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On the cover: Installer Luis Ventura tape-seals a tap collar to a duct board box before attaching flex duct, on site with Greener Solutions, in Jacksonville, Fla. See the story on page 33. Photo by Ted Cushman.

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DEPARTMENTS

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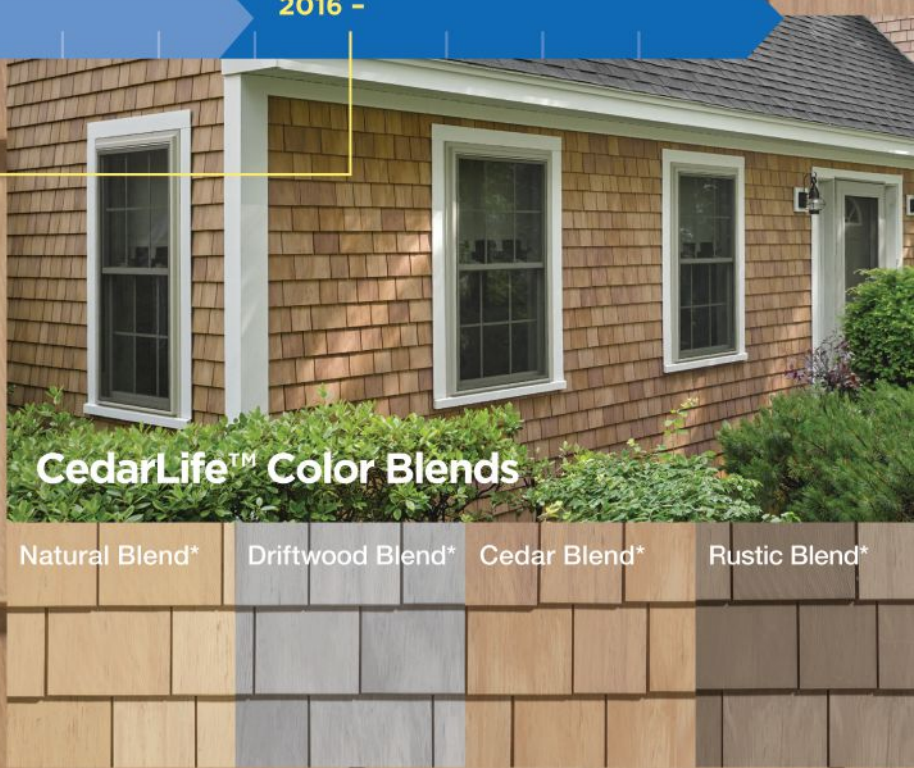

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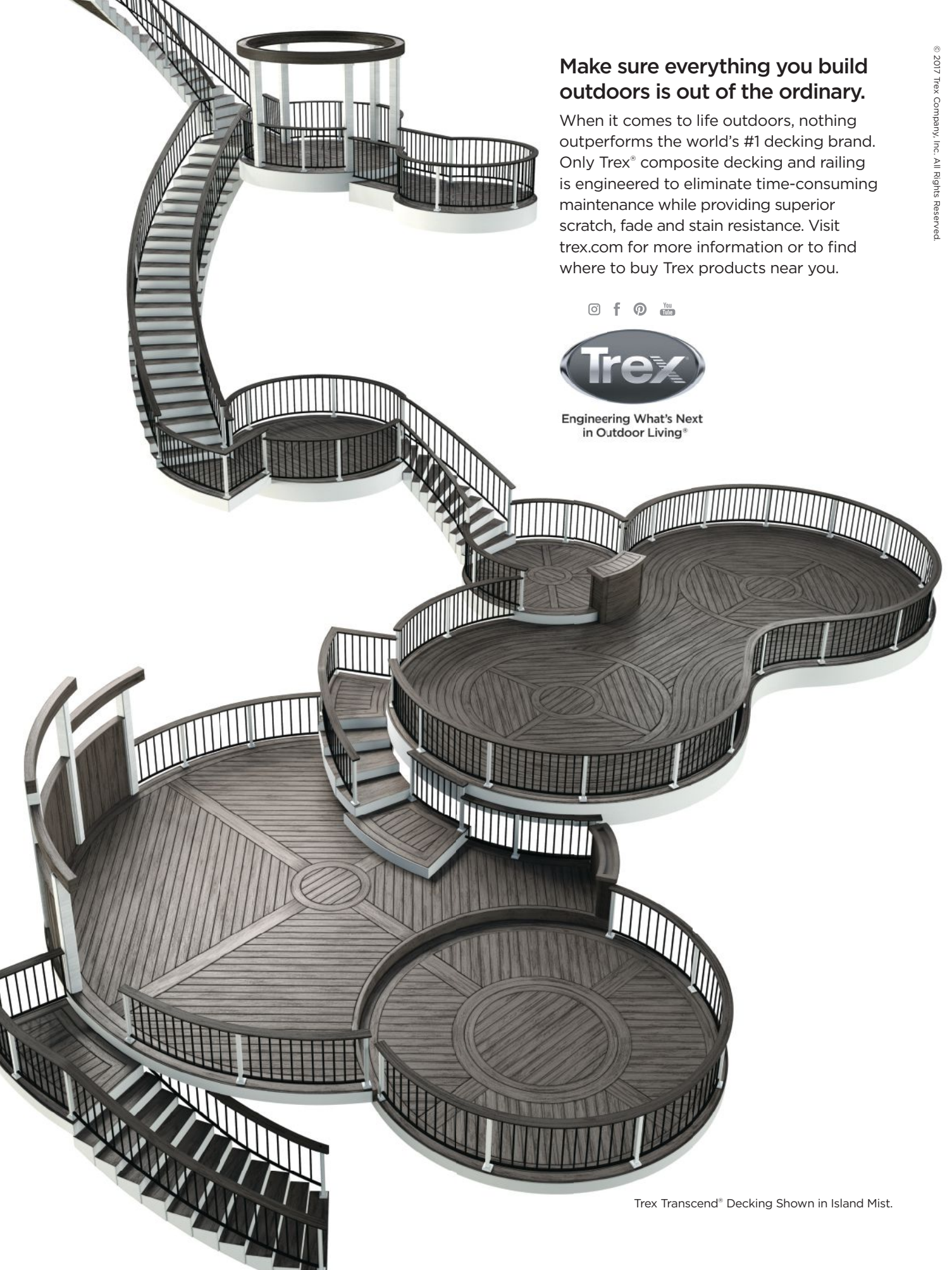

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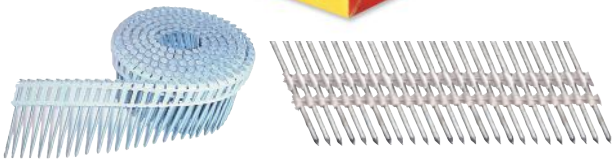

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BY GREG AND SUSAN BURNET

Basic Wall Framing

In May, we discussed snapping and squaring layout lines for walls. This *Training the Trades* segment focuses on laying out and building basic stud walls. We'll cover how to frame window and door openings in the next segment.

Once we've snapped lines on the deck or slab for all the walls, I note which walls extend the full width of the building. We call these "through walls" (in some regions, they're called "by walls"). Walls that intersect with through walls are called "butt walls." Typically, the longer exterior walls are through walls, and the shorter exterior walls—often gable walls—are butt walls. Inside the house, hallway walls and the longer walls in primary rooms are usually through walls, while closets and other typically shorter partitions are generally butt walls.

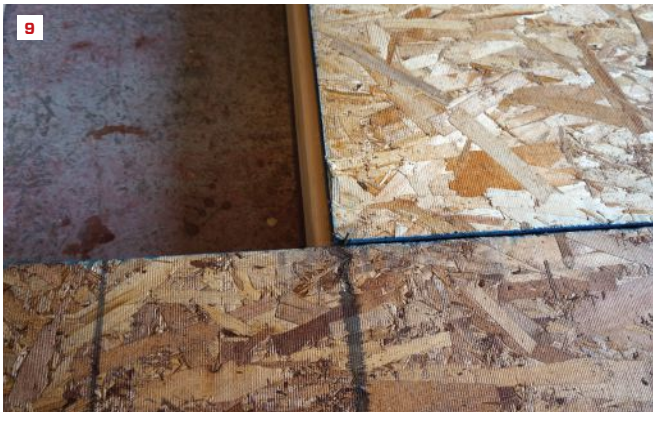
We frame and raise through walls first, so that their corners can accept the butt walls. Butt walls get nailed to the corners of the through walls when the walls are raised. But the process begins with laying out the wall plates. As with every step in the framing process, precise layout is a must for straight and square walls.

Greg and Sue Burnet are co-owners of Toolbelt Productions (toolbeltproductions.com), an education and training firm for the building industry.

Top and bottom plates. First cut the plates to length: Put the top and bottom pieces together and cut through both **(1)**. Using the saw kerf as a guide, finish the cut through the second plate. For a 16-inch-on-center layout, hook the tape at the end of the plates and mark the plate 3/4 inch below the 16-inch mark, at 15 1/4 **(2)**. This lets the sheathing break in the middle of a stud (see photo 9). Continue marking each stud—at 31 1/4, 47 1/4, 63 1/4, and so on—to the end of the plate **(3)**.

Photos by Sue Burnet

Corners, intersections, and double top plate. For attaching abutting walls at the corners, nail studs together in an L, and for attaching intersecting walls, nail short scraps between two studs to make a ladder **(4)**. Separate the top and bottom plates and distribute all the parts (corner studs, ladders, and regular studs) between the plates on a flat surface **(5)**. Nail through the plates to secure each stud. Attach a second top plate (note that this is 3 1/2 inches short on the right to accept the top plate of the intersecting wall) **(6)**.



Add the sheathing. Before sheathing the wall, stretch a tape diagonally from the corners to make sure that the frame is square **(7)**. In many parts of the country, sheathing is installed vertically, with the long side of the sheathing running parallel to the studs. To install the sheathing horizontally, as we do here, measure up 48 inches at either end and snap a line to guide the sheathing placement. Drive a nail beside the line to butt the sheathing against **(8)**. Stagger the seams of the sheathing on the second course, leaving the nails in place temporarily as spacers to allow expansion between panels **(9)**. Some sheathing comes with lines inked at 16-inch intervals on the panels, to follow when you're nailing.

For a more detailed discussion on framing walls, go to **www.jlconline.com/training-the-trades/basic-wall-framing**.

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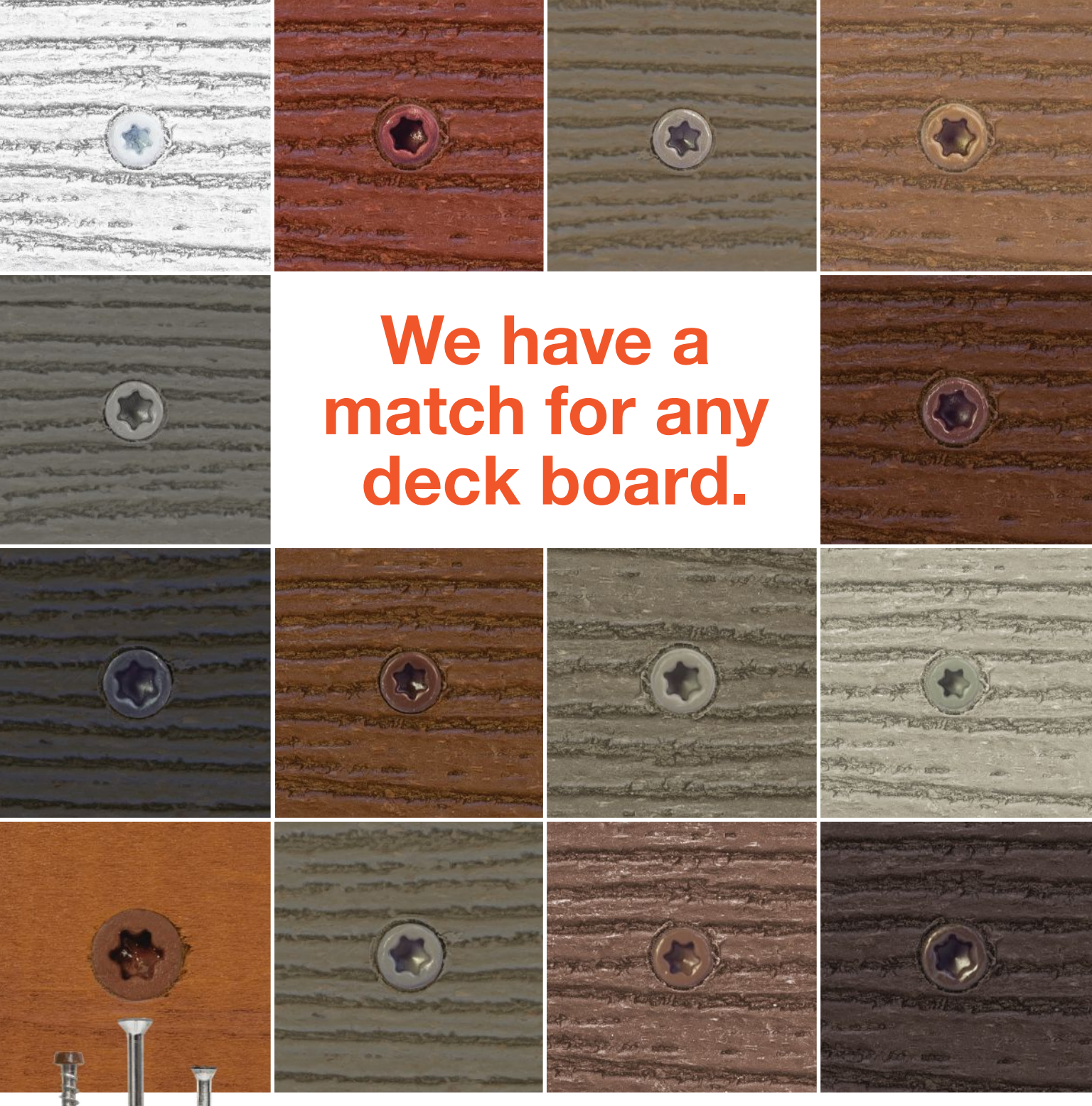

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Q How can I be sure that I have proper thinset coverage for the tile I'm using?

