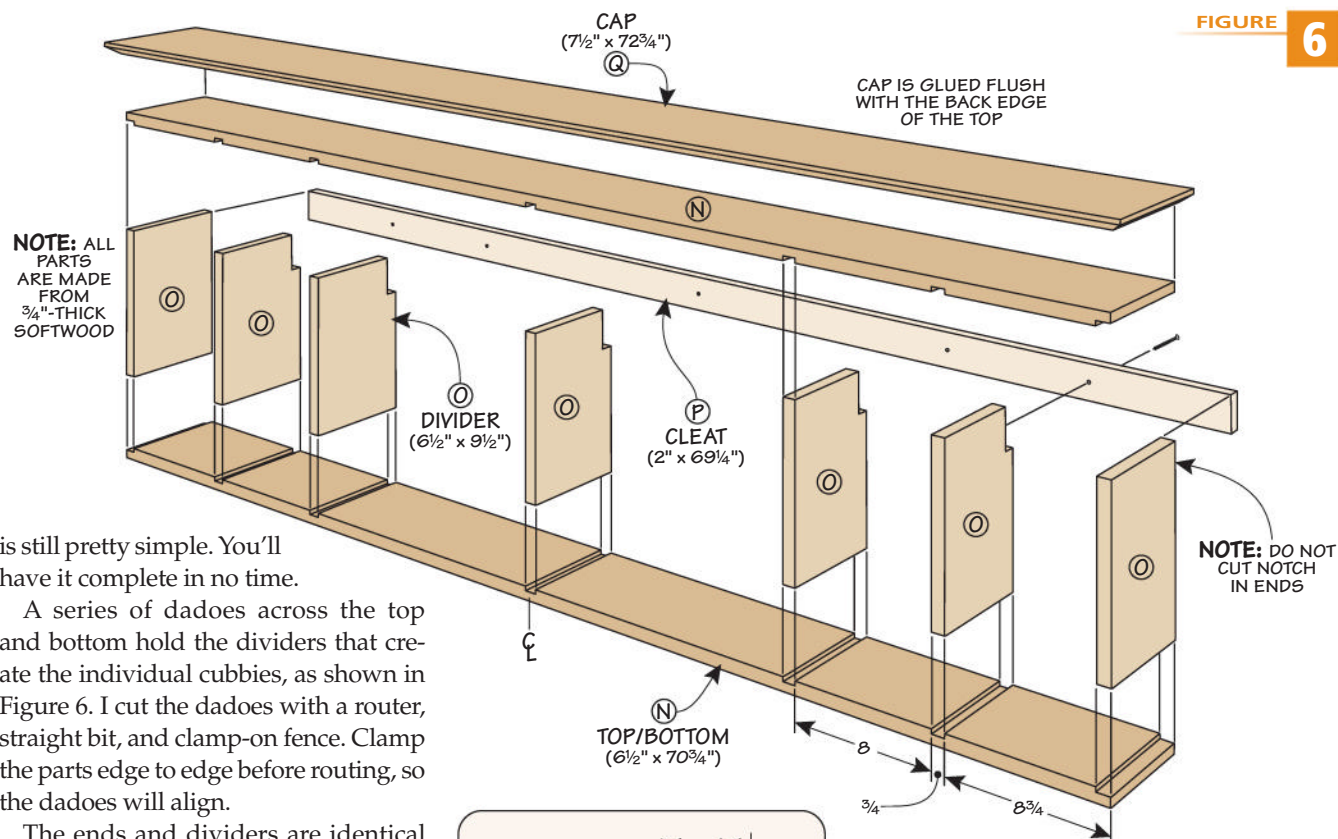
ADJUSTABLE SPACERS. The three long slots in the tool rack will work fine for storing and organizing many tools. However, if you'd like to keep some tools

together (a set of chisels, for example), you can make smaller adjustable spacers. These are simply screwed to the back anywhere you like. This allows you to reposition, add, or remove spacers without much hassle.

To make sliding the tools in and out easier, size the gaps between the spacers to be slightly larger than the width of the tool, as shown in Figure 5b.

WALL SHELF. The remaining component is the long wall shelf. And while some of the pieces are long, the construction



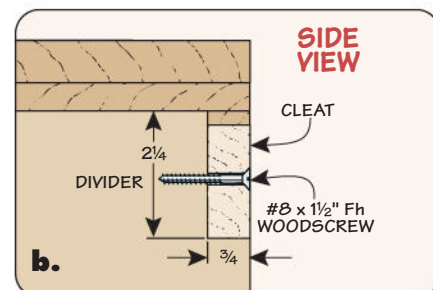
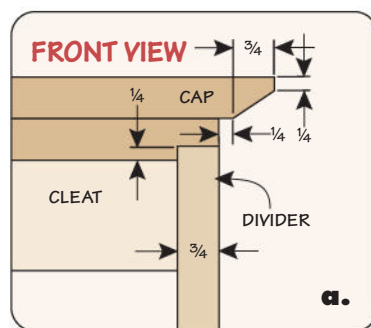


is still pretty simple. You'll have it complete in no time.

A series of dadoes across the top and bottom hold the dividers that create the individual cubbies, as shown in Figure 6. I cut the dadoes with a router, straight bit, and clamp-on fence. Clamp the parts edge to edge before routing, so the dadoes will align.

The ends and dividers are identical in size. The only difference is that the dividers have a notch on the back to accept a cleat, as illustrated in Figure 6b. The cleat is glued and screwed into the dividers when you assemble the main part of the shelf.

I topped off the shelf with a cap. It has a bevel on the front and ends. Cutting the bevel on the long front edge isn't a big deal. Simply stand the workpiece on edge and make the cut. However, there's no good way to support such a long piece on end (and it would be too tall for my shop anyway). Instead, I used a hand plane to shape the



bevel. When cutting across end grain, it's important that the blade is very sharp. You can read more about the technique I used at woodsmith.com/magazine/sip.

The three parts of this project can

turn a small space into a well-organized, enjoyable workshop. Best of all, it doesn't cost a lot or take much time to build.

MATERIALS & SUPPLIES

Workbench

A	Upper Ledger (1)	1 1/2 x 5 1/2 - 72
B	Lower Ledger (1)	1 1/2 x 5 1/4 - 62
C	Brackets (2)	3 x 4 1/2 - 26 1/16
D	Supports (2)	3 x 5 - 23
E	End Cleats (2)	1 1/2 x 3 - 10
F	Center Cleat (1)	1 1/2 x 3 - 43
G	Shelf (1)	1 1/2 x 11 1/2 - 46
H	Wide Planks (9)	1 1/2 x 5 - 78
I	Narrow Planks (2)	1 1/2 x 2 1/2 - 78
J	Back Rail (1)	3/4 x 5 1/2 - 70 3/4

K Fixed Spacers (4)

L	Front Rail (1)	1/2 x 2 1/2 - 1 1/2
M	Adjustable Spacers (5)	3/4 x 2 1/2 - 7 3/4
N	Top/Bottom (2)	1/2 x 2 1/2 - 1
O	Ends/Dividers (7)	3/4 x 6 1/2 - 9 1/2
P	Cleat (1)	3/4 x 2 - 69 1/4
Q	Cap (1)	3/4 x 7 1/2 - 72 3/4

- (12) 3/8" x 5" Lag Screws
- (21) 3/8" Flat Washers
- (4) 3/8" x 4" Lag Screws

- (4) 1/4" x 3" Lag Screws
- (4) 1/4" Flat Washers
- (8) #8 x 3" Fh Woodscrews
- (4) #10 x 4" Fh Woodscrews
- (5) 3/8" x 3" Lag Screws
- (1) 7" Face Vise
- (70) #8 x 2" Fh Woodscrews
- (10) #8 x 1" Fh Woodscrews
- (8) #8 x 1 1/4" Fh Woodscrews
- (5) #8 x 1 1/2" Fh Woodscrews

Heavy-duty Veneer Press

Gluing veneer demands clamping pressure distributed across a wide surface. This veneer press ensures you'll always get perfect results.

Adding veneer to a project is a great way to create an eye-catching look without breaking the bank. And one of the most challenging aspects of using veneer is applying consistent pressure evenly across the surface as you glue it in place.

HIGH PRESSURE. The veneer press you see here more than adequately serves the purpose. There are two big advantages to its design: It's inexpensive to build, and it's more convenient than manhan-

dling a lot of clamps and cauls to get the job done before the glue sets.

The double-layer MDF platens are dead flat and smooth. This means the resulting panel will be smooth with a consistent glue line. A shop-made knob and threaded rod assemblies in combination with thick hardwood cauls create plenty of clamping pressure. All in all, the veneer press is easy to build and yields big benefits while adding another tool to your shop arsenal.



Wrench it Down. A wrench is the best tool for applying maximum clamping pressure between the platens.

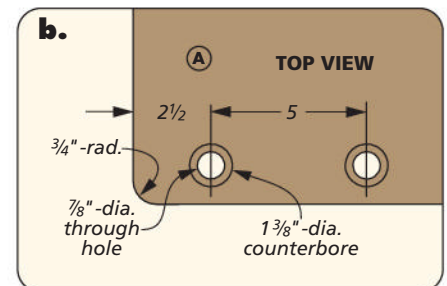
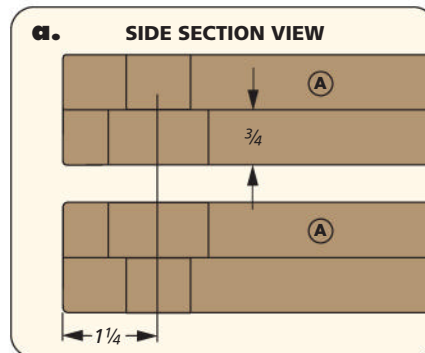
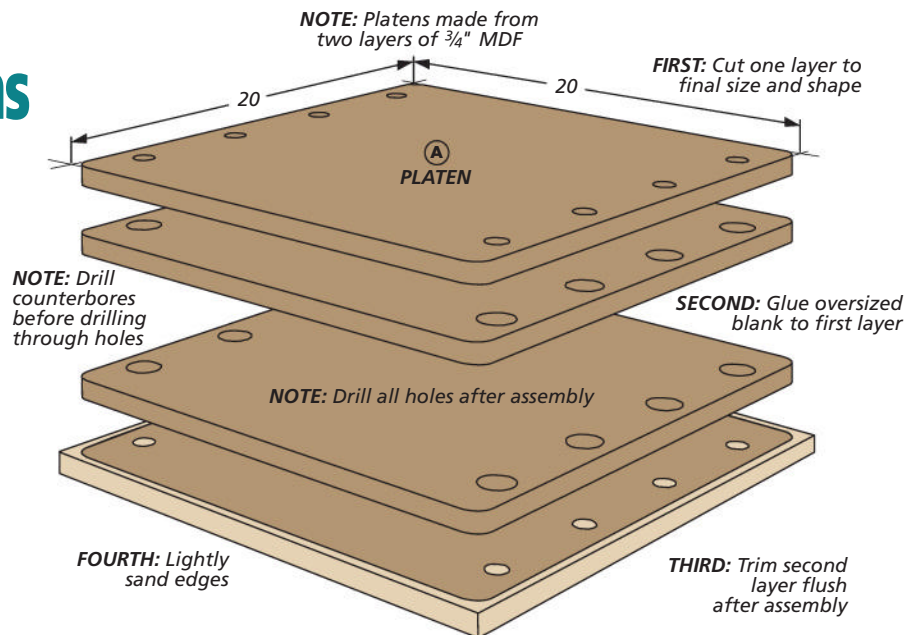
Flat & Smooth **Platens**

The two platens on the veneer press are identical. They're each made from two layers of MDF. MDF is flat, smooth, and dense — an ideal combination for a veneer press. You can make the platens any size, but I found the size shown here works well for veneering panels for boxes or small cabinets.

GLUE & TRIM. To make each of the platens, start by cutting one layer to final size and rounding over the corners, as shown at right. This layer serves as a template for trimming the second layer flush after it's glued up.

To make the second layer, I cut a piece of MDF about $\frac{1}{4}$ " to $\frac{3}{8}$ " oversized. This allows a little wiggle room for positioning it on the first layer when the glue and clamps are applied. I glued up both platens and stacked them together on a flat surface with waxed paper between them before clamping them with a series of clamps. You can also make clamping cauls to ensure there's plenty of clamping pressure at the center of the platens. For lack of any other method of clamping, you could simply set a heavy weight, like a concrete block, on top. Once the glue dries, trim the second layer flush on each platen.

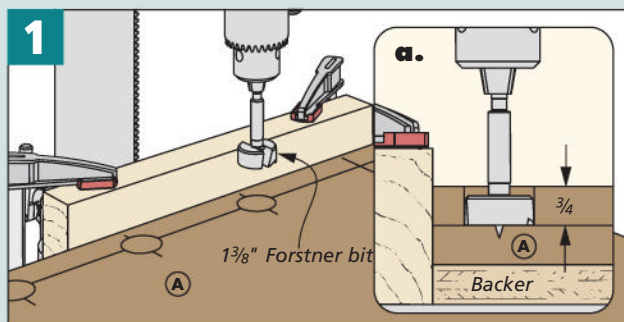
COUNTERBORED HOLES. Your next step is to lay out a series of counterbored holes along two edges of each platen. The through holes are oversized to accom-



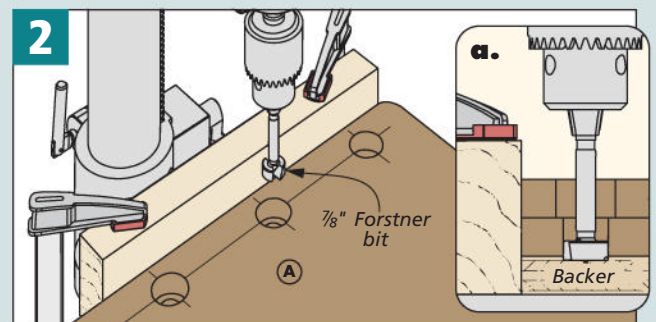
modate the threaded rod for the clamping screw assemblies. The counterbores on the inside face of each platen hold springs that help separate the platens, allowing you to insert the workpiece (details 'a' and 'b').

The drawings above and in the box below show where to locate and how to drill the holes. I started by drilling the counterbores with a Forstner bit. Using the centerpoint left from drilling the counterbore as a guide, it's an easy task to follow up with a smaller bit to drill the through hole.

Counterbore & Drill



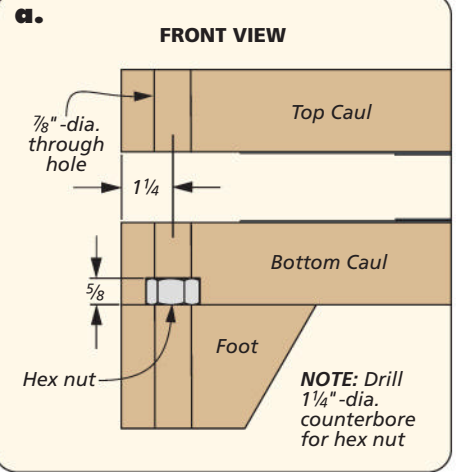
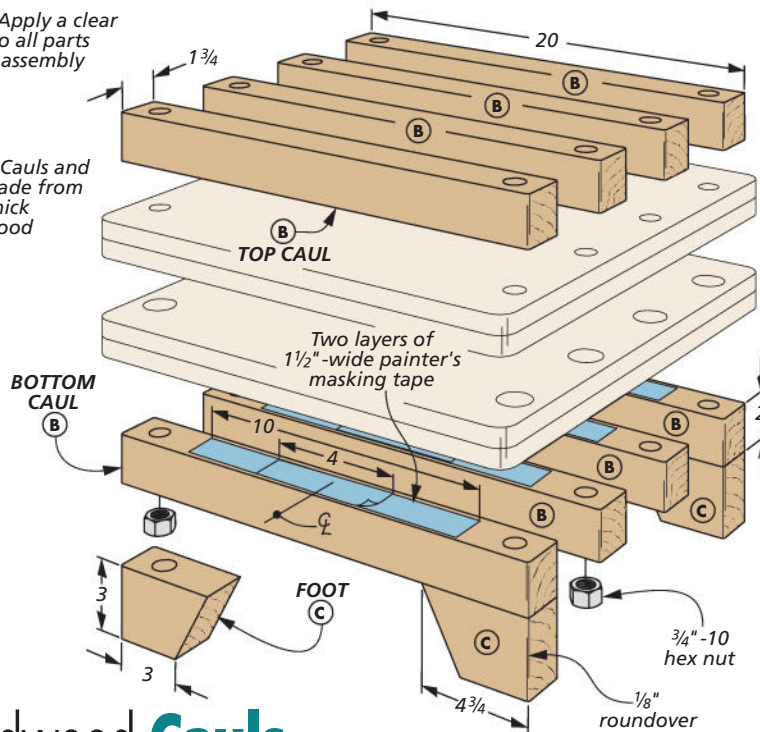
Large Counterbores. After gluing up the platens and trimming them to size, drill counterbores on the inside faces. The counterbores hold the springs that separate the platens.



Through Holes. To provide clearance for the threaded rod used to provide clamping pressure between the platens, drill through holes at all the counterbore locations.

NOTE: Apply a clear finish to all parts before assembly

NOTE: Cauls and feet made from 1 3/4"-thick hardwood



Hardwood Cauls

There are just a few more things to do to complete the veneer press. The maple cauls you see above are up to the task of applying consistent clamping pressure. To elevate the press and provide clearance for the threaded rod, I added four hardwood feet. Finally, you'll add all of the hardware that ties everything together and turns all of the parts into a fully functional veneer press.

TOP & BOTTOM CAULS. The eight cauls are identical in size and shape. After they're sized, I rounded over the ends at the router table.

Next came some work at the drill press. The bottom cauls are counter-bored to house hex nuts. The counterbores are sized so that the hex nuts have to be pressed into place to secure them.

After the counterbores are drilled, oversized through holes need to be drilled through all of the cauls. These holes allow the cauls to move freely along the threaded rod.

Installing the hex nuts into the counterbores on the bottom cauls comes next (photo below). For extra security, fill the voids around the nut with glue or epoxy.

HARDWOOD FEET. The details for making the feet are shown above. I started with

an extra-long blank. It's easier to drill the through hole for the threaded rod before cutting the foot to final shape. Then simply cut the legs to shape and sand them smooth before gluing them to the bottom cauls. Just make sure the through holes align with those in the cauls to allow free movement of the rod.

CREATING A CROWN. Creating a crown on the cauls helps distribute clamping pressure to the center of the platens. But machining perfectly matched crowns would be a difficult proposition. You want them all to be consistent. So I simplified the crowning process by applying a couple strips of painter's masking tape, as shown above.

HANDWHEEL ASSEMBLIES

To tie everything together and make a fully operational veneer press, you'll make a series of handwheel assemblies. Each assembly starts with a threaded rod and a coupling nut. That's topped off with a plywood handwheel.



Seat the Nut. With the power off, a drill press can be used to force the hex nut into the counterbore in the bottom caul.

MATERIALS, SUPPLIES & CUTTING DIAGRAM

- | | | | |
|---|----------------|-----------------------|--------------------------------------|
| A | Platens (2) | 1 1/2" MDF - 20 x 20 | • (8) 3/4"-10 x 2 1/4" Coupling Nuts |
| B | Cauls (8) | 1 3/4" x 2 - 20 | • (1) 3/16"-dia. x 18" Steel Rod |
| C | Feet (4) | 1 3/4" x 3 - 4 3/4" | • (8) 3/4" Flat Washers |
| D | Handwheels (8) | 1 Ply. x 3 1/2" -dia. | • (8) 1.218" O.D. x 4" Comp. Springs |
- (8) 3/4"-10 x 12" Threaded Rod
 - (8) 3/4"-10 Hex Nuts
 - (10 ft.) 1 1/2"-wide Painter's Tape

1 3/4" x 5" - 84" Hard Maple (5.8 Bd. Ft.)



1 3/4" x 4" - 24" Hard Maple (1.3 Bd. Ft.)



ALSO NEEDED:

One 48" x 48" sheet of 3/4" MDF

One 24" x 24" sheet of 1/2" Baltic birch plywood

ROD & NUT ASSEMBLY. The first order of business is to cut the threaded rods to final length. I like to file off the sharp edges after cutting.

The coupling nut is pinned to the threaded rod (drawings at right). To do this, thread the coupling nut onto the rod and then drill two holes for steel pins to secure the nut to the rod. The lower right photo shows how a drill press vise securely holds the assembly for drilling.

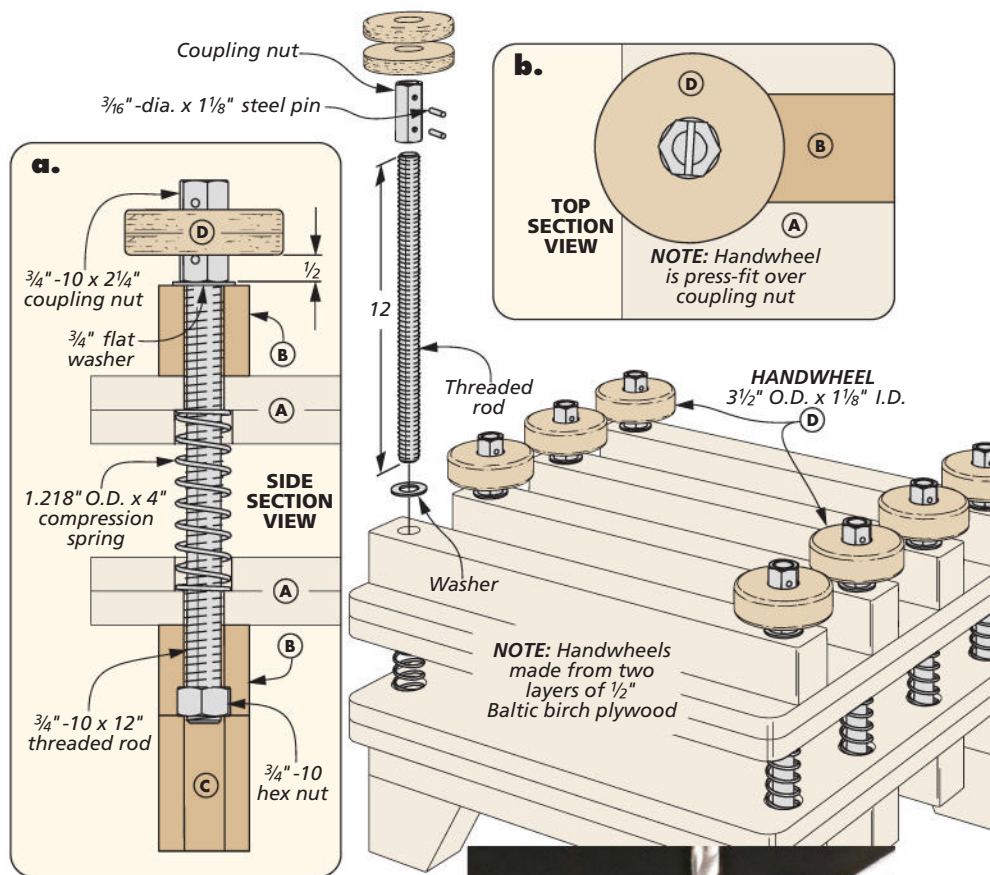
You'll need to cut the 16 pins from $\frac{3}{16}$ " steel rod. I cut them about $\frac{1}{8}$ " longer than needed. After you peen them into the holes you drilled through the coupling nut and threaded rod, grind or file them flush with the coupling nut.

PLYWOOD HANDWHEELS. The handwheels are made from two layers of $\frac{1}{2}$ " Baltic birch plywood. The How-To box below shows how to create the final shape of the handwheels at the drill press.

Each handwheel is a press-fit over the coupling nut, as shown in Figure 3 below. A few solid taps on the bottom end of the threaded rod will seat the handwheel midway onto the length of the coupling nut.

ASSEMBLY. Before assembling the veneer press, it's a good idea to apply a clear finish to the platens and cauls and a coat of wax between uses. This helps prevent glue from sticking.

Putting everything together goes quickly. Arrange the bottom cauls to align with the holes in the bottom



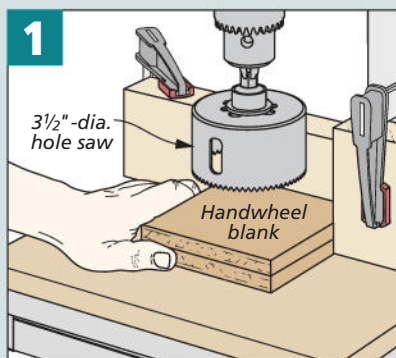
platen. Insert the springs then add the top platen and cauls. Thread the rod assemblies through until they engage the nuts in the bottom cauls.

USING THE PRESS. The handwheels make it easy to quickly tighten the cauls to bring the platens together. But for really torquing down, it's best to use a wrench on the coupling nut.

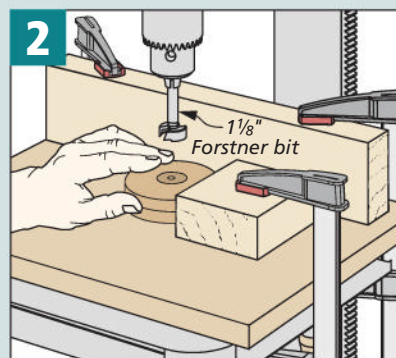


Clamp & Drill. A drill press vise holds the rod assembly securely while drilling the through holes for the pins.

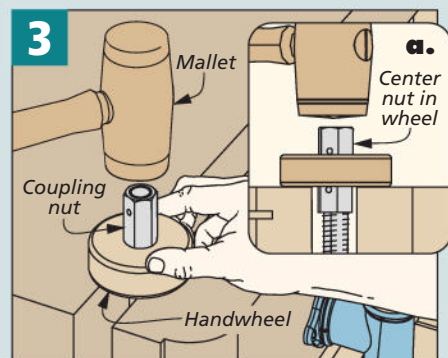
Making the Handwheels



Making Handwheels. Use a hole saw or wing cutter to create the outside diameter of the handwheel.



Inside Diameter. Switch out the drill bit to enlarge the center hole for a press fit over the coupling nuts.



Installing the Handwheel. Fitting the coupling nut into the handwheel just requires a few taps with a mallet.

Custom Clamp Cart

Turns out that what's more important than the number of clamps you have is where and how they're stored. If you can't get the clamps you need when you need them, then having them around doesn't do too much good.

A clamp cart rolls in as an obvious solution. Unfortunately, most clamp carts are one-dimensional. You need a whole lot more for a successful glue-up than an A-frame full of clamps. Designer John Doyle took a look around a typical assembly here and noted all the other stuff: brushes, cauls, drills, nailers, and tape. What he came up with is the cart you see here.

OPTIONS & MORE OPTIONS. The drawing on the next page calls out all the storage features that are packed into this cart. I want to mention one thing before we dive into the construction process. Other than the basic shell of the case and upper drawers (a must), the number and arrangement of all the organizers is up to you. You may want to add more clamp racks and delete some of the tool storage features shown in the photo at right.



We show this made in Baltic birch plywood because it's going to live on the set of the *Woodsmith Shop* TV show. Feel free to make it from any type of plywood you wish. One final suggestion: Consider painting the cart to add some color (and fun) to your shop space.

A Buffet of Storage. The front side of the cart provides tool storage options, drawers, and a couple bonus surfaces.



FRONT OF CART

NOTE: SCREWS REINFORCE DADOES, RABBETS, AND GROOVES FOR SOLID, QUICK CONSTRUCTION

ARRANGE CLAMP RACKS TO SUIT YOUR NEEDS

TOOL MAT CREATES CUSHIONED AND QUIET WORKSURFACE

FULL-EXTENSION DRAWER SLIDES ALLOW COMPLETE ACCESS TO CONTENTS

CUSTOMIZE THE DRILL/DRIVER SHELF TO YOUR COLLECTION OF TOOLS

CONVENIENT CUBBIES FOR NAILERS AND PINNERS

4" CASTERS ALLOW YOU TO MOVE THE CART WITH LITTLE EFFORT

CONSTRUCTION DETAILS

OVERALL DIMENSIONS:

33 $\frac{3}{4}$ " W x 54" H x 23 $\frac{1}{4}$ " D

MATERIALS & SUPPLIES

A	Sides (2)	21 $\frac{3}{4}$ x 48 - $\frac{3}{4}$ Ply.
B	Drawer Shelves (2)	8 $\frac{3}{4}$ x 31 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.
C	Drawer Divider (1)	9 $\frac{1}{4}$ x 4 - $\frac{3}{4}$ Ply.
D	Worksurface (1)	15 x 31 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.
E	Case Bottom (1)	21 $\frac{3}{4}$ x 31 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.
F	Divider (1)	15 x 27 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.
G	Shelves (2)	15 x 15 $\frac{1}{2}$ - $\frac{3}{4}$ Ply.
H	Case Back (1)	31 $\frac{1}{4}$ x 47 $\frac{1}{2}$ - $\frac{3}{4}$ Ply.
I	Pull-Out Dividers (2)	13 $\frac{1}{2}$ x 15 - $\frac{1}{4}$ Hdbd.
J	Base (1)	23 $\frac{1}{4}$ x 33 $\frac{3}{4}$ - $\frac{3}{4}$ Ply.
K	Drawer Sides (4)	3 $\frac{3}{8}$ x 8 - $\frac{1}{2}$ Ply.
L	Drawer Fronts (2)	3 $\frac{3}{8}$ x 14 $\frac{7}{8}$ - $\frac{3}{4}$ Ply.
M	Drawer Backs (2)	3 $\frac{3}{8}$ x 13 $\frac{1}{2}$ - $\frac{1}{2}$ Ply.
N	Drawer Bottoms (2)	7 $\frac{1}{2}$ x 13 $\frac{1}{2}$ - $\frac{1}{4}$ Hdbd.
O	Hor. Clamp Strips (6)	3 x 13 $\frac{1}{2}$ - $\frac{3}{4}$ Ply.
P	Hor. Clamp Sides (6)	2 $\frac{1}{2}$ x 12 $\frac{1}{2}$ - $\frac{3}{4}$ Ply.
Q	Hor. Front Rails (3)	1 x 13 $\frac{1}{2}$ - $\frac{3}{4}$ Ply.
R	Tray Front/Back (2)	4 x 15 $\frac{3}{8}$ - $\frac{3}{4}$ Ply.
S	Tray Sides (2)	4 x 4 $\frac{3}{4}$ - $\frac{3}{4}$ Ply.
T	Tray Bottom (1)	4 $\frac{3}{4}$ x 14 $\frac{3}{8}$ - $\frac{1}{4}$ Hdbd.
U	Clamp Rack Tops (4)	4 x 15 $\frac{3}{8}$ - $\frac{3}{4}$ Ply.
V	Clamp Rack Backs (4)	3 $\frac{1}{4}$ x 15 $\frac{3}{8}$ - $\frac{3}{4}$ Ply.
W	Brackets (8)	3 $\frac{1}{4}$ x 3 $\frac{1}{4}$ - $\frac{3}{4}$ Ply.

