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ISSUE 298 // APRIL • MAY 2021





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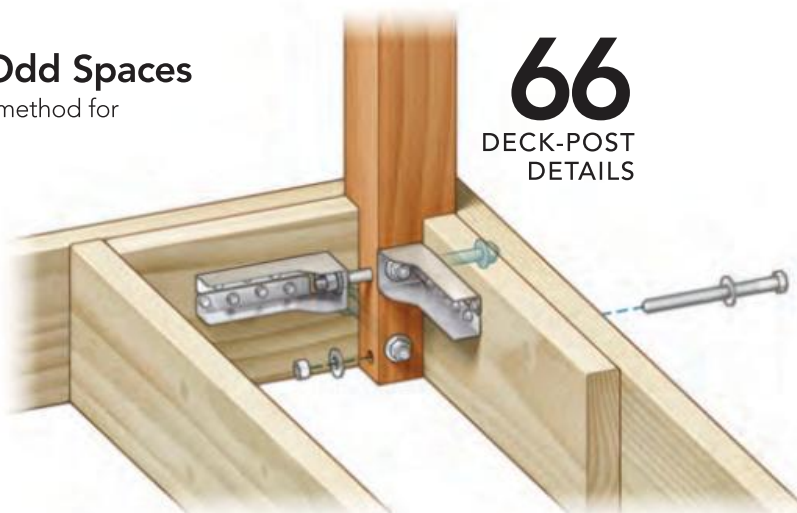
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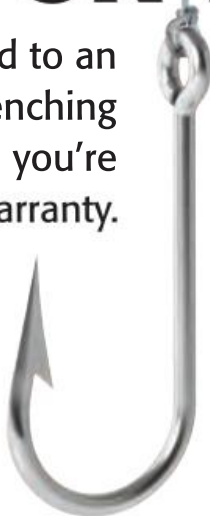
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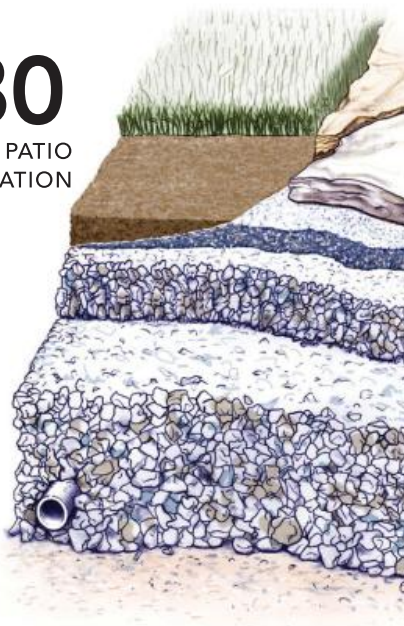
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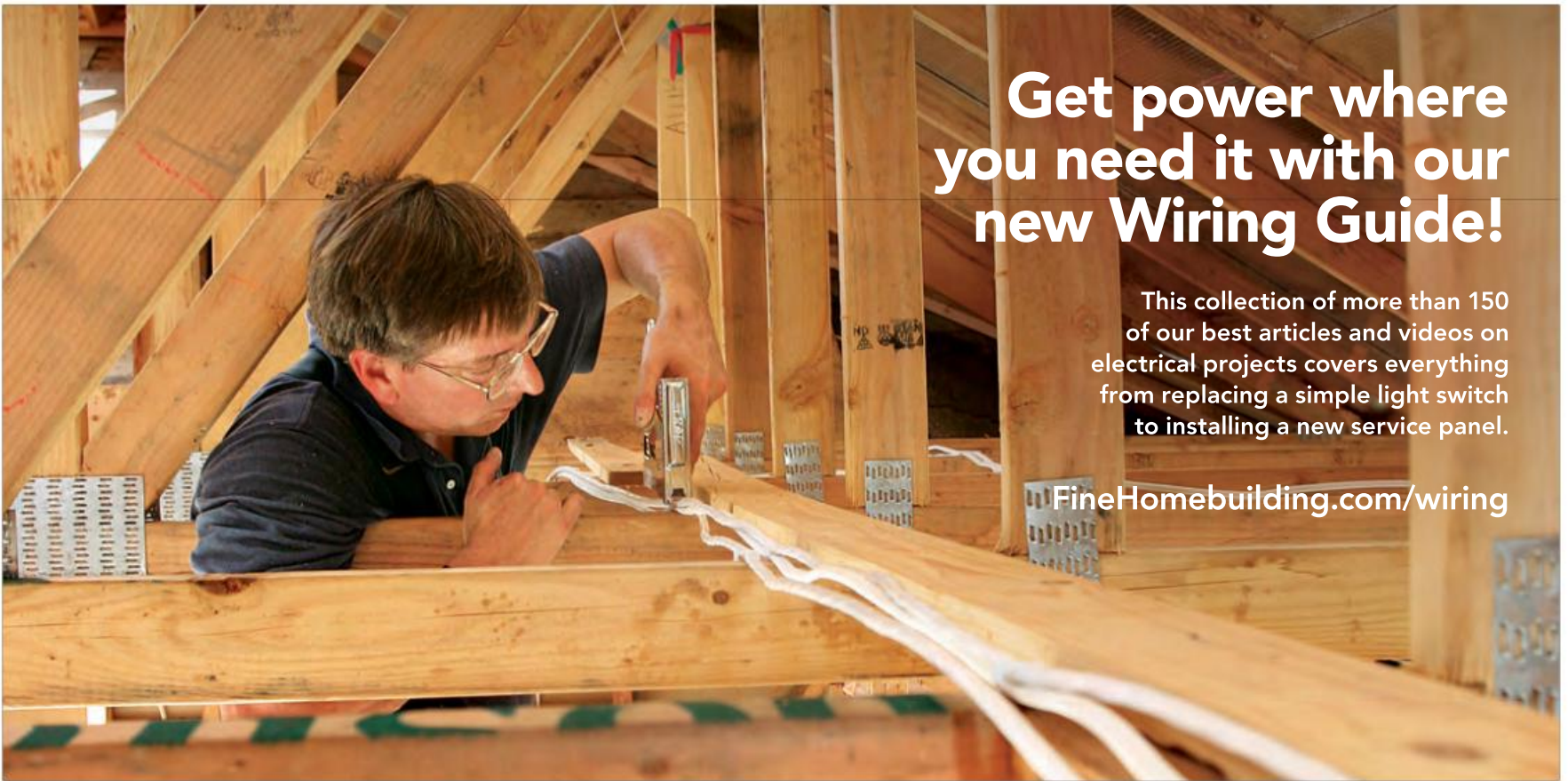
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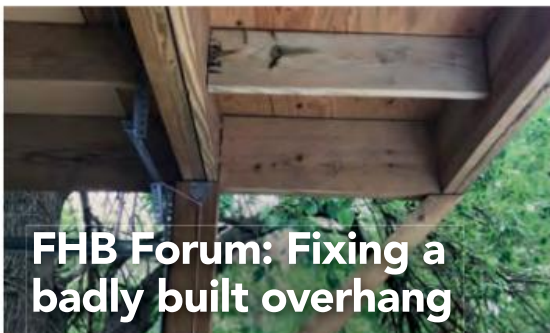
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FHB Forum: Fixing a badly built overhang

One reader asked about ways to reinforce a failing carport to avoid a costly rebuild. See the suggestions, offer advice, or ask a question of your own at FineHomebuilding.com/forum.



Episode 323: Rescue a Sagging Beam

A listener writes in to ask if jacking up and repairing some butchered framing in his house will do more harm than good. Catch up on all episodes at FineHomebuilding.com/podcast.



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THE VOICES OF EXPERIENCE



JAY CRANDELL has over 30 years of experience in construction, engineering, and innovative building technology research for private- and public-sector clients. He has conducted benchmark studies of major natural disasters and conducted research to address significant structural, energy, and building-science challenges. His work has helped to propel many innovative technologies into the International Codes and consensus standards. In this issue, he co-authors an article on controlling water vapor in wall assemblies (pp. 48-53).

Over a 30-year career in construction, **FERNANDO PAGÉS RUIZ** (co-author of "The Nuances of Vapor Control," pp. 48-53) has become a dedicated proponent of building innovation in low-cost housing. He is author of *Building an Affordable House* (2005) and *Affordable Remodel* (2007), both published by The Taunton Press. Fernando's award-winning homes have appeared on HGTV, and he is currently working with Andrés Duany on the design and fabrication of a new generation of manufactured housing.



DUO DICKINSON started making things in 1979, apprenticing at a millwork shop and architectural office. He has had his own architectural practice for over 30 years, and has built almost 900 things. He has written eight books, including *The House You Build* (The Taunton Press, 2004), and is a staff writer for several web and print publishers, including Hearst. He has written for *Fine Homebuilding* magazine in the past; in this issue, he discusses ways of rethinking deck design (Building Matters, pp. 86-88).



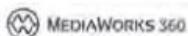
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Publisher	Renee Jordan
Senior Vice President, Sales	Russell Ellis 917-767-5338 rellis@taunton.com
Associate Publisher/Advertising Director	Noelle Kennedy 203-304-3530 nkennedy@taunton.com
Senior Account Manager/Integrated Media Midwest/Northwest	Robert Reed 630-460-2585 rreed@taunton.com
Group Marketing Director	Robina Lewis 203-304-3532 rlewis@taunton.com
Sales and Marketing Manager	Kelly Kingston
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Tiling in the 21st century

I built three showers and one tub surround in the 1990s using details from *Setting Ceramic Tile* by Michael Byrne. One section of Byrne's book appeared as the article "A Mortar-Bed Shower" in *FHB* #32, in which he demonstrates how to build a shower by attaching roofing felt to studs, topped by a floated mortar wall, or cement backerboard. For showers, this method was combined with a shower-pan liner, mud bed, and subdrain. On the walls and the shower floor, the waterproofing layer was not directly under the tile, resulting in perpetually damp mortar between the tile and the pan liner, and a musty smell when regularly used.

When building a new home in 2016, I found that methods and materials have taken a quantum leap forward and the waterproofing layer is now commonly placed directly under the tile, using sheet or fluid-applied membranes. Lightweight, already-waterproofed backerboards are available. And, with the waterproofing layer directly under the tile, traditional shower-pan liners have largely been supplanted by surface-level center or linear drains. I have now built two showers and one tub surround using these new methods and materials. The ease of installation and quality of the finished product is light-years better.

I recently purchased access to your archives and found articles on linear drains, tile backerboard, a curbless shower, and installing a premade shower niche in a Schluter-system shower. But an article on how to build a shower, from start to finish, using these new materials, or how they compare to the traditional methods, is conspicuous in its absence. I believe such an article would be welcomed by many readers who, like me, need to build a shower once in a while.

—RALPH POND
Garden Valley, Idaho

Editorial director Brian Pontolilo replies: Thank you for sharing your experience, Ralph, and for your recommendation. While we still need to find the right how-to project for you, turn to pages 28-35 for Joshua Oduin's "Waterproofing Tile Showers," which takes a good look at many of the products you've mentioned.

Modifying trusses

As a residential building inspector for the city of East Peoria, Ill., I enjoyed Neil Thompson's fine article "Successful Floors With Trusses" (*FHB* #297). Mr. Thompson discusses field-trimming floor trusses that are too long or out of square. My advice is to call your inspector

first, lest you run afoul of the International Residential Code (IRC). Section R502.11.3 is specific: "Truss members and components shall not be cut, notched, spliced or otherwise altered in any way without the approval of a registered design professional."

By the strict letter of the IRC, an unauthorized field

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63 South Main Street
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■ your safety

Home building is inherently dangerous. From accidents with power tools to falls from ladders, scaffolds, and roofs, builders risk serious injury and even death. We try to promote safe work habits through our articles. But what is safe for one person under certain circumstances may not be safe for you under different circumstances. So don't try anything you learn about here (or elsewhere) unless you're certain that it is safe for you. Please be careful.

—BRIAN PONTOLILLO
editorial director

trim is thus forbidden. Section R104.1 does allow the inspector to approve a common-sense modification, but the devil is in the details. I once found a floor truss that had been trimmed 8 in. on-site. This resulted in a stop-work order and the loss of two days until an engineer could re-certify the truss.

Call your inspector once you realize there is an issue and explain the modification. Keeping your inspector in the loop will minimize potential delays and avoid a costly stop-work order.

—JOE BOYER
via email

Author Neil Thompson replies: Any trimming of floor trusses that we do is typically less than 1/4 in. to avoid affecting the structural integrity of the unit, and is only to adjust alignment. For any modification of the truss greater than 1/4 in., we work with the truss designer and their engineers to come up with an approved repair for each truss involved. All adjustments executed on the project shown in the article were less than 1/4 in. and were done to create a plumb surface to which we could attach the sheathing. We do not condone any field adjustments without the consent of the structural engineers along with properly certified and stamped repair drawings.

Changed for the better

It was a blast to see Joseph Kitchel's article, "Staircase Renovation," in the first anniversary issue (*FHB* #297). That was one of the articles that cemented my love affair with *Fine Homebuilding*. Early in my career, it took the mystery out of stairs and enabled me to take on a job fixing up a set in a

Victorian house. Simply understanding how old newels were attached was an epiphany.

More importantly, because at that point in my life I was still wrestling with the question of whether a relatively smart guy would be "wasting his potential" (my mother's words) by going into the trades, those early issues let me know that there were in fact smart people doing this work.

The republished article, alongside the following one on flared shingle corners, also showed how the magazine has changed, for the better I think. Kitchel's piece was great for its day. I happily slogged through its descriptive writing 40 years ago. Re-reading it, though, the article felt dense; the information was difficult to wrap my head around, even though I know a lot more about stairs today. But the article on flared shingle siding? I plowed through its photos and captions in no time, picking up a bunch of useful techniques. Some readers complain that the magazine has been dumbed down over the years. I don't think so. I just think the staff has mastered the technique of presenting information in a way the reader can grasp efficiently.

—ANDY ENGEL
Former *FHB* editor

P-trap of necessity

I chuckled when I saw the picture of the P-trap self-plunging sink drain in Spec (*FHB* #296) because it reminded me of my childhood in the '70s. I am one of 12 children and at the time my parents had children in college along with infant twin girls. Life was chaotic but pleasantly memorable. By profession, my father was a mechanical engineer for the U.S. govern-

ment, but a self-made auto mechanic out of necessity. At some point in time the P-trap in the main bathroom failed. There were no big box stores such as Home Depot or Lowes to run to, so my dad went to the garage and returned with a radiator hose and some hose clamps. The only difference from the photo in the magazine was a black flexible pipe verses a white flexible pipe. That plumbing solution remained until my parents sold the house many years later.

—JOE RILEY
via email

Hard hats, please

On the front page of the February/March issue (*FHB* #297), you have five people engaged in one of the more dangerous aspects of home building—rolling trusses—and not one of them is wearing a hard hat. Not a good example.

—MARK SALOMON
Via email

Frost heave advice from Frank Lloyd Wright

Thank you for Glenn Mathewson's excellent Know the Code, "Protecting foundations from frost" (*FHB* #297). His analogy of the "three-legged stool" of frost heaves is vivid. One of the legs he described is wet soil.

Besides good drainage, another often overlooked factor to keeping the soil from getting too wet is large roof overhangs. Frank Lloyd Wright wrote that deep overhangs give a building a "sense of shelter." They can also help prevent frost heave.

Keep up the great work, and here's to another 40 years of *Fine Homebuilding*.

—SAM BOWCOCK
Northern Kentucky



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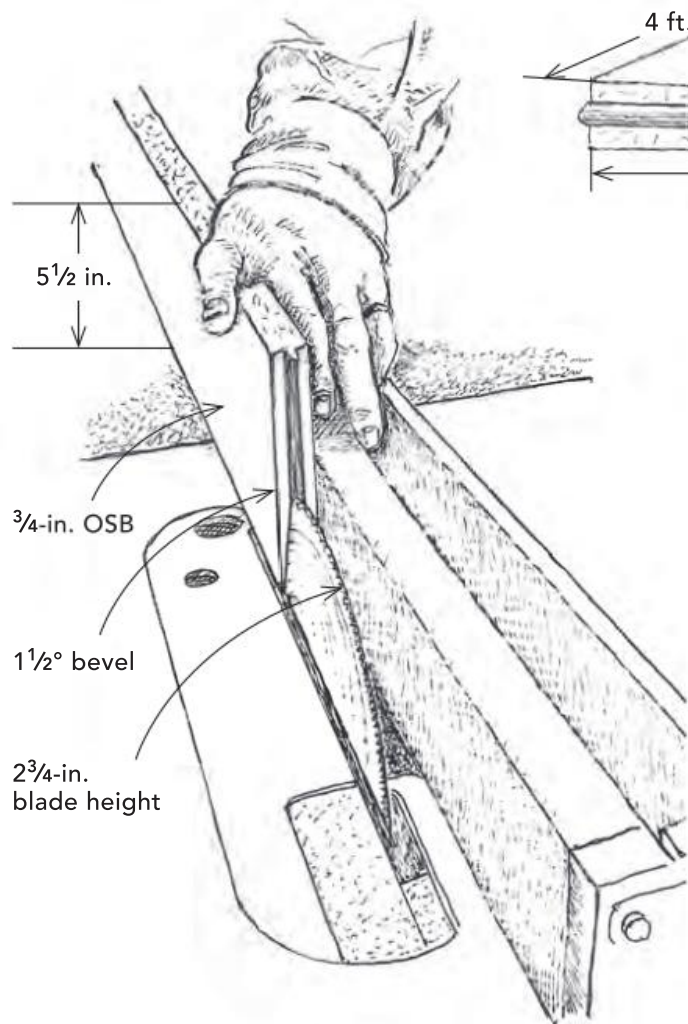
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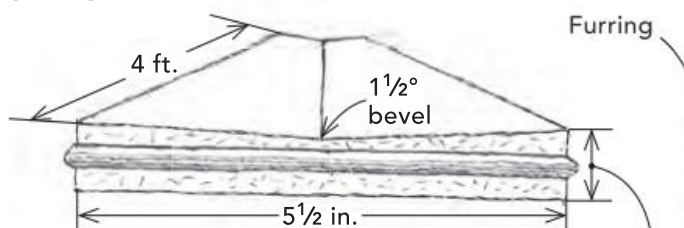
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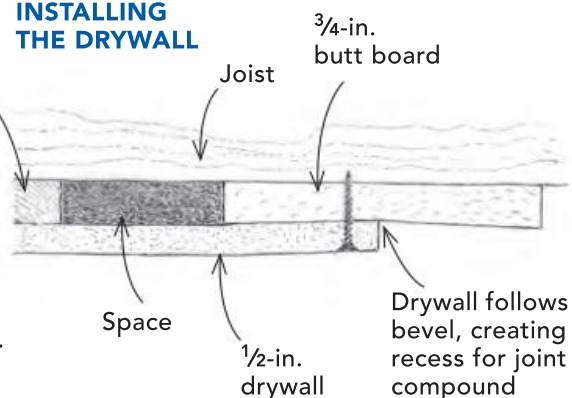
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Butt boards for smooth ceilings

Finishing the butt joints where the short ends of drywall panels meet takes more time than finishing the seams where the tapered, long edges of panels meet. Because there isn't a recess at the butt, you get a buildup of joint compound. To combat this issue, we use butt boards. There are ready-made butt boards that you can buy, but we like to make our own. We use 3/4-in. OSB and rip 4-ft. pieces into 5 1/2-in. strips. We set our tablesaw's blade height to 2 3/4 in. and the bevel to 1 1/2° and run the strip through the saw. Once one side is beveled, we flip the piece and bevel the other side.

When using butt boards, hang the drywall panel so that the butt end lands in about the middle of a stud, joist, or rafter bay. Once the drywall is fastened to the framing, we install the butt board on the floating end of the panel. The next piece of drywall is installed on the other side of the butt board. The drywall ends follow the contour of the bevel, creating a recessed joint that's less visible and easier to finish.

—AARON MILLER
Pollard, Ark.

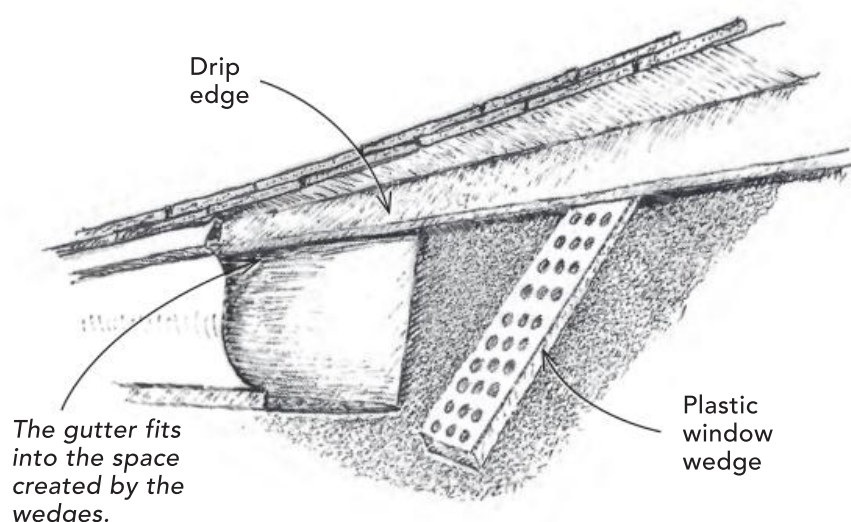
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Share your methods, tricks, and jigs with other readers. Tag them @FineHomebuilding on social, email them to us at fh@taunton.com, or upload them to FineHomebuilding.com/reader-tips. We'll pay for any we publish.

Help installing gutters

There are plenty of ways to install gutters after the roofers have come and gone, but I like to use hard-plastic glazing wedges roughly 3 ft. on center that I put under the drip edge, as shown in the drawing. Then I tuck the gutter under the drip edge on top of the wedge and I remove the wedges as I install the gutter. The wedges hold the drip edge off the fascia without scratching it.

—MICHAEL FULLER
Runnells, Iowa



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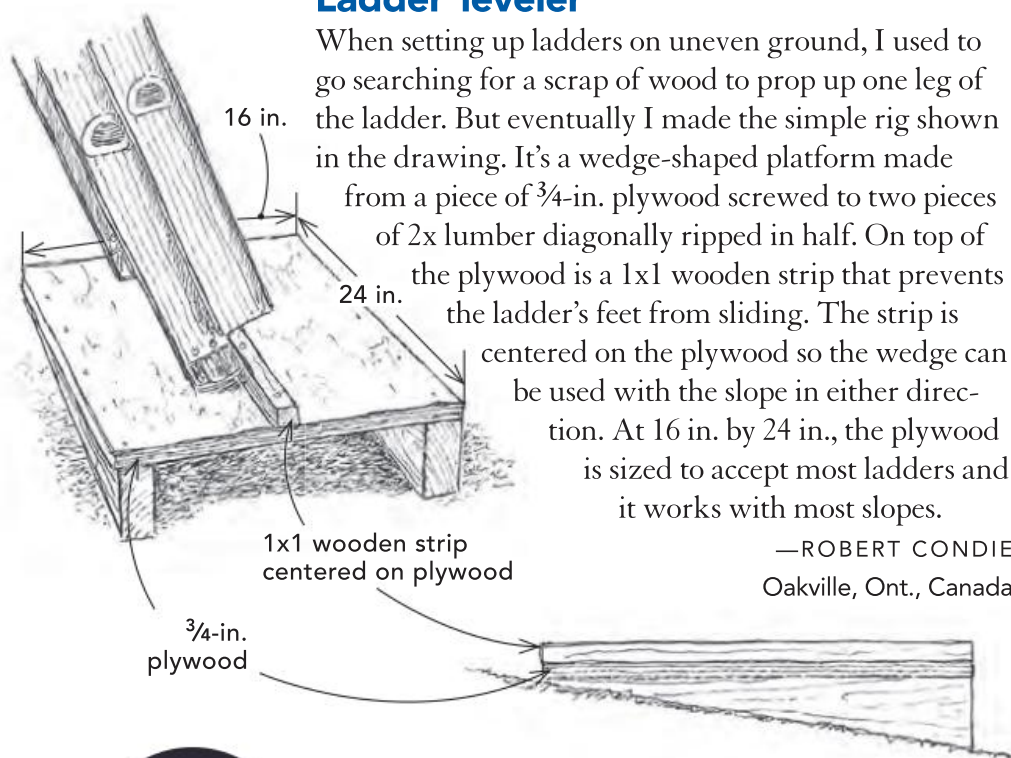
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Safety bucket

You should always have a first-aid kit and fire extinguisher on your job site, no matter how small the project. The problem is that one or both are usually inside the job box or truck, or somewhere else far from where the work is happening. Instead of sending someone running to find them during an emergency, I put both items inside a 5-gal. bucket with a loosely fitting lid that identifies what's inside. The bucket makes it easy to move the kit around no matter where the work is happening, even on roofs and scaffolds, and the lid keeps the contents dry and protected. I show the bucket's location to all of my crew and subcontractors every day before we start work.

—GRAHAM JOHNSTON
Savannah, Ga.

Ladder leveler

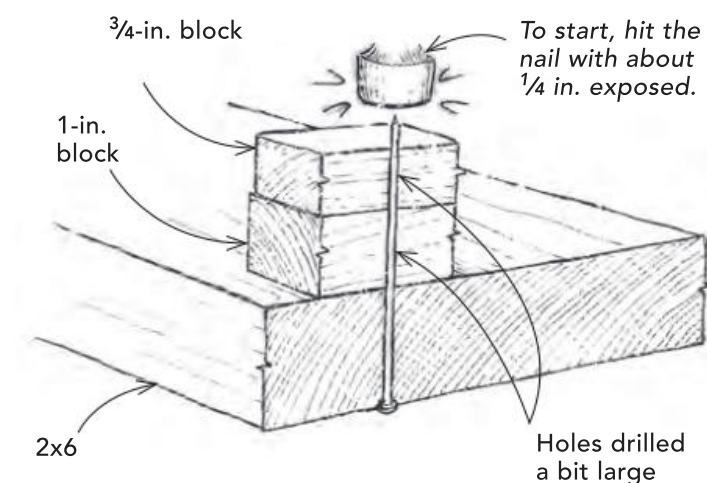


When setting up ladders on uneven ground, I used to go searching for a scrap of wood to prop up one leg of the ladder. But eventually I made the simple rig shown in the drawing. It's a wedge-shaped platform made from a piece of $\frac{3}{4}$ -in. plywood screwed to two pieces of 2x lumber diagonally ripped in half. On top of the plywood is a 1x1 wooden strip that prevents the ladder's feet from sliding. The strip is centered on the plywood so the wedge can be used with the slope in either direction. At 16 in. by 24 in., the plywood is sized to accept most ladders and it works with most slopes.

—ROBERT CONDIE
Oakville, Ont., Canada

Pulling nails from redwood

I had to remove 2x6 redwood exterior trim that the homeowner wanted to repurpose. Unfortunately the $3\frac{1}{2}$ -in. box nails bent every time I tried to pound them out from the back side. Years and years of paint cover-



ing the nail heads didn't help. With a hundred of these nails to remove, I needed a solution. I decided to drill a hole just slightly larger than the nail shank in 1-in.- and $\frac{3}{4}$ -in.-thick pieces of scrapwood.

With the two holes aligned, I put the drilled scraps over the nail, leaving only about $\frac{1}{4}$ in. of the nail sticking out. With a hard tap on its pointed end, the nail was freed. I removed the $\frac{3}{4}$ -in. piece and struck again, further driving out the nail without bending. A third hard tap drove the nail out enough to pull it out, leaving a clean hole and mostly intact redwood.

—SCOTT GILLESPIE
Richmond, Calif.



TIMELESS TIP

ISSUE 3 // JULY 1981

Jackson Clark's tip for linking two chalklines together first appeared in *Fine Homebuilding* issue #3 in the summer of 1981, but the technique is as useful now as it was 40 years ago. When we had work done on our roof last year, the builders used this trick as though everybody knows it.

—CHARLES MILLER

Snapping lines

When snapping a series of chalklines, as on roofs or siding, two people can hook their chalk-box lines at the clip by inserting one line through the other, as shown in the drawing. Worker A reels in the hooks to his end and they snap lines until worker B's line goes dry. Then worker B cranks his line while exposing A's for more snapping. There is no walking back and forth, and no time wasted rechalking the lines.

—JACKSON CLARK
Lawrence, Kan.



