



knock-down Shelving System

This set of shelves uses a clever design of interlocking notches and keys that make it a snap to set up or take down. It's sure to be a fun weekend build.

Big, towering, and ornate bookcases and shelving units certainly have their place in the woodworking pantheon. But every once in awhile, you just need something simple and useful. This little knock-down shelving system was designed and built with exactly that sentiment in mind.

SIMPLE DESIGN. As you can see, there isn't a whole lot in the way of parts to this

setup. A set of four frames provide the basic structure, while shelves that are each made from two thick maple planks pass between the frames.

FASTENER-FREE ASSEMBLY. But the unique part of the system is how it's assembled. When they're butted together, the shelf planks are narrower than the openings in the frame and pass through them easily. Then, driving hardwood

keys into grooves at the ends of the planks spreads them apart. Notches cut in the outside edges engage with the frame stiles to lock it all together. If you ever need to take the shelving system apart to move it, you can simply tap out the keys, remove the shelves, and it all breaks down neatly into a tidy stack of frames and boards for storage or transport.

center of the groove on the back of the shelf with a square, I traced that mark to the face of the shelf. Then I used the guide block you see in Figure 2 to start the holes for the shelf pins.

INSTALL BASE SHELF. As I mentioned earlier, the shelf pins support the shelves. They're attached to the wall pins through the flanges. There are also set screws in the flange that let you fine-tune the angle of the shelf pins to level the shelf if needed (Figure 3). When the pins are aligned properly, just slide the base shelf onto the pins. Now you can start assembling the rest of the display shelf. This starts with attaching an upright to the base shelf you just installed.

BOLT ON UPRIGHT. Figure 4 shows how to attach an upright to the base shelf. This is a straightforward affair that involves joining the upright to the shelf with a pair of connector bolts into the threaded inserts in the upright. When the bottom connection is secure, you can focus on the next shelf.

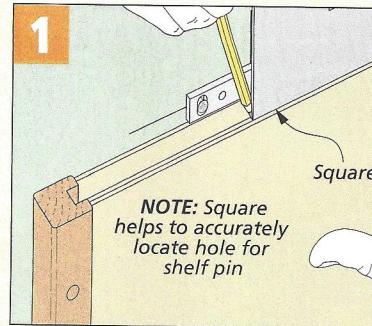
ONWARD & UPWARD. Installing the next shelf starts with loosely attaching it to the upright and cutting a spacer to hold it level in place (Figure 5). This frees your hands so you can dial in the exact location of the wall pins for this shelf. When you're confident about this mark, remove the shelf and drill the holes for the wall pins like you did when working on the base shelf.

After installing the wall pin, set the shelf and spacer back in place. Now draw a line on the shelf where the hole for the shelf pin needs to go. Drill the hole in the shelf with the guide block like before. Then back at the wall, attach the shelf pin to the wall pin at the flanges and slide the shelf in place. (Although the pins are holding the shelf at this time, I left the spacers in place for the whole installation process.) Now tighten the connector bolts (Figure 6).

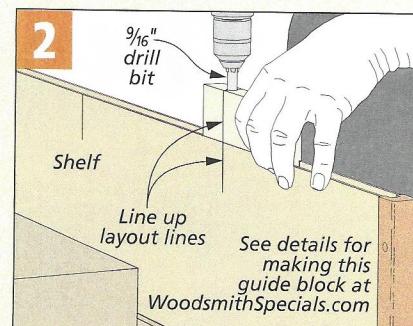
REPEAT. Okay, you've completed the cycle of installing a shelf, an upright, and another shelf. So you're back to installing the next upright. All you have to do is repeat the same steps for the remaining parts.

This process may seem a little tedious, but it's worth the effort. Your reward will be that you have a display shelf that seems to float effortlessly on the wall.

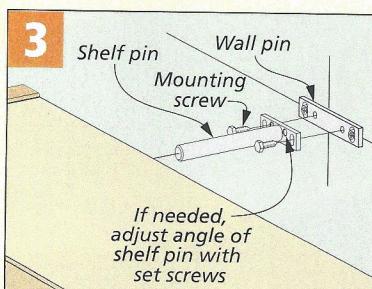
How-To: Install Base Shelf & Uprights



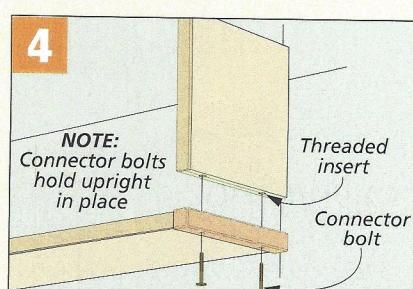
Base Shelf Pin Holes. With a helper, use a square to mark the location of the pins in the groove in the shelf.



