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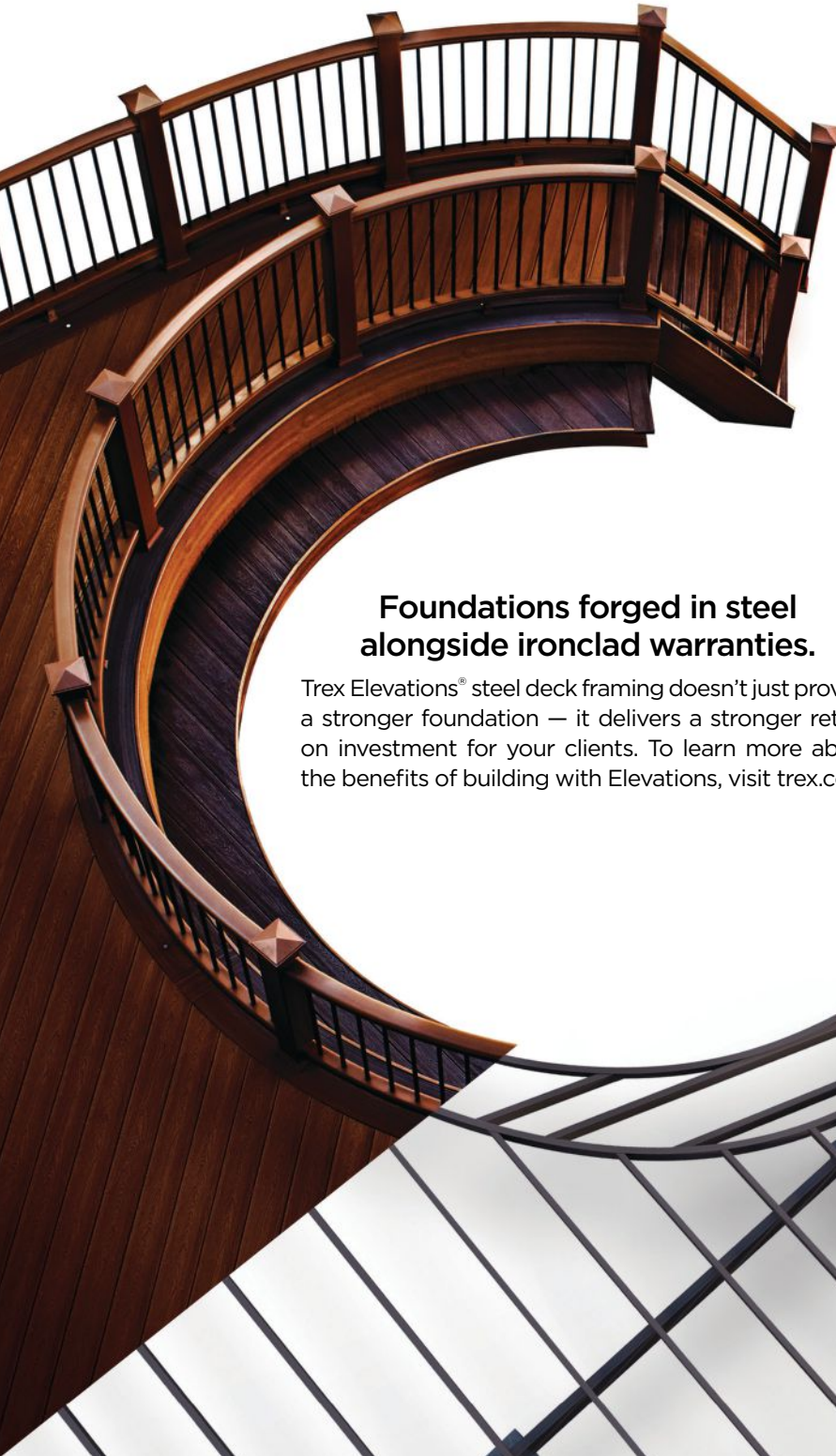


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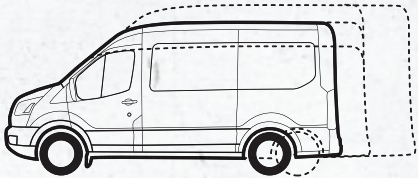


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On the cover: Indigo Ruth-Davis, of Montpelier Construction in Vermont, tapes down an air barrier above the top-floor ceiling, prior to roof framing. Photo by Greg Whitchurch

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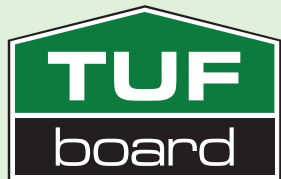
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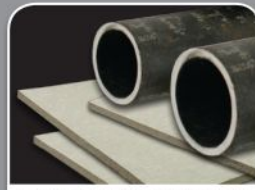
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Reader Feedback

The following excerpts are taken from comments in response to the JLC articles referenced.

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Letters

“TRAINING MILLENNIALS FOR CAREERS IN THE TRADES,” BY CLAYTON DEKORNE (ONLINE, 2/5/15)

Conrad vonBlankenburg: There was a time in this country when the school system (starting at about the seventh grade) gave students two parallel paths to choose from. The students were tested for aptitude and interest, and then counseled to follow a college-prep or a trade/industrial arts path. Both offered unlimited opportunity for anyone who wanted to work hard and get ahead.

The trade path can continue in several directions after the work is mastered. But the education mafia killed the trade path because it did not put money in the fraud called education today.

Ask yourself why construction defects are out of control today. Why does it take 10 people six months to build the same house that two highly trained men could build in 12 weeks in the 1960s and '70s?

Saw Dust CEO: It might become an issue of supply and demand. The contractors I see out in the field are aging; as they leave the field, they need to be replaced with the next generation's skilled worker. Money is an issue in the lack of interest in staying at a trade job—or for that matter, entering the industry. It's great that there are construction management degrees, but we need production field people to make money. We need to raise the pay scale for skilled workers. I think this would attract a larger pool of talent or at least create interest in learning and choosing a career in the trades. If there is going to be a high demand for skilled workers, someone is going to have to pay, whether it's the taxpayer—for schools to educate and train—or the homeowner who needs something built or repaired.

Shawn McCadden: This message needs to get to politicians from those of us in the industry who vote, as well as the trade associations. I suggest we be loud and diligent about bringing this up to them until they have no choice but to address this concern. There are so many good reasons to do it.

Norman Palmer: Paid internships from a custom home builder or design-build remodeler to first- and second-year architectural students could be a convincing factor for some to forgo formal education, and instead learn to build and create and design on the fly. This is not a total solution, but more than likely the student will be interested in learning and being productive ... just one avenue to consider as part of many solutions.

Bruce Bergen: I teach psychology at both a univer-

sity and a community college. I find that many of my students would be far better served in one of the college's excellent trade programs, not because they are any less intelligent but because so many of them will only complete two years of college and end up only qualified to work in a call-center cubicle for little more than minimum wage. Matthew B. Crawford has written about this perception and the problem in our schools, both in an article, “Shop Class as Soulcraft,” at thenewatlantis.com and in a book with the same title. The antiquated idea that “blue collar” work is somehow for the less intelligent simply does not square with the multiple intelligences required of a skilled craftsman.

Mike Moore: Isn't it ironic that we, as a society, have fostered the illusion that marching two by two into a cubicle farm is somehow for the smart kids that are “good at school,” while construction, which touches many aspects of S.T.E.M. (Science, Technology, Engineering, and Math—the cool education buzzword of today), is somehow seen as the leftovers for those who aren't perfectly suited to college? Where did we go so wrong?

Anonymous. It is very difficult in general to attract young potential talent. I do not know how things work in markets outside the Chicago/Milwaukee areas, but around here it is hard to attract young persons when the wages are suppressed, given what is expected out of workers. I work as a subcontractor for many area contractors, and I am always squeezed by them to lower my rates and that goes directly to addressing wages and a greatly slimmed-down profit line. All the semi-skilled guys I have had in the last 10 years quit after six months because they did not see enough reward for the amount of effort that was required ... that is a hard fact, and something that is not talked about widely. Gone are the days when you start an apprentice-level guy at, say, 12 bucks an hour and he is happy with that for six months ... believe me, it is not going to happen when he needs to physically work hard for it and simultaneously have a hardened skin for the pressure he is put under. Every single young guy that I have trained has expressed this way of thinking, and in today's world they have a point. Given the relative costs of everything today, they cannot make do ... but it is what I and other small contractors like me can afford to pay and still keep the doors open and make a living.

Gil Paben: I graduated May 24, 1966, from Nebraska Tech, in Building Construction Technology. I know it's the best thing I ever did. I worked for a custom builder



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and a tract builder before going out on my own (with a partner). I also took some evening business classes about the same time. Glad I did that, too! The knowledge I learned at tech school had me working beside the older carpenters and [eventually] being able to do more than what I had learned in class. I could lay out rafters, lay out the floor system, do material estimating, even sharpen tools like chisels, handsaws, and circular saw blades, which some could not do and still can't. There were also some tips and tricks I learned that I shared with older carpenters, trying not to be too assertive, as I was then still considered "wet behind the ears."

All-in-all, it worked out well, and I've enjoyed training new employees through the years (two of which are in business for themselves now). You are always learning in this industry, but having had two years at tech school made all the difference. My partner retired four years ago, but I'm still at it and happy to have my son (graduate of the Construction Management program at C.S.U.) working with me. Been in business for 38 years now, loving it, and still going. Wishing good luck to our industry!

"SLIDESHOW: ON SITE WITH DIAMOND PIER," BY MIKE HORGAN (ONLINE, 1/26/15)

Dustin Lema: Any information about the costs, delivery times, and the like?

Mike Horgan responds: We get these—the DP75, spec'd for size here by our structural engineer—for \$175 each. That includes all the hardware you could need: the 4-foot-long pins (they also come in longer lengths for different situations); anchor bolts that come pre-installed in the pier; pointed end-caps for the entry end of the pins; and heavy plastic caps for covering the exposed end of the pins (which the inspector just pops off so he can check the depth at the same time he does the frame inspection). They are stocked at our local supplier, so we get them dropped off at site within an hour, usually, of a phone call. The hammer rental costs \$50 for an entire day, but you can also install them with a sledge hammer, which we tried and it worked just fine, though the machine makes much easier work of it.

Now, someone will surely say, a Sonotube

only costs \$25 to \$30. But that is, in reality, only one very small aspect of the entire process. We had 16 tubes spec'd altogether here. Total time of install for all 16 of these diamond piers was less than 2 hours, from pre-install-stake-out to we-started-framing. And it took only one person—me—to do the entire install of the Diamond Piers while the other guys kept working on a different aspect of the job. No two guys digging holes 4 feet deep and 3 feet wide, no moving parts to balance, no waiting for inspection, no waiting for concrete delivery or mixing and lumping bags, no waiting for concrete to cure, no cutting off the j-bolt you installed that sits juuuuust a little too proud of your concrete that sank overnight in the tube so you can't install your post base properly—none of that. In less than two days, we finished framing on a 70-by-20-foot deck, start-to-finish, and called for footing and framing inspection simultaneously. I'm skeptical of most fancy building materials by nature, but these things are great. For total efficiency, they're a no-brainer. Unless you're trying to pound into rocks ... then you're SOL.

"MAINE ISLAND HOUSE MAKE-OVER," BY TED CUSHMAN (ONLINE, 12/8/14)

Eric Tavitian: I cut my teeth on similar houses in the Boston inner city and suburbs back in the early '70s. Now I run a small general construction company in the Ventura, Calif., area. I gained most of my knowledge of Cal. Codes from having begun here in the San Fernando Valley suburb area of Los Angeles. The requirements for insulation aren't as intense here as in Maine, but we still do quite a lot of retrofitting to make things more efficient. I really dislike having to tear a structure down if it can be saved. If people continually tear things down to make way for the new, then we lose sight of our past. Even though this is only sunny Southern California, and houses date back only to the late 19th century, it is still this area's history, and in many ways that history is very rich. Some of it should be preserved. So retrofit works for me.

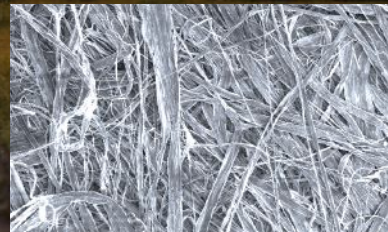
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Q I am putting a deck on a home with a water table trim. Can I attach the deck ledger directly to the water table or does it need to be removed?

A Mike Guertin, a builder and remodeler in East Greenwich, R.I., and a presenter at JLC Live, responds: The answer to your question depends on whether the specific details of the house where you are building the deck can satisfy the prescriptive code conditions, or alternatively, whether your local code official would accept another ledger-fastening system. But even if you do need to remove the water table to mount the ledger, you can use a detail in the code that actually makes the flashing simpler.

The 2015 IRC Table R507.2 (*Deck Ledger Connection To Band Joist*) covers lag-screw and through-bolt fastening and is similar to the deck-ledger tables in the 2009 and 2012 IRC. Unlike those, however, the 2015 version provides a schedule for fastening a ledger with 1-inch-maximum sheathing thickness between the back side of the ledger and the face of the band joist. So if the water table trim on your client's home is 1 inch thick and attached directly to the band joist without any other wall sheathing (housewrap is OK), then you can follow the bolt-spacing schedule and mount your ledger right over the water table trim.

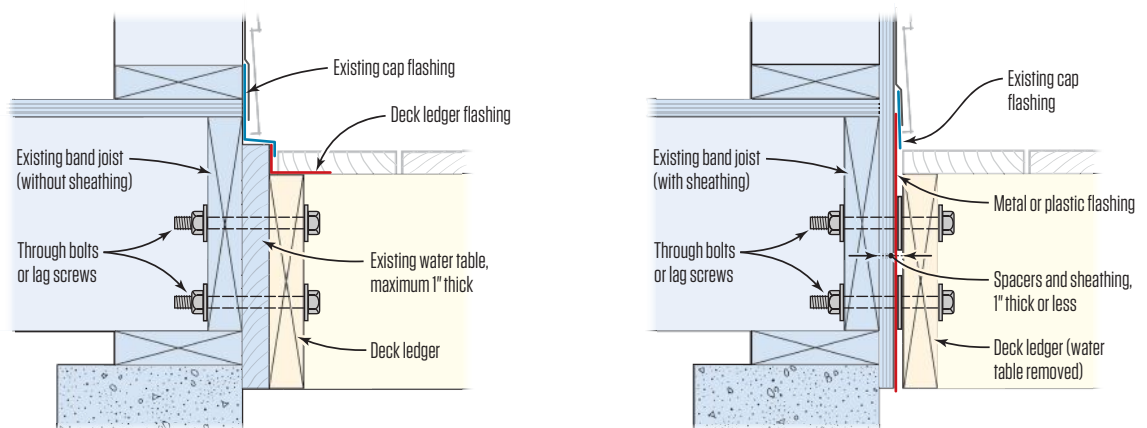
If the wall does have sheathing on it, then you must remove the water table trim where the ledger will be installed in order to satisfy the prescriptive fastening table

in the code. With the water table removed, you can either mount the ledger in direct contact with the wall sheathing using lag screws or bolts, or space it off the wall using stacks of washers at each bolt or another device, like Deck-2-Wall spacers, provided that the total thickness of the sheathing and the spacers is 1 inch or less.

One advantage of removing the water table to install the ledger is that the flashing is simpler. After you remove the water table, leave the cap flashing in place. Then slip a sheet of flashing (metal or plastic) under the water table drip-cap flashing and let it extend over the foundation. The flashing sheet covers the complete area that the water table covered, and it sheds water so you don't need to install a separate flashing over the ledger. The existing cap can extend over the decking or it can be cut back and left behind the ledger. With this method you'll need to flash the butt joint where you cut the water table for the ledger. Just tuck a couple of inches of flashing behind the ledger. In the water table to back up the butt joint.

There is an alternative ledger-fastening system that permits you to install the ledger without removing the water table, but you will need to run the system by your building official for approval. Attach-A-Deck is made for installing ledgers over existing siding without removing the siding, so it would work for the water table as

Attaching a Deck Ledger: Two Options



well. First you bore 2-inch holes through the siding (or in your case, the water table), and bore pilot or clearance holes through the wall for the lag screws or through bolts that you'll use to fasten the ledger. The Attach-A-Deck devices are filled with a good-quality sealant, and when the ledger tightens to the wall, the devices inject the sealant behind the siding. Attach-A-Deck doesn't have an International Code Council Evaluation Services Report, but the manufacturer has independent testing data and a fastener guide for fastener spacing.

I am installing corrugated metal roofing. What is the best way to cut the roofing to fit a valley?

