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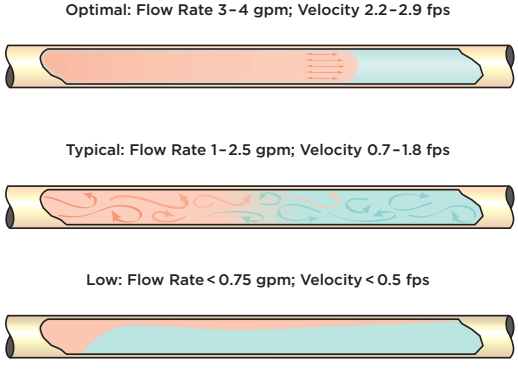

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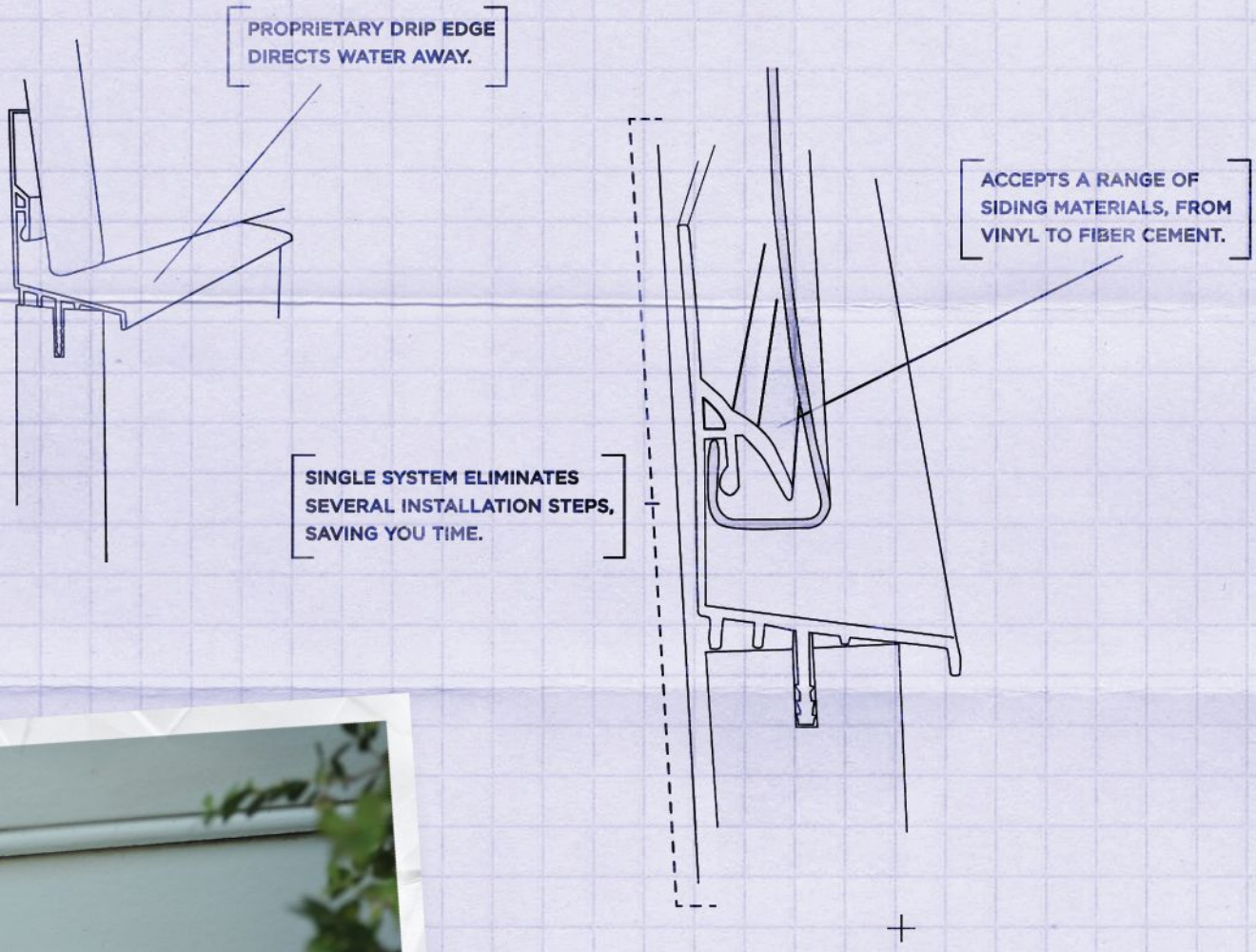

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Letters

Don't Cut Historic Timbers

I work for a Vermont company that specializes in restoring and preserving timber-frame structures, so after reading the table of contents blurb for Gary Morrison's article "Strengthening an Old Roof" in your December issue — which read "New LVL framing straightens and stiffens an underbuilt timber frame" — I enthusiastically turned to the article itself. But my enthusiasm turned to dismay when I saw that the author had cut the purlins and chopped out the "waste" on either side of the rafters.

In any historic timber-framed structure — and especially one dating back nearly 300 years — the joints are among its most important features. Arbitrarily cutting original framing members destroys the historic fabric that makes the buildings so special.

After sharing the article with a co-worker, he and I quickly figured out a way to straighten the roof without disturbing the original framing: by adding supplementary 2-by lumber rafters between the original timber rafters, with their upper edges below the faces of the purlins. Pairs of tapered shims could then be placed between the purlins and new rafters as needed to transfer the load. This would also cost much less than the LVL approach that was actually used.

Scott Killian
Vergennes, Vt.

Taking Exception

I believe Dennis Dixon does himself, the construction industry, *JLC,* and the magazine's subscribers and advertisers a great disservice by using derogatory slurs to label the very people who hire contractors ("Getting Paid for Preconstruction Advice," *Business,* 10/12).

Newbies? Bottom feeders?? Price-shoppers?

Sadly, Mr. Dixon did not need to do this to get a valid message across. His point about a contractor and a potential client seeing things the same way could be made (and has been, in first-class magazines like *Fine Homebuilding*) in a way that is not condescending and mean-spirited.

For Mr. Dixon to avoid a "hypocrite" label, I trust that when he goes to buy a new work truck, he does no Internet research (that would be free pre-sales advice), visits the first dealership he sees (to avoid price-shopping), asks no questions (free advice), and hands the salesperson a blank check. No haggling of course — hagglers must be like bottom-feeders. I have no guess as to how he has avoided being a "newbie" in some way at some point in his life.

Dave Bell
Anaheim, Calif.

Estimating and Design Proposal

The following excerpt was taken from comments posted on JLC's *website (jlconline.com) in response to "Getting Paid for Preconstruction Advice," 10/12.*

Great article. I am glad to know that I am not alone. There are professionals out there who tell the potential clients upfront that we (the professional contractors) get paid for our work, including the work we have to put into designing, estimating, and planning a project. I have a document that's similar to the author's PSA (professional services agreement). I call mine an E/D (estimating and design) Proposal. I explain our process — which is detailed on our website — to the potential clients when they first call about their project. I ask if it sounds reasonable, and if they say yes, then we book the initial meeting. There's no charge for the initial meeting, but I get a chance to explain to them in detail about our design and estimating process.

I have had huge success in selling more jobs using our E/D Proposal, and if a client is willing to go through our process then I can prepare a proper lump-sum price for the work. For a typical master-bathroom remodel, the cost to design the project is about $2,000. The clients pay a deposit and progress payments as the design goes forward. If they decide to hire us, we discount the design fee. If they decide not to hire us, they pay the balance of the design fee and are issued a package that they are free to use at their pleasure. We rarely lose a job because of our final price, because we walk the clients through the process and they can see that the clients are more in charge of the cost of the project than the contractor is.

Thanks for the article. More contractors need to charge for the professional services they are giving away for free. — *svandyke*

KEEP 'EM COMING!

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From the JLC Forums

Patching for Smaller Recessed Lights

Tips from a January 2013 thread about patching holes in drywall to accept smaller-diameter recessed fixtures.

I have a homeowner who wants to replace 6" recessed light fixtures with 4" fixtures. Some but not all of the smaller cans will be in the same spots, and I can't think of a good way to patch a 6" hole and then put a 4" hole in the same spot. — *htroberts, North Carolina*

Cut out the existing hole to something near a 10"–12" square. Take a piece of 3/8" plywood about 10"x 20" — adhesive on the ends — prop it up in the hole — pull it down against the back of the existing DW while you put screws up through it from the room side. Put your new hole in —tape and finish. — *Happy Home, Greensboro, N.C.*

How I repair them (I have repaired many): I cut the mixing sticks for 5-gallon paint buckets in half, place them in the hole, and secure them [with screws]. I have a hole saw for 6" recessed lights, so I cut new slugs out of scrap drywall, place the slug into the hole, and secure to mixing sticks. I tape with FibaFuse (not FibaTape) — it is very thin and lays down really nice — use Easy Sand, then Plus3. That solves the abandoned light locations.

For the locations where you will be putting 4" cans in the same spot: [Create a custom slug from scrap drywall using] a drywall circle cutter, set it to 4" (8" circle), score both sides. On the same center point, reset the cutter to 3" (6" circle), score only the back, then carefully break off the 1" [ring of gypsum] leaving the face paper intact. Using Easy Sand, secure the slug to the ceiling by the [face paper] flange, tape as normal. Bore the hole for new light.

You do know that if there is insulation in the [ceiling], you need IC-rated lights, or keep the insulation 3" from the luminary. I know of no 4" IC recessed luminaries that are a remodel configuration.

One more thing. If you remove the can, you should be able to remove the frame in the ones that get the new luminaries by disassembling the frame through the hole. — *tjbnwi, Northwest Indiana*

Built-Up Exterior Trim

In this October 2012 thread, contractors provide a variety of solutions for building up exterior trim to better complement the thickness of cedar shingles.

I have used plenty of 5/4 trim with shingle siding, but would rather use thicker trim. I was thinking of going with 4/4 material (3/4" net) boosted out with some scrap 7/16" OSB. With this arrangement, my casings ... would be about 1/4" proud of the shingle butts. What do you think? — *IamTheWalrus*

I've done buildups like this before. Normally rip cedar instead of using OSB. — *tjbnwi, Northwest Indiana*

Bad idea. OSB swells and rots like crazy. Good idea: Space 1/4" plastic shims along the back of your trim pieces and tack them in place with stainless staples. Orient them so that the inside 1" of your trim does not have any shims on it ... Presto, you have padded out your trim, made a rainscreen detail, and corrected for the material buildup on window flanges. — *NW Architect, Portland, Ore.*

We commonly use 1/2" treated plywood as a packer behind window surrounds. — *Nate E, New Jersey*

I would add strips at the edges only. This gives the finish piece of trim the ability to dry on the back side. — *Calvert, Dallas, Pa.*

We used to rip one side of the 1x4 corner trim down to 2 3/4" so that the corner was 3 1/2" wide on both sides once you butt the ripped piece to the full piece. Then we would [rip the waste] into two equal pieces and use that as a buildout shim. All of the jobs we did were lapped siding that would come out with beat-up 1x cedar on the bottom for packaging, so we made use of that stock as well. — *Dlhunter, Chester County, Pa.*

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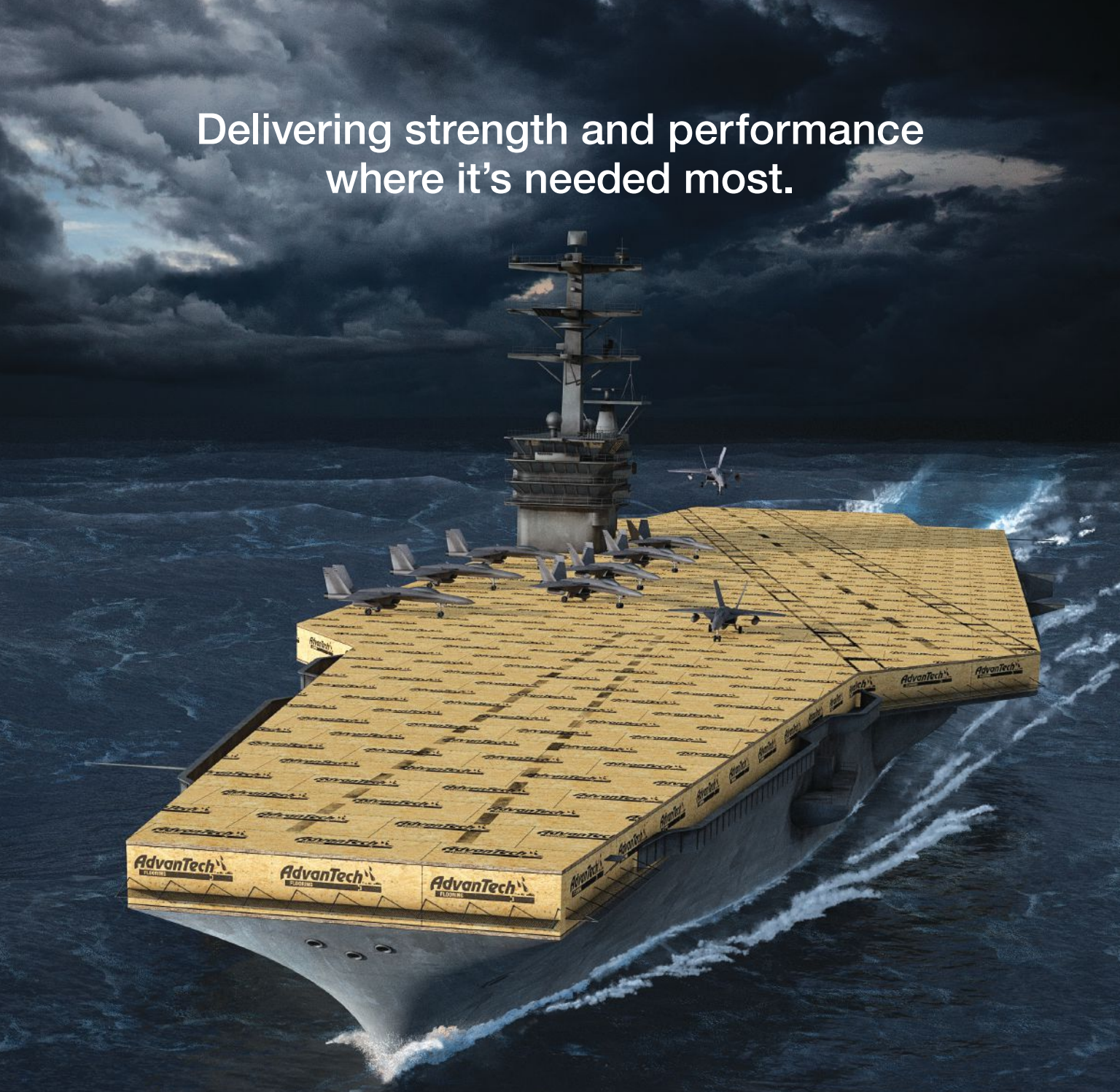

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"Overbaked" Fiberglass Batts Linked to Odor Problems

Real estate agents often suggest that their clients bake bread or cookies just before an open house to create a warm and inviting aroma. But as an ongoing quality-control issue concerning Owens Corning (OC) fiberglass batts demonstrates, the aroma of baked goods can be a problem when it's coming from the insulation.