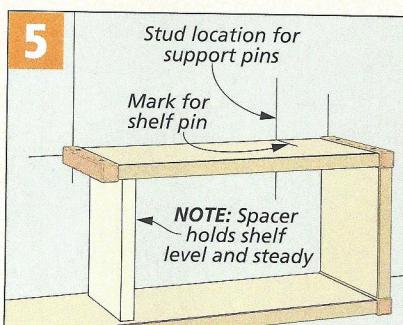
Drill Shelf Pin Holes. A simple guide block starts the hole square. Remove it and finish drilling to the proper depth.



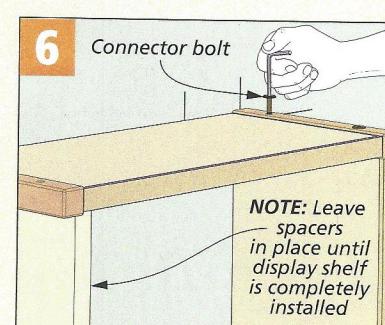
Attach the Shelf Pin. The shelf pin attaches to the wall pin. Set screws allow you to adjust the angle.



Bolt on Upright. Connector bolts through the corner blocks tie the uprights to the shelves.



Next Shelf. Loosely attach the next shelf to the upright. Then repeat the wall and shelf pin installation.



Install Shelf. Tighten the connector bolts in the first upright before moving on to the rest of the display shelf.

MATERIALS & SUPPLIES (HORIZONTAL DISPLAY)

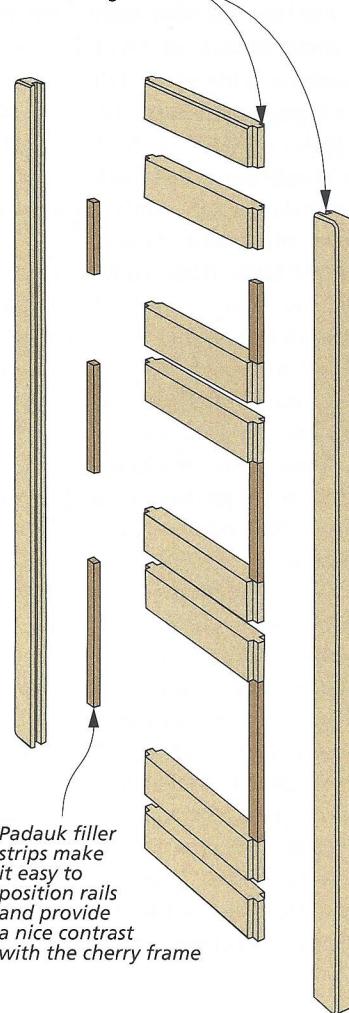
A	Crnr./Cap Blocks (16)	1 1/4 x 1 1/4 - 10 1/8	I	Term. Uprights (2)	1 ply. - 9 3/4 x 10 3/8
B	Base Shelf (1)	1 ply. - 9 3/4 x 90 3/4	J	Term. Uprights (2)	1 ply. - x 9 3/4 x 5 3/8
C	Shelves (2)	1 ply. - 9 3/4 x 36 3/4	K	Edging (2)	1/4 x 1- 294 rgh. • (12) Wall Pin Sets
D	Shelf (1)	1 ply. - 9 3/4 x 24 3/4	F	Conn. Upright (1)	1 ply. - 9 3/4 x 18
E	Shelves (2)	1 ply. - 9 3/4 x 18 3/4	G	Conn. Upright (1)	1 ply. - 9 3/4 x 14
F	Conn. Upright (1)	1 ply. - 9 3/4 x 18	H	Conn. Uprights (2)	1 ply. - x 9 3/4 x 10
G	Conn. Upright (1)	1 ply. - 9 3/4 x 14	I	ALSO NEEDED:	Three 48" x 96" sheets of 1/2" birch plywood
H	Conn. Uprights (2)	1 ply. - x 9 3/4 x 10			

CONSTRUCTION DETAILS

OVERALL DIMENSIONS:

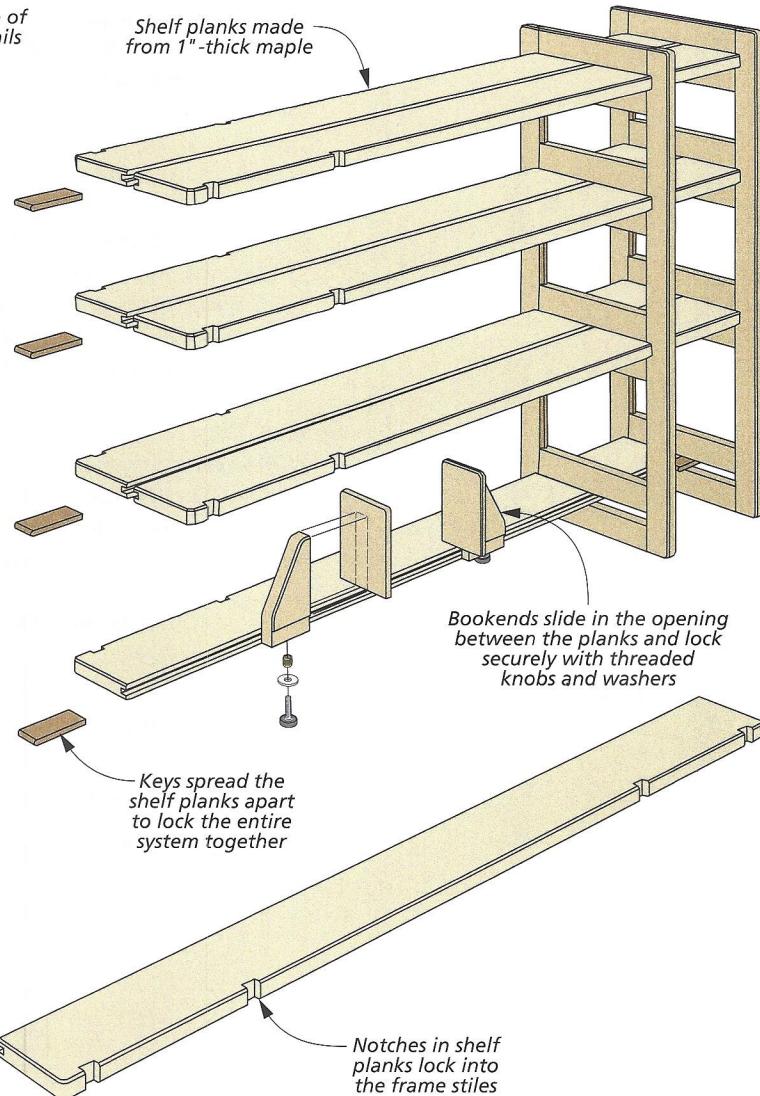
63"W x 38"H x 14 $\frac{3}{4}$ "D

Frame rails and stiles
joined with stub
tenons and grooves

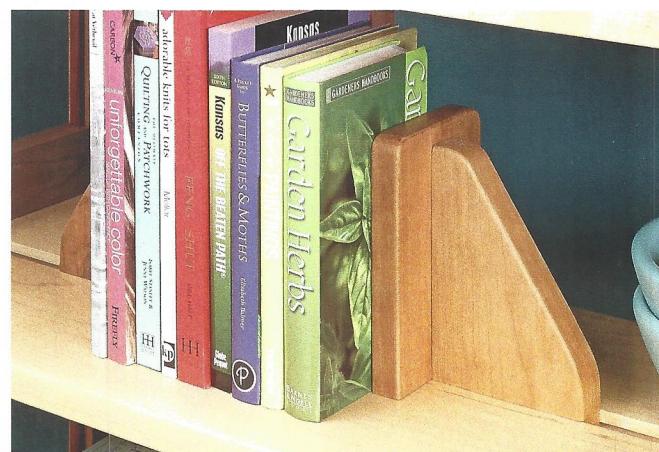


Each frame is made up of
two stiles and eight rails

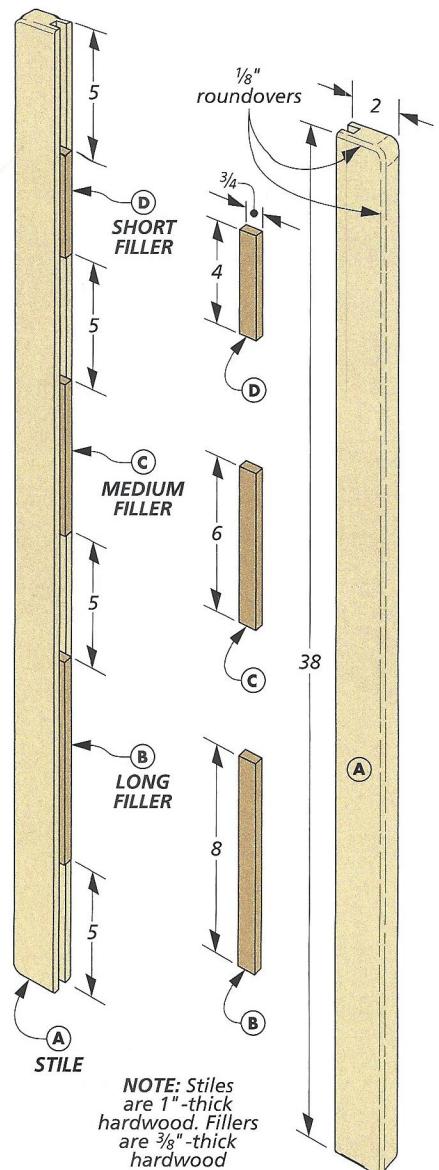
Shelf planks made
from 1"-thick maple



Spacers. Hardwood keys are the secret to the shelving system's construction. They spread the shelf planks apart, locking the notches on the shelf planks into the frame stiles.



