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editor's letter

BUILD A BETTER BACKYARD

From late spring through early fall, Connecticut has wonderful weather, perfect for spending time outdoors. So, when my family and I moved here, we looked for a house with a big deck in the back. We were fortunate to find one, but after moving in we realized that we didn't have enough outdoor furniture to fill it. If I weren't a woodworker, we probably would have been off to the home center to buy a table and chairs. But my love for wood furniture led me into the shop instead, and I made a pair of garden benches.

Making those two benches taught me a lot about how to tailor furniture to survive outside. It needs to shed water and be able to dry quickly, so mold and fungi don't start growing. I also learned that you should relax and have fun when you're building for the outdoors. No matter how well you design and construct outdoor furniture and projects for the yard and garden, eventually it all loses the battle against Mother Nature. Accept that truth and you won't be nearly as stressed when building for the outdoors as you might be when making indoor furniture, which we hope will last for several lifetimes.

This collection of outdoor projects covers every area of the living and working space you find out the back door. There are compost bins and raised beds to improve your garden, an arbor to create a beautiful and shady spot for resting, and plenty of chairs, benches, and tables to use for relaxing. Some of the projects can be made in just a few hours (or even less) with the basic tools that most homeowners already have, while others will satisfy that desire to challenge ourselves that pushes every woodworker from one project to the next.

Now is the time to get out in the shop (or yard) and start building. Spring and summer are closer than you think. And remember to have fun.

—MattK enney,
Outdoor Projects editor

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Group Publisher	**Anatole Burkin** aburkin@taunton.com
VP, Advertising Sales	**Rick Straface** rstraface@taunton.com
Advertising Director	**Peter Badeau** 203-304-3572 pbadeau@taunton.com
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VIDEO:

Appealing Adirondack

This classic chair (p. 74) has been elegantly refined for comfort. Watch how easy it is to assemble the curved parts, and learn the simple technique for cutting and shaping the arms.

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VIDEO: **What's an Arbor Without Vines?**

You've built a beautiful arbor (p. 34), but is your task complete? Not until you add some greenery. Learn how to choose the right vines and train them so they'll complete the picture.

Cold-Frame Construction

Watch Rob Wotzak build the cold frame featured on p. 26. You'll see how he laid out and cut the angled side pieces, assembled the lid and box, and installed the hinges and the lift.

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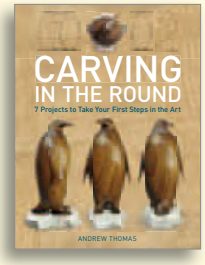

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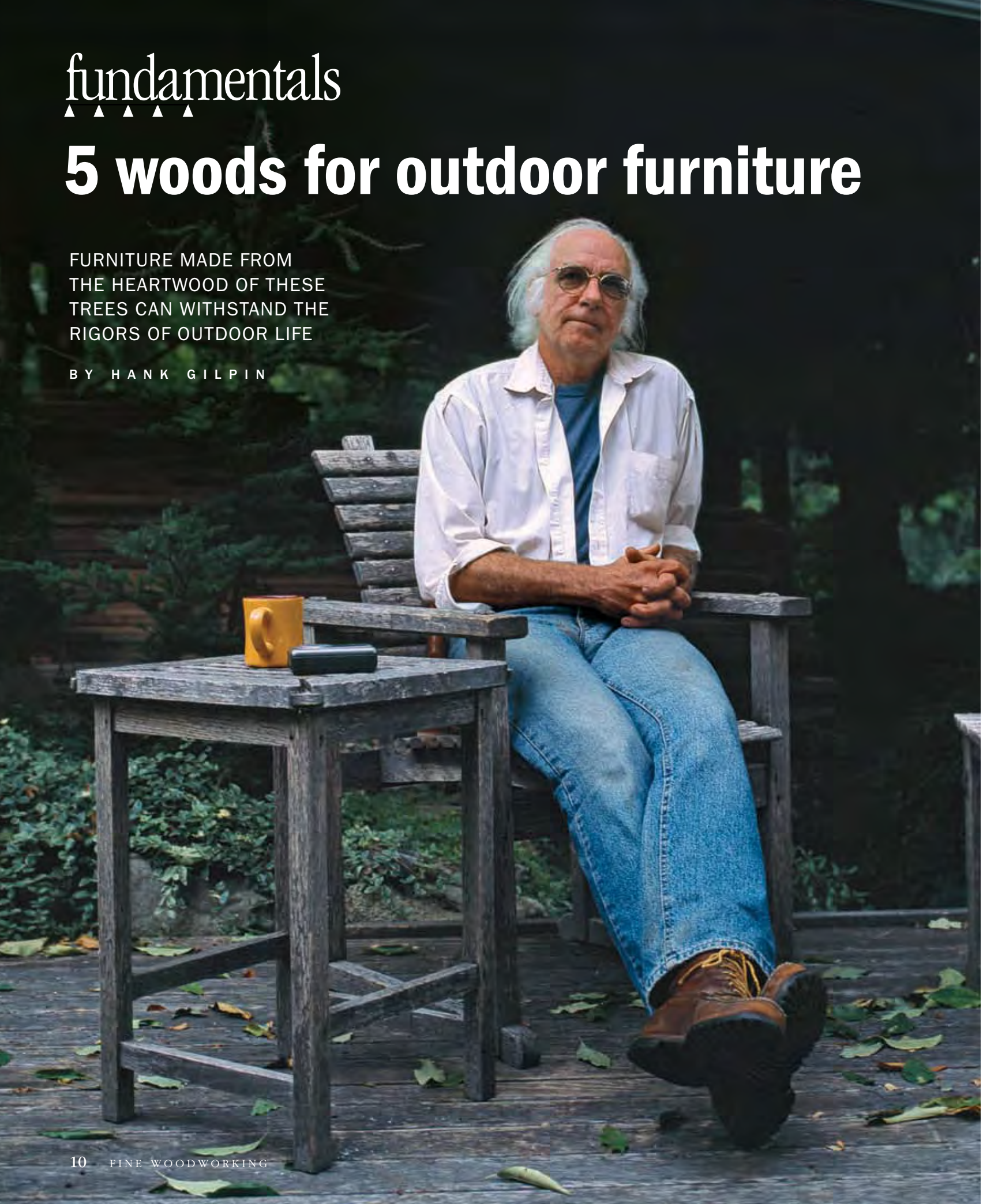
5 woods for outdoor furniture

FURNITURE MADE FROM THE HEARTWOOD OF THESE TREES CAN WITHSTAND THE RIGORS OF OUTDOOR LIFE

BY HANK GILPIN



After a long day in the shop, I like to head out to the backyard, sit back in a chair, and have a cold drink. It's a relaxing few hours for me. But the wood chair beneath me is under constant stress. It's out in the weather all day, every day. And every minute, the elements are working to tear it down. Outdoor furniture won't last forever, but you can greatly extend its life by using the right wood (and the right joinery).

What makes a wood right for the outdoors is its ability to resist decay. I've been making outdoor furniture for decades, and I've used a wide variety of woods to do it. Teak is far and away the best. It resists decay, is very stable, and naturally fades to a beautiful silver-gray. But it also is very expensive, so I don't use it. In fact, I don't use any exotics. There are plenty of domestic species that do great outside. The five that top my list are white oak, black locust, eastern red cedar, northern white cedar, and bald cypress. You should find at least one of these where you live (and you can get the others online).

Regardless of which wood you use, one bit of advice applies to them all. Use only the heartwood for outdoor furniture (and anything else you make for the outdoors). Sapwood is too rich in sugars and other tasty treats to survive very long in the wet, wild, and often warm wilderness out the back door. Fungi, the critters most responsible for decay, tear through sapwood but have a much harder time with heartwood. Wind, rain, and sun also cause decay, but you can mitigate their impact with smart design, like making sure surfaces that face up are sloped to shed water and that exposed end grain has plenty of room to breathe and dry.

Also, applying a finish is a Sisyphean task, and it only delays the inevitable. So, skip the finish, let the wood weather to its natural gray, and relax.

Hank Gilpin is a professional furniture maker in Rhode Island.

White oak

White oak is widely available, much less expensive than teak and other exotics, and withstands the elements for years. The one knock against white oak is that it can be tough to work. Also, be aware that different parts of the growth rings weather differently. The early wood (the part of the growth ring that grows first) is more porous and softer than the late wood, so the surface becomes uneven. To minimize that effect, look for lumber with tight annual rings.

Latin name:
Quercus alba

Average price per bd. ft.: $4–$5
(more for quartersawn)

Specific gravity: 0.68*

Percent shrinkage:
Tangential: 10.5
Radial: 5.6
T/R ratio: 1.8

***BEHIND THE NUMBERS**

A wood's **specific gravity** speaks to how hard, dense, and heavy it is. The higher a wood's specific gravity, the tougher and stronger it is, basically.

The **percent shrinkage** indicates stability. There are three numbers to consider: tangential and radial shrinkage and the ratio of the two. As the ratio gets higher, wood is more prone to warping.

Outdoor design, perfected. *With surfaces designed to shed water, simple but strong joints, and stainless-steel screws, Gilpin's white-oak chair is sure to stand up to the elements.*

Heartwood is the answer to outdoor wood longevity

Sapwood, the outer rings of the tree where cells are still alive, is a tasty treat. This fence post illustrates why you shouldn't use sapwood in outdoor furniture. After just a few years of contact with soil, it has been eaten away. But the heartwood, the durable inner rings where the cells are no longer alive, remains as strong as ever. It's the same story for furniture. Sapwood will rot quickly, leaving you with a weakened or unusable piece of furniture.

Photos, except where noted: staff

Black locust

Of all the domestic woods I know—and I know a lot—black locust resists the ravages of fungi and moisture the best. It is the best choice for furniture parts that are in direct contact with the soil. As it never has more than three years' worth of sapwood, there is very little waste. The downside is that it is tough to work. Although it grows just about everywhere, it can be difficult to find because it is only just now appearing on the fringes of the commercial radar. However, with a bit of leg work (try an Internet search) you should be able to find it in your area.

Latin name:
Robinia pseudoacacia

Average price per bd. ft.:	$3–$4
Specific gravity:	0.69
Percent shrinkage:	
Tangential:	7.2
Radial:	4.6
T/R ratio:	1.6

Legs built to last. *Because the end grain of its slab legs is in direct contact with the soil, Jennifer Wickham made this bench from black locust. No other domestic wood is better at handling the stress of constant exposure to dirt, moisture, and fungi.*

How to build furniture that survives outside

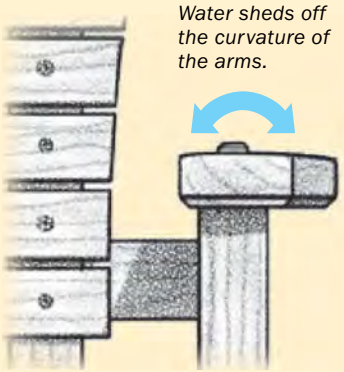
Building durable outdoor furniture isn't only about picking the right wood. It's just as important to build smart. That's because it expands and contracts far more than indoor furniture does.

Start by creating surfaces that naturally shed water, such as angled seats. Keep parts narrow and give them enough space to expand and contract. On a seat, for example, six narrow slats are better than four wider ones. Leave end grain exposed where possible; that allows the wood to dry more easily, making it more difficult for mold and fungi to start growing.

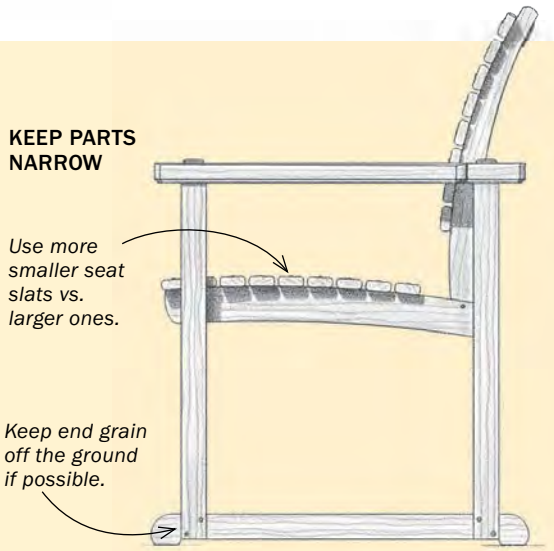
When it comes to joinery, simpler is better. Mortise-and-tenon joinery, bridle joints, and lap joints are good choices. Use a waterproof glue, like Titebond III, to hold the joints together, and reinforce them with a peg or two. Or you can forgo traditional joinery altogether and use mechanical fasteners such as bolts and screws made from stainless-steel or brass. Ceramic-coated decking screws work, too.

—Matt Kenney is a senior editor.

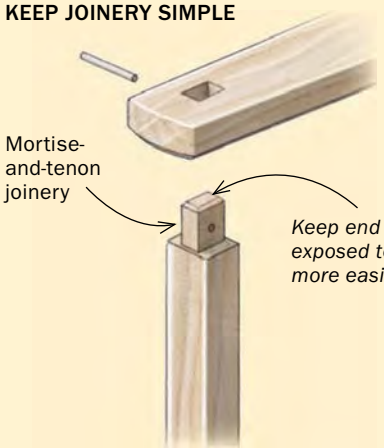
SHED WATER NATURALLY

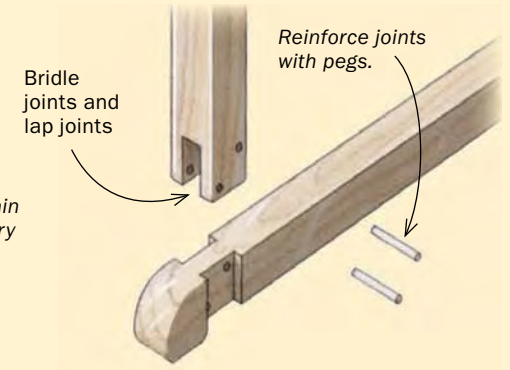


KEEP PARTS NARROW



KEEP JOINERY SIMPLE





Photo, top right: Jessica Wickham; drawings: John Hartman

Bald cypress

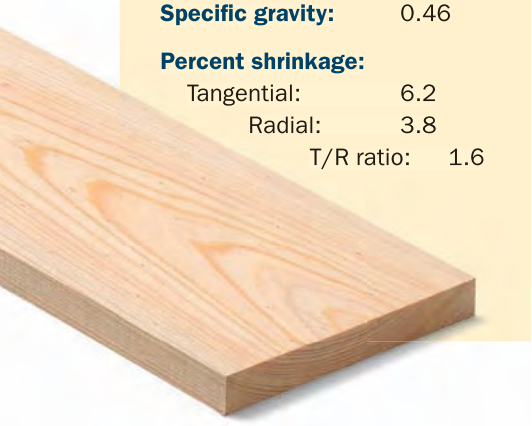
A light but durable wood, bald cypress is great for furniture that you need to move around often. It works very well with hand tools, and doesn't clog sandpaper as fast as northern white cedar. However, it can be oily, which makes glue-ups tough. Acclaimed furniture maker Brian Boggs has tested many glues on it and recommends using Oak & Teak Epoxy Glue (glueoakandteak.com), which is specially formulated for oily woods. Bald cypress grows in a fairly large part of the country and isn't difficult to find.

Latin name:
Taxodium distichum

Average price per bd. ft.: $4–$5

Specific gravity: 0.46

Percent shrinkage:
Tangential: 6.2
Radial: 3.8
T/R ratio: 1.6



Bald is beautiful. *Although its parts are beefy, Brian Boggs's chair isn't heavy because it's made from bald cypress. It's no problem to move it from spot to spot, so you're always sitting in the sun (or shade, if you prefer).*

Two cedars

There are two good options with cedar: eastern red and northern white.

Red cedar challenges black locust in terms of durability, and is another great choice for any part that is in direct contact with soil. It's not difficult to work, but is often very knotty. However, if you design with foresight you can locate joinery to miss the knots, or use red cedar only for those parts that touch the ground or are buried in it, and use another wood for everything else (it all turns gray in the end). It grows just about everywhere, but to find it in sizes suitable for anything other than fence posts and wood chips for hamster cages, try local sawmills.

Northern white cedar isn't as decay-resistant as red cedar, but still holds it off for many years. It's light and fibrous, but resists splitting very well. It's perfect for furniture that is brought in and out of storage or otherwise moved around a lot. Don't use galvanized fasteners, which will cause staining. Instead, use stainless-steel, brass, or ceramic-coated deck screws.

Lightweight Adirondack. *There's a lot of wood in an Adirondack chair, which can be very heavy. That's why Tom Begnal made this one from northern white cedar* *(see p. 74).*

Latin name:
Juniperus virginiana (Eastern red)

Average price per bd. ft.: $5–$6

Specific gravity: 0.47

Percent shrinkage:
Tangential: 4.7
Radial: 3.1
T/R ratio: 1.5

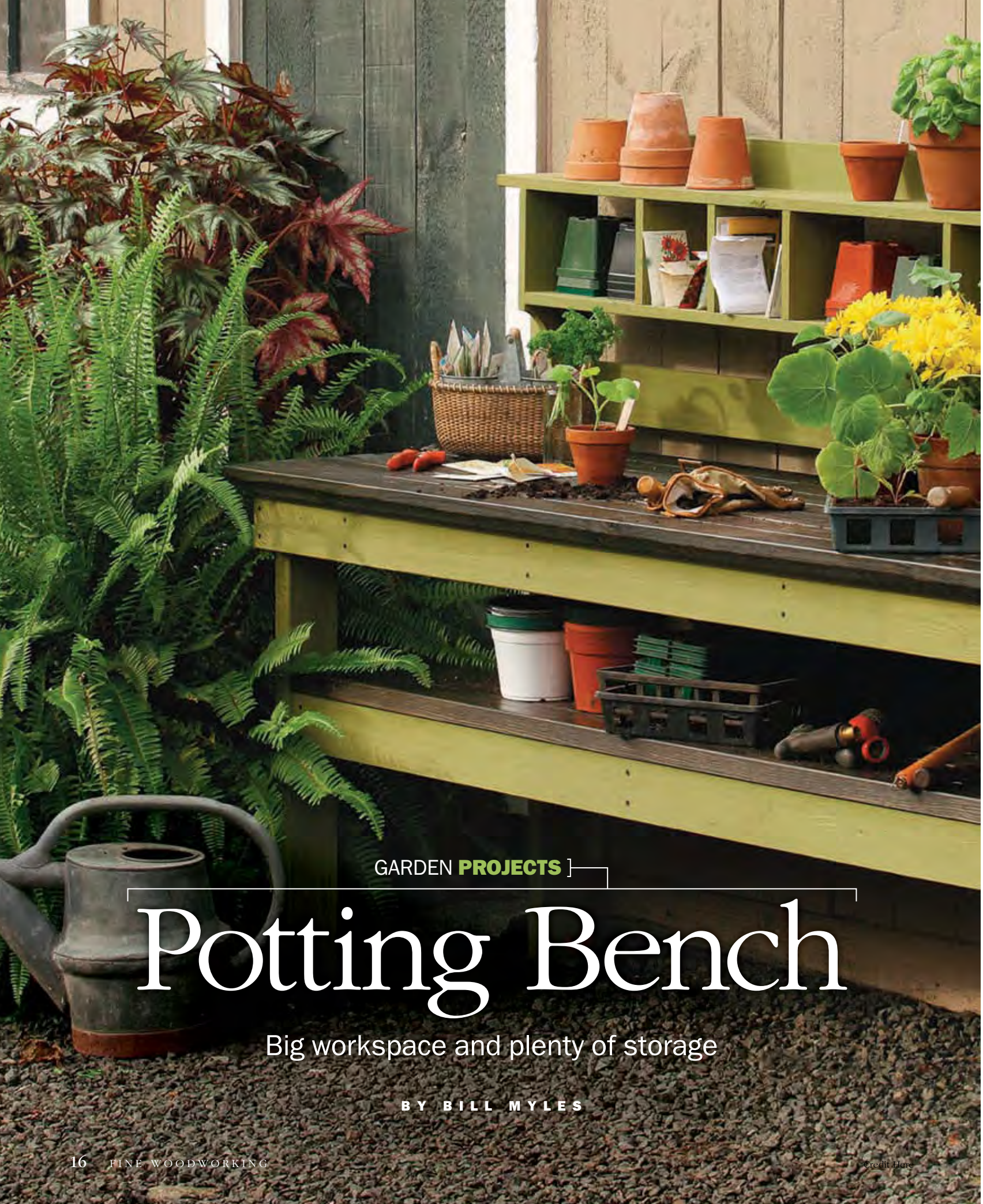
Latin name:
Thuja occidentalus (Northern white)

Average price per bd. ft.: $5–$6

Specific gravity: 0.31

Percent shrinkage:
Tangential: 4.9
Radial: 2.2
T/R ratio: 2.2

Photo, top right: Brian Boggs



GARDEN **PROJECTS**

Potting Bench

Big workspace and plenty of storage

BY BILL MYLES

Credit Here

Photo, this page: Thomas Allen

In the heart of every gardener is the desire for a potting bench—one that can be used year-round, though there will be times when it stands still and orderly, its surface swept and tidy, with tools, pots, labels, and soil all in their places.

As a carpenter, I have come across a few potting benches—some bluntly utilitarian, some detailed like fine furniture. For this bench, which isn't difficult to build, the original design concept came during the give-and-take between carpenter and client.

My client wanted a potting bench for her garden for seed sowing, transplanting, and potting up cuttings. She wanted the bench to be 6 ft. long, about 2 ft. deep, and 32 in. tall. She requested organizing shelves on top and a hatch with hardware cloth, providing a potting surface that allows excess soil to fall through to a bin on the shelf below.

Deciding on materials for the potting bench was easy. I chose redwood because it's readily available on the West Coast and because it naturally resists rot. When choosing wood, look for pieces that are relatively straight, dry, and knot-free. If redwood is unavailable, consider cedar, another good weather-resistant wood.

To assemble the bench, I used 2½-in.-long ceramic-coated deck screws. Redwood is fairly soft, so drilling pilot holes for screws isn't necessary unless you are within 1½ in. of the end of a board. In this case, drill ⅛-in.-dia. pilot holes to keep the wood from splitting. For a rustic look, drive the screws flush with the surface and leave them exposed. But for an elegant look, countersink the screws so that the heads are ¼ in. to ⅜ in. below the surface (a ⅜-in.-dia. Forstner bit works best for this). The resulting holes can be filled with plugs, giving your bench a finished look and making the top easy to clean.

Making the frames

The upper frame consists of a 66-in.-long 2x4 rear apron, a 69-in.-long 2x4 front apron, and four 20½-in.-long 2x4 stretchers. Using two screws at each connection, attach the outer stretchers to the aprons, offsetting the front apron by 1½ in. at each end. The inner stretchers determine the location of the hatch. I left 18 in. between these two pieces and set them 6 in. to 8 in. from one side or the other.

The lower frame is similar to the top, except that the front and back rails are each 66 in. long and the three stretchers are each 19 in. long. Attach the outer stretchers to the ends of the rails with screws, placing

What you'll need

MATERIALS

Redwood or cedar lumber:

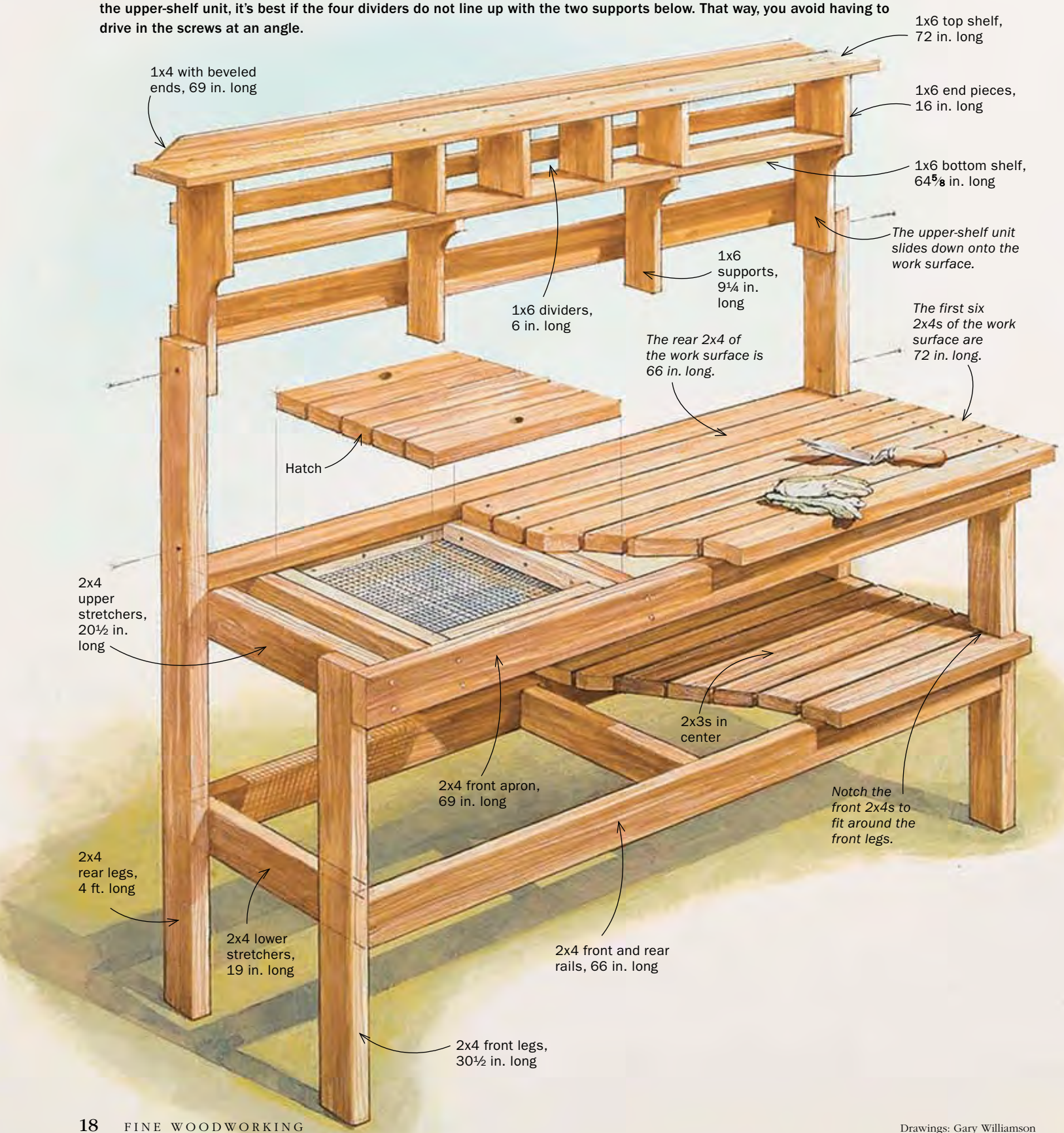
- **Eleven 12-ft.-long 2x4s**
- **One 12-ft.-long 2x3**
- **One 8-ft.-long 1x6**
- **Two 6-ft.-long 1x6s**
- **Two 8-ft.-long 2x2s**
- **Three 6-ft.-long 1x4s**

HARDWARE

- **One 2-ft.-long by 2-ft.-wide piece of ½-in. hardware cloth**
- **One hundred 1⅝-in.-long ceramic-coated deck screws**
- **Two hundred 2½-in.-long ceramic-coated deck screws**

Building the bench

The overall directions for the potting bench are simple, and you can modify the design according to your needs or style. Myles added boards to the back of the top shelves, for example, to keep things from falling off, but that's optional. He also cut the lower supports and ends of the top shelf on an angle to break up all of the straight lines. When assembling the upper-shelf unit, it's best if the four dividers do not line up with the two supports below. That way, you avoid having to drive in the screws at an angle.



Drawings: Gary Williamson

the front-rail ends flush with the outer side of the stretchers. Place the third stretcher in the center.

Cut two 2x4s 30½ in. long for the front legs and two 2x4s 4 ft. long for the back legs. Mark the front legs 15 in. from the bottom. This is where the top of the lower frame will line up. Mark the back legs at 15 in. and at 30½ in. from the bottom. The first mark indicates the top of the lower frame, and the second mark indicates the top of the upper frame.

Once the legs have been cut and the top and bottom frames constructed, they can be connected. The easiest way to attach the legs is to stand the two frames on their backs, 10 to 11 in. apart. Line up the frames to the marks on the back legs. Use three 2½-in.-long screws at each connection.

For the front legs, line up the lower frame with the 15-in. mark and align the top edge of the upper frame with the top of the leg. Drive screws from the outside of the legs into the frames. The bench can now be tipped up onto its legs with the bottom shelf and work surface screwed on.

Assembling the bench

The lower-shelf surface consists of one 2x4 66 in. long, four 2x4s 69 in. long, and two 2x3s 69 in. long. Using two screws at each end, install the 66-in.-long piece first, between the back legs and flush with the back edge of the frame. Next, install the two front 2x4s. The first board should overhang the frame by 1½ in., so you will need to cut notches 1½ in. deep and 2 in. long from each end

Overhang the edge of the lower shelf. *Cut notches from each end of the front two boards to fit around the front legs.*

Evenly space the upper- and lower-shelf boards. *Use shims as spacers and to keep the boards in place while driving in the deck screws.*

Photos, except where noted: Boyd Hagen

Add the hatch

Add a screen. *Affix the hardware cloth to the sides of the interior stretchers. The 20¼-in.-long cleats hold the hardware cloth in place and support the hatch.*

to fit around the front legs (see top photo, previous page). The second board has notches 1½ in. deep and 1½ in. long cut from each end. After these boards have been screwed in, place and space evenly the remaining four boards on the frame and line up the ends. Use cedar shims as spacers between adjoining boards to adjust the gaps and hold the boards in place while you drive in the screws (see bottom photo, previous page).