Bio-based binder. A little more than two years ago, OC reformulated its familiar pink fiberglass batts by replacing a formaldehyde-based binder with a "greener" material containing no formaldehyde. While the performance of the reformulated batts — dubbed EcoTouch by the manufacturer — was unchanged, installers quickly noticed a minor side effect of the new binder: When removed from their plastic wrapping, the batts smelled distinctly of what's been described as caramel or cooked sugar.

OC declines to say exactly what's in the formaldehyde-free binder, beyond describing it as a "bio-based material." Some nice sleuthing by Martin Holladay at the Green Building Advisor site (greenbuildingadvisor.com), however, suggests that a key ingredient may be maltodextrin, a corn-derived substance found in many processed foods and beverages.

In any event, the company took the precaution of circulating a letter explaining the new aroma to contractors and consumers early in 2011.

"The use of natural ingredients can sometimes cause different scents

Owens Corning is scrambling to remedy a manufacturing problem that has caused some of its EcoTouch batts to give off a strong and persistent "burnt sugar" smell.

■ California builders are reportedly pleased with the newest version of the state's building code, which was adopted by the California Building Standards Commission in January and will take effect in 2014. The updated code clarifies the rules for accessible building, stipulating that single-family homes — unlike apartments and condos — need not be wheelchair-accessible. The streamlined accessibility requirements, it's hoped, will help curb "drive-by lawsuits," in which attorneys and advocacy groups were able to squeeze money from businesses perceived to be in violation of accessibility rules by threatening legal action if their demands weren't met.

■ Because heat-reflective white roofing can cut power consumption by reducing air-conditioner loads, utilities and some state and local governments have long offered incentives to encourage its use. A recent demonstration project by the Lawrence Berkeley National Laboratory could someday lead to similar programs for light-colored parking lots. According to the LBNL researchers, pavement accounts for 35% to 50% of the surface area in a typical city, and heat-reflecting asphalt can be as much as 40° cooler than conventional paving on a hot, sunny day.

Offcuts continued on page 21

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when installing the product," the letter read in part. "This scent is very similar to the smell of baked goods. This scent is normal for bio-based materials, and will dissipate after a few days."

"I kinda like it." To the extent that anyone noticed the new smell at first, the reaction seems to have been mostly positive — not surprisingly, given that the old formaldehyde-based binder had a characteristic smell of its own, which reminded many installers of cat pee.

In what was likely a typical reaction in the weeks following the EcoTouch rollout, an August 2011 posting on the Contractor Talk website from an insulation contractor identifying himself as "Parts" asked if anyone knew when OC batts acquired their new smell. "Instead of the old cat smell," he noted, "it smelled ... like a burnt caramel."

Following up on his initial post a few days later — after noting that he'd since been asked about the odor by two other contractors and one homeowner — Parts pronounced himself satisfied. "I kinda like the new smell of it, myself," he wrote.

Covering the costs. But sometime in the past year or so, occasional shipments of EcoTouch batts have given off a much stronger and more persistent burned smell, which doesn't dissipate even after weeks of post-installation exposure to air. In what was apparently a response to customer complaints, OC recently began sending contractors an updated version of its 2011 explanatory letter, which is identical to the original except for an additional closing paragraph.

"As always," the added text reads in part, "Owens Corning stands behind its products and will cover the cost of replacing any products that do not meet customer needs. Please do not hesitate to contact your local Owens Corning Area Sales Manager if you have any concerns."

According to an unnamed OC spokesperson who agreed to respond to *JLC's* questions by email, the company has so far received a total of 31 odor-related complaints. The stronger odors seem to originate during manufacturing, when inconsistencies in the thermal curing of the binder may allow some batts to become "overbaked." (Because it contains no binder, loose-fill fiberglass is not affected.)

"The cure cycle has always been a critical component of how well insulation performs and how it smells," the spokesperson wrote. "We are implementing

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improved cure control systems to assist manufacturing personnel in properly curing EcoTouch insulation and eliminating instances of odor ... and, in fact, we have measured reduced instances of over cure situations."

OC declined to answer questions about the feasibility of pulling out overbaked batts at the manufacturing end before they enter the supply stream, or about how many defective products it has so far paid to replace. But the encouraging news for contractors who use OC batts is that the odor problem seems to be limited in scope, and the company is making good on its promise to replace any defective material. — *Jon Vara*

■ The New Energy Efficient Home Tax Credit — the only federal incentive available for energy efficiency in new homes — was saved from expiration when Congress passed the American Taxpayer Relief Act of 2012 on January 1 of this year, as part of the closing act of the "fiscal cliff" drama. That action retroactively renewed the $2,000 credit (which is available to builders and developers of energy-efficient new homes) through 2012 and extended it to the end of 2013. To be eligible for the credit, a home must use at least 50% less energy than the baseline established by the 2006 IECC. That's a change from the previous version of the credit, in which homes built before 2012 used the 2004 IECC as the baseline.

■ In the wake of a sewage spill caused by the unpermitted connection of 17 bathrooms to one septic system, the owner of a Chino Hills, Calif., mansion has agreed to correct a wide range of code violations and cease operation of a business in a residential zone. The case has drawn attention to so-called "birth tourism" operations, which cater to women who come to the U.S. on tourist visas to give birth. Although birth tourism itself is not illegal, critics charge that the practice has led to the creation of overcrowded and illegal "maternity hotels" in certain popular destinations.

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Q&A

Q. Installing Interior PVC Trim

On a bathroom remodel, my client has requested flat 1x6 PVC trim fitted with a profiled PVC cap piece to match the look of the period baseboards in the rest of the house. What's the best way to smooth out the routed surfaces after I cut the profile in the cap piece? And should the joints be glued, or should I leave them unglued so they can expand and contract (the technique I use for exterior PVC trim)?

A. *Gary Katz, a frequent contributor to* JLC *and moderator of the JLC Online finish-carpentry forum, responds:* I've installed PVC trim on a number of interior projects using the same basic techniques I use with wood and have never had a problem. I've had the best results with Versatex cellular PVC (versatex.com). It has sharp, clean corners and nice edges, mills beautifully with a router bit, and has a finish that accepts paint very well; it's not mirror-glossy like some other brands, which practically require etching to bond well with paint. To smooth routed PVC edges or surfaces that have dried PVC glue on them, I use fine-grit (P320 or P400) sandpaper, which allows me to buff a profiled PVC edge right back to its almost-shiny factory finish.

I miter outside corners and cope inside corners, fastening the outside corners together with glue and one-inch-long 23-gauge pins, the same fasteners I use for wood. To fasten the trim to the wall, I use 2¼-inch-long 15-gauge nails. On the interior of a home, nail holes in PVC can be filled with almost anything used with wood; Bond-and-Fill (bondfill.com) is a safe choice. To glue joints together, use PVC cement, since wood glues like Titebond II don't work all that well with PVC. Sometimes I use Versatex's branded PVC cement, but I've also used 2P-10 (fastcap .com), especially on self-returns and small pieces. If you use 2P-10, be careful — and don't use the activator: It will melt the PVC and bond your fingers to the plastic instantly. I don't bother using any adhesive on cope joints, whether I'm working with wood or PVC trim — there's nothing to glue to and no reason for it.

One reason I don't worry much about the PVC expanding or contracting is that interior trim runs are usually much shorter than exterior trim runs, where the potential for movement is much greater. Also, PVC trim shrinks and expands because of changes in temperature; if it's installed when the temperature is anywhere near 70°F, it's unlikely to move much later on.

Q. Vent Insulation Clearance

Do I still have to use a metal shield and leave an air space around a Type B vent pipe if it is passing through a drywall ceiling and fiberglass batt attic insulation, both of which are noncombustible?

A. *Mike Hamlin, an hvac contractor in Meredith, N.H., responds:* The short answer is yes, because no manufacturer or code official would want to leave the decision of whether or not the air space is necessary up to an installer or homeowner. The installation instructions for the AmeriVent B-vents we typically install specifically call for a minimum one-inch clearance to both combustible materials and insulation, regardless of insulation type. In addition, the various supports and firestops provided by AmeriVent and other manufacturers are designed to ensure that this one-inch spacing is maintained around the B-vent pipe as it passes through ceiling and wall assemblies.

In general, the installation of gas piping and venting systems is governed by both the manufacturer's installation instructions and by NFPA 54, the National Fuel Gas Code. In addition, some local codes may contain addendums to NFPA 54 requirements, in which case the more stringent rules apply, as interpreted by the local code official. In my experience, most officials go strictly by the book to avoid questions of liability, and don't care whether the insulation is fiberglass, foam, cellulose, or something else. (Also, keep in mind that the paper backing on some types of batt insulation is flammable, even if the insulation itself is not.)

Q. Hallway Outlets

I know that in living spaces — such as bedrooms or dining rooms — the NEC requires an outlet in every wall that is longer than 2 feet, and that the outlets can't be greater than 12 feet apart. But what about hallways? Do the same rules apply? And for the purpose of locating electrical outlets, when is a hallway not a hallway?

A. *Harlan Madsen, an electrical contractor in Bloomington, Minn., responds:* Hallways are a gray area in the NEC. While Article 210.52(H) requires at least one receptacle in hallways that are 10 feet (or more) in length, the NEC doesn't clearly define what a hallway is. Our rule of thumb is that if it looks like a hallway, it is, regardless

Q&A

of whether there are wider areas where a desk or a chair could be located. When in doubt, we always check with the GC to clarify the plans, and add outlets as needed to satisfy the client.

Q. Roofing Underlayment: Vertical or Horizontal?

Most roofers I know install roofing underlayment horizontally, but I've seen a few cases where the underlayment was pulled down vertically from the ridge. Does the direction of the underlayment matter?

A. *Dave Molloy, a roofing contractor in Cincinnati, responds:* The primary purpose of roofing underlayment is to provide temporary weather protection both before the finish roof installation and later (should the finish roof become damaged). According to code, underlayment should be "applied shingle fashion," parallel to and starting from the eaves (2012 IRC, R905.2.7). In practice, though, there are times when it's quicker to install the underlayment vertically, such as on a steeply pitched dormer roof (see photo, below). Over small areas like this, I don't think it makes much of a difference whether the underlayment is installed vertically or horizontally.

Water moves quickly and predictably down a steep roof. I'd be more concerned about leaks if the rafter lengths were long or the roof pitch shallow, in which case the slow-moving water would have time to fan out horizontally beneath the edge of vertically run underlayment. Think of individual step flashings along a wall/roof junction compared with a single long base flashing: The step flashings are more effective because as water flows down the roof and starts seeping diagonally beneath a shingle tab, the flow is interrupted by the next flashing and redirected down the roof. In the example in the photo, the longest vertical lap appears to be less than 6 feet and the pitch is steep, so I doubt the roof will leak if the felt is temporarily exposed to rainfall.

Actually, I've seen countless shingled roofs with both shallow and steep pitches that have been installed without underlayment, and I've never seen the need to replace them to correct the violation. As a business owner, though, it's really hard to argue against narrow code details. Lawsuits are based on these details, even if actual practice is based upon something less rigid. If your code official enforces the horizontally installed roofing underlayment requirement, I wouldn't argue with him.

Some roofers install underlayment vertically over short steep roof decks to provide quicker protection from the weather, but not all building inspectors will approve this practice. In general, the IRC specifies horizontal underlayment installation.

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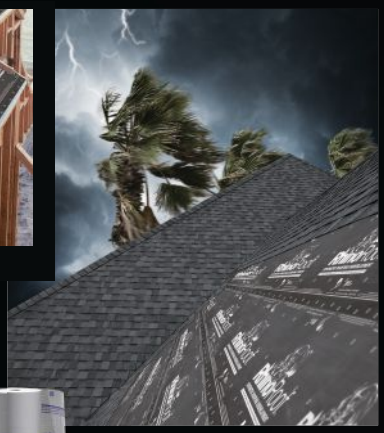

