



The Kitchen Cabinet

How to design and build one with basic tools

by Will Hasson

The fundamental building block in every successful kitchen is the below-the-counter cabinet. It supports the work surface above and makes for organized storage beneath. Though this essential built-in can take on a multitude of styles and refinements, at heart the construction requirements are all the same. A sturdy case and framework, easily operable drawers, doors that fit and proper scale are common to good cabinets, whether made of painted plywood or expensive hardwood. In this article, I will describe the basic steps involved in building an uncomplicated, yet handsome, kitchen cabinet unit for about \$140 in materials.

The cabinet shown above is the standard 24-in. depth, and is designed for the typical $\frac{3}{4}$ -in. thick by $25\frac{1}{2}$ -in. plastic-laminate countertop. Its $35\frac{3}{4}$ -in. height, also standard, accommodates appliances such as dishwashers and trash

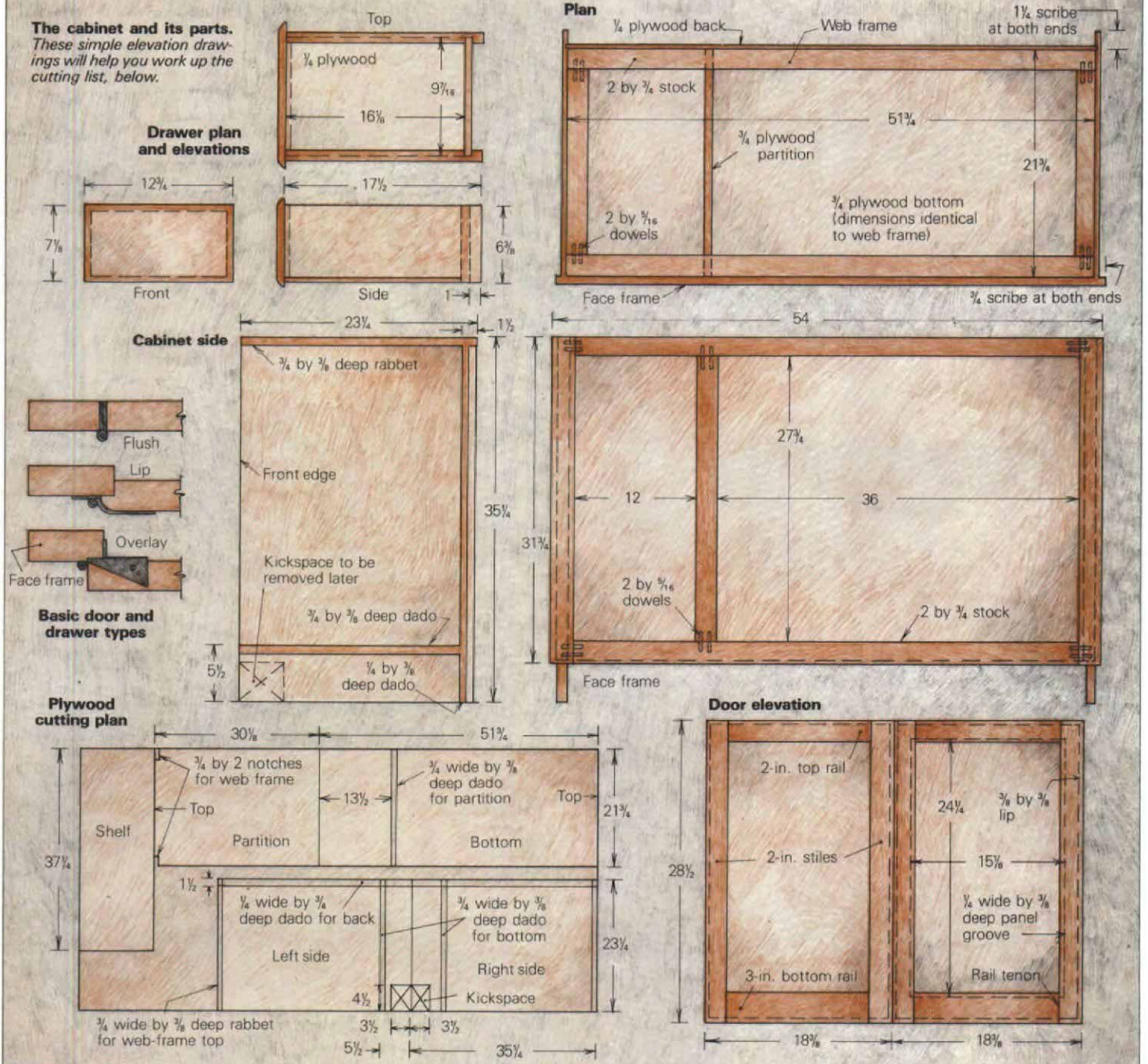
compactors, and presents the countertop at a level on which most people can work comfortably. These dimensions are used widely in the trade, but you can change the height to suit yourself just by adding or subtracting an inch or so. The 54-in. length here is arbitrary, but it makes good use of a single sheet of plywood and has room enough for a small sink to be let into the countertop. Also, a cabinet of this general size is small enough to move easily from shop to site—an important consideration.