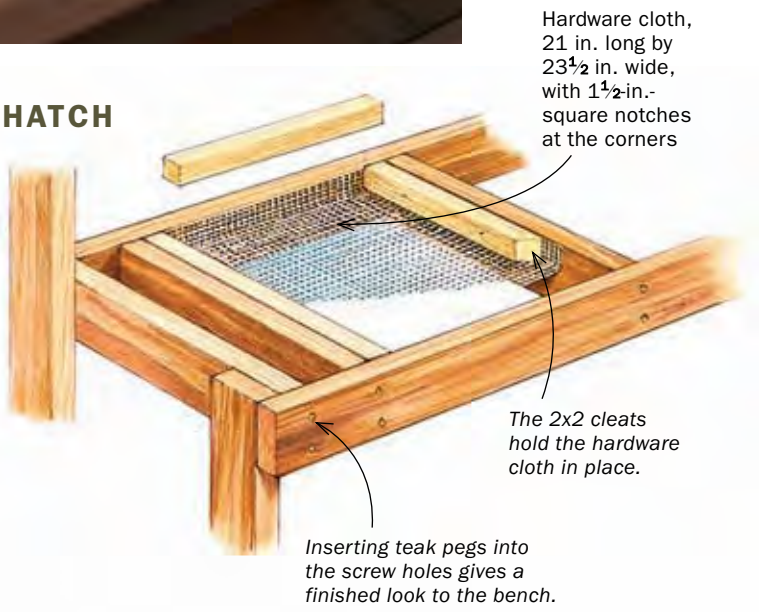
The work-surface boards, one 66 in. long and six 72 in. long, are installed in the same manner as the lower-shelf boards, except that you will not need to notch around the front legs. Install the 66-in.-long piece first between the back legs, followed by the front piece, which will overhang the front and sides by 1½ in.

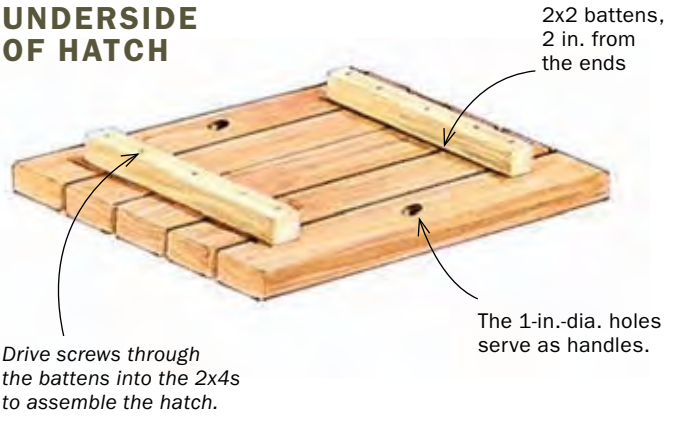
Cutting the hatch

To cut the hatch, place a straightedge on top of the bench. Sight down through the cracks to find the inside edges of the stretchers that will frame the hatch opening. Draw lines for both sides of the opening. Use a jigsaw to make the cuts. The gap between the boards should be wide enough to insert the blade to start the cut. If it's not, drill a hole next to the line to insert the blade.

To assemble the hatch, take the cutout pieces and lay them on top of the bench, upside down. Make sure to match the spacing of these pieces with the spacing of the work-surface pieces. Use two pieces of 15-in.-long 2x2s as battens to hold the hatch together. Place the 2x2s 2 in. from the ends of the 2x4s, and screw them together. With a 1-in.-dia. Forstner bit, drill two holes in the hatch to serve as handles.

Use tin snips to cut a piece of hardware cloth 21 in. long by 23½ in. wide. Cut 1½-in.-square notches from each corner, and fold up the sides, using a block of wood as a straightedge. Fit the hardware cloth snugly into the hole. Cut two 2x2 cleats 20¼ in.





Finish it off

Plugs conceal the countersunk screws. *Painting them black protects them from the elements and adds a decorative touch.*

Apply a wiping varnish to the work surface. *It protects against moisture, but reapply yearly for best results.*

long, which are used to affix the hardware cloth to the sides of the interior stretchers (see photo and top drawing, opposite page). These cleats also support the hatch, so make sure they are securely attached. Cut two more pieces to fit to support the front and back, and screw them into place. The hatch should fit down into the opening and sit flush with the rest of the bench.

Fitting the upper-shelf unit

The upper-shelf unit is made with 1x6 redwood and consists of a 72-in.-long top shelf, a 64⅝-in.-long bottom shelf, two 16-in.-tall ends, two 9¼-in.-tall supports, and four 6-in.-tall dividers.

First, screw the two supports to the bottom shelf. Next, screw the dividers to the top shelf, making sure not to line up dividers with supports and avoiding awkward assembly.

Once the dividers have been attached to the top shelf, flip it upside down and screw the dividers to the bottom shelf. Affix the ends with screws.

There are two 66-in.-long 1x4s (or 1x2s) and one 69-in.-long 1x4 with beveled corners screwed to the back to prevent items from falling off the shelves. The shelf unit should now slide snugly between the two back legs and can be attached with two screws driven into each leg. □

Bill Myles is a carpenter in Southern California.

TIP

MILK PAINT ADDS A VINTAGE LOOK

Applying two coats of bayberry green milk paint gives the frame a beautiful, old-fashioned finish. Here are some tips for working with this nontoxic option:

- *Stir frequently. The powder/water mixture tends to settle.*
- *Work quickly, and avoid painting in the sun. Milk paint dries faster than other paints.*
- *Seal it. A coat of polyurethane will protect a milk-painted wooden surface from water marks.*

Source: milkpaint.com

Photos, this page: Timothy Fagan (top left); Steven Cominsky (top right, bottom right)

Raised beds can go where no other garden can. *Whether you're trying to avoid your preexisting soil or your sunniest spot happens to be on a hill like this, a raised bed is the perfect solution. A few rocks along the bottom help level the bed at this site.*

Raised Beds

Create a home for better veggies

BY LINDA CHISARI

Raised beds solved many of the garden problems that faced me 20 years ago in our new Southern California home. Among the challenges were terrible soil, a concrete-paved yard, arid growing conditions, small children, and a big, exuberant puppy. When we read the real estate agent's description of our house-to-be, four words eclipsed all others: "perfect backyard for pool." To me, those words meant a warm southern exposure and a sizable empty space in which to plant a vegetable garden.

The sizable sunny space turned out to be about 2,000 square feet of concrete pavement. True, it was large enough for a decent-size garden. But also true was that what little soil existed was heavily compacted and lacked organic content. Once before, we had been faced with difficult growing conditions. On a granite ledge with no soil in New Hampshire, my husband had built a raised bed where I grew a small salad garden. So I figured, why not design a system of raised beds that would allow me to grow vegetables at this new home?

Decide on the materials and a design

There were a number of reasons why raised beds seemed the perfect way to garden. First, my husband was an accomplished carpenter and could build the boxes. Second, we could leave the concrete in place and simply break up the portions under the boxes to provide drainage. Soil quality was a third reason. We were able to fill the beds with soil by using compost from our own pile and supplementing it with some topsoil and chicken manure. This created a great growing medium.

Because we live in a Mediterranean-type climate with less than 10 in. of rainfall per year and almost none between April and November, we knew we would have to irrigate. Raised beds allowed us to set up an irrigation system that included a hose bib in each box. This would allow us to water each bed independently.

It didn't take long for us to see that our raised beds had several unanticipated advantages. Our golden retriever loved to race around the beds but rarely jumped into them. Our children could easily ride their Big Wheels around the obstacle course we had unwittingly developed for them. And neither of these activities nor my gardening compacted the soil because no one ever walked on it. It remained fluffy and well aerated, allowing plant roots to grow freely.

I wanted eight raised beds, and I wanted them made out of wood. Construction-grade redwood, which contains knots and some imperfections, seemed like a logical choice because we knew it would last many years and would cost less than many other types of wood.

The design of the beds was based on practical considerations. The dimensions, 8 ft. long by 4 ft. wide, were derived from the fact that lumber is available in 8-ft. lengths, so there would be minimal cutting and no waste. I could comfortably reach only 2 ft. into the beds, so a width of 4 ft. would allow access to the middle of the

Pressure-treated alternatives

If you'd like to avoid using wood treated with chemical preservatives for your raised beds, here are a couple of options:

- **Recycled-plastic lumber**
  Many of the plastic milk bottles, detergent containers, and grocery bags we recycle are being mixed with wood fiber to make a new generation of decking material: composite lumber. This recycled-plastic lumber is now available in many home-improvement stores.
- **Naturally rot-resistant woods**
  Redwood, cypress, red cedar, and black locust are all, to varying degrees, rot resistant. They can be expensive, though, and supplies may be limited by region.

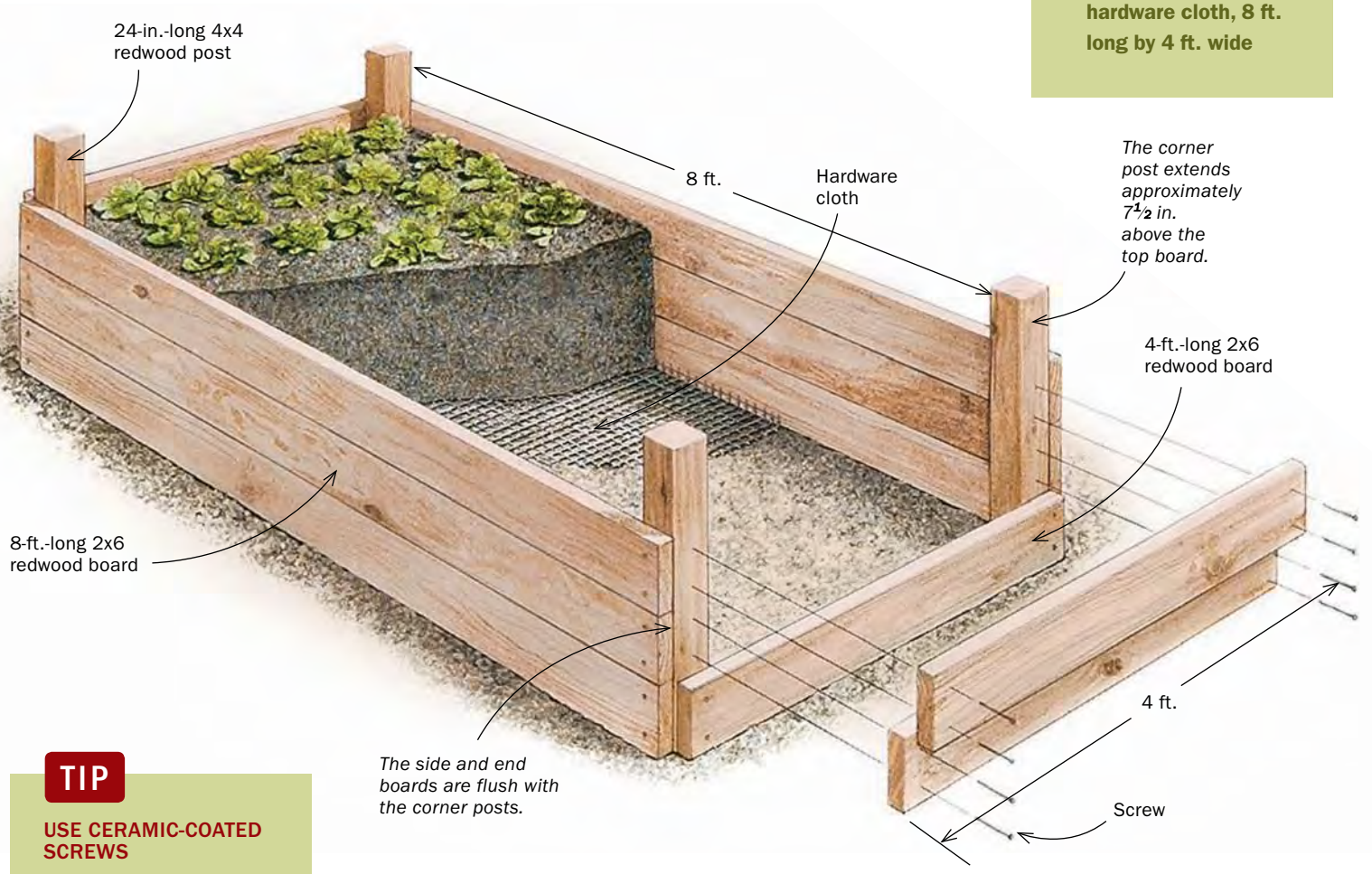
Photos: Stephanie Fagan (opposite); Scott Phillips (this page)

Blueprint for a raised bed

1. **To make the corner posts, measure and cut the 8-ft.-long 4x4 into four 24-in. lengths.**
2. **To make the long sides of the bed, nail three 8-ft.-long 2x6s one at a time to two corner posts; you will have boards stacked three high. The bottom board should be flush with the bottom of the post, while the top board should end approximately 7½ in. short of the top of the post. Repeat to form the second long side.**
3. **Cut the remaining three 2x6s in half to yield six 4-ft.-long 2x6s for the short ends.**
4. **Stand the two long sides of the bed parallel to each other, approximately 4 ft. apart. Nail the 2x6 end pieces to the corner posts, three to each end. Align them so that they are flush with the posts. The raised-bed form is now complete.**
5. **If you're worried about gophers or moles, staple an 8-ft.-long by 4-ft.-wide piece of ½-in.-square hardware cloth across the bottom of the box. This allows drainage and root growth but keeps the critters out.**

What you'll need (per bed)

- One 8-ft.-long 4x4 redwood post for the corners
- Nine 8-ft.-long 2x6 redwood boards for sides and ends
- 1-lb. box of 3½-in.-long ceramic-coated decking screws
- ½-in.-square hardware cloth, 8 ft. long by 4 ft. wide



TIP

USE CERAMIC-COATED SCREWS

Galvanized nails and screws are perhaps the most common outdoor fasteners, but they don't play well with redwood. A chemical reaction can occur and stain the wood. So use ceramic-coated decking screws instead.

beds from either side. I measured several of our chairs and found that they all had a seat height of 16 to 19 in. Because we had decided to use 2x6 redwood, we could stack the boards three high and end up with a finished height of 16½ in. (the actual width of a 2x6 is 5½ in.). This made the edge of the box a comfortable height on which to perch and gave more than enough root space for the plants.

The boards were screwed to 4x4 corner posts that extend nearly 8 in. higher than the sides. I sometimes drape bird netting for pest protection or row covers for

Drawing: Gary Williamson; photos (opposite page): Rosaline Wanke

Measure, mark, and cut the side posts. *You'll need only one 8-ft.-long 4x4 post for each bed because you'll cut it into four equal pieces, one for each corner (left). Attach three 8-ft.-long 2x6s to the corner posts with nails (right).*

warmth over the posts. The paths between the beds are 3 ft. wide to accommodate a wheelbarrow.

Accessorize your bed

Beds can be customized to meet a variety of specific needs. For some clients, I've designed beds that have a 6-in.-wide board or "cap" around the edge to make sitting more comfortable. (This makes it more difficult, however, to turn the soil.) For other beds, I've extended the corner posts up to 8 ft. to allow the attachment of trellises for beans, cucumbers, and other climbers. In gopher-prone areas, I've designed beds that have hardware cloth tacked across the bottom. For some beds, I've devised a system of hoops, using PVC irrigation pipe, over which to drape bird netting or row covers to keep cabbage loopers out.

I have experimented with several irrigation products, including microemitters, soaker hoses, and drip pipe. I prefer the flexible soaker hoses available in most hardware and garden stores. They can be snaked in any configuration and are easily removed when it's time to turn the soil. I use inexpensive chopsticks to keep the hoses in place.

Because the price of redwood has risen, many clients ask about using less expensive pressure-treated wood (see p. 23). I discourage them from making this choice because I'm not comfortable using chemically treated products around food crops.

It has been 20 years since we built our beds, and we are beginning to see signs of wear that indicate we need to start rebuilding. They have certainly been a good value, having held up to blasting sun and year-round cultivation. Where there was once only concrete, the soil is now black and rich and teeming with earthworms. The eight beds also make crop rotation easy to track. Everything I've grown in the garden has thrived.

Over the years, we have slowly removed the concrete paving between the boxes and replaced it with a thick layer of pea gravel that allows the little rain we get to percolate into the ground. And it crunches delightfully underfoot. Because the vegetable garden is the primary view from our kitchen window, it has been an added pleasure to look out on the raised beds with their profusion of vegetables, herbs, and edible flowers spilling over the edges. Thanks to the raised beds, we can enjoy homegrown produce every month of the year. □

Linda Chisari is a landscape designer in Southern California, where she gardens year-round.

Pull it all together. *Stand up the constructed long sides of the bed so that they are 4 ft. apart and parallel to each other. Complete the bed by nailing the short 4-ft.-long 2x6 boards to the posts.*

Cold Frame

Extend your growing season with this warm environment

BY ROB WOTZAK

Experience has taught me that the simplest solution is often the best. I wanted to spend more time using my new cold frame than building it, so I designed a compact, easy-to-move, low-maintenance box with a special feature: a hydraulic riser. This heat-sensitive opener regulates the temperature in the cold frame so that I don't have to check on my plants as often.

Cold frames are little solar greenhouses that provide a favorable environment for hardening off seedlings, growing cool-weather crops, and protecting tender perennials. They don't require outside energy; instead, they collect and retain warmth when the sun's rays penetrate the clear-plastic, glass, or fiberglass sash. The walls of the frame are most often constructed out of wood, but it's not unusual to use concrete, stone, or even straw bales. There is no standard-size cold frame, so its dimensions will depend on the amount of available space, how you plan to use the cold frame, and the size of your sash material; 3 to 4 ft. is a convenient space to reach across.

I used a 72-in.-long and 36-in.-wide sheet of acrylic for my sash and clear 2x6 cedar for the structure. The cost of cedar is justified by aesthetics; plus, the wood is rot resistant, lightweight, and easy to work with. I attached the 2x6s to 2x2s in the corners, and the sash frame is made out of 1x2s.

Because this simple design requires only a few different lengths of wood, you might want to ask the folks at the lumberyard to make all your cuts to size, which they will often do for free or for a small fee. The only tricky cut to make—and the only one they won't make for you at the lumberyard—is the one to create the triangle-shaped side boards, which are made from one 33-in.-long 2x6 cut on the diagonal.

Rob Wotzak is a carpenter and a web producer for FineHomebuilding.com and GreenBuildingAdvisor.com.

What you'll need

WOOD

FOR THE BASE:

- Four 31½-in.-long 2x6s
- Five 71-in.-long 2x6s
- One 33-in.-long 2x6
- Two 9½-in.-long 2x2s
- Two 15-in.-long 2x2s

FOR THE LID:

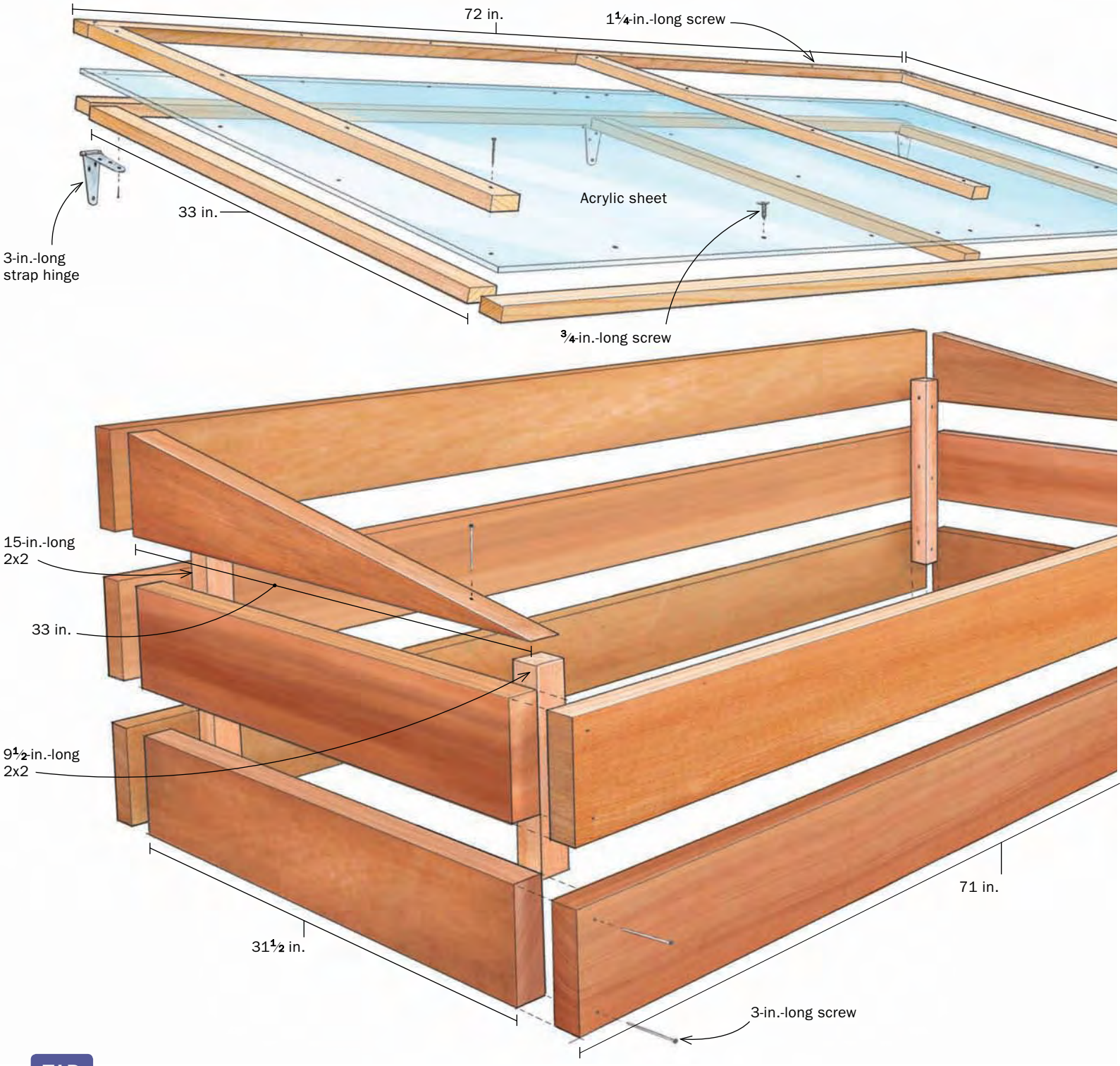
- Three 72-in.-long 1x2s
- Three 34½-in.-long 1x2s
- Three 33-in.-long 1x2s

GLAZING AND HARDWARE

- One 72-in.-long by 36-in.-wide sheet of clear acrylic
- Three 3-in.-long stainless-steel or brass strap hinges
- One solar-greenhouse vent opener
- Twenty-four 1¼-in.-long stainless-steel self-tapping deck screws
- Forty-six 3-in.-long stainless-steel self-tapping deck screws
- Fourteen ¾-in.-long stainless-steel pan-head screws

The hardest part isn't that difficult. *The two angled pieces (shown below in the finished frame) come from simply cutting a 2x6 diagonally (inset). Have someone at the lumberyard make the rest of the cuts for you.*

Nuts and bolts of a cold frame

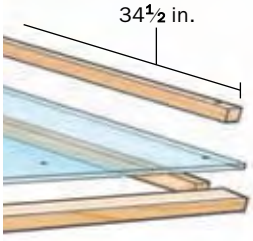


TIP

PICK THE RIGHT SPOT

The ideal location for a cold frame is a southern or southeastern exposure with a slight slope to ensure maximum solar absorption and good drainage. A sheltered spot with a wall or hedge to the north will provide protection against winter winds. Sinking the frame into the ground somewhat will also allow you to use the earth for insulation. Create a path to your cold frame, and clear plenty of space around it to maximize accessibility.

Photos: Kerry Ann Moore; drawings: Rob Wotzak



2x2s guide the sides. *Screw two 71-in.-long boards into the butt ends of two 31½-in.-long boards so that they make a shallow box. Attach the 2x2s in each corner to align the second and third layers and to fasten everything together.*

Let the lid shed water. *To assemble the lid, clamp the acrylic sheet between the 1x2s. Use 1¼-in.-long deck screws spaced about every 12 in. to attach the layers together. Leaving off the bottom strip allows rain and snow to glide off rather than puddle on the surface. Along the front, use pan-head screws to fasten the acrylic to the wood.*

TIP

CAREFUL WITH THAT DRILL

Predrill all screw holes to avoid splitting the wood or cracking the acrylic. Take care not to penetrate the other side of the material you are predrilling.

An automatic opener is the finishing touch. *After attaching the lid to the frame, it is time to add a solar vent opener ($50, charleysgreenhouse.com, No. 3515), which relies on a wax-filled piston to open the cold-frame lid automatically on sunny days to prevent overheating.*

Two Compost Bins

One is dirt simple to make,
the other does the aerating for you

BIN GROWS WITH THE PILE

Compost piles are ever-changing. One week you add some material; the next week you remove even more to fertilize your garden. This simple bin can handle those changing demands. Just add a level of side planks when the pile grows, and take them down when it shrinks. Or better still, have a small bin for compost that's just starting out and a large one next to it for compost that's ready for use.

HASSLE-FREE SIFTING

It's no fun sifting through compost to remove matter that is not completely decomposed before you can use the good stuff. That's not a problem with this bin. Compost falls onto an angled screen, which you tap with a shovel, causing the clean material to fall through. Everything else stays on top, making it easy to collect and put back into the bin.

Photos, this page: Virginia Small (left); Melissa Lucas (right)

Easy to make and adjust

A compost pile is not a garbage pile, and one way to differentiate clearly between the two is with an enclosure—a compost bin. The ideal bin retains heat and moisture, is easy to fill and empty, and fends off raccoons, dogs, and other animals.

My own homemade compost bin is easy to assemble and disassemble and works with whatever-size compost pile I have at a given time (see left photo, opposite page). It is made of rough-sawn hemlock 1x12s, each 5 ft. long. I cut the corners from both ends of the boards to create tabs. To keep the boards in place when they are stacked in a bin, I make the tabs into notches by screwing a foot-long 1x3 across the end of each board. I make the notch slightly wider than the width of the boards to allow for movement.

The finished boards stack tier upon tier, like Lincoln Logs. To assemble the bin, I place two boards on the ground parallel to each other. Then I slide two more boards into the notches to form a square. Each time I reuse a board, I put the opposite side inward; consequently, the boards have remained serviceable, even after 10 years. A short piece of scrapwood held by a stake fills in the 6-in.-wide gap at the bottom of the two sides where the boards are held above the ground.

One bin is the minimum for good compost. Two bins allow the ingredients in one to age while new material is added to the second.

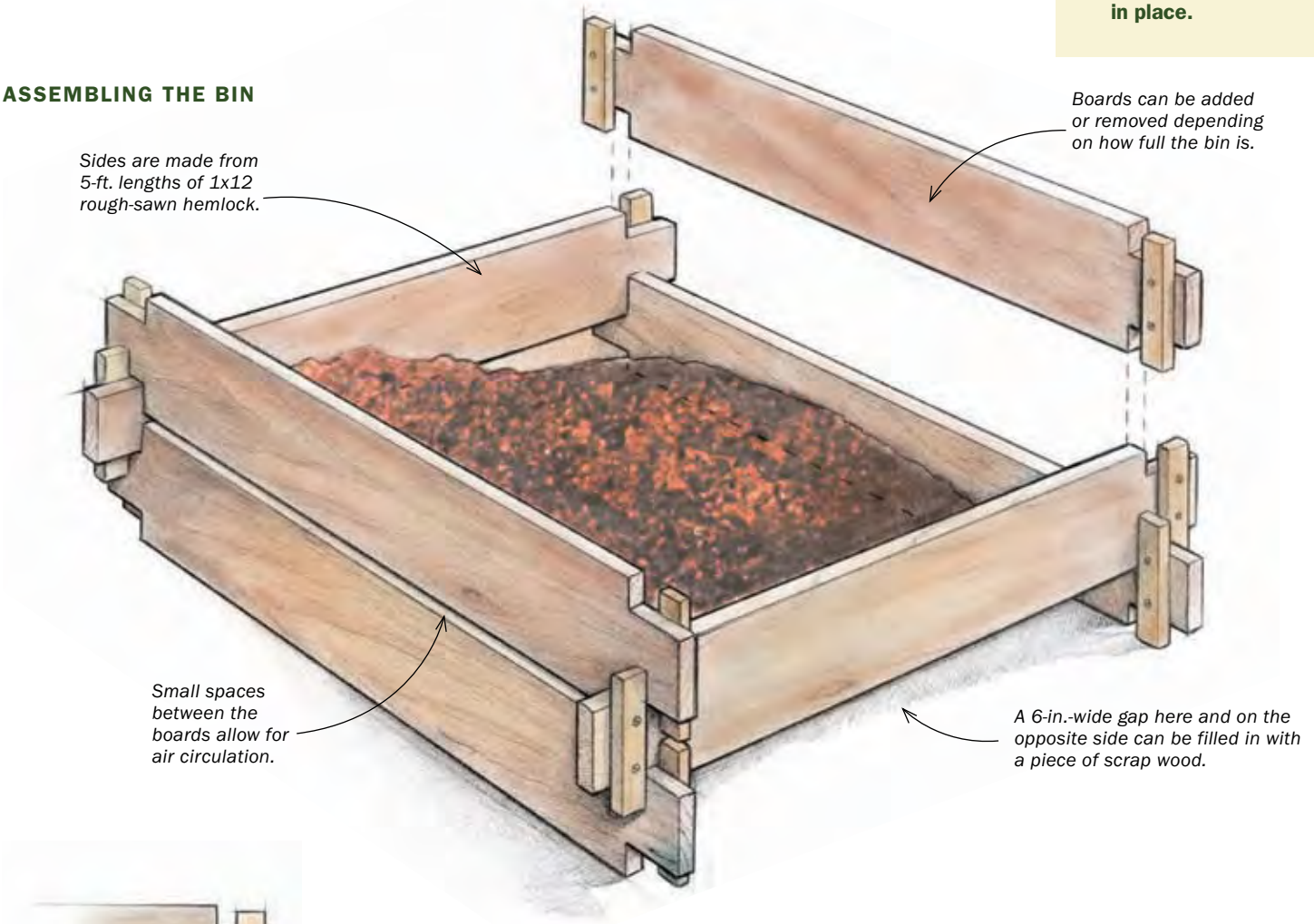
Lee Reich is a soil scientist and author of several books, including Weedless Gardening *(2001, Workman Pub.).*

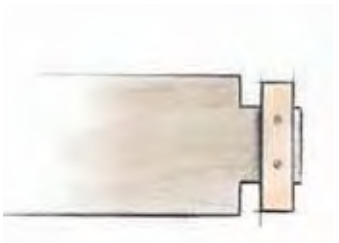
What you'll need

MATERIALS

- **Rough-sawn hemlock 1x2s, each 5 ft. long (the number will vary depending on the size of your compost pile)**
- **1x3 tabs, 1-ft. long each, screwed across both ends of each board to keep the boards in place.**

ASSEMBLING THE BIN





CREATING THE NOTCHES

Cut the corners out of each board to create tabs at both ends. Then screw a foot-long piece of 1x3 across the end of each tab to create a notched end. The notches will keep the boards in place when stacked.

