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On the cover: A carpenter with Creative Carpentry, of Austin, Texas, flashes a recessed window opening with a fluid-applied flashing. See the story on page 49. Photo by Matt Risinger.

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BY SUE BURNET

Building Schools

This month, *Training the Trades* takes a look at two of the many building schools that teach construction trades to students at a variety of levels, from aspiring pros to serious DIYers working on their own homes.

HAMMERSTONE SCHOOL, TRUMANSBURG, N.Y.
Maria Klemperer-Johnson started Hammerstone: Carpentry for Women out of her desire to, as she puts it, "work with more people like herself."

It all began when she was young, she explains, working with her father on carpentry projects. After high school, she pursued a more traditional route, of college and grad school, but yearned to do something more creative and eventually decided to give carpentry a shot. She started out in a local cabinet shop, then went on to work for a residential home builder, where she also learned timber framing. In 2005, she and her husband designed and built their own timber-frame straw-bale home.

In 2007, she opened her own contracting company, and a few years later, she established Double Dog Timberworks. Then, in 2013, she started the Hammerstone School, which has ignited her passion for teaching the building trades to women.

All-female approach. In particular, Klemperer-Johnson wants to empower women who wish to develop trade-related skills and find employment in the building industry. She decided on a female-only approach for a number of reasons; the first was to create a "nonjudgmental environment for women

Maria Klemperer-Johnson teaches an all-female class at Hammerstone school. This year, the school will start offering mixed-gender classes as well.

Photo: Alison Usavage



Students attend a Yestermorrow roof-top classroom to learn about solar-panel installation (above left and center), while others work on a framing crew (above right).

to learn." She also wanted to allow her students to shed some of the preconceived societal notions that exist in what is largely a male-dominated industry. She says that her team has received great feedback from students, who have expressed that they deeply appreciate the learning environment she's created.

After school lets out. Although Klemperer-Johnson's initial goals were to try to create a path for more women to move into industry jobs, she has found that many of her students simply want to develop the skills necessary to work on their own homes, to create home projects, or simply to better understand the construction process and lingo so they can feel more knowledgeable and comfortable when dealing with contractors they hire.

But a small percentage of women from the Hammerstone program do transition to carpentry jobs. As Klemperer-Johnson points out, the school is like the construction industry as a whole: You have to pour a wide variety of prospects into a funnel to see who ends up in the jar. And as we've discussed previously in this column, Hammerstone shares the same challenge as most other construction education programs out there: finding people who want to make construction a career.

Klemperer-Johnson says she will continue offering basic skills and specialty project courses, but she is always looking for women who are seeking a path into the construction industry. And beginning this year, for the first time since its inception, the school is planning to offer a few mixed-gender classes, to gauge the response.

To learn more about the Hammerstone School and read about the classes offered, visit its website at hammerstoneschool.com.

YESTERMORROW, WAITSFIELD, VT.

Tucked away in the Mad River Valley of Vermont, the Yestermorrow Design/Build School offers construction trades schooling with a unique twist. Started 36 years ago, Yestermorrow provides a curriculum with a focus on sustainable building practices. The school offers nearly 100 courses, on subjects including sustainable building design and construction, architectural woodworking, energy efficiency, building science, and working landscapes and ecosystems.

Different classes for different skill sets. Because the school has programs for people with a wide range of skill sets and backgrounds, I asked Katie Tomai, student services coordinator, which classes would appeal more to trade professionals. Tomai says there are a number of certificate programs at Yestermorrow that run longer and are more intensive than the week-long classes that are aimed more at owner/builders.

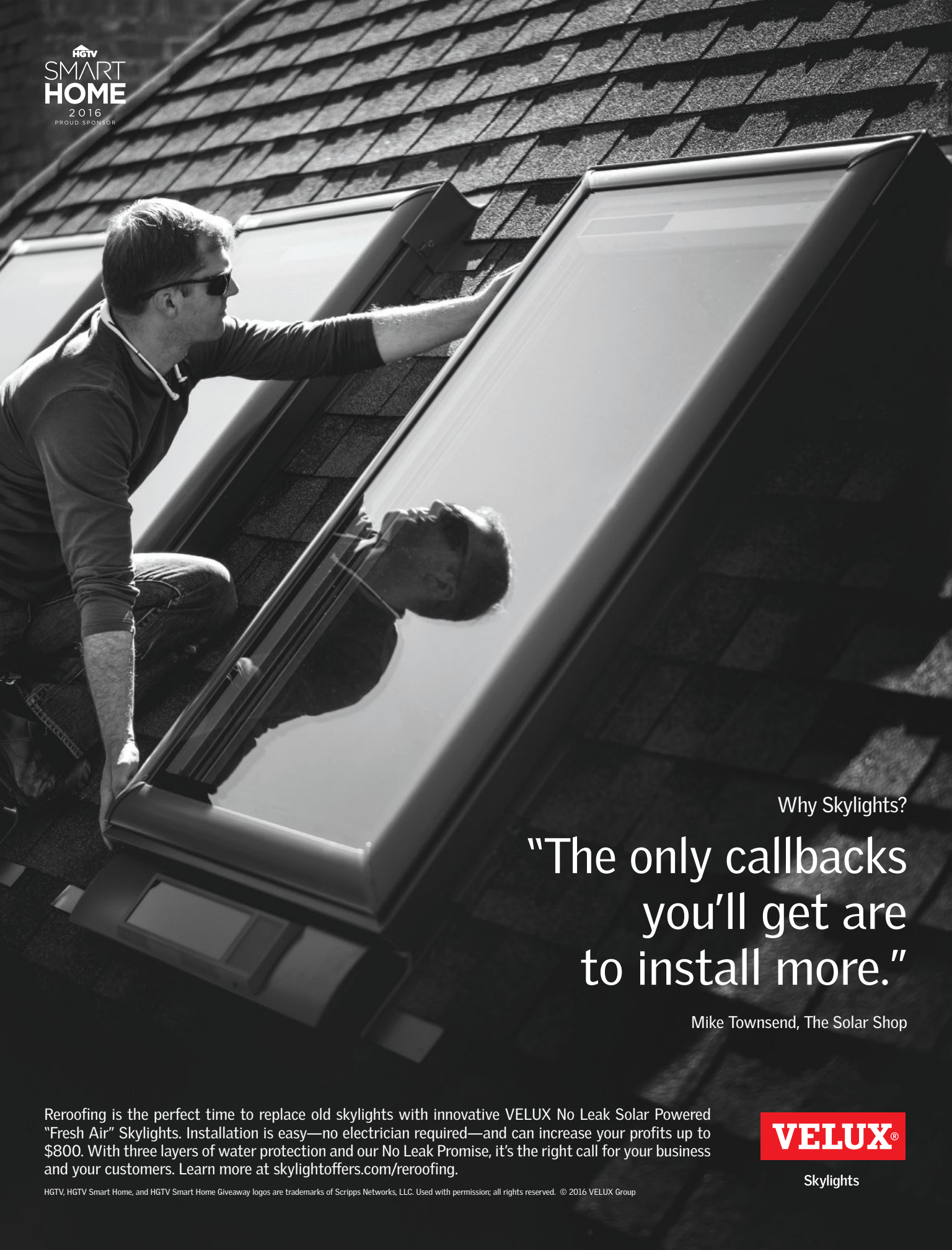
In particular, Yestermorrow offers certificates in Building Science & Net Zero Design, Sustainable Building & Design, Woodworking, and Residential Design & Construction. Admittedly, Tomai says, the courses on Residential Design & Construction may be old hat for many of *JLC*'s readers, but they are great for young people wishing to learn the basics of residential construction or to see if a trade might be a good fit for them. In addition, someone wanting to make a transition to the construction industry from an unrelated field may find Yestermorrow's courses beneficial.

Learning for credit. Many of the classes meet criteria for AIA CEU credits. Yestermorrow also has partnerships for college credits with a number of schools and organizations, including Sterling College, University of Massachusetts Amherst, and Goddard College. And this year, the school offered a Lead Carpenter Weekend Workshop in conjunction with and facilitated by NESEA (Northeast Sustainable Energy Association).

Tomai says that Yestermorrow is in the process of fleshing out its course offerings for 2017, and it is hoping to include more programs that would appeal to professionals in the building trades. You can read more about what Yestermorrow has to offer along with its current courses and programs at yestermorrow.org.

Sue Burnet and her husband, Greg, own Toolbelt Productions (toolbeltproductions.com).

Photos: Mike Ridell



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Q I'm interested in designing and building a two-story house using Structural Insulated Panels (SIPs). Which way should the panels be oriented, and what are my options for attaching the second floor to the walls?

Floor Attachment to Structural Insulated Panel (SIP)

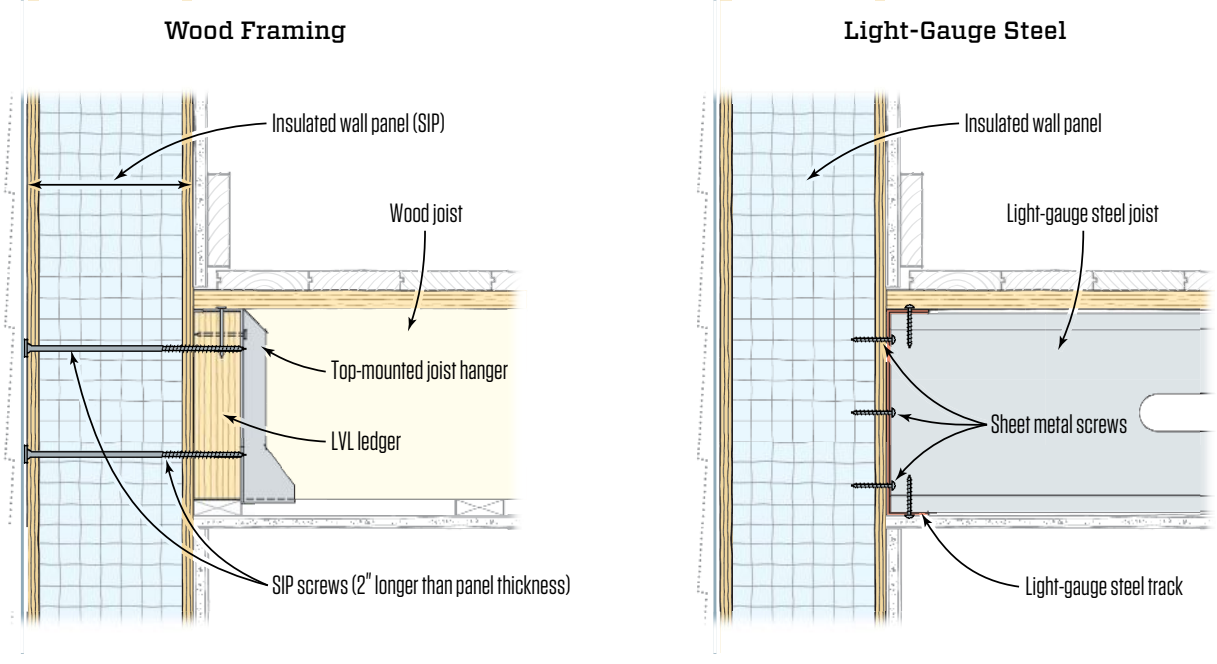

Illustration by Tim Healey

A Bill Chaleff, an architect from Water Mill, N.Y., and a presenter at JLC Live, responds: If you are considering this type of construction, first I recommend that you build the exterior walls with "jumbo" 8-foot-wide panels, standing on end and running the full height of both stories, in balloon-frame fashion. I've been using this strategy successfully for more than 25 years.

BALLOON FRAMING THE WALLS

Balloon framing makes the best use of the panels' most fundamental advantage: resistance to wind and air infiltration. With amazingly few joints and cracks, houses made with SIPs routinely deliver blower-door test results less than 2 ACH at 50 pascals, and there are many documented results of less than 1 ACH at 50 pascals.

Also, should your house design be a New England "half house," the short second-floor walls will act as a cantilever when the walls are balloon-framed; the SIPs will be strong enough to resist both roof thrust and lateral wind loads.

Other advantages to balloon framing with SIPs include being able to weather-in a two-story house very quickly without having to first frame interior walls or the second-floor deck. Using SIPs in this fashion also eliminates all of the through-wall joints that come with platform framing, and it gives you the option of using light-gauge-steel framing on the inside—steel framing has the advantage of always being straight and true, without the warping, splitting, twisting, shrinking, or cracking that can occur with wood

framing members. Additionally, light-gauge-metal framing comes pre-punched for wiring, piping, and small ducts (in the joists).

After you've installed the wall SIPs and roof SIPs, and your house is weathered in, you'll be able to install all the deck framing in a protected indoor environment. At that point, there are basically two options for framing the floors: conventional wood joists or light-gauge-steel joists (see Floor Attachment to Structural Insulated Panel (SIP), previous page). Let's look at wood framing first.

Balloon framing with SIPs makes the best use of their most fundamental advantage: resistance to wind and air infiltration.

WOOD FLOOR FRAMING

Where the wood floor-framing members—whether they're composite joists or dimensional lumber—meet the exterior SIP walls, they should be attached to a ledger, flush-framed (meaning that the tops of the joist are flush with the top of the ledger) and hung on top-mounted joist hangers. The trouble with that strategy, however, is that the horizontal flange of the joist hanger that rests on the top edge of the ledger is usually more than 1 1/2 inches deep. To eliminate this problem, we always specify that the ledger be an LVL.

The LVL ledger is fastened to the inner skin of the SIP by first tacking it in place with 3-inch screws. Then, specialized SIP screws are driven through the wall and into the ledger from the outside. These screws should be 2 inches longer than the nominal wall-SIP thickness, so for a 6-inch-thick SIP, use 8-inch SIP screws. Depending on the loads, the SIP screws may or may not require washers under the head. The spacing will vary according to your engineer's specifications, but I always recommend spacing the pairs of ledger-attachment screws no more than 12 inches on-center.

STEEL FLOOR FRAMING

Light-gauge-steel joists are flush-framed into a metal track. The track is screwed to the inner skin of the SIP with No. 12 by 1 5/8-inch sheet-metal screws, with the spacing and number of screws being a function of the load calculations—but again, the spacing should be no greater than a pair of screws every 12 inches. Be sure your engineer or architect uses the correct shear value for the screws based on 7/16-inch-thick OSB, (the inner skin of a SIP). We use 140 pounds for the sheet-metal screws and 600 pounds for the SIP screws.