Starting out—Constructing cabinets should always begin with a drawing of exactly what you have in mind. The drawing is indispensable for working out proportions, making cutting lists and for seeing the relationships between the different parts. You can use the drawings and cutting lists on the facing page as models for

preparing your own design and material requirements. If you do as much as you can on paper before you cut any wood, you'll save yourself a lot of time and frustration.

Almost all cabinets have the same parts: a case (or carcass), a face frame, doors and drawers. The cabinet shown here is designed to feature wood, and therefore has a carefully joined face frame and panel doors. The face-frame members are doweled together, and the whole frame is then applied to the front of the case. It provides jambs for the cabinet doors, defines the openings for the drawers and generally stiffens the carcass and helps it resist lateral racking. The doors and drawers have $\frac{3}{8}$ -in. rabbeted inner edges so they overlap the face frame $\frac{3}{8}$ in. to form a lip on all sides, and so the drawer fronts and door frames project $\frac{3}{8}$ in. beyond the plane of the face frame. This arrange-

The cabinet and its parts. These simple elevation drawings will help you work up the cutting list, below.



ment looks good, and the rabbits allow considerable latitude in fitting doors and drawers into the cabinet. Once the face frame is made and attached, however, you can choose between either overlay or flush detailing, as shown in the drawing above.

In our shop, we make the face frame extend $\frac{3}{4}$ in. beyond the sides of the case so the cabinet can be scribed to fit snugly against interior walls and against other adjacent cabinet units.

You can build the entire cabinet unit with just a few tools. A table saw or radial arm saw is useful for ripping frame members and drawer sides to width and for crosscutting them accurately to length. The case sides and back, however, are best cut with a skill saw, since in many cases it's almost impossible to wrestle a full sheet of $\frac{3}{4}$ -in. plywood onto a saw table. You will also need an electric drill with a sharp

$\frac{5}{16}$ -in. bit (preferably a brad-point bit) and a doweling jig for joining frame members.

It's possible, but not advisable, to get the job done without a table saw or radial saw. Without standing power tools, you would have to use a circular saw for all the ripping and crosscutting and a router for cutting the grooves, rabbets and dados. By hand-planing the frame members and drawer sides to finished width, you could certainly get accurate results, though it would take you considerably longer this way than if you were to use a standing power saw.

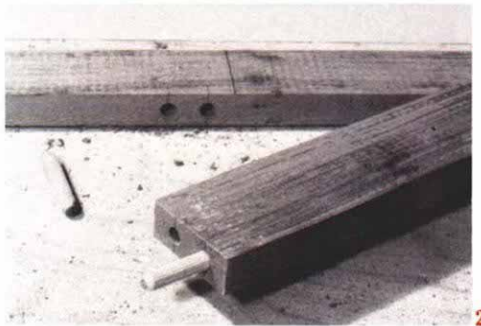
Making the face frame—Construction begins with the face frame. Rip $\frac{3}{4}$ -in. solid stock into 2-in. wide strips and cut them to length. A crosscut jig for your table saw can be a great help in cutting accurate 90° angles. One way you can build a jig like this is described in the

Cutting list

Part	How many?	Size (in.)
<i>Case</i>		
Partition	1	$30\frac{3}{8} \times 21\frac{3}{4} \times \frac{3}{4}$ -in. ply
Bottom	1	$51\frac{1}{4} \times 21\frac{3}{4} \times \frac{3}{4}$ -in. ply
Sides	2	$35\frac{1}{4} \times 23\frac{3}{4} \times \frac{3}{4}$ -in. ply
Shelf	1	$37\frac{1}{4} \times 14 \times \frac{3}{4}$ -in. ply
Back panel	1	$51\frac{1}{4} \times 30\frac{1}{2} \times \frac{3}{4}$ -in. ply
<i>Web frame</i>	2	$51\frac{3}{4} \times 2 \times \frac{3}{4}$
	2	$17\frac{1}{4} \times 2 \times \frac{3}{4}$
<i>Face frame</i>	2	$50 \times 2 \times \frac{3}{4}$
	2	$31\frac{3}{4} \times 2 \times \frac{3}{4}$
	1	$27\frac{1}{4} \times 2 \times \frac{3}{4}$
<i>Doors</i>		
Stiles	4	$28\frac{1}{2} \times 2 \times \frac{3}{4}$
Rails	2	$15\frac{1}{8} \times 2 \times \frac{3}{4}$
Rails	2	$15\frac{1}{8} \times 3 \times \frac{3}{4}$
Panels	2	$15\frac{1}{8} \times 24\frac{1}{4} \times \frac{3}{4}$ -in. ply
<i>Drawers</i>		
Fronts	4	$7\frac{1}{8} \times 12\frac{3}{4} \times \frac{3}{4}$
Sides	8	$6\frac{3}{8} \times 17\frac{1}{2} \times \frac{3}{4}$
Backs	4	$6\frac{3}{8} \times 9\frac{1}{16} \times \frac{3}{4}$
Bottoms	4	$16\frac{1}{8} \times 9\frac{1}{16} \times \frac{3}{4}$ -in. ply
<i>Kickplate</i>	1	$54 \times 3\frac{1}{2} \times \frac{3}{8}$
<i>Hanger bar</i>	1	$37\frac{1}{4} \times 3\frac{1}{2} \times \frac{3}{4}$