A John La Torre Jr., a builder in Tolumne, Calif., replies: A circular saw equipped with a metal-cutting blade will work just fine. Set the blade just deep enough to cut through the low parts of the corrugation and cut slowly. I have

also had good results cutting metal roofing using an angle grinder equipped with a metal-cutting blade. Other tools that work well on corrugated metal are sheet-metal nibblers and sheet-metal shears, which do not produce sparks or metal shavings.

In the absence of any of these electric tools, I've had good luck cutting metal roofing using two off-set aviation snips (see photo, right). Aviation snips have compound cutting action to give them greater leverage for cutting through thicker metal, and the off-set blades mean I can keep my hands safely above the metal. These snips come in two colors: green and red. With the green snips, the waste comes off the right side of the blade, and with the red, the waste comes off the left side. I hold green ones in my left hand and red ones in my right hand. Then with the blades positioned about an inch apart, I make my cut with both snips at once and the waste curls up between them, creating the same effect as sheet-metal shears. This works for cutting across a sheet as well as at an angle.

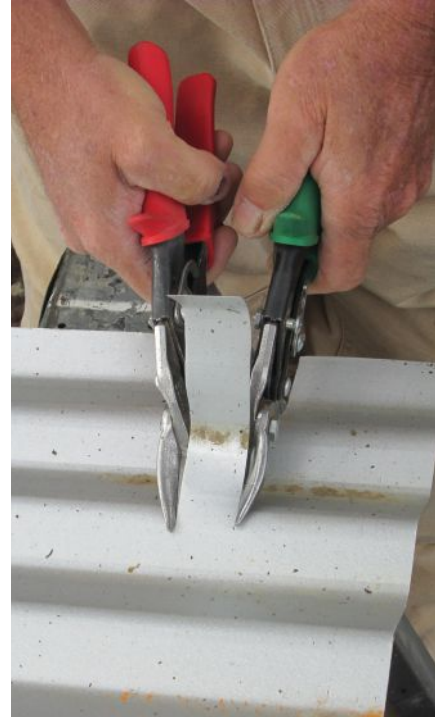


Photo: John La Torre Jr.

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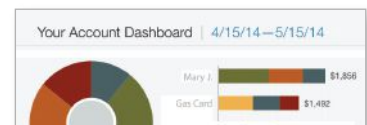
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BY JOHN SPIER



Fast, Accurate, and Attractive Concrete Piers

The time-honored method for putting small piers under buildings and decks is to stick Sonotubes into holes in the ground and fill them with concrete. But I've never been a big fan of those cardboard contraptions; they're flimsy, prone to collapse, and difficult to install plumb and level, and it's hard to get a clean finish on the concrete when you use them. And at the end of the day, you've got a bunch of square structures sitting on round bases. I've been building a lot of small buildings lately, and I decided a while ago that there had to be a way to make nicer-looking piers.

Ideally, I like my small buildings to sit on substantial-looking square or rectangular piers, perfectly aligned at the corners and edges of the buildings (1). I want the piers to be exactly the right size, in exactly the right place, and all at the same height, so I don't need to do any shimming or trimming. Of course, I also like to install these piers with minimal effort and with as little

site disturbance and cleanup as possible. The two buildings pictured in this article are small sheds; one sits on four piers at its corners, and the other is cantilevered in both directions on six piers. The basic techniques for forming and pouring the piers were the same for both, and I've also used the same techniques for piers that support posts for the decks that I build.

FORMS FROM SCRAP LUMBER

First, I knock together form boxes from scrap materials—usually leftovers from a framing job (2). I always pour concrete to the top of the forms, so I make them a few inches deeper than the part of the pier that will be visible above grade; the extra inches ensure that the forms will extend into the ground a little. If I'm siting a structure on uneven ground, I approximate the heights. The cantilevered shed that I built was on a gently sloping site, so for those piers,

Photos: John Spier

the height of the boxes varied according to the topography.

To lay out the boxes, I set them in their ballpark locations and mark the ground. After cutting out the sod to the size of the boxes (3), I dig out flat areas where they will sit (4), making a nice, clean, and level base for each one. I try to get the areas fairly close to their final heights (5).

LEVEL ALL THE FORMS AT ONCE

With the form boxes in place, I nail or screw a perimeter of 2x4s or 2x6s to them to connect them all together. Using fairly straight stock ensures that the tops stay in line and in plane. If need be, a diagonal or two can be added to keep the assembly square.

Next I level the whole assembly, scraping and adjusting the ground under each box until all the tops are exactly at the correct height. When everything is level, I stake the assembly in place as a unit (6). I find this process much faster and easier than setting, plumbing, and leveling each form box individually.

DIG THE HOLES LAST

At this point, I dig the holes for the piers down to frost depth—36 inches in my area—packing some of the excavated soil around the boxes temporarily if needed to contain the concrete for the pour. With most soil conditions I find that I can dig each hole to the proper depth in about 15 to 20 minutes using just a shovel, crowbar, and post-hole digger (7). Occasionally, I hit a big rock or a root that requires extra work, so I also keep a reciprocating saw and a small jackhammer handy.

Digging the holes by hand means no over-digging—the soil becomes the concrete form below grade (8). As I dig the holes, I throw the dirt into the middle of the structure's footprint, to keep the mess contained.

Our concrete supplier uses a dry-mix truck, so I can have the exact amount of concrete I need for the piers mixed and poured on site (9). After the concrete cures, I strip the forms, often without disassembling them completely; I simply loosen the corners and lift them off the top. Then I





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pound them back together and set them aside for the next job.

I finish up by replanting some of the sod around the outside edges of the piers and raking out the extra material for a smooth grade under the building. At the end of the project, I can walk away from a brand new building in the middle of an established lawn—with no evidence that the ground has ever been disturbed.

FLOOR FRAMING ALTERNATIVE

For the cantilevered building, I assembled the main floor beams directly on top of the form boxes, drilling and installing the anchor bolts through the beams (10, 11). I then poured the concrete around the bolts with everything in place. This guaranteed perfect bolt placement at the right height and saved lots of time. (I often do the same with mudsills on simple foundations; see “Wet-Set Mudsills,” Apr/07). Framing the floor before the pour made stripping the forms a bit more difficult, but all in all it saved a lot of time over conventional forming and framing methods. The floor of the smaller building was much simpler to frame—just eight pieces of wood and four blocks in the corners for the bolts—so I framed it after the piers were cured and stripped.

For most small buildings and average-size decks, a 16-inch-square box is easy to dig and makes an attractive pier, but I’ve made piers as small as 12 inches and as large as 24 inches. A 16-inch hole gives me about 1.75 square feet of bearing area, or between two and five times as much as a typical tube form. And if I want more of a footing, I can usually flare the bottoms of the holes.

Of course you could always add a manufactured base, such as a Bigfoot, to give a Sonotube pier greater support. But that would mean leaving a big, expensive piece of plastic in an oversized hole, not to mention the extra work digging and backfilling.

I’ve sometimes been accused of being a square peg in a round hole. In this case, I’ll own it. I’m happy to have figured out how not to put round piers under square buildings.

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





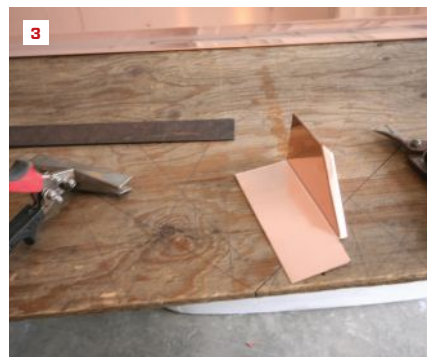
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Best-Practice Apron Flashing

BY KYLE DIAMOND

My company has done a fair amount of remodeling work on older homes, and over the years we've grown accustomed to working with copper, using it for roof flashings on both remodels and new construction, budget permitting. In addition to copper's attractive appearance and known durability, we like the ability to solder the seams, which allows us to efficiently prefabricate aprons at dormers and chimneys—we just couldn't do that with aluminum or galvanized metal. Granted, copper is more expensive and soldering takes time. But we end up with a one-piece, maintenance-free assembly that's easy to install and, I believe, more watertight than anything we could achieve with other flashing metals.

Most of the corner flashings we come across, even if made from copper, are modified step flashings, cut in place to wrap the corner of the wall or chimney, while the leg running along the roof slope laps the apron (1). Both pieces may or may not be set in sealant, and usu-

ally the outside corner where the counterflashing and step flashing meet is unattractive if left exposed by the roof's shingle coursing. Instead, for a more-effective and better-looking result, we integrate the exposed apron with the corner flashing using soldered lock seams. Whether it's for a single unit or for multiple dormers or chimneys, we make the flashing all at once on the ground, saving considerable time on the roof.

Starting out. We cut and bend lengths of 16-ounce copper for the apron using a metal brake (we use a Tapco Pro). We make both the vertical legs and the legs that run along the roof slope 4 to 5 inches long (see illustration, page 28). We hem the bottom edge of the apron, then bend a slight, 5-degree "kick" about an inch up from the hemmed edge. This crease provides a measure of reinforcement along the length of the exposed apron, helping it keep its shape.

Next, we bend the apron to the roof slope. We

Photos: Kyle Diamond

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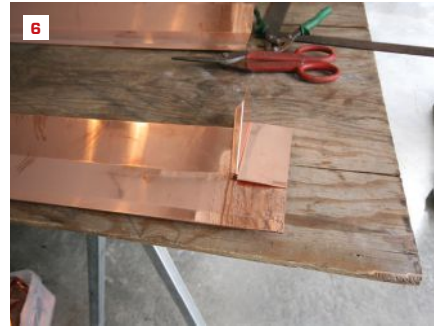
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under-bend the angle to provide tension, which helps the apron stay tight to the roof when installed (2).

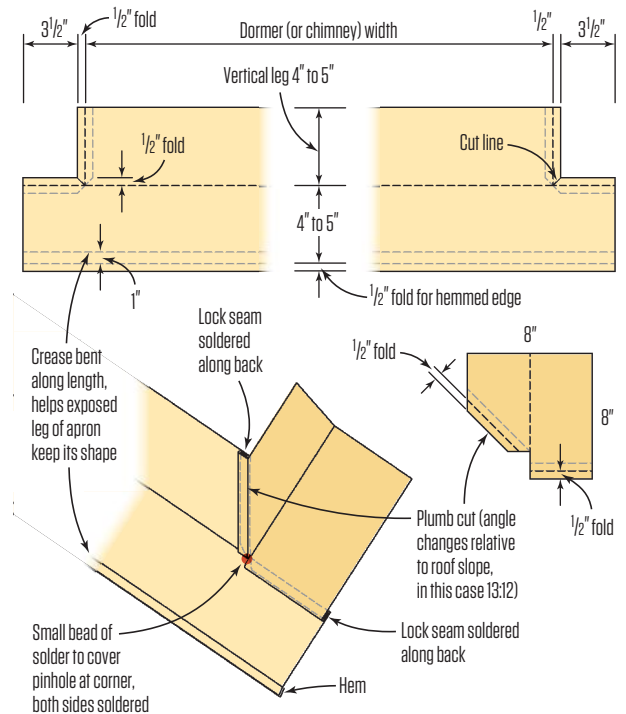
Corner pieces. Using tin snips and hand brakes (we use Malco's), we fabricate the corner pieces (3). We cut standard 8-by-8-inch copper step-flashing pieces to accommodate two locking seams, cutting an angle for plumb (see illustration, right). Then, we notch out the corners of the apron piece 3½ inches in from the ends, make a 45-degree cut to the inside corner, and fold over two ½-inch seams (4). We leave the folds on the apron and corner pieces slightly open to help join them together (5).

Locking seams. With the corner piece "snapped" into place (6), we hammer flat the seams, then temporarily lock them together by creating a small dimple with a light tap on a nail. This little indent keeps the seam from slipping during soldering (7). We solder the lock seams from the back (for soldering tips, see the slideshow "Soldering Seams" at jlconline.com) and install a small bead of solder to cover the pinhole at the corner on both the interior and exterior sides. Be careful not to use excessive heat when soldering the exterior.

The finished assembly provides a clean-looking transition from the apron to the sidewall step flashing and allows for some flexibility if the shingle coursing doesn't line up with the dormer (8). This detail can be used on a variety of siding and roofing types—in this case, stucco-clad dormers with asphalt shingles (9).

Kyle Diamond is a partner with his father, Dale, at New Dimension Construction, in Millbrook, N.Y.

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Two Critical Budget Mistakes

For most residential contracting firms in the U.S., March 31 marks the end of the first quarter of the 2015 fiscal year. This means that, sometime in April, you're likely to review the company budget and compare actual results with what you had forecast. And that's when you might discover that you made two big mistakes several months before.

THE FIRST MISTAKE

Typically most prevalent among younger companies, this mistake centers on unrealistic or dangerous assumptions. Unrealistic increases in volume combined with unrealistic decreases in job costs produce great numbers on paper, but are difficult to put into practice without specific, measurable tactics implemented by seasoned management. Such budgets tend to be disregarded—and round-filed at the first

plan for cash requirements during growth; and regularly monitor results to test your assumptions.

THE SECOND MISTAKE

Growing companies of any size or maturity make this error, which centers on having insufficient processes and practices for the current level of volume. As they grow, companies pass through up to five predictable stages:

1. Owner does it all
2. Owner begins to delegate
3. Owner delegates everything except sales
4. Owner delegates everything
5. Owner works only on strategy

The mistake is taking on more work before investing in processes and practices to manage it. Chaos, loss of employee and customer satisfaction, and reduced profits predictably follow.

Solutions: Forward-thinking companies invest in infrastructure—including tools, equipment, education, and training—that is appropriate to the future. Therefore, investment precedes and controls growth. Of course, you also need to budget for the increased expenses, devise metrics for success, and monitor the results.

Be as reasonable in your assumptions regarding your processes and practices as you are in creating the budget; most major change initiatives require a minimum of three to four months to complete implementation and another six to eight months to determine effectiveness. Don't rush this component of successful growth. Plan for it, implement it, measure it, and then reap the rewards.

Developing effective standardized processes is vital to generating sustainable profits. Focus on only one component of company success at a time—if you impose two or three changes simultaneously, you'll rapidly lose control. So, for example, initiate production efficiencies before making a big marketing change, or introduce financial controls before sales reforms. That way, every member of the team can concentrate on the opportunity with the greatest impact, and they can all work together to attain the expected outcome.

Judith Miller is a Seattle-based business consultant and trainer.

Build the company budget in the same way you build a job estimate.

opportunity. As a result, the opportunity to repair as well as review is wasted.

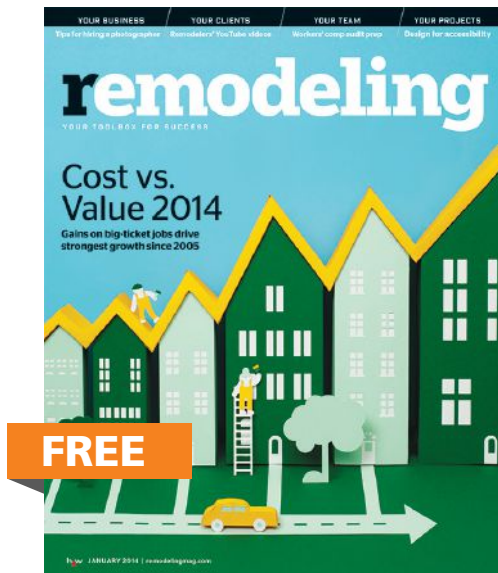
Solutions: Build the company budget in the same way you build a job estimate—combine accurate historic information with an informed understanding of the short-term future to predict a desired outcome. Do the following:

- Hold your company's annual growth rate to no more than 15% to control processes and therefore profits.
- Budget job-cost savings at no greater than 5% annually.
- Learn about fixed and semi-variable overhead costs so you can budget a reasonable overhead that correlates with the projected revenue goals.
- Remember that overhead tends to increase as a percent of sales as the company grows.