A Tom Meehan, co-author of *Working With Tile* (Taunton Press, 2011) and a second-generation tile installer from Harwich, Mass., responds: General recommendations for thinset coverage for tile are 80% for most interior work and 95% to 100% for exterior work. For shower areas, the recommendation is for at least 95% coverage.

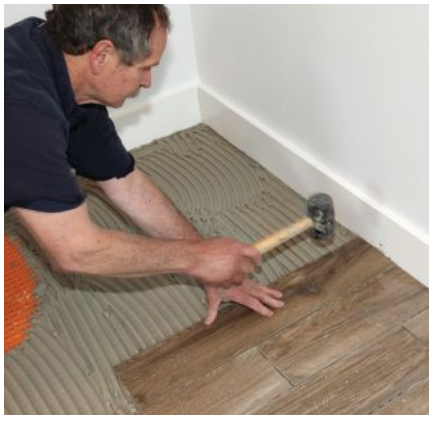
Certain types of tile carry their own coverage recommendations as well. For natural stone, that number is 95% to 100%. Glass tile always requires 100%. And as a general rule, err on the side of greater coverage, especially when you're dealing with large floor tile. I've seen kitchen floors where the tile seems just fine—until the appliance guys roll a refrigerator across the floor, and a tile cracks because of inadequate coverage. The most important reason for getting consistent coverage at the recommended levels is that the thinset needs to support the tile evenly over its entire area.

The first step is using a trowel with the proper-size teeth for the tile you are installing. I always go over an area with the flat side of the trowel first to ensure a good bond with the substrate, and then comb a layer of thinset with the teeth, keeping the ridges going in one direction. Swirling or mixing the direction of the ridges can create voids that result in uneven coverage and support.

When I set each tile in place, I push it down with a slight side-to-side motion. Then I tap the tile down with a rubber mallet to prevent high corners or lippage **(1)**. It's a good idea to check the coverage as you progress through a project, so after installing a few tiles, slip a margin trowel under the edge of a tile and lift it. If the tile comes up too easily, you probably haven't achieved proper coverage. After lifting the tile, check to be sure the thinset is adhering to most of the tile surface **(2)**.

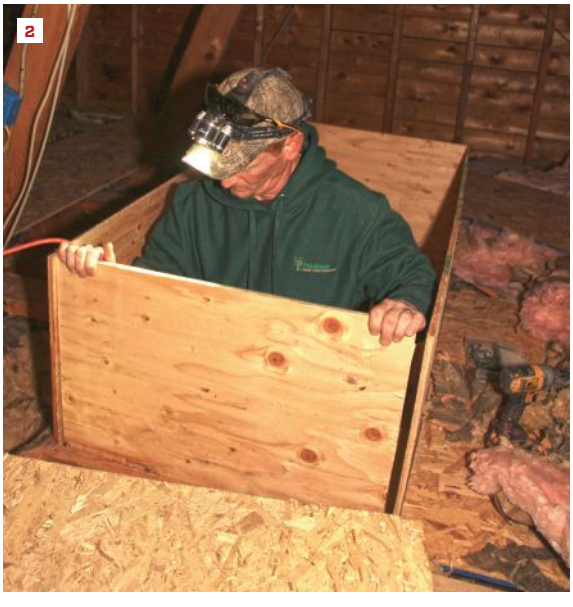
Corners are particularly tough areas to achieve adequate coverage on, and they're also the most vulnerable part of the tile for breaking. I drag the corner of the tile through the fresh thinset or butter the corner with thinset to ensure that it will be well supported.

Don't forget to wipe tiles down after cutting them on a wet saw. Even if you've applied the thinset properly, a wet surface can keep you from getting the proper coverage.



After combing the thinset out in one direction, press the tile into the thinset and tap with a rubber mallet **(1)**. Two tiles had two different results: The tile on the left had achieved proper coverage, with thinset adhering to most of it. The tile on the right did not **(2)**.

Photos by Roe Osborn



Before rebuilding an attic hatch, home-performance-retrofit technician Marcus Clement builds a plywood dam around the attic floor opening to contain blown cellulose insulation **(1, 2)**. The full job included removing all the old, low-performing batt insulation from the attic, sealing air leaks, and blowing an R-60 cellulose blanket into the attic.

Photos by Ted Cushman

A Site-Built Insulated Attic Hatch

BY TED CUSHMAN

Updating the attic of an existing older home is bread-and-butter business for Matt Damon and Paul Shepherd, the owners of Penobscot Home Performance, in Bucksport, Maine. In May, *JLC* stopped by a jobsite in Rockland, Maine, to see the company's crew building and installing an insulated hatch in the attic.

The full attic job included removing all the existing fiberglass insulation, sealing up all the typical leaks (including partition-wall wiring penetrations, recessed lights, bath fans, and a chimney chase), and then blowing an R-60 blanket of cellulose insulation into the lid. "We blow at 18 inches depth, and it settles to 16," explained Matt Damon.

Retrofit standards in Penobscot's market call for an airtight attic hatch that roughly matches the insulation value in the rest of the attic. Over the years, Damon, Shepherd, and their crews have worked out a solution: a lightweight panel door with a handle in the center, topped by several 2-inch layers of rigid insulation (either polyiso or extruded polystyrene), for an R-value of about 40.

"We put a 1x2 ledger around the opening, and we kerf in a weather strip for airtightness," said Damon. To gain access to the space, the homeowner pulls down the existing access ladder, grasps the door by the handle, and lifts it up. To secure the closed door, the owner dogs it down with window sash locks installed at both ends.

"The design has evolved over time," Damon said. "We used thicker plywood for some of the first ones we made, and those doors were kind of heavy and hard to lift. Now, we use thin AC plywood, or even lauan. We used to use hook-and-eye hardware to lock the doors down, and we've found that the window sash locks are easier to use and work better."

The Penobscot crew tests its jobs with a blower door on the way out, to make sure each job is meeting program targets. The attic hatches are "super tight," Damon said. "Once in a while, if the caulking detail around the ledger isn't perfect, you can get a little air coming out. Then the guys go back and do what we have to do to fix it and tighten it up."

Ted Cushman is a senior editor at JLC.

Clement screws a ledger to the plywood hatch box **(3, 4)**. After measuring the opening and cutting a piece of plywood to size, he screws a cabinet door handle to the center of the door **(5)**. The door handle makes it easy to carry the door blank back to the opening for test-fitting and scribing **(6)**, so that he can trim the door as needed for a better fit.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Clement test-fits the thin plywood door blank in the opening **(7)**. Once the piece is trimmed to fit, he screws a 1x2 edge to the blank **(8)** and cuts out foam insulation for the door, using a handsaw **(9)**. He stacks up the insulation **(10)**, secures it with foil tape **(11)**, and installs weather stripping on the door edge **(12)**.

Building a Decorative Cupola

BY BROOKS BAKER

In the northwest corner of Arkansas where I work, most cupolas you see are rotting away on top of dilapidated old hay barns, where the only creatures that seem to enjoy them are the resident cows. So I was a bit surprised when a client approached me about building a cupola on the roof of her home. This one would not be functional for ventilating the building below, like those on the barns, although it could have been with a different installation strategy. Instead, it would be purely decorative—a way to dress up an otherwise straight and boring roof.

Before I began building the cupola, I did some research to determine a size that would be proportionate to the roof. On the internet, I found a formula that would work well for this project: Each side should be about 1¼ inches wide for every linear foot of roof ridge. The ridge measured 29 feet long, so I decided on a cupola that was 36 inches square.

The construction was actually quite simple. I made it in three parts: a base that would saddle over the ridge, a main section with louvered sides, and a hip roof with surfaces that curved up to a point. I used cedar and exterior-grade plywood for all the components and gave the whole cupola three coats of white exterior paint.

Brooks Baker is a finish carpenter who works in Fayetteville, Ark.

Building the frame. First, the author built the 2x6 frames for the top and bottom of the cupola's louvered center section. To help prevent water from collecting on the horizontal surfaces, he milled a 20-degree bevel along the outside edges of the frames. For each frame, he cut four 36-inch-long pieces of 2x6 with mitered ends and assembled them picture-frame style using exterior glue and pocket screws **(1)**. Diagonal measurements confirmed that the assembly was square **(2)**. He glued and screwed the first frame onto 4x4 cedar posts that he finished with chamfered edges **(3)**. After flipping the assembly over, he glued and screwed the second frame, with the bevel facing down, to the other ends of the 4x4 posts **(4)**.

Photos by Mike Baker

Adding the louvers. Before installing the louvers, the author attached a beveled sill to the frame between the posts, to help shed water **(5)**. He laid out the louvers on the jambs, spacing 35-degree lines evenly top to bottom **(6)**. After installing the jambs, he glued and nailed the louvers—each of which had been cut to a 35-degree angle along one edge—to diamond-shaped blocks that separated each layer **(7)**, leaving enough room at the top of each louvered section for a decorative frieze. For scribing the gentle arch on the frieze boards, a thin ripping acted as a batten to create a perfectly even curve **(8)**. The author cut the curve on a band saw, smoothed and chamfered the edges of the boards, and glued and nailed them to blocks at the tops of the louver jambs **(9)**.


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A "witch's hat" roof. To make the swooped roof on the cupola, the author cut four hip rafters, which met at the peak, out of cedar 2x6s **(10)**. He created the curve using the same batten method he'd used for the curved frieze. Right-angled plumb cuts at the bottom of each rafter would provide attachment for the cupola fascia. After screwing rough-cut pieces of 1/2-inch plywood sheathing to the rafters to create the swooped roof planes **(11)**, he shingled the cupola roof with architectural-style shingles to match the roof below, using a narrow, 4-inch shingle exposure to provide better coverage. He used cap shingles along each hip; the housing for a weather vane sealed the peak.


13


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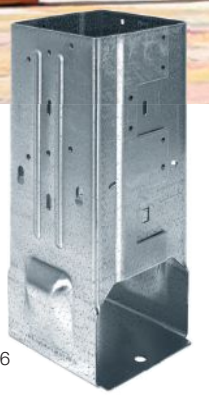
Assembly. The cupola's base, which saddled the ridge of the roof, was made from 3/4-inch exterior plywood, with corner gussets for reinforcement and boards applied to the exterior for a paneled look. To secure the base to the roof, the author screwed it to blocks that had been screwed to the roof and sealed with silicone caulk **(12)**. Caulking sealed the sloped edges of the base, but the bottom edges were left open to allow water to escape **(13)**. After painting all surfaces, he screwed the louvered section to the base **(14)**. He then added insect screen inside the louvered section, and screwed the roof section on **(15)**. A decorative weather vane topped off the completed cupola.

Great beauty demands a solid base.



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BY MELANIE HODGDON

Foundational Flaws

We've all heard this building adage: If you start off with a foundation that's out of level or not square, you'll still be fighting it when you do the roof. In bookkeeping, there are also "foundations," although the consequences of a problem in one may not be as easily or immediately visible. What typically throw business financials out-of-whack are inconsistent record keeping and faulty accounting—and the best remedy is creating tried-and-true procedures and slavishly following them on each and every job.

CLASSIC ERRORS

The following are errors that I see all the time:

1. You get a payment from a customer based on a payment schedule, but you haven't created an invoice yet. You process the payment to get it into the bank, and you figure that you'll eventually get that invoice entered—when you get a spare minute. What you've done is credit Accounts Receivable without recording income. If you never get around to generating an invoice to match the payment to, you'll end up with negative Accounts Receivable and no income reported for that job.

2. You generate an invoice. But when the customer pays, somebody makes a direct deposit in the software, crediting an income account—instead of following a payment process to credit Accounts Receivable. This results in doubling the income (once from the invoice and once from the deposit), but the customer will still appear to owe you because the payment process never occurred.

3. You enter a bill for materials or from a subcontractor. This affects your cost and Accounts Payable. But when you pay the bill, you absentmindedly write a check (perhaps you're at the lumberyard with your checkbook in hand and decide to take care of it), and back in the office, the check is entered and applied to a cost account. This results in doubling the cost (once from the bill and once from the check), and you still appear to owe the entire amount.

4. You dutifully record lump-sum payments to your credit card but either don't know how to record individual purchases, or miss a bunch. The result is a negative balance on your credit-card account, and the loss of potentially thousands of dollars of legitimate business expenses from your financials.