Drawings, this page: Bob La Pointe

A bin with built-in sifting

I come from a long line of gardeners. Over the years, I've experimented with many methods of composting, but they all had the same two problems. First, not everything decomposes at the same rate; some material is still in its original form even after a few months and has to be returned to the bin. Second, even with frequent turning, the compost doesn't get enough air, which leads to slow decomposition.

This design, which I arrived at after two previous attempts, solves both problems. First, it's raised off the ground 3 ft., sitting on a 4-ft.-deep by 5-ft.-wide deck of spaced boards. That allows for more even airflow and improves aeration. As a result, compost material breaks down more quickly and more evenly.

To solve the other problem (material not decomposing at the same rate), I installed an angled chute beneath the bin. The chute is made from a screen captured in a wooden frame. I rake compost out of the bin and onto the screen. After letting it sit for a few days to dry, which makes it easier to sift, I tap the bottom of the screen with a shovel to create a bounce. Material ready for use falls through into the area for finished compost. Everything else is moved down to a holding area, and eventually goes back into the plastic bin.

Fred Pappalardo gardens in Provincetown, Mass.

Essential steps for producing good, rich compost

Compost is made from the breakdown of organic material with nonorganic material like minerals and sand added for texture. The heat generated kills any weed seeds and reduces vegetable matter to finer particles. The resulting "black gold"—a loose, odorless, rich source of nutrients—will greatly improve the quality of your soil and the health of the plants that live in it.

WHAT TO ADD:

- Garden trimmings and weeds
- Dry leaves
- Vegetable waste
- Coffee grounds
- Apple cores, banana peels, and citrus rinds
- Rice
- Pasta (and the sauce if it doesn't contain meat)
- Salad greens (and the dressing if it's made from vegetable oil)
- Breads

WHAT TO BE WARY OF:

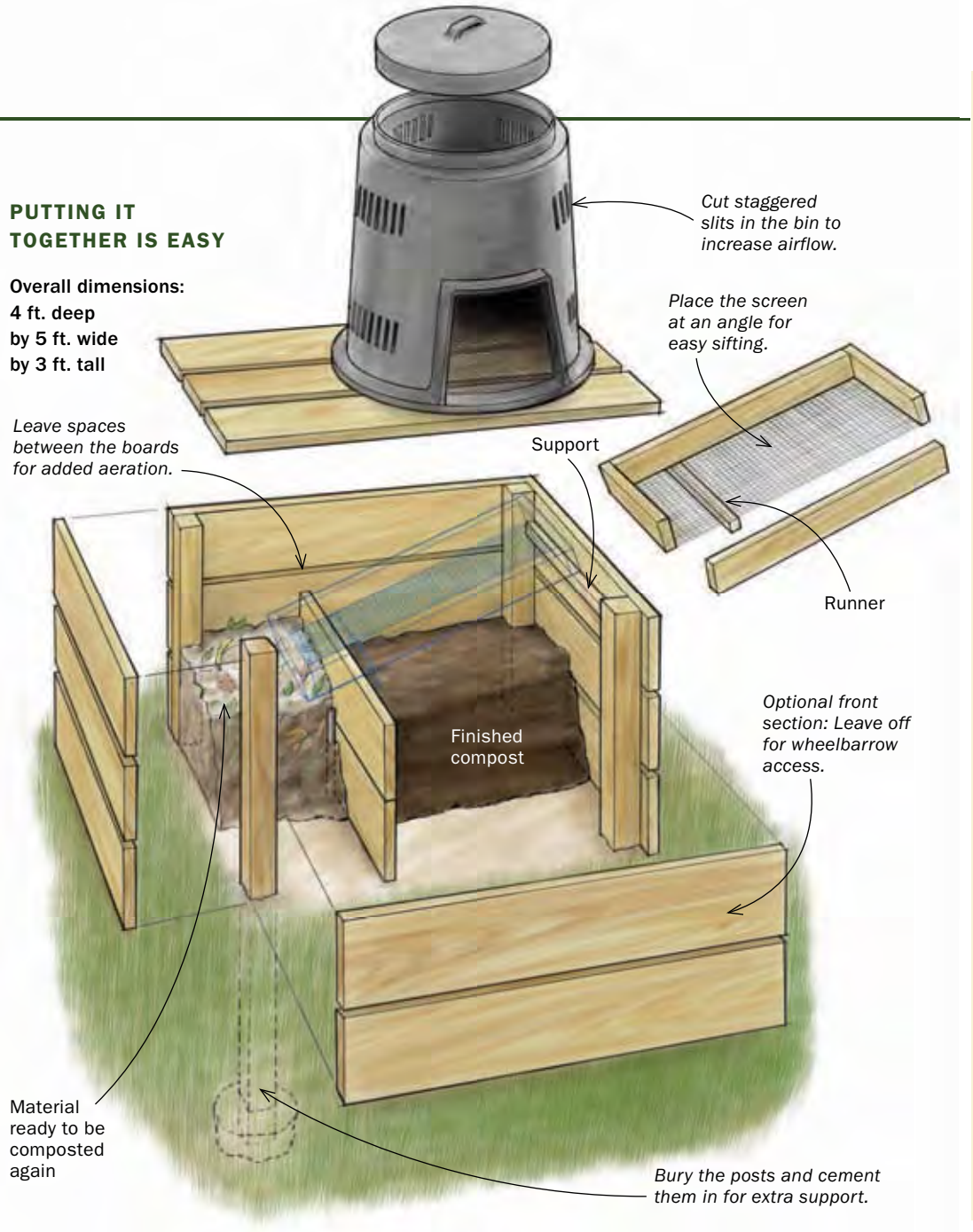
- Animal products, like meat, bones, or fats—they will rot and give off bad odors
- Whole eggshells—crush them first to help them decompose
- Shredded paper, except in small amounts and only if the paper doesn't have a lot of ink or color in it
- Sawdust made from pressure-treated lumber
- Anything that might be toxic to you. Remember, whatever goes into your compost goes into your vegetable garden and ultimately into you.

1. Maintain a proper moisture level. *This is critical for making successful compost. Add just enough water to make the ingredients glisten.*

2. Add nitrogen. *This will help balance the amount of green and brown ingredients in your pile.*

3. Turn the pile. *Forking it from one bin to another will speed up the composting process and solve problems like too much water, too little air, or bad smells.*

Photos, this page: Melissa Lucas (top left, top right); Virginia Small (bottom three)



PUTTING IT TOGETHER IS EASY

Overall dimensions:
4 ft. deep
by 5 ft. wide
by 3 ft. tall

What you'll need

MATERIALS

PLASTIC COMPOST BIN

- **Bin with a door at the bottom**

BIN PLATFORM

- **Four 6-ft.-long 4x4s**
- **Five 5-ft.-long 2x10s**
- **Six 4-ft.-long 2x10s**
- **Two 3¾-ft.-long 2x10s**
- **Three 5¼-ft.-long 2x10s**
- **Forty-four 5-in. by ⅝-in. hex-head lag screws**
- **Twenty ten-penny nails**
- **One 3-ft.-long 1x1**
- **Three 2-in. by ⅝-in. hex-head lag screws**

SCREEN

- **Two 4-ft.-long 2x4s**
- **Two 2-ft.-long 2x4s**
- **Eight 3-in. by ⅝-in. hex-head lag screws**
- **½-in. hardware cloth**
- **Staple gun with wood staples**
- **One 2-ft.-long 1x1**
- **Two 2-in. by ⅝-in. hex-head lag screws**

THE PLATFORM

1. SET THE POSTS

Dig four post holes: 5 ft. apart for the back and front and 3¾ ft. apart for the sides. Sink the 6-ft.-long 4x4 posts at an appropriate depth for your soil type. (I buried mine 3 ft. deep because, on Cape Cod, we have only sand to dig in.) You may want to cement in the posts for added stability.

2. ATTACH THE BACK AND SIDES

Across the back two posts, screw in three of the 5-ft.-long 2x10s, leaving about 1 in. between them to allow for airflow in the bin. On each side, screw in three of the 4-ft.-long 2x10s, also leaving a 1-in. space. The front may be left open to allow for wheelbarrow access or can be partially closed in using two of the 5-ft.-long 2x10s.

3. CREATE A DIVIDER

Place the two 3¾-ft.-long 2x10s in an upright position on their longest side, approximately 20 in. from the left side. Nail the boards in place from the rear. If you have attached the front section, nail the divider in from the front as well. For added support, drive a stake into the ground on either side of the divider.

4. SCREW IN THE SUPPORT

Attach the 3-ft.-long 1x1 support using three 2-in. screws to the right side of the bin, about 5 in. below the top. This piece will support the screen on a slope.

5. PLACE THE TOP

For the top of the platform, nail down the three 5¼-ft.-long 2x10s starting from the rear, leaving 1 in. between them.

THE SIFTING SCREEN

1. MAKE THE FRAME

Screw together the 2x4s using the 3-in. screws to make a rectangle roughly 2 ft. long by 4 ft. wide.

2. AFFIX THE SCREEN

Staple hardware cloth to the bottom side of the rectangle to create a screen.

3. ATTACH A RUNNER TO THE FRAME

Screw in the 2-ft.-long 1x1 using two 2-in. screws across the bottom of the screen, about 10 in. from one end, to make the runner. This piece rides along the divider and allows the screen to move back and forth.

Drawings, this page: Chuck Lockhart

Photo, this page: Bruce Wenner

Easy Arbor

Simple construction for a shady place to relax

BY FRANCES WENNER

Beautiful and utilitarian. *This unpretentious arbor provides backyard privacy and planting opportunities galore.*

Vine fever caught me early. My garden dreams were draped and swagged in clematis, roses, and honeysuckle. Out in the garden, I crammed vines onto every inch of fence and over every available structure, whether shrub, picket, or trellis. Still, it was clear that the extravagant roses and muscular wisteria I craved would overwhelm any ordinary garden structure.

These thoughts continued to bubble along in my subconscious until a trip to England provided an unexpected piece of inspiration. While visiting the charming garden adjacent to a small Somerset nursery, I was struck by the beauty and utility of a simple wooden arbor through which the garden path passed. Its rustic good looks complemented the whole garden, and the billowing roses appeared sublimely content. Happily, Bruce, my spouse and chief garden engineer, was with me and took pictures of the structure, including the construction details.

Getting the posts right is essential

Once home, we saw that the obvious place to build our own arbor was along the east boundary of our property. There, it would complete the circle of our backyard design, adding privacy. The spot we chose is unusual in that it occupies slightly sloping ground. Books advised us that the arbor location needed to be level, but because level does not exist on our two acres, we decided to position the arbor where we thought it would look at home and hoped for the best.

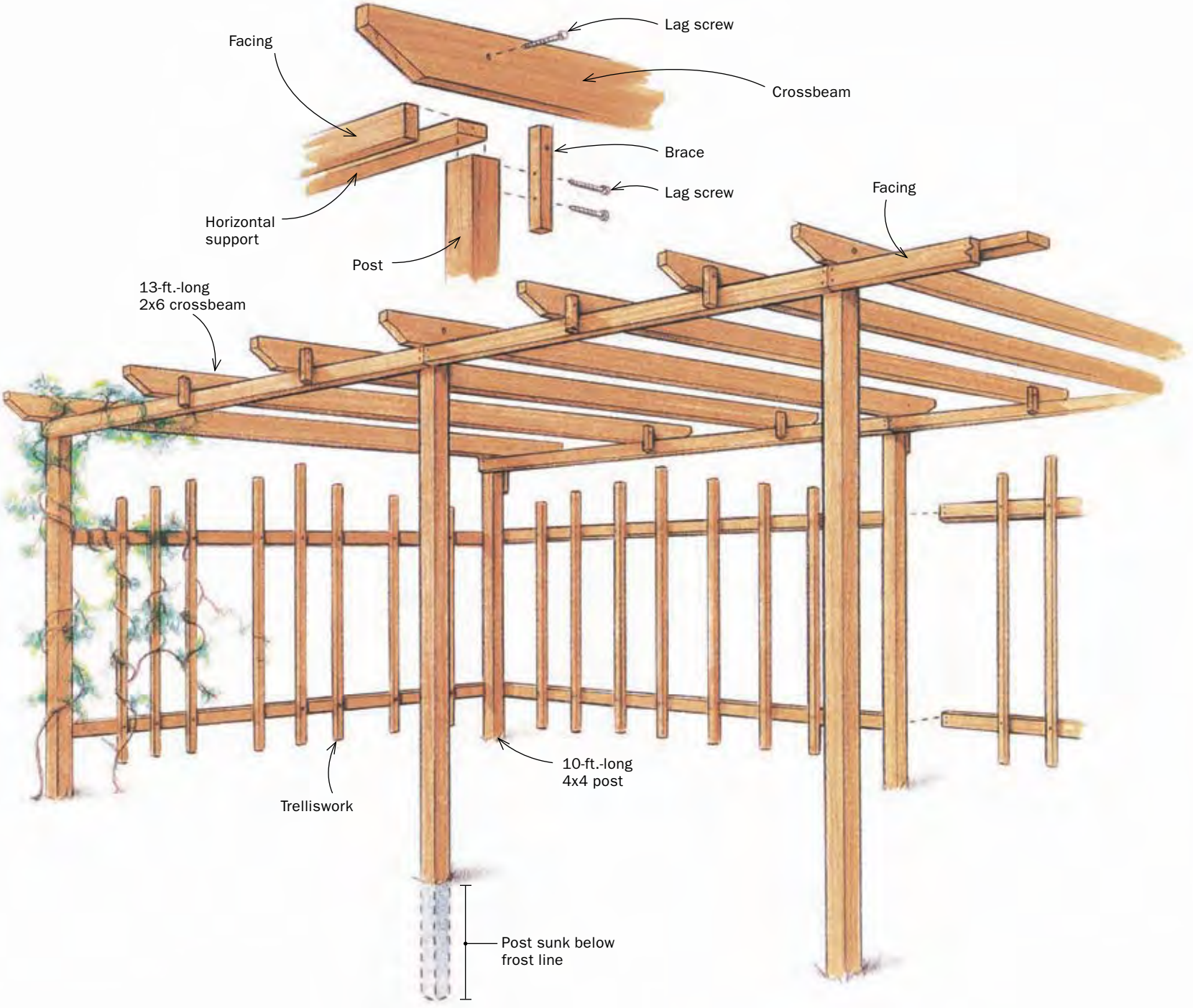
We took careful measurements, purchased lumber and hardware (see the materials list on p. 36), and rented a gas-powered auger. We decided to use pressure-treated lumber for the arbor because of its weather resistance. Cedar or redwood would have been good looking and durable enough but also considerably more expensive.

Before beginning construction, we dug 14 holes for the 10-ft. 4x4 posts in two rows of seven, to a depth of 2 ft., which is just beneath the frost line in our area. Check local codes to determine the frost line in your area and sink the posts beneath it. We used the rented power auger to save time and effort, but a muscle-powered post-hole digger or shovel would have done the job. We set the posts in two rows, 11 ft. apart. As we went, we measured to make sure the top of each post was precisely 8 ft. above ground, ensuring that the arbor followed the contour of the land.

The posts were spaced 8 ft. apart on center and topped with 8-ft.-long 2x4 horizontal supports. The supports were laid wide side down, meeting in the center of the tops of the posts. We tacked the supports to hold them in place and then added the facings. The facings were also 8-ft.-long 2x4s, one board for each horizontal support, placed flush with the top outside edge of the horizontal support. Once all of the supports and facings were tacked

A home for climbing plants

Wenner used pressure-treated lumber for all of the arbor components. Posts should be treated because they are sunk into the ground, but cedar or redwood are good alternatives for the other arbor parts.



What you'll need

- **Fourteen 10-ft.-long 4x4 posts**
- **Thirty-six 8-ft.-long 2x4s for horizontal supports, facings, and trelliswork on the arbor back**
- **Two 11-ft.-long 2x4s for the trelliswork on the end posts**
- **Nineteen 13-ft.-long 2x6 crossbeams**
- **Thirty-eight 2x2 vertical braces—24 cut to 7½-in. lengths, 14 cut to 10-in. lengths**
- **Fifty-one 1x2 slats for trelliswork in varying lengths between 5 and 6 ft.**

Photos, except where noted: Frances Wenner; drawings: Bob La Pointe

on, we secured them with 2½-in.-long and ¼-in.-diameter hex-head lag screws. The screws for the horizontal supports were countersunk because the crossbeams were placed directly on top of them.

Crossbeams create a sense of enclosure

A total of 19 crossbeams span the top of the arbor. They are 13-ft. lengths of 2x6s, with both ends cut at 45° angles. One beam is situated over each pair of posts, and in each interval between the posts, two more beams are equally spaced. To secure the crossbeams, we mounted vertical 2x2 braces, cut to 10-in. lengths, onto the back side of each post. More braces, 2x2s cut to 7½-in. lengths, were added to the front of the facing for the beams running in between the posts.

The braces were positioned, their bottoms flush with the bottom of the facing, and fastened with two 2½-in.-long and ¼-in.-diameter lag screws. Then we placed the crossbeams against the braces, securing them with two 2½-in.-long screws

Let a machine do the work for you. *With the help of a rented power auger, set the posts in holes 2 ft. deep. A post-hole digger would also get the job done, but more slowly.*

A sloped spot still works. *Keeping all of the posts at the same height above the ground helps the arbor fit into the landscape.*

Take care of the soil. *Amending the soil with compost and organic matter will help climbers get off to a healthy start.*

through each brace and into the beam. The beams between the posts were secured further with 3½-in.-long lag screws, driven through the horizontal supports and up into the beam.

The final step was to close off the back and bottom end of the arbor with trelliswork. We attached two rows of 8-ft.-long 2x4 horizontal boards to the back of the posts, 40 in. apart, and fastened each with two 2½-in.-long lag screws on each end. Then we added vertical 1x2 slats to form the trelliswork.

The arbor was complete—an empty canvas to paint with plants. While my husband and son worked on the arbor, I prepared beds at the foot of the posts and along the full length of the arbor's back. I amended the soil with as much organic matter as I could lay my hands on, and dug a deep hole at the base of each post for a rose. On the back side of the posts, I dug another hole for clematis. These two plants would form the backbone of my composition. □

Frances Wenner has been gardening in the Kansas City, Mo., area for more than 35 years. She writes a gardening column for a local garden bulletin and lectures regularly for several horticultural organizations.

Design the interior, too

In the center of the arbor, we placed a cedar bench of simple design to blend in with the structure and provide a place of repose among the roses. The arbor has become one of our garden's loveliest and most appreciated features.

- **LET CONTAINERS PROVIDE COLOR**

  Flanking the bench, two terra-cotta pots were set on brick platforms and hold long-blooming annuals for summer-long interest. From this spot, we enjoy a cross view of our garden, softly framed by the rose- and vine-clad arbor.

- **USE THE BEDS TO ENHANCE THE ARBOR**

  The beds beneath the posts are filled with an ever-changing array of bulbs and perennials as I search for the best choices to set off the arbor climbers.

- **EVERYBODY LOVES FRAGRANCE**

  The deliciously scented, pale yellow 'Graham Thomas' honeysuckle (*Lonicera periclymenum* 'Graham Thomas', USDA Hardiness Zones 5–9) twines over the trellis behind the bench, pouring its perfume over the fortunate who pause here to rest.

Photo, this page: Bruce Wenner

Pergola Principles

Strong joints and tough materials withstand the elements

BY CHIP HARLEY

Building a pergola can be a lot like building a piece of fine furniture. The finished product exhibits great craftsmanship while showcasing the beauty of wood. Unlike a cherry Shaker table, though, a pergola is exposed to sun, rain, wind, and snow. It's important to build one that can weather the elements and live a long life.

Look to the site for inspiration

The narrow pergola shown here consists of four posts supporting a canopy of purlins and joists. With its solid joinery and thick timbers, you could make this pergola with a much bigger footprint. Using the basic tunnel shape as a starting point, I looked to the house for inspiration because my goal was to integrate the pergola's design with the site. I wanted to mimic the brackets that support the gable eaves on the main house, so I used 6x6s chamfered to a point and notched over the posts. The corbels beneath these

IS IT A TRELLIS, AN ARBOR, OR A PERGOLA?

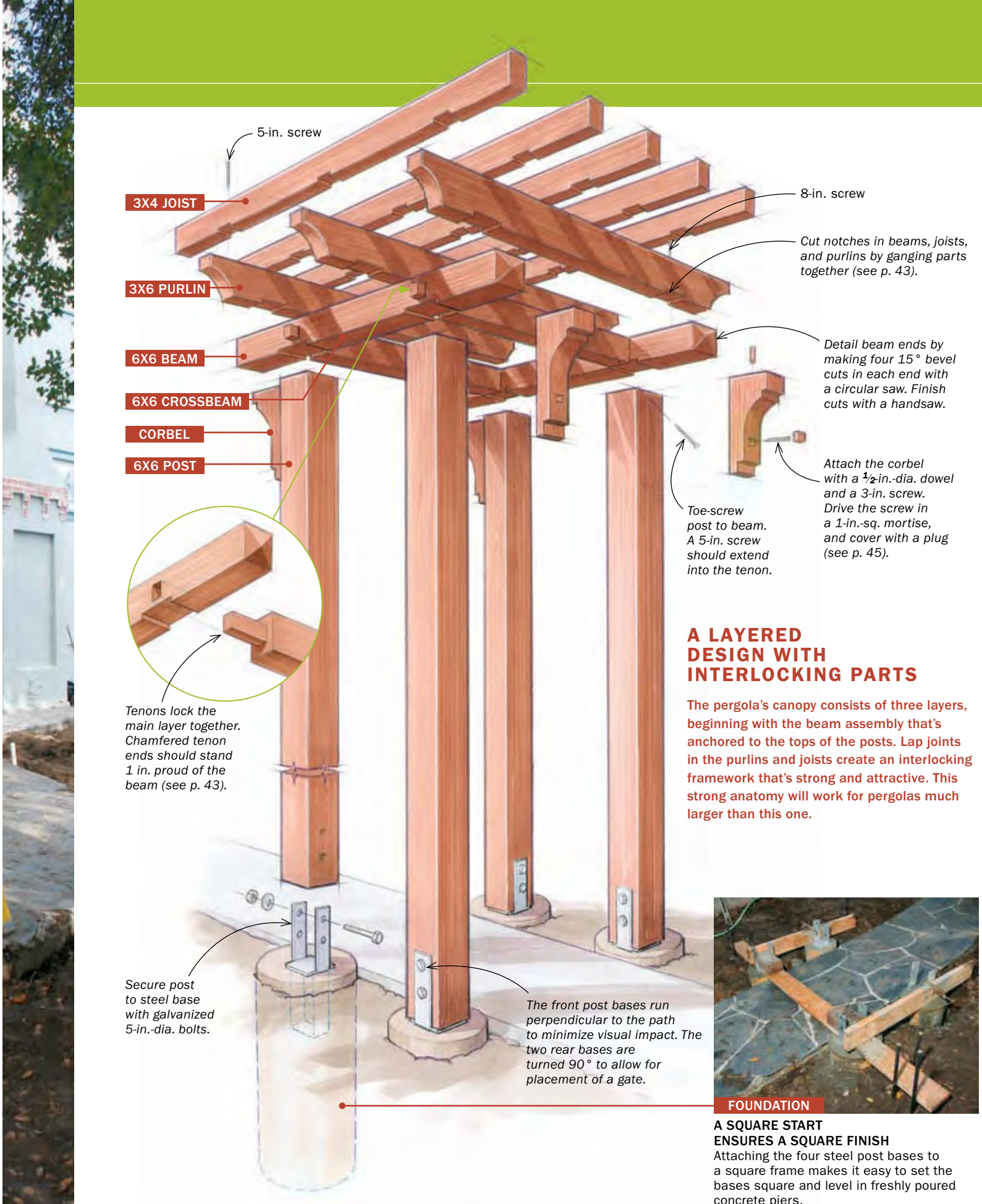
Although the terms often are used interchangeably, trellises, arbors, and pergolas are distinctly different structures. A trellis is typically a latticework built to support climbing plants or vines. It can be a simple panel attached to the side of a building, or it can be freestanding in a garden or yard.

Trellis

An arbor usually incorporates a trellis into its structure, creating a tunnel-like passageway of climbing plants. Arbors have a continuous run of latticework from one side of the "tunnel" to the other, often in an arched shape.

Arbor

Pergolas, too, are designed to support climbing plants. Unlike arbors, though, pergolas simply have posts supporting a rooflike structure. They're most commonly used to shade a walkway or a deck.



A LAYERED DESIGN WITH INTERLOCKING PARTS

The pergola's canopy consists of three layers, beginning with the beam assembly that's anchored to the tops of the posts. Lap joints in the purlins and joists create an interlocking framework that's strong and attractive. This strong anatomy will work for pergolas much larger than this one.

A SQUARE START ENSURES A SQUARE FINISH
Attaching the four steel post bases to a square frame makes it easy to set the bases square and level in freshly poured concrete piers.

Drawings: Dan Thornton; photo, facing page: Janet Delaney

TEMPORARY BRACES KEEP POSTS PLUMB

Once the concrete set, I installed the four posts. With the posts braced plumb, properly spaced, and cut to height, I took all the measurements needed to build the canopy in my shop.

POSTS

Use spacers and braces. *Install temporary 2x4 spacers to maintain uniform distance between posts. Horizontal cleats clamped outside the braces keep them in place and provide a nailing surface for a diagonal brace that extends to a stake in the ground.*

Bore holes from each side. *Center an auger bit in the post base hole while an assistant helps to keep the bit level with a combination square. Bore halfway through the post, then finish the hole from the other side.*

Make this cut carefully. *Level top cuts are made with posts in place, two passes for each post. Although it's not used here, a guide block clamped to the post would support the base of the saw to ensure a precise cut.*

beams were copied from the ones on the house, lending another visual tie-in. To evoke the Craftsman aesthetic, I chose large-dimension stock. Although 2x6s and 2x4s would have worked well for the upper layers, I used 3x dimensions to keep in scale with the 6x6 posts and beams.

I designed the construction details to ensure the pergola's stability and longevity, and I also wanted to show some level of craft without making the process too difficult or expensive. To guarantee the pergola's durability further and to enhance its visual appeal, I chose redwood reclaimed from an old bridge. Although I built the canopy in my shop, this pergola could be built on site using common carpentry tools.

Build the canopy on the ground

With the initial sitework complete and the posts braced plumb as shown above, I took measurements for the beam notches and cross-beam lengths, and headed to my shop to build the canopy. We began with the main 6x6 beams, which would be notched to fit on the posts. Because the beams and posts would be set flush to each other on the sides, I eased the edges of the notches and the tops of the posts with sandpaper. This treatment emphasizes the joint and hides small inconsistencies.

The two 4x6 crossbeams between the two main beams add structural integrity to the pergola. Mortise-and-tenon joints give the assembly the strength to resist racking, and the shoulders of the tenons set the distance between the posts. The proud through-tenons add visual interest.

Photos, except where noted: Christopher Ermides

THE CANOPY GOES TOGETHER WITH LAP JOINTS, MORTISES, AND TENONS

The technique I use to notch the beams also works for lap joints in the purlins and joists. I cut lap joints with the parts ganged together, using a sacrificial piece of plywood to eliminate tearout.

