Building a Strong, Light Carcase

Thin, deep front rails give a refined look with plenty of strength

by Garrett Hack

Some people think that the larger a piece is, the more difficult it is to build. That's true to a certain extent, but designing and building smaller, more delicate pieces that still will stand up to the rigors of normal household life—kids and dogs included—is a challenge of its own. Perhaps the most difficult situation is the table or desk with drawers.

Three pieces of wood joined to form a U-shape have virtually no structural integrity. Exert a little pressure on one side, and the corner joint will fail. In contrast, if you join four pieces of wood to form a box, you've got a fairly sturdy structure. Put a top (or bottom) on the box, and you have a structure that will take some abuse. But if you cut a bunch of holes in the front of the piece (drawer openings), you've eliminated much of its strength.

Furnituremakers have come up with various ways of strengthening desks and tables whose fronts are mostly drawers, such as beefing up the frame internally and using heavy-duty front rails. Neither of these is ideal. An internal frame (basically, a shallow box around the internal perimeter of the carcase, sometimes with a crossbar) reduces useable drawer space, and thick, bulky front rails may fit the bill structurally, but they aren't the most aesthetic solution. My solution addresses both of these shortcomings.

Unless you use it to stand on while changing a light bulb, most of

the stress on a piece of furniture like this is from racking, not downward compression. What's needed then are not massive front rails, but deep rails—rails that tie the front of the piece to the three solid sides of the carcase and provide maximum resistance to racking. Together with the table's leg-and-apron construction, these thin, deep rails ensure a piece of furniture that is tough but still looks quite refined, as shown in the photo on the facing page.

Carcase joinery

After I've prepared all my stock and turned the legs for this side table, I begin cutting the joinery. I used a pair of haunched tenons for each leg-to-apron joint (see the drawing on p. 64). Adding a haunch to a tenon increases the glue area of the joint, making it stronger. Even more importantly, though, the haunches increase the mechanical resistance of the joint to twisting.

I lay out my mortises first, clamping all the legs together side by side so that the mortises are all positioned identically. I make all of the mortises with a shop-built slot mortiser, but if you don't have a mortiser, a plunge router and mortising jig (or mortise chisel and mallet) will also work fine. Next I square the ends and then chop the haunch mortises with a sharp paring chisel. To keep the haunch mortises consistent, one to another, I make a small pattern from scrap, and use the pattern as a depth and angle check.

After I've cut all the leg mortises and the corresponding apron tenons, I cut, plane and scrape the front rails. It's important that the faces of the rails that accept the stiles be finish-planed now so that you don't alter the fit by removing stock after cutting the joinery. I also cut the bead into the lower front rail and aprons now, using a scratch stock. I clamp the three front rails together edge to edge to align them, as I did the legs, and I mark out the tenons at each end and the dovetailed slots for the stiles.

I rout the dovetailed slots first, and then work out the pin width and depth on one end of each of the stiles, leaving them long so I can rout a few trial pins. Then, once I have a good pin, I cut the stiles to length and rout the remaining pins. Next I mortise the front legs for the rails, mortise the rails themselves for the drawer runner and kicker tenons and then cut the front rail tenons (see the drawing on p. 64 for joinery details).

Because I wanted maximum joint strength, I mitered the apron tenons at each rear leg. Mitering the tenons allows me to make them longer than would be possible if their ends were square, increasing the glue surface and strengthening the joint. I mark the cutoff line on the tenon by sticking a sharply tapered pencil in through the opposite mortise.

While the leg-to-apron joints are still together, I also score the legs where the tops of the aprons intersect them and carry these marks around each leg with a sharp knife. I crosscut the legs just shy of this mark. Then I plane the legs level with the rest of the carcase after glue-up so that legs and aprons are all precisely even.

I drill the pocket holes in the aprons, using an angled fixture on my drill press to hold the apron in place. I use a Forstner bit first to provide a flat seat for the screw head and then follow with a slightly oversized twist bit to allow for seasonal movement of the wood. I generally prefer buttons for attaching tabletops, but for this small a table, either the buttons would have to be so thin that they would have broken, or they would have to be so thick that they would have interfered with the drawers.