The frame. With the doweling jig indexed on the pencil mark (1) Hasson bores out the end grain in a frame member. The hole is bored to the proper depth when the electrical tape on the drill bit is flush with the top of the jig, which is a self-centering dowel-guide made by Dowl-It (Box 147, Hastings, Mich. 49058).

For joining face-frame members, a single pencil line (2) marks the intersection of an upright. Lines to mark bore centers have been extended with a combination square down the edges to ensure accuracy in locating holes.



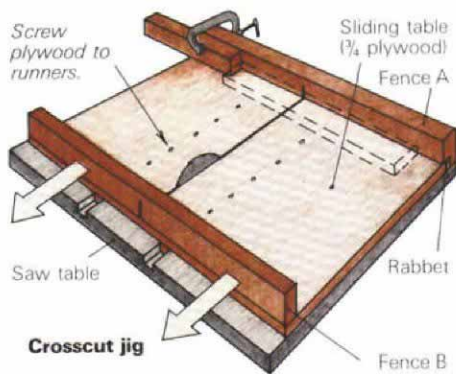
Crosscut jig

A simple table-saw attachment is especially useful for cutting frame members to length. We have four different versions for cutting various angles and sizes of work. The one drawn below is for making precisely square cuts in stock up to 2 ft. wide.

The guide rails on the bottom of the jig fit into the two miter grooves milled into the saw table on either side of the blade. We use oak or maple for the rails because these woods are hard and slippery. The runners should slide easily without any side-to-side movement.

The rails must be exactly perpendicular to fence A, which is rabbeted on its underside. In our latest version, I placed the rails in the table grooves and put a dab of glue atop their ends. Then I positioned fence A on the glue points and adjusted it perpendicular to the rails with a combination square. When the glue had set up, I applied glue to the edge of a $\frac{1}{2}$ -in. plywood panel and carefully slid the edges into the rabbet at the bottom of fence A, clamped it in place, and screwed the plywood to the runners, without moving the assembly from the table saw. Later I glued fence B to the top of the plywood. It keeps the ends of the plywood from flopping around and gives ballast to the front of the jig.

Passing the jig over the sawblade a few times will cut a workable slot in the plywood table. If you use the jig with a dado blade, make several shallow cuts to form the blade slot.

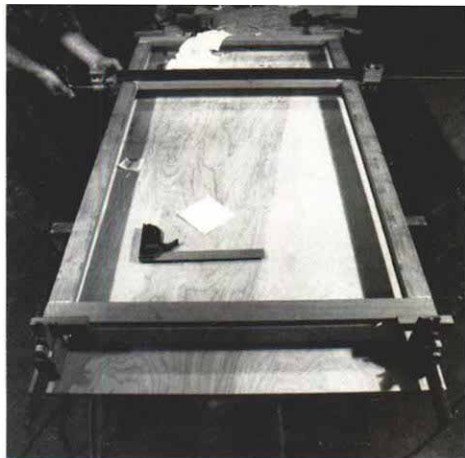


sidebar at left. Lay the frame members on a flat surface in the positions they belong in and label both sides of each joint. Holding one piece tightly in position with your fingers or a clamp, draw two lines across the joint. These lines mark the centers of the $\frac{5}{16}$ -in. dowel holes, so don't put them too close to the edges of the stock—about $\frac{1}{2}$ in. is good. Next, carry the marks over the edges and ends of the strips with a combination square. A doweling jig is crucial to this operation because it ensures that the dowel hole is square to the surface and in just the right spot. Center the indexing mark of the doweling jig (mine is self-centering) on the lines and bore $\frac{5}{16}$ -in. dia. holes slightly more than 1 in. deep for 2-in. dowels (photo 1, above). Drill a test hole to the right depth, and mark the drill shank with a piece of electrical tape where it's flush with the top of the jig. The tape will mark the depth for all the holes.