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On the Job

Framing Fix for a Faulty Foundation

by Jason Fultz

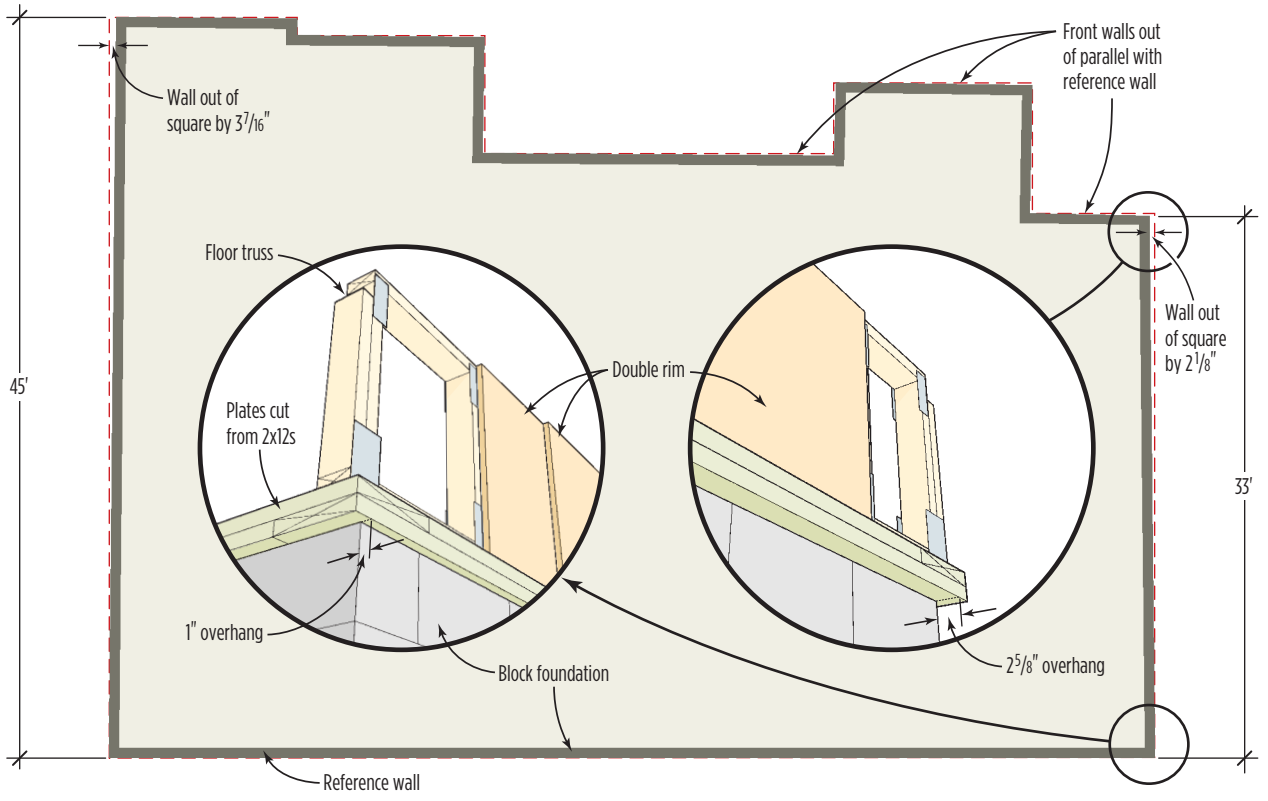
Recently we were hired to frame a new 3,000-square-foot house, but before we could get started we had to fix some serious problems with the block foundation. The mason who built it apparently had a broken level, because the interior bearing walls were at least an inch higher than the perimeter walls, which were neither level nor square. The project GC had hired a second mason to remove the top block course and level the foundation, but without much success: When we arrived on site and checked his work with our transit, the foundation was still out of level by as much as 1½ inches **(1)**. Anxious to get started, we decided we could correct these problems with some creative framing.


1

Squaring the Walls

Using the longest foundation wall for reference, we found that one foundation wall was out of square by 2⅛ inches over about 33 feet, while the opposite wall was out of square by nearly 3 7/16 inches over about 45 feet **(2)**. The

2 **Tapered Plates Help Square Up the Foundation Walls**



short offset wall sections at the front of the house were out of parallel with our reference wall by about 1¼ inches from one side of the offset to the other .

Since the foundation would eventually be covered with man-made stone veneer, we planned to extend our sill plates out past the 8-inch-wide block foundation by at least 1¾ inches (to account for the thickness of the veneer, sheathing, and siding). Normally we would do this with 2x10 PT stock, but by using wider 2x12s instead, we were also able to compensate for the out-of-square walls.

First, we aligned 2x12 plates on the 33-foot foundation wall with their inside edges flush with the inside of the wall. Then we marked them — as shown in the illustration on the previous page — so that there would be an inch of sill plate extending over the foundation at one end of the wall (¾ inch less than the desired 1¾ inches), and 2⅝ inches extending over the foundation wall at the opposite end (⅞ inch more than the desired 1¾ inches). We snapped a line from mark to mark and ripped off the excess, so that instead of being 2⅛ inches out of square, the left-hand wall was now only ½ inch out of square over 33 feet.

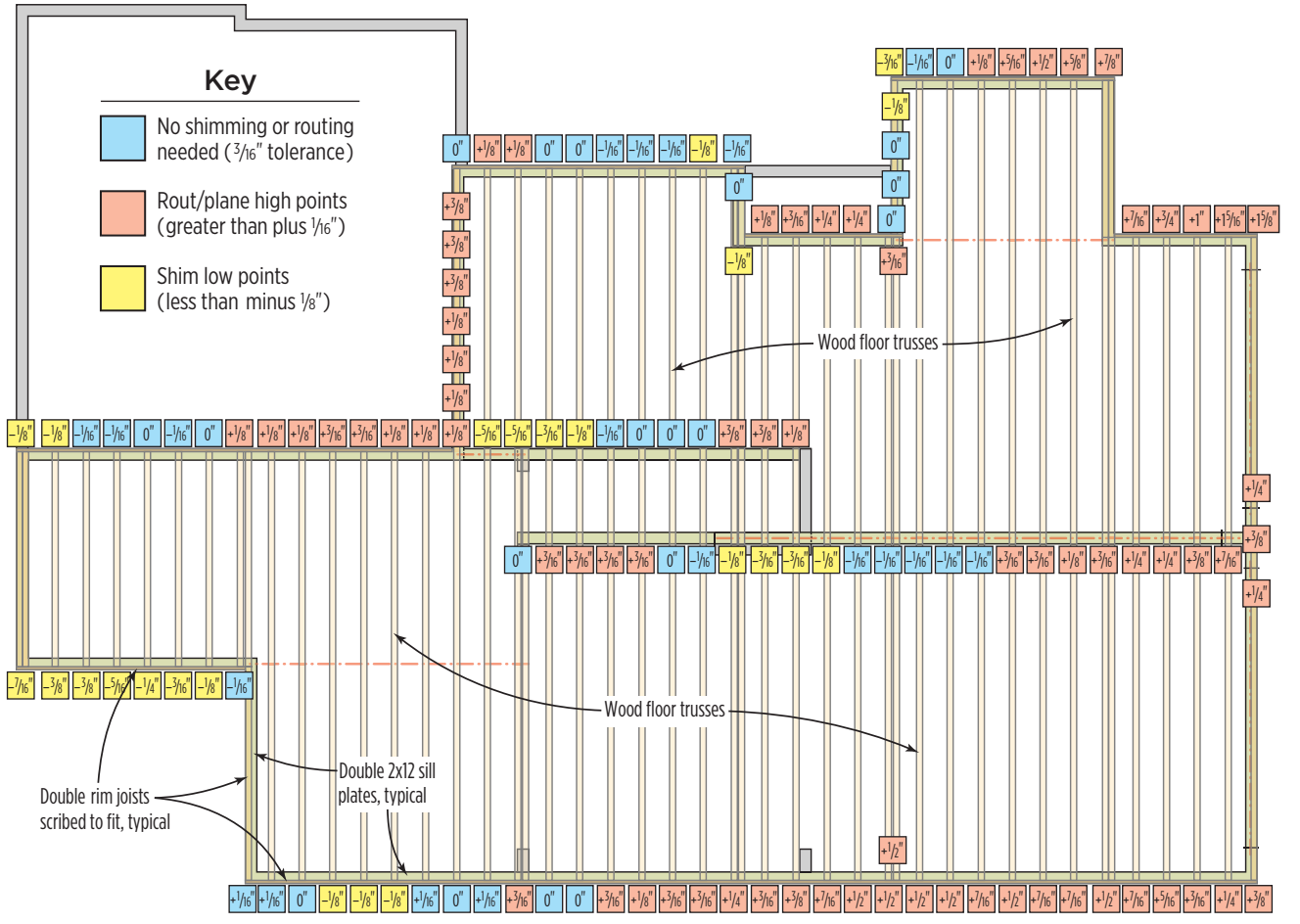
We used the same technique on the opposite wall, but ended up with a larger 3¼-inch overhang at one end. This brought the wall to about 1 3/16 inches out of square (instead of 3 7/16 inches out of square) — not perfect but much more manageable.

We corrected the front offsets in a similar fashion to make them both square and parallel with the reference foundation wall. Later, the rock mason made up for the variations in the sill-plate widths by building up his scratch coat in the sections where the sill plates extended farther past the block foundation wall than they should have, and by cutting down the stone in sections where the sill plates didn't extend past the block foundation far enough.

Leveling the Floor System

Instead of shimming the sills level and filling the gaps with grout, we decided that

3 Sill Plate Elevation Map



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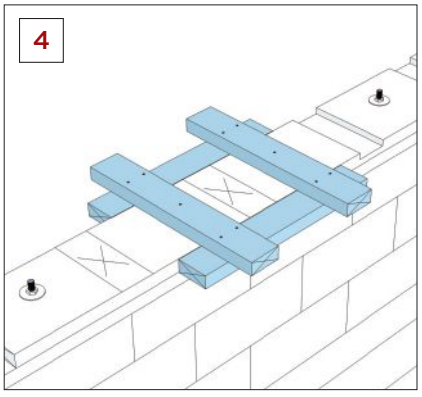

the best way to fix the out-of-level block work would be to level the trusses. We would shim the trusses that were low and cut slots in the sills with a router where the trusses were high, eventually bringing all of them to the same level. We started by setting up our rotary laser to take elevation readings all along the top of the sills. We found that there were very few floor truss locations that were "right" — almost everything would have to be modified to bring it to level — but we wanted to come up with a plan that would require the least amount of shimming.

Double plates. To make sure we wouldn't try to cut slots where anchor bolts were located, we doubled up the plates. First, we marked our truss layout on the lower plates before attaching them to the block wall. Where an anchor bolt coincided with a truss position, we cut off the bolt flush with the top of the block using an angle grinder, then installed another anchor bolt beside it that was out of the way of our layout.

Once the lower plates were pulled down snug to the wall, we attached the upper plates, transferring the floor truss layout from the lower to the upper layer. Then we took elevations at each layout mark, starting with a section of the block foundation that was nearest to level and using that as our benchmark for elevation readings across the rest of the floor truss positions. The whole process sounds tedious, but it took only about an hour.

Before heading home, I transferred those elevations to a plan view of the foundation. While analyzing the data later that evening, I determined an elevation that would require the least amount of routing and shimming across all of the other floor truss locations. From that benchmark, I calculated the depth of each notch and the height of each shim and marked them on the floor plan **(3, page 30)**.

Notching and shimming. The next day, we notched the sills using a Porter-Cable fixed-base router equipped with a Bosch 3/4-inch double-flute straight router bit. This router has accurate micro depth adjustment, which made it easy to set it to the precise depth required for each notch. To accurately guide the router, I built a simple jig out of four short lengths of 2x4s **(4,5)**. We ripped shims out of oak for the few places where the trusses needed to be shimmed; none were more than 5/16 inch thick.

After installing the trusses **(6)**, we scribed the 23/32-inch rim material to fit. To make sure there would be plenty of bearing, we doubled up the rims where we had corrected for the out-of-square walls.

Cost

We probably did a little more shimming and routing than we had to, but the floor system ended up no more than 3/16 inch out of level across the entire foundation. It took an additional day and a half to square and level the floor system, at a rate of $90 per hour for three carpenters. While this added $1,080 to the project budget (in addition to the amount the homeowner had already paid to the second block mason), the homeowners were happy to get their project back on track.

Jason Fultz *and his brothers David and Robbie are partners in Fultz Bros. Construction in Norton, Va.*

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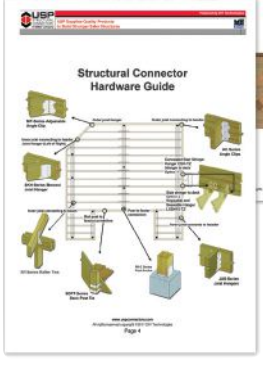

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Upgrading the WRB With a Drainage Mat

by Steve Long

Over the more than 30 years I've worked in my family's specialty masonry products business, I've often been asked to consult on moisture problems in wood-frame construction. Most of the damage I've seen is caused by substandard water-resistant barriers (WRB) and poor flashing details in stucco or adhered masonry veneer.

Although there have been gains made in the code to address these issues, I come across the same installation errors on new construction. One of the most common is to allow a single layer of building paper or housewrap to serve as the WRB. The results can be catastrophic: The OSB sheathing and studs around the window on this home **(1)** essentially turned to compost within a few years. Another recipe for disaster is failing to install weep screeds at the wall base. Stone veneer and stucco are often run below grade for aesthetic reasons, and this practice can trap moisture in the wall assembly, either from above as it runs down behind the cladding, or from below as it wicks up from the ground. Without a weep screed — which provides both a capillary break and an escape route for excess moisture — rot is almost inevitable. In this case **(2)** entire chunks of siding fell off the wall. Even more water can get behind the cladding when step and kick-out flashings at roof-to-wall and roof-to-chimney connections are improperly installed or missing **(3)**.

Drainage mat. To avoid these moisture-related problems, many of the plaster and remediation contractors I work with install a drainage mat as part of their system. Rainscreen matting — typically a thin plastic matrix that water easily drains through — has been used for more than a decade in Canada and has become more common in my area over the past few years. Many contractors use it under wood-shingle and fiber-cement siding, but I think it's particularly well-suited for stucco and stone veneer.

One of the products I represent is Keene Driwall Rainscreen .020-1, a ¼-inch-thick plastic matrix laminated to a nonwoven vapor-permeable fabric. It works by reducing hydrostatic pressure: Bulk water in the exterior plaster is

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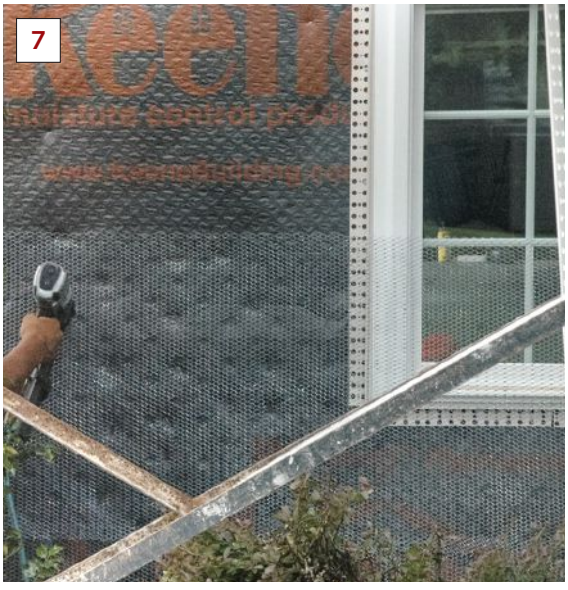

driven inward, where it hits the fabric and drains down the inside face and out the weep screed.

