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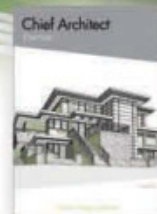
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FLIPPING HOUSES

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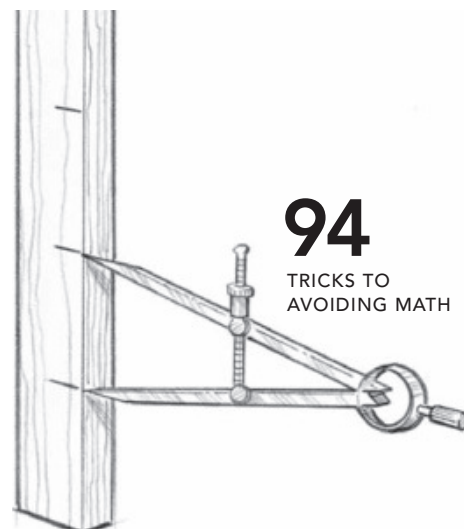
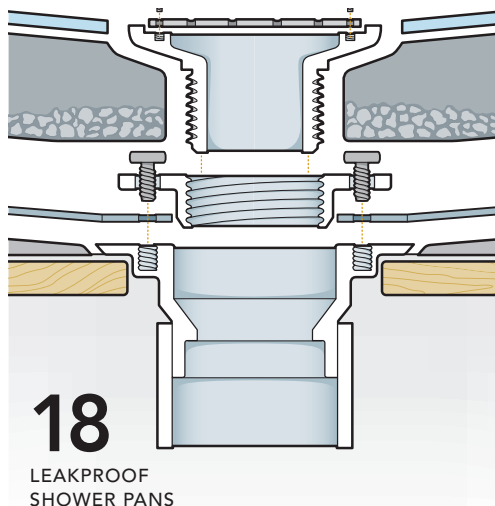
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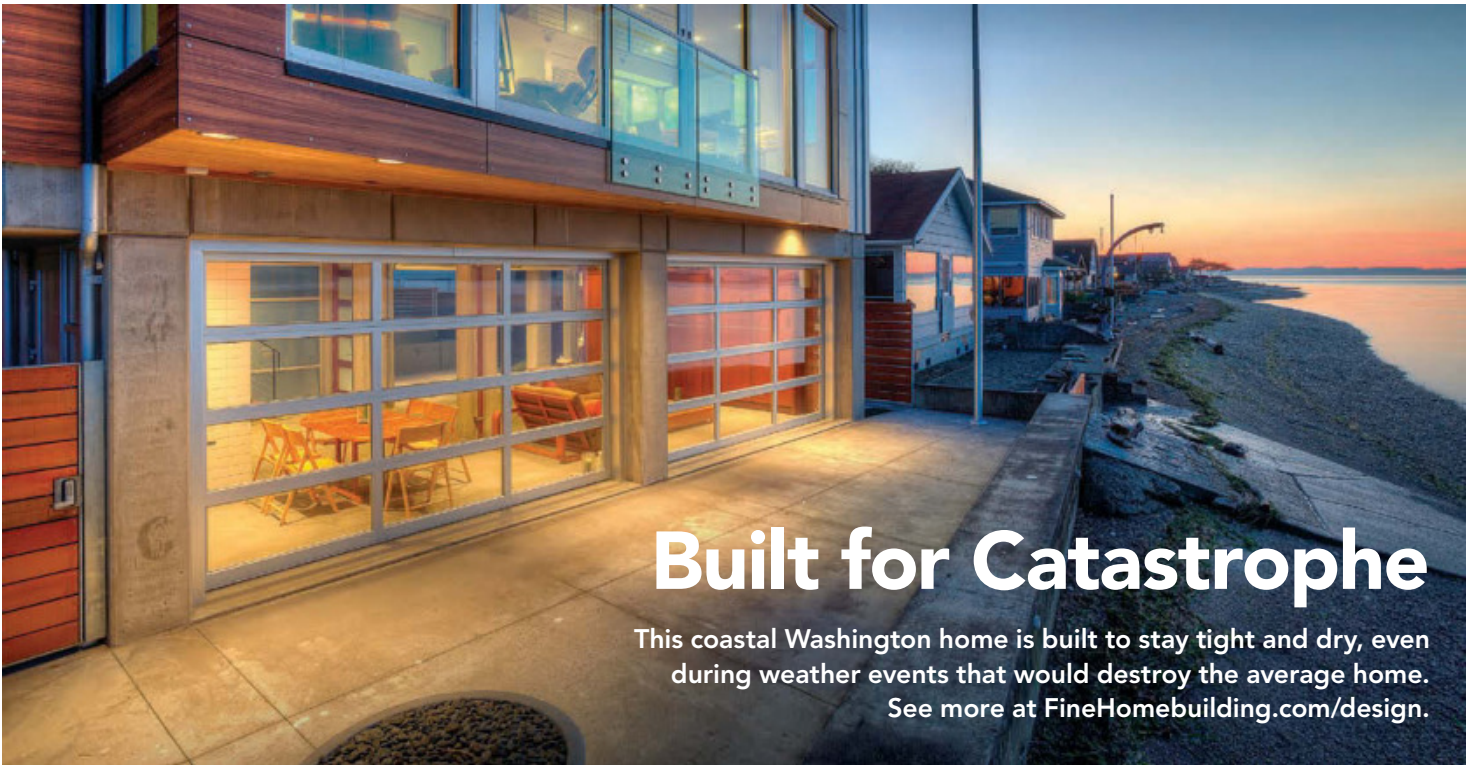
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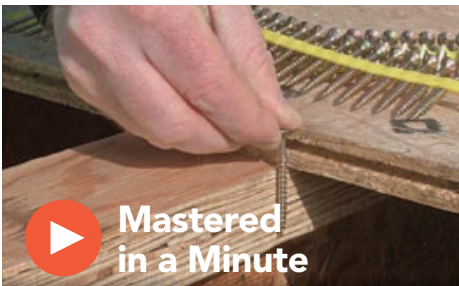
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This coastal Washington home is built to stay tight and dry, even during weather events that would destroy the average home. See more at FineHomebuilding.com/design.



Mastered in a Minute

When installing subfloors, use the right adhesives, fasteners, and techniques to ensure that finished floors are quiet and solid.



Ep. 170: Is there a skilled trade gap?

One listener wonders why he's not seeing much demand for experienced carpenters in his part of the country.

Rigid cap flashing

Flashing tape over head trim

Flashing tape over top window flange

Flashing tape over side window flange

Missing window flashing?

What's the best way to resolve workmanship issues when hiring a contractor to build your dream home? Join the conversation or start your own at FineHomebuilding.com/forum.

The essential timber-frame joint

Builder Will Beemer shows how to create a large pegged mortise-and-tenon joint, a fundamental detail in traditional timber-frame construction. Watch the entire series at FineHomebuilding.com/exclusive.





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contributors

THE VOICES OF EXPERIENCE



STEVE CIMINO ("Building for Floods," pp. 52-55) has covered architecture and design as both a digital content manager at the American Institute of Architects and a frequent contributor to *ARCHITECT* magazine. After graduating from Boston University with a degree in print journalism and spending a half-dozen years as a writer and editor in Washington, D.C., Steve currently freelances on numerous subjects from his home in scenic downtown Los Angeles.

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Former contractor **GLENN MATHEWSON** ("Know the Code: Site-built shower pans," pp. 18-20) has served Westminster, Colo., as an inspector and plan reviewer for over 10 years. He is also a professional consultant, a speaker on the residential applications of construction codes, and an author whose works include 60 published articles and the International Code Council's first industry-specific code book, *Deck Construction Based on the 2009 IRC*.

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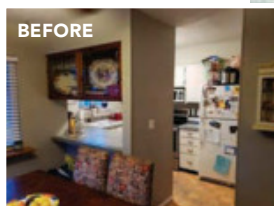
A photograph of two men, likely Home Depot Pro employees, standing at a construction site. The man on the left is wearing a black polo shirt with a 'Pro' logo and a black baseball cap. The man on the right is wearing a grey button-down shirt. They are both looking at a yellow notepad held by the man on the left. In the background, there is a yellow forklift and a large pile of lumber.

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“When remodeling a home, you never know what is going to come up when you start tearing things apart—and the more knowledge you have, the better informed you are.”

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—JUSTIN FINK
editorial director

Confidence is catching

This is more of a thank you than a question. I've been reading the magazine since 2001 (I just had to move my huge stack of back issues when I converted my old office into a bedroom), and it has always been my go-to resource when doing work on our home.

My wife and I recently completed our first kitchen renovation, and we did the majority of the work ourselves—something that wouldn't have been possible without the help of your fantastic publication (and books).

I read an awful lot of books and guides before embarking on this project, but my primary resource for all things remodeling is *Fine Homebuilding*. I have found it to be consistently the single best resource out there, especially when I have technical questions regarding structural

work, plumbing, and electrical. When remodeling a home, you never know what is going to come up when you start tearing things apart—and the more knowledge you have, the better informed you are about making cost-effective decisions, whether you are doing the work yourself or hiring someone else to do it.

So here's a huge thank you to all the craftspeople who build and renovate homes and take the time to write all those wonderful articles and answer questions on forums. We couldn't have done it without you. There are a lot of people out there like us who aren't contractors, just homeowners who want to do a good job on our projects and learn about what goes into building our homes.

The trouble with projects like this is that it can be a bit addictive—now I want to do even more home projects!

—JEROME KELTY
via email

Customized wire strippers

I liked Ron Wlock's wire stripper suggestion in the March issue ("Tips and Techniques," *FHB* #281), but I'll do him one better. How often does the average electrician or even homeowner strip any wire thinner than 14 ga. (lighting fixtures excepted)? Rarely. The

16-ga., 18-ga., and 24-ga. holes and the grabber at the end are largely unused but constantly in the way. So, I cut them off. I put my Milwaukee stripper in a vice and used a metal-cutting angle-grinder disk to take off the offending front end, then rounded over the new front end with a belt sander. Now, I can reach into an electrical box knowing the first slot is 14 ga. and the second is 12 ga. Plus, the tool's nose is shorter, making stripping easier in tight spaces. By the way, I have a second untruncated stripper for stripping lighting and other small wires.

—LEE R. ROHMAN
Virginia Beach, Va.



Truncated stripper. Cutting off the smaller slots of a wire stripper makes it easy to find the most-common 14-ga. notch.

Correction

In "Synthetic Decking Comes of Age" (*FHB* #282) we incorrectly identified Deckorators Voyage decking as a cellular PVC product, when in fact it is a composite product composed of polypropylene and mineral fiber.



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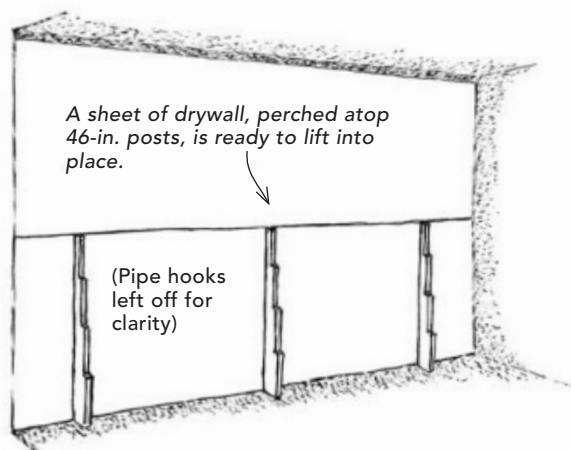
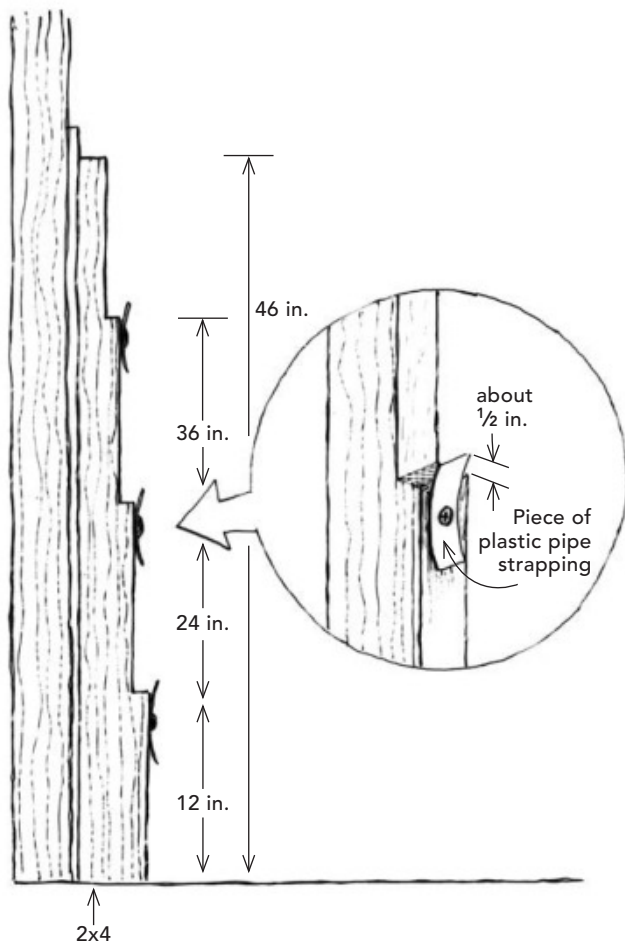
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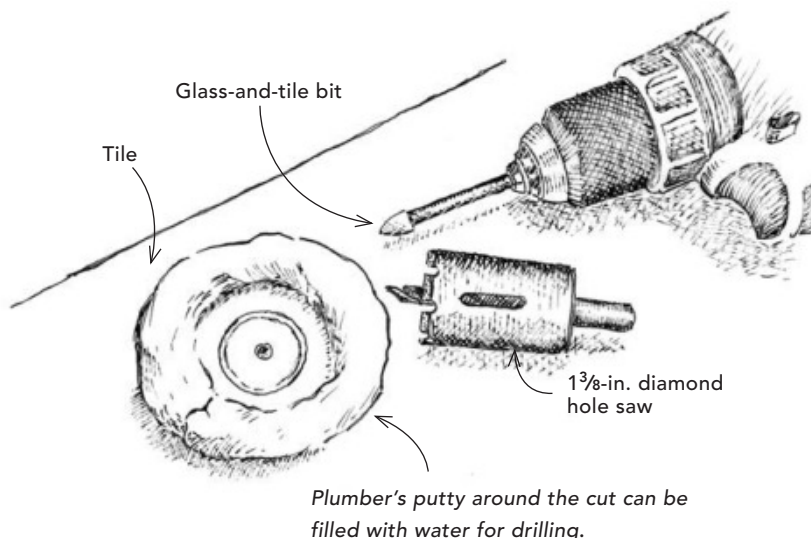
Handling 12-ft.-long pieces of $\frac{5}{8}$ -in.-thick drywall by myself on a recent project was trying, to say the least. I didn't have any hired help, so I enlisted the help of some 2x4s. As shown in the drawings, I cut three 46-in. pieces of 2x4 with notches at 12 in., 24 in., and 36 in. At each level I put a piece of plastic pipe strapping protruding about $\frac{1}{2}$ in. above the notch to keep the drywall pieces from sliding off. I drove a screw at the top of each 2x4 to secure them to the wall studs. The notches give me an incremental lift, and the 46-in. step gives me a short final lift or a resting point to cut out openings for windows or switches.

—JON KARNER
Minneapolis, Minn.



submit a tip

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Round cutouts in tile

Diamond hole-saw pilot bits often leave a lot to be desired when going up against tile, so when I'm drilling a $1\frac{3}{8}$ -in. hole for my plumbing penetrations I will often start them with a glass-and-tile bit. The pointy end starts the hole, and then I finish the cut with the diamond hole saw. I use plumber's putty to establish a dam around the cut, allowing me to fill the cut area with water and drill it wet. The water eliminates dust and lubricates the cut.

—DAVID SCHMID
Indianapolis, Ind.

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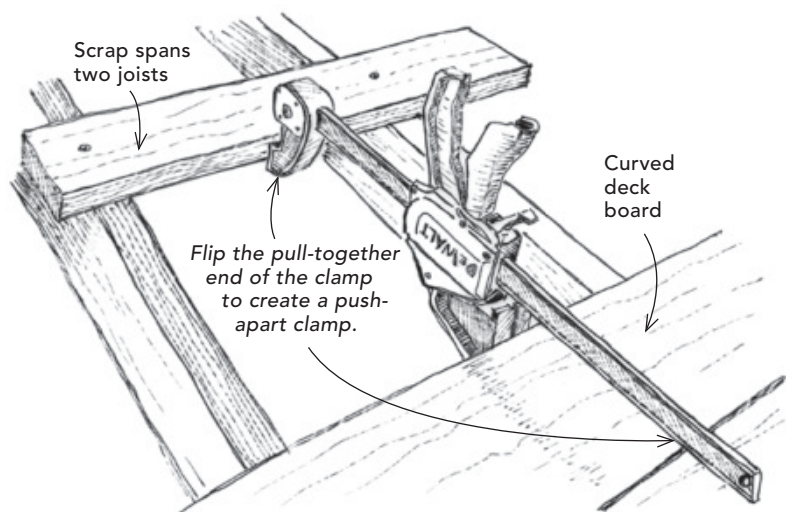
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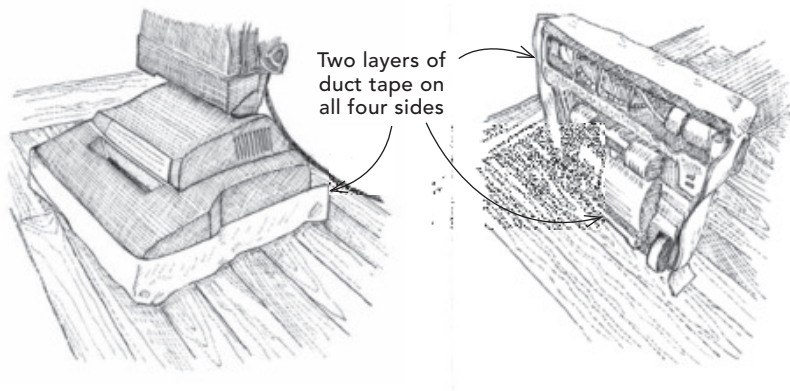
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Clamp turnaround

We recently installed an Ipe deck and ran into a problem with a curved board that wouldn't lay straight. So I turned the stationary end of a clamp we were using around and installed it on the other end. This turned it from a traditional pull-together clamp into a clamp that pushes pieces apart. I screwed temporary scrap to a couple of joists, and used the clamp to push the board into place before fastening. It was pretty handy in a pinch.

—SAM DURDALLER
Levittown, N.Y.



Vacuum upgrade

While vacuuming a floor between sanding sessions during a recent renovation, I noticed the vacuum was leaving a lot of dust/sanding debris on the floor. Recalling an idea from my younger days racing cars, I made a ground-effects kit out of duct tape to boost the vacuum's suction. I placed one piece of duct tape on each side of the vacuum facing outward, then another piece on each side facing inward, so the sticky sides face each other. To my delight, the setup really helped gather the dust.

—RAY IVY
Birmingham, Ala.

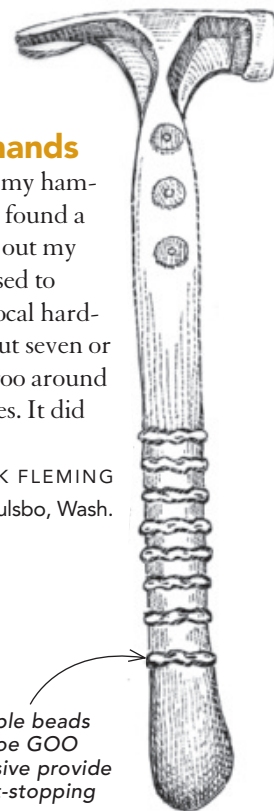
Hammer in sweaty hands

After nearly losing my grip on my hammer because of sweaty hands, I found a way around the problem. I got out my tube of Shoe GOO (typically used to repair shoes and found at my local hardware store) and proceeded to put seven or eight continuous beads of the goo around the portion where my hand goes. It did the trick.

—JACK FLEMING
Poulsbo, Wash.



Multiple beads of Shoe GOO adhesive provide sweat-stopping power.



An alternative workbench surface

Eighteen years ago I performed some gunsmithing on an old rifle. To prevent scratching or damaging the firearm, I covered my workbench with a remnant of short, plush carpeting. This worked so well that it has remained there permanently, for the following reasons:

- It prevents scratching or other surface damage on a project.
- Workpieces do not slide around as much.
- Small parts and screws stop where they drop, and are less likely to bounce off and disappear.
- Wooden surfaces and furniture are protected from scratches.
- Protruding fasteners, hinges, and latches sink into the pile and stabilize the parts or assemblies.
- Heavy objects are easily manipulated by sliding them on the carpeting.
- Cardboard-fabrication projects are made easier as the box cutter's tip penetrates through the cardboard for a clean cut and remains sharp.

(One caveat: Never drill into the carpeting. It will ball up on your drill tip.)

—KEITH OJALA
Hancock, Mich.

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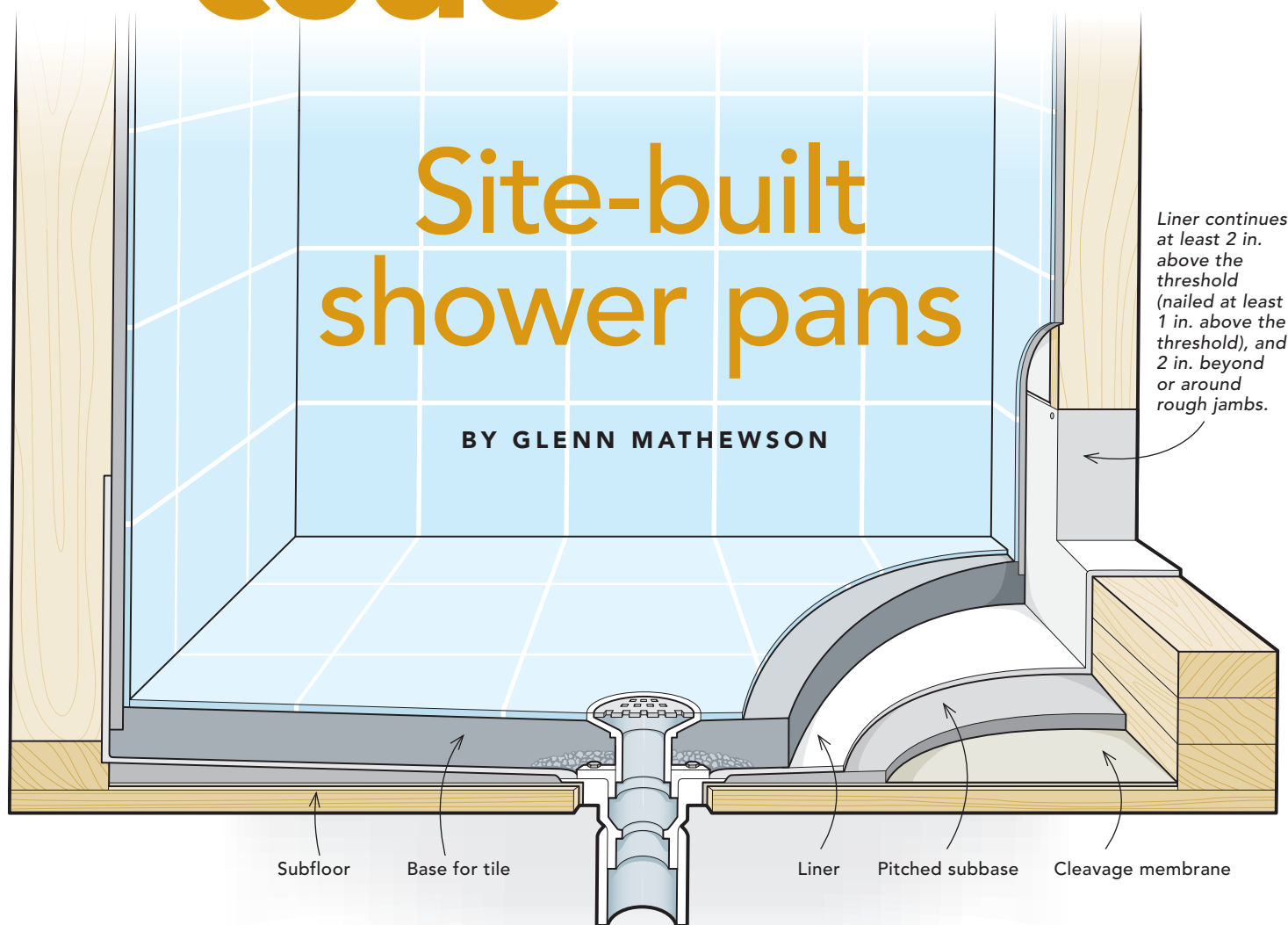
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Site-built shower pans

BY GLENN MATHEWSON



Field-fabricated shower pans (or “receptors,” as the code refers to them) have been acknowledged by plumbing codes at least as far back as the 1955 Uniform Plumbing Code. Built in place from various parts and pieces, site-built shower pans allow for an endless variety of shower-floor arrangements, including curbless, roll-in showers.