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Problem-solving through stair landings

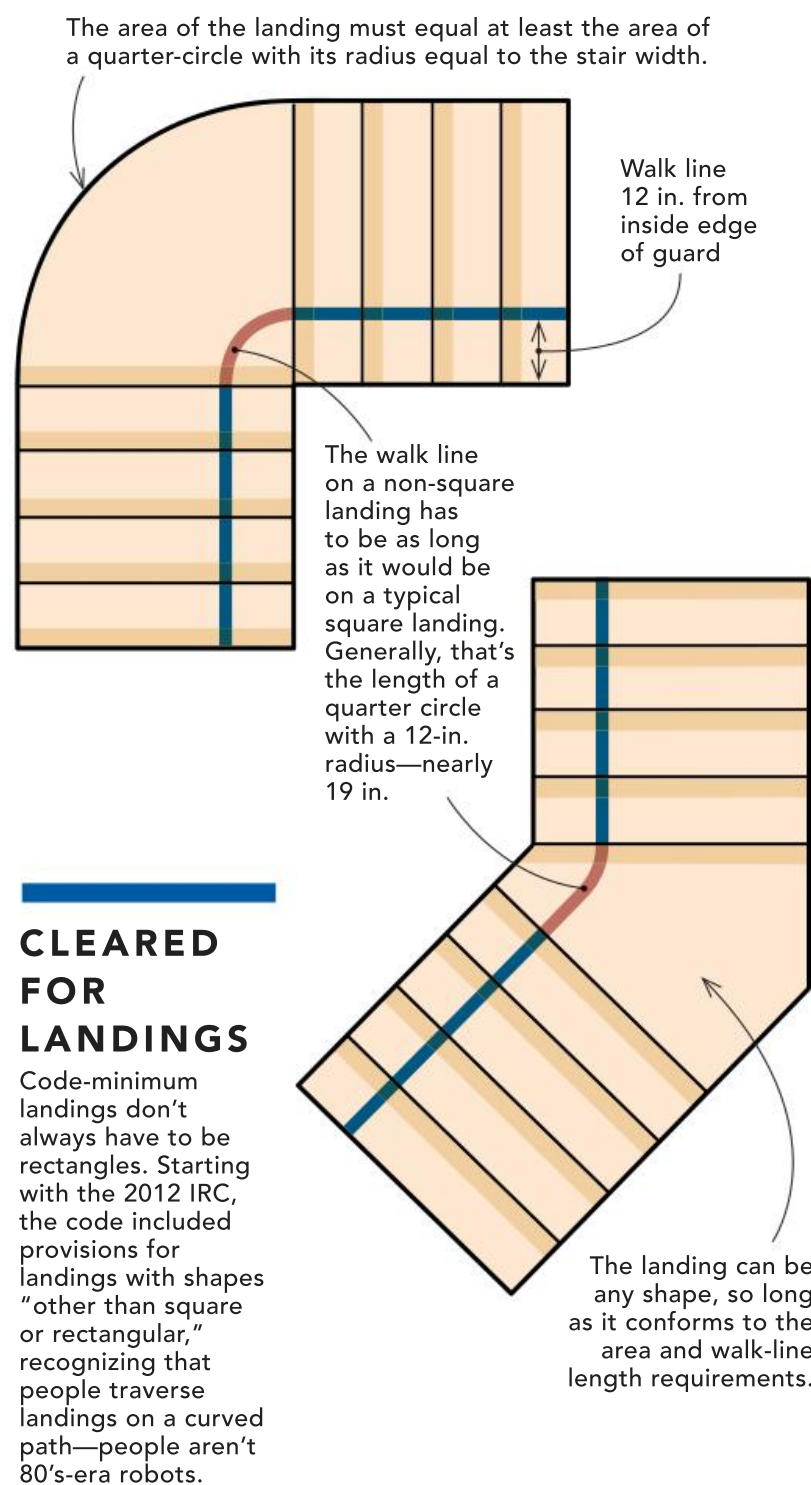
Stairways and their guards have been an artistic focal point of house design since long before the invention of building codes. When model codes began to address stair design for houses in the mid-1900s, the provisions were carefully crafted to maintain the long-appreciated architectural freedom. Uniformity of treads and the dimensions of winder treads—pie-slice-shaped stairs that wrap around a bend in a flight of stairs—were the first stair components addressed, followed by maximum rise and minimum run. This pattern of incremental code development has continued, with more provisions for stairways in each new edition. While “more provisions” is usually thought of as “more rules,” new rules are often meant to provide more allowances, not more prohibitions.

Stairway landings are a good example. From the first edition of the International Residential Code, requirements for landings were straightforward but somewhat limiting. A landing or floor was required at the top of each stairway. These landings had to be at least as wide as the stairs and at least 36 in. “in the direction of travel.” The

slope of the landing was also limited to 1/4-in-12, the same as stair treads.

These provisions are about all that’s necessary for most stairway landings. And more often than not, these features aren’t even noticed. On decks, the top landing is usually just an indistinguishable part of the deck. The bottom landing is often something existing or integrated into the landscaping, like a sidewalk, patio, or flagstone area. There are landings that take center stage, however, and they have an opportunity to stand out with creative design. A landing between two flights on a stairway—especially one that turns—can be a distinguishing feature on its own.

An intermediate landing on a stairway can serve a few functions. It can look architecturally pleasing, as it may allow a long stairway to turn and fit better to the shape of the space it’s in or around. It’s also safer for those with mobility challenges, as it breaks up a long ascent into two multiple shorter stairs and provides a safe place to rest. If heading the other direction, it may shorten the distance of your tumble in an accidental fall. And landings can help solve other house-design quan-



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daries; the IRC doesn't limit the total height of a stairway between floors provided that there are intermediate landings at least every 151 in. (R311.7.3). Adding a landing can allow for greater heights between floors.

Intermediate landings can also be used to eliminate a required handrail. A handrail is often a design-afterthought nightmare, as the guards that protect people from falling off the sides of stairs may not have been designed to accommodate a handrail in an attractive way, or an adjacent wall surface may be irregular or architectural and not conducive to one. In deck construction, some finish materials used to create a certain look may not come in dimensions or grades needed to create compliant handrails. Since handrails are not required for stairs three rises or less, you can add an intermediate landing or two to avoid the need for what would be an awkward handrail. Rather than a nine-rise flight of stairs with a handrail, you could choose three runs of three-rise stairs with intermediate landings instead.

And these landings don't always have to be rectangular. The common belief that stair landings have to be square or rectangular is an understanding gleaned from early versions of the code, which stated: "Every landing shall have a minimum dimension of 36 inches measured in the direction of travel." But when the following sentence was added to Section R311.7.6 in the 2012 IRC, it was made clear that creative designs are welcome in some instances: "Landings of shapes other than square or rectangular shall be permitted provided the depth at the walk line and the total area

is not less than that of a quarter circle with a radius equal to the required landing width."

In a rather cryptic manner, the code is allowing a landing at a turn in a stairway, between two flights, to be non-square. The core concept is that people don't walk in right angles as they turn on these landings; they walk in a curve, usually closer to the inside. If you're turning to the right on an intermediate landing and heading to the next flight of stairs, why do you need the outer corner of the landing

maintain their stride without tripping. In contrast, a landing is meant to break the uniformity of someone's step and put an obvious end to their walking rhythm. For this reason, the uniformity of rise and run can be different in the stairs on each side of a landing.

Winder tread depth is measured along what the code refers to as the "walk line." The walk line is the point on a tread 12 in. from the narrower side of the winder treads (the inside of the turn and measured from

area of an odd-shaped landing must be no less than the area of a quarter circle with a radius equal to the width of the stairs. The outside edge doesn't need to be circular, but that is the most compact shape.

There's little difference between designing an odd-shaped landing with these mental gymnastics and designing a single winder tread between two standard stairs (which is also permitted). A landing, however, will allow you to have taller individual stairs on each side. A landing would also create two separate "stair flights," while a winder tread is just another step in a single flight. Continuous handrails are only required for each stair flight, so they can end and begin at an intermediate landing. That said, the continuous rail can also be interrupted at a turn in a stairway at a winder, so there is no benefit in that regard to either design. What is different is when landings are included, there is no limit to the vertical rise of the stairway. With winders, there is.

Understanding these newer code provisions allows designers and contractors more freedom than they had previously when there were fewer "rules" in the code. Though it's seemingly a paradox, more code can mean more freedom—but it's not an inspector or plan reviewer's job to teach this freedom to you. If you want to know the freedom the code allows, you've got to know the code. Make it your friend. It's not as bad as the rumors you hear—not all of them, at least.

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

**"If you're turning to the right
... and heading to the next
flight of stairs, why do you
need the outer corner of the
landing at your left? You don't.
Cut it out if you'd like."**

at your left? You don't. Cut it out if you'd like. The code simply wants you to have two things in these conditions: A long enough step to break your walking rhythm, and a place to rest.

The earliest codes for stairs included provisions for uniformity in the geometry of treads and a recognition of winder treads and how to measure the uniformity of their "run" (tread depth). Both of these concepts inform this discussion of intermediate landings. A winder must have a tread depth that's consistent with the winder treads before and after it so people walking up and down it can

inside of the guards), which is where the average user walks along a curved stair. To anticipate where on a non-square landing a stair user would most likely walk at a turn in the stairway, the code uses the walk-line concept from winder treads: The distance along the arc of the walk line of a non-square landing (12 in. from the turning side) must be at least as long as the same distance on a square landing. Generally speaking, it's the length of a 90° arc with a 12-in. radius (just under 19 in.), but the location of the guards will affect this generalization. To allow people sufficient space on the landing to rest, the total

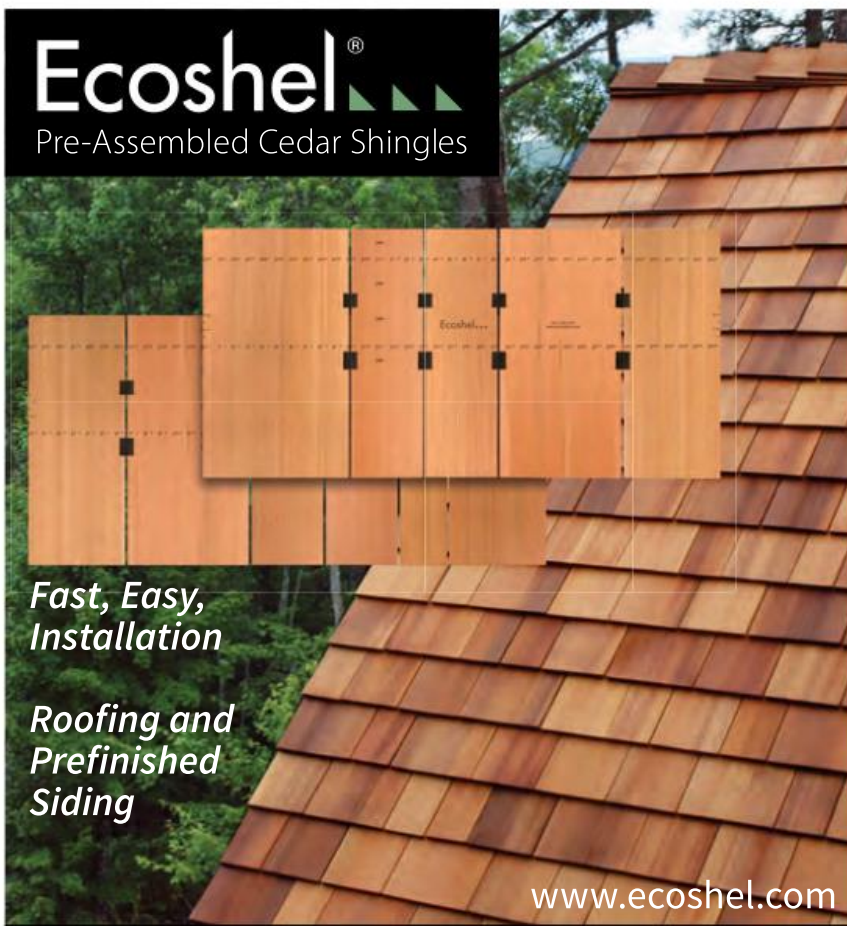
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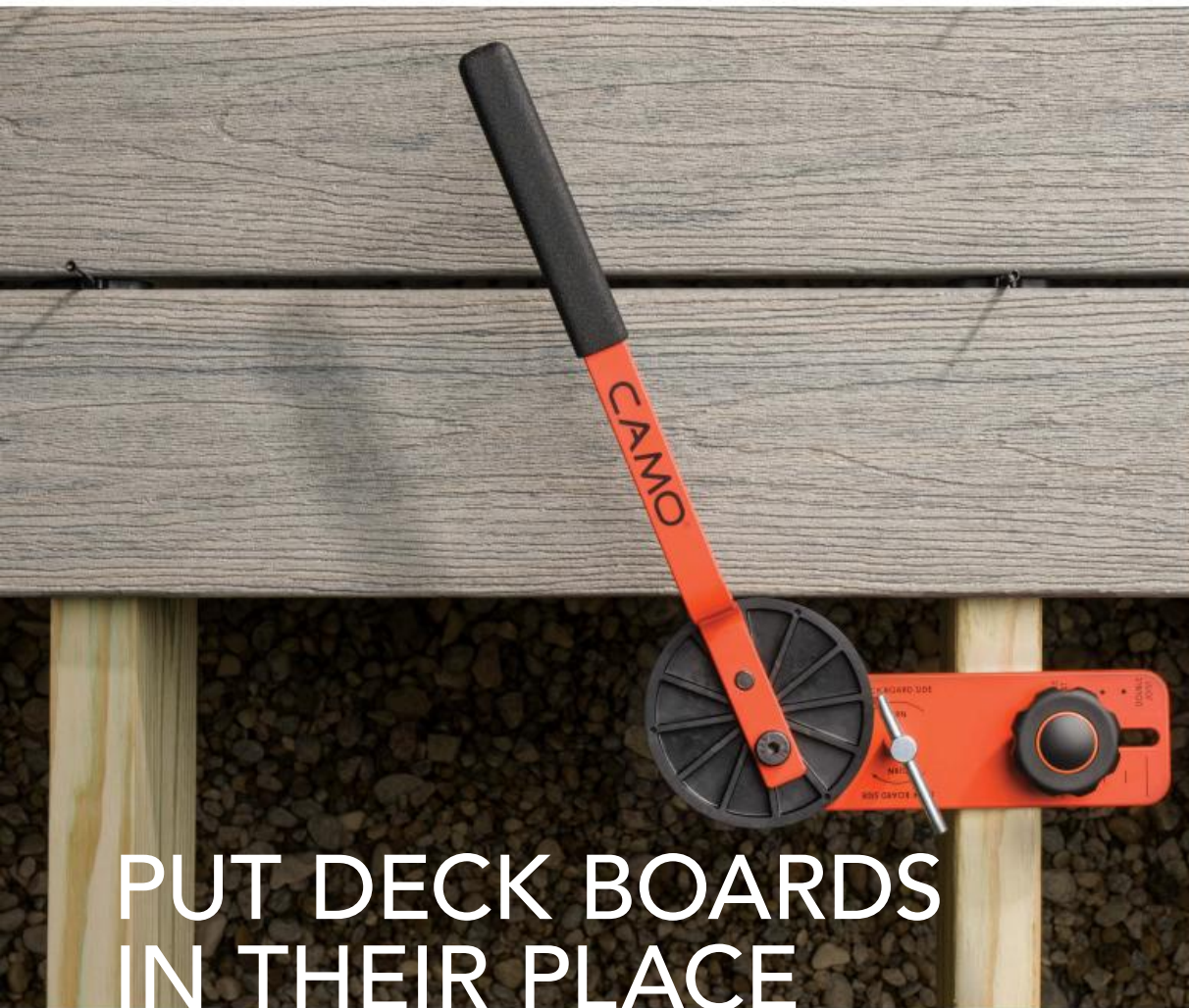
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PUT DECK BOARDS IN THEIR PLACE

With spring upon us, deck-building season has begun. The deck builders I know seldom get excited about new tools. They save their minimal praise for things that work better than what's come before. These trusted deck builders tell me that even if you already have a deck-board straightener, you should still consider getting a Camo Lever (\$105). The Lever slips over single and doubled wood and steel joists to hold warped deck boards in place. But unlike some other board benders, the Lever locks in place, freeing both of your hands for fastening.

You can also use the tool to cinch a bunch of wood or composite deck boards for fastening them all at once. I tried it out, and found that the deck builders are right: It works better than any board bender I've used before.

Patrick McCombe, senior editor



Better bender. The Camo Lever uses an eccentric cam to push resistant deck boards into place, and then holds them there for fastening. Notably, it works with both steel and wood joists.

Brush with greatness

Like many of us in the sawdust arts, I don't enjoy painting, and I'd give myself a B as a painter—not bad, but hardly great (or efficient or fast). Yet, in small batches, doing my own painting has saved or made me tens of thousands of dollars. I recently started using the Richard 13425 1-in. Elegance Trim Brush (\$9 on amazon.com), which has really upped my game. I like to overpaint the trim, lapping onto the walls just a bit, then cut the walls into the trim. Cutting in with a Richard trim brush is way faster compared to a regular brush. My guess is a four-fold increase in speed, and the cuts are laser straight.

With this brush, work is more like drawing than painting. Just dab the brush in the can and wipe a little off the bottom of the bristles, "load" the wall by wiggling the paint on there about 1 in. from the cutline, then cut wall to trim. Its dazzling how well I was able to ride this brush along the trim without riding over. And it's comfortable to hold—I can hold it in several different positions and still get remarkable results. I have a short list of things that are "the best 10 bucks I ever spent," and this one races to the top. It'll earn its keep in the first 15 minutes of your next paint job.

Mark Clement, carpenter

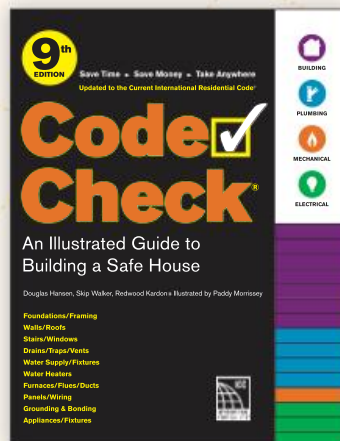
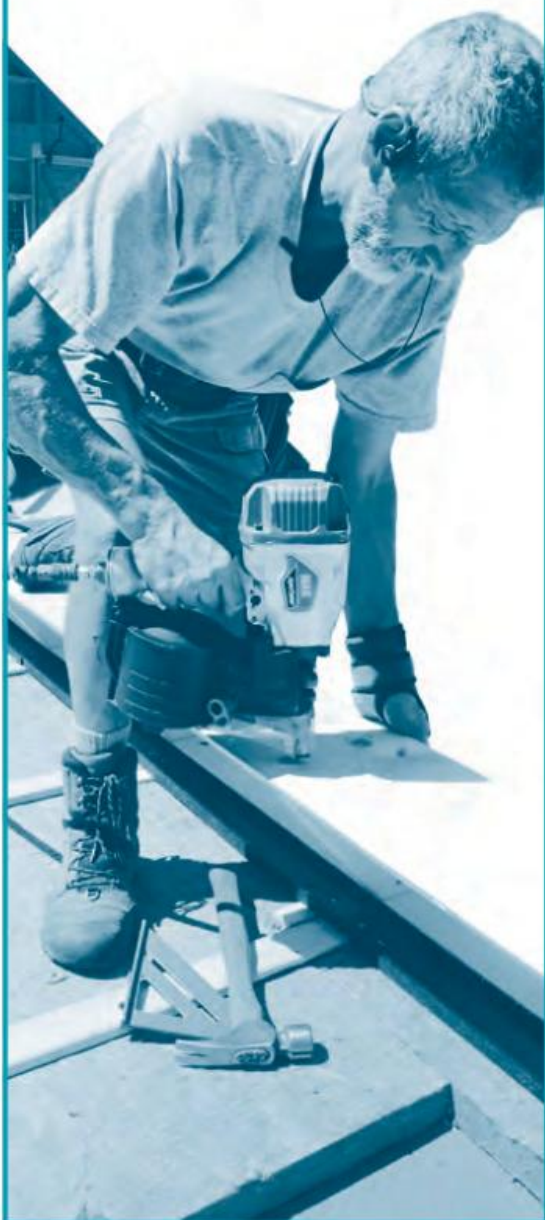


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Set-and-forget kneepads

I've never managed to make kneepads a regular part of my work routine, mostly due to my hatred for the itchy, sweaty, irritated feeling caused by the elastic straps around my legs. But recently I bought a pair of Carhartt kneepads, which are a relatively new product designed to slide into the pocket of the double-front work pants that the company has been making for years.

The pads are made from a grid of hexagonal polyurethane foam that's thin, lightweight, and flexible, and can even be left in the pants when washed. When I first slid the \$40 pair of pads into the pockets on the front of my pants, I dropped onto my knees on the subfloor expecting to be wowed. Instead it felt sort of like kneeling on a yoga mat, which isn't much in the way of padding. Then I went about my day of work and something amazing happened—I completely forgot I was wearing knee pads. The beauty of these knee pads is that they offer a decent level of daily protection—more than enough to take the edge off when kneeling during tilework, on top of demolition debris, on joists, and more—but otherwise don't become a bother.

Justin Fink, builder-at-large



Trouble-free kneepads. Carhartt's washable kneepads come in three different sizes and fit right inside the company's popular double-front carpenter's pants.

Photo: courtesy of Carhartt

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Waterproofing Tile Showers

New systems guarantee a lifetime of worry-free performance

BY JOSHUA ODUIN

Custom-tiled showers are a sizable investment, and should last the lifetime of your home. Unfortunately, if you tear up shower tile that was installed in the 1990s and earlier, as I often do, you'll find a host of catastrophes, including horrifying mildew and mold growth as well as failed framing—rotted through after long-term exposure to water.

The culprit is bad building science. From a construction standpoint, the function of a shower is to protect the wood structure of the home by capturing water and directing it into the plumbing system. Old substrate systems fall far short of this goal. The trouble is that tile and grout are water-permeable, meaning they let water through to the substrate. Unfortunately, without a waterproofing layer, the substrate soaks up water. The hope was everything would dry between showers, but in bathrooms that are used regularly, that doesn't happen.

The new standard for tile substrates is waterproof, meaning that no water gets to the substrate, keeping your house dry and healthy for decades. And thanks to a wide array of innovative waterproofing products, it's easier than ever to meet that standard. In fact, these new systems are so reliable that some manufacturers now offer lifetime warranties on their waterproofing products, if used as directed. Others have extended their warranties significantly.

I decided a long time ago to make my own decisions about tile waterproofing, rather than letting builders or clients make them based on budget or misleading infor-



Photo this page: Jeffrey Tryon



THREE WAYS TO WATERPROOF |||||

The new standard for tile substrates is waterproof, not water-resistant, and these three systems all deliver. Most shower-system manufacturers make all three types of products, so if you stay in a given brand family, you can mix and match them as needed, enjoying warranties that range from 25 years to life.



FOAMBOARD is fast and easy. A foamboard tile substrate is a backerboard and waterproofing system in one. Most brands also offer preformed shower pans that interlock with the wall panels. Joint sealant completes this DIY-friendly system.



SHEET MEMBRANE is unbeatable. Effective over everything from traditional backerboard to a mud-bed shower pan, bonded sheet membrane offers the highest level of waterproofing, durability, and crack isolation.



LIQUID-APPLIED MEMBRANE is convenient to work with. Sometimes used as a complete waterproofing system on its own, this versatile product is best employed as a complement to other approaches.

mation. While the new products add some cost and/or time to most jobs, I want to stand behind the products I use, knowing that I've done everything in my power to create beautiful, durable showers.

A closer look at shower assemblies

Bearing the bulk of the water and weight, the shower pan is where a durable waterproofing system is most critical. So I'll start there, taking a quick look at the two most common approaches to pans: preformed, high-density foamboard bases, and custom-formed mud beds.

A later arrival on the scene, foamboard shower pans are presloped, drain-ready, easy to install, and ready for tile. Combined with a specialized sealant for the drain and seams, they are also waterproof. While they have a few downsides (see p. 30), a foam pan can be a very effective base for a waterproof shower.

My preferred base for a shower is a mud-bed pan, custom-formed from dry-pack concrete. While this traditional approach takes practice and experience to master, the payoff is a rock-solid, completely customizable pan that works with any drain or shower configuration.

The traditional mud-bed approach starts with a "pre-slope"—a preliminary mud bed sloped to the drain and then covered with a synthetic rubber or plastic shower-pan liner or hot-mop tar. A second mud bed goes over that for the tile to adhere to. Concrete is porous, of course, and the top layer becomes saturated with water. Unfor-

tunately, without proper waterproofing over the top, the concrete becomes an unhealthy sponge, threatening the health of the home and its occupants.

To deal with this, there is a two-part drain assembly: the usual finished drain cover on top, flush with the tile, and a second drain below, in the form of "weep holes," which are intended to allow water that seeps down to the liner to escape into a lower portion of the drain.

In consistently warm, dry climates, where the shower can dry out between use, these assemblies sometimes hold up, but in the other weather regions you get mold and mildew. Also, if and when the concrete cracks, even a little, bulk water passes through.

The good news is that you can have all the benefits of a custom mud-bed pan without any of the potential problems. The solution is to apply a bonded sheet membrane (see p. 32) over all surfaces, keeping water out of the concrete entirely. This also makes the mud-bed pan easier to build, without the two-step process, rubber liner, two-part drain, etc.

The old-school approach to shower walls is similar. It starts with a vapor retarder like tar paper or plastic stapled to the studs. Then cementboard, or expanded metal lath and hand-floated mud, go on as a base for the tile. Once again, you have a porous substrate that holds and traps moisture.

In one large master bathroom I worked on, the traditional shower assembly I tore out had cementboard walls

FULL FOAMBOARD SYSTEM

This full Wedi Building Board system includes wall panels and a presloped, one-piece pan, with a quick-curing sealant used at joints, seams, and penetrations.

PROS

- + Quick
- + DIY friendly
- + Wall panels easy to cut and handle
- + Tile substrate and waterproofing in one step

CONS

- ✗ Relatively pricey
- ✗ Limited pan sizes and shapes, although they can be field-trimmed



Attach the drain flange. Joint sealant goes below the flange, and a threaded collar pulls it tight. More sealant goes over the top.



Apply thinset. Apply a notched coat of thinset mortar to the back of the pan and the subfloor.



Place the pan. Walk all over the pan to collapse the thinset ridges and ensure the pan is fully bonded.

with a layer of Aquabar tar paper behind, a water-resistant approach some contractors still rely on. Both cementboard and tar paper were trashed from constant saturation. Today's waterproofing materials go on top of the substrate, sealing out water entirely.

Wood-framed homes expand and contract with fluctuations in temperature and humidity. Properly built tile shower (and floor) assemblies not only protect the wood framing from moisture, but also isolate the tile from the framing, allowing small cracks in the substrate—usually around the perimeter of the shower pan—without telegraphing them to the tile and grout above. This ability varies by system, with sheet membranes taking top honors and the old-school mud-bed approach, with the waterproofing between layers of mud, failing the test.

Of course, no tile assembly can survive improper framing. It's paramount that the structure of the home is engineered to meet all seismic and load-bearing requirements, and meet or exceed building codes. That means the subfloor for floor and shower tile should be a mini-

imum of 5/8-in. plywood—I always use 3/4-in. for floors with 16-in. joist spacing. With wider joist spacing, check with the waterproofing manufacturer for their tested assemblies.

Three great tools for waterproofing showers

As they have in other aspects of tile-setting, Europe has led the way in waterproofing. The most innovative products come largely from Italy (Mapei) and Germany (Wedi, Schluter, and Ardex), though U.S. companies like Laticrete have also stepped up.

There are three types of proven products for waterproofing shower substrates—sheet membrane, liquid-applied membrane, and foam-board—and you can often use them together in the same shower. Because tile-backer manufacturers offer at least two of these product types, you can stay within a single manufacturer's lineup for any shower and guarantee full warranty protection. The three custom showers featured in this article demonstrate how easy this is to do.



Apply sealant. The pan is rabbeted to accept the wall panels. Apply a full bead of sealant along each notch.



Add wall panels. Start from the bottom and work upward. Wall panels get a bead of sealant in the joints also.



Specialized fasteners. Wedi's screw and washer system attaches the panels securely. Drive them carefully, just flush with the surface.



More sealant over the seams. A bead of sealant goes over every seam and is troweled flat.



Tape adds insurance. For added resistance to movement in the framing and substrate, I add fiberglass tape at the joints around the shower pan, embedding it in the sealant.



Done in a day. Seal every screw and plumbing penetration with the Wedi sealant, leave it 20 to 30 minutes to skin over, and you're ready for tile.

Another key factor in maintaining warranties is using products as intended. Manufacturers provide detailed instructions on proper use, so read them carefully.

Like any building material, each type of waterproofing has its trade-offs. Understanding them will help you design the right combination for your skills and needs. Product availability is another challenge, so it's important to understand more than one approach.

Sheet membranes can't be beat

In many ways, bonded sheet membranes are the top-tier waterproofing option. While not the best option for DIYers, they are the most durable and versatile barrier, with the best crack-isolation properties and best permance ratings (see "Perm ratings," p. 35), and I recommend them highly for pros skilled in the tile trade. Top brands include Schluter, Noble Company, Ardex, Wedi, Mapei, and Laticrete.