Installation. Keene .020-1 is applied over 60-minute Grade D building paper or an equivalent membrane — in lieu of the second layer of Grade D or equivalent required by code — with the fabric side out **(4)**. The scratch coat adheres to the fabric and metal lath and is stopped from entering the matrix by the fabric **(5)**, which provides a ¼-inch-wide uninterrupted air space for drainage and ventilation. It's easy to cut the membrane around penetrations like jambs and heads of windows and doors **(6)**, and to wrap it around corners to allow an air space at the edge of the facade. Accessories like window casing beads **(7)** and control joints go on top of the drainage mat; the weep screed is placed on the sheathing with the WRB lapped over it. Once the house is completely wired **(8)**, it's ready for plaster.

Cost. Keene .020-1 costs about 65 cents per square foot, with a 4-foot by 65-foot roll going for about $170. On average, it adds about 5% to the project cost for new construction and 2.5% for remediation work.

Steve Long *owns E.R. Long Associates, a specialty masonry accessories company in Phoenixville, Pa.*

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Wind- and Solar-Powered Generator

by Steven Rundquist

A few years ago, I got fed up with our noisy gas generator and decided to build a generator powered by renewable energy. My Colorado-based timber framing company often works on remote sites, so I wanted a portable unit that we could easily haul to the site and use to run our tools, and that could later be plugged into the finished structure to provide temporary power for lights and outlets **(1)**. I don't know much about electricity, though, so I enlisted my friend and colleague Mel Wright, of Greeley, Colo., to actually put the pieces together.

The heart of the system is an Outback 3,500-watt 24-volt DC/120-volt AC inverter (outbackpower.com), which is powered by four 220 amp-hour 6-volt absorption glass mat (AGM) batteries. The batteries are wired in series, which increases the voltage of the system to match the inverter. The batteries are charged with a pair of Kyocera 135-watt solar panels (kyocerasolar.com) and a 400-watt Air-X wind turbine (now called the Air 40, available from Primus Windpower) managed by a Morningstar PS-15 charge controller (morningstarcorp.com). Everything is mounted on a small trailer **(2)**.

Power management. My system isn't very big, but it keeps up with the needs of our two-man crew all day long, day in and day out, as long as we manage our power usage carefully. For example, the 3,500-watt inverter produces about 30 amps of continuous AC power (watts ÷ voltage = amps), which is plenty to run the basic power tools we use to cut our frames. But we can't run heavy-duty tools like our chain mortiser and 16-inch circular saw at the same time without excessively draining the batteries or blowing a fuse. While fuses are easy to replace, and sunny Colorado days with a bit of wind recharge the batteries pretty quickly, this setup forces us to get into the good habit of planning ahead.

When we do run low on power, we break out the hand tools — slicks, chisels, layout tools, and the like — while the system recharges. I actually see that as a good excuse to get my hands on the wood again, dive in deep, and remind myself why timber framing is just such a wonderful way to make a living. But if we wanted to expand the system and add more capacity, Mel tells me that the first thing he would do is add more solar panels. The two that we have now produce about 5½ amps per hour each (135 watts ÷ 24 volts = 5.6 amps). In theory, if we were to use about half the total amp hours stored in the batteries,

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it would take about 10 hours for the panels to recharge them (though remember that the wind generator also helps charge the batteries). Doubling the number of solar panels would cut our charging time roughly in half. We could also add more batteries, since the input capacity of our inverter is 300 amps at 24 volts.

As voltage in the batteries drops, power available to the inverter drops too, which makes energy management critical; otherwise, you would have to make the system much bigger to keep everything working at the same pace. As configured, my system would not keep up with a typical framing crew with a compressor, chop saws, and nail guns, but it works wonderfully for my small company.

Cost. I found the wind generator on Craigslist, but all of the parts can be found either at Home Depot or online. Our cost to build it was about $4,000, with the inverter — a top-of-the-line unit that can provide power for a small house — accounting for probably 50% of the total cost. I'm not sure what has happened to the price of inverters over the past five or six years, but the price for solar panels has dropped dramatically since we built our system, so a more powerful system could probably be built for about the same cost.

Right now, Mel is reconfiguring the generator. When we built the unit, all of the batteries and hardware went into a single box, which made it too heavy to lift and move around easily **(3)**. Mel is breaking the components down into smaller modules so that one or two guys can maneuver things around more easily. There are less expensive ways to get power, but none feels as good as plugging into the sun and wind.

Steven Rundquist *owns Brewster Timber Frame Co. in Bellvue, Colo.*


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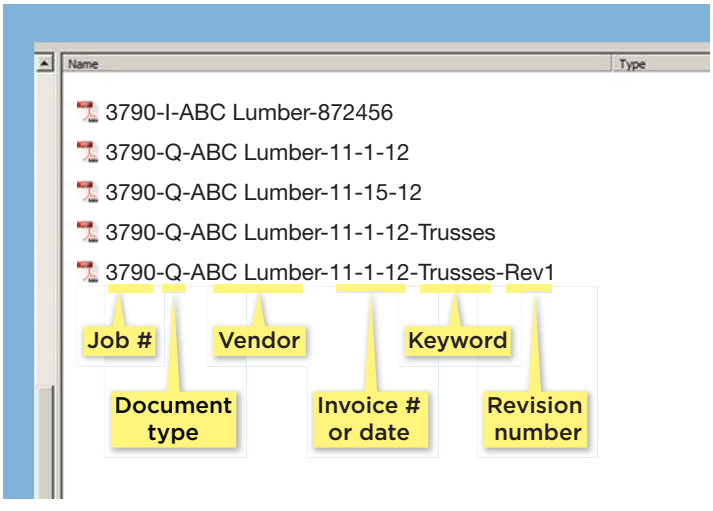
Going Paperless

by Allan Edwards

I am a custom home builder with a small office. We build only a handful of homes each year, but the average price is $3 million or higher, and each job generates 1,500 to 2,000 documents. I committed to the concept of a paperless office three years ago after a client asked to see all invoices for her job. After scurrying around making copies of 1,100 invoices, some which were missing or misfiled, we realized we needed a better system.

Today, we store 99.9% of our documents in digital format on our server or a cloud-based service. Stored documents include proposals, architectural drawings, contract documents, POs, invoices — almost everything affecting our jobs. We scan, label, and file all paper documents, but the fact is that more than 80% of all documents are now sent to us as PDFs, and I expect that percentage to grow.



The author's file-naming convention divides the file name into several parts. First comes the job number, which is usually the job address, followed by the document type — "I" is an invoice; "Q," a quote; "D," a draw request; "PO," a purchase order; "CO," a change order; and so on. Next comes the name of the vendor or sub, followed by an invoice number, or by a date that distinguishes between versions. In some cases, a keyword suffix is added to help narrow the search. Another suffix is added when a document is revised: Rev1, Rev2, etc.

Benefits and Savings

Having everything available digitally gives us quick access, and the time we save is by far the biggest benefit of reducing or eliminating paper. It is surprising how much human time is wasted by moving a document or invoice around an office, shuffling from one stack or one desk to another. I estimated that a clerical person or office manager spent three weeks a year just filing the documents in our office!

Now if a client wants to see a batch of invoices associated with a billing, we can easily provide that. We see dozens and dozens of instances where the ability to quickly obtain a digital invoice, photo, cut sheet, or other document saves us time — and money! Remote access is also invaluable: If a project manager is on a job and needs to review the plumbing selections, he can retrieve the document from our cloud-based service using a notebook computer or mobile device.

Storing documents in digital format is also valuable for estimating. We bid as many as 15 new homes per year, and as part of our process we often review recent invoices or quotes from similar jobs. There are countless instances where the ability to quickly obtain a digital document, invoice, photo, or cut sheet has improved the accuracy of our bid.

Another big benefit of going paperless has been that we no longer need actual file cabinets in our office. We're headquartered in a rather expensive area, and eliminating file storage has saved us $4,800 a year in lease payments, not to mention the cost of file cabinets, file folders, and labels.

We build most custom homes using cost-plus contracts, where we are entrusted with other people's money. Cost-plus requires that we convince clients that we are diligent and trustworthy in our accounting processes, and a large part of that involves furnishing them with all invoices pertaining to their project. Many banks also require us to provide copies of invoices for each draw we submit. By showing them our digital storage methods, we are able to assure them that backup documentation for draws and billings are just a click away for them and their lender.

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Another advantage to going paperless is our ability to upload various documents to our online project management platform where clients can easily access them. These include permits, engineer inspections, selections, surveys, budgets, and many other documents. This transparency builds our clients' confidence in us as their builder, and the goodwill and trust it creates is invaluable to that relationship.

File Names and Folders

Digital storage is convenient and saves time, but there's more to it than merely creating and receiving digital documents. For the system to work as designed, it's important to establish a clear-cut method of naming files. File names must be consistent so that using them becomes second nature for everyone when filing and retrieving documents. Without a logical, consistent file-naming system, searching for a digital file can be just as inefficient as digging through physical files in a storage cabinet.

Our file-naming system is simple yet effective (see example, page 47). It acknowledges that most of the documents we store are related to a particular job and come from vendors or subcontractors. It also accounts for the fact that some documents are revised, and it allows for storage of several versions. For example, we receive hundreds of quotes from subs and vendors each year, many of which are adjusted based on our review. It isn't uncommon to have several quotes from a sub or vendor for one item related to one job. In this case, we use the date of each requote to distinguish one version from another. Sometimes we add a keyword, like "trusses" or "tile," which makes it easier to find what we're looking for.

On our local server, we store documents in separate folders. For instance, office and administrative documents (such as insurance policies, tax documents, and the like) have their own folder and subfolder system. We upload job-related documents to Builder Trend, a cloud-based system, which makes them available to field personnel. We store quotes for every job on our local server in a folder labeled "Quotes," moving them as their status changes between subfolders labeled "Current," "Accepted," and "Rejected."

For documents that are emailed to us — including an increasing number of invoices — we use a two-monitor setup. We can view the invoice on one screen

while we enter the data into our accounting system on the other screen. Once it's been posted, the invoice is saved to our server.

Equipment and Services

Although we are receiving more and more digital documents via email, we still deal with a fair amount of paper, so our scanner is an important piece of equipment. We use the Fujitsu ScanSnap S510. It's easy to operate, and its scanning speed makes up for the high price ($725). We also use eFax, a $10-per-month digital fax service, which converts paper faxes into PDFs. But paper faxes are disappearing from our business; even subs who used to do everything via fax are somehow learning how to send invoices as PDFs.

Finally, an online backup system is an absolute requirement, and several are available at reasonable prices. We use MozyPro ($375 per year for 100 GB) and back up daily to ensure that our files will be safe even if we were to lose our server and computers to fire or mechanical failure.

Of course, the most important factor in implementing a digital storage system is commitment from you. Digital storage has to become a routine part of your daily operating methods. Superintendents who receive documents by email must get into the habit of forwarding those messages to the office so that they can be uploaded into the storage system. And all paper documents, no matter how insignificant, must be scanned and filed.

The transition from paper to scanning was not as difficult as I expected; we set a date and changed over from that point forward. For some in-progress jobs that were not too far along, we went back and scanned prior items so we would have a complete set of digital documents. The cost was minimal: The temporary person we hired needed only three days to scan everything into the system.

Allan Edwards *is owner and president of Allan Edwards Builder in Houston.*

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Part II

Building Stem Wall Foundations

Continuous steel reinforcement ties the poured concrete walls to the footings

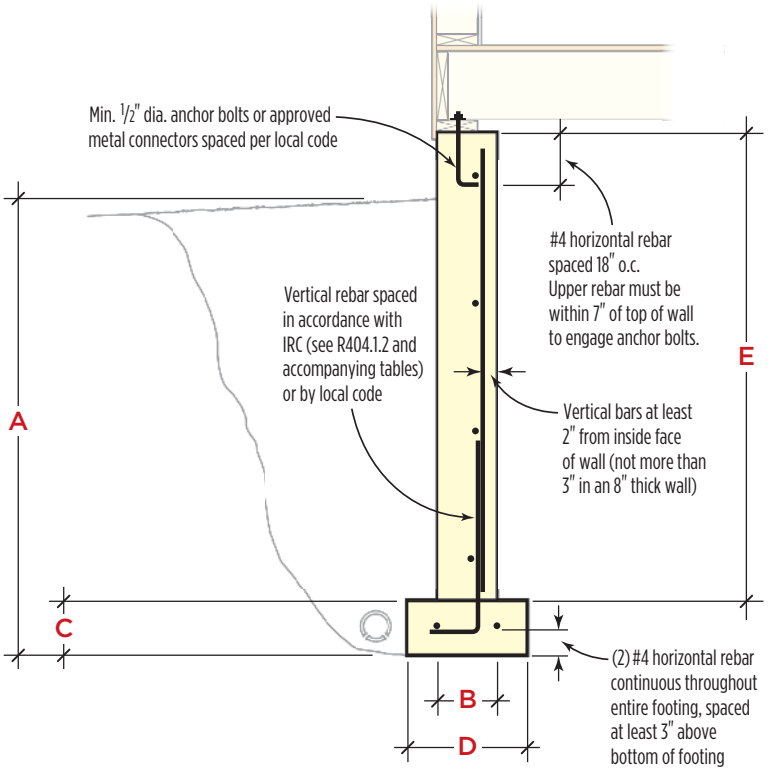
by Tim Uhler

[Editor's note: this is the second part of a two-part story; Part I appeared in the February issue.]

Before we form any walls, we scatter our 2-foot-by-8-foot MDO (medium density overlay) Plyform panels along the outside and inside of the footings (**see Figure 1, page 55**). These forms are actually made of plywood, with a special MDO facing that increases their durability and prevents the grain of the plywood from transferring to the concrete. Plyform panels are available in various thicknesses; the ones we use are $1\frac{1}{8}$ inches thick and very heavy, so scattering them in advance allows us to simply roll them over and into place as we work.