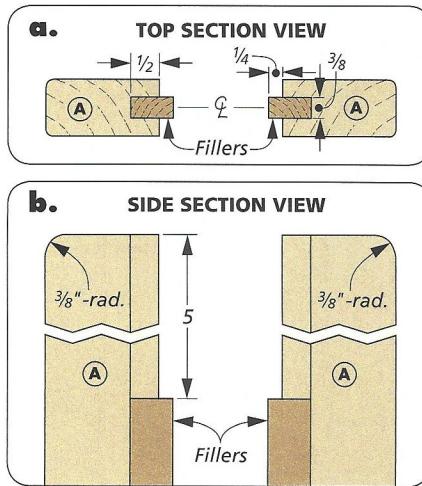
Sliding Bookends. Bookends help to make the unit quite useful as a bookshelf. They slide in the space between the planks and lock down securely with threaded knobs.



build the Basic Frames

The framework of the knock-down shelving system consists of four frames that look like the ones you see in the main drawing on the next page. Each frame is made of two stiles that surround eight rails. They're joined to one another with stub tenon and groove joinery.

You'll also notice that the frame has a few additional parts, which are the filler strips shown in the drawing at left. These strips of varying length serve a couple of purposes for the shelving system. First, they fill the grooves in the stiles in between the rails. And second, they provide a handy method for aligning the rails as you assemble the frames later on by simply butting the rails against them.



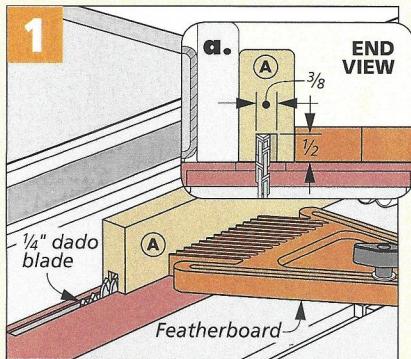
COMPLEMENTARY WOODS. To give the shelving system a stylish look, I used a few different types of hardwood with complementary colors. That started with the frames, where I made the rails and stiles from cherry, and then the filler strips from an exotic wood known as padauk. Since these parts are fairly small, I didn't have to buy a large, expensive board to get all the padauk I needed for the shelf. Later on, you'll note that I also made the keys from padauk. And the shelf planks are made from thick slabs of maple.

GROOVE THE STILES. After cutting all the stiles to size from 1"-thick cherry, the first order of business is to cut centered grooves in the inside edge of each of them. A simple method for ensuring centered grooves is to cut them in two passes, flipping the workpiece end for end between the passes. Figure 1 in the box below provides the details. You'll also want to note that the final grooves are $\frac{3}{8}$ "-wide, so I set up a $\frac{1}{4}$ " dado blade in my table saw to cut them.

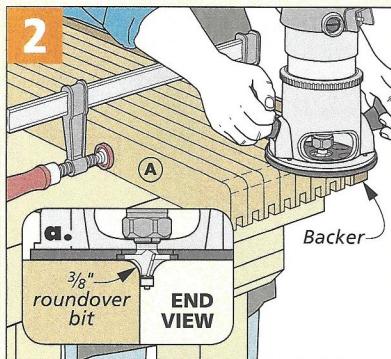
ROUT RADII. As detail 'b' shows, a $\frac{3}{8}$ " radius adorns the outside-facing corners of each stile. Before doing any assembly work, it was easy to clamp all the stiles together in order to rout these radii using a roundover bit (lower middle drawing).

FILLER STRIPS. Now you can move along to the padauk filler strips that fill the grooves in the stiles. I started by planing a board down to thickness until it fit nicely

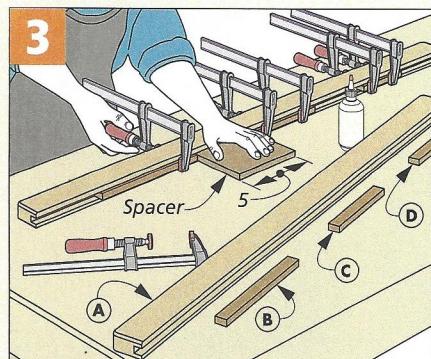
How-To: Shape the Stiles & Install the Fillers



Centered Grooves. After the first pass, flip the stile end for end to cut a centered groove in the piece.