Before you join the frame members, think which parts should go together first. Generally, the rule is to work from the inside out. With

large, complicated frames it is sometimes useful to glue up the frame in sections, letting the glue in each section dry before assembling it into a complicated whole. After drilling all the holes, baste the dowels on one end with a thin coat of yellow (aliphatic-resin) glue, and drive them home (2). To assemble each section, apply glue first to the end-grain edges, letting it soak in and reapplying as necessary. Then coat the dowels and close the joint.

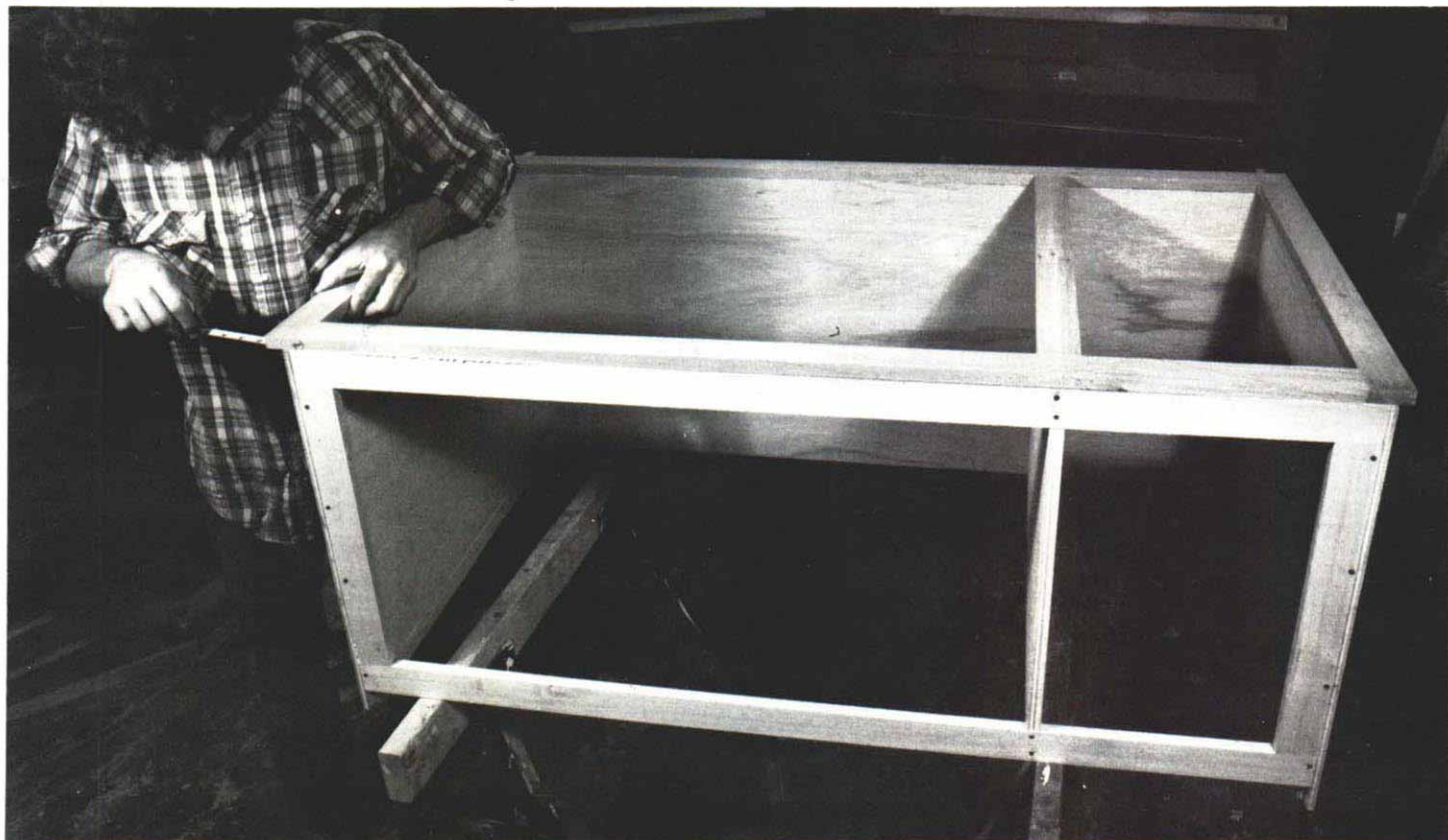
Clamp the frame together with bar clamps, and use wooden pads between the clamp jaws and the face frame to avoid crushing the edges and to direct the clamping force to the joint area (3). Small pieces of paper between the clamp and the frame will prevent the glue from reacting with the metal and staining the wood black. Don't rush. Work steadily and carefully, making certain that everything is flat and square. After the glue dries, tool off the squeeze-out with a sharp chisel or paint scraper. Plane or sand the face frame with a belt sander to even out the joints; then set it aside.