- (16) #8 x 1 $\frac{1}{4}$ " Fh Woodscrews
- (50) #8 x 1 $\frac{1}{2}$ " Fh Woodscrews
- (16) #10 x 1 $\frac{1}{4}$ " Lag Screws
- (4) 4" Locking Casters
- (2 pr.) 8" Self-Closing Drawer Slides
- (2) 4 $\frac{1}{2}$ " Drawer Pulls w/Screws

SECOND SET OF RACKS STABILIZE CLAMPS WHILE THE CART IS IN MOTION

CART'S BOTTOM SERVES AS AN EXTRA SHELF FOR SUPPLIES

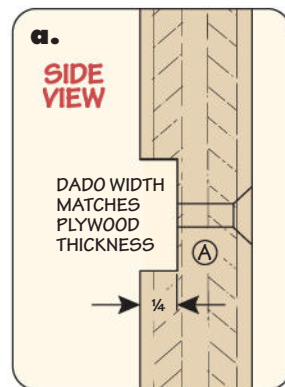
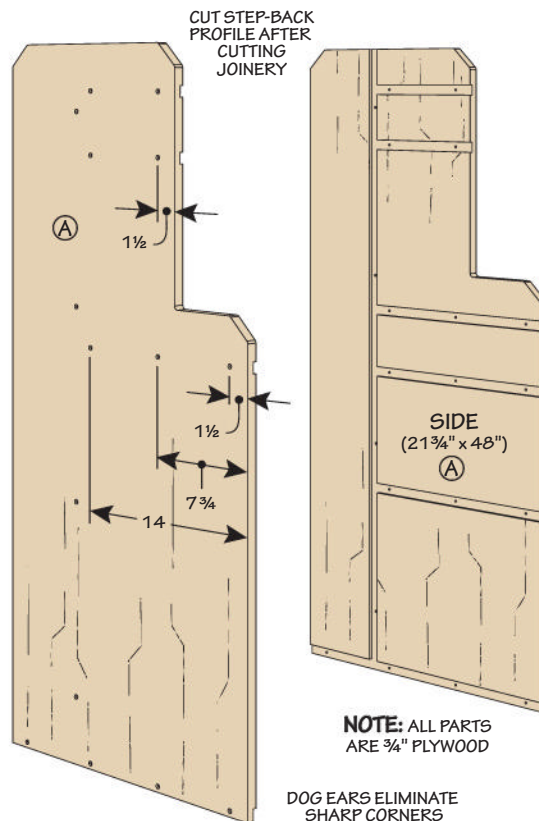
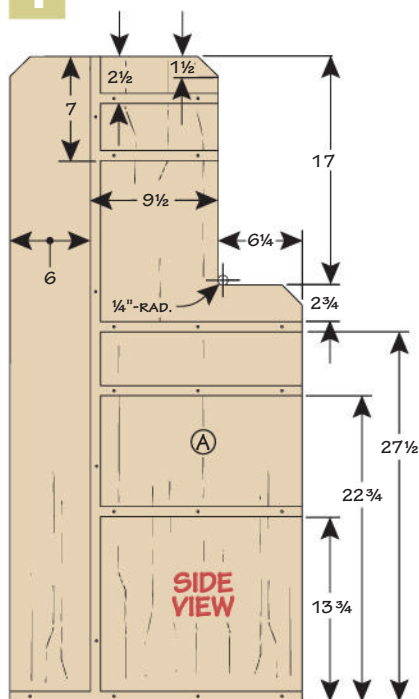
NOTE: BACK CAN HOLD CLAMPS WITH 36" CAPACITY

NOTE: AS AN OPTION, ATTACH CLAMP RACKS TO THE SIDES TO HOLD 48" CLAMPS

NOTCHES IN CLAMP RACKS MATCH CLAMP BARS

BACK OF CART

1 **FIGURE**



“plywood” bits, and a couple metric bits. These are relatively inexpensive and one is likely to work to achieve a solid joint.

After the cross-grain cuts, the long groove comes next. An edge guide and your router team up since you’re already dialed in. Otherwise, a table saw and a dado blade offer a good alternative.

NOTCHED. This is the point

where the step-back profile comes in. The lower left drawing shows how I made this detail. Keep the jigsaw out to dog ear corners, making friendly surfaces.

Jigsaws aren’t known for the smooth surfaces they leave behind. So all of the cut edges require attention. Where possible, I use a block plane. Yes, you can use hand planes on plywood. They leave a smooth surface and work quickly. The areas where a plane can’t reach are smoothed with a combination of a rasp and files. A few sanding block strokes are the final touch.

One last item sits unchecked on the list: drill shank holes for screws that reinforce the dados, rabbet, and groove. I drill these from the joinery side and eyeball the center. Then from the outside face, I add the countersink. This approach eliminates a bunch of measuring and aligning.

DIVIDERS & SHELVES

We’ll leave the sides for the time being and turn our attention to the parts that connect them. Figure 2 gives the over-view of the array of vertical dividers and horizontal shelves. Look close, and

Joinery in the Sides

The sides of this cart carry the load in both the design and structure. A quick look at Figure 1 illustrates these points. The step-back profile keeps the cart from looking like a giant box. (We’ll get to that in a bit.) Notice also the dados, grooves, and rabbets that register and anchor many of the cart’s other components. That’s where I want to begin.

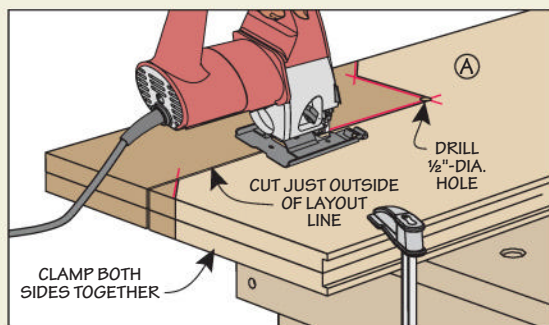
ESSENTIAL JOINERY. One benefit of plywood construction is the use of

straightforward joinery techniques. The parts for the cart offer you several approaches for cutting the joints.

I formed the rabbet along the bottom and the stopped dados before the center groove. My reason is to prevent tearout. The backside of a dado (or a cross-grain rabbet) is liable to chip as the bit exits the cut. By making those cuts first you avoid opportunities for chipped edges.

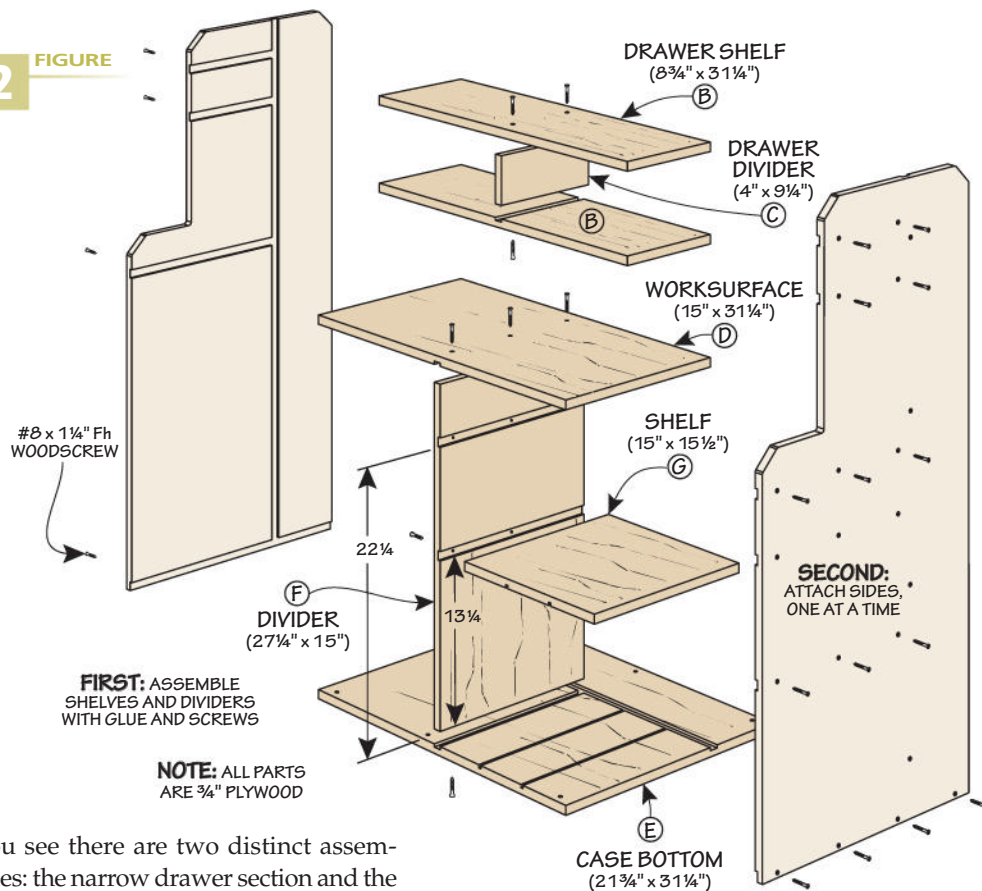
I routed the rabbet along the bottom with a hand-held router and an edge guide. I removed the edge guide and used straightedges to locate the dados, as shown in the upper left side view drawing. I selected a straight bit that matched the thickness of the plywood, as in Figure 1a. Plywood may not match its stated thickness. As a result, I have standard bits,

Cut the Step-Back



Jig Saw to the Rescue. Cut in from the top and front edges to the hole at the corner.

2 FIGURE



you see there are two distinct assemblies: the narrow drawer section and the lower section.

DRAWER CASE. I'll discuss these from the top down. The drawer section creates two compartments for small drawers. The top of this unit works as a bonus storage shelf. The horizontal shelves are identical. They run from the front of the stepped edge of the sides to the groove. Figure 2c shows this, but the concept applies for the other parts in this drawing. Opposing centered dadoes house a short divider, as you can see in Figure 2a. This section can be glued and screwed together.

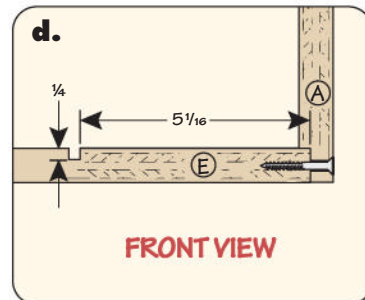
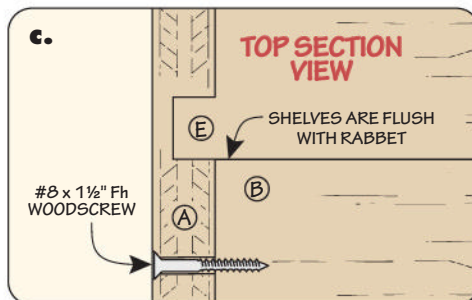
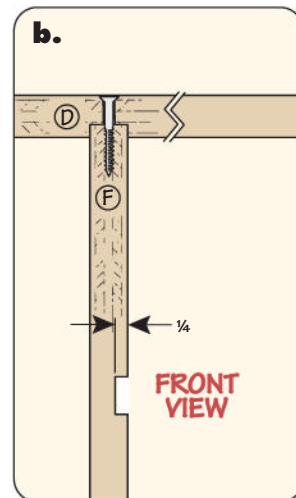
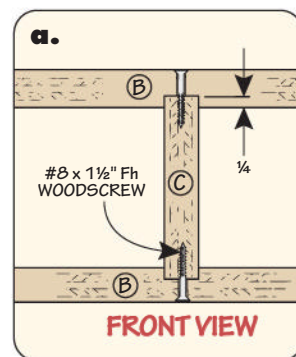
LOWER SECTION. There's more going on down below. The worksurface and case bottom are the same length as the drawer shelves (just different widths). These also have the same centered dado. The bottom holds a groove for the back and a few more dadoes on its right side, as shown in the Top View drawing at right. These are narrow and meant to hold hardboard dividers to help organize the space.

The lower divider comes next. I assembled the sides, worksurface, and bottom without glue to determine the length of the divider. The divider houses dadoes that line up

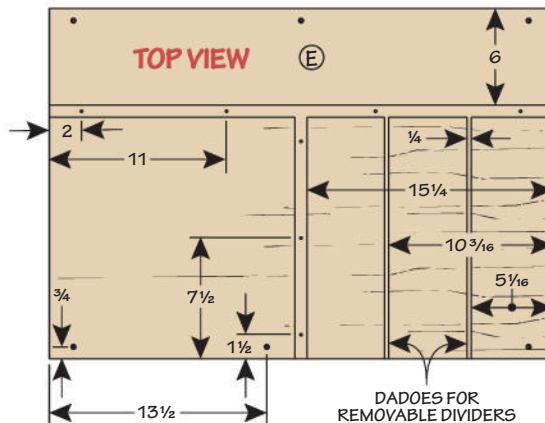
with those in the right case side, as in Figure 2. The lower dado captures a shelf that has dadoes which align with the dadoes in the case bottom. The shelf for the upper dadoes will be addressed on the next page.

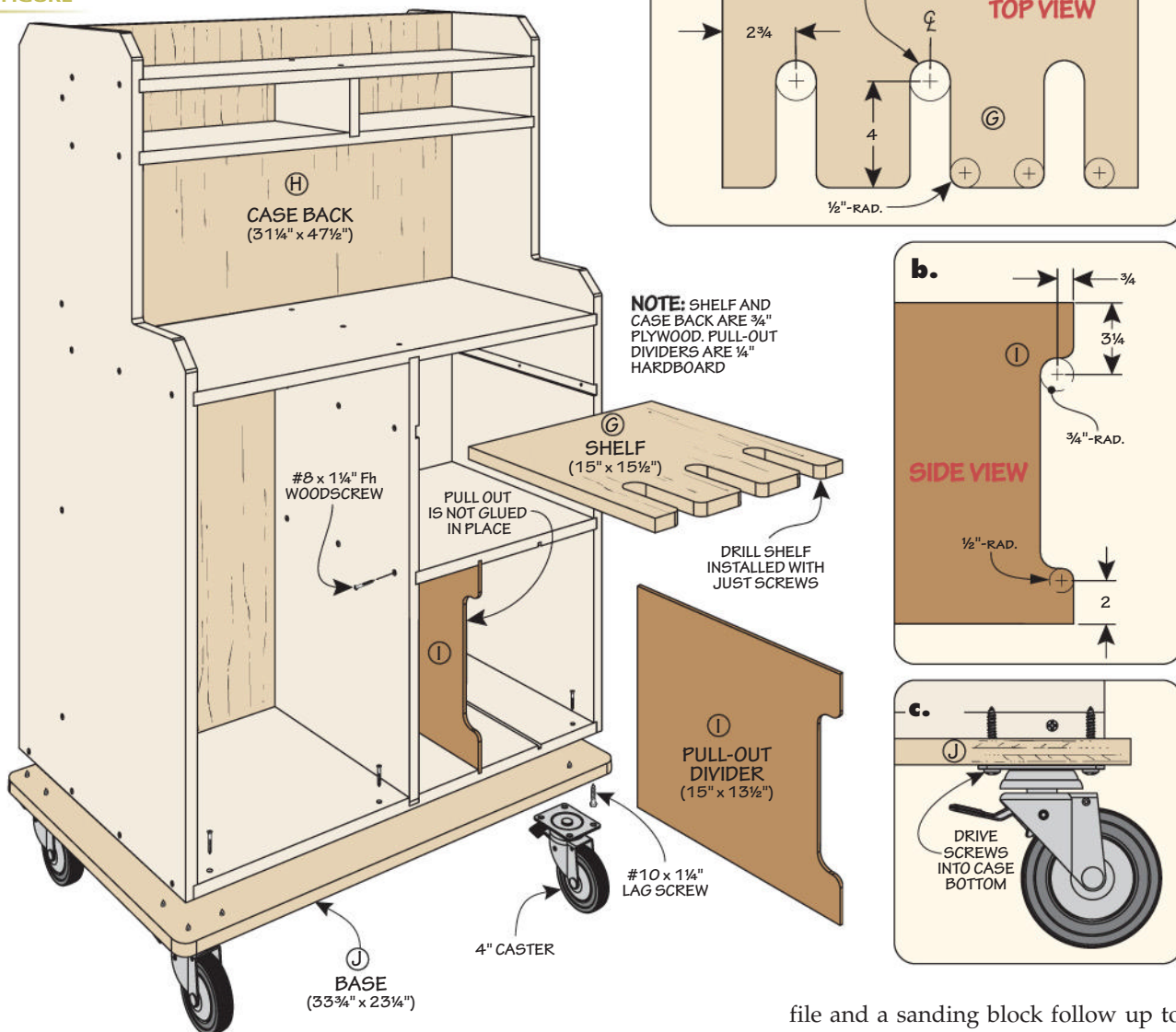
ASSEMBLE, OR NOT. The lower section is ready for assembly. To keep the parts square and aligned, I clamped the sides on as forms (no glue on these). Then I drove screws into the divider from the worksurface and bottom.

With the subassemblies ready, tackle the main case glueup. Apply glue to dadoes on one side. Then insert the drawer case and the lower



assembly. Brush glue into the dadoes on the other side and drop that into place. Cinch on a few clamps to hold the parts while you drive screws through the sides.





Casework Punch List

You may have noticed that the back of the cart is missing from the process so far. Well, there's only so much that can fit on a page. Let's take care of that now. This is a large piece that's cut to fit the opening. I eased the edges with a block plane in order for the back to slide in its grooves with hand pressure. Screws hold the back in place, so you don't need glue, yet I like the added strength glue provides. Dribble glue into the top of each groove. As you slip the back in, glue spreads along the rest of the joint.

A DIFFERENT ORDER. I want to pause for a moment to discuss assembly strategies.

Several woodworkers I know don't like sliding parts into a completed assembly. In their minds, the parts end up undersized, compromising the strength. The part may also bind mid-assembly. If this describes you, feel free to hold off on the case assembly until you have the back cut to size.

CUSTOM OPTIONS. The lower right compartments of this cart are designed for storage. Two options are shown in Figure 3. A shelf features several deep notches to hold cordless tools. Figure 3a shows my layout. This shelf slips into the dadoes and is secured with screws only — in case you want to change it later on.

Form the notches in two steps. Drill out the root of the notch with a Forstner bit at the drill press or with a drill guide. Cut down the sides at the band saw. A

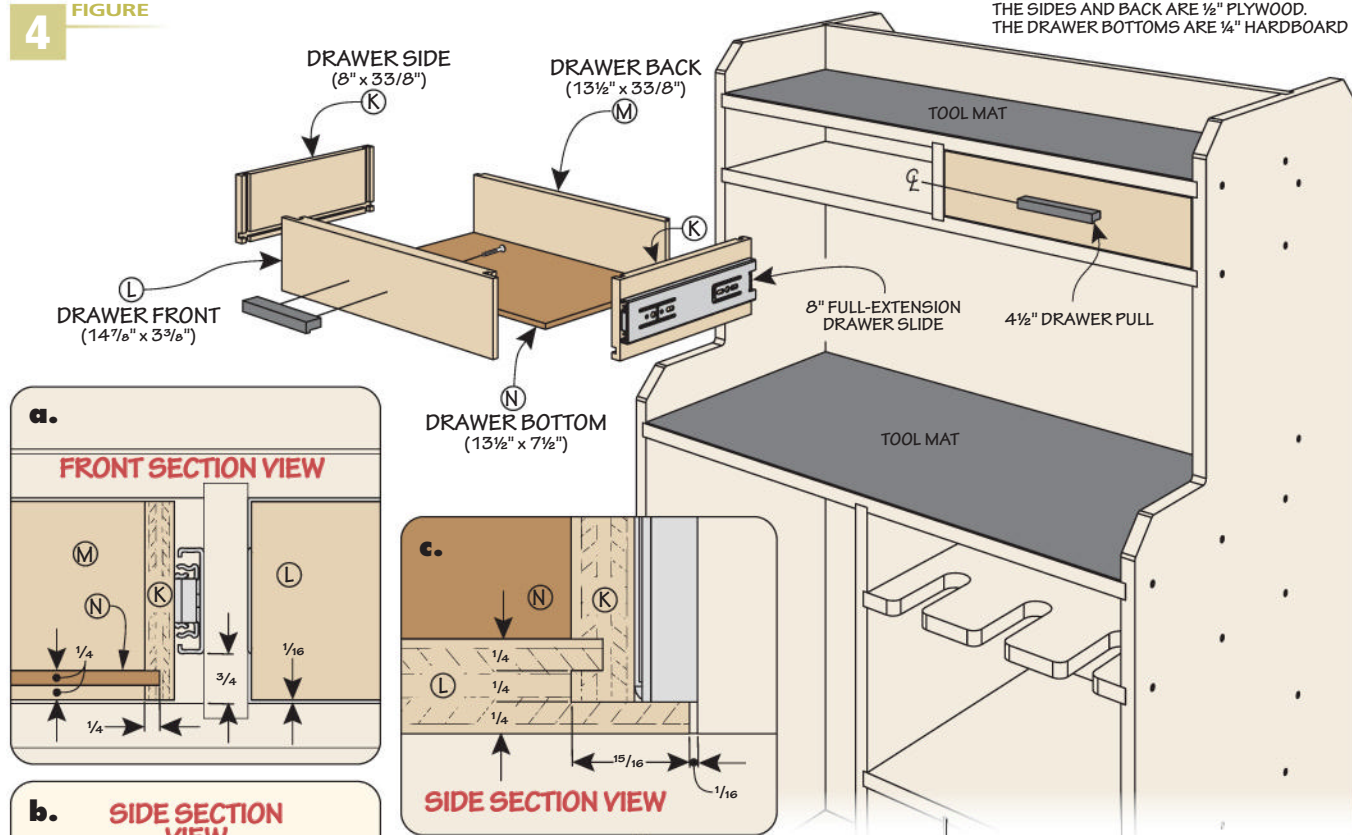
file and a sanding block follow up to smooth away blade marks.

A pair of hardboard dividers partition the bottom compartment. A long relief cut on the front edge permits easy access to whatever you store here, as shown in Figure 3b. John intended these for air nailers and I have to agree. Though a pocket hole jig fits in there nicely, too.

The process to shape the cutout is similar to the drill notches. Here's the difference: after drilling the end radii, I set the band saw rip fence so that the blade cuts along the baseline. Thin hardboard cleans up with a few sanding block swipes.

LET'S ROLL. Without wheels, a cart is just a stand. It's tempting to simply bolt casters to the case bottom. I think it pays to follow the lead of what's shown here. The first thing to do is cut a large base panel. Your ankles will thank you

NOTE: DRAWER FRONT IS $\frac{3}{4}$ " PLYWOOD. THE SIDES AND BACK ARE $\frac{1}{2}$ " PLYWOOD. THE DRAWER BOTTOMS ARE $\frac{1}{4}$ " HARDBOARD



for the radius on the corners. The case is centered on the base and attached with screws. The overhanging edges give the cart a slightly larger footprint and more stability. Just as important are the thicker anchor points for the casters. Two layers of plywood mean you can use longer screws.

This is born from experience. Once while moving a shop cart, the casters caught on a sidewalk seam. The short screws yanked out of the plywood bottom, skidding the cart to a landing.

DRAWERS

Up at the top of the cart, two small drawers add more value than their size indicates. These are an ideal place to stash an extra tape measure, a few pencils, driver bits, and other assembly paraphernalia. And yes, the drawers ride

on full-extension slides. The slides keep the drawers closed during cross-shop maneuvers. The slides also prevent accidental drawer removal on these shallow organizers. That said, you can go without the slides (and gain a little extra space), if you dare.

JOINERY CLINIC. The drawers are assembled with locking rabbets at the front and a tongue and dado at the back. The good news? Each joint begins the same way. Figures 4b and 4c show the structure. Identical dados cut at the front and back of each side anchor the drawer's front and back.

The front of the drawer is made from $\frac{3}{4}$ " plywood. Cut a deep slot across the end to fit the dado in the side. The depth of this slot takes into account the thickness of both the metal slide and the drawer side. The inner flange of the slot gets trimmed back to form an overhang that conceals the slides.

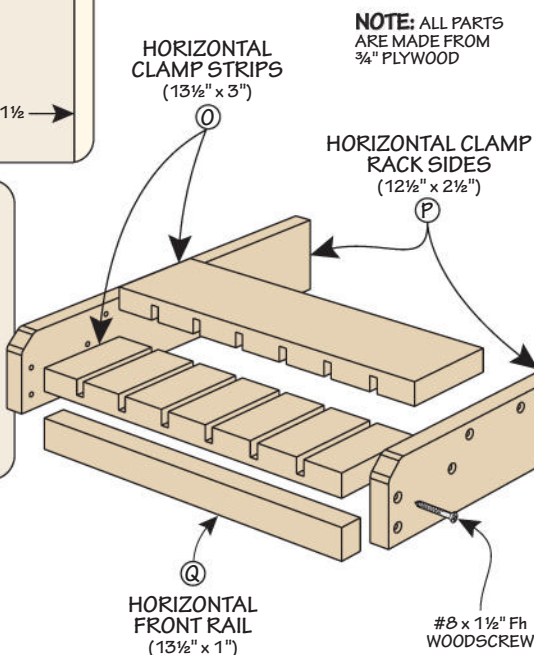
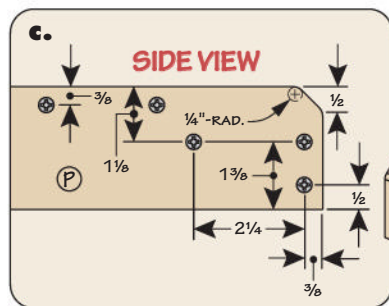
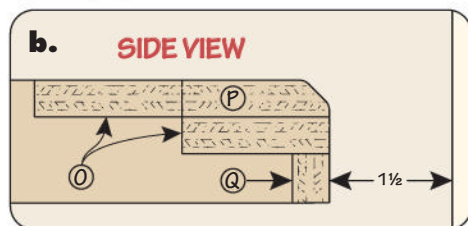
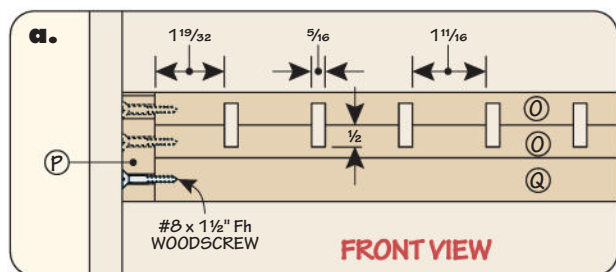
Figure 4c shows a perfectly fitting joint. However, I usually leave a hair of a gap where the inner flange fits into the side. This way, the drawer side seats against the front. To my mind, this makes sure the joint is tight.

THE BACK IS EASY. Naturally, the back of the drawer requires less fussing than the front. Here all you need to do is form a tongue on each end of the back. I aim for a press fit and for the side to bear tight against the shoulder of the joint, as shown in Figure 4b.

Wrap up the joinery work by cutting a groove around the inside edge of all the drawer parts. This is shown in Figure 4a. Clamp the drawer parts together (sans glue) to determine the final size of the drawer bottom. Take your time as you trim these parts. I like a close fit so that the bottom helps square up the drawer when the glue and clamps go on.

WRAP IT UP. The slides and a slim pull complete the drawers. Figure 4a shows the mounting location of the slides. The pulls are centered on the drawer front.