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BY CHRIS YERKES

The first shingle for the starter course is scribed to the corner, leaving space for the rainscreen **(1)**. The author uses a block plane to trim the shingle to the line **(2)** and fastens it to the corner. Then he scribes the adjacent shingle to the corner **(3)**, trims it, and fastens it in place to complete the corner of the starter course. The first shingle for the outer layer of the bottom course is kept clear of the flashing below **(4)**. That shingle is scribed, trimmed, and nailed in place, with a final edge tune-up done using a block plane **(5)**.

Weaving Stained-Shingle Corners

Many installers—either from a design standpoint or because they don't want to take the extra time—simply butt siding shingles into corner boards. But I vastly prefer the classic look of woven corners, with the shingle siding wrapping seamlessly around the corners of the house.

Additionally, I think woven corners can make the corner of a house more weathertight than corner boards. You end up with multiple layers of shingles that have alternating seams and that, if installed correctly, can do a better job of keeping water out than a single butt joint between corner boards could.

We recently completed the siding shown in this article on a home for which the owners opted for chocolate-brown prestained white-cedar shingles. The project was a greenhouse addition to the home, and the short section of siding below the greenhouse glazing gives us a good opportunity to look at starting and finishing a corner in just a few courses.

STARTER COURSE

Before I start shingling, I check that the corners of the house are level with respect to each other *and* with respect to the rest of the house. I also check the spacing of the courses to make sure that the exposure will be consistent top to bottom. In this case, the bottom shingles started over the water-table flashing below, and the top shingles tucked under the trim below the greenhouse glazing above.

A corner weave works by overlapping the edges of successive shingle courses to make the corner weathertight. The trick is to keep the overlap seam in each course even and tight and to alternate the direction of the overlap from course to course.

The bottom course on every sidewall shingling project is a double course. The starter course is installed first and is then covered by a second, visible course. The starter course kicks the bottom course away from the wall at the proper angle, and also helps to

Photos by Roe Osborn

To rough-cut a shingle to the scribe line, first score it with a razor knife **(6)**, then snap off the waste **(7)**. When the shingle is fastened in place, fine-tune the edge with a block plane, holding it flat against the adjacent shingle **(8)**. A 6d stainless steel finish nail, driven through the edge and set, finishes the joint **(9)**.

make the first course weathertight.

I usually shingle a building one wall at a time, wrapping the shingles around the corner to guide the courses on the adjacent wall. I run the starter-course shingles over to about 6 inches from the next corner that I will be weaving. Then, leaving about the same distance from the corner, I install the first few shingles of the starter course on the adjacent wall.

The first corner shingle I pick extends past the corner by an inch or so. Holding the shingle in place, I scribe a line on its back along the end of the wall, leaving plenty of room for the rainscreen **(1)**. Then I plane the edge of the shingle to my line **(2)**, and staple it to the wall.

The edge of that first shingle must be trimmed precisely to allow the adjacent shingle to lie flat. If the edge sticks out too much, the adjacent shingle will crack when you fasten it, or the corner will bulge out and the corner seam will open up. And if the edge is shy, there will be a gap and the corner won't be weathertight. So I fine-tune the edge using a block plane, and then, letting my pencil follow the planed edge, I scribe the starter shingle for the adjacent wall **(3)**. I then plane it and fasten it into place.

SECOND LAYER OF BOTTOM COURSE

I hold the first corner shingle for the second layer of the bottom course so that the bottom of the shingle is even with the bottom of the starter course, about 1/4 inch above the flashing. As recommended by Maibec (and as required by the International Residential Code), I offset the shingle edge at least 1 1/2 inches from the nearest gap between shingles in the previous course—in this case, the starter course **(4)**—and I make sure my corner shingles are always a minimum of 3 inches wide.

Using a sharp pencil, I draw a line on the back of the shingle, following the edge of the corner. If there's only a small amount of material to remove, I shave to the line using a block plane, and when the edge of the shingle is nearly perfect, I nail it in place. I do any fine-tuning by making a couple of passes with a block plane, keeping the sole of the plane absolutely flat against the adjacent shingle **(5)**.

Sometimes, though, there's too much material to efficiently remove it with a plane, so I first score near my scribe line using a razor knife **(6)** and snap off the waste **(7)**. Then I plane the edge to the line, fasten the shingle in place, and use a block plane to fine-tune the edge until it's even with the adjacent shingle **(8)**.

FASTENING THE CORNER

I always use stainless steel fasteners—in this case, 16-gauge staples 1 1/4 inches long with a 7/16-inch crown—to attach sidewall shingles. I fasten each sidewall shingle with two fasteners 1 inch up from the top of the exposure line and about 3/4 inch in from each edge. Fasteners should be driven flush, not overdriven.

For corner shingles, I add a third fastener—a little closer to the corner edge and a little lower than the fastener on that side of the shingle. This helps to stabilize the shingle and anchors the free edge at the corner.

I finish the corner on each course by hand-nailing a 6d stainless steel ring-shank trim nail through the face of one shingle and into the edge of the abutting shingle about 2 inches up from the bottom edge **(9)**. I finish by setting the nail flush.

WEAVING SUCCESSIVE COURSES

After nailing in all the bottom-course shingles along the wall, I measure up for

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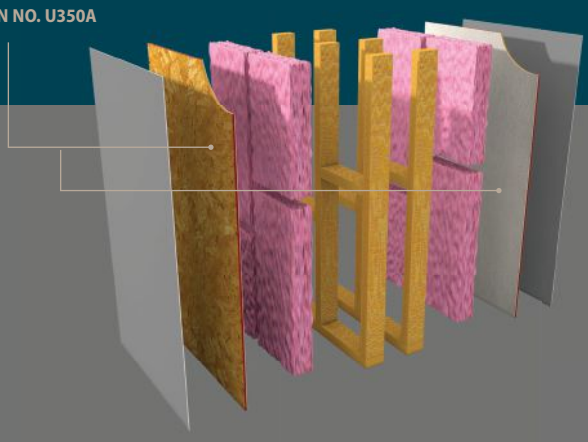

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the exposure I need and draw a level line around the corner **(10)**. It's imperative that the shingles on the corners be installed dead-on level.

Given the water-table trim on this project, I trimmed the bottom-course shingles before fastening them because I couldn't plane to the bottoms of the shingles after they were installed. But in most cases, I fasten the shingles first and then trim them flush, which is what I did with the successive courses.

To create a true shingle weave on a corner, the direction of the seam needs to alternate from course to course. For this corner, the seam on the bottom course faces the front of the building, which means that the seam on the next course needs to face the side of the building.

I trim each corner shingle as before, doing the rough cut with a razor knife **(11)**, and planing the edge even with the corner. Then I apply and trim the facing shingle, as described previously. On a larger job, I might use a mini-router with a bearing bit to rough-cut the edge, letting the bearing ride on the adjacent shingle. But even with a router, I would finish the edge with a plane.

A level line guides each following course **(10)**. Trim shingles in place using a razor knife **(11)** and a block plane. A corner notch lets the top courses slip into a rabbet in the trim above **(12)**. At the top, the cutting is completed with a knife **(13)**. The top course is hand-nailed **(14)**. A coat of matching stain finishes the corner **(15)**.

TOP COURSE

I continue to install the shingles up the wall, alternating the direction of the seam with each course. Near the top of the wall, the shingles must be cut shorter, and for these courses I usually cut enough shingles for the entire course to the proper height on a table saw.

With this project, the top courses of shingles fit into a rabbet on the back of the trim. I build these corners as I did the ones for the lower courses, but I notch the upper corner of each shingle so that it slips into the rabbet **(12)**. That lets me cut and plane the shingle in place.

I fasten and trim these corners the same as I did the ones below, planing as much as I can and then using a razor knife to trim the very top **(13)**.

The final course must be face-nailed **(14)**. Some contractors try to get away with a finish nailer for this step, but I prefer the control and the clean, finished look of hand-nailing with trim-head nails—which are also much better at holding the shingles than finish nails. I snap a line across the course in non-permanent chalk to keep the face nails in a neat, straight line. The corner for the top course is fastened and trimmed the same way.

FINISHING

When the entire corner is finished, I check all the edges and smooth out any minor irregularities with a block plane. At this point, I'm shaving off tiny slivers.

When I'm happy with all the edges, I apply a healthy coat of matching solid-color stain to any bare wood **(15)**. I make sure to get the exact stain from the shingle manufacturer so that the corners blend in seamlessly with the rest of the shingles when the stain dries. I also dab a little stain on the heads of all the exposed nails, making them all but disappear.

Chris Yerkes owns Cedarworks, in Brewster, Mass.

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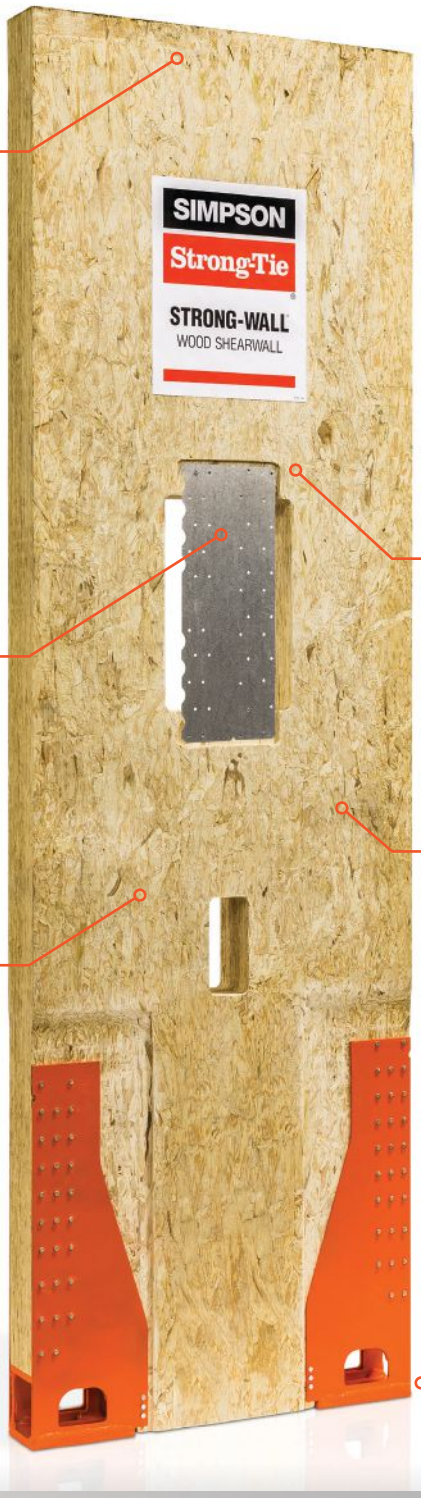

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Working on the flat roof of an existing building, Rob Paisley and his crew lift panels of National Gypsum eXP gypsum board into place for a fire separation wall **(1)**. The wax-impregnated product is designed to resist months of outdoor exposure during construction. Two layers of 1-inch material will provide two hours of fire protection. Shown here, the second layer must be slipped into the narrow space between the existing structure and the new building **(2)**. Steel H-studs slip over the edges of the gypsum board to hold it in place **(3)**.

Two-Hour Fire Separation Wall

BY TED CUSHMAN

Portland, Maine, is like many cities on the Atlantic Coast: In the popular parts of town, housing is scarce and property values, along with rents, are rising. In the older, fully built-out parts of the city, developers are looking for high-density solutions. In many cases, the answer is an infill project. Outdated, older single-family homes are being torn down, and the few small remaining empty lots are being developed to support shoulder-to-shoulder multifamily construction.

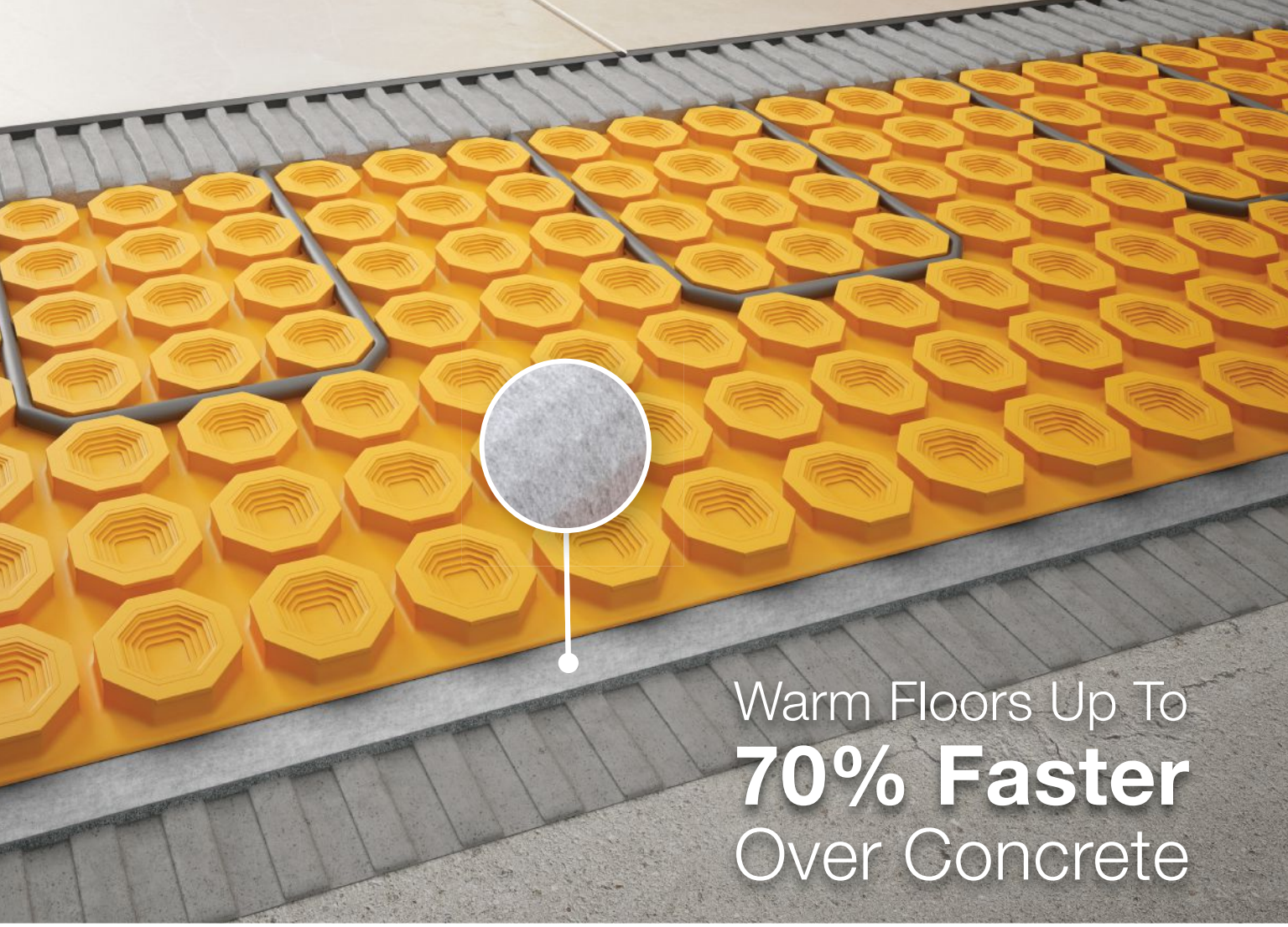
Last month, *JLC* showcased the balcony structure of a new four-unit apartment building in Portland, built on a tight lot with close setbacks. This month, we'll take a look at a nearby building under construction that's not just close to the neighbor—it's touching it (well, almost).