While the 1955 code permitted site-built pans only in special cases where the installation of a premade pan was demonstrably impractical, such pans are now common and have their own

provision in section P2709 of the IRC. A major perk of site-built shower pans is that they allow the installation of custom tile, stone, or other aggregate floor surfaces. The downside of these finishes is that they aren’t themselves waterproof.

Because of this, hand-fabricating shower pans can increase the chance of failure, and code provisions generally address two hazards: leaks and sanitation. A minor leak may only be discovered after the nearby walls or floor below are heavily damaged (code is not concerned with a visible escape

of water pouring out onto your bathroom floor, but rather a sneaky invisible leak). And if the pan isn’t properly sloped to carry water to the drain, water standing in the pan can become a petri dish of bacteria and possibly a slipping hazard.

There are many resources available regarding the techniques and skills required to assemble a quality site-built shower pan, but they often fall short in explaining the details required by modern plumbing standards. The first step in a site-built shower pan installation—and the first signal to the

inspector of what’s to come—is the two-part drain assembly. Like all drains, the intent is for bulk water to drain through the visible drain opening. But these drains go a step further. Long showers, slow drains, or minor cracks or shrinkage in the grout can allow some water to sneak through the shower floor’s surface. A secondary drain, mounted on the waterproof pan under the shower’s finished floor, drains this water away.

When an inspector shows up to do the rough-plumbing inspection and sees a two-part drain in place, it triggers a



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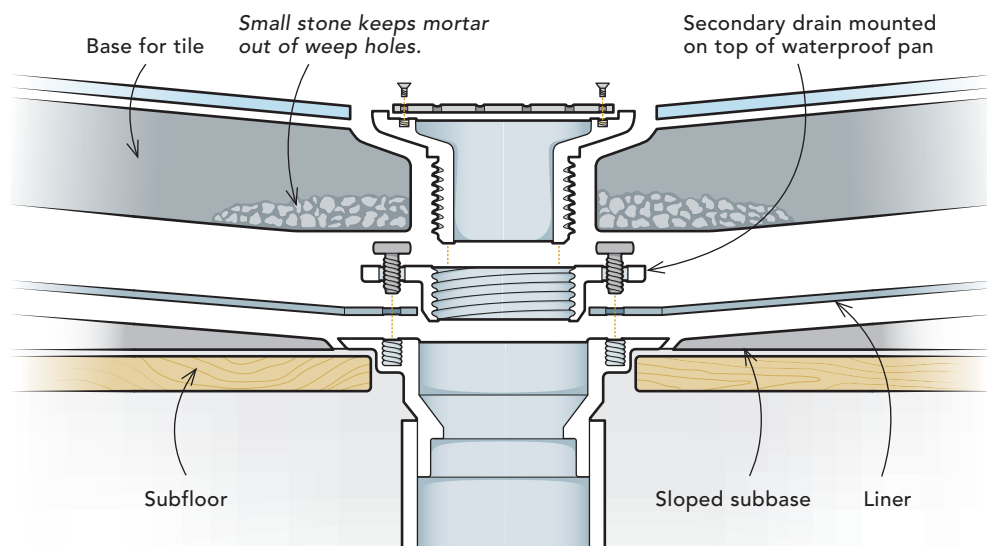
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LAYERS OF A SHOWER PAN

Code requires that lining materials in field-built shower pans slope $\frac{1}{4}$ in. per ft. toward weep holes in the sub-drain. The liner sits atop a smooth, solidly formed subbase laid on the flat subfloor. The mud base for the tile goes above the liner, and gravel is typically packed around the drain's weep holes to prevent this mortar layer from clogging it.



future inspection that not every house receives: a shower-liner inspection, detailed in section P2503.6 of the IRC. It also prompts the verification of solid blocking in the walls surrounding the shower for backing and attaching the liner. This blocking or backing often isn't easily visible once the liner is installed. The liner itself must be recessed into its backing "so as not to occupy the space required for the wall covering." In other words, the face of the liner should be flush with the face of the studs so the wall covering can be installed flat to the wall. A surprise to many, this means the blocking and studs may need to be shaved down by the thickness of the liner material to accommodate it.

Before the liner is installed, a solid subbase must be installed to create a smooth and uniform slope to the drain. The subbase must slope $\frac{1}{4}$ in. per ft. toward the drain from all portions of the pan. Modern shower styles use offset drains or linear drains for a sleek look that keeps the drain out from underfoot when showering. Whatever the drain's shape and location, the sloped subbase is critical to moving bulk water from the

shower floor, and the sneaky water that gets through it, toward the drain.

Shower curbs, which prevent bulk water from running out of the shower, are not required, but there are provisions for their installation when they're included (and where they are incorporated, they're typically roughed in before the subbase). Curbs must be at least 2 in. higher than the drain, but not more than 9 in. higher. Because they act as dams that can raise water level in the shower area, the top of an included curb becomes the benchmark for the height of waterproofing. For curbless showers without such a dam, the floor-level threshold at the opening serves the same purpose. It is where visible water will escape and limit the rise of water up the walls.

After the sloped subbase is in, the liner can be installed. The code offers a number of choices for this application, from the time-tested but relatively outdated use of lead sheets and hot-mopped layers of asphalt felt to the common plastic lin-

ers used today. Alternative, proprietary products are also popular and can be approved locally. Whatever the product, the liner must extend at least 2 in. beyond and around rough jams at the opening and at least 2 in. above the finished threshold, whether it's at the floor level or on a raised curb. Perforations or nails cannot penetrate the liner less than 1 in. above the finished threshold.

With the liner installed and visible, the next step is the leak test. The drain must be sealed so the pan can be filled with water to a depth of at least 2 in., measured at the threshold. Where there's no curb at the threshold, as in a curbless design, a temporary curb must be constructed for the leak test. This is often just a piece of lumber laid in place with an additional length of liner draped over it. This can be tricky to set up and should be planned for ahead of time when building a curbless shower.

Though few enjoy being tested, leak tests should be low-stress occasions because the

installer has the answer key. There are no special qualifications necessary to observe a wet floor, so the inspector should have little to do other than nod at a full pan and a dry floor. If the liner doesn't leak for the 15-minute duration of the test, it passes. If it leaks, it fails. It's important to not make a mess when filling the pan for the test, as a dry floor is necessary to ensure there are no leaks.

The question of whether the code requires a similar liner over shower seats often comes up, but the IRC offers no guidance here. Common sense would dictate that the same minimum $\frac{1}{4}$ -in-12 slope is critical to keep bulk water moving. The finished floors of showers can slope up to $\frac{1}{2}$ -in-12; anything steeper could be a slip hazard. For a seat designed for sitting, that hazard could be argued as "bather beware" if he chooses to stand on it. But remember, the code is a minimum standard and not a measure of fine home building. It would always be wise to waterproof the seat in some manner.



For more editions of "Know the Code," visit FineHomebuilding.com/knowthecode.

Glenn Mathewson is a consultant and educator with buildingcodecollege.com.

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STURDY, COMMON- SENSE HINGE TEMPLATES



Simple and accurate. Plywood templates from Templaco make it easy to mortise hinges. They're secured to the door with captured nails.

Templaco Tools templates have been a staple of my door-hanging work since I entered the finish-carpentry trade. My door box contains two routers, a big corded drill for boring, and single templates for 3-in., 3½-in., and 4-in. hinges as well as a multistrike template that will rout the four most common strike-plate shapes. Templaco makes a dizzying array of templates for every conceivable door size and configuration, hinge, strike, flush bolt, and mortise lock. Prices range from \$29 for a single 3-in. hinge template, to \$67 for a full-length 6/8-door three-hinge template, to \$315 for a three-sided pocket-door hardware template. Templaco will also customize a template if they don't have what you need.

I like these tools for lots of reasons. They are simple, durable, and relatively inexpensive. I can use them on newly installed jambs without stops or existing jambs with stops already on. They're adjustable, so I can place the hinges exactly where I want on the edge of the door, and they work for different door thicknesses. The built-in spacer that automatically sets the head gap on the jamb is pretty much foolproof. Because the templates are made from plywood instead of metal, I can easily repair a router ding with auto-body filler or modify them as needed. One routine modification is to screw a fence onto a template so it can be clamped to the door rather than using the captive nails that normally attach it.

I can sense a few questions floating out there: No, these templates won't replace a microadjustable metal jig for some remodeling work—especially when hanging a house full of new doors in old jambs—but I have found they will do what I need 90% of the time. And yes, I know that any competent finish carpenter can build their own plywood hinge templates. In fact, you can see some of my techniques for doing just that in this issue (pp. 46-51). But these templates are already made from nice plywood, they're edgebanded, they have a laminate surface that my router can easily slide on, and they have built-in stops and template nails. Besides all that, they just work great.

Kit Camp, former finish carpenter and woodworking teacher in Portland, Ore.

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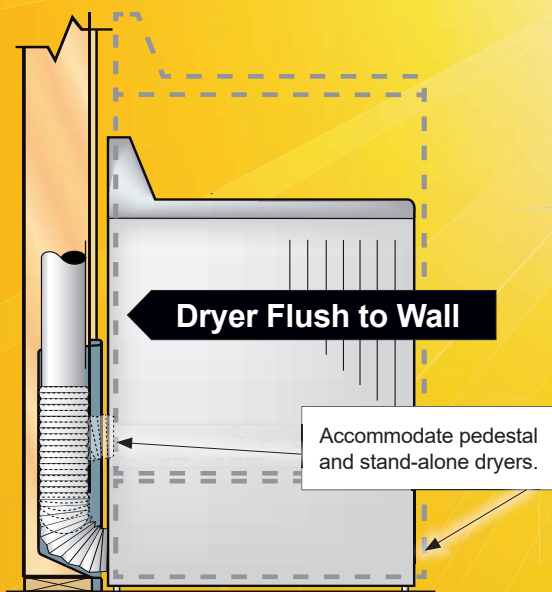
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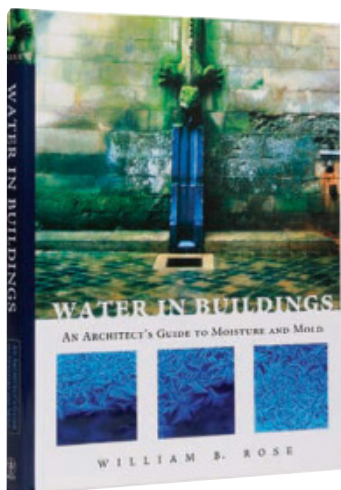
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Water in Buildings

by William B. Rose

Jon Wiley & Sons, Inc.; 2005
288 pages; \$100

How water affects building

Shortly after beginning as an editor at *Fine Homebuilding*, I worked with Bill Rose, a research architect at the University of Illinois at Urbana-Champaign (“Details for a Dry Foundation,” *FHB* #111). Bill struck me as an architectural iconoclast, arguing against such standard practices as crawlspace and roof venting. I’d only recently left my job as a carpenter, so I was initially aghast at these blasphemies. But the longer I worked with Bill, the more my own views changed.

Very few people I’ve known can make science understandable and relevant the way he can. In fact, he’s such a good writer that I dropped \$100 to buy his book, *Water in Buildings: An Architect’s Guide to Moisture and Mold*.

It begins by explaining the behavior of water in basic scientific terms, teaching about the effects of surface tension, vapor pressure, and capillary action. It sounds dry, but I assure you it’s not. It does take some focus to read, because the content is so richly detailed—not because it’s boring.

Once you’re through the initial chapters, Bill takes you into his world, which includes distillations of others’ research, results of his own research, and case studies of building failures. He takes a historical approach, explaining how incon-

clusive research and primitive materials from the 1930s and 1940s led to the codification of crawlspace and roof venting. He then explains why neither works very well and offers alternatives.

Despite its title, *Water in Buildings* isn’t just about water. It also explains air movement in houses and offers some good advice for making buildings last. Two of my favorite building tricks come from this book. The first concerns crickets. Most crickets terminate at the upper corners of the chimney and drain right onto the step flashing. It’s a fussy detail to get right. Bill suggests simply making the bottom of the cricket a little wider so the valleys drain a few inches away from the side of the chimney. It’s easier to flash, and directs the water further away from the chimney.

The second is simply spreading a layer of gravel below a porch or deck. This keeps your feet out of the mud as you’re building, and it short-circuits capillary movement of ground water, helping to keep the structure above dry. I don’t have space to explain the why of that here, but it’s a real effect that *Water in Buildings* covers in depth. Buy the book. It will make you a better builder.

Andy Engel, a lead carpenter for Hudson Valley Preservation in Kent, Conn.

Cut-resistant work gloves

I always thought carpenters were supposed to have rough hands with some scars, but then I cut one of my fingers bad enough to warrant surgery. That Christmas, my brother bought me a pair of silver-and-white prep chef’s cut-resistant gloves as a gag gift. He was surprised months later when I told him how much I liked them. You can slice a fresh utility-knife blade across the palm and it barely leaves a mark. The only problem is that they lack dexterity. I did some searching and came across a wide variety of other cut-resistant gloves and eventually landed on a polyurethane-coated pair made by G-Tex for assembly workers (\$7 per pair). They aren’t as cut-resistant as the silver-and-white chef’s gloves, but they are stretchy, durable, and inexpensive. They’re also thin enough that I can easily grab a dropped bit or peel the backing off of flashing tape without removing them. They aren’t great for cold-weather work, but they have quickly become my favorite warm-weather gloves.

Justin Fink, editorial director



Thin and breathable.

These cut-resistant gloves are good for everything from cutting thin metal and changing the knives in a thickness planer to framing walls and laying asphalt shingles.



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A better way to grout

In my constant search for products to make grouting more tolerable, I ran across the Barwalt Ultra Grouting System (\$95). The setup consists of a rinse bucket, two hook-and-loop grout-sponge handles with interchangeable sponges, and two scrubbing pads. The bucket's wheels make it easy to move when full and a plastic screen that stands off the bottom cleans dirty sponges and keeps the rinse water cleaner. Three spindles on top of the bucket wring the sponge after it's rinsed.

The setup I bought includes a large floor float that's roughly 5 in. by 13 in. and a smaller wall float (6 in. by 11 in.). After using the system for the first time, I realized I've been grouting the wrong way for 18 years. The bucket screen keeps the water clean longer, saving water changes and making it worlds easier to keep up with the quick-drying premixed grouts. The padded handles on the sponges are comfortable and keep your hands out of the rinse water. The rollers quickly wring out the rinsed sponge with a few passes. Unfortunately, the oversize sponges are too big for tight areas like backsplashes, but a regular grout sponge fills in when needed. If you grout more than once or twice a year, it's a no-brainer.

Andrew Grace, a remodeler in Ligonier, Pa.



Faster grouting. Plastic rollers quickly wring out the padded-handle sponges without soaking your hands. The rollers make the sponges drier, so you don't wash out the grout as you tool the joints.

Photo: courtesy of Barwalt

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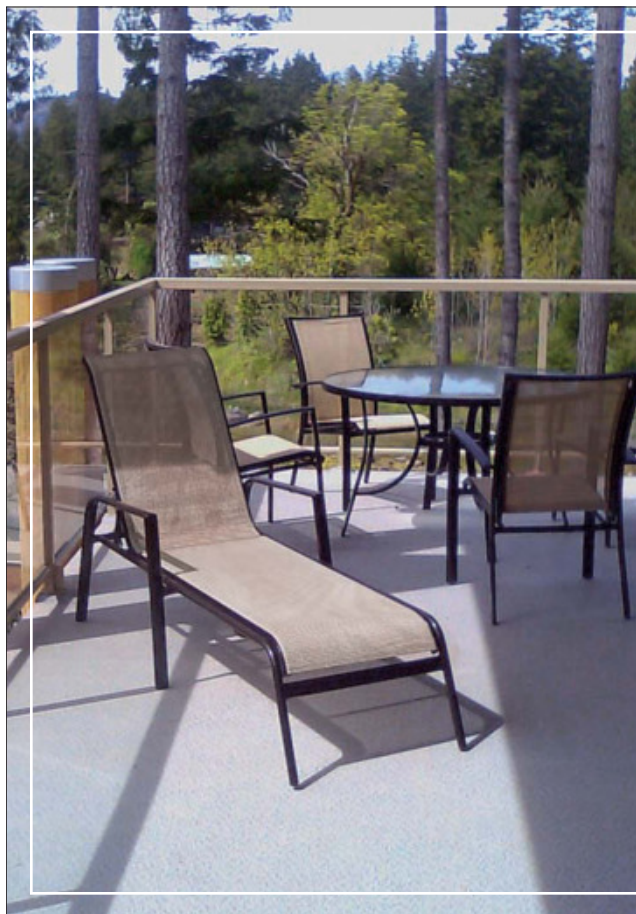
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*Sorry, felt paper, we can do better.

Trim-saving pry bar

As a remodeler, removing trim is an almost daily chore. I have tried any number of pry bars or combination of pry bars to make the job easier with little success, typically ending up with broken trim, broken drywall, or both—until a recent trip to the big box, when I picked up the Trim Puller by Zenith Industries (\$29).

Removing trim on a remodeling job usually falls into three categories: removing the trim to preserve and reuse, removing the trim for replacement while saving the wall board, or removing both for total replacement. When both are destined for the trash, we pull it all down with a mattock and that's that. But on simple trim swaps, drywall damage from prying at trim adds another layer of repair to the work. And on historical renovations, one false move has banished me to the shop for days, replicating and finishing custom moldings, usually for free. When the blade of the Zenith Trim Puller is driven between the wall and the trim, it stays flat to the wall and the 15° wedge pops the trim loose. Paint scuffs replace drywall gouges and the trim is removed intact. I have yet to break a piece of trim with this tool.

It may be hard to get excited about a bent chunk of steel with a plastic handle. That is, until you've tried this particular bent chunk of steel. I can't express how much time and money this pry bar has saved me.

A.G.



Trim specialist. The Zenith's wide blade with its 15° wedged center pops off trim without damage.

Photos: Patrick McCombe

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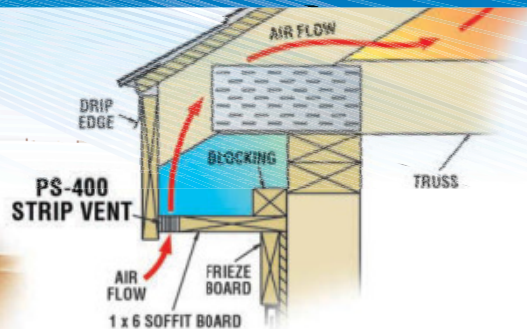


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The Ins and Outs of Exterior Doors

A crash course in choosing a door, from basic features to premium upgrades

BY PATRICK MCCOMBE

I can't think of something in a house that's more important than the front door. It keeps out wind, rain, and intruders; it greets guests and provides light and fresh air; and it gets used every single day. For an exterior door to do a good job, its beauty must be more than skin deep—it's the things you don't see at first that determine whether an exterior door is ready for the long haul.

In addition to the years I spent as a carpenter installing exterior doors, I also spent a few years selling them at a pro-oriented lumberyard, where we had an in-house door shop and sold hundreds of doors every year. I got to see what makes a good door, and I also heard from builders and homeowners about all the possible problems. I learned what to know when ordering a door, and what you should look for when comparing options. Prices vary widely, so I'll discuss options for all budgets. □

Patrick McCombe is a senior editor.

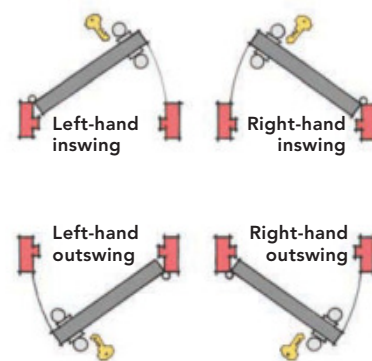
FOOLPROOF ORDERING

INSWING VS. OUTSWING

The first step in picking a door is to decide whether the door will swing in or out when it opens. In the United States, inswing doors are far more common than outswing doors, because you can open an inswing door when there are several feet of snow outside, and enter the house easily when your hands are full. That said, they don't seal as well as outswing doors because wind pressure will work to open the door instead of pushing it closed. Because of their weathertightness, outswing doors are a better choice for coastal areas, though they can be harder to open for the reasons mentioned above.

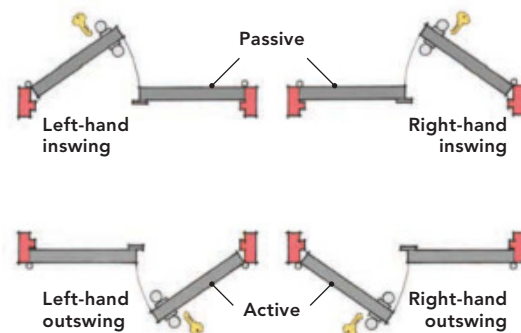
SINGLE DOOR

One way to tell the swing, or "handing," of a door is by standing in the doorway with your back to the hinge-side jamb. If the door swings left, it's a left-hand door, and vice versa. Note that this is not a universal convention; some manufacturers use different nomenclature and methods for determining handedness.



DOUBLE DOOR

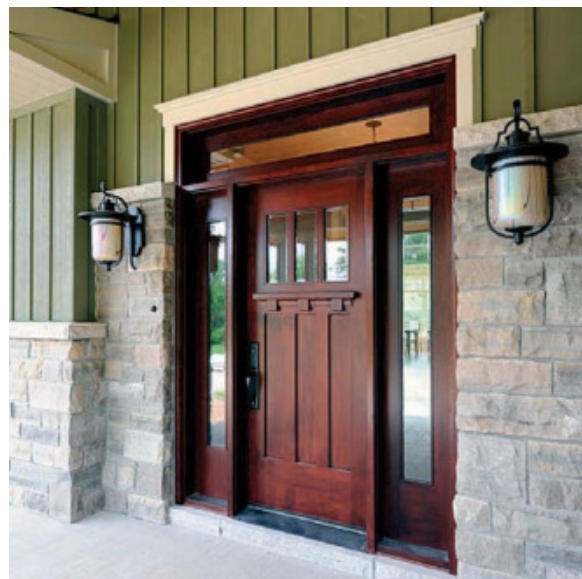
If your opening has a pair of doors, you'll have to specify which door is the active door. The active door is the one you use most often and the one you have to open before you can open the passive door.



SIZING

The width and height (in that order) of a door is identified by feet and inches, with the odd convention of removing the feet and inches labels. So a 36-in. by 80-in. door, the most common residential size, would be described as 3/0 x 6/8 (pronounced as "three-oh, six-eight"). Although custom doors can be virtually any size (See "Build a High-Performance Exterior Door," *FHB* #256), major manufacturers offer entry doors in widths from 2/0 to 3/6 and in heights from 6/6 to 8/0 or taller. Remember that the IRC says that at least one door in the home must have a minimum 32-in. clear opening, which requires a 3-ft.-wide door slab.