Radius. Stacking the stiles and routing a roundover along the corners is an easy way to form all the radii.



Install Fillers. A spacer block allows you to position the filler strips properly as you glue and clamp them in place.

in the grooves in the stiles. After ripping some longer strips to width, I used a stop block attached to an auxiliary fence on my miter gauge to cut the three different sizes of filler strips to consistent length.

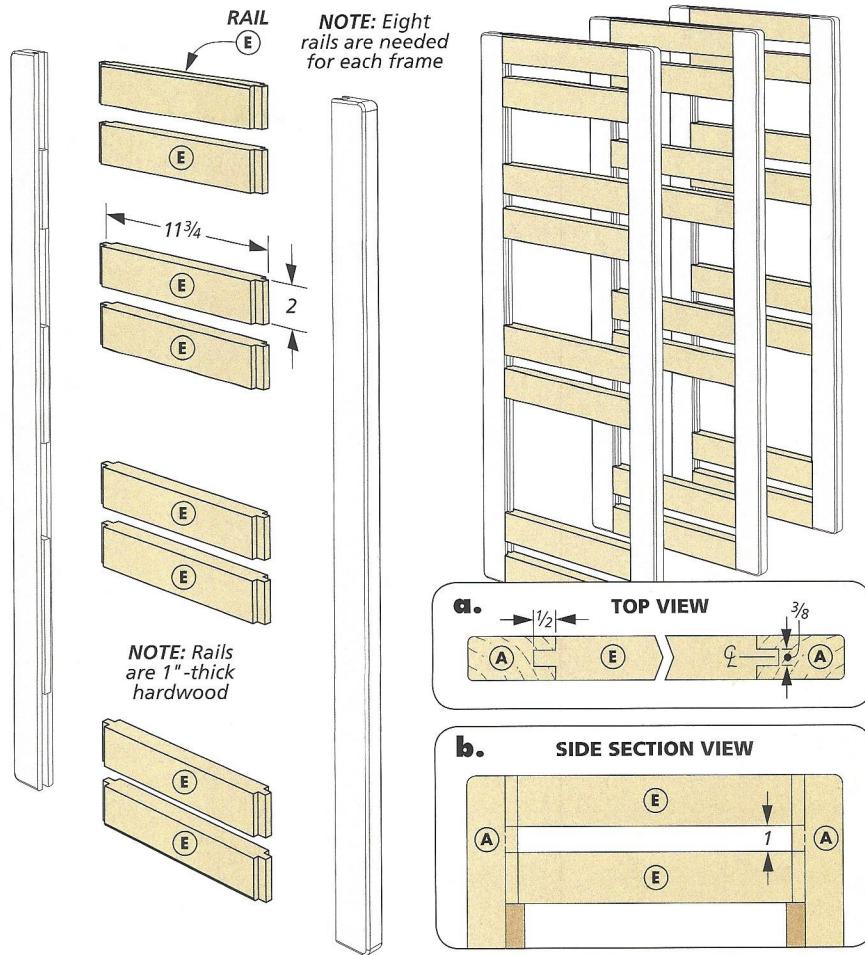
FILLERS TO STILES. As mentioned earlier, the fillers establish the positions of the rails when you perform the final assembly of the frames. So the next order of business is to glue the fillers into the stiles at the correct locations. To help in this effort, I made some spacer blocks that matched the width of two of the rails plus the space between them (Figure 3, previous page). This allowed me to space the filler strips consistently as I glued them into the grooves in the stiles.

STUB TENONS ON RAILS

You can now turn your attention to the final components of the frames, which are the rails. Like the stiles, they're made from 1"-thick cherry. They have stub tenons on the ends to fit the grooves in the stiles.

Typically, I would cut stub tenons like these using a dado blade. However, a dado blade can leave an uneven surface on the tenon cheeks, and the top tenons on this shelving unit were going to be quite visible once it was all assembled. For that reason, I used a two-pass method to cut tenons with cleaner cheeks.

The method I used is shown in Figures 1 and 2 below. First, you establish the shoulder of each tenon before passing the rail through the blade on end to cut

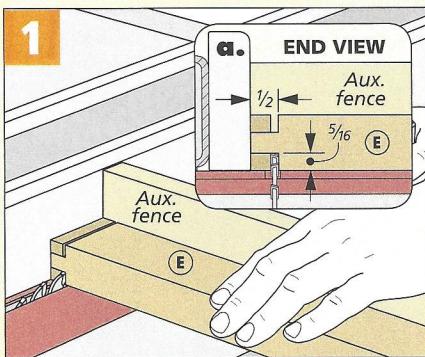


the cheeks. Details for the backer board I used to support the rails for this cut can be found at WoodsmithSpecials.com.