Learning how to make reasonable assumptions at every level of your company's development is critical to budgeting success, especially during periods of growth or contraction. You need to control growth to protect profits;

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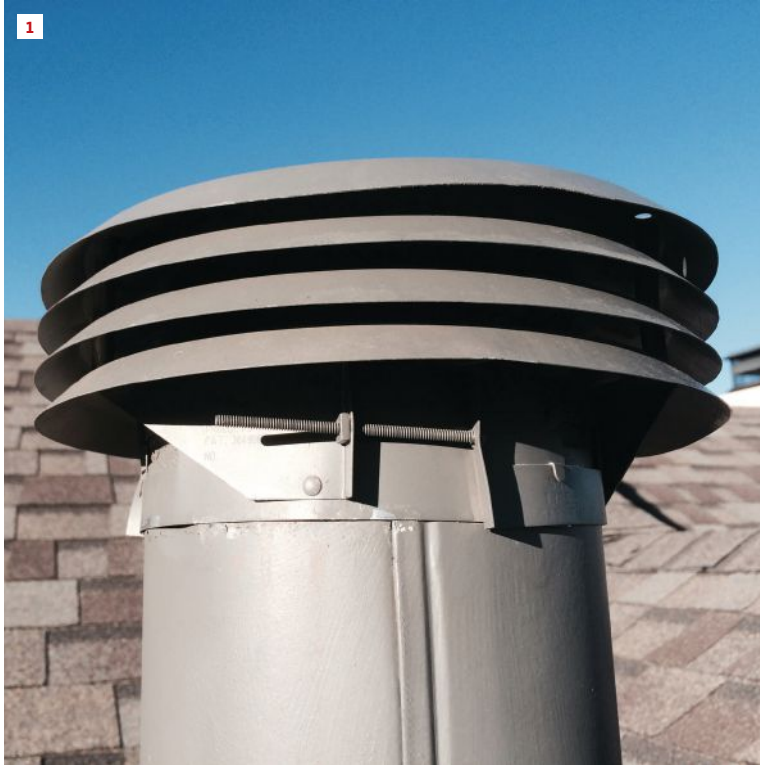
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BY GLENN MATHEWSON



How a New Roof Poisoned a Family

“Nothing is an island.” I often use this phrase when I’m teaching or administering the building codes. Whether you’re building a deck, remodeling a kitchen, or just replacing asphalt shingles, every system in a structure is connected to something else. Successful contractors must be aware not only of the building phases that they control, but also of all aspects of a building that could be affected by the work they do.

HAIL STORM EQUALS ROOF REPLACEMENT

Recently I was called in to inspect a roof-shingle replacement job that had inadvertently and adversely affected the health of the family living below. A neighborhood in my jurisdiction had gotten hit with a severe hail storm; so severe, in fact, that nearly all the houses in that neighborhood needed to have their roofing replaced. To satisfy insurance requirements, roof

replacement needed to be done within a short period of time after the damage, creating a boon of available work for roofing contractors, but a backlog of work for building inspectors.

In one of the houses that got a new roof, the family members began to complain of headaches and nausea. When their symptoms didn’t abate, their doctors started looking into possible causes, such as carbon monoxide poisoning. Winter had just set in with two weeks of very cold weather, so the home’s gas furnace had been running hard. The homeowners called in an HVAC technician to inspect it, and on finding a small crack in the heat exchanger, he called for a red-tag lock-off (immediate shut down) of the furnace—or for the unit to be replaced. With winter making its presence felt, shutting down the furnace and going without heat was not an option for the homeowners, so they decided to replace it.



RED FLAG MISSED

While replacing the furnace, the HVAC technician noted moisture in the vent and the beginning signs of corrosion. He suggested that the new roof—which was still in my queue, waiting for its inspection—could be leaking. The homeowners then called my office to voice their concerns, and I noted on their inspection ticket that they wanted to discuss these issues with the inspector during on-site inspection of the new furnace. But with the roof now covered in snow, inspection of the roof was still weeks away.

Assuming that the health issues they were experiencing stemmed from the cracked heat exchanger and that a bad flashing boot on the roof was causing the leak that the tech had found, the family went back to their lives. But the health symptoms did not go away.

When I arrived to inspect the new furnace, the homeowners mentioned contacting the city about their concerns with not

getting the roof inspection. And after listening to them explain their circumstances, I was convinced that there were issues that had not been considered. But the roofing contractor had verified that the flashing had been properly installed around the existing furnace vent, and the furnace contractor had verified that the furnace had been installed correctly. So where could the problems be coming from?

B-VENT CAP IS THE CULPRIT

Both the original furnace and the new furnace were connected to Type-B vent to exhaust combustion gases up and out of the house. This commonly used metal vent has a double-wall construction with an insulating layer of air that allows it to be installed with tight clearances to combustible materials. Type-B vents are made by a variety of companies, each of which uses proprietary mechanical twist-and-lock connection joints between segments. These connections allow you to assemble

separate lengths into a continuous vent quickly without using fasteners. Each company also makes a termination hood or vent cap that covers the vent after it exits through the roof. Exposed to the elements, the vent cap on this house's furnace vent had been badly damaged during the hail storm, so the insurance company listed the cap for replacement in its scope of work.

Matching a new roof cap to the specific manufacturer of an existing vent pipe is almost impossible on older homes because of the differences in the locking joints. So roofing contractors typically replace a damaged hood with a universal model that doesn't connect with a twist connection but rather just slides over the end of the vent. To function properly, these replacement caps must be installed at the proper height above the end of the vent before being tightened in place with the integral clamp (1).

On this particular job, the cap had been pushed down too far over the vent, ultimately blocking off the top of the vent. With



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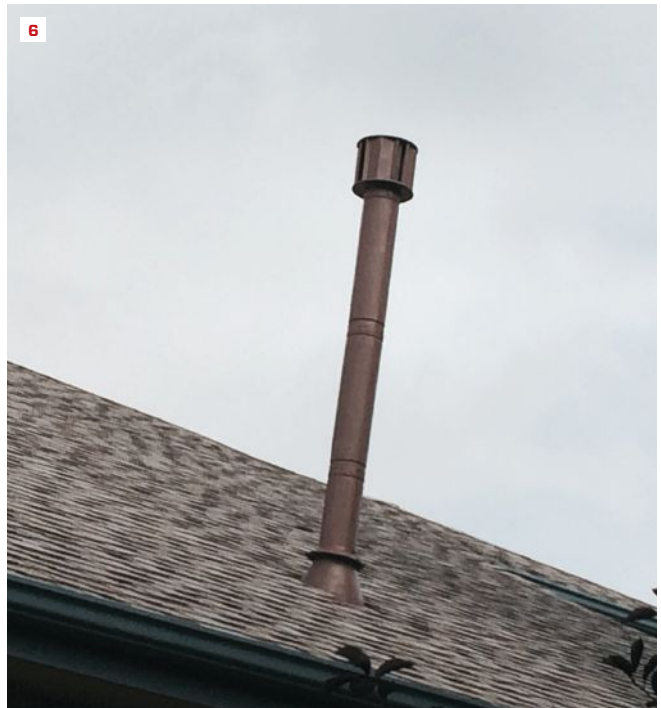
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the vent blocked, the hot exhaust gases from the furnace could no longer escape, introducing carbon monoxide into the home. Then as these gases began to cool in the sections of vent that passed through the cold attic and outside air above the roof, moisture vapor in the gas condensed into liquid water inside the vent. This explained the moisture that the HVAC technician found in the vent, a red flag that was misread. The roof replacement had created a problem with the furnace venting, and as a result, the family was suffering from carbon monoxide poisoning.

Raising the cap and securing it at the proper level (2) solved the problem of the condensation, which stopped the “leak.” But more importantly, it removed the source of carbon monoxide entering the home, and the family’s health improved immediately.

OTHER COMMON B-VENT PROBLEMS

When properly installed, B-vent pipe is a quick, efficient, and relatively inexpen-

sive way to vent a gas furnace or water heater. But to prevent problems, roofing contractors and other professionals that interact with B-vent in the course of their work need to have an understanding of how B-vent works.

Besides installing the roof cap too low, another common mistake is accidentally turning the whole vent when removing a cap, instead of turning just the cap. Once the joints between the sections of pipe are no longer interlocked, the sections can disconnect inside the building—and reconnecting them is often impossible from the top of the roof. A sure sign of a disconnected joint is B-vent that moves horizontally in all directions on the roof instead of being rigid (3, 4).

Yet another mistake is snipping the flange around a cap that has a larger diameter than the vent (5). It is then impossible to clamp or secure the cap to the vent.

It is also common to see B-vent pipe that extends unusually high above the roof sur-

face because of a nearby air inlet (like an evaporative cooler) or the adjacent sidewall of an upper floor. (Generally, vents must be at least 8 feet away from a wall or extend above it). In these cases, braces extending from the pipe down to the roof must be installed to provide lateral restraint. Without these braces, the vent is subject to movement and possible disconnection caused by wind (6). I’ve had to fail many roof replacement jobs where these braces were not reinstalled.

The takeaway for contractors: If you touch it, understand it. When you replace or repair a portion of a system, always check to make sure it will work with the rest of the existing system.

The takeaway for inspectors: Look at every inspection as the work of a life-safety professional—something to take very seriously.

Glenn Mathewson is a certified code professional and an inspector for the city of Westminster, Colo.



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BY TED CUSHMAN

Moisture in Fat Walls—A Closer Look

Last summer, JLC reported on research by Kohta Ueno of Building Science Corp. (BSC) into moisture accumulation in double-stud walls (see “Studying Moisture in Fat Walls,” Jun/14). Ueno had planted moisture meters on the sheathing of a 12-inch-thick stud wall in a zero-energy house in Devens, Mass., built by Transformations Inc.

Transformations’ standard wall system, in place in dozens of homes in a Devens development, is a 12-inch double-stud wall sheathed with Huber Zip sheathing and insulated with medium-density open-cell polyurethane foam, spray-applied in the field. But Carter Scott, Transformations’ president, wanted to know if dense-pack cellulose insulation, which might be more economical, would work as well. So the researchers put instruments into walls—on the north and south sides of one of Scott’s homes—with three different insulation strategies: 12 inches of dense-blown cellulose; 12 inches of medium-density open-cell spray foam; and 6 inches of the open-cell foam.

Over three winters of observation, the BSC instruments showed moisture levels in the sheathing rising every winter in all three wall types, as interior humidity penetrated the house walls and condensed against the cold OSB. But when outdoor temperatures rose during springtime, the walls would dry out again, then spend the summer in a dry condition, only to come under moisture attack again the following winter. The cellulose walls got the wettest during the three cold-season cycles, but all three wall types spent a significant amount of time in a risky moist condition during winter and spring.

Mold and rot require both heat and moisture to grow. In the winter the walls may be wet, but there’s not enough warmth for mold to thrive. In the spring the walls get warmer, but over the course of the season they dry out to the point where there’s not enough water to support the mold. So the critical question for wall durability was whether the walls were warm enough and wet enough at the same time—and for long enough—to allow fungus to get a foothold and damage the building. To find out for sure, Ueno and his team decided to cut the test walls open and inspect the sheathing.

In theory, the data from the instruments indicated that the walls had been in danger—particularly during the second of the three winters of observation, when a home ventilation system was inoperative and indoor humidity levels rose above the intended design condition.

In a report posted on the BSC website (building.science.com), Ueno writes: “Under high interior humidity loading (nonfunctional ventilation system, 40% to 50% interior relative humidity), all test walls showed moisture contents and sheathing-insulation-interface relative humidities well into the high risk range. The cellulose walls showed particularly high moisture contents (sheathing in excess of 30%), while the open-cell spray-foam walls showed moisture contents in the 18% to 25% range. In addition, the monitoring showed evidence of liquid water condensation (which can result in quick degradation) in all walls, and the condensation was substantial in the cellulose walls. These condensation issues occurred on the north and south sides.”

But when Ueno and his colleagues cut the test walls



1. After three seasons of moisture and temperature monitoring, workers pull sections of Zip sheathing panels from the test wall section of a house in Devens, Mass.

Photos: Building Science Corp.



2. The wall system has good drying potential to both the inside (through the painted drywall) and the outside (through the permeable Zip sheathing), but the cold OSB on the exterior does suffer increased moisture and condensation during the coldest months of the winter.

3. Moisture sensors in the building walls allowed the Building Science Corp. research team to remotely measure and record the moisture content of the framing and sheathing throughout three winters of house operation.

4. Nails rusted slightly after three seasons of moisture accumulation—clear physical evidence of moisture attack, but not as grave as the data had suggested.

5. A close-up of the OSB sheathing removed from contact with the low-density spray foam of the insulated wall cavity shows no sign of fungal attack at all, much less any deterioration that might compromise the sheathing's function.

open to examine the sheathing after three seasons of monitoring, the results were surprising.

Says the BSC report: “Based on the data, calculations, and analysis, all three walls should be at high risk of failure; the analytic tools used indicate that these walls should have failed. However, disassembly showed that the walls were essentially undamaged by the monitored moisture exposure. This suggests that the walls, at least in the configurations tested, were far more

robust than current analysis tools would indicate.”

“All the instrumentation and monitoring said that these walls got hammered in terms of moisture content, relative humidity, condensation, anything like that,” Ueno told *JLC* in a phone interview. “And the current analysis tools in the toolbox say this wall should be toast. But we opened it up and it was like, ‘Huh. Well, there’s a little bit of grain raise. The fasteners are a little bit rusty. That’s about it.’”

MORE ROBUST THAN YOU WOULD THINK

What explains the surprising lack of damage? Ueno says, “Joe [Lstiburek, BSC’s founder and principal] has said for years that building assemblies are more robust than we give them credit for. This is a solid demonstration of that fact.” But the BSC researchers are not sure themselves exactly why a stud wall that should theoretically be damaged by fungus shows no sign of any fungal attack.

continued on page 43



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Protective mechanisms. In a section of the report titled “Protective Mechanisms,” Ueno considers the possibilities.

In the case of the cellulose-insulated walls, the borate treatment in the cellulose may deserve partial credit (borates in cellulose function as a preservative as well as a fire retardant). Writes Ueno, “In the product installed at this site, the cellulose insulation contains 15% or less (by weight) boric acid and sodium tetraborate pentahydrate; other cellulose insulation manufacturers use ammonium sulfate in this role in conjunction with borates. Previous field observations have provided evidence that these preservatives can migrate into adjacent materials (e.g., sheathing or gypsum board), thus providing them with some protection.”

“What the cellulose guys say, and what I’ve seen too, is that cellulose does a nice job of protecting whatever it’s in contact with,” Ueno told *JLC*. “I know that the cellulose guys sometimes over-sell it, but the bottom line is, there is a lot of truth to that.”

But what about the foam-insulated walls? Ueno considered several possibilities. One suggestion was that the foam might be depriving mold organisms of oxygen to grow. But Ueno doesn’t think that hypothesis rings true. “If you look at the foam under a microscope,” he says, “it’s basically an open web. If you were a tiny person, you could walk between these cells. So there is no way that oxygen is being held out. And if you read the food-science literature, you learn that mold needs only a minuscule amount of oxygen to grow. So it’s probably not the oxygen thing.”

What about temperature? “Another thing we were kicking around was, is it the flash heating [the chemical reaction that generates heat when spray foam is applied]?” says Ueno.

“Does it sterilize that surface, and then it’s encapsulated?” asked Ueno. “But again, look at the food-science stuff, and the temperatures you need to kill mold seem to be really hot for half an hour. Spray foam is not staying hot for half an hour in a wall.”

Another possibility is that the spray foam is creating a thin, dense layer of plastic film over the OSB when the spray first

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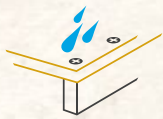


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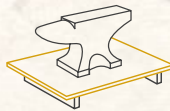
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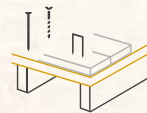
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contacts the board, forming a barrier between mold spores and the OSB food source. Or, perhaps the foam insulation creates a capillary pathway that stores moisture and draws it away from the OSB. Ueno says there's nothing in the available literature about those possibilities—leaving the question, for the time being, unanswered.

But whatever is going on with the Transformations walls, Ueno says, nobody should assume that the same good luck would protect some other wall that gets exposed to similar moisture conditions. "One of the things I pointed out in the report is, it could be the combination of this specific sheathing with this specific cellulose or this specific spray foam," he explains. "I'm not positive."

Letting walls dry. In the final analysis, Ueno and his colleagues are holding to the recommendations they formulated before their destructive investigation revealed the undamaged walls. "The cellulose walls clearly showed the highest moisture accumulation: the use of interior vapor control more restrictive than Class III (latex paint) is recommended," Ueno writes. A Class II vapor retarder (1 to 0.1 perm; for example, a variable-permeability membrane or vapor retarder paint) will reduce moisture risks to more reasonable levels. However, Ueno continues, "It is entirely likely that many double-stud walls insulated with cellulose with only Class III vapor control provide fine service. A Class I vapor retarder (polyethylene) is not recommended because it completely eliminates inward drying."

As for the spray-foam walls, where moisture accumulation was less extreme, Ueno writes, "It is a marginal judgment call whether a Class II vapor retarder is needed or warranted."

"The ocSPF [open-cell spray foam] material, at the thickness applied, provides reasonable vapor control (2.0 to 2.5 perms in 12-in.). The use of a Class II vapor retarder would definitely be conservative, but the double-stud walls insulated with ocSPF have a history of providing excellent performance in this builder's houses." (These recommendations, Ueno cautions, are specific to the conditions in a Zone 5a climate like Massachusetts; in colder climates, other methods might be advisable.)