5. You make payments on a truck loan every month and classify them as Vehicle Expenses, an account that appears on the Profit and Loss. In fact, the principal portion of the payment should be reducing the amount of the loan, displayed on the Balance Sheet.

A related error is made when neither the loan nor the truck is recorded on the financials. The results are that the truck isn't included as a Fixed Asset on your Balance Sheet, the loan isn't included as a Long Term Liability on your Balance Sheet, and your expenses are inflated on your Profit and Loss, making your taxable bottom line smaller, because the loan principal (instead of just the interest) is classified as an expense.

6. You carefully reconcile your bank account each month, matching transactions to your statement. However, you show some transactions for which the bank statement doesn't have a match. You let them slide (after all, you *are* reconciling the ones on the statement), and after several years, there may be dozens of these transactions, all contributing to your apparent cash balance. Let's say a $10,000 deposit from 2009 never cleared. Then your cash balance is overstated by $10,000. Or maybe you have $15,000 in assorted checks and debits over five years; your cash balance is then understated by $15,000.

The result is more dramatic than that, however. All those uncleared deposits and withdrawals appear on your past years' financials, which can affect your taxable bottom line. Let's say that the $10,000 deposit that didn't exist (according to your bank) credited an income account. Then whatever year that deposit was made in, your taxable income was overstated by $10,000. The reverse is true for your debits. At each reconciliation, it's critical to investigate any suspicious-looking uncleared transactions; they could be duplicates or they could even be drawn on the wrong bank account. Clean them up to keep your cash (and financials) accurate.

As errors in a foundation affect the roof, some errors impact your financials and your taxes. Look for odd, lingering unpaid balances, unexpected negative balances, and figures suggesting amounts that are still owed (or that you owe others) when you "know" they're not. If you're not sure how to get your financial records square and level, seek assistance from somebody who can train you in the methods required to avoid those rooftop issues.

Melanie Hodgdon is president of Business Systems Management and co-author of A Simple Guide to Turning a Profit as a Contractor.

BY TED CUSHMAN

This high-performance townhouse project, although precertified as a Passive House building, didn't comply with Maryland's prescriptive energy code because some of the windows, chosen for a winter solar heating contribution, exceeded the state's maximum Solar Heat Gain Coefficient (SHGC).

Photos: Flywheel Development

A New Way to Meet the Energy Code

Ever since the Home Energy Rating System (HERS) index was introduced by the Residential Energy Services Network (RESNET), people have been talking about whether builders should be able to use HERS as a way to comply with the building code. In some states, that's starting to happen. The International Code Council (ICC) voted in 2013 to create an Energy Rating Index (ERI) pathway to code compliance, based on the HERS index. To allow its inclusion in the code, RESNET has also converted the formerly proprietary HERS index to a consensus standard maintained under the open stakeholder procedures of the American National Standards Institute (ANSI).

A permissive option rather than a requirement, the ERI pathway lets builders use a HERS rating to comply with the 2015 International Energy Conservation Code (IECC) if they wish, and so far 10 states have adopted versions of the IECC that include the ERI. If you work in a jurisdiction that has adopted the 2015 edition of the IECC, you can get a new house approved by obtaining a HERS rating that meets the ERI threshold for your climate zone, specified in a table in the code.

For help understanding the options, *JLC* turned to an expert: Joe Nebbia, a code consultant with Newport Partners, based in Davidsonville, Md. Nebbia, who teaches comprehensive energy-code education sessions for builders, has been participating in a multistate Department of Energy (DOE) study to assess whether education outreach can boost the industry's compliance levels and improve the performance of houses. Maryland was one of the first states in the nation to adopt the 2015 IECC, and it does offer the ERI pathway to builders. Nebbia walked us through the various options for code compliance under the 2015 IECC, starting with the basic "prescriptive pathway."

"In Chapter 4 of the residential code," said Nebbia, "you will see a whole lot of requirements that are basically a checklist. You put in this much insulation or more, you use windows with this rating or better, you use this much efficient lighting—that sort of thing." If you follow the prescription, you pass.

But if you know what you're doing—or if you have expert help—you can choose to follow the "simulated performance alternative" pathway to compliance, which has existed in Section 405 of the IECC for many years. To take that pathway, you have to model your proposed building using appropriate software and compare the model of your plan against the model of a "twin home" specced out to comply with all the mandatory requirements and prescriptive measures in the base code. If the model says your proposed building will have energy costs equivalent to (or lower than) the prescriptively compliant baseline house, then your proposal will be approved—but at inspection time, your local inspector will want to verify that you actually built what you drew.

FLEXIBILITY WITHIN LIMITS

The performance pathway offers trade-offs, but only in certain defined areas. Many parts of the prescriptive code are also "mandatory"—meaning that even if you follow the simulated performance alternative, you can't get out of those requirements. So, for example, Nebbia explained, the band joist of a wood-framed floor system always has to be insulated to the code-required minimum, and air-sealed as specified in the code—that's mandatory. On the other hand, slab perimeter insulation is prescriptive, but it isn't mandatory—so if you follow the prescription, you will pass, but if you don't follow it, you might still pass. Suppose it's impractical for some reason to install rigid foam insulation on the edge of the slab up to the top of the concrete, as prescribed in the code. With the simulated performance alternative, you may be able to omit the slab edge insulation from your design, as long as the modeling substantiates that your house will perform as well as a baseline house.

The simulated performance alternative is more flexible than the prescriptive pathway, but it is still limited and constrained, Nebbia explained. Ever since the 2009 edition of the IECC, for example, the code has not allowed builders to trade off equipment efficiency against envelope requirements. "So let's say I plan to install a super-efficient ground source heat pump or something like that," said Nebbia. "Well, the building that I'm being compared against also gets a super-efficient ground source heat pump. I don't get any credit."

THE RATINGS GAME

Enter the ERI. Written into the 2015 IECC, the ERI "was mainly a change that was requested by the larger production builders," said Nebbia, "because so many of them were already getting an energy rating done on their homes. The goal was to have a path that uses that same energy rating system to show code compliance."

Like the simulated performance alternative, the ERI pathway does not get a builder off the hook for mandatory items in the code. But it does expand the available trade-offs, said Nebbia, including HVAC: "Unlike section 405, you can use heating, cooling, and water heating—basically any load in the building—and take credit for that efficiency." There are backstops, though: You can't go below the minimum insulation requirements from the 2009 IECC.

So far, builders have been slow to take up the ERI option. One reason, said energy rater Gary Boyer of EDGE Energy in Beltsville, Md., is that most advanced builders can already pass code easily using simpler methods. Instead of using advanced software such as REM/*Rate* to model their buildings (which requires time-consuming data entry), builders can show compliance using the much more rudimentary RES*check* app (a free download from the DOE). Another reason, Nebbia suggested, is that the HERS rating thresholds set by the ERI are quite a bit more stringent than the rating a house would earn just by complying with prescriptive code. In the 2018 edition of the energy code, he said, the step up won't be so sharp.

THE FREEDOM TO BEAT CODE

So far, Gary Boyer said, he has been asked only once to help a builder use the ERI option—for the townhome project shown on page 29, built by developers Jessica Pitts and John Miller of Flywheel Development, based in Washington, D.C. "They built these super-cool modular net-zero row houses," said Boyer. "The walls were like R-50—it was way over the top. But RES*check* was penalizing them because the windows didn't meet what it wanted. So I had to model it for them with REM/*Rate*."

Pitts and Miller described the problem to *JLC* in a phone call. The building, it turns out, was precertified as a Passive House and designed using the Passive House Planning Package (PHPP) to meet the stringent airtightness and energy-conservation specifications of the Passive House program. Clearly, the building exceeded code.

"But we had a challenge around the Solar Heat Gain Coefficient (SHGC) factor for the windows," Miller explained. "Our south-facing glass is designed to be oriented in such a way that it does admit light in the winter to help warm the house. That's what the Passive House Planning Package expected us to do, so we went with that because we needed that solar heat gain in the wintertime for heating. And it was not code compliant because it didn't meet the minimum SHGC factor for the code."

In the design, most of the south-facing glass is sheltered under front porch roofs that will block summer sun, but allow low-angle winter sun in—a smart passive-solar technique. But RES*check* couldn't capture that benefit, and the prescriptive pathway in the code wouldn't allow the trade-off.

Maryland has an industrial and modular building program that regulates plan review and inspections of modular projects, Miller said, and Flywheel is using a modular manufacturer that works directly with a third-party plan reviewer. "They needed to see something in their package that checked the right box, and we couldn't check that box," Miller said. "So we needed the REM/*Rate* model."

Passive House buildings use far less energy than average code-compliant houses. But you don't have to be that far beyond code to get value from the ERI compliance pathway. Joe Nebbia said he expects to see more mainstream builders picking up the approach. "It's not here to save the builder who has no understanding of energy performance and can't meet the prescriptive code," Nebbia said. "It is going to be used by a lot of big builders who have a standard product where they know where that HERS rating is going to be coming in, and they know that they can get efficiencies by trading it off, but they are much better than code minimum. It also might be used by builders who are doing a lot of above-code programs like Energy Star, because they know that they've got an efficient product, and this just simplifies their code compliance."

Ted Cushman is a senior editor at JLC.


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Air Conditioning for Humid Climates

Air-sealing, right-sizing, and smart controls are the keys

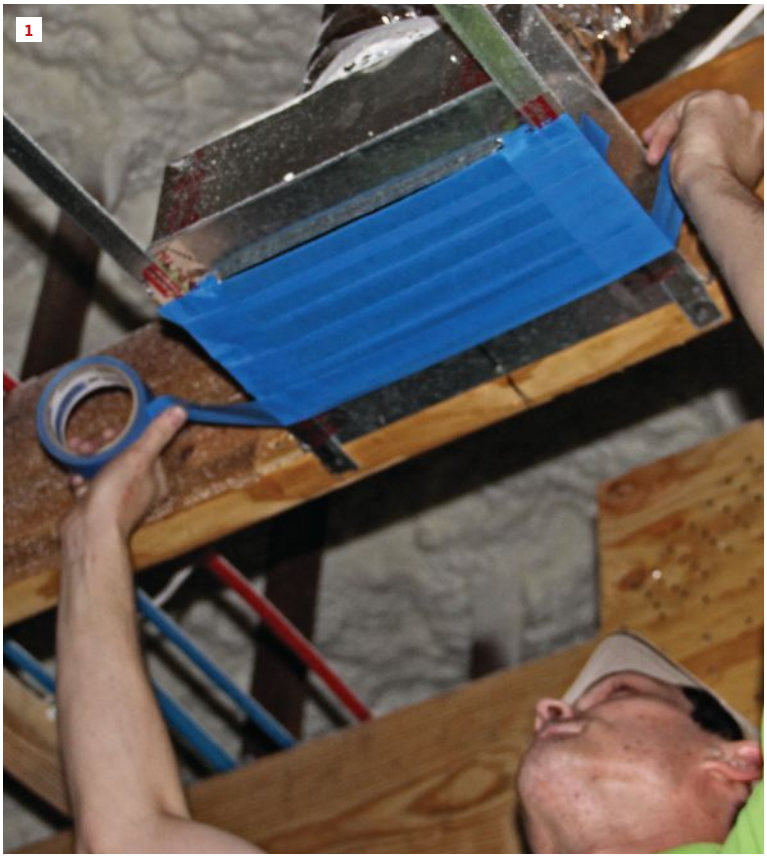
BY CURT KINDER

I manage a full-service HVAC contracting company in the Jacksonville, Fla., market. I'm a trained and experienced engineer, and I got into the air conditioning business after I contracted with a local builder, Dan Hovis of Hovis Custom Builders, to build a custom ICF (insulating concrete form) house for me about 10 years ago. Dan told me that local HVAC contractors wouldn't bid on systems for his custom homes because they didn't believe that a three-ton system could easily handle a 3,000-square-foot house.

"Well," I said, "I'll design it myself." So I did. Out of that experience, Dan and I formed Greener Solutions as a joint venture. My company now designs and installs the HVAC systems for all of Dan's ICF homes. We also install systems for some quality stick-frame builders in our area, and we do system replacements in existing homes of all types and ages.

Whether it's a new home or a retrofit, we insist on right-sizing the systems. We do a room-by-room load calculation using the Air Conditioning Contractors of America (ACCA) Manual J, we specify the ducts supplying each room using ACCA Manual D (if we're installing new ductwork), and we choose mechanical equipment to match those loads and that ductwork. We believe in trusting our numbers—we do the calculation right, and we build the system to match.

Photos by Ted Cushman



The author blower-door tests each home's insulated shell at an early stage in the construction, to identify and seal air leaks. Above, technician Adam Hovis temporarily masks an energy recovery ventilator (ERV) outlet in preparation for a blower-door test **(1)**, while the author tapes over an open drain **(2)**.

ENVELOPE QUALITY CONTROL

For right-sized equipment to perform reliably, we have to be able to count on the building envelope to also perform as designed. So even though I'm the air conditioning contractor and not the framer, the window installer, the insulator, or the siding contractor, I insist on quality control for the envelope details. And in this case, I don't trust: I verify.