John recommends topping the upper shelf and worksurface with cushioned tool mats. That the mats protect the plywood is secondary. His main goal is to eliminate a harsh, loud surface when items get set (dropped) onto them. From a visual standpoint, the mats break up the color of the plywood, too.



NOTE: ALL PARTS ARE MADE FROM 3/4" PLYWOOD

NOTE: IN OUR VERSION, CLAMP RACKS ARE SPACED 4" APART

Mix & Match Organizers

What remains on this project are the clamp holders — kind of the whole purpose for this cart. What's nice here is that the cart provides several large areas to fill with holders, racks, and trays. It doesn't matter what your clamp collection looks like.

On these pages, I show several clamp organizers. They're designed around bar clamps. The focus here is on case, panel, and frame assemblies.

HORIZONTAL RACK. Let's start with the lower compartment on the front of the cart. This section is deep (15"). That's too deep for the usual suspects in clamp storage. The solution John chose was a clever rack that holds F-style bar clamps horizontally. We fit three racks into that space. You could easily add a fourth. The compartment accepts clamps with a 12" capacity.

Figure 5 shows their construction. The main part of the rack consists of a pair of offset clamp strips with dadoes in them (Figure 5a). You just slide the

clamps into the dadoes and their weight holds them in place. The completed clamp rack is sized to fit the opening in the case.

Creating perfectly aligned dadoes starts with a wide plywood blank. To support the blank, I attached an auxiliary fence to the miter gauge and used the rip fence to position the dadoes at the desired locations. After completing the dadoes, just rip the clamp strips to final width.

Screws connect the strips to long sides, as in Figure 5c. Notice in Figure 5b how the two strips are staggered with each other. The upper corner of each side is relieved with a chamfer. The last part of the rack is a rail that tucks under the lower clamp strip. This increases the stiffness of the assembly. A rack full of clamps is heavier than you think. A few more screws attach the completed rack to the cart.

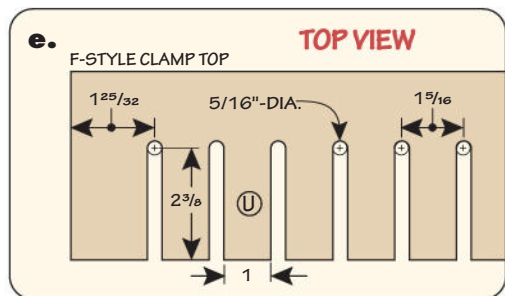
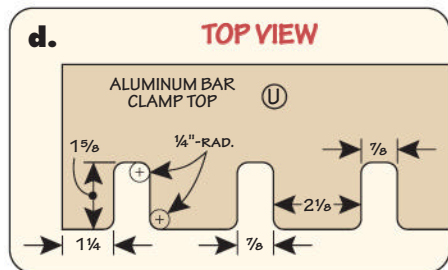
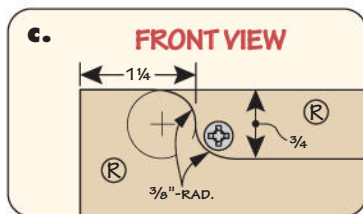
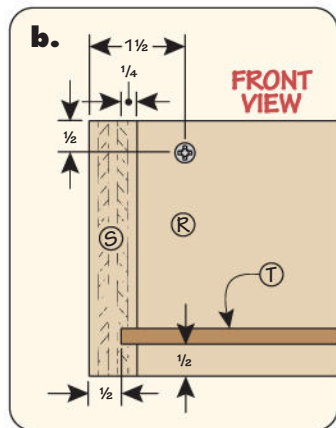
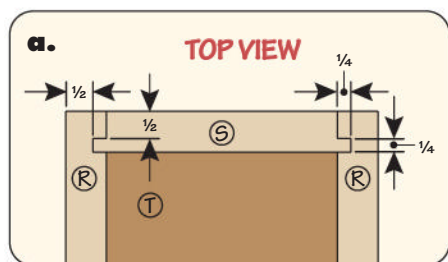
A QUICK TIP. In this orientation, it's tough to see the length of the clamp. To

avoid playing "guess the clamp size," I like to label the head of the clamp with its capacity.

ON THE BACK

The back of the cart presents a larger canvas, as shown in Figure 6 on the next page. It's also much shallower than the front compartments. This is the place to tuck in your longer clamps. Clamp racks aren't the only options, though.

YOU'LL NEED A TRAY. One of the other clamp carts in the shop has a couple of trays. These have proven to be practical enough that John included one here. The obvious reason is to hold glue bot-



6 FIGURE

TRAY SIDE
(4" x 4 3/4")

TRAY
FRONT/BACK
(4" x 15 3/8")

F-STYLE CLAMP TOP
(4" x 15 3/8")

CLAMP RACK BACK
(3 1/4" x 15 3/8")

TRAY BOTTOM
(4 3/4" x 14 3/8")

NOTE: TRAY BOTTOM
IS MADE FROM
1/4" HARDBOARD.
ALL OTHER PARTS
ARE 3/4" PLYWOOD

ALUMINUM BAR
CLAMP RACK

F-STYLE
CLAMP RACK

ALUMINUM BAR
CLAMP TOP
(15 3/8" x 4")

#8 x 1 1/4" Fh
WOODSCREW

CLAMP RACK
BRACKET
(3 1/4" x 3 1/4")

tles and keep them from tipping while you wheel the cart around the shop. It's sort of shocking how many different types of glue one accumulates. The trays work well for storing small clamps (band clamps, C-clamps, etc.) or other assembly accessories. Again, these multiply like rabbits.

The construction of the tray is shown in Figures 6a and 6b. The corners are assembled with tongue and dado joints. Cut a dado at each end of the front and back. Then tongues are formed on the ends of the sides.

TRAY RELIEF. Take a look at Figure 6c. This shows a relief cut along the upper

edge of the tray front. This provides easier access to the tray's contents. This sort of detail I like to form by drilling the ends of the relief with a Forstner bit. Then cut along the lower edge at the band saw. Clean things up with a file and sanding block.

MORE CLAMP RACKS. The rest of the back is populated with conventional clamp racks. These consist of a top and a back supported by a pair of brackets. Notches cut in the top accept the bar of whatever clamps you have. This rack is meant to hold a set of long pistol-grip clamps as well as a handful of aluminum bar clamps.

The size and spacing of the notches is shown in Figures 6d and 6e. You may need to alter these to suit your own clamps. The spacing of the notches is

determined by the size of the clamp head. Just like the relief on the tray, I formed these notches by drilling out the root of the notch at the drill press. The sides of the notches are formed at the band saw.

After cutting the backs, cut a batch of brackets. These are angled to eliminate a sharp corner at the bottom.

The length of the clamps determines the rack's location on the cart. It's a good idea to make a second rack to support long clamps. This keeps the bars from clanging like wind chimes as you move the cart around your shop.

My shop isn't large enough to hold a dedicated assembly zone. A cart like this lets you transform the area around it into a glue-up headquarters when the need arises. That makes an anxious task more inviting.

Custom Leather Tool Holders

Here are a few ideas for protecting your edge tools.

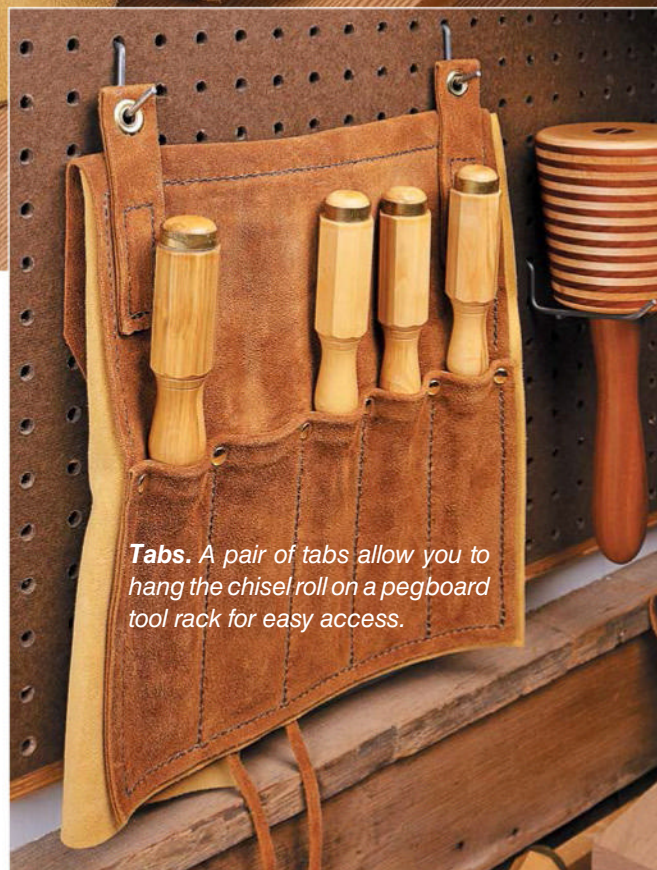
Purchased leather tool holders make it easy to both protect and transport edged tools like chisels, scrapers, and even small planes. The only problem is that these tool holders are expensive and usually designed to accommodate a specific set of tools.

The good news is you can easily make your own custom tool holders. The techniques you'll use are detailed starting on page 3. In the photo above, you can see how to combine these techniques to make a chisel roll, block plane pouch, and scraper wallet. Of course, you can also mix and match those techniques and these ideas to design your own tool holder.

CHISEL ROLL

A handy project for just about any woodworker is a chisel roll. It's the most involved of the three projects shown, but it's still pretty straightforward to make.

It has a couple of features that aren't found on traditional rolls. The first is the large upper flap. This helps hold the set



Tabs. A pair of tabs allow you to hang the chisel roll on a pegboard tool rack for easy access.

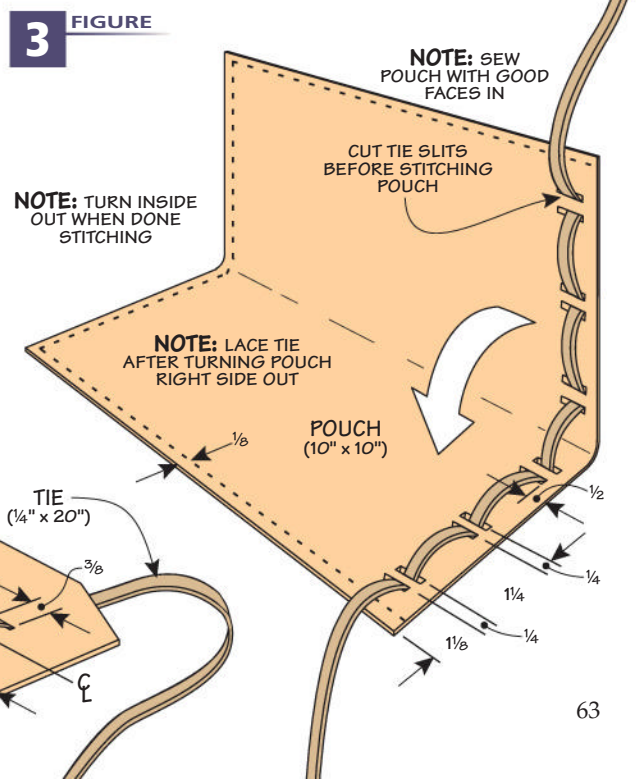
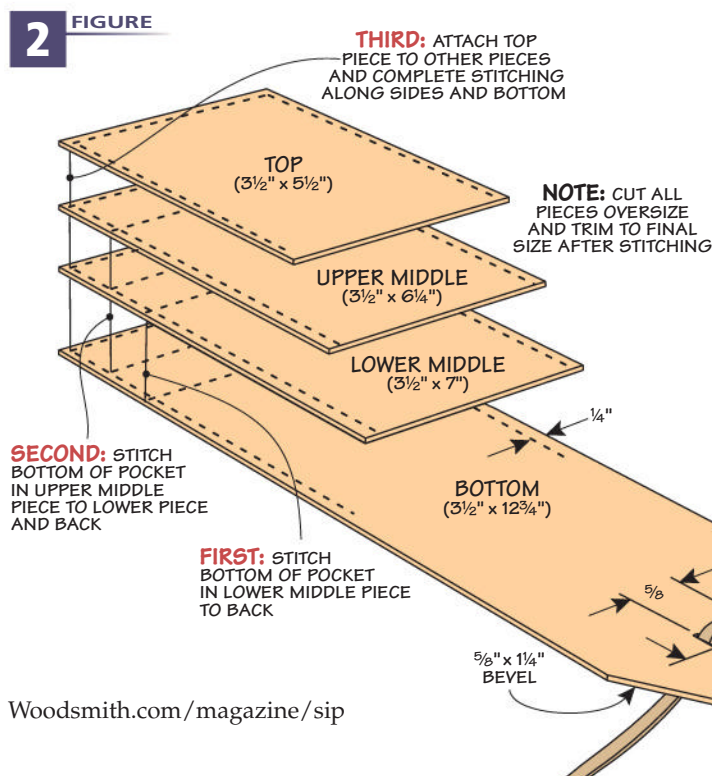
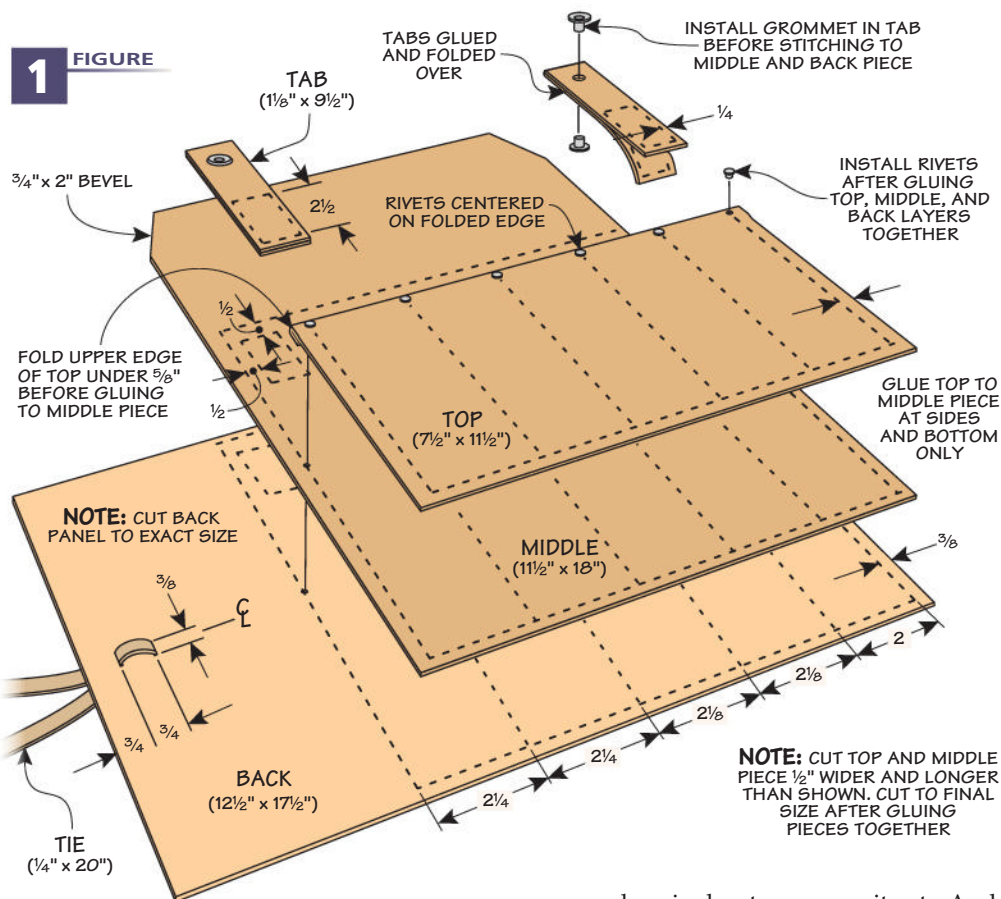
This chisel roll holds a set of five chisels. However, you can modify the layout and even the size of the pockets to match your tools.

TIE CORD. All of the projects are secured with a simple tie cord. The cord is made by cutting a narrow strip of leather and held in slits.

Another easy project is the scraper wallet. This is really just a sandwich of leather pieces that creates pockets for the scrapers. In order to access each scraper, they're set in staggered pockets. To create these, you'll need to assemble things in the right

In Figure 3 at lower right, you can see that the final project — a block plane

This pouch is made from just a single piece of leather. It's sewn inside out along the bottom and one edge to form the pouch, then reversed.





Steps for Leather Projects

Create rugged, great-looking tool holders with just a few tools, some scraps of leather, and an afternoon.

I've always admired the leather tool rolls many carvers use to protect their knives and gouges. The idea seemed perfect for other woodworking tools as well. But I always thought working with leather required a lot of special skills, tools — and sewing.

As it turns out, working

with leather is a lot simpler than it looks. And in a few hours, you can make a custom tool holder from some small, inexpensive pieces of leather.

Making a tool holder out of leather has a few advantages. Leather cuts and shapes easily and can be fastened in several easy-to-master ways: gluing, stitching, and rivets. And the order of “construction” is similar to woodworking. You start by cutting pieces to size, then shape them to fit. Finally, the pieces are joined together.

After taking a look at the essentials, you can try your hand at Leather Tool Holder, or you can design one to suit your tools.

GETTING STARTED. With so many different types of leather available, choice can be overwhelming. I chose split

suede because it's thin and flexible. This makes it easy to stitch together, but it's still tough as nails. You can usually find it at craft and fabric stores or from a leather supply store. (Sources are listed on page 97.)

LAYOUT & SIZING

You really only need a few things to cut leather. The first is a smooth, flat work-surface. I used a plastic, “self-healing” mat, as you can see in the left margin photo.

The second thing is a cutting tool. I found that a utility knife with a fresh blade works just fine.

The final item is a straightedge. For this, you can turn to a framing square. It's just the right length to handle the size of pieces you'll be working with and helps to lay out square corners.

LAYOUT. Spread the leather on your work-surface and look it over to get the most out of the pieces. Be on the look-





Cutting Leather. A framing square guides a sharp utility knife as you cut through the leather in one pass.



Folded Edge. Rub the leather with a piece of metal to create a "crease." Then glue the mating faces with contact cement.

out for stains, brands, or holes. Keep in mind that one piece may be covered with another, so you don't always need a piece with two "perfect" faces.

DON'T MOVE IT. Once you have the location picked out, center it on your work-surface and mark out the pieces with some chalk. Since the leather can stretch and distort as you work, you don't want to move it around while you're cutting. This can result in rounded corners and wavy edges. So it's best to leave it in place and just reposition the square to make the cuts.

Sizing each piece of leather is determined by how it'll be used. For example, if a piece will be layered and matched

edge to edge with another, it's a good idea to cut both pieces a little oversize (about $\frac{1}{2}$ "). Other pieces can simply be cut to the exact size you need.

MAKE THE CUT. To make a cut, press down firmly on the framing square and slice completely through the leather in one pass (left photo above). Then reposition the square to make other cuts.

PREPARE THE SEAMS. Once you have the parts cut, you can lay out the seams for stitching. You can draw the seams in place with a pencil, but most of the time I use an auxiliary vise called a "stitching pony" to guide the stitching (refer to the box below). To keep the pieces

aligned, I glue the parts together with contact cement.

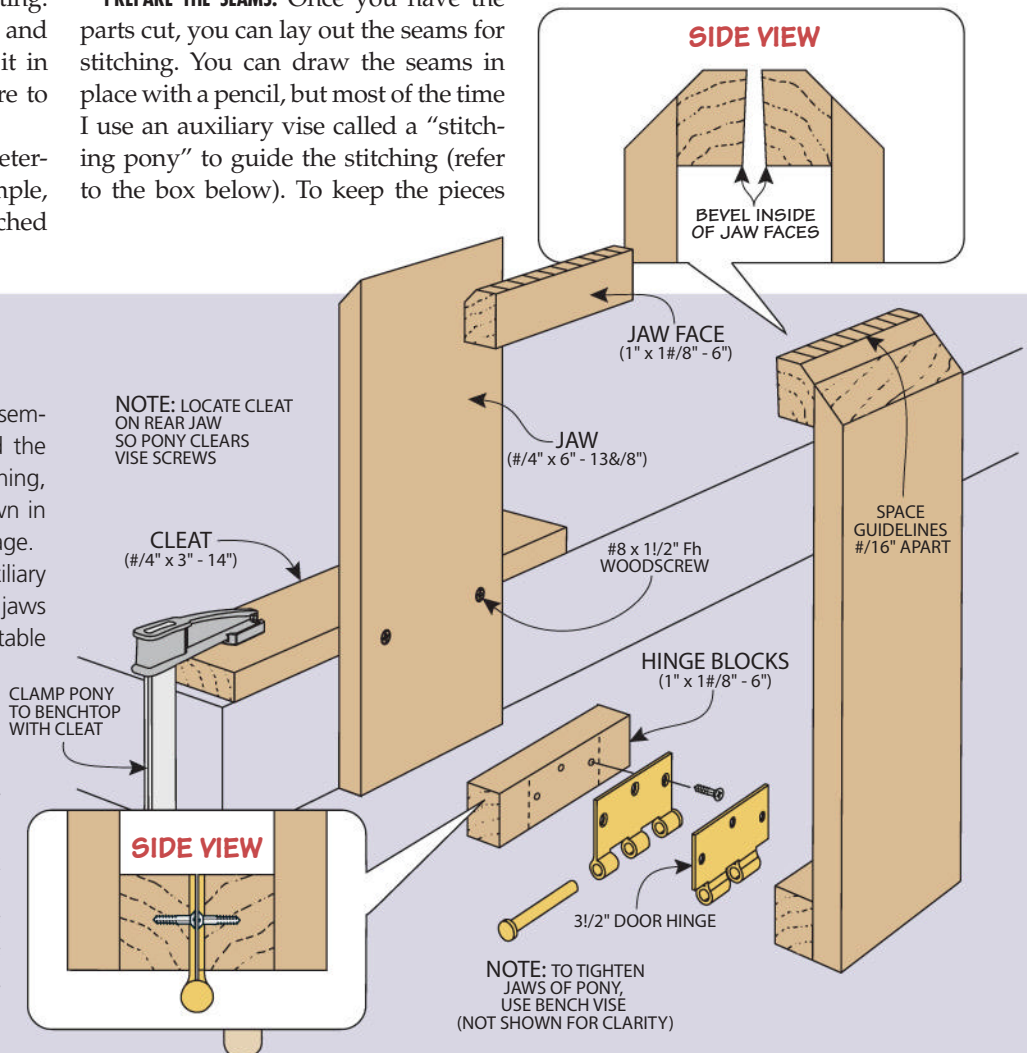
FOLDED EDGE. There's one other thing you can do with the cement. And that's create a folded edge. You can see it on the top of the chisel pockets on the tool roll. It's a good way to create a smooth, durable edge. The right photo above shows you how it's done.

Stitching Pony

Small leather projects are easily assembled with hand stitching. To hold the parts together and guide the stitching, I made the stitching "pony" shown in the main photo on the previous page.

The pony is basically a set of auxiliary jaws for a bench vise. The long jaws bring the pieces up to a comfortable working height. And bevels on the top edges of the jaws allow easy clearance for stitching, as shown in the drawing at right.

I attached a cleat to the rear jaw so the pony could be clamped to the benchtop. This way, it won't fall out as you loosen the bench vise. The final detail is the series of evenly spaced lines on the top of the jaws. They serve as a guide for spacing the stitches.



Stitching the Leather

At this point, the leather pieces are sized and nearly ready to be stitched. Even though you glued the pieces together, what really adds strength is the stitching. All the stitching is done by hand. And it's surprisingly easy to do. There are a couple of other ways to secure the leather — rivets and grommets — and I'll talk more about these later.

Before getting into stitching the leather, you need to do one more step. Unlike sewing fabric, the needles are only used to pull the thread through the leather; they don't actually pierce the leather — you'll use an awl for that.

PUNCHING HOLES. To do this, place the leather pieces in the stitching pony with the seam aligned with the top of the jaws, as you can see in the photo above.

When punching the holes, you'll use

a diamond-shaped awl. Hold the awl so that one flat of the blade is resting on the pony. This will create a series of angled holes. The angled holes help guide the thread to create a straight seam and keep the leather from tearing.

THREAD THE NEEDLE. Now you're ready to thread the needles and get started stitching. You'll actually use two thick, blunt needles, one on each end of the thread. Threading a needle sounds simple enough. But when working with leather, there are a few twists, as shown in the box at left.

First, to get the thick thread through the needle, flatten the end with your fingers and slip it

through the eye of the needle. To keep the thread from pulling out of the needle as you sew, push the needle between the strands of the thread and pull the thread tight. Finally, twist the loose end around the working length of the thread.

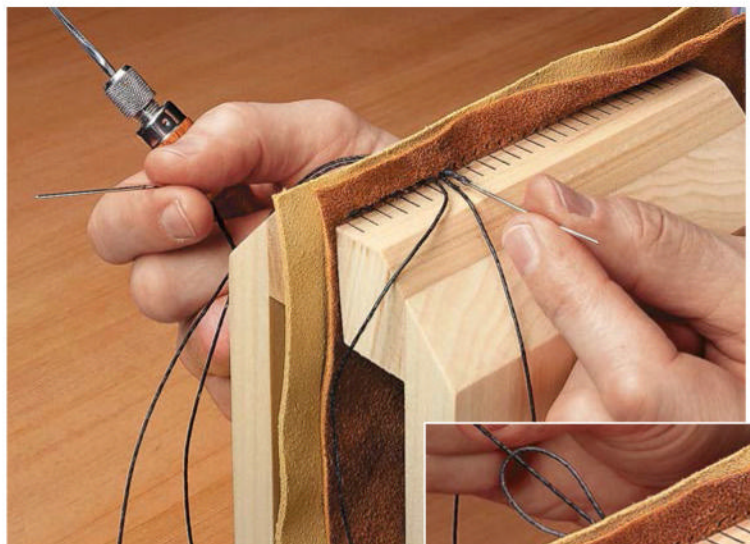
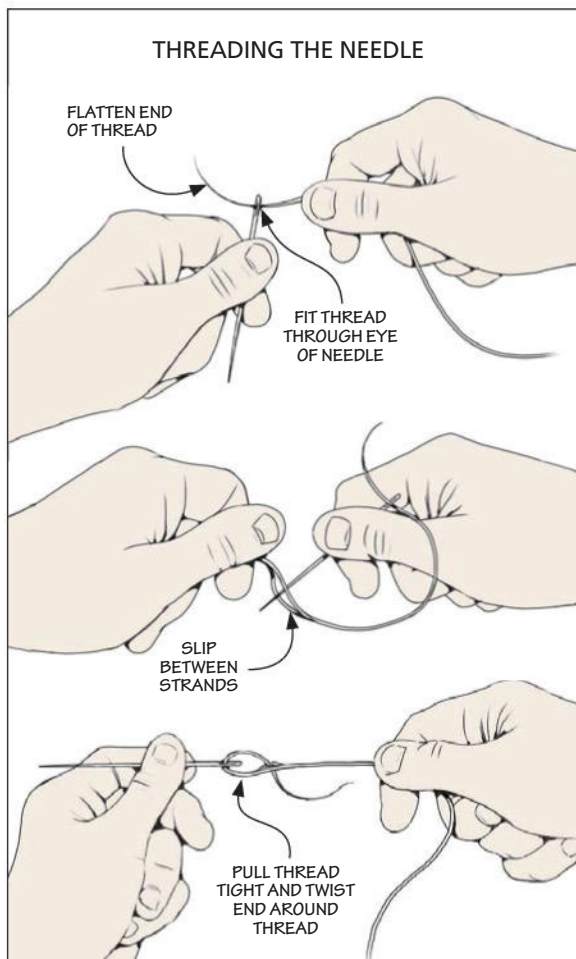
The five-stranded thread is heavily waxed for sewing leather. As you pull the thread, the wax melts a bit to lubricate it, making it easier to pull. Once in place, the sticky wax acts like a glue and helps hold the thread secure.

To keep the thread easy to manage while stitching, I only cut short lengths (just less than a full arm spread). It won't take you long to figure out how much thread you'll need for each seam.

MAKING STITCHES. To start sewing, stand at one end of the pony and thread one



Punch Holes. Align the awl with the guide lines on the stitching pony and pierce the leather to create the seam.



Weaving Stitch. With a needle on each end of the thread, start weaving them back and forth through the holes in the leather. As you complete each stitch, pull the thread snug (inset photo).

needle through the first hole until the thread is centered. Then, with a needle in each hand, cross the needles through the next hole. This creates a strong, interlocking stitch. As you complete each stitch, pull the thread just until it's snug. If you pull it too tight the leather will pucker.

TROUBLESHOOTING. One thing that can trip you up is if a needle runs between the strands of the opposite thread. This creates a snag and prevents you from pulling the stitch tight.

If you catch it right away, you can just back the needle out and continue stitching. Another solution is to cut the crossed thread free. To do this, carefully cut away some strands until the thread is freed up. (You should only need to cut two strands.)

When you reach the end of a seam, you need to secure the stitching so it doesn't pull out. To do this, reverse directions and back stitch two holes. Then cut the thread flush to the surface.

LONG SEAMS. The stitching pony is wide enough to handle most of the seams in the chisel roll. But a few of the seams are longer, so you'll need to shift the leather in the pony. I prefer to punch the holes and stitch as I go before repositioning the pieces.