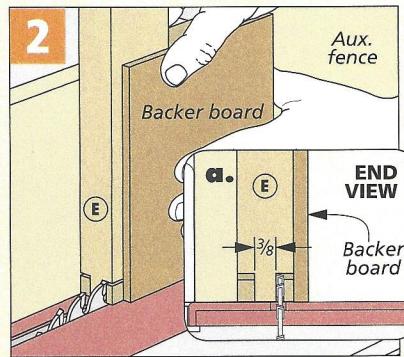
FINAL FRAME ASSEMBLY. Now all that's left is gluing the rails between the stiles to complete the frames. Figure 3 below has

the details you need. Even though the fillers establish the rail locations, it's still helpful to have some spacers on hand to force the rails up against the filler strips and hold them in position as you're applying the clamps.

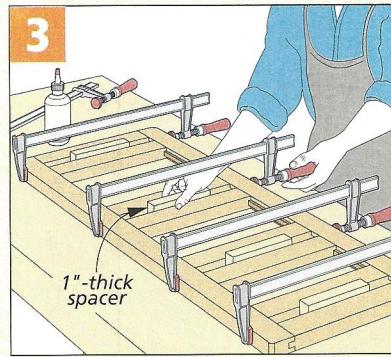
How-To: Cut Tenons & Assemble the Frames



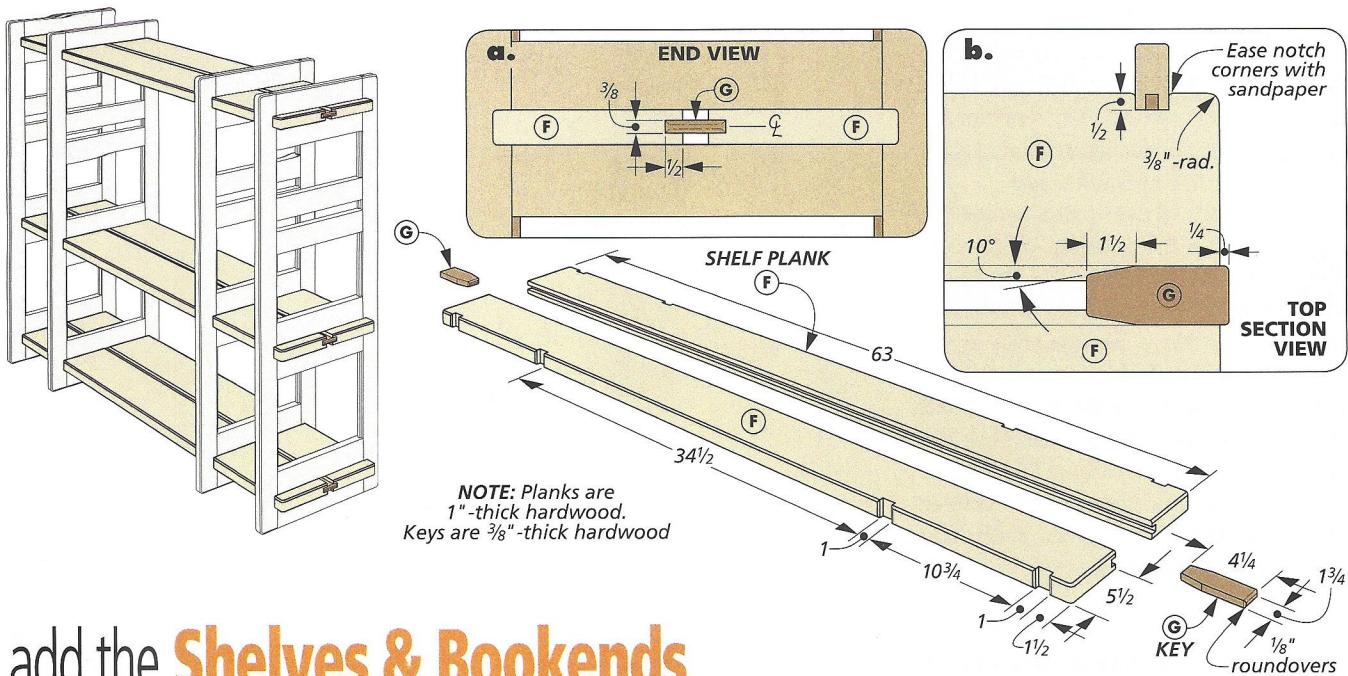
Stub Tenon Shoulders. Use the rip fence to establish the position of the tenon shoulders before cutting.



Stub Tenon Cheeks. This backer board supports the rails vertically as you cut the tenon cheeks.