When gluing up the face frame (3), check for square, and position clamp blocks to direct clamping pressure across joint lines.

The basic case (4): $\frac{3}{4}$ -in. plywood sides, bottom and partition are glued and nailed in place with 6d cement-coated nails. Notches in the top of the partition will receive the web-frame top.

Apply the face frame (5) with the cabinet laid on its back. Before gluing face frame to carcass, check the scribe depth (the amount by which the frame overlaps the sides). Re-check periodically while tightening the clamps. The web-frame top has already been glued and nailed into notches in the partition and into rabbets in the case sides.



The case—The case or carcass determines the interior space of the cabinet. The sides, bottom and interior partition and shelf in this cabinet are all $\frac{3}{4}$ -in. plywood, and the back is $\frac{1}{4}$ -in. plywood. We use lauan plywood for these parts because it's easy to work, and has an unobtrusive color and grain pattern that doesn't clash with the solid woods on the face of the cabinet. A web frame, similar to the face frame, is fitted into rabbets and holds the carcass together at the top. The bottom of the case is housed in dados in the sides.

Now lay out the cabinet sections on the plywood in the most economical fashion (drawing, p.33). Cut the plywood for the sides, bottom and partition, and mark the positions of the dados and rabbets. Remember there are two opposing sides, one the mirror image of the other. Avoid making a pair of identical sides by accident, and having to scrap one.

Set your table saw or router to cut a groove $\frac{3}{4}$ in. wide by $\frac{3}{8}$ in. deep. Now rabbet the tops (inside) of the case sides and dado the bottoms

as shown in the drawing on p.33. Then cut $\frac{1}{4}$ -in. wide by $\frac{3}{8}$ -in. deep grooves for the plywood back.

Next, dowel-join and glue up the web-frame top just as you did the face frame. It has the same outside dimensions as the plywood bottom panel, and is held in the rabbets cut into the top of the case sides and in two notches cut into the partition top. The web frame holds the top of the case together, and serves as a cleat for attaching the countertop.

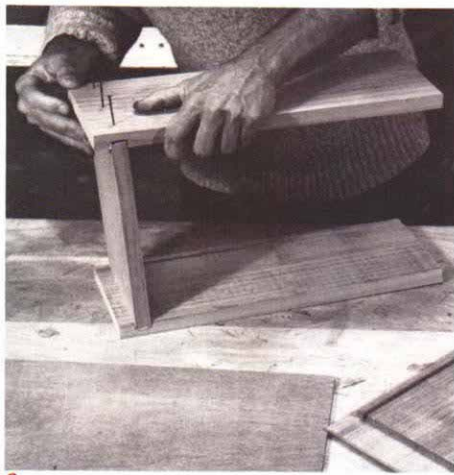
When the carcass components are cut to size, nail and glue them together from the bottom up (4). Use 6d cement-coated nails, and draw a centerline opposite the dados to aid in locating the nails. Lay the partially assembled case on its back and align the side and partition while nailing the web frame in place. Make sure the distance between the partition and the sides is equal at the top and bottom.

After assembling the case, attach the face frame (5). If the cabinet is to be painted or if nail holes are not objectionable, the face frame

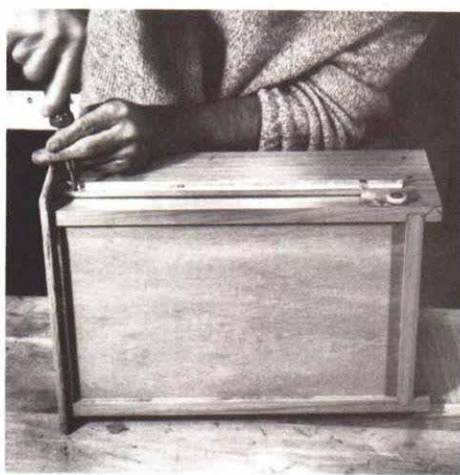
can be glued and face-nailed to the body with 6d finishing nails. A neater way is to glue and clamp the face frame to the case, though this requires a good supply of bar clamps and C-clamps. Whichever method you use, leave an equal overlap at each side for scribing. When the frame is glued in place, saw out the kickspace notches.

Drawers—Doors and drawers fall into one of three categories, depending on how they relate to the face frame. Lip doors and drawers are the traditional choice. Overlay doors and drawers are used almost exclusively in mass-produced kitchen cabinets, mainly because they are so quick and easy to install. But they also give a kitchen a clean, solid look. Flush doors and drawers (they fit flush with the face frame) make the cabinets look like furniture, and are by far the most difficult to install, as each one must be hand-fitted.