RIVETS & GROMMETS. Besides stitching, there are some other fasteners you can

add to a leather project to secure pieces together — rivets and grommets.

Rivets work to keep a seam from tearing or loosening at the end. I used these at the top of the pockets in the chisel roll.

Grommets provide reinforcement around holes. They both come in two parts. The parts fit together through a hole and are then "set" to form a strong connection.

PILOT HOLES. The process for installing either begins with a pilot hole. For the rivets, I drilled a pilot hole with a twist bit that's slightly bigger than the stem on the rivet. Just take it easy on the speed, because the leather can climb the bit and get tangled.

To drive the rivets together, you'll need a setter and a steel plate. As you drive the pieces, you can feel them slide together and then bottom out for a solid connection, as shown in the photo above.

Grommets are installed in a similar way. The only real difference is that the hole is larger. To make these holes, I used a 1/4" chisel to make a square hole (see inset photo below). Then you can fit the two parts of the grommet together. Using a setting tool and matching anvil, roll the stem of the grommet tight to the washer (main photo below).

By combining these simple techniques, you can make a wide variety of projects from leather.



Riveting Leather. Fit the stem through the hole and place it on the anvil plate. Place the washer over the stem and tap the pieces together with a hammer.

Rivet Tools. The rivet setter is sized to match the rivet stem. The plate has dimples to accommodate several sizes of rivets.



Anvil & Setter. The tools you need for setting grommets are similar to rivet tools, only a bit larger to match the wider stems.



Setting Grommets. You can quickly create an opening for a grommet with a few chisel cuts (inset photo). Then place the face of the grommet in the anvil and tap the setting tool to compress the stem.

Garden Arbor

This arbor presents a few challenges — the biggest being its size. But don't let that scare you. It's designed to be built and assembled in small, manageable sections.

Ask me what's different about building an outdoor project, and I'd probably rattle off a list: the different kinds of woods you use, the need for exterior-grade hardware and glue, as well as the different finishing options. But none of these differences really affect the woodworking part of the project — how the pieces are cut and put together.

But this outdoor project is different for another reason — its size. Standing almost 8' tall, this garden arbor is easily the biggest woodworking project I have ever tackled.

Even though there was plenty of woodworking involved in building the arbor, it also challenged me to get out of my usual woodworking "routine." After all, when building a project of this scale, you just can't always approach things the same way.

For instance, cutting a tenon is usually a simple matter on the table saw. Unless the piece you're working with happens to be an 8'-long 4x4 post. This is what got me to reach for a tool I don't

often use: a hand saw.

If it's been awhile since you've used a hand saw, don't worry. The pieces don't have to fit like a glove. In fact, having a little "play" in the fit is what you're after. It allows the arbor to go together easier later on.

OUTDOOR MATERIALS. As for the materials, I built my arbor out of redwood. If redwood isn't available in your region, don't worry. There are a number of other woods that can be used with great results, including cedar, white oak, and Douglas fir.

Because this project will be outside in all weather conditions, it's important to use screws that aren't going to rust and glue that's going to hold. That's why I chose exterior-grade hardware. And

when gluing pieces together, I used *Titebond III*.

OUTDOOR INSTALLATION. Finally, building this garden arbor lets you get outside a bit, too. But you won't need a large crew to put it together. It's designed to be built and assembled in smaller sections, so you can break it down and reassemble it easily.

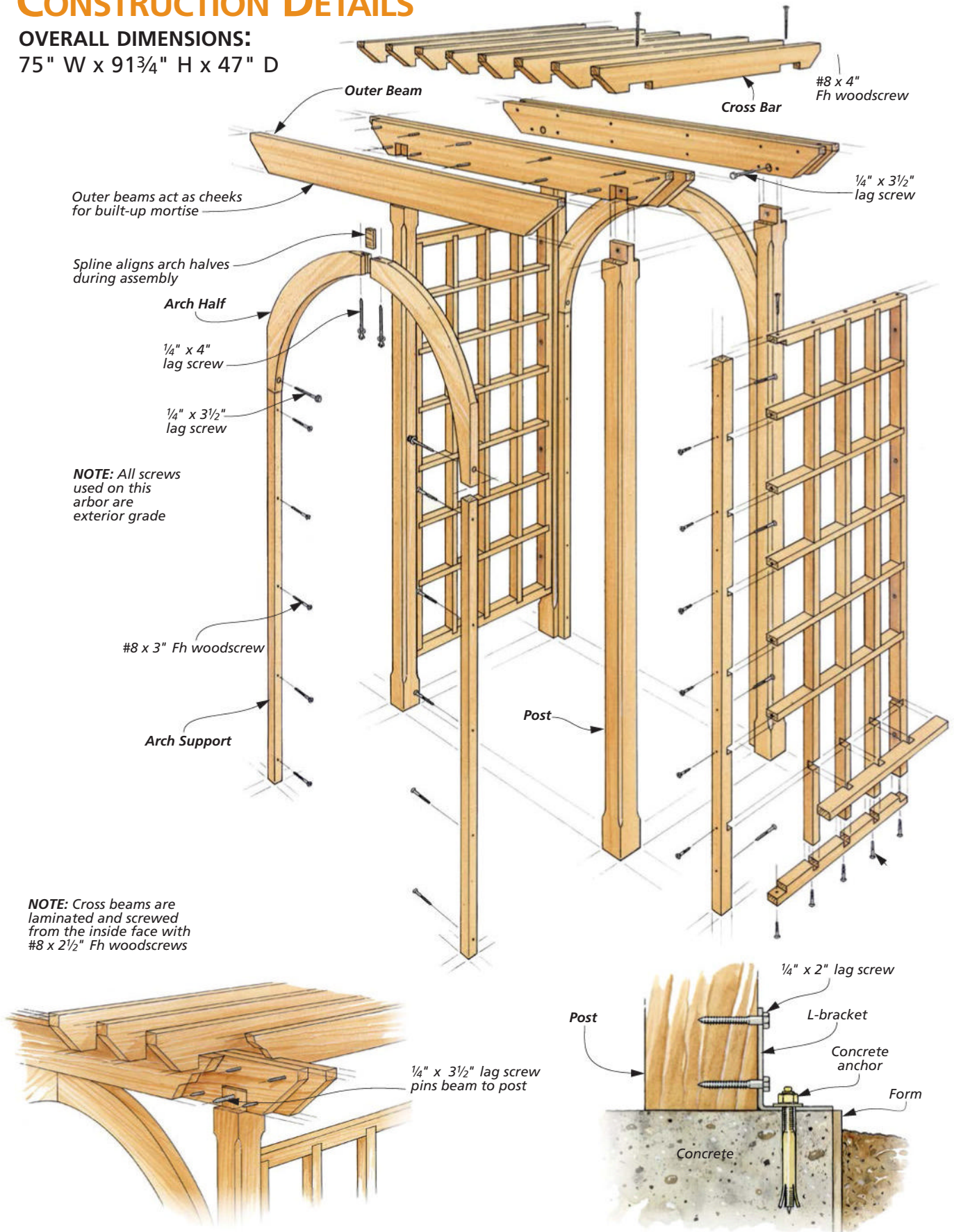
And when the arbor is ready to be installed, you get to be a construction worker for a day. (I was the foreman, of course.) This arbor is set on concrete pads and secured with expandable anchors and L-brackets, as illustrated in the right detail at the bottom of the next page. You'll find a complete description of the installation procedure when you get to page 75.



CONSTRUCTION DETAILS

OVERALL DIMENSIONS:

75" W x 91 $\frac{3}{4}$ " H x 47" D



Side Assemblies

To build the arbor, I started with the side assemblies you see in the drawing at right. Each assembly includes two posts, as well as a lattice screen that connects the posts at the sides of the arbor.

POSTS. I began with the posts. These are designed to be cut from 8'-long 4x4s ($3\frac{1}{2}" \times 3\frac{1}{2}"$). But it's more important that the posts are straight. So if you have a hard time finding straight 4x4s at the lumberyard, you can glue up the posts in three pieces (visit woodsmith.com/magazine/sip for more info). Just be sure to use a weather-proof glue.

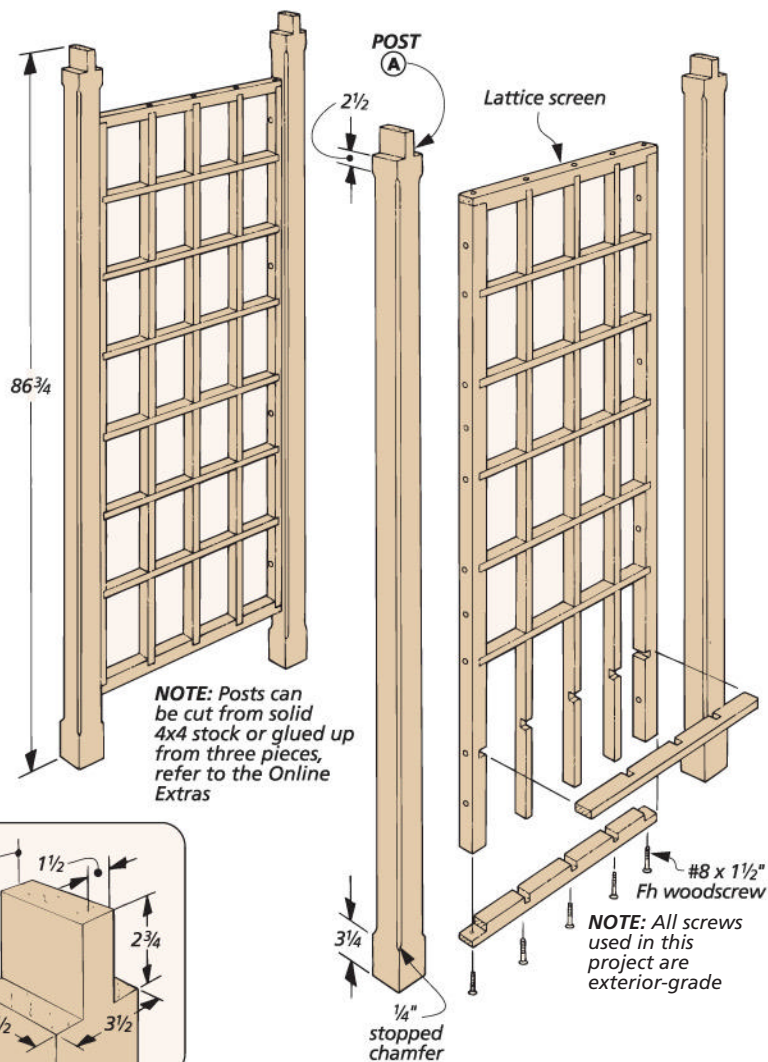
Once you have your posts, the first thing to do is to cut them to final length ($86\frac{3}{4}"$), as shown at right. My first instinct was to use the table saw. But then I realized that these pieces were too long, so I used a hand saw instead.

With the posts cut to length, the next step is to cut the tenon on the top end of each (drawing and detail 'a'). These tenons will fit into the beam assemblies later. And since the mortises in the beams will equal the thickness of "two-by" material, I cut these tenons $1\frac{1}{2}"$ thick.

Because of the length of the posts, I used a hand saw to cut the tenons. Go to the website for details on cutting tenons with a hand saw or circular saw.

All that's left to complete the posts is to rout a stopped chamfer on each edge (drawing above).

LATTICE SCREENS. The next step is to make the lattice screens that join the posts, as shown above. These screens are built

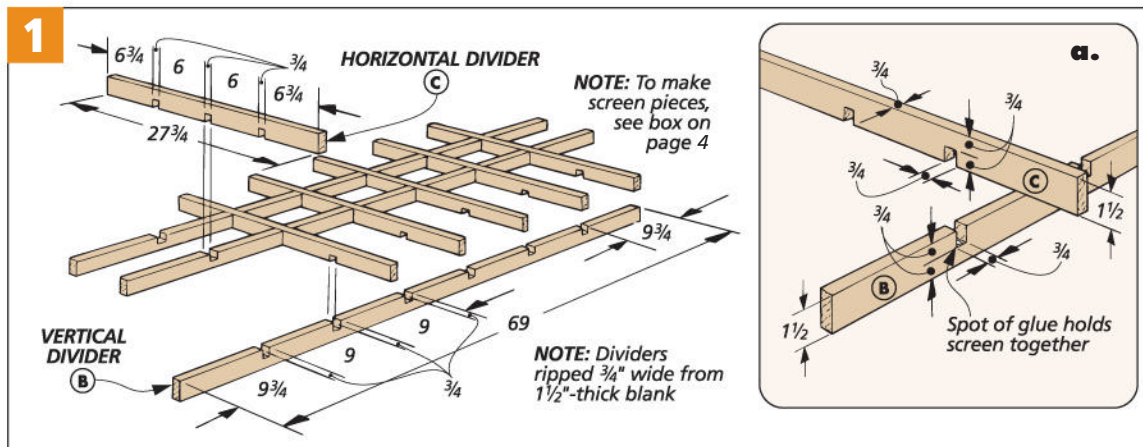


in two steps. First, I made the dividers inside. Then I added the frame that surrounds them (Figures 1 and 2).

SCREEN DIVIDERS. To make the screens, I started with the vertical and horizontal dividers, as you see in Figure 1. And to join these dividers, I used simple half laps.

You might think that cutting all those half laps (and getting them to line up) would be a hassle. But not really. The secret is to lay out and cut a series of notches in 2x8 blanks and then rip the strips from the blanks, as shown in the box on the next page.

After the notches were cut on the



blanks for these pieces, I ripped them $\frac{3}{4}$ " wide (thick). Then I assembled the dividers, putting a tiny spot of glue (*Titebond III*) on each half lap to hold the pieces together.

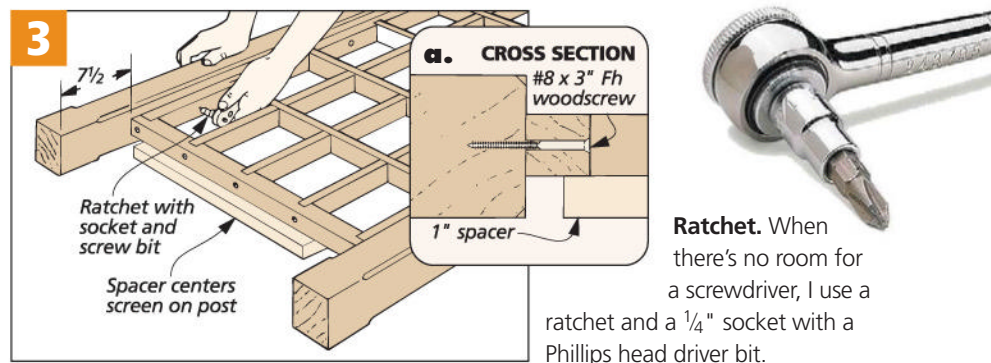
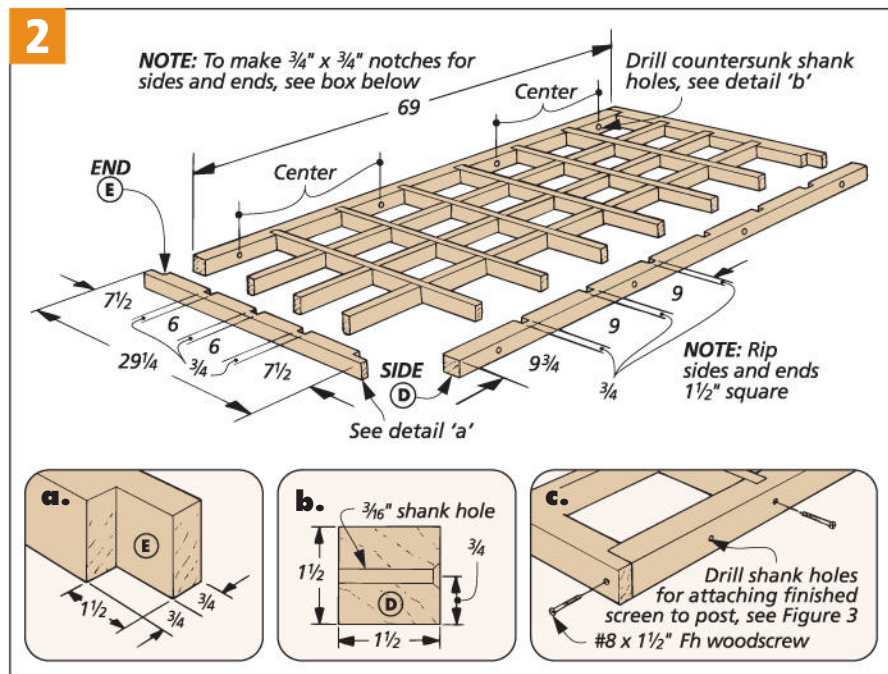
SCREEN SIDES & ENDS. With the dividers assembled, the sides and ends of the screen can be added as a frame around the dividers, like you see in Figure 2. These frame pieces are notched just like the dividers, but here you won't cut true half laps — the notches simply fit over the dividers.

I built the sides first, starting with an oversized blank. But this time, I laid out the pieces by setting them against the divider assembly and marking them from the horizontal pieces. Then after the notches are cut, rip them to width so they match the thickness of the divider pieces ($1\frac{1}{2}$ ").

The screen ends are a little different from the other screen pieces. In addition to the $\frac{3}{4}$ "-wide notches that hold the vertical dividers, the ends also have $1\frac{1}{2}$ "-wide rabbets to hold the screen sides (Figures 2a and 2c).

Before screwing the frames to the dividers, drill a series of countersunk shank holes in the sides, as indicated in Figures 2b and 2c. These holes allow you to attach the completed lattice screens to the posts, like you see in Figure 3. (There's not enough room to do this after you've assembled the screens.)

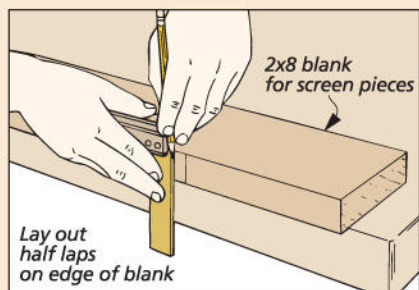
ASSEMBLY. Now the sides and ends can be screwed to the dividers (Figure 2c). Then the completed screens



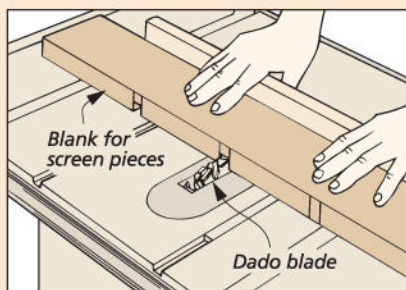
can be screwed to the posts (Figure 3). To do this, I set the screens on spacers to center them on the posts. The only problem is there's not enough room

for a screwdriver. So I used a ratchet and a $\frac{1}{4}$ " socket with a Phillips head driver bit, like you see in the margin photo at right.

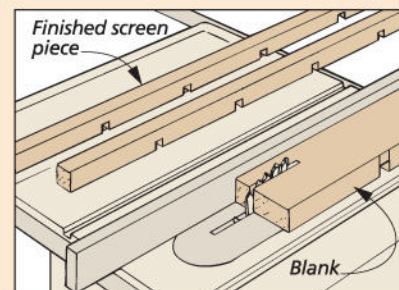
Cutting Screen Pieces



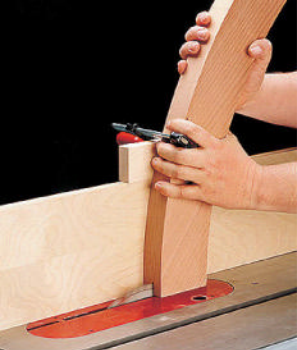
Step 1. First, cut a blank to final length and then lay out the position of the notches on the edge of the blank.



Step 2. Cut a series of $\frac{1}{4}$ "-wide dadoes across the blank, using the miter gauge and an auxiliary fence for support.



Step 3. The last thing you need to do is rip the individual screen pieces to final width (thickness) from the blank.



Tall Fence. When cutting the groove on the ends of the arch halves, I used an auxiliary fence and a scrap runner to support the workpiece.

Arches & Cross Beams

Now that the side assemblies of the arbor are complete, it's time to connect these assemblies at the front and back with arches and cross beams (shown in the drawing at right).

ARCHES. To keep things simple, I made each arch out of two pieces. There are a number of ways to do this, but to make all the pieces identical and keep the waste to a minimum, I started out by making a template.

ARCH TEMPLATE. The arch template starts out as a square hardboard blank (26" x 24"), as illustrated in Figure 4. This will create a 26"-tall arch that will be 48" wide after the halves are glued up.

To lay out the template, I made a simple compass from a piece of scrap. A hole for the centerpoint and two for the pencil determine the final size of the curves (26 $\frac{1}{8}$ " for the top curve, 22 $\frac{1}{2}$ " for the bottom), as shown in Figure 4. I used a nail for the centerpoint, holding it against the corner while drawing the curves (Figure 4a).

Note: The size of the top curve creates a flat spot at the top of the arch. This is intentional — it lets the arch fit tight against the cross beam later (Figure 9b).

ARCH HALVES. Once the template has been cut out and sanded, use it to lay out the arch pieces. Each of the four

arch halves starts out as a 36"-long 2x12 blank (Figure 5). Then you can cut the pieces to shape and sand them smooth.

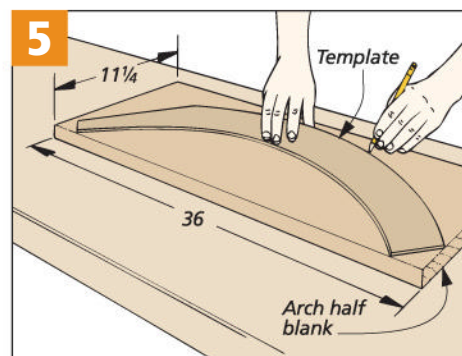
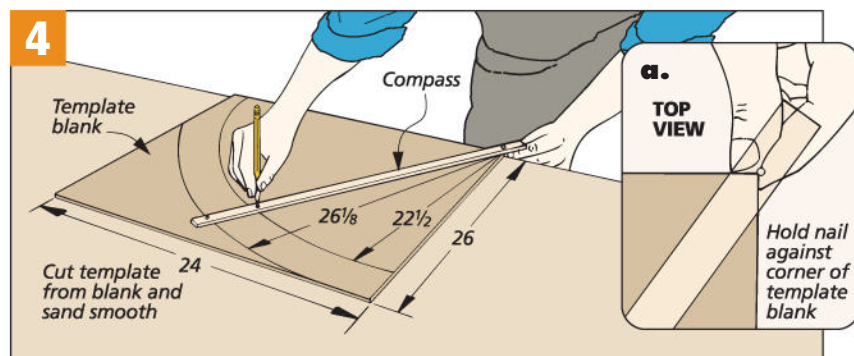
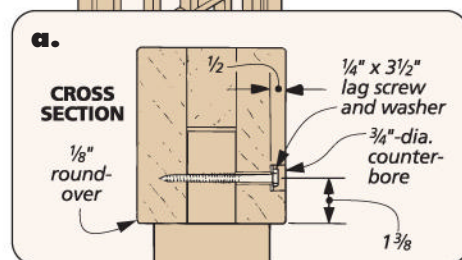
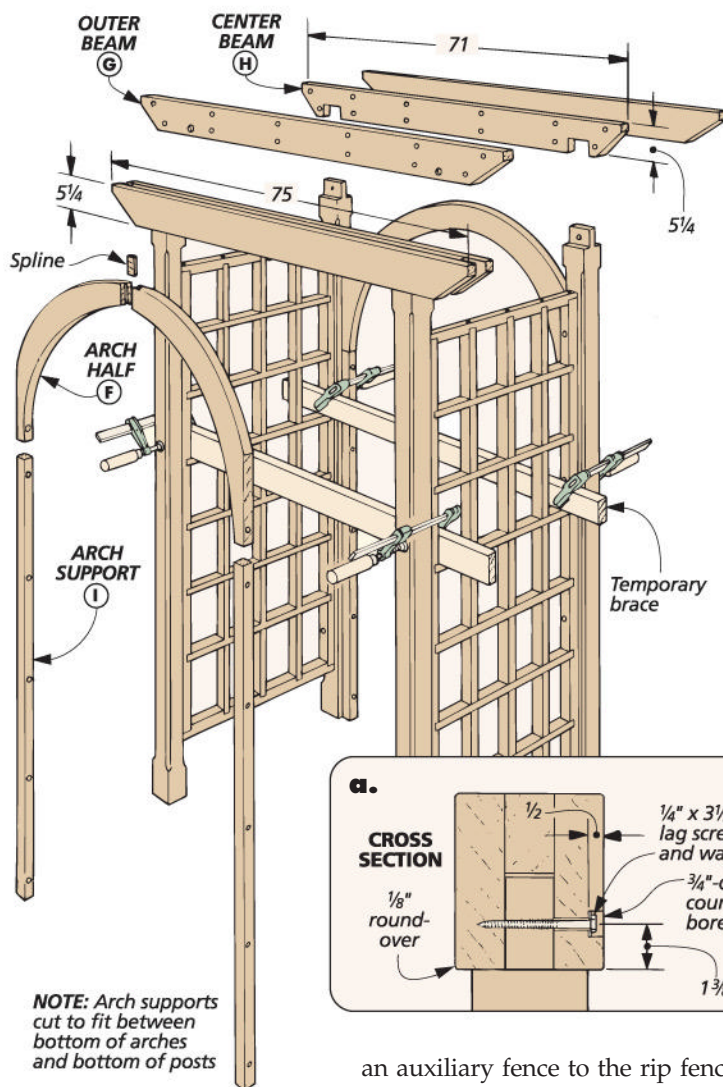
Next, to keep the halves of each arch aligned, I added a spline. To do this, I cut a centered groove in the top end of each arch half, cutting it in two passes (Figure 6).

Note: To prevent the workpiece from tipping as the groove is cut, I attached

an auxiliary fence to the rip fence and clamped a scrap piece to the arch to act as a runner. This is shown in the margin photo at left.

After cutting the grooves on the arch halves, you'll cut splines to fit. Make sure the grain runs across the joint line to prevent the spline from splitting, as in Figure 7a.

ARCH ASSEMBLY. Now the arches are ready to be glued together (Figure 7). To hold the joint, I clamped a pair of



cleats to each piece and then clamped the cleats together.

Since the arches will be “framed in” by the posts and cross beams, it’s important that they end up square. One easy way to check this is to make sure the flat edges along the outside are parallel. So before the glue sets up, measure across the arch assembly at the top and bottom of these flat edges to make sure the dimensions are the same, as shown in Figure 7.

All that’s left to complete the arches is to rout roundovers along the curved edges (Figure 7a).

CROSS BEAMS. At this point, work can begin on the cross beams (main drawing). Each beam is a lamination of three nearly identical 2x6s: two outer beams and a shorter center beam (Figure 8).

Before laminating the pieces, I created the mortises for the tenons on the posts. This is a simple matter of cutting two notches in the center beams — the outer beams will form the sides of the mortise (Figures 8 and 8a). Note: The distance between these notches should equal the final width of the arches (48”).