Sheet membranes are typically made of polyethylene, with a bonding fleece on both sides to help with adhesion. They are applied to the substrate with thinset mortar—some requiring modified, others unmodified. Most sheet-waterproofing systems come with preformed inside and outside corners as well as 5-in.-wide seam tape to ensure 2-in. overlaps. These are also applied with thinset.

Although sheet-membrane systems are marketed as DIY-friendly, I don't recommend them for first-time tilers. They require 100% thinset contact in every joint. That means you have to use the right product, at the right consistency, and collapse every trowel ridge while leaving a thin layer of thinset behind every seam. For beginners, it's just too easy to overwork the joints and leave a path for water.

Taking advantage of their unmatched strength and durability, I use sheet membranes on all of my mud-bed shower pans, and occasionally on walls too, in place of foamboard systems. Strong enough to make up for a less-than-perfect substrate, bonded sheet membranes

SHEET MEMBRANE OVER EVERYTHING |||||

I prefer solid, customizable mud-bed shower pans, and a bonded sheet membrane is by far the best way to fully waterproof the concrete. On these walls, the sheet membrane (Ardex SK 175) went over standard Hardiebacker cementboard—stiffer than drywall and less expensive than foamboard.

PROS

- + Unmatched permeability ratings
- + Unmatched strength and durability
- + Works over any substrate

CONS

- ✗ Requires skill and experience to apply properly
- ✗ Seam banding builds up in corners



Walls first. After attaching standard 1/2-in. cement backerboard, apply a “scratch” or “burn-in” coat of thinset with the flat side of the trowel, followed by a notched coat. Run the 3/16-in. V-notches horizontally to make air easier to evacuate.



Roll out and press on. After cutting it to size, roll on the bonded sheet membrane, and smooth it with your hands to get it to stick in place. It helps to use a pretty viscous thinset mix.



Collapse the ridges. Use a flat trowel to evacuate all of the air bubbles and flatten the thinset ridges to get adhesion across 100% of the surface. Run your hands over it last to feel for any lingering air pockets, and push those to the edge with the trowel.



Same at the seams. When applying multiple sheets on one wall, overlap them by 2 in. and evacuate excess thinset. Don't overwork joints, however. There must be a thin layer of thinset everywhere for proper performance, and it also starts to stiffen before long.



Special accessories for penetrations. Smart collars are available for common plumbing penetrations. The pipe collar fits tightly, while one for a mixing valve directs water around it and down.



are also a great way to level the playing field. As a general contractor and a tile-setter, I can control every aspect of my jobs, from framing to finishes, but if you are a tile specialist, without as much control over the substrate, bonded sheet membranes will go over whatever backerboard the contractor or drywallers choose to install, and still guarantee a waterproof assembly.

Unlike with liquid-applied membranes, which I'll discuss in a moment, you can apply a sheet membrane over a mud-bed assembly without letting the concrete dry fully first. And they can be tiled on immediately as well. That said, I always allow sheet membranes a few days to cure before flood-testing the waterproofing (more on that later) and setting tile.

Because sheet-membrane systems utilize overlapping strips to waterproof seams, there is inevitable buildup in some spots, especially corners. To accommodate these raised areas, I use a medium-bed thinset and a larger notch trowel (3/8-in. to 1/2-in.) when setting tile on top.

Plumbing penetrations are prone to leaks and water infiltration, but sheet-membrane systems provide great products for sealing these weak points too, including collar seals that go around pipes, and gaskets that seal around the mixing valve.

Also, you can use the standard seam strips in nonstandard ways: around the edges of niches and curbs, and even around the entire floor—taking advantage of their strength and crack-isolation properties.

Foamboard systems cost more but are easier to use

Foamboard systems can be used for walls, the pan, or both to create a shower substrate. Most systems also offer preformed niche boxes that integrate nicely as well. Between the parts and over the seams goes a liquid-applied elastomeric sealant, creating a fully waterproof substrate with an excellent factory warranty.

While a little pricier than other approaches, foamboard systems are quick and easy to use, making them a great option for DIYers. They



Pan membrane goes down the same way. The sheet seals around a wide, sloped drain flange (designed for sheet membranes), which glues directly onto the ABS plumbing pipe. After collapsing the ridges, eliminating bumps, and evacuating bubbles, run your hands over the sheet to check for a 100% bond across the entire surface.

Bandings seal and reinforce the seams. Preformed corners go on first, applied with more thinset, and then banding strips follow along the joint line. It's critical here not to press out all of the thinset and leave a path for water. The edges should be covered also. Feather them with a sponge to finish the job.



Waterproof, top to bottom. After applying bandings to each seam, let the thinset cure overnight and you're ready to tile. For easy insurance, I sometimes brush a liquid-applied membrane, also part of the Ardex 8+9 system, over each joint and seam.

are a backerboard and waterproofing system in one, eliminating the need for a separate cementboard or mud bed and then a sheet or liquid membrane over the top. And the lightweight foamboard is easy to handle and cut—slicing and snapping like drywall.

Time-tested products include Schluter-Kerdi-Board and Wedi Building Board, though there are other excellent newer products, including Johns Manville Goboard, USG Durock Ultralight, Laticrete Hydro Ban, and Prova's Prova-Board Plus.

Most systems offer presloped foamboard shower pans, rabbeted at their edges to accept the wall panels. The first step is bonding the base to the subfloor with thinset mortar. Then the sealant is squeezed into the rabbets like caulk and the wall panels slide into place, attached directly to the framing with screws and specialized washers. Last, more of the same sealant is troweled over each seam and penetration.

Generally, I use foamboard on walls only, with a custom mud-bed pan below (by using a sheet membrane from the same foamboard

manufacturer to waterproof the pan, I keep the warranty intact). The foamboard is faster and less labor-intensive than installing backerboard or drywall and then waterproofing over the top of it. My main issue with foamboard shower pans is the limited range of sizes, drain types, and drain locations. The preformed pans are also relatively expensive, compared to a mud bed and sheet membrane.

My personal favorites in the foamboard family are Wedi Building Board and Laticrete Hydro Ban, which seem stiffer and more durable than Schluter-Kerdi-Board and others. Both of my favorites offer a compatible sheet membrane that I use on my mud-bed pans.

Different foamboard systems require different fasteners, some with washers attached and others using specialized screws only. Be careful to sink fasteners so they just dimple the board, sitting flush with the surface but not much farther.

Just as drywallers use joint tape to prevent cracks between panels, I use the tape recommended by the manufacturer to reinforce the joints

HYBRID APPROACH

Staying within the Laticrete Hydro Ban family of products, I combined foam wallboard and joint sealant, sheet membrane for the mud-bed pan, and a liquid-applied membrane on seams and corners. This created a very flat wall substrate, perfect for the large-slab tile in this master bath.

PROS

- + Combination of speed and versatility
- + Foamboard walls are fast and flat
- + Mud-bed pan is rock solid and completely customizable

CONS

- ✗ Mud-bed pan and sheet membrane require training and experience



Walls are easy. Foamboard cuts with a utility knife and attaches with specialized screws. Run a bead of sealant between each panel and trowel more over the seams, then coat fasteners and seal around penetrations.



Custom drain. I'm using a Laticrete linear drain here, setting it in the dry-pack mud-bed shower pan before installing the bottom piece of foamboard over its back edge.



Liquid-applied membrane is a versatile tool. After finishing the mud-bed pan, I waterproof the drain area with two coats of a quick-curing liquid membrane from Laticrete, building a seal 6 in. up and out in all directions.



Fabric banding at the edges. To prevent cracks in the tile and grout, the critical joints around the pan get a fabric banding. Like the liquid membrane, this is designed to go over damp concrete for the best bond, so you might have to dampen the mud bed before installing it.



Sheet membrane is last. Finally, I apply a sheet membrane over the mud-bed shower pan, letting the banding set up for an hour or two before applying the main sheet. I wait so the banding won't slide when I bed and smooth the final layer in thinset.



Coat the seams. Though not specifically required by this system, liquid-applied waterproofing is cheap insurance, and every brand offers it. The shower curbs are formed with cement backerboard and covered with the bonded sheet membrane before I brush on the liquid-applied product.

around the foamboard shower pan, embedding it in the joint sealant. It's not officially part of this system, but it's a cheap, easy way to add mechanical reinforcement to critical seams.

Liquid membranes are versatile insurance

Liquid-applied membranes are handy and versatile, but they have their limitations. Some of the best-known brands are Laticrete Hydro Ban, Redgard, Mapei Aquadefense, and Ardex 8+9. You can apply products like these on just about any shower or floor substrate quickly and easily, using a roller or paintbrush.

While not quite as a strong and durable as sheet membranes, with somewhat lower crack-isolation abilities, liquid-applied membranes go down as a thin, flat layer, in large areas and corners alike. Also, liquid-applied waterproofing tends to be less costly than other options.

Liquid-applied membranes can be used in two ways: as a stand-alone waterproofing system or as a complement to other systems. As a standalone system, I tend to use them for small areas like tub surrounds and other places where a superflat surface and a uniform layer of thinset are paramount—under small mosaic tile, for example, where excess mortar would squeeze up through the gaps.

On mud-bed shower pans, I don't trust a liquid-applied membrane on its own. I like the durability and crack-isolation properties of sheet membrane over concrete, and I feel more confident standing and working on it than I do a liquid-applied film, which is more vulnerable to damage. A number of sheet-membrane or foamboard waterproofing systems include a liquid-applied membrane or sealant as one of their components, to waterproof seams, joints, and penetrations. This is how I use liquid-applied waterproofing most often.

While my favorite sheet-membrane systems require large overlaps, and don't call for liquid-applied membranes specifically, I often add one at seams and joints anyway, for additional peace of mind. All brands offer a liquid product that can be used this way, and since they're so quick and easy to apply, it's hard to say no to the cheap insurance.

First, make sure you're applying the waterproofing at the required thickness, measured in mils (1 mil equals 0.001 in.). Second, be sure to apply the correct number of coats. The most accurate way to measure thickness is using a wet-film gauge, which is a great idea when you're

still getting used to these products. In general, the rule of thumb is that the finished membrane should be the approximate thickness of a driver's license. It's better to be too thick than too thin.

Another critical guideline is the cure time between coats, usually a full day for the first coat and less for the second. However, there are an increasing number of faster-curing products that come in handy when time is a big factor. Ardex 8+9 and Laticrete Hydro Ban Quick Cure are two well-known examples. If you are applying a liquid membrane over a dry-pack-mortar shower pan or mud-floated walls, you need to let the mud properly cure first, which typically takes 72 hours.

Some liquid-applied waterproofing requires mesh tape or fabric reinforcement in the corners and transitions. Even when it's not required, I think it's an easy way to add strength to areas that are vulnerable to expansion and contraction in the framing.

The flood test, and the bottom line

Whether plumbing inspections require a shower-pan flood test or not, I always do one for peace of mind. A flood test lets you know what you are providing to the customer, and saves you the immense hassle and expense of coming back six months later to tear out the tile and track down leaks.

A flood test is relatively simple. Once the waterproofing has been installed and allowed to cure, per manufacturer's recommendations, the shower pan is plugged with a cap or test balloon and then filled to the level of the curb with water, or to a marked line. Then the water is left to sit in the pan for a minimum of 24 hours. If the

water level doesn't drop (other than by evaporation), the pan passes the test. If it does leak, you'll generally notice water on the nearby sub-floor or the ceiling below, and you'll have the chance to track down and fix the leaks before tile is installed.

If you are hiring a professional, it is important to ask which waterproofing methods and products they plan to use, and why. If you're doing the work yourself, as a pro or DIYer, do your research, follow current professional standards and product guidelines, and consider one of the training courses offered by manufacturers. Understanding current waterproofing options will help you create a tiled shower that will stand the test of time. □

Joshua Oduin builds and remodels homes in Oregon and Washington. Photos by Asa Christiana.

PERM RATINGS

How waterproofing is tested and classified

A perm rating is a standard measure of a material's permeance, based on the quantity of water vapor that will pass through it in a given period under a given amount of pressure. The higher the number, the more readily vapor can diffuse through the barrier.

I want my shower-tile substrates to perform at 2 perms or less overall—ideally closer to 1 perm. With that in mind, here are the perm ratings for commonly used waterproofing systems in showers.

- Tar paper, 5 perms
- Laticrete Hydro Ban liquid-applied membrane, 1.27 perms
- Schluter-Kerdi sheet membrane, 0.75 perms
- Schluter-Kerdi-Board foamboard, 0.48 perms
- Ardex SK 175 sheet membrane, 0.5 perms

Steam showers are a different beast—to handle higher temperatures and vapor levels, steam showers require higher-level waterproofing systems. In short, they must be virtually vaporproof. For a system to qualify for steam-shower use, it needs a perm rating of 1 or less for residential use and 0.5 or less in a commercial setting. Appropriate waterproofing systems for steam showers include Schluter-Kerdi-DS and Ardex SK 175 sheet membranes, and Wedi Vapor 85 foamboard.

—J.O.

A seasoned mason's guide to laying out and laying up a classic feature of Roman architecture

BY JOHN CARROLL

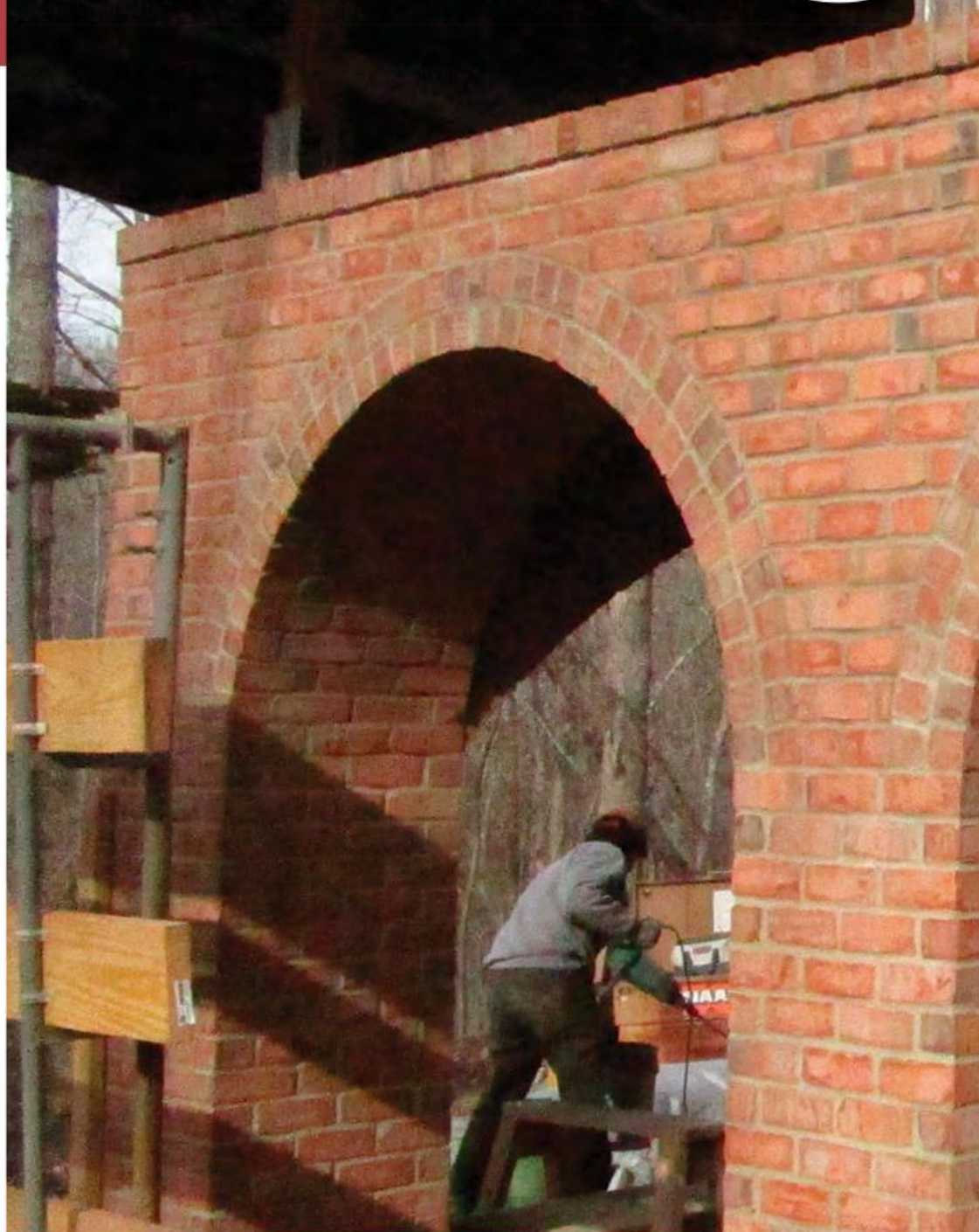
I've been doing masonry work for decades, and the vast majority of that work involves setting rectangular shapes down in straight lines. But once in a while, I get to work outside the straight lines and build brick arches, which demand a higher level of planning and layout. I recently built a series of brick arches for the support structure under an addition.

Although the arch is a very strong and time-tested architectural element, the arches for this project were mainly aesthetic. The actual support for the addition came from six cast concrete pillars that were placed before I arrived. My job was to add brick veneer around the columns and then to connect the columns with arches: four semicircular arches (what I call Roman arches) on the sides and a segmental arch at one end. This article will cover my approach to the general process of laying out and building the Roman arches.

The grade under this addition sloped down, and on the higher side, the contractor had joined the columns with poured-concrete sections at bench height, while on the lower side he left those spaces empty to provide walkout access. The first task was laying the brick veneer around the concrete columns up to where the arches would begin. I went 18 courses high, and with some careful planning, the top courses all ended up three bricks wide, which gave me an all-important consistent starting point for building the arches. □

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

Building



BUILD AND SET THE SEMICIRCULAR FORMS

I typically make my own forms (called "centerings") when building arches, but this time the general contractor, Kevin Davidsaver, took care of fabricating them. These Roman arches all have a 73¼-in. span. To ensure that the forms fit between the columns, he

built them with ⅛ in. of play on each side.

The forms for these arches consist of half-circle faces cut out of ¾-in. plywood using a router and a circle jig **1**. When setting the pivot point and the radius of the jig, be sure to deduct for the skin that covers the arch form—

which in this case is ¼-in. hardboard **2**. Davidsaver made the forms 1½ in. narrower than the 24-in. thickness of the walls to keep them from interfering with the stringlines we use to keep the walls straight.

I laid these arches with two rowlock courses—"rowlock"



Brick Arches



2

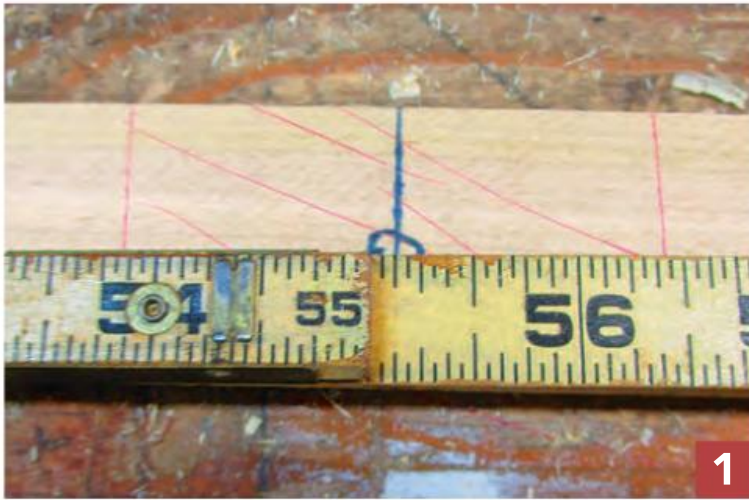


3

means the bricks are laid on their long, narrow edge rather than flat on their widest surface (in this case, relative to the arch). To make the tops of the arches work out even with the brick courses on the columns, I use my story pole to set an elevation string for the brick

course near to the top of the arch. The total height of the arch face is $7\frac{3}{8}$ in. (two rowlock courses plus a $\frac{3}{8}$ -in. mortar joint), so we set the forms so their tops are exactly $7\frac{3}{8}$ in. below the string **3**, and then secure the forms in place with screws.

SPACE THE BRICKS



I planned to lay the bricks for the arch in an offset (staggered) “running bond” pattern. To have the same pattern where the arch meets the columns on both sides, you need an odd number of courses. To lay out an odd number of courses on an arch, masons start with a “keystone” brick that straddles the exact center of the arch. I begin by marking the form’s center (its apex), then I measure and mark half the thickness of a brick in both directions.

To get the spacing for the courses on the first layer, I first rip a 1/8-in.-thick strip of wood from clear 2x material for a story pole. I hold one end of the strip at the bottom of the form, tight to the course on the column where the arch starts, bend the strip around the form, and transfer the location of the center brick onto the strip.

After laying the strip flat on top of the workbench, I measure the distance from the end that touched the column to the far side of the center brick **1**. In a typical mason’s layout, each “space” represents the size of one brick plus one mortar joint. By measuring to the far side of the center keystone brick, the number of spaces (bricks plus mortar joints) in the layout will be consistent for both sides of the arch. For these arches, the distance from the column to the far side of the center brick was $56\frac{7}{16}$ in., which I divided by $3\frac{1}{8}$ in.—the course spacing I’d used on the columns below the arches. I convert those measurements to decimal equivalents before doing the division to get the number of spaces; the result of this particular math problem is just over 18.

Because the tapered mortar joints on the arch are wider at the top, this spacing tends to look too big in the finished arch. I add a space, making it 19, and re-divide the overall distance by this figure. For this arch, that results in a spacing of 2.9703947 in., or about 1/32 in. shy of 3 in. This spacing yields a fairly narrow 1/4-in. mortar joint where the rowlock courses rest on the form, but the tapered mortar joints make that spacing look acceptable.

In most construction—especially in masonry work—1/32 in. is usually negligible, so rounding up the spacing to an even 3 in. would seem to make sense. But when 1/32 in. is added 19 times, the cumulative gain of 9/16 in. in 18 courses becomes significant; the last course would not fit in the remaining space. To solve the cumulative error problem, use a regular old calculator and convert to metric measurements, which eliminates the process of changing inches to decimals and back again for the layout.

Here’s how it works. The metric distance on the story-pole strip is 143.4 cm, which I divide by 19 to get 7.5473684 cm for each space. I enter that into my calculator. Then I use the add-on feature to add that number to itself, rounding the total either up or down to the nearest millimeter. For example, I round the initial number down and record it as 7.5 cm. Adding the full measurement to itself gives me 15.094736, which I round up to 15.1 cm. I continue the add-on process through the entire 143.4 cm and record the results.

I then carefully transfer those measurements to the story-pole strip **2**. The rounding represents less than 1 mm between spaces, or less than 1/25 in. With the spaces laid out on the strip, I transfer the layout to the form **3**. I mark the entire form on both sides and connect the layout marks with lines across the form to guide the actual course placement **4**.

LAY THE FIRST COURSE

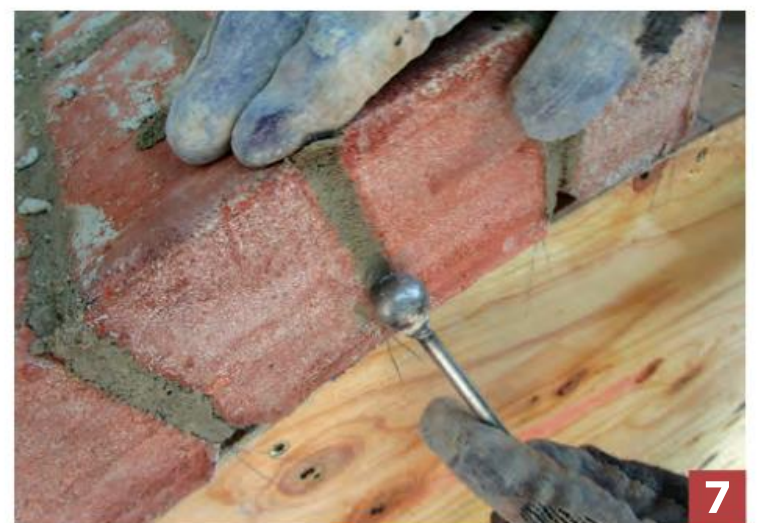
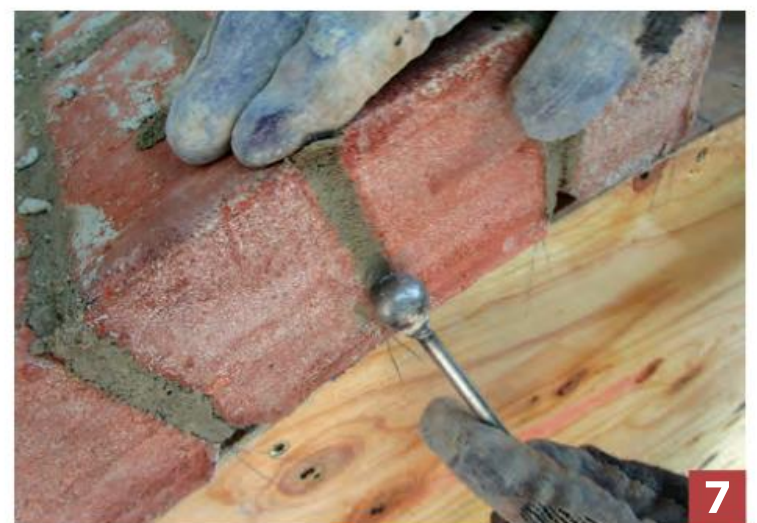
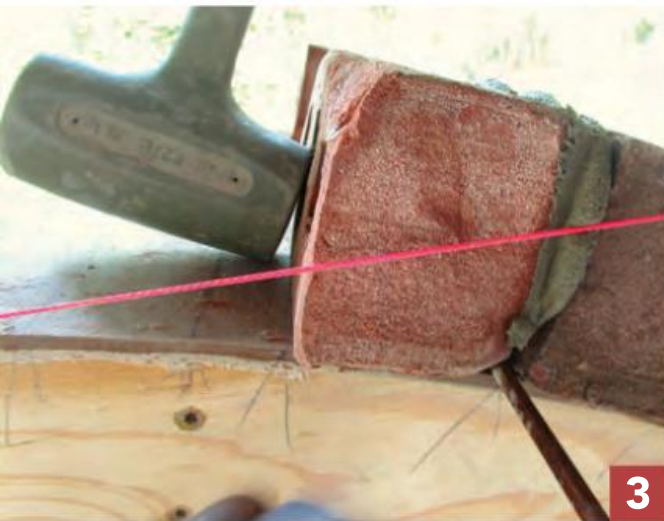
To create the rowlock courses around the arch, the edge of the bricks have to lay flat against the curved form. To continue the running-bond pattern from the columns, I start every other course with a half brick. To keep the outside faces of the bricks in plane with the wall, I set them just inside guide strings I stretched between my corner poles.

For structural purposes I want to fully pack the joints with mortar. But I also want to end up with neat, clean, and properly finished mortar joints on the inside face of the arch, which is hidden until the form is removed. To satisfy both of these goals, I pack the top edge of each brick about three-quarters full as I lay the bricks, leaving the bottom quarter clear of mortar **1**. That bit I fill and tool after removing the form.

The orientation of the bricks changes as you work up and around the arch, starting nearly level but becoming increasingly vertical as you go up. The “keystone” brick in the center of the arch is completely vertical. On the bottom courses, I lay down a bed of mortar on the preceding course, but as the courses tilt up, it's easier to butter each brick with mortar as I set it in place **2**. With both

methods, I always leave the inner edge of the joint clear of mortar. After placing each brick, I tap it to the layout lines marked on the form **3**.

To keep the concealed joints free of mortar in situations such as this, masons typically insert removable spacers. For the horizontal joints, I set 1/4-in. metal rod on the form against each course as I go to help keep that part of the joint clear of mortar until later **4**. To keep the vertical head joints between the ends of the bricks clear, I push a piece of foam backer rod into each joint against the form **5**. After filling the joint with mortar, I cut the rod even with the top of the bricks **6**. After I finish laying each course, I fill and tool the joints between the rowlock courses on both faces of the arch **7**.



LAY THE SECOND COURSE

The only visible part of the second rowlock layer is the exposed ends of the bricks, so this layer goes more quickly and easily. But the layout and the installation of the bricks on this layer have to be just as precise as the first. To offset the courses at the apex of the arch, I have to center a mortar joint directly over the keystone brick on the first rowlock course. So I measure and mark that joint **1**.