I tell my builders that I want to be at the house with my blower-door rig as soon as we have an envelope to test. Ideally, we like to have the attic insulated with spray foam on the underside of the roof sheathing, so our ductwork can be in the conditioned space. And we want to test the home's airtightness as soon as the roof is sprayed but before the walls are insulated—and before there's any drywall loaded into the house to block our access to the walls.

At this point, we're not trying to get a number for anybody's checklist. We just want to find the leaks. So we tape up all the known holes: missing door knobs, dryer vents, bath vents, fireplaces, and the like. Then we crank up the blower door. When you depressurize the house to 100 pascals, you can hear the leaks—they howl.

It's hard to get the pressure cranked down that low if the house is full of holes. But we've learned that air-sealing is iterative. The big leaks hide the small ones. So first you find and fix the big leaks, and then you go back through, with the higher air pressure working in your favor. Now the fans can do more, and the smaller leaks will start to reach out and touch you.

We like to run our test while the foam contractor is still on site. We flag issues using spray paint, and the foam guys come back in to hit the low spots and point-seal the leaks. Then we may take a second (and even a third) run through with a different color paint.

Our main reason for plugging the air leaks is to control moisture.

Technician Jack Hogan zeros the electronic manometer before the blower-door test **(3)**. Hogan points out an air leak near the patio door **(4)**. Hovis marks a gap in the foam insulation for correction by the foam crew **(5)**.

In Florida, humidity is the 800-pound gorilla in the room. I'm particularly concerned about the attic, because even if it's air-sealed and insulated, it usually does not have supply and return registers, so it's indirectly conditioned. I don't want moisture entering that space where it could condense on the ducts.

But I especially don't want excess moisture infiltration in the occupied rooms of the house—in part because of how humidity affects occupant behavior. I'm trying to save the occupants from themselves. If the homeowners are uncomfortable because of the humidity, they will do the only thing that they know how to do: reduce the thermostat set point. The problem there is that we run an outdoor dew point in the 70s for four or five months of the year in Florida, and if your interior temperature measures much below the outdoor dew point, you run a good risk of condensation in the wall cavity behind the drywall—and that's asking for serious trouble.

QUALITY DUCTWORK

Once our Manual J design for the house has given us a room-by-room estimate of the heating and cooling loads, the next step is to use Manual D to specify the airflow needed to meet all those loads on the design day. Then we can make a duct plan.

If I input a room's design load in our Manual D software, it will supply me with the duct sizing: "That room needs one 6-inch duct or two 4-inch ducts." But when in doubt, we increase the duct diameter. If we arrive at the site and we see that we're installing a 60-foot run of 10-inch duct, we may decide to bump it up to 12 inches. This reduces the friction losses and makes sure we have enough air going to the room.

In some cases, however, we may prefer a small-diameter duct. As far as I know, we're the only company in town that uses 3-inch-diameter flex duct. Most companies bottom out at 4 inches, because

Above, installer Luis Ventura inserts a tap collar for a flex-duct connection to a duct board box **(6)**, then tape-seals the collar to the box **(7)**. He butters the inner liner of the flex duct with mastic **(8)**, slips the duct liner over the collar, and tightens a cable tie over the joint using a tensioner **(9)** before taping the flex duct outer liner to the box **(10)**.

that's what the suppliers sell. But we stock 3-inch flex duct by special order so that we can right-size the airflow to walk-in closets, pantries, commode closets, and other very-low-load spaces.

A classic example of this situation is a house with the air handler in the garage, and a laundry room by the entry door from the garage—the first room you hit coming into the house after parking your car. That laundry room will have almost no load, because it has no windows and it's mostly connected to the interior. But it's the first room coming off the air handler, so if you provide it with a 4-inch duct, the register will blow about 60 cfm even though the room only needs 10 cfm. In mid-summer you could hang meat in there—and in the winter when you're heating, it's much warmer than it needs to be.

People may not care a lot, because they don't spend much time in there doing laundry. But you've sacrificed air that is needed elsewhere, and created a comfort issue and sometimes even a noise issue in the laundry room. It's better to use a 3-inch duct, not a 4-inch one, so that you can keep that chilled air backed up in the system for where it's needed—like in the family room, the kitchen, or the southwest bedroom.

Like everyone else in our market, we use a box and flex-duct distribution system, because there isn't the budget to run hard metal duct in a house. And flex duct works fine—as long as you install it correctly. But as with the roof insulation, quality control is what determines whether the duct system works the way it was designed to work.

So our installers are trained to fully stretch the duct out before they connect it, so that the steel wire coil in the duct doesn't crumple inward and create friction in the air path. They know to support it properly, and to seal it carefully at every connection. We are also the only company I know of in our market using Smart Elbows from

Ventura attaches a Hart and Cooley "Smart Flow Elbow" to ensure good airflow through a curved section of flex duct **(11)**. Besides enforcing a smooth bend, the Smart Elbow helps to hold ducts away from obstructions **(12)**. Hogan butters an inner liner with mastic **(13)**, wraps a cable tie around the connection **(14)**, and butters the seams of a register boot with mastic to ensure airtightness **(15)**.

Hart and Cooley. This product is a plastic brace that supports and stiffens flex duct when it has to go around a bend, enforcing the proper radius and keeping the duct from folding in on itself.

In an extreme case where we need a lot of air to flow easily around a corner, we use a hard elbow. I'm looking at an example right now where a design studio is located at the end of a 50-foot run of 12-inch duct, with two 90-degree bends. The duct is properly sized, but to be safe, we're going to use hard steel 90s so we will know that there won't be wire creating turbulence in the air path. It costs a little more for the elbow and its insulation wrap, and for the labor to splice it to the flex duct run, but it buys peace of mind.

EQUIPMENT OPTIONS

The last step in designing an air conditioning system is choosing the equipment. This decision isn't about brand names; just like with Ford or Chevy trucks, people have their favorites, but either maker can supply roughly equivalent products, whether you want the basic economy model or the luxury model with all the accessories. Trane, Carrier, Bryant, American Standard, or Lennox—they're all solid, and I'm probably leaving out a few good ones that I just don't have experience with. Right now, I mainly install systems from Bryant and Trane.

Let's take a look at the choices, starting at the bottom end and assuming that the house needs a three-ton system. Suppose a landlord wants the basic minimum system for a rental house. The code-required minimum Seasonal Energy Efficiency Rating (SEER) is 14. We price a properly sized and installed three-ton code-minimum system at about $4,500. That system has a single-stage compressor and a single-speed blower motor. When the thermostat calls, it will turn on or turn off—that's it. But it will cool the house.

A preapplied paper ruler helps foam installers and inspectors verify application thickness **(16)**. In this high-end system in an insulated attic, three zone supply ducts coming out of a distribution box are equipped with motor-controlled dampers **(17)**; illuminated LEDs on the control device indicate which zones are active **(18)**. Heat from the geothermal system also preheats hot water **(19)**.

The next step up is to a SEER 15 or 15.5 system, which we install for about $5,300. For that money, you get a variable-speed air handler and a touch-screen thermostat with integrated humidity control. If the house is too humid, the air handler can slow down to keep the coil colder and remove more moisture. I recommend this $800 upgrade; it's quieter and it provides better comfort.

The next upgrade is to SEER 16 or SEER 17, a system with a two-stage compressor as well as a variable-speed air handler, which costs about $6,500 in our market. This three-ton system can drop down to its two-ton mode when the loads are lower (which is 90% of the time). It can also handle up to three zones; the low stage is called upon when only one or two zones need cooling. This is the minimum system we'll install if there is zoning in the mix.

Finally, at the top end is a system with a true variable-speed compressor as well as a variable-speed blower, such as the Bryant Evolution Extreme or the equivalent Carrier GreenSpeed. This equipment is rated at SEER 20 and goes in for about $9,000. These systems can dial way, way back to a whisper for low loads—low enough to handle a single small zone when needed. In summer, they'll run almost continuously—but so quietly that you barely notice them. They offer superb dehumidification. The system shown on this page is an equivalent Water Furnace geothermal unit.

Each step up delivers an improvement in comfort and in humidity control. In states like Florida, where electric rates are moderate, the energy savings associated with higher SEER ratings won't typically justify the investment as they might in a higher-priced power market. Still, the comfort gains and the reduced risk of moisture damage and mold are strong arguments in favor of the upgrades.

Curt Kinder runs Greener Solutions AC Services, in Jacksonville, Fla.

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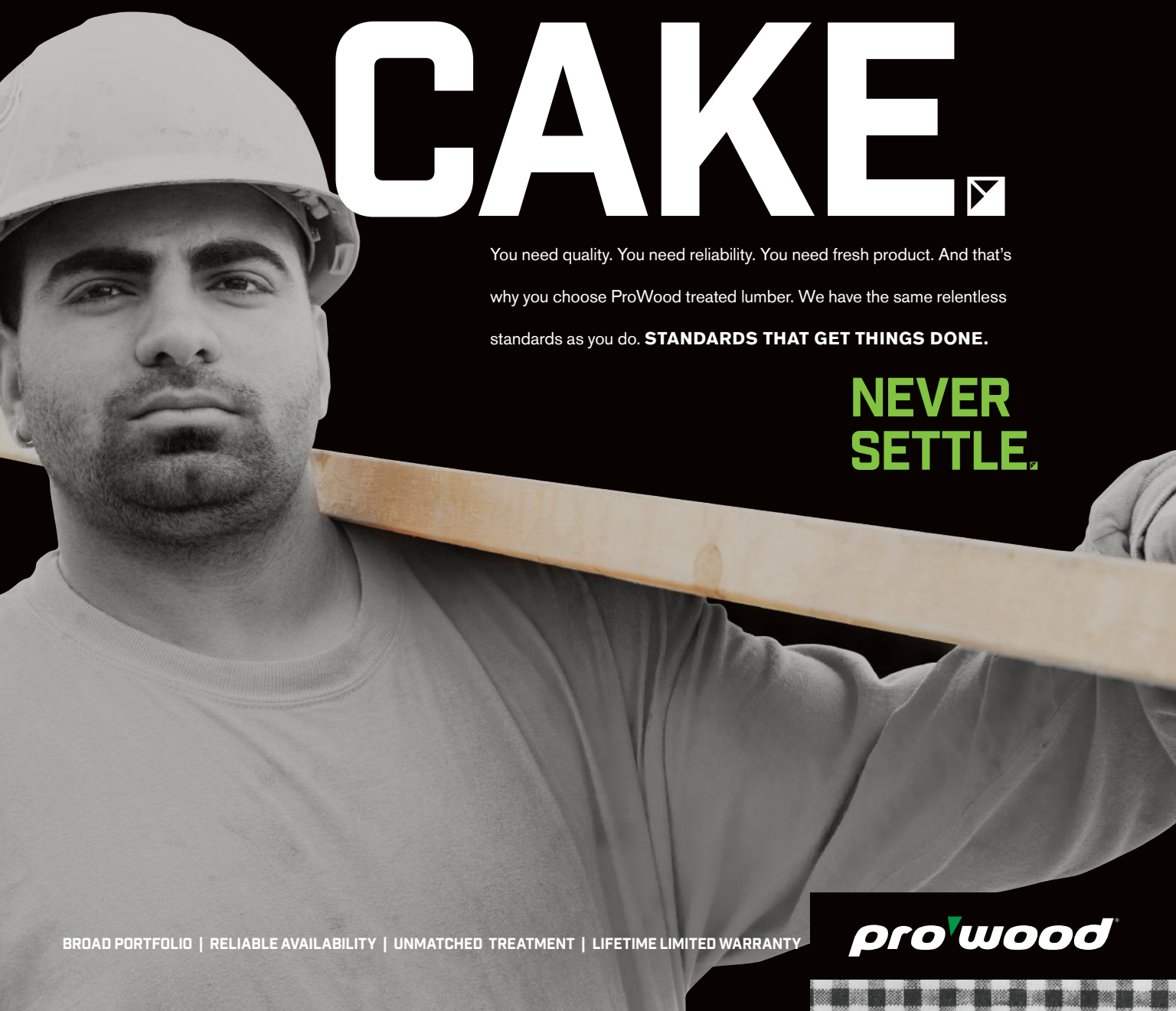

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Common Deck Stair Defects

Build deck stairs according to best practices rather than code to protect your customers and avoid liability

BY BRUCE BARKER

As an ASHI home inspector, I inspect decks every day. Most have multiple defects, which is to be expected on older decks. But I also find serious problems with recently built decks, which is less understandable. In particular, I like to focus on stairs, because of the role they play in deck safety.

Indoors or out, stairs are one of the most dangerous systems anywhere in a building. Falls involving stairs can result in serious personal injury; that's where the big money is for attorneys. On a deck, stairs are third (behind ledger detachment and guard failures) in terms of number of injuries suffered.