Frame Assembly. Spacers help to hold the position of the rails as you glue and clamp the frame together.



add the Shelves & Bookends

With the frames assembled, you can turn your attention to the remainder of the parts that make up the shelving system. Those include the shelf planks, keys, and adjustable bookends.

START WITH THE SHELVES. The four shelves are each formed from two maple planks. After cutting them to size, I formed a groove along the inside edge of each to accept the key later on. These grooves can be cut in the same manner as those on the frame stiles, as shown in the lower left

drawing on page 12.

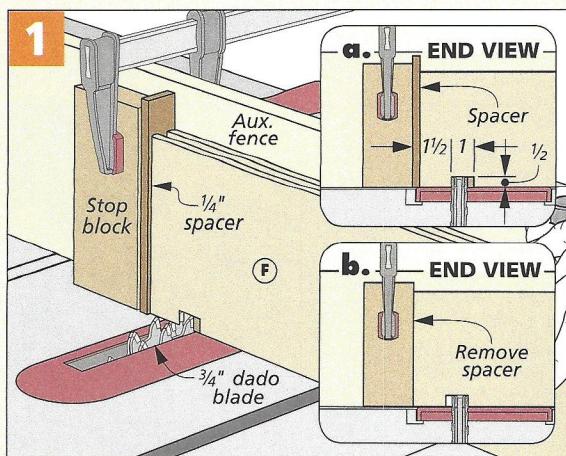
NOTCHES. The next step is critical to how this shelving system is assembled, and that's the four notches formed on the outside edge of each shelf plank. As you'll recall, later on these will lock against the inner edges of the frame stiles to hold the entire unit together.

To cut the notches, I stood each plank on edge and passed it over a dado blade. Each notch is wider than the full width of a dado blade, so cutting them required two

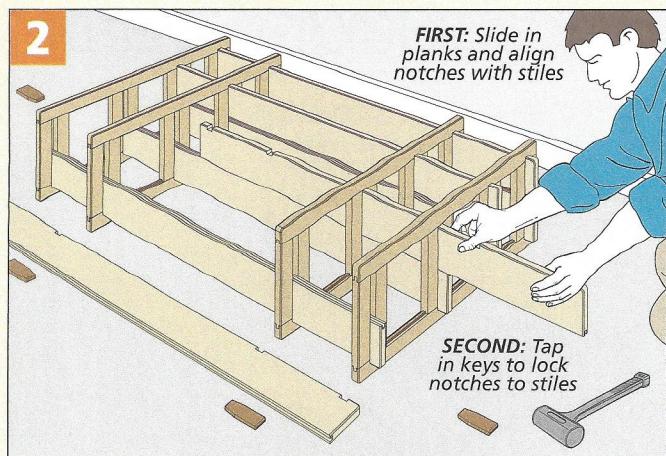
passes each. I used the setup shown in Figure 1 below to make forming the notches a precise and efficient process. After cutting them all, I sanded a slight radius on the edge of each notch so that they would seat better against the stiles.

RADIUS. The last step to complete the planks is to form a radius along all the outside-facing corners. Here again, you can shape these in the same manner as you did for the stiles (refer to the lower middle drawing on page 12).

How-To: Notch & Install the Shelves



Notches. An auxiliary miter fence with a stop block and spacer is the trick to cutting the 1"-wide notches. Remove the spacer after the first pass to complete the notch.



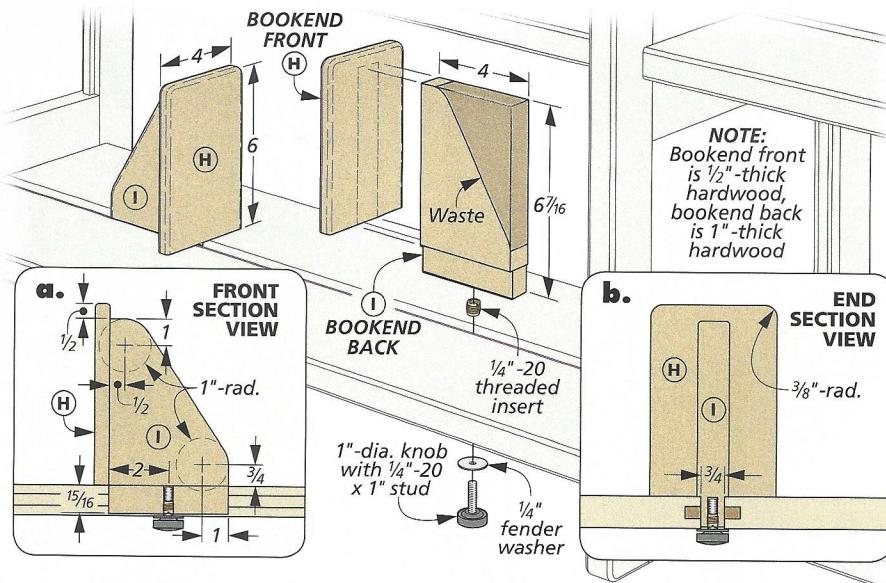
Assembly. It's easiest to assemble the shelving system with the frames positioned on edge. Carefully slide in the shelf planks and align the notches with the stiles before driving in the keys.