Because the circumference of the arch above the first rowlock course is larger, I need a separate story-pole strip for the second course. As before, I use the add-on calculator feature and my metric tape to measure and mark the spaces on the strip for the second layer. This layer has 20 courses on each side of the arch. I transfer the spacing layout from the strip onto the bricks of the first layer **2**. Again, I lay out all the courses on both sides of the arch and connect the marks with guide lines on top of the first layer **3**. With no concerns about keeping the inner part of the joints clear on this course, I pack all the joints completely as I lay the bricks **4**. And because only the ends of the bricks will be visible, I lay the second rowlock course in a stacked bond instead of a running bond, which takes less time and uses materials more efficiently.





REVEAL THE INNER ARCH

After both brick courses for the arches are laid, the contractor and owner have us form and pour steel-reinforced concrete above each arch, which is probably overkill from a structural standpoint. After giving the brick arches several days to cure, we remove the centering forms to expose the inside surfaces of the arches.

Before the joints can be filled and finished, they have to be thoroughly clean and clear of debris. For these joints, we first remove the foam backer rod that we used to keep the vertical joints open **1**. Using a hammer and chisel, I remove stray crumbs of mortar from the faces of the bricks **2**. Then I run a grinder equipped with a 1/4-in.-thick masonry blade along the horizontal bed joints to remove any mortar that got past the steel rods we used to protect them **3**. The joints here are in good shape—all of our careful and methodical work while laying the bricks pays dividends. The final step before filling the joints is spraying them with water so that the brick and hardened mortar don't suck moisture out of the new mortar as we fill the joints **4**.



FINISH THE JOINTS

For filling the joints, or “tuck-pointing,” we use mortar that is slightly thicker than what is typically used for laying the brick. After mixing this stiffer mortar, we let it slake (sit) for about 20 minutes, which is a bit longer than the usual slaking time. The stiffer mortar sticks more readily to the bucket trowels that we use as hawks for dispensing the mortar.

Tuck-pointing trowels are very thin and come in a variety of widths. Because of the irregular bricks, these joints vary in width slightly. With all of our tuck-pointing trowels kept close at hand, we choose the widest one that will fit into each joint to maximize the amount of mortar we can push in **1**. It usually takes three or four passes to fill the joints up to the face of the bricks. To dispense the mortar for the vertical head joints, we switch to a narrower bucket trowel **2**.

After letting the mortar in the joints set up slightly, we run a barbell jointer over the joints to give them a concave profile, pressing hard as we go **3**. This applied pressure

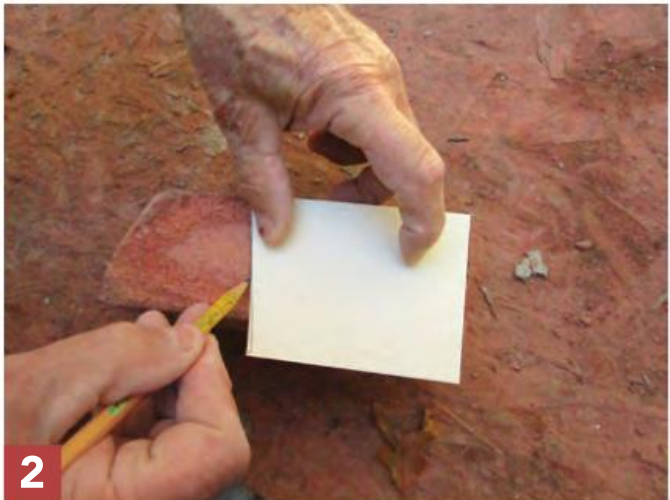
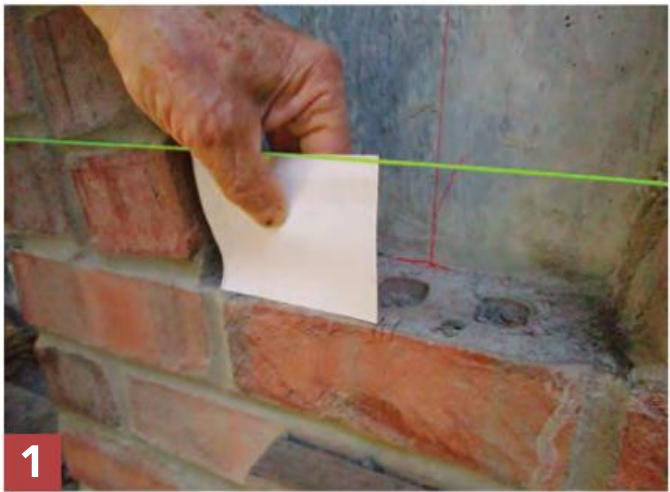
further packs the mortar into the joint, pressing it tight against the edges of the bricks. We finish off the joints by brushing them lightly with an old bristle paintbrush **4**.





FILL IN THE FIELD

Filling in the brick veneer between the arches requires cutting bricks to fit against the curved rowlock courses. The easiest and most accurate way to template the shapes is with cards cut to the width of a brick plus one mortar joint. I cut the angle on the card and test-fit it in place **1**. When I'm happy with the fit, I transfer the shape to a brick **2**, and then used a grinder equipped with a diamond blade to cut the angle. The cut brick then fits perfectly **3**.



Matt Risinger

This Austin builder is using his growing network to teach builders and clients to demand better

BY AARON FAGAN

We caught up with regular *Fine Homebuilding* contributor Matt Risinger as he was en route from his home in Austin, Texas, to a job site in Missouri—where he would be meeting with builder Jake Bruton and architect Steve Baczek. They are all part of The Build Show Network, Risinger’s growing group of mentors utilizing social-media platforms to advance the culture of the home-building

industry by holding it to a higher standard through the power of example.

Matt is the owner of Risinger Build, host of The Build Show, and founder of Build Productions. The object of these ventures has been to shape what we talk about when we talk about building by helping people recognize quality craftsmanship and understand the role building science plays in creating lasting, healthy homes.

AF: What did the building-science learning curve look like when you began?

MR: It was huge for me. Honestly, *Fine Homebuilding* was a big part of that story. I started subscribing to the magazine in the late 1990s and thought, “I can’t imagine building one of these houses. They are so detailed and cool.” I mean, I was building matchstick-box houses. Then when the mold crisis hit, I started to get connected to EEBA [the Energy & Environmental Building Alliance], the Houses That Work program, and eventually people like Mark LaLiberte and Joe Lstiburek.

AF: The view from here is that you’ve grown your media presence in a widening circle of education and leadership. It’s not just about promoting a local business any longer; you appear poised to make real progress toward smashing old myths that performance comes at the expense of aesthetics.

MR: I love that I get a lot of views on my videos, because it allows me to have more of a mouthpiece in the marketplace for

people to demand better. I’ve realized over the years that you can’t just tell builders to build better. They have to have a market that gives them the incentive to change. That’s what it’s been about with my videos as they’ve gotten more traction. Years ago, when I had 50,000 subscribers or so, the split was probably 80% professionals and 20% nonprofessionals. Today, as I am approaching a million, it’s just about the flip of that: 30% to 40% builders, remodelers, and architects, and at least 50% people who want to know what builders think is the best way to build. I’ve got people in the comments writing, “Hey, I told my builder about this, and he didn’t know anything about it, but he is super excited to do this for my house.”

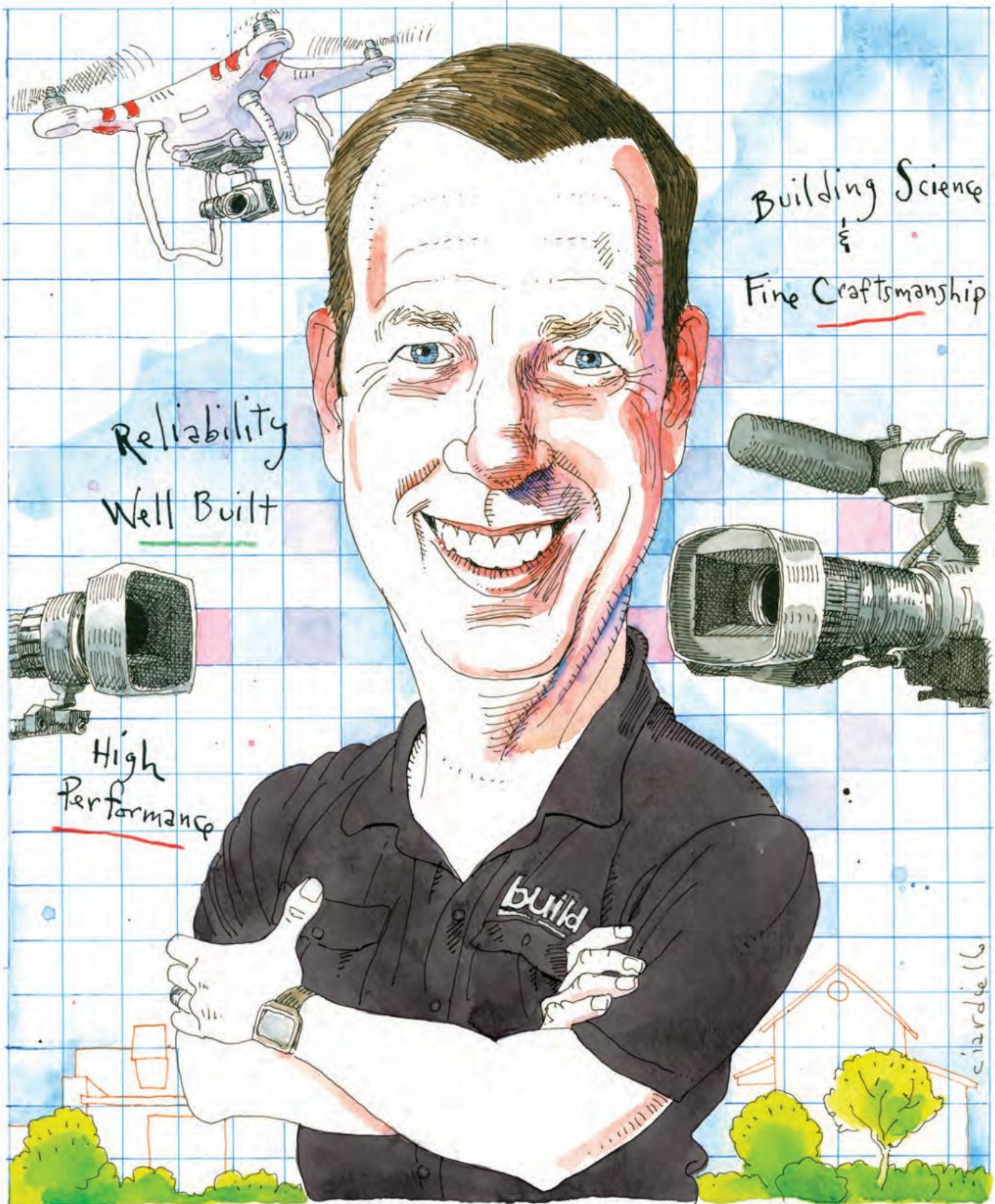
AF: That’s extraordinary, what you just said. That’s culture change happening in real time.

MR: That’s what I’m hoping for. You know, I traveled to Europe last year—it’s not that I’m enamored with Europe or that I think Europeans are so awesome—but

one thing I think they have gotten right is they have a very long-term view on houses. And we, historically as Americans, have had a very short-term view about houses. If I can help dispel that notion even in 1% of the American population, I will have made a huge difference.

AF: A lot of high-performance products come from Europe. How far are we from having more homegrown triple-glazed windows?

MR: That’s the bummer. There are American companies that have the technology and the ability, but they don’t feel like the product will sell. So, they don’t market them a whole lot or sell many. It’s this little fringe business for them. Whereas other manufacturers, that’s all they make. If you need to buy a window in Ukraine, you can’t find a double-glazed. Part of that is climate—I get that companies here have got to sell across the country. But something that I talk about a lot is glazing. I feel like that’s such a low-hanging fruit. Most of our glass is an R-3. All we’d have to do is go



to an R-6 and our houses would be hugely more efficient.

AF: And that would hold true for heating and cooling climates?

MR: In every climate. Just because we are in Texas or Florida doesn't mean we don't have a 30° delta between inside and outside the majority of the year.

AF: When you think of where you began and where you are today, what stands out?

MR: One thing that I've always tried to do is baby-step my way toward a better house by doing things a little better on every project. I didn't go from building 2x4 houses to all of a sudden building some "gee-whiz" house.

AF: How do you bridge building best practices with reality? How do you communicate tricky details with tricky personalities?

MR: I am always talking about craftsmanship. The best materials can perform horrendously if they are installed incorrectly, so we have to really pay attention to our craftsmanship. Most of the time, I'll take a good craftsman with real basic materials any day over a real fancy material with a lesser craftsman installing it. That's been another key to success over the years: finding talented subcontractors who can do good work on my projects.

AF: Finding teachable people and treating them right.

MR: Yes, exactly. For instance, I've used the same frame carpenter the last twelve years—pretty much on every job, with very few exceptions. We negotiate his rate every January, so when we have a big project that comes up, we look at it together and pretty much know how long things will take. We plug in a value into the spreadsheet for the budget. But if it takes longer, I pay him more. And if it takes less, he leaves earlier, and we have money that goes back into the contingency for my client. My clients are cost-plus. And I tell them that they bear the risk of some price increases. But what that nets them is a really excellent job that's done well, and people are going to get paid fairly for their job. Working with the same tradespeople has been invaluable.

AF: How has the COVID-19 pandemic influenced people's thinking about high-performance homes, especially in regards to air quality?

MR: I think the pandemic has been really good for high-performance builders. Number one, people are paying attention to their indoor spaces more. My wife is on the school board, and toward the start of the pandemic she got an email from one of the moms asking if she knew the MERV rating on the school's HVAC system. I think it is fantastic that a parent is even asking and would know what to do with the number even if she was given one. So, people have at least some knowledge of filtration—enough to ask what the MERV rating is. I don't think that kind of attention to indoor-

/// The building world is nothing but mistakes. There's no perfect house. It's what you do with mistakes and how you avoid them. It's one of the reasons I love building science. ///

air quality would have happened without the pandemic.

AF: There really is a visceral, palpable difference in the air quality of a high-performance home.

MR: That's right. It is really hard to explain without experiencing it firsthand. There's something Steve Baczek says to the argument that "houses need to breathe"—he says, "It's not breathing unless the wind is blowing." So, what happens if you have a day of still weather? Now you've got no fresh air. My supertight house has a fresh-air system constantly delivering MERV 15-filtered, dehumidified air.

AF: I remember taking Joe Lstiburek's class on The Perfect Wall and thinking there wasn't anything in it about water and capillary action that I didn't learn in

high school. How is it the entire building industry has been so misaligned with basic physics for so long?

MR: Part of it is short-term thinking. American culture thinks about a house for about five years, and that's about it, because that's how long our warranty is going to be for a builder and that's how long the homeowner is going to live in it. And then the other part is our economic wealth as a nation and our ability to purchase things has made our houses a commodity. That's a bummer. It means we are incentivized to build cheap.

AF: A house becomes a financial product, not a home.

MR: If we knew a house was going to be in a family for another generation or two, I think we would do things very differently. And that's the mindset they have in Europe. That's what I love when I go over there and see what they're doing.

I went to the Bau trade show in Germany two years ago, and there's not one asphalt shingle to be had. And I tried, just to see. The attitude is: Why would I put a 30-year shingle on a roof? It's stupid. I'm going to do ceramic or metal, and that's it. Those are your only choices, really. When you go to the roof-supply store, the gutters in stock are copper. There are no garbage products. There are no cheaper-than products. You need new gutters? Well, you save up, and you buy copper, because that's the right material to use for gutters. I love that attitude.

I tell my clients, "There are times when I'm going to put the house's priorities, and what it needs, above your own. Especially when it comes to the budget." And that's one of them: I'm not going to let a client put an asphalt-shingle roof on their house. Because I think that's putting their priorities over the house's priorities. On the other hand, if they want to use Formica countertops in the kitchen, go for it! Even your \$200-per-sq.-ft. marble from Italy is going to be out of style in five or 10 years, so I could care less about that. Regularly in Austin, five-year-old houses are getting resold and people are immediately doing million-dollar remodels, because they see styles from five years ago as off-trend. That half-million-dollar kitchen cabinetry and

countertop package is getting sent to the Habitat ReStore.

AF: That's crazy.

MR: Totally crazy. That's why I aim to build a really good envelope. They aren't going to remodel the envelope in five years, but most likely they are going to rip the kitchen out, so whatever you want to do there, I'm totally fine with. When it comes to the envelope—things that matter, like what I might get sued on when it comes to water intrusion—I'm going to put my foot down and say, "Look, we are going to do this, because this is the right thing to do for you, for the house, and for Austin, Texas."

AF: On Twitter, you recently quoted James Joyce: "Mistakes are the portals of discovery." Could you talk to us about the value of mistakes?

MR: Oh man, so many failures. All of my more popular videos are my mistake videos. I did one recently about five mistakes I made when I remodeled my house 15 years ago; things I wish I had been smarter about or things I didn't know that came back to bite me. So many mistakes over the years.

AF: It's interesting that they're so popular.

MR: The building world is nothing but mistakes. There's no perfect house. It's what you do with mistakes and how you avoid them. It's one of the reasons I love building science. Buildings will fail given the right set of physics, so we should probably know what those things are, so that we can do our best to avoid them. The number-one reason for construction-defect litigation is water. That's 80% of everything that's out there being litigated. So, we should probably be experts in water.

AF: That's counterintuitive! One would think you need to be an expert in wood or something like that.

MR: Nope. Just water. Just water and what it does. If you're good at that, then everything else will kind of fall in line.

AF: How did The Build Show Network come to pass?

MR: It's an extension of The Build Show. A lot of that was born from two things. When I started my company in 2005, I had a group

of mentors who were about 20 years older than me; they took me under their wing and let me take them to lunch once a month to ask questions. They were so generous with their time, which was invaluable for

// You can't just tell builders to build better. They have to have a market that gives them the incentive to change. //

me as a young builder. The second thing is I felt like *Fine Homebuilding* and *JLC* were very New England-based at the time and weren't putting out a lot of content about how to build a really good house in a hot, humid climate.

The Build Show Network has been about getting like-minded people on board to shoot their version of The Build Show, and that has allowed me to further the mission of teaching that next generation of builders how to build better. My desire would be to have about 15 to 20 builders, remodelers, or architects on the network in the coming years in all different climates and areas of North America.

AF: Cape Cods were a direct innovative response to building on this side of the Atlantic. So much of our built environment now appears incompatible with its environment.

MR: One hundred percent. When Frank Lloyd Wright built modern houses, they leaked like a sieve. Most modernist buildings were pretty terrible, uncomfortable and leaky. And now we like that style, and chemistry can overcome some of those issues with really good peel-and-sticks and membranes and roofing. But will they last? Only time will tell. Some tried-and-true aesthetics don't have to so heavily rely on the forgiveness of amazing chemistry to stay together.

AF: You used to build your houses to the standards of the Austin Energy Green Building program; has that changed?

MR: I don't rate my houses with their program anymore. This is not a knock on them, but I don't like how those types of programs are so checklist-based. I've gravitated toward Passive House [PHIUS] certification. I love that it's a performance standard. They don't care about how you get there as long as you get there. You can do a bike rack or not, they don't care. What they care about is performance. And you have to prove you can meet their energy-efficiency standard. I like that.

I am taking the path to certify my house, which is under construction now, through PHIUS, and that will be the first my company has done. It's not an easy process. There are a lot of hoops to jump through, and hopefully I'll make it. Nonetheless, it has been really fun to dig into their principles and really understand the certification process. And I love that they've now adapted their performance standards based on climate zone. Because a house in Texas is not a house in Germany where Passive House originated.

AF: What's on the horizon given this precarious moment we are in?

MR: I'm pretty bullish on the future. I'm an optimist by nature. As a result of the pandemic there's more and more interest in better-built houses. I feel like builders are interested in building better and clients are interested in them building better for them. I feel like we have a good future.

AF: How would you summarize the long-term vision for the Build Show Network?

MR: Increase mentorship in our industry. Social media allows that to some extent, but there is only a limited amount of back and forth on that. As I grow my network, I have some ideas about doing more to draw young people into the trades through training and mentorship. I see that as a huge looming disaster in our country. We are already taking some good steps toward averting that outcome, and I want to be a part of that. □

Aaron Fagan, a former associate editor for *Fine Homebuilding*, is a freelance writer and the author of three books of poetry, including *A Better Place Is Hard to Find* (The Song Cave, 2020).

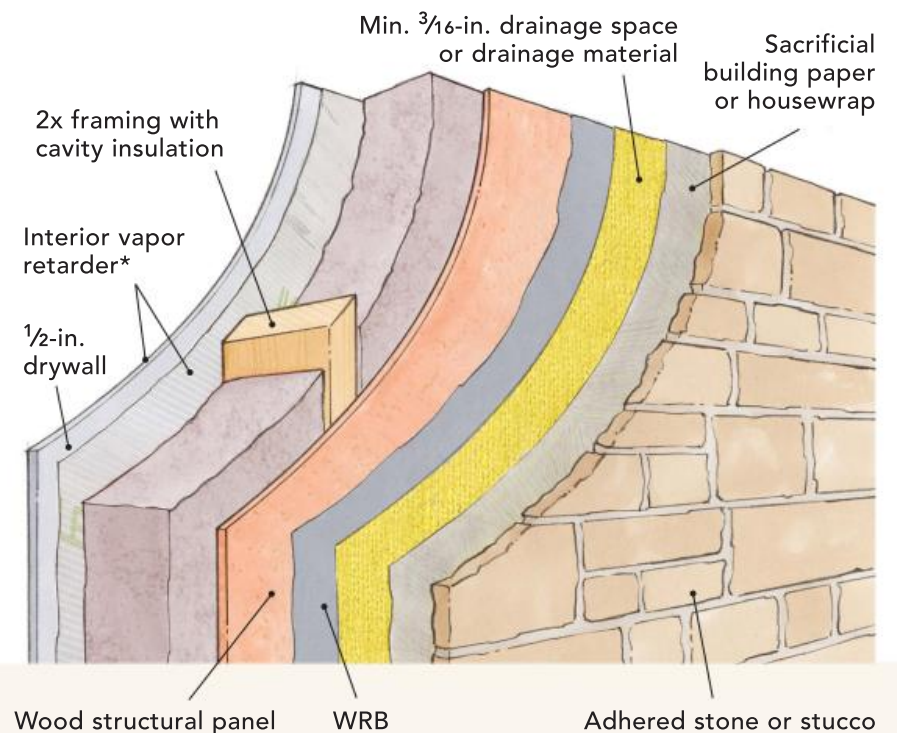
Successful Vapor Control

Vapor drive isn't as obvious as air or water leaks, but the potential for mold and rot is just as real

BY JAY CRANDELL, P.E., AND FERNANDO PAGÉS RUIZ

Building materials and wall assemblies have evolved significantly over the last century. Where walls were once sheathed with lumber boards, most homes now are sheathed with plywood and OSB. We replaced interior lath-and-plaster with gypsum wallboard. Insulation became the norm, and energy codes have continued to add even more and different types of insulation. These changes affect the moisture behavior of walls and, when not thought out or tested, can cause problems. For example, starting in the 1990s, we discovered that improved flashing and water-resistive barrier (WRB) requirements were needed to better protect water-sensitive materials in walls such as plywood, OSB, and drywall.

We also realized that as insulation levels increase and heat flow through wall assemblies decreases, air leakage becomes more of a problem. Air leaks allow airborne moisture (vapor) inside walls, where it can condense on cool surfaces and lead to mold



WALLS THAT WORK

A durable assembly considers inside and outside sources of water vapor and allows drying to exceed wetting over the long haul. Managing water vapor depends on climate, the insulation strategy, and the vapor-permeance characteristics of every building component from interior paint to exterior cladding. Vapor control is more than an interior vapor retarder. These three drawings show conventional walls with cavity insulation only and three different cladding types. Exterior continuous insulation is addressed later.

*Some interior vapor-retarder options for each assembly

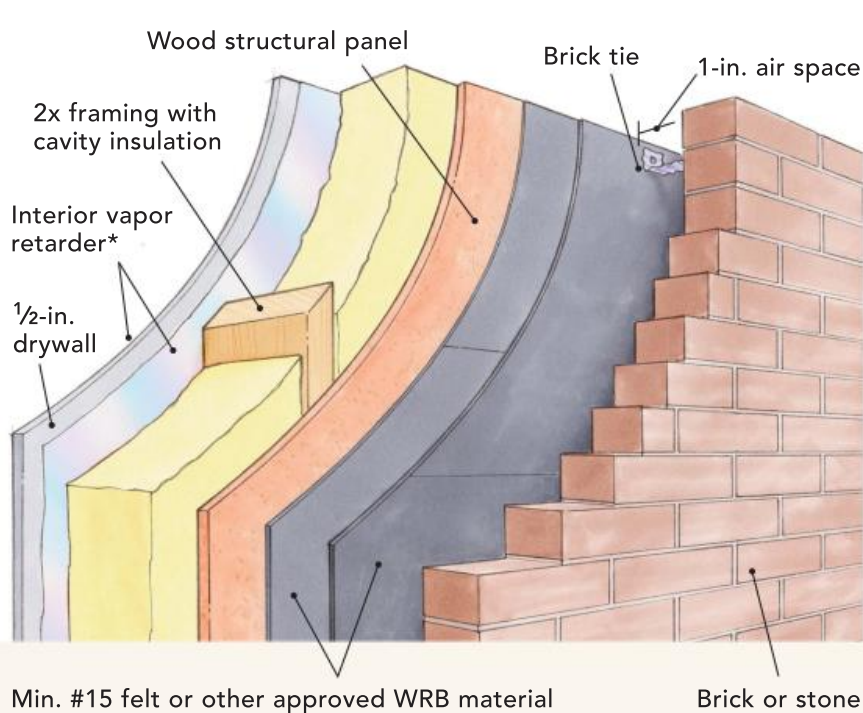
STUCCO AND ADHERED MASONRY

Stucco and adhered masonry need a drainage space behind the first layer of WRB. Traditional stucco uses two layers of building paper, relying on “wrinkling” of the paper layers to provide drainage. This method is now limited to the “dry” climate region (see map, p. 52). In “moist” and marine climates, positive drainage is required and preferred in any climate.

* Climate zone 1: No interior vapor retarder
Climate zones 2 to 4, excluding marine: Class III vapor retarder
Climate zones 4 to 6: Class II smart vapor retarder
Climate zones 5 to 8: Class I smart vapor retarder



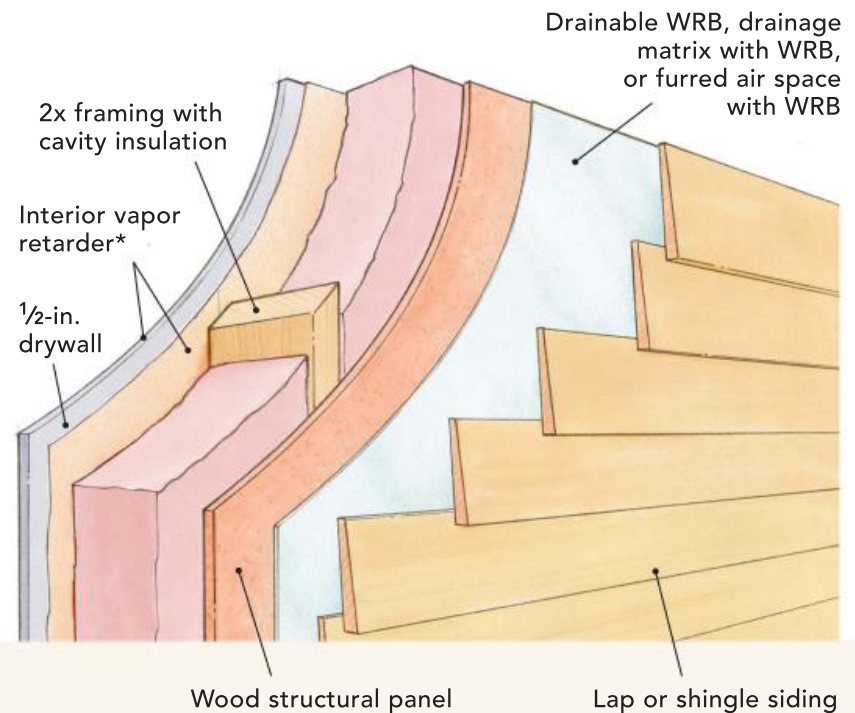
Slow the flow. A properly installed vapor retarder slows seasonal water-vapor movement to prevent wet walls. The most sophisticated (smart) vapor retarders also become more vapor open when assemblies need to dry, creating a more forgiving wall assembly.



MASONRY VENEER

Brick- and stone-veneer walls, like other reservoir claddings, benefit from a larger vented air space that helps remove inwardly driven vapor from the brick so less diffuses into the wall. The air space also speeds drying when conditions are right, and allows bulk water to drain.