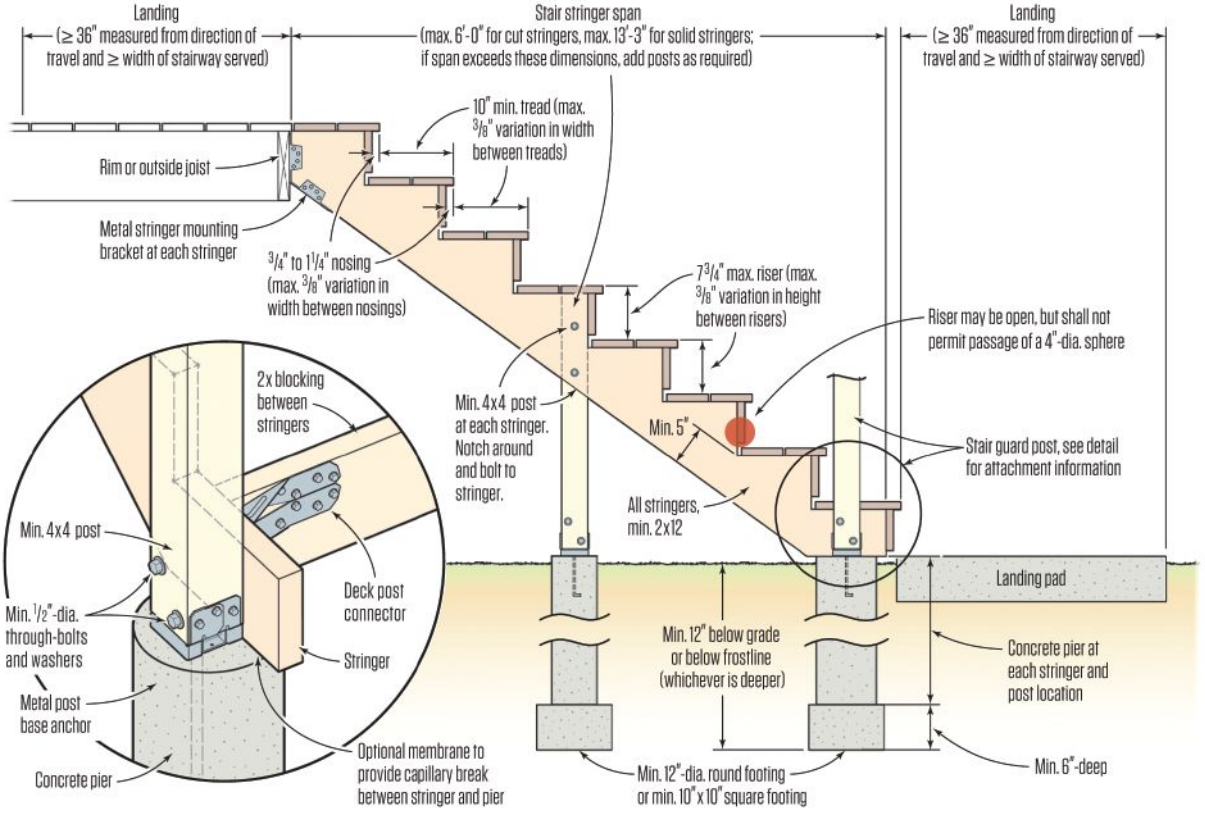
Photos by Bruce Barker

STAIRS BUILT RIGHT

Interior and exterior stairs share almost all of the same requirements. If anything, deck builders should be more careful about applying current safety and structural standards to exterior stairs because they are subject to environmental conditions that may exacerbate safety and structural problems.

But which standards apply? It's best to think of building codes as minimum standards, not as the standards for contractors who build quality decks. Keep in mind that even when a deck complies with a local building code, the code official who inspects it is not

Deck Stair Requirements



Shown here are DCA 6 recommended standards for deck stair stringers, risers, treads, and landings, and the components that support them. Note that in the stair example shown here, two posts and piers support each stringer; a typical 36-inch stair with three stringers requires six post and pier supports. Extending piers below frost depth is critical in cold climates where frost heave could lift the landing at grade. Wet and clayey soils are most at risk for substantial heave.

responsible for ensuring that the deck is safe.

To improve safety and to reduce liability risk, deck builders should follow current best practices as presented in the latest edition of DCA 6, the American Wood Council's *Prescriptive Residential Wood Deck Construction Guide*. Accordingly, I define "defect" as a failure to comply with these best practices. In fact, since a deck that passes local code inspection may still be unsafe, I believe that DCA 6 should be the standard to which all decks are built, regardless of what might be allowed by local building codes.

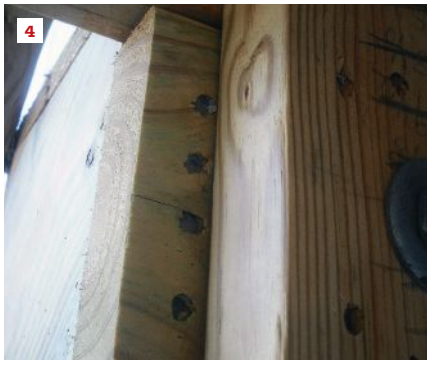
STRINGERS

Before getting into deck stair defects, let's look at how DCA 6 recommends that stairs should be built, starting with the stringers, risers, treads, and landings, and the components that support them (see "Deck Stair Requirements," above). When I'm evaluating a deck stair, this is where I start.

Stringers typically have two bearing points, with the plumb (vertical) cut bearing on a rim joist or on a beam, and the seat (horizontal) cut bearing on—at minimum—a solid landing. To help resist both vertical and lateral loads, stringers require proper support and attachment at these bearing points. Without proper support, vertical loads (gravity) can pull the stringers down from their bearing points, while lateral (horizontal) loads can pull the stringers away from their bearing points. Most builders worry more about vertical loads, but lateral loads are also a frequent cause of a deck stair failure: The fasteners withdraw from the bearing point, then gravity takes over.

Seat cut. DCA 6 recommends supporting the stringers using

All illustrations by Tim Healey



TOP ROW: The bottom of the stringer also needs adequate bearing: At least 1 1/2 inches of the heel of the seat cut should bear on the landing. This example **(1)** is prone to splitting along the grain. Stringers also require adequate bearing on either a rim joist or a dropped header. Without it, the stringer can split along the grain **(2, 3)**.
SECOND ROW: Fastening stringers with nails through the header into the end grain of a stringer **(4)** has minimal resistance to withdrawal. Toenailed stringers are less susceptible to withdrawal, but the connection can still fail as the framing ages and is structurally compromised **(5)**. At a cost of a few dollars each for the connectors and recommended fasteners, the most cost-effective way to hang a stringer is with metal hardware. But this one **(6)** has been installed incorrectly: The stringer isn't fully bearing on the connector seat. Another red flag: The fasteners are drywall screws instead of approved connector nails.

posts that bear on footings, but this is an installation detail that I can't recall ever seeing. If there is good stringer bearing on a solid landing, and if the stringers are restrained against lateral movement, I usually declare victory and move on. But I live in a warm climate, where we don't have to worry about frost heaves that could move the stringers and loosen the connection at the plumb cut. Those who build decks in cold climates should consider using the DCA 6 details.

It's best if the entire stringer seat cut bears on a solid landing, but at minimum, at least 1 1/2 inches of the seat-cut heel should bear on the landing. Allowing the toe of the seat cut to be the only part of the stringer that bears on the landing can cause the stringer to shear along the wood grain **(1)**.

Plumb cut. For maximum plumb-cut bearing and fastening area, the ideal stringer position has the top tread even with the deck flooring, which allows the stringer plumb cut to fully bear on the rim joist or beam. This location makes installing the stair guards and handrails more difficult, however, so it's more common to see the top tread dropped one riser below the deck flooring. Unfortunately, I've found that this often leads to unsafe attachment details with inadequate bearing that can allow the stringer to shear along the grain **(2, 3)**.

Stringer attachment. One of the most serious deck stair defects is a poor connection between the stringers and the deck. Failure at this important connection is common, particularly when the stringers have been nailed to the framing, because nails are subject to withdrawal.

For example, I often see stringers fastened to a dropped header

A 2x12 stringer has a maximum unsupported span of 6 feet. These stairs **(7)** are likely to deflect and cause the stringers to either pull loose from the framing or shear along the grain. The problem is made worse with overcut notches, which weaken a stringer **(8)**. The minimum recommended depth of the uncut portion of the stringer is 5 inches, as measured to the closest saw kerf and not the notch itself. Shown in the illustration on the facing page are the recommended standards for deck stair guards, which are subject to the same requirements as interior stairs.

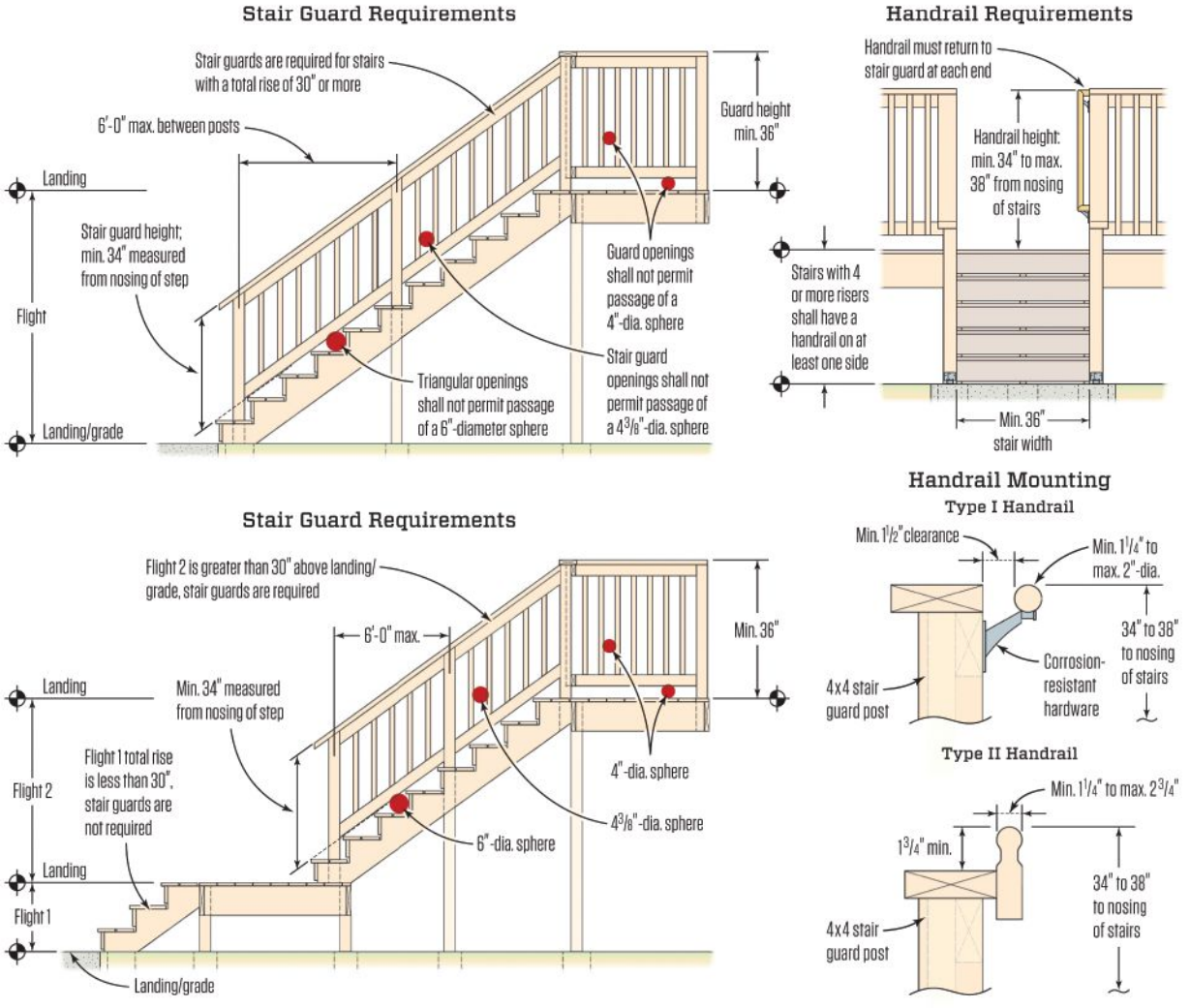
with nails driven into the stringers' end grain **(4)**. If the stringers are also bearing on—but not attached to—a landing and have no other attachment to resist lateral loads, the nails will do little to prevent the stringers from pulling away from the framing. If the stringers are bearing on the ground, the problem is even worse.

Sometimes the stringers are toenailed to the deck framing **(5)**, an attachment method where the nails aren't quite as subject to withdrawal. Sometimes this method works—if an adequate quantity of the correct kind of nails is properly installed (there are rules about how to correctly install toenails), and if the wood and the nails maintain their integrity over the life of the deck. That is a lot of ifs.

To avoid extra work and eliminate drop headers, end-nailing, toenailing, and other questionable stringer connection methods, DCA 6 recommends the use of metal hardware specifically designed for stringers, such as Simpson Strong-Tie's LSCZ or LSSU connectors. At a cost of a few dollars each for the connectors and recommended fasteners, this is the most cost-effective stringer connection method.

But in order to provide both the vertical and lateral support for the stringers, these connectors must be installed according to manufacturer's instructions. For example, stringers should fully bear on the connector seats. Screws are not allowed—unless specifically allowed by manufacturer's instructions, and then only manufacturer-supplied screws may be used. Deck screws and drywall screws are not allowed **(6)**. Finally, the round and oblong holes are there for a reason: They are saying, "Put a fastener here."