With new construction, follow the door manufacturer's instructions for rough-opening sizes. When matching existing openings, remove the casing and measure the height and width of the opening and the thickness of the wall to avoid surprises. More than once I had customers who ordered doors that were too big because they assumed the existing jambs were thicker than they were. One customer ordered a new door based on the existing door it would replace, only to discover that someone had removed the jack studs to squeeze a larger door into a too-small rough opening.



TRANSOMS AND SIDELIGHTS

Many doors have small windows called sidelights on one or both sides of the door. Usually sidelights are fixed, but they can also be operable. Sidelights come in 10-in., 12-in., and 14-in. widths. Transoms (windows above the door) come in several widths to match the various door and sidelight combinations. They can be round, rectangular, or elliptical, and they come in many heights.

GETTING A GOOD DOOR

For a door that works like it's supposed to, insist on these basic construction details.

MATERIAL



STEEL is the least expensive option. You can find prehung steel entry doors for less than \$150. The most expensive setup with sidelights and a transom could be \$2000 to \$3000. Steel paints nicely, but staining is difficult. Steel slabs also can't be easily trimmed to fit an existing opening. This material isn't a good idea for those living close to salt water, but in noncoastal areas, a regular paint job can keep rust at bay for decades.



FIBERGLASS doors are in the middle to high end. Prices start at a few hundred dollars for a basic prehung door to \$5000 to \$10,000 for fully optioned models with sidelights and a transom. Fiberglass doors can be painted or stained to look like wood, and some models have a smooth skin, while others have a faux-wood-grain texture. The big pros of fiberglass doors is they don't rust, and they offer the look of wood with little maintenance.



WOOD doors have a wide price range. Six-panel pine doors can be found for a few hundred dollars, or you can commission a hardwood door that costs thousands. The great thing about wood is the wide variety of species and finishes available, but each comes with the universal downside of necessary ongoing maintenance. Because of this, wood doors should be covered by a storm door, roof, or generous overhang.



SILLS

Inexpensive doors will have a nonadjustable aluminum sill, but an adjustable sill should be the bare minimum, allowing it to be raised as the sweep wears or the building settles. Consider raised coastal sills in areas subject to regular wind-driven rain. You can also order relatively flat ADA sills that are less of an obstacle to those with mobility issues.



ADJUSTABLE
INSWING SILL



COASTAL
SILL



OUTSWING
SILL



ADA SILL

CONSTRUCTION

Less expensive doors have narrow stiles, as little as 1 in. across. Narrow stiles are weaker and more prone to warping than wider stiles. High-quality wood and fiberglass doors have stiles that are 4 in. or more. You can find out the width of stiles and rails on steel and fiberglass doors in the manufacturer's technical data.



JAMBS AND CASING

Prehung entry doors are usually sold with the exterior casing already installed. The most common casing is 2¼-in.-wide brick molding. This chunky casing works with a wide range of claddings, including brick, clapboards, vinyl, and even stone veneer. Most suppliers can also install 5/4-in. or 1-in. nominal casing in several widths if you need to match existing doors and windows or to cover an oversize opening. Some suppliers will even custom-mill casing to match existing profiles.

The most common jamb thicknesses for exterior doors are 4⅞ in. and 6⅞ in. This assumes a 2x4 or 2x6 wall with a ½-in. layer of sheathing on the outside and a ½-in. layer of drywall on the inside. You can get wider jambs for homes with foam sheathing or thick claddings, and old homes often need unusually sized jambs because of thick plaster walls and board sheathing. You can extend jambs for thick or odd-size walls from the inside or outside with ¾-in.- or 1-in.-thick flat stock applied to the existing jamb. But beware site-applied extension jambs on the inside of inswing doors, as they will prevent the door from opening all the way. The same is true when you put extension jambs on the outside of outswing doors.

HINGES



NONADJUSTABLE hinges work fine for lightweight wood (less than 75 lb.), steel, and fiberglass doors without a lot of glass.

To ensure smooth operation, insist on **BALL-BEARING** hinges on heavy wood doors, ¾-lite and full-lite steel and fiberglass doors, and on doors taller than 6/8.

SPRING hinges automatically close the door after it's opened. They are often used on doors connecting garages and living spaces.

LOCKSET PREP

Most door slabs are cross- and edge-bored for a standard lockset and the jamb is prepped for the strike plate. Door suppliers will drill the door for a deadbolt for a few bucks more, which saves installation time and prevents the agony of drilling the door incorrectly. They may also be able to make the mortise for popular brands of mortise locks.

WEATHERSTRIPPING

Good weatherstripping is really what makes a door perform. It's important to match the reach of the weatherstripping to the door's edge profile. Doors with square corners use **MEDIUM-REACH WEATHERSTRIPPING**.

The alternative is **LONG-REACH WEATHERSTRIPPING**, which is used on eased-edge doors. Long-reach weatherstripping on a square-corner door will pinch, making the door hard to close. Some manufacturers also offer magnetic weatherstripping, but there are complaints that it makes doors hard to open.



GETTING A BETTER DOOR

These worthwhile upgrades make a door easier to live with and last longer.

MULTIPOINT LOCK

Multipoint locks employ three or more locking points to make the door more secure and wind resistant than a typical lockset/deadbolt combo. The setup also relieves stress on the hinges and jambs because the locks shoulder more of the door's weight. If you're using a multipoint lock, have the supplier prep the door and install the hardware, because the process is finicky.



ADJUSTABLE HINGES

Adjustable hinges can move the door slab on three axes to correct for seasonal movement, slight warpage, and the shrinkage of new framing. They're a worthy upgrade on any door, but especially helpful on heavy doors, like those with a lot of glass. Insist on adjustable hinges on patio and other double-door setups, no matter what material the doors are made from.



COMPOSITE JAMBS

The weakest link in modern exterior-door systems is the jamb. Generally made from finger-jointed stock with a thin coat of primer, they can rot in short order if they're in a wet spot. Composite jambs have either a composite bottom to prevent water wicking or they're entirely composite. Both last much longer in adverse conditions.



IMPACT-RESISTANT CONSTRUCTION

In hurricane-prone areas, impact-rated doors are a must. You can see the steel skin inside this fiberglass door that prevents breaches by flying debris. Glass must also be able to withstand an impact equivalent to a 9-lb. 2x4 flying at 50 ft. per second. Suppliers in coastal areas can help you match a door to your specific wind-zone requirements.





COMPOSITE SILL

Instead of wood (which can rot) under the aluminum sill, composite sills use either a fiber-composite or high-impact-plastic base under the aluminum. They're available in both inswing and outswing versions.



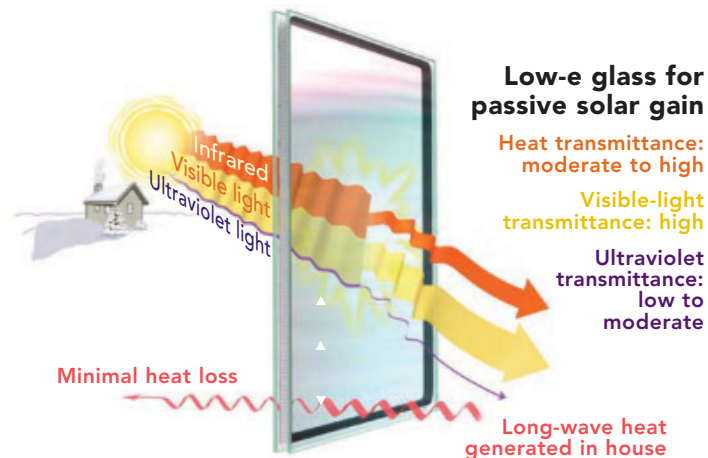
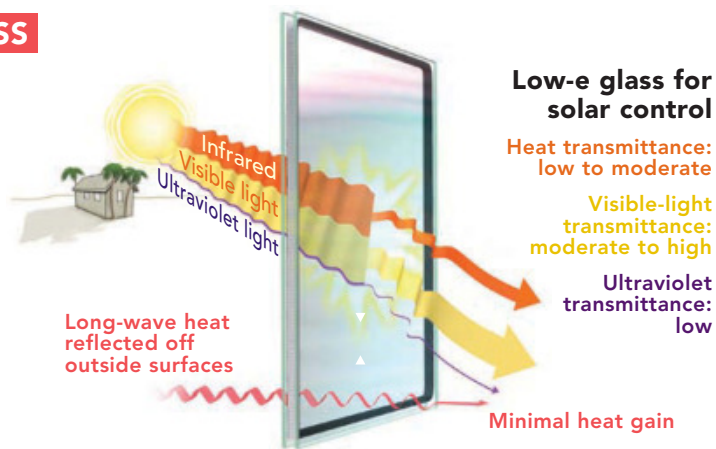
**INSWING
COMPOSITE SILL**



**OUTSWING
COMPOSITE SILL**

UPGRADED GLASS

Low-e coatings in heating climates and a low SHGC (solar heat gain coefficient) in cooling climates are a good start, especially on doors with a large percentage of glass. Even better is to choose the glass that's best for the elevation. Low-e coatings on north-facing doors and low-SHGC coatings on west-facing doors is the general rule, but site-specific conditions can affect those recommendations.





Build a Fireplace Brick by Brick

BY MIKE MEHAFFEY

Tips for building a long-lasting,
heat-throwing firebox

In some parts of the country, a house isn't considered a home unless it has a fireplace. A fireplace isn't necessary for heating or cooking as it was just a couple centuries ago, but it's still the centerpiece of many new homes, providing ambiance and, hopefully, supplemental heat. I say "hopefully" because some builders and designers don't take into consideration that how a fireplace works is at least as important as how it looks.

As Sir Benjamin Thompson—better known as Count Rumford—realized in the late 1700s, most of the heat coming out of a fireplace isn't dancing off the flames; it's radiating from the firebox walls. To make the most of this, he designed a fireplace that's wide, tall, and shallow, with sides that angle in toward the back to radiate heat out into the room. Prior fireplace designs—and many since—have sides that go straight back or angle only slightly, radiating heat toward each other rather than out into the room where it's wanted.

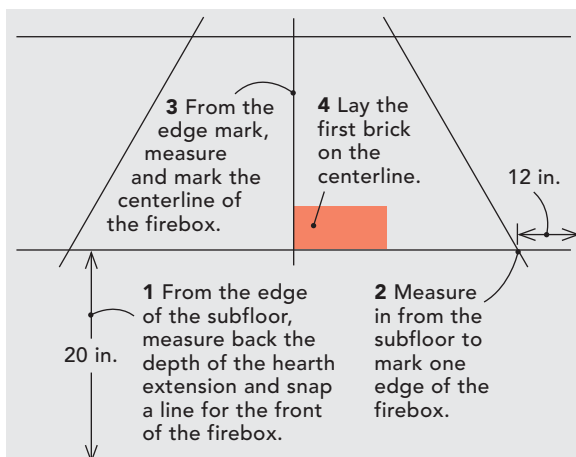
The one knock against Rumford fireplaces is that the original versions were often so shallow that the fire very nearly spilled out into the room along with the heat. But the idea behind them does work for heating a room, and so people frequently ask me to build them.

I've adapted Rumford's principles to modern aesthetics and code to build fireplaces that produce ripping fires that warm the space, but are also deep enough to assuage any concerns about safety. While the International Residential Code (IRC) has an exception for shallower Rumford-style fireplaces, my version is a hybrid based on the IRC's standard firebox dimensions, which means it doesn't require any special parts, and it won't get any side-eye from code officials.

Mike Mehaffey is a mason and owner of Stone Waleryszak LLC in Exeter, N.H. Photos by Matthew Millham.

LAY THE HEARTH

When laying the hearth—the floor—of the firebox, work from the center out to help keep joints aligned. Code dictates how far the firebox must be from combustible materials based on the size of the firebox opening. This one is 42 in. wide and 42 in. tall.



Mark the center. Measure off of the adjacent subfloor and mark the centerline of the firebox perpendicular to its front edge.



Work from the center out. Lay the end of the first brick for the hearth on the centerline, and level it both along its length and width.



Line and stick. Use a stringline as a guide to keep the bricks in line and in plane as they're tapped down to the proper elevation.



Stay on bond. Mark the center of a brick in the preceding course to help keep the bond pattern perfect. Keep joints tight at about $\frac{1}{16}$ in.



Don't get sloppy. Trowel on enough mortar to fill the joints—roughly $\frac{1}{8}$ -in. thick—and bevel the edges to avoid excess squeeze-out.



Backer brick beyond. Use firebrick and refractory mortar in areas of the firebox exposed to fire, and less expensive backer brick and Type-S mortar in areas that don't get direct fire exposure.

BUILD THE FIREBOX

The key here is to keep everything symmetrical. Measure from the center out to make sure the sidewalls leave an equal exposure of the bricks in the hearth below.



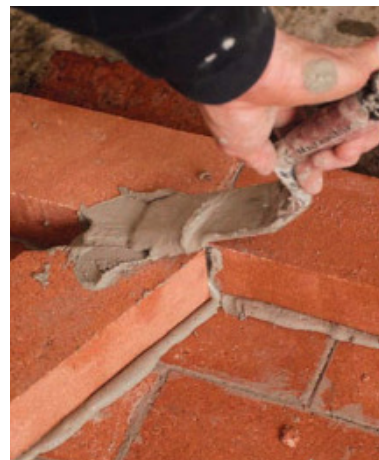
Angle in. The sidewalls should ideally face the room, not each other, to radiate heat into the room. Dry-lay in the first course on one side to establish the angle, then replicate it on the other side.



Back, then sides. For each course, lay the back first, and then lay the sidewalls, starting at the front edge and working back.



Precut sidewall bricks. Use a power saw to cut half-bricks and miters for the sidewalls. Use a rafter square to mark straight lines for the cuts.



Fill the gaps. Trowel refractory mortar into the gaps where the sidewalls meet the back.



Trim to fit. Use a brick hammer to trim the miters of bricks that butt into the back wall. Support the back of the cut with your hand.



Keep it level. Use a level frequently to ensure the walls are level, in plane in every direction, and plumb.



String for plumb. Use stringlines where possible. Here, stringlines plumbed down from a temporary outrigger aid in laying the front edge of the sidewalls plumb. Screws hold the lines in place above, and line pins secure them under the first course of bricks.



Get some air. If makeup air isn't supplied to a room mechanically, supply vents are required in the firebox. Follow the manufacturer's instructions for supply-vent installation.



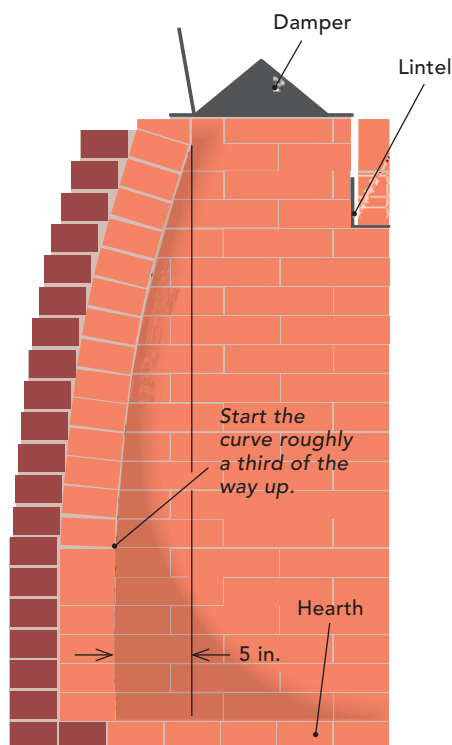
Level across. Lay a long level across the sidewalls for each course, and tap down bricks as necessary to keep their heights even.



Strike that. Fill any gaps in the joints and strike them after the mortar has set up slightly. Use the thin edge of the brick jointer to recess the joints roughly $\frac{1}{16}$ in.

CURVE THE BACK

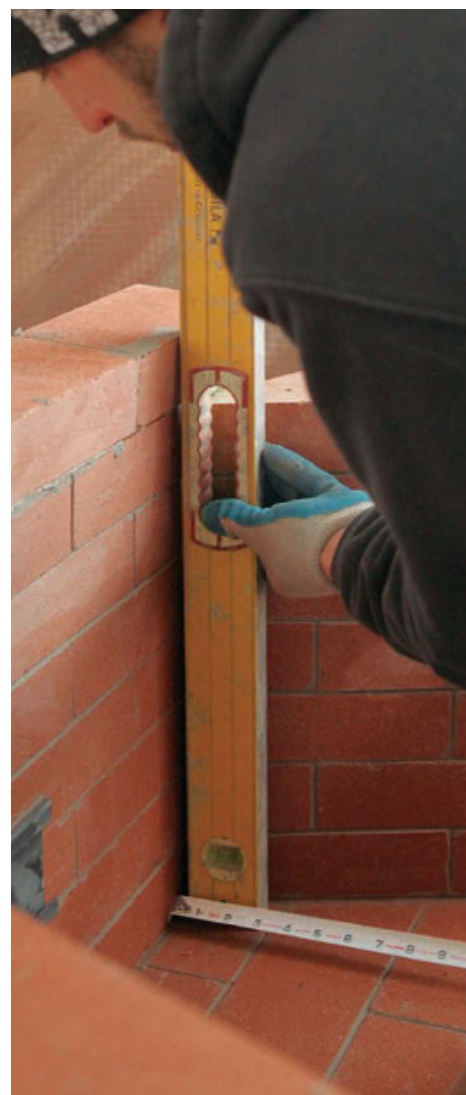
The back walls of standard-depth fireboxes typically lean toward the front to carry the damper. Creating a curve provides an elegant, flared appearance.



End of the curve. Determine how far the back wall has to come in to carry the damper, and mark it on the hearth at both ends to guide the curve's construction.



Tilt it slightly. Start the curve at the seventh course by laying the bricks with joints slightly wider at the back— $\frac{1}{32}$ in. or so to start—than the front.



Check your progress. Use a level and tape measure on both ends of each course to see how far the curve protrudes into the box to keep it even and check progress.

Keep it plane. Hold the level against the face of the walls to ensure the bricks in each course are in plane with each other.



Follow the curve. Trim the sidewall bricks to follow the lean of the back wall and test their fit before mortaring them in. The sidewalls get progressively shorter in length as the curve goes up, and the sidewall bricks that abut the back become shorter and shorter.



Head lock. Work from the outside in as the curve gets steeper; the mortar in the head joints—those on the ends of the bricks—helps keep individual bricks from sliding off. The exposed bed joints in the curve should have the same thickness as the bed joints in the courses that were laid level.



Stop the curve. Use a level and a tape measure to determine how much needs to be trimmed from the bottom of the last course of bricks to level the back wall.



Top it off. Custom-cut and lay the last course of the firebox's back wall level and plumb to carry the damper. Lay sidewall bricks as necessary to stabilize the curve, but leave space for the lintel, and fill in the sidewalls level with the back wall after the lintel is set.



Hit the mark. The face of the top course should be plumb up from the mark on the hearth floor.

ADD THE LINTEL AND THE DAMPER

The firebox tops out with a lintel in front, which carries the weight of the masonry above, and a damper behind, which seals the fireplace from the flue above when not in use. The damper must sit at least 8 in. above the bottom of the lintel on standard fireboxes.



EXCLUSIVE VIDEO

Visit [FineHomebuilding.com/magazine](https://www.finehomebuilding.com/magazine) to see a full step-by-step, members-only video of this firebox build.

Level the lintel. Set the lintel in refractory mortar, flush with the front edge of the firebox opening. By code, the lintel must bear at least 4 in. on each of the sidewalls. Remove rust from the faces exposed to the firebox, and coat with high-temperature paint.



Break the bond. Don't bond the bricks on top of the lintel to the walls below; this allows the steel lintel to expand and contract without pushing on the masonry.



Plane it out. Use a level to make sure the bricks atop the lintel are in plane to provide a flat surface for the fireplace surround that comes later.



Fill the sidewalls. Once the lintel is set, fill in the sidewalls level with the back wall, cutting bricks as necessary to provide a flat surface to carry the damper.



Ready to cap. Dry-fit the damper, trace its perimeter, and then remove it and apply refractory mortar inside the line.



Set the damper. Remove the damper's flap to make it easier to handle and set it atop the firebox.



Bevel the edge. From below, use a small trowel to neatly bevel the mortar joint between the walls and the damper.



Allow for expansion.

Leave a 1/4-in. gap between the damper and the brick atop the lintel.



Backer up. Use less expensive backer bricks and Type-S mortar behind the firebrick lining of the firebox.



Clean it up. Once the joints are set, sponge off the bulk of the excess mortar, then use a brush and a diluted solution of acid-based cleaner and water to scrub the walls, and immediately rinse with clean water.

A No-Math Approach to Valley Plates

Whether you're tying in new gable dormers or adding a chimney cricket, giving the valley jacks a place to land has never been easier

BY JOHN CARROLL



Depending on where you live, and who you're framing with, you'll hear valley plates called a lot of different names: valley boards, blind valleys, California valleys, reverse valleys, layover valleys, false

valleys, and sleepers. Valley plates are used most commonly when framing layover gable dormers or chimney crickets as a means of attaching the new framing to the existing sheathing and rafters, and to provide a place for the valley jacks to land. Compared to laying out and installing the ridge board and common rafters, framing the valley plate can be pretty confusing. It's possible to figure the layout using geometry—the valley plate is essentially the hypotenuse of an imaginary triangle laid flat on the roof deck. But I prefer to avoid the math, instead relying on stringlines, measurements, and some creative marking in place. □

John Carroll is author of *The Complete Visual Guide to Building a House* (The Taunton Press, 2014).

Lay out and install the valley plate

The valley jack rafters need to rest on a plate. The plate doesn't need to be beveled, but because of its thickness, you need to install it inside the valley line; the object is to get the top outside edge of the plate in plane with the tops of the common rafters.

2 Snap a line between the top and bottom points to lay out the valley.

3 Set a scrap of wood along the valley line.

1 Use a straight-edge to extend the plane of the common rafters to the deck of the main roof.

4 Set a second scrap against the ridge. Scribe along the edge to mark an angle on the first scrap. Cut along the line.

5 Place the scrap piece against the ridge. Move it along the ridge until the top corner is even with the top of the ridge.

6 Mark the sheathing along the edge, and measure the distance from the valley line.

7 Transfer this distance to the bottom of the valley, and snap a line between the two marks. This is the valley-plate line.

Lay out and install the valley jacks

8 Slide the scrap piece down to the bottom edge of the ridge. Scribe along the edge of the scrap piece.

9 Measure the distance between this line and the valley-plate line. This is the minimum board width needed for the valley plate.

10 Measure the length of the valley-plate line, and cut the valley plate with the appropriate miters at the ends.

11 Nail the valley plate along the line.

1 Hook a tape measure over the nearest installed common rafter. Mark the ridge at 16-in. intervals, to match the spacing of the common rafters. (On a small roof, there might be only one or two jack rafters.) Use a square to mark the layout on the ridge.

3 Measure the distance from the top of the ridge to the outside of the valley plate at each rafter location. This is the length of the valley jacks.

2 Place the blade (the 24-in. leg) of a framing square against the common rafter, and mark the plate along the end of the tongue (the 16-in. leg). Repeat this process, if necessary, after you install each jack rafter.

4 At the top of a piece of rafter material, lay out a plumb cut to match the common rafters. Set the saw to 0° and make the cut.

5 Mark the valley-jack length along the top edge from the long point of the plumb cut. At the mark, lay out a level line to match the common rafters.

7 Nail the jacks in place.

6 Set your saw to a bevel that's equal to the pitch of the main roof, and cut along the line. Make the line the short point of the bevel.