We talked with contractor Rob Paisley on site during the framing of the new apartment building. The property is sited on a double lot, adjacent to an existing building that dates back to the 1800s.

A recent change in the neighborhood's zoning allows the developer to build a new four-story structure directly abutting the older house. But while that zoning change was pending, Paisley renovated the existing house. Now, he's constructing the new building next door.

"When you do that," Paisley explained, "the new structure has to be completely isolated from the old one." To accomplish the required fire separation, Paisley and his framing crew built a typical two-hour firewall (in Paisley's phrase, a "burn wall") between the two structures as they framed the new building.

Photos by Ted Cushman



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This isn't the only fire-rated wall in the building. The building's two stairwells and its elevator shaft are each isolated from the rest of the structure with two-hour fire-rated assemblies. That was a challenging problem, said Paisley. "There is no plate-to-plate connection anywhere in this building," he said. "It literally has to be broken everywhere, which makes this hard."

With no wood-to-wood connections, keeping the walls straight and plumb has had its own difficulties. And with four occupied floors above the garage level, topped off by a walkable rooftop patio, resistance to lateral loads is also a concern. "This project encompasses every bit of residential and commercial you'd be likely to see in one building," said Paisley. "It could be a crash course for somebody who has never done it before."

Paisley beefed up structural assemblies in several places—for instance, adding shearwalls in the garage level and applying structural sheathing to both faces of some wall assemblies. For the wall backing up the two-hour gypsum-panel assembly, Paisley's crew installed old-school diagonal bracing between the studs.

As the new building rose next to the old one, the two-hour fire separation assembly had to be pieced together in between. That's accomplished using light-gauge-steel H-studs and C-runners, attached to the wood framing with aluminum breakaway clips. The 4-foot-by-2-foot pieces of gypsum board slip into the channels of the vertical H-studs and horizontal C-channels, and are secured lightly to the metal with screws. Then the metal framework is attached to the wood framing of the buildings on either side using the aluminum clips.

The gypsum board is tested to hold up for two hours in the event of a fire, allowing time for occupants of adjacent buildings to evacuate and for firefighters to extinguish the fire. If fire spreads into the wood walls on either side of the firewall (and the assembly works as designed), the heat of the fire will melt the aluminum clips only on the affected side, so that collapsing stud walls on that side would not pull down the firewall.

Ted Cushman is a senior editor at JLC.

Paisley uses metal screws to pin the H-studs and C-channel to the gypsum board **(4, 5)**. At each stud location, he places a heat-softenable breakaway aluminum clip **(6)**. He then screws the clip to the C-channel **(7)** and to the stud **(8)**. If a fire should cause a structural collapse on one side of the wall, the clips would melt and allow the wood to fall away, leaving the firewall intact to protect the other building.


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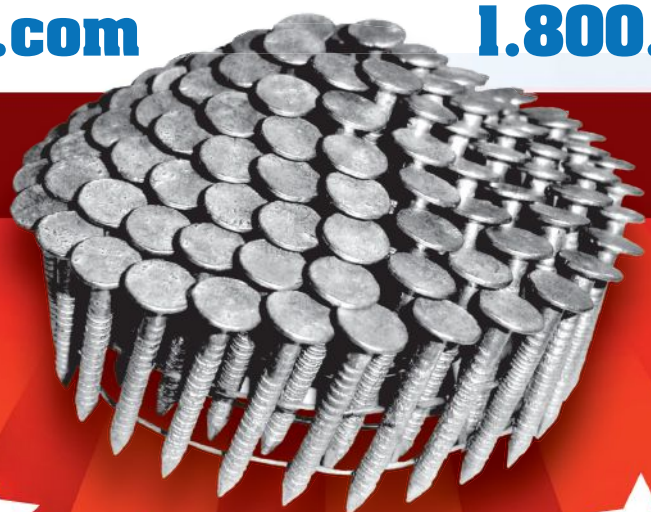

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BY MELANIE HODGDON

Ten Tips for Improving Cash Flow

Too many companies go belly up not because they aren't profitable, but because they have poor cash flow. With an unhealthy cash flow, you may need to delay payments—antagonizing your subs and suppliers—and you may end up paying interest on cash (by drawing on your line of credit or, far worse, your credit card). On the other hand, a healthy cash flow means you can keep up with your bills and stay on good terms with your subs and suppliers, as well as take advantage of date-driven discounts.

Here are 10 simple tips for keeping your business in the black.

FUND PROJECTS WITH CUSTOMERS' MONEY

This seems so obvious, but at least once a week I discover yet another contractor funding his customers' projects. The strategies are somewhat different depending on whether the job is a contract price or T&M; the first three tips below relate to contract pricing, while the fourth applies to T&M.

1. Get an initial payment at contract signing. Even though it may feel like you haven't spent any money yet, you will certainly be spending it before the job starts. You will be planning and perhaps preordering, and even if these tasks are treated as overhead in your company, you're still investing money in the project. It's easy to sell this deposit as a good-faith payment to hold the customer's place in your schedule. Be aware that some states regulate the amount that can be requested for a deposit.

2. Base milestones on the start, rather than the completion, of a task. If you have tied a 25% payment to "completion of drywall" and there's one piece of drywall sitting uninstalled next to a wall because of a last-minute change to the electrical, you'll be stuck. It's far better to have the payment tied to "delivery of drywall" or "ready for drywall installation." This also protects you from delays created by unexpected back orders. If those imported Italian tiles get hung up somewhere (or arrive broken), you'll still get your money.

3. Get payment for change orders at time of signing. Hopefully, you have already trained your customer to know that contracts are associated with a financial obligation. Get payment up front to cover not only the actual cost of the change order, but also the additional time and effort (think overhead) required to estimate and write up the change order, order materials, connect with subcontractors, adjust schedules, and so on. Waiting until the end of the job means the company will subsidize the change work and present the customers with an unpleasant surprise at the end of the project—just before you ask them to write you a nice testimonial.

4. Avoid subsidizing T&M jobs. By definition, T&M jobs are based on actual costs (and hours of labor) invested in the project. However, this also means that the company can end up subsidizing the project during the gap between the accrual of the cost and payment by the customer. The more time between payments, the larger

Healthy cash flow means you can keep up with your bills and stay on good terms with your subs and suppliers, as well as take advantage of date-driven discounts.

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this gap is. The best way around the problem is to request a deposit to cover costs incurred between the signing of the contract and the presentation of the first T&M invoice. Companies handle such deposits in a variety of ways. Here are some options.

- Credit the entire deposit to the first T&M invoice. This is not recommended, because you lose the advantage of having a significant new influx of funds.
- Credit the entire deposit to the final invoice. This works well as long as the deposit doesn't exceed the amount of the final invoice. If that happens, you'll be sending your customer a refund check, which sends a message to the customer that you really didn't need the amount you charged them.
- Credit percentages of the deposit to subsequent invoices. For example, if you have estimated a job will take six weeks and your contract states that you will invoice every week, then credit back one-sixth of the deposit amount to each invoice.

If you wait until the end of the project to get paid for a change order, you will be presenting an unpleasant surprise just before you ask your clients to write you a nice testimonial.

USE TIMING TO YOUR ADVANTAGE

For many contractors, the challenge isn't paying, it's paying *now*. Given another two weeks, they'd have the cash. Controlling when bills are due is one step toward being able to meet your payment obligations. Here are some suggestions.

5. Work with big-ticket vendors (such as insurance companies) to position your payments away from other large payments. For example, if you are making estimated income tax payments out of your company in January, April, June, and September, see if you can shift

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the due dates for your workers' comp premium away from those months.

6. Get two credit cards, with statement periods a half-month apart. For example, if Card A's cycle ends on the 15th and Card B's cycle ends on the 30th, then you can split payments into two parts two weeks apart, to give you additional time to accumulate cash.

7. Control withdrawals. If the owner/partner/officer of the company takes a regular draw, schedule it so it doesn't coincide with payroll.

8. Schedule sub payments to your advantage. Create a subcontractor agreement that controls when you will pay bills. For example, your agreement may state that any bills received between the 1st and the 15th of the month will be paid on the 18th of the month; bills received between the 16th and the last day of the month will be paid on the 3rd of the following month. Engineer the schedule so that sub payments don't align with other large payouts.

9. Watch discount dates. Always take advantage of discounts; if it means saving $2,000 on a materials bill, it may even be worth it to draw on your line of credit for a few days—although in theory you should already have your customer's cash in hand in time to make the payment.

TAKE CONTROL

Ben Franklin said, "A penny saved is a penny earned." Obviously, if you spend less, you'll have more on hand to reduce potential cash-flow crunches.

10. Do comparison pricing regularly. Can you negotiate a lower cellphone bill? What about health insurance? When was the last time you discussed discounts with a supplier? The marketplace is constantly changing, with new plans and options. Check them out.

Life is filled with enough uncertainties—the ability to pay bills on time shouldn't be one of them. If you enact some of the strategies listed above, you may discover that you can exercise more control over cash flow than you realize.

Melanie Hodgdon is owner of Business Systems Management (melaniehodgdon.com).

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BY DOUG HORGAN

Photos by Doug Horgan

A Leaking Patio Above Living Space

Patios over occupied rooms are a popular amenity in our market, offering a combination of privacy and outdoor space. But rooftop patios present technical challenges. The bulk-water-management details are complicated. And because those details often involve intersections between various building assemblies that have to be constructed in the proper sequence by different trades, they're tricky to coordinate.

In the case of a remodeling job, such as an addition, where a new patio roof has to be tied into the walls of an existing building, the issues can get particularly complicated. My example in this article is just such a case: water-management problems in a rooftop patio that was built as an addition to an existing house.

I was called in to troubleshoot a walkout basement room, surrounded on three sides by the house and its wings, with visible leaks in the ceiling and walls. To make things more interesting, this room contained an indoor swimming pool, which we thought might have been contributing to a condensation problem in the walls or ceiling. But condensation didn't seem to me to be the most likely suspect. The pool had an automatic cover and a really good dedicated dehumidification system. And in fact, on closer inspection, the pool had nothing to do with the water damage. Instead, the problem was easily traced to incorrect waterproofing and drainage details where the rooftop patio met the main house walls, and especially where the patio roof passed over the outside wall of the lower-level room.

There was a lot of messy staining around windows in the front wall, which usually indicates that water in the wall above the windows is leaking through the head and around the jambs. Similar staining appeared to originate from cracks in the ceiling, and also ran down the inner wall opposite the windows.

EXPOSING THE DAMAGE

I used a pinless moisture meter and a thermal camera to locate wet areas. Then I opened up the ceiling in the worst spots and found lots of water damage and staining, especially in the roof structure near the front wall and windows with all the staining. To check for rot, I stabbed the joists and headers with a jab saw; the saw easily sank into an LVL, indicating severe rot.

When we stripped off the soffit and fascia at the eaves, where the patio slab crossed over the lower

Telltale water staining showed up at the base of the wall, but was traced back to leaks at the top of the wall **(1)**. Stains in the ceiling **(2)** were tracked back to their origin using a moisture meter **(3)**. When the drywall was removed, the stains and moisture damage were evident **(4)**.

wall, the nature of the problem became clear. The lead photo (see previous page) shows the edge of the waterproofing that runs under the patio slab, on top of the structural framing and sheathing. The detail consists of bituminous peel-and-stick membrane with a layer of 6-mil poly on top of it. The bituminous material laps down onto the end of the roof structure at the top of the framed wall, and the plastic sort of flops down over that. Both of them stop at that point.

Any water that soaked through the concrete slab and reached these waterproof materials would travel along until it reached the edge of the building, then it would drool down into the end of the roof framing and onto the wall. There was no attempt to collect, manage, or drain the water. So the roof near the wall and the wall itself had become saturated. Naturally, the untreated wood was rotten.

It's hard to know what somebody's thinking was in constructing an assembly like this, but many people don't understand that water will penetrate the concrete in this situation. The top surface of this slab had been treated with some kind of waterproofing at some point, as if the idea was to block all the water on the top surface. Whatever the intent, the reality was that water penetrated the slab, reached the plastic and the membrane, flowed to the edge of the building, and soaked into the wood. At that edge, there was extensive damage. In the field, toward the center of the ceiling, the wood remained dry and intact.

There was additional damage localized below the railing posts, another typical trouble spot. It appeared that the post-base waterproofing was faulty. Wood posts are difficult to waterproof; we steer toward round metal posts that we can durably waterproof, or we attach rails into the outside of the structure, past the waterproofing.

We also uncovered mistakes around the other three edges (the two sides and the back of the patio). The patio waterproofing wasn't well-connected to the walls at those junctures either. The back wall of the pool room, originally built as the exterior wall of the main house, was 8-inch-thick structural masonry, which is more fault-tolerant. It consisted of an outer layer of brick and an inner layer of 4-inch concrete block, with soldier courses every six courses in the brick exterior to tie the two walls together. The masonry didn't soak up much moisture, and in any case, it was rot-proof. The side walls were newer construction: wood

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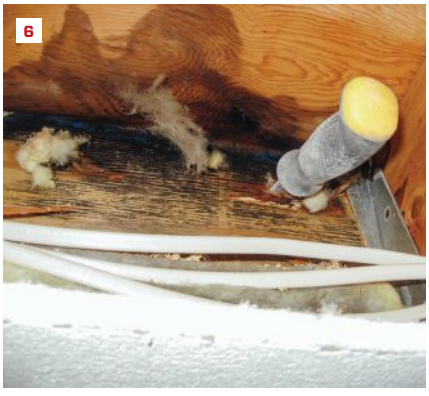
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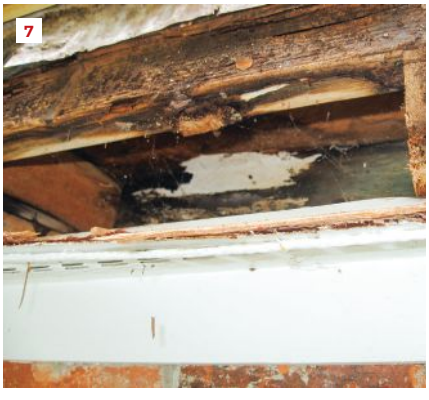
With the ceiling cavities opened up, it was clear that water had entered the roof from the brick-veneer wall above **(5)**. Damage to the framing had progressed alarmingly: a jab saw sank easily into an LVL framing member near the front wall **(6)**. Opening the eaves revealed serious flaws in the waterproofing details **(7)**. Rather than tear out and rebuild the existing roof and topping, the owners chose to construct a new room above **(8)**.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8

framing with a brick-veneer cladding, with building paper over the wood walls and a drainage cavity behind the brick. This had leaked and damaged the ceiling drywall below, but the wood framing was in decent shape, so the leak was apparently not as bad as at the edge. The severe damage was mostly limited to the front wall and the outer portion of the roof structure.