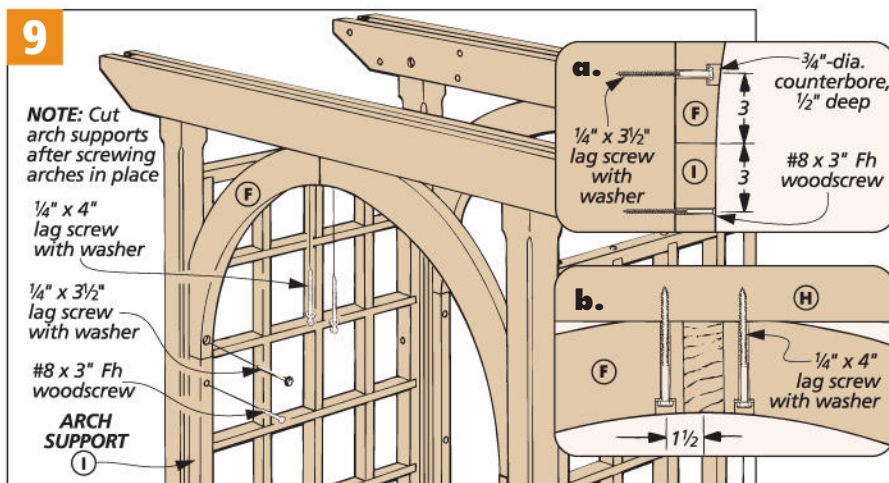
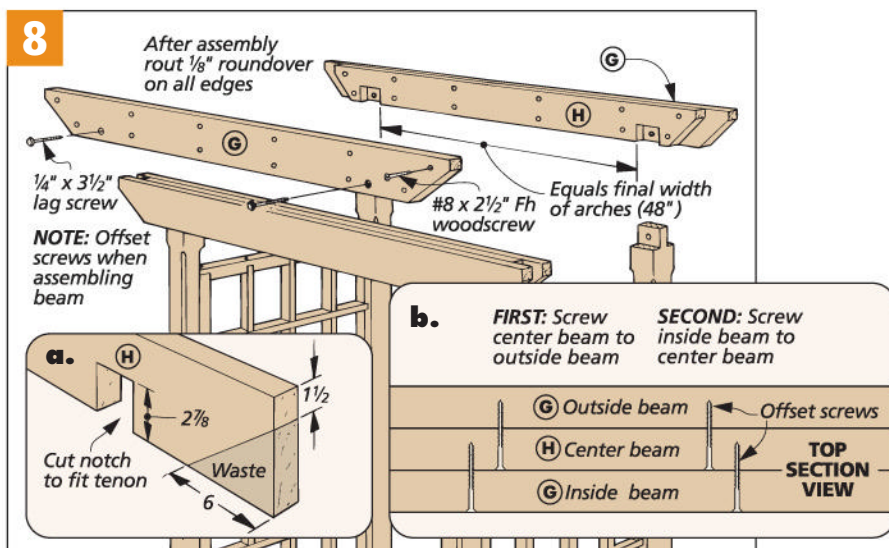
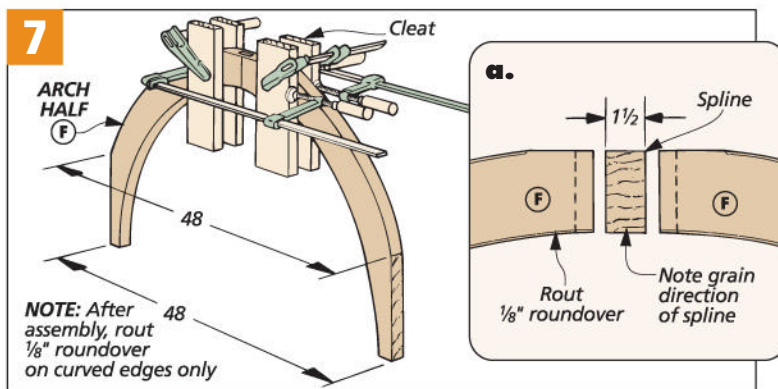
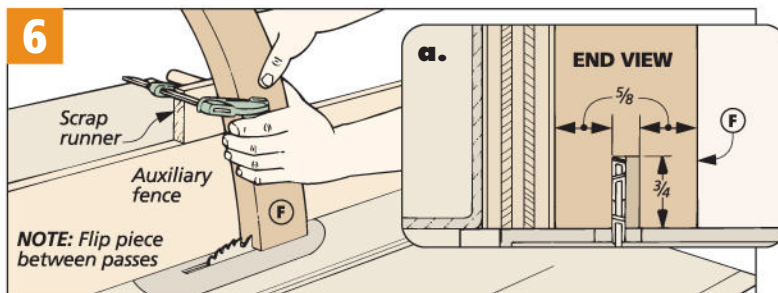
When the notches are complete and the bevels on the ends of the beams are cut, I began gluing and screwing the beams together. Work from the outside in so the screws end up on the inside faces, as shown in Figure 8b. (And be sure to offset the screws.)

When the glue is dry, rout a $\frac{1}{8}$ ” roundover on the edges and drill counter-bored pilot holes so you can “pin” the tenons with lag screws (detail ‘a,’ previous page).

The trick to adding the arches and beams to the posts is standing the posts upright. To make this simpler, temporarily clamp braces across the posts, as illustrated on the previous page.

ARCH SUPPORTS. With the beams and arches screwed in place, I added arch supports to the inside faces of the posts (drawing and Figure 9). These extend from the arches to the bottoms of the posts. And they match the bottom ends of the arches ($1\frac{1}{2}$ ” x $1\frac{1}{2}$ ” with roundovers on their outside faces).

When the arch supports are complete, they’re simply screwed to the posts, as in Figure 9a.



Cross Bars

At this point, the arbor is nearly complete. All that's left to add are the cross bars that lay on top of the beams, as shown in the drawing at right. These bars are notched to fit over the cross beams and are simply screwed in place.

I started by cutting eight cross bars to finished length (47") from 2x4s, refer to the drawing at right.

While these blanks are square, the notches on the bottom edge of the bars can be laid out and cut.

To find the distance between these notches, I measured the distance between the cross beams. (Mine were 28 $\frac{1}{4}$ " apart.) The width of the notches in the cross bars equals the final thickness of the cross beams. (Mine were 4 $\frac{1}{2}$ " thick.) After the notches have been laid out, they can be cut with a hand saw or a jig saw.

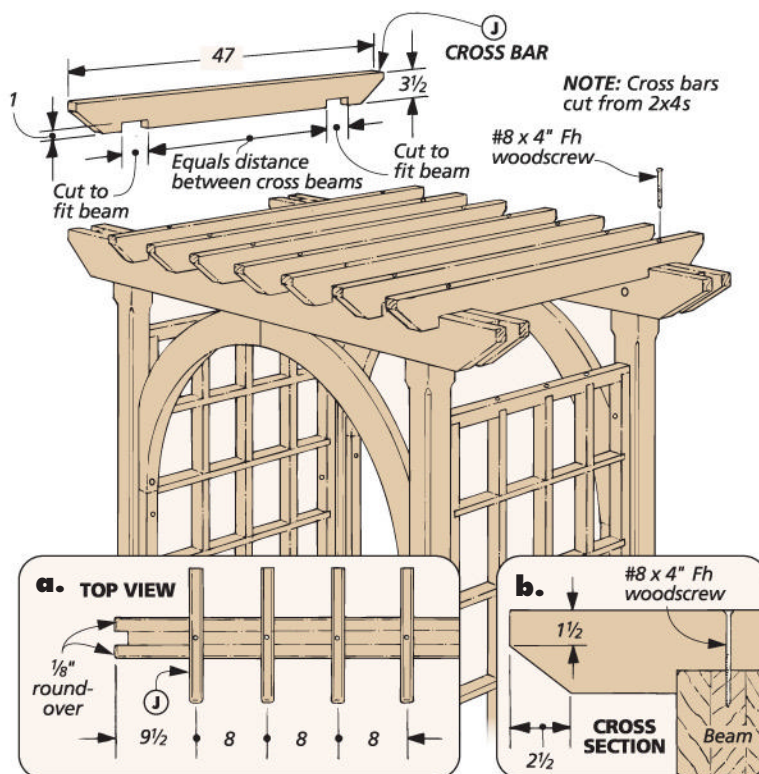
Shop Tip: Instead of laying out the notches on each cross bar separately, I laid out and cut the notches on a single bar. Then I used this bar as a template for laying out the others.

With the notches cut, the next thing to do is cut the bevels on the ends of the

bars (detail 'b'). Like the notches, I laid out and cut the bevels on one bar and then used it as a template for the others.

To complete the cross bars, I routed a $\frac{1}{8}$ " roundover around all the edges, as in detail 'a.' Then I drilled pilot holes for

screwing them to the cross beams. (The bars are spaced 8" apart, as shown in detail 'a.'). But before screwing the bars in place, I disassembled the arbor and applied the finish — take a look at the box below.



Finishing the Arbor

When it came time to finish the garden arbor, I used an exterior, semi-transparent stain. I made this choice based on the following factors: It protects the wood from sunlight. It doesn't hide the clear grain of the redwood. And it evens out any color variations in the wood.

Application. To get the stain into all the corners of the lattice screen and cross beams, it's best to spray the stain on with a spray bottle. Any excess can be wiped off with a rag afterward.

Top Coat. When the stain is dry, the arbor is ready for a top coat. Here, the choice is typically either a spar varnish or a pen-



etrating oil finish. For this project, I chose *General Finishes'* Outdoor Oil. It isn't quite as durable as varnish, but it's much easier to apply. More importantly, you

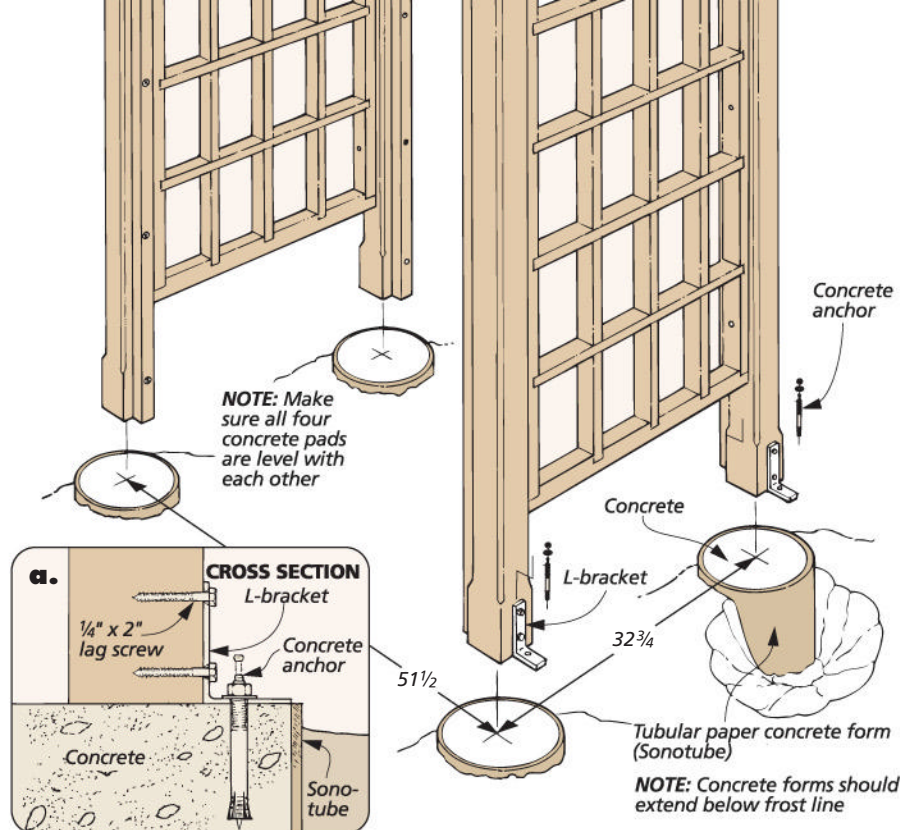
won't need to strip all the old finish off when it's time for a fresh maintenance coat next year (as you would with varnish). Instead, just apply a fresh coat over top.

Arbor Installation

After all the parts of the arbor are finished, the last thing to do is haul them out to your lawn or garden and reassemble the arbor. This isn't terribly difficult. But getting the site ready can be a project in itself. There are a number of ways to install the arbor. But no matter how you do it, the key is to get everything level.

To install the arbor, I used tubular paper concrete forms called Sonotubes, concrete anchors, and L-brackets, as indicated at right.

CONCRETE FORMS. The first thing to do is carefully stake out the location of the arbor. The ground in the area should be fairly level. But rather than trying to level the ground perfectly, I decided to pour concrete pads and make sure they were level. That's where the Sonotubes come in handy. These concrete forms can be set so they end up level with each other. (To check the forms, you can cut a long straightedge and set a level on top of it.)



ANCHORS. Once you've poured the concrete and allowed it to dry, the arbor can be set in place and fastened to the concrete pads. To do this, I used concrete anchors and L-brackets (detail 'a').

There are various types of anchors

you can use. The ones I found expanded when a pin was driven into them. (I had to enlarge the hole in the L-bracket to fit over the anchor). After bolting the L-bracket down, the arbor can be attached with lag screws.

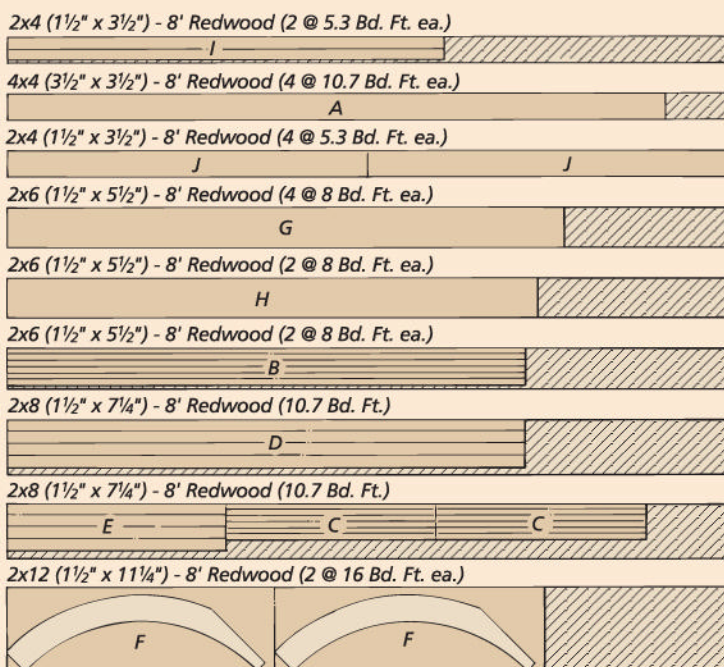
MATERIALS, SUPPLIES & CUTTING DIAGRAM

A	Posts (4)	3 1/2 x 3 1/2 - 86 3/4
B	Vertical Dividers (6)	1 1/2 x 3/4 - 69
C	Horiz. Dividers (12)	1 1/2 x 3/4 - 27 3/4
D	Screen Sides (4)	1 1/2 x 1 1/2 - 69
E	Screen Ends (4)	1 1/2 x 1 1/2 - 29 1/4
F	Arch Halves (4)*	1 1/2 x 11 1/4 - 36 rgh.
G	Outer Beams (4)	1 1/2 x 5 1/4 - 75
H	Center Beams (2)	1 1/2 x 5 1/4 - 71
I	Arch Supports (4)	1 1/2 x 1 1/2 - 58
J	Cross Bars (8)	1 1/2 x 3 1/2 - 47

*Also Needed: 24" x 26" hardboard panel for template

- (4) 1/4" x 4" Lag Screws w/Washers*
- (8) 1/4" x 3 1/2" Lag Screws w/Washers
- (36) #8 x 3" Fh Woodscrews
- (44) #8 x 1 1/2" Fh Woodscrews
- (48) #8 x 2 1/2" Fh Woodscrews
- (16) #8 x 4" Fh Woodscrews
- (4) Concrete Forms and Concrete
- (4) Concrete Anchors
- (4) Mounting Brackets w/Lag Screws

*Note: Use exterior-grade hardware.



Serving Tray Table

This two-part project sets a classy stage for your next get-together. The leg joinery and round tray certainly will keep you entertained in the shop.

Many furniture projects have a “just sits there” feel. It’s not a criticism, that’s the nature of a bookshelf. I for one enjoy when a project has an element of movement or transformation. This little table surprises with exactly that.

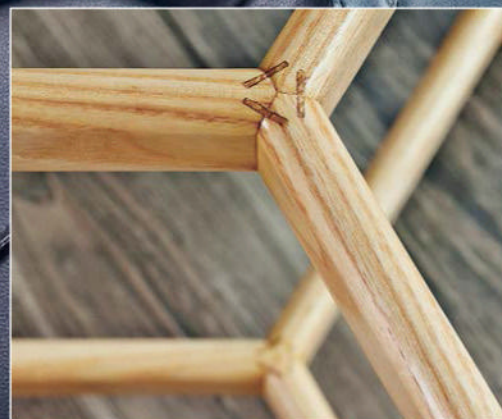
While coming off as a sleek, two-toned side table, the top moonlights as a serving tray. What I like about the effect is its simplicity. There’s no hardware to release or folding of the base. Feet on the tray’s bottom rest in divots in the base’s stretchers.

With two distinct sections, it makes sense to go with different wood species for a pleasant contrast. The tray is cherry. The rich color suits the function of serving and showing off what it holds. The table’s base should feel solid. Here the bold grain lines of ash emphasize sturdiness. The dark and light tones along with the muted and distinct grain patterns complement rather than clash.

Design editor Dillon Baker picked up the movement idea in the design elements. The whole project has a subtle Art-Deco feel to it. You’ll find a circle motif throughout the project: round legs, repeated cove and roundover profiles, and the tray itself. It brings a sense of unity to the various parts and pieces. By the end of the project, you’ll gladly pour a round in celebration of another completed piece.



Coved Tray. The cherry tray works just as well as a standalone piece. You’ll be ready for elegantly entertaining company no matter where they choose to gather.

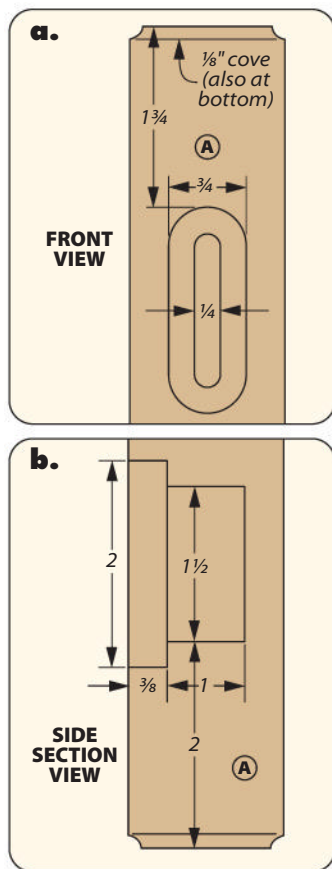


Three Splines. The three stretchers meet with miters in the middle. Thin splines register the parts and increase the joint’s strength.



Legs & Stretchers. Each leg is topped with a small cove profile. The pockets in the stretchers catch feet attached to the underside of the tray.

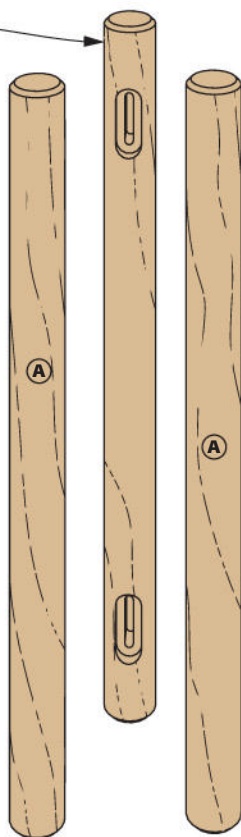




LEGS
(1 1/2" x 20")

NOTE: Legs start extra-long and are cut to length after mortises are created

NOTE: Legs are made from 1 1/2"-dia. hardwood dowels



and be prepared to spend some time sorting through dowels to find three straight, consistently sized specimens. Leave the legs 2" extra long for now.

JOINERY. The second question has to do with forming the mortises in each leg, as in the left drawing. Shop Manager Marc Hopkins answered that one for me. (Whew!) He created the box shown in the drawings below. The idea is to make a round leg blank act like a square leg. A stop in the end registers the top end of the leg. A screw on the opposite end keeps the leg from rotating. (This part gets cut off later.)

STEPPED MORTISE. The top of the box has two slots where the mortises are located. These slots, along with a plunge router, are used to create a stepped mortise. Detail 'a' below shows the main portion of the mortise created with a spiral upcut bit. A guide bushing follows the slot for this cut.

The second part of the mortise provides a seat for the stretcher. This cut is made with a dado cleanout bit. The bearing on the bit follows the edge of the slot, as shown in detail 'b.'

After dancing this two-step on each leg, you can cut them to final length. Each end receives a small cove formed at the router table.

A TRIO OF STRETCHERS

A double layer of stretchers joins the legs, as you can see in the drawings at right.

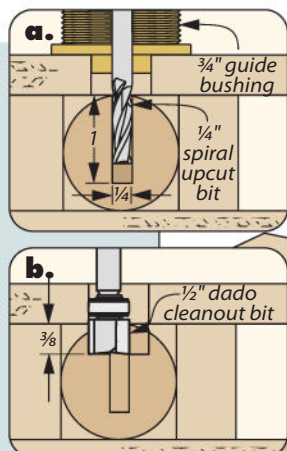
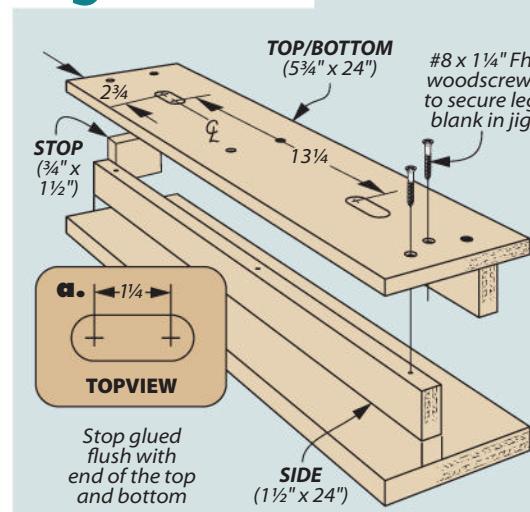
Round Out a Table Base

If you're like me, one of the first questions about this project concerns the round legs. Are they turned? Do you rout them round at the router table? While you can do either of those, we

chose to purchase round legs. You can find the source on page 97.

If you have a good woodworking store nearby, you can pick out 1 1/2"-dia. dowels yourself. Bring along calipers

Leg Mortises

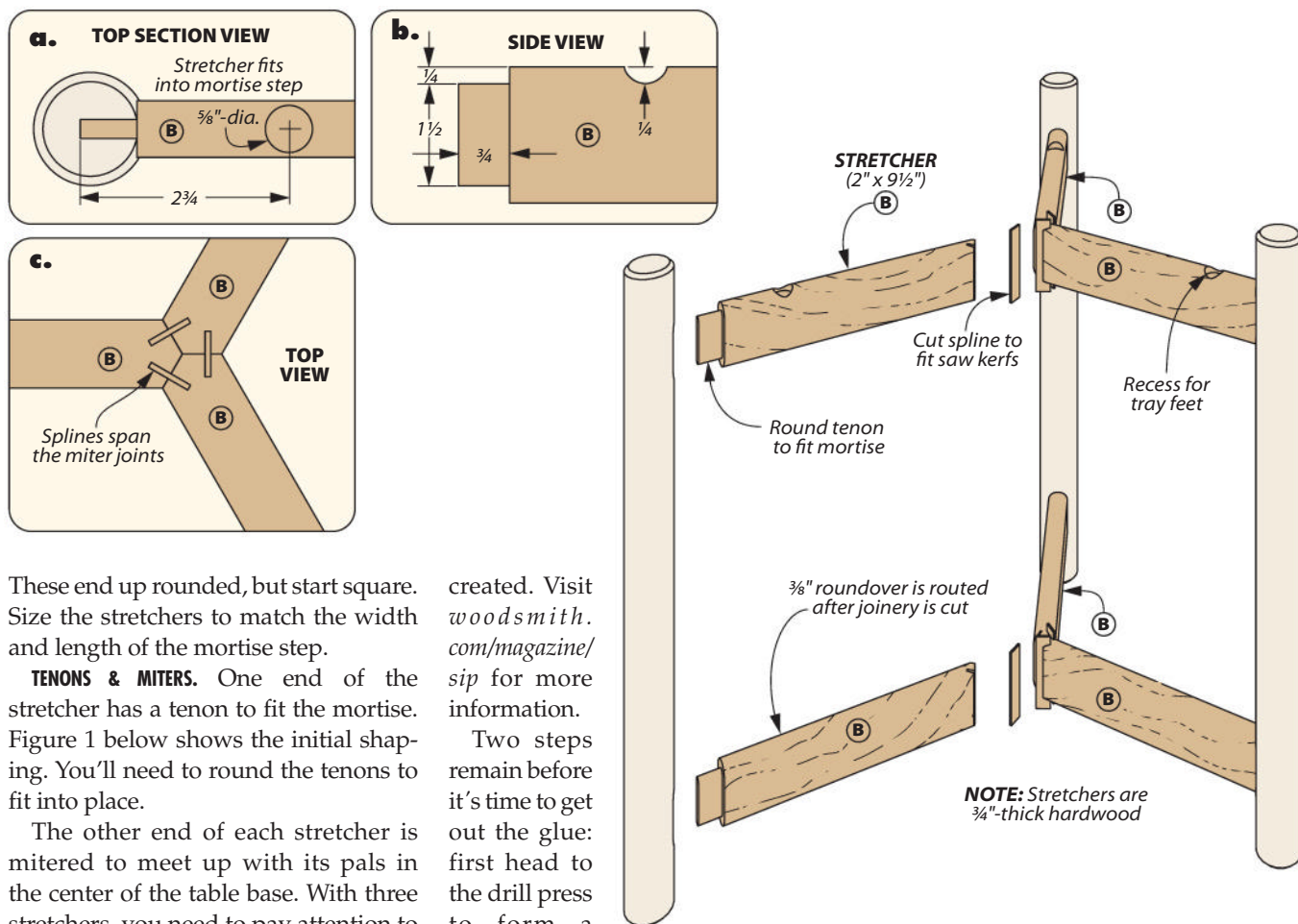


Use plunge router to form mortises in multiple passes

Extra-long leg secured in the jig with a woodscrew

NOTE: All parts are made from 3/4" plywood

Mortising Box. This plywood jig captures a round leg and provides a flat surface for the router to ride along. Openings in the top guide the bits for the stepped mortise.



These end up rounded, but start square. Size the stretchers to match the width and length of the mortise step.

TENONS & MITERS. One end of the stretcher has a tenon to fit the mortise. Figure 1 below shows the initial shaping. You'll need to round the tenons to fit into place.

The other end of each stretcher is mitered to meet up with its pals in the center of the table base. With three stretchers, you need to pay attention to the angle. It isn't your typical miter. Figure 2 has the setup you need.

Three pieces coming together is a tricky glueup. One answer is to reinforce the miters with splines (Figure 3). Another aid is the assembly jig Marc

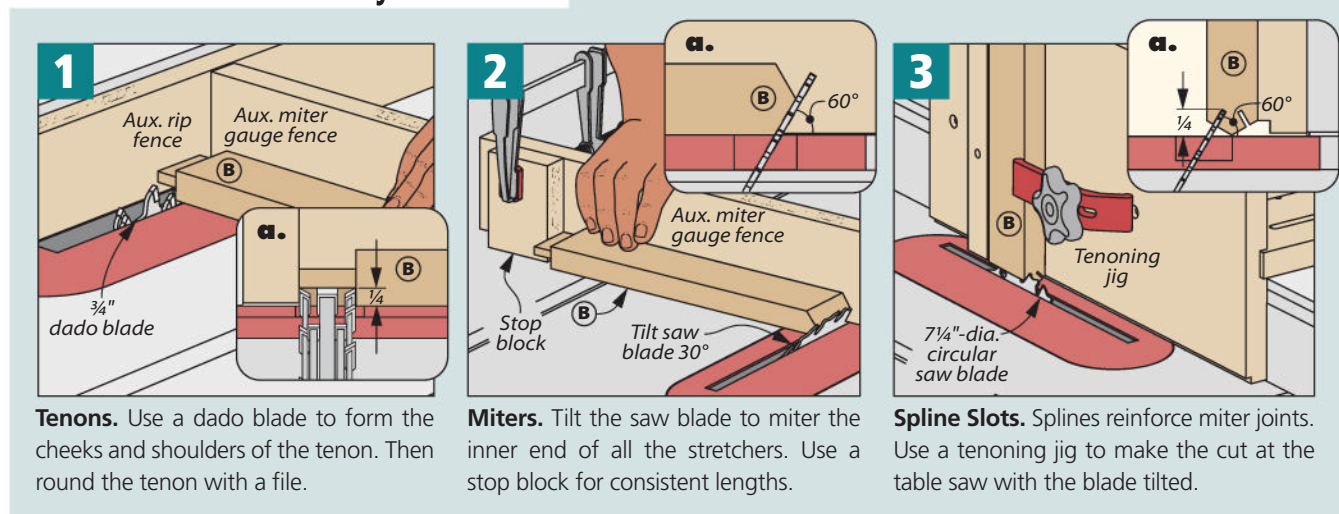
created. Visit woodsmith.com/magazine/sip for more information.

Two steps remain before it's time to get out the glue: first head to the drill press to form a pocket on the upper stretchers, as in details 'a' and 'b' above. These are used to capture the feet of the tray. The second step is to round over the edges of the stretchers at the router table. These should be a firm

slip fit into the mortise step in the legs (detail 'a').

Cut thin splines to match the slots. Once they're made, glue up the stretchers one set at a time.