* Climate zone 1: No interior vapor retarder
Climate zones 2 to 5: Class III vapor retarder
Climate zones 4 to 6: Class II smart vapor retarder
Climate zones 5 to 8: Class I smart vapor retarder



WOOD, COMPOSITE, OR VINYL

Wood, vinyl, and composite siding aren't reservoir claddings, making inward vapor drive less important, but a drainage space or material prevents moisture accumulation behind the siding and helps protect the wall, even if not required by code. Note that some sidings may not qualify as a vented cladding without a back-vented air space.

* Climate zone 1: No interior vapor retarder
Climate zones 4 to 6: Class II smart vapor retarder
Climate zones 5 to 8: Class I smart vapor retarder
(Use of a Class III vapor retarder is dependent on both climate zone and whether the siding is vented.)

3 CLASSES OF VAPOR RETARDER

Vapor permeance, measured in “perms,” represents a standard measure of water-vapor movement through a material under laboratory conditions. A membrane with a high perm rating allows water vapor to pass through easily. In contrast, one with a low perm rating throttles the passage of water vapor. Vapor retarders are the building component most-often described with a vapor-permeance rating, but all materials, even those not expressly designed to affect the flow of water vapor, have a perm rating. The IRC groups vapor retarders into three classes.

CLASS I VAPOR BARRIER

0.1 perms or less (sheet polyethylene)



CLASS II VAPOR RETARDER

0.1 perm or greater up to 1 perm (kraft-faced fiberglass batts)



CLASS III VAPOR RETARDER

1 perm up to 10 perms (painted drywall often applies; check permeance of paint)

Grouping vapor retarders into three classes creates overly broad ranges and some confusing contradictions. For example, a ten-fold difference exists between a Class II barrier of 0.1 and 1. And in the starkest contradiction, the IRC defines a vapor-permeable material as any with a perm rating greater than 5. This means a Class III vapor retarder with a perm rating of 5 could be considered both a vapor retarder and a vapor-permeable material. While these classification oddities remain in the code, engineers considered the “worst-case” scenario when establishing the newest IRC provisions.

and rot. It also wastes a lot of energy. The solution in the energy code was to tighten up building envelopes to limit air leakage. Unfortunately, we have paid less attention to improving vapor control in step with the changes to wall assemblies over the course of several decades.

Water vapor is simply water in its gaseous state. We experience its effects on our own comfort: When humidity spikes on a hot day, it feels much warmer than the temperature alone would indicate. Many building components—especially wood—are affected by water vapor as well. If you have a door that sticks in the summer but not in the winter, it’s likely that water vapor is the culprit. But this is a minor nuisance compared to the damage water vapor can wreak inside a wall.

The problems associated with poor vapor control are not as immediately obvious as those from bulk water or air leaks, and their solution even less so. Vapor diffusion through materials, or vapor drive, is a much more subtle form of moisture intrusion. While rain leaking through an improperly installed window may be obvious straight-away, water vapor is diffuse and invisible, and capable of causing damage slowly and often imperceptibly. And while the damage from a poorly flashed window tends to be localized to the portion of the wall where the leak occurs, insufficient vapor control can have destructive impacts that, over time, affect a much larger area than a water or air leak.

The extent of this problem and the need for improved code provisions was realized in a review published in 2015 by the Applied Building Technology Group, which can be found online at appliedbuildingtech.com/rr/141003. It assessed data from both good- and poor-performing walls in various climates and provided a rational basis to begin to fill gaps in the code.

New code rules help

The International Code Council responded to poor water-vapor control with improved provisions in the 2021 International Residential Code (IRC). Even if your jurisdiction is using an older version of the IRC, you may want to implement the 2021 version’s vapor-management prescriptions right away, because older versions may allow for some risky wall assemblies.

In heating climates, the effects of excessive vapor diffusion into wall cavities typically

manifests as repeatedly wetted sheathing (cycling above 20% moisture content each winter), with or without condensation or rot. In cooling climates or anywhere air conditioning is used in the summer, vapor problems can show up as mold or condensation on the back side of drywall.

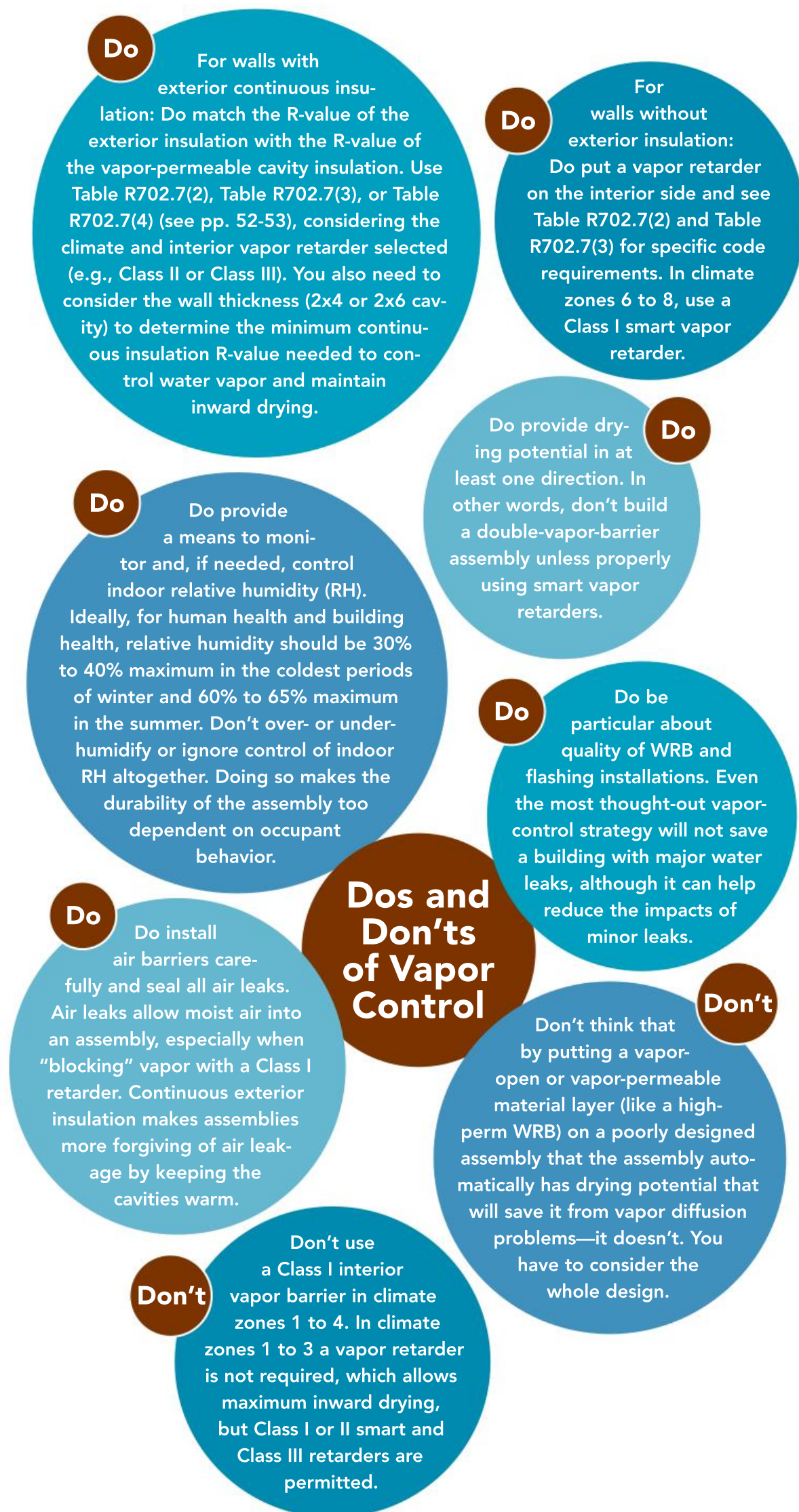
There are hundreds, if not thousands, of possible wall configurations and material combinations that affect water-vapor behavior. The 2021 IRC does a good job tackling the complexities of the vapor-control issue. Code writers had to balance the variations in water vapor's behavior across the nine U.S. climate zones with the various properties of the wall's interior layers, exterior layers, and insulation, as well as the insulation strategy (e.g., cavity insulation only or cavity plus continuous exterior insulation).

Blocking water vapor is imperfect

In most climates, the traditional method of reducing moisture accumulation inside a wall is to use a suitable interior vapor retarder. The 2021 IRC follows this conventional approach for wall assemblies without exterior continuous insulation. What's still missing from this approach, however, is specifications for minimum permance requirements for materials on the assembly's exterior side when a Class I or II interior vapor retarder is used in colder climates as specified in the code.

Unfortunately, most exterior materials (except WRBs) do not have any product-specific perm-rating information or requirements, or the information we have about them is too generic to be very useful (for more on perm ratings, see facing page, left). For example, research data indicates that OSB's permance may vary from less than 2 perms to as much as 5 perms. Depending on the climate and the vapor retarder used inside, this difference in exterior sheathing permance can have a significant impact on its moisture content during the winter. Fortunately, this is rather easy to remedy by going beyond code minimum and using a Class I variable-permeance (smart) vapor retarder in colder climates.

When Class III interior vapor retarder is used without exterior insulation, it becomes important in climate zones 4 and higher to use vented claddings, such as vinyl siding, to aid drying and prevent excessive wetting of the sheathing during winter. The sheathing permance is important too. A



ANSWER THESE QUESTIONS FOR

Are you using exterior insulation?

Continuous exterior insulation affects the vapor-retarder requirements, because it controls water vapor by temperature and permeance. Whether or not you are using exterior insulation, your design starts with Table R702.7(2). From there, other tables or footnotes are accessed to address specific design conditions or options. Also see Table R702.7(1), which defines vapor-retarder classes. This table is the same in prior code cycles, except when it comes to using paint as vapor retarder. The coating must now be identified as a vapor retarder and applied in accordance with manufacturer instructions.

What’s your climate zone?

You will need to know your climate zone to choose a compliant vapor-retarder solution matching your insulation strategy (which must also satisfy the energy code). Refer to climate map N1101.7 to find your climate zone. The 2021 IRC version shows that climate boundaries have moved slightly northward in recent decades.

Which retarder is right?

Next, refer to Table R702.7(2): “Vapor Retarder Options” to determine what vapor retarders are permitted in your climate with your cladding. Study the footnotes.

A Class I and II vapor retarders with vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B) shall be allowed on the interior side of any frame wall in all climate zones.

B Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an approved design.

C Where a Class II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table R702.7(4) and the Class II vapor retarder shall have a vapor permeance of greater than 1 perm when measured by ASTM E96 water method (Procedure B). (NOTE: This requires that the Class II vapor retarder is also a smart vapor retarder, like coated kraft-paper facing on fiberglass batts; use of a Class I smart vapor retarder would provide equal or better performance.)

Class III vapor retarder provides more inward drying potential, but increases outward vapor flow toward the sheathing in winter, which is why highly vapor-permeable exterior sheathings (e.g., gypsum sheathing and fiberboard) are required above climate zone 5 when exterior insulation isn’t included. The same sheathing-permeance concern arises with use of a Class II vapor retarder in climate zones 6 and higher, but

addressing this nuance remains a gap in the code. More details can be found in the IRC tables, above.

Exterior insulation helps

If we keep the temperature inside the wall cavities closer to the temperatures inside the home with exterior insulation and use a vapor retarder that maintains inward drying, we keep the vapor from condensing

inside the wall and the relative humidity low enough to prevent mold and reduce moisture uptake by wood materials.

But success requires the right ratio of continuous exterior insulation to interior cavity insulation, which depends both on climate and the vapor retarder selected. Even if the outer layers have low permeance and prevent the wall from drying outward, the wall will be protected against diffusion-based

TABLE R702.7(1) VAPOR RETARDER MATERIALS AND CLASSES	
Class	Acceptable materials
I	Sheet polyethylene, nonperforated aluminum foil, or other approved materials with a perm rating of less than or equal to 0.1
II	Kraft-faced fiberglass batts, vapor retarder paint, or other approved materials applied in accordance with the manufacturer’s installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0
III	Latex paint, enamel paint, or other approved materials applied in accordance with the manufacturer’s installation instructions for a perm rating of greater than 1.0 and less than or equal to 10.0

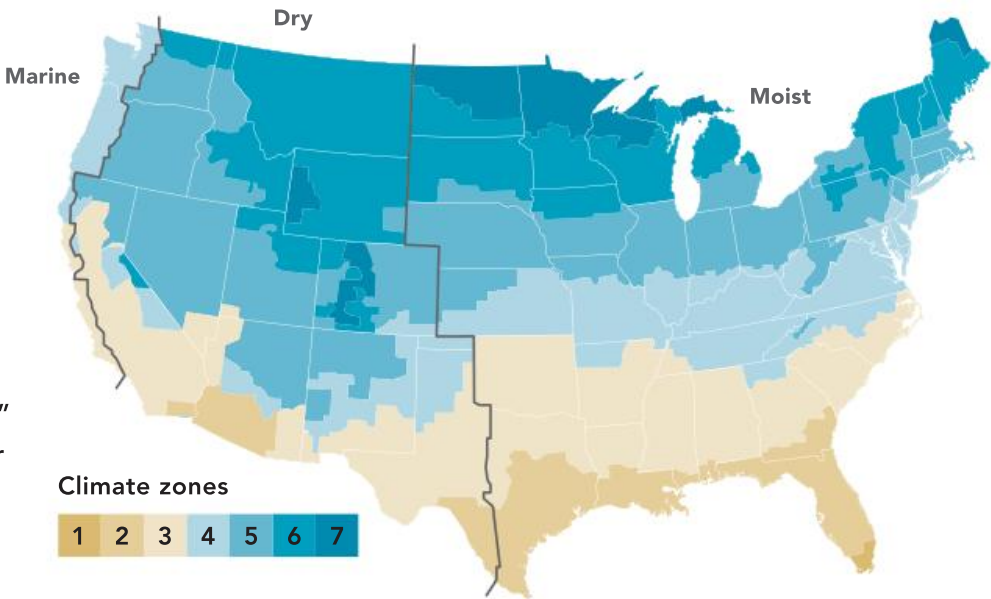


TABLE R702.7(2) VAPOR RETARDER OPTIONS			
Climate zone	Vapor retarder class		
	Class I ^A	Class II ^A	Class III
1, 2	Not Permitted	Not Permitted	Permitted
3, 4 (except marine 4)	Not Permitted	Permitted ^C	Permitted
Marine 4, 5, 6, 7, 8	Permitted ^B	Permitted ^C	See Table R702.7(3)

SUCCESSFUL VAPOR CONTROL

Will Class III work with your wall?

Refer to Table R702.7(3) to see if a Class III retarder will work with your wall assembly. Table R702.7(3) includes both permeance-controlled wall designs (those without continuous exterior insulation) and temperature-controlled wall designs (those with continuous exterior insulation). The exterior insulation assemblies work in all climates by changing the insulation ratio (or R-value) accordingly. For walls without continuous insulation, a Class III vapor retarder does not work in colder climate zones. Walls without exterior insulation also require an appropriate sheathing material (based on its permeance). You will need to install a vented cladding (like vinyl) to help remove moisture that accumulates in and passes through cold sheathing in the winter.

- A** Vented cladding shall include vinyl, polypropylene, or horizontal aluminum siding, or brick veneer with a clear air space as specified in Table R703.8.4(1), or other approved vented claddings.
- B** The requirements of this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11 [Energy Efficiency].

Can I install less exterior insulation?

Table R702.7(4) is a new table. It specifies a Class II vapor retarder, and the code requires it to be a smart vapor retarder (like conventional coated kraft-paper-faced batts) and allows you to use less exterior continuous insulation than the specifications published in Table R702.7(3). You can use less exterior insulation because of the additional interior vapor control with a Class II compared to a Class III vapor retarder. The overall wall insulation design will still need to meet the energy code, but this option makes it possible to not “overshoot” the energy code while maintaining good water-vapor performance.

moisture accumulation because the air in the cavity will be warmer, lowering the risk of reaching the dewpoint inside the wall.

Interior drying is maintained with a Class III vapor retarder or Class I or II smart vapor retarder. Tables R702.7(3) and R702.7(4) provide different minimum continuous-insulation R-value requirements based on fibrous-cavity R-values for 2x4 and 2x6 walls, and these vary by climate.

Why use the 2021 code today?

Most of us do not want to hire an engineer to calculate hygrothermal designs for walls we build. The 2021 IRC provides guidance that builders can use today. With Section R702.7: Vapor Retarders as a guide, you can have reasonable assurance that the walls you build will perform well, and the vapor-retarder and vented-cladding options offer flexibility for the presence or absence of exterior insulation.

It doesn’t contradict existing regulation, and does fill some gaps in earlier code cycles, to prescribe more-resilient wall assemblies. □

Jay Crandell, P.E. has more than 30 years of experience in construction, design, research, development, and building codes. Fernando Pagés Ruiz is a builder and an ICC-certified residential building inspector active in code development.

TABLE R702.7(3) CLASS III VAPOR RETARDERS	
Climate zone	Class III vapor retarders permitted for ^{A,B}
Marine 4 (2021 IBC includes all of zone 4)	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 2.5 over 2 x 4 wall Continuous insulation with R-value ≥ 3.75 over 2 x 6 wall
5	Vented cladding over wood structural panels Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 5 over 2 x 4 wall Continuous insulation with R-value ≥ 7.5 over 2 x 6 wall
6	Vented cladding over fiberboard Vented cladding over gypsum Continuous insulation with R-value ≥ 7.5 over 2 x 4 wall Continuous insulation with R-value ≥ 11.25 over 2 x 6 wall
7	Continuous insulation with R-value ≥ 10 over 2 x 4 wall Continuous insulation with R-value ≥ 15 over 2 x 6 wall
8	Continuous insulation with R-value ≥ 12.5 over 2 x 4 wall Continuous insulation with R-value ≥ 20 over 2 x 6 wall

TABLE R702.7(4) CONTINUOUS INSULATION WITH CLASS II VAPOR RETARDER	
Climate zone	Class II vapor retarders permitted for ^A
3	Continuous insulation with R-value ≥ 2
4, 5, 6	Continuous insulation with R-value ≥ 3 over 2 x 4 wall Continuous insulation with R-value ≥ 5 over 2 x 6 wall
7	Continuous insulation with R-value ≥ 5 over 2 x 4 wall Continuous insulation with R-value ≥ 7.5 over 2 x 6 wall
8	Continuous insulation with R-value ≥ 7.5 over 2 x 4 wall Continuous insulation with R-value ≥ 10 over 2 x 6 wall

A The requirements of this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11[Energy Efficiency].

Bold Moves

Make the Space

How completely rethinking the floor plan helped resolve a cold, cramped master bathroom

BY ROB YAGID

The owners of this Massachusetts Victorian were no strangers to the work of Byggmeister Design Build. Over the years, the firm, which explicitly focuses on remodeling work with a commitment to efficiency, completed a finished basement and an extensive garage project on the property. So, when the owners sought a new master bathroom, they already knew that they'd be getting an expertly crafted space and an improvement to the home's efficiency along the way. The finished bath is a complete transformation, and an



A design in waiting. A stained-glass window the owners were saving for special use now sits at the center of the master-bedroom wall, around which traffic circulates from the new entry to the new bathroom and walk-in closet.





New view. Once an entry to a second-floor balcony, new opposing vanities now flank a trio of high-performance windows that simulate architecturally appropriate leaded glass. A generous shower with a glass-paneled corner allows light to fill the space.



“Our favorite projects involve taking the weakest part of a house and turning it into the best part of the house.”

—Byggmeister project team

example of what’s possible when you reassign value to existing spaces.

When looking at the original layout of the master suite (facing page, top), it’s easy to become enamored by the opportunity the balcony affords. After all, access to the outdoors—light and views—is a conventional element sought after in the bid for comfort. But the energy demands of a home should also be a priority. And in truth, the balcony was underutilized. It was high maintenance

and its leaky old door offset any real comfort and efficiency that the daylight imparted on the space.

“Our favorite projects involve taking the weakest part of a house and turning it into the best part of the house,” wrote the project team. “In this case, we chose to capture the old balcony as indoor space and relocate the bathroom to that end of the master suite.”

By moving the bathroom to the balcony position, the team was able air-seal and

improve insulation levels in the exterior walls. High-quality, tight windows keep the thermal boundary in check, without completely losing access to the light and views that help bring the space to life.

The abundance of floor space on this side of the master suite allowed the owners additional amenities within the bathroom. Now, they have a spacious walk-in shower, a separate toilet closet, dual vanities, and a makeup counter. The result is an elevated



THE BIG SHIFT

Moving the bathroom to the opposite side of the bedroom not only gave the room increased square footage by taking over an underused balcony, it enhanced the circulation through the master suite and opened opportunities in peripheral areas. By adding a small addition and moving the bedroom entry door, dead space in the hall was layered into the creation of a new walk-in closet.

1 While somewhat functional, the existing master bath was cramped and lacked storage and a sense of comfort.

2 Dead space in the existing plan provided opportunity for greater functionality and inspired the bath relocation.

Before

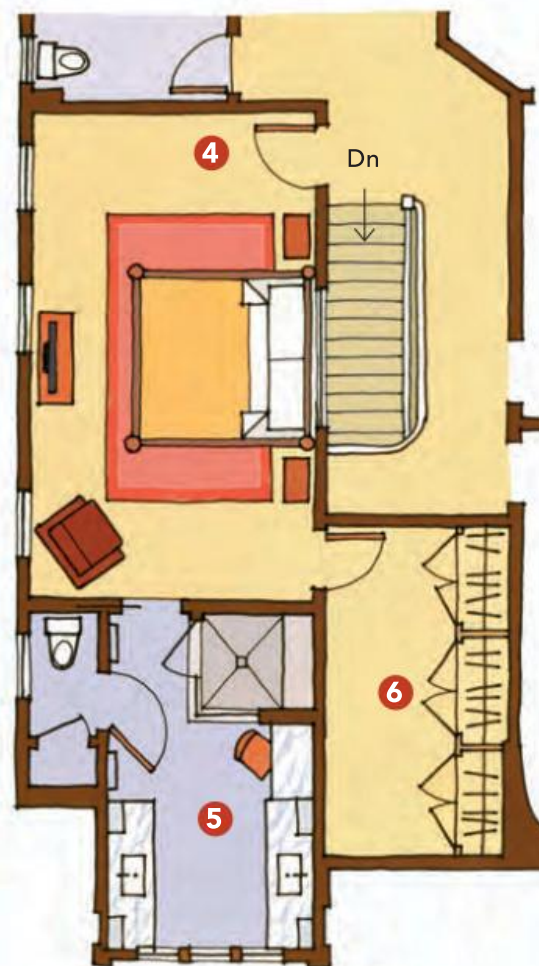


3 A leaky entry door opened onto an underutilized balcony.

After

4 Moving the wall separating the old bath and the bedroom made it possible to rearrange the entry to the bathroom, which improves the flow through the entire space.

5 The shower, water closet, and vanities are placed to alleviate congestion when moving through the bathroom, and a built-in makeup counter maximizes the utility of the space.



6 By adding a small addition and capturing existing space in the hall, the team was able to create a large walk-in closet and dressing room.

0 2 4 8 ft.

master suite that improves both circulation and functionality.

The team's favorite part? "The homeowners report that the bathroom—where the old balcony had been—is now the most comfortable room in the house." □

Rob Yagid is founder and executive director of Keep Craft Alive. Photos by Jim Raycroft, courtesy of Byggmeister Design Build.

Location Newton, Mass. Architect Doug Ruther Interior design Karin Mahdavi

Built-ins for Odd Spaces

A simple, foolproof method for off-angle cabinets

BY GARY STRIEGLER



Just about every job I work on has one or two odd cabinets that aren't quite what your typical kitchen-and-bath cabinetshop is used to dealing with. What I call "off-angle cabinets" are a great example. Sometimes you find them tucked under a stairway, but they are also common in second stories with sloping ceilings. The room shown here was an unfinished bonus room that the owners wanted to turn into a play and study room for two young boys, and I had to make two off-angle cabinets to fit against the slope of the gable roof.

I developed a method to build these odd-shaped cabinets so they fit every time. It all starts with the back; I scribe-fit a piece of $\frac{1}{4}$ -in. plywood that will become the cabinet back, but first I use it as a template to build the cabinet. The face frame exactly matches the template, but the cabinet box doesn't. Instead, when I draw the layout on the template, I shift the lines for the sides close to the wall and ceiling in about $\frac{1}{4}$ in. That leaves $\frac{1}{4}$ in. of face frame overhanging the cabinet box to be scribed to fit the wall and ceiling.

My construction methods for off-angle cabinets are a little bit different than standard cabinets. I essentially build a box within a box. The interior box supports the shelves and reinforces all the joints in the outside box. For the room here, I realized it would be a lot easier to get all the pieces of material I needed up the narrow stairway than to bring the assembled cabinet upstairs. So I started by ripping $\frac{3}{4}$ -in. plywood into eight $11\frac{1}{4}$ -in. strips in my shop. I also cut and sized all the lumber I needed to make the face frames. I planned to make all the plywood cuts with a track saw, but first I had to figure out what angle to cut the plywood. I cut a scrap of lumber and made a couple of test cuts comparing them to the layout on the plywood back; it turned out to be 44° .

I'm sure there are some carpenters who could just take some measurements and go build this cabinet. When possible, I am much more comfortable marking the length in place than measuring. Working from a full-scale pattern reduces the chance of error, in my experience; once I have the pattern right, I just cut pieces to match and put them together. It is pretty simple, but I'll take simple every chance I get. $\square$

Gary Striegler is a trim carpenter in Fayetteville, Ark. Photos by Matthew Millham.



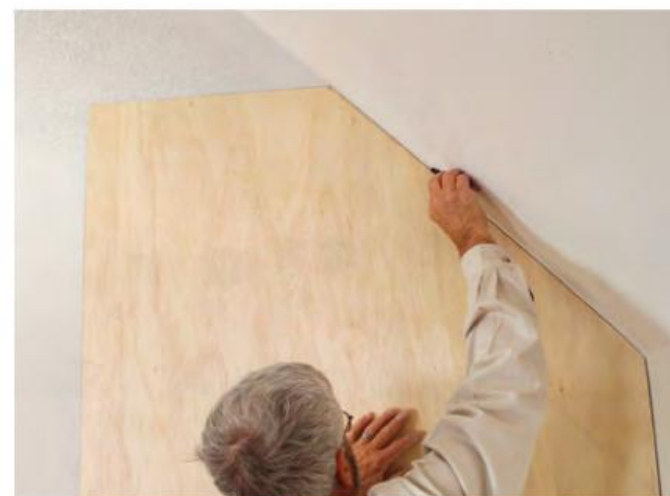
MAKE A TEMPLATE

It all starts with the back panel, which also serves as a template for the carcass. I already know the height and width I'm aiming for, and how far off the floor it has to be to accommodate a built-in-desk below. I simply draw the outline of the cabinet's perimeter on the wall, then cut and scribe the back to fit in that space.

MARK THE PERIMETER Measure off the floor to mark the top and bottom of the cabinet back, and off the wall to mark its width, then use a level to extend the marks level and plumb.



ROUGH THE BACK Measure the lengths on the wall, transfer them to the plywood back, then use a track saw to cut the plywood to its rough shape.



SCRIBE TO FIT Hold the plywood back in position on the level lines and check the fit. If there are any gaps along the wall or sloped ceiling, mark and scribe it to fit.



MARK OFFSETS I draw lines 1 in. in from the edge of the sides that butt into the wall and ceiling, which leaves the plywood back hanging over $\frac{1}{4}$ in. A 3-in. offset at the bottom accommodates the bottom shelf and a hardwood cleat for fastening to the wall. Use an angle finder or make test cuts to determine the cut angle for the intersecting wall and ceiling planes, which is needed later.

BUILD THE BOX

I prefer to mark trim lengths in place rather than use a tape, and I use that same method for the parts of these cabinets. The layout lines and the edge of the plywood back are my starting points. I precut all of the plywood to width on a tablesaw at my shop, and cut all the parts to length on-site with a track saw.



MARK IN PLACE When possible, use the layout lines as a guide to mark where to cut pieces to length.



FASTEN AS YOU GO Fasten parts as they're cut for a tight fit, for accurate marks, and to ensure nothing gets mixed up.



PREP THE POCKETS Pocket-hole screws secure the face frame along the sides that butt into the wall and ceiling. Drill the pocket holes before the entire perimeter of the cabinet is fastened to make things easier.



SPACE IT OUT Adjustable shelves don't work with this cabinet, so I space them evenly with pieces of plywood cut to the height between shelves, and nail them to the sides of the box with 1 1/4-in. brads.





HIDE THE FASTENERS

Fasten the shelves through their tops down into their supporting spacers using 2-in. brads. The next layer of spacers will conceal these nails—just one less thing to fill before finishing.