A BETTER WAY

If we had built this patio, we would have used our standard details for tying low-slope roofs to masonry walls. On the sides, we would have continued the deck waterproofing all the way to the side walls and tied it into the drainage plane on the side walls with a properly lapped waterproof detail. On the back wall, where the roof had to tie to double-wythe masonry, our typical detail is to cut a groove into a horizontal mortar joint and to insert flashing into that groove, waterproofing with adhesive sealant. That detail does involve some risk, however, and we would provide the owner with a disclaimer.

At the front of the wall, we would have continued the waterproofing membrane out past the wall and tied it into a drip-edge that was outboard of the exterior trim. Additionally, we would have provided gutters and downspouts to capture that water, as well as water flowing off the surface of the slab, and direct it safely down to the ground. That would keep the water from dripping onto the brick, where efflorescence from the concrete could stain and discolor the brick. Post bases would have been fastened before waterproofing, with provision made for free drainage and good weeps, so that there wouldn't be a constant presence of standing water or moisture next to the waterproof layer.

In order to repair the problem at this point, we proposed demolishing the whole slab and replacing it, as well as repairing the rotted portions of the roof and outside wall structure, using appropriate water-management and waterproofing details. But the homeowner suggested instead that we build a new upper-story room and tie the roof of that room into the existing house roof. So that's what we did: We removed the entire slab and the eaves trim and constructed a new second story for the building. In photo 8, you can see the roof structure under construction.

Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company in MacLean and Middlebury, Va.

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BY TED CUSHMAN

Tesla Powerwall: Not Just for Solar

It has been almost a year since Tesla Motors introduced the Powerwall, a backup battery power source for homes and small businesses. Now, Vermont's public utility, Green Mountain Power (GMP), is starting its pilot program to install 500 Powerwall units for customers.

And as *JLC* learned from GMP executive Josh Castonguay, the Powerwall isn't just a cool accessory for homeowners with solar panels on their roofs. Whether it's paired with a solar array or not, GMP sees the Powerwall as a practical way to protect rural homeowners against local power outages, and also as a way for the utility to match the variable loads in its service area to the variable solar and wind sources that now make up more than 15% of GMP's generating capacity.

JLC recently went on site with electricians Scott Millette and Brian Ritz (Peck Electric, Burlington, Vt.), to see a Powerwall installed in a home. Millette has been installing and servicing electric-car recharging stations for GMP for several years. Putting in Powerwalls is a little different, he said, "but I have no trouble grasping it."

Electricians Brian Ritz (left) and Scott Millette (right) use a floor jack to maneuver a 214-pound Powerwall unit into place in a Vermont home. The battery is only rated for temperatures down to -10°F, so it can't face Vermont winters outdoors.

Photos by Tim Healey

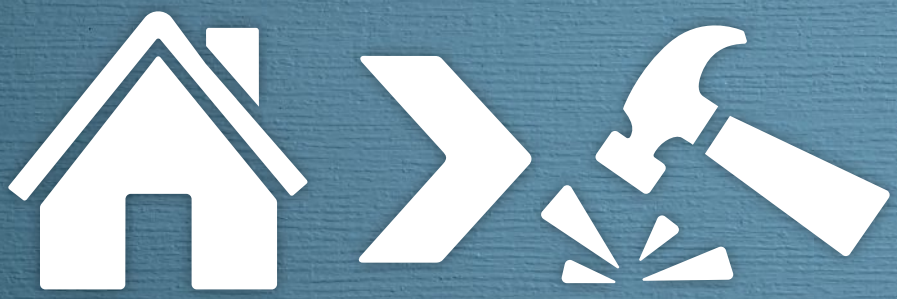
It's not just the Powerwall. The Peck Electric crew needs to install a whole assortment of components to support the battery's multiple functions (see illustration, page 41). The heart of the system, of course, is the battery itself—a 214-pound, 51.3-inch-by-34-inch-by-7.2-inch unit that arrives in its own plywood crate. The electricians bolt a steel mounting rack to the wall, jack the battery into place, attach it, then remove the crate and protective plastic wrap.

Next, the installers mount a "StorEdge" inverter supplied by SolarEdge, a major manufacturer of inverters for home solar systems. The inverter converts DC to AC power and vice versa, as needed to charge the battery or to draw power from it. The inverter has two modules: one that does the current conversion, and one that handles switching to feed power into the battery or draw power out of it, and to direct AC current to household backed-up loads, main loads, or into the grid. Wired to the inverter is a small transformer serving the backed-up circuits (this component is necessary to provide consistently regulated 120-volt current and grounding). In backup mode, the transformer feeds regulated power through the "load center"—a small breaker box similar to a subpanel, with circuit breakers for the individual backed-up circuits in the home.

Helping to manage all these devices is a "smart meter," which monitors and reports on current flows throughout the system, enables GMP technicians to communicate with and control the battery and the inverter, and alerts the power company to any malfunction.

The example shown here is a simple backup power system for a house with no site-generated energy. If the house did have solar panels, they too would be wired into the inverter. In that case, the electricians would also equip each rooftop module with its own "power optimizer" designed to improve the efficiency of the inverter. The smart controls would allow the power company to direct solar-panel output as needed to household loads, into the battery for later use, or out to the street.

Grasping the ins and outs. By the middle of May, Scott Millette had installed seven Powerwalls—"probably more than anybody else in the country," he told *JLC*. With a three-man crew, he said, the process takes about a day and a half. "It's actually a very user-friendly install," Millette said. "With every install, we learn new tricks, and the process becomes easier. But it's not difficult."



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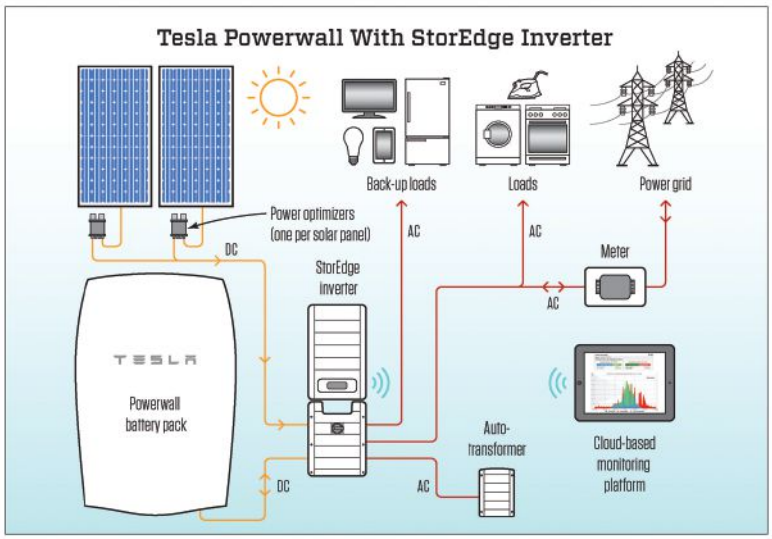

The StorEdge inverter handles AC/DC power conversion, managing solar-panel output as well as charging or discharging the Powerwall battery. The inverter directs AC output to backed-up circuits, the home's main loads, or the grid in response to signals from the GMP smart meter.

Non-electricians, however, may not find the Powerwall setup so easy to understand. In principle, a battery is simple: It's a power storage device. You can charge it up, and you can run it down. But a house-mounted Powerwall is a little more complicated than that, because it's capable of serving multiple functions—which is why it comes with an elaborate control system.

For starters, if the electric company offers off-peak rates, the battery could store up power during off-peak periods and let the homeowner use that power during on-peak periods. Or, if the homeowner has solar panels, the battery can store up solar power during the day so the homeowner can use it at night, when there's no sun. The battery can also provide limited backup power to a house in case of a "service interruption," or power outage (the main selling point for most people).

That emergency backup function is nice—and it's multiplied many times over for houses that do have solar panels. Homeowners are sometimes surprised to learn that "grid-tied" solar panels usually don't serve as backup power during an outage. Typically, the panels are set up to cooperate with the grid—and when the grid goes down, the panels quit working too. But in a Powerwall-equipped house, the panels can stay engaged; the battery and its associated control systems serve to smooth out the peaks and valleys created by intermittent sunshine, and keep a steady supply on hand for the house. So if a weather event or some other mishap knocks out a home's utility service, solar panels paired with the Powerwall could keep the home running indefinitely, at least on partial power.

The utility side. But all that is still only half the story. Battery storage also offers value to the power company—that is, if they can share the control of it. Even before Powerwall came along, Green Mountain Power was already investing in battery storage—not for one house at a time, but on a utility scale. The Stafford Hill Solar Farm, built on a landfill in Rutland, Vt., has 7,700 solar panels covering 15 acres of land. That's 2 megawatts (MW) of power in full sun, and

The Peck Electric crew connects the StorEdge switching module to a power transformer. Supplied with power from the battery through the StorEdge unit, the transformer will maintain clean, grounded 120-volt current for backed-up loads in the case of a utility power outage.

it's coupled to 4 MW of battery storage in a local microgrid. The microgrid is connected to a Rutland high school, providing an emergency shelter in case of a disastrous power failure.

The U.S. Department of Energy put up seed money for the Stafford Hill project, but GMP invested the lion's share of the project's cost. Vermont regulators approved—because GMP persuaded the state that it will quickly earn its money back and reap savings for ratepayers. That's because GMP gets charged an annual "capacity" fee by regional power-grid managers, based on the power Vermont pulls from outside providers during the region's annual peak hour of use. The fee is Vermont's share of the cost of keeping generating plants on standby so that peak loads won't overwhelm the system. If the utility can supply its own standby capacity and call on its big battery bank to help out during that one peak hour of the year, it can avoid some of that penalty fee.

The utility can also reap value by purchasing power when it's cheap, and storing it for use during high-cost periods (what's called "arbitrage"). GMP generates a lot of its own power, but it also buys power from other suppliers on the regional grid. The prices for that purchased power can change by the hour, as demand fluctuates. In fact, late at night when demand drops off, some regional generating companies who operate plants that are hard to shut down are stuck with extra power that they have to get rid of, even if they have to give it away—or even pay someone to take it. So with its big battery bank at the ready, GMP can sometimes get paid money at 2 a.m. to store power that it can turn around and sell for full price at suppertime the next day.

Batteries are also an effective way to perform a function called "frequency regulation" on the power grid. Alternating current is supposed to be generated and transmitted in a nice, uniform wave-form at 60 Hz (60 Hertz, or 60 cycles per second). But a lot of factors can create interference and distortion on that smooth wave—noise that can impair the function of motors or electronic

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Scott Millette pulls cable into the smart meter box from the home's main panel. To the left of the panel is the load center with breakers serving the home's backed-up circuits.

devices. Very well-controlled power generators, such as some gas-turbine power stations, can help "clean up" that "dirty" power on an entire network. But it turns out that batteries are the best frequency-regulating technology going. GMP could get paid by other utility providers to use its Stafford Hill facility to help clean up grid power—not a huge income stream, but something the power company is considering.

A distributed solution? All these functions, in theory, could also be performed by batteries like the Powerwall, scattered around in houses—as long as, that is, the batteries can be centrally controlled, or "dispatched," by the power company. And that's where Vermont's "smart grid" comes in. GMP has already installed "smart meters" throughout its service area. Long run, the utility could use its web to manage thousands of scattered batteries and solar panels, as well as managing local loads—for instance, turning electric water heaters on and off as supply and demand on the grid fluctuate—to smooth out consumption and production curves, and potentially save money for everyone using the grid.

For now, GMP is focusing on the power backup and load-shaving potential of the Powerwall, and it's proposing to share the cost with homeowners based on that split. The homeowner pays part of the cost of the battery and gets a few hours of backup for critical loads if the power goes out. The power company pays for another share of the cost (as well as financing the deal), and in return gets some ability to "dispatch" the battery for its own purposes: avoiding capacity charges for peak use, and buying and storing cheap power during off-peak hours. If consumers prefer, they can buy the battery outright and not share control with the utility; but GMP expects most people to opt for the sharing arrangement instead.

Ted Cushman is a senior editor at JLC.

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Fluid-Applied Window Flashing

As close to foolproof as it gets for recessed openings and other complex flashing details

BY MATT RISINGER

The first time I saw a "liquid housewrap" being installed, I was skeptical. I figured that a painted-on version of housewrap would never be as good as the "real" thing. But whenI heard of it being used as a replacement for the origami-type work normally required to flash a recessed window, the light switched on for me.

Fluid-applied weather barriers and flashing membranes have been around for more than 10 years, mainly in the commercial building world. But I feel like it's just been in the last two years or so that they have started to gain traction in the residential world.

I've gravitated to using fluid-applied flashing mainly for window and door flashing, and particularly for recessed windows and for "outie" windows on houses with thick exterior insulation—applications that are extremely challenging to do with flexible membrane flashings for even the most experienced craftsman. And even if you have someone on the crew with the talent and patience to do a good job, it's painstaking and time-consuming, making fluid-applied flashing cost-effective for complex flashing jobs.

Photos by Matt Risinger

SORTING OUT LIQUID MEMBRANES

There is a wide selection of "fluid-applied" or "liquid" membranes designed as alternatives to building wraps and flexible flashing products. The market is a bit confusing because it is still very much oriented to the commercial world. The term "fluid-applied membrane" is used for a variety of materials, the most prevalent of which are spray-on weather-resistive barriers (WRBs), often referred to in the commercial market as simply "air barriers." (For commercial construction, water control is largely managed by a rainscreen facade, while air leakage is controlled by an "air barrier" applied to the structure beneath the facade.) Many of these are formulated specifically for concrete structures (either above or below grade), and some of these commercial barriers are two-component systems that must be mixed on site, adding a level of complexity that I don't see catching on in the residential market.