Get More From Your Router

A veteran carpenter shares his secrets

BY KIT CAMP

I'm a little embarrassed to admit just how many routers I own, from small laminate trimmers to 3-hp monsters. Let's just say it's more than a dozen, and less than two dozen. For someone buying their first router, I would recommend a combination kit with a plunge and a fixed base. These are available with either full-size (1½-hp to 2-hp) or trim-router size (1-hp to 1¼-hp) motors. My favorite full-size combo kit is the DeWalt DW618PK (\$200), which I have been using since I tested router kits for the magazine a number of years ago. For day-to-day finish-carpentry tasks, I'm quite partial to the trim-router size. My favorite in this category is another DeWalt combo kit, the DWP611PK (\$170).

I use routers in three main ways: to add decorative details, for precise tasks like hinge-mortising and joinery, and for creating complex curved shapes.

This article shows just a sample of what you can do with a handheld router. The tasks you can tackle are limited only by your imagination—and your collection of routers, jigs, and bits. □

Former finish carpenter Kit Camp teaches woodworking to students in grades 6 to 12 in Portland, Ore. Photos by Asa Christiana, except where noted.

Five tips to get you started



1 START WITH GOOD BITS

I use high-quality bits from Amana, Whiteside, Onsrud, and Freud. Their slightly greater cost is offset by significantly better construction and performance. I've seen some cheap hardware-store bits blow apart during use.



Amana 53407-1
3-wing slot cutter



Freud 32-504
rabbeting bit

LMT Onsrud
52-367 spiral
upcut bit



CMT 801.128.11B
mortising bit

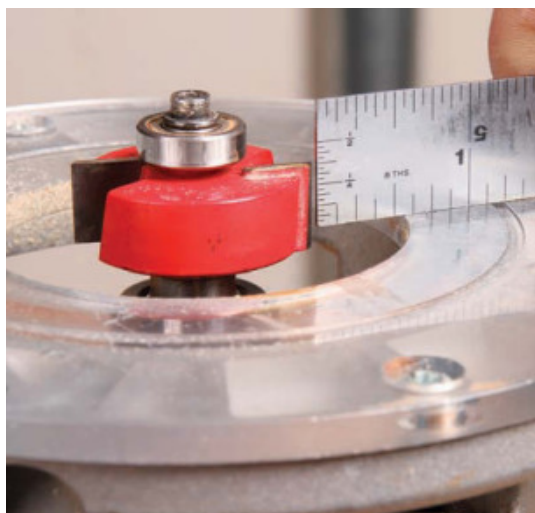
2 DON'T HIT BOTTOM

Safe, effective router use starts with how you install a router bit in the collet. Push the bit to the bottom of the collet and then pull it back up slightly to make sure the collet can fully tighten down on the shank.



4 HOLD STEADY

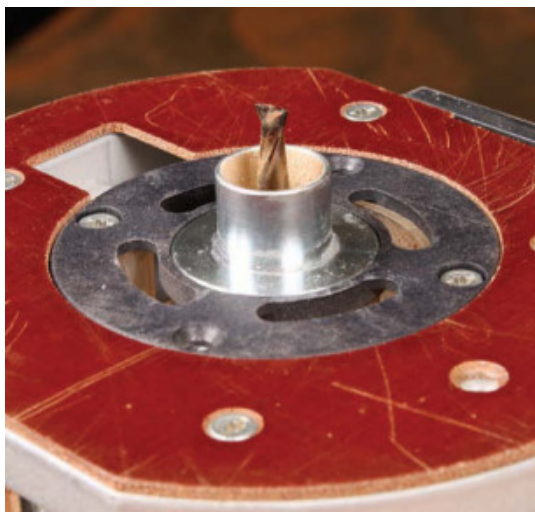
Another must-have is a teardrop-shaped oversize acrylic base plate. The bigger base allows you to focus your pressure on the inboard side when the base is overhanging an edge, which is especially helpful around corners.



3

CHECK DEPTH

A 6-in. ruler with graduations on the end (leevalley.com) is a must-have accessory. It makes it easy to set the bit to the exact projection needed.



5

TRAVEL WITH A GUIDE

Most mainstream routers can be fitted with guide bushings, also called template guides. These inexpensive accessories allow you to follow a pattern without a guide bearing on the bit.

Crisp edge profiles

I have two small routers with 1/8-in.- and 1/4-in.-radius roundover bits permanently installed because I use them so often. These profiles—especially the 1/8-in. setup—touch up the edges of stock coming off the tablesaw and soften the edges of face frames and closet shelves faster than a block plane or sanding block. I also have a box full of beading bits, cove bits, chamfer bits, and fluting bits that allow me to match edge profiles or create moldings on site. The two main issues that come up when edge-routing are chipout and burning. Burning is the easiest to avoid. Assuming your bit is sharp and free of pitch, the trick is moving at a steady pace without slowing or lingering. For deep profiles, make a series of passes, saving a light pass for last. To avoid chipout, rout with the grain when you can, or try climb-cutting (see below).

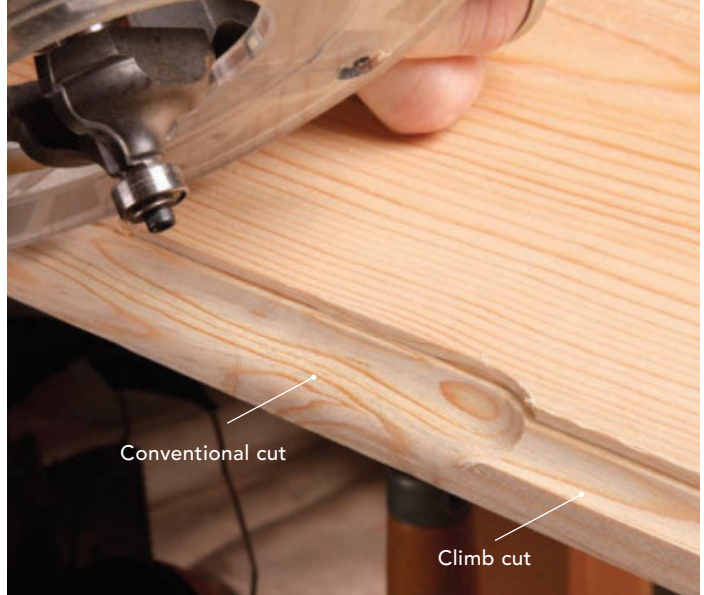
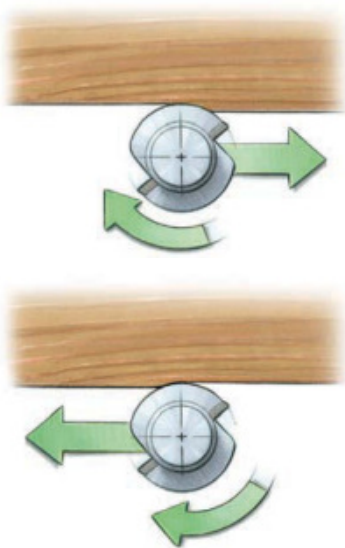
TWO TYPES OF CUTS

Conventional cut

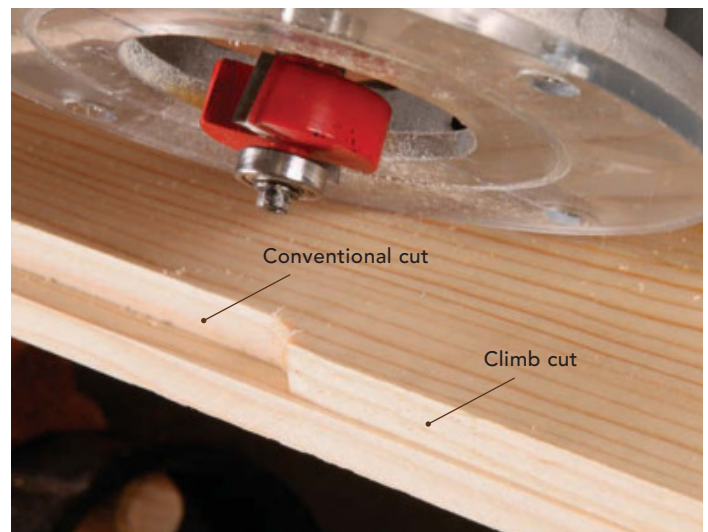
Generally you should move a router against the bit's rotation, but sometimes moving the bit in this direction tears the wood fibers deeper than the profile will cover. Some woods are especially prone to tearout, and grain direction plays a big part.

Climb cut

Going the other way—cutting with the rotation—is called climb-cutting, and can eliminate tearout. It's a self-limiting way to make a deep, bearing-guided cut in a series of passes without adjusting the bit depth. When climb-cutting, make a series of light passes and hold on tight to the router.



Start with climb cuts. Use one or two climb cuts to remove most of the material. The bearing is not yet touching the wood, so these cuts are made by feel, which is easier than it seems. Finish up the profile with a conventional cut with the bearing riding the edge. If necessary, lower the depth for a very light final pass.



Crisp rabbets. Climb cuts can also be used to cut clean rabbets. I like a big Freud rabbeting bit (32-504) that includes multiple bearings for different-size rabbets. Start with a light climb cut to break the edge; finish with a pass in the conventional direction.

Perfect hardware mortises

I use a trim router to make fast, accurate mortises for hinges and other types of door and cabinet hardware. I almost always use my own shopmade templates together with a short, top-bearing, pattern-routing bit. To keep the bearing in touch with the edge of template, you have to start the router at full depth. To do that, you can either tilt the spinning bit into the cut or build templates with extra room in the opening for starting the bit.



Quick jigs. By ripping 1/2-in. birch plywood to precise widths and joining it with staples, you can build a precise template around a strike plate or hinge leaf. Glue the edges and drive staples across the joints on both sides.



Line it up and go. Use centerlines on the jig and workpiece to align them, and make sure the jig is long enough for clamping without impeding the router. Attach a fence to the bottom to register the jig on future workpieces.

Sturdy splines

I use spline slots for wrapping beams and posts with finish material, changing directions with tongue-and-groove flooring, and making solid-wood panels of all kinds. I prefer splines over biscuits, as the splines are guaranteed to fit tightly and bring slightly warped boards into perfect alignment.

A router works better than a tablesaw for spline slots because it rides over any curve in the workpiece, keeping the slot a uniform distance from the face, and it lets me start and stop the bit short of the board ends, hiding the splines in the finished work. A slot cutter (such as the Amana 53407) can also cut excellent biscuit slots.



Clamp and go. Clamp the board to the bench, and start and end each cut a little short of the end of the board so the splines stay hidden. Make sure you run the router on the top face of each board, so the face stays aligned even if the boards vary in thickness.



Increase your footprint. Use an extended base for stability and keep the router base on the front of the material for all the grooves or slots you need. This corrects for variations in material thickness, and ensures that the faces of the boards will be flush.



Make snug-fitting splines. Rip off your spline stock on the tablesaw, making sure everything comes together perfectly before applying glue. Snug splines will bring the boards into alignment, even if they are slightly warped.



No-worry glue up. Before gluing, have the clamps close by and adjusted to the proper length. The splines keep the boards aligned during glue up, but alternate the pipe clamps top and bottom to keep the panel from bowing up or down.



Work clockwise. I use a top-bearing, flush-trim bit (CMT 801.128.11B) in a fixed-base router. Set the depth so it matches the thickness of the hinge or strike and make the mortise in one pass. Move clockwise around the template to hug the outside, and then crisscross the middle to finish the job.

Flawless results. After squaring the corners with a chisel, drop the strike into place and drill pilot holes using a self-centering bit. I save the templates that I think I'll use again, though making a replacement only takes a few minutes.



Deep mortises

With a plunge base, straight bit, guide bushing, and template, you can excavate deep, smooth mortises in a series of passes. The finished mortise is smaller than the template due to the bushing offset, but it's easy to cut tenons to fit. To keep chips from packing the mortise, attach a vac to the router, pause often to suck out the chips, or tip the router upward so the motor blast blows chips out.



Make a template. I made this jig from $\frac{3}{4}$ -in. veneer plywood with four plunge cuts on my sliding miter saw and fastened it to the stock on the layout lines with a pair of finish nails and a clamp.



Dig a hole. Rout the 2-in.-deep mortise with a large upspiral bit (LMT Onsrud 52-367) in a series of $\frac{1}{4}$ -in.-deep passes. Move clockwise around the jig and then back and forth across the middle before plunging again. Do this until you reach the final depth, set with a stop on the router.

Straight sides.

The guide bushing stays engaged with the template no matter the depth of the cut, so the sides of the hole are as smooth and straight as those made by big industrial machines.



Snug fit. Make matching tenons on the tablesaw using a dado set or tenoning jig. Go for a snug fit and then round the corners with a chisel or wood rasp.



Fast, accurate casework

I use routers for a variety of cabinetmaking tasks, like making dados for shelves and flush-trimming solid edgebanding. To make dados, I make a plywood T-square jig that clamps to the workpiece. I run the router on top of the jig, using a top-bearing bit that rides against the fence. This way, the jig can be aligned directly with the layout marks, and having the jig on one edge of the dado prevents chipping. It also helps to rout on the right side of the fence, so the cutting action pulls the bearing against the fence, rather than wandering away.



Flush-trimming. Both face frames and solid edgebanding can be trimmed quickly and accurately with a bottom-bearing, flush-trimming bit. To steady the router, keep the bit projection to a minimum and keep your grip low. To prevent chipout, use one or more climb cuts.

Production curves

You can use a router with a shopmade template to replicate curved shapes like rafter tails or head casing. I lay out the shape and then I cut out the template with a jigsaw or bandsaw, leaving $\frac{1}{8}$ in. to sand off. A smooth pattern is critical, as any bump or dip in the template will be followed by the bearing and reflected in every workpiece. To fill a small flaw in the edge, try a little Bondo. Also, to give the bearing a smooth exit or entry to the cut, I make my patterns wider or longer than the workpiece.



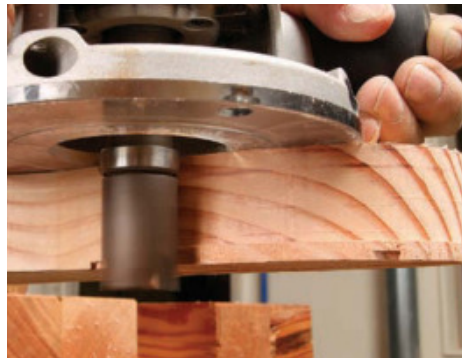
Cut and smooth the template. On the job site, I usually saw the pattern with a jigsaw and smooth it with a belt sander. The front wheel of the belt sander can be helpful in tight curves. Sand by hand, backing the paper with whatever works to match the shape.



Rough out the cut. Use the template to trace the outline on each piece, and then rough them all out with a jigsaw, leaving a scant $\frac{1}{8}$ in. or so to rout off. That amount of waste makes for a nice, clean cut.



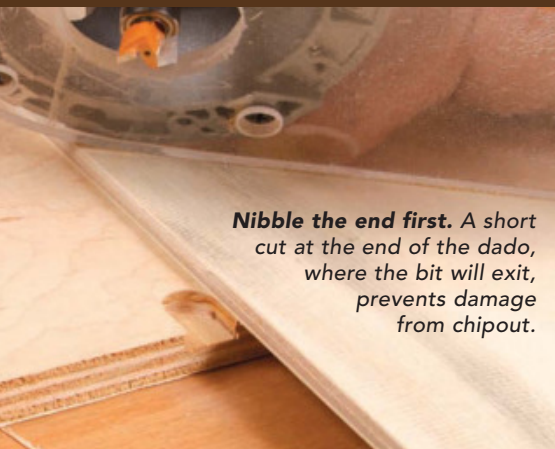
Rout as much as you can. Start with a top-bearing flush-cutting bit (Amana 45368), with the router riding the top of the jig. Set the depth of cut so the bearing is riding on the template.



Plunge and proceed. Remove the jig and use the same bit to shape the rest of the edge, with the bearing riding the area you just routed. If the bit still can't reach the bottom edge of the workpiece, switch to a bottom-bearing bit and rout from the other side.



Clean curves. If you've cut away most of the waste before routing, and used a sharp bit, you will typically have very little sanding to do. With the template in hand, it takes less than an hour to produce a dozen curved rafter tails like this.



Nibble the end first. A short cut at the end of the dado, where the bit will exit, prevents damage from chipout.



Make the full cut. Use a smooth, steady speed that doesn't bog down the motor. Because these dados are usually shallow, you can make them in one pass.



Strong connections. The same setup can be used for both dados and rabbets and produces a strong case that's easy to assemble. With undersize plywood, use a smaller bit and make another pass after moving the fence.

An aerial photograph showing several houses in a residential neighborhood completely surrounded by floodwater. The water is a murky brown color, and the houses are white with dark roofs. The scene illustrates the impact of flooding on residential areas.

Building for Floods

A New Orleans prototype home may provide a path for builders looking to weather rising sea levels and intense storms

BY STEVE CIMINO

According to Vol. I of the Fourth National Climate Assessment, a comprehensive federal climate report released in 2017, the global sea level has risen 7 in. to 8 in. since 1900—three of those inches since 1993. A study from the National Academy of Sciences predicts that by the year 2100, global sea levels could rise by at least two more feet, resulting in more frequent and severe flooding. At the same time, storms like Hurricanes Harvey, Maria, and Florence, which set various state and national rainfall records, are increasingly responsible for catastrophic flooding.

With these floods come devastated communities. Research from the Union of Concerned Scientists estimates that as many as 2.4 million homes, worth roughly one trillion dollars, could be at risk by the end of the 21st century. As these major storms intensify and families in flood zones prepare for potential destruction, you'd think the residen-

tial design market would be teeming with plans for resilient homes that anticipate not only hurricanes but the rising waters that follow. Surprisingly, you'd be wrong—these projects remain outliers in a market in which cost is still king.

That said, a prototype for reasonably “future-proofed” homes has stood tall in New Orleans since 2010. Known as Green Dream 2, it is a single-family house built in the aftermath of Hurricane Katrina that directly answers uncertainties about how to design affordably and resiliently in areas prone to flooding. Its mere existence raises the question: Why aren't there more like it?

Strategies and hurdles

The Green Dream 2 project was led by Building Science Corporation (BSC) in partnership with the Louisiana State University Agricultural Center (LSU AgCenter). It was sparked by a request from



Portland Community College and Catholic Charities's Operation Helping Hands. It was preceded by Green Dream 1, a similar New Orleans-based project on a smaller scale that was also designed by Betsy Pettit, FAIA, and her team at BSC.

"The Green Dream concept was to build a home with not only high energy efficiency but also a resistance and resilience to local natural hazards, to a level above the code and ordinance minimums," says Claudette Hanks Reichel, Ed.D., director at the LSU AgCenter and advisor on the project.

At 1944 sq. ft., the one-story Green Dream 2 house is modest in both size and presentation. It was built to "code-plus"—beyond minimum requirements—but rather than hire an engineer, BSC chose to follow the 130-mph prescriptive guide in the American Wood Council's Wood Frame Construction Manual, which provides a tested system that was fairly easy to construct. Reichel calls it

a "cookbook approach" that hews more conservative but is considered builder-friendly.

Some choices were no-brainers, such as energy-efficient windows with both an impact rating and a low solar heat gain coefficient. The foundation features adjustable concrete piers on the grade beams, added to compensate for the sinking New Orleans soil. "That was a local invention and a necessity because the soil in that area is like muck," Reichel explains. "If you have uneven subsidence, instead of lifting up your house and adding shoring to the piers or the foundation, which is a major expense, you can just adjust the piers to keep everything level."

Green Dream 2 uses a closed-cell spray-foam system, which is compatible with climates like New Orleans's—where constant use of air conditioning will lead to inward water-vapor drive and inevitable decay—but takes the burden off the builders. "With closed-

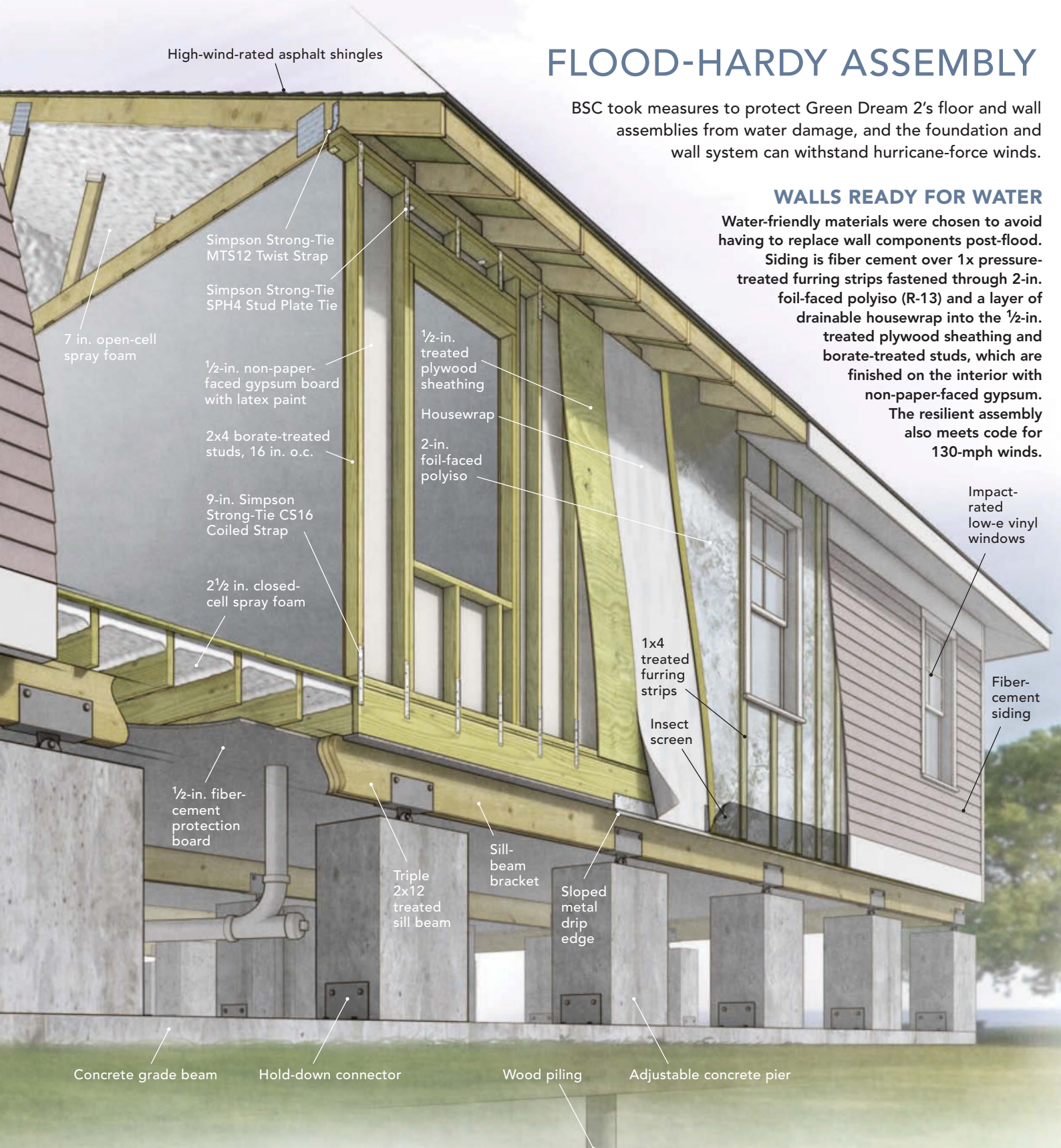
FLOOD-HARDY ASSEMBLY

BSC took measures to protect Green Dream 2's floor and wall assemblies from water damage, and the foundation and wall system can withstand hurricane-force winds.

WALLS READY FOR WATER

Water-friendly materials were chosen to avoid having to replace wall components post-flood.

Siding is fiber cement over 1x pressure-treated furring strips fastened through 2-in. foil-faced polyiso (R-13) and a layer of drainable housewrap into the 1/2-in. treated plywood sheathing and borate-treated studs, which are finished on the interior with non-paper-faced gypsum. The resilient assembly also meets code for 130-mph winds.