Following the engineer's plans or prescriptive guidelines, we connect wall rebar to the rebar already installed in the footings. In our area, the schedule for 2-foot-tall walls — the size we typically build — calls for vertical rebar 48 inches on-center, with

Sizing and Reinforcement Guidelines



Min. Requirements for Foundations Supporting Bearing Walls

# of floors supported by foundation	A (distance below grade)	B (min. wall thickness)	C (min. footing thickness)	D (min. footing width)
1	12"	6"	6"	12"
2	12"	6"	6"	15"
3	12"	8"	8"	23"

Min. Wall Requirements (Grade 60 Reinforcement Steel)

B (min. wall thickness)	E (max. wall height)	Horizontal rebar	Vertical rebar
6"	24"	(1) — #4 rebar	#4 rebar at 48"o.c.
6"	36"	(2) — #4 rebar at 18"o.c.	#4 rebar at 48"o.c.
6"	60"	(4) — #4 rebar at 18"o.c.	#4 rebar at 24"o.c.
8"	48"	(3) — #4 rebar at 18"o.c.	#4 rebar at 48"o.c.
8"	72"	(4) — #4 rebar at 18"o.c.	#4 rebar at 48"o.c.
8"	108"	(6) — #4 rebar at 18"o.c.	#7 rebar at 36"o.c.
10"	108"	(6) — #4 rebar at 18"o.c.	#6 rebar at 36"o.c.

Under normal soil conditions, prescriptive guidelines can be used to size footings and foundation walls and determine vertical and horizontal steel reinforcement schedules. The guidelines shown here are contained in the author's local building code (Kitsap County, Wash.), which was amended from Sections R403 and R404 of the IRC.

a single continuous horizontal rebar at the top of the wall (see illustration, left). Taller walls require more steel (**Figure 2**).

We work in two-man teams when forming walls, preferably with a third laborer available who can find — or cut — pieces as we go. Since the Plyform panels cost about $40 apiece, we're reluctant to cut them to fit. Usually we don't have to, since we've accumulated an assortment of sizes over the years. We also won't cut a piece of panel to fit gaps that are less than 1 foot wide. Instead, we span these short gaps with sections of galvanized sheet metal that we keep on hand just for this purpose.

I like to form the longest wall first, starting at a corner. One carpenter nails two 8-foot-long panels together with a single duplex nail (for easier disassembly later on) to form the outside corner, while another nails two 4-foot-long panels together — again, with a single nail — to form the inside corner. From there, we work outward in both directions. This approach staggers the interior and exterior panel joints, which makes the walls straighter and stronger.

When we formed the footings (as described in Part I of this article), we installed Rap-I-Form metal form clips (awardmetals.com) in the wet concrete. As we assemble our form, we place additional form clips on the footing so every panel will have a clip within 2 to 4 inches of each end, to keep the panel ends from spreading. At the top, we clip only enough to hold things together while we form. Later, we'll come back and add enough clips so that they are spaced about 2 feet apart.

Tall walls. If we're building on a sloped site and need taller walls, or if the owner simply wants a taller crawlspace, we can stack the 2-foot-wide panels horizontally to form 4-foot or 6-foot walls. Access to the interior of the foundation can get tricky once we start stacking form panels, though, so we plan our work carefully, first completing long 2-foot-tall sections across the back and sides of the foundation before going any higher.

We set the second or third row of panels on snap ties laid across the tops of the lower forms, following the same spacing as our form clips (**Figure 3**). Wedge-shaped "shoes" driven between the snap ties and the forms tighten them against the ties' internal washers. The ties leave a 3/16-inch gap between the forms where the water will leak out as we pour, but we just scrape the overflow off, and the gaps make it easier to strip the forms.

When stacking forms, we use the same-size panels in each row so the vertical joints line up. This speeds up forming, since once we know what sizes are on the bottom, we can grab two of each. It also makes the forms easier to strip. And if any of the concrete is exposed, straight joints look nicer.

When walls are taller than 6 feet, we orient our forms vertically (**Figure 4, next page**). This requires closer spacing of the form clips on the footing to prevent the bottom of the wall from blowing out under the load of the concrete, and we make sure clips are placed an inch or two from each panel edge. Vertically, we place snap ties in slots cut at 1-, 2-, 4-, 6-, and 7-foot intervals along the long edges of the panels. This has proven to be a good spacing for keeping the panels from bulging as the concrete is placed.

If we are pouring a 9-foot-high wall, we stack one-foot-wide panels on snap ties at the top. When pouring 10-foot-high walls, we stack 2-foot-wide panels on top.

Figure 1. Workers finished up the steelwork before scattering the heavy Plyform panels, with one continuous row of horizontal rebar about 3 inches up and another row at the top of the verticals.

Figure 2. Reinforcement schedules for tall walls typically call for horizontal rebar on 12-inch to 18-inch centers depending on site conditions and structural requirements.

Figure 3. To build 4-foot or 6-foot-tall foundation walls, the author stacks his forms horizontally on snap ties laid across each lower course. Aligning the stacked panel joints vertically speeds installation and makes it easier to strip the forms later.

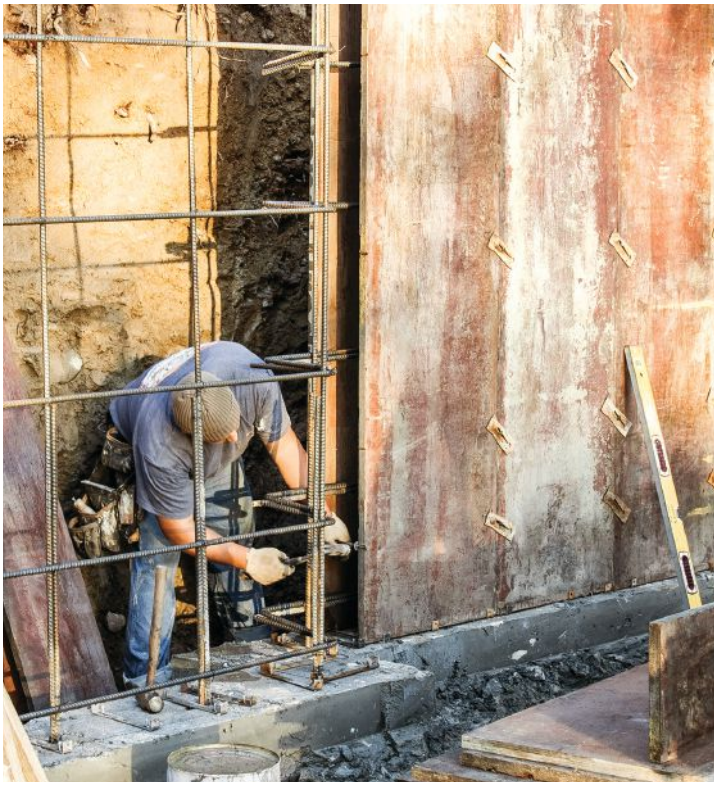


Figure 4. The author forms 8-foot-tall walls vertically, placing snap ties in slots located 1, 2, 4, 6, and 7 feet along the panel edges.

Figure 5. A reference line snapped within the top inch or two of the forms indicates the elevation of the top of the wall. The author tacks a 3d finish nail every 12 to 16 inches along the snapped lines to make them easier to find during the pour.

Figure 6. Even though the mix from the line pump is smooth and easy to work with, the author's crew still spends a few moments flattening out the concrete and patting down stray aggregate while installing hardware.

At inside corners, we drill through the inside panels and poke snap ties out on the same 1-2-4-6-7 spacing so that these weak points have plenty of support. To make sure there's enough room for wedges, we space the holes about 3 inches off the inside corner. We reinforce outside corners with metal plumber's strapping about every 2 feet vertically. Then we line the tops of the walls to make sure they are straight, brace them as needed, and double-check the diagonals.

Shooting grade. Once the wall forms are built, I set up the laser so that it's about one foot taller than the form. Then I mount the detector on a 1x2 stake and go around the forms marking level. Keeping the top of the concrete within the top one inch of the form makes it much easier to trowel. We mark the form every 25 feet or so, which eliminates any sag in the string when we snap lines (usually in white chalk for bet-

ter visibility). Then we tack 3d finish nails every 16 inches along the snapped lines to indicate final grade (**Figure 5**).

The pour. The line pump operator controls both the speed and the accuracy of the pour. But I can help him by assigning a crew member to work with him, mainly to make sure he keeps the concrete right at the elevation line. Meanwhile, I watch the forms. Usually only two of us need to be on site for the pour, but if the walls are taller than 4 feet, I like to have an extra guy on hand to minimize the need to climb over the forms or in case something goes wrong (**Figure 6**).

Since the concrete mix that comes out of the line pump is super smooth, we don't need to vibrate the forms. If we're using a regular mix with larger aggregate, we work the concrete as we go, shoving a 1-by up and down into the forms to move the water to the edge.

After the concrete has firmed up for 30 minutes or so, we trowel the top smooth, then set our J-bolts or Simpson MASA mudsill anchors (which we prefer) about 48 inches on-center. If hold-down bolts are specified, we've already placed them in the forms using Simpson AnchorMate Anchor Bolt holders (strongtie.com) prior to the pour (**Figure 7**).

Before leaving for the day, we scrape any wet concrete off all of the inside corners and from the top of the footings to make stripping the walls easier. Depending on the time of the pour and the weather, we'll either come back to strip the walls the next day or wait a couple of days to let the concrete firm up (**Figure 8**). Afterward, we oil the daylights out of the forms before storing them at our shop under tarps. The forms last forever if they're taken care of.

We've started framing as early as the day after we strip the forms, but usually we wait a few days, especially with taller walls (**Figure 9**).

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

Figure 7. The author prefers Simpson MASA mudsill anchors over traditional anchor bolts for fastening the framing to the foundation. In the rush of the pour, this shear brace template was installed upside-down, so the author will just pop it out after the concrete has set up.

Figure 8. Workers scrape the panels clean as they strip the forms from the foundation. Later, they'll oil the panels before storing them.

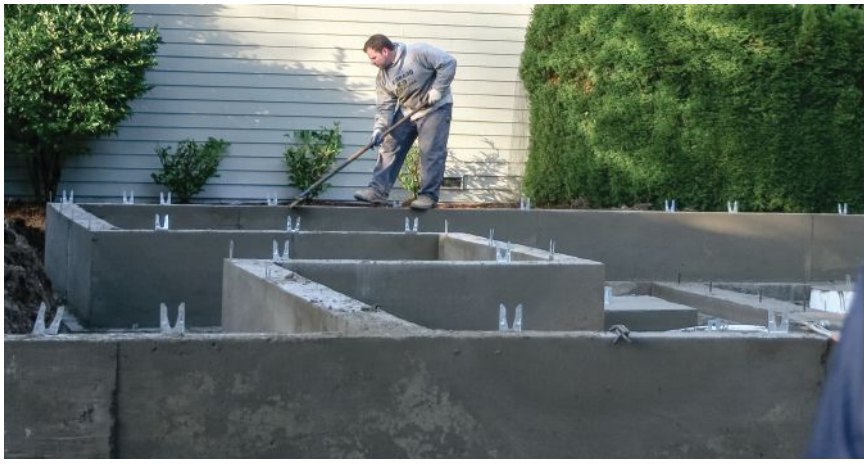
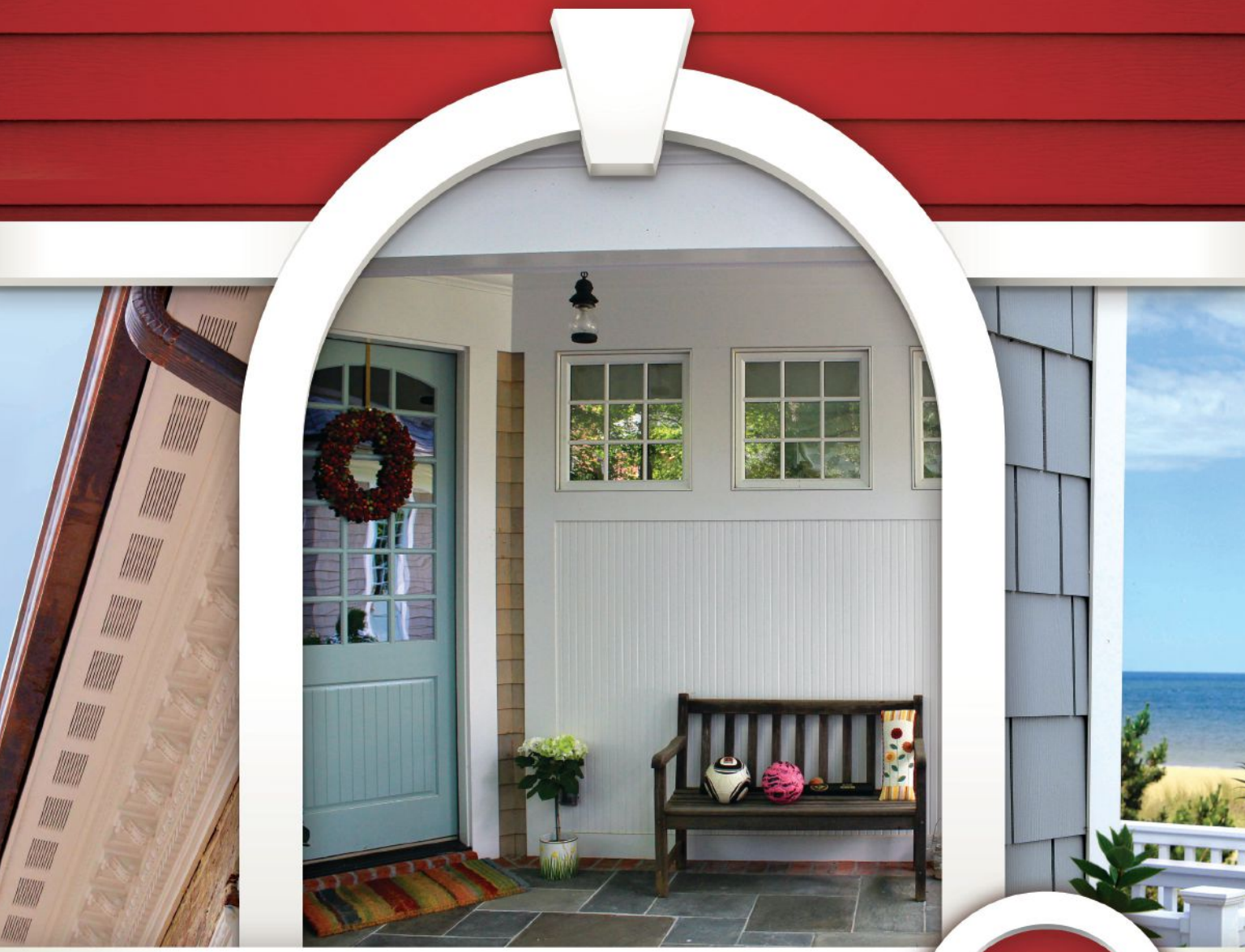


Figure 9. Before installing the mudsills, the author uses a scraper to smooth out any trowelling irregularities on the top of the stem walls.