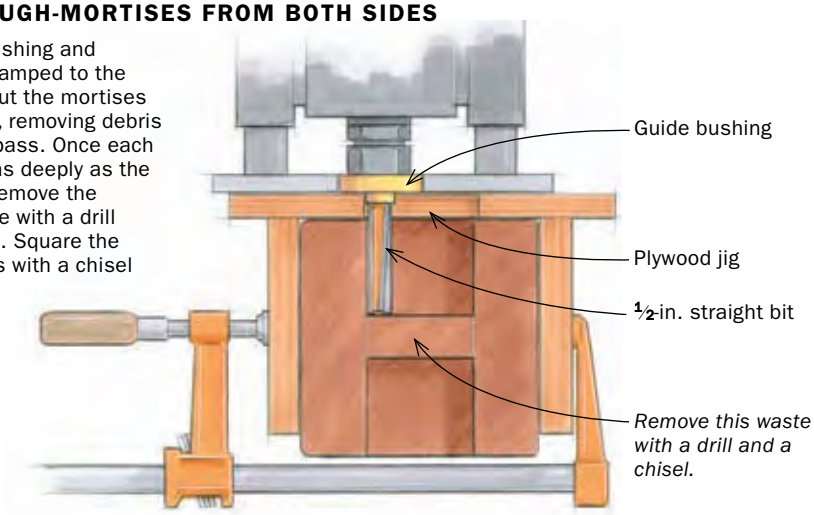
LAP JOINTS

Cut lap joints in stages. *Make a series of closely spaced kerfs with a circular saw. After knocking out the waste with a hammer, finish with a chisel. Use a trim router and a combination square to fine-tune the fit.*

MORTISES

ROUT THROUGH-MORTISES FROM BOTH SIDES

With a guide bushing and a plywood jig clamped to the beam, plunge-cut the mortises in ¼-in. stages, removing debris after each full pass. Once each side is routed as deeply as the bit can reach, remove the remaining waste with a drill bit and a chisel. Square the mortise corners with a chisel and a rasp.



TENONS

Cut tenons with a crosscut sled. *Made of plywood, the sled rides on runners that fit in the tablesaw's miter-gauge grooves. Cut the tenon shoulders first, using a finish-cutting blade. Then switch to a stacked dado set to maximum width, and make multiple passes to cut each tenon cheek. For an easier fit, use a utility knife to pare out the section of tenon corners that won't be visible.*

Test-fit, adjust, and assemble. *Chamfer the tenon ends, and use a handplane to trim the tenon if the fit is too snug. Then coax the joints together with a wood mallet and scrap block.*

HIDDEN FASTENERS LOCK THE LAYERS TOGETHER

Once all the pieces are cut, I lay out everything on a table, then mark and label the pieces. Fine-tuning the notches happens now, too, so that assembly goes smoothly at the site.

Install the beam-and-cross-beam assembly. *Test-fit post cutoffs in the beam notches before hoisting the unit on top of the posts. Slight adjustments to post locations are made by loosening the spacer clamps.*

Add the purlins and joists. *Any adjustments to lap joints are made on the ground in the dry-fit/layout stage. The joists lock the purlins in place. Install long screws from above to tie the two layers together and keep the joints tight.*

I cut the through-mortises in the 6x6 beams with a plunge router equipped with a guide bushing and a straight bit. (This also could be done using a straight bit with a top-mounted bearing.) Between ¼-in.-deep passes, I vacuumed the mortise to keep the router running smoothly. Using a saddlelike plywood jig, I was able to line up the mortise from both sides, leaving it perfectly square so that the cross-beam shoulder sits flush with the beam.

We cut the tenons on a tablesaw and cleaned up the cheeks with a block plane, chisel, rasp, and sanding block until they slipped into the mortises without binding.

After cutting the 3x6 purlins to length, we used a pattern to mark the curved ends, then made the cuts on a bandsaw. We used a drum sander to smooth out the saw marks. Next, we laid the 3x6 purlins on the beam assembly, centering them over the beams and scribing notch locations with a marking knife. The ¾-in.-deep lap joints lock the beams tight to the crossbeams.

The topmost layer consists of five 3x4 joists placed over the 3x6s. The layout again began with finding the center of the lower layer. Once the 3x4s had been cut to length, I finished the ends with a simple ¼-in. chamfer.

Corbels complete the details

The final pieces cut were the four corbels. I made a stiff paper template from a tracing of an existing corbel on the house and used it to draw the four corbels on pieces of 4x6 redwood. These pieces were cut on the bandsaw and cleaned up on belt and drum sanders. I used a hollow-chisel mortiser to cut 1-in.-sq. mortises about 1 in. deep in the faces of the corbels. I then made square plugs with finished, chamfered ends to fit snugly into these holes.

Assemble the beams and crossbeams

Careful, precise work in the shop ensures that the assembly work on site goes smoothly. With all parts cut and ready, it was time to assemble the canopy on the posts. We kept the beam-and-cross-beam assembly together, lifting it onto the posts as a unit. A small amount of fussing resulted in the beam notches sliding cleanly over the posts. We clamped the beams tight to

CORBELS

Toe-screw posts before adding corbels. *Drill pilot holes and drive two 5-in. screws through each post and into the tenon (1). This permanently secures the canopy to the posts. Now attach the corbels with hidden fasteners. To locate the dowels accurately, use a dowel center, pressing the corbel up into the beam at the desired location on each post. Before inserting the dowel in the corbel, dip it in water and coat both ends with exterior-grade polyurethane glue (2). A screw through the mortise locks the corbel in place (3). Finally, glue a plug into the mortise (4) to hide the screw head and to mirror the through-tenons.*

the crossbeams and set the 3x6 purlins in place over the beams. The layer of 3x4 joists was assembled in the same way, resulting in a rigid structure that locked in place without fasteners.

When the final position of all pieces was established, we fixed the beams to the posts with 5-in.-long exterior screws. By drilling pilot holes up at an angle from the face of the posts into the beams, we were able to catch the tenons as well. These screws were countersunk, and the heads later were covered by the corbels. We used 8-in. screws to fasten the purlins to the beams and 5-in. screws for the joists. Screws were countersunk slightly, and the holes were filled with silicone after the wood was coated with clear finish.

With the fence and gates installed, the pergola is now the centerpiece of the garden. My clients and I eagerly await the arrival of the final touch, clusters of white wisteria gracefully entwined in the redwood canopy. □

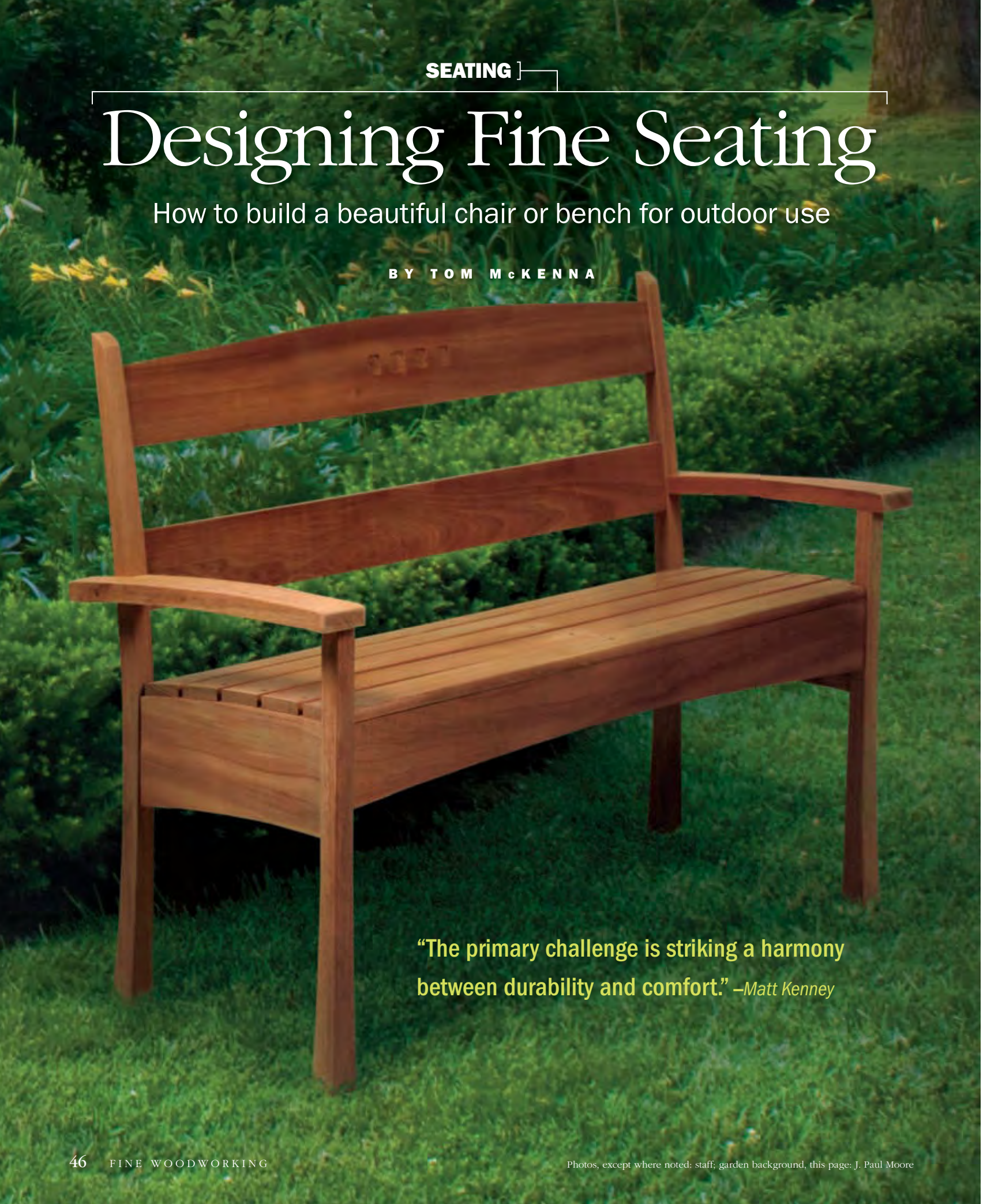
Chip Harley is a principal in the design/build firm Holland & Harley Construction Inc. in Berkeley, Calif.

SEATING

Designing Fine Seating

How to build a beautiful chair or bench for outdoor use

BY TOM McKENNA



"The primary challenge is striking a harmony between durability and comfort." –*Matt Kenney*

Photos, except where noted: staff; garden background, this page: J. Paul Moore

As a furniture maker, I aspire to build things that will look beautiful for a lifetime. I spend a lot of time on the design and choose the best-looking lumber for the project. I work hard to cut strong, long-lasting joinery and add in tolerances that allow for expansion and contraction of the wood so that doors and drawers don't bind and tabletops don't split. Last, I apply my favorite finish to illuminate the wood and protect it over time.

When you build for the outdoors, though, many of those efforts are in vain. Think about all that an outdoor piece must endure throughout the seasons. It gets soaked with rain and scorched dry by the sun. It freezes in winter, gets scratched up by squirrels, cats, and other critters, and even endures the indignation of being used as a Porta-Potty for the birds. Not exactly a prime environment for a period piece with a French polish.

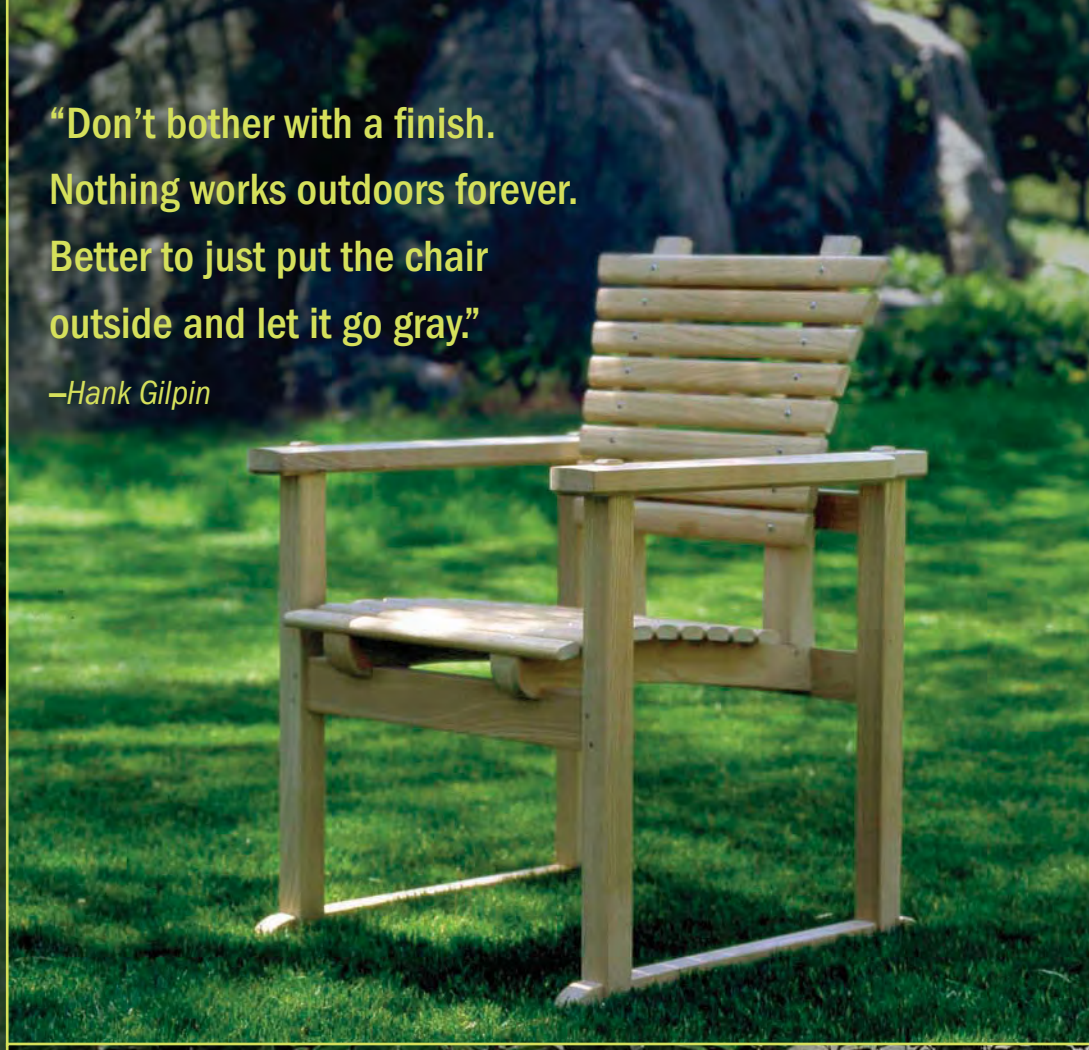
I'm not recommending that you head to a discount store and buy resin chairs and tables. Far from it. You can still make elegant furniture for your garden, deck, or patio. You just have to figure out the best approach to building for a brutal, decay-prone environment, and accept the fact that nature always wins.

As Hank Gilpin says, "Enjoy the pleasure of making it, but remember that all things go away."

In this article, you'll learn about designing for the outdoors from three furniture makers. Gilpin and Michael Fortune have been building outdoor furniture for many years. Matt Kenney, a *Fine Woodworking* senior editor, had never built a piece for the outdoors until this year. So he took tips from Gilpin on how to make a piece last.

Each of these makers offers an outdoor chair (Kenney's is a bench) that is both attractive and comfortable, using materials and joinery that will push back against nature's onslaught. If you want to go beyond these designs, you'll also get some great tips on building for the outdoors in general, such as choosing the right wood, glue, and hardware, and whether to apply a finish (some do, some don't bother).

Tom McKenna is managing editor.



Photos, this page: Jonathan Binzen (top); Michael Fortune (bottom)

Adirondack with a twist

by Michael Fortune

The most important criterion for an outdoor chair is that it be comfortable for relaxing, reading, and conversing in a garden setting. The Adirondack chair is a traditional outdoor design, and the form has been widely copied. I'm not big on copying, and I wanted to introduce some playful curves while increasing the comfort. So I made some changes.

Most traditional Adirondack seats are around 14 in. high and sit rather low at the back. To make my version easier to get in and out of, I made the seat 16 in. high at the front. I also made the back of the seat a bit taller. By the way, the part of the seat that protrudes past the arms is the perfect place to set a summer drink.

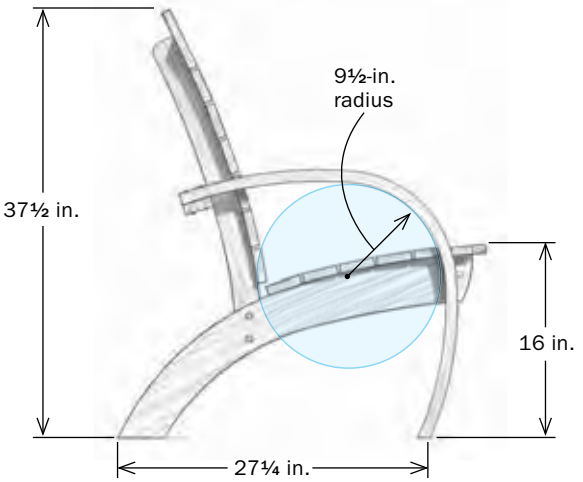
The wide curved arms make strong visual statements, reflecting the natural shapes found in gardens, and they provide structural integrity. Each arm is made from eight, ⅛-in.-thick laminations, assembled on a bending form (see drawing, opposite page) using Titebond III, a highly water-resistant glue. You'll need to draw a full-size side view to work out the arm curve.

The legs appear to angle inward toward the back, but the side assembly is an easy-to-make flat plane. The illusion makes the chair more interesting from all angles.

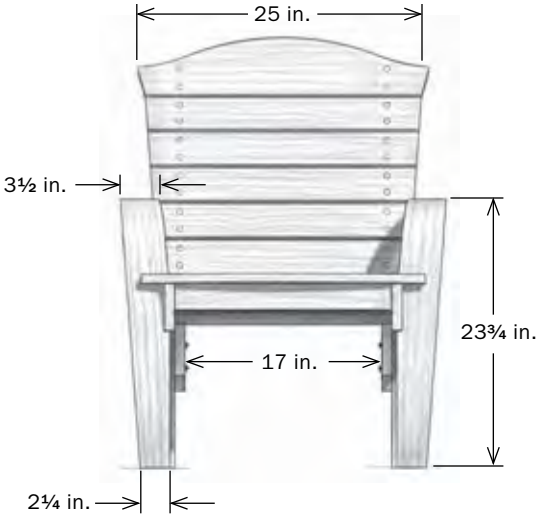
All of the joints are assembled using stainless-steel bolts and decking screws. To notch the arms for the legs, I used a couple of quick jigs to guide the router: one for the right assembly and one for the left.

I've made these chairs in a variety of woods suitable for outdoor use, such as cedar, larch, and mahogany. With these woods, I often apply a clear penetrating finish, like Watco exterior. You also could allow them to weather and develop a silvery color—I like that transformation on this particular chair. I've even painted some of these chairs my favorite color, periwinkle blue.

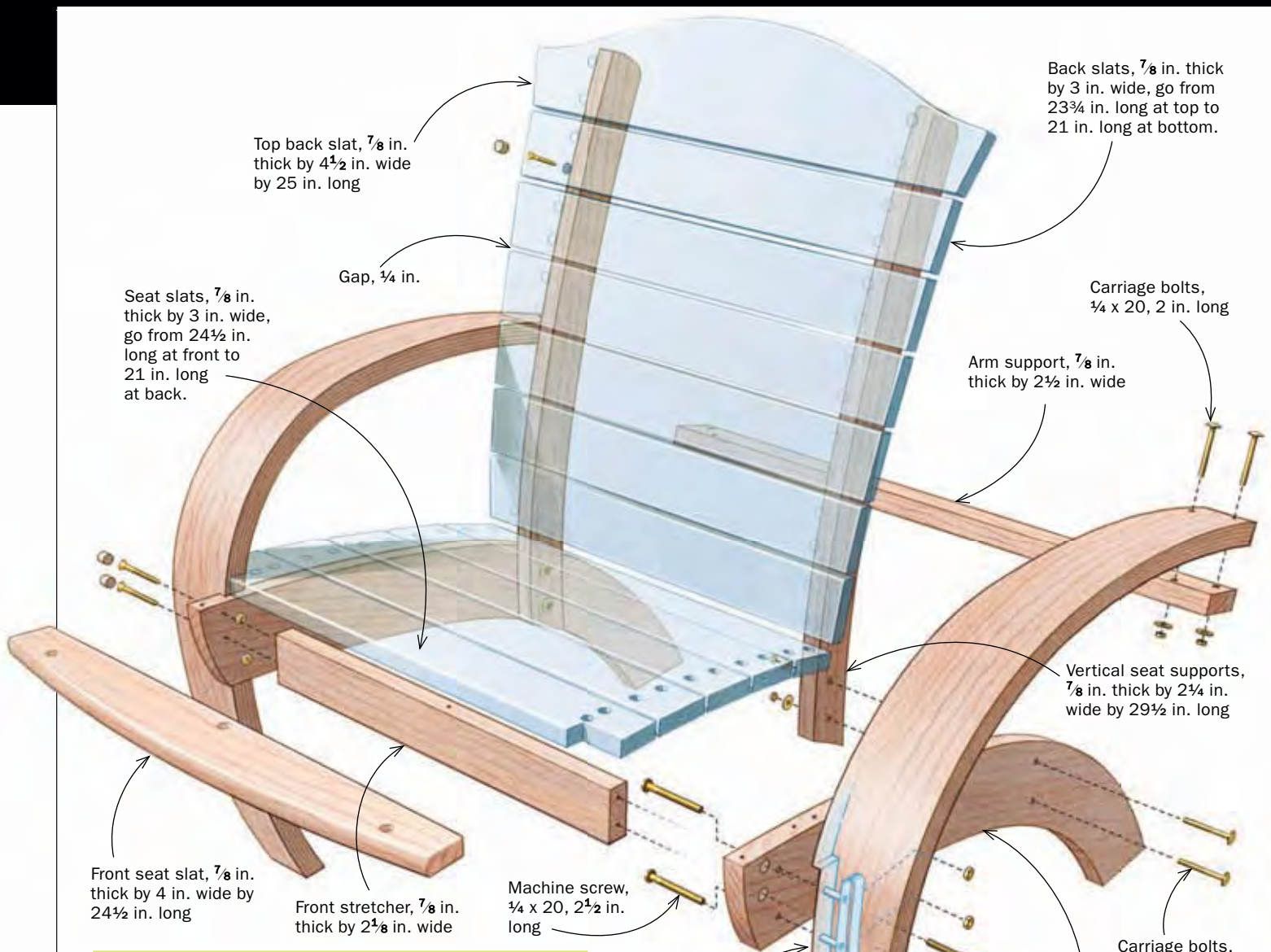
SIDE VIEW



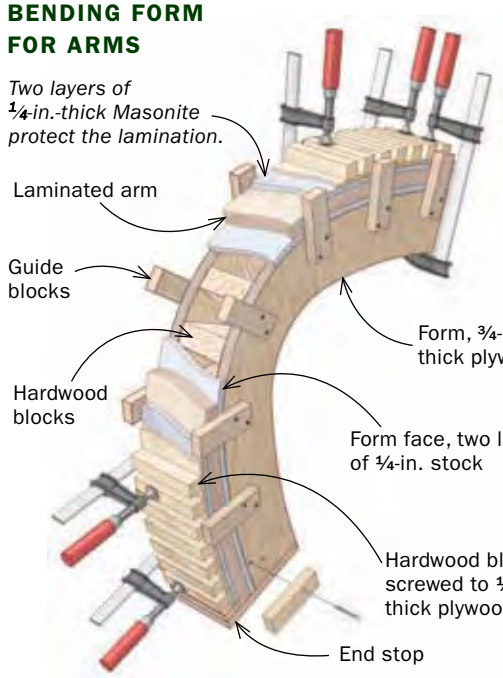
FRONT VIEW



Photo, this page (bottom): Michael Fortune; drawings: John Hartman



BENDING FORM FOR ARMS



This chair celebrates its joinery

By Hank Gilpin

When it comes to building this, or any, outdoor chair, the wood choice and joinery are most important to making it last.

The top wood choice would be teak, the miracle outdoor wood. It doesn't move, has no coarseness, and ages into a beautiful silvery-gray sheen. It also has natural decay-resistance. The problem with teak is its hefty price tag. Other candidates that work well include black locust, osage orange, mulberry, white oak, cedar, redwood, and walnut.

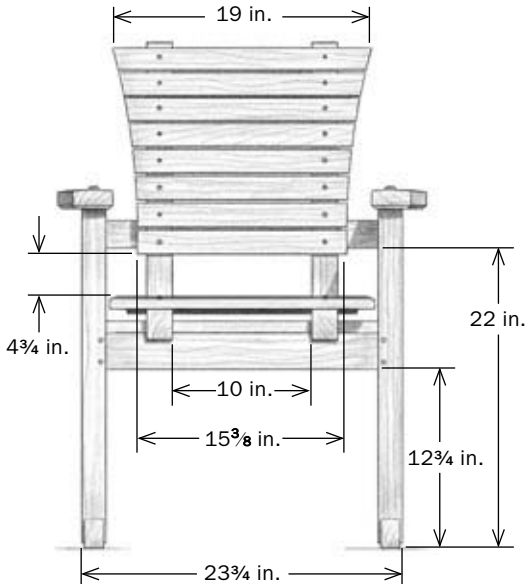
I tried to keep the joinery simple and I hid none of it, choosing to make it a key element of the design. The chair has straightforward mortise-and-tenon joints, bridle joints, and lap joints. The most exacting joints to cut are the large through-tenons that connect the leg posts to the arms. I also kept the seat and back slats narrow to reduce the amount of wood movement. An outdoor chair is going to get soaked with rain one day then baked by the sun the next, so movement will be severe.

The only curves are in the seat and back supports, and they are simple bandsaw cuts. You'll need to draw a full-size side view to work out these curves. The seat and back slats are profiled using a router and screwed on with visible, stainless-steel screws. Why hide them? Instead, I make the countersunk hardware part of the overall design. By the way, use good hardware. If you think you are gaining by putting a plug over a cheap screw, you're fooling yourself. The moisture goes in there and rusts it right out. You just don't see it happening until the thing falls apart.

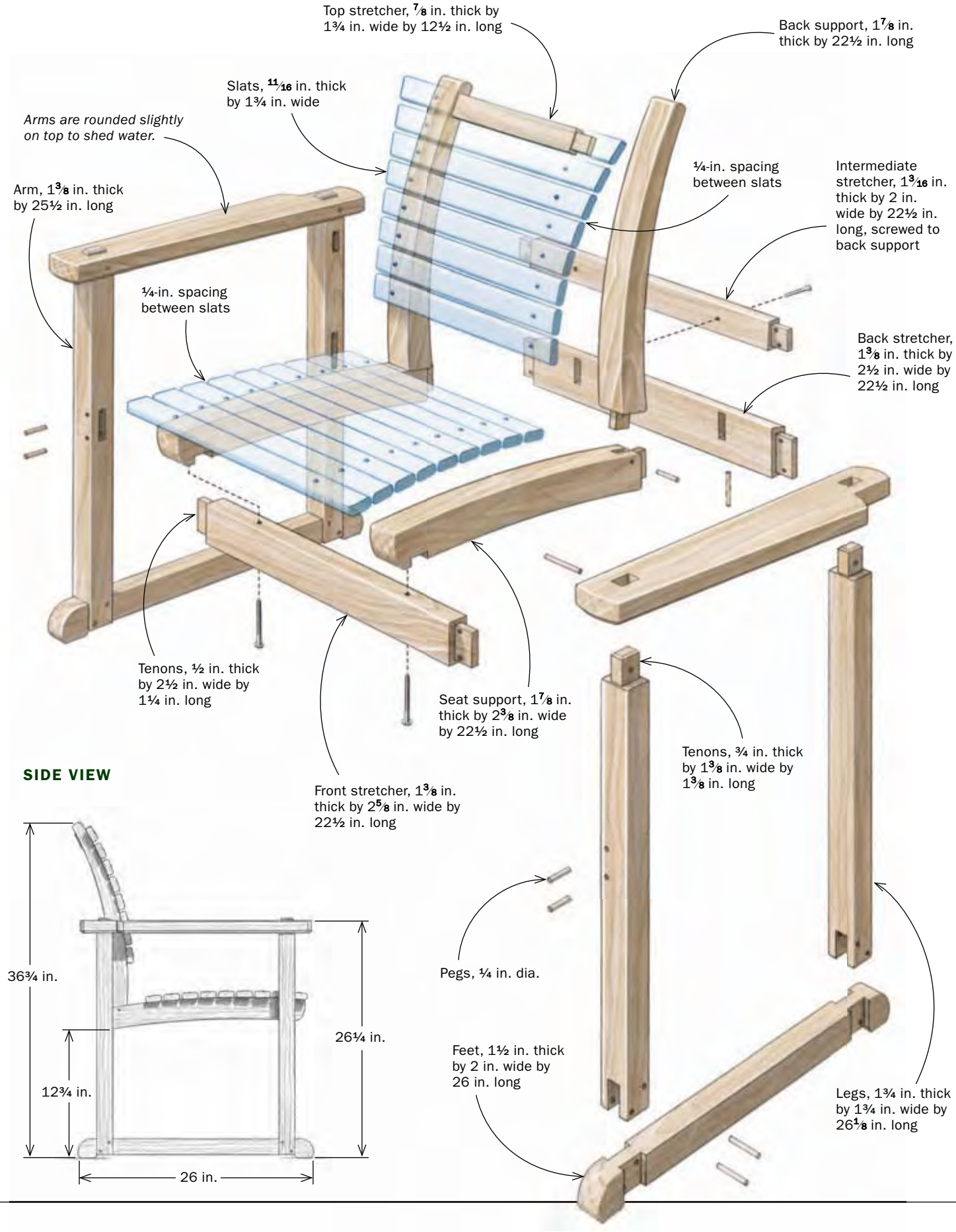
I didn't bother with a finish. Maintaining a finish on outdoor furniture is an assignment to hell because you'll be refinishing your furniture all the time. Nothing works outdoors forever (and I mean nothing). Better to just put it outside and let it go gray.