The details for drawer construction depend upon the type of drawer (lip, overlay or flush)



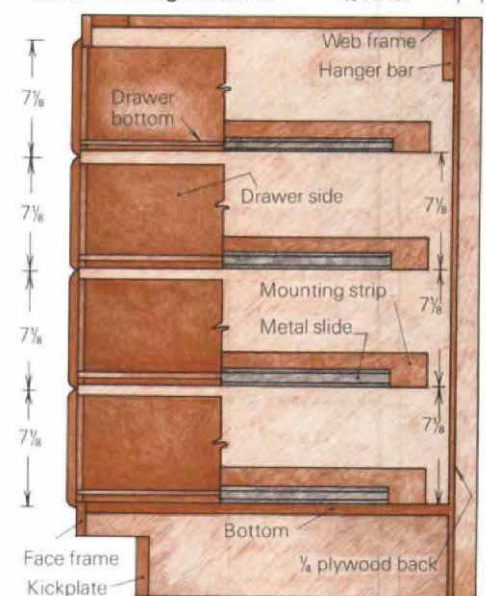
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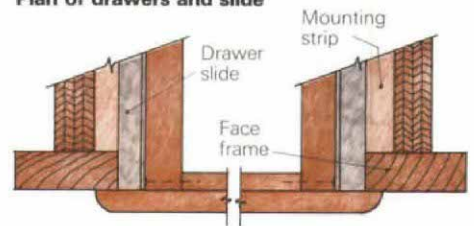
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Section through drawers

1 1/4 scribe



Plan of drawers and slide



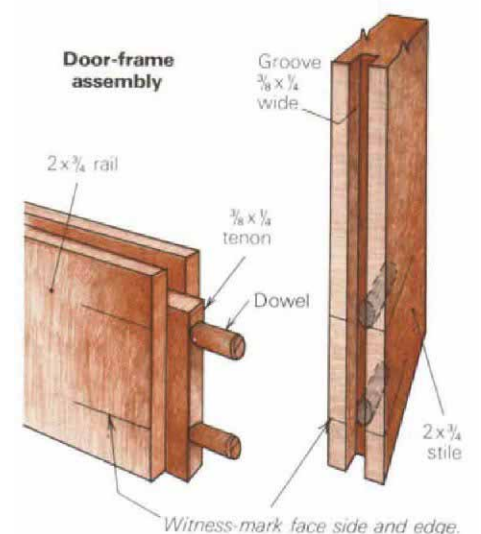
Drawers. After cutting the components (drawing, above), assemble the drawer by gluing and nailing the dadoed sides to the back (6). Slide the drawer bottom into its groove, and cap the box with the drawer front. Bore pilot holes for nailing the sides into the rabbeted front to avoid splitting the wood. The front edges of the drawer front have been shaped with a router and a 3/8-in. rounding-over bit.

Screw the slides to the drawer sides (7). The wheel flange should be flush with the side's bottom edge, and the track parallel to the edge.

Inside the cabinet (8) drawer slides are fixed to a mounting strip that holds them flush with the face frame. The mounting strips are glued and screwed to the case sides.



8



A bottom rail, with doweled tenon and panel groove. The stubby tenon adds strength and lets you plow unstopped grooves in the stiles.

and the kind of drawer-slide mechanism you use. We use metal slides with nylon rollers for mounting the drawers because they are easy to install and because drawers glide smoothly and quietly on them. The slides come in a number of sizes, based on the dimensions of the drawer and the expected weight of its contents. Each drawer requires a pair of slides, which fit into a corresponding pair of tracks mounted on the inside of the cabinet. The slides in this cabinet are Grant #336 (Grant Hardware Co., High St., West Nyack, N.Y.; and 16651 Johnson Dr., City of Industry, Calif. 91745).

Begin laying out the drawers by considering the inside dimension of the opening in the face frame into which they will fit. In this cabinet, the drawer opening is 12 in. wide and $27\frac{3}{4}$ in. high. To keep things simple, we'll construct four identical drawers (drawing, facing page, top). Add the opening height plus the width of two lips ($27\frac{3}{4}$ in. + $\frac{3}{8}$ in. + $\frac{3}{8}$ in. = $28\frac{1}{2}$ in.) and divide the total by four to determine the height of each drawer front ($7\frac{1}{8}$ in.). The length of the drawer front is the width of the opening plus the width of two lips ($12\frac{3}{4}$ in.).

Cut out the drawer fronts and calculate the width of the rabbet on the inside of each drawer front required to overlap the drawer sides, the metal slide and the face frame. The side thickness is $\frac{3}{4}$ in.; almost all metal slides require $\frac{1}{32}$ in. between the drawer side and the face frame; and the lip width is $\frac{3}{8}$ in. This adds up to $1\frac{1}{32}$ in.

Cut the rabbets in the drawer fronts, and set them aside while you make the other drawer parts. The width of the sides will be the drawers' front height less the width of the two $\frac{3}{8}$ -in. lips (in our case, $7\frac{1}{8}$ in. - $\frac{3}{4}$ in. = $6\frac{3}{8}$ in.). The drawer length of $17\frac{1}{2}$ in. in this cabinet is arbitrary. Drawers can be as long as the depth of the cabinet will allow.