FIND THE INTERSECTION To determine where the spacer goes on the angled side, I simply pull a tape square off the previous shelf and mark where the shelf's height intersects the slope.



TWO-PART SPACER

Depending on your shelf layout, the spacer on the sloped side may require two pieces. The cut angle identified earlier (in this case, 44°) comes into play here.



SLIDE CAREFULLY

Go slow when adding shelves in the upper sloped portion to avoid damaging the sharp edges created by the angled cut.

STIFFEN AND TRIM

The plywood back and 1-in. (nominal) face frame give the cabinet rigidity, and cleats provide the needed strength to hold it on the wall. Trim is optional, but I never miss an opportunity to add a little flourish.



BACK IT UP Align the back flush with the side that will be visible in the room, leaving the edge against the wall running long. This excess gets trimmed later.



STAPLE LIBERALLY Because this construction method is a little unorthodox, I fasten the back with $\frac{5}{8}$ -in.-long $\frac{3}{8}$ -in.-dia. crown staples around the entire perimeter and into the shelves roughly 3 in. on center to add rigidity and holding power.



ASSEMBLE THE FACE FRAMES I build the face frames using the back template as a guide. Because the back is slightly larger than the cabinet box, the face frame will overhang slightly, to be scribed to the wall and ceiling if necessary.



FASTEN THE FACE Glue around the entire front edge of the box, then clamp the face frame to the box along the bottom and side that faces into the room, and fasten the hidden sides, which overhang the box, with pocket screws. Allow the glue to set before removing the clamps and sanding.



CLEAT IT Add 2 1/4-in. cleats to the bottom and upper interior of the box for attachment. Cut the pieces for a tight fit, then fasten with 2-in. brads through the sides and crown staples through the back.



ADD THE NOSING To hide the edges of the plywood shelves, cut and fasten molding with glue and 2-in. brads.



PLANE IT FLUSH Trim the bit of the back that overhangs the cabinet before testing its fit against the wall and ceiling. Scribe the face frame as necessary for a tight fit, then fasten the cabinet to the studs with long screws through the top and bottom cleats.



TRIM IT OUT Though not entirely necessary, I like to add a little trim to these odd cabinets. The top has a routed-edge top cap over a piece of panel mold. A narrow scribe mold covers the plywood back.

Table-Saw Molding

The secret is in the order of cuts

by Bruce Andrews

When the landmark Winooski Block was finished in 1862, the builders festooned it with all manner of ornamental moldings and wooden filigree. But by the time we (Moose Creek Restorations Ltd.) got the repair contract, 117 Vermont winters had weathered, cracked and split all of its remaining woodwork. Three-fourths of the building's cornice moldings were either rotten or missing. We were to replace 10,000 linear feet of various moldings, not one of them a type manufactured today, and we didn't even own the usual tool for milling moldings, the spindle shaper. We still were able to complete the job, relying on our table saw and a lot of careful planning. We found that the table saw could handle most any profile—it could even scoop out concave curves—but we also learned that every profile required its own sequence of cuts. Figuring out that sequence is the heart of our method.

The first thing we worried about was getting enough good stock. Molding stock must be the highest quality, close grained and knot free. We were still short of stock after several deals to obtain a couple thousand board feet of Vermont pine in varying widths, thicknesses and lengths—all rough cut and in need of finish planing, dimensioning, and in some cases, drying. We were bemoaning our plight when two young entrepreneurs wandered into our office. They asked if we knew anyone who could use several thousand board feet of redwood and cypress beer-vat staves from the old Rheingold Beer brewery that was being dismantled in Brooklyn, N.Y. Well, yes, we probably knew someone. The wood reeked of stale beer, but it was superb for our purposes. It was straight, close grained and of course, well seasoned.

Before any shaping could be done, we had to prepare our stock. We thought that the wood might have nails hidden in it, but we found none. We did find metal flecks where the vat bands had deteriorated, but with wire brushes and large paint scrapers we removed almost all the rust. On our 16-in. radial-arm saw, we ripped the lumber to the rough sizes we needed, about $\frac{1}{4}$ in. thicker and $\frac{1}{2}$ in. wider than the dimensions of the finished moldings. Next we prepared the stock on a jointer and a thickness planer. Once we had dressed down the old surfaces $\frac{1}{4}$ in., the wood was perfect and unmarked. As we worked,

we checked our cutters for sharpness. Our stock was as straight and as square as we could make it; we were ready to begin shaping.

Setting up—Milling complex moldings on a table saw requires precision. Begin with an accurate template of the molding, to which you can adjust the sawblade's settings and against which you can compare results. The best template is a short piece of the molding you want to copy. If you must create a template from molding in place, you'll have to use a profile gauge. (See Figure 2 on the next page.) Many exterior moldings are too large to be handled with one application of the gauge. If this is the case with your trim, you'll have to take a series of readings, transfer them to paper and combine them for the complete profile. In fact, it's a good idea to sketch all molding profiles on site, for the gauges may get distorted before you return to the shop. Fashion your template out of a rigid material such as Masonite or plywood.

Before any cutting, even before setting the sawblade, scrutinize the template or molding cross section. The question is how to determine the order of the cuts. You don't want to take out a piece of stock you'll need later to run against the fence for making another cut. Think things through on a piece of paper. Certain cuts simply have to be made before others.

In Figure 1, for example, cut 1 is crucial because it is a dividing line between two curves: If its angle is incorrect or its cut misaligned, the proportions of both curves will suffer. If it is too deep, it undercuts the convex curve; if too shallow, material in the notch will have to be cleaned out later—a waste of time.

Cut 2, which creates the concave curve, must meet precisely the high point of cut 1. Because the stock is fed into the sawblade at an angle, this is a delicate cut.

Cuts 3 through 6, creating the convex curve, must be made after 2. If they had been made before 2, the convex curve would have made subsequent cuts a problem. (The stock could easily roll on that curve as it is fed into the sawblade.)

Cut 7 is delayed so that the point it creates with cut 2 won't be battered as the stock is maneuvered over the saw. Cuts 8 and 9 are made last, because leaving the corners of the stock square

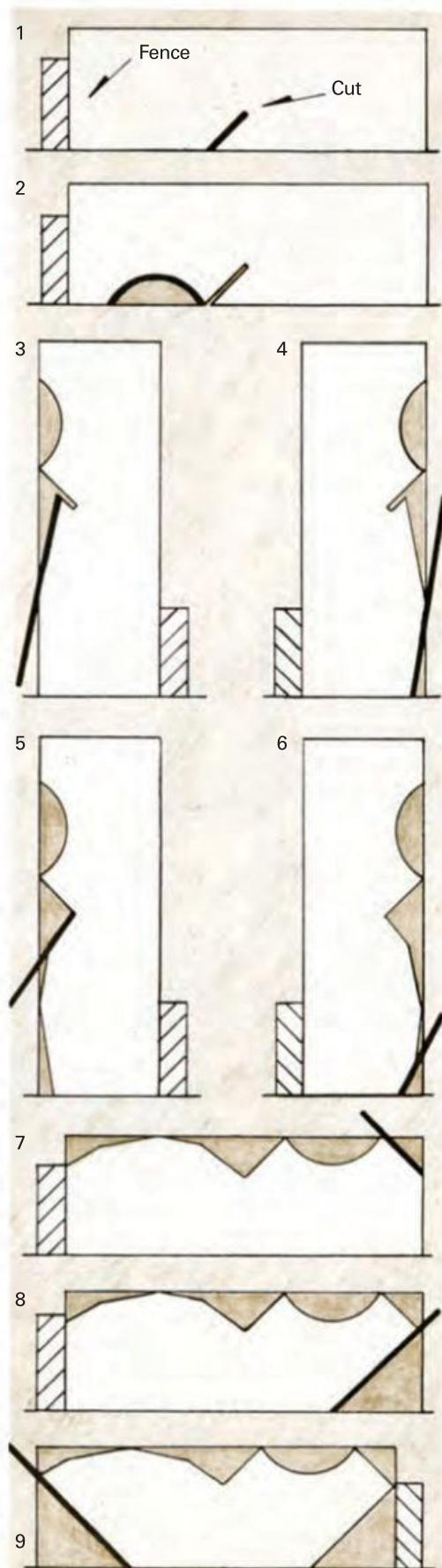


Figure 1: Sequence of cuts

Illustrations: Carol Hubbard



The Winooski Block (left) is capped by a cornice assembly over 6 ft. wide; it consists of 14 elements, including 7 moldings that were reproduced on a table saw. The milling of the molding is described on the facing page.

You need a template to mill new moldings. Use a piece of the original, or transfer readings from profile gauge to paper on site and cut a template later in the shop.

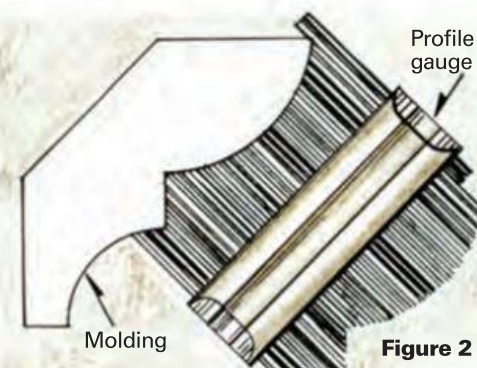


Figure 2

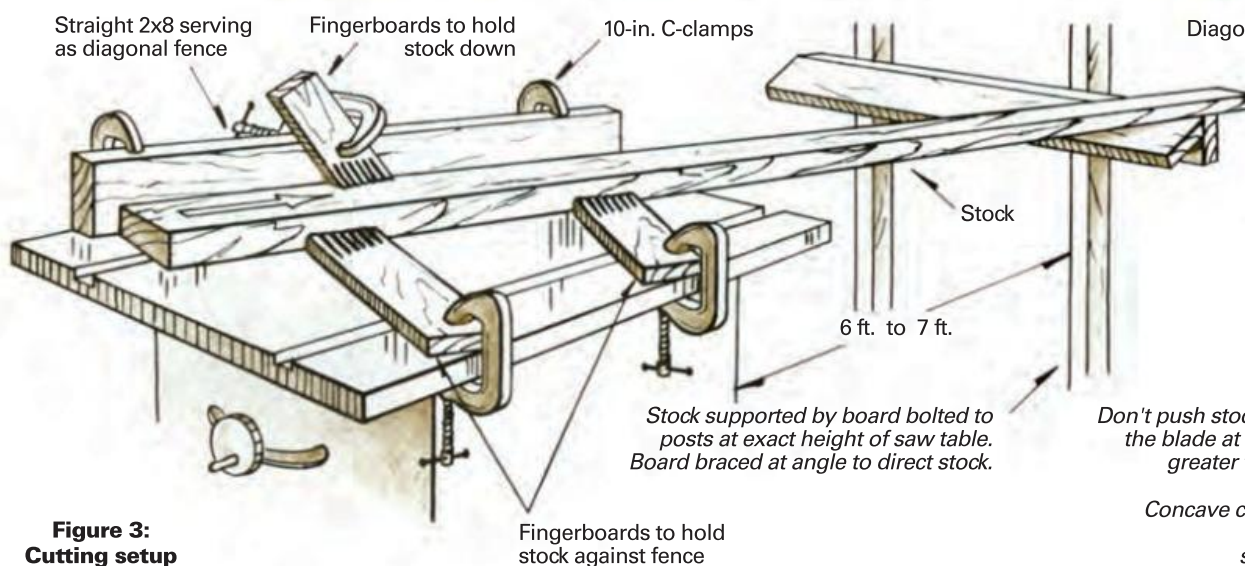
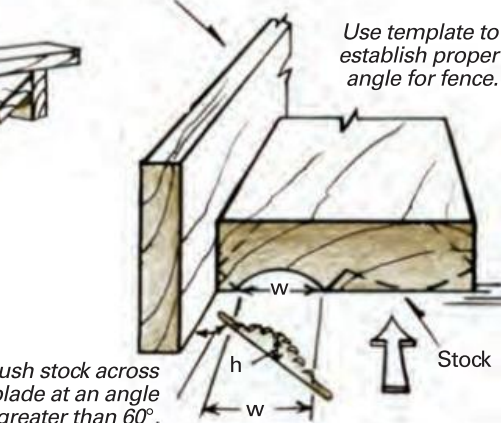


Figure 3:
Cutting setup

Cutting the concave curve



Concave curves may require several passes, starting with the blade set low. On the last cut, saw points should just touch curve outline.

ensures the stability and accuracy of preceding cuts. (Cuts 3 through 6 would have been almost impossible if cut 9 had preceded them.)

To save time, pass all molding stock through a given saw setting; be fastidious about such settings, making practice cuts on scrap work. Cut more molding stock than you'll need at each setting, so you'll always have waste stock with the necessary previous cuts. In other words, to get an accurate setting for cut 5, you'll need stock with cuts 1 through 4 already made.

Cutting—We used a 10-in. Rockwell Unisaw with a 48-point carbide-tipped blade for all molding cuts. For most cuts we used the rip fence provided by the manufacturer. For cut 2 however, we needed a diagonal fence, so we tried a 2x8, used a template to carefully set it at the proper angle for the desired cove, and clamped it to the table with 10-in. Jorgensen C-clamps (Figure 3). To reduce stock flutter we used fingerboards, pieces of wood with a series of parallel kerfs cut in one end. Two fingerboards clamped to the table held the stock against the fence, while one fingerboard clamped to the fence held the stock down. The kerfs allowed enough play to let the wood slide through, but maintained enough pressure to ensure a straight cut. Using fingerboards and extension tables, you could cut all the molding unassisted, but you may prefer to have a helper to pull the stock gently through the last few inches of a cut. Several times a day, wipe the tabletop and sawblade clean with turpentine, to minimize binding.

Except for cut 2, all cuts were made with the

rip fence running parallel to the blade on one side or the other. As shown in Figure 1, cuts 1 and 2 were made with the stock face down on the table, while cuts 7, 8 and 9 were made with it face up. The stock stood on edge for cuts 3 through 6. (When cutting some symmetrical convex shapes, you can leave the sawblade at the same angle, and after one pass, turn the stock 180° to get the cut whose angle mirrors the first.) Each cut was preceded by carefully adjusting blade height and angle against the template. The last cuts on a molding (cuts 8 and 9) should be slightly larger than 45°—if your sawblade will tilt just a little more—to avoid gaps where the building surfaces are not quite perpendicular.

We cut the concave shape (cut 2) into the molding by passing the stock diagonally across the table-saw blade. (See Figure 3, at right.) To set the blade and fence correctly, you'll need a piece of the old molding. (A template is less effective.) Holding the high point of the curve over the blade, slowly crank up the blade so that the tip of the highest tooth just grazes that curve's apex; lock the setting and try a few cuts. To create the width of the curve, angle the piece of molding until all the teeth of the exposed blade lightly touch the arc of the molding. Another person should snug the fence against the angled molding and then clamp the fence to the table while you hold the molding in place. You'll have to tinker a bit to get the exact angle you need.

You can create almost any symmetrical curve with this method. Pushing the stock across the blade at a wider angle will result in a wider curve. However, the widest angle at which we

would push wood across the blade is 60°; with wider angles, not enough of the sawteeth are gripping and the blade will bind. (I'm not sure why, but a 48-tooth carbide blade binds up less than an 82-tooth one. It may be that the chips clear more easily.) If the blade is binding, make several passes to get the curve, starting the blade low and cranking it up 1/4 in. for each pass. Don't get so wrapped up in your calculations that you become careless. Keep fingers clear of the blade. The speed at which you feed the stock must be determined on the job: Too fast and the blade will bind, too slowly and the wood will burn. The greater the angle of feed, the more often you should clean the blade.

The quality of the wood greatly affects the complexity of cuts you can make. Hardwoods are more difficult to mill without proper equipment. If concave curves are possible at all on hardwood, you'll have to make many gradually increasing cuts; the angle of the stock to the blade will be limited. Fortunately the grain in our cypress varied less than 1/4 in. in 15 ft.

To refine the shape of our convex curves, we used many tools, including jack planes, curved shavehooks and spokeshaves. Among power sanders, Rockwell's Speed-block was the favorite; we clamped the finished molding to benches and sanded it using 50-grit pads.

Using these techniques we milled 1,000 linear feet for each of nine molding types, some more complex than the one described above. □

At time of writing, Bruce Andrews was a partner of Moose Creek Restorations Ltd., in Burlington, Vt.

Rock-Solid Guard-Post Connections

Tested and approved
installation details to
help you build safer
deck railings

BY MIKE GUERTIN

As deck builders know, building codes went from saying nothing about decks twenty years ago to providing prescriptive solutions for almost every part of them in the 2021 International Residential Code (IRC). Builders who follow the IRC's guidance are likely building safer decks than they did before. Still, the code falls short on prescriptive details for one important component: guards.

Whether a guard system is site-built or manufactured, it relies on the underlying deck framing and, usually, 4x4 wood posts. The 2021 IRC requires that guards be designed to resist a concentrated 200 lb. load applied at any point along the top in both downward and outward directions (if a guard also serves as a handrail, say for deck stairs, it has to resist 200 lb. in

Continued on p. 70

BRACKETED CONNECTIONS

Proprietary hardware made by Simpson Strong-Tie, MiTek, and Screw Products, Inc. are used to reinforce the guard post to the deck framing along the rim joist and end joists. The manufacturers have installation guides that are important to follow to ensure sound post reinforcement. The connection designs shown here are applicable for 36-in. guards on residential decks. Check the hardware manufacturer's literature for use with taller guards.

Simpson Strong-Tie

DTT2Z Includes structural screws for installation. Installers must provide own 1/2-in. hex-head bolt or threaded rod.



Screw Products, Inc.

Decklok Lateral Anchor Installers must provide own 1/2-in. hex-head bolts.

MiTek DTB-TZ Includes structural screws for installation. Installers must provide own 1/2-in. hex-head bolt or threaded rod.

Simpson Strong-Tie HD3BHDG

Installers must provide own 5/8-in. machine bolts and 5/8-in. hex-head bolt or threaded rod.

SCREW AND BLOCK CONNECTIONS

FastenMaster and Simpson Strong-Tie have installation guides for framing arrangements to reinforce guard posts located inside of deck frames using their proprietary screws and blocking. The model and length of the screws, positions through the framing and blocking, and size and location of the blocking is unique to each company and is not interchangeable with other brands of screws. Each company has three basic configurations that work for posts along a rim board, along end joists, and for outside corners. You may already be blocking around your guard posts for reinforcement and to support decking, so following one of these manufacturers' designs probably won't be much of a change.



FastenMaster ThruLok

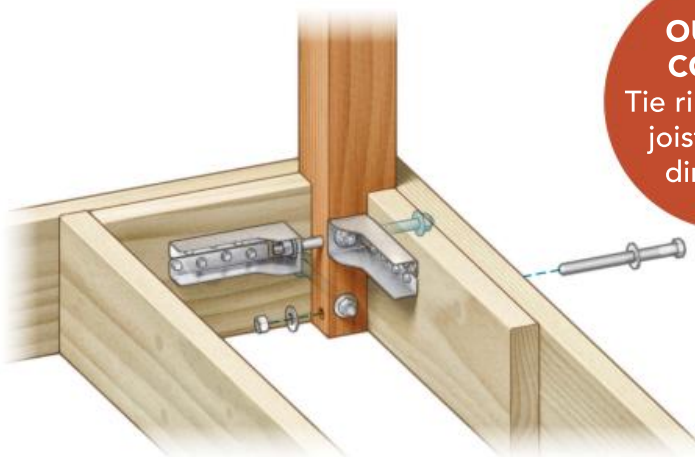
Simpson Strong-Tie Strong-Drive SDWS Timber Screw

POSTS **INSIDE** OF DECK FRAMING

Mounting posts inside of framing gives you the most options in terms of fastening. Bolts and tension ties were my go-tos for a long time, but Simpson Strong-Tie now makes screws—the Strong-Drive SDWS Timber Screw (see p. 67)—that’s approved for guard-post connections inside of framing. According to Simpson, its installation details meet the 600-lb. ultimate load requirements that are now the standard for manufactured guards with wood components. FastenMaster’s Thrulok screw-bolts are another option, though check their installation guides for details; they differ from what’s illustrated here.

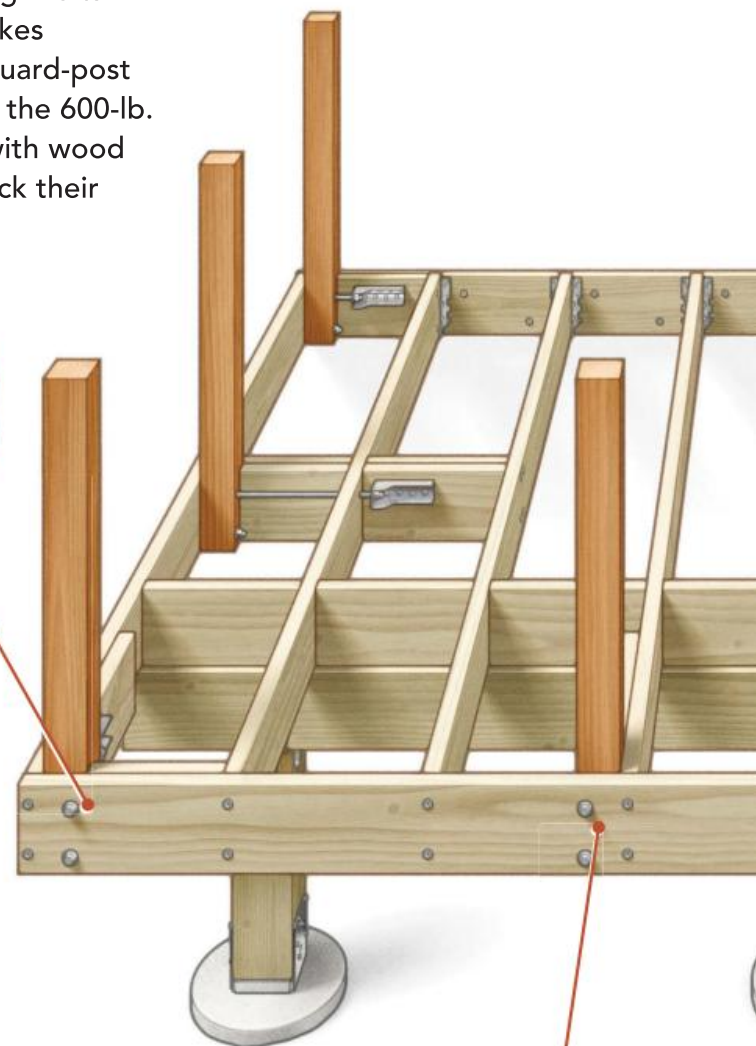
TENSION TIES

2x blocking along the rim and end joist reinforces the post and moves the connectors and bolts back from the joist ends so they don’t split.



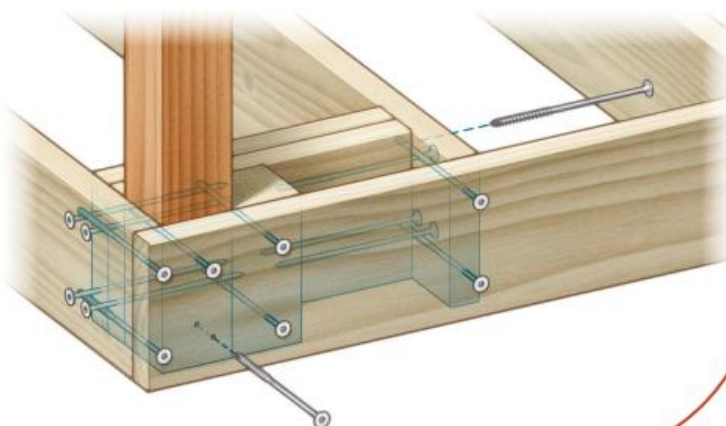
OUTSIDE CORNER

Tie rim and end joists in two directions

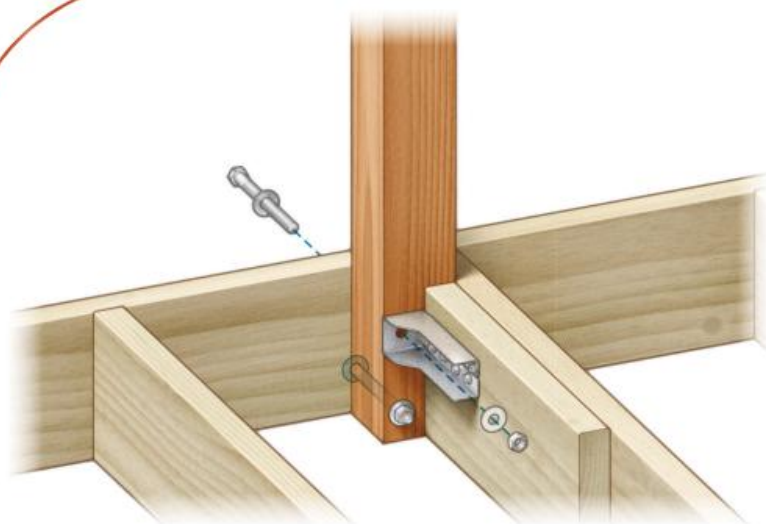


SCREWS

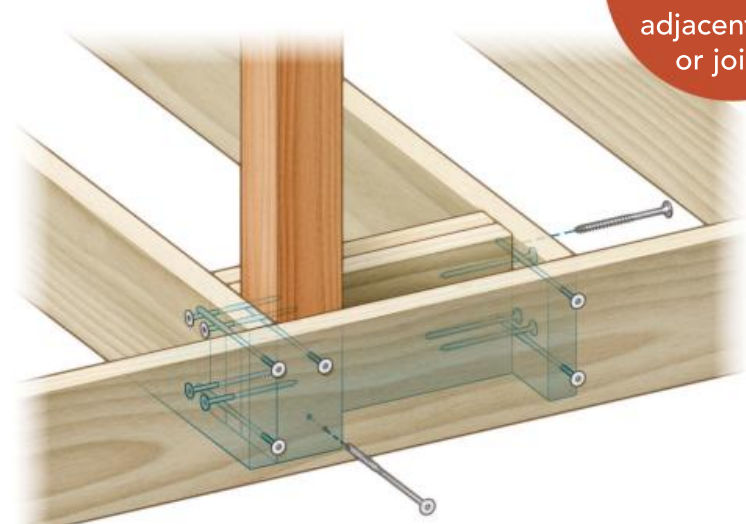
Double 2x blocking and a 4x block bolster the connection between the rim and end joists.



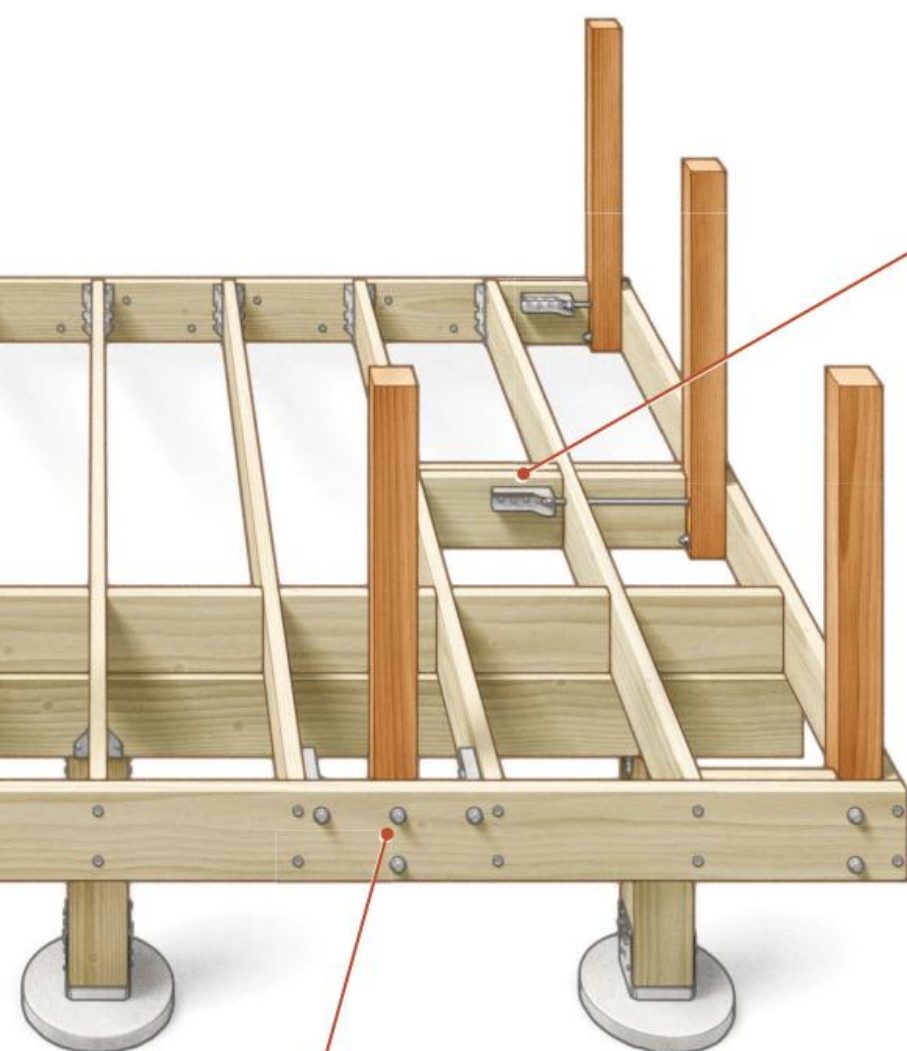
RIM, BESIDE JOISTS Tie the rim to the adjacent joist or joists



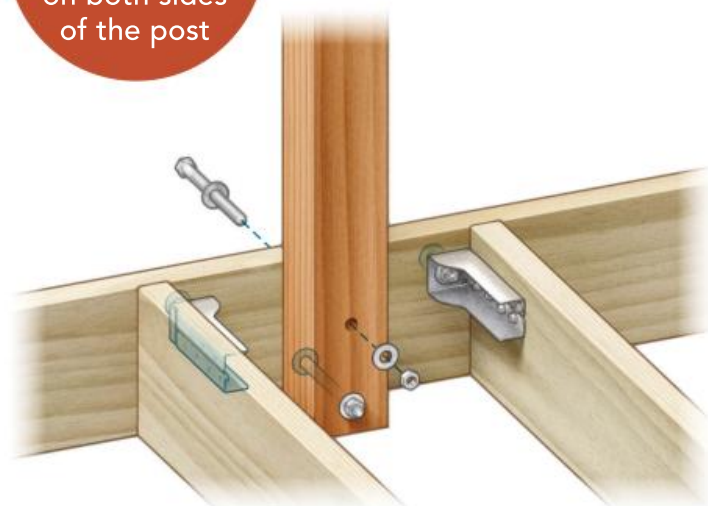
TENSION TIES Block behind the post to the adjacent joist, and secure the upper bolt to the blocking with a tension tie.