Stretcher Joinery Details

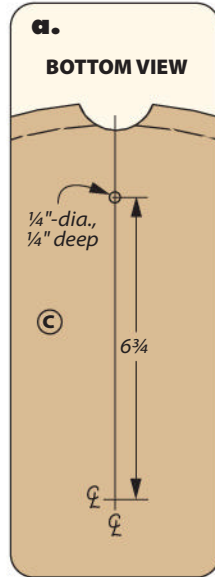




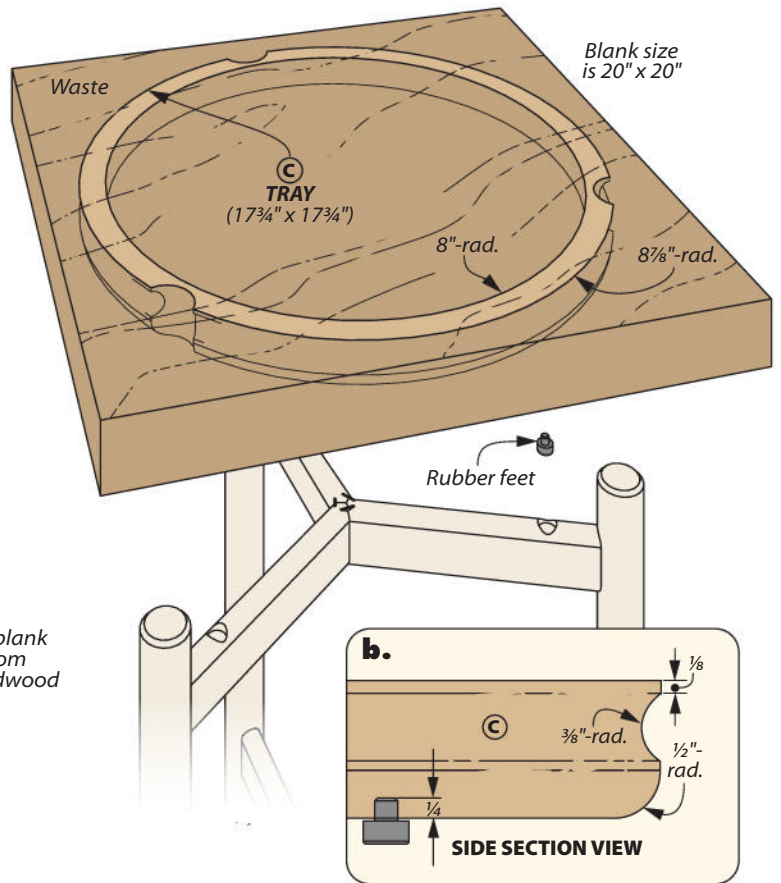
Notched Tray. Notches in the tray wrap around the legs on the table's base. They're a fun detail, too.



Tray Feet. Small rubber feet anchor into the recesses you drilled in the stretchers earlier.



NOTE: Tray blank is made from 1 1/2"-thick hardwood



Let's Make a Round Tray

It isn't often that you see a whole magazine spread devoted to a single workpiece, especially a tray. However, a quick survey of this page and the next will reveal how much is going on.

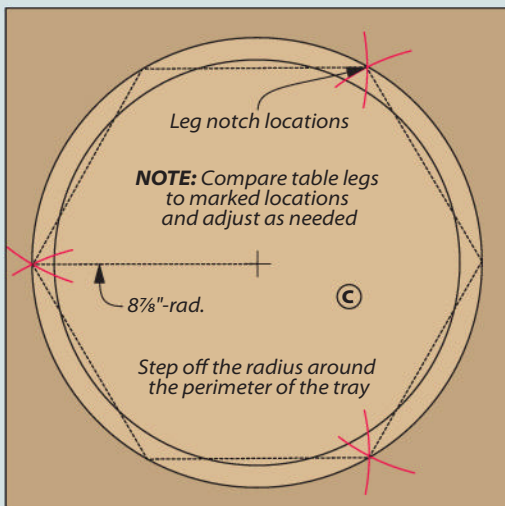
Gluing up a thick, oversized tray blank is where it all begins.

LAY OUT CIRCLES. Once your glueup is complete, define the overall shape of the tray with a compass from the cen-

ter point of the blank. Here you'll mark both the outside perimeter and the dished, inner portion.

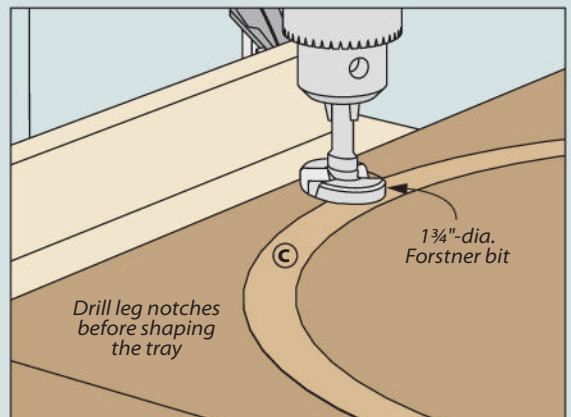
One of the defining features of the tray is how it wraps around the legs in the base.

Practical Geometry



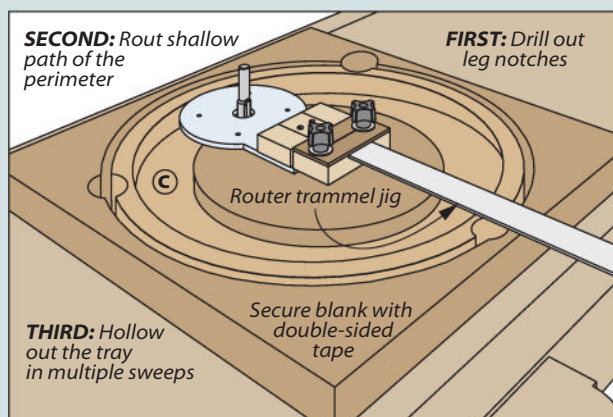
Math You Use.

With a compass set to the tray's radius, step off around the perimeter. Every other step marks the location of a leg notch.

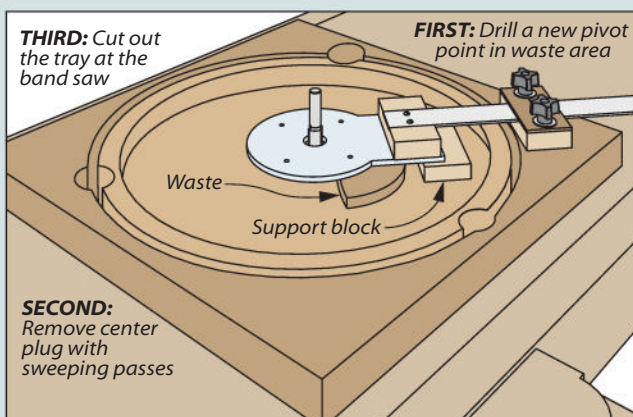


Verify, Then Drill. Compare the assembled table to your marks. Then drill out the notches in the tray blank at the drill press.

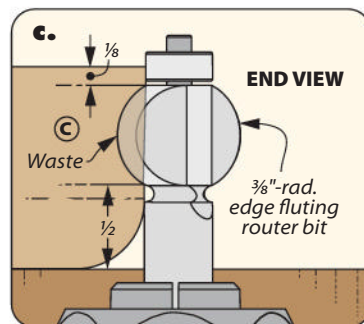
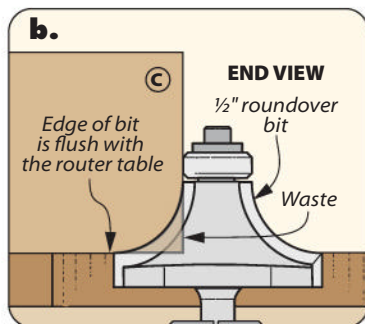
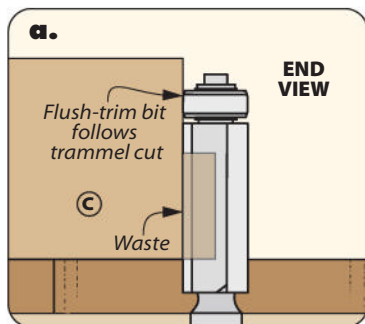
Routing Around & Around



Circle Routing. Establish the outside of the tray with a 3/4" - deep channel (cut in several passes). Then turn your attention to hollowing out the inside of the tray.



Off-Center Routing. Reposition the trammel outside the tray. Tape a support block to the bottom of the baseplate to keep the router balanced for the final passes.



That's the next layout task. The box at the bottom of the previous page explains how to do that. In theory, the marks match up with the base you glued up. Just in case there's any variance, however, set the base on the blank and see how close you are. There may be some adjustments necessary. Once you've made the necessary accommodations, drill the leg holes, which will become notches later.

SPIN IT RIGHT ROUND

I turn to a router trammel jig whenever I need to make a round tabletop. You'll give yours a workout for the next few steps. The box above highlights the process to follow.

Define the outer edge of the tray with a few passes, but don't rout all the way through. We need the blank intact for the time being.

TURN, TURN, TURN. The inside of the tray is hollowed next. Not only will you make

passes around, but also progressively deeper. Then adjust the trammel for a tighter radius and repeat. You can make this go quicker by using a larger diameter bit. Keep your shop vacuum close by. This stage creates a drift of chips.

It's impossible to rout away the pivot point at the center of the tray. So, I routed as tight as the jig would allow before removing it. To clear out the plug, I drilled a new pivot hole in the waste area outside the tray, as shown in Figure 2 above. With this arrangement, you can sweep across the plug with your router. To keep the router from tipping in and spoiling your work, tape a support block under the baseplate.

CUT & SHAPE. Quality time spent with a card scraper and a sander will get you a smooth inner surface on the interior of the tray.

At this point, I cut the tray free, following the path that was routed earlier. I used the band saw, but a jig saw would work here as well.

Detail 'a' shows how to clean up the edges with a flush-trim bit. A roundover bit follows to ease the lower edge (detail 'b'). The final routing step is with an edge fluting bit (refer to sources on page 97). This creates a rounded groove around the tray, as in detail 'c.'

Rubber feet mounted on the bottom face line up with the recesses in the stretchers. Now it's time to put your feet up.

Materials & Supplies

- | | | |
|----------|--|--------------------|
| A | Legs (3) | 1 1/2 x 1 1/2 - 20 |
| B | Stretchers (6) | 3/4 x 2 - 9 1/2 |
| C | Tray (1) | 1 1/2 x 17 3/4 - 3 |
| | • (6) 1/16" x 1/2" - 2" Hardwood Splines | |
| | • (3) 1/2"-dia. Rubber Feet w/Screws | |



Shaker-Style Cherry Vanity



Bathrooms have changed. What were once strictly functional spaces have given way to rooms with a more “furnished” appearance.

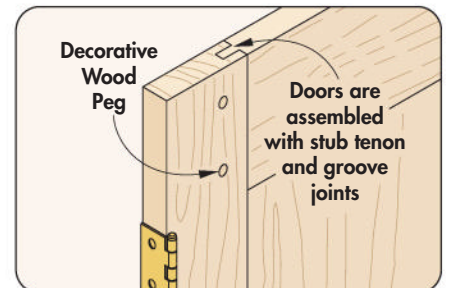
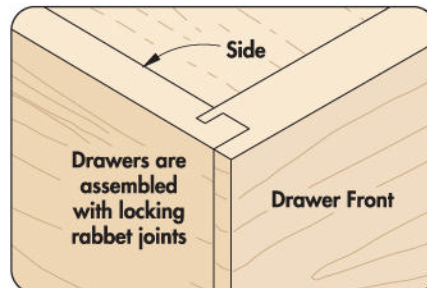
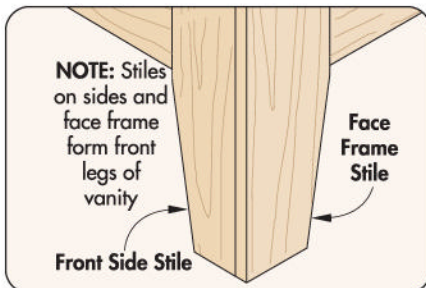
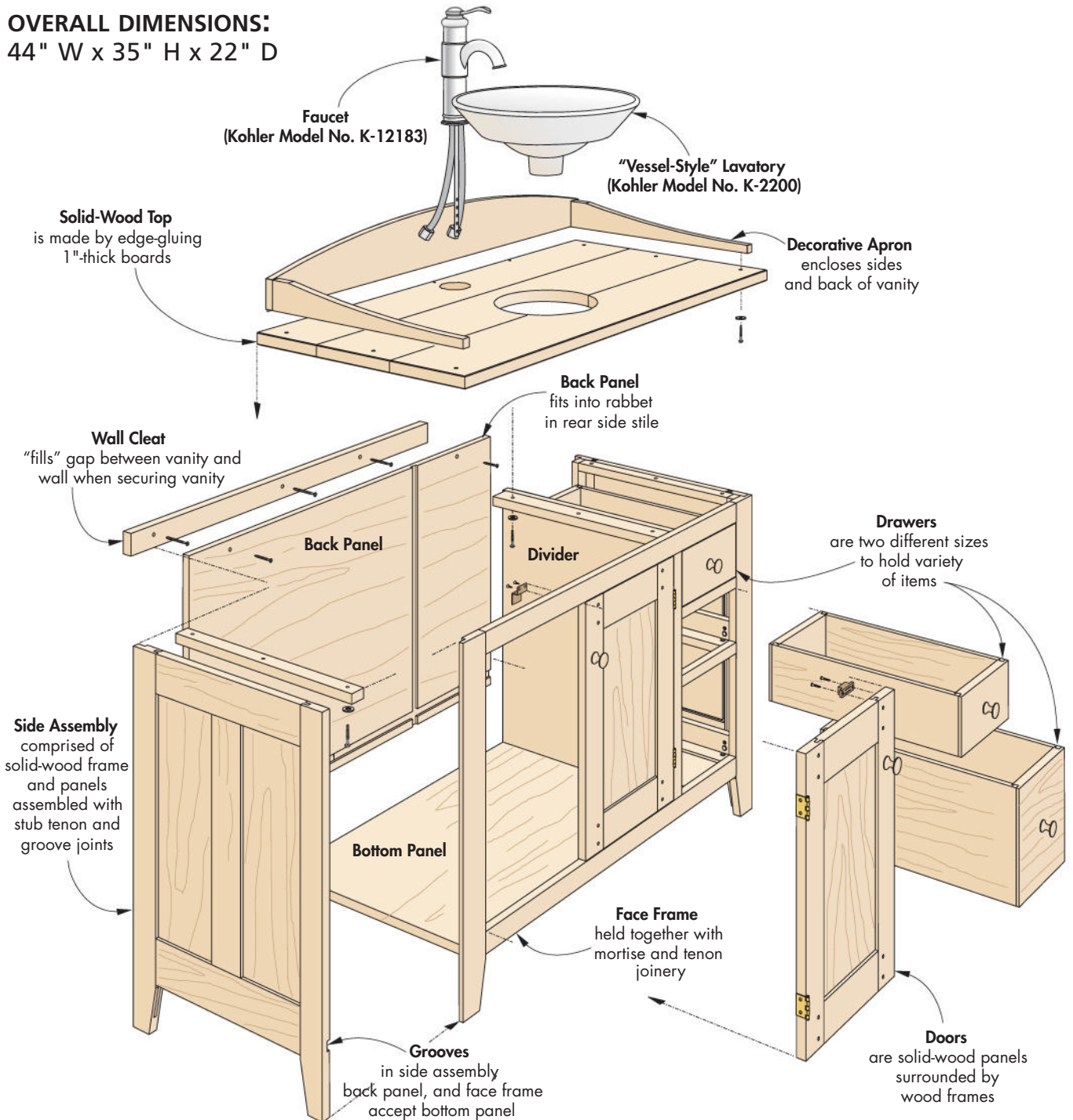
This bathroom is a perfect example. The focal point of the room is a

cherry vanity that’s designed to look more like a piece of furniture than a simple, utilitarian cabinet. With its solid-wood panels, tapered feet, and pegged joints, the vanity is inspired by traditional Shaker designs, a style

that’s also right at home with many different styles of furniture. Additionally, we’ve included an option to replace the wood top with a granite slab, which gives the vanity a more contemporary flair (inset photo).

CONSTRUCTION DETAILS

OVERALL DIMENSIONS:
44" W x 35" H x 22" D



Mortise & Tenon Face Frame

A hardwood face frame covers the front of this vanity. It consists of three vertical stiles and four horizontal rails that form openings for the doors and drawers (see illustration below).

AN OVERVIEW. To create the appearance of a piece of furniture, each end stile of this face frame acts as a front leg of the vanity. More accurately, it makes up half the leg. The other half is formed by the front side stiles.

The face frame is constructed with $\frac{3}{4}$ "-thick rails and stiles, which are connected with mortise and tenon joints.

For the sake of proportion, all four parts of the face frame (A, B, C, D) are different widths.

As for length, the dimensions shown below take into account 1"-long tenons — which are typical — on the ends of the top and bottom rails, middle stile, and drawer rails.

LAY OUT MORTISES. After cutting the frame pieces to length, lay out the locations of the mortises according to detail 'c',

below right. Notice that each of these mortises is $\frac{1}{4}$ " wide and 1" deep (see 'b' below). As you can see, the lengths of the mortises vary depending on which frame piece is tenoned to fit into it.

MAKE THE MORTISES. Once the layout is complete, you're ready to cut the mortises. I used a benchtop mortising machine to cut the square holes (Photo, upper right). Of course, you could also drill overlapping holes on a drill press and then clean out the waste and square up the ends of the mortise with a chisel.

CUT THE TENONS. The next step is to cut the tenons to fit the mortises. All of the tenons are 1/4" thick and 1" long (detail 'a').

The width varies depending on which mortise the tenon fits into. To simplify things, the project is designed so that by cutting $\frac{1}{4}$ "-deep shoulders on all four sides, you'll end up with a tenon of the correct width. An easy way to accomplish that is to use a dado blade mounted in a table saw (photo, lower right).

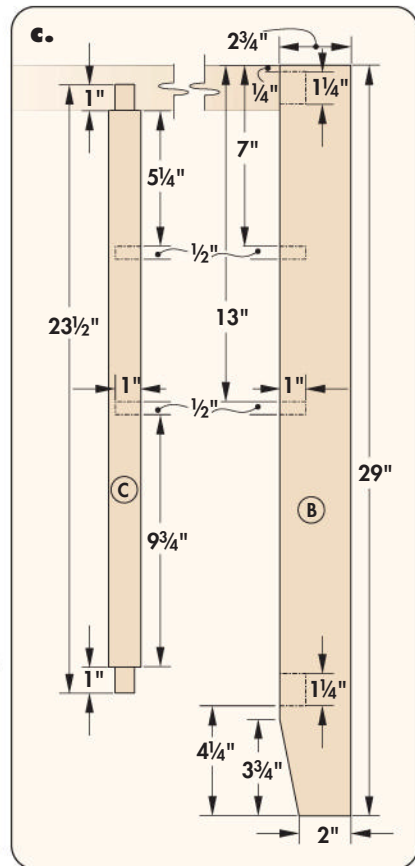
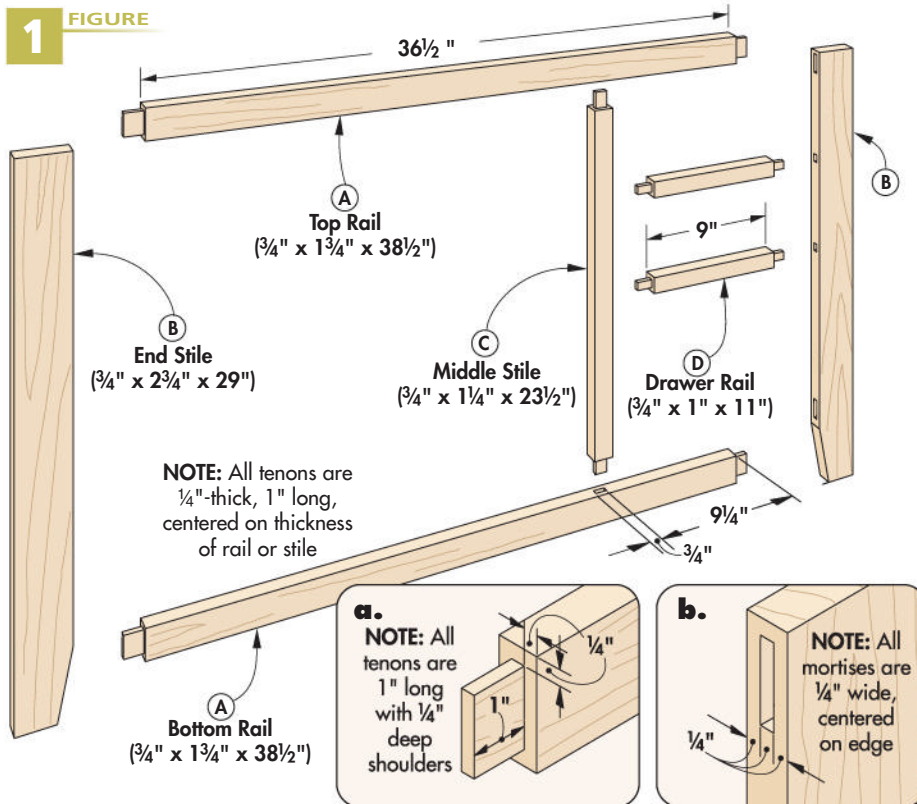
TAPERED FEET. There's one thing left before assembling the face frame. That's to trim the bottom of the end stiles at an angle to form the tapered feet of the vanity (detail 'c'). After sanding the edge smooth, just glue and clamp the face frame together.



Making Mortises. A mortising machine and a 1/4" square chisel and bit make quick work of cutting the mortises.



Tenon Shoulder. To define the length of the tenon, butt the workpiece against an auxiliary fence, then make a pass.



Frame & Panel Side Assemblies



Straight Cauls. To ensure a perfectly flat side assembly, clamp it between two pairs of straight boards. The bottom board is notched for clamp clearance.

Once the face frame is complete, you can turn your attention to the side assemblies. These assemblies consist of a divided wood frame that creates openings for a pair of solid-wood panels (Illustration, below).

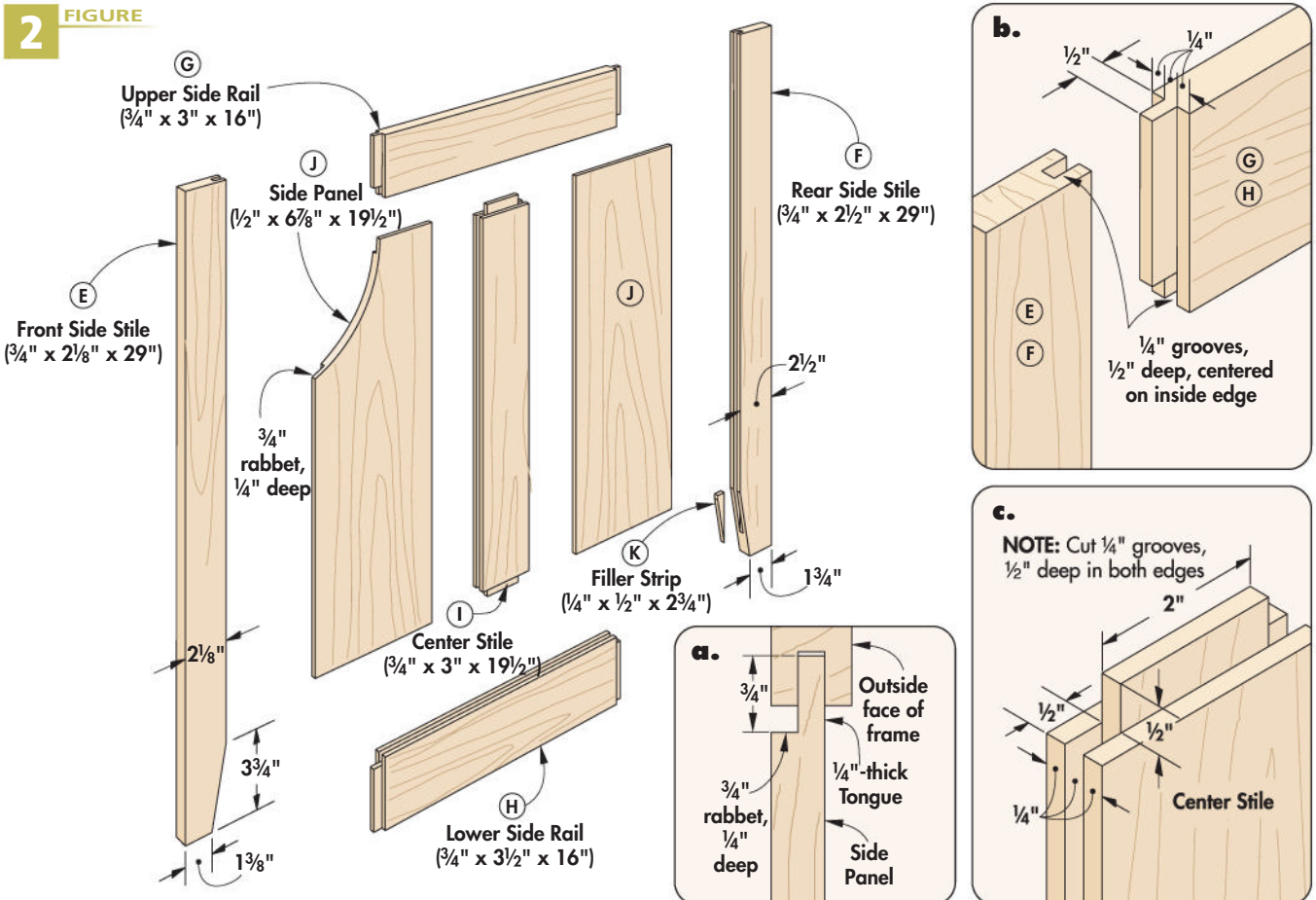
BUILD THE FRAMES

The frame for each side assembly is made up of three stiles (two side stiles and a center stile) and two rails.

Like the face frame, all these pieces are $\frac{3}{4}$ "-thick hardwood. And here again, they differ in width. In particular, note that the front side stile (E) is $\frac{3}{8}$ " narrower than the rear side stile (F). This is so the stiles appear to be the same width once the side assemblies are connected to the face frame.

Also note that the upper side rail (G) is $\frac{1}{2}$ " narrower than the lower side rail (H). And the center rail (I) is 3" wide, which provides a substantial-looking divider in the middle of Fig. 2.

STUB TENONS & GROOVES. To simplify construction, the frames are assembled with stub tenon and groove joints. Both ends of each rail have a stub tenon that fits into a groove in the stiles (detail 'b'). And a tenon on each end of the center stile fits into grooves in the rails (detail 'c'). The grooves in the frame pieces also accept the solid-wood panels. Note that the center stile gets a groove on both edges. All the other frame pieces are grooved on the inside edge only.



There's nothing complicated about cutting stub tenon and groove joints. Before you get started, though, take a minute to label each piece to avoid getting them mixed up. It's also a good idea to label the outside face of each piece and then use it as a reference when machining the joints (see the box below).

CUT TAPERS. The next step is to use a jig saw or band saw to trim the bottom of each side stile at an angle, once again forming a tapered foot. Since the stiles are different widths, adjust the width of the bottom end of the stiles accordingly.

SOLID-WOOD SIDE PANELS

With the frames complete, it's time to start on the solid-wood panels. In keeping with the Shaker styling, I wanted the side panels to be flat on the outside for a clean, simple look.

The side panels (J) are made from $\frac{1}{2}$ "-thick hardwood. For appearance, it's a good idea to cut these panels (and the panels for the doors that are added later) from boards that match closely in color.

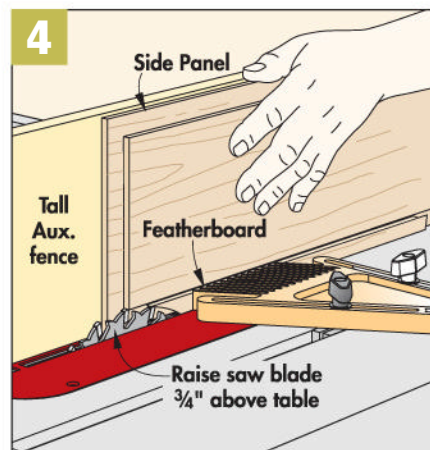
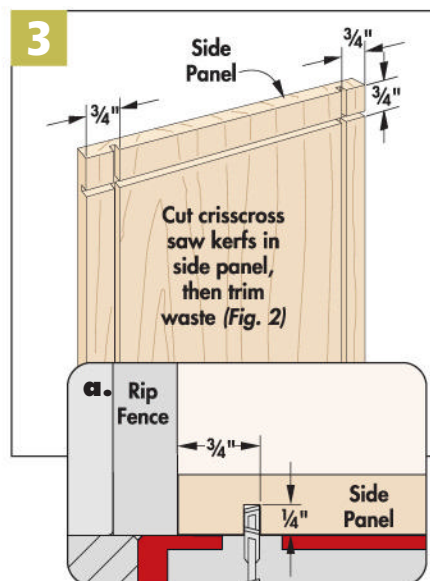
To determine the size of the panels, dry-assemble the frames, measure the openings, and then add $\frac{7}{8}$ ". That's $\frac{1}{8}$ " less than the combined depth of the grooves. Once the sides are assembled, this will allow the panel to expand and contract with changes in humidity.

TONGUES. If you look at the Side Assembly Illustration again (Figure 2 on page 85), you can see there's a tongue on all four edges of the side panel that fits into the grooves in the frame pieces. Each tongue is formed by cutting a wide rabbet all the way around the back of the side panel (Figure 2a).

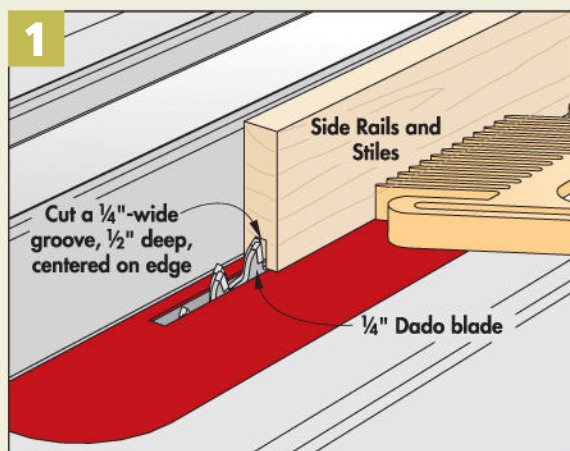
To cut the rabbet, I used a two-step process on the table saw. First, with the panel lying flat, I cut four shallow, crisscross kerfs (Figures 3 and 3a). Then stand the panel on edge and run it against a tall auxiliary fence to remove the waste material, leaving a $\frac{1}{4}$ "-thick tongue (Figure 4).