Remember, when it comes to building an outdoor chair, don't obsess. Just accept the fact that the chair is essentially being placed into a decay-prone situation and you're only going to get X number of years out of it. You can make a nice chair, but don't be too precious about it. Ultimately, you want a comfortable place to sit outside, read a book, and drink a beer.

FRONT VIEW



Photo, this page (bottom): Jonathan Binzen


Top stretcher, 7/8 in. thick by 1¾ in. wide by 12½ in. long
Back support, 1 7/8 in. thick by 22½ in. long
Slats, 11/16 in. thick by 1¾ in. wide
Arms are rounded slightly on top to shed water.
¼-in. spacing between slats
Intermediate stretcher, 1 3/16 in. thick by 2 in. wide by 22½ in. long, screwed to back support
Arm, 1 3/8 in. thick by 25½ in. long
¼-in. spacing between slats
Back stretcher, 1 3/8 in. thick by 2½ in. wide by 22½ in. long
Tenons, ½ in. thick by 2½ in. wide by 1¼ in. long
Seat support, 1 7/8 in. thick by 2 3/8 in. wide by 22½ in. long
Front stretcher, 1 3/8 in. thick by 2 5/8 in. wide by 22½ in. long
Tenons, ¾ in. thick by 1 3/8 in. wide by 1 3/8 in. long
SIDE VIEW
36¾ in.
26¼ in.
12¾ in.
26 in.
Pegs, ¼ in. dia.
Feet, 1½ in. thick by 2 in. wide by 26 in. long
Legs, 1¾ in. thick by 1¾ in. wide by 26 1/8 in. long

Comfortable bench for a garden, patio, or deck

By Matt Kenney

When my family and I moved to Connecticut, we found ourselves living in a house with a large deck out the back door. Unfortunately, we didn't have much furniture to put on it. So I decided to build a garden bench.

I had no experience with outdoor furniture, but while visiting with Hank Gilpin I asked him for some advice. Gilpin has been building beautiful outdoor furniture for decades, and he gave me some great tips on design and construction.

The primary challenge of building outdoor seating is striking a harmony between durability and comfort. The first step is choosing the right wood. I used sipo, a tropical wood and cousin to mahogany. It stands up to the outdoors very well and its surface has remained comfortable to the touch after several months outside.

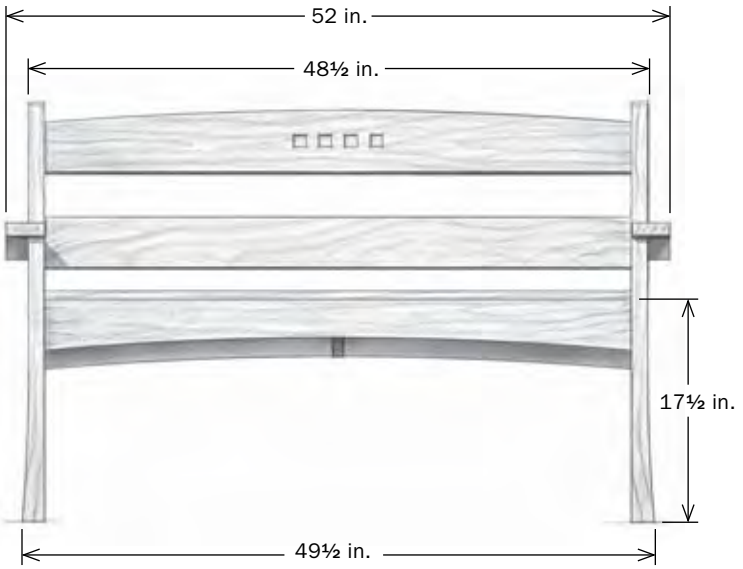
One tip Gilpin gave me was to make the seat slats narrow to reduce the amount of wood movement. I used five narrow seat slats, spaced about ½ in. apart, rather than fewer wider slats. Gilpin also recommended that I design to shed water wherever possible. Toward that end, the seat curves downward from the front, which not only helps water roll off but also is more comfortable than a flat seat. And I set the seat slats on top of the side rails (instead of between them) to expose the slats' end grain so it can dry easily after each rainstorm.

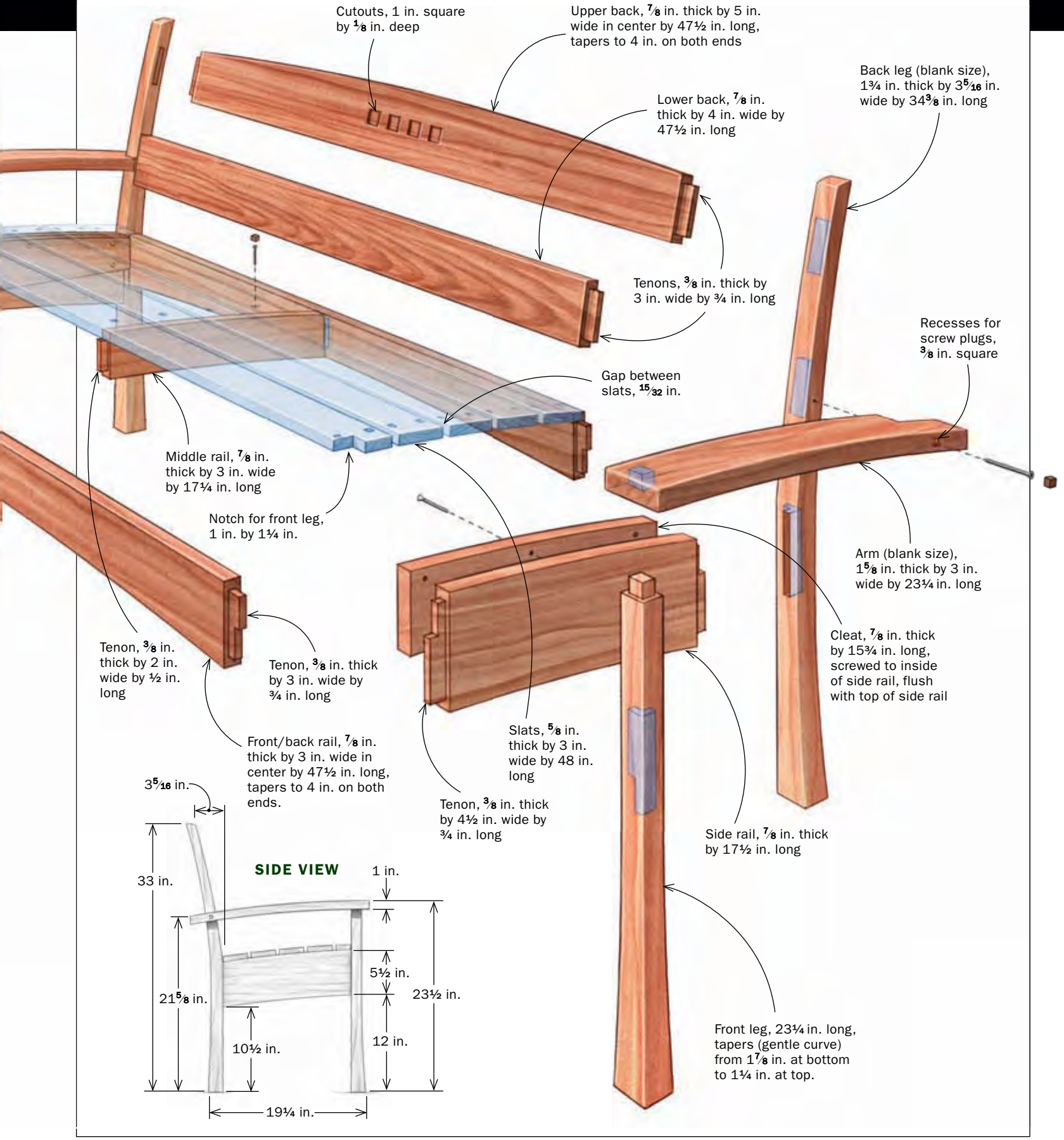
Ceramic-coated decking screws hold the slats to the rails, and I plugged the counterbores with face-grain plugs made from cocobolo. Face grain sheds water better than end grain, and cocobolo is a dense, weather-resistant tropical wood. Gilpin avoids plugs and leaves his screws exposed, but I think my plugs will hold up.

The back is sloped and curved, which adds comfort. Again, a full-size side view will help you work out the angles and curves. The arms are wide enough to serve as a drink rest, but not so wide that expansion and contraction becomes a worry. And water rolls off their downward curve.

Finally, like Gilpin, I used mortise-and-tenon joints, held together by Titebond III, to bring all the parts together (except for the seat slats). It's very important that the joint fits well and that there are no gaps around the shoulders, where water might sneak in and eventually tear apart the joint. And, like my mentor, I chose not to apply a finish.

FRONT VIEW




Cutouts, 1 in. square by 1/8 in. deep
Upper back, 7/8 in. thick by 5 in. wide in center by 47½ in. long, tapers to 4 in. on both ends
Back leg (blank size), 1¾ in. thick by 3 5/16 in. wide by 34 3/8 in. long
Lower back, 7/8 in. thick by 4 in. wide by 47½ in. long
Tenons, 3/8 in. thick by 3 in. wide by ¾ in. long
Recesses for screw plugs, 3/8 in. square
Gap between slats, 15/32 in.
Middle rail, 7/8 in. thick by 3 in. wide by 17¼ in. long
Notch for front leg, 1 in. by 1¼ in.
Arm (blank size), 1 5/8 in. thick by 3 in. wide by 23¼ in. long
Cleat, 7/8 in. thick by 15¾ in. long, screwed to inside of side rail, flush with top of side rail
Tenon, 3/8 in. thick by 2 in. wide by ½ in. long
Tenon, 3/8 in. thick by 3 in. wide by ¾ in. long
Front/back rail, 7/8 in. thick by 3 in. wide in center by 47½ in. long, tapers to 4 in. on both ends.
Slats, 5/8 in. thick by 3 in. wide by 48 in. long
Tenon, 3/8 in. thick by 4½ in. wide by ¾ in. long
Side rail, 7/8 in. thick by 17½ in. long
3 5/16 in.
SIDE VIEW
1 in.
33 in.
5½ in.
23½ in.
21 5/8 in.
10½ in.
12 in.
19¼ in.
Front leg, 23¼ in. long, tapers (gentle curve) from 1 7/8 in. at bottom to 1¼ in. at top.

SEATING

Bench with Asian Flair

Teak and strong joinery guarantee a long life

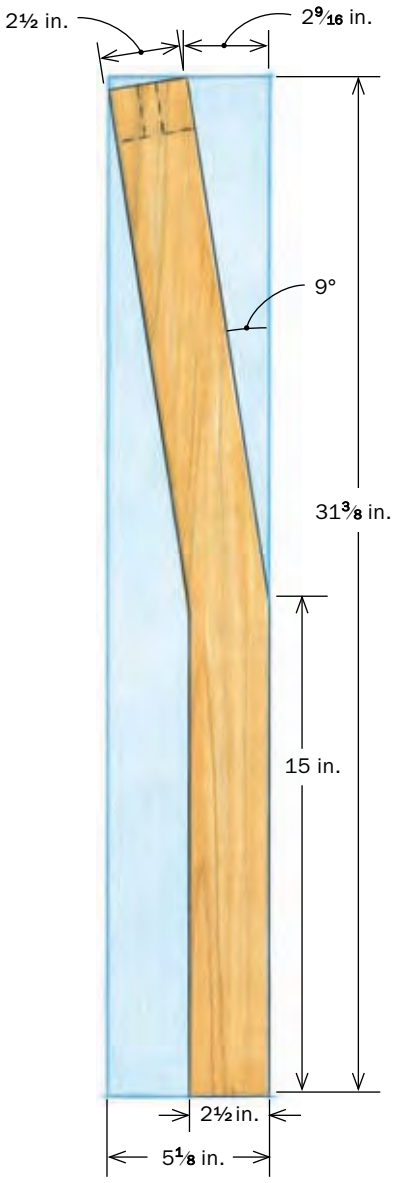
BY RUSSELL JENSEN

A client approached me about a Tudor-style garden bench I had made for the local university. She loved the bench, but wanted something more Asian in style. So, I decided to incorporate a curved back rail and armrests as well as tapered back splats with a cross rail between them. The final design is a blending of Asian aesthetics and traditional Tudor style. The curved top rail, armrests, and tapered splats are very reminiscent of Buddhist temple gates in Japan, while the straight, chunky front legs and angled back legs are strictly Tudor.

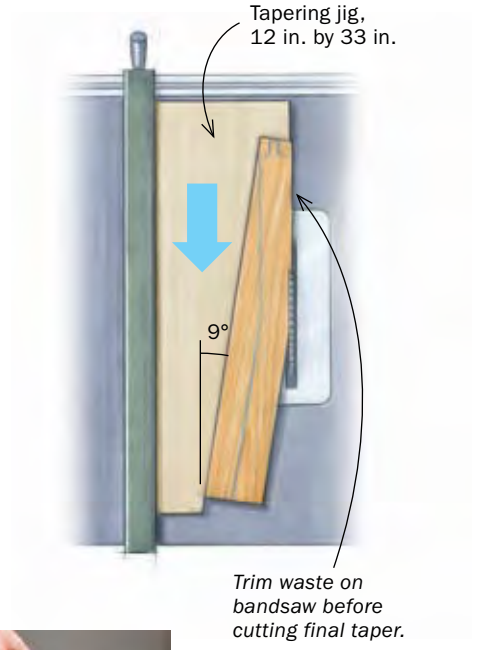
Since this is an outdoor bench, I used teak. Highly weather resistant, teak is my first choice and is worth the expense and extra care it takes to work, but there are less-expensive woods such as Spanish cedar, white oak, ipé, and jatoba that also work well outdoors. This bench is built almost entirely with mortise-and-tenon

Photos, except where noted: Anissa Kapsales; this page: Russell Jensen

SHAPE THE REAR LEGS



Use a tapering jig for the front angle. *After cutting close to the line on the bandsaw (left), make a simple tapering jig to clean up the cut on the tablesaw (below).*



Make stop cuts on the back. *Jensen cuts close to a pencil line, and then turns off the saw before removing the piece and flipping it to cut the other end (left). A quick stop at the spindle sander cleans up the waste that remains (below).*

joints, and because there are so many, you'll need an efficient way to crank them out. I'll demonstrate a simple template-guide jig for the mortises, and time-tested methods for making tenons to fit. Even though teak can be tricky to glue, the combination of mortise-and-tenon joinery and marine epoxy ensures the bench will last.

Choosing and milling the stock

I made the bench out of 1-in.-, 1½ in.-, and 2-in.-thick teak. Start by rough-cutting the lumber a couple of inches longer than you need. All the 2½-in.-thick parts, such as the legs, arms, and curved back rail, are made of 1½-in. stock glued together with West System epoxy. I do this because 3-in.-thick teak is expensive and hard to find, but it is a good idea regardless of the wood. When choosing stock for the rear leg, steer away from using plainsawn stock on the front

of the leg, as this will result in an unattractive, stepped-grain pattern when the angle is cut.

After gluing the legs, arms, and rear rail, allow the epoxy to cure and then mill all the lumber to thickness. Now true up all the edges on the jointer and rip everything to width. To give yourself a little play when cutting out the patterns, leave about ¼ in. extra on the width of the curved pieces and tapered back splats.

Shape the rear legs

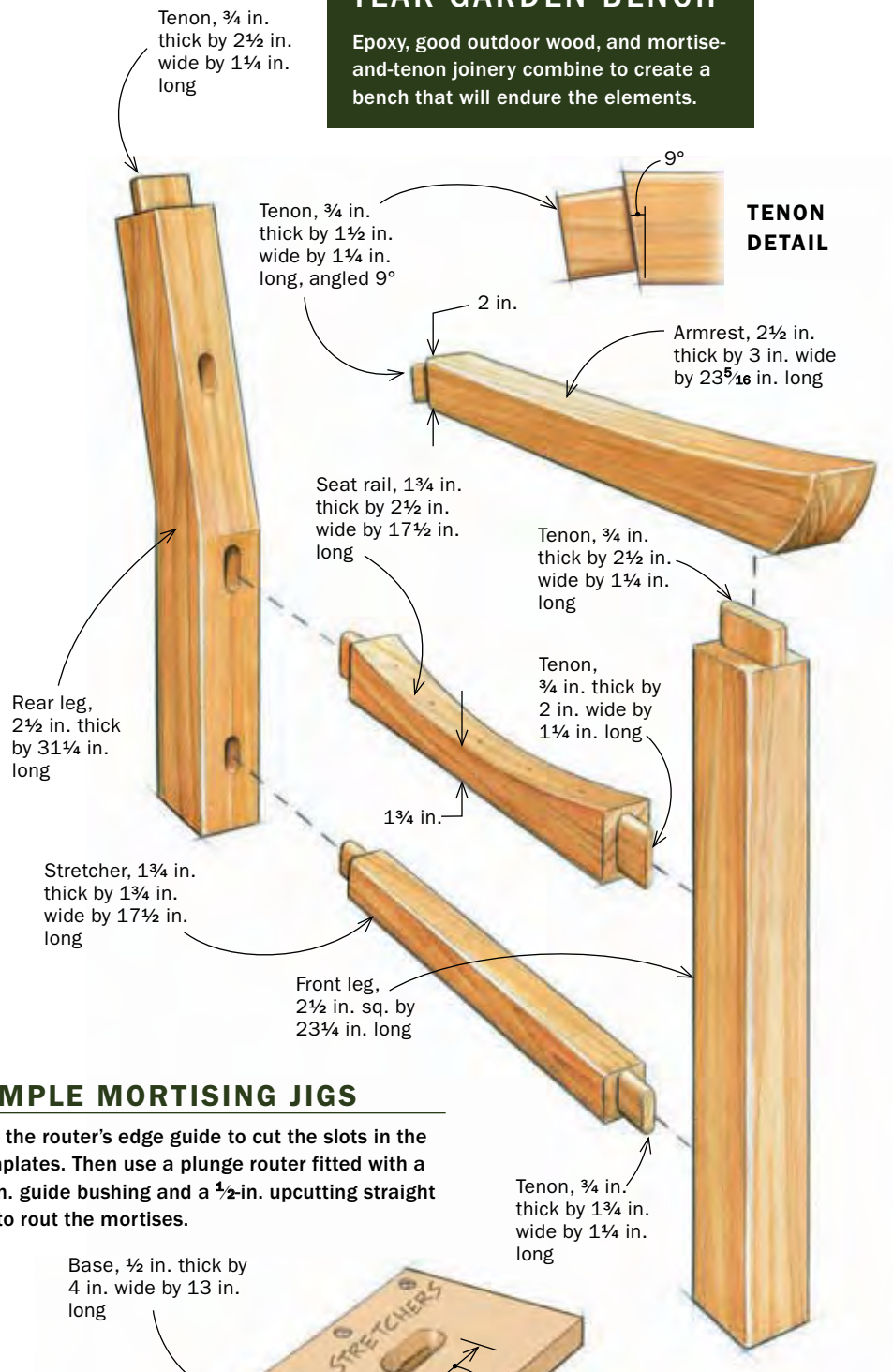
The straight, square front legs are easy to mill and lay out. The rear legs are more of a challenge. First, lay out the shape on the blanks. Then rough out the front angle at the bandsaw, staying 1/16 in. proud of the line. Now use a shopmade tapering jig on the tablesaw (see photo, p. 67) to cut a clean taper. Even though the bandsaw is an extra step, removing most of the waste first makes for a cleaner and, more importantly, safer tablesaw cut. Next, rough out the back of each leg at the bandsaw, followed by a series of stop cuts at the tablesaw to clean up the bandsaw marks and size the leg to 2½ in. The material that is left can be cleaned up with hand tools or at the spindle sander. With the rear legs cut to shape, cut them to length.

Quick, accurate mortises with a router

There are 40 mortises of four different lengths in this bench, but you can simplify the process using two easy-to-make jigs. Most of the

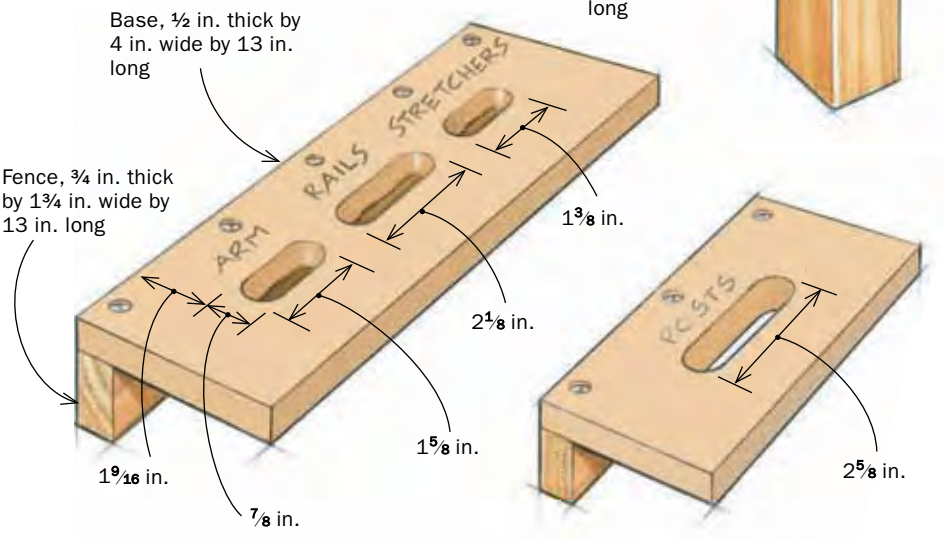
TEAK GARDEN BENCH

Epoxy, good outdoor wood, and mortise-and-tenon joinery combine to create a bench that will endure the elements.

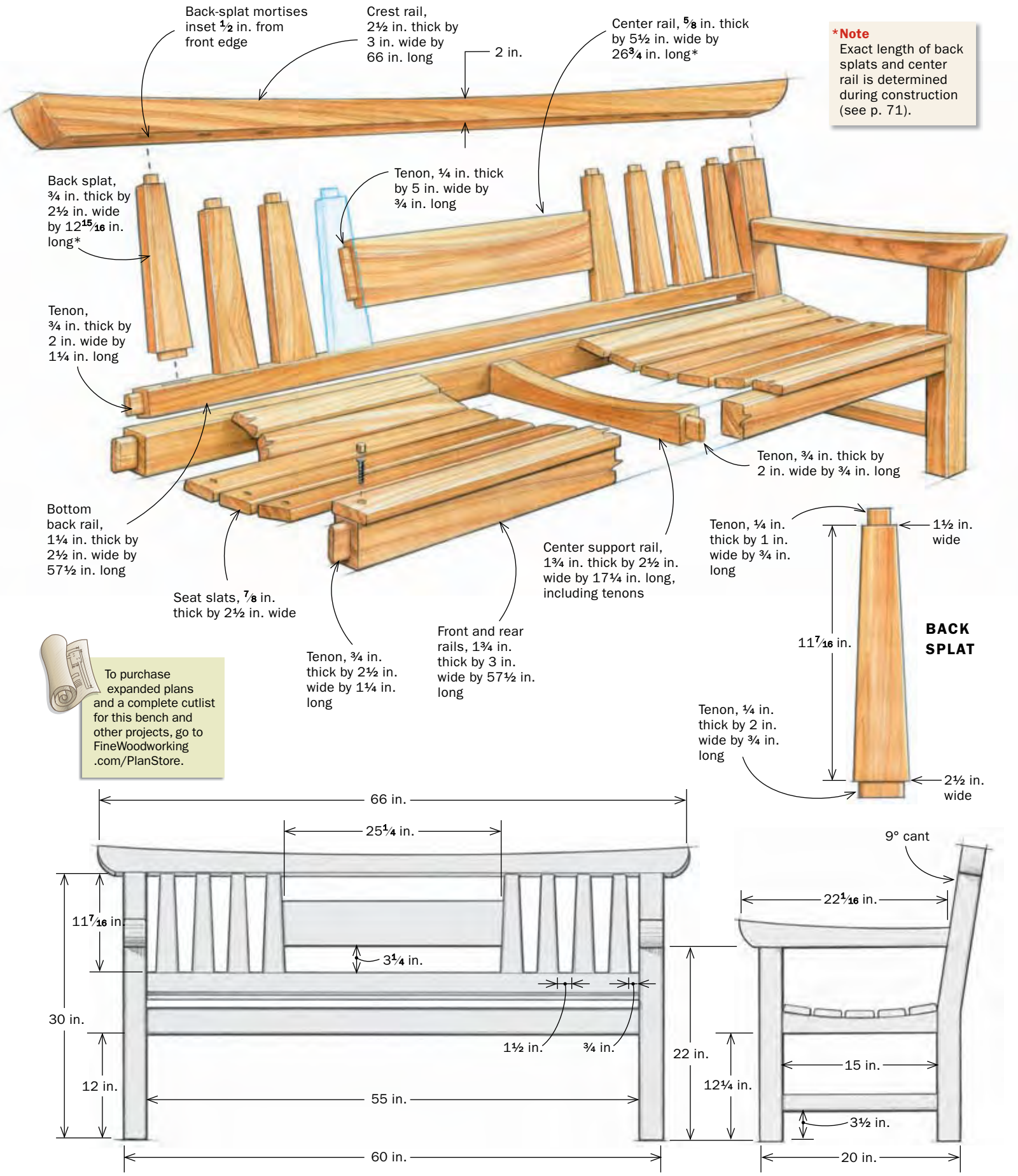


SIMPLE MORTISING JIGS

Use the router's edge guide to cut the slots in the templates. Then use a plunge router fitted with a 5/8-in. guide bushing and a ½-in. upcutting straight bit to rout the mortises.



Drawings: Bob La Pointe



***Note**
Exact length of back splats and center rail is determined during construction (see p. 71).

To purchase expanded plans and a complete cutlist for this bench and other projects, go to FineWoodworking.com/PlanStore.

CUT ANGLED TENONS ON THE ARMRESTS

Cut stock to size. *Use a miter saw to cut the blank to size with a 9° angle at the tenoned end.*

Cut the shoulders and cheeks. *Place the angled end against the rip fence to set the miter-gauge angle and cut the shoulders. Then cut the cheeks using a tenoning jig, keeping the end flat against the tabletop.*

Move to the bandsaw. *Once you've cut the cheeks and shoulders, use the bandsaw to make the angled cuts at the top and bottom of the tenons and a handsaw to trim the remaining material.*

MORTISE, THEN SHAPE THE CREST RAIL

Mortise for the back splats. *A plunge router equipped with a guide fence makes cutting these mortises a snap (above). To lay out a graceful curve on the top edge (right), Jensen puts a clamp on each end, rests a strip of MDF against the clamps, and pulls the strip back, clamping it in place at the center.*

mortises are ¾ in. thick, located where the legs meet the arms and where the legs meet the stretchers. I use jigs for these.

Sixteen smaller mortises join the back splats to the top and bottom stretchers that make up the back assembly. I make these by carefully laying them out and then outfitting my plunge router with an edge guide.

Once you have marked the mortises on all four legs, use a router equipped with a template guide and a jig. Each jig is ½-in. MDF with a hardwood fence screwed to it, and a corresponding slot routed in the MDF for each different-size mortise (see drawing, p. 69). To make the jigs, mark the MDF and plunge the router in and along using the router's guide fence. Because I use a ½-in. upcutting spiral bit and a ⅝-in. template guide to make the ¾-in. mortises, my template holes have to be ⅛ in. longer and wider than the actual mortise. Making accurate jigs is essential to creating perfectly centered mortises, so testing them on a piece of scrap is always a good idea.

Rounded tenons for routed mortises

For the tenons, start by making the shoulder cuts on the tablesaw. Clamp a short stop block to the rip fence, and set the tenon length from the stop block to the far side of the blade. The block keeps the piece away from the fence as you make the cut and prevents a dangerous binding or a crooked cut. After adjusting the blade height, make all the shoulder cuts, then use a shopmade tenoning jig to make the cheek cuts. I cut the tenons to height on the bandsaw and complete the top and bottom shoulder cuts with a handsaw, cleaning up any roughness left from the handsaw cuts with a sharp chisel.

When making the back shoulder cut on the top of the rear leg, elevate the leg with a ¾-in. shim so the lower, angled part of the leg doesn't interfere with the cut.

To fit the tenons in rounded mortises, make four small chisel incisions where the shoulder meets the corners of the tenon, and round over the corners with a rasp.