Simple lines, remarkable woods and structural integrity *combine with impeccable craftsmanship to make the author's Shaker-inspired hall table a jewel in wood. All drawer faces are from one pear board; the carcase is carefully grain- and figure-matched bird's-eye maple, and the pulls and pegs are rosewood.*

Rosewood pegs strengthen the joint, *and they add a distinctive touch to the author's table. The adjustable wrench keeps the pegs properly oriented, parallel to the case's top and sides.*

Assembly

After I finish planing and scraping all parts not already smoothed, I begin the assembly: first both rear legs and apron and then the two front legs and two bottom drawer rails. After the glue has set on these first two subassemblies, I join them with the side aprons.

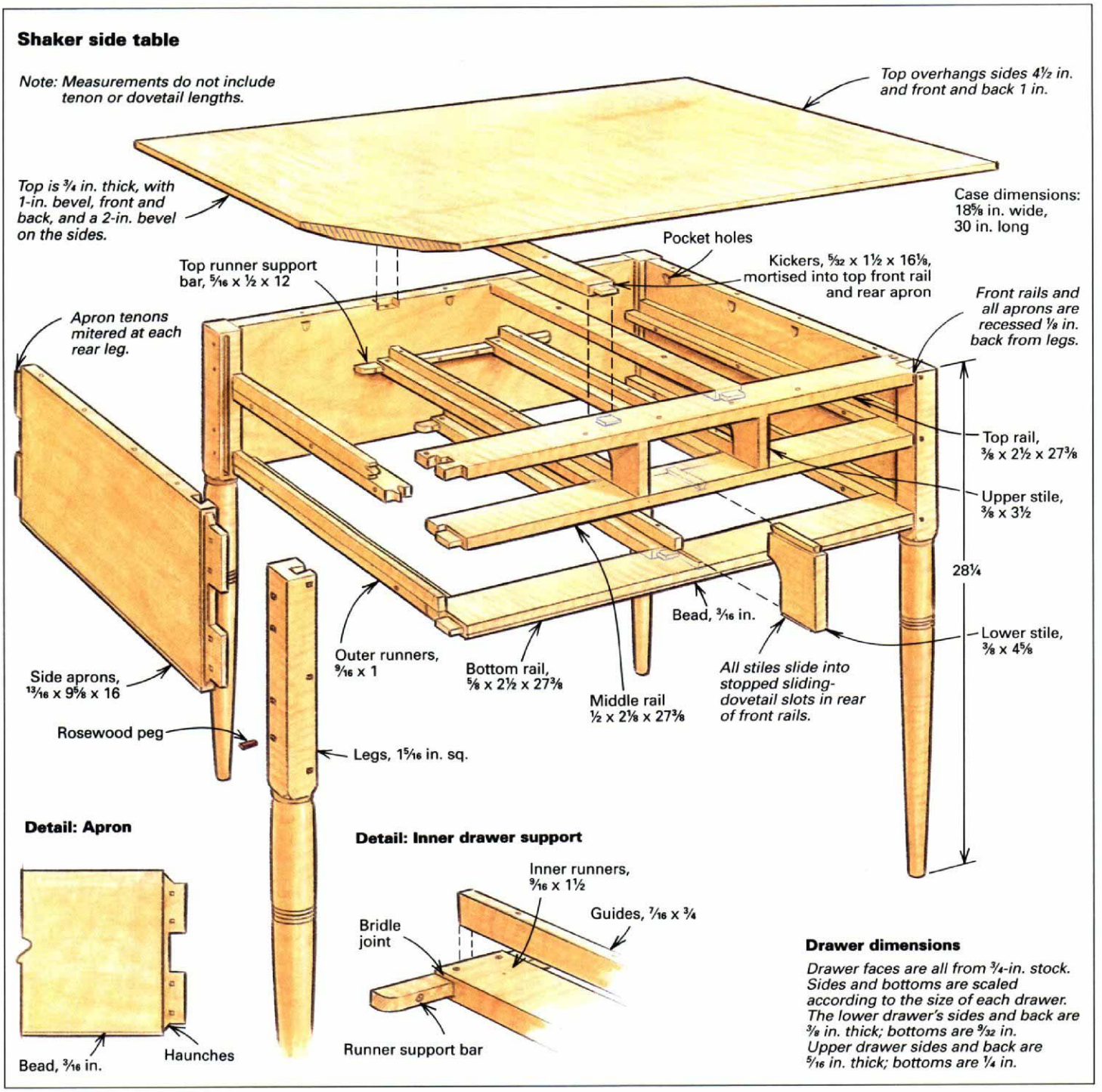
The top drawer rail finishes the case assembly (see the drawing). This rail was sometimes left out by the Shakers in similar pieces, but it's an important element when trying to maximize strength while retaining a delicate-looking carcase. Not only does it add strength to the carcase but also it completes the drawer face frame visually and drops the top drawers slightly so that they're more accessible beneath the overhang.