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Getting Started With TPO Roofing

This tougher alternative to rubber membrane can be installed without adhesive

by Emanuel Silva

Over the years, I've installed quite a few low-slope EPDM rubber roofs with good results. But the adhesive is messy stuff to work with, and it's difficult to apply when the temperature falls below 45°F or so. So when I knew I'd be installing membrane roofing as part of a recent porch project, I decided to try TPO roofing instead, which can be heat-welded without any adhesive.

TPO Basics

TPO stands for thermoplastic polyolefin. It's a fabric-reinforced plastic that's much tougher and more resistant to punctures than EPDM. The company I worked with, Flex Roofing Systems (flexroofingsystems.com), offers the material in white, tan, or gray. White is a popular choice in hot climates because it reflects light and minimizes solar heat gain.

To make sure I got started on the right foot, I made contact with a manufacturer's rep

Figure 1. Using a membrane on all three decks ensures that water from rain or snowmelt will drain away from the house. On the ground-floor deck, the membrane keeps water away from the foundation, protects the underlying framing and connections, and allows for dry storage underneath.

Figure 2. To protect against fastener show-through, the author added a layer of wood-fiber recover board, fastened to the structural deck with the same reinforced galvanized screw plates and 1⅝-inch screws used to secure the TPO membrane.

who was doing a demonstration at my local materials supplier. After coming to my job site to help draw up a stock list, he recommended that I use .045 material. It's more flexible and much easier to work with than the heavier .060 or .080 membrane used on many commercial jobs, and carries the same warranty.

A Three-Level Porch

The project was a three-level porch on an older multifamily house just outside Boston. All three levels would have floating decks, with the TPO membrane acting as the waterproof layer beneath (**see Figure 1**).

The framing was straightforward. I sloped the floor joists away from the building at ¼ inch per foot to provide drainage, and fastened the pressure-treated 4x6 posts for the railings to the joists with bolts and steel brackets.

The structural decking is ¾-inch AdvanTech, and according to the TPO rep, it's acceptable to install the membrane directly over the AdvanTech. But to be on the safe side, I decided to put down an additional layer of ½-inch wood-fiber recover board — the same material that's ordinarily used under rubber membrane — just in case any of the fasteners holding the AdvanTech to the joists backed out in response to lumber shrinkage or changes in temperature (**Figure 2**).

TPO roofing that isn't ballasted in some way is ordinarily cemented to the underlayment to keep it from tearing loose in high winds. But because the porch roofs would be held down by the floating decks, I was able to eliminate that step. Fitting the membrane was just a matter of taking accurate measurements and allowing the correct amount for overlap at the seams, a turned-down strip at the fascias, and a turned-up section for flashing where the material meets the building (**Figure 3**). The membrane is fastened through to the deck with the same screws and plates used to install the recover board. The 3-inch strip of membrane that turns down at the outside edges of each deck — and the wider strips that are turned upward and flashed against the building — were adhered with double-sided Eternabond tape recommended by the TPO rep (eternabond.com).

Materials Compatibility

According to the TPO rep, the membrane is compatible with all nonbituminous flexible flashing materials. But when I double-checked with W.R. Grace, the rep there told me that regular Ice & Water Shield shouldn't be used in direct contact with TPO. He recommended a different product, Grace Ultra, for this application. My regular lumberyard didn't stock it, so I had to get it from a nearby commercial roofing supplier. It cost almost twice as much as standard Ice & Water Shield and is slightly thinner and more flexible, but is handled and installed the same way (**Figure 4**).

Figure 3. Cutouts in the membrane (A) allowed it to slip over the tops of the posts, minimizing seams; an open cutout at the outside corner column accommodates the membrane turn-down along both edges. The upper edge of the first sheet of membrane is screwed to the deck at 12-inch intervals. A preprinted line 4 inches from the edge marks the correct overlap for the next sheet (B). Turned-down membrane edges are secured to the PVC fascia with double-sided tape approved by the TPO manufacturer (C).

Figure 4. Because seams at inside corners leave a potential pinhole leak where the deck and walls intersect, a prefabricated corner piece is heat-welded to all three surfaces (A, B). Peel-and-stick membrane flashing adhered to the sheathing (C) will later be covered with housewrap.

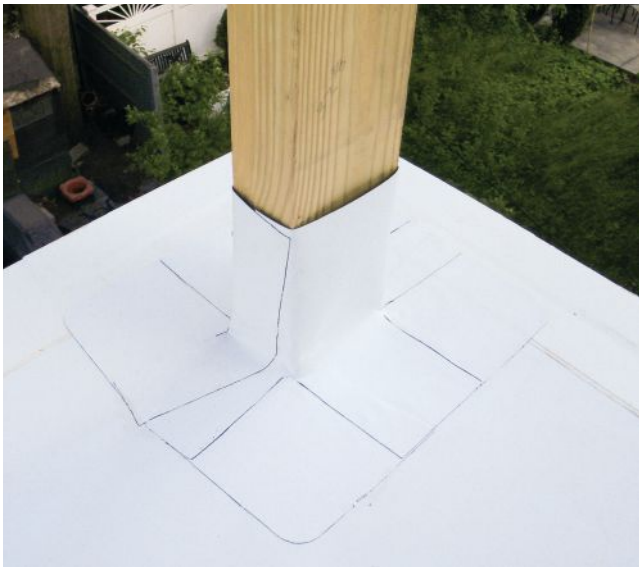

Figure 5. Square-sectioned flashing boots are temporarily secured with provided band clamps before being welded to the deck with the heat gun and roller (top). The orange-handled tool next to the post is a pointed probe that's run carefully along welded seams to pinpoint any missed areas. The boot's overlapping split side — which allows it to be wrapped around a continuous column — is welded closed (see photo on page 59). The open top of the finished boot (above) will be covered with flexible flashing.

Heat Sealing

After rolling out the membrane on the decks, fitting it over the posts, and screwing it down at the required spacing, I was ready to heat-weld the seams. On large commercial jobs, long straight seams are sealed with a wheeled hot-air welding machine, but that would have been unwieldy for such a small project.

Instead, I used a hand-held heat gun designed for use in obstructed areas. This is a specialized commercial tool, and because it retails for about $700 I was glad to be able to borrow one from the roofing rep.

It has a narrow tip designed to fit between the overlapping sheets of material, and 10 different temperature settings that let you choose just the right heat level for the prevailing conditions — up to 960°F for cold weather, or lower settings when it's warmer. After practicing on some scrap material, I quickly became comfortable with the process of heating the material and working the roller against it to produce a good seal. The resulting seams are very strong — there's no way to pull them apart without tearing the material itself.

I was able to move ahead at about a foot per minute on the straight laps between sheets, but the flashing boots were relatively slow going (**Figure 5**). It took me almost an hour to seal the first one, although I soon managed to cut that time in half.

Finishing Up

After sealing all the seams and flashing the inner edge of membrane to the wall of the house, I wrapped all the deck posts with Grace Ultra and lapped it down over the flashing boots. I then gave all three levels of the deck a water test to make sure I hadn't missed anything.

Figure 6. Once the completed membrane had been flashed and leak-tested, mahogany decking was fastened to tapered pressure-treated sleepers (left). The finished porch was trimmed out with PVC post and column wraps, moldings, and balusters, combined with mahogany stair treads, fascia trim, and railings (below).

I ran water over each of the boots with a hose, then worked my way across the floor toward the house wall while watching carefully for any drips below. I did find a small leak at the base of one boot, which was easily fixed by wiping it dry, reheating the seam, and going over it again with the roller.

The posts themselves were later boxed in and capped with PVC trim, which prevents any water from soaking into the structure through the end grain of the posts (**Figure 6**). To further protect the TPO membrane where it's in contact with the sleepers that support the deck boards, I placed an additional 3-inch-wide strip of material under each sleeper. These extra strips aren't cemented or heat-sealed, but are held in place by the weight of the floating deck above.

Labor and Materials

Because this was my first time with a new material, I didn't try to hurry the job. Working with one helper, it took me about 10 hours to install, seal, and flash the membrane on each of the three decks, not counting the time to put down the underlayment. The total cost for materials came to about $2,500, with the flashing boots accounting for almost a third of that (we used 15 4x6 boots, which cost $45 apiece, and two larger custom-made ones for the corner column at $75 each). In all, the cost was pretty comparable to what it would have cost to do the same project with black rubber roofing. Although material costs were about 20% higher, labor costs were reduced because we didn't have to spend time spreading adhesive or standing around and waiting for it to set up.

Emanuel Silva *owns Silva Lightning Builders in North Andover, Mass.*

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Easier Coved Ceilings

Prefab parts and flexible drywall simplify the installation of this classic detail

by David Hanson

Older homes present more of a challenge to a carpenter's abilities than today's run-of-the-mill spec houses. There aren't as many of them in our area (Washington state) as there are on the East Coast, but we enjoy working on them whenever we get the chance. On a recent project, we were contracted to remove a 1970s family room that had been grafted onto a classic 1920s house and replace it with a more architecturally appropriate addition. Coved ceilings were a prominent feature in most of the rooms on the main floor, and the homeowners wanted to replicate this detail in the addition.

As in most houses built before the mid-1930s, the home's walls and ceilings had been finished with cement-based plaster applied over wood lath nailed to the framing. After World War II and up until 1959, houses around here were still plastered, but with a composition rather than wood lath — my father's favorite was "gyp lath," which was sold in 2-foot by 4-foot sheets perforated with ¾-inch holes to allow the plaster to bond to the surface. It wasn't until about 1960 that gypsum-based drywall systems similar to those used today were widely adopted, at which point coved ceilings and other decorative plaster details virtually disappeared from the repertoire of most builders.

Framing

In the case of this home, the original coved work was relatively simple — as long as the finishing was done by a skilled plasterer. Blocking cut at the desired radius had been fastened to the wall and ceiling framing before installation of the wood lath to make a curved transition between the wall and the ceiling (**see Figure 1, next page**).

A few years ago, we tried to duplicate this look by mounting sections of precut molded Styrofoam on top of conventional drywall. The foam cove molding was coated with fiberglass mesh, allowing it to be finished along with the wall and ceiling drywall with joint compound. While

Figure 1. The ceilings in the original house had an interesting cove detail (above) that the homeowners wanted to duplicate in their new addition, but with typical drywall instead of traditional plaster-and-lath construction (right).

Figure 2. To provide a solid attachment point for the prefabricated arches, the author installed rows of blocking between the wall and ceiling framing. The blocking is centered 12 inches from the wall/ceiling intersection, and also provides good backing for drywall.

Figure 3. To bring the 5/8-inch ceiling drywall, 1/2-inch wall drywall, and 1/4-inch flexible drywall that would be used to form the cove into the same plane, 1/4-inch plywood furring strips needed to be attached to the blocking.

the product worked fairly well and the end result was satisfactory, it was expensive. I also had reservations about putting such a flammable material on the ceiling of a client's home.

Looking for an alternative, I discovered an online company that offers prefabricated parts for framing various types of vaulted and coved ceilings (archwaysandceilings.com). For this project, we used prefabricated ½-inch-thick by 1¾-inch-wide MDF arches to form the coves, which we covered with flexible ¼-inch-thick drywall.

We ordered the arch kit directly from the company, using its simple online form to provide details about the project, such as the perimeter of the room, the radius of the cove, and the number of inside and outside corners. Within about two weeks, a couple of well-packed boxes arrived at our job site with our parts.

Arch installation was quite simple and fairly fast. First we installed blocking between the wall studs and rafters centered 12 inches down from the ceiling and 12 inches out from the walls — our arch radius (**Figure 2**). Then we snapped chalk lines across the wall and ceiling framing and blocking on our 12-inch marks to align the arches.

We needed to bring the various thicknesses of drywall (5/8 inch, ½ inch, and ¼ inch) all into the same plane, so we fastened ¼-inch plywood furring strips to the blocking (**Figure 3**). Incidentally, if we had wanted to create reveals, we could have furred out either the wall or the ceil-

Figure 4. The arches were fastened to the furring strips 16 inches on-center. A narrow crown stapler and dabs of construction adhesive were used to make the attachment.

Figure 5. Inside and outside corner arches were also included in the kit. Pairs were butted together to form each corner and fastened in place with glue and staples.

ing (or both) with thicker blocking.

An unexpected consequence of furring the walls and ceilings out to match the various drywall thicknesses was that it reduced the radius of our cove. Instead of the 12-inch radius that we had planned, the radius was now 5⁄8 inch smaller, so we set up the rip fence on our table saw to cut a consistent 1⁄2 inch off each arch.

Finally, we fastened the arches to the furring strips 16 inches on-center with a narrow crown stapler and construction adhesive (**Figure 4**).

Corners. The kit also included prefabricated inside and outside corners. At first, it was a little difficult to figure out how the pieces fit together, but after trying a few different combinations it became clear which two arches needed to be paired together to form each corner (**Figure 5**).

Flexible Drywall

Once the framing was in place and we had finished insulating the walls and ceiling, we started hanging drywall, beginning with the ceiling. To form the coves, we used CertainTeed's ProRoc Flex 1⁄4-inch flexible drywall panels. Flexible drywall is available from a number of manufacturers, and usually can be installed wet or dry. Wet panels are typically about twice as flexible as dry panels. As with a sheet of plywood, the strength axis is lengthwise, so changing the panel's orientation can increase its flexibility.

A 12-inch radius is pretty tight, so we wet each drywall panel after cutting it to size, by spraying both sides with a mister (**Figure 6**). To make the wet panels even more flexible, we allowed them to sit for a few minutes before installing them.

Figure 6. Workers sprayed both sides of each panel with a mister. Allowing the wet panels to sit for a few minutes before installation increased their flexibility even more, making it easier to form the flexible drywall to the 12-inch radius of the cove.

Figure 7. When forming the panels, crewmembers worked slowly and avoided pushing hard on the center of the panel, which would break the paper face and buckle the drywall (above). Once the panels conformed to the cove, they were screwed in place with regular drywall fasteners on 5-inch centers (right).

Before installation, we spread construction adhesive on the arches, then used regular drywall fasteners on 5-inch centers to pull the panels tight to the framing (**Figure 7**). Our preferred method was to work each 8-foot section with three guys, spending a few minutes to slowly press the drywall into place with our hands before finally screwing the panel in place.