FLOOD-READY FLOOR

The raised 2x10 floor assembly bears on triple 2x12 beams and is insulated with closed-cell spray foam, which is more resistant to water damage than other types of insulation. Above the joists is 3/4-in. treated subfloor sheathing and vinyl flooring. Below is a layer of 1/2-in. fiber-cement board for protection against critters.

RAISED HIGH ON PIERS

Rather than a standard foundation with flood vents, the house is built on piers, 3 ft. above grade. Wood pilings along with concrete grade beams and adjustable precast concrete piers accommodate any shifts that result from unstable clay soils. Metal saddles and bolts at the four corners of the house anchor the frame.

cell spray foam, if there's a problem, you have to scrape it away and then either get a Froth-Pak [to patch it] or hire someone to restore it," Reichel says. "But it's an easier first install, and you can do it no matter how high off the ground you are. Plus, it's a bit less expensive than the rigid-foam-board system, when you factor in the installation cost."

Even while making strides toward buildability, the durability of the assemblies was never compromised. The house was designed to be fully flood-damage resistant, or "flood-hardy," as Reichel calls it. For instance, owing to concerns about having to replace flood-damaged OSB sheathing, the lower level is all solid wood and plywood, with spray-foam insulation and polyiso insulating sheathing used further from the ground. Although not waterproof, all of these elements are more water resilient, so in the event of a flood, "this house would be washable, drainable, and dryable, without having to cut it," Reichel says.

To protect the house's mechanical components from water damage, equipment that might normally have been located in a basement or crawlspace was installed in the unvented conditioned attic where it would be well above flood waters. This includes an air-source heat pump and inline dehumidifier—the latter is crucial to maintaining comfort and air quality in a tight home in a humid climate.

Negotiations and complications

Even with a major disaster as the catalyst for a resilient build, getting all involved parties on the same page can be difficult. "Deciding how high these houses should be raised was very controversial," Pettit says. "A lot of people didn't agree that 3 ft. off the original grade was high enough. There was a lot of talk about flood vents, which would allow water to go through the crawlspace or a latticed-in area below. But we didn't want to trust a flood gate. Our feeling was, the more open you can make it, the better."

BSC preferred a scenario where the underside of the floor structure was the enclosure on the underside of the building, and water could go through as needed; when the Army Corps of Engineers themselves couldn't guarantee that there was a "right" elevation height, the firm stuck with 3 ft.

"When the levies failed during Hurricane Katrina, the water was 8 ft. high," Reichel notes. "At that point, you're likely getting water either way. So regardless of raising the house 3 ft. or 5 ft., the flood-hardy system was our response to that. I always remind people, if there's even the remote possibility of flooding—if you're not on a mountain—then it makes sense to make your first floor as flood-hardy as possible." Regardless of any debate over design-build specifics, Reichel sensed a genuine excitement as to what Green Dream 2 could mean for more resilient homes in the devastated community.

"It was the kind of project where, if you can do it and have success with it, the word spreads, and then builders who can handle that level of work can market it," she says. "You can get ahead of the curve and sell it as preventative instead of essential."

What will trigger residential resilience?

Recent hurricanes in Houston, Puerto Rico, and the Carolinas have decimated neighborhoods and reinforced the need for resilient designs. So why isn't the market demanding homes that can stand up to rising waters, and why aren't firms producing them?

For starters, Reichel notes that certain minimum requirements—like those that guide building elevation—are set not because they're the safest but because they're closely tied to how insurance companies determine premiums. The companies make decisions based on flood maps, which focus on the 1% probability of the 100-year flood

without factoring in changes in drainage, topography, or the increasingly frequent storms that accompany climate change. "These required elevations provide an insufficient level of protection," she says, "yet we adopt them as a building standard."

Another obstacle is cost. "Closed-cell foam insulation is more expensive than a fibrous product," Reichel says, noting that treated wood adds cost, as does using plywood instead of OSB. This matters in a modest home market. "Getting into a decent home that accommodates a family's needs is tight enough; additional costs make it even more challenging."

"I think the architecture community is quite interested in resilience," she adds, "but they don't do a lot of single-family housing below the high-end market. Those that are for middle incomes and below are done by builders. And builders are understandably risk-averse and have low margins; it's a competitive business to be in. It is difficult for them to change unless the market is really demanding it."

Pettit concurs, noting that her firm isn't the only one that has embarked on forward-thinking residential projects like Green Dream 2 but also that others don't readily come to mind. "The codes have to spark change," she says. "That's really the only thing that will make a builder, a developer, or even an architect do anything different. But changing codes requires a lot of evidence-based research, and we're one of the few industries that doesn't invest a portion of profits in R&D."

Eventually, homes that are up against large bodies of water will need to be renovated or redesigned—with these principles of resilience and durability at the forefront—or risk ruin. But for now, projects like Green Dream 2 stand out as precursors for the inevitable evolution in climate-centric residential design. □

Steve Cimino is a Los Angeles-based writer and editor.



“This house would be washable, drainable, and dryable, without having to cut it.”



Post and Beam Shed



Modern hardware takes the place of traditional, time-consuming timber-frame joinery

BY JOSEPH TRUINI

Unlike in a traditional post-and-beam structure, there's not a single scarf joint or mortise-and-tenon joint in this whole shed. Built on a conventional 2x6 floor, the frame is assembled with metal fasteners called T-Rex connectors. Each connector's flange is screwed to a supporting member, and its leg slides into a post or beam with a slot cut to receive it. These joints are held together with aluminum pins. This modern construction method might not impress timber-frame purists, but it does provide a quick and strong way to build a beautiful post-and-beam structure. While it's attractive on the outside, what makes this build truly special is what's visible on the inside: an exposed frame of large white-pine timbers that would warm the heart of any barn builder. □

Joseph Truini is a writer from Roxbury, Conn. This article is an excerpt from his book, *Building Sheds* (The Taunton Press, 2016). Photos by Geoffrey Gross, except where noted.

THE TIMBER FRAME

This spacious 14-ft. by 20-ft. post-and-beam shed melds traditional architecture with modern building methods, resulting in a timber-frame building that goes up surprisingly fast. The floor is framed fairly conventionally with 2x lumber (see inset), and topped by a frame of rough-sawn, full-dimension 6x6 posts, 6x10 beams, and 4x8 rafters, with a few other sizes mixed in for girts, plates, and bracing. The walls are braced with diagonal 4x5s, and the window and door openings are framed with 4x4s and 4x5s. All of the timbers are white pine, sourced from a local sawmill. Other species of wood can work just as well, although most are heavier.

BUY-AND-BUILD KIT

All the metal connectors, building plans, and jigs needed to erect a post-and-beam frame can be purchased through Connex Post and Beam (ctpostandbeam.com). T-Rex connectors are available for various sizes of posts and beams, including both rough-sawn lumber and standard nominal lumber.



THREE JIGS MAKE THE JOB EASY



Slot the posts. Cut six 6x6 posts to 84 in. long, then make a 1/4-in.-wide by 5-in.-deep slot in both ends of each post (done here with a Prazi Beam Cutter). To center the slots, make a plywood jig that guides the saw, and screw it to the post.



Chamfer the slots. A router fitted with a second plywood jig and a 45° chamfering bit eases the edges of the slots to allow the T-Rex connectors to sit flat against the post ends when inserted into each slot.

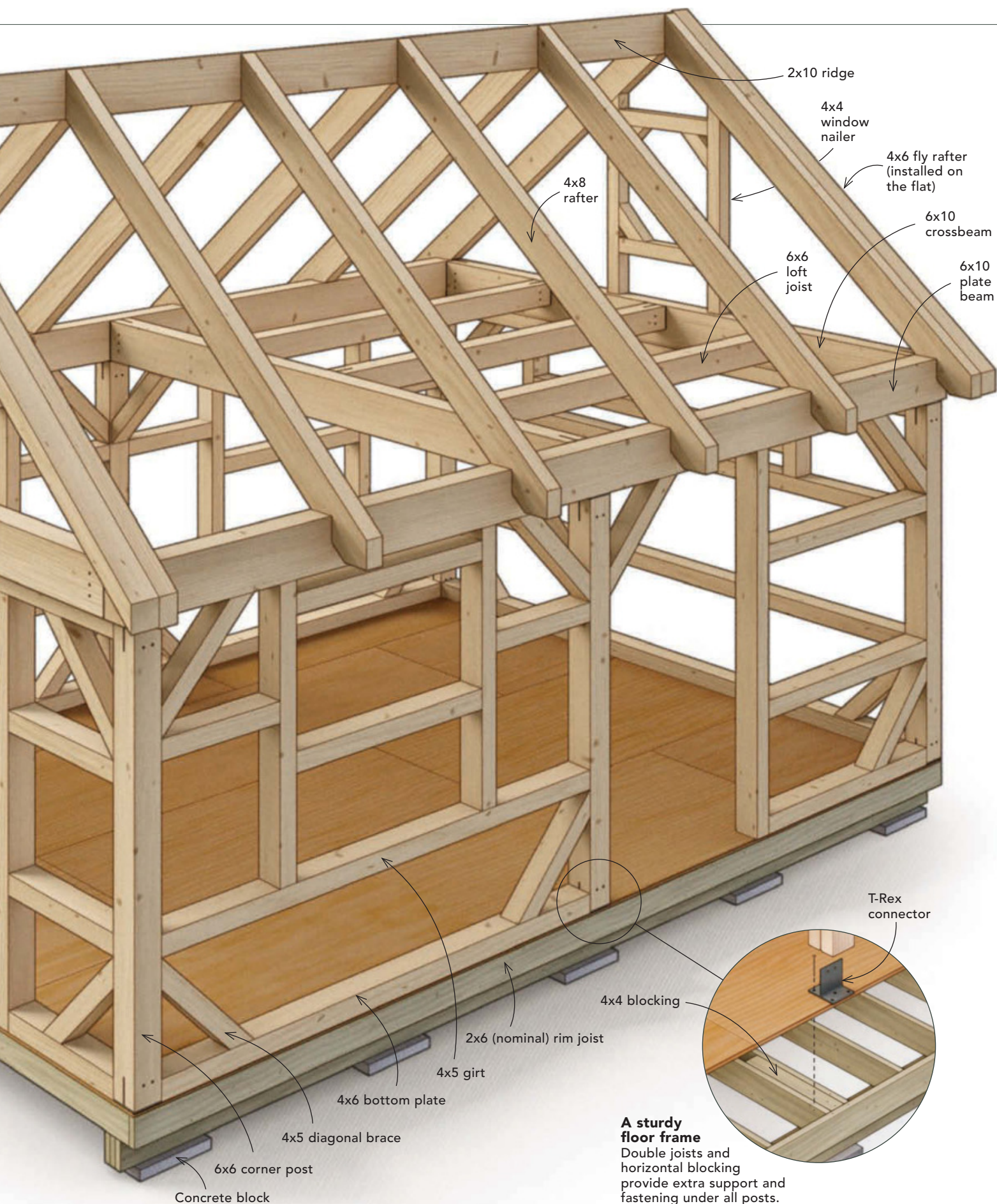


Bore the holes. Screwed to the post, a third jig made from scrapwood and two steel bushings provides an accurate way to drill holes for the aluminum pins that secure the posts to the connectors. Bore two holes clean through both the post and the connector with a 1/2-in. twist bit.

Attach the connector.

With its edges flush with the edges of the plywood deck, fasten the connector to the floor and the blocking below with six 4-in.-long structural screws. Hammer a 1/2-in. by 6-in. aluminum pin through each hole to secure the posts.





RAISE THE FRAME

The 6x6 posts attach directly to the floor framing, and support an overhead framework of horizontal timbers: two 6x10 plate beams that span the length of the barn (the ends of the plate beams overhang the end posts by 2 in.), three 6x10 crossbeams that run perpendicular to the plate beams, and three 6x6 joists that fit between two crossbeams to frame the loft. A dozen 4x8 rafters spaced 44 in. apart—flanked by 4x6 fly rafters on the gable ends—come together along with a 2x10 ridge to form the gable roof.



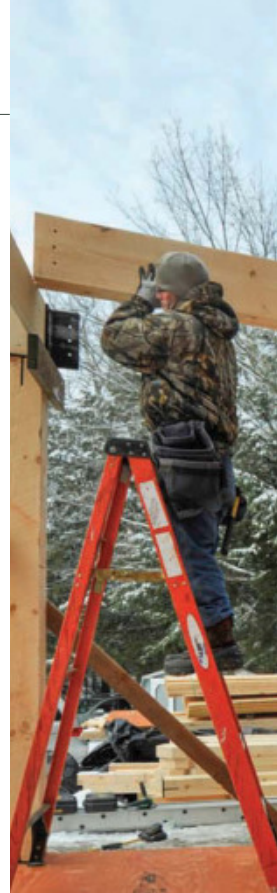
Braces hold the posts plumb. After securing all six posts (each with two pins), use a 4-ft. level and temporary 2x4 diagonal braces screwed to the posts to hold them plumb.



Raise the beams. If you set the plate beams manually rather than with a lift, it takes at least four people and some sturdy ladders. Fasten the connectors to the beams, lower each into the post slots, and secure them by driving two pins through the holes at each post.



Crossbeam prep. After setting the two long plate beams, fasten temporary 2x6 cleats to the posts, positioning them so their top edge is even with the bottoms of the beams. The cleats establish the height of the crossbeam connectors and hold up the crossbeams until you can drive in the aluminum pins.



It takes two to raise rafters. Working off a scaffold plank eases the task of setting rafters. Start by fastening the lower ends of the second and fifth pair of rafters to the plate beam with two 10-in. screws.



Crossbeam placement.

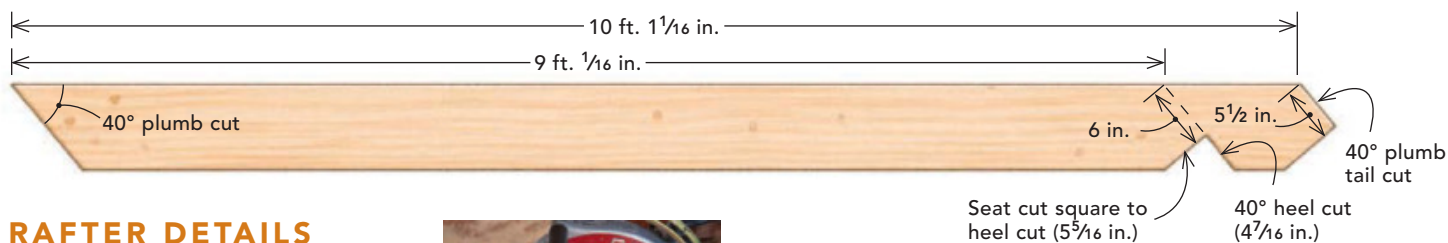
Lower each crossbeam into place, fitting the connectors into the slots. Resting the crossbeam on the 2x6 cleats, hammer three aluminum pins through each end of the crossbeam.



Install the 6x6 joists. To support the overhead storage loft, install three 6x6 joists similarly to the crossbeams. Screw the connectors flush to the tops of the crossbeams before installing the 2x4 joist-support cleats. With the 6x6 joists in place, drive two pins through each end of each joist.



Brace the frame. With the beams in place, secure the 4x6 bottom plate and the 4x5 wall braces with 8-in. structural screws, drilling deep counterbores so the holes can be plugged for a clean look. Then add nailers and blocking for windows, doors, and siding.



RAFTER DETAILS

Cut each rafter from a 12-ft. 4x8. The plumb cuts at the top and bottom of the rafter, as well as the heel cut of the bird's mouth, are 40° and so make a 10-in-12 roof slope.



Cut the rafters with a big saw. You also can use a standard 7 1/4-in. saw, but you'll have to either cut from both sides or finish the cut with a reciprocating saw or handsaw.



Raise the ridge. Like the plate beams, the 2x10 ridge is 20 ft. 4 in. long. After marking the rafter layout to match the plates, push the ridge up between the rafters, and secure each rafter to the ridge with two 6-in. screws. Install the remaining rafters.



Add the four 4x6 fly rafters. The fly rafters are the same length as the main rafters, but they have no bird's mouths. Hold them against the gable-end roof rafters with their top edges flush, and fasten them with 10-in. screws about 16 in. apart.

SKIN THE FRAME

With the structure raised, work on the roof and walls can begin in any order, or simultaneously. The roof is sheathed with rough-sawn 1x8 pine boards, covered with plywood above to create a substrate for shingles. The barn's walls are sided with rough-sawn, 1x8 tongue-and-groove pine installed vertically in keeping with traditional barn architecture. Pine siding is readily available, affordable, and attractive, but it isn't very weather resistant and must be protected—and then maintained—with an exterior stain or paint. Siding the upper half of the gable ends first means that tools or ladders won't bang against and damage siding below. This heavy pine tends to bow and warp, which can pull regular nails free. Here we used 8d double-hot-dipped galvanized spiral-shank decking nails from Maze Nails.



Sheathe the roof. Work from scaffolding to install the first 4 ft. of 1x8 skip sheathing on the roof, using 10d nails to hold the 1x8s to each rafter. To create a more shingle-friendly substrate, add a layer of 1/2-in. CDX plywood.



Shingles finish the roof. After adding a drip edge, you can use a variety of roofing materials. Asphalt architectural shingles were used here.



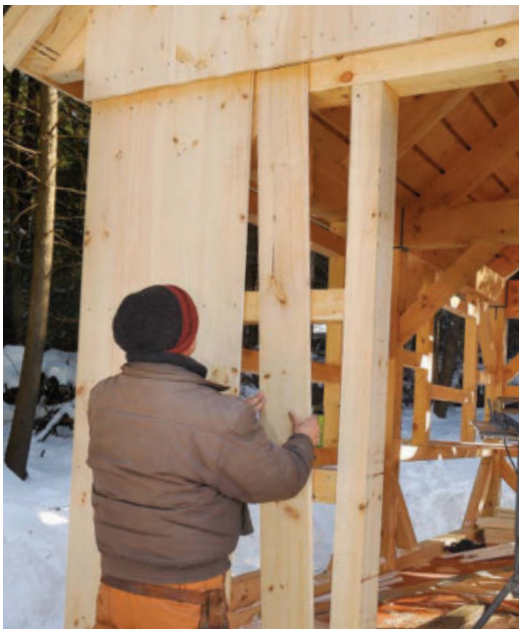
Start mid-gable. Cut each piece longer than necessary, with the upper end cut at 40°. Face-nail the right-hand piece plumb, with its tongue to the right. Rip and glue a spline in the groove, and install the left piece with its tongue facing left. Side in both directions for symmetry.



Trim the gable siding to length. Snap a chalkline on the siding 1 in. below the bottom edge of the crossbeam. Cut along this line by screwing a 2x4 to the wall to guide a circular saw.

Run the siding.

The bottom siding on the gable ends butts to the overhanging crossbeam. The lengths should be consistent now, so you can cut a bunch of pieces assembly-line style.

**Persuading warped siding.**

Green, rough-sawn pine isn't known for its straightness. It can be levered tight to the previous piece by driving a chisel into the framing, prying the siding against the previous piece, and nailing.



Keep the siding plumb. Check every couple of feet to be sure the siding isn't sneaking out of plumb. It is particularly important to check when siding runs above and below a window opening.



Notch boards as needed. With a window or door opening, hold the siding piece in place temporarily, and mark the cut from the back. To notch around rafter tails, measure and draw lines with a square.

WINDOWS AND DOORS FINISH THE BUILD

Along the sides are a fixed transom window and several barn-sash windows, which use a clever and traditional opening detail. These windows, made from rotproof cellular PVC, came from Connex Post and Beam, but wood units can be used as well. In contrast to the barn's straight lines and square architecture is a pair of 30-in.-dia. round windows set in the gable. The doors, a single sliding slab on the eave wall and strap-hinged double doors mounted to 2x4s on the gable, are all made in the traditional style, using tongue-and-groove pine fastened to cross battens.



Trim the barn-sash opening with PVC. Install the angled sill first, followed by the casing legs. The casing overlaps the opening by $\frac{3}{4}$ in.



Install the barn-sash keepers. Screw foot-long pieces of 2-in.-thick pine, with $\frac{3}{4}$ -in. dowels installed in them, to the inside of the posts. This provides a stop for the window sash when open.

SIMPLE BARN SASH

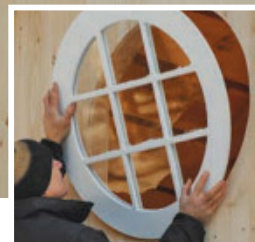
There is no mechanism to these windows. Closed, they simply sit on the sloped sill, held by the overlapping exterior trim and a barrel bolt. Open, they lean inward against keepers.



Set the sash. The barn sashes simply slip into place. A small barrel bolt at the top of each sash keeps it closed.



Cut the circle. When framing the round window, space two posts slightly more than the window diameter apart, and fill in the corners with angled nailers. After the siding is up, attach a string to a screw in the opening's centerpoint, and tie a pencil to the other end. Use it to draw a 30-in.-dia. circle onto the siding, and then cut out the opening with a jigsaw.



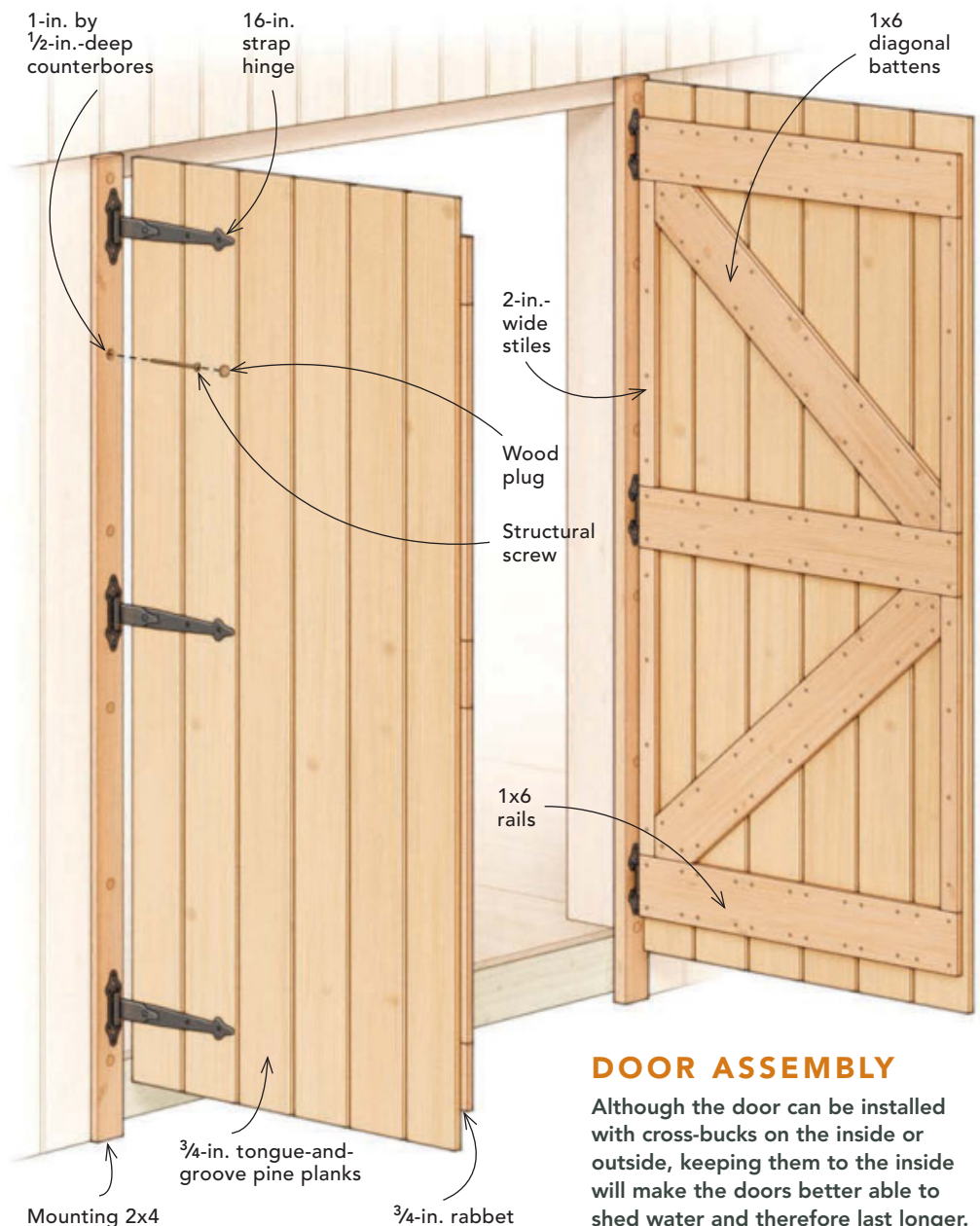
Set the round window. Fasten the window through the flange and into the siding and timber frame with $2\frac{1}{2}$ -in. exterior trim-head screws.