ASSEMBLE SIDE PANELS. Now you're ready to assemble the side panels. Since these panels are solid wood, we left them loosely "floating" in the frames, which allows for seasonal wood movement. So, apply glue to the mating frame pieces. As for the panel, center a dab of glue on the tongue of the top and bottom edges. This will allow for movement, but still keep it centered in the frame. After fitting it all together, clamp it as shown in the Photo on page 85 to ensure a flat, square assembly.

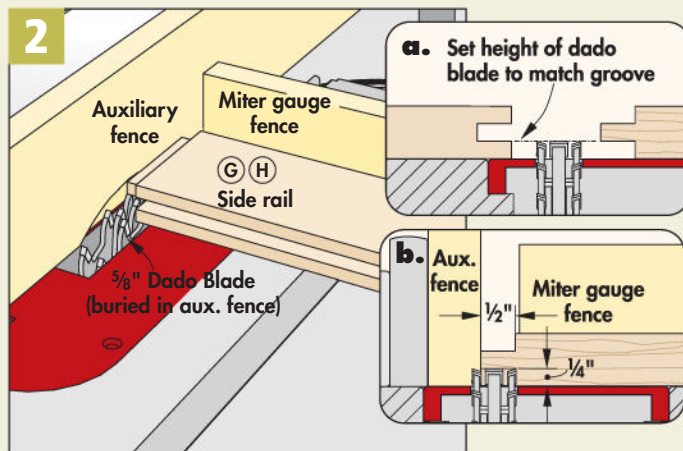
The final step in making the side assemblies is to glue in a wedge-shaped filler strip (K) to cover the exposed groove in the tapered feet.



Cutting Stub Tenons & Grooves



Centered Grooves. To cut the grooves, set the fence so the blade is centered on the edge of the workpiece. Then run the outside face of each piece against the fence.



Cutting Tenons. For the tenons, set up a wider dado blade and adjust its height as in detail 'a' above. Then, using the miter gauge, make two passes, one on each side.

Bringing it All Together Case Construction

At this point, the two side assemblies and the face frame are complete. Connecting these three assemblies — and adding a plywood back panel, bottom, and divider — will create the carcass for this vanity.

CASE JOINERY

To see how all these parts fit together, take a look at the Illustrations below and on page 88. Notice that the side assemblies fit into rabbets cut in the end stiles of the face frame (Face Frame Rabbet, next page). The back panel (L) fits into a rabbet in each of the rear side stiles.

In addition to the rabbets, there's a groove near the bottom of the face frame, side assemblies, and back panel. These grooves hold the plywood bottom panel (M) of the cabinet.

Finally, dadoes in the back and bottom panels accept a plywood divider (N). Like its name implies, it divides the case into two compartments, one for the

plumbing under the sink and the other for the drawers.

Now, it might seem like cutting these joints is a pretty routine operation. Just mount a dado blade in the table saw and make the cuts, right? Actually there's more to it than that.

GROOVES FOR BOTTOM. Take the grooves that hold the bottom panel, for instance. It might seem natural to run the top edge of the face frame and side assemblies against the table saw rip fence. The problem is the blade would be located quite a distance from the rip fence — too far to make the cut safely. As a result, it would be all too easy to twist the workpiece during the cut, causing it to kick back.

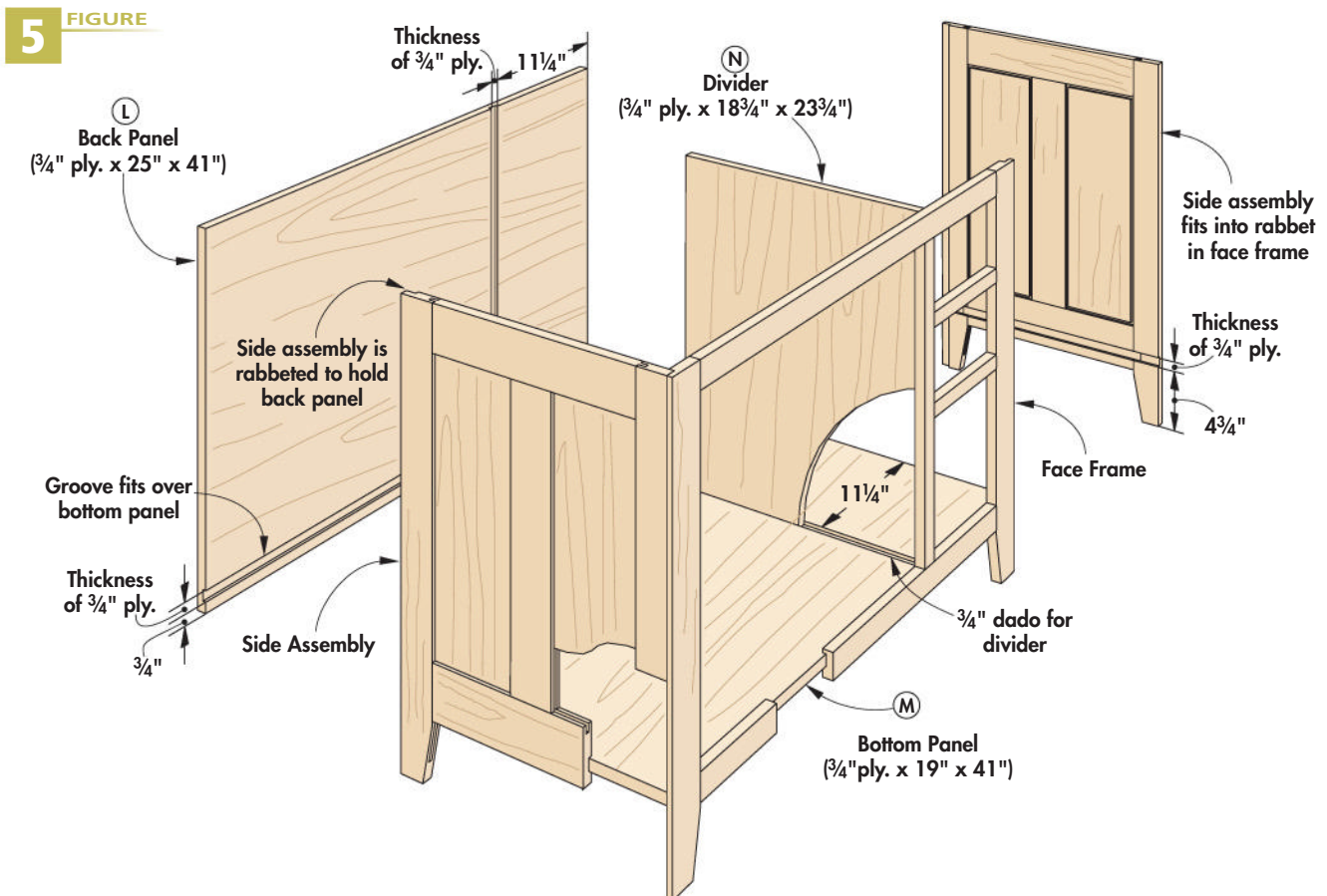
One way to prevent that would be to set the fence closer to the blade and run the feet of the face frame and side assemblies against it. That, however, presents another difficulty. The fence isn't long enough to provide continuous support

for the span of the feet. This could cause the outboard foot to "hook" around the end of the fence partway through the cut, causing a dangerous situation. The solution is to temporarily attach a straight board to the feet and run it against the fence (Upper Photo, page 88).

As for the corresponding groove in the back panel, there's no need to adjust the width or the height of the dado blade. Just reset the rip fence and make the cut.

Dadoes for Divider — Once the grooves are completed, you can focus on the dadoes in the back and bottom panels that hold the divider. Again, no need to adjust the dado blade. You'll also be able to cut both dadoes using a single fence setting.

CUT THE RABBETS. That brings us to the rabbets I mentioned earlier. As you recall, the rabbets in the side assemblies hold the plywood back panel, so they can be made using the same dado blade setup as the preceding cuts.



This time, however, the rip fence will have to be positioned right next to the blade. To prevent the blade from cutting into the fence, you'll need to attach an auxiliary rip fence. Adjust the fence so it just "kisses" the side of the blade. Then, with the rear side stile riding against the fence, make a single pass to cut each of the rabbets.

The procedure for cutting the rabbets in the end stiles of the face frame is almost identical, only these rabbets must be a hair wider. That's because they fit over the side assemblies, which are a full 3/4" thick. So here, take a minute to readjust the dado blade for a slightly wider cut. Make test cuts and check the fit first. Then cut the rabbets in the face frame (Photo, right).

ASSEMBLING THE CASE

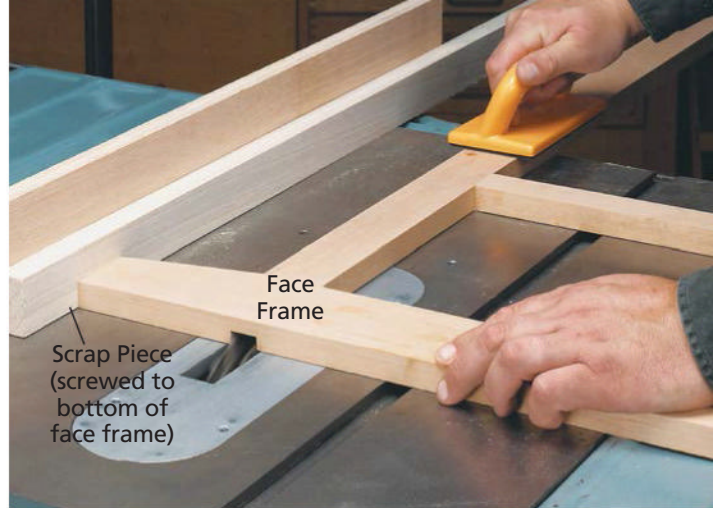
Once all the joinery for the case is complete, you're ready to put it together. This is a pretty large case for one person to assemble. So to make things go as smoothly as possible, I'd recommend rounding up a friend to help. Also, be sure you have enough clamps on hand. Finally, it's a good idea to use

a slow-setting glue like liquid hide glue to allow plenty of working time.

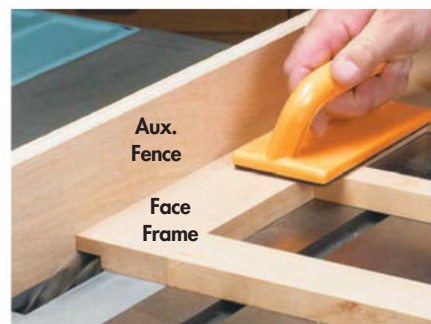
Before applying any glue, however, don't forget to dry assemble the case, check how things fit together, and then make any necessary adjustments.

One more note — it's best not to permanently attach the back panel at this time. You can use it to help square up the case, but hold off on the glue for now. You'll appreciate having easy access to the back of the case when installing the drawer guides.

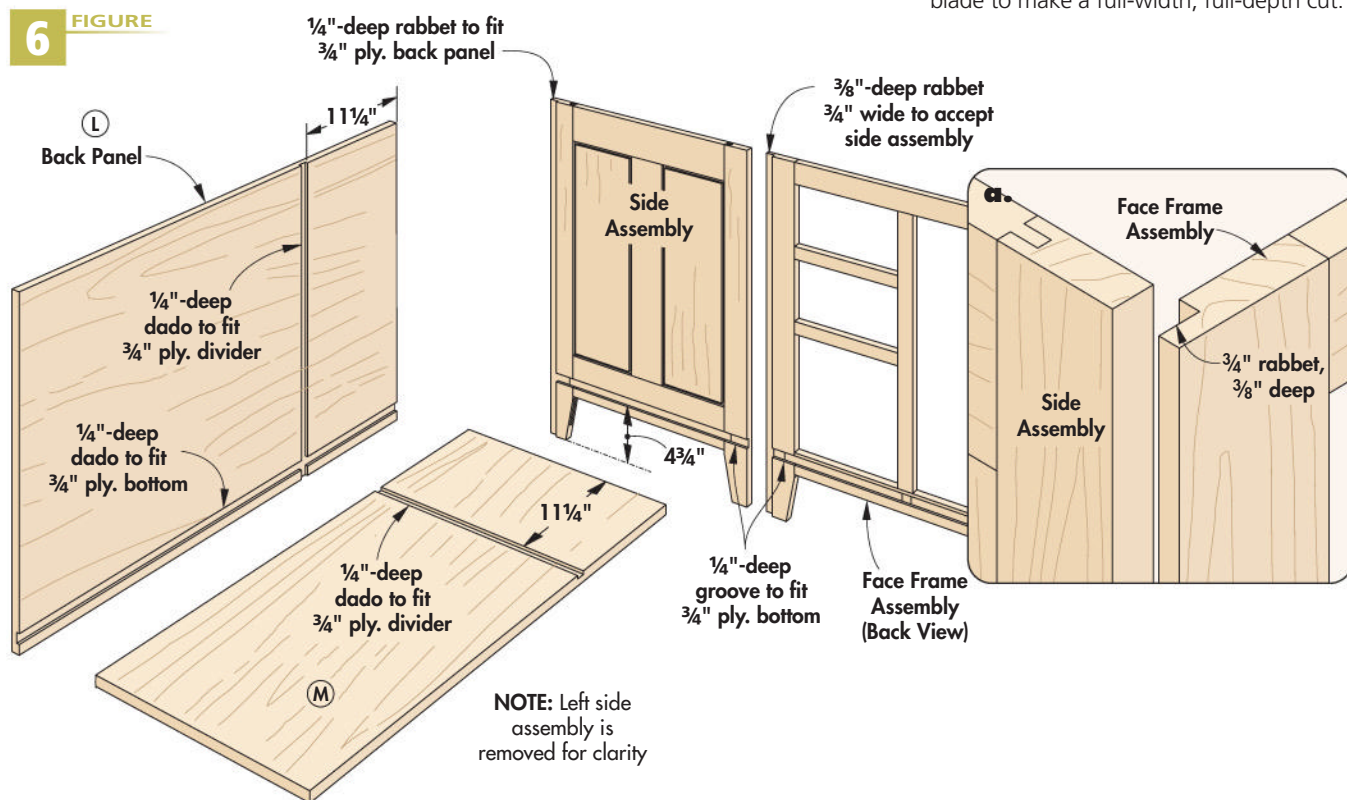
GLUE-UP. With that in mind, brush glue into the appropriate joints. Then join the face frame with one side assembly and fit the bottom panel into place. Now slide in the divider. (It's also glued along the front edge where it meets the face frame.) Finally, add the second side assembly, set the back panel in place, and clamp the case.



Face Frame Groove. When cutting the groove in the face frame and side assemblies, a board screwed to the feet provides a continuous surface that rides against the fence.



Rabbets. To cut the rabbet in the face frame in a single pass, set the fence so it just grazes the blade. Then raise the dado blade to make a full-width, full-depth cut.



Shop-Made Guides & Drawer How-To

No vanity is complete without a place to put all the odds and ends. A tall lower drawer and two smaller upper drawers provide that storage.

GUIDE SYSTEM

To support these drawers in the opening, I added a simple system of wood guides (see Illustration below). Nylon “bumpers” installed in these guides, and also in the divider, ensure smooth-sliding drawers (Guide Details).

One thing to be aware of is that the drawer guides are different on each side of the opening. On one side, the drawers ride on three L-shaped guides. These guides are attached to spacers, which are

used to “build out” the guides so they’re flush with the frame opening. On the other side, the guides are narrow strips of wood attached directly to the divider.

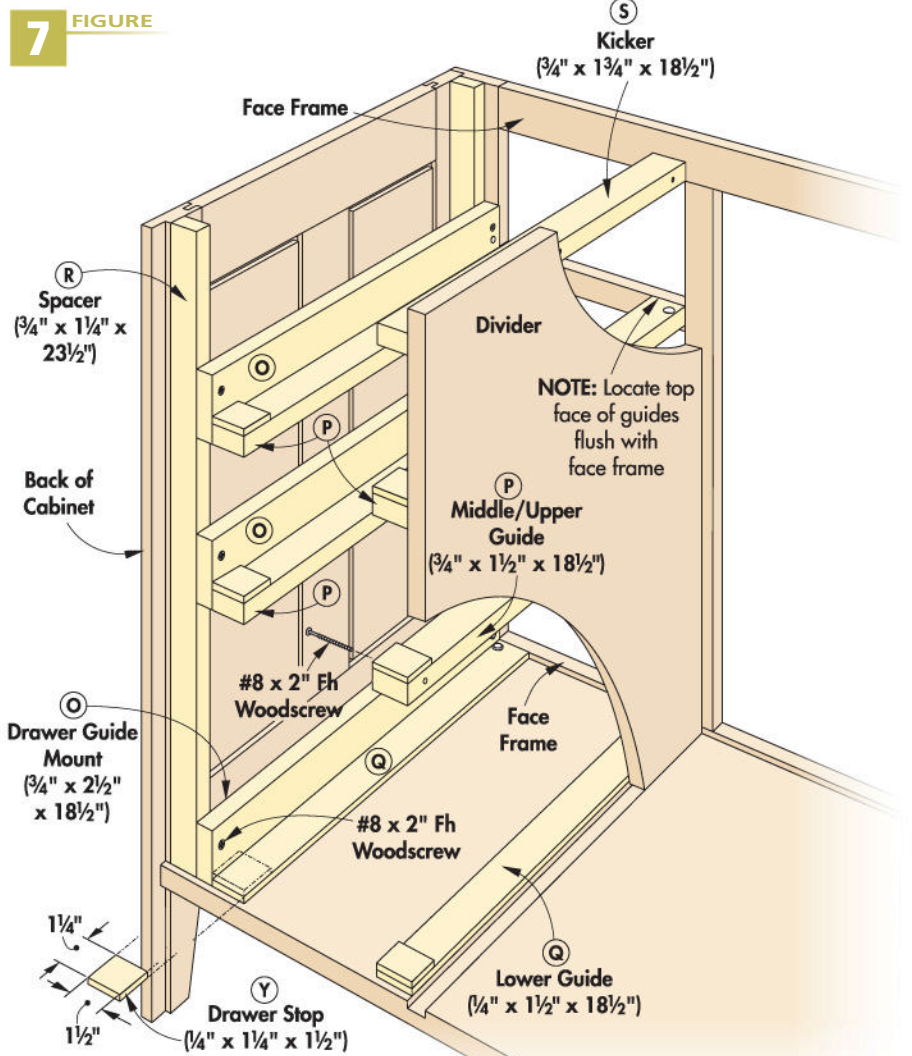
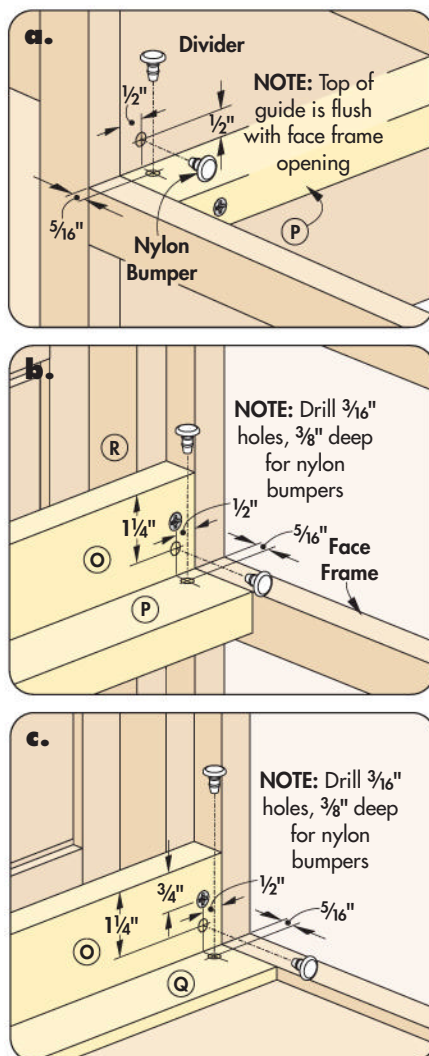
There’s something else you may have noticed about these drawer guides. Specifically, the lower guides. That is, the horizontal leg of the L-shaped lower guide is thinner than the corresponding legs of the guides above it. Likewise, the lower guide on the “divider” side of the opening is thinner than the ones above it. This is necessary to make the lower guides flush with the bottom rail of the face frame.

MAKE THE GUIDES. There’s nothing complicated about making these guides.

Size the pieces according to the dimensions shown in the illustration below. Pre-drill all the mounting holes, as well as the holes for the nylon bumpers (in the guides and the divider). Then glue up the L-shaped drawer guides.

Before attaching the guides, you’ll need to install the spacers (R) I mentioned earlier. These are just strips of $\frac{3}{4}$ "-thick hardwood. Once cut to size, they’re glued to the side assembly.

INSTALL THE GUIDES. Now it’s time to install the guides. The key thing to pay attention to here is that they align from one side to the other. If they don’t, the drawers will bind when you try sliding them in and out.



To ensure proper alignment, clamp them in position flush with the opening and secure them with screws. Then press the nylon bumpers into place. Note: To get the bumpers in the lower guides to fully seat, you'll need to drill those holes $\frac{1}{8}$ " deeper.

Finally, to prevent the top drawer from tipping down when it's opened, I added a hardwood kicker (S) on one side. It's positioned flush with the bottom edge of the top rail and glued to the divider.

BUILD THE DRAWERS

Once the guide system is completed, the three drawers can then be built to fit in the openings. Take note that they're sized slightly smaller ($\frac{1}{16}$ ") than the opening to create a uniform gap all the way around. As for length, the drawers are $1\frac{1}{4}$ " shorter than the full depth of the opening.

As you recall, the drawers are different sizes (the lower drawer is taller than the upper drawers), but their construction is identical. The drawer fronts and backs (T, U) are made of $\frac{3}{4}$ "-thick hardwood, and the sides (V, W) are $\frac{1}{2}$ "-thick stock (see Drawer Assembly Illustration at right).

LOCKING RABBET JOINTS. For strength and durability, I used a tried-and-true joint to assemble the drawers — a locking rabbet joint. To withstand constant

tugging on a drawer, it has a tongue on the front and back that fits into a dado in the side. (It's sometimes called a tongue and dado joint.) Whatever you call it, the Box below will walk you through the process of using a table saw to cut the joint.

Before you machine the parts, it's a good idea to label the inside face of each piece. Using this face as a reference will ensure consistent results. Also, use a backer block for support when you cut the groove in the end of the front and back pieces (Fig. 1). It helps to hold the workpiece steady during the cut.

Once the joinery is complete, it's just a

matter of cutting a groove in each piece to hold a $\frac{1}{4}$ " plywood bottom. After gluing up the drawers, I installed two additional nylon bumpers in the back of the drawer.

DRAWER STOPS. All that's left is to add the drawer stops (Y). These are wood blocks that "stop" the drawer flush with the front of the face frame when you close it. A quick way to determine the size of the stops is to install the drawer, position it flush in front, then measure the distance between the back and the end of the drawer guide. Then cut the stops to that size and glue them to the guides.

FIGURE 8

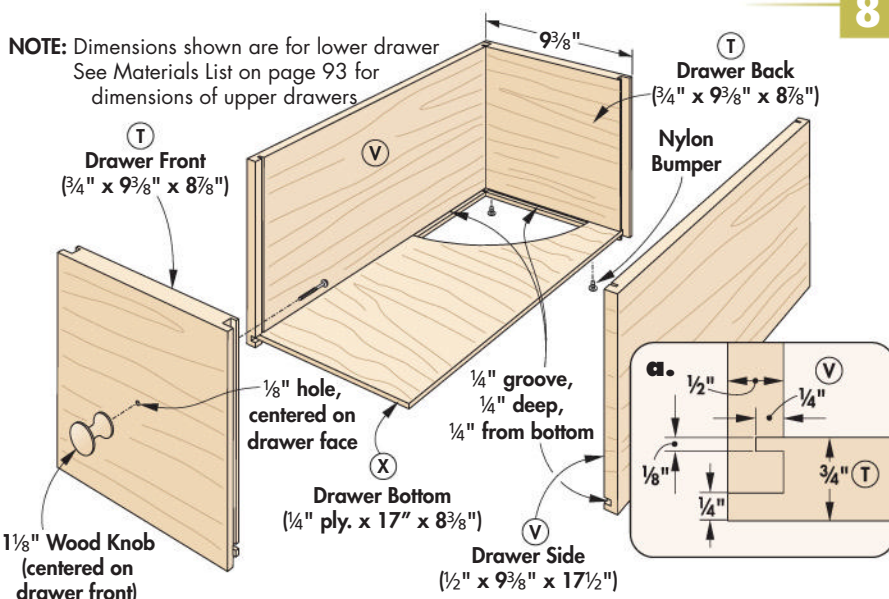
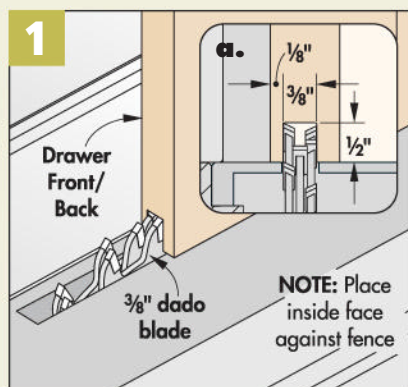
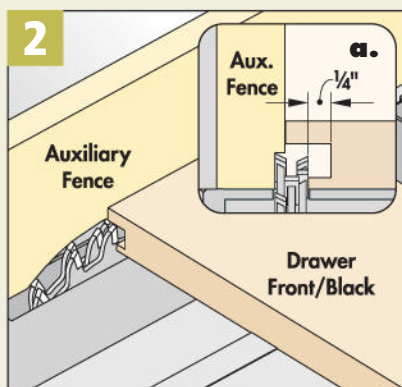


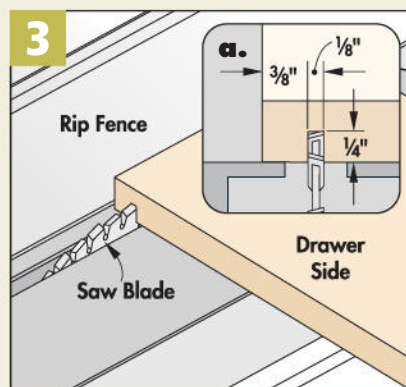
Table Saw Technique: Locking Rabbets



Cut a Dado. With the drawer front (or back) standing on end, use a $\frac{3}{8}$ " dado blade to cut a groove in the end.



Trim One Tongue. Next, butt the end of the front (or back) against an auxiliary fence and trim the tongue to length.



Matching Dadoes. Replace the dado blade with a saw blade and cut a dado in the sides to accept the tongue.

Adding Cabinet Doors & A Solid-Wood Top

Two of the most distinctive features of this bathroom vanity are its frame and panel doors, and its solid-wood top.

BUILDING THE DOORS

The construction of the doors is identical to the side assemblies. Each door consists of a solid-wood panel surrounded by a hardwood frame (Door Assembly). Here again, stub tenon and groove joints are used to assemble the doors. Only this time, to add a decorative touch, I installed wood pegs in the corners of the frame.

Like the drawers, the doors are sized to fit the opening with a $\frac{1}{16}$ " gap all around. The dimensions for the rails (Z) and stiles (AA) shown below take that into account. After sizing the pieces, cut the stub tenons and grooves.

ADD THE PANELS. The solid-wood panels are next. They're wider than the panels in the side assemblies, so you'll have to edge-glue boards to make panels that are wide enough. Aside from that, though, the procedure for making them is the same. That is, cutting rabbets on all four sides of each panel to form tongues that fit into the grooves in the frame pieces (refer to page 86).