Cutting the drywall to fit the inside corners proved to be tricky. There may be some mathematical way to figure out the curve where the panels meet, but whatever the formula is, I can't find it on my framing square or construction calculator. Instead, we scribed a pattern on a scrap panel through trial and error, then used that pattern for the remaining corners.

Finishing. Once the drywall was installed, finishing was straightforward — except (again) for the corners. In fact, the hardest part of the whole job was taping the outside cove corners around the fireplace chase (**Figure 8**). We installed some plastic flex bead that our local supplier had in stock, but found that the taping bead along its edge disappeared when we bent it enough to conform to the corner. To build up the edge so that our taping knives would have a smooth surface to glide over, we attached sections of thick plastic string from a WeedWacker to the edge of the bead with a hot-melt glue gun.

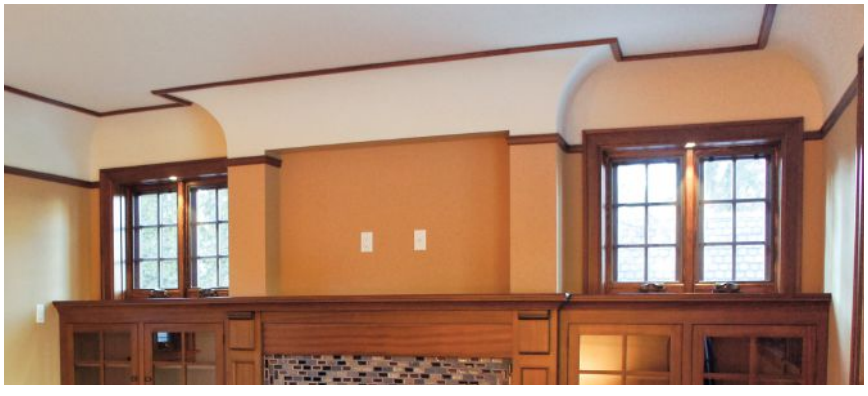

Figure 8. In the completed addition, the room's coved ceiling closely matches the appearance of the main house's original plaster ceilings.

We could have saved a lot of time if I'd attended the JLC Live show in Portland *before* we taped the corners rather than afterward. There I found Strait-flex's Arch-Flex corner bead (straitflex.com), which would have worked perfectly in this application.

Cost

The cost of the arch kit was about $650, which included enough material to do two rooms, or about 120 linear feet of wall. The flexible drywall cost about $19 per sheet, so our total cost in extra materials for this project was about $810. I estimate that we spent an additional 37 man-hours installing the arch kit and hanging and taping the flexible drywall, compared with our standard wall treatment. When factoring our markup and labor costs, this added about $2,400 to the cost of the materials used on the project. To me that seems like a reasonable amount, considering the added style the coved ceilings contribute to the room.

David Hanson *is a third-generation builder and a principal at Hanson Carlen in Spokane, Wash.*

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THURSDAY, MAY 9

1:00–2:15 PM

Differentiate or Die

Sam Geist, Geist and Associates, Entrepreneur, Marketer, Facilitator

Transitional times negate the "business as usual" approach, and offer a unique opportunity to adopt a bold plan, to take a firm stand to differentiate yourself and your organization from the competition. But the biggest issue in business today is a failure to execute. It's easy to talk about what makes our company special, but talk doesn't get things done. In this session, Sam presents options to create effective differentiation, and demonstrates a step-by-step approach that will help attendees to successfully move strategy to action.

2:30–3:30 PM

Big Data and the Future of Remodeling

Jonathan Smoke, Chief Economist, Hanley Wood

Is the roller coaster ride finally over? In this session, Hanley Wood's Chief Economist, Jonathan Smoke, reaches into his big bowl of data to assess the short- and long-term outlook for housing and remodeling. Attendees will learn what the numbers can tell us about the nature of remodeling demand and how to leverage data to maximize business success.

3:45–4:45 PM

Growing Profits While Reducing Risk

Douglas R. Delp, President, The Delp Group

Remodelers worry about liability for the structures they build, but few pay enough attention to their risks as business owners and employers. Doug Delp specializes in helping small companies with human resource issues they can't handle themselves. In this session, he explores a variety of critical vulnerabilities, including employment liability and workers comp insurance, subcontracted vs. W2 employee labor, hiring practices, overtime policies, health insurance and employee benefits, and more. Attendees will learn how to avoid the mistakes of the past and how to protect their hard-won profits from Murphy's Law.

5:30–6:30 PM

Welcome Reception

6:30–9:00 PM

Networking Buffet

FRIDAY, MAY 10

8:00–9:00 AM

Marketing on the Move

Andrew Davis, Tippingpoint Labs

The digital revolution has made it possible to scale our interactions with current customers in ways we couldn't imagine a decade ago. In this presentation, one of the brightest minds in media and marketing will show you how to turn your everyday business activities into marketing and customer service content—content that makes your clients happier and drives new business more efficiently. You'll learn how to leverage social media, and new mobile technology to become a mobile marketing machine.

9:15–10:15 AM

Debunking the Biggest Lies About SEO and Social Media

April Wilson, Director of Marketing, Hanley Wood Exhibitions

How do you know if those SEO experts you're paying are really doing their job? Does social media ever actually drive business? In 10 years working with top brands and business owners on digital marketing, April has learned that most companies neglect of SEO and Social Media. This session will explain what SEO is, how it works, and why and how to use it. And you'll learn where to participate in social media, how to measure it, and which channels best support SEO.

10:30–11:30 AM

Social Media Success Stories

Panel of remodelers (TBD)

Does social media really work for remodelers? This session brings together three remodelers who have been using a variety of social media long enough to be able to report on why it works, why it doesn't, how they monitor results, and how their strategy has evolved. Panelists will make brief presentations and answers questions from the audience.

11:30 AM–1:00 PM

Lunch

1:00–3:00 PM

Workshop: High-Profit Selling

Mark Hunter, "The Sales Hunter"

In this two-hour extended session, Mark will drill down on four mission critical area's that attendees will be able to implement immediately:

- Closing faster: strategies to combat homeowner indecision
- Maximizing margin: how to "upsell" in a way homeowners will thank you for
- Qualifying prospects: avoid wasting time with people who are only posing as customers
- Leveraging price: use your experience, finished product, and success history to create competitive differentiating value

3:15–4:15 PM

Thinking Big and Living Large

Al Walker, Al Walker and Associates

After sitting in a meeting room all day long, you're tired of thinking. It's time to laugh with Al Walker, as he pokes a lot of fun at himself and at life. This presentation is perfect for business people who want to think big, live large, and laugh all the way to the bank.

6:30–9:30 pm

Big50 Reception and Dinner

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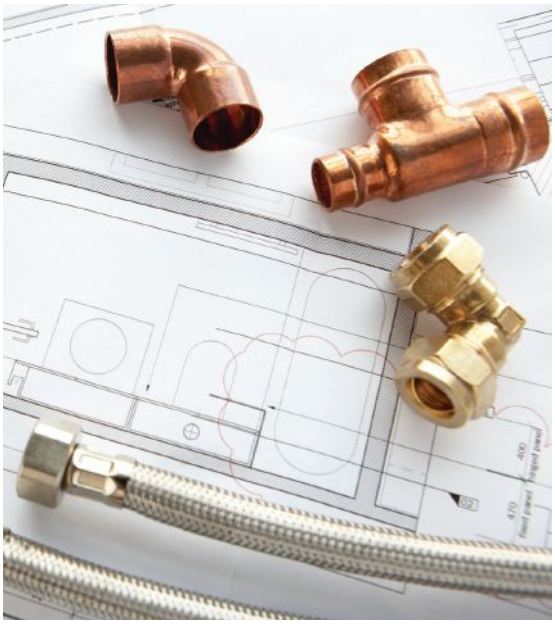
Efficient Hot-Water Piping

Smarter layouts and right-sized pipes save time, water, and energy

by Gary Klein



How long are you willing to wait for hot water when you turn on the tap? That's a question I began asking in 1993, while researching the design of hot-water systems for the California Energy Commission. Most people told me that they want "time to tap" to last only a few seconds. But in the real world, it often takes a minute or more before hot water begins flowing out the faucet.

That's because traditional methods of sizing distribution piping are based on maintaining adequate system pressure. Plumbers often use oversized pipes to overcome the pressure drop caused by excessive pipe lengths and sharp changes in direction. It's not unusual to see a ¾-inch-diameter supply line installed where a ½-inch-diameter pipe will provide adequate flow, even though this nearly doubles the volume of water contained in the pipe (**see Figure 1, next page**).

In cold-water piping, excess volume doesn't waste water or affect energy performance, but in hot-water piping, it's a different story. Unless that extra volume of water is already hot, it will have to be purged from the pipe before hot water is delivered to the fixture. This wastes both water and energy. In fact, in the typical household, as much as one out of every three gallons of heated water runs down the drain unused.

This waste can often be minimized by installing on-demand hot-water circulation (see "Hot-Water Circulation," 12/10). But the best strategy is to first squeeze as much inefficiency as possible from the hot-water distribution system. To do this, I size the hot-water piping to provide just the right amount of hot water to each fixture. I also try to minimize the number of branch lines and keep trunk lines and "twigs" (called "fixture branches" by the Uniform Plumbing Code, "fixture supplies" by the International Plumbing Code and the IRC) as short as possible. To maintain pressure, I try to minimize the number of fittings — particularly hard 90-degree elbows — and avoid pipe configurations that restrict water flow. And to conserve energy and keep the water hot for clustered hot-water events, I make sure the pipes are wrapped with adequate insulation.

Feet of Pipe Per Cup (8 oz.) of Water				
	Pipe Diameter			
	3/8"	1/2"	3/4"	1"
K copper	9.5	5.5	2.8	1.6
L copper	7.9	5.2	2.5	1.5
M copper	7.6	4.7	2.3	1.4
CPVC	n/a	6.4	3.0	1.8
PEX	12.1	6.6	3.3	2.0
"Copper rule"	8	5	2.5	1.5

Figure 1. Minimizing the volume of water in the piping between the hot-water source and each fixture is one key to reducing waste in a hot-water system. To find the volume of water contained in piping runs of various diameters, divide the total length of each trunk, branch, or twig by the corresponding ft/cup value. For quick approximations, divide by the "copper rule" values in the bottom row. An efficient layout for copper will perform even better with CPVC or PEX.

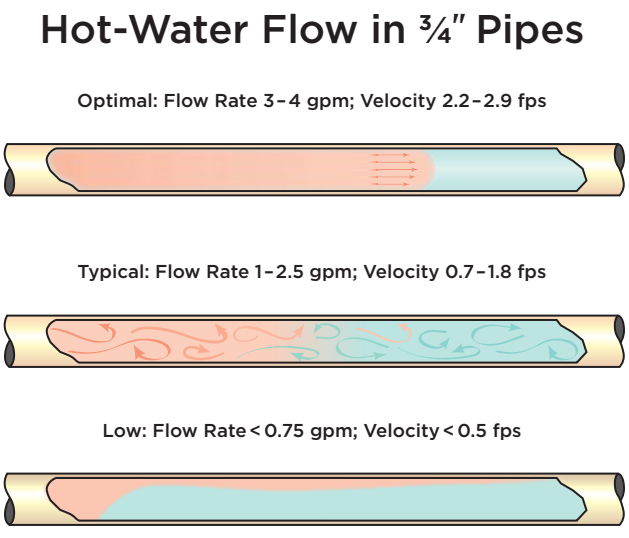


Figure 2. Flow rate affects how hot and cold water interact in the piping during hot-water delivery. A flow rate of 3 to 4 gpm creates a "plug flow" (top), which pushes cold water out of the pipe without much mixing, minimizing wasted water and time-to-tap. At low flow rates (bottom), a thin stream of hot water rides up on top of the cold water (or spirals around it) and cools quickly; up to twice the standing volume of water must flow through the pipe to achieve the desired temperature. At flow rates typical for many fixtures (center), hot and cold water mix reasonably well, but up to 1.5 times the standing volume of water in the pipe must flow through before hot water arrives.

Right-Sized Pipe

To avoid oversized pipes, I size the twigs according to the actual flow rates of the fixtures the pipes serve. I basically size branches and trunk lines the same way, but also take into consideration the likelihood (though small) of simultaneous draws from different fixtures on the same branch or trunk line. I always try to choose the smallest diameter pipe that will provide adequate flow at the available water pressure to meet the real demand.

Keep in mind that hot-water pipes no longer have to carry a large volume of water. Most homes now have water-saving 2.5-gpm showerheads and 2.2-gpm faucets, while fixtures that conform to the EPA's WaterSense program have even lower flow rates.

Velocity and flow rate. Some rural homes served by wells may have less than 35 psi of static water pressure, in which case friction loss is a real concern, and pipes must be sized to maintain pressure. But static water pressures of 40 psi to 80 psi are now required under most plumbing codes, making pressure drop less of an issue. In houses where system pressures are greater than about 50 psi, pipe sizing should be dictated by the maximum allowable velocity.

To avoid excessive noise, erosion, and water hammer, the Uniform Plumbing Code (UPC) limits water velocity to 5 ft/sec in copper pipe and 10 ft/sec in most types of plastic pipes. Since hot water behaves differently at different flow rates, the optimal water velocity in hot-water piping is between 3 ft/sec and 4 ft/sec (**Figure 2**).

The flow rate through a hot-water pipe depends mainly on the pipe's interior diameter and the velocity of water moving through it. Decreasing the diameter of a pipe while maintaining a given flow rate increases the water's velocity. You can see from the charts prepared by the Oak Ridge National Laboratories for different types and sizes of pipe (**Figure 3**) that the velocity increases rapidly as the flow rate increases in a given diameter pipe. Many combinations of flow rate and diameter result in unacceptable pressure drops. Picking the right pipe diameter minimizes the loss of water, energy, and time spent waiting for hot water to be delivered to a fixture.

Trunks, Branches, & Twigs

A smart plumbing design starts with the location of the water heater. Sometimes the location is flexible, in which case I try to position the heater to minimize the length of the trunk lines. For example, simply moving the heater from an attached garage or corner in the basement to a more central location relative to the fixtures shortens the pipes, reducing the volume of water in the lines. Most of the time, though, the water heater and fixture locations are pre-determined.