Stringer construction. Almost all stringers on deck stairs are



cut stringers. The two most common cut-stringer defects that I see are overspanning and overcutting.

The minimum recommended size for a deck stair stringer is 2x12, which has a maximum recommended unsupported span of 6 feet. Often this maximum span is dangerously exceeded, resulting in overspanned stringers that will deflect and cause the connection at the deck to pull loose and fail. In some cases, overspanned stringers may shear along the wood grain **(7)**.

The minimum recommended depth of the uncut portion of the stringer is 5 inches. The measurement is to the saw kerf, and it's common to find stringers with dangerously overcut notches **(8)**. Stringers that are overcut have the same potential failures as overspanned stringers. In both cases, they can be repaired by installing intermediate support posts.

RISERS AND TREADS

In both DCA 6 and the 2015 IRC, requirements for riser height and tread depth are 7¾ inches (max.) and 10 inches (min.) respectively, though local requirements vary. These measurements are taken at the leading edge of the treads.

To me, the more important safety issue is that the riser heights and tread depths be uniform. Risers or treads that vary more than ⅜ inch between any two risers or treads create a fall hazard, because people become accustomed to a certain feel when using stairs. A variance can cause someone to lose balance and fall. The most common location for a large variance between riser heights is at landings.

Many deck builders seem to be unaware that open risers allowing a 4-inch-diameter sphere to pass through are not permitted on

Though common, 2x4 handrails **(9)** are not considered graspable and should be avoided. Bottom guard rails on stairs should be oriented close enough to the tread nosings so that a 6-inch-diameter sphere will not pass through the triangle created by the riser, tread, and rail **(10)**. Wooden stair guard posts should be located so that the span between posts (as measured horizontally) is no more than 6 feet. This is a new deck stair that passed inspection **(11)**.

stairs that are more than 30 inches above grade (or the floor below). This is a common defect in older decks, but I often find it on newer decks too.

HANDRAILS

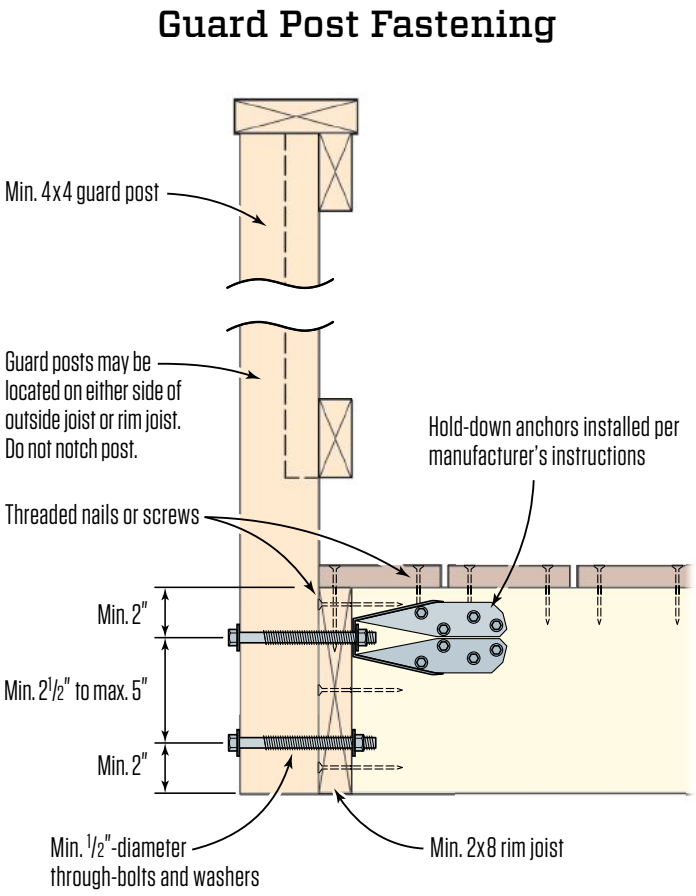
Like deck stair guards, deck stair handrails share the same requirements as for interior stairs, including requirements for a graspable shape and termination in a post or a return. This means that very few deck handrails comply with code or best practices, including those with typical 2x4 and 5/4 rail caps **(9)**. A 2x4 handrail is not graspable, especially by children and others with small hands, the elderly, and those with impaired mobility—the people who need a safe, graspable handrail the most.

Deck stair handrails should also be continuous from above the top tread or landing to above the last tread in the flight of stairs, and terminate in a return or into a support post. If the guard is properly installed otherwise (which it often isn't), the easiest fix for most handrail problems is to install a separate graspable handrail.

GUARDS

Guards for deck stairs share the same requirements as guards for interior stairs (see "Stair Guard Requirements," page 45). Two of the more common stair-guard defects I see include failing to install vertical infill components so that a $4^3/8$-inch-diameter sphere will not pass through, and failing to install the guard bottom rail so that a 6-inch-diameter sphere will not pass through the triangle created by riser, tread, and guard bottom rail **(10)**.

In addition, 4x4 wood support posts for stair guards should be



A strong connection between guard posts and deck framing is critical to deck safety. The illustration (above left) shows an example of a connection made with a metal hold-down anchor, and details the other DCA 6 fastening requirements for guard posts. Above all, avoid notched posts **(12)**, which may develop cracks originating in the corner of the notch and running parallel to the grain, which weakens the post.

installed so that they are no more than 6 feet apart. Post spacing must be measured horizontally, not along the length of the guard.

Guard posts must be able to withstand a 200-pound load in any direction. The easiest way to comply with this requirement is to install hold-down connectors, especially at the top of the stairs, following the manufacturer's instructions (see "Guard Post Fastening," above).

Posts should never be notched around the framing, because that practice increases the odds that the post will develop cracks that originate in the corner of the notch and run parallel to the grain, weakening the post **(12)**.

If the bottom guard post extends below grade and also supports the stair stringer, a pair of ½-inch-diameter hot-dipped galvanized machine bolts (not carriage bolts) with washers on each end can be used to fasten the post to the stringer. This same detail can be used with intermediate stair guard posts.

LANDINGS

A solid landing, at least as wide as the stairs and at least 36 inches deep in the direction of travel, should be located at the top and bottom of each flight of stairs. A flight of stairs should not rise vertically more than 147 inches without a landing. An intermediate landing is a small deck, and should be built as such, including appropriate footings, posts, and bracing.

Bruce Barker is a licensed contractor and certified ICC inspector. He owns Dream Home Consultants, in Cary, N.C. A version of this article originally appeared in Professional Deck Builder.

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Photos by Gary Striegler

Building a Federal Mantel

For production efficiency, break the job down into components

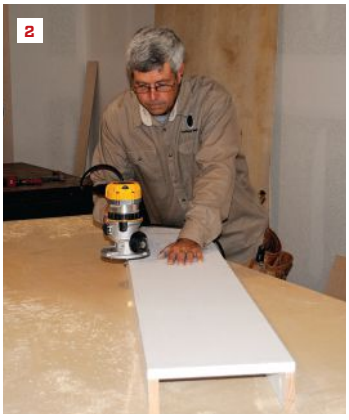
BY GARY STRIEGLER

Every mantel I've ever built has begun with a picture supplied by the client. I've built mantels from internet pictures, magazine pictures, even pictures on my own website, but I had never picked out a design for myself until recently, when I built a new rental home. I gave myself three guidelines: The mantel had to be different from anything I'd built before; it had to be historically inspired; and it needed to have interesting details without being overly ornate. I looked through books on historical homes but couldn't find anything that completely satisfied my criteria. Then, while leafing through a Kuiken Brothers molding catalog one day, I found a mantel design in its Federal collection that fit my needs perfectly.

ADAPTING THE DESIGN

An inspiring picture is fine, but every mantel has to be proportioned to the space where it's being built. In this project, I wasn't restricted by anything on the fireplace wall, such as windows or built-ins that could affect the size and proportions of the mantel.

The design of a mantel starts with the size of the firebox (which can vary from project to project) and the amount of non-combustible clearance that the code requires around the firebox. In my area, that clearance is 12 inches above and to the sides of the firebox. I opted to cover that surface with tile that looks like brick; being fairly thin, the tile wouldn't affect the depth of the pilasters (the vertical parts of the mantel made to mimic columns) on each side of the



Build the pilasters. The pilasters that flank both sides of the firebox are designed to look like columns. The author screws and glues together U-shaped pieces that act as the foundation for the pilasters **(1)**. A router with a flush trim bit evens out the edges **(2)**. To simulate fluting, the author mounts reeded molding to 1-by boards **(3)**. He adds small strips to the sides of the reeded boards **(4)** before mounting the boards to the pilaster foundations **(5)**.

firebox. Had I used full-thickness brick veneer or stone, the pilasters would have needed to be proportionately deeper to look right.

The width of the pilasters can vary, too; I typically make them between 8 and 12 inches wide, which for most mantel heights is neither too spindly nor too beefy. Because this room had 9-foot ceilings, I opted for wide, 12-inch pilasters.

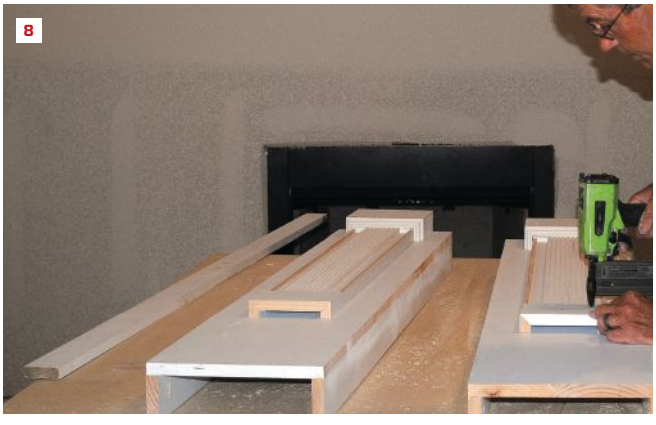
Next, I consider the dimensions of the mantel shelf. On many of the historic mantels I've seen, the shelf is barely deep enough for a pair of candle sticks, but I prefer the shelf to be at least 5 inches deep, and most of my clients want shelves that are 7 to 8 inches deep. I set the overall depth of this mantel shelf at 6 inches—which would allow room for displaying objects and still look proportionate to the rest of the mantel—with a depth of 7½ inches where the shelf stepped out over the pilasters.

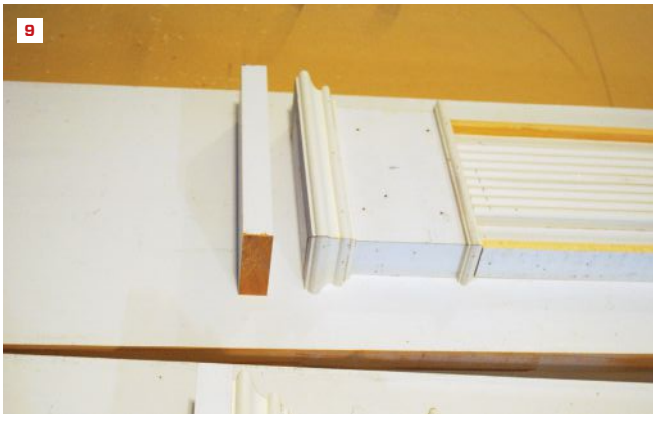
The height of the mantel shelf depends on the size of the room, the height of the ceilings, and what the client plans to put in the space above the mantel. I generally aim for 60 to 66 inches for finished mantel shelf height. Taking into account the 9-foot ceilings and a large TV that would be installed over the mantel, I set the height for this mantel shelf at 62 inches.

BUILDING THE PILASTERS

I used primed finger-jointed poplar for all the finish material in this mantel because it stays flat and straight. The moldings all came from Kuiken Brothers.

When I build a mantel, I break it down into parts or components. The challenge is building the parts in the right sequence. I usually start with the pilasters, which I build out to look like columns and





Bases and capitals. To complete the columned look, each reeded section receives a base and a capital. After finishing the bottom of the reeded section with a 1-by block, the author wraps the block with panel molding **(6)**, below which he installs a U-shaped base **(7)**. For the capitals, he installs smaller U-shaped pieces above the reeded sections **(8)** and then adds layers of molding and a block for the "top" of the column **(9)**.

to give the mantel its depth. A wide piece that is "U"-shaped in section forms a foundation for each pilaster. To make the foundation pieces shown here, I ripped 2½-inch strips and then ran them on edge through a thickness planer to make them uniform. I glued and pocket-screwed the strips to 1x12 boards **(1)** and flush-trimmed the edges with a router **(2)**.

After making the pilaster foundations, I added the reeded detail that lends the pilasters a "fluted" look. Reeded trim is fairly thin in section, so I mounted it on a 5-inch-wide piece of flat stock **(3)**. To add a sense of depth and another level of detail, I glued and nailed 1⅛-by-⅜-inch strips to the edges of the flat stock **(4)**. I centered the reeded assemblies on the pilasters 7 inches from the bottom and tacked them in place, then flipped the pilasters over and drove screws through the back of the pilasters and into the reeded assemblies **(5)**.

Below the reeded piece, I made a 7-inch-tall two-step base—essentially the base of the column. I capped the bottom of the reeded trim with a rectangular block of 1-by stock, and then wrapped the cap with mitered panel-mold trim **(6)**. To complete the base, I made another U-shaped assembly, 2 inches deep and butt-jointed together. After attaching nailing blocks to each pilaster, I glued and nailed the bases in place **(7)**.