SCREWS Double 2x blocking ties the joist to its neighbor, sandwiches the post to the rim, and provides face-grain screwing for optimal hold.

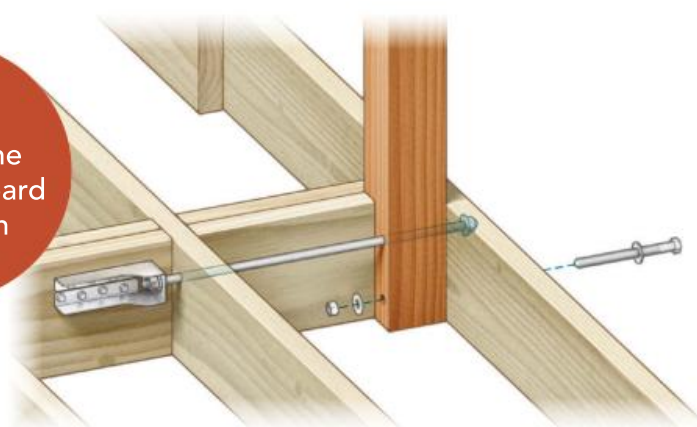


**RIM,
BETWEEN
JOISTS** Tie the
rim to the joists
on both sides
of the post

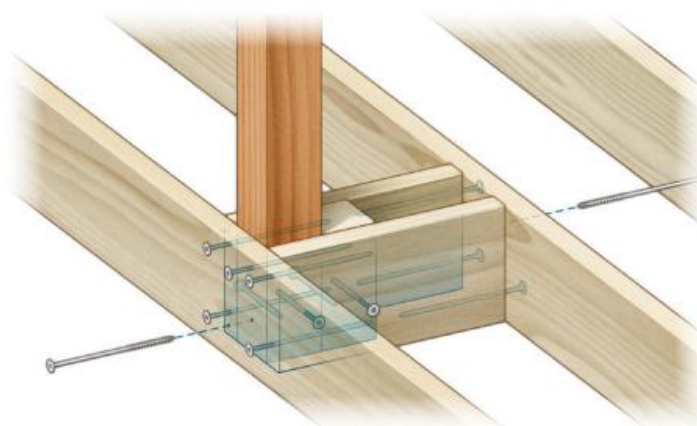


TENSION TIES Tension ties on the joists adjacent to the post prevent the rim from being levered off the joists.

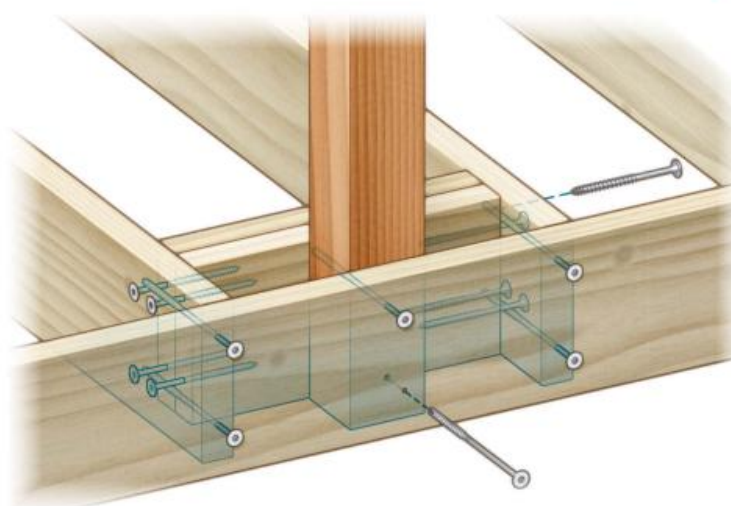
**END
JOIST**
Transfer the
load to inboard
joists with
blocking



TENSION TIES Using two sets of double-2x blocking to tie back to the second inboard joist bay allows use of a single tension tie for a solid connection.



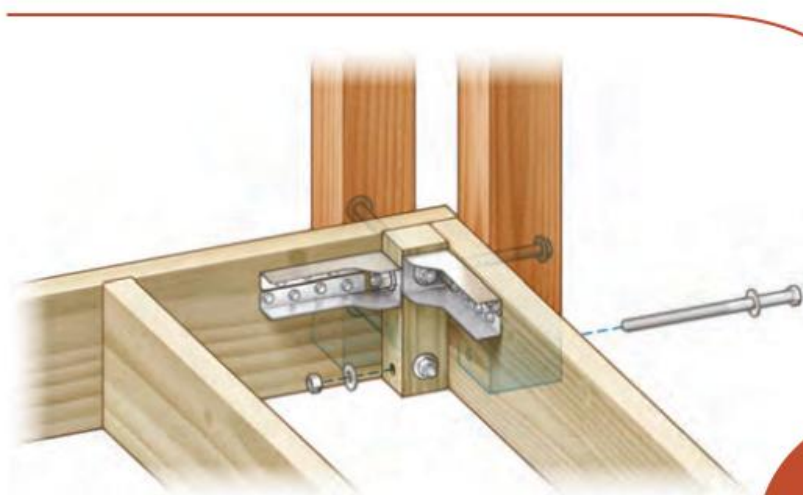
SCREWS A combination of 2x and 4x blocking ties the end joist to the first inboard joist and braces the post.



SCREWS Double 2x blocking ties the joist to its neighbor, sandwiches the post to the rim, and provides face-grain screwing for optimal hold.

POSTS **OUTSIDE** OF DECK FRAMING

While it's often easier to mount posts outside of the deck framing, going this route can limit your fastener and hardware choices. Simpson Strong-Tie doesn't have details for using its Timber Screws for these connections, so tension ties are my go-to for solid outside-the-rim attachment. That's not to say it can't be done with screws, but you'd have to have an engineer design a solution.

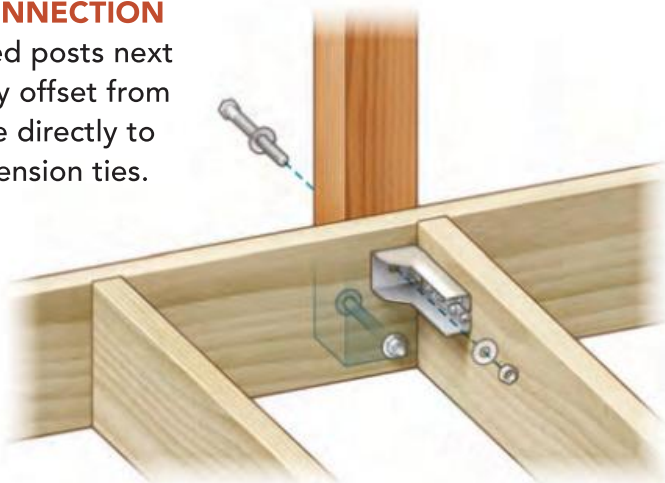


BLOCKING INTERFERENCE A square rip of 2x allows the tension ties to be installed closer together up high to resist outward thrust.

OUTSIDE CORNER
Tie rim and end joists on two axes

DIRECT CONNECTION

Rim-mounted posts next to or slightly offset from joists can tie directly to them with tension ties.



RIM, BESIDE JOISTS Tie the rim to the adjacent joist

Continued from p. 66

any direction). Manufactured guards must be tested for code approval, and that testing includes safety factors of up to three times the 200 lb. required by code. Rarely does anyone test site-built guards to make sure they're in compliance, but the new code provides some requirements and restrictions we can use to guide their construction.

The IRC now requires that guards have a continuous load path to the deck joists; they can't connect to the rim joist alone. Where guards are connected to joists at the ends of a deck, the joists must be connected to inboard

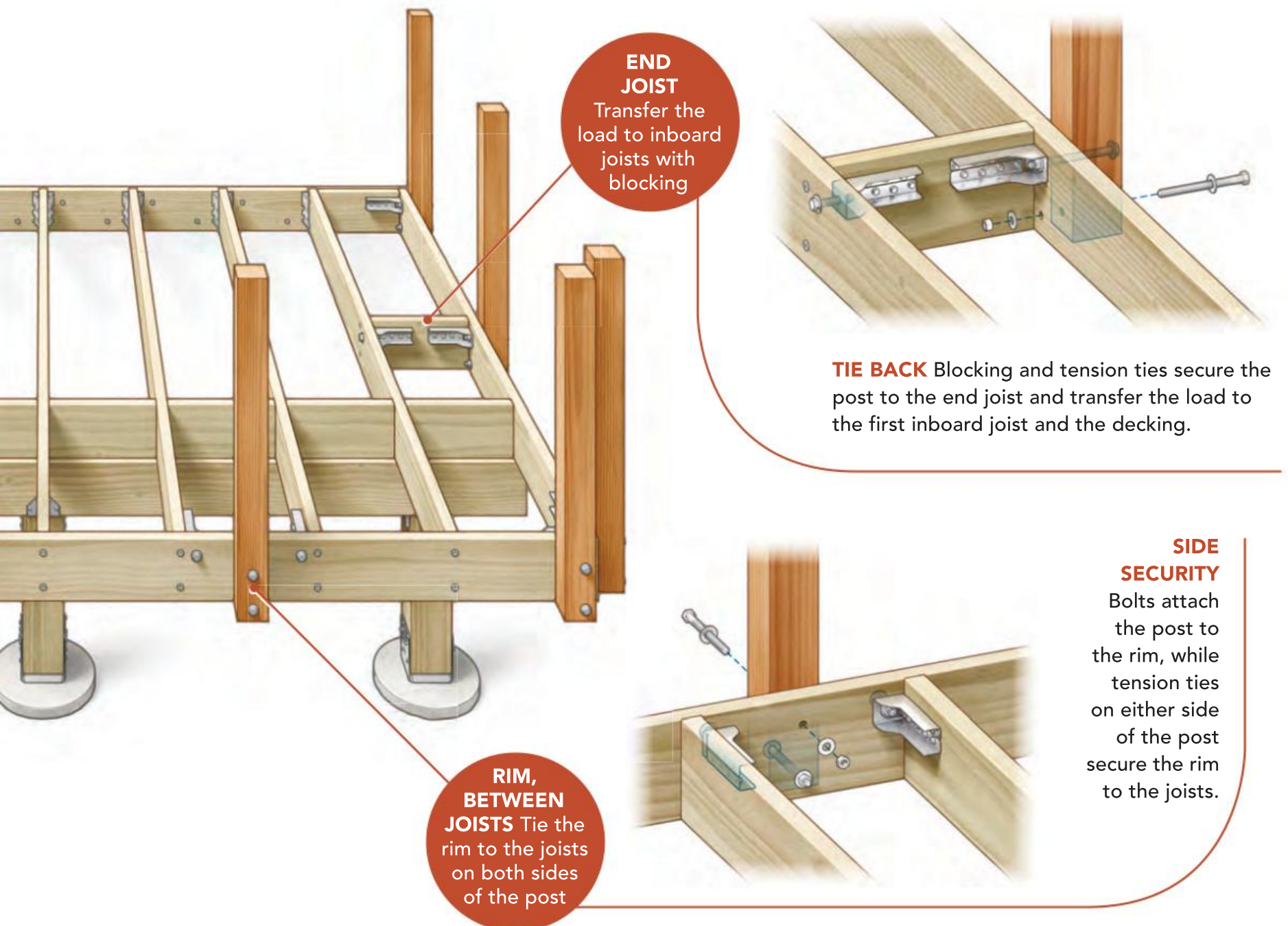
joists to help resist rotation. This is usually done with blocking, but the blocking connections can't relay solely on fasteners driven into end grain.

Testing done at Virginia Tech in the early 2000s showed that the common ways builders were fastening guard posts to deck frames couldn't meet the code-required load plus a two-and-a-half-times safety factor (the standard for some manufactured guard systems). It's easy to understand why these old-school connections—many relying on fasteners into end grain—failed. Guard posts

are essentially levers. A 200-lb. load applied horizontally at the top of a post translates to roughly 1400 lb. at the bottom of the shortest guard height allowed by code (36 in.). That leverage can easily pry the rim off the joists. This, not the connection between the guard post and framing, tends to be the weak point. But it's easy to reinforce.

The examiners at Virginia Tech found that when using metal hardware that transfers the load from the posts to the deck joists, the posts and deck frame can handle the load—two-and-a-half-times

CONNECTION DETAILS What's shown here are the basics, but you can extrapolate these connections to fit almost any scenario—from 45° outside corners to double- and single-post inside corners, and just about every other situation where posts get attached to deck frames.



safety factor included—without deflecting beyond the code limit. From the original few post-to-frame connection details developed at Virginia Tech, numerous combinations have arisen using the same principle: Reinforce the deck framing and the post at the connection.

This article illustrates 12 different post-to-frame arrangements. The details vary depending on whether the posts are installed inside or outside of the rim board and end joists. Most have been tested either by Virginia Tech or by hardware manufactur-

ers, but their designs don't address every possible scenario where you need a guard post. I have, on occasion, extrapolated a few post-to-frame attachments, and done my own unofficial testing to gauge their strength. You may also encounter unique post locations that don't have a tested reinforcement design. You should be able to extrapolate a connection design from the ones shown here, or you can ask an engineer to design one.

Reinforcing guard posts to the deck frame using metal hardware or extra screws and blocking may seem like overkill, especially if

your current post-connection practices seem rock solid. But unlike framing connections inside a house, deck-framing materials are subject to pronounced swings in moisture content that lead to swelling and shrinking, freeze/thaw cycles, and fastener corrosion that can loosen up connections. Collapses aren't common occurrences, but if a guard does give way when people are leaning against it, they're likely going to fall. □

Mike Guertin is editorial advisor.
Drawings by Christopher Mills.

HOUSES

ARCHITECTURAL CHALLENGES AND SOLUTIONS

BY DESIGN

CURATED BY KILEY JACQUES





HISTORIC HOUSE, CONTEMPORARY FLOOR PLAN

This Shaker house is located in a historic district of Harvard, Mass. The new owners relished its architectural features but disliked the peculiar floor plan. The kitchen faced the driveway to the north, making it a dark space. Given the bucolic fields and natural light to the south, the orientation made little sense. The dining area felt more like a hallway and could seat only four—an unfortunate arrangement for entertaining.

The biggest move was to bring a portion of the screened porch into the conditioned space. In the kitchen, avoiding the need for posts and soffits was key to creating a clean, open plane. “We didn’t want it to feel like a room that used to be cut up—with all the memories of it in the ceiling,” says architect Katie Hutchison, noting that the solution required complex steel-beam resolutions and shear reinforcement.

The house’s location in a historic neighborhood meant exterior changes needed to be imperceptible, which is why the archway openings were infilled with dark-colored custom doors meant to read like the original screens. In the same vein, although the sill heights were changed when replacing failing casement windows behind the new built-in banquette seating in the kitchen, the grouping and general design concept were kept intact to satisfy the Historical Society. The whole project is characterized by major changes made to look modest.

Designer Katie Hutchison Studio, katiehutchison.com
Builder Brown Construction Building & Remodeling, Inc.
Location Harvard, Mass.
Photos Katie Hutchison, courtesy of Katie Hutchison Studio



PIVOT-POINT SOLUTION

The form of this house is a response to the environmental conditions, which included required buffers from nearby wetlands, a natural stream, and an existing well. Building on the already disturbed site of an existing mobile home reduced additional impact on the site, while leaving a portion of the seven acres relatively untouched.

The “bend” at the center of the house is a direct result of these restrictions. This pivot point created a few advantageous design opportunities—the biggest of which was keeping the scale in check. The bulk of the building’s length visually disappears when viewed from the majority of exterior angles. The one-story eastern side of the house has a modest profile, and is broken up with two lower “sheds” sided in clear-finished cedar. Seen broadside from farther away, the western side of the house is appropriately stately. The orientation allows the high window in the south gable to bring light deep into the kitchen.

Sustainability measures included advanced framing methods to minimize wood and maximize insulation. The framing is stacked to create a direct load path from roof to foundation. In the center section, the framing pivots around the main entry and stair connecting all three floors.

As the homeowners intend to age in place, the linear main-floor plan keeps all essential elements on one level. From the entry, the space opens out and down, following the topography. The distant view is framed by two mature cedar trees—another decision made to tie the home to its site.

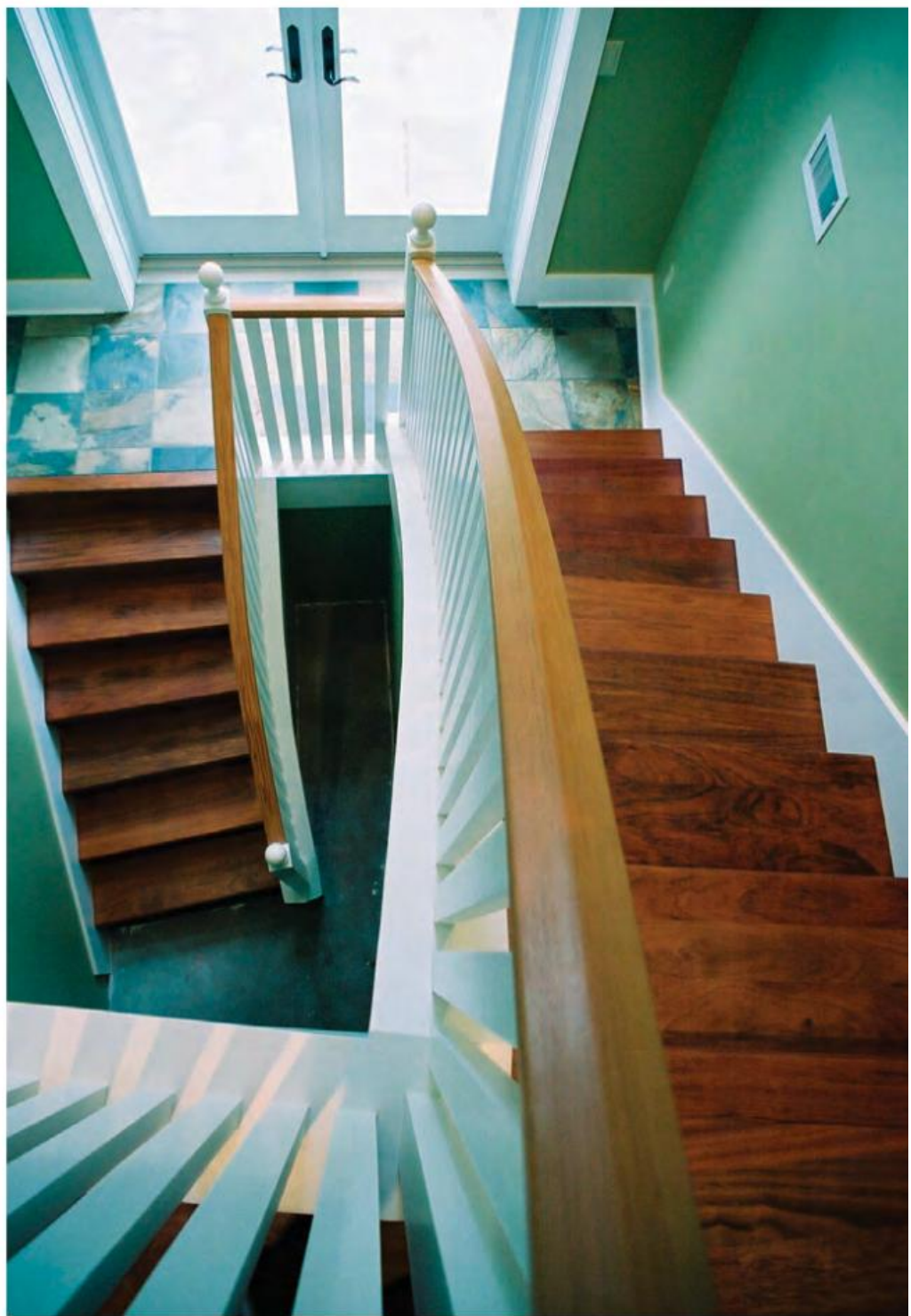
Designer Harrison Architects, harrisonarchitects.com

Builder Phoenix Construction,
myphoenixconstructioninc.com

Location Woodinville, Wash.

Photos Rob Harrison, courtesy of Harrison Architects





/// I took a 'Design with Nature' approach to the site. By layering the various constraints, you end up focusing in on the area that makes the most sense to build on. ///

—Rob Harrison, Harrison Architects

2020 Fine Homebuilding House

GREENWICH, CONNECTICUT

FineHomebuilding
HOUSE
ELEVATING THE STANDARD OF BUILDING

*Noise Reducing
Insulation*

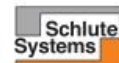


Interior insulation details

The team at the **2020 Fine Homebuilding House** has finished installing a continuous layer of Rockwool Comfortboard 80 rigid mineral wool insulation on the full exterior of the house, and has now moved to the interior of the build. Except for a few places where there was not enough space to build double-stud walls, Rockwool Comfortbatt insulation is being used in all of the exterior-wall cavities, while Rockwool Safe'n'Sound batts provide acoustic insulation between floors and around bedrooms and bathrooms.

Follow the build: @finehomebuilding and [FineHomebuilding.com/fhb-house](https://www.finehomebuilding.com/fhb-house)

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SPEC

NEW AND NOTABLE PRODUCTS



SMART LOCK IN A SMALL PACKAGE

Most smart locks include a bulky box that mounts on your door, but Level hides all of the technology inside for a clean look. The Level Bolt simply replaces the internal parts of your deadbolt, so you can keep the look of your original door hardware while adding the ability to use voice control or a mobile app in addition to your old keys. The Level Touch is a complete lock that works just like the Bolt, but also opens with a simple touch or key card. One of the most user-friendly features is the easy-access battery that hides under a cap on the end of the deadbolt itself. Level locks work with Android and Apple devices, and cost between \$230 and \$400, depending on model and accessories. —Jennifer Morris, editorial assistant



HIGH-QUALITY DECK LIGHTING

One thing that I think is often overlooked on deck projects is low-voltage LED lighting. There's an abundance of options out there, but I try to stick with brands that will stand the test of time. I've been let down so many times by premature failures of outdoor LED systems that I was determined to find at least one brand that I could stand behind after installation. For me, that's In-lite.

I like to use the In-lite Fusion 22 fixture for seating areas and the HYVE 22 for stair risers. They're easy to install, come with a five-year warranty, and retail for around \$40 to \$45 each. I've enjoyed using these lights so much that I worked with the company to create a limited edition Dr. Decks Dark light, featuring a black bezel that makes the lights less conspicuous than the standard stainless-steel versions.

In-lite also carries a multitude of lighting options for landscaping and other outdoor features. Visit their website or my Dr. Decks Instagram page and YouTube channel for inspiration. —Jason Russell, custom deck builder



SHOCKPROOF USB OUTLET

Legrand has taken two types of common receptacles and combined them into one stylish package. Part of Legrand's popular Radiant Collection, these new outlets provide the safety of ground-fault protection in wet locations like kitchens and bathrooms without giving up the convenience of built-in charging ports for your mobile devices. Receptacles are available with two USB-A ports, two USB-C ports, or one of each, all in either 15-amp or 20-amp versions. Plus, there are several unique finishes available to help you coordinate your outlets with the style of any room. Prices range from \$55 to \$65 depending on outlet type and finish. —Rob Wotzak, digital brand manager



MAKE DECK FRAMING LAST

I have been in the framing and deck-building business for about 20 years. In that time I have torn off many old decks here in Utah, and the number one problem I see is rotting joists and ledgers. The rot almost always comes from the top, where the water penetrates through the fastener holes and rots out the framing from the top down. I believe that the longevity and durability of the joist needs to come from some sort of water diversion above. In my experience, the best product for this is G-tape acrylic flashing tape. The cost and ease of use is far superior to any other product that I've found for the job. I won't build a deck without it.

G-tape comes in 2-in., 4-in., 6-in., 9-in., and 12-in. widths, making it perfect for everything from capping single deck joists to wrapping the tops of built-up beams. The tape easily tears by hand, its acrylic adhesive allows it to be repositioned after placing it down, and it stays workable over a wide temperature range, making it much more convenient to work with than many alternative types of flashing tape. —Levi Tippetts, home builder



EASY HIDDEN FASTENERS

FastenMaster's Cortex line of screws and plugs has been a go-to solution for installing Azek, Trex, and Wolf composite and PVC decking and trim for years. You just use the included bits to countersink and install the screws, and then you tap the matching plugs into the holes flush with the surface of the boards, completely hiding each fastener. It can be a bit fussy to handle the tiny Cortex plugs and get them lined up just right, which is why FastenMaster introduced a collated option to several versions of the plugs—the most recent made to match all colors of Trex Select decking. The plastic collating strips are not just time savers, they also make it easier to hold each plug to align its "grain" with the matching pattern in a board before driving it home. Packs come in two sizes for installing either 100 linear feet or 300 sq. ft. of decking. —R.W.

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Stairs to a pitched landing

I'm having trouble figuring out how to design and build an 8-ft.-wide set of stairs from a new deck down to an existing concrete slab. The deck is level, but the concrete slab isn't. The height from slab to top of deck at the left end is $35\frac{3}{4}$ in. and at the right end the height is $37\frac{1}{4}$ in., for a total difference of $1\frac{1}{2}$ in. How can I account for the height difference and make the stairs safe and comfortable to use?

—GEORGE MATHIAS
via email

Editorial advisor Mike Guertin replies: I can think of three approaches, and none is perfect. Each is a trade-off between following the code, appearance, and complexity of layout and labor.

The simplest and most code-compliant solution is to build a one-step-high, 8-ft.-long landing on top of the concrete slab that will extend at least 3 ft. beyond the bottom riser of the stairs to the deck. Frame the landing level, with one side taller than the other to account for the out-of-level slab. Then you can cut a conventional set of stairs between the landing and the deck with even riser heights. I'd make the landing 6 in. high at one end and $7\frac{1}{2}$ in. at the other. That leaves $29\frac{3}{4}$ in. total rise from the landing to the top of the deck, which translates into three treads and four risers at $7\frac{7}{16}$ in.

The landing breaks the cadence of stair-walking. Once users step onto the landing from the stair, they will have to take a second step before stepping from the landing to the concrete slab. Though the rise from the concrete slab to the top of the landing is



Level the landing with 2x blocks, including midspan support if required by span.

different along its length, at the point where a person steps up onto the landing or off of it, they will visually navigate it as a single step and won't experience the unevenness.

Another approach is to figure out your stairs based on the average, or middle, height of the deck, which would be $36\frac{1}{2}$ in. Lay out and cut one stringer for even risers of $7\frac{5}{16}$ in. Use that as pattern to cut four additional stringers the same size and four additional stringers with $\frac{3}{4}$ in. of extra lumber at the bottom cut. Position each stringer, with taller ones to the taller-height end of the stairway and others to the shorter-height end. Scribe the bottom of each stringer to account for the out-of-level slab. This will result in the risers at the ends of the stairway being $\frac{3}{4}$ in. taller or $\frac{3}{4}$ in. shorter than the $7\frac{1}{4}$ -in. rise the other steps have. The middle third of the bottom step will be within the maximum $\frac{3}{8}$ -in. deviation allowed for riser heights, but the ends will not be code-compliant, so check with your local code official before using this approach.