Set the first door. Attach the 91-in.-long mounting 2x4 to the door so that its top is even with that of the door. Use three 16-in. strap hinges to connect the two. Place the door in its opening.



Finish up. Secure the top of the mounting 2x4 with a 6-in. screw through the top counterbore, check the door for plumb, then screw the remaining counterbores. Hang the second door the same way.



DOOR ASSEMBLY

Although the door can be installed with cross-bucks on the inside or outside, keeping them to the inside will make the doors better able to shed water and therefore last longer.

THE FINAL DETAILS

Because pine siding isn't rotproof, it has to be finished with paint or stain. The plank floor in the loft has to be installed as well, and stone dry-stacked below the barn's floor will complete the traditional look.



FLOOR THE LOFT



PAINT OR STAIN



CLOSE OFF THE BOTTOM

House-Flipping How-Tos

If you know your market and you can stomach the risk, there's still money to be made

BY SEAN GROOM

Before the Great Recession, making money in real estate seemed like such a straightforward equation that it was too good of an opportunity to pass up—just buy a house, wait a few months for prices to appreciate, and then sell the house for a profit. Between 2000 and 2006, house prices in the four hottest markets—Washington, D.C., Los Angeles, Miami, and San Diego—rose 150%. Purchasing houses in dire shape, then remodeling and reselling them commonly offered even greater returns.

House flipping quickly evolved from a side hustle to a profession to the subject of reality TV shows. By 2006, flips accounted for about 8.6% of home sales nationwide, and in hot real-estate markets like Washington, D.C. and Chicago they were about 20% of sales. Let's call this period of house flipping version 1.0.

We all know how the story played out. After years of home prices ratcheting upwards, they began to plateau in 2006, and it wasn't long before the real-estate market resembled a collapsing Ponzi scheme. Without the benefits of instant equity and a highly liquid market, property owners with balloon-payment loans or adjustable-rate mortgages defaulted in large enough numbers to bring everything crashing down in 2008. While the decline in the 20 largest markets averaged more than 30%, in the

hardest-hit markets, like Las Vegas, prices fell 60%. When the market bottomed out in 2008, investors started grabbing distressed houses at steep discounts. In 2012, comparatively slower but steady price increases began on a national scale, supporting a new, healthy flipping market—version 2.0.

Today, prices in a majority of real-estate markets have rebounded to at least pre-2008-crash levels. Combine the increased

prices with a relatively low inventory of houses for sale, and owner/occupant buyers have been dipping deeper into the low end of the market, taking on repair and upgrading projects themselves. Plus, the most obvious flip-worthy houses have been snapped up over the last decade as new investors continue to crowd into the market. With narrow profit margins, investors need to have a solid business plan and they must be disciplined





A FIVE-STEP GUIDE TO FLIPPING A HOUSE

STEP ONE FIND A PROPERTY

Though all methods of buying a home are possible, many flippers prefer direct sales from the homeowners (or FSBOs). These owners are typically very motivated to sell, there's no realtor to be paid, and there's more time to evaluate the home than there is at an auction. But finding these properties isn't easy. Some flippers send direct mail; some use social media. No matter how you decide to do it, get the word out that you're looking to buy properties if you'd like to avoid realtors and auctions.

is irrelevant, but that the decision to flip a particular house is a business decision and the purchase is largely based on one significant number, the after-repair value, or ARV.

ARV is the exit price—what the upgraded house will sell for. Like everything in the flipping process, this number is speculative; an educated guess. A house is worth what someone will pay for it on any given day—no more. So, there is no benefit to being optimistic about the ARV. It's best to plan for the lowest likely ARV, and to see if you will be able to turn a profit at that price.

Justin Pierce, a Virginia real-estate investor who has completed about 50 flips, says a great advantage of flipping during market versions 1.0 and 2.0 was that there was a lot of sales activity in very localized communities. Back then, he was able to pull three or four recent sale prices for the same-model house in the same development. That many closely matched comps gave him a pretty good idea of the ARV. Lately, however, he's found that distressed houses in developments are largely gone in his area. They've been snapped up by flippers or DIY owners looking to acquire fast equity. Instead, the potential flips are what he calls "nonconforming." They aren't part of a development and true comparable sales in the same neighborhood or school district don't exist.

This is why watching the Multiple Listing Service (MLS) and really knowing the

to succeed. This is the current flipping market—version 3.0.

If you've looked at a run-down house in your neighborhood and thought, "I could fix that up and sell it for a decent profit," there are a few lessons to learn from those who have succeeded and those who have struggled in the flipping business before you dive in. And they're all informed by the recent ups and downs of the national real-estate market.

ARV is the key

Not every run-down house is a good candidate for a profitable flip. Successful flippers reject dozens of properties for each one they take on. Unlike most home buyers, though, they aren't looking for the right floor plan or the best school district. It's important to understand that a house flipper is a real-estate investor, not a homeowner or a craftsman. That's not to say the quality of the work

market is important. Justin, who has taken the time to get a real-estate license for MLS access, generates and evaluates his own comps. It's just too risky, in his mind, to rely solely on someone whose interests are not directly aligned with his. He also uses the license to list and show his houses—this way, he gets immediate feedback on the price and can lower it before it sits stagnant on the market. He also uses his license to represent the occasional buyer. Touring houses with a buyer gives him two market insights: He can see the quality of the houses at different price points, and he gets a feel for what is selling.

If you're considering flipping a house, Justin recommends you visit open houses, listen to the comments of visitors, and check out the condition of different houses and see what they sell for. In a similar vein, visit the model homes of big builders to see what is popular—they've already done the market research.

The hunt is half the battle

While the ARV is the most important number to determine before buying a house to flip, you make your money based on the purchase price. So chiseling away at the front-end cost helps to ensure your profit.

There are four avenues for purchasing a house: through a private sale (for sale by owner, or FSBO), from a wholesaler, through a realtor-listed transaction (often found on the MLS), or at a bank auction. Justin says he's been to one auction and hasn't been back. They don't offer enough time to thoroughly inspect the house to get a handle on the likely renovation costs, he says. And the competitive bidding atmosphere generally pushes the price beyond anything that could reasonably generate a profit. That leaves the other three options.

The MLS is a great tool for price research and it can be a source for finding potential properties. With patience, you'll find flip-worthy deals listed on the MLS, and having an agent to negotiate with on the other side



STEP TWO DETERMINE THE AFTER-REPAIR VALUE

Once you have found a property, determine its after-repair value, or ARV. This is how much can you likely sell the house for after you've done the necessary updates and appropriate upgrades. The ARV is speculative, but your success depends on it, so you can't do enough research here. Get to know the neighborhood you're considering working in, find out what buyers in this area and price range will pay for, and study recent comparable sales, or comps. A bank won't write a mortgage on a house unless the appraisal assures them that the house is collateral for the loan. Since the appraisal is based on comps, your ARV should be too.

can be beneficial, since they'd like to see the deal succeed.

A wholesaler is someone who looks for properties they can purchase inexpensively enough to resell to a home flipper before they actually come into possession of the property. If the numbers work, wholesalers are a viable way to acquire a property. And anyone can act as a wholesaler. If you get an especially good deal on a property while looking for an investment, sometimes the quickest route to a profit is to sell it to a flipper or someone looking for rental properties without exposing yourself to the risks of flipping it yourself.

But it's often private sales—houses that are sold before listing—that offer the best potential for a return on your investment. Many

sellers are willing to take less than market value for an immediate payday over a longer, unsure timeline, even if there's the prospect of a higher sale price. A common example is someone who has come into possession of a house after a parent's death. In many cases, the home needs a great deal of work, so they are willing to take an immediate cash payment to be rid of the property. By selling the house to a real-estate investor, they eliminate the mortgage contingency, sell it as-is without cleaning or fixing the property, and close the sale in as little as a week. In exchange, they take a hit on the sale price.

How do you find these sellers? It isn't something that happens overnight. Liz and Jason Haynsworth started flipping houses in 2009 in East Dallas as a sideline and it quickly became their full-time job. For the Haynsworths, as with most house flippers, a big part of the work is finding prospects. They have found mailings to be a cost-effective method. Rather than just blanket-ing a zip code with postcards, they target things like appraised value, absentee owners, eviction proceedings, preforeclosure action, and expired MLS listings. The point is to

The lesson here is that if you decide you want to flip houses, you are a real-estate investor, not a craftsman.

let people who might be thinking of selling know that you're buying.

Another of their strategies is to post and advertise on Facebook, Instagram, and Twitter. The idea is that when somebody says, "I need to sell this house," they, or someone in their circle of friends, thinks, "Oh, Liz and Jason buy properties."

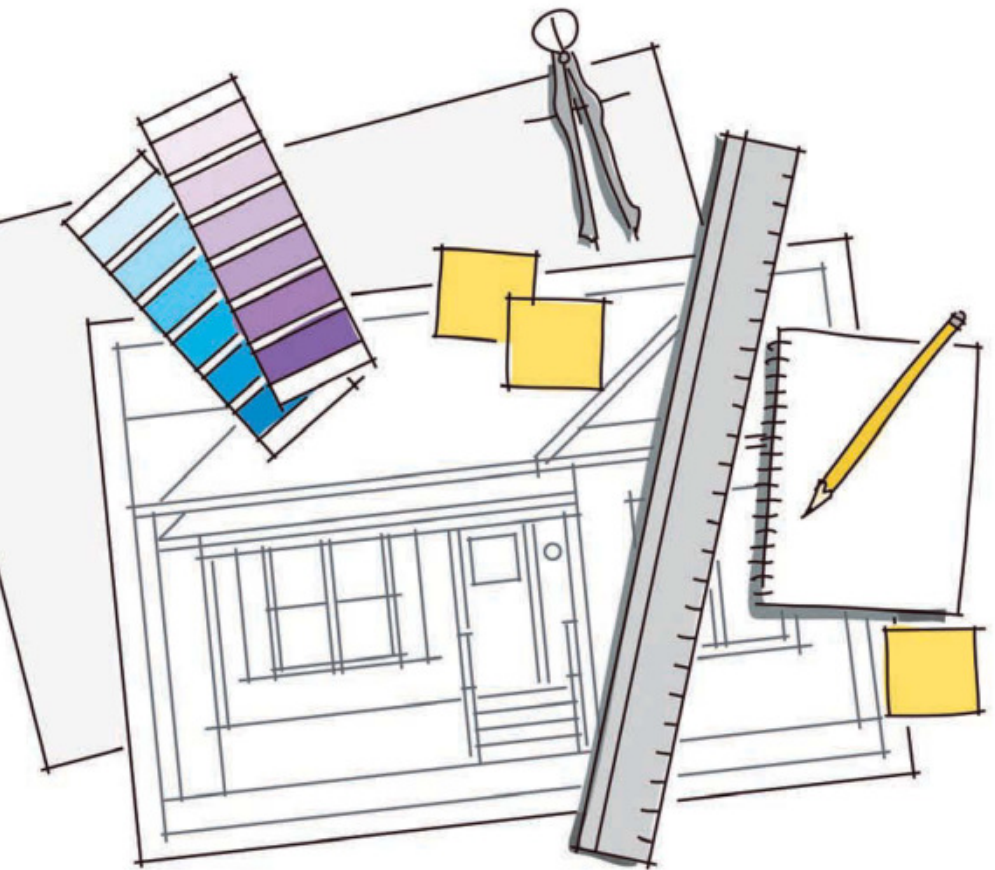
Once you have a lead, the next step is a careful screening. For Justin, screening is a matter of listening to the language people use. If the phrase "market value" comes up, it's probably best to move on to the next opportunity. To smooth the negotiation-and-sale process, Justin says he is up-front about his costs and what he can pay for a property, explaining why he has to buy at a discount and how he's not pocketing that much of a profit when he resells the property.

Business costs are time-sensitive

There are two types of costs involved with flipping a house: business costs and renovation costs. The business costs are pretty straightforward—they include transaction costs and carrying costs. The transaction costs are real-estate-agent fees, transfer taxes, closing costs, capital-gains taxes, and income tax. The carrying costs include interest, property taxes, utilities, and maintenance like lawn mowing and snow plowing, which are time-sensitive. If you blow your renovation timetable, you blow your financial-cost calculations as well. So, successful flipping is based on minimizing the time you own the house. Not only does a quick turnaround lower your carrying costs, it means that you're more likely to sell the house in the same market conditions as you purchased it, improving the odds that your ARV is accurate.

For Justin, an ideal flip is four to five months from closing to closing—when you factor in one month for listing on the market and one for a traditional closing on the resale end, the remodeling work needs to happen quickly. Depending on your relationship with the contractors you'll be using on a project, you might want to consider building deadline rewards and penalties into the contract to protect yourself against the cost of owning the property for extra weeks or months.

Investors find financing for their flips from a handful of sources: Some pay cash; some borrow from family, friends, or fellow investors; some go through hard-money lenders.



STEP THREE DO THE MATH

Once you've determined the property's potential ARV, it's time to crunch some numbers to figure out how much you can pay for the house and still turn a profit. Folks flipping houses all across the country use the same basic equation to determine their maximum purchase price. The equation gives you a starting point; each deal requires fine-tuning based on specific projected costs and situations. To do the math, you'll need to have a renovation-and-repair budget and timeline. The timeline will help you determine the likely financial costs and carrying costs. And you need to have a target-profit margin. Most flippers aim for a profit of 15% of the ARV. The formula is simple: ARV minus costs, profit, and renovation budget equals purchase price. Here's an example:

$$\begin{aligned} &\$500,000 \text{ After-repair value} \\ &- \$75,000 \text{ Financial and carrying costs} \\ &- \$75,000 \text{ Profit target 15\%} \\ &- \$50,000 \text{ Renovation budget} \\ &= \$300,000 \text{ Purchase price} \end{aligned}$$

If you can't acquire the house for this purchase price, it's best to walk away and look for another property. There's too much speculation in the math and uncertainty in the process to add more risk to the equation.

Banks often offer the lowest interest rate, but the process is slow. If a sale depends on a quick closing, bank financing isn't an option. The Haynsworths use friendly investors—financial partners with whom they have a relationship. This gives them a better rate than hard-money lenders offer, and the ongoing relationship is advantageous as well.

After the first few flips, they approached a local bank for a line of credit. They felt the local bank would be more flexible than a national bank, and they developed a business plan to accompany the successful pitch.

Justin is more likely to use a hard-money lender. These lenders are more expensive than a bank, with interest rates in the 12%

to 15% range, plus perhaps four points. The advantage is that they finance real-estate investments every day and the cash is immediately available, which lets him work with 50% to 75% debt, so he can do more projects to both generate more money and spread out the risk.

One thing that Justin believes remodelers and builders overlook when they take on a flip is determining if it is actually their best opportunity for profit. If the return on building a spec house is greater than your expected return from flipping the house, that's where your money should be going. (If

flipping three houses a year gets you a larger return than building one spec house a year, you should be flipping houses.) It is important to not only evaluate your return on the money that you invest in the project for the time it's invested, but also to make sure you are paid for the time you sink into the project, whether it's labor or paperwork.

Stick to the plan

It's also important to estimate your remodeling costs before you purchase a property because the offer price for the house is driven by this cost. If you'll be doing the work your-

self, make sure to do a thorough inspection of the house to evaluate its condition; if you're contracting out the work, bring in the contractor and subs to get estimates and a reliable schedule. Unaccounted-for expenses will come out of your pocket at the end of the deal.

Though every project will need a different number of repairs and renovations, there are some things you can do to protect yourself. Working in familiar neighborhoods gives you a sense of the problems you are likely to find. Liz and Jason developed their model working in a neighborhood dominated by

STEP FOUR PURCHASE PROPERTY AND GET TO WORK

Two sure ways to diminish your profits are to blow the renovation-and-repair budget and/or the timeline. Your renovation-and-repair plan should be based on what buyers are willing to pay for in your specific market. In many markets, "upgrades" will never yield a return from cost-conscious buyers. They will only lower your profit. Also, every day added to the renovation-and-repair timeline adds to your carrying costs. During this phase of the flipping process, your job is to stay focused on executing the plan to stay on deadline.



ranch houses. They gut every house and remodel each with a midcentury-modern flair, and can safely budget \$100,000 for remodeling house after house in this area.

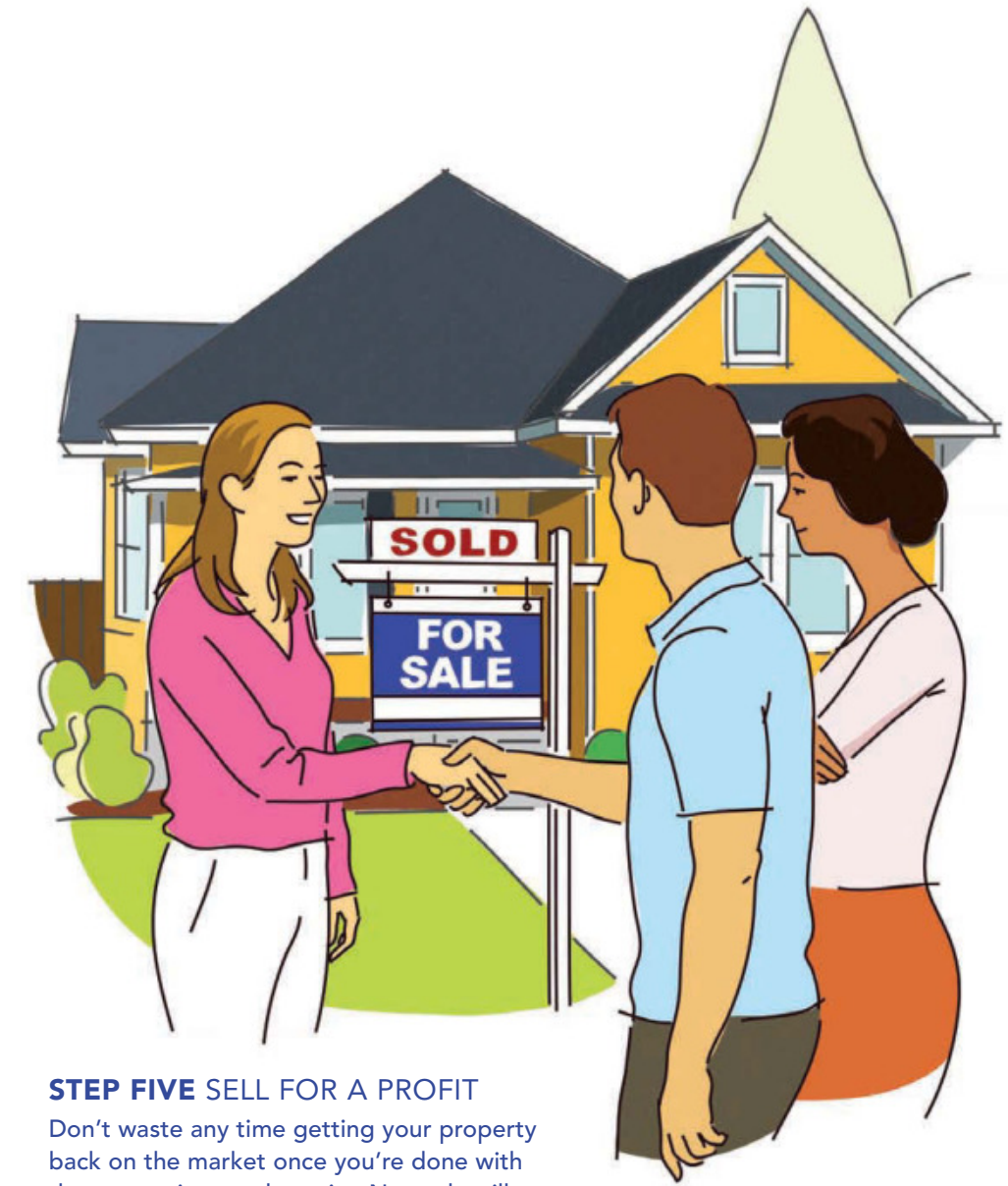
Developing the budget is one thing; sticking to it is another. Rick Trimble started flipping houses in 2006 in Washington, D.C., right at the tail end of the housing boom. About 20% of the local market was house flips at that point. He hoped there was a market in slightly higher-quality finishes and finish work. In the projects he did from 2006 to 2008, he found there were opportunities to add a built-in or a drop zone by the door that would add a couple of hundred dollars here and there. These decisions ate away at the repair budget and the schedule, and in the market of falling home prices, he wasn't rewarded for these spur-of-the-moment extras. Listening to potential buyers touring his projects, Rick noticed that their focus was on price, not details and materials.

It's critical that buyers pay for anything that you put into the house. A \$10,000 appliance package in a \$200,000 house doesn't make sense; it won't move the selling price any more than a \$2,000 appliance package would. Rick's mistake was to treat his first projects as calling cards for his fledgling remodeling business. Instead of booking profits, he just recouped his costs. The lesson here is that if you decide you want to flip houses, you need to make sure there is a return for every outlay and hour of labor in the project.

The other lesson to learn from Rick's experience is that house flipping involves risk. The model requires very short-term ownership of an asset, speculating that improvements will raise the price enough to recoup the investment and earn a return. In hindsight, Rick purchased his properties at the height of the market and had to sell as prices dropped. Of course, it's hard to identify that inflection point in real time; this concerns Justin and Liz in the current market.

Still interested?

The number of flipped properties in 2016 and 2017 were the highest since the 2006 peak. And while the gross profit of flip sales has climbed, net profits have fallen consistently according to ATTOM Data Solutions, an industry data group. This is a sign that there are a large number of people entering the flip market and raising the purchase price of homes. And while sales prices are rising, the rate is relatively mod-



STEP FIVE SELL FOR A PROFIT

Don't waste any time getting your property back on the market once you're done with the renovations and repairs. Not only will you continue to incur carrying costs as you wait to sell, but the likelihood of the market changing increases. If you did your research, your property will now be precisely marketable to buyers looking for homes in your neighborhood and in the price range of your speculative ARV.

est and not enough to offset the gains on the purchase side.

The Haynsworths are now focused on new construction—in the sizzling Dallas real-estate market, the pressure on the purchase price of potential flip properties from large, highly capitalized investment groups has squeezed the profit margin. The profit potential for flipped houses now seems to be in smaller real-estate markets that aren't saturated with investors focused on flipping.

If you're in one of these markets and still attracted to flipping houses, do a gut-check: What's your tolerance for risk? Are you patient enough to wait for the right deal? Can you deal with uncertainty? Remember that you're not the only one competing for labor in a tight market, and that rising interest rates not only affect you but also the purchasing power of potential buyers. □

Sean Groom is a contributing editor.