The drawer sides, back and front are grooved along their bottom inner edges to receive the $\frac{1}{4}$ -in. plywood bottom. Plow the groove $\frac{1}{4}$ in. deep and $\frac{3}{8}$ in. from the bottom edge. The sides have a $\frac{3}{4}$ -in. wide dado cut 1 in. from the rear edge to house the drawer back. Nail and glue

the drawers together, making sure they are square (6). Apply glue to the joints but not to the bottom panel, which should float freely in the groove. This is especially important if the drawer bottom is made of solid wood rather than plywood, because gluing it will cause it to crack eventually.

Half of the drawer slide is screwed to the drawer sides (7); the other half is attached to the sides of the cabinet on a spacer strip that brings it flush with the face frame. Locate the bottom edges of the spacers the same distance apart as the height of the drawer fronts. This will give you a guide for attaching the slides (8). All metal slides come with slotted holes to allow up-and-down and in-and-out adjustments. Use the slotted holes until the drawers run properly, and then drive the rest of the screws to lock the slide in place. You'll probably have to shave the top and bottom edges of the drawer fronts with a plane to regularize the spaces between them.

Panel doors—Frame-and-panel construction is common to most cabinet doors because it can be varied in so many ways. The inner edges of the frame may be molded with a router or shaper, be treated with applied molding or just be left square. The panel may be flat or raised, or glass may be used instead of wood.

Construction is basically the same regardless of the details. The first step, again, is to make a cutting list. Door stiles should be equal to the height of the door opening plus $\frac{3}{4}$ in. for the lips top and bottom. Calculate the width the same way. For a pair of doors, the opening plus $\frac{3}{4}$ in. is divided by two to get the width of each individual door. The length of the rails equals the width of the door less twice the width of the stile plus twice the depth of the panel groove for cutting a short tenon on the rail ends. In this cabinet, rail length is $15\frac{1}{8}$ in. ($18\frac{3}{8}$ - 4 + $\frac{3}{4}$). Typically stiles and top rails are 2 in. wide. Bottom rails are $1\frac{1}{2}$ times as wide to add visual weight and to increase the amount of wood involved in the joint.

After ripping the stiles and rails to width and

cutting them to length, arrange the pieces on a flat surface and mark the joints for dowels. Keep the holes far enough from the edges to prevent cutting into the dowels when rabbeting the outer edge for the lip and grooving the inner edge for the panel (drawing facing page, bottom). Mark the inner edge of each piece so rabbeting, grooving and drilling get done in the right spots. Then bore for dowels.

Make a $\frac{1}{4}$ -in. wide groove in a scrap piece of wood for testing the thickness of the rail tenons. Now cut the tenons $\frac{1}{4}$ in. thick by $\frac{3}{8}$ in. wide on both ends of the rails. Do this on a table saw or with a router, or clamp the rail in a vise and cut the tenon with a good backsaw. Make sure the tenons fit snugly, but not too tightly in the test groove.

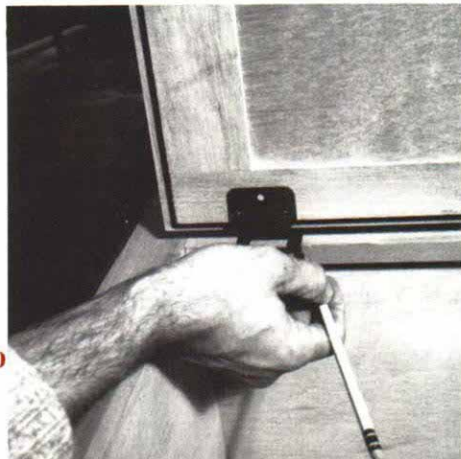
The next step is to groove the inner edges of the frame members to receive the panels and tenons. Be certain to mark the outside face of each member and hold that face against the saw fence when plowing the grooves for the panels. Cut the $\frac{1}{4}$ -in. plywood panel to fit, and then assemble the frame around it. Again, don't glue the panel into the groove. Be sure the doors are square and flat; otherwise they won't lie flat against the cabinet when closed.

Once the glue has dried, cut the $\frac{3}{8}$ -in. by $\frac{3}{8}$ -in. rabbet all around the door's inner edges (9), and you're ready to put on the hinges. Hinges are made for all three kinds of doors, and each style requires a specific type of hinge. It is best to install the hinges for lip doors on the doors first, spacing them one hinge length down from the top and the same up from the bottom. Next, set the cabinet on its back, put the doors in place and mark the position of the hinges (10). Drive one screw into each hinge and see if the door swings freely and lies flat. If it does, drive in the rest of the screws. If the fit is skewed, remove the screws, readjust the hinges as necessary, and try again. Now install catches to keep the doors flat against the face frame. Mount the catches opposite the door pulls. We use the common roller variety. Screw the male half to the top of the door stile, engage the two halves and screw the catch plate to the mount-



Lipping. A $\frac{3}{8}$ -in. lip is cut around the inner edges of the door (9) after the outer edges are rounded over. A wooden auxiliary fence makes it easy to expose the right amount of the dado head to get the $\frac{3}{8}$ -in. rabbet.