BOTH WALLS WORK

Carter Scott, the builder whose concerns prompted the BSC study, told *JLC* in an interview in February that he's comfortable now with either type of 12-inch double-stud wall. In a planned development near Northampton, Mass., in fact, Scott now plans to build both ways. Thirty-two of the units are part of a co-housing community where the planners prefer cellulose

for its "green" attributes. The remainder of the development is slated for spec houses, which will most likely get spray foam. Depending on the amount of rooftop solar on each house, most of the houses will exceed net-zero performance, producing more energy each year than they consume.

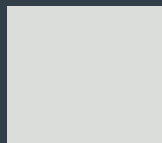
Contributing editor Ted Cushman is based in Peaks Island, Maine.



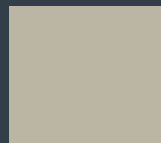
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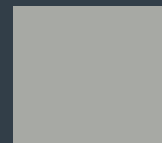
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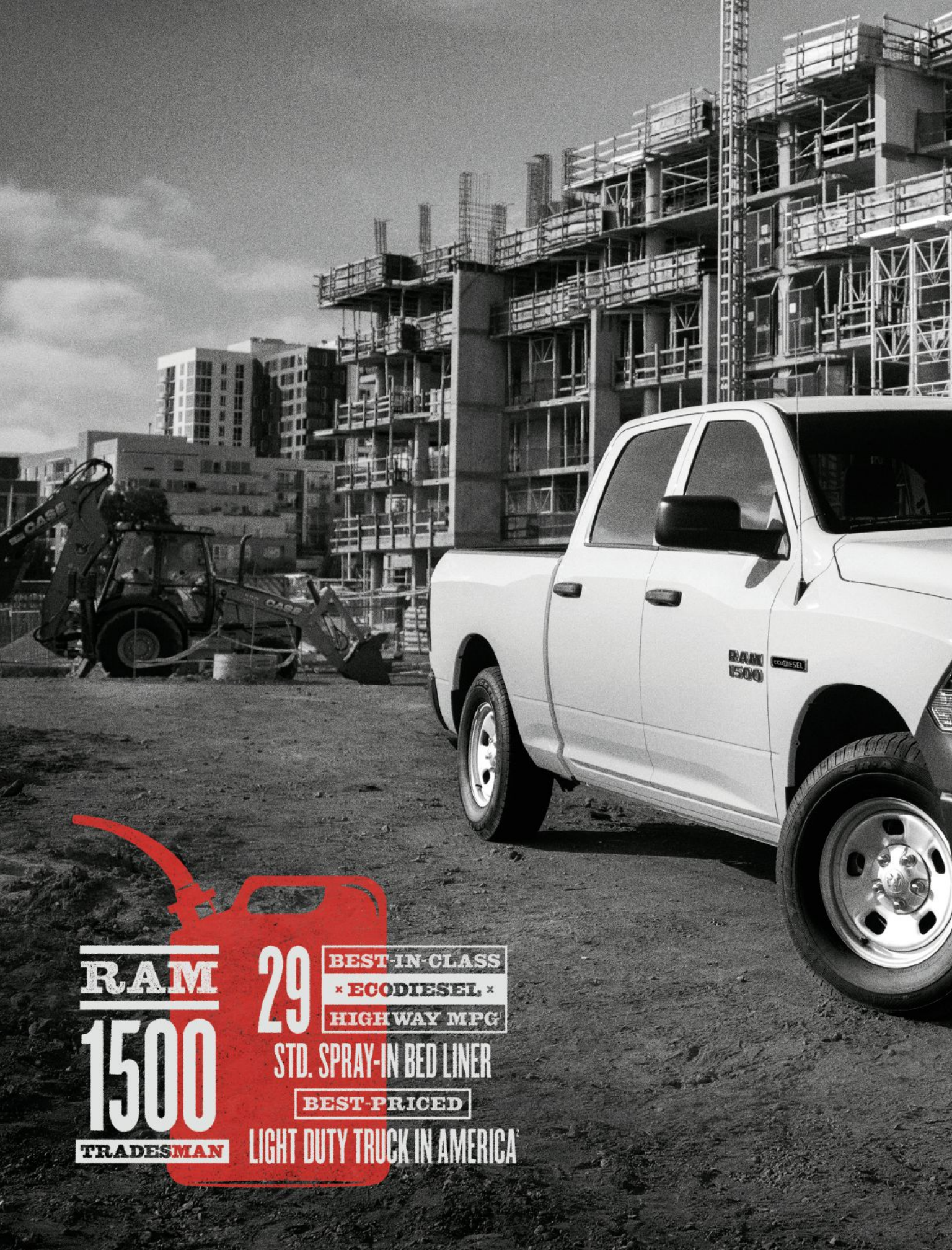
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EXTERIOR DOORS



Pre-Hanging Exterior Doors Improve accuracy and save headaches by bringing it in-house

BY GREG BURNET

It wasn't long ago that the same carpenters who formed the foundation for a house were also responsible for framing, building the stairs, trimming the interior, and hanging the doors. In our rush to keep up with the post-WWII building boom, some elements that carpenters would normally have handled on site were sourced to factories and assembly lines. Ready-to-install stairs, windows, doors, and even whole houses began arriving on building sites where less-skilled labor was needed to install them.

While I have no problem with progress or the concept of “working smarter, not harder,” I do have issues with having to correct a defective product that I've paid someone else to supply. Such is the

case with many of the pre-hung doors my company has received from suppliers over the years. We've seen doors not hung square in their frames, misaligned hinges, incorrect lock bores, improperly set stops—you name the problem and we've probably seen (and fixed) it. Faced with the reality that ordering pre-hung doors has become a bit of a gamble, we've brought some of our door hanging back in-house.

WHY SHOULD I DO THE PRE-HANGING?

Aside from assuring a proper fit, pre-hanging my own doors has many other advantages. First, I'm able to choose the jamb

Photos: Sue Burnet



material—including the species, width, and type—which is important when we work in older buildings that don't have conventional walls. For example, standard-width 4 $\frac{1}{16}$ -inch-wide jambs don't work when the walls are framed with full-dimension 2x4s with $\frac{1}{8}$ -inch plaster on both sides.

Another advantage is being able to use any kind of hinges and hardware. We do everything we can to ensure the longevity of our installations, and we don't skimp on hinges. Many pre-hung doors come with cheap stamped-steel hinges that don't hold up over time, whereas we hang most of our doors on heavy-duty, solid-brass hinges that we select to match the hardware in the rest of the house. (Try telling a supplier to order a pre-hung door with 4x4 solid brass butt hinges in an oil-rubbed bronze finish with non-removable pins, and see what kind of response you get.) And when we do our own pre-hanging, we're not limited to the prep-work done for a "standard" lockset and deadbolt.

Pre-hanging our own doors also lets us handle doors with a unique configuration such as an integral transom. While our company does install standard doors in conventional projects, we focus on these "Specials," which are sometimes challenging, but always

satisfying. And we're often able to incorporate a reclaimed door or glazing into the project. Many of our clients enjoy having a unique vintage door in their house and saving a piece of history from going to the landfill in the process.

In a nutshell, pre-hanging our own doors gives us far better quality control, which translates to fewer problems with the installation and fewer problems with the door's function and operation down the line. But perhaps the most compelling reason for hanging our own doors is simply that it minimizes the headaches associated with fixing other people's mistakes, saving us time, aggravation, and money.

ASSESSING THE PROJECT

I approach each door that I pre-hang by making a list of requirements. First on the list is the size of the door I need to install and whether the door opens right-handed or left-handed. Next, I note the width and species of the jamb. The width is based on the wall that the door will be going into; the species matches, when possible, what has been used for other doors in the building. We also note the type and quantity of hinges for the door, again trying to



match the existing doors in the building. Finally, I note the lockset and deadbolt requirements.

Once I've gathered this information, I order the necessary components. For an interior door, these typically include the unprepped door slab—with no machining—jamb and stop material, hinges, and hardware.

For an exterior door, the list is a bit different. If we're not using a reclaimed door, I order the slab—again unprepped, which means the door has not been bored, mortised, or otherwise machined for hardware. For most projects, I order rabbeted jamb stock (we used Dura-Frame jambs for the projects shown in this article), along with any weatherstripping that is necessary. I also order an adjustable aluminum sill with integral thermal break. The final items are the hinges, lockset, and deadbolt, along with any special hardware items, such as a closer, viewer, or kick plate.

In one of the projects pictured here, the client had selected a fiberglass entry door, which we ordered as “no prep” from our lumberyard when we ordered the rest of the items on our list. For the other project shown in this article, we hung a pair of wood doors in a custom jamb with a transom.

PREPPING THE SLAB

After all the components have been delivered, the first thing we do is check the slab for square. It's surprising how often we see wood slabs that aren't square. If not recognized and corrected, an out-of-square slab will cause a lot of frustration during the pre-hanging and installation process. Wood slabs can be trimmed or planed slightly to correct for problems, but fiberglass slabs have little room for trimming, so they need to be square and flat when they arrive from the supplier.

If a door is to operate properly, either the width must be undersized slightly in relation to the jamb or the door needs to be beveled on the strike side. Both methods provide the necessary clearance for the door as it swings past the leading edge of the jamb. Most wood doors are beveled, while most steel doors are undersized. Fiberglass doors typically have wood cores behind the stiles and use a different method to provide clearance: The wood cores have slightly eased edges that allow the slab to be hung either left-handed or right-handed and make it unnecessary to plane a bevel for clearance on the latch edge.

Most fiberglass door slabs without glazing are reversible. But



those with integral glazing have a defined interior and exterior side (the side of the glazing retainer molding with the exposed screws faces toward the interior). To keep myself oriented when mortising for the hinges, I mark the upper interior corner of the slab with a piece of painters tape **(1)**. I then set the slab aside and turn my attention to preparing the jambs.

FABRICATING JAMBS

For the fiberglass door shown here, our supplier provided us with jambs pre-cut to the lengths that we needed. This particular jamb stock also came with weatherstripping inserted into a kerf that ran along the inside corner of the rabbeted section. After removing the weatherstripping **(2)** and setting it aside temporarily, I ripped the jamb stock to the correct width.

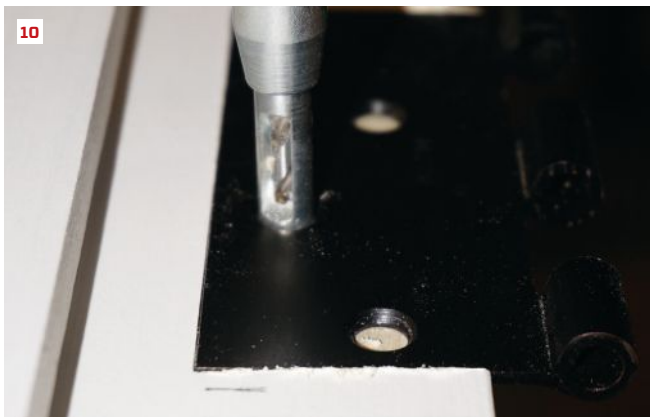
Because the wooden door was an odd size and a custom fit, we fabricated the jamb by cutting the legs and head to length, then rabbeted the side jambs to accept the head and sill. To make those rabbets, we set the depth of the miter saw to cut about halfway through the jamb stock, and then made successive passes across the stock. We removed the waste material from the rabbet with a sharp chisel.

STORY POLES FOR HINGE LOCATIONS

In almost every phase of the work I do, I rely on story poles for transferring measurements whenever possible, especially when there are multiple components that need to fit and operate together. Story poles minimize errors, which in turn increases efficiency. Generally, I just use simple strips of wood with the hinge locations marked on them. My standard layout for doors is to mark the top of the top hinge 7 inches down from the top of the story pole, and mark the bottom of the bottom hinge 11 inches up from the sill end of the pole. Then I center the middle hinge between the top and bottom hinges. With the hinge locations laid out on the story pole, I'm ready to mortise for the hinges.

JIG SIMPLIFIES HINGE MORTISING

To lay out the hinge mortises (or gains, as they're sometimes called), I set the hinge-side jamb leg flat on a bench and insert the head jamb into its rabbet. Working from the head jamb, I butt the story pole against a spacer such as a nickel **(3)** or a small, square brass rod about 1/8 inch wide **(4)**, which provides clearance at the top of the door. (A 1/8-inch drill bit also works well as a spacer.) I



then transfer the marks from the story pole to the rabbeted portion of the jamb (5).

While hinge mortises can be cut with a hammer and chisel, we rely on using a router and a simple hinge jig, which is faster and more accurate. The Hinge Mate jig we use is compact and clamps to the piece being mortised, so unlike hinge jigs that attach with nails, it doesn't leave holes. We adjust the jig for the size of the hinges (4 inches in the photos here) we're installing. To set the depth of the bearing-guided bit, we place the base on two hinge leaves, and then lower the bit until it just contacts the jamb (6). We clamp the jig and cut each mortise in less than a minute (7).

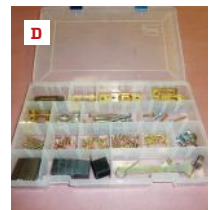
The ½-inch-diameter router bit supplied with the jig leaves mortises with ¼-inch radius corners. For the fiberglass door, we ordered hinges with a corresponding radius. But for the wood door, we used square-cornered hinges to match the other doors in the house, so the corner of each mortise had to be squared up to receive the hinges. A spring-loaded corner chisel makes quick work of cutting a perfectly square corner (8). The remaining fragment of wood is easily removed with a chisel or knife (9).

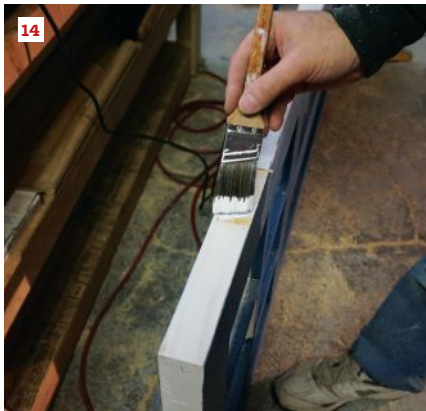
While the router is still set up, we cut the hinge mortises on the

DOOR HANGER'S TOOL KIT: THE SHORT LIST

Here are a few of the tools that I keep in my tool belt or in the truck when pre-hanging or installing doors. Many are specialty tools, but they pay for themselves the first time you use them. —G.B.

- **Hinge jig & router:** for fast and accurate hinge installation
- **Door bore kit & heavy-duty drill:** simplifies lockset installation
- **Vix bits:** self-centering for pre-drilling hardware screws
- **Butt mortise plane:** quieter, cleaner option than a router and jig
- **Jigs & templates:** homemade for specialty hardware
- **Power plane:** for fitting wooden doors and beveling door edges
- **Door stands:** holds door slab on edge while working (A)
- **Corner chisel:** makes square corners for mortised hardware
- **Magnetic levels:** will stick to metal hinges or to metal frame
- **Plumb bob:** always accurate for plumbing jambs
- **Door lifter:** Door Jack lets you safely lift doors with your foot (B)
- **Hinge tool:** Knuckle Bender from FastCap for adjusting hinges
- **Winbag:** inflatable bag moves heavy doors in the frame (C)
- **Spare hardware/hinge shims:** extras for when you need them (D)
- **Door dolly:** homemade for wheeling around heavy doors on site





door if need be. We begin by setting the door slab in our spring-loaded door bucks to lay out the hinge positions on the edge of the door. Without a spacer this time, we place the story pole flush with the top of the door and mark the hinge positions. We then align the jig, clamp it in position, and rout the hinge mortises on the door.

With a hinge leaf placed in each mortise, I drill a hole for every hinge screw (in the jambs and in the door) using a self-centering Vix bit (10). These spring-loaded bits ensure accurate placement of hardware screws—something that many pre-hanging facilities seem to have a hard time getting right these days. After drilling the holes, I drive the screws to secure the hinges (11).

BORING FOR THE LOCKSET AND DEADBOLT

To drill the holes in the slabs for the lockset and deadbolt, we use a boring kit made by Classic Engineering. This kit contains a jig as well as various bits and parts necessary to bore all the holes for most entry hardware quickly and efficiently. The heart of the system is a heavy, cast-aluminum jig that clamps firmly to the door and accurately guides the boring bits to make the necessary holes.