Angled armrests are a fun challenge

Making the armrests is tricky, due to the angled tenon that fits into the rear leg mortise. First, set a miter saw at 9° and cut off

MAKE THE SPLATS

Real-world measurement. *Dry-fitting makes it easy to measure the exact shoulder-to-shoulder dimensions of the back splats.*

Taper the back splats after cutting the tenons. *Use two jigs to create the tapered back splats. The first holds the square splat and the second (shown) holds the splat that has one side already tapered.*

the end of the blank where the tenon ends. Then move to the tablesaw. Instead of relying on the angle gauge, use the angle on the end of the arm blank, resting it against the stop block and angling the miter fence to meet it. Then cut the shoulder on both arms, adjust the miter gauge to the other side of 9°, and cut the other shoulder. Next, bring the arms to the tenoning jig, lay the 9° angle flat on the table, clamp it into the jig, and cut the tenons. Again, lay out the width of the tenon and cut it freehand on the bandsaw. Then remove the waste with a handsaw and round the edges with a rasp.

Curved pieces create an Asian feel

Now you are ready to cut the curves for the armrests and crest rail. Again, careful layout is the key. With a pencil, draw the shape directly on the stock. Create the radius at the ends with a compass. For the long curves, I simply bend a thin piece of MDF, held back by clamps, and trace the line. Step back and look at the lines, redrawing them until they look good.

Once I have settled on the shape, I cut it close to the line on the bandsaw, and then finish at the spindle sander or with a sanding drum on the drill press. If you are unhappy with the smoothness of the curve after using the spindle sander, some aggressive sandpaper, a slightly curved sanding block, and good old-fashioned elbow grease will smooth out the curve nicely. When I have to make two identical parts, like the armrests, I work one at a time, using the first piece as a pattern for the second. I do this because the stock is thick. Ganged together, it measures 5 in., and I can only sand up to 4 in. with my spindle sander.

Mark the center rail. *Add the tapered back splats to the dry-fit assembly, and clamp the center rail in position so you can mark its tenon shoulders.*

Use two jigs to taper the back splats

I dry-fit and clamp the whole bench except for the armrests. Doing this allows me to measure for the back splats. I can determine their exact length from shoulder to shoulder, cut the tenons while the pieces are still square, and then create the taper. After I've accurately measured the size of the back splats, I make the tenons using the same method used previously.

The center rail is joined to the two center splats with a mortise and tenon. It is easier to cut the mortises in the two center splats before proceeding with the tapers. This

GLUE UP IN STAGES

Start with the ends. *After cleaning the joints with acetone (teak's oily properties make this a necessity), Jensen glues and clamps the two end sections (above). The easiest way to glue and assemble the bottom rail, the seat rail subassembly, and the two ends is on end (right). Then tip the bench upright and clamp.*

is accomplished the same way as the other mortises for the back splats. Lay out the position of the mortises on the two center splats, use double-sided tape to attach the piece to a larger block of wood (to safely balance the router), and cut the mortises. Once the mortises are complete, cut the tapers in the splats using tapering jigs. Keep a couple of the cutoffs from the tapering process to help out when gluing the center rail to the two splats.

Join the center rail to the back splats

Even though teak is very stable, I still like to make the center rail from a quartersawn piece that has the grain running as perpendicular to the face as possible. This offers a clean look and also minimizes expansion and contraction of the tenon.

Once you've added the tapered back splats to the dry-fitted bench, mark where the bottom of the center rail will intersect with the two back splats. Align the two lines to the bottom of the center rail, clamp it to the splats, and trace out the two inside angles with a very sharp pencil. Transfer that same angle about 1/16 in. past where the tenon will end and cut off that angle at the miter saw. Now you can proceed to make the shoulder cuts and tenons the same way as on the angled tenon of the armrest. Cut the tenons to final length after they are made.

Support rail eliminates flex in seat

Because the bench has a span of almost 5 ft., it is essential to mount a support rail to stop excessive flex under the seat slats. The center support rail is essentially the same as the two end rails, but is 3/4 in. longer because it goes directly from the front rail to the back rail, rather than front leg to back leg as the end rails do.

For the mortises, refit the jig used for the end support rails. Unscrew the wooden fence on the side of the jig and then calculate where it needs to be attached above the guide hole. Find the center on the insides of the front and back rails of the bench, clamp the jig down, and rout the mortises. After you have made the tenons on the blank, find the center on it and one of the end support rails. Put them together, lining up the center marks, and transfer the curve onto the center rail. You can

Glue the center rail to the center back splats. *Jensen uses the cutoff pieces from the tapering process to create a square clamping surface (above). The tapered back splats, center rail, and crest rail complete the glue-up (right).*

then proceed to cut out the curve at the bandsaw, and take it down to the line at the spindle sander.

While the bench is still clamped, predrill and counterbore for the seat slats. This will be almost impossible after the armrests are glued in place.

Before gluing up the bench, I put a ¼-in.-radius roundover on all the exposed edges, being careful not to rout past the points where one piece joins another (I mark these transitions during the dry-fit). Rough transitions can be cleaned up with hand tools after glue-up.

Glue the bench in sections

I use slow-curing West System epoxy to glue the bench together. Its 50- to 60-minute open time eliminates drama in the workshop. I recommend breaking the glue-up into a few sessions.

Glue up the two ends first. Since some of the mortises intersect, it's important to lay down the assembly so that no epoxy gets into the adjoining mortises.

The next step is to glue the two long seat rails and the lower back rail into the two end pieces. This step requires three 6-ft.-long clamps.

Now, to prepare for the final assembly, glue the center rail to the two center splats. You can use the two cutoff pieces saved from the tapering process on the outside tapers to provide a square surface to clamp. Glue the center support rail to the front and back seat rails. After this has dried for 24 hours, clean up any squeeze-out with a sharp chisel. The final gluing is to join the tapered back splats and the curved top rail. This is where the slow-cure epoxy really comes in handy.

Now you can screw the seat slats into place with 1½-in. stainless-steel screws and use a tapered plug cutter to make plugs for the counterbored holes. Glue the plugs into place and let them dry before cutting them flush to the seat slats.

Teak is a fascinating wood. Incredibly durable, it can survive outdoors untreated for decades. In fact, left unfinished it becomes more beautiful as it ages. Because of this, I leave the bench as is, except for "painting" the bottoms of the legs with epoxy to ensure that no water wicks into the end grain. □

Russell Jensen is a furniture maker in Sudbury, Ont., Canada.

Plug the screw holes. *After screwing the seat slats down, glue in plugs, then cut them flush.*

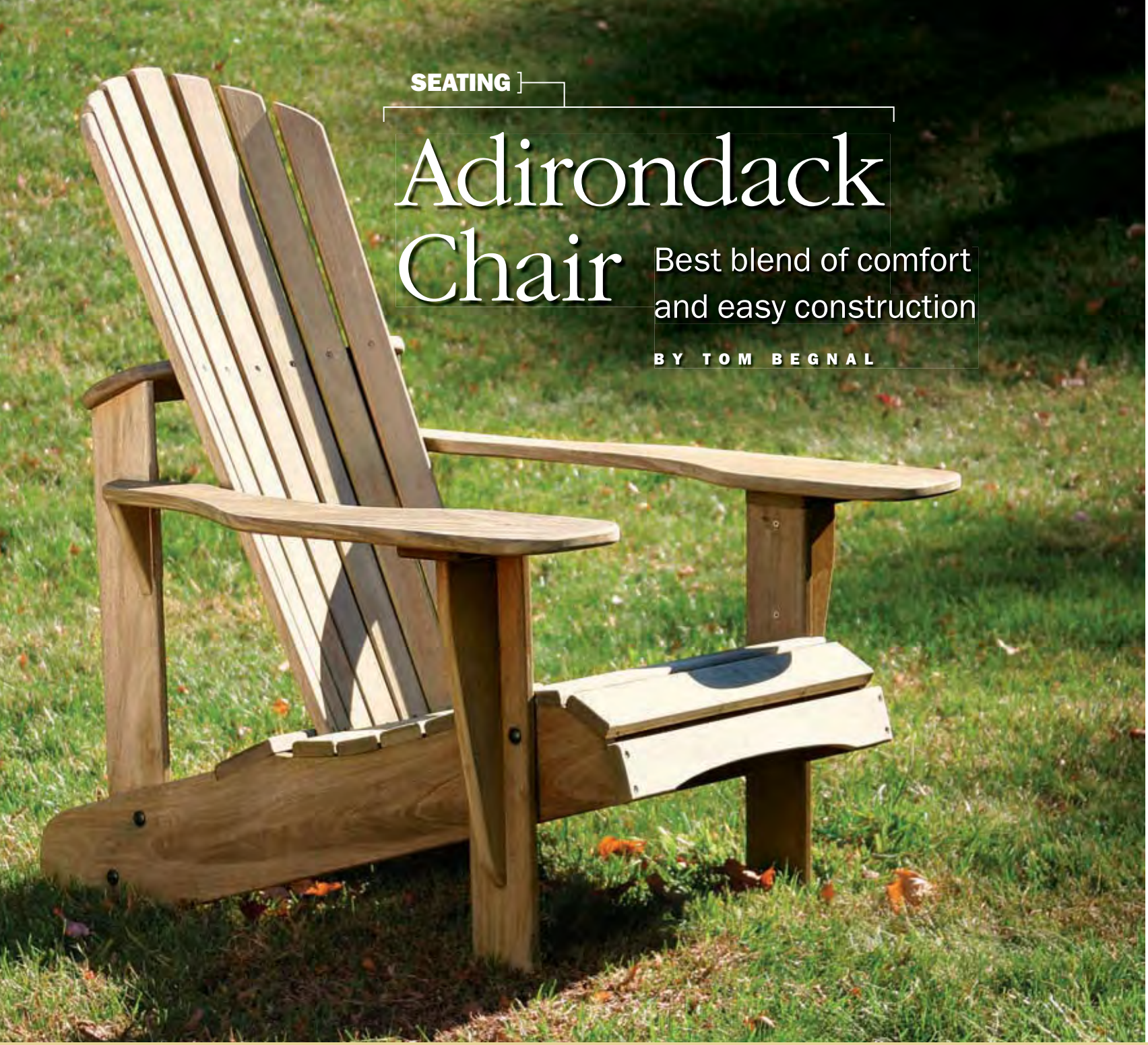
Seal the legs. *Seal the bottoms of the legs by coating them with the same epoxy used in the glue-up.*

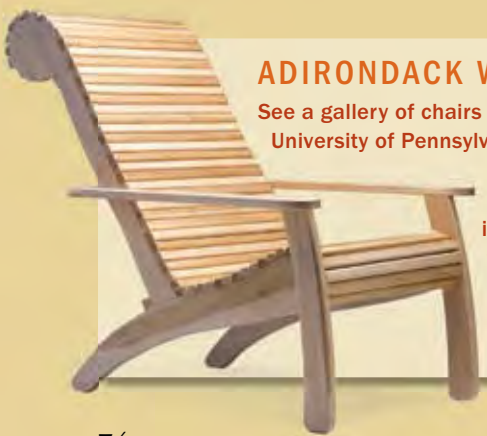
SEATING

Adirondack Chair

Best blend of comfort and easy construction

BY TOM BEGNAL





ADIRONDACK WITH A TWIST

See a gallery of chairs (pp. 82–83) from Indiana University of Pennsylvania's design competition. Chairmakers were invited to develop their own interpretations, using the basic concept of this classic chair as a point of departure.

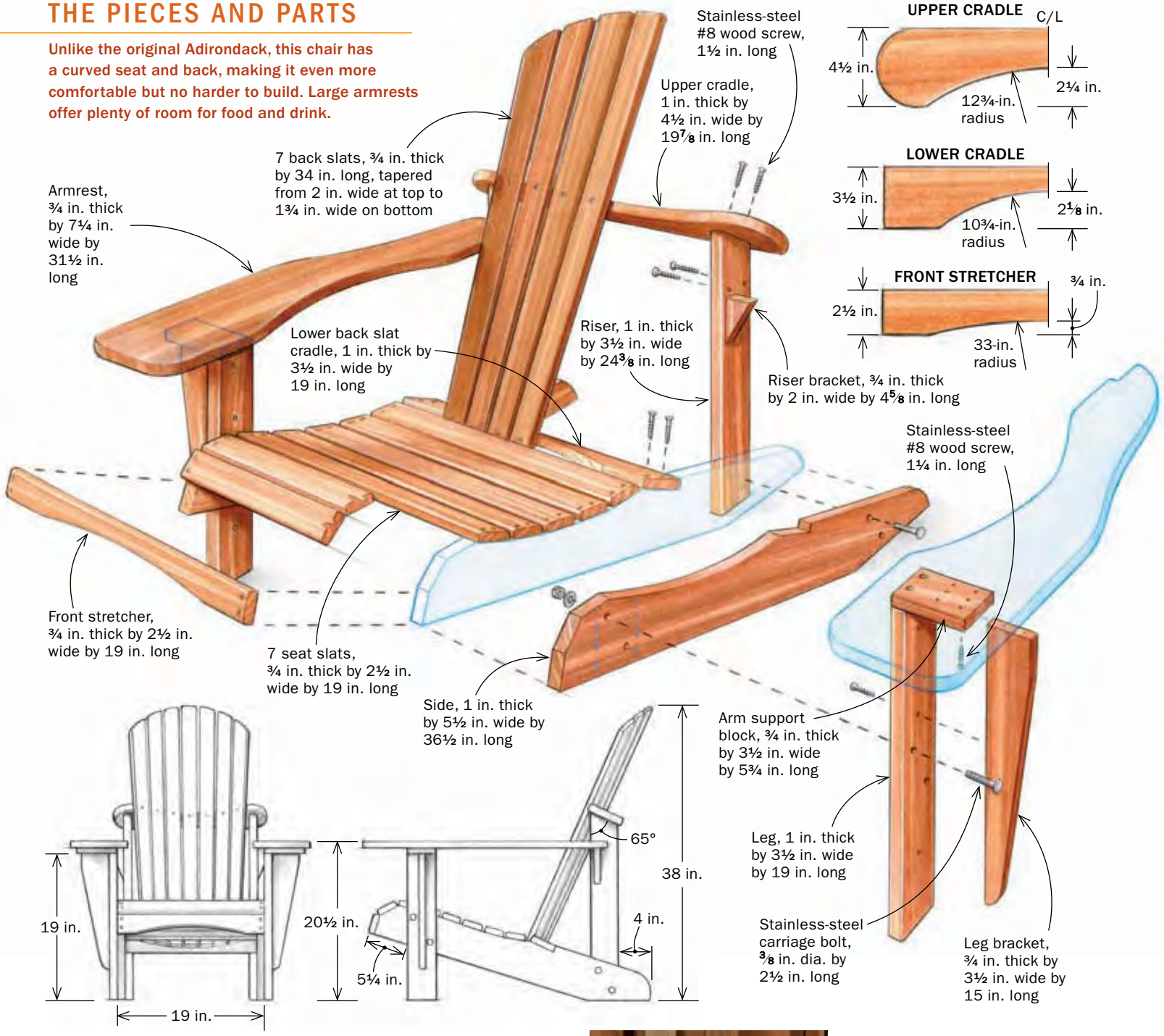
This quintessentially American outdoor chair was born in the early 1900s in the Adirondack mountain region of New York state. The generous slant of the seat and back make it an inviting place to relax outdoors. And for those who like to graze while relaxing, armrests the size of small tables offer plenty of room for a plate of snacks and a favorite beverage.

Unlike the original, our chair has a curved seat and back, making it a place where you won't mind spending a lot of downtime. It is made from western red cedar, a weather-resistant, lightweight wood available at most lumberyards. Cypress, mahogany, and redwood also are lightweight and enjoy the outdoors. Ipé and

Photos, this page: Michael Pekovich (top); Roy Engelbrecht (bottom left)

THE PIECES AND PARTS

Unlike the original Adirondack, this chair has a curved seat and back, making it even more comfortable but no harder to build. Large armrests offer plenty of room for food and drink.



teak are at home outdoors, too, but expect a chair made from either to be a muscle-strainer.

Most of the parts are made from presurfaced "1-by" stock, but for the parts that carry extra load—sides, legs, risers, and cradles—I used 5/4 presurfaced stock. Much like a 2x4, the actual dimensions end up slightly less. That said, if you use teak, ipé, or any other hardwood, you can build the entire chair from 1-by boards.

Begin with the sides

The sides are the foundation of the framework. Cut a full-size pattern, then transfer it to the stock, and cut out the shape with a

TIP

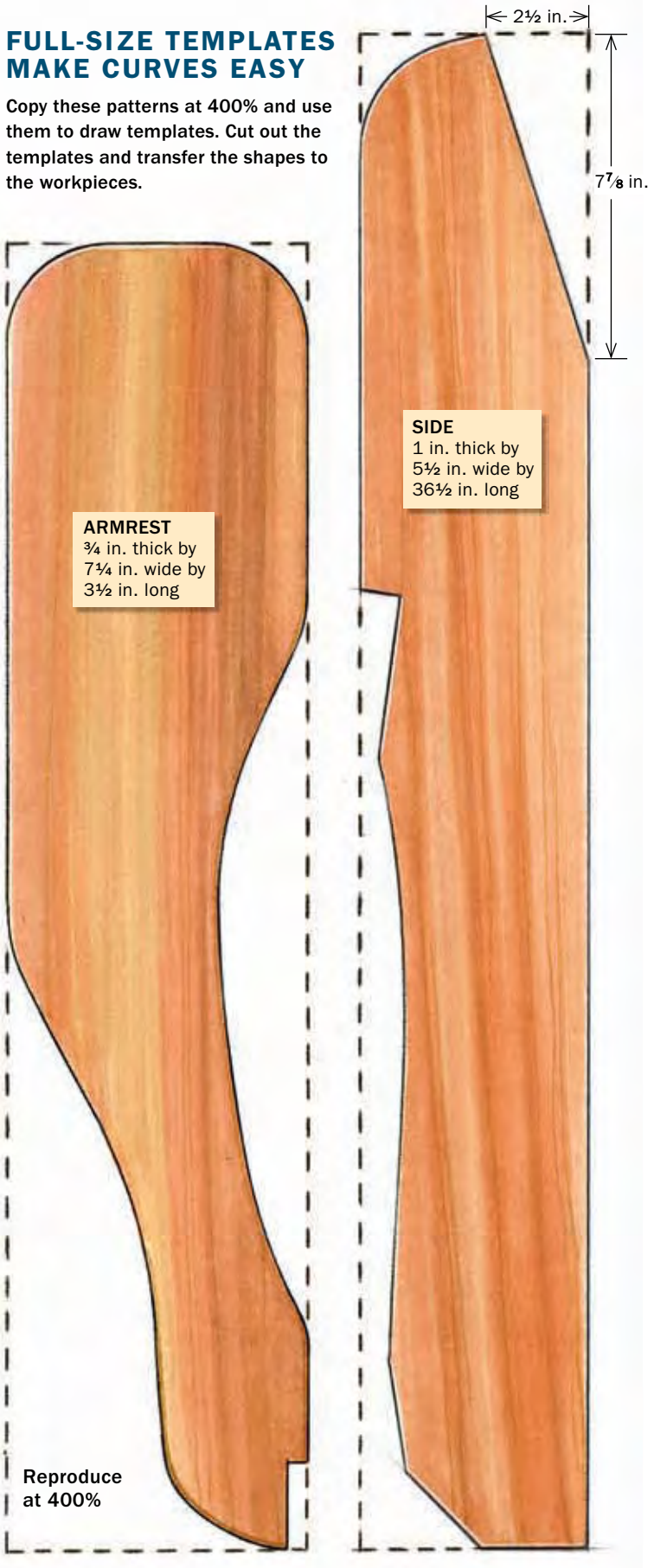
MAKE A JUMBO COMPASS

The compass is a thin strip of wood about 36 in. long. Measure 1 in. from the end, and drill a hole to accept a nail. Create a pivot point by driving the nail through the strip and into a square block of ¾-in.-thick stock. The location of the pencil hole will vary depending on the radius of the arc.

BEGIN WITH THE SIDE PIECES

FULL-SIZE TEMPLATES MAKE CURVES EASY

Copy these patterns at 400% and use them to draw templates. Cut out the templates and transfer the shapes to the workpieces.



Trace the shape. *Use a thick-paper template to outline the side shape on stock.*

Tape sides together. *Begnal uses double-sided tape to hold the boards together as he cuts them.*

Keep the parts taped together. *A file, followed with sandpaper, is a good way to smooth the edges of inside or outside curves. Start sanding with coarse paper, say P80-grit, working up to P150-grit.*

jigsaw (or bandsaw, if you have one). Smooth the sawblade marks on the edges of the sides with a plane, scraper, or sanding block.

Cut seat slats, stretcher, and lower back-slat cradle

Cut the seat slats to size before moving on to the front stretcher. To lay out the curve along the bottom edge of the stretcher, make a jumbo compass (see tip, p. 75) Measure 33 in. from the compass pivot point and drill a ⅛-in.-dia. hole to accept a pencil point.

Before scribing the curve, add reference points to the stretcher. At a point ¾ in. from the front edge, draw a line across the length of the piece. On that line, mark the center point. Now, place the stretcher on a workbench. Align the pivot point of the compass with the centerline on the stretcher, positioning the pencil on the center point. Use the compass to scribe the arc across the stretcher, use a jigsaw or bandsaw to cut it out, then smooth the sawn edges.

Again, turn to the jumbo compass to scribe the curved front edge of the lower cradle. Relocate the pencil hole to create a 10¾-in. radius. At a point 2⅛ in. from the front edge of the cradle, draw a reference line across the length of the piece. Then, mark the

Photos, except where noted: Anissa Kapsales; drawings: Bob La Pointe

TAPER AND SHAPE THE BACK SLATS

Just saw and smooth. *The back slats taper ⅛ in. on each edge, but you can cut the whole ¼ in. of taper on one edge. Lay out the taper and then cut it with a jigsaw (above) or bandsaw. Then smooth away the saw marks using a block plane (right) or sanding block.*

end-to-end center point on the line and cut the curve with a jigsaw or bandsaw. After that, smooth, sand, and round over the edges.

Move on to the leg assemblies, then the back

Each of the two leg assemblies is made up of a leg, a leg bracket, and an arm-support block. With the parts disassembled, drill all the shank holes in the legs and support block. Use a jigsaw or bandsaw to cut the taper on the bracket, and then smooth with a smoothing plane. Now, sand all the leg parts and round over the edges. But do not round edges where parts meet. Screw one block to the top of each leg. For each leg assembly, screw a bracket to the underside of a block and outside of a leg.

The back assembly is made up of two parts: a pair of vertical risers and a pair of riser brackets. Once the parts are cut, rounded, and smoothed, screw them together. To locate the proper position for the riser brackets, place a leg assembly on the riser with both bottom ends flush, then use the arm-support block as a straightedge to scribe a line across the riser. Position the bracket so that its face is flush with the front edge of the riser and its top edge is at the marked line. Secure each bracket in place by driving three screws through the inside face of the riser and into the bracket.

Make the upper cradle

To create the curved front edge, use the jumbo compass again. This time, though, locate the pencil hole 12¾ in. from the nail hole. Again, add a reference point to the cradle. Draw a line 2¼ in. from the front edge of the cradle, and then mark the end-to-end center point on the line. Use the compass to scribe the arc.

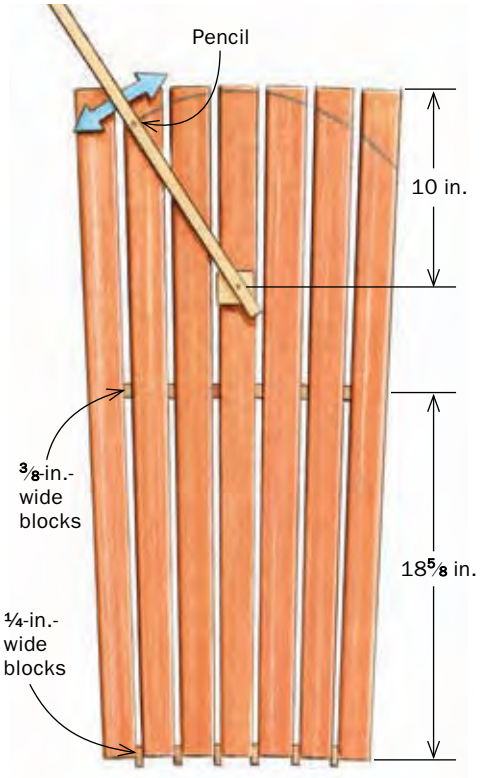
The end curves are next. I experimented with several shapes on the end of a 4½-in.-wide piece of cardboard. When I hit on one that looked good, I cut out the curve and used the cardboard to trace the shape on each end of the cradle. Use a jigsaw or bandsaw to cut them out, and then smooth the sawn edges.

Cut out the arms

The arms are the focal point of the chair. Enlarge the drawing on the opposite page to trace a full-size pattern on stiff paper or

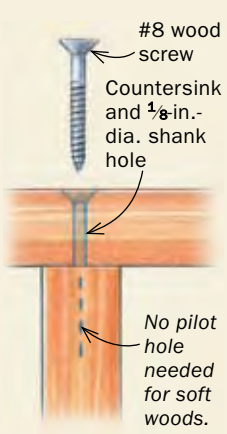
SCRIBE AN ARC ON THE BACK SLATS

Use the tip on p. 75 to create a jumbo compass. After that, measure 10 in. from the nail hole and drill a ⅛-in.-dia. hole—a size just big enough to accept a pencil point.



Mark the arc. *A clamp and some light pressure keep the back slats and spacers from shifting while Begnal uses the jumbo compass.*

ASSEMBLE THE BASE



SCREW DETAIL

Make a subassembly. *Screw the stretcher to the front and follow with the lower cradle.*

Add one leg assembly at a time. *Use a spring clamp to temporarily clamp each one to a side piece, then square it to the work surface.*

Secure the leg assemblies. *Once the leg assemblies are in place, drill ⅜-in.-dia. holes through the sides and legs and add bolts, nuts, and washers.*

Online Extra

Tom Begnal walks through the complete assembly process at **FineWoodworking.com/outdoorprojects.**

cardboard. Cut out the pattern and use it as a template to trace the shape on each length of stock. Then use a jigsaw or bandsaw to cut out both arms at the same time. Smooth the edges, round them over, and sand through P150-grit.

Taper the back slats

There are a number of ways to taper the seven back slats, including a tapering jig on the tablesaw or bandsaw, but the simplest way is just to lay out the taper in pencil and make the long cut with a jigsaw. Then just sand the edge to remove saw marks.

When the tapered slats are done, you can trace the top curve on all seven of them. Start by placing them edge to edge with a pair of spacers between each. Redrill the pencil hole on the jumbo compass 10 in. from the nail. Position the pivot point 10 in. from the top end of the slats and centered on the middle slat. Scribe the arc across all the slats. Cut out the curved ends with a jigsaw or bandsaw. Sand each sawn edge and sand the faces through P150-grit before rounding the edges.

Now you're ready to trace the top curve on the back slats. Start by placing all the back slats edge to edge with a pair of spacers between each. Redrill the pencil hole on the jumbo compass

Attach the upper cradle. *Use a temporary spacer board to ensure that the risers stay parallel when the upper cradle is attached.*

ADD THE ARMS AND SLATS

Add the arms. *Drive the riser screws (at the back) first to be sure the arm notch fits snugly around the riser. Begnal conceals the screws by driving them in from the inside of the riser and the underside of the support block.*

Position the back slats. *Start with the center slat, then the two end slats, and work your way in. The slats must be aligned at the bottom of the lower cradle, with even spacing between them.*

Layout trick. *Place the chair on its back and use spring clamps to level it. This will allow you to rest the slats on the cradles and adjust positioning without slippage.*

10 in. from the nail. Position the pivot point 10 in. from the top end of the slats and centered on the middle slat. Scribe the arc across all the slats.

Cut out the curved ends with a jigsaw or bandsaw. Sand or scrape each sawn edge and sand the faces through P150-grit before rounding the edges.

Assemble all the parts

You are ready to start putting the chair together. Stainless-steel screws (countersunk) and carriage bolts eliminate the need for glue. Start the assembly by screwing the stretcher to the front end of each side piece. With the stretcher mounted, add the lower back-slat cradle to give some rigidity to the subassembly.

Now, on each side piece, mark a line 5¼ in. from the front face of the stretcher. Elevate the stretcher until the back ends are flat on the work surface. Then place a leg against the side piece, and use a square to make sure it is square to the work surface and on your mark. Add a clamp to make sure it won't inadvertently shift out of position as you drill a pair of ⅜-in.-dia. holes through the legs and sides. Bolt the leg in place, then attach the other leg.

With the legs safely at first base, the back assembly is now at bat. At a point 4 in. from the back end of the side, clamp a riser to a side piece. Check for square with the work surface, then drill the holes and add the bolts. Follow the same procedure for the second riser.

The upper cradle is next. Position the cradle so that its back edge is set back ¼ in. from the back edges of the risers. Measure and drill for a pair of shank holes at each end of the upper cradle.

After you attach the upper cradle, add the arms, as it becomes a chore to attach them once the back slats are in place. Position each arm so that the notch fits around the riser, and screw through the riser and arm-support block.

The back slats are attached to the lower and upper cradles. I attach the center slat first, then move to the two outside slats and work inward. Before drilling the shank holes, it is important to align them from left to right, up and down, and keep the spacing even to maintain a nice curve on the bottom and the top.

Seat slats are the final step. *The seven slats are attached at each end. The ⅜-in. spacers between each slat make placement a snap.*

Give the entire project a quick once-over with P150-grit sandpaper, and break any sharp edges. You can leave the chair unfinished and let it weather naturally. Or, three coats of spar varnish provide a finish that will hold up well in an outdoor environment. A fresh coat every couple of years should keep the chair happy and fit for decades to come. □

Tom Begnal is a woodworker in Kent, Conn.