The final solution is to cut each stringer with its rise calculated for its particular position along the width of the stair. It's more work, but it may look better and be safest. It's unusual, but there's nothing in the code that requires that the risers be equal at each point along a tread from left to right. Lay out and cut one stringer for five rises at $7\frac{7}{16}$ in. for the tall-height end of the stairway. Lay out and cut another stringer for five rises at $7\frac{1}{8}+$ in. for the shorter end of the stairway. Find the locations of the intermediate stringers, measure the slab-to-deck height at each, and calculate the riser height for that stringer—it will be different from the others.

This is an unconventional approach to designing a stairway, but the risers will be equal at any point along the width of the stairs, which is the intent of the building code. But run this approach by the local building official before attempting it to make sure it's acceptable.

Though it may be more work—especially if the slab or patio the stairs land on is large—there's always the option of removing

SECOND LANDING

When an existing landing is out of level and can't be fixed, building a level landing on top of it can offer a code-compliant path to building safe deck stairs.

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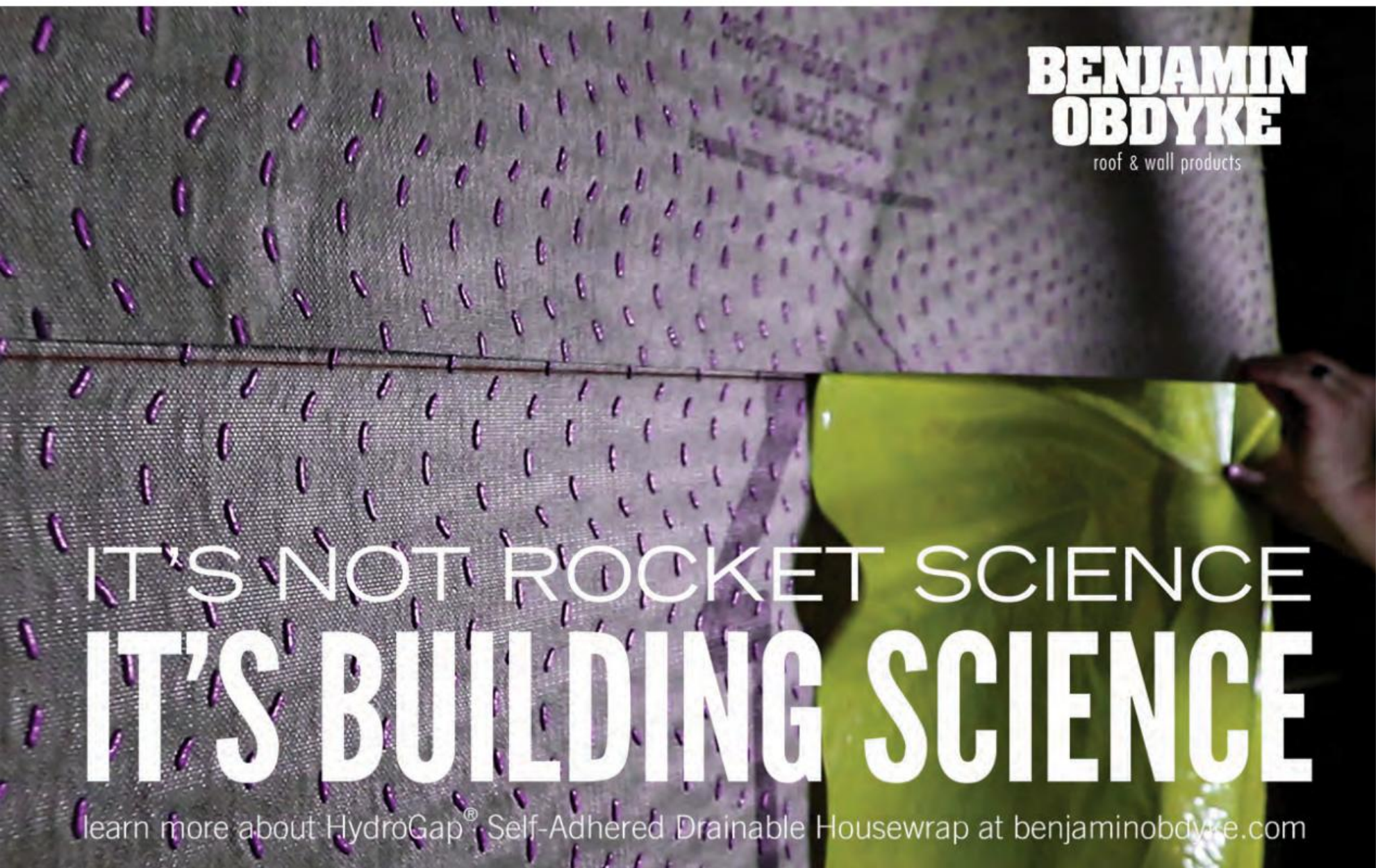
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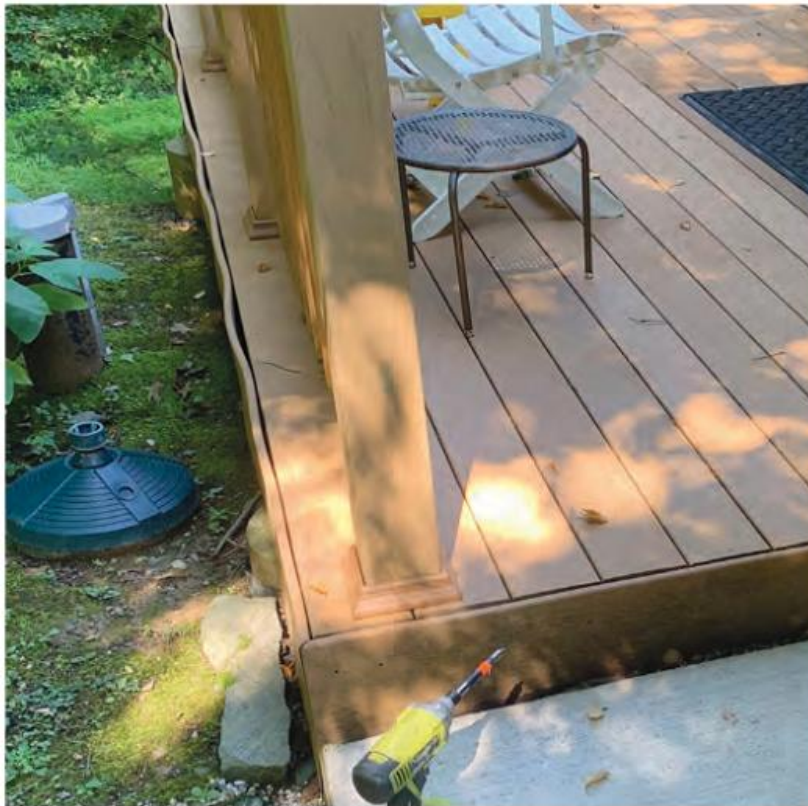
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GET OUT OF MY FASCIA

Composite fascia boards are susceptible to oil canning, meaning they become wavy and push away from the framing on hot days if not properly fastened. If the decking doesn't overhang the fascia, debris can fall behind the oil-canned fascia and make the condition permanent.



and repouring the slab, or capping it with an additional layer of concrete or pavers to make it level.

Oil-canning deck fascia

I've seen composite fascia boards set flush to the top of the deck boards several times. At least twice, that fascia had become wavy and pushed away from the framing. This seems like it's more a fault of the construction method than the material. I live in the Hudson Valley of New York, where we have an abundance of falling plant matter from spring through fall. I think this debris works its way between the fascia and framing and gets saturated with water, making for a nearly constant amount of moisture between the fascia and the framing member. Either that moisture alone or a couple of freeze/thaw cycles creates this wavy effect. Am I just seeing a lowball application by substandard contractors, or is this actually a recommended method of installation?

—MARK
via email

Bruce Verblaaauw, of NJ Decks and Railings by C. Verblaaauw & Sons, LLC, replies: What you have seen and diagnosed correctly

is what the industry calls "oil canning." As a contractor who builds only decks, I would never allow my crews to install the fascia like this. I see it done a lot by others, though. It is a quick way to hide the ends of composite decking boards, but it comes at the expense of the customer. At least one manufacturer, Trex, now excludes warranty claims on their fascia when it's been installed flush with the top of the decking.

My crews install a border of decking that runs perpendicular to the main deck boards. This hides the ends of the boards and overhangs the fascia by $\frac{3}{4}$ in. all around the deck to keep water and debris from getting behind the fascia board. It takes a little more time, and we have to install blocking between the joists at the sides of the deck to support the border, but that work pays dividends in looks and longevity.

Oil canning can still happen due to expansion and contraction from temperature changes if you are not careful. We install fascia boards with three screws spaced every 12 in. to avoid this problem. Several companies (FasterMaster, Starborn Industries, and TimberTech, among others) offer special fascia screws that come with a countersinking bit. These bits drill a hole in the fascia that's larger than the screw. The screws

keep the fascia flat while allowing for expansion and contraction along its length.

Flashing a deck the hard way

The family that built our home and deck didn't use any flashing between the deck ledger and the house. I've confirmed there is no major damage, but I want to add the correct flashing to make things right. How can I go about doing this?

—AARON GRAMES
via email

Remodeling contractor Andy Engel replies: It would have been so much easier if they'd done it right the first time! In any event, you'll need to remove a course or two of decking at the house, and a course or two of siding above the deck. If there's siding below the deck, you'll need to remove a course there as well. This will allow access to slip the new deck flashing under the house's weather-resistive barrier (WRB). You'll have to cut the WRB just above the ledger. Fold up the WRB to expose about 1 ft. of the sheathing above. Tape the WRB to the siding above to keep it out of the way.

If you have access below the deck, the next step is to build a temporary support beam to take the load off the ledger. This is potentially dangerous, so if you aren't completely certain how to do it safely, hire a pro. Be sure to lag-bolt framing lumber between the bases of the outer posts and the joists near this temporary beam to help prevent the deck from pulling away from the house. Block off all unnecessary access to the deck from above.

If your deck is too close to the ground to get under, you'll have to remove several feet of decking near the house to have access to support the joists from below. You'll probably have to block under each one with scraps of lumber.

With the safety issues in hand, back out the existing lag bolts or structural screws from about 10 ft. of ledger at a time. You might also need to pull the joist-hanger nails if they're long enough to protrude through the ledger. If you do this, replace them with $1\frac{1}{2}$ -in. structural screws as you

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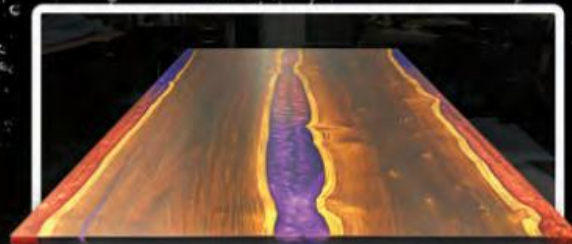
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go—both Simpson Strong-Tie and MiTek make them for joist hangers.

With a section of the ledger detached from the house, slide metal or PVC flashing behind it. The flashing needs to be on top of the WRB below the ledger, lapping it by 2 in. or so. Above the ledger, the flashing should extend at least 3 in. up behind the WRB, and more is better.

Using new lag bolts or structural screws in new holes and spaced according to the table in the DCA 6 guide or the International Residential Code, reattach that section of ledger. Move over to the next 10-ft. section, leaving the adjoining ledger loose enough to be able to lap the flashing you're about to install 6 in. laterally over the flashing you've just placed, and repeat the process.

Once the flashing behind the ledger is complete and the ledger is reattached to the house, move to the top and complete the flashing. Place a drip cap made from the same material as the flashing over the ledger, notching the down-leg at each joist. Run a band of 9-in. self-adhering membrane (I like 3M's All Weather Flashing Tape) so that it laps both the top of the drip cap and the top of the flashing. Fold the WRB back down over the new tape and flashing, and tape any side cuts you had to make in it. Reinstall the decking and siding and pop a cold one. You've earned it.

Getting patio bases right

I'm planning to build a flagstone patio this spring. I've been told the most important step is preparing the base correctly. Do you have any tips for doing that work?

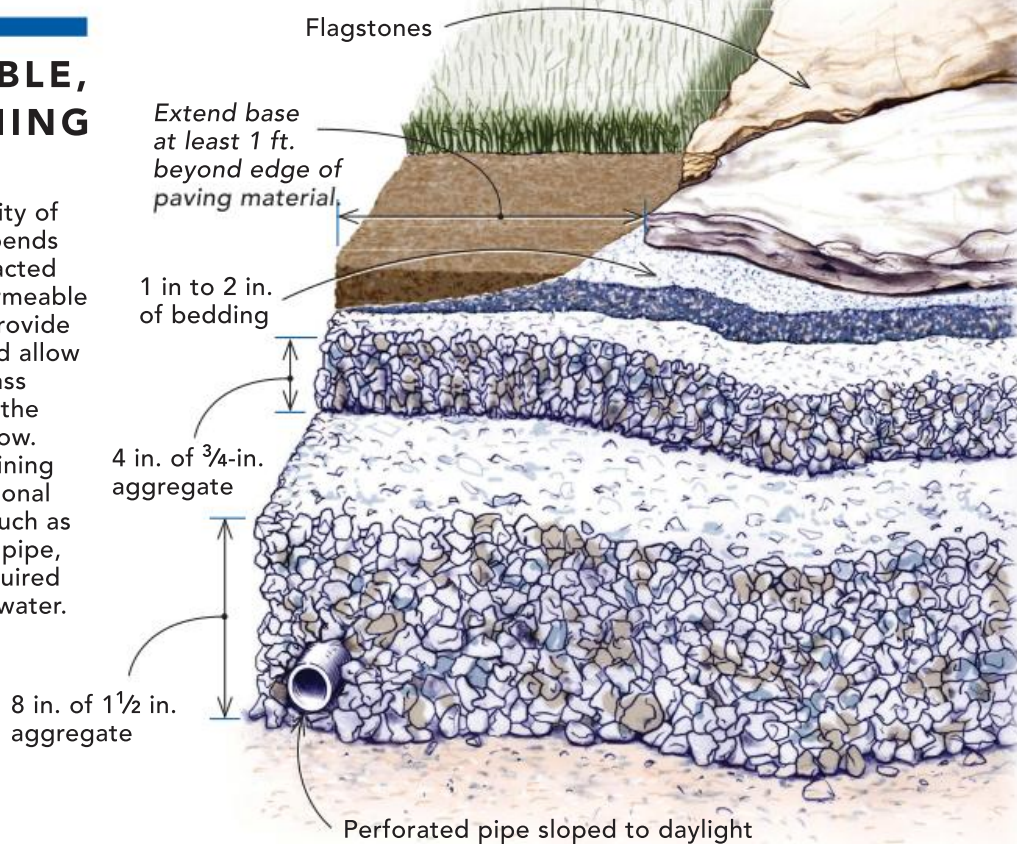
—ANITA
via email

Brian Post, a stoneworker and landscape architect from Chester, Vt., replies: The goal of a patio foundation is to provide a stable base that won't settle or heave. Settling occurs from poor compaction or erosion. Heaving is caused by freezing water and tree roots. Drainage and compaction are the keys to avoiding those things and ensuring a patio's (or a stone walk's) longevity.

Using clear (also called "clean") crushed stone for the lower layers is key to a solid

A STABLE, DRAINING BASE

The longevity of a patio depends on a compacted base of permeable gravel to provide stability and allow water to pass through to the ground below. In slow-draining soils, additional drainage, such as perforated pipe, may be required to remove water.



foundation. Avoid using rounded stone—crushed stone should be angular and jagged so the pieces lock together. Don't use a material with fines (this includes sure-pack, crusher run, plant mix, and quarry process). The fines prevent drainage.

Every layer of a patio's foundation needs to be thoroughly compacted. It's best to use a jumping-jack-style compactor because its action reaches about 9 in. deep. A plate compactor can also work, but you need to work in much thinner lifts of material, about 2 in. at a time. Compacting by hand or driving a loaded pickup or earth-moving machine back and forth also works, but again, only with shallower lifts. Compactors can be had at nearly any rental yard.

The first step is digging down to about 16 in. below finish grade. (This can be reduced in areas with hard soil and no ground frost.) Prepare the foundation at least 1 ft. beyond each patio edge and compact the subsoil thoroughly. In poorly draining soil (such as clay or fine silt) or if water concentrates at the patio site, such as from a roof or because of runoff, pitch the subgrade 1/4 in. per ft. to a perforated collector pipe that slopes to daylight. In erodible soil such as sand, loam, or silt, lay down a layer

of filter fabric to prevent soil eroding into the voids in the aggregate.

Begin filling the foundation with clean crushed aggregate. Compact in lifts sized to the ability of the compactor you are using. I like to use 1 1/2-in. aggregate for the first 8 in. or so, followed by 3/4-in. aggregate for the top 4 in. The smaller stone is easier to level by hand. Smooth and compact the top of the aggregate at 1 in. below the bottom of the thickest flagstone you're using.

The flagstone is set in 1 in. to 2 in. of bedding material, which also fills the joints between stones. For larger flagstone, 3/8-in. clean pea gravel or chip stone creates a great, free-draining bedding. For flagstone averaging under 1 1/2 sq. ft., though, using 3/8-in. bedding can allow some movement underfoot. This isn't a structural issue, but some people don't like it. An alternative is to bed smaller flagstones in 3/8-in. sure-pack, which is a mixture of 3/8-in. and smaller stones and fines. This will pack hard and let very little water through. If you're using sure-pack, place filter fabric under the bedding so the fines can't fall into and clog the coarser aggregate below. Smooth and compact the bedding and you're ready to begin laying flagstones.

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Rethinking the deck

In 2020, we began seeing things differently. Porches are no longer just decoration for our front doors—we use them. Our terraces that were formerly employed for weekend gatherings are now enjoyed most days the weather allows. And we no longer see decks as just a way to expand our home's interior; they are fast becoming as important as any other room in the house.

For three generations, most home builders thought of decks as part of a simple binary: the outside to a home's inside. Decks have historically been used as social places, but if we have learned anything from living, working, schooling, and socializing at home this past year, it's that we use every part of the place we live in multiple ways, and the evolution of our decks will be part of that. A year of looking at our homes differently has helped us discover that our decks can be used for more than just socializing outdoors. How do we change our decks to respond to our new focus?

The good and the bad

The benefits of decks are obvious. Decks are less expensive than the finished spaces inside a home, and quicker to build, plus they offer an expanded livable area in fair weather. The downsides are also clear to the thoughtful homeowner. Poorly designed decks are all around us and have been



tacked on to millions of homes over generations. These crude constructions are as ugly to look at from inside the house as they are ad hoc and awkward in the landscape they're intended to complement.

As our perception of our homes evolves, these traditional decks have less worth than they've had in the past. Hanley Wood's Cost vs. Value 2020 survey showed a decline in retained value in recent years. Simply extending the floor plane off interior rooms is no longer enough.

Plus, the standard, pressure-treated lumber used to create the average deck may be relatively cheap, but it cracks, splinters, and moves in ways that are brutal to touch, or even to walk on. When things pop and crack, it's not just ugly, it's dangerous. All the artificial materials of plastics and composite woods are, well, artificial. But the beauty, soft density, and



Deck with a view. This ipe wood deck follows the footprint of an existing terrace off the basement. The columns that support the deck extend to become the newel posts that suspend the cable barrier rails, which allow for full appreciation of a great view. The newel-post caps echo the home's gable roof.

wonderful stability of teak, ipe, or ironwood come at a price (and can burn feet in a southerly exposure). Thinking about cost, exposure, and use before throwing a deck onto a home maximizes the value of what is built.

Think of it this way

The average deck was never intended to offer up the functional versatility many of us have tried to wring from them during a year of forced confinement. We have spent endless 24-hour days in our homes, rather than just using them as nighttime respites or weekend retreats. It's likely that decks

will come to have the same level of thought put into their design and execution as the rest of a house in terms of how they are seen, touched, and experienced. Here are some considerations to address the possibilities:

What do you see from your deck?

If the view is a good one, railings of cable or glass can make the edge of the deck just a physical barrier rather than a visual one—and orienting stairs down in front of a view removes that barrier entirely. Conversely, if what is seen is either ugly or disrupts your privacy, solid walls or plantings can provide

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Where is the sun? A south-facing deck will bake people in the summer and be delightful in the winter. Overhangs need to shade when the sun is high and let light in when it is low. East and west also make mornings or sunsets delightful (east for the former, west for the latter). But the absence of light makes those orientations pretty dim when sun leaves them. And northerly exposure creates mold but offers shade, a gift in southerly homes.

Do you want to see your deck when you are inside your home? Having to constantly look at a deck you can't use in cold or inclement weather can be a real bummer. If you are creating a new deck, provide access and orientation to avoid direct visual integration to your home's interior. There are two essential ways to avoid the sad view of an unusable deck: First, orient its floor area away from windows by studying the floor plan of the home objectively. Second, where possible, drop the deck level to mitigate the deck's presence as seen from inside.

Steps are not just a way down; they open up space visually. As previously mentioned, if you can orient steps in front of doors and windows, there will be no railing system blocking your view. A landing outside the door with steps to a lower-level deck beyond opens up the view from inside. Plus, steep steps are scary and dangerous, and the classic 3-ft.-wide gangplanks that funnel people up and down single file actually inhibit connection to the yard. The typical deck that's even with or a step

"...we no longer see decks as just a way to expand our home's interior; they are fast becoming as important as any other room in the house."

down from the home's floor level elevates the deck above the outside world, but it doesn't provide a great transition to it; a lower-set deck has a better relationship to the landscape and better integrates the home with it.

What will you touch on your deck? Material—natural or painted, wood or steel, organic or institutional—can create a place that delights your eyes. If your deck is the extension of your home's interior, material choices matter. If you will rest your hand on a railing or wall top, it might justify the added cost of a denser, tighter, softer-to-the-touch material. This also applies to walking barefoot on the deck. If you sit directly on your deck, the decking itself may cry out for a material upgrade from pressure-treated wood, to avoid its warps, cracks, and screws. Denser woods, composites, or plastic products offer a smoother, flatter material that responds better to touch. All of the deck's surface materials can make it as visually rewarding as any space in your home, or as depressing as your attic or basement.

Where do you sit, and what do you do on your deck? If you are eating, how big is the table? If you only need a table for four,

it is easily moved. If there is a family table for eight, the table will block views and need a permanent, fixed area to allow it to be easily used. Where is the kitchen or barbecue? If you are working, where is the sun, the power, the shade? What you build at the sides and over your deck can control those things. Where you sit orients your eyes: the farther from a railing, the more the view is obscured. If a deck's railings can be less enclosing, and its steps can more effortlessly transition to the landscape, a deck can be part of your home's site, rather than something built over it.

- Let there be light (and power). Electricity can extend the usability of decks, adding nighttime lighting, allowing workday use, and even creating comfort in the cold (heaters) or the heat (fans). Deck design can adapt to how we use decks, but the location of electricity has become critical. Integrating outlets into deck railings, floors, or exterior walls of the home is easy if you think of it before you build—retrofitting conduit and boxes is just another average-deck disappointment for those who want their deck to be a visual extension of the fit and finish of their home.

- Make it fire friendly. Many of us have found great joy in leaving our screens at the end

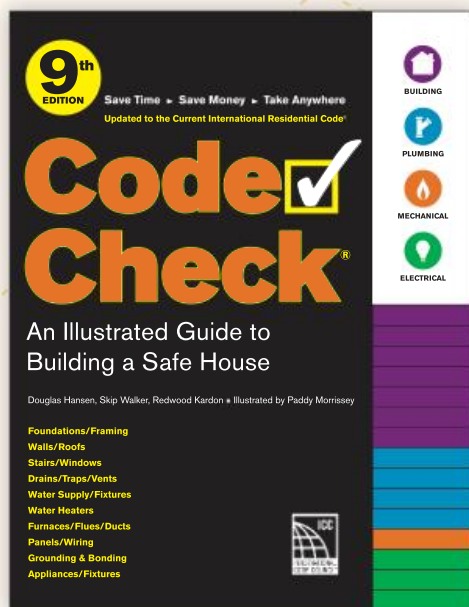
of the day and focusing on the simple beauty of a fire in a fire pit—in much the same way that we like watching the water from our homes. Wooden decks and open flame are clearly not a good combination, but UL-listed "fire features" are available that are safe (just make sure to hide the gas canister). Another option is to change levels down to a masonry terrace or patio below and set up your fire there.

- Cook with gas. Just as fire pits have become more popular, so too has cooking—everyone has probably cooked more in the last year than any other year in our memory. While barbecuing is nothing new, the capability to cook outdoors on a regular, even daily basis means that any number of gas appliances and outdoor kitchens can be a determination of how our decks are designed, and what we see from inside our homes.

The respite and connection to the outdoors a deck provides are more valuable than ever before, as the COVID-19 pandemic has more consciously forced millions to be part of their homes, both inside and outside. Unless designers think about the possibilities, users regret what was not offered. It is no longer enough to just "get out" on a deck.

Fads and trends mean that today's black trim may scream 2020 in a decade, but rethinking how we design and make decks is part of a wholesale evolution in how we use our homes. Either we learn from how we now see and use our homes, or we build future renovations into the homes we create today.

Duo Dickinson is an architect in Madison, Conn.



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keepcraftalive

CELEBRATING PASSION FOR BUILDING

Brad Stoppenhagen has always loved to build. From a young age he was driven to construct things; to take them apart and put them together again. He has attributes that can be ascribed to so many carpenters and builders: an engineer's inquisitiveness of the built world around him, and a desire to manifest his abilities into the creation of something of real value and of immense meaning to the people he works for.

Brad was always meant to be a builder, but it wouldn't be until later in life that he'd be doing the work he always loved in a professional capacity. Like so many other young adults who show an aptitude and interest in construction, Brad was told not to enter the trades—indirectly, by the cultural norms around him that associate success with a college degree and not a job site, and directly, by relatives who were builders themselves and discouraged him from the work.

But after more than 20 years in corporate America, he finally took the leap. For the past four years, Brad has been self-employed, focusing his energy and talent on small to mid-size remodeling work in and around Cincinnati.

"I've never been happier with what I do," says Brad, a statement he can make proudly as he finds himself at a fortunate crossroads with his business. He's busier than ever and cherishes the lifestyle self-employment as a tradesperson can afford. "I can work when I want to work, taking on the projects I want to take on."

That flexibility means the future is full of possibilities—to grow his business, or not. "Physically, I'm fine. I'm probably in the best shape I've been in since high school. But at my age, I know I have a limited time to do this work."

When it comes to deciding what to do next, Brad is considering building a co-op of craftsmen who also see themselves as stewards of the homes they work in. This time, nobody's standing in his way. —Rob Yagid, executive director, Keep Craft Alive

"Twenty-plus years in the corporate environment made me realize there are no sure bets. There really isn't the security that you think there is. I'd rather put fate in my hands and be responsible for where I go."

BRAD STOPPENHAGEN
REMODELER
CINCINNATI



Keep Craft Alive is our campaign celebrating those who have chosen to passionately pursue a career in design, building, and remodeling. Find out more and show your support by visiting KeepCraftAlive.org, and use #KeepCraftAlive to share your passion for the cause.

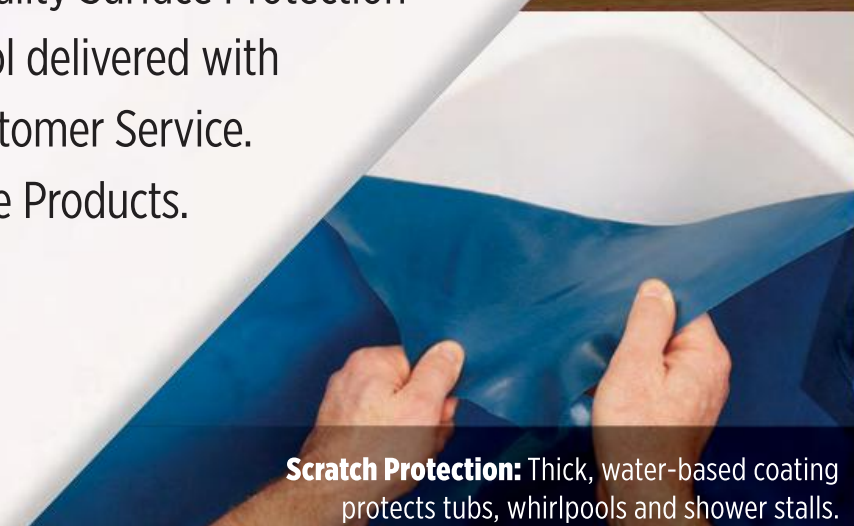
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