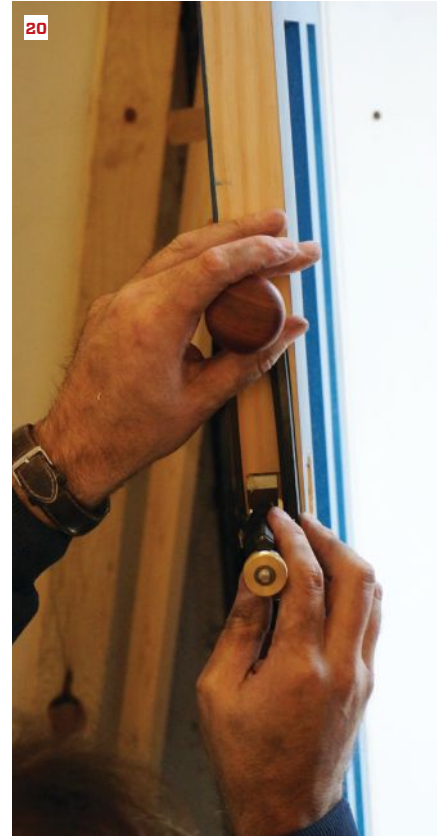
We start by adjusting the jig to the backset distance (the distance

from the door's edge to the center of the lockset holes). Then, we place the jig on the door and align it with one of the registration marks (typically 36 inches from the bottom of the door to the center of the lockset and 41 inches to the center of the deadbolt). Next, we tighten the clamps to secure the jig to the door, and we drill the holes. For the lockset and deadbolt holes, we use a 2 1/4-inch self-feeding spur bit (12), and for the edge bores, we use a 1-inch spade-type bit (13).

We always use a heavy-duty, 1/2-inch electric drill to power the large bits through the door slab. A quick-release bit holder that's included with the boring kit makes bit changes quick and easy, so we don't have to reach for a chuck key when switching between bits for the different size holes.

PUTTING THE UNIT TOGETHER

Cutting, mortising, and drilling the door and frame expose raw wood, so we always seal these areas with a fast-drying primer to minimize the chance for moisture to enter and cause decay (14). To assemble the jamb, we first drill holes through the jamb for the screws that will fasten the side jambs to the head and sill (15). These holes are countersunk on the back of the frame to help



minimize any chance for splitting. Before driving the screws, we apply a generous bead of sealant to the rabbeted areas of the side jambs (16). We then place the side jamb on the head and sill and drive 2-inch coated screws to secure the joints (17).

As with most fiberglass door slabs, the bottom edge of this slab had been machined with grooves during the manufacturing process to accept the door-sweep weatherstripping. We tapped the door sweep into the grooves, snugging it up against the bottom of the slab (18). We also reinserted the weatherstripping that we had removed earlier into its kerf in the side jamb. Finally, we brought the door slab to the assembled frame, inserted the hinge pins, and our pre-hung unit was ready for installation.

We always prefer to install the lockset and deadbolt during the pre-hanging process in our shop, but in this instance the homeowner supplied those items, so we installed them on site after installing the door.

To install the lockset and deadbolt, we first slide the cylinders into their respective holes and score the outlines of the latch faces onto the edge of the door using a utility knife, which leaves a finer line than a pencil does. I chisel around the perimeter of the plates

as well as in the field of the mortise, removing most, but not all, of the waste (19). Then I use a butt mortise plane to take the mortises down to their final depth (20). A router and template can also be used for this operation, but I find my method less dusty and just as fast, especially when working with just one or two doors.

With the hardware installed, the final step is adjusting the height of the threshold via its built-in adjustment screws. The door sweep should make firm contact with the threshold surface. I make a final check of the hardware operation and trim around the door.

It took just about 2 hours to pre-hang the fiberglass door in our shop. Because of the custom nature of the other project, pre-hanging the wood door took a bit longer. We've found that hanging multiple units at one time and using an assembly-line approach can make the procedure go considerably faster. I figure that the cost of pre-hanging our own doors compared with buying factory-hung units to be a wash. The biggest savings are in time and aggravation, because we're installing a better product.

Greg Burnet owns Chicago Window and Door Solutions and is a presenter at JLC Live.



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AIR-SEALING



Air-Sealing Techniques From a Passive House Pro Even conventional homes can benefit from advanced methods and materials

BY INDIGO RUTH-DAVIS

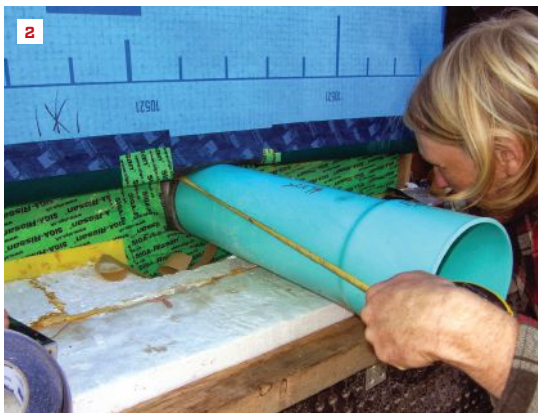
In Vermont, at Montpelier Construction, we strive to be energy-conscious builders. One of our founding partners, Malcolm Gray, studied energy-efficient construction and renewable energy at Goddard College in the 1970s and remembers doing heat-loss equations on a slide rule. While the technology has certainly advanced since then, we continue to pursue the same goals, now with our Passive House and weatherization work.

The core of our business will always be the traditional craftsmanship that we bring to our projects, but incorporating Passive

House air-sealing techniques and energy modeling is now becoming at least as important as making every piece of finish trim fit just right. The most basic component of this is airtightness.

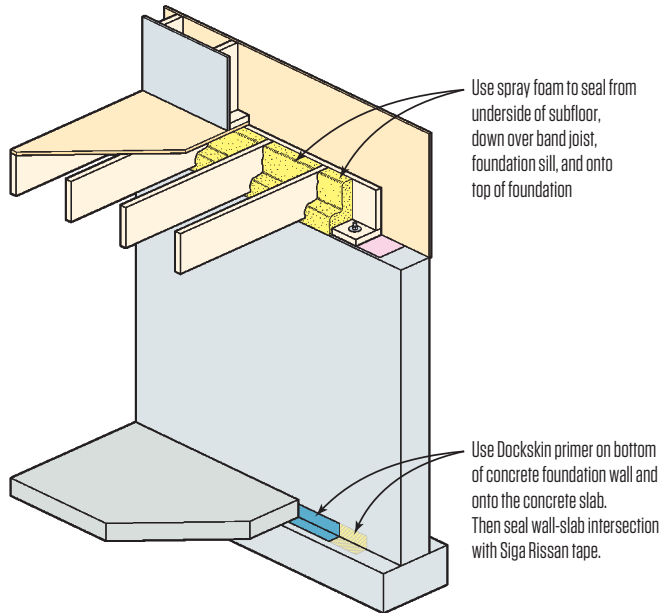
Even if you aren't building to the stringent German standard, there's a lot to learn about methods and materials for creating a draft-free, energy-efficient home. In this article I'll explain some of the techniques we used in a recent Passive House build, shown here in the photos. But I'll also talk about how these techniques can be used in more conventional buildings (shown in the illustrations).

Photos: Greg Whitchurch



Foundation

A concrete foundation is air impermeable, but on the interior, you must air-seal where the foundation meets the framing and where the foundation and slab meet.



Air-sealing is the cheapest way to reduce energy use in homes. Without airtightness, insulation is useless. Airtight buildings are much more comfortable and less drafty too. The Passive House standard places emphasis on airtightness to protect the wall assembly from moisture-laden air finding its way in. In super-insulated assemblies, the potential for mold and moisture damage to occur can be great. Therefore, keeping airborne moisture out of the wall or roof assembly with proper air-sealing is key to a healthy and resilient high-performance building.

Achieving the Passive-House airtightness requirement is painstaking, but not impossible. In the design phase, we defined the boundaries of the house's air barrier, then used airtight membranes, high-quality acrylic tapes, caulks, and other special products—most made in Europe but available in the U.S. (See page 61 for a list of air-sealing products we used.) One of the first things a Passive House Consultant does when planning a project is work with the builder to define the boundaries of the house's one continuous air barrier. A decision must be made about every part of the house and whether it will be conditioned space. Communication is critical to developing a strategy that will work on paper and in the field.

Everyone from the homeowner to each tradesperson needs to know what we are trying to accomplish and how we are going to do it. All it would take is one member of the team who doesn't understand or care about the airtightness goal to undermine our efforts with a hole or two poked in the wrong place.

STARTING UNDER THE HOUSE

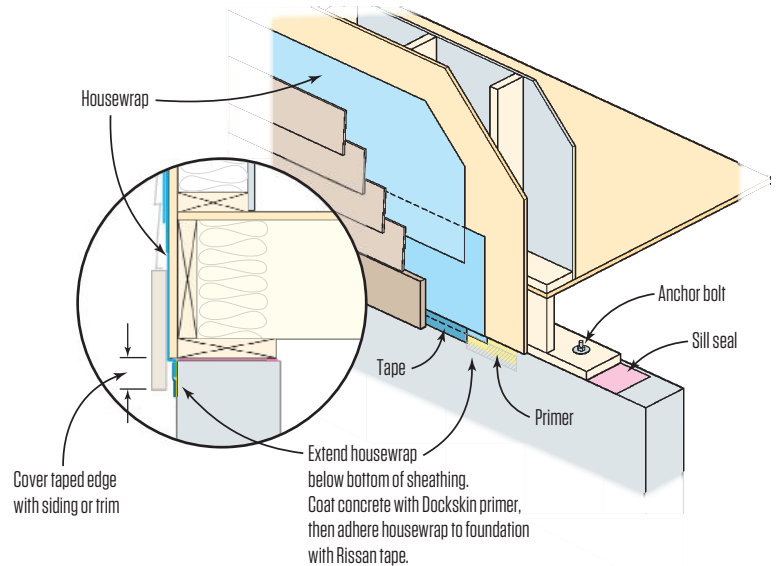
The air barrier begins under the house. Surprisingly, there is some air movement below grade. The air barrier under the footing and slab is also a vapor retarder and radon retarder. For this, we used 10-mil Stego Wrap. We weren't satisfied with the adhesion from the tape that is sold with the Stego Wrap, so we switched to Siga Rissan tape. Rissan is so sticky that the reinforced tape will pull apart before the bond with the plastic gives out. As you can imagine, this created a number of interesting folds at the four corners of the house, similar to wrapping a present (1).

If you aren't aiming for Passive House airtightness, but still want to do a good job in a conventional building, pay attention to the junction between the foundation wall and slab, which is a potential air leak when there isn't a continuous plastic layer below. This seam



Foundation to Framing

Traditional sill seal doesn't do a very good job, plus foundation J-bolts though the sill seal and pressure-treated sills can leak lots of air. On the building's exterior, use housewrap to seal the framing-to-foundation intersection.



can be sealed with Siga's Rissan tape after you've primed the concrete with Siga's Dockskin liquid sealer (see Foundation, facing page). The tape, available in 2.5-, 4-, and 6-inch rolls, has a divided peel-away strip, so it's easy to fold into corners.

If the foundation wall is poured concrete, no separate air-barrier layer should be needed, as concrete is fairly airtight. Be sure to seal any service penetrations before they are inaccessible (2). Make sure to air-seal and insulate behind electric service panels.

If you have a CMU foundation, depending on the type of block, it could be fairly leaky and needs to be sealed with a coat of plaster or a fluid-applied air barrier. By the way, basement windows are notoriously leaky and provide little useful light. If they don't serve a good purpose, don't put them in.

FOUNDATION TO FRAMING

The connection from the foundation air barrier to the wall air barrier is often a difficult junction to seal in a conventional house. Typically, builders install sill seal between the masonry and the framing, which is marginally effective, especially when the foundation's J-bolts pass through the sill seal. The top of the foundation

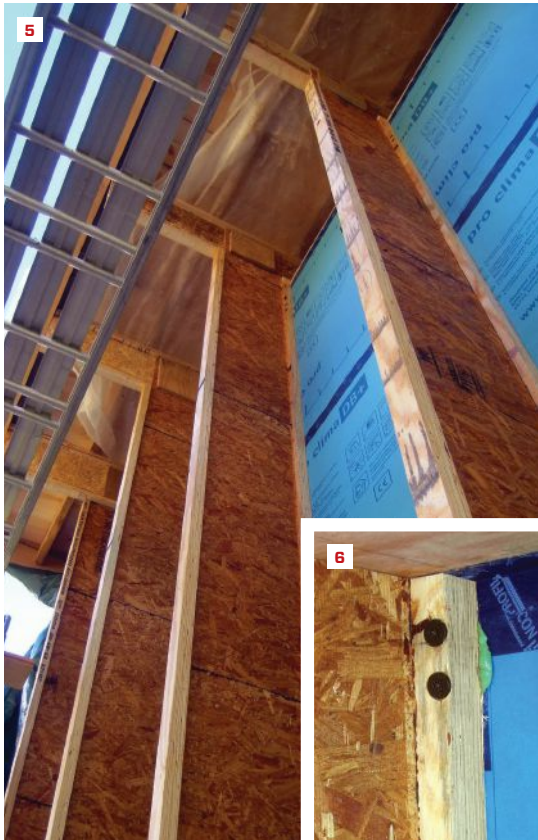
wall is rarely flat enough for generic sill seal to fill the gap between the concrete and band joist, resulting in serious air leaks as well.

In our Passive House, though, that connection wasn't an issue. Because the foundation air barrier ran up the outside of the foundation (3, 4) and was more or less in line with the air barrier running up the outside of the structural wall, there would be no J-bolts penetrating the air barrier or gaps between the top of the foundation wall and the mud sill to worry about.

In some buildings, taped housewrap might be your best air barrier. Instead of just stapling it at the bottom of the wall sheathing, tape it to the foundation wall with a 6-inch-wide piece of 3M flashing tape or Siga Rissan tape after priming the concrete with Siga Dockskin.

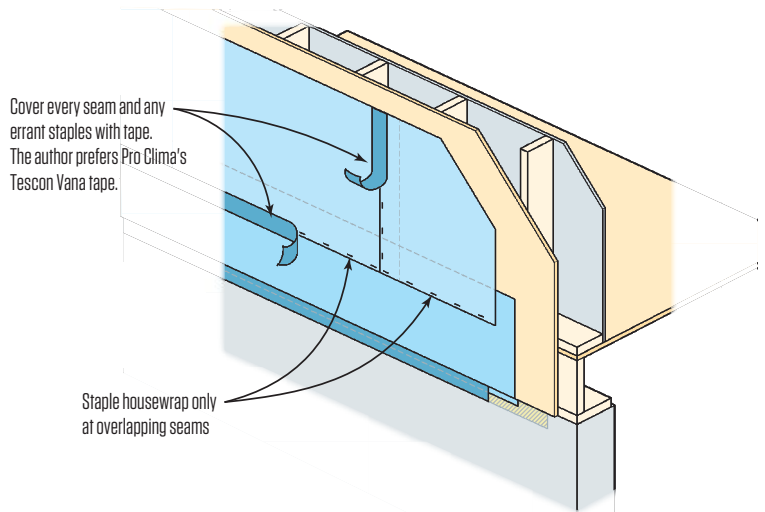
If the foundation is insulated on the outside, leave a section of insulation off at the top of the concrete wall until the connection between the air barriers is made. If the concrete itself is the finish above grade, hold the apron board trim 2 inches down to hide the taped seam (see Foundation to Framing, above).

Another way to seal the foundation-wall-to-framed-wall connection is from the inside with spray foam. With a froth pack, foam



Framed Wall Air Barrier

Holes in the housewrap, even small ones from staples, compromise the air barrier.



Cover every seam and any errant staples with tape. The author prefers Pro Clima's Tescon Vana tape.

Staple housewrap only at overlapping seams

from the underside of the floor sheathing down the band joist and connect it to the foundation wall. This approach still leaves the subfloor-to-wall-bottom-plate connection as a potential air leak that will need to be sealed with foam or caulk. The Passive House Institute doesn't recommend relying on spray foam as an air barrier because it can crack over time, but I think it's a significant improvement over relying on traditional sill seal.

FRAMED WALL AIR BARRIER.

Defining a continuous air barrier on the framed-wall part of the building can be tricky. In a conventional building it could be dry-wall or vapor retarder on the inside, or housewrap on the exterior. An interior air barrier is preferable from a moisture-control perspective, but every electric outlet and floor seam needs to be sealed, which is time-consuming. An exterior air barrier is less desirable from a building-science perspective, but makes it easier to achieve continuity—by simply taping the seams and holes in the housewrap or by using the Huber Zip System.

In a Passive House or super-insulated wall, the air barrier needs to be on the inside to prevent inside moisture from getting into the

wall assembly and condensing. While polyethylene sheeting is a good choice for an air barrier under and around the foundation to keep out as much ground moisture as possible, it isn't a good choice for a framed wall, except in the coldest climates. Where there is a possibility of vapor drive both from the inside out and from the outside in, a variable-perm vapor-control layer, such as the Pro Clima DB+ that we used on our Passive House, can be a safer option. The vapor-control layer can also serve as the air barrier.