Reinventing the Adirondack

7 designers bring the classic form into the 21st century

First designed over a century ago, the Adirondack chair is a casual outdoor stalwart. But that doesn't mean it's a perfect design. Adirondack chairs can be uncomfortable and difficult to get in and out of. And the chair is so common in American yards that it has become a bit, well, boring. It's still an icon of American design, but there's definitely room for improvement. The seven designers featured in this article all took up the challenge of redesigning the venerable classic.

A maker of indoor chairs for 40 years, Robert Erickson knew that he would rethink structure, comfort, and color to create an Adirondack chair with the comfort and beauty of his indoor chairs. He also set the goal of making a chair that could face the weather with impunity. After experimenting with two designs, Erickson settled on a design that blended features of both.

Online Extra

To see an audio slide show of the wide range of superb chairs Erickson has made in his four-decade career, go to at **FineWoodworking.com/outdoorprojects.**

The other six redesigns in this article were made for an exhibition exploring the Adirondack chair. The chairs vary from subtle (adding curves to the legs and arms) to radical recastings (Adirondack as rocker).

Photo, this page: Robert Erickson

ROBERT ERICKSON

To improve its weatherproofing, Erickson made his chair entirely knock-down, so the parts could be coated with marine paint before assembly and disassembled and repainted down the road. For comfort, he left off the low stretcher that adds racking resistance but stops you from tucking your feet under the front of the classic version. To restore the chair's rigidity, he added a welded steel bracket under the seat.

Wood is rot-resistant European elm, quartersawn and knot-free.

Back planks are bent-laminated to lumbar curve from four plies of solid elm using waterproof Titebond III glue.

Epoxy primer

Marine paint

Where hands rest, flat-head brass wood screws and Lee Valley countersunk washers lie flush to the surface.

Custom-welded steel bracket, attached with stainless-steel bolts, adds strength and racking resistance. Bracket is powder-coated to prevent rust.

Brass connector plate

Figure-eight fasteners, weatherproofed with gun-bluing and lacquer

Wooden brace could be substituted for steel bracket to provide racking resistance.

Seat slats follow the shallow S-curves of the back leg's top edge.

All visible screws and washers are bronze or brass.

Adjustable leveling glide

Seat slats attached with round-head brass wood screws with washers.

Shopmade brass connector plate, ⅛ in. thick

Teflon glide

All joints are screwed or bolted butt joints, so the chair can be assembled after painting—and disassembled for repainting.

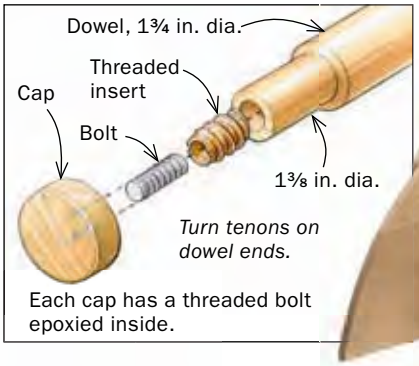
Photo, this page: Sugar Pine Studios; drawing: John Tetreault

Other inventive designs

These chairs are a sampling from Indiana University of Pennsylvania's second exhibition on the Adirondack theme. Professor Christopher Weiland and director Steve Loar invited students and alumni from recognized furniture and design programs, challenging them to explore and redesign the century-old Adirondack chair. These are design exercises, so feel free to vary materials or joinery for outdoor use.

NICOLE TARTONI *Indiana University of Pennsylvania (IUP)*

This version borrows its inspiration from a sundial. To allow the chair to recline and break down, Tartoni incorporated hand-turned, threaded dowels into the design, construction, and function. Upright, the chair stands nearly 41 in. tall. Fully reclined, it is 47 in. deep and 30 in. wide.



ANTHONY McCARTY, IAN ELDRIDGE, AND SAMANTHA SARHADI *Purchase College, State University of New York*

While the construction of this chair is traditional, the design is not. Adirondacks can be hard to exit, and the backs aren't always comfortable. So the makers removed an arm, allowing for easy exit and a wider variety of body positions. This left the chair visually asymmetrical, so they varied the angle and size of the back slats. The chair is 33 in. deep by 30 in. wide by 40 in. tall.

RON MORETTI *IUP*

Moretti likes the traditional version, but felt it could be streamlined and softened. His chair has more curves and is tapered nearly 6 in. to the back. The seat slats must follow the taper. Unlike the typical Adirondack chair, which has the seat slats resting directly across the side supports, Moretti used a bracket to recess the slats slightly. The chair (40 in. deep by 24 in. wide by 41 in. tall) breaks down to four pieces.

Photos, these two pages: Roy Engelbrecht

MARK WEABER ***Lehigh University***

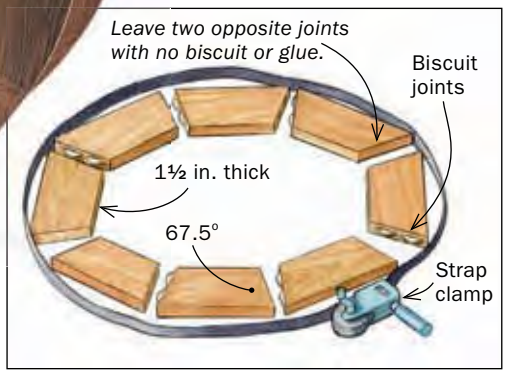
At the time the call for entries was announced, Weaber was studying ergonomics in design. The thin slats allowed a more ergonomic profile than the traditional chair. He curved the front slats down and around to avoid sharp edges. For a smoother front surface, he glued the back and seat slats to the framework and reinforced them with a cleat and screws from the back. The joint between the back post and back legs is a half-lap, pared by hand for a gap-free shoulder. The chair is 40 in. deep by 25 in. wide by 41 in. tall.

ISAAC HILLSON ***IUP***

Hillson's chair (29 in. deep by 22 in. wide by 32 in. tall) merges two typical outdoor images, the wheelbarrow and the Adirondack chair. The wheel turns on a dowel, which is glued into larger dowels at both ends to keep the wheel in place. The seat supports run from the front to the back at an angle, where they fit over the larger dowels.

MATHEW NAUMAN ***IUP***

Nauman's chair merges the Adirondack with a rocker. Nauman created the rockers as one large circle, then broke the circle into halves. He began with eight biscuited segments. The resulting octagon was glued and clamped, and the two halves were rough cut to a circle on the bandsaw and then finish-routed using a template. For strength, Nauman inserted ¼-in. dowels to support the biscuit joint. The chair is 32 in. deep by 24 in. wide by 36 in. tall.



Red Cedar Table

Photos: Doug Stowe; drawings: Bob La Pointe

Simple construction with a few basic tools

BY DOUG STOWE

Western cedar is one of the few inexpensive roughsawn woods available from typical neighborhood lumberyards. It also is a fantastic wood for outdoor furniture, because it resists the elements very well. So, it's a great choice for rustic furniture meant to live outside.

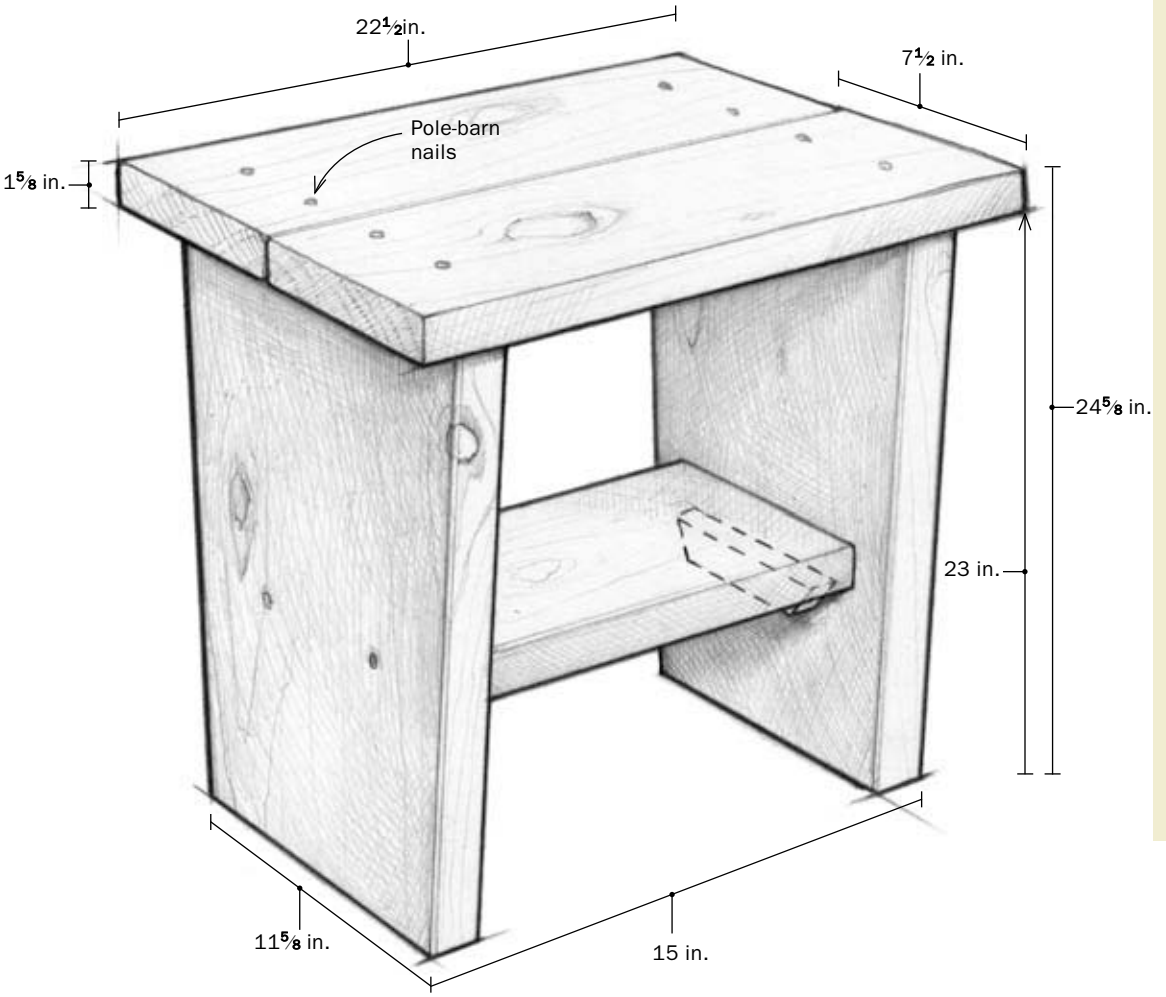
These tables can be made so quickly that the joke in my family is that they can be made in five minutes. That, of course, isn't quite accurate. But despite being quickly made, the tables have been useful and beautiful for many years. The roughsawn wood, complete with knots and imperfections, never goes out of style.

You can make the basic table, or spice it up a bit with the design variations shown at the end of this article. Also, with simple changes in the lengths and widths, you can make tables for a variety of uses.

Because this is a very simple table, you don't need a fancy shop to make it. In fact, you don't need a shop at all. I've made

Great on a deck or patio

This table is sized to sit alongside a chair—a great place to rest a drink—and can be made quickly with common homeowner tools. Western cedar is one of the few roughsawn woods widely available from lumberyards. Long pole-barn nails are used to secure the parts.



What you'll need

MATERIALS

2 X 12 WESTERN RED CEDAR:

- **2 sides (1⅝ in. thick by 11⅝ in. wide by 23 in. long)**
- **1 shelf (1⅝ in. thick by 7½ in. wide by 15 in. long)**
- **2 shelf supports (¾ in. thick by 1½ in. wide by 6 in. long) with 15° angle on each end**
- **2 top sections (1⅝ in. thick by 7½ in. wide by 22½ in. long)**

HARDWARE

- **12 6-in. pole barn nails**
- **8 #6 common nails**

Cut the parts to size

Rough out all of the parts first by cutting them an inch or two longer than their final length. This allows you to cut the ends square to the sides easily when you cut the part to its final length.

First cut parts longer than you need. *Use a carpenter's square and a pencil or pen to mark a line, and cut the stock by eye with a circular saw.*

Then cut them to length. *Use a Speed Square to guide the saw accurately to get a square cut. Hold the square tightly in place. The first cut is made close to the end of the stock. Turn the stock end for end, mark the length, and then align the guide and saw to cut at the mark.*

Rip the shelf supports. *Use a ripping guide to get a straight cut and supports that are a consistent width along their length.*

many of these tables outside, using a circular saw to cut the parts to length (a handsaw works nearly as well). Using sawhorses to hold the stock is an improvement over working on the ground, but don't let a lack of sawhorses keep you from getting started. If you work on the ground, just lay scraps of wood underneath to provide clearance for the blade.

The parts are easy to make

One of the reasons this table can be made so quickly is that you don't need to mill any of the lumber. After you get it home, it's just a matter of cutting the parts from the boards.

Begin by cutting all the parts to rough length. I cut them about 1 in. to 2 in. longer than the finished dimensions to allow for the ends to be accurately trimmed square. To square the ends, use a Speed Square held against the sides of the stock as a cutting guide. Hold the square tight to the stock. Then hold the saw tight to the square, aligning the blade with your line of cut. After you cut one end, turn the stock end for end. Now mark the stock to the exact length required. Align the Speed Square so that the sawblade lines up with the mark.

Now, rip the supports for the lower shelves from thinner ¾-in. stock. This can be done with a handsaw or circular saw with a ripping guide. Set the guide so that the distance is 1½ in. between the guide fence and the blade. Place your wood on sawhorses or on the ground with scraps of wood to lift it.

Mark the 15° angle on the ends of the shelf supports using a

Lay out the angle on the shelf supports. *Mark the 15° angle using a sliding T-bevel. Measure from the first layout line to determine the support's final length.*

Cut the shelf supports to length. *A handsaw will be more accurate and safer to use on small stock than a handheld power saw.*

Guiding circular saws

Although a trained carpenter may do very precise work by eye with a steady hand, there are some simple tricks that may make even an experienced carpenter's work more accurate and efficient. A high level of accuracy may not seem necessary in rustic work, but you still want your tables to rest firmly on the ground without rocking, and square cuts will help.

For square end cuts, a Speed Square held tightly to the stock with one hand, or clamped in position with a small clamp, makes a great guide for a circular saw. Simply hold the square tightly to the edge of the stock, put the saw in place to start a cut, and slide the square along until the sawblade aligns with the mark for cutting length.

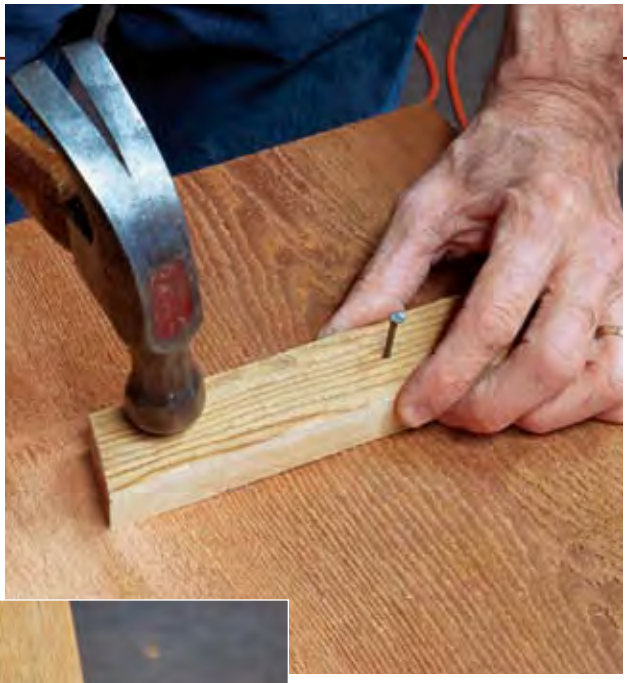
An aftermarket ripping guide can help make long cuts without wandering. Adjust the space between the guide and the blade to control the width of the stock. You might need to change the position of the wood on the sawhorses as you cut, to avoid cutting your sawhorses.

A clamp-on saw guide is also useful in making long ripping cuts, particularly when tapering cuts are required. Measure and allow for the width of the plate of the saw, from the edge to the blade, as you lay out your cuts.

Assemble the base

The major parts are held together by 6-in. pole-barn nails, which have tremendous holding strength because their shanks have sharp rings cut into them. The shelf supports are attached with common nails.

Position the shelf supports. *Use a carpenter's square to align them. The nails are driven partway into the supports beforehand so that a single hammer blow will seat them.*



Drive the nails home. *After seating both so that they are started into the sides, use quick, strong hits to finish the job.*

Chamfer the edges of the sides. *For the best results, skew the plane at a 45° angle. Because this is a rustic table, absolute accuracy is not required. If you don't have a plane, coarse sandpaper and a block will also work.*

sliding T-bevel and pencil or pen. Use a small handsaw like the one shown on the previous page to make the necessary cuts quickly and accurately. This is easier and more accurate with a handsaw than with a power saw.

Begin assembly with the base

Using pole-barn nails to hold all of the parts together, start assembling the table by attaching the shelf supports to the sides. I use a carpenter's square to help hold the supports in alignment as the nails are driven into place. Also, drive the nails partway into the support before carefully placing it in position, and then drive the nails through the support (with one or two sharp hits) and into the side. After the nails begin to penetrate the side, remove the square and drive them down so the heads are flush with the surface.

Use a plane to lightly chamfer the edges of the legs and the shelf. To plane the ends, hold the plane skewed at a 45° angle, not across. Planing straight across the end grain will cause tearout. Then plane the long edges, again holding the plane at the same angle.

Carefully measure and mark the locations for the pole-barn nails to attach the sides to the shelf. The nails should be located

Predrill pilot holes for the pole-barn nails. *Measure so that the nails will be equally spaced, then drill with a bit that has a slightly smaller diameter than the nail. Drill all the way down into the piece below, to keep it from splitting.*

Nail one side to the shelf. *Support the side with a cardboard box or crate. Insert the pole-barn nails in the pilot holes. Position a side over one end of the shelf. Then drive the nails in tight.*

Attach the top. *Position the top boards so that there will be a space between them and then drive the nails in place.*

about 3½ in. from each side and centered on the shelf. Then drill pilot holes for the nails. Use a drill bit slightly smaller than the diameter of the nails, and drill from the inside surface all the way through. Drilling from the inside helps to ensure the nail hits the center of the shelf.

Prop up the side so that it is easy to hold the shelf in position for nailing. A crate or cardboard box will do. Insert the nails in the pilot holes and drive them partway into the table sides so that when the shelf is in position, it can be easily nailed in place. Be

Variations

ASSEMBLE YOUR TABLE WITH DOWELS

First assemble the table with screws in place of the nails. Then remove one screw at a time and replace it with a ⅞-in.-diameter dowel, left proud of the top and with a rounded head.

Hold the table down with your weight. *Use a ⅞-in. auger bit in a ½-in. drill.*

Drive dowels in place using another dowel. *This protects the rounded ends from the hammer. Also, use a water-resistant glue.*

careful that the shelf is tight to the support and equally spaced from the edges of the side. Then turn the parts over and follow the same procedure for nailing the other side in place.

Attach the top

The top is made of two pieces of 2x8 Western cedar, centered over the table ends and attached with more pole-barn nails. Crosscut the two pieces to length as you did the base parts.

Before attaching the top, use a block plane held at an approximately 45° angle to chamfer the ends and sides of both top pieces. I prefer to chamfer more heavily on the bottom edges and plane more lightly on the top edges. Keep in mind the need to do both top boards the same. I count strokes of the plane, using the same number on each part to ensure equal chamfers. Leave the center edges (where the two parts of the top will meet) only lightly chamfered.

CUTOUTS IN THE SIDES

The double diamond shape used here can be laid out with a combination square, or you can design a shape to match your style.

How to cut into tight corners. *Cut straight up the middle first. Remove most of the waste by cutting proud of the layout lines, then go back and cut on the line.*

Jigsaw is the right tool for the cutouts. *The narrow blade can make the transition from the bigger diamond to the smaller one without creating a big gap.*

Mark the locations for the nails and drill pilot holes through the sections of the top. Use a carpenter's square to help mark the holes accurately.

Mark a centerline on the top edges of the sides to help with the positioning of the top's two boards. Then align one half of the top, insert the nails in the pilot holes, and drive them into place. After that, nail on the second top board, keeping a small gap between the two boards to allow them to expand and contract, and for the inside edges to dry out more easily.

Don't worry about a finish. The cedar will age to a wonderful silver gray. The nails might rust and cause some staining, but that just adds to the table's rustic charm. □

Doug Stowe is a furniture maker in Eureka Springs, Ark., and has written many articles and books about woodworking. This article is adapted from his book Rustic Furniture Basics *(2009, The Taunton Press).*

Give nature a head start. *Want the weathered look now? Spray on an ebonizing solution made by steeping steel wool in 1 gallon of vinegar. Test on scrap first and add water to lighten the color from black to weathered gray.*

SHAPE THE EDGE OF THE TOP

Lighten the look. *The angled edges make the top appear thinner. By clamping a saw guide in place as shown, your cuts can be made uniform. Cut the ends first and then the sides.*

Pedestal Table

With roots in the rain forest, this ipé table can survive the brutal outdoors

BY DAVID BEDROSIAN

Last summer brought a new pool to our backyard. With it came more company and the need for a better outdoor table. Rather than purchasing something mass-produced, I designed a table to match the wooden deck that completes our backyard landscaping. Both the deck and the table are built from ipé (pronounced ee-pay), a dense South American hardwood. I like ipé for outdoor furniture because of its rich color, dimensional stability, and natural resistance to decay. But you could substitute white oak, cedar, or any other wood that will withstand the elements.

Ipé may not be available at the local hardwood dealer. You may have to visit a lumberyard that sells high-end deck material, or you can order the ipé online. It comes in a limited number of standard dimensional lumber sizes. Although the stock sizes may be limited, ipé comes planed and ready for sanding.

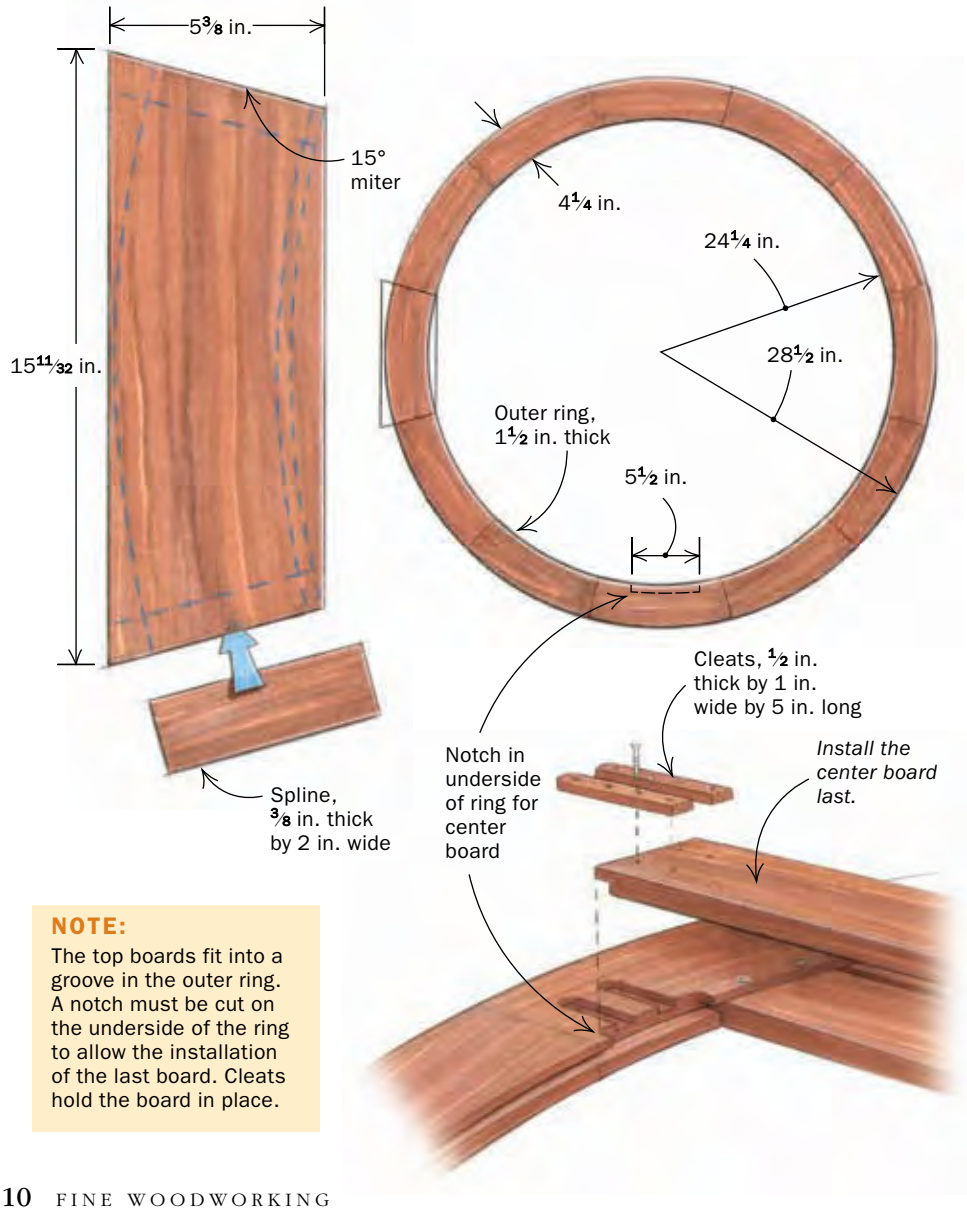
The table is about 5 ft. dia. and seats six comfortably. The top is made of 1¼-in.-thick by 6-in.-wide boards surrounded by an outer ring built from 12 segments of 2-in.-thick by 6-in.-wide stock joined with splines (see drawing, p. 110). Each inner board is glued and screwed into a groove in the outer ring. Gaps between the boards lighten the look of the top and allow water to drain. The gently curved legs attach to the base with mortise-and-tenon joints. An oil finish highlights the ipé's rich color.

When you lift the first board, you'll notice that ipé is much denser than other woods. Although it can be jointed and planed with steel knives and light cuts, ipé is tough on tools. Use sharp carbide blades and bits in your saws and routers. Even so, you'll need to rout in shallow passes. The wood is difficult to handplane, but

A sled guides cutting the segments to length. *Wedges cut to the 15° miter angle position the stock for crosscutting. The last two pieces won't be cut until the others are glued up, to allow for tweaking the final fit.*

Tenoning jig and a dado blade slot the segments. *Splines sawn from ipé scraps fit in the slots to secure the joints.*

Can you have too many clamps? *Blocks held to the segments with the red clamps provide purchase for small bar clamps to pull the segments together.*



NOTE:
The top boards fit into a groove in the outer ring. A notch must be cut on the underside of the ring to allow the installation of the last board. Cleats hold the board in place.

it sands to a very smooth finish. Drilling was required for the stainless-steel screws I used throughout (to prevent staining). Also, you must seal all end grain or ipé will split. Take extra caution with ipé sawdust, a respiratory irritant. The oil in the wood makes the sawdust stick to walls, clothes, even the inside of dust-collector pipes. It also may stain other unfinished wood.

Because of ipé's oily nature, both the makers of Gorilla Glue and of Titebond III, two waterproof glues that I use for outdoor pieces, recommend gluing it soon after machining or lightly sanding the surfaces of joints if there is a delay before glue-up. I glued all of the joints within a few days of machining and have not had any joint failures. I used Gorilla Glue for the joints where the squeeze-out could be removed easily and Titebond III for the others.

Start with a full-scale drawing

Make a full-size drawing of the tabletop on a 5-ft. by 5-ft. sheet of plywood. This will show the exact size of the outer ring and later will serve as a support board for machining the top. To determine the inside diameter of the ring, measure the combined width of the nine inner boards including the ¼-in. space between them, and then subtract ¾ in. This will allow the inner boards to fit in a ⅜-in.-deep groove in the ring. Mark the centerpoint on the plywood and draw an inner circle of this diameter. Draw the outer circle's radius 4¼ in. larger.

Photos: Andy Engel; drawings: Bob La Pointe

Router on a trammel cuts the circle. *Blocks screwed to the plywood template secure the ring. After cutting a shallow groove, the author removes the ring and jigsaws the waste away. He finishes the cut by replacing the ring on the template and trimming with a router.*

Using dividers, lay out 12 equal segments representing the 12 boards that will make up the ring. Then you'll know the exact length of each segment. The angle at the end of each segment is 15°. I cut 10 of the segments on my tablesaw using a sliding crosscut sled with a 15° wedge (see photo, opposite page). Even a slight inaccuracy in the angle will lead to a gap between the last two boards in the ring, so I left those long and custom-cut them for a precise fit.

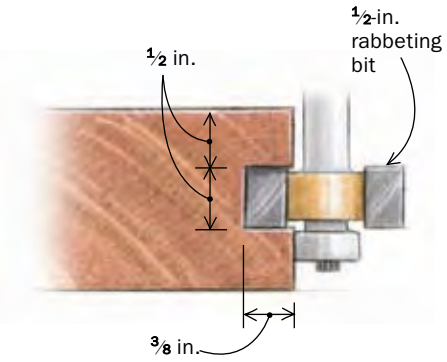
The joints between the segments are strengthened with ⅜-in. by 2-in. ipé splines that fit into grooves cut in the end of each segment. I glued the segments together one joint at a time using angled clamping blocks.