I cut the dovetailed ends of the rail first, lay it in position, scribe around it and chop the mortise to receive it. Then I drill and countersink a few holes in the rail to secure the top and glue and screw (insurance) the rail into place. I level the top of the case with a jointer plane, working slowly around the piece to take care not to tear out any fibers as I pass over the legs. I finish the carcase assembly by tapping the stiles home into the stopped sliding dovetail slots in the front rails, dabbing just a bit of glue into the slots.

I pin all the joints with small, square rosewood pegs because they add mechanical strength to the joints and because I like the contrast with the maple. I mark out peg locations with an awl, rub a small square of masking tape over the hole-to-be (it prevents tearout when drilling) and drill my holes. To make it easier to fit the pegs into their holes, I square the top third of each hole roughly with a paring chisel, pare the bottom two-thirds of each peg fairly round and taper the end of each peg with a little pencil sharpener. I drive the pegs home with a 12-oz. hammer (rosewood is very dense and not likely to be damaged by the metal). When hammering, I hold onto the pegs with a small adjustable wrench to keep the pegs parallel to top and sides (see the photo above). I tap the pegs home and then pare them almost flush with a chisel, finishing up with a block plane and a scraper.

The next step is to install the web frame: drawer runners, guides and kickers. If you want the drawers to glide smoothly, you must plane all wear surfaces glassy smooth (wax applied later will further reduce friction). The guides should be parallel to the carcase sides and the runners flush with the top of the drawer rails. I cut the guides so they're just shy of the stile faces and the rear of the

Photo facing page: John Sheldon



carcase; that way, I only have to worry about the fit of the runners.

The runners for the top bay of drawers serve as kickers for the bottom drawers, preventing them from dropping down when they're partially open (see the drawing for details). I thickness the runner stock so that it's ⅛ in. thinner than the front rails, which allows the drawer to drop slightly but not scrape the kicker on opening. I thickness the top drawer kickers similarly.

I glue and screw the outside runners and guides into place. For the interior runners, I tenon the front end to slip into the mortises in the face-frame rails, and then I use a bridle joint at the rear to attach the runners to the support bars, as shown in the drawing above. The beauty of using this bridle joint is that it allows adjustment of the runners horizontally and vertically before screwing the bar in, and it lets me install the runners and guides after the case is assembled, making that job considerably simpler.

I center the guides on the runners, apply glue and screw through the runners into the guides from below. Winding sticks help me get everything on the same plane, and a few sticks cut to *exactly* the widths of the drawer openings keep the guides parallel. The last parts to go in are the top drawer kickers, which I tenon into the top drawer rail at the front and set into a mortise at the top of the apron in the back. In addition to keeping the drawers from dropping when they're opened, the kickers also add to the overall integrity of the carcase.

I like to have the top and case completed and assembled before starting on drawers in case there's any tension between the carcase and top. I don't want any surprises (drawers binding, for example) after I've fitted the drawers (see the box on the facing page

Photos except where noted: Vincent Laurence; drawing: Bob La Pointe

for how I build and fit drawers). I milled the boards for the top nearly to final thickness, matched and glued them and then finish-planed and scraped top and bottom.

I beveled the underside of the top all around, rough-cutting the bevel on the tablesaw and then finishing up with a sharp plane held askew. I drew a pencil line all around the edge as a guide for the bevel. This thin beveled edge is pleasant visually, lightening the top in appearance, but without diminishing the mass and the strength of the top in the middle. Before securing the top, I apply a coat of finish to both the top and bottom.