For windows and other detail flashing, I'm usually looking for a liquid flashing membrane sold in either caulk tubes or sausage packs. Sometimes the brush and roller formulations are sold in

Many builders are unsure about what to do with recessed openings. Driving by this site, the author stopped to look at the detailing on a large, recessed arch-top window. From a distance, it was evident it wasn't flashed well **(1)**. The opening had been flashed with a peel-and-stick material, the window unit installed, and then the housewrap simply folded over the returns **(2)**. Recently, on one of his own sites, he showed up to find his framing sub had done something similar **(3)**.

buckets. (The commercial spray-on products are sold almost exclusively in 5-gallon buckets and 52-gallon drums.) Manufacturers often (but not always) offer two varieties of the fluid-applied flashing membrane suitable for window flashing: a thick, high-solids formulation (often around 50 mils wet) for gunning into corners and seams, and a thinner product (25 mils wet or less) for brushing or rolling onto the "flats"—the jambs and sheathing surfaces around the window opening.

Here are some of the single-component, fluid-applied compounds suitable for window flashing, but I'm sure there are other products available:

Carlisle BarriBond is available in 20-ounce sausage packs. It is a high-solids material that can be used by itself for window flashing (gunned into the corners and troweled out on the flats) or used with Carlisle's roller-applied BarriSeal-R fluid-applied membrane, which comes in 5-gallon pails.

DuPont offers Tyvek Fluid-Applied Flashing and Joint Compound—a thicker compound for corners and seams—and the thinner Brush Formulation for the flats. Both are available in 28-ounce cartridges, 10-ounce tubes, and 3.5-gallon pails.

Henry Air-Bloc LF is a single-component liquid flashing, sold in 20-ounce sausage packs. This one product can be used for corners and seams, and then troweled out to cover the flats.

Huber makes Zip System Liquid Flash. Available in 20-ounce sausage packs and in 29-ounce cartridges, it is also intended to be applied to corners and seams and troweled out to cover the flats.

Polyguard makes a thick joint filler called Blue Barrier Liquid Flashing 2100 (available in 20-ounce sausage packs and 2-gallon pails) and a thinner

To remedy the botched window job on his site, the author worked with the local Tyvek distributor. The housewrap was peeled back and FlexWrap applied along the edges of the recessed opening and over the window flanges **(4)**. Next, Tyvek Flashing and Joint Compound is gun-applied into the corners **(5)**, followed by a second, more fluid product—Tyvek Brush Formulation **(6)**—to create a seamless membrane around the entire window.

roller-grade material—called Flash 'N Wrap 2400 (available in 5-gallon pails)—for the flats.

Prosoco offers FastFlash in two formulations—a gun-grade product available in 20-ounce sausage packs and 29-ounce cartridges, and a roller-grade material sold in 2-gallon pails.

HOW NOT TO DO A RECESSED WINDOW

We see a lot of recessed windows in my area in Austin, Texas, particularly on Tuscan-style or Spanish Colonial homes where the windows are recessed to give the impression of an extra-thick masonry or adobe wall. Nearly all these homes are wood-framed and have stucco exteriors that wrap back into the window well.

Recessed windows are basically a set of two window openings—a larger opening that returns into the wall to a second, recessed face, in which you have the window rough opening. The way builders typically detail this stepped opening is shown in the photos on pages 50 and 52: First, they install a peel-and-stick membrane (or worse, a laminated-plastic-and-paper flashing, which doesn't hold up well to UV light and usually begins to deteriorate before the job is completed). The jamb flashing is folded around all the corners and crevices in the recessed window well. Then, whatever WRB is used on the walls is folded back into the window well after the window unit has been installed.

Often the window is left like this for the stucco crew to pin down the flaps with lath. Sometimes it's taped off with sheathing tape, or occasionally another layer of peel-and-stick is applied to cover the window flanges and lap out onto the face of the sheathing. But no matter how many layers are

Unsure of what to do on a Zip System wall, a builder simply installed wide pieces of a paper-and-plastic-laminated flashing tape, which he planned to secure with Zip System sheathing tape. This detail would likely have deteriorated quickly and become a homeowner's nightmare. With almost no roof overhang on this house, these openings will be exposed to a deluge of water.

piled on, there are going to be myriad gaps—and probably reverse laps as well.

GETTING RECESSED WINDOWS RIGHT

The first time I used a fluid-applied water barrier, I was building a house for which the architect had specified deep window recesses. In the past, I'd used DuPont FlexWrap for these tricky waterproofing details. DuPont has good instructions, but even for the most astute installer, the origami can be confusing. So, I asked my local DuPont rep to meet me on the jobsite to show us how its fluid-applied flashing materials worked for a recessed window.

DuPont makes three viscosities. The thinnest (runniest) is a fluid-applied weather barrier that is meant to be sprayed on the bulk of the building's field. We haven't used this product, only the two fluid-applied flashing formulations—the thicker, higher-viscosity Flashing and Joint Compound and the thinner Brush Formulation, which feels like a slightly thinned latex caulk. Neither of these liquid materials will stick to any Tyvek building wrap, so all the transitions from the wrap need to have either FlexWrap or StraightFlash as a bridge. We used FlexWrap for the outermost portion of the window as usual, then gunned a heavy bead of the joint compound into the corners. We followed this by applying Brush Formulation, which comes in a quart tube, squeezing out a zig-zag bead and painting it out on the jambs, head, and sill. I was amazed at how easy these products made what is otherwise a very difficult detail—no more folding flexible flashings into corners and hoping the installers got the overlaps correct.

Recently, I drove by a house under construction, and as I always do, I slowed down to scope it out. On that project, the builder was using the Zip System for his sheathing and weather barrier. And like so many houses around here in Austin, it had recessed windows, but it was a fairly modern design and had almost no roof overhang.

I work only on architect-designed homes and have done my share of modern homes with no overhangs. A deep, 2-foot roof overhang will do a good job at shielding (and shading) windows, and I think deep overhangs make the most sense in our climate. But when you build for architects, you have to respect their design decisions, which are often driven by a wide range of factors that appeal to the owner, and climate is almost never one of these. Our job as builders is to just make the design work.

I could see right away on this build that the windows were not being done very well. The builder was using a paper-and-plastic-laminated flashing that is not very sturdy to begin with, and that disintegrates rapidly when exposed to UV light. I see it used all

Reaching out to a fellow builder, the author brought in his own framing sub to demonstrate how to flash the recessed windows. Using the Polyguard Blue Barrier system on one window, a carpenter first applied the thicker of two flashing compounds—Joint Filler 2200—into the corners and to fill the gap between the exterior sheathing and the framing. He then brushed on the thinner, Flash 'N Wrap 2400 **(8)**. The goal is to create a seamless membrane that covers the entire jamb, all surfaces of the recessed opening **(9)**, and the face of the surrounding exterior sheathing **(10)**.

over the South. On this job, as is common practice on windows, it was just stapled to the jambs before the window units were installed. My guess is that the builder was just going with what he'd always seen done; I doubt he was trying to be cheap. In our area, the weather barrier and the window flashing are usually done by the framing crew, and unless you work with your subs on specific detailing practices, they are, understandably, going to do what is most commonly done.

I decided to approach the builder as humbly as I could to introduce myself and tell him what I have learned about flashing recessed windows. Surprisingly, he was very receptive to hearing me out and seemed to appreciate the insights I had to offer. Because I was working on this article, and wanted to use the example in my video blog, I offered to bring my own framing crew over to demonstrate two different products I had samples of—Polyguard Blue Barrier system and Huber Zip System Liquid Flash. As long as the builder would let me film and photograph the demonstration, I didn't mind paying my sub a little extra for the job. The photos on this page and the next show how we applied the two different flashing systems. After the windows are installed, the flanges will be coated with more Liquid Flash.

WAY OF THE FUTURE

I've been following the research at the University of Texas Construction Science Durability Labs, where multiple samples of all types of WRBs and flashing compounds are undergoing durability testing. The products have been installed on test racks and exposed to the elements for more than

On a second recessed window, a carpenter demonstrates the use of Zip System Liquid Flash. For this product, Huber went with a trowel-grade, single-component material that has a viscosity somewhere between a joint filler and a brush formulation. Step one is to apply a thick bead of Liquid Flash in all the corners and seams, then apply multiple beads on the flat surfaces of the jambs and the step created for the recessed opening, and on the face of the sheathing **(11)**. These beads are then smoothed out with a trowel **(12)**.

two years. For me, the big takeaway from this research is that fluid-applied and adhesive-backed WRBs along with thick-mil fluid-applied WRBs and flashings are the future of water control in our industry. They're easy to apply and they eliminate the potential for reverse laps. And as important, the testing shows that they hold up better over time, even when exposed to UV—which is a big deal in our climate. On big jobs that take a long time to finish and when subs are busy and take a while to get to a job, the water-control materials are exposed for extended periods. This is why I have become a big fan of Polyguard AlumaFlash, which can be left exposed indefinitely, and of the thick-mil fluid-applied materials that are formulated for the commercial markets to resist UV light much longer than residential-grade materials.

Fluid-applied flashings cost a lot more than your average peel-and-stick. We're paying around $27 for large cartridge tubes; the Zip System Liquid Flash costs on the order of $36 per cartridge. But with it, we don't need to put the highest-paid carpenter on the job. And when I asked Jeremy Martin, a fellow builder in the Austin area, about this cost, he said about a recent job, "I didn't even consider the cost. My client is an attorney, and I know that one leak would cost 50 times what the initial cost for the fluid-applied will be." Aside from the cost of dealing with a leak down the road, the peace of mind alone is worth it.

Matt Risinger owns Risinger Homes, in Austin, Texas, and is a regular contributor to JLC.

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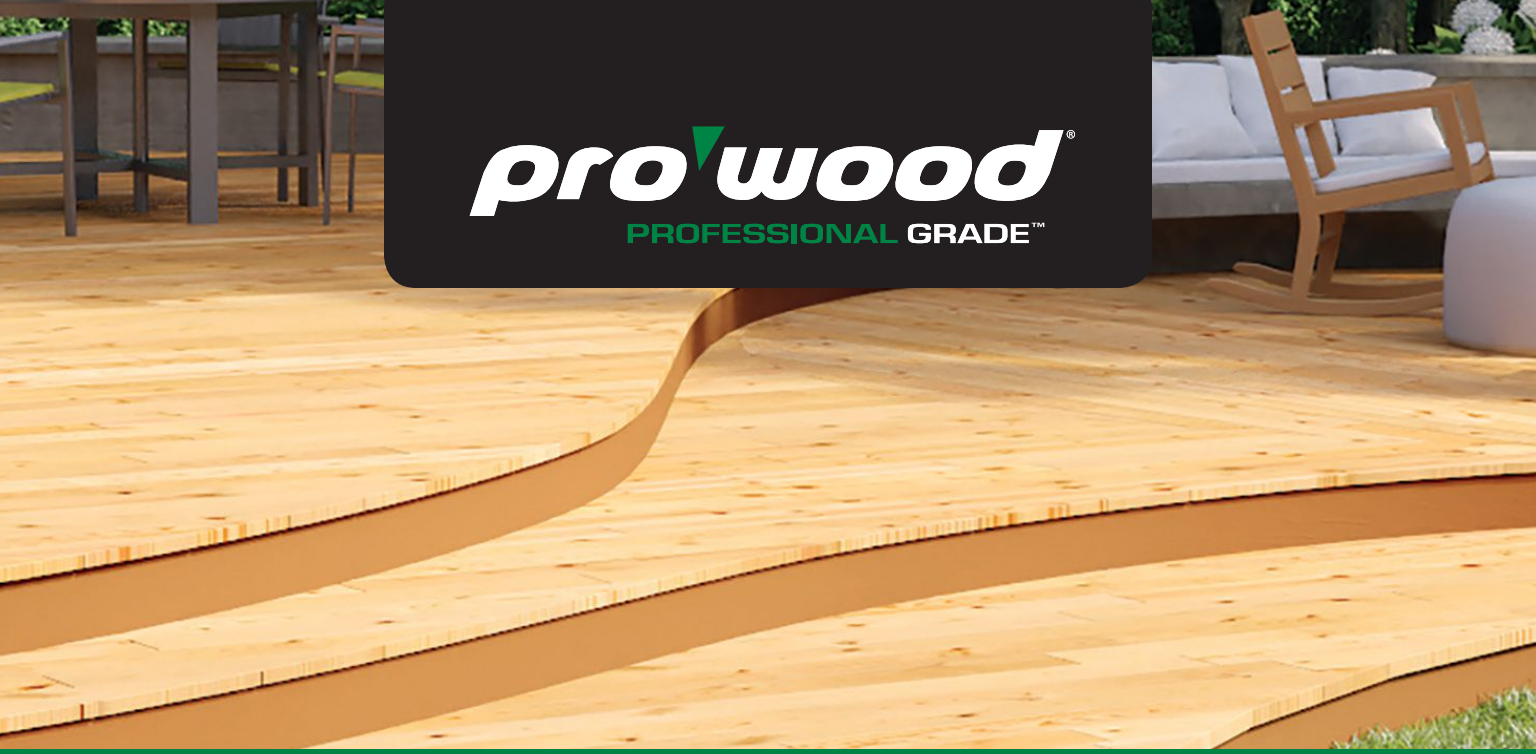

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Building and Raising Exterior Walls

One crew's methods for running an efficient job

BY MATTHEW ANDERSON

In the previous two issues of *JLC,* I wrote articles covering the processes of snapping layout lines for exterior walls ("Layout Lines for Exterior Walls," Apr/16) and of laying out the plates for exterior walls ("Layout for Exterior Wall Framing," May/16). Now it's time to build those walls.

PREFRAMING FABRICATION

Tim Uhler pointed out in his excellent article "Efficient Framing" (Mar/16) that "high-quality framing and production comes from good organization and planning," and I could not agree more. As with Tim's crew, we have a crew hierarchy with one "crew chief," or lead carpenter, who is in charge. On our crew, the lead carpenter worked with an experienced assistant doing the layout. After the layout was finished, both carpenters jumped in immediately to help the rest of the crew finish the preframing fabrication work.

Every person on our crew has access to the plans, but instead of working directly from multiple sets of plans, we prefer to make a master list of all the parts that need to be built. Then each crew member copies the list for whatever parts he is making. On the list are the quantity and the length of every framing member that will be used to build the walls.