With a complete and permanently sealed air barrier, not destroying it as we built our insulation curtain wall was our only remaining challenge. Our insulation curtain wall consisted of 16-inch vertical wood I-joists spaced 36 inches on-center (5) filled with dense-pack cellulose. Six-inch-long HeadLok screws were used to attach the I-joists. These screws would penetrate the air barrier, so to seal the screw holes, we pre-drilled each joist while it was on the ground, then applied Pro Clima's permanently flexible caulk, Contega HF (OR-F), to each hole. The screws cinched the joist tight to the DB+ and the caulking was compressed for a good seal (6).

DB+ is a reinforced paper-based product that requires a certain amount of care during installation. It comes in 4-foot rolls, which

Use the Right Materials in the Right Locations

Many of the products we use for air-sealing aren't available at the local lumberyard—at least not yet. However, there are specialty building-supply companies with robust websites and knowledgeable staff who can answer most of your questions and help with ordering.

FOUNDATION

- **Vapor and radon retarder:** Stego Wrap, 10 mil, 14-by-210-foot roll, \$345. stegoindustries.com
- **Tape:** Siga Rissan, 2.4 inches by 82 feet, \$33. smallplanetworkshopstore.com or sigacover.com

WALLS

- **Membrane:** Pro Clima DB+, 53-inch by 131-foot roll, \$238. foursevenfive.com
- **Tape:** Pro Clima Tescon Vana, 2 3/8 inches by 98 feet, \$42. foursevenfive.com

WINDOWS

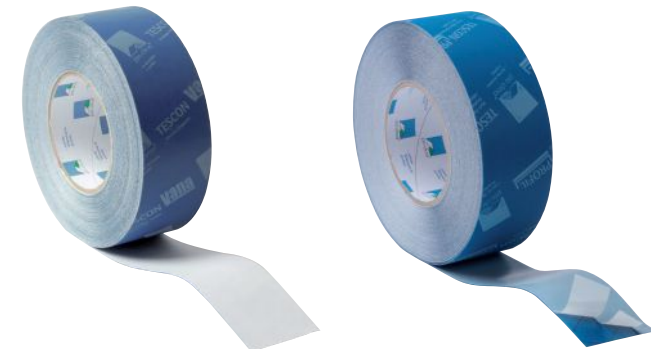
- **Interior tape:** Siga Corvum, 2 inches by 82 feet, \$57. smallplanetworkshopstore.com or sigacover.com
- **Exterior tapes:**
 - Pro Clima Tescon Profil, 2 3/8 inches by 98 feet, \$53. foursevenfive.com
 - Siga Wigluv, 2 1/4 inches by 131 feet, \$59. smallplanetworkshopstore.com or sigatcover.com
 - Zip tape, 2 inches by 60 feet, \$19. huberwood.com
 - 3M #8067 flashing tape, 4 inches by 75 feet, \$38. 3m.com

CEILING

- **Membrane:** Pro Clima Intello, 5-by-164-foot roll, \$333. foursevenfive.com
- **Tape:** Pro Clima Tescon Vana, 2 3/8 inches by 98 feet, \$42. foursevenfive.com

MISCELLANEOUS PRODUCTS

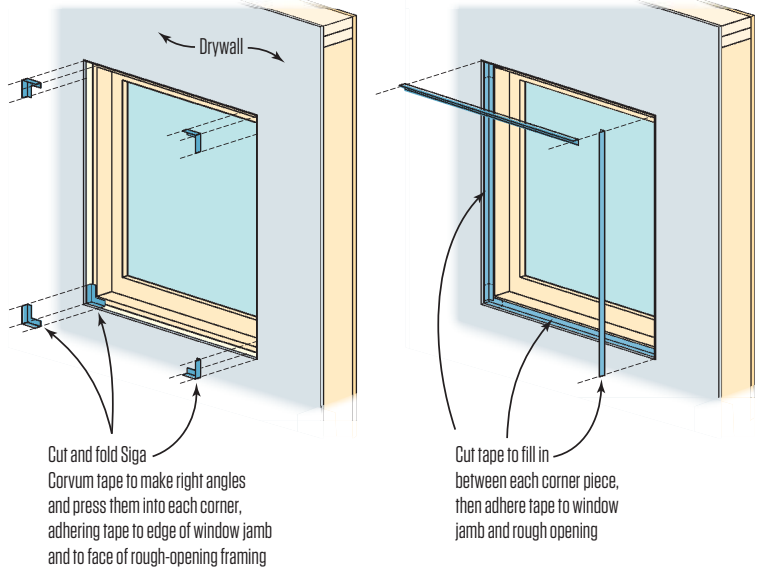
- Prosoco R-Guard Cat-5 fluid-applied WRB, 5-gallon bucket, \$503. prosoco.com
- Prosoco R-Guard Joint and Seam Filler, 20-ounce sausage tube, \$31. prosoco.com
- Pro Clima Contega HF (OR-F), 10.5-ounce cartridge, \$14. foursevenfive.com
- EPDM gaskets for penetrations, prices vary. foursevenfive.com
- HeadLok 6-inch-long screws, box of 50, \$35. fastenmaster.com
- Dockskin Primer, 8.8-pound bucket, \$120. smallplanetworkshopstore.com or sigacover.com





Windows and Doors

Stuffing fiberglass in the space between a window frame and its rough opening won't block air movement, and it can be problematic to get foam in there, especially if the space is narrow. Tape works better to air-seal a window in the interior.



are easy to handle. The membrane is stapled to the building only at the seams, where they will be covered with tape (see Framed Wall Air Barrier, page 60). We used Tescon Vana from Pro Clima to tape the seams and any rips or tears from the installation.

WINDOWS AND DOORS

The most challenging part of the wall air barrier is the airtight connection to the windows and doors. The windows on our Passive House project were going to be “outies,” so a connection needed to be made from the DB+ air barrier on the sheathing to the windows set on the outside of the wall. Our ¾-inch plywood bucks were set in place before we started wrapping the building with DB+ (7). The DB+ was carefully cut around the window and taped to the buck with Tescon Vana. All the seams in the buck were sealed with Proso's R-GUARD Joint and Seam Filler. The outer half of the window buck was then protected with Proso's R-GUARD fluid-applied WRB. This is a vapor-open, waterproof, weather-resistant barrier that is simply rolled on.

Effectively taping the windows for airtightness on the interior side requires some skill and takes time to master. We still spray-

foam windows in place for insulation, but the tape provides the real permanent air barrier.

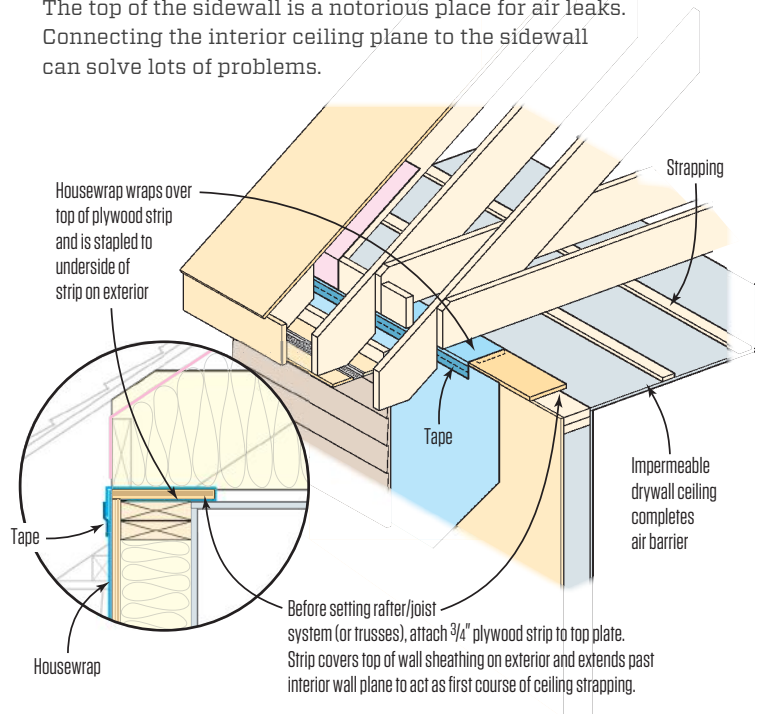
When builders switched to using spray foam to seal windows on the interior, it was a big improvement over stuffed fiberglass. In some situations, however, the spaces between the rough opening and the window jambs are too narrow for the foam gun to fit into, and if the window or frame shifts over time, the spray-foam seal can break. Because of this, Passive House builders rely on high-quality acrylic tapes to seal the window to the rough opening. We've found that Siga's Corvum tape is the easiest to use. It's pre-folded on the roll with a narrow side and a wider side. The narrow edge is applied to the window frame, and the wider side spans the gap and is adhered to the rough opening. The four corners require an additional, specially folded piece of tape for maximum airtightness (see Windows and Doors, above). Siga's Youtube channel has a good video on the process. Zip tape and 3M #8067 flashing tape also do a good job sealing the outside of windows, but are not as vapor-open.

Properly detailed head flashing and sill-pan flashing are still your first line of defense against water intrusion from the exterior.



Walls to Ceiling

The top of the sidewall is a notorious place for air leaks. Connecting the interior ceiling plane to the sidewall can solve lots of problems.



Before setting rafter/joist system (or trusses), attach 3/4" plywood strip to top plate. Strip covers top of wall sheathing on exterior and extends past interior wall plane to act as first course of ceiling strapping.

If a window or door isn't properly flashed, then no amount of special European tape can make it last.

WALLS TO ROOF

The soffit framing on our Passive House was built on top of the insulation assembly, which was above the air barrier (8), so there were no framing penetrations to deal with. The air barrier on the ceiling was our most important surface to completely seal. This roof assembly was designed to be both foam-free and unvented, utilizing the advanced moisture-controlling properties of Intello (9).

To seal the holes for ventilation intake and exhaust and for electric and water service, we used EPDM gaskets taped directly to the air barriers. A section of the conduit or piping must be placed through the gasket before insulating.

In most conventionally framed buildings, you'll need to find a way to connect your ceiling plane to the wall air barrier. No matter how bomb-proof your wall and ceiling air barriers are, if they aren't connected all the way around the building, neither will be effective.

Cap off the top of your wall by attaching a strip of plywood to the

top plate before setting your trusses or joists and rafters. Wrap housewrap from the exterior wall sheathing up and over the plywood strip, and then staple it to the underside of the strip. The strip can also serve as the first course of strapping (see Walls to Ceiling, above).

It's not uncommon to stand on the top plate when setting trusses or joists and rafters. Be forewarned that wrapping the plate area with housewrap might make it very slippery, and you'll want to use a fall protection system.

Once the building is dried in, you can strap the rest of the ceiling, then hang and fire-tape the ceiling before framing the interior walls. This way, the drywall air barrier isn't broken by the top plate of each wall partition.

The concept of one continuous air barrier from under the slab to the roof is simple enough to apply to any building. Penetrations of this barrier should be identified in the design phase along with a strategy for dealing with them. Our success on our Passive House project was a product of this approach.

Indigo Ruth-Davis is a PHIUS+ Certified Passive House Consultant and builder. He is a partner at Montpelier Construction.

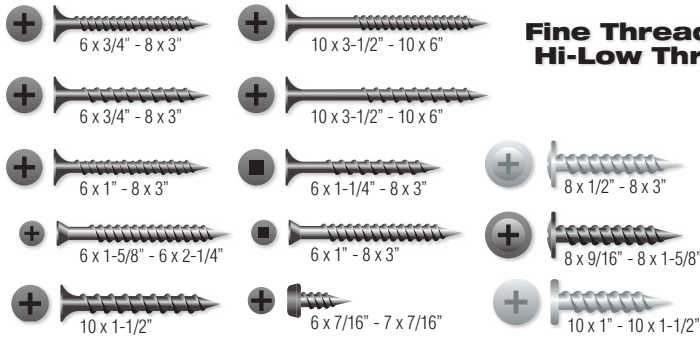
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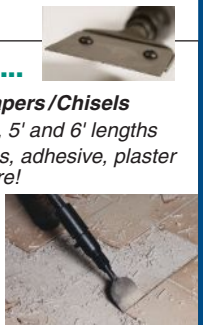
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Paintbrushes Pro Tips for Choosing, Using, and Cleaning

BY SCOTT BURT

Chances are, at some point in your career, you'll have to do the paint work on one of your jobs. It could be that you won't be able to find a pro who has time for your job, or maybe you'll be over budget and have no money to hire an outside painting contractor. Or maybe you've just always wondered how the pros brush out a finish that looks as perfect as a spray job.

If any of those scenarios are familiar, this article is a good starting point. Brush selection is key. Buying a good brush starts with the finish you'll be applying and where you'll be applying it. But getting good results goes beyond choosing the right paintbrush. You also have to learn the techniques for efficiently laying down a good

finish, some of which I'll cover here. And of course, if you want to be able to use that \$15 to \$20 brush again and again, knowing how to clean it is also important.

WHAT MAKES A GOOD BRUSH

The essential function of the paintbrush is to hold and release paint, and there are three components—handle, ferrule, and bristles—that determine how well that happens.

Handle. If you're holding a paintbrush for any length of time, you want a comfortable handle. If you can't grip a brush comfortably, it will show in the entry and exit of your brush strokes, which

Photo: Tim Healey



are what make a smooth finished surface. On better brushes, the handle is generally made of a lightweight hardwood. Usually, the wood is unfinished, which is easier to grip than wood that has a glossy finish.

Some marine-grade brushes made for clear varnishes and urethanes have an easy-to-clean glossy handle. At the other end of the spectrum, cheaper, plastic-handled brushes are usually throw-away tools—used, for example, to oil a deck and then tossed out.

I prefer brushes with a 7- to 8-inch-long, unfinished handle. For close-in detail work, such as cutting in interior trim, I choke up my grip on the brush, with my finger tips gripping the metal ferrule close to the bristles (1). But when I'm laying on a lot of paint, such as on exterior siding, I hold the brush further out on the handle (2). That extra length is also handy for extending my reach.

The ferrule is the corrosion-resistant metal band at the center of the brush that connects the handle to the bristles. Inside the ferrule, the bristle pack is set in epoxy at the base of the handle. On some brushes, the bristles may be internally wrapped in a concealed aluminum band within the external ferrule cladding.

Good brushes have a wooden or cardboard spacer—known as the plug—inserted in the ferrule housing to divide the bristle pack into two sections. The plug (or plugs) creates a paint well that holds paint and allows it to flow to the tips of the bristles. This well has more volume toward the handle and gradually tapers down toward the

tip of the brush. Along with the bristles themselves, the size and shape of the well determine how the brush holds (not drips) and releases paint. The quality and interplay of components define the basic differences between a really good brush and a cheaper one. A loaded brush can weigh several pounds, so sound construction and ergonomics are important considerations.

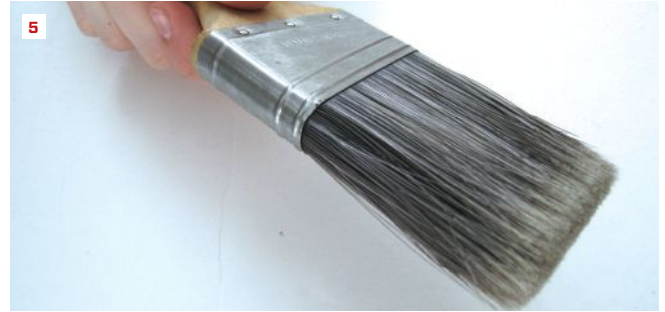
Bristles. Synthetic bristles are the most popular option these days. In the not-so-distant past—before water-based finishes became the norm—natural-hair bristles made from hogs or oxen were used in the best brushes. But natural-hair bristles can swell when used with water-based finishes, making the brush unusable for most work.

Today, the best brushes are made from blends of synthetic nylon and polyester bristles. In fact, for the majority of today's finishes, there is no need to buy a natural-bristle brush.

A brush with all-nylon bristles is too flexible and soft for fine work, and all-polyester bristles are too stiff and don't hold paint well. The right blend of bristles can spread paints and primers well and can also work in stains and urethanes without shedding, decomposing, hardening, or swelling. For most painting jobs, it is better to have a slightly stiffer brush than too soft of a brush.

A stiff brush with some flex lets you jam paint into spots where it's needed, without flattening out. Good synthetic brushes flex and change shape well, but they also return consistently to their origi-

Photos: 1 & 2, Andrew Warner; 3, Jefferson Kolle



nal form. Also, unlike natural-bristle brushes, they don't shed or shorten much with repeated use. The business end of a synthetic bristle is frequently tipped (shaved down to a sharper point) and flagged like a split end (3), giving the tip of the brush the very best ability to spread paint. The back 80% of the bristle pack holds and releases paint to the bristle tips.

SIZE MATTERS BUT SHAPE MATTERS MORE

When I check out how well a brush might work for me, the first thing I look at is the ferrule design.