Rout the outer ring round

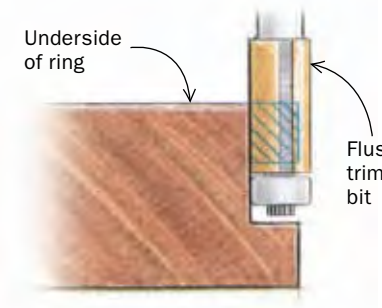
With the glue dried on the outer ring, the next step is to make it circular using a router and a trammel jig. Secure the ring to the plywood by screwing blocks around the inside edge of the ring. Be sure the ring is aligned with your full-scale drawing so that you can pivot the router trammel on the centerpoint drawn on the plywood.

I used a ½-in. solid carbide spiral bit to rout a shallow groove for the outside curve. I then lifted off the outer ring and

Groove the ring for the top boards. *A ½-in. bearing-guided rabbeting bit makes the cut. To control the depth on multiple passes, successively smaller guide bearings are used until the groove reaches ⅜ in. deep.*



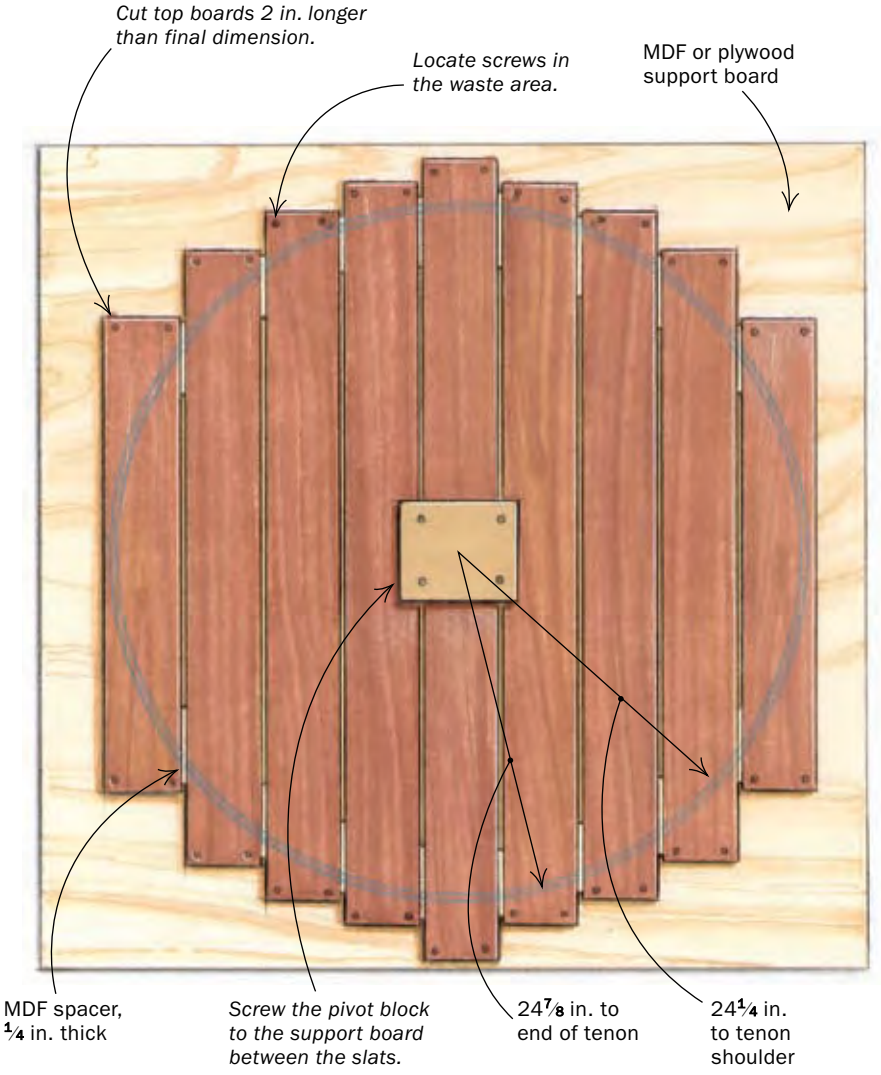
Clearance for the last board. *The shorter boards slide into the groove, but the last one must be dropped into place. Working on the bottom of the ring, a flush-trimming bit removes the necessary material.*



RADIUS AND TENON THE TOP BOARDS

Pivot block prevents marring the top boards. *Drive screws between the top boards to hold the block in place. A pivot pin in the trammel engages the center hole in the block.*

Rout the tenons first. *To minimize tearout, the author uses a ½-in. spiral up-cutting bit and ¼-in. MDF spacers between the boards where the router will pass. Take shallow passes until the tenon thickness matches the groove in the ring.*



used a jigsaw to cut away most of the waste. Then I reset the ring on the template and cleaned up the edge with the same router setup. After routing the outside of the ring, I fastened blocks around it to hold the ring in place and removed the inner blocks. I used the same procedure to rout the inner circle. A belt sander cleaned up the outside edges.

I routed a ½-in.-wide groove ⅜ in. into the inside edge of the ring to hold the inner boards (see photo, p. 111). To ensure that the ring and the inner boards are flush, the distance from the top of the ring to the bottom edge of the groove should equal the thickness of the inner boards. I used a ½-in. rabbeting bit and took several passes with guide bearings of diminishing size to get to the full ⅜-in. depth of the bit. If you are going to apply a finish to the table, apply it to the inside edge of the ring before routing the groove. This will prevent any problems gluing the inner boards.

A small section of the bottom of the inner ring must be removed so that the longest inner board can be inserted in the groove. Mark the width of an inner board on the ring and use a flush-trimming router bit to make this cut.

Lay out the top on the template

I chose grain- and color-matched boards for the top and cut them about 6 in. longer

Adjust the trammel and rout the tenons to length. *Cut a deep groove ⅜ in. out from the tenon shoulder, stopping short of routing all the way through the boards. Unscrew the boards and finish the cut on the bandsaw.*

than needed. Use two screws at each end to secure the boards to the plywood, good side up, placing the screws in the waste area. I used ¼-in. MDF spacers between the boards at the cut line to ensure consistent spacing and to minimize splintering. To prevent finish from getting on the glue surfaces of the inner boards, I applied finish to the sides of the boards before screwing them down.

The end of each board gets a curved tenon with a shoulder radius that precisely matches the inside of the outer ring. I used my router trammel and a scrap of MDF to fine-tune the radius for a snug fit.

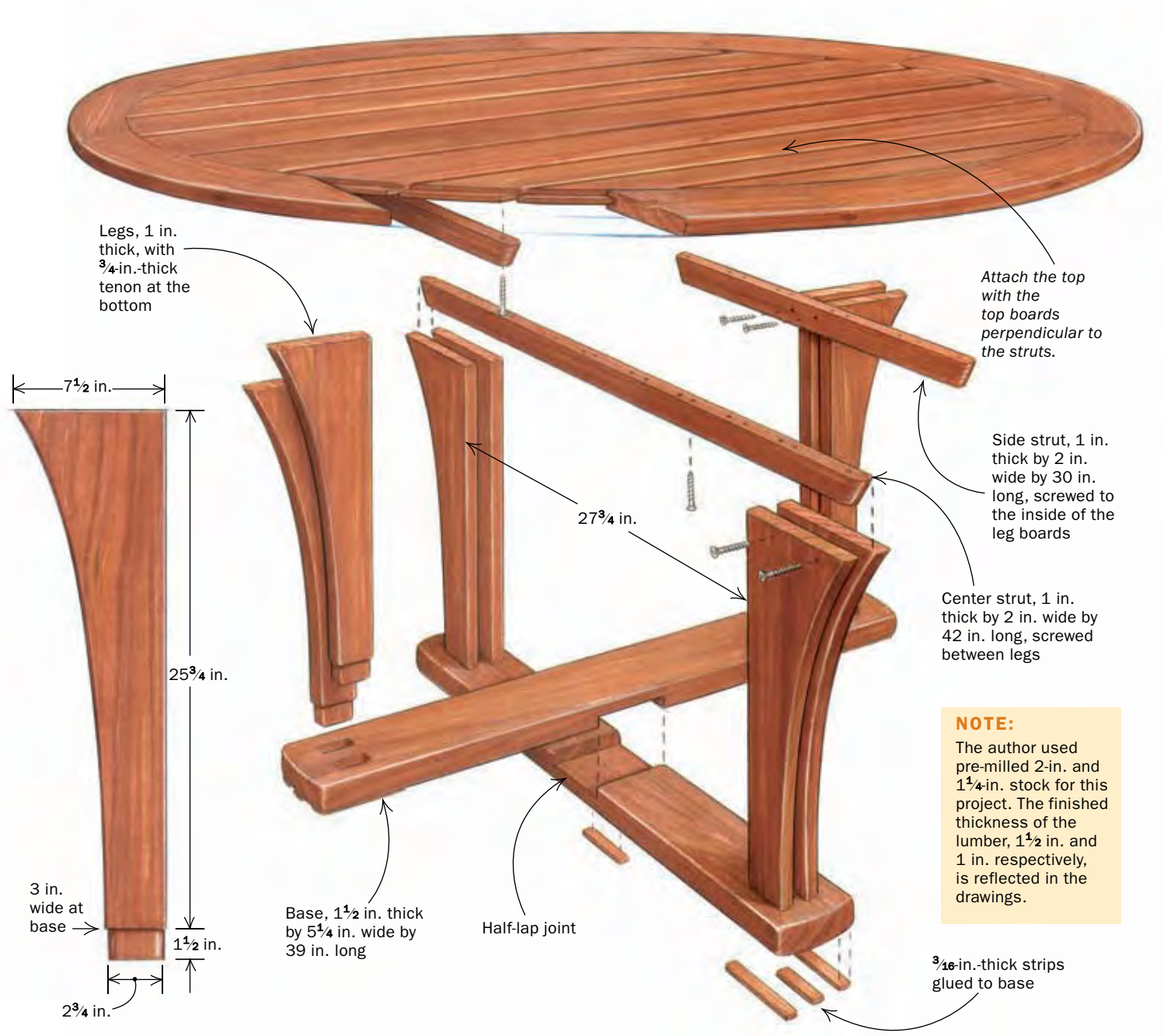
Rather than drilling a hole in the ipé for the centerpoint of the trammel, I fastened a scrap of ¼-in. MDF to the top with screws placed between the boards. A similar piece of MDF fastened to the trammel below the router ensured a 90° cut. I cut the tenons in several passes, increasing the depth of cut by about ⅛ in. until the tenon thickness matched the groove in the outer ring.

The tenons are cut to length by increasing the radius of the trammel by just less than ⅜ in., the depth of the groove in the outer ring. Make several passes until the bit almost cuts through to the plywood. Don't rout through the boards, as doing so would separate them from the screws holding them in place. I left about 1/32 in., which was cut easily on the bandsaw and

Rabbeted top boards fit the ring. *Working from below, the boards are spaced with ¼-in. shims. A deadblow hammer adjusts them so that the final, center board aligns with the clearance slot.*

Cleats support the last board. *Fitting into channels routed in the ring, two cleats made from ipé scraps are screwed home.*

MAKE AND ASSEMBLE THE BASE



NOTE:
The author used pre-milled 2-in. and 1¼-in. stock for this project. The finished thickness of the lumber, 1½ in. and 1 in. respectively, is reflected in the drawings.

then sanded flush to the tenon with my belt sander. Be sure to number each board to keep them in order for final assembly.

Dry-fit the top, starting with the small boards. The middle board is last and should fit into the groove at one end and the cutout at the other end. Position the boards and then drill holes for two screws at the end of each. Clearance holes in the ring and pilot holes in the boards will prevent splitting. Locate these screw holes as close as possible to the inside edge of the ring to minimize the chance of splitting the tenons. With the holes drilled, remove all of the boards, apply glue, and screw the boards in place. Two support strips glued and screwed into grooves routed on the bottom of the inner ring secure the end of the middle board in the cutout. Round over the outside edge of the top and bottom of the outer ring and sand the top flush.

Shape legs with a router and template

The eight curved legs that support the tabletop are machined from 1¼-in.-thick ipé. The top portion of the leg is wider than the 6-in. ipé boards that I had, so I glued each leg from two pieces. To ensure that the pieces matched in color and grain, I bandsawed the initial curve into the lower leg, then glued the cutoff to the wider, upper section.

After the glue set, I bandsawed away most of the scrap and machined the legs to final size using the template with a router and a flush-trimming bit. A ½-in. roundover softens the front edges of each leg. A ¼-in. roundover softens the back edges.

Tenoning the legs. *A pair of dado blades spaced with a scrap of ¾-in. plywood tenon the 1-in.-thick leg in one pass.*

Clamping jig positions the legs during glue-up. *The jig's shoulders are square, and the center is the width of the space between the legs. The legs' tenons fit into mortises routed into the base. Prefinishing the pieces prevents glue squeeze-out from staining the wood.*

The final step in making the legs is to machine the tenons that will fit into mortises in the base.

This table needs a solid base to support its weight and prevent it from tipping over. For strength, I made the base from two pieces of 2-in.-thick ipé joined with a glued and screwed half-lap joint. To elevate the base above rain puddles, I glued 3/16-in.-thick strips of ipé under the legs.

The table legs fit into mortises machined in the base using a plunge router, bushing guides, and an MDF jig with cutouts for both mortises. Be sure the spacing between the mortises and tenons allows a 1¼-in.-thick piece of ipé to fit snugly between the legs.

Three ipé struts screwed to the underside of the tabletop keep the table boards aligned and secure the top to the legs. One long strut runs below the center of the table and is sandwiched between opposite pairs of legs. Two shorter struts run parallel to the long strut and are screwed on the inside edges of the other legs. Because the struts aren't glued to the legs, the top can be removed for winter storage.

To keep the table looking like new, I brushed on two coats of Penofin penetrating oil, following the manufacturer's directions. Ipé also can be left outdoors without finish. It will weather to a gray color. □

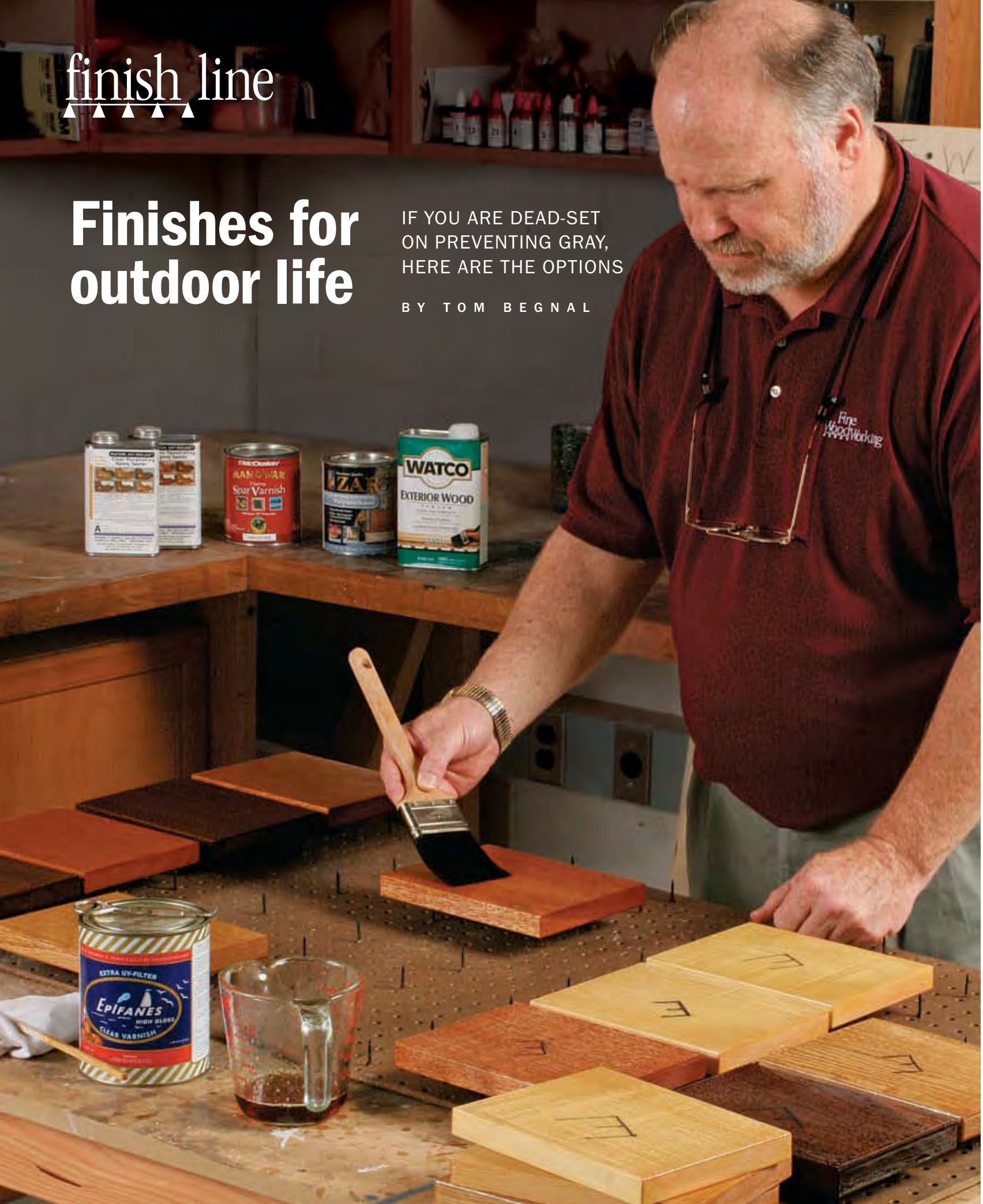
David Bedrosian is an electrical engineer and woodworker in Waterloo, Ont., Canada.

finish line

Finishes for outdoor life

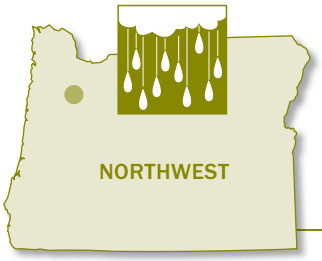
IF YOU ARE DEAD-SET ON PREVENTING GRAY, HERE ARE THE OPTIONS

BY TOM BEGNAL



How we tested

We treated five wood species with five outdoor finishes. To find out how the samples would hold up over the course of the year to the weather in different regions of the country, we sent a rack of sample boards to Oregon, New Mexico, and Louisiana, while one stayed in Connecticut. Each region subjected the samples to a unique set of climate conditions. The data represent average numbers.



Salem, Ore.

Lots of cool temperatures and high humidity. On average, only one day in five is sunny.

Seasonal temperatures (°F) (high/low)
Winter: 48/34
Summer: 79/50

Relative humidity (AM/PM)
Winter: 74%/87%
Summer: 43%/85%

Sunny days: 77

Rainfall: 39 in.

Snowfall: 7 in.

Bridgeport, Conn.

In winter, freezing and thawing cycles aren't kind to wood.

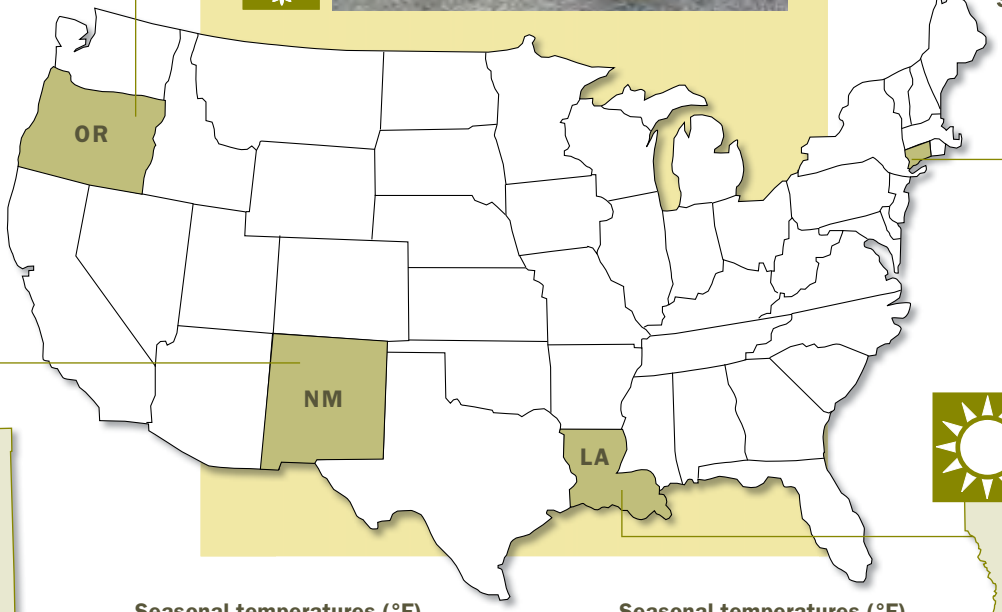
Seasonal temperatures (°F) (high/low)
Winter: 38/24
Summer: 80/63

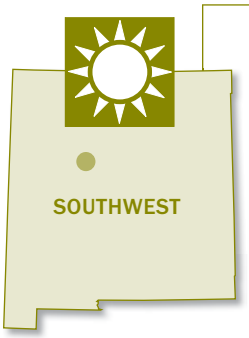
Relative humidity (AM/PM):
Winter: 58%/71%
Summer: 61%/78%

Sunny days: 99

Rainfall: 42 in.

Snowfall: 26 in.





Albuquerque, N.M.

Plenty of sunshine, not much rain, and low humidity make for a wood-friendly environment.

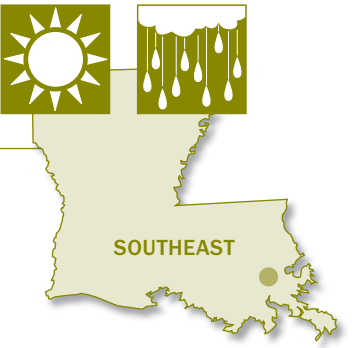
Seasonal temperatures (°F) (high/low)
Winter: 49/24
Summer: 91/62

Relative humidity (AM/PM)
Winter: 38%/67%
Summer: 25%/57%

Sunny days: 167

Rainfall: 9 in.

Snowfall: 10 in.



New Orleans, La.

Hot and humid summers. Plenty of rain. Freezing and thawing cycles are as rare in Louisiana as snowy owls.

Seasonal temperatures (°F) (high/low)
Winter: 63/44
Summer: 90/72

Relative humidity (AM/PM)
Winter: 66%/85%
Summer: 65%/91%

Sunny days: 101

Rainfall: 62 in.

Snowfall: ¼ in.

The great outdoors isn't great for wood. No matter if it's a fallen maple tree in the back woods or an Adirondack chair in the backyard, nature wants to convert all dead wood into compost.

Sunlight and moisture do a lot to start the process. Sunlight, particularly the ultraviolet (UV) wavelength, causes a chemical degradation in wood. Moisture absorbed by the wood fibers causes them to expand and contract, producing surface checks. Also, the freezing and thawing cycles common in northern climates can exacerbate the weathering process. Left unfinished, a new piece of furniture will start to look weathered in a few weeks. In a year, it can look ancient.

If you choose the right woods and don't mind that slightly shaggy silver look, you can forgo a finish. But if you want to keep a piece looking pristine, a protective finish is a must. And if you want to see and enjoy the wood, you'll want a clear finish.

WATCO EXTERIOR WOOD FINISH

Source: rustoleum.com

Price: $14/qt.

Application: Two coats, each applied liberally

Results: The outdoor penetrating oil finish was the easiest to apply, but at the end of the yearlong test, all the samples, except for those in New Mexico, had weathered to various shades of gray. All the samples had rough surfaces. Shallow cracks and checks were common. Some pine samples had full-thickness checks on the end.

Rating: Unacceptable

There are several types made for outdoor use. But, as we discovered in a yearlong test, they don't all deliver. Some offered almost no long-term protection. Others did much better. But our test did more than help us find good outdoor finishes. It also showed us how different wood species hold up to the weather. And it gave us new insight into the effect of climate on both finish and wood.

Testing tells the tale

The test evaluated the four types of finish used most often outdoors: penetrating oil, water-based polyurethane, marine spar varnish, and marine extra-UV-filter varnish, plus a combo touted by a finishing expert, epoxy and marine extra-UV-filter varnish. Also, to see if the wood species made a difference, we applied each finish to five different woods: cedar, ipé, mahogany, pine, and white oak. All, except for pine, are known to hold up to the outdoors better than most. Finally, to see how geography factors in, we ran the test in four regions of the United States with distinctly different climates: the Northeast (Connecticut), Northwest (Oregon), Southwest (New Mexico), and Southeast (Louisiana).

Each wood sample was ¾ in. thick by 6 in. wide by 8 in. long. For consistency, all the samples of each wood came from the same board. And every coat of finish was applied equally to both sides and all edges. Each finish was applied according to the manufacturer's recommendations shown on the label.

We built four test racks, each designed to hold 25 samples. One rack went up on the flat roof of our Connecticut office building (a perfect out-of-the-way

ZAR EXTERIOR WATER-BASED POLYURETHANE

Source: ugl.com

Price: $28/qt.

Application: Three coats

Results: On average, about 20% of the finish had deteriorated, resulting in areas of weathered gray. Where the finish remained, much of it showed areas of flaking and chipping. The mix of grayed wood and remaining finish produced an unsightly mottled look.

Rating: Unacceptable

Photos: staff; drawings: John Tetreault

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McCLOSKEY MAN O'WAR MARINE SPAR VARNISH

Source: mccloskey finishes.com

Price: $20/qt.

Application: Four coats

Results: The finish generally held up well on the mahogany, ipé, and pine. Same with the cedar samples, except for the one that visited New Mexico—that one showed some finish deterioration. The white oak samples had the toughest time, with about 40% of the finish deteriorating.

Rating: Fair to good

location, we thought, until summer arrived and a colony of hornets built a nest at the trapdoor leading to the roof); the other three went to our regional testers. All the racks were positioned to face south, ensuring maximum exposure to the sun, with the samples tilted at 45° to prevent standing water.

What we learned

After 12 months, all the samples came home to our shop. The results are shown on these pages. For space reasons, we only included photos of the white oak (a light-colored, open-grained wood) and ipé (a dark-colored, close-grained wood).

One thing was immediately obvious: The samples finished with oil suffered the most. All five wood species in all four regions had roughened surfaces. With the exception of those from New Mexico, all the bright surface colors had been replaced by various shades of gray. Also, all the samples showed end-grain checks and surface cracks, most of them minor. The pine samples, however, showed several end-grain checks that extended the full thickness of the wood.

In fact, the oiled wood didn't look any better than unfinished wood exposed to the same conditions. So unless you want to reapply the oil every couple of months, don't bother with it.

Although faring better than penetrating oil, both the exterior water-based polyurethane and the spar varnish were disappointments. All the water-based poly samples showed deterioration, some minor but most closer to major. Spar varnish held up slightly better, with a 50/50 split between major and minor levels of deterioration. The spar-varnish pine

EPIFANES HIGH GLOSS MARINE VARNISH

Source: epifanes.com

Price: $45/qt.

Application: Seven coats, thinned per instructions

Results: No sign of finish deterioration, no sign of flaking or chipping. Samples showed only the slightest change in color. Mind you, it takes a while to apply the seven required coats.

Rating: Very good

Source:
smithandcompany.org

Price: $42/qt. plus $45/qt.

Application: Three coats epoxy plus five coats Epifanes (unthinned)

Results: No sign of finish deterioration, no sign of flaking or chipping. Only the slightest change in color.

Rating: Very good

SMITH & CO. PENETRATING EPOXY SEALER UNDER EPIFANES MARINE VARNISH

sample from New Mexico was an exception, as it held up pretty well.

Without question, the marine extra-UV-filter varnish and the epoxy plus marine varnish looked the best. The colors maintained much of their brightness. Surface cracks, checks, or defects were almost nonexistent. The only reason I rated them "very good" rather than "excellent" was because the colors changed slightly during the yearlong test: The ipé lightened. The white oak lightened, but only a bit. The cedar and pine darkened. The mahogany darkened, except in New Mexico, where it lightened slightly.

Interestingly, the samples from New Mexico suffered the least. Oregon samples did better than those from Connecticut and Louisiana. The Connecticut samples looked the worst. So, our test showed moisture causes more weathering than UV light. Combine it with freezing and thawing cycles, as is common in north, and the wood weathers even more.

As far as wood species go, the cedar and ipé samples held up a bit better than the others. Mahogany and white oak showed slightly more weathering. The pine boards had the toughest time.

Choosing a favorite

The Epifanes finish and epoxy-plus-Epifanes held up equally and the work to apply them was about the same. Forced to pick a favorite, I'd take the Epifanes, because it is one product, not two. □

Tom Begnal is a woodworker in Kent, Conn., and a former associate editor at Fine Woodworking.

Which finish is right for you?

A PROTECTIVE FILM FINISH

Keep wood looking new. *After about a year outdoors, this project finished with Epifanes looks almost as good as it did after its first day.*

THE WEATHERED LOOK

No finish at all. *If you like the rustic look of weathered wood, don't bother to add a finish. Oil finish (Watco) didn't have a visible effect after a year. But ipé, cedar, and mahogany weathered the best, in that order.*

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