Above the reeded detail, I installed a 5-inch-tall three-step capital detail. The foundation for this detail was a U-shaped assembly, as with the base, that attached at the top of the reeded section **(8)**. The capital assembly was shallower than the base, though, and I wanted it to look more like molding, so I mitered the edges. A thin molding wrapped around the bottom of the assembly for the first step. At the top of the capital, panel molding wraps

Pilaster installation. To position the pilasters, the author draws plumb lines beyond the code minimum clearance **(10)**. Before securing attachment boards to the wall, he levels between them **(11)**. He nails the pilasters to the boards **(12)** and the panel sections to the pilasters **(13)**, then adds a built-up panel between the pilasters **(14)**, trimming it to finish the plywood edge **(15)**.

around the assembly with a 1-by block over that as the top step **(9)**. I had also planned a paneled detail at the top of the pilasters and above the capitals that would tie in with the panels over the firebox, but I opted to install that detail after I'd installed the pilasters.

INSTALLING THE PILASTERS

The pilasters attached to the wall with a strip of MDF that I glued and nailed over the drywall. I can never hit more than one stud with these strips, but by the time I've nailed the strip into the bottom plate and that one stud, the yellow glue has done the rest.

To position the attachment blocks, I measured the code minimum of 12 inches from the edge of the firebox plus ¾ inch for the thickness of the strips that form the sides of the pilasters. Using a long level, I drew a plumb line for each of the pilaster nailing strips **(10)**. I set the strips in place, without attaching them to the wall, and leveled the tops of the strips with each other **(11)**. After securing the strips, I slipped the pilaster assemblies on and attached them by nailing through the sides **(12)**.

To make the upper panel section of the pilasters, I glued 1-by strips to the backs of wider 1-by material. After sanding the edges, I nailed the upper panels in place **(13)**, but to ensure that I had the correct size and placement, I waited on installing panel mold for the flat panels until I had finished the horizontal panel section between the pilasters.

I built out the area between the pilasters with three layers of ¾-inch MDF glued and nailed to the wall. I was concerned about the horizontal panel section being too tall, so I built in an extra step. After adding a strip of pine to finish the bottom edge of the MDF

Mantel shelf. The author scribes the mantel shelf to the pilasters and panels **(16)**, and then offsets the lines for the layers of molding. Initial cuts made on a table saw are finished with an oscillating cutter **(17)**. A pieced-in layer of MDF adds thickness to the shelf **(18)**. A straightedge ensures that the shelf is flat **(19)** before it's attached to the mantel below **(20)**.

blocking, I installed finger-jointed poplar in two pieces over the MDF build-out—a 1x6 board below with a 1x12 above. Then I skinned over them with 1/4-inch plywood, leaving the bottom 3 inches uncovered to form the extra step **(14)**. I added a small molding to cover the exposed bottom edge of the plywood **(15)**.

At this point, I could have applied the molding to create the panels, but for my eye, it is easier to get the panel sizes right after the shelf and all the moldings above it are in place.

THE MANTEL SHELF

On most mantels I build, the shelf is supported visually by crown molding below. This mantel was a bit different—instead of crown molding, there was a simple panel-mold profile. I made the mantel shelf with a layer of finger-jointed poplar on top of a layer of 3/4-inch-thick MDF. I used a different panel-mold profile to trim the edge of the shelf.

I wanted the shelf to step out around each pilaster. To get the layout right, I tacked the poplar board in place on top of the pilasters and marked precisely where the pilasters stepped out **(16)**. Then I offset the measurements by a couple of inches to create a little separation between the two layers of molding.

Cutting around the offsets on the table saw took a little planning. First I had to remove the guard from the saw. After setting the blade to the proper width for the main expanse of shelf, I lowered the blade, turned the saw on, and then slowly raised the blade, letting it cut up through the material and making sure my hands were nowhere near the spot the blade would pop through. For these operations, I always make sure I'm using a sharp blade, and

Shelf trim. Panel molding tops the pilasters below the mantel shelf. The author marks the length of each piece of molding in place **(21)**, and then cuts it carefully on a miter saw using a stop **(22)**. He then nails each piece onto the mantel **(23)**. Another band of molding wraps around the edge of the mantel shelf, as well, following the contours of the pilaster below **(24)**.

whenever possible, I have someone on hand to help me. After making the initial cuts on the table saw, I finished the cuts with an oscillating tool **(17)**. For the MDF layer, I just made a straight rip and added filler pieces where the shelf stepped out **(18)**.

To make sure the shelf had no sag to it, I placed a long level on top of it to act as a straightedge when I secured the first piece of panel molding underneath **(19)**. I then nailed the shelf to the tops of the pilasters and into the MDF backing along the back edge of the shelf **(20)**.

From there, I needed to do a lot of careful cutting and fitting. I scribed the length of each piece in place **(21)**, cut it on my miter saw using a stop **(22)**, and then installed the molding, wrapping it around the facets of the pilasters **(23)**. I repeated the process for the molding that finished the edge of the mantel shelf **(24)**. Outside corners are what show off a molding profile, so I made sure that this mantel had plenty of them.

CREATING THE PANELS

The panels on this mantel were actually outlines that I made from narrow panel molding with a defined bead detail. I glued and nailed the pieces onto the flat sections at the top of each pilaster as well as above the firebox. I knew that once painted, the profile would stand out.

To look right, the panels above the firebox needed to be at least a couple of inches wider than their height. They ended up being 8 inches tall, with the middle panel 25 inches wide and the two smaller side panels 10½ inches wide. I carefully cut each piece for the panels with a miter saw, using the stop on my saw stand.

Creating the panels. Molding outlines on the flat surfaces create a paneled look. A spacer block positions the preassembled side pieces **(25)**, which then rest on the block during installation **(26)**. The center panel has inverted corners for added interest **(27)**. At the pilasters, a horizontal bead of molding gives the panel a better proportion **(28)**, and a rectangle of molding creates the pilaster panel **(29)**.

When I'm cutting small moldings, I always make sure there is a good, sharp blade in the saw, and after each cut, I keep the saw down until the blade has completely stopped spinning. To hold the smallest pieces in place while cutting them, I use a long scrap of 1-by material.

I like to preassemble panels on a flat surface, using a small amount of glue and short headless pins (making sure to keep my fingers clear when pinning the corners together). To install the panels, I used a 1-by spacer block ripped to a width that would center them vertically on the flat panel. I first used the block to scribe vertical layout lines on each side to place the side panels **(25)**. Then I rested the molding assembly on the block, lined up the edge with the layout line, and nailed the assembly in place **(26)**.

For the middle panel, I had inverted the corners to add interest. I centered this panel between the side panels, also resting it on the block while nailing it into place **(27)**.

For the panels at the top of the pilasters, I added a bit more detail. First, I wrapped a small panel mold around each pilaster a couple of inches above the capital, which helped create a better proportion between the height and width for the last panel detail **(28)**. I used a scrap of 1-by as the spacer block for the bottom of these panels, which left a slightly wider space above the panel **(29)**.

All that was left to do at that point was to have the painters come in to fill all the nail holes and give the mantel a few coats of paint.

Gary Striegler owns Craftsman Builders, in Fayetteville, Ark., and teaches workshops at the Marc Adams School of Woodworking. His website is craftsmanbuildersnwa.com.

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BY LAUREN SHANESY

1. Water Tank Replacement Simplified
The EZTR40 condensing tankless water heater from Noritz America is designed to replace existing 40-gallon tank-type water heaters. Installers don't need to change out the vent, as the heater vents with 2-inch, flexible polypropylene tubing that can be threaded directly through an existing B-Vent. The EZTR40 also uses the same half-inch gas line used by existing tank units. The heater has a 12-year warranty, and while the pricing varies, the company says the product costs less than $2,500. noritz.com

2. New PVC Exterior Trim
Wolf Trimboards are made from high-cell-density PVC that the company says will not absorb moisture and keeps the boards from swelling, rotting, splitting, cupping, or delaminating when exposed to the elements. The trim can be routed, mitered, and heat-formed, and can be cut, drilled, nailed, and glued with regular tools. It is available in smooth-matte or wood-grain finishes, or can be painted for a customized look. Pricing available only through distributors. wolfhomeproducts.com

3. Weather-Resistant Sliding Glass Wall
NanaWall Systems' new ClimaClear glass wall is a frameless individual-panel sliding system designed for large openings. To seal the entire wall from wind-driven rain and reduce air infiltration, the system uses transparent vertical weather seals between the panels, male-female panel interlocks and double fin brush seals at the top and bottom rails, and an ADA-compliant water-drainage system with a recessed saddle sill with adjustable floor sockets. Pricing is not yet available. nanawall.com

4. Wider Pocket Door Frame
Johnson Hardware's new 1562 Series Commercial Grade Bypass Pocket Door Frame offers twice as much width as the company's standard pocket doors, creating a wider room divider using a single wall recess. The frame is designed to support two solid-core bypass doors (up to 200 pounds each) in a standard 2x6 timber-framed or steel-framed stud wall and accommodates doors up to 3 feet wide by 9 feet high by $1\frac{3}{8}$ inches thick. A 36-by-108-inch kit costs about $350. johnsonhardware.com

5. Smarter Shims
SmartWedge shims are 100% polyethylene plastic, making them a practically indestructible product for installing doors and windows, for framing, and for deck building. Unlike wood shims, they are moisture-resistant and won't swell, compress, or decay, and they will not split when fastened by nails or screws. The teeth on their faces interlock to hold them securely at the thickness you set. The standard shims are 8 inches long and 1 5/8 inches wide, but shims are also available in a range of widths and lengths. Prices start around $10 for a 30-pack. calculated.com

5

6. Bringing the Heat Outdoors
Homeowners don't have to stop enjoying outdoor living when it gets cold outside. Infratech's slim infrared heaters range from 1,500 to 4,000 watts of coverage; can be wall-, ceiling-, or flush-mounted to blend into outdoor areas; and come in a number of different models—with single- or dual-element heat zones and six color options. Custom colors are available to match existing décor. The company claims the heaters produce zero gas emissions. Installation and product costs may vary, but the company says the standard entry costs are around $2,200. infratech-usa.com

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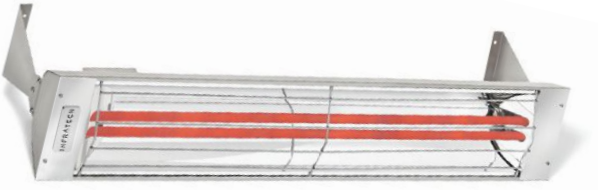

7. Sharper Drywall Corners
Trim-Tex's Angle Master is a 3.25-inch-wide flexible vinyl trim that's designed to fit any angled corner. The company claims that the material won't mold and that it holds its shape for a corner finish, eliminating waves, blisters, cracking, or fuzz. The trim is simply pressed into place and uses the company's "Mud Lock," which consists of microscopic hooks that increase the total surface area of the trim for a stronger bond. A 100-foot roll costs $35. trim-tex.com

7

8. All-in-One Sound and Thermal Floor Barrier
The Ditra-Heat-Duo provides a floor-warming and sound-control system in one single-layer underlayment system. Schluter says that the membrane is ideal for ceramic and stone tile installations, especially in multifamily buildings, and that it increases the impact insulation class of a concrete slab floor, reduces impact sound transmission, supports heavy floor coverings, and warms tiled floors faster over concrete substrates by directing heat to the tile, not to the subfloor. The flooring membrane is priced at $3.47 per square foot. schluter.com

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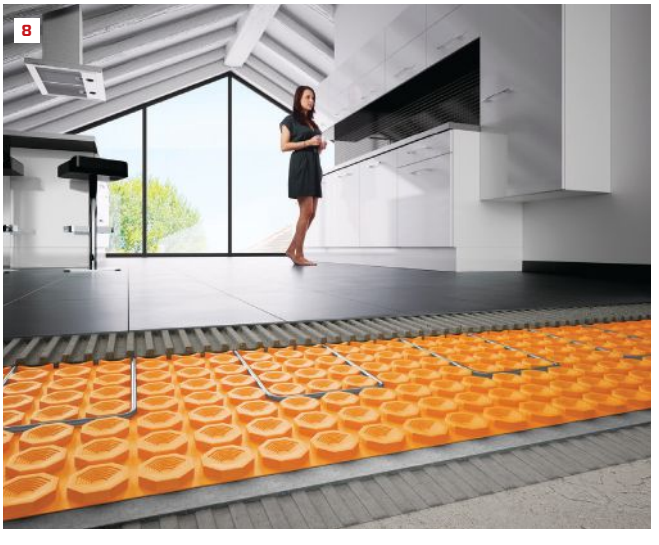