KEYS. Like the fillers in the frames, the keys are made from the exotic wood padauk for a nice contrast with the maple planks. You'll want to start by planing stock down for a snug fit in the grooves in the planks. Then rip the pieces to width before using a miter auxiliary fence with a stop block to crosscut them. I trimmed the angle on the front corners at the band saw before sanding the keys smooth and rounding the outside ends of each.

SHELVING SYSTEM ASSEMBLY. After applying a finish to the components, you're ready to put your shelving unit together. Figure 2 on page 34 provides a good overview. Once everything is aligned properly, use a mallet to tap in the keys, which in turn seats the notches over the edges of the stiles to lock the assembly together.

BOOKENDS

If you want to use your shelving system for storing books, these bookends are a useful



addition. Each consists of a front and back made from cherry. You can make as many pairs as you desire.

After cutting the bookend fronts and backs to overall size, the first thing I did was drill a hole and install a threaded insert in the bottom end of the bookend back (photo at left). This is easier to do with a thick, square blank. Then rabbet both faces of the bottom end of the bookend back to fit the space between the two shelf planks. You'll want it to slide smoothly in the groove with little play.

With that done, I laid out the profile on

Insert Press. The drill press is great for driving threaded inserts in straight. Refer to *WoodsmithSpecial.com* for more on this setup.

each bookend back as shown in detail 'a' above and cut it out at the band saw. After sanding it smooth, I rounded the ends and edges of both parts before gluing and clamping them together.

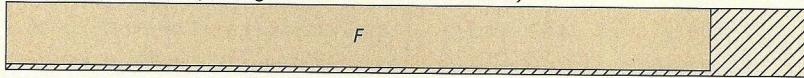
A studded knob and washer fit the threaded insert and allow you to lock the bookends in place (detail 'b'). Loosening the knob allows you to slide and reposition the bookend easily.

This simple, clever shelf is sure to find a useful spot somewhere in your home. In fact, you might find that you'll want to build several of them for kids' rooms, your own room, or even the living room. And if you ever need to move it somewhere, like off to college, it will break down easily and stack nicely for transporting.

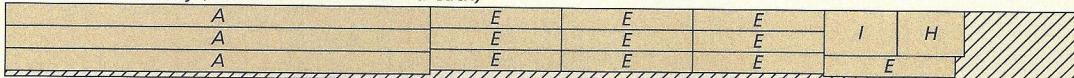
MATERIALS, SUPPLIES & CUTTING DIAGRAM

A Frame Stiles (8)	1 x 2 - 38	D Short Fillers (8)	3/8 x 3/4 - 4
B Long Fillers (8)	3/8 x 3/4 - 8	E Frame Rails (32)	1 x 2 - 11 3/4
C Medium Fillers (8)	3/8 x 3/4 - 6	F Shelf Planks (8)	1 x 5 1/2 - 63

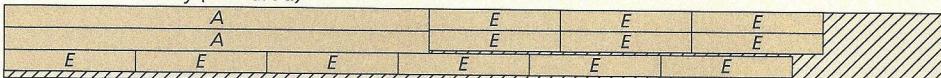
1" x 6" - 72" Hard Maple (Eight boards @ 3.0 Bd. Ft. each)



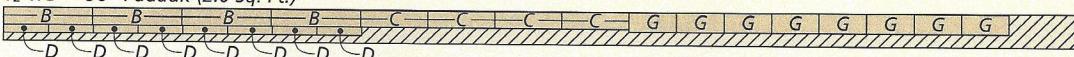
1" x 6 1/2" - 96" Cherry (Two boards @ 4.3 Bd. Ft. each)



1" x 6 1/2" - 84" Cherry (3.8 Bd. Ft.)



1/2" x 3" - 96" Padauk (2.0 Sq. Ft.)



G Keys (8)	3/8 x 1 3/4 - 4 1/4
H Bookend Fronts (2)	1/2 x 4 - 6
I Bookend Backs (2)	1 x 4 - 6 7/16

- (2) 1/4"-20 Threaded Inserts
- (2) 1/4" Fender Washers
- (2) 1"-dia. Knobs w/1/4"-20 x 1" stud

NOTE: Parts B, C, D, G, and H are planed to final thickness