Hinges are first mounted on the doors, and then the doors are held in place against the face frame while screw centers are marked (10).

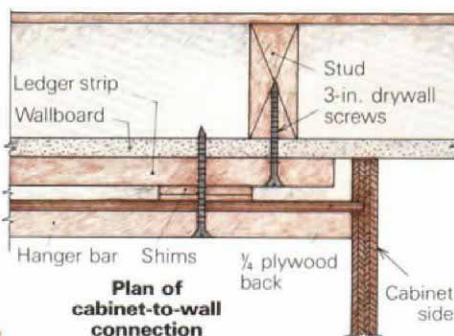




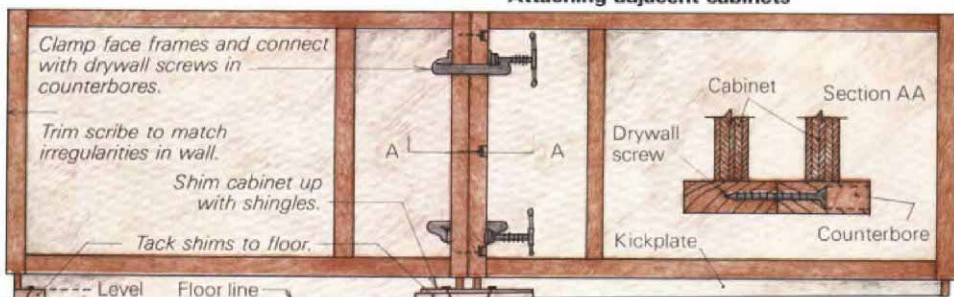
11 A template (11) makes drilling holes for shelf rests quick and accurate.



The hanger bar for attaching the cabinet to the wall is glued and nailed to the bottom of the web frame (12). The kickplate overlaps the side by the same amount that the face frame does.



Attaching adjacent cabinets



ing block with the door closed. Magnetic catches are also good, but best of all are self-closing hinges, which let you do away with catches all together.

While the back is still off, bore holes for the shelf rests. Make a drilling jig like the one shown in photo 11 with $\frac{1}{4}$ -in. dia. holes, 2 in. on center, for press-in shelf rests. Use a piece of tape on the drill bit to regulate the depth of the hole. I drill the vertical rows of holes about a foot apart toward the back of the cabinet. The shelf should be about 14 in. wide, rather than span to the front of the cabinet. This narrower shelf lets you get at pots and other stuff stored in the rear of the cabinet.

A 1x4 hanger bar for installing the cabinet should now be nailed and glued to the bottom of the web frame and to the sides of the cabinet (12). Finally, slide the $\frac{1}{4}$ -in. plywood back into its groove and nail it in place. Give everything a good sanding, and protect the wood with the finish of your choice. For wood finishes, we prefer Watco Danish Oil or lacquer, but for cabinets that are used frequently, polyurethane is the best choice.

Installation—Chances are good that the space your cabinet will occupy is neither level, square nor bordered by perfectly flat walls. These imperfections are usually slight and of no structural consequence, but they can drive the meticulous installer crazy. A few tips:

First, measure the highest and lowest points in the room and determine the differential. If the difference is an inch or less, I shim up the bottom of the cabinets, starting at the lowest point in the room. If the difference is more than 1 in., I split it by adding shims at one end and cutting the bottoms off the cabinets at the other. When the cabinets are level, pull them away from the wall and attach 1x4 ledger strips to the wall opposite the hanger bars.

Return the cabinets to their intended positions and check any counter-to-wall intersections for fit. If the wall is irregular, plane the scribing strip to match the wall contour (for more on scribes, see the next article).

When the cabinets are scribed and level, clamp the neighboring face frames together (if you've got more than one cabinet) and attach them with three counterbored drywall screws. Don't worry about plugging the counterbores—they won't show, and you can easily remove the cabinets if you decide to take them with you. Once the face frames are joined, screw the hanger bars to the wall ledgers, filling any gaps between the two with shims. It doesn't take a lot of screws for a solid connection; two per cabinet should do it.

Cut the kickplate to fill the gap at the back of the toe-space, and attach it in place with 6d finishing nails. We recommend finishing the juncture between the flooring and the kickplate with dark-colored vinyl coving. The coving makes this busy but hard-to-reach kitchen cranny easier to clean, and protects the kickplate from scuff marks. □

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