HOUSES

ARCHITECTURAL CHALLENGES AND SOLUTIONS

BY DESIGN

CURATED BY KILEY JACQUES





THE ULTIMATE BUILT-IN

During the whole-house remodel of a nondescript 1960s two-story home, Reader & Swartz Architects removed all of the interior walls on the second floor to make way for an open floor plan containing a dining area, library, and expansive kitchen; only the stairs were retained. The old studs at both ends of the gabled structure were stripped of drywall and insulation, and new birch veneer plywood-faced structural insulated panels were mounted to the outside face of the studs. New 2-in. by 2-in. horizontal wood ledgers screwed to the refurbished studs create a grid into which 1x wood shelves were inserted to form a layered library wall. On one end of the loft, bookshelves are accessed by an alternating oak- and maple-tread staircase attached to the side of a built-in refrigerator. The treads extend across the width of the stair, becoming display shelves beneath. On the other end of the room, there's a rolling ladder—salvaged from an old telephone building—hung from barn-door tracks. All of the new ductwork, conduit, and vent pipes were left exposed for an industrial look.

Designer Reader & Swartz Architects, readerswartz.com

Builder David L. Goode INC.

Project location Winchester, Va.

Photos Anice Hoachlander, Hoachlander Davis Photography, except where noted





SAME SQUARE FOOTAGE, BUT BIGGER

The current homeowner grew up in this classic agrarian cottage on Martha's Vineyard. When she inherited the property, she decided to convert what had become a two-family house back to a single-family residence, similar to the one she remembered. The challenge was to make the 1200-sq.-ft. home feel bigger than it is. LDa Architecture & Interiors's design plan eliminated redundant spaces to create a cohesive single-family layout. To start, they gutted compartmentalized spaces to make living areas feel roomier. Cased openings allow common areas to overlap while remaining distinct, and vaulted ceilings in the kitchen and porch add volume. They also changed the circulation; rather than cutting through rooms, occupants now walk along the edges, which makes floors look wider. To enhance natural light, dormers were added to the second floor, and a new porch in the knuckle of the two forms expands the kitchen into an outdoor dining area. Simple materials and light paint colors keep the small spaces from feeling cramped.

Designer LDa Architecture & Interiors, lda-architects.com

Builder 41 Degrees North Construction, 41degreesn.com

Project location Martha's Vineyard, Mass.

Photos Sean Litchfield Photography





LET'S TALK DESIGN

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“The flooring was a laborious 1½-in. width, but it created a mottled mass to contrast the consistency of the rift-sawn white-oak panels. I like to say to people it was the first piece of furniture in the house.”

—Caleb Bruce,
homeowner/builder





WHOLE-HOUSE CUSTOM CABINETRY

The owner/builder of this house is a cabinetmaker, and maximizing wood products that he could fabricate and install himself was his primary goal. Eggleston Farkas Architects designed a simple wood box on a concrete slab. The main floor has just two interior framed walls for shear and plumbing runs. All other interior partitions and finishes are wood; the only gypsum wallboard is on the ceiling. The house is essentially one big cabinet comprised of separate units connected by a $\frac{1}{8}$ -in. reveal line. Wall intersections, window openings, doors, base, and crown all work within this system. All Euro-style cabinet boxes, including the backs, were built using prefinished, $\frac{3}{4}$ -in.-thick panels for extra strength and better soundproofing. The cascading waterfall staircase was built using leftover tongue-and-groove flooring. To get it to glue up flat, the builder cut off the tongue and groove and re-ran all edges using a glue-joint-cutter head on a shaper. Each tread/riser was glued up edge to edge as one flat piece, then cut and mitered at the nosing.

Designer Eggleston Farkas Architects, eggfarkarch.com

Builder FOCI Construction

Project location Eugene, Ore.

Photos Ken Gutmaker



Follow the Build

Construction is underway on the latest *Fine Homebuilding* demonstration home in Louisville, Kentucky, but there's more to the project than we can fit into the pages of the magazine. Visit us online and tap into additional information about the build, including ongoing updates from the job site and much more.

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NEW AND NOTABLE PRODUCTS

FOR THE RUSTIC CHEF

Weltevrete's Outdooroven XL is a simple yet ingenious combination of an open grill and a smoking oven, making it ideal for the creative cook who likes to have more than one hand in the proverbial pot. The setup is easy to integrate into an existing outdoor kitchen. Make a homemade pizza in the oven while smoking meat and veggie toppings on the grill. Corten steel gives the Outdooroven its distinct look—as the steel erodes, a rusty-red layer forms and protects against further corrosion.

- Pizza oven, grill barbecue, and smoking oven all in one
- Includes pizza stone, two grill racks, 39-in. pipe, and charcoal slider
- \$2265

weltevrete.eu

Curated by FHB staff. Photos courtesy of the manufacturers, except where noted.



HANDLE HAVEN

Made in Brooklyn, the Elements collection from Watermark Designs is taking the bath industry by storm. Featuring 16 faucet-handle styles grouped into four categories of materials, the collection offers a wide range of color, form, and texture options. RAW features hand-poured, sealed, and reinforced concrete, while ROCK comprises hand-finished natural stones and marbles. The LUMBER series is made of real wood grain sealed in concrete, and FORGED is hand-worked and lacquered liquid metal. Watermark Designs also offers faucets using the art of guilloche, a decorative treatment that results in a pattern of interlacing curved lines. No matter the combination, a unique design statement is certain.

- Over 380,000 possible combinations
- An online configuration tool allows users to visualize options
- 24 finishes
- Faucets: \$1300 to \$2180; handles: \$550 to \$850

watermark-designs.com



TYVEK ADDS A DRAINABLE MEMBRANE

After years of offering only a variety of both smooth and crinkly drainable WRBs—despite the presence of more robust plastic mesh membranes from several direct competitors—DuPont (dupont.com) has added a 1/4-in.-thick drainable, ventilated membrane to their suite of Tyvek products. Dubbed DrainVent, the membrane is similar to competitive products in that it is not actually a WRB. With a perm rating of 100, it's intended to be applied over a well-detailed WRB to provide a reliable gap behind the cladding, which can be anything from stucco to brick to clapboards.

Unlike DrainWrap and StuccoWrap, two long-standing Tyvek products designed to provide only enough of a gap to promote drainage, DrainVent is designed to provide drainage and airflow. We found an online retailer selling 4-ft. by 50-ft. rolls of the product for about \$190 plus shipping, putting it roughly in the neighborhood of Benjamin Obdyke's Slicker Classic and Mortairvent by Advanced Building Products, as well as other competitors.



The honeycomb shape of the plastic mesh lies flat and offers good compression resistance, and the product still cuts easily with a sharp knife.



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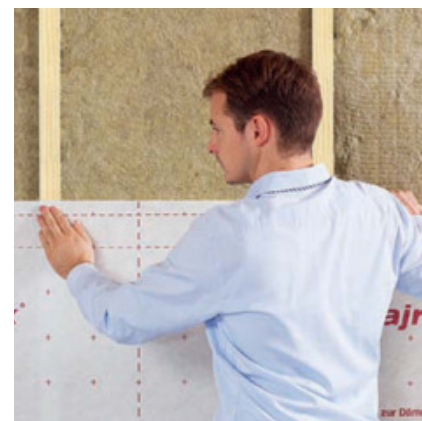
NEARLY INVISIBLE FLOOR FINISH

I love the look of natural wood, but uncoated wood isn't a smart choice for hardwood flooring, and even the most matte polyurethane still looks like polyurethane. For me, Bona Traffic Naturale (bona.com) was just another finishing product promising a no-coat look, and I was skeptical until I saw it used in a house. It truly creates a raw, bare-wood look, and claims are that it holds up like a champ. I had used Bona waterborne polyurethane before, which applies with impressive ease and delivers fantastic results, so I figured I would give Traffic Naturale a try on my 90-year-old maple flooring. If I hadn't been the one pouring the finish and pushing the roller for all three coats (Bona recommends at least two), I'd have sworn there was nothing on my floors. This two-part finish (the water-based polyurethane is catalyzed with an isocyanate hardener) is easily applied, dries fast, and doesn't darken the wood surface much, if at all. One gallon covers approximately 350 to 400 sq. ft. and sells for about \$130. —Justin Fink, editorial director

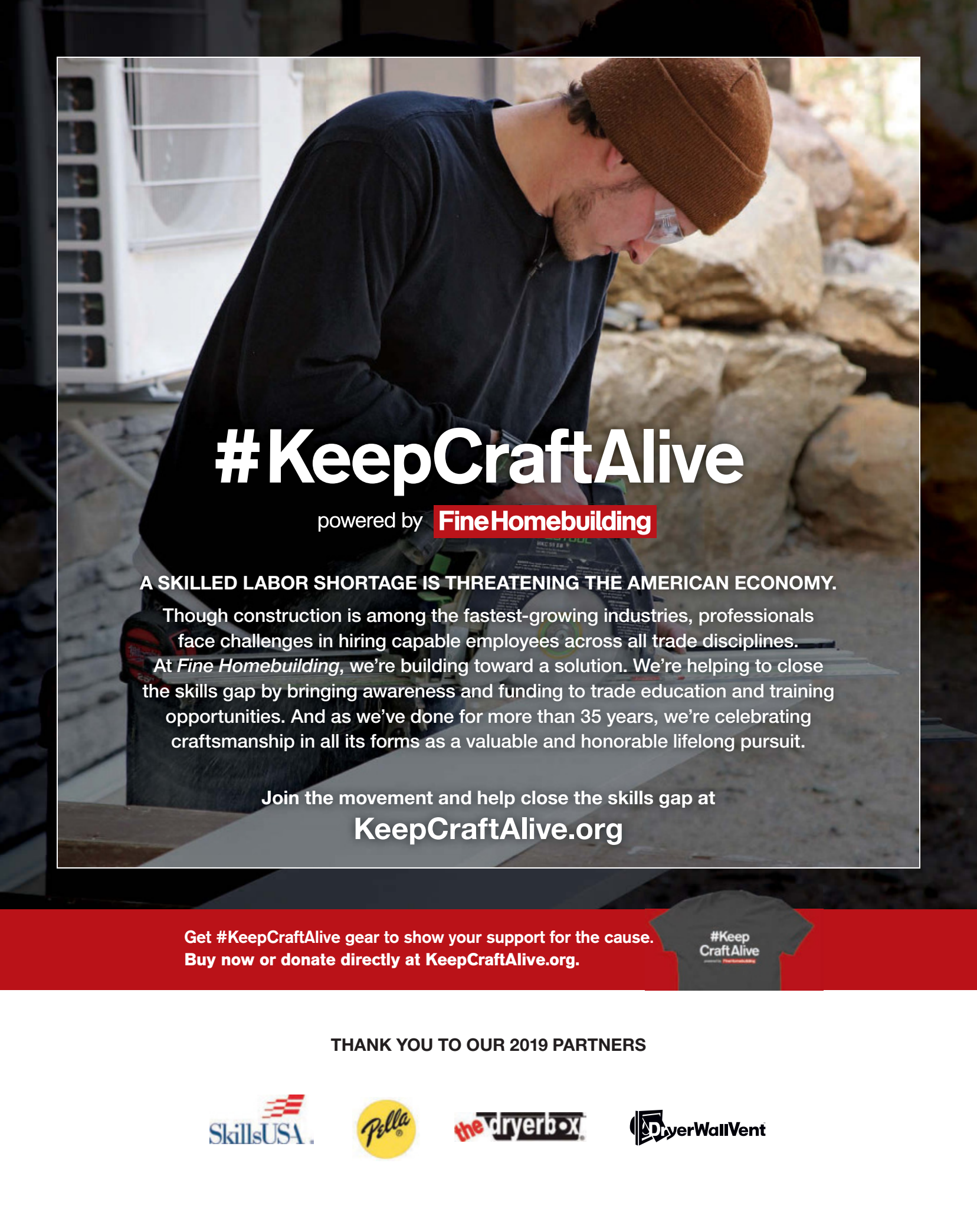


DOUBLE-SIDED AIR-BARRIER TAPE

Tacking an air barrier to the interior face of framing is a great way to control the movement of air and vapor through the wall and ceiling assemblies, and is gaining popularity among those who are focused on building energy-efficient homes. Although certainly more expensive than fastening these membranes with staples—the long-standing go-to method—Siga Twinet double-sided mounting tape does offer some advantages. First, it eliminates thousands of staple holes; a definite improvement over the alternative, though one that's arguably marginalized by the fact that you still need to add the usual furring strips to permanently secure the membrane in place. But one strong benefit of Twinet may be its usefulness for sealing the edges of each piece of membrane along plates and in corners (the weak points in an air-sealing job), where caulk is the traditional (messy) choice. A 164-ft. roll of tape sells for about \$53 (sigatapes.com).



Air-sealing aid. Siga Twinet double-sided mounting tape makes installing an air barrier easier by eliminating the need for staples and caulk.



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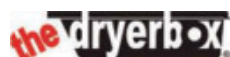
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Soundproofing a floor with a wood ceiling below

I'm trying to install sound insulation between my first floor and basement, and I don't want to use drywall. The house is essentially all wood except for the concrete basement floor. The floor joists between the basement and first floor are 2x10s on 16-in. centers. On top of that are two layers of 5/8-in. plywood glued and nailed, with oak hardwood flooring above that. I'm planning on installing mineral-wool sound-control batts between the joists, and will install knotty pine 1x6 boards for the ceiling. My question is, what can I use between the joists and the knotty pine to minimize direct sound transmission? Do you have any recommendations?

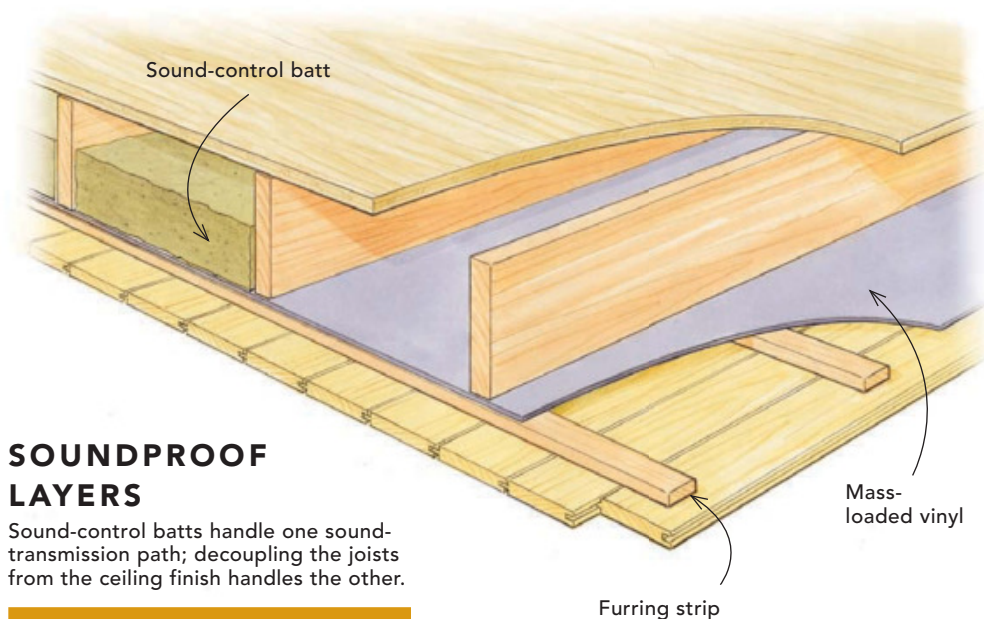
—GEORGE GULL
via email

Editorial advisor Mike Guertin responds:

Adding the sound-control batts will help reduce the sound transmission through the air between the floor surface and the ceiling below. The transmission through the joists is an even more important pathway to address. So don't skimp or you may be unhappy with the results, and you only have one chance to get things right.

The two basic approaches to controlling sound through the joists are decoupling the framing members from the ceiling material and adding mass (density). These two approaches work best when used in combination.

Some type of furring or strapping is the simplest way to decouple the ceiling from the joists. Resilient metal channel is the



SOUNDPROOF LAYERS

Sound-control batts handle one sound-transmission path; decoupling the joists from the ceiling finish handles the other.

go-to for the best performance for the cost. You'd need about 850 linear ft. for the ceiling, which would be about \$300. But using resilient channel will require installing the tongue-and-groove pine with screws rather than nails—a step you may not want to take. An alternative to resilient channel is 1x3 wood furring. It doesn't reduce sound transmission as well as resilient channel, but you can nail the ceiling planks into it. And if it's available at your local lumberyard, it should be a little more economical than the resilient channel.

A common and cost-effective way to add mass is to install 5/8-in. drywall. But since you want to avoid this, you'll have to use an alternative like mass-loaded vinyl, a roll-sheet material about 1/8 in. thick that is fastened to the underside of the joists and helps to dampen sound. Use it in combination with wood furring strips by first applying the mass-loaded vinyl to the joists and then the furring over it.

The vinyl will cost about \$0.75 per square foot more than using drywall. If cost is a concern, you can eliminate the addition of mass and just go with decoupling. In that

case, wood furring can be applied over adhesive-backed, 1 1/4-in.-wide by 1/4-in.-thick foam-gasket material to help isolate the furring from the joists a little better than with direct wood-to-wood contact.

A patch for reclaimed doors

I got a great deal on some beautiful old reclaimed doors to replace my house's flat hollow-core doors. There's just one problem: The hinge mortises and lockset holes on a couple of the replacement doors are on the opposite side from what I need. I know how to make the holes and mortises on a new door slab, but what's a good way to fill the old holes? I'm going to repaint the doors before I hang them.

—JANICE
via email

Anthony Vitale, trim carpenter and owner of Probuilt Woodworking, responds: The way I like to approach this fix is by using a Dutchman patch. This seems to be a more effective method than using fillers that may shrink and crack with seasonal climate

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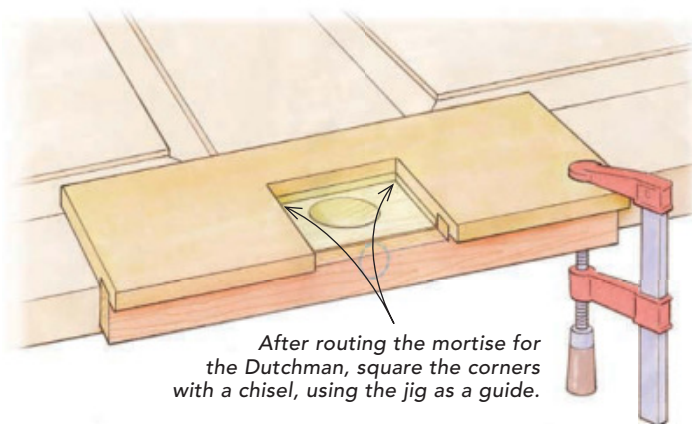
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After routing the mortise for the Dutchman, square the corners with a chisel, using the jig as a guide.

DUTCHMAN PATCH

To change a door's swing, use a simple template, a router, and a Dutchman to patch old lockset holes and hinge mortises before making new ones.

changes, and it provides material for new screws to bite into if needed.

To do this, I start by making a simple MDF mortising jig using 1/2-in. MDF with an edge setup that registers square off the edge of the door. In conjunction with this jig I use a straight, upcut spiral bit and bushing. The size of the template is arbitrary and only needs to be larger than the patch you're creating. You don't need to make the mortise too deep; I generally shoot for around 1/4 in. Once the jig is made, run the router around the perimeter of the jig and then clean out all the waste. Once finished with the router, square up the mortise with a sharp chisel.

Next, make the material for the Dutchman. Using a bandsaw or tablesaw, resaw a piece of hardwood to thickness and cut to length with a miter saw. Typically you want this material to be 1/16 in. proud of the surface once glued in. After gluing in the patch and letting it set, use a block plane to waste away most of the excess that's proud of the door surface. Use an orbital sander to flush the patch with the door, sanding beyond the Dutchman so the surface of the door and newly patched area are seamless and unnoticeable when painted.

Heating a tri-level addition

I have a tri-level home (split level) with an attached one-car garage off the kitchen. I want to tear down the wall between the kitchen and garage to make the garage part of the living space. The garage is a step below the kitchen, and I plan to build it up so it's level with the adjacent living

space. The house has a forced-air heating system, and even though the furnace is less than five years old and puts out plenty of heat, it all seems to end up on the top level. The kitchen is on the middle level and the only room over a crawlspace, and it has a constant chill in the winter. I plan on insulating the garage and under the kitchen as part of the remodel, but how can I efficiently heat and cool this new combined space and tackle the problem of all of the heat rising to the top floor?

—MARK HOBGOOD
via email

Noah Racette (@HVAC_artisan), an HVAC installer in Delavan, Wis., replies: There are unique challenges when it comes to heating and cooling tri-level homes. As you've experienced, different parts of the house commonly end up being different temperatures. You'll do yourself good to find a contractor who has experience dealing with similar projects to find solutions that work.

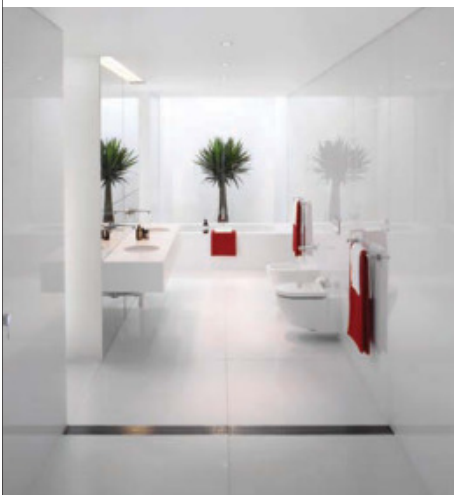
As you noted, good insulation is the first thing you'll need to make this expanded space comfortable. As for conditioning it, here are a couple options.

Option 1: Install a minisplit heat pump in the new space to provide supplemental heating and cooling. This is my preferred solution for your situation, and I think it would result in the most comfort. Minisplits are very efficient and can heat well even in very cold temperatures—including the worst days we had during this past winter's polar vortex in Wisconsin. These systems have an outdoor condenser and an indoor cassette or head installed on the wall or in

the ceiling. If you prepare for it before you start the remodel, the refrigerant and electrical lines that run between the minisplit's outdoor condenser and indoor head, as well as the system's condensate drain line, can be concealed within the wall during framing, and power can be run to the condenser location ahead of time. If you go this route, leave the existing ductwork underneath the kitchen to help mix the air within the home when the forced-air system runs.

Option 2: Extend the existing forced-air system to the new space. This may not deliver ideal comfort and may be more complicated, but it's likely the less expensive approach since it would allow for the existing equipment to condition the expanded space. Since the garage floor is a step down from the kitchen, there may be adequate space for ductwork to be routed through the new floor joists. If you do this, I would recommend installing 2 in. or more of EPS foam over the entire garage floor beneath the new floor joists and insulating the new ductwork to prevent heat loss. The main drawback with this option is that it alone won't make the space any more comfortable than the kitchen is already. Zoning the central heating system and installing motorized dampers in the ductwork would help, but this work would be costly and include a lot of extra components that can fail.

There are, however, more straightforward approaches to dealing with the uneven heating and cooling with either option. First, if the thermostat is in the middle floor of the home—as it often is on tri-levels—relocating it to the upstairs hallway near the bedrooms would help ensure comfortable sleeping temperatures. Additionally, running the fan on the furnace continuously can mix the air within the home to minimize your stratification issues and balance the temperatures between levels. Just make sure your furnace has a variable-speed, or ECM, blower motor, which can run constantly without using much more electricity than a light bulb. If the furnace has a conventional PSC blower motor, running it constantly would show up on your energy bills, and you'd save money in the long run by changing it out for an ECM blower.



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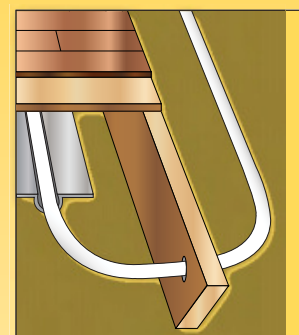
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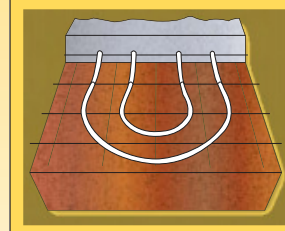
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In favor of wood-fiber insulation

What would you say if you were told that there is a type of insulation made from a renewable resource that performs well and is both water resistant and vapor-open? Plus, it doesn't make you itch, it has zero VOCs, and it has an exceptionally low carbon footprint compared to other insulation materials. You may have heard of wood-fiber insulation board—also called low-density fiber board (LDF)—but you probably haven't used it yet. Maybe you should.