Ferrule design. In cross-section, ferrules have one of three shapes: squared corners with parallel sides, rounded corners with parallel sides, or oval. I use all three types, depending on the job I'm doing. The shape of the ferrule defines the shape and thickness of the bristle pack. Different ferrule shapes hold and release paint in different ways, and your selection should be based on an understanding of what it is that you want to accomplish.

Brushes with square-cornered ferrules tend to be narrow (4), and they don't hold as much paint as ones with rounded corners. This is desirable for tight cuts and small surfaces where not much paint is needed. They are like pointers.

I would use a brush with a thicker, round-cornered ferrule (5) for most situations where I am both cutting precision lines and wanting to spread paint quickly.

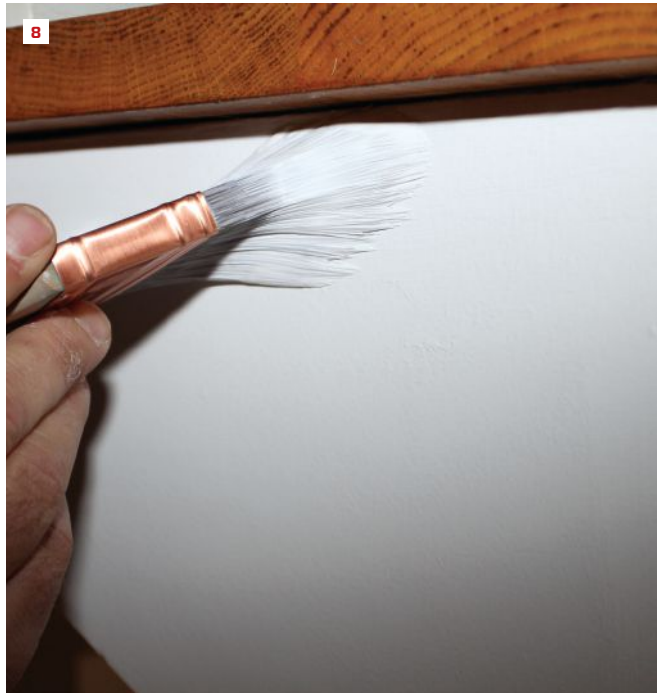
A brush with a larger, oval-shaped ferrule (6) will hold more paint, allowing for a longer pull on larger surfaces before needing to be reloaded with paint. Typically, I'd use one of these brushes for open-road paint spreading where there is some cutting, but there are no precision or detailed cuts.

Width is critical. While the components described above help to determine the thickness, general shape, and material hold and release characteristics of the brush, the width of the brush is also critical. This choice is usually made based on the task at hand. Most commonly, brushes come in ½-inch increments, from 1 to 4 inches.

If a brush is too large for the task, it is difficult to do precise and detailed work. Typically, inexperienced painters buy brushes that are too large for the job. On the other hand, if a brush is too small, the project will take longer, and the surface will appear overly brushed, resulting in a flashy look where the paint doesn't lay down and level out.

Paints dry quickly these days, so finding the right balance between quality and production is essential. Your siding doesn't need to be cabinet grade, and you don't want cabinets to look like siding. Your brush doesn't know the difference, so you need to.

Success is not always a function of a brush's width. I can spread paint faster, cleaner, and more efficiently with a fat, oval 2-inch brush than with a skinny, square-ferruled 3-inch brush. The 3-inch



will pull a wider stroke, but the 2-inch will move more material. Brushing is a game of laying out material efficiently and getting it level in the fewest number of moves possible.

ANGLED OR STRAIGHT BRISTLES

Traditional brushes are available with the ends of the bristles angled or parallel to the leading edge of the ferrule.

Angled brushes are easiest to use when cutting lines, because they lend themselves well to “pointing” and pulling out lines. They work really well on edge (7) when cutting wall paints into ceilings or trim casings (8). They are also great for brushing installed siding, where some cutting is required, but moving lots of paint is the top priority.

Straight brushes, also known as flat brushes, are the better choice for laying out paint on larger, flat surfaces when cutting is minimal. Also, straight brushes are best for not leaving bristle marks (9). A good example of where you would use these is cabinet-grade panel work, where the finish needs to be applied with a brush, but look as if it were sprayed.

MY PERSONAL FAVORITES

Surfaces to be brushed can vary from drywall, to cabinets, to rough exterior siding, or even concrete. A brush doesn't have to specialize in any of them, as long as it works well on all of them. Prep work is important because the smoother and cleaner the

surface, the more the brush will glide across the surface.

Brushes are like hammers: It's almost impossible to own just one, but you always have a favorite. By far my No. 1, desert-island brush that I always need within reach is 2 inches wide and has a rounded-corner ferrule and angled-cut bristles. It's a brush that's capable of both interior and exterior work with latex/waterborne paints and primers. Using it, I can cut where needed (I'm nutty about cutting), and I can also flat-brush broad surfaces. It's the brush that will solve the most problems on any given day. I like the Purdy Pro Extra or XL Elite series (purdy.com).

My second choice would be a 2 1/2-inch-wide, oval-ferrule, angled-cut-bristle brush that I use where I need to do less detailed cutting and have a bit more open road to spread paint faster and heavier. This is a brush that I could use on anything from exterior siding to interior trim. My choice here is the Proform Picasso (proformtech.com). It is not a cutting specialist, but rather a good, all-around mover of paint that cleans well. Lifespan for the Proform brushes isn't quite as long as for the Purdy brushes, but it's tolerable. When Picassos aren't available, this spot can easily be filled by a Purdy of the same shape and size.


My third favorite is a 3-inch-wide, straight-cut, rounded-corner-ferrule brush that I use where there is very little cutting and just plain, open road of finish that needs to lay down.

The fourth brush in my kit is a 1- or 1 1/2-inch-wide brush with a square-corner ferrule and angled-cut bristles. We refer to brushes


Photos: Andrew Wornier



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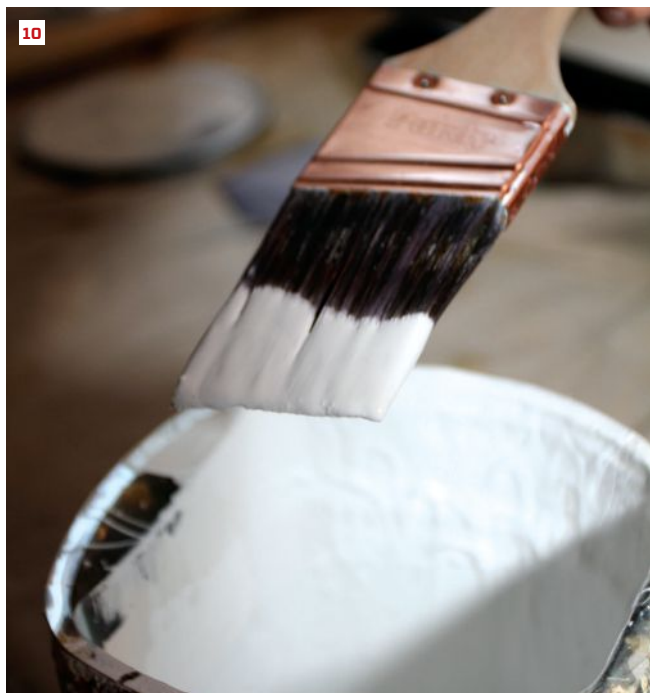


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like this as “snipers,” because they get into tight spots when there is no room for error. The day you needed one, but didn’t have it, you would pay twice the retail for one. The same can be said for a small artist brush, which is worth its weight in gold.

BRUSHING TECHNIQUES

Loading a brush with paint is about getting the bristles wet one-half to two-thirds of their length (10), and then either tapping on two sides of the can, or dipping and then wiping on the rim. I rarely wipe, because it seems redundant to me to load the brush and then put all that paint back in the can. I want to load the brush, then take all that paint to the wall for distribution, which is why the brush has to be designed to hold paint well. So I dip and slap, filling the inner well of the bristle pack—to the point of almost dripping. The vigor of the tap you make inside the can determines how much paint the brush ends up holding.

You should never brush from a full gallon can; I rarely carry more than a third of a gallon when working from one. For smaller-scale tasks, I also like to use a Handy Pail (bercomincorporated.com), because of its disposable liners and the magnet that holds a brush suspended in paint when it’s not being used (11). (It’s important to never let your brush dry out.)

The first move at the wall is always to unload the brush in the first pass, then move the paint exactly where and how you want it, working toward your last stroke. Many painters need to be re-

minded to reduce the number of moves to a consistent minimum in the act of loading and spreading paint from a brush.

CARE AND LIFESPAN

Brush lifespan varies with how much it’s used and how well it’s maintained. I expect two to three months of daily use from a brush. Over time, brushes lose their sharpness and start to splay out from their original shape. At that point, they live out their retirement brushing dust or spot priming.

Today’s paints are generally fast-drying, and sometimes excess paint will cake and dry on the top half of the bristles where they enter the ferrule. I often clean my brush at lunchtime, or even sooner, to avoid contamination from dried paint falling off the ferrule or upper bristles into a just-brushed surface.

By emptying the brush on your work surface before cleaning, you need less water for cleanup. Two to 3 quarts of warm water is generally enough. Start by pressing your brush into the bottom of the pail, then reach in for a series of squeezes. As the paint liquefies, it is possible to squeeze most of it out of the brush. Then rinse it with clean water and shake it out completely so that no water runs in the brush when you resume painting.

Do not pour wastewater down the drain where it can clog a septic system’s filters or weaken the natural bacteria in septic tanks. Also, never dump paint waste in the yard. The best method for wastewater management is at your jobsite dumpster. Pour the

Photos: Andrew Wornier



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wastewater from your cleanup pails onto the piles of scrap wood and sawdust in the dumpster. This is a convenient and effective filtration system, as the solids will separate and dry out, while the small quantity of water is quickly absorbed by the rest of your porous jobsite waste.

Some guys do the “boot tap,” where they slam the brush against the toe of their shoe or some other object to dry the bristles. Brushes don’t appreciate this treatment at all; it’s a great way to weaken the ferrule.

For end-of-the-day cleaning, empty the brush as completely as possible by unloading it on your work surface. Then, press the entire length of the bristles from the top down with both thumbs. Use a second bucket with cleaner water after the initial cleaning. Keep flipping the brush over and working out the paint until only clean water exits the brush as you rinse. Run a brush comb through the bristles to make sure they are all straight (12). Avoid using wire brushes to clean paintbrushes. If your brush is getting that messy, a change of habits is in order.

Some painters like to use a brush spinner—a specialized tool for removing cleaning solvents and drying the bristles. Centrifugal force flings away the solvent and dries the bristles quickly. I don’t like brush spinners, except maybe for drying the bristles on a large

exterior brush. Spinners tend to splay out the bristles, making the brush lose its shape.

After a couple of good, final shakeouts, I return the clean and slightly moist brush to its case to preserve its shape and keep it clean and protected (13). Store brushes at room temperature and avoid letting them freeze in the truck between uses. When you open the brush case, you want the bristles to feel soft, moist, straight, and tight. If any bristles have become bent out of shape, trim them with scissors.

Cleaning a brush that’s been used in a solvent-based finish is more complex, mainly because you can’t just dump out the paint thinner you’ve used. I use three different buckets. Bucket three has the dirtiest thinner and the solid wastes that I’ve poured off from bucket two, which is where the majority of the cleaning takes place. Bucket one has the cleanest thinner and is only used for a final rinse. When the thinner in bucket one gets too dirty, I pour it into bucket two. Everything in bucket three can be allowed to dry out, then disposed of properly as waste. Many municipalities have special days during the year when they accept dried paint and dirty thinner at their waste and trash processing centers.

Scott Burt owns Topcoat Finishes (topcoatfinishes.com) in Jericho, Vt., and partners in Prep to Finish (preptofinish.com), teaching classes in painting.

Photos: 11 & 13, Andrew Wormer; 12, Tim Healey

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Remodeling America’s Housing: The bi-annual State of the Remodeling Industry report, issued by the Joint Center for Housing Studies at Harvard University, is considered the nation’s preeminent examination of remodeling’s current state and future prospects. Kermit Baker leads that report, and at RMLC he’ll reveal what’s in it and what’s to come in your profession.

No. 1’s: What do some of America’s best remodeling sales reps know that you don’t? We convene a panel of top salespeople from operations across the country so they can tell you how they do it.

The Boomer Builder Boom: New-home builders and the media may focus on millennials, but for remodelers, it is baby boomers who constitute the biggest growth market. In this presentation by Hanley Wood’s Metrostudy division, we’ll look at what this group will want from you and what they’re willing to spend to grow old in place.

Air to the Throne?: When the green movement began, the focus was on saving energy, but lately it’s turned to air quality. In this presentation, experts from the Building Performance Institute reveal the challenges of maintaining air quality in today’s homes and the opportunities for remodelers to capitalize on this growing concern.

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BY LAUREN HUNTER



1. Design Your Door

Mahogany-stained Spanish cedar with frosted laminate windows (shown) is just one combination among countless available through Clopay's Reserve Wood Collection Custom Series garage door program. From traditional to contemporary, if you can draw it, you can have it. Available wood species are essentially unlimited, including reclaimed lumber, and there are numerous stain, metal, and glass options. The polystyrene-insulated wood doors feature an R-5.9 insulation value and a one-piece drop-cap design to keep water from flowing behind grooved overlays. A single-car overhead door starts at \$6,400, depending on wood species. clopaydoor.com.



2. Test Your Metal

Gerard USA's stone-coated-metal roofing systems are designed to withstand battering from damaging hail, UV rays, and even fire. The 26-gauge base steel is sandwiched between layers of zinc-aluminum alloy and acrylic coatings, and topped with ceramic-coated stone granules. The composition gives Gerard metal roofs a Class A fire rating backed by a lifetime warranty. Choose from tile, shake, and shingle profiles in 18 standard colors. gerardusa.com.



3. Protective Pouch

Next time you're working at a height, keep parts and pieces safely ensconced in the Arsenal Topped Parts Pouch. The clever design features Ergodyne's Trap Door top that blocks the opening if the pouch tips or overturns. Parts can be dropped in easily, but users have to reach in to pull them out. The pouch has loops for hanging from a belt. Available in canvas or tarpaulin, the Arsenal Topped Parts Pouch retails for \$33. ergodyne.com

4. Let There Be Control

Lutron's Caseta wireless dimmers work with a range of bulbs, including dimmable LEDs and CFLs. The in-wall dimmers don't require a neutral wire and can easily be swapped out with an existing light switch. To control table and floor lamps, simply plug the wireless lamp dimmers into a standard wall receptacle. Also available is the Smart Bridge Pro, which connects to a home's Wi-Fi router and allows users to control connected devices from a smartphone. The Smart Bridge sells for about \$200; Caseta dimmers start around \$50 each. lutron.com

Products

5. Easy-Install Joist Hanger

MiTek's THFI face-mount hanger incorporates the installation ease of a top-mount hanger with the flexibility of a face-mount, according to the maker. "Seat Cleats" that lock the bottom flange of the I-joist into the hanger eliminate the need for joist nails, removing one step from the installation process. The THFI's side flanges extend to the top chord of the I-joist, so web stiffeners are also not required. Alignment tabs simplify the THFI's proper vertical alignment. mitek.com

6. Temp Tracker

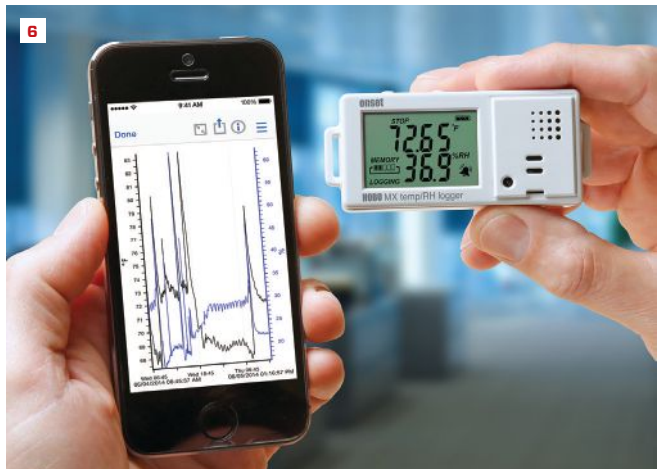
Onset's HOBO product line includes versatile tools for contractors to monitor what's going on inside a home. Among them is the MX1101 temperature and humidity logger, which delivers data wirelessly to mobile devices for easy downloading and analysis. In homes, the MX1101 can help users identify mold-prone areas or fine-tune a home's heating and cooling needs. The associated mobile app lets users configure the device, set the time-frame for monitoring, and receive alarm notifications if problems arise. Compatible with iOS and Android, the HOBO MX1101 is available for \$135. onsetcomp.com