Typically, one person makes all the headers. Unlike our colleagues on the West Coast who have ready access to thicker stock such as 6x8s, we make our headers from built-up layers, depending on the thickness of the wall framing. For 2x6 framing, headers are made from three layers of 2-by stock and a layer of 1-inch solid foam insulation **(1)**. As each header is assembled, the crew member writes the length on the header, stacks it with others that are the same length, and then crosses it off his list.

In a different area of the jobsite, another crew member cuts sills and cripples. Cripples are the short studs that fill in the framing

Photos by Roe Osborn

below window sills and above headers if needed. Each different window rough opening has its own size sills and cripples, and in most cases, there are many windows of the same size in a home. The crew member in charge of cutting these pieces works at a chop-saw station, where he can use a stop to make repetitive cuts **(2)**. Working off the list, he cuts, labels, and stacks pieces in piles according to their length and function.

We cut all the jacks (trimmers) for the window and door openings. These are nailed to full-length studs and then stacked **(3)**. We generally do all the built-up framing required for prescriptive wind codes as the walls are being assembled. We also preassemble the corners **(4)**. We make our corners U-shaped out of three 2x6s, with scraps of 2x6 nailed at each end to keep the "U" spread properly. Because of the many jogs in this house, we made a total of 10 corners for the first-floor walls. The L-shaped partition backers are also preassembled and stacked.

Most of the houses we frame use wall studs that come precut to a length of 92⅝ inches from our lumber supplier. This length makes the interior walls the right height for two sheets of drywall without our having to piece in a narrow strip. Using precut studs not only saves us the time it would have taken to saw the boards to length, but also eliminates a ton of wasted wood. The exception to this is an area such as a garage where the walls are built on a stem wall rather than on a sheathed deck. The exact length of these studs is determined on site, and they need to be custom cut. For such studs, we cut a pattern with a stop nailed on one end. The crew member cutting the studs then simply butts the stop to the end of the stock, draws a line, and cuts the board to length **(5)**.

Most of the houses we frame are multistory and are built on full-depth poured basement foundations. Solid, safe stairs help the framers work much more quickly and efficiently, so we usually build the stairs as part of the prep work. Even if the contractor has called for a custom staircase, we build and install temporary stairs to allow crew members to move between levels quickly and safely. It's easy to determine rise and run from the plans, and once a pattern stringer is made, a carpenter can usually build a set of stairs in less than a half-hour **(6)**.

ASSEMBLING THE WALL FRAME

By lunch break, layout was done and most of the parts were cut and ready to go. At that point, one of the lead carpenters began building the walls. The first walls we choose to frame are the ones

that extend all the way to the edge of the deck—in this case, the front and back walls of the house. The end walls fit in between those walls and are built after the first walls are raised. The front of this house was actually three walls separated by short jogs. To work efficiently, we assembled all three walls at the same time.

After removing the tacks that held the plates together during layout, we line up the edge of the bottom plate with the snapped line, making sure the ends are 5½ inches from the layout line for the intersecting wall (or even with the layout for one of the jog walls). The tacks keep the plate in place while the wall is built and raised. The bottom plates are then tacked to the deck every 3 feet or so **(7)**. The top plates are set on the deck more than the distance of a stud length away so they won't be in the way during assembly.

The first framing pieces loaded in are the king/jack stud combinations, which are set in place for the sides of each opening in the three walls. Based on the number written in the opening, the person loading the parts also grabs the right-size header and sets it in the opening. Working down the walls, we nail the king/jack studs to the bottom plates. Then, the headers are snugged into place, nailed through the side of the king stud, and toenailed to the jack as well **(8)**.

Corners, partition backers, and full-length studs come next, and the person doing the loading grabs them from their respective piles and sets them in place near the layout marks. When the walls are loaded, he nails these pieces to the bottom plate, working from one end of the house to the other. After nailing the last corner, he jumps up on the deck, scoots the top plates over to each of the walls, and nails them off one at a time **(9)**.

Cripples and sills for the window openings are next in line. One framer grabs the proper-size pieces from the piles and distributes them to their respective openings. As these are set in the openings, the crew member positions one of the two sills against the bottom plate and transfers the layout for the cripples from the bottom plate onto the sill **(10)**. The other sill stays in the opening until installation.

The cripples are nailed to the bottom plate. Then, lining up the cripples with the transferred layout lines, we nail them to the sill **(11)**. A second sill completes the framing for the rough opening. The wall height for this house worked out so that short cripples were also needed between the top of the

header and the top plate. These short pieces are cut from scrap and nailed into place on the layout **(12)**.

SQUARE THE FRAME

Once each wall is framed, we check to make sure it's square. We measure diagonally corner-to-corner and adjust the wall by moving the top plate (along with rest of the framing) one direction or the other **(13)**. For this step, our measurements have to be absolutely the same.

When the wall is perfectly square, we toenail through a window header to keep the wall in position while it is being sheathed. One tack is sufficient for shorter walls, but we may tack the wall in two or three places for longer walls. These tacks need to be removed before the walls are raised.

After squaring each wall, we nail on the second top plate. This second plate overlaps from wall to wall to tie the walls together. Depending on the wall configuration, either we hold the top plate back the width of the wall framing (in this case, 5½ inches) or we leave a longer section out that is installed later, extending over the end of an adjacent wall.

This house was built in a high-wind region and plans call for the sheathing to be installed vertically for shear strength. The plans are specific as to the placement of the plywood sheets. Typically, plans call for full sheets to span the openings whenever possible and to start at least one stud bay from the end of a wall. Ripped widths fill in the ends. We usually run the sheathing to the top edge of the second top plate unless plans call for a different strategy. If there is a second floor, we use metal straps to bridge the sheathing between the two floors to provide uplift resistance.

We lay the sheathing panels on the wall framing one by one and tack them to the frame with a nail at each corner **(14)**. When all the sheathing is tacked in place, we cut out the openings for the windows **(15)**. We've found that the quickest way to cut openings is using a bearing-guided flush trim bit in a heavy-duty router. We simply plunge the bit through the sheathing and then rout the opening, letting the bearing ride along the framing of the rough opening.

When the window and door openings are cut out, we go back and nail off the sheathing. To comply with the high-wind code, we drive nails 4 inches on-center for the perimeter nailing (including around all openings) and 6 inches on-center in the field. The sheathing has to extend down to cover the


10


11


12


13


14


15

deck framing when the walls are standing, so we trim off the excess sheathing along the bottom edge.

RAISE AND BRACE THE WALLS

Before lifting, we have the wall braces and the laser level ready. The last thing we do before lifting the walls is remove the tacks that we drove to hold the wall square. You'll know pretty quickly if you've missed any.

For most walls we build, a crew of four provides plenty of lifting power to raise them into position. Most walls are light enough that you can drive a hammer claw into the plate and lift it to get a grip. For longer, heavier walls, we slip blocks under the plates to get the most positive starting grip. On rare occasions, we use a telehandler to raise large, heavy walls, such as a tall gable wall. A coordinated effort sets the wall upright in just a few seconds.

After the wall is up, we check to make sure the bottom plate is right on the snapped layout line. If it needs to be moved in or out, a persuasive tap with a sledge hammer usually does the trick. At that point, the bottom plate is nailed to the deck with two nails at the base of each stud. (Some crews are not quite as careful where they drive these nails, and many an electrician or a plumber has cursed out such framing crews after hitting a nail while drilling a hole through the plate in the middle of a stud bay.)

While one or two crew members hold the wall upright, the others work quickly to attach braces. There are many methods for bracing walls, including spring braces and scissor braces that use lumber that's on site. We prefer using the adjustable metal braces from Proctor (proctorwalljacks.com) that attach to the top plate and angle back to the deck. After getting the wall close to plumb by eye, we nail the bottom of the brace to floor framing. We then set a laser level on the bottom plate and adjust the brace in or out until the wall is perfectly plumb **(16)**. We put in one brace every 4 to 6 feet.

It's important that the braces are nailed into floor joists (not just the deck) for maximum strength. This is easy for the walls that run perpendicular to the joists. If the wall is parallel to the joists, we nail a 2-by scrap across two floor joists and then attach the bottom of the brace to that.

SMALL WALLS ARE SHEATHED LATER

Smaller walls with no openings do not need to be built and lifted like the walls just described. It's usually easier to build them on the deck near their

final location. Then one person can lift them and scoot them into place. On the front of this house, the small walls help to tie the three jogs together. With only studs and corners, these walls go together and slip into place quickly.

Because the ends of these short walls lap onto adjacent walls, it's easier to build them without sheathing. Later, a crew member goes around the house, filling in all the missing spaces.

To nail the corner intersection between two walls, nails are always driven through the last stud on a wall and into the corner assembly of the adjacent wall. We try to make sure the plane of the wall continues evenly through the end of the adjacent wall, so we use toenails to align the studs at the corner.

SPECIAL STRATEGY FOR THE GARAGE

By the end of that first day, our crew of four had built all but one exterior wall. The next day, most of the crew went to work on the garage, while one of the crew finished up that final wall.

The garage presented a unique problem because the walls sat on top of stem walls—there was no flat surface to build the wall on. In cases such as these, we create a temporary support for the wall by setting staging planks on top of piles of 2-by scrap **(17)**. The top plate lies on top of this support and blocks on top of the stem wall next to the mudsills support the bottom plate.

The wall is built in the same progression, with the king/jack assemblies and full-length studs done first and then the opening details added afterward. The wall is squared, sheathed, and raised as before, but this time there isn't a place to attach the metal braces to. Instead, we use a 2-by to brace the wall. The two-car garage was wider than the longest framing stock we had, so we sistered two boards together to span across the garage diagonally for the brace **(18)**. With a calm wind, one brace was sufficient to hold the wall steady until other garage walls were built, which then effectively braced the ends of the first garage wall.

BEARING WALL

A 2x4 bearing wall in the middle of the house was the last wall to be built along with the first-floor exterior walls. No sheathing was required for this wall, so it was pretty light. Because of the weight factor, this wall can be built anywhere there is enough room on the deck, then raised and slid over to its layout line. Once it's in place, we nail


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off the bottom plate and nail the end stud to the intersecting wall.

We brace the wall plumb as before, but at this point, we still haven't squared the bearing wall so that the ends are plumb. To do this, we first attach a metal brace to the intersecting wall and draw it in or out until it's plumb. This in turn makes the bearing wall square and the end of the wall plumb. Then we nail on a diagonal 2-by to keep the wall square and plumb.

With an experienced framing crew, many tasks happen simultaneously, and crew members know to move to the next item on the list. So while two crew members work on the bearing wall, one crew member jumps on filling in the remainder of the doubled top plate, while another installs the sections of sheathing that had been left off during wall construction. This person also has the task of finding any nails that might have missed their mark, which he bangs back through from the inside. Not only are errant nails dangerous for people who do work in the stud bays, but they are also a red flag to an inspector that the sheathing might not be properly nailed in that spot. This framer goes back and re-nails any areas where the nails missed and makes sure that every sheathing panel is completely nailed off.

STRAIGHTENING WALLS

The final task before we can start framing the second floor is straightening the walls. In the past, we have rigged up elaborate strings and blocks, but we've run into problems because of irregularities in the material. Despite our best efforts, there were always places where the walls weren't completely straight, and the strings always seemed to be in the way as the framing continued. We discovered that the best way to straighten the wall is by eye.

Here is where the adjustable braces really shine. One of the crew stands on a ladder and sights down the edge of the top plate, and a second crew member literally dials in the walls by turning the screw adjustment to make micro-adjustments at every brace **(19)**. With braces every 4 feet, we can usually make most walls perfectly straight very quickly. On the rare occasions that a wall bends in or out in between braces, we either reposition the braces to the trouble spots or simply add another brace. These braces usually stay in place until the second-floor deck is framed.

Matthew Anderson is the owner of Anderson Framing and Remodeling, a building company based in East Sandwich, Mass.

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Working Lead-Safe

Containment and cleanup can safeguard clients and their children, but are we doing enough to protect ourselves?

BY TOM O'BRIEN

None of us are getting any younger. And for some remodelers, the years seem to have taken a heavier toll: High blood pressure, kidney trouble, memory problems, mood disorders, and erectile dysfunction are all age-related maladies. But each of those is also a symptom of lead poisoning. If you work on old houses and haven't been as scrupulous with your personal protection as you have been with your containment measures, you might not be as old as you feel. And it's probably not too late to do something about it.

THE TROUBLE WITH LEAD

Lead is not nuclear waste. In solid form—be it a car battery, a water pipe, or an intact paint film—it poses no danger. But if it's broken up into tiny particles, small enough to be absorbed into the bloodstream, it becomes poisonous. "Lead is medically classified as a poison when it gets in your body; so it's not a hazardous material, not a cancer-causing product, it's a poison," says Peter Lawton, a former remodeling contractor, who founded LeadSmart Training Solutions after a doctor informed him that his blood lead level (BLL) was dangerously high.

To function properly, the human body requires trace amounts of metallic nutrients such as iron, magnesium, and calcium. It has no use for lead, but is unable to distinguish it from the others. So if a lead molecule is floating around in the bloodstream, and there isn't enough calcium to go around, the body will grab hold of the lead and plug it into a place where it just gums up the works (sort of like hiring your out-of-work brother-in-law for a stain-grade trim job).

In young children, the effects of lead exposure can be devastating and permanent because it interferes with brain development. Adults who have ingested extreme doses of lead in a short period of time have also suffered irreversible damage, from heart attacks, strokes, and organ failure. Most adult lead poisonings, though, are of the chronic variety, caused by small exposures that build up in the body over time, giving rise to the symptoms mentioned above that mimic those of aging.

Other health problems that chronic adult lead poisoning can

Photos by Tom O'Brien except where noted

Capture lead dust at the source using vacuum-attached power tools. If a tool wasn't engineered at the factory for dust-collection, aftermarket manufacturers, such as Dustless Technologies (maker of the recip-saw attachment shown here), might be able to provide a retrofit dust shroud **(1)**. Costing about the same as a top-of-the-line miter saw, a negative air machine significantly reduces airborne pollutants, making the jobsite safer and the cleanup easier **(2)**. This BuildClean unit **(3)** pulls air from all sides, first through a prefilter and then through a HEPA filter, before clean air is discharged through the port at lower right in the photo above. For lead-safe operation, this port must be hooked up to a discharge hose to eject the filtered air outdoors.

lead to include type II diabetes and nerve damage. "Lead will actually situate itself in the synapses between nerve endings and slow down the transmission of a signal through your body's nervous system," says Daniel Askin, president of ESCA Tech, a manufacturer of testing and cleaning products for the lead industry. For instance, some people with lead poisoning "have noticed that, if they decide to pick up a pen, they have to wait for their hand to start moving," he adds.