The product was first produced in Europe in the 1930s, but it wasn't until the mid 1990s that it started to penetrate the market. Since that time, it has grown to become a small but significant part of the insulation market, and is starting to gain ground with environmentally conscious designers and builders in North America. Wood-fiber board makes use of softwood residual timber, and in Europe it competes with extruded polystyrene (EPS) in price and performance. The imported products available in North America sell at a higher price point, but they are arguably within reason if you consider their features and benefits. Also, costs could drop if they were to be manufactured domestically. Currently, there is at least one company—Maine-based GO Lab—looking to build a manufacturing plant in the U.S.



Dry board. Wood-fiber insulation is suitable for roof and wall assemblies. The two layers of 1⁹/₁₆ in. (R-11.6) Gutex Multitherm shown here are vapor-open and waterproof.

Composition

Wood-fiber insulation and cellulose insulation are made from the same raw material, but cellulose is newspaper, whereas wood fiber comes from softwood chips. According to GO Lab president Josh Henry and marketing director Matthew McConnell, the company is gearing up to produce wood-fiber insulation in a former paper mill in Madison, Maine. They describe the process of making it as similar to making

paper. There are two ways to do it—the dry method and the wet method—and each results in a product with different properties. Similar processes are used to make medium-density fiberboard (MDF) and hardboard such as Masonite.

The wet method has been around longer and is more like paper-making: Wood chips and shavings are ground and mixed with water and binding additives, and the pulp is then compressed and dried. (The

reclaimed water is used in the next batch and scraps are mixed back in with fresh pulp.) The result is relatively dense sheets up to ¾ in. thick, though they can be laminated with water-based glues to make thicker boards.

For the dry method, the ground wood fiber is dried, then mixed with a pMDI (polyurethane) binder and paraffin wax for water resistance, compressed, and cured with steam and pressure. The result is a



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wide range of available densities. This method uses up to 40% less energy than products made using the wet method.

The composition varies a bit between manufacturers, but even more so by product type: board, batt, or blown. Common dry-method boards such as Gutex Multitherm are 95% wood fiber by weight, 4% resin binder, and 1% paraffin wax. GO Lab is planning to make a batt, similar to those on the European market, containing approximately 85% wood fiber, a polyester binder, and ammonium polyphosphate (a common food preservative) as a flame retardant. The blown-in is usually composed of wood fiber and a flame retardant such as borate.

Properties

Depending on density and additives, wood-fiber insulation can be dry fibers for loose-blowing or dense-packing, batts for installation between framing members, rigid and semi-rigid boards used primarily for continuous exterior insulation, or rigid boards for insulating structural sheathing or flooring underlayment. The most common material in the U.S. is rigid insulation board, which is made using the dry method, with waxes and tongue-and-groove edges on all four sides. There are only two companies now supporting this market in North America: Gutex, sold exclusively by 475 High Performance Building Supply in Brooklyn, and Steico, sold by Global Wholesale Supply in Maryland. A similar product, available in limited quantities, is Agepan, sold by Small Planet Supply. Another company, MSL in Quebec, manufactures



One of the most exciting things about wood-fiber insulation is the size of its carbon footprint—it's miniscule. In Europe, it's carbon negative.

wood-fiber board using the wet method to create sheathing that is structurally comparable to OSB but with far better insulating qualities.

The most popular of these products all come in manageable sizes, have tongue-and-groove edges on all sides, and have a paraffin-wax additive that sheds water while allowing the product to remain vapor-open, which many designers and builders consider to be a more resilient approach than continuous insulation like foam that blocks vapor flow.

Gutex and Steico both offer several other rigid boards in various densities, R-values, thicknesses, and edge styles; with varying levels of wax,

depending on the need for water repellency. The commonly available types can remain exposed to the weather for several weeks, and the recommended details for all of them include taping flashing to the face of the insulation board. A feature of wood-fiber insulation that is often touted, especially in European advertising, is its high thermal-storage capacity, almost ten times more than mineral wool. That can be a benefit when the days are warm and sunny and the nights are cool, because heat stored in the wall assembly can slowly radiate to the interior.

One of the most exciting things about wood-fiber insulation is the size of its carbon foot-

print—it's miniscule. In Europe, it's carbon negative. According to Floris Keverling Buisman, 475 High Performance Building Supply co-owner, that's partly because only 3 in. are typically needed to achieve high levels of energy efficiency there, and largely because the FSC-certified wood content comes almost entirely from within 80 miles of the factory. Of course, the wood still needs to be dried, which uses energy. And when it's shipped to North America, its embodied carbon level climbs. But Floris has calculated that in many cases, it can still be a carbon-negative material, even with shipping.

Applications and installation

Wood-fiber insulation is available for almost any above-grade application, either as batts in framing lumber bays, loose-blown for attics, or as rigid board for continuous exterior insulation. Products are even available for slab insulation, though the insulation has to go above the slab. It can also go on the interior side of walls or roofs, and some types can be directly plastered over.

Fiber boards are usually installed over structural sheathing, but they are stiff enough to span studs or rafters if there is other lateral bracing. Due to their high compressive strength, they are easier to install on the exterior, using battens and long screws, than mineral wool or even most rigid foam, because they don't compress significantly. Also, because of the tongue-and-groove design, the joints between panels don't have to land over framing.

Rigid board can be installed on the interior or exterior of



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Wood-fiber insulation products

There are only a small number of brands of rigid wood-fiber insulation available in the U.S. When GO Lab hits the market, there will be five, including:

Gutex Multitherm

R-VALUE R-3.7/in.

WEIGHT 8.74 lb./cu. ft.

PERMEABILITY 44 perms, approx. 18.5 perms for 2³/₈ in. material

COMPRESSIVE STRENGTH 1462 lb./sq. ft. (approx. 10 lb./sq. in.)

FIRE RATING (ASTM E119) at 4-in. thickness passed 1-hr. testing as part of assembly

FIRE RATING (ASTM E84) Class B material (a Class A product was recently announced)

Agepan THD

R-VALUE R-2.87/in.

WEIGHT 14.36 lb./cu.ft.

PERMEABILITY 18 perms



Steico Universal Dry (shown)

R-VALUE R-3.5/in.

WEIGHT 11.23 lb./cu. ft.

PERMEABILITY 46 perms, approx. 19.4 perms for 2³/₈ in. material

MSL SonoClimate Eco4

R-VALUE R-2.7/in.

WEIGHT 16.5 lb./cu.ft.

PERMEABILITY 26 perms

COMPRESSIVE STRENGTH (ASTM C-209) ≥ 50 lb./sq. in.

masonry buildings, though it should not be used for interior or exterior basement-wall insulation unless there is also an impermeable insulation layer to provide dew-point control.

Steico and 475 High Performance Building Supply both have documents showing a variety of installation details. Europeans tend to rely on acrylic tape for waterproofing more than U.S. designers and builders, and the installation details reflect that—the face of the insulation board is treated as the water-resistive barrier (WRB), with flashings taped to the insulation. However, there are some reports of wind-driven rain getting through the tongue-and-groove joints, so for North American builders who are not comfortable relying on wood-fiber panels as their

WRB, they can use structural sheathing behind the insulation as the airtight layer and as the location for a secondary WRB.

Regardless of whether the panels are used as the WRB or not, the most common products available in North America are all tongue-and-groove, and are installed horizontally with the tongue facing up to shed water.

Will Grupenhoff, co-owner of Global Wholesale Supply, says that in North America, wood-fiber insulation board is almost always installed with rainscreen battens to create a rainscreen gap, though it is also possible (and common in Europe) to use the insulation board as a base for a stucco system. Albert Rooks, owner of Small Planet Supply, says that in colder and damper climate zones it's critical to include at least a 3/4-in.

ventilated rainscreen—though 1½ in. is safer—to allow walls to dry quickly, before mold or fungus can take hold on the wood-fiber board.

GO Lab claims its product will be able to stay exposed on roofs for up to ten weeks before ultraviolet rays degrade the paraffin's waterproofing properties.

Special considerations

The wet method of making wood-fiber insulation does not include the moisture-repelling wax, so a separate WRB is required. MSL has some products with a pre-adhered WRB.

Blown-in and batt wood-fiber products are not often used in the U.S., at least not yet, but Gutex and Steico offer those products (Gutex Thermoflex and Steico Flex), and GO Lab intends to as well. Formulations include a polyolefin binding agent and ammonium phosphate as a flame retardant. The specs for each are similar, R-3.9 to R-4 per in., which is equal to or better than most of the fibrous cavity insulation alternatives.

Blown-in fiber does not have synthetic binders or paraffin, but it does have about 9% ammonium salts as a flame retardant. The insulating value is R-3.6 to R-3.8 per in., similar to cellulose and higher-performing blown fiberglass.

Wood-fiber board's sound attenuation is excellent—from 36 to 50-plus decibel reduction, depending on product and assembly. This is thanks to its high density, irregular airspaces, and interlocking, air-blocking tongue-and-groove joints.

Contributing editor Michael Maines is a design/build contractor in Palermo, Maine.

Cost and availability

475 High Performance Building Supply stocks Gutex Multitherm 60 (2³/₈ in. thick) and Thermoflex 5½-in. batts (available in 267-sq.-ft. pallets at \$3.41 per sq. ft.). The company can also special-order other sizes by the container. The savings from buying by the container is like getting an extra inch of insulation depth for free. Installation details are available at foursevenfive.com/smart-enclosure.

Germany-based Steico is Europe's largest manufacturer of wood-fiber insulation. It's U.S. distributor, Global Wholesale Supply, is based in Maryland (globalwholesale.biz). They primarily carry batts and rigid board, but can also do blown-in. They stock both 40-mm board (about 1½ in.) and 60-mm, and they sell by the pallet, with custom pricing based on the product.

MSL's SonoClimate Eco4 is available from Performance Building Supply in Portland, Maine (performancebuildingsupply.com), currently by special order only.

Agepan THD in 2-in. thickness is available from Small Planet Supply (smallplanetetsupply.com), with pricing available on request.

GO Lab has not yet announced pricing, but their goal is to be competitive with other premium insulation. They are aiming to be in the market in 2020.

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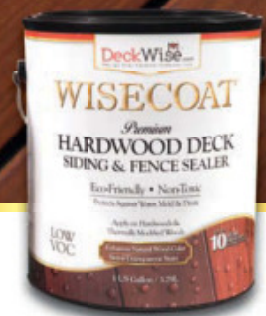
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Avoiding numbers

I once read that the artist Pablo Picasso had trouble with arithmetic because he was incapable of interpreting the numeral 7 as anything other than a human nose in profile. “Ah, a kindred spirit,” I thought. Yes, numbers are an indispensable part of the building trades, but for some of us they’re a necessary evil, with emphasis on the word “evil.” Whenever there’s a way to take the measure of a thing without resorting to those slippery little bugs called “numbers,” I’m the first to try it. If you happen to be a math wiz, I envy you, and you can skip this story. But if you’re numerically challenged like the rest of us, here are a few tricks that might help keep you straight.

The simplest way to avoid measuring is to mark your work in place whenever possible. That may sound obvious, but I often see experienced journeymen pulling measurements that seem unnecessary. For instance, when framing walls flat on a deck, the jack studs need to be trimmed to compensate for vagaries in the header width (due to crooked lumber, misalignment, etc.). The simplest way to trim a jack is to butt its top against the header and strike a mark on the bottom end flush with the king stud. Reach for a

nearby circular saw and buzz it, and you’re done.

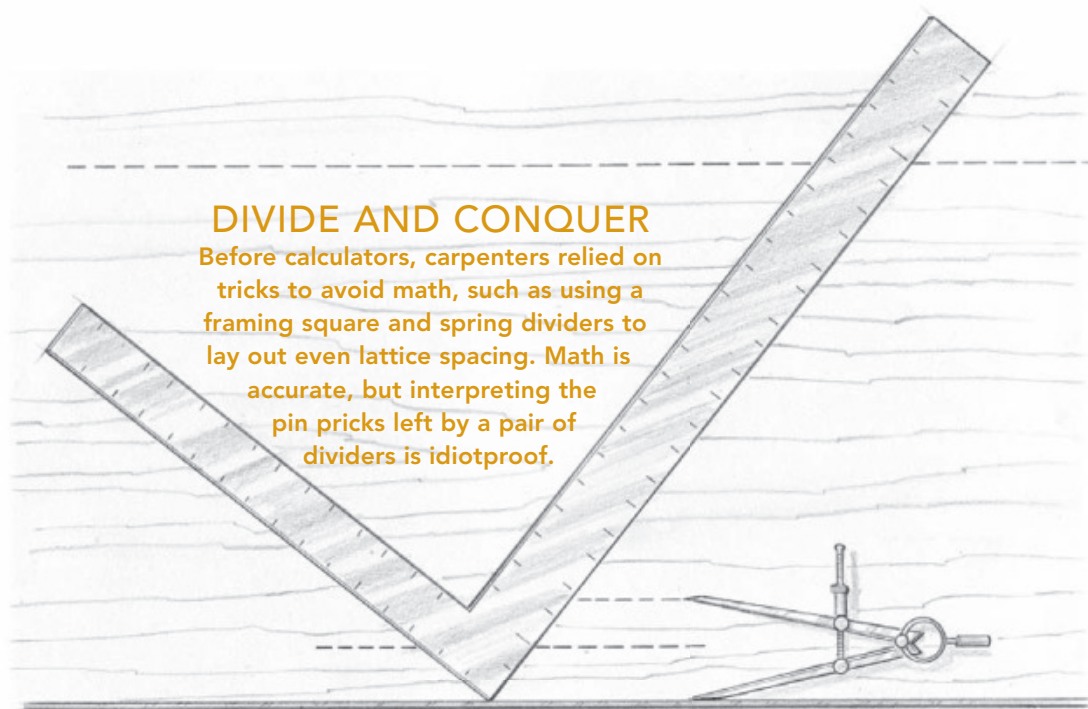
Striking a mark rather than measuring is also useful when the target is above eye level. Suppose you need to determine the stud length for a garage wall that steps down from the main subfloor, and you already have a regular 8-ft. wall standing adjacent to the garage. You could measure from the garage slab to the top of the regular wall and subtract 4½ in. for the thickness of three plates. You’ll need a tall stepladder to get your eyeball high enough for an accurate measurement—and you’ll need to hope you got the math right. Or, you could stack

three scraps of 2x on the slab, stand a 10-ft. 2x4 on top of the stack, and strike a mark flush with the top of the regular wall.

A similar trick is useful for mitering door and window trim. First, chop all the legs in the room to rough length, using a stop on the saw so you don’t have to measure each one. Use the leftovers to make head casing. Tack all the head casing in place and miter all the legs. Set the chopsaw square and leave it there. Then mark each leg by standing it upside down—point to the floor for doors and point to the stool for windows. Tick a mark by feel at the top of the head casing and chop it square.

You could also stand the leg right-side up and mark the long point of its miter, but a square cut is visually easier to zero in than an oblique cut. Believe me, when you’re an old wood butcher with bifocals sliding off the end of your nose, you’ll appreciate the difference.

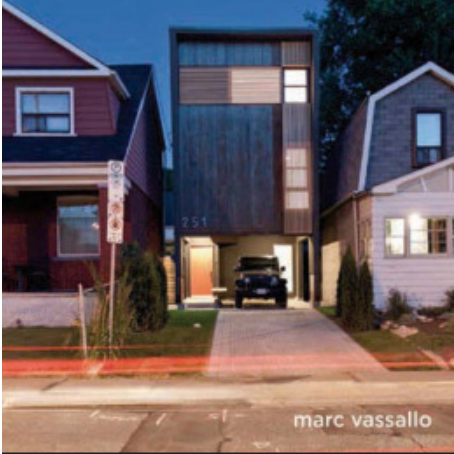
The best way I know to avoid errors and keep your tape in your pouch is to make a story pole. Think of a story pole as a ruler with only the marks you need for the job at hand. There are 4800 marks on a standard carpenter’s tape, and a good story pole gets rid of the ones you don’t need. I make story poles for siding, stairs,



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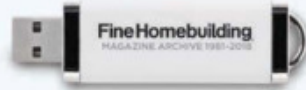
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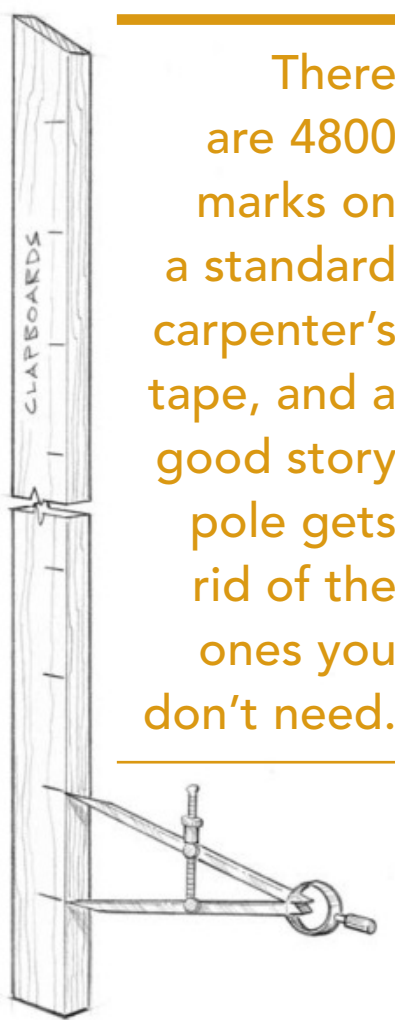
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millwork—anything with repeatable increments. So, for instance, if I'm building a set of winder steps and I need to plot the elevation of the winders on the wall framing, I refer to a single story pole instead of multiplying the riser height at each location.

Fortunately, being a woodworker, I have an inexhaustible supply of rip offcuts and leftover boards from which to make story poles. A light-colored fine-grained wood works best. One end of the pole usually represents a starting point of some kind, such as the subfloor or soffit. I cut this end square and write its meaning as clearly as possible. I cut the other end at an angle to quickly identify it as the non-reference end of the pole.

Laying out a story pole starts with marking a few given dimensions, such as the width of a frieze. I do this carefully because a mistake on the pole will be reproduced wherever the pole is applied. Then, for stepping off repetitive increments such as risers or siding courses, I put away my tape and use a spring divider. A spring divider is a compass with a steel point on both legs instead of a pencil. Spring pressure on the legs affords very fine adjustments. It takes some practice to divide, say, $108\frac{3}{16}$ in. into 14 equal increments. If you fall short on the first try, there's a tendency to open the legs too much and thus overshoot on the next try. Practice makes perfect. Sure, there are calculator functions that can generate a list of measurements and will round them



There
are 4800
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pole gets
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ones you
don't need.

off to whatever degree of accuracy you require. But transferring all those fractions to the pole risks error. The pin pricks left by a pair of dividers are idiotproof as long as you start and stop in the right place.

The final step in preparing a story pole, or "rod" as the British call it, is to label it clearly. This is particularly important on a complex job such as a paneled library, where you might have height rods and width rods for each wall. Writing "north wall/height" with a bold

marker will make it easier to pull the desired rod from the bundle when you need it. If I'm using a 2x4 as a story pole on a framing job, I flag it with blasts of spray paint; otherwise it's liable to end up as fire blocking, or I'll lose it among the hundreds of identical 2x4s lying around the site. Please don't ask if this has happened to me before.

Sticks can be useful for measuring even without marks. We once rebuilt a Victorian cornice with heavy corbels. Between the corbels were multiple short moldings requiring hundreds of inside measurements. By sliding two slender sticks alongside each other and pinching them between thumb and fingers, we were able to transfer the lengths needed to the trim stock. Sliding sticks also come in handy to extend one's reach, such as when measuring the height of a tall ceiling. This is an awkward task with a tape alone, but you can make the job easier and more accurate by sliding a pair of sticks from floor to ceiling, clamping them, and then lowering the combined sticks to be measured.

A spring divider lets me step off long story poles with no numbers whatsoever, but for dividing shorter distances there's a hybrid trick that is part numerical and part graphic. The numerical part is easy and reliable because it bypasses fractions. Imagine that you need to find the center of a board that is $7\frac{5}{16}$ in. wide. Lay your framing square diagonally across the board so that the corner (0) touches one edge and the 8 touches the opposite edge. The

center of the board will be at 4, and a line gauged through that point will be the centerline.

The same trick works when dividing something into multiple parts. Suppose I have to apply lattice to a frame opening of $29\frac{1}{8}$ in. I'm using $1\frac{1}{2}$ -in.-wide lattice strips and I want all the intervening spaces to be equal. Ideally, the width of the spaces would also be $1\frac{1}{2}$ in. to create a perfect on-center spacing of 3 in. (lattice + space). That doesn't work out, though, because $29\frac{1}{8}$ divided by three gives me nine units with $2\frac{1}{8}$ in. left over. I want a space at both edges of the panel, so there will be nine strips and ten spaces. The aggregate width of all the strips is $13\frac{1}{2}$ in. ($9 \times 1\frac{1}{2}$), and the remaining aggregate width of all the spaces comes to $15\frac{5}{8}$ in. ($29\frac{1}{8} - 13\frac{1}{2}$). The width of a single space will therefore be one-tenth of $15\frac{5}{8}$.

I would rather avoid this numerical equation—there's way too much room for error. So I gauge a line on a sheet of plywood $15\frac{5}{8}$ in. from the edge. I lay my square on the plywood with the corner (0) on the edge and the 20 on the line, and I tick a mark at 2 (one-tenth of 20 in.). The distance from the tick mark to the edge is the unit space, so I set my dividers to unit space plus lattice width to step off the layout on the frame.

There's no avoiding math in carpentry—it comes with the territory. But let's face it: Building in today's complex environment is a constant battle to maintain focus. Don't clutter your head with unnecessary numbers that can turn around and bite you in the butt.

Scott McBride is a builder and writer in Virginia.



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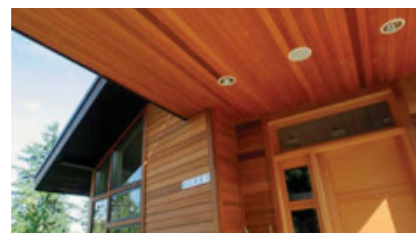
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Had you known Libby Schrum growing up, you likely would not have envisioned her in a woodshop in Maine carving out a career as a professional furniture maker. An avid athlete, Libby graduated from Southwestern University with a sports-management degree. Not unlike many new graduates, she recognized rather quickly a general frustration and disinterest in her chosen field. "At some point, my mom asked, 'If you could do anything, what would it be?'" she recalls. The simple question sparked a new course of study and work that would fuel her inner maker.

What followed was an intensive at the Center for Furniture Craftsmanship, an MFA from the Rhode Island School of Design, a fellowship, and a job as a cabinetmaker for a boat company turning out world-class yachts. Each step of the way, Libby honed her design sensibilities and her technical skills.

She eventually struck out on her own and successfully built a studio where her work speaks for itself. "I have not found woodworking to be a lucrative career, but it is extremely fulfilling," Libby says. "I'm able to step back and realize that with my hands and my ideas, I've made something beautiful—objects people can use and interact with, that say as much about me as they do about the world we live in."

With a busy shop, Libby still finds time to inspire and educate others through her program, STUDIOcation. "I know that there are people who dream in furniture, just like I do. They can see the concept in their head and if they only had the know-how, or machines, or space, they could build it." STUDIOcation is the place to realize those dreams. It's her way of sharing her love of woodworking and passing on the joys of craftsmanship.

—Rob Yagid, executive director,
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