7. Well-Balanced Bag

Quikrete's newest concrete mix balances working time and a fast cure for the best of both worlds, without sacrificing performance. Q-Max Pro offers one-hour working time, three-hour walk-on time (at 1,000 psi), and 6,500-psi compressive strength when fully cured. The combination lets contractors complete projects quickly while meeting requirements for both structural concrete use and concrete repair. Good for slabs, steps, floors, ramps, sidewalks, and patios, Q-Max Pro offers crack and freeze-thaw resistance. An 80-pound bag retails for less than \$10. quikrete.com

8. Tile to Suit

Wood-patterned porcelain tile with marble accents in gray, white, and black tones comprise the dapper designs of Walker Zanger's Sterling Row collection. The tiles' geometric patterns are inspired by suit fabrics and other menswear staples, with names including tuxedo, houndstooth, argyle, wingtip, and more. The tiles are suitable for all surfaces, including walls, floors, and even poolsides. Ideal for accent areas, pricing ranges from \$55 to \$145 per square foot. walkerzanger.com





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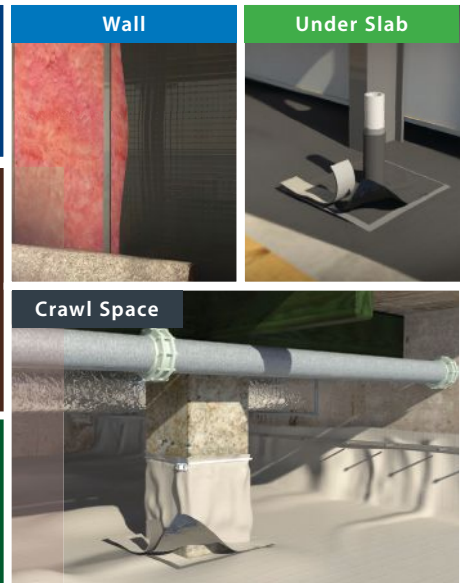


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9. Safety Where You Are

SawStop is bringing its injury-preventing technology to a new portable jobsite model. In addition to SawStop safety technology that stops the blade instantly upon contacting flesh, the table saw offers one-turn blade elevation and quick-tilt blade angle. Other features include a T-style fence with “ErgoLock,” a low-profile blade guard, large wheels for easy portability, and an accessory drawer. The \$1,300 price tag may seem steep for a portable table saw, but is likely less than the cost of a missing finger or worse. sawstop.com

10. Stretch Your Sawhorse

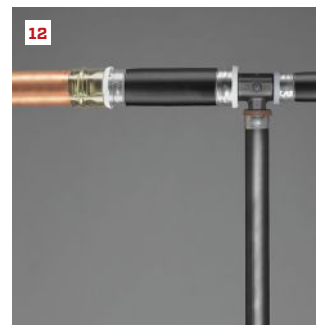
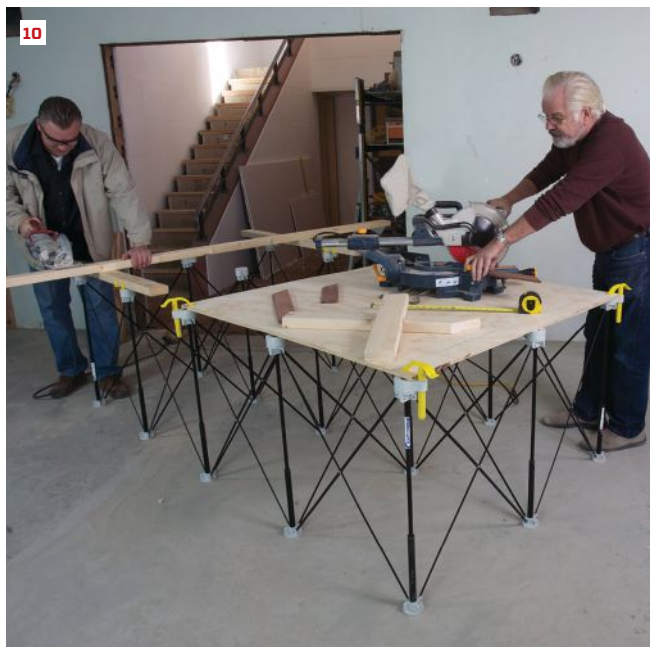
Centipede Tool offers workstations that expand and collapse in seconds. The smaller Centipede Sawhorse accommodates a 2-by-4-foot tabletop and can hold up to 1,500 pounds. The larger Support XL doubles the capacity to up to 3,000 pounds over a 4-by-8-foot area. Both models have steel frames and a molded P-Top at the point of each strut. This top spins 360 degrees for ideal positioning and is replaceable if damaged by a misguided cut. The Sawhorse (\$90) comes with two bench clamps, four “X-cups” (to hold 2x4 cross supports), and a storage bag. The kit for the Support XL (\$150) has two additional bench clamps. centipedetool.com

11. Quick-Installing Stone Veneer

Environmental Stoneworks is making its Clip-Stone mortarless stone veneer system more widely available. The manufactured stone pieces install one at a time, but go up quickly thanks to a clever, self-spacing metal clip on the back of each stone. The clip maintains a $\frac{5}{8}$ -inch gap between the veneer and the substrate, allowing water to move to weep holes in the starter channel. With no mortar or mason necessary, ClipStone is relatively easy to install, even for siding contractors who don't usually work with stone. Pricing ranges from \$10 to \$12 per square foot. myclipstone.com

12. Copper-to-PEX Solution

Viega's adapters—specifically designed for the ProPress system—let installers merge copper and PEX tubing systems. Like the maker's other press-system solutions, the fittings are flameless. They also meet Zero Lead requirements and are available in sizes up to 2 inches. Adapters for joining copper and PEX tubing are approved for plenum applications and meet or exceed a number of industry standards. viega.com



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EDITED BY BRUCE GREENLAW



Makita's Drywall-Installation Kit

BY MYRON FERGUSON

When Makita recently introduced the 18-volt XT255M 18V LXT combo kit for fastening and routing drywall, I couldn't wait to give it a test drive. I've used cordless drywall screw guns and routers before, but they weren't powered by lithium-ion batteries. The kit includes the model XSF03 screw gun and the XOC01 router, powered by 4-amp-hour batteries. Both tools have reinforced my opinion that going cordless can give drywallers a huge boost in productivity.

XSF03 DRYWALL SCREW GUN

Like conventional corded screw guns, the brushless XSF03 has an inline grip on the

motor housing, a two-finger trigger with a lock-on button, a magnetic insert-bit holder that prevents screws from falling off the bit, and a nosepiece that works as an adjustable depth stop and pulls off for extracting screws or driving in tight places.

The tool also has the usual spring-loaded clutch that isolates the bit holder from the motor until you push a screw tip against the drywall, allowing you to feed screws onto the bit with the trigger locked on. But the XSF03 adds a unique "Push Drive" mode. When you pull or lock-on the trigger in this mode, the motor doesn't even run until you push the screw tip against the drywall.

This makes your jobsites quieter and saves battery life.

The tool also has an LED headlight, which is nice for working in closets. You can turn it off if you don't need it. Like other screw guns, the tool has a belt hook up top, but it also comes with an extra hook that can mount to either side of the base, another feature that I really like.

The XSF03 is comfortable, well-balanced, and pretty quiet. According to Makita, in internal testing, it drove 1,800 screws through ½-inch drywall into 20-gauge steel studs on a single charge. I didn't test this claim, but I've installed drywall with the tool almost all day and haven't had to change batteries.

A fuel gauge on the base of the tool helps you avoid a sudden loss of power (see photo, page 82, top left). The batteries fully recharge in about 40 minutes. Thankfully, they're easy to swap. This might not seem important, but I've found that the batteries on some cordless tools can be difficult to remove after they've been exposed to drywall dust.

XOC01 DRYWALL ROUTER

I haven't used a cordless drywall router since I owned a Senco model years ago. When that died and the model was discontinued, I adjusted to using a corded model again. Until I started testing Makita's new XOC01, I hadn't realized how much I missed the cordless freedom when cutting outlet, door, and window openings.

The XOC01 spins drywall bits at the industry-standard 30,000 rpm, so it has plenty of speed. As for runtime, Makita claims that the tool can cut the openings for 100 single-gang outlets per charge. I didn't count, but that seems like a reasonable estimate. To install or remove a bit, you can simply remove the adjustable shoe and use it as a collet wrench (see photo, page 82, top



The screw gun has a handy fuel gauge. The “D” button turns the base-mounted LED light and the innovative “Push Drive” mode on or off.



The router’s adjustable shoe doubles as a collet wrench.

right). That’s really important to me, because when a bit breaks I want to be able to replace it quickly. A longer wrench is also included with the kit in case you need more leverage.

On the downside, the router, unlike the screw gun, doesn’t have an LED light or a battery fuel gauge. I also wish it (and other drywall routers) had a belt hook so I could alternate between fastening and routing without having to set the tools down.

Makita sells an optional vacuum attachment (part number 193455-7) for this tool, but I haven’t tried it.

THE BOTTOM LINE

Both of these tools have the power and runtime I need to get the job done, along with some slick user-friendly features. But the tools are normally used together and waiting for one of the two batteries in the kit to recharge is not an option. If you buy the XT255M kit and plan to do big jobs,

you might want to buy an extra battery or two. The kit costs \$400 and also includes a charger, two Phillips insert bits, two drywall bits, the collet wrench, and a contractor bag. Makita provides a 3-year warranty for the tools and a 1-year warranty for the batteries. Both tools are also sold in their own separate kits and as bare tools.

Drywall Screw-Gun Specs

Motor type: brushless
Weight with battery: 3.8 pounds
RPM: 0 to 4,000

Drywall Router Specs

Motor type: brushed
Weight with battery: 3.7 pounds
RPM: 30,000

Myron Ferguson is a drywall contractor in Middle Grove, N.Y., and presents the Residential Drywall clinic at JLC Live.

BOSCH WET/DRY VACUUMS

Oregon contractor Paul Johnson gave the 38-pound, 14.5-gallon Bosch VAC140A vacuum a thumbs up in our August 2014 issue. The vacuum can be used with or without Bosch’s disposable bags and accepts three types of filters, including a HEPA filter for compliance with the EPA’s RRP lead-paint rule. A mechanism that reverses air flow in short bursts every 15 seconds helps keep the filter clean without interrupting suction. You can plug a power tool drawing up to 7.5 amps into the vacuum, and when you use the tool it will trigger the vacuum. And you can dial down the vacuum’s amperage draw to reduce suction or prevent circuit overload. In a series of tests, it easily sucked up dry concrete mix, powdered drywall compound, and nails.

After using the vacuum for an additional six months, Johnson’s opinion hasn’t changed, except that when not using a bag, he has found that it can be pretty hard to lift the vacuum and empty it into a big dumpster. “If I were buying a vacuum now, I would probably choose Bosch’s new 28-pound, 9.3-gallon model VAC090A,” says Johnson. “It’s a smaller version of the same vac, and I would just have to empty it more often.” It costs \$600 versus \$670 for the VAC140A.

—Bruce Greenlaw



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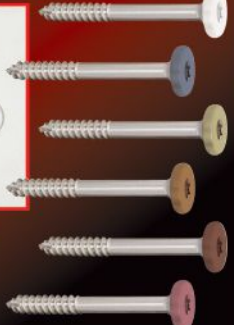
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Milwaukee M12 Fuel Hackzall

BY STEPHEN KLUG

When my crew and I tested the 18-volt Milwaukee M18 Fuel Sawzall reciprocating saw for the May 2014 issue of *JLC*, it quickly bumped our deluxe 15-amp corded model right off our jobsites. We loved the new saw's cordless convenience, competitive cutting speed, and ample runtime. We also appreciated its lever-action blade clamp, pivoting hang hook, and other high-performance features.

When *JLC* followed up by asking us to field-test the Milwaukee M12 Fuel Hackzall, I thought this new mini recip might be an ideal lightweight and maneuverable companion to the heavy-duty M18 Fuel. Nine months later, the M12 Fuel holds a prestigious position on our work van.

QUICK TOUR

Several 12-volt recip saws are available, including the M12 Hackzall that Milwaukee introduced in 2008. Most of these veteran compacts can easily be used one-handed, which is great when you need to hold an off-cut, navigate tight spaces, or reach to make a cut. But the new M12 Fuel Hackzall is the first 12-volt recip with a brushless motor. It also has a class-leading stroke length of $\frac{5}{8}$ inch and, according to Milwaukee, the most effective counterbalance for reducing vibration. The kit we tested includes a 4-amp-hour battery for extended runtime, and there's a fuel gauge on the tool to monitor the charge.

Advanced electronics protect against overloading, overheating, and overdischarging.

Other features include a variable-speed trigger, a bright LED headlight with a 10-second afterglow, and a time-tested keyless Quik-Lok blade clamp that allows you to insert the blade upside down if necessary. Like other 12-volt recips, the saw has a fixed shoe rather than an adjustable one, which means you lose some control over the maximum cutting depth and can't expose fresh saw teeth to extend blade life. Also, these 12-volt recips don't have a belt hook. But you can park the M12 Fuel in your toolbelt if necessary, and it can conveniently stand upright on its battery when you set it down.

ON THE JOB

So far, we've used the M12 Fuel Hackzall a lot for demolishing plumbing, cutting chrome closet pole, and breaking down 1-by lumber and 2x4s at the lumberyard. We've also made plenty of quick cutoffs and plunge cuts with it on our remodeling jobs, switching to the M18 Fuel Sawzall only when we need to make demanding two-handed cuts. The grip is comfortable, and the low vibration is especially noticeable when we're making one-handed and plunge cuts.

According to Milwaukee, the saw cuts about 50% faster than the older M12 Hackzall, generates more power under load

than several 18-volt models to help prevent it from bogging down, and can consistently make up to 60 crosscuts per charge through 2x4 pine under optimal testing conditions when equipped with the 4-Ah battery and a Milwaukee thin-kerf wood blade. We haven't conducted our own speed and runtime tests, but we have no complaints about the saw's performance for the cuts we make. In one timed trial, however, it took 1 hour and 20 minutes to fully recharge the battery, which might be a problem if you only have the one battery included with the kit.

THE BOTTOM LINE

If I were to own just one recip saw, I would choose the powerful Milwaukee 18-volt M18 Fuel Sawzall that we tested earlier. Since we started testing the M12 Fuel Hackzall, though, we use a full-size recip only when we need all that muscle. Lightweight and compact, the new Hackzall is surprisingly powerful for a 12-volt tool, has excellent runtime, and is easy to use with one hand for maximum versatility. I would appreciate an adjustable shoe rather than a fixed one, and I wish the kit came with a plastic case rather than a contractor bag for easier storage in our work van. I also think Milwaukee should offer a kit with two batteries for those who have yet to buy into its M12 cordless platform. But this is an excellent complementary tool for us.

At homedepot.com, the bare tool (model 2520-20) currently costs \$140, while the kit we tested (model 2520-21XC) costs \$200. At the moment, that site is offering a free extra battery or an additional M12 tool with the kit, though that might change any time.

2520-21XC Specs

Motor type: brushless
Weight with battery: 4.1 pounds
Stroke length: $\frac{5}{8}$ inch
Strokes per minute: 0 to 3,000
Price: \$200
Included in kit: one 4-Ah battery, charger, blade, contractor bag
Warranty: 5 years tool, 3 years battery

Stephen Klug owns Fine Building & Finish, in Yarmouth Port, Mass.

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BY JON VARA



1. When the city of Alameda, Calif., took a strip of his property to widen the street, the builder of this spite house struck back at a neighbor who favored the wider street by erecting a 10x50-foot two-story home on the remaining scrap of land.

2. This spite house in Seattle is a compact 15 feet wide across the front, but tapers to less than 5 feet wide at the back, as shown here (yellow house). Enter the geographical coordinates *47°38'19"N, 122°18'5.5"W* into the Google Earth search box to see its peculiar wedge-shaped outline from above.

3. The 8-foot-wide O'Reilly Spite House in West Cambridge, Mass., memorializes the abutting landowner's refusal to offer a reasonable price for the land on which it sits.

4. The history of the Skinny House in Boston's North End is sketchy, but it's said to have been the builder's way of putting the squeeze on his brother, who had previously built a much larger house on the back portion of the same jointly-owned lot.

Spite Houses

Building a new house is ordinarily a cheerful, upbeat activity for all concerned, suggestive of good economic times and happy families.

But new construction can have a darker side: When a feud between neighbors spills over into architecture, the result is a so-called "spite house"—a structure built specifically to cut off an enemy's daylight, view, or access to the street.

Thanks to modern building codes and zoning, building a true spite house like one of those shown here—all of which have long outlived their disgruntled builders—would be all but impossible today. And while that's a clear loss for future architectural historians, it's certainly good news for homeowners with ornery neighbors.

JLC contributing editor Jon Vara lives in Cabot, Vt.

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