The finish is built up of thin coats of spar varnish, linseed oil and turpentine. I rub each coat in well, let it dry until it just starts to tack up and then vigorously rub off any excess. To bring out the contrasting grain of the bird's eyes, I add a small amount of Minwax Golden Oak oil stain to the varnish mixture. After three or four coats of this finish, inside and out, I polish the whole piece with steel wool and a mixture of beeswax, linseed oil and turpentine. I give the drawer runners, guides and bearing surfaces of the drawer sides the same treatment. □

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Building and fitting drawers

***Drawer face blanks that are snug but do not bind** are key to sweetly fitting drawers. Hack leaves the drawers snug at this point, so there will be a minimum amount of play when he planes the sides.*

***Planing drawer sides to fit** is a painstaking process. Hack takes a few passes with a plane and checks the drawer in its opening. The chamois between the drawer side and the board supporting it protects the inside face of the drawer side.*

The trick to getting drawers to fit sweetly is to cut the faces to fit the openings *exactly* (see the top photo). If you can't fit a drawer in its opening, you can always plane the sides to fit—but you can't add any wood back if you start with a sloppy fit.

I cut and pare the dovetail pins on the drawer face first. Then I finish-plane the inside and outside of the drawer faces so that they are at final thickness before I mark and cut the tails at the front of the drawer sides. I also drill the holes for the tenon on the pull now.

To keep the drawers both strong and light, I varied the drawer side thickness, so the smaller upper drawers have thinner sides than those below. As with the drawer faces, I finish-plane the insides and outsides of the drawer sides before marking out the tails, except for the first few inches of the *outside* face around the joint. I leave this area unplaned at this stage because I'll be cleaning up the joint with my plane after glue-up anyway.

Once I've cut and test-fitted the drawer-face dovetails, I cut the sides to length and rout sliding dovetail slots from the bottom of the sides about ¾ in. in from the end. Because the thickness of the drawer back won't affect the fit of the sliding dovetail joint, I finish-plane the backs after I have fit the joint. I used the tablesaw to plow drawer bottom grooves into the faces and sides. I also set aside a piece of scrap with the groove in it to use later for sizing the beveled drawer bottoms.

Beginning with the face dovetails, I assemble each drawer, squaring each corner as I tap it home and clamping the joint if necessary to keep it square. Often I won't even use clamps, though, because a properly fitting set of dovetails doesn't require clamping. After I've joined the drawer face and sides, I slide the back into its dovetailed slot in the side. When the back is two-thirds home, I put a small amount of glue in the slot and on the pin and finish tapping it home. Then I check (and adjust, if necessary) again for square by measuring the diagonals and comparing. I set the drawer on my tablesaw's flat-ground top while the glue is setting up. This way, twist won't be built into the drawer from sitting on a less than flat surface.

I proportioned the thickness of the drawer bottom to the drawer sides by eye and by feel: thinner bottoms for the smaller upper drawers and thicker bottoms for the larger drawers below. I beveled the underside of the drawer bottoms, so I could keep the bottom thicker in the middle (and therefore stronger). And I could position the bottom a little deeper in the drawer and still have enough lip to support the bottom securely. Also, a beveled bottom has a certain elegance. I glue up the bottoms from thicknessed stock, rip and crosscut each bottom to size, finish-plane the top surface and then rough out the bevels on the tablesaw. Then I plane each bevel until it fits in the grooved piece of scrap I saved for testing this fit, finish-plane the underside of the bottom and slide it home into the drawer frame, securing it with two screws at one-third points across the bottom into the drawer back.

The first step in fitting drawers is to plane the area I left unplaned around the half-blind dovetails joining the drawer faces to the sides. Then I just plane both sides equally, constantly testing the drawer in the opening until there is a total of about 1/16 in. play from side to side, as shown in the bottom photo. (For larger drawers, I'd leave a bit more clearance.)

Next I level the bottom of the sides and face with a jointer plane, working with the grain all the way around. I also ease all the edges, so they're more pleasing visually and tactilely and to help the drawers glide more smoothly. Once the bottom is level, I flip the drawer over and level the top, stopping often to check the drawer's fit. For drawers of this size, 1/16 in. play at the top is plenty for seasonal movement. —*G.H.*