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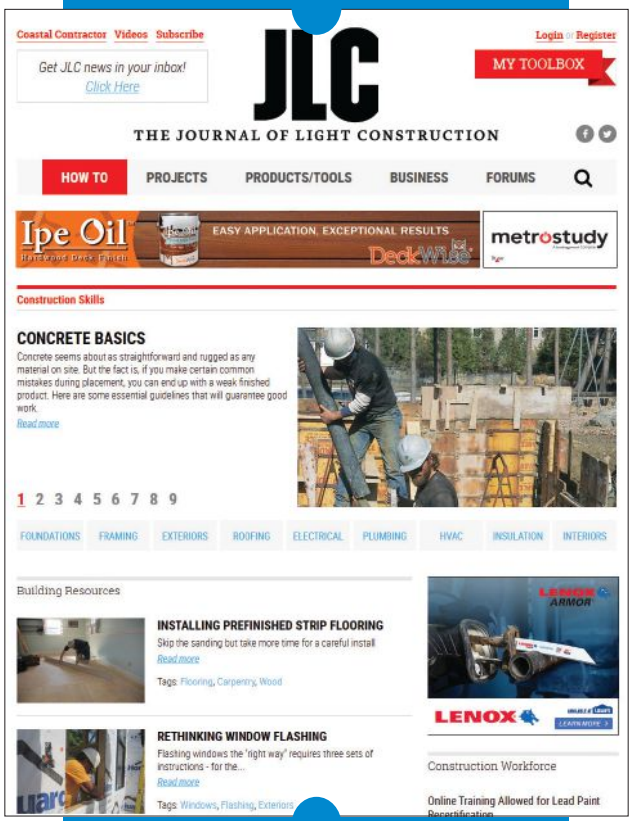
9. Pop-Up Drainage Emitter
Pop-up drainage emitters from NDS provide an outlet for water that's captured by grates, catch basins, channel drains, and gutters, and directed away from structural foundations through drainage pipe. The emitter is designed to open under minimal hydrostatic pressure from water in upstream drainage pipes and close as flow diminishes. During dry weather, it's closed, blending discreetly into the surrounding landscape and keeping debris and rodents from entering drain pipes. Pricing varies by size; a 3-inch pop-up emitter with elbow costs about $22 online. ndspro.com

10. Smart, Green Thermostat
The Ecobee4 smart WiFi thermostat model relies on a remote room temperature sensor with motion detection to sense when homeowners are home or away. The system can reportedly adjust temperatures accordingly and manage hot and cold spots in the home. The company says the Energy Star–certified product saves heating and cooling costs. The model comes with a built-in Amazon Alexa speaker for voice activation; homeowners can also control the thermostat through a smartphone app. The thermostat retails for $250. ecobee.com

11. WiFi-Enabled Dishwasher
Bosch's redesigned dishwashers feature a third rack for extra loading capacity, "EasyGlide" wheels for smooth operation of the racks, tines that can fold or stand up depending on what's being loaded into the dishwasher, an ExtraDry setting with higher water temperatures, and a Speed60 cycle for a quick wash. The dishwasher, along with other kitchen appliances from the brand, will be equipped with the company's Home Connect system, which allows homeowners to remotely control appliances through a smartphone app. Pricing begins at $750. bosch-home.com/us/

12. Built-in Cabinet Lighting
In response to the growing popularity of integrating LED lights in kitchens, Wood-Mode has launched a custom lighting program in collaboration with Häfele LED solutions. Through a three-step process, the program assists designers with planning, selecting, and configuring designs for LED lighting and its wire management, drivers, and switches. The program focuses on seven lighting applications, including interior drawers, under cabinets, and interior cabinets. Pricing varies by cabinet configuration. wood-mode.com

JLC



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hanleywood

BY TIM UHLER

Cordless In-Line Circular Saw

In January, Makita created a huge buzz at the World of Concrete show, in Las Vegas, by demonstrating its new cordless in-line circular saw. Until then, it seemed that a powerful blade-left cordless saw for framers wasn't in the cards. But the Makita XSR01PT looks a lot like the Skilsaw worm drives many of us grew up using, and everything I was seeing on social media suggested it had power comparable to or even better than a corded saw. I found myself wondering: Was this the saw I'd been dreaming about?

FEATURES

The Makita XSR01PT saw is nearly identical in layout to all the other blade-left in-line and hypoid saws we've reviewed over the years. Its rear-handle design is more comfortable to use than a top-handle configuration because you push the saw; top-handle saws involve more pulling and at an odd angle, and they have less reach for cutting rafter tails and sheet goods.

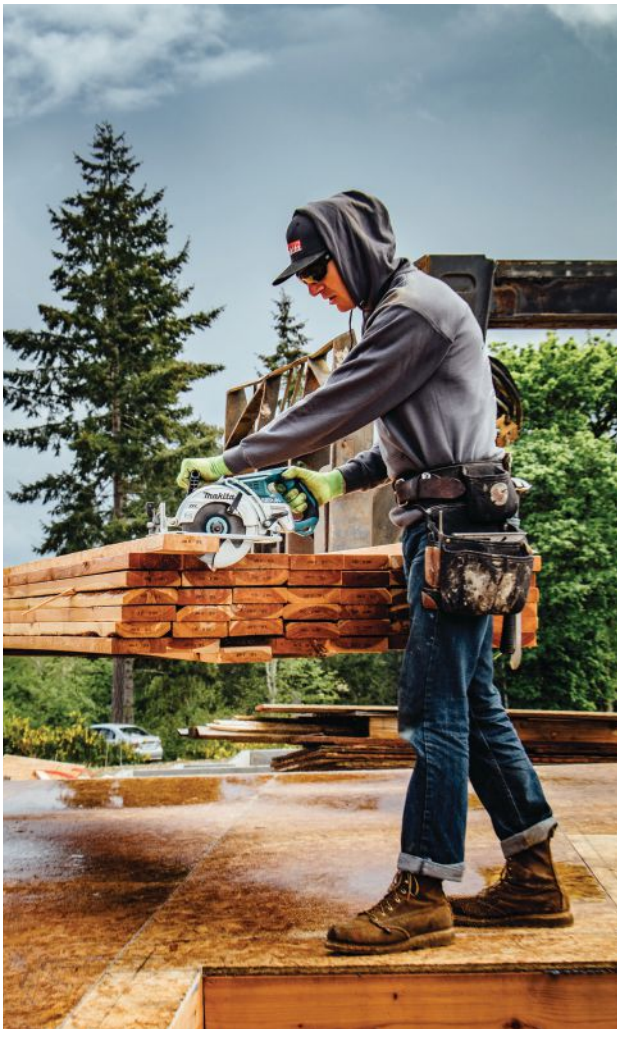
This Makita saw runs off two Makita 5.0-Ah batteries that are stored directly behind the brushless motor and under the top handle. This layout allows for the handle to be placed behind the motor, like on the saws we love out here in the West.

The saw bevels to 53 degrees, with positive stops at 22.5, 45, and 53 degrees. It's designed to use a 7 1/4-inch blade and has a cutting depth of 2 9/16 inches (our Skilsaw cuts 2 3/8 inches). The extra 3/16 means we can use it to cut 2 1/2-inch flanged I-joists; this is a big deal for us because the Makita is much easier on the arm than our Big Foot. And on some jobs, the engineer requires us to use 3-by mudsill or 3-by blocking for straps; with the Makita, we don't need to roll out another tool to make the cuts.

The brushless motor on this saw is crazy small, but it spins the blade at 5,100 rpm, a tad bit slower than the Skil at 5,300 rpm. I haven't noticed the difference in use though. One feature of this motor is that it adjusts torque and cutting speed automatically. Apparently, this helps performance. If I pull the trigger with no load, I can hear the motor adjust speed when it enters the material.

I can get this saw to bog down and trigger the overload protection, but I have to push the saw hard to do it. I was taught that if a saw needs to be pushed, the blade isn't sharp enough, so I try to never push a saw. Doing so wears the saw out, warps blades, and can be unsafe. So the overload protection hasn't been a nuisance for us.

One feature we've come to love is the electronic brake and the relatively soft start, for safety. Unlike a wormdrive saw that will



Pros of cordless on a wet site. According to Makita, its "Extreme Protection Technology (XPT)" improves dust and water resistance in harsh conditions by channeling water and dust away from the internal components. It seems to be working; using this tool in a way-above-average wet spring didn't present any difficulties for the author. And no cord means no tripped power.

Photos by Tim Uhler

twist when the trigger is pulled, this saw doesn't move. I've gotten used to the "kick" on my Skilsaw. The lack of kick, though, on the Makita means I can use it one-handed when I need to trim a rafter tail or even trim a wall plate. The electric brake and lack of kick on startup also make this a safe saw to train new framers with.

The rafter hook is almost 3½ inches, and we can hang it off I-joists and anywhere else we need to. It almost fits over the top plate of a 2x4 wall, but I don't recommend that.

This saw is balanced just like a corded in-line saw. It weighs about a pound more than the Skil but doesn't feel heavy. The batteries are located roughly center, keeping the weight right in front of the handle.

The rubber grip is comfortable to use and allows plenty of room for the user to wear gloves and pull the trigger. In order to activate the trigger, you have to press a button with your thumb—a safety feature on all cordless circular saws. I have gotten so used to the button that when I use other saws without one, I still try to press the button even though it doesn't exist. The depth of cut and bevel have nice large handles, as well, so they're easy to adjust and manage.

PERFORMANCE

Can this saw replace a corded saw for framers and concrete formers who need power to cut dense materials? The answer is, absolutely yes! I can't count the number of times one of us has yelled in joy when making cuts in LVL or dry Doug fir 2x12. We started joking on the jobsite that the attention this saw was getting was going to make our wives jealous.

We haven't found a situation where the Makita made us wish we had a corded saw rolled out; it has as much power as my four-year-old Skilsaw. I've ripped 3-foot pieces of 1¾-inch LVL to try and overheat it, to no avail. Ripping three layers of 7/16-inch OSB for roof sheathing didn't present any problems either. I can get the saw to stop if the material starts binding, but I can also do that to every corded saw I've reviewed.

We loved this saw so much that we immediately bought a second kit. We have six batteries (we had two from a drill/driver kit) and have not yet had both saws down charging. The dual-port chargers claim to charge 5.0-Ah batteries in 45 minutes or less, and that seems about right. Going cordless meant learning some new habits, however; I always put every battery—regardless of charge—on a charger during lunch.

The kit with charger, two batteries, saw, and bag can be found online for about $360. That is about $100 more than the Skilsaw Lightweight Magnesium at $200 plus a 100-foot 12/3 extension cord at $50. But I also factor in the following variables in favor of the Makita: no trip hazard, convenience of being cordless, safety, and no downtime due to cut or nicked extension cords being taken out of service.

I highly recommend this kit. It has plenty of power, is comfortable to use, and makes it possible to go cordless for cutting on a framing site.

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash.

Rear handle means more reach. Like other rear-handle in-line saws, this cordless version allows for great reach while pushing through a cut. Because there's no cord to nick, it also means a safer and more productive jobsite.

Small, brushless, and powerful. Dual 18V batteries sit just behind the motor; a built-in gauge shows their charge level. Despite its size, the motor yields plenty of power to compete with worm drives. A large rafter hook tucks out of the way when not in use.

July Advertising Index

Classifieds

BY JOHN SPIER

As part of a volunteer group, the author helps rebuild a school in Haiti **(1)**. The project included a large pavilion to shelter students from sun and rain **(2)**. The community celebrates completion of the school after an intense week of work **(3)**.

Building a World Away

The country of Haiti, located on the western portion of the Caribbean island of Hispaniola, between Cuba and Puerto Rico, is just a couple of hours from the U.S. by airplane but a lifetime away in cultural and economic terms. The country has been ravaged by centuries of corruption, exploitation, environmental degradation, and more recently, devastating earthquakes and hurricanes. Most of Haiti's 10 million residents live in extreme poverty with little chance for improvement.

In April, I spent a week in Haiti as a volunteer, lending my construction skills to the rebuilding of a school destroyed by Hurricane Matthew. The project was organized by Haven (havenpartnership.com), a nonprofit founded in Ireland in 2007 specifically to work in Haiti. The charity has a full-time presence in Haiti, promoting education and employment, building livelihoods, opening access to water and sanitation, and providing shelter.

On this trip, I joined about 40 other volunteers of all ages and from all walks of life. We hailed from many different countries but shared a commitment to give back to those less fortunate than ourselves. We spent a hard week working long days in hot, humid, and less-than-comfortable conditions.

As one of the few construction professionals on the site, I was tasked with some of the more complex work. Sharing knowledge with and teaching carpentry skills to other volunteers and Haitian workers was especially satisfying. We rebuilt and replaced roofs at the school and built and installed bookshelves along with blackboards, benches, and other furniture. We built a new kitchen facility and a pavilion for the students to escape the intense Haitian sun and frequent rain. We also repaired and equipped an athletic field, and landscaped, cleaned, and painted the entire complex. At the end of seven long days, we had transformed a ruin into an attractive and functional school facility ready for 220 students and their teachers.

The Haitian people that I met and worked with were unfailingly friendly and optimistic. They take their schooling seriously, as education is one of the only routes available to them for betterment and to escape poverty. Every morning, the children emerge from their dirt-floored, tin-roof houses wearing their immaculately clean, pressed uniforms and walk hand-in-hand to school. On our last day, we opened the gates, and the entire community poured in to see what we had done. The palpable sense of wonder, happiness, and gratitude was overwhelming—one of the most rewarding moments in this carpenter's life.

John Spier owns Spier Construction, a building and remodeling company on Block Island, R.I.

Photos by David Cantwell

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