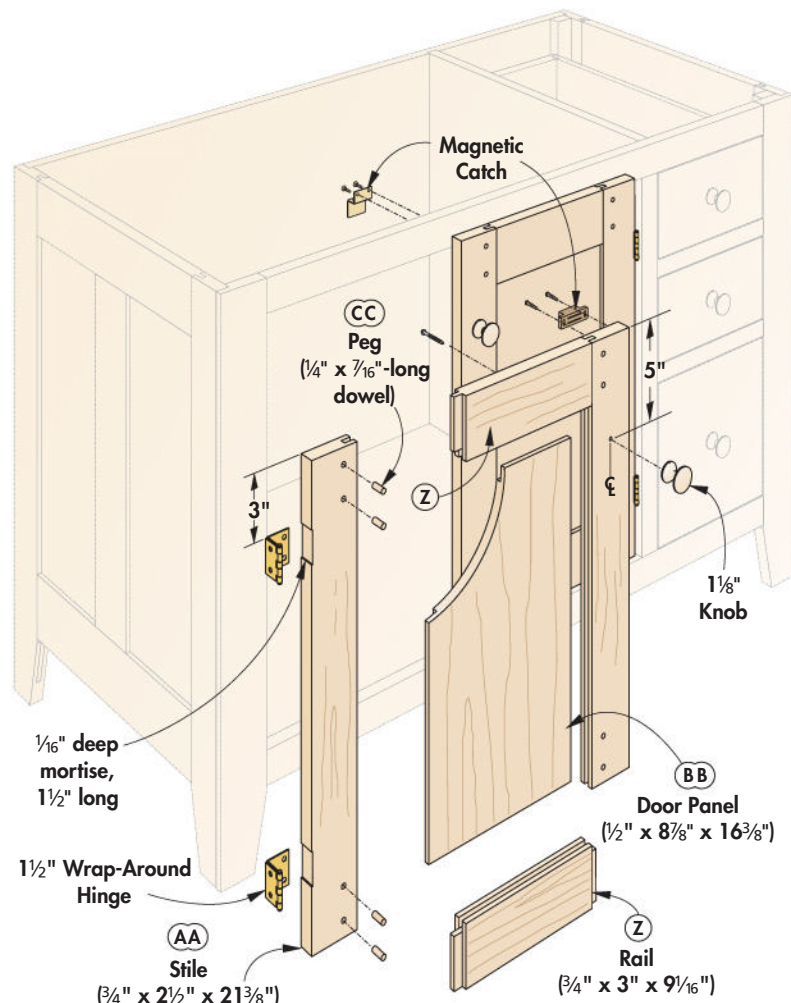
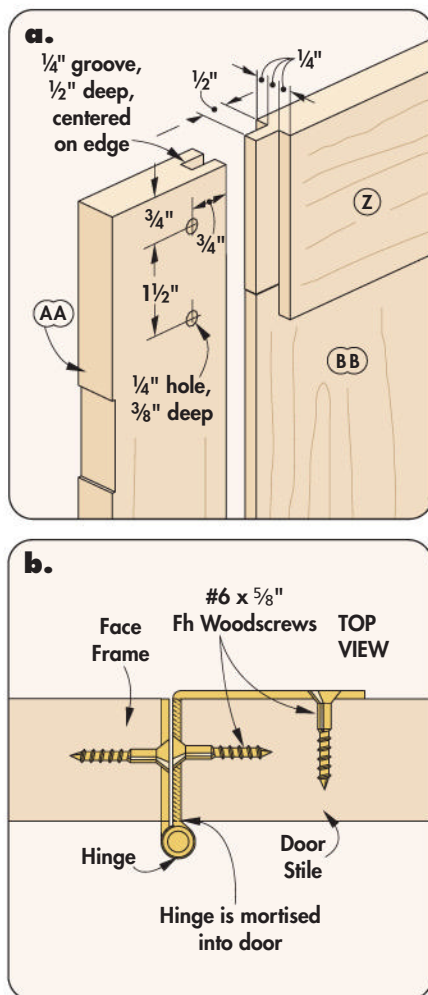
DECORATIVE PEGS. After gluing and clamping the door, you can add the wood pegs. The pegs are $\frac{1}{4}$ " dowels that fit into holes drilled in the frame (Tenon Detail). It's best to cut the dowels a bit longer than needed so they stand a bit "proud." Then apply glue, tap the pegs into place, and sand them flush.

INSTALL DOORS. All that's left is to hinge the doors to the cabinet. The hinges I

used are mortised into the door and surface-mounted to the face frame. This automatically establishes a $\frac{1}{16}$ " gap between the door and the frame, since that's the thickness of the leaves. Notice, too, that these hinges wrap around the door (Hinge Detail). This makes it easy to hold them in place as you install screws in both the edge and the back of the door. Once that's done, position the door in the opening and secure the hinge to the frame.

TOPPING IT OFF

This bathroom vanity is just about done. To complete it, I added a thick, solid-wood top and a three-part apron assembly. You'll see this procedure (and the vanity's installation process) on the next pages.



EDGE-GLUED PANEL. The top panel (DD) consists of 1"-thick boards that are edge-glued together. Because of the moist environment of the bathroom, I'd recommend a waterproof glue like *Titebond III*. Apply the glue, then position the clamps in an over-and-under arrangement to ensure even clamping pressure and a flat panel.

ADD THE APRON. Now you can turn your attention to the apron. It's made up of three parts: a back apron (EE) and two side aprons (FF). After cutting the curved pieces to shape (see Patterns below), they're screwed together to form the U-shaped apron (Apron Corner Detail).

The apron is attached to the top with screws. To allow for expansion and contraction of the wood, the screws for the side aprons pass through oversize ($5/16"$) shank holes that are counter-bored on the bottom side for the screw heads (Mounting Detail). Since the screw holes for the back apron are in

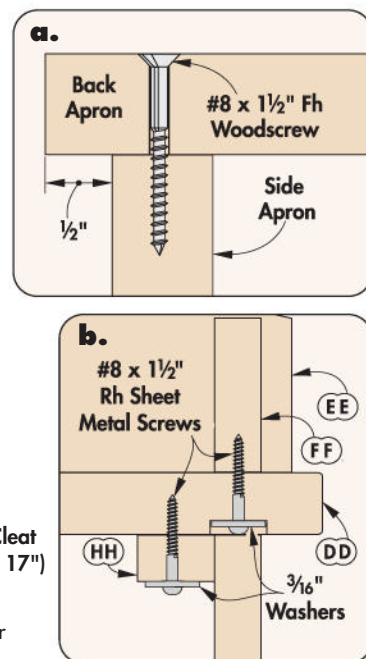
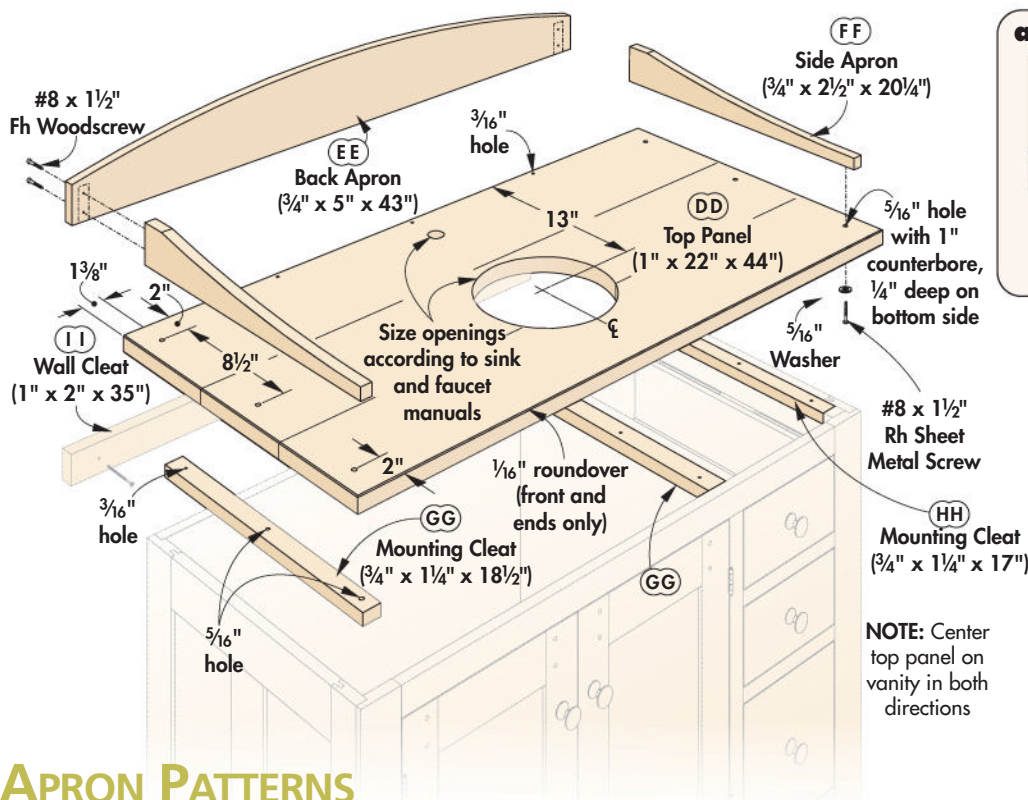
Moisture Prevention. To prevent damage from water, seal the top with three coats of spar urethane.



line with the grain direction, they're standard size ($3/16"$).

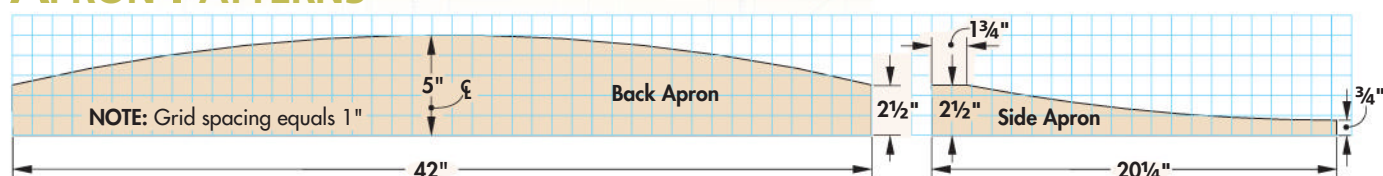
INSTALL TOP. With the apron in place, it's time to install the top. It's held in place with screws that pass through cleats (GG, HH) mounted to the cabinet. As before, wood movement must

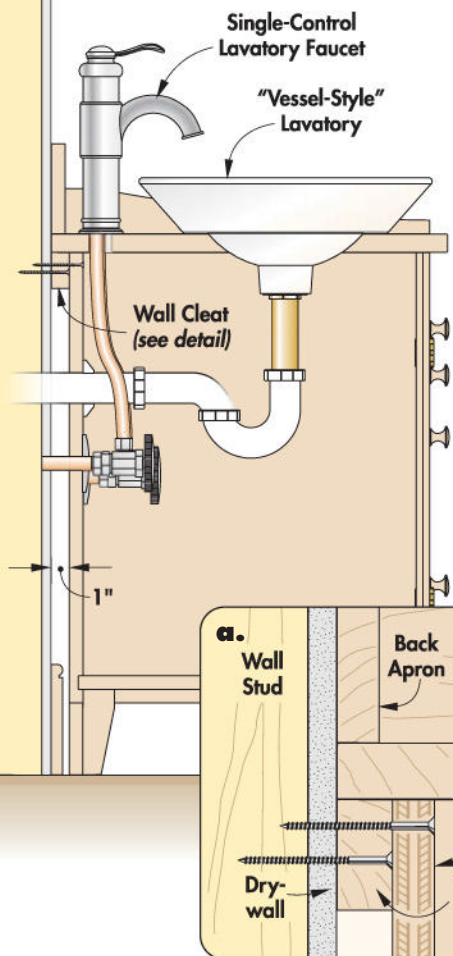
be taken into account to prevent the top from cracking. So here, the front and middle screws pass through oversize ($5/16"$) holes in the cleat. The back screw, which goes through a smaller ($3/16"$) shank hole, fixes the back edge of the top.



NOTE: Center top panel on vanity in both directions

APRON PATTERNS





Vanity Installation

Typically, when a furniture project is completed, you just set it in a room and wait for the compliments. With this bathroom vanity, however, there's a bit more involved.

The biggest consideration is the plumbing for the sink. Depending on whether the pipes come from the wall or the floor, you'll need to cut an opening either in the back or bottom panel to accommodate them.

Also, if the vanity accidentally gets bumped, it could cause a pipe to get knocked loose. So you'll want to secure it to the wall to prevent that from happening.

WALL CLEAT. An easy way to do that is to attach it to a wall cleat that is, in turn, fastened to the wall (see illustrations at left). The wall cleat is just a scrap piece of wood that's thick-nessed to fill the void between the back panel and the wall (1", in my case). Screw this cleat to the wall studs, and then set the vanity in place and fasten it to the cleat with screws from inside the cabinet.

Just a note here. The screws only need to be "snugged" enough to keep the vanity from shifting. In fact, if you over-tighten them — and the wall isn't plumb — it could raise the feet of the vanity off the floor. Once you have the vanity properly mounted, all that's left is to install the sink and faucet and make the final plumbing connections.

MATERIALS & SUPPLIES

A	Top/Bottom Rails (2)	$\frac{3}{4}$ - $1\frac{3}{4}$ x $38\frac{1}{2}$
B	End Stiles (2)	$\frac{3}{4}$ - $2\frac{3}{4}$ x 29
C	Middle Stile (1)	$\frac{3}{4}$ - $1\frac{1}{4}$ x $23\frac{1}{2}$
D	Drawer Rails (2)	$\frac{3}{4}$ - 1 x 11
E	Front Side Stiles (2)	$\frac{3}{4}$ - $2\frac{1}{8}$ x 29
F	Rear Side Stiles (2)	$\frac{3}{4}$ - $2\frac{1}{2}$ x 29
G	Upper Side Rails (2)	$\frac{3}{4}$ - 3 x 16
H	Lower Side Rails (2)	$\frac{3}{4}$ - $3\frac{1}{2}$ x 16
I	Center Stiles (2)	$\frac{3}{4}$ - 3 x $19\frac{1}{2}$
J	Side Panels (4)	$\frac{1}{2}$ - $6\frac{7}{8}$ x $19\frac{1}{2}$
K	Filler Strips (4)	$\frac{1}{4}$ - $\frac{1}{2}$ x $2\frac{3}{4}$
L	Back Panel (1)	$\frac{3}{4}$ ply. - 25 x 41
M	Bottom Panel (1)	$\frac{3}{4}$ ply. - 19 x 41
N	Divider (1)	$\frac{3}{4}$ ply. - $18\frac{3}{4}$ x $23\frac{3}{4}$
O	Drawer Guide Mounts (3)	$\frac{3}{4}$ - $2\frac{1}{2}$ x $18\frac{1}{2}$
P	Middle/Upper Guides (4)	$\frac{3}{4}$ - $1\frac{1}{2}$ x $18\frac{1}{2}$
Q	Lower Guides (2)	$\frac{1}{4}$ - $1\frac{1}{2}$ x $18\frac{1}{2}$
R	Spacers (2)	$\frac{3}{4}$ - $1\frac{1}{4}$ x $23\frac{1}{2}$
S	Kicker (1)	$\frac{3}{4}$ - $1\frac{3}{4}$ x $18\frac{1}{2}$
T	Front/Back (Lower) (2)	$\frac{3}{4}$ - $9\frac{3}{8}$ x $8\frac{7}{8}$
U	Fr/Bk. (Upper/Middle) (4)	$\frac{3}{4}$ - $4\frac{7}{8}$ x $8\frac{7}{8}$
V	Sides (Lower) (2)	$\frac{1}{2}$ - $9\frac{3}{8}$ x $17\frac{1}{2}$
W	Sides (Upper/Middle) (4)	$\frac{1}{2}$ - $4\frac{7}{8}$ x $17\frac{1}{2}$
X	Bottoms (3)	$\frac{1}{4}$ ply. - 17 x $8\frac{3}{8}$

Y	Drawer Stops (6)	$\frac{3}{4}$ - $1\frac{1}{4}$ x $1\frac{1}{2}$
Z	Door Rails (4)	$\frac{3}{4}$ - 3 x $9\frac{1}{16}$
AA	Door Stiles (4)	$\frac{3}{4}$ - $2\frac{1}{2}$ x $21\frac{3}{8}$
BB	Door Panels (2)	$\frac{1}{2}$ - $8\frac{7}{8}$ x $16\frac{3}{8}$
CC	Pegs (16)	$\frac{1}{4}$ x $\frac{7}{8}$ dowel
DD	Top Panel (1)	1 - 22 x 44
EE	Back Apron (1)	$\frac{3}{4}$ - 5 x 43
FF	Side Aprons (2)	$\frac{3}{4}$ - $2\frac{1}{2}$ x $20\frac{1}{4}$
GG	Mounting Cleats (2)	$\frac{3}{4}$ - $1\frac{1}{4}$ x $18\frac{1}{2}$
HH	Mounting Cleat (1)	$\frac{3}{4}$ - $1\frac{1}{4}$ x $17\frac{1}{2}$
II	Wall Cleat (1)	1 - 2 x 35

- (15) #8 x $1\frac{1}{2}$ " Rh Sheet Metal Screws
- (5) Screw-On Shaker Knobs (Cherry)
- (5) #8 x $1\frac{1}{4}$ " Fh Woodscrews (for Knobs)
- (22) #8 x 2" Fh Woodscrews
- (6) #8 x $1\frac{1}{2}$ " Fh Woodscrews
- (18) Nylon Stem Bumper Glides
- (2pr) $1\frac{1}{2}$ " Wrap-Around Hinges
- (2) Magnetic Catches for Inset Doors
- (6) $\frac{3}{8}$ " I.D. x $\frac{3}{4}$ " O.D. Fender Washers
- (1) Lavatory Faucet (Kohler K-12183)
- (1) "Vessel-Style" Lavatory (Kohler K-2200)



V-Block Upgrades

Round and octagonal parts present challenges for workholding. One solution is a simple V-block. I don't do simple.

I made a thick V-block from two layers of plywood. A kerf down the middle protects fragile corners. I added a hardboard stop on one end. This keeps the

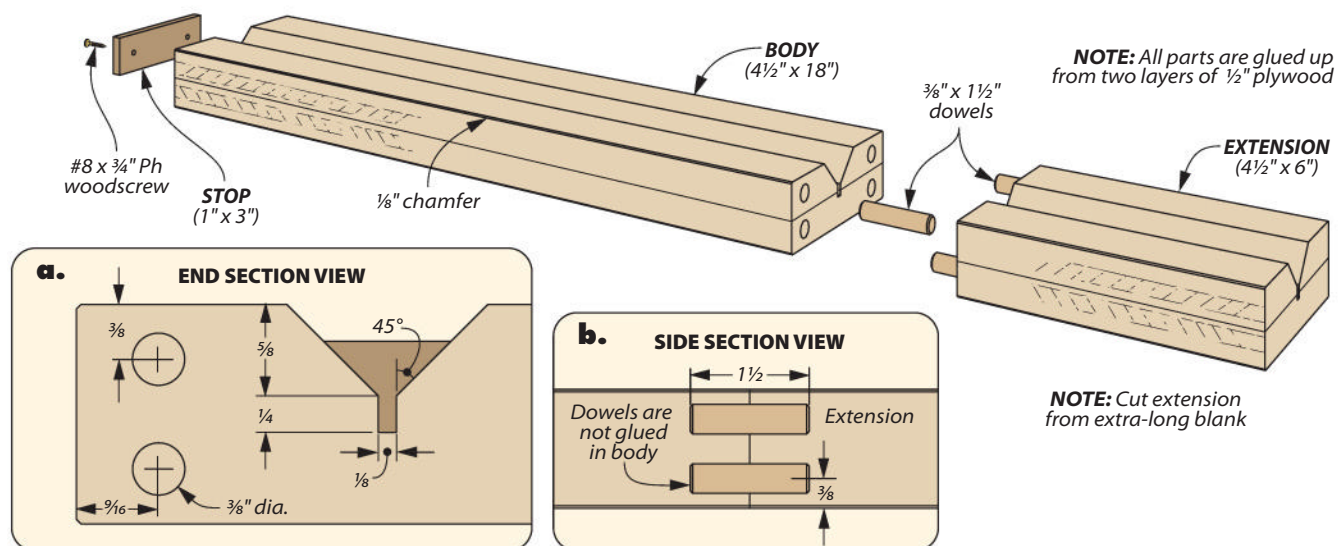
workpiece from sliding if I'm using a hand plane.

Then to support long parts, I cut off one end. I didn't want to lose it, so I can connect them back together with dowels. One side is unglued.

*Phil Huber
Urbandale, Iowa*



Dowel Holder. In addition to a V-block's utility at the workbench, it also comes in handy to cradle a round workpiece (like the dowel above) at the drill press.





Saddle the Horse. The cleats of the shelf fit around the lower stretchers of these sawhorses. The platform offers easy access to hardware and small tools.

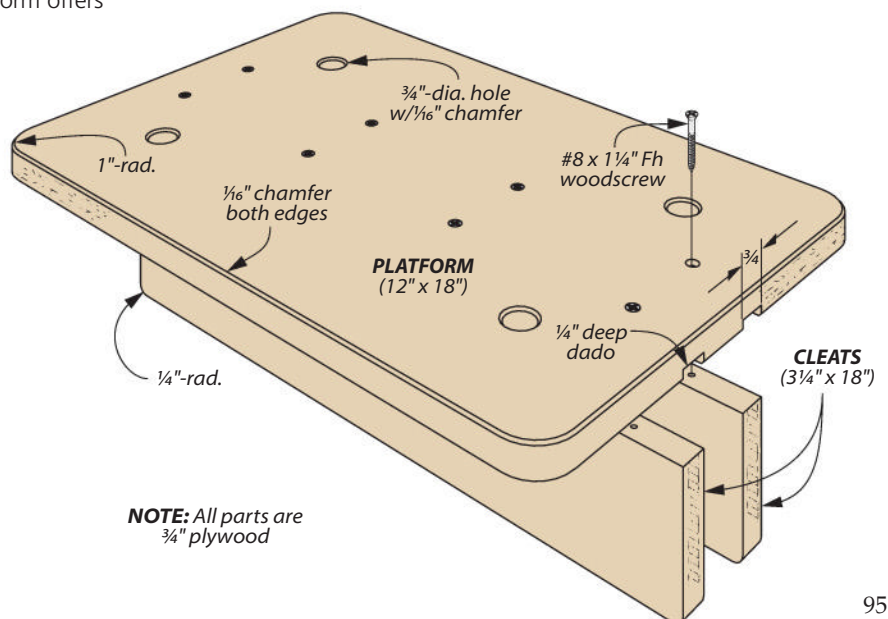
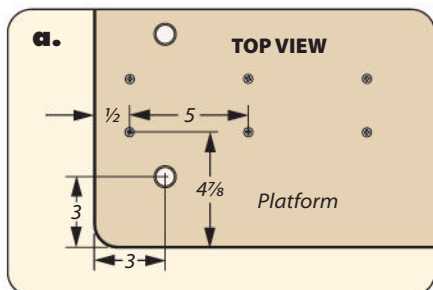
Sawhorse Shelf

A set of sawhorses I made from a design in *ShopNotes* 108 has been sitting around my shop for some time. I recently decided to make an addition to them.

The unique parts of these sawhorses are their thick stretchers. These provide some extra rigidity to the frames, but also served

as a place to saddle the shelf you see here. The shelf is a platform with two cleats beneath, meant to store a pencil, tape measure, or whatever else I might want on hand. I also added holes to let me hang the shelf on the wall.

*Jerry Christian
Clayton, North Carolina*



NOTE: All parts are $\frac{3}{4}$ " plywood



Four-Step Drawer Liner

Well-made drawers always bring a project to the next level. It's rewarding to open a drawer and be greeted by a clean, locking rabbet joint, and there are a few things that transform a cabinet from a hunk of wood to a piece of furniture quite like an array of knobs (aside from the finish, perhaps). Yet there's one part of a drawer that often gets overlooked: the bottom.

For many people (myself included for a while) a plywood bottom is enough. However, a nice drawer liner isn't just for the looks — there are some benefits even in a shop cabinet like the one you see above. First off, the felt keeps the tools from sliding around in the drawer. Second, it makes cleaning the drawer a lot easier (as long as you have a pull tab). All you need to do is pull out the liner, blow out any dust with an air hose, then wipe the drawer bottom and put everything back.

You can see the steps I took to make the liner to the right. I used a piece of posterboard as rigid backing, so that was first to be cut. After cutting an oversized piece of felt as well, I coated one side of the posterboard with spray adhesive. Before laying on the felt, I folded a small piece of painter's tape in half and stuck it to the posterboard; this would be the pull tab. To finish up, I laid the felt onto the posterboard, rolled it out, and cut it flush.

*Jordan Harper
Altoona, PA*



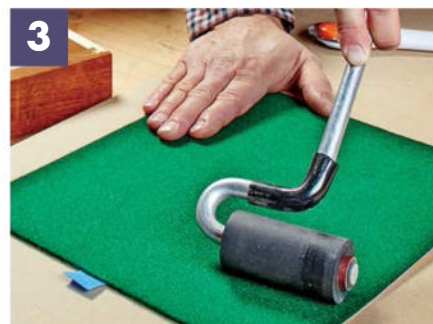
Pull Tab. A simple piece of folded painter's tape makes a great pull tab for easy drawer cleaning.



Posterboard Back. Begin by cutting a piece of posterboard to size. This piece will act as a backer for the felt.



Spray Adhesive. A coating of simple spray adhesive works well to adhere the felt to the posterboard.



Roll On. Apply an oversized piece of felt to the posterboard, then roll out any bubbles and waves with a J-roller.



Trim Flush. Use a wheel cutter to trim the felt to final size. A ruler makes a good straightedge to keep the cut flush.

Woodsmith Shop TV Season 20

Project Sources

Most of the supplies you'll need for projects in this book are available at hardware stores or home centers. For specific products or hard-to-find items, take a look at the sources listed here.

Manufacturers and retailers will periodically redesign or discontinue some of their items. It is wise to gather all the hardware, supplies, and tools you need before you get started, as the products may have changed from how we've shown them in this book. It's easy to adjust dimensions or drill different-sized holes to suit your hardware.

ROLLING WORK CART (P. 6)

The heavy-duty, 1½" x 5" locking swivel casters (2498T642) came from **McMaster-Carr**. For the drawer handles, I used extruded aluminum pull material from **Outwater Industries** (ALU1818-S). It comes in 12'-long pieces that you simply cut to the length you need.

The full-extension drawer slides can be obtained from **Rockler**. You'll need four pairs of the 14"-long drawer slides (68898) and four of the 18" slides (63269).

SHOOTING BOARD (P. 26)

- **McMaster-Carr**
1½" x ¾" UHMW 8702K493
1½" x 2" UHMW 8702K467
¾" Studded Knob 6079K14
1½" Studded Knob 6079K23
1" Threaded Knob 6333K2
¾" Black Washer 92140A118
¾"-dia. Steel Rod 5227T282

BEAM COMPASS (P. 32)

- **McMaster-Carr**
1½" Aluminum 6023K14
1½" Aluminum 6023K27
10-32 Thumbscrews 94567A390

JAPANESE HALL CABINET (P. 36)

When ordering the "Open Weave Cane" at **Rockler** (MCONFIG814) you have to put a value in the order field for pricing. The cabinet was rubbed with *General Finishes* "Seal-a-Cell." When dry, it was topped with two coats of lacquer.

- **Table Legs.com**
2¾" White Oak . SQ2750X29-WO
2¾" Walnut SQ2750X29-WA
- **Rockler**
110° Hinges 32894
¾" Cane 84608
- **Lee Valley**
½" Magnet Set 99K3320
Feng Handle 02W1331

WALL WORKBENCH (P. 44)

- **Woodcraft**
7" Face Vise 162794

VENEER PRESS (P. 50)

- **McMaster-Carr**
2¼" Coupling Nuts 90264A241
¾"-10 Threaded Rod 90034A064
¾" Flat Washers 91083A036
4" Comp. Springs 9657K466
¾"-10 Hex Nuts 90490A436
¾" Steel Rod 4416T91

CUSTOM CLAMP CART (P. 54)

- **Lee Valley**
4" Locking Casters 00K2003
- **Rockler**
8" Drawer Slides 64819
- **Menards**
Drawer Pulls 4883068

LEATHER TOOL HOLDERS (P. 62)

When you purchase leather, you're buying a random cut piece from the supplier. Split-suede leather is sold by the square foot, and is generally sold in pieces 12 to 15 square feet in size. The nyltex thread we used can be purchased from *MacPherson* and

all other materials came from *Tandy Leather Factory*.

- **Tandy Leather Factory**
Leather (Economy Suede) 9827
Stitching Needles 1195-00
Awl Set 3209-00
Grommet Setter 8097-02
Brass Grommets 11291-01
Brass Rivets 1273-11
Rivet Setter 8100-00

SERVING TRAY TABLE (P. 76)

We decided to purchase dowels to use for the legs on the table from *Bell Forest Products*. You can feel free to turn the legs or make them at the router table instead. *Bell Forest Products'* website doesn't have a search function, so you'll navigate by wood species (we used white ash dowels). The finish on the tray and table base is two coats of spray satin lacquer.

- **Woodline USA**
¾" Edge Fluting Bit WL-1475

BATHROOM VANITY (P. 82)

- **Woodcraft**
Shaker-style Knobs 161859
- **Patio Furniture Supplies**
Nylon Stem Glides 30-736
- **Walmart**
Wrap-Around Hinges 20554958
- **Rockler**
Magnetic Door Catch 30546
- **Kohler**
Faucet K-14404-4A-CP
Sink K-2200-HV

MAIL ORDER SOURCES

Bell Forest Products
877-770-9663
bellforestproducts.com

General Finishes
generalfinishes.com

Kohler

Lee Valley
800-871-8158
leevalley.com

MacPherson Leather Company
macphersonleather.com

McMaster-Carr
Mcmaster.com

Menards
menards.com

Old Masters
800-747-3436
myoldmasters.com

Outwater Industries
800-631-8375
outwater.com

Patio Furniture Supplies
954-497-1106
patiofurnituresupplies.com

Rockler
rockler.com

Table Legs.com
800-748-3480
tablelegs.com

Tandy Leather Factory
tandyleather.com

Walmart
walmart.com

Woodcraft
800-535-4486
woodcraft.com

Woodline USA
800-472-6950
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or to find a dealer near you!