GOT LEAD?

Studies have theorized that lead could be absorbed through the skin or the eyes if either of these organs is damaged or bleeding, but no evidence of poisoning as a result has emerged. Generally speaking, lead gets into the body in one of two ways: by ingestion (eating or drinking) or inhalation.

Ingestion is the cause of most childhood, paint-related lead poisonings. Dust accumulates on surfaces—because of poor housekeeping practices, lack of proper maintenance, or sloppy renovation work—and it gets on children's hands and is ingested when they put their fingers in their mouths. Adult workers are less susceptible to this type of poisoning, unless they eat or smoke without first washing their hands and face.

Inhalation is generally how workers are most at risk. "Dust in the air is responsible for most of the instances of adult lead poisoning," says Ronald Kraatz, senior manager of Connecticut Children's Medical Center's Healthy Homes Program. He adds that the amount, and the toxicity, of the dust "are directly related to the method you're using to get loose paint off."

An open flame or a high-temperature (+1,100°F) heat gun is the most dangerous method of paint removal because it creates lead fumes, which are not gases, but tiny dust particles (less than 1 micron) that are small enough to penetrate into the deepest recesses of the lungs where they are easily absorbed into the bloodstream.

Sanding, scraping, and grinding produce larger dust particles that aren't as easily sucked deep into the lungs and are more likely to be trapped by the cilia and coughed up. But if you inhale enough of it, some of this dust will get into the bloodstream, and some of what's coughed up will get a second chance if it's swallowed.

DETERMINING YOUR BODY BURDEN

For contractors who often work on houses where lead paint is likely to be present, regular blood testing is the best way to determine if they, or their employees, have a chronic lead problem. "We recommend that you get your Blood Lead Levels tested

Photo 3 courtesy BuildClean

Use a respirator. Reusable, half-mask respirators provide reliable protection for workers, but only if they fit properly—so they require careful fit testing. They are available in a variety of sizes; this one is sized "medium" **(4)**. Workers who are not willing, or able, to get professionally fitted and trained should consider a high-quality disposable respirator such as this N100 **(5)**. An N95 **(6)** is one of the least expensive alternatives for workers who are unable to get professional fit testing.

every six months," says Thomas St. Louis, the Occupational Health Program supervisor for the state of Connecticut.

Unless you do the same type of work on a regular basis, a single BLL test may not tell you very much. "BLL just tells you what's running in your veins at that given moment," says Peter Lawton. This is because the human body has the means to excrete moderate amounts of lead (by perspiration, urination, and defecation). According to St. Louis, "The way the body works is that [after an acute dose] your BLL will spike, but once you eliminate the exposure, every month the body will eliminate half the burden." That's the upside. The downside is that some of the lead that's circulating in the bloodstream may be picked up by the corpuscles and put to use somewhere, or be stored in fat cells or bone tissue.

The amount of lead that isn't purged is what's known as "body burden." It's possible to do a bone scan to determine how much of this an individual might be carrying around, but such testing is not widely available and is unlikely to be covered by insurance.

Although it's not perfect, regular BLL testing for yourself and your employees will provide clear evidence as to whether your lead-safe work practices are effective; it can also protect you from liability if a new hire is carrying around lead from a previous job, or if a current employee picks it up on a side job.

If the family doctor is no help, your local health department should be able to provide blood-testing advice.

GET THE LEAD OUT

BLL is measured in terms of micrograms of lead per deciliter of blood (µg/dL). For children, the growing medical consensus is that there is no safe BLL. For adults, the mainstream medical community generally agrees that 40 µg/dL is the danger level.

Providers of alternative medicine offer a variety of treatments that claim to rid the body of lead and other toxins, and some of these may be effective, but it's difficult to find evidence to back up the claims.

At this time, the only treatment for lead poisoning that's recognized by most medical authorities is chelation, which uses chemicals that bind themselves to lead and promote its excretion. Because these chemicals also scoop up vital nutrients, chelation can be a painful, debilitating experience that's medically frowned upon unless a patient's BLL is above 50 µg/dL.

"In the vast majority of cases, the answer is to remove the individual from the risk and let the BLL go down naturally," says St. Louis. He says he has seen workers who showed up with a BLL of 50 and just a


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Clean and cool. In order for any of these respirators to seal tight to the face, you must be clean-shaven **(7)**. To prevent a shower of toxic debris from falling into your mouth, remove the mask by first bending over and then pulling it down and away from your face **(8)**. A cooling vest can make the experience of wearing disposable coveralls tolerable, if not enjoyable **(9)**.

month later had a level that was down to 25, after they had stopped doing the lead work and perhaps had started taking better care of themselves.

A healthy lifestyle can also reduce the body burden. Good nutrition makes it less likely that the metabolism will seek out a lead molecule as a calcium substitute. A regular program of exercise increases the excretion of lead through sweating (just make sure to take a shower immediately afterward to wash off the lead). And don't forget to stay hydrated: "If you have lead in your body, and you're well-enough hydrated so that your urine is running clear instead of dark yellow, then you're maximizing the amount of lead that your kidneys can remove," says Daniel Askin.

The other crucial step in reducing your body burden is to not add any more to it.

DAMP DOWN THE DUST

The best form of personal protection is not a respirator, but a plan. As the late Dennis Livingston, a groundbreaker in the field of lead-paint safety, used to say: "Generate the least amount of dust in the smallest space for the shortest length of time."

Identify the leaded surfaces that will be disturbed, including by subcontractors. And create a work plan that gets all of the dirty work done at the beginning of the job. Then you can clean up, check your work, and proceed as if it were a typical remodeling job.

During the "lead work" portion of the job, the single best thing you can do to protect yourself and your workers is to minimize airborne dust. Here are a few proven techniques.

- Mist surfaces with water before disturbing the paint layer.
- Use a sharp knife to separate paint joints before removing trim elements.
- Never use open flames or high-temperature heat guns to strip paint.
- Use only power tools that have effective, vacuum-operated, dust-collection systems **(1)**.
- Consider purchasing a negative air machine to capture airborne dust **(2, 3)**; don't put a fan in the window, because it might blow lead dust all over the neighborhood.
- Regularly HEPA-vac the floors so you don't crush paint chips and create more dust.

Studies have been done that conclude that if you were to scrupulously follow these rules, you could safely dispense with respiratory protection altogether. However, OSHA will not let you off the hook unless you conduct dust-sampling tests to prove that every one of your planned dust-generating activities produces less than the permissible limit (50 micrograms per cubic meter of air) for airborne lead dust.

RESPIRATOR 101

Absent a foolproof system for working dust-free, everybody who's on site during the leaded portion of the job must be outfitted with eye protection—either goggles or wraparound safety glasses—and a respirator. Theoretically, a reusable half-face respirator **(4)** provides superior protection compared with a disposable. But these devices are more difficult to breathe through and come in different sizes. So in order to use one properly, every wearer needs the following:

- Medical clearance from a doctor
- Training on how to use and maintain a respirator
- Fit-testing

Experts agree that the best respirator in the world will do more harm than good if it doesn't fit properly. "When I worked in the lead industry in the 1970s, respirators came in one size only and it was 'Not Mine,'" says Daniel Askin. "Several years later, I came upon one of those respirators and I had myself fit-tested and my fit factor was 2" (meaning that the filter was capturing only 2% of the pollutants he was breathing in). Askin points out that a half-mask respirator can also inhibit one's ability to talk to co-workers. "If you have trouble communicating, you're going to be taking it off and putting it back on, giving you no protection for the time that it's off your face."

If you're not in a position to have all of your employees professionally certified, Askin and others suggest using N100 disposable respirators **(5)**, which meet the same HEPA filtration standards, but in a simpler, one-size-fits-all configuration. N100s aren't cheap though. Even when purchased in bulk, they can cost as much as $10 each.

Thomas St. Louis, of the Connecticut department of health, worries that the high cost of an N100 makes people use them too long. "We recommend that you find a NIOSH Certified N95 disposable respirator." He says that this less expensive alternative **(6)**—costing as little as $3 each in bulk—is "sufficient to capture lead dust" and cheap enough to be a true throwaway. "Every time you come off the job for a break, I recommend disposing of it and putting on a new one when you get back to work."

Regardless of which respirator you choose, you have to lose the beard. None of these will form a tight seal to the face unless the wearer is clean-shaven **(7)**.

Also, be mindful that after a long day's work, the mask may well be covered in lead dust. To prevent being showered by dust while removing the mask **(8)**, Askin says, "I bend over at the waist and I take the respirator off by grabbing the bottom and pulling it down and away from my face." If yours is a reusable respirator, make sure to clean it properly and replace the filters often.

HYGIENE

Most other techniques for working lead-safe fall under the category of good hygiene. If in doubt, ask yourself: "What would mom expect of me in this situation?"

Coveralls. Nobody likes to wear Tyvek suits. These garments are infamously confining and stiflingly hot. But they do make it simpler to ensure that lead dust clinging to workers' clothing does not escape the worksite. "If you have to put a suit on, it's only so you don't become a walking source of poison," says Peter Lawton. Although he has no suggestions for how to add style points, he says that if you wear a cooling vest **(9)** underneath, you won't break a sweat, even in an attic in August.

Instead of wearing disposable coveralls, Catherine Brooks, owner of Eco-Strip, a distributor of lead-safe paint-removal products, brings a change of clothes (including boots) to the job, leaves them inside the containment area until the dirty work is done, and carries all of the soiled items out in plastic bags. She also puts down "tacky mats" (such as Poly-Tak "Clean Mats" from Surface Shields) outside the entrance to the work space to catch any dust on the bottom of shoes. Whether or not you choose to wear the suit, Thomas St. Louis recommends having "a dedicated set of boots that only get used on lead jobs."

Tobacco. Don't smoke on the job. Beyond the obvious health risks, smoking a cigarette in a leaded work area means that the lead dust on your fingers will be transferred to the paper, ignited, and inhaled deep into the lungs, where it's likely that all of it will go right into the bloodstream.

Liquids. As mentioned earlier, staying well hydrated helps the kidneys excrete toxins. Just make sure that your water bottle is not dust-covered. Store it in a box with a cover, remove your dust mask carefully, and rinse your mouth out before you swallow the first drink.

Break time. "Never bring food into the work space," says Mike McKinnon, manager of Hygenall Corp., a maker of lead-cleaning products. Unless you're confident that the lead work will be completed and cleaned up by lunchtime, you should designate a separate space—elsewhere on the jobsite or outside—to serve as the break room.

If running water is not available to enable the workers to wash their hands and faces before eating, you can set up a makeshift washing station, with soap, paper towels, and a few buckets of water. "There's no question that you need to clean your hands before eating lunch and you need to eat lunch anywhere but in the work area," says Daniel Askin.

CLEANUP TIME

The RRP (Lead Renovation, Repair and Painting) regulations are very clear on how the jobsite should be cleaned before the warning signs are put away and the barriers taken down. But you must also account for the debris that has settled on your tools, your clothes, and your skin.

Tools. If this is a one-and-done lead job, be sure to vacuum all of the tools and scrub them with a wet wipe before taking them out. But if any tools are going on to another job where lead paint is likely to be encountered, simply put each one in a heavy-duty plastic bag and seal it up to contain the mess. For remodelers who routinely work on old houses, Peter Lawton suggests setting up

Cleanup. Dedicating a set of tools (such as wrecking bars, extension cords, recip saw, toolbelt, paint removers) strictly for lead work saves significant cleaning time and lessens the chances of spreading the dust around **(10)**. A variety of products are available that may ease the drudgery of removing "sticky" lead dust from surfaces, skin, and clothing **(11)**.

a dedicated bin for all tools that are used only for lead jobs **(10)**.

Vac. The HEPA vac should also be thoroughly cleaned or wrapped in plastic before it's taken out. If the bag needs to be emptied on the job, it should be done before any other cleanup measures have begun. And whoever does it must be fully protected and extremely careful to contain the contents, which are likely to be heavily leaded.

Clothing. Sadly, the incidences of family members being sickened by lead from a parent's or spouse's work clothes are well documented. If you need to wash your lead-covered clothing at home, follow these guidelines:

- Keep clothing items in plastic bags until they're ready to go in the washer.
- Handle contaminated clothing gently to prevent creating airborne dust.
- Wash the clothing separately from everyone else's clothes.
- Scrub your hands thoroughly after putting lead-covered clothing in the washer.
- Run a rinse cycle before adding detergent, to remove loose dirt.
- After removing the work clothing from the washer, run another rinse cycle—before doing a load of household laundry.

Skin. Lead dust has often been described as "sticky," meaning that once it gets on a surface, especially skin, you have to scrub vigorously to get it all off. I never understood why this was so until Mike McKinnon explained it in terms of chemistry: "Lead is a cationic metal, which means it has a strong positive electrostatic charge. This property makes it stick to skin and other surfaces that have a negative charge." His company and ESCA Tech both offer a variety of surfactants (a fancy name for detergents) that claim to easily strip lead from skin as well as other surfaces **(11)**.

Regardless of the soap you choose and of whether you're washing up for a lunch break or in an after-work shower, make sure you get clean.

NEVER TOO LATE TO QUIT

Lead is worse than tobacco—about that, there's no doubt. But, for those of us who work on old houses, and who haven't protected our personal safety as diligently as we have the safety of the innocent bystanders, the good news is that if we quit our bad habits now, and don't put more lead in our blood, our bodies are capable of reversing the damage—maybe even eliminating the need for that Viagra prescription.

Tom O'Brien is a freelance writer and a restoration carpenter in New Milford, Conn.

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Products

BY LAUREN HUNTER

1. PVC Trim-Board Screw

Simpson Strong-Tie's PVC Trim-Board screw, engineered for low-torque installations of PVC trim and fascia, has a triple-threaded design, a box-shaped cutter head, and a flat underhead to improve pull-through resistance and leave a clean finish. A T-20 bit is included; the screw's six-lobe design helps reduce cam-outs for longer bit life. Look for online pricing around $11 for a 70-count box of the paintable, white, exterior-grade screws. strong-tie.com

2. Multifunctional Flooring Adhesive

A single-component 5-in-1 adhesive, Supreme Green DriTac 7800 offers subfloor moisture control with no testing required, sound control, and isolation of old cutback adhesive. The material also supresses cracks and includes a bond-only option. Designed for engineered, solid-wood, and bamboo flooring with no restriction on plank size, Supreme Green easily cleans off hardwood flooring wet or dry. Its "green" claims include zero isocyanates, VOCs, or solvents. Pricing for contractors would be approximately $1.25 per square foot. dritac.com

3. Fine-Ground Porous Hardscaping

Porous Pave has refined the size of recycled-rubber chips used in its surfacing. Chips now range from 1/8 to 1/4 inch, creating a porous, durable, and flexible pour-in-place permeable paving material. The finer grind retains 93% of the porosity of the coarser material, which is still available for some applications. Ideal for courtyards, patios, and walkways, Porous Pave XL offers a 50/50 blend of rubber chips with aggregate for installed thickness of 1 to 2 inches. Porous Pave XLS has a 100%-recycled-rubber chip content. The $5 average per-square-foot price depends on material and thickness. porouspaveinc.com

4. Keep Cords Connected

Designed for the jobsite, the Twist & Seal Maxx cord protector accommodates commercial-grade electrical cord connections up to 10 gauge, while automatically adjusting to smaller-diameter cords. The patented product helps prevent electrical shocks, accidental disconnections, and other hazards. A model for homeowner-style extension cords, the Cord Protect, is priced at $9; Twist & Seal Maxx pricing is being determined, with availability this summer. twistandseal.com

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5. New Mini-Split Options

Johnson Controls introduces seven new duct-free mini-split air conditioners for its York brand. The Z Series is a 30.5 SEER single-zone system. Other models include a 20 SEER R Series unit, and the 22 SEER multi-zone W Series featuring a central controller that can operate up to 16 indoor units. Wired and wi-fi communication platforms are available. Operating temperatures range from -22°F to 129°F, and capacities range from 3/4 ton to 4 tons. Check with your dealer for pricing. york.com

6. Easy-Install Floor Box

Ideal for open-concept living spaces with any floor covering, the Steel City Residential Floor Box offers a single-gang configuration and flush-to-floor installation in wood subfloors. A kit available for new and old-work installations includes a UL- and CSA-certified 15A, 125V tamper-resistant receptacle, installation instructions, and a template for the floor opening. The metallic outlet box has 1/2-inch knockouts, pry-outs, and integral cable clamps for NM sheathed cable, as well as a stamped, one-piece brass cover and a neoprene gasket. Priced around $60 at retail; ask about contractor pricing. tnb.com

7. Outdoor Kitchen Introductions

New appliances and storage from Coyote Outdoor Living offer versatile options for outdoor kitchens. The C1CH36 drop-in grill, priced at $1,600, has more than 875 square inches of cooking area and burns either charcoal or wood chips. Meanwhile, the ceramic Asado Smoker ($1,260) lets grillmasters smoke, bake, sear, or grill without modifier accessories. Storage options include a single-door, two-drawer combination ($650), a dry pantry with drawers ($900), a pull-out ice chest ($700), and a pull-out trash and recycling unit ($550). Confirm pricing with dealers. coyoteoutdoor.com

8. Shaker Closet Design

Simple white meets sleek Shaker in the latest closet offering from Woodtrac by Sauder. The flat white Shaker-style panels bring a transitional or contemporary aesthetic to closets and other storage areas with shelving, door, and drawer combinations. Solid shelving improves storage in pantries and bathrooms with wipe-clean surfaces that keep spills from reaching the floor. Pricing will vary by product selections. woodtrac.com

9. Shower With Storage
Sterling's Store+ shower has eight pre-molded locations to accommodate dishwasher-safe accessories that snap in and out of place with no tools. The walls have semi-recessed corner storage niches and molded foot ledges. Each storage shower includes a rimmed shelf/soap dish, storage bin, towel bar, and shower hook; additional accessories are available. The shower pan itself has a low 3-inch threshold and improved water containment. Look for list prices starting between $680 and $850, depending on size and features. sterlingplumbing.com

10. Tricked-Out Garage Door Opener
Ryobi has entered the garage-door market with a model that does way more than raise and lower a door. The base unit offers a 2-hp motor, a wall controller, a wireless keypad, two remotes, a safety sensor, and motion-controlled overhead LED lighting. The unit plugs into a standard outlet, but also accommodates a One+ battery that gets charged when not in use, and can operate as backup power for up to 100 open-and-close cycles. Other creative modules include a laser-light parking assist, retractable cord reel, Bluetooth speaker, a fan, and a forthcoming carbon monoxide detector. The wi-fi-compatible Ryobi One+ Garage Door Opener retails for $240 and accessory modules range from $45 to $65. ryobitools.com

11. Power for the Jobsite
Weighing less than 53 pounds and featuring an ergonomic handle, Hitachi's EC99S air compressor is easy to transport around the jobsite. The 4-gallon twin-stack unit has an oil-lubricated cast-iron pump and thermal overload protection for the 15-amp direct-drive induction motor. The compressor can run multiple nailers depending on the application, by offering 3.1 cfm at 90 psi and 3.05 cfm at 100 psi. The locking regulator and 105 psi-on/135 psi-off pressure switch means users won't have to worry about pressure wander or pressure-starved tools. Other features include a ball-valve drain cock, shock-absorbing feet, and a factory-installed universal quick coupler. Priced at $200. hitachipowertools.com

12. Light Line
The new Lighting Systems line from Kichler includes tape lighting, undercabinet task lighting, step or hallway lighting, and more. Items like low-voltage tape light and hard strips work in conjunction with power supplies, including the line's new dimmable power supply, to efficiently convert line voltage into the appropriate usable power. Undercabinet fixtures have a built-in driver to help convert power, so they can be directly wired into line voltage or run together. An optional plug is also available. Contact Kichler for pricing. kichler.com

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BY CHRIS ERMIDES

Tested: Festool TXS Compact Cordless Drill

I've been testing the Festool 10.8-volt TXS cordless drill for the past few months, and I have to admit to being pleasantly surprised by its design and performance. I was a little skeptical of this particular model because at first it felt lightweight—especially for its $235 price tag ($285 with a right-angle chuck). Once I began putting it to work, however, I quickly learned that this drill—as small and compact as it is—means serious business.

After using the TXS for a short while, it became my go-to drill/driver for many tasks. I really like the weight (only 2 pounds!), balance, power, and precision of the drill. It fits nicely into my Occidental Framers pouch, and having three interchangeable heads (a quick-change "Centrotec" head, a keyless chuck, and a right-angle chuck) meant I only needed one tool with me at all times. I even used the tool for setting plaster washers into 165-year-old ceiling joists, and for this task, it was able to keep up with its more powerful, 15-volt counterpart—the Festool C15.

The TXS was designed for much finer work, though. The two speed settings (low: 0 to 400; high: 0 to 1,200) and 12 clutch settings (with a torque range of 1.7 to 30.09 inch-pounds) offered awesome control for every application—it won't strip screws in cabinet-grade plywood, for example.

I used it most often for pocket-hole joinery, installing cabinet and door hinges and drawer glides, and for cabinet installations. It set 2 1/2-inch screws through 3/4-inch plywood into studs without effort. The drill was great for setting electrical outlets and switches, as well. The variable-speed trigger has a soft actuation, but was still firm enough to maintain even slower speeds without losing the right "touch." The 3/8-inch keyless chuck accepts 1/32-inch to 3/8-inch drill bits and worked as expected on poplar, maple, and oak stock.

The LED light, which is located at the base of the tool just above the battery, seemed at first to be dimmer than I wanted, but I quickly found it perfectly bright for even the darkest nooks—like in the back of a cabinet. It throws light from the bottom of the tool, though, casting a shadow beyond the work area. I find any light that's located on the bottom of a tool to be

Photos above and on facing page by Chris Ermides

The Centrotec quick-change chuck holds Festool's proprietary bits and makes for a smoother rotation of the bit by gripping it in two places—the bottom and the middle of the shaft (above). Smoother rotation translates into more precise control. Add to that the benefits of a light weight, a firm trigger, and 12 torque settings, and you have enough control that you won't spin out screws in 1/2-inch VC plywood (above left).

annoying for that reason, but that's a minor criticism of this drill. (That said, I wish that drill manufacturers would develop an adjustable work light—one that you can spin around just like a torque setting dial—because where you need the light depends on how you're holding the drill and where you're working.)

Of the three interchangeable heads, the Centrotec chuck is the one users will probably use most often. It's a quick-change system that accepts only Festool's proprietary bits. Removing the Centrotec chuck offers added versatility; the drill accepts all bits or bit holders. The Centrotec chuck design does lend itself to smoother driving of screws because it holds the bit in two places rather than one, and it holds the bit at a higher point on the shaft, so there is less maneuverability when it spins. I compared this with other drills that I have and while it wasn't a scientific test, I did notice a difference in the play when a bit spun in the Centrotec chuck vs. other drivers in my shop.

The base of the tool holds up to four bits in magnetic slots. I liked the idea of this feature, but found it cumbersome, as my hand inevitably knocked the bits out of their slots. I prefer keeping a small case of assorted bits with me at all times anyway, so onboard bit storage has never been important to me for any drill or driver I've owned.

The fuel gauge shows in the same window as the LED light in a series of up to three green lights. It's possible to engage the trigger (without turning the drill on) to switch on the light briefly and check the status of the battery. The LED light turns on only when the trigger is depressed, which works fine.

I often use drills left-handed, so I appreciated the location of the forward/reverse button, which is high enough that you won't accidently trip it with the natural grip, but convenient enough to quickly set without having to change your hand's position. It also locks in the middle setting, so if you throw it into your pouch, you don't have to worry about it accidentally running and depleting the battery.

If you're considering purchasing this drill and foresee a potential need for the right-angle attachment, I recommend forking over the extra $50 and going all out at $285 to get it. You can buy similar attachments for about $20, but this head is compact, and it accepts the keyless chuck and Centrotec heads. You may not use it often, but when you do, you'll be glad you have it. I used it a couple of times when assembling cabinets. While it can be a little awkward at first (as any right-angle attachment can be), the convenience of being able to run a screw or drill bit in at an odd angle is nice to have.

Chris Ermides is a senior editor at Tools of the Trade *and* JLC.

Festool TXS Specs
Battery: 10.8 volts / 2.6 Ah Li-ion
Chuck capacity: 1/32 inch to 3/8 inch
Motor: DC
RPM: 0 to 400 (low); 0 to 1,200 (high)
Torque range: 1.7 to 30.09 inch-pounds
Weight: 1.98 pounds
Cost: TXS Plus (drill, two batteries, charger, Centrotec chuck, keyless chuck, bit, bit holder, Systainer case), $235; TXS Set (TXS Plus kit and right-angle chuck), $285
COO: Germany

Stepladder Turned To Small Staging

The top step of a stepladder might seem to some folks to be a design flaw: Why have a step that's dangerous to use? Traditional ladders also limit your range of motion in relation to the work area; you can reach only so far when standing on a narrow step. With Werner's new ladders, those limitations don't exist—you can stand on the top step and reach in any direction from the top of Werner's Podium Ladder. This relatively new-style stepladder line features a broad platform and a waist-high guard rail. Factory-installed spring-loaded casters, available on select models, deactivate automatically when the ladder is in use. These casters are available on the heavy-duty, 375-pound-rated Type IAA model, and on the 300-pound-rated Type IA fiberglass model. The Grade 1 Type IAA PD7303 series (shown) starts at $260 for a 3-foot model. wernerco.com —*C.E.*

Load Ladders Effortlessly

Many work vehicles are so tall you would need to stand on one ladder to load another ladder on top. This is hardly ideal, which is why many companies offer racks that tilt down from the side of a box truck or van. Gentili came at the problem from a completely different direction: The G2000 rack loads from the rear, sliding out like a drawer slide and then pivoting down on gas pistons. The ladder can be strapped to (or unstrapped from) the rack, tilted up, and pushed forward until it locks into position. With this system, you barely have to lift the ladder off the ground to get it into the rack. Gentili has been selling the G2000 Ladder Rack in Europe for nearly 20 years. It's currently distributed in the U.S. by Inlad and is available online at inlad.com. Cost: $1,900 plus shipping. —*C.E.*

Classifieds

BY SEAN GYLLENBORG

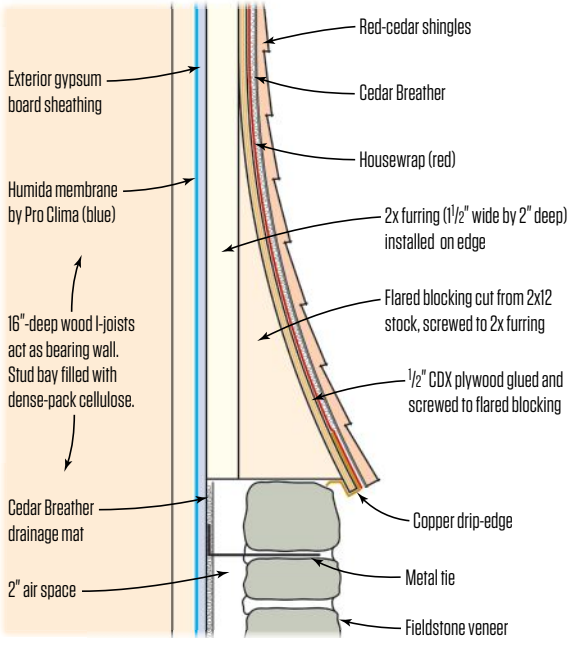
Curved Cap for a Stone Base

Two years ago, my wife and I broke ground on a 1,100-square-foot Passive House, with an eye toward moving into it when we downsize someday—for now, we plan to rent it out. The exterior is a mix of stone and red-cedar shingles, and to make a durable transition between the two materials, we flared the shingles so they would overhang the stone. This allows water to drip freely away.

To create this detail, we began by strapping the wall over the sheathing, in-line with the framing. We then screwed curved blocks cut from 2x12s at the base of each strap (see illustration, below left). To draw the curve on the blocks, we simply flexed a metal straightedge, using only the distance up the wall where the curve starts and the width of a 2x12 to define the curve. Over the blocks, we glued and screwed ½-inch CDX as a nail base for the shingles, and to complete the overhang, we ran copper drip-edge along the bottom and installed copper end caps at the exposed ends. Typar and Cedar Breather followed by red-cedar shingles completed the exterior.

Sean Gyllenborg is the founder and owner of Gyllenborg Construction, in Morrisville, Vt. For more about this house, visit jlconline.com.

Flared-Shingle Transition



Photos by Sean Gyllenborg; illustration by Tim Healey

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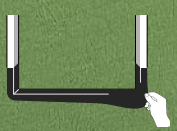

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