Twigs. Since each twig serves a single faucet, shower, or appliance, its diameter should be determined solely by the flow rate of

Water Velocity (feet/second) for Different Pipe Sizes and Flow Rates

	Flow Rate (gpm)												
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0
3/8-inch K Copper	1.3	2.5	3.8	5.1	6.3	7.6	8.9	10.1	11.4	12.7	13.9	15.2	17.7
3/8-inch PEX	1.7	3.3	5.0	6.7	8.3	10.0	11.7	13.3	15.0	16.7	18.3	20.0	23.4
1/2-inch K Copper	0.7	1.5	2.2	2.9	3.7	4.4	5.2	5.9	6.6	7.4	8.1	8.8	10.3
1/2-inch PEX	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.2	9.1	10.0	10.9	12.7
3/4-inch K Copper	0.4	0.7	1.1	1.5	1.8	2.2	2.6	2.9	3.3	3.7	4.0	4.4	5.1
3/4-inch PEX	0.4	0.9	1.3	1.8	2.2	2.6	3.1	3.5	4.0	4.4	4.9	5.3	6.2

Figure 3. Pipe sizing is determined by the flow rate of each fixture in gallons per minute (gpm) and the maximum acceptable velocity (in feet per second) of the pipe used to serve it. Note that velocity increases as pipe diameter decreases. Numbers in red exceed the recommended maximum hot-water velocity of 5 ft/sec for copper, or 10 ft/sec for PEX and CPVC (not shown).

the device it serves. For instance, a garden tub requiring a 10-gpm flow rate should have a larger-diameter twig than a 2.2-gpm lavatory sink.

Even though a 3/8-inch-diameter twig may provide an adequate flow rate for a particular fixture, remember that most plumbing codes specify a minimum pipe diameter for each type of fixture. While the 2012 IPC/IRC allows 3/8-inch-diameter pipe for lavatory sinks, the UPC requires at least 1/2-inch-diameter pipe for all fixtures unless the design has been engineered and approved by an inspector.

Branches. Branch lines serve two or more twigs. For best performance, I try to keep branch lines to a minimum, and connect twigs directly to a trunk line.

Trunks. Trunk lines serve a combination of twigs and branches, and — in a well-designed system — act as an extension of the water heater. In other words, once a trunk line has been charged with hot water after an initial use (or with a recirculation pump), hot water is then available almost instantaneously to the remaining twigs connected to the trunk.

To determine the diameter of the twig, branch, and trunk lines, I add up the flow rates of the outlets that they serve. I also estimate how many fixtures are likely to be operated simultaneously for any significant period of time. (One reason most hot-water lines are oversized is that plumbing codes assume more than one fixture is drawing hot water about 70% of the time. But research with more than 17,000 days of data on more than 150 homes from climate zones throughout the U.S. and parts of Canada shows that this occurs only about 10% of the time.)

Once I know the pipe diameters and lengths, I can calculate the volume of water contained in each twig, branch, and trunk line. This volume and the fixture's flow rate determine the time-to-tap for hot water to arrive at each fixture.

My goal is to achieve a time-to-tap of two to three seconds at a flow rate of about 2 gpm. If there is only one cup of water between the fixture and the hot-water source, time-to-tap will be less than four seconds at 1 gpm; at 2 gpm it will take less than two seconds for the hot water to arrive.

Improved Layout

Right-sizing the piping is only part of the answer. To reduce time-to-tap, you also have to keep the water in those pipes hotter longer. That means shortening the length of runs, and reducing heat loss from the piping.

About 60% of homes built in the U.S. since 1970 have slab-on-grade foundations, 20% have crawlspaces, and 20% have basements. In a hot-water distribution system, the type of foundation a house has usually determines where the plumbing and the water heater are located.

Below-slab plumbing is an accepted practice in some jurisdictions, but it presents a number of problems. Pipe runs in homes plumbed this way are generally much longer than needed, because the pipes are often placed in drain or utility trenches rather than in separate trenches that follow the shortest route between fixtures. I've even seen water supply piping routed back underground rather than directly through a wall when the fixtures were located on the same wall.

In a two-story slab-on-grade house, plumbing trunks should run between floors, with twigs dropping down to first-floor fixtures and rising up to second-story fixtures. In a home with a basement or crawlspace, trunk lines should generally be located in the floor system to have the shortest possible twigs.

Insulation. Besides increasing pipe lengths, these practices have energy consequences. Water in uninsulated piping loses heat five to 10 times more quickly under a slab than in room-temperature

Figure 4. Pipe insulation prevents heat loss and improves system performance, especially when pipes are located underground or outside the thermal envelope. Wall thickness of the insulation should at least equal the nominal diameter of the pipe.

How To Measure Hot-Water Flow Rates

Knowing the flow rate of each hot-water outlet can help you understand the layout of an existing hot-water distribution system without seeing the pipes. It might come in handy, for example, if you were trying to decide whether an under-sink circulating pump would satisfy a homeowner's complaint about having to wait too long for hot water. Here's how to test the system.

1. Fixture flow rate. Focusing on sinks and showers one fixture at a time, turn the hot tap on full and capture the water for 15 seconds. Measure the volume in gallons (16 cups per gallon), and multiply the result by 4. This is the flow rate in gallons per minute for each fixture.

2. Cold-start volume. Record the time-to-tap at each hot-water outlet. Allow the system to completely cool down after each fixture test (consider testing a different fixture each morning). Multiply time–to–tap by flow rate to get the cold-start volume for each fixture.

3. Hot-start volume. At the sink with the largest cold-start volume, turn the hot water on full, and record the time-to-tap again (it should be similar to the first measurement, but it may not be identical). Turn off that tap and immediately go back to each previously measured hot-water outlet, and repeat the time-to-tap test. Multiply time-to-tap by flow rate to get hot-start volume.

4. Compare results. Fixtures with a decrease in hot-start volumes of 50% or more are on the same trunk line as the sink with the largest cold-start volume. The greater the reduction, the closer the outlet is to the trunk line. Fixtures with two similar wait times are likely on separate trunks from the sink with the longest cold-start time.

air. For this reason, I think it's better to run piping for single-story slab-on-grade houses within the thermal envelope, either in the ceiling framing or buried within the attic insulation. Unless the ceiling will be insulated with blown-in insulation, the pipes should be wrapped with pipe insulation.

Most local codes don't require insulated hot-water pipes unless there is a circulation loop, but they should. When hot-water events on the same twig, branch, or trunk occur between 10 and 45 minutes of each other, insulation significantly lowers the time-to-tap by reducing the rate at which the water cools down. For example, R-4 insulation doubles the cooldown time of ½-inch pipe, and triples the cooldown time of ¾-inch pipe. In addition, insulation reduces temperature drop between the water heater and the fixtures while hot water is being used, regardless of the time between uses.

The 2012 IECC (R403.4) now requires minimum R-3 pipe insulation for most hot-water piping. My rule of thumb has been to size insulation thickness so that it is equal to the pipe's nominal diameter (**Figure 4**). If you're using hardware-store-variety polyethylene pipe sleeves, check their R-value; some ½-inch wall pipe insulation is rated as low as R-2.2.

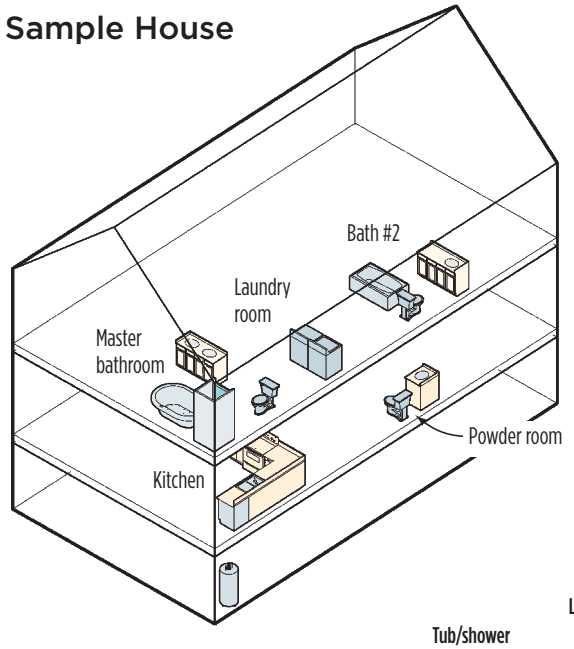
When installing pipe insulation, slightly compress the sections lengthwise and seal the joints at the slits and between sections. (If you use foam pipe insulation that doesn't comes with integral sealing tape, check with the insulation manufacturer for the recommended sealant.) Orienting the slits so that they face down will prevent the sleeves from falling off the pipe if the sealed joints fail.

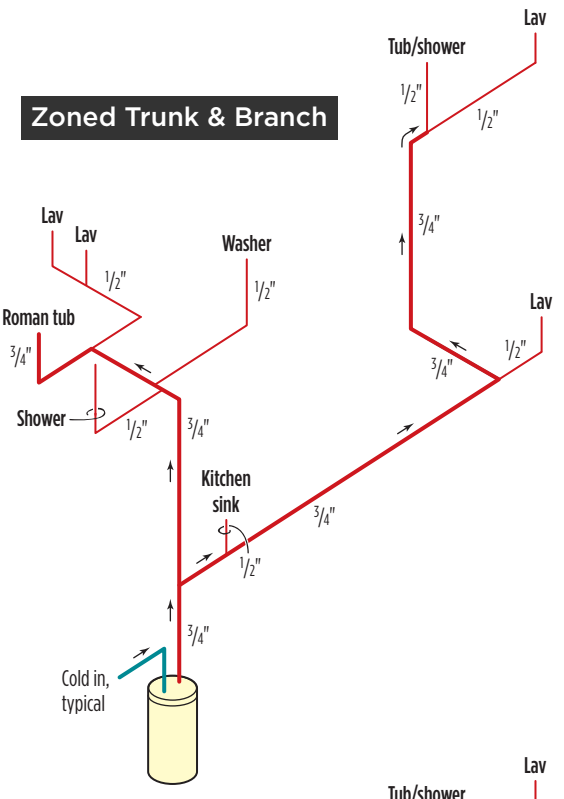
Performance

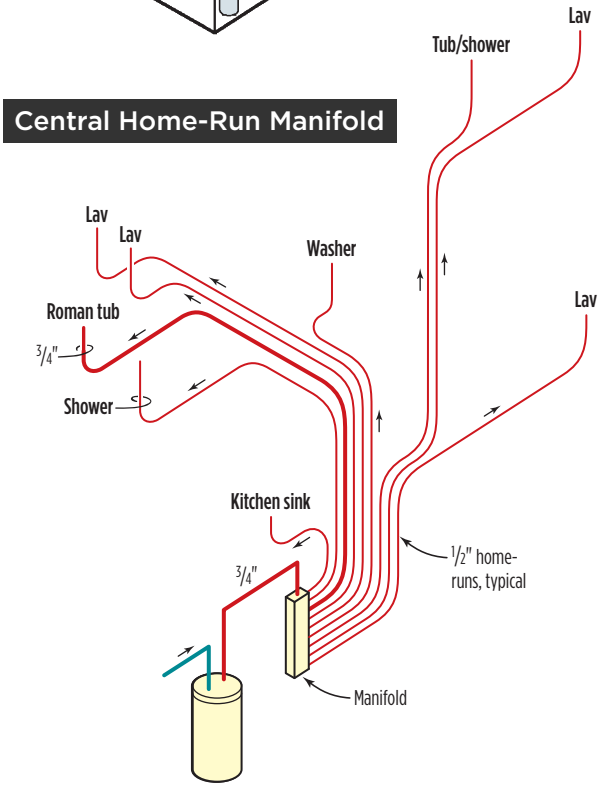
To illustrate the advantages of high-performance distribution piping, I've compared the performance of three different plumbing configurations in the same floor plan (**Figure 5**). In each case, the water heater is located in the same place in the basement, and I've evaluated performance both with and without on-demand circulator pumps. These could be located either at the hot-water heater, which would require a dedicated return line for each zone, or underneath a fixture, in which case the cold-water line would act as a return. (To keep the schematic simple, the pump locations are not shown.)

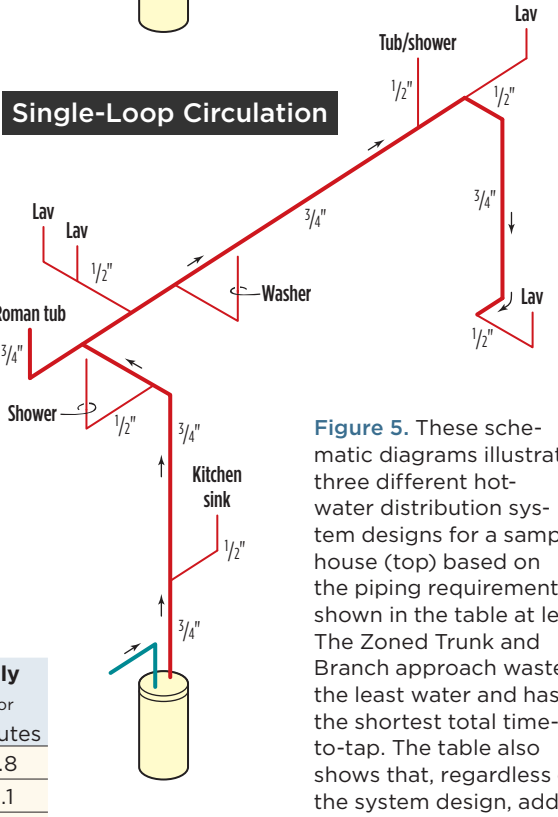
Zoned trunk-and-branch. In our example, the location of the water heater created a two-directional plumbing configuration, with one trunk line going up to the second-floor master bathroom and the other going past the kitchen and powder room on the first floor, then up to Bath #2. Depending on how the upstairs laundry room is supplied with hot water (our example shows it supplied from the master bath), this layout contains about 61 feet of ¾-inch pipe, 67 feet of ½-inch pipe, and 10 feet of ⅜-inch pipe (these are stems from the angle stop to the fixture), for a total of 138 feet. Assuming an average total of 20 daily cold-start events,

Comparing Efficiency in Three Hot-Water System Designs









	Length of piping (feet)				Water and Time Wasted Daily			
					As Shown		With Circulator	
	3/4"	1/2"	3/8"	Total	Gallons	Minutes	Gallons	Minutes
Zoned	61	67	10	138	12	7	1.3	0.8
Manifold	65	259	10	334	23	8	6.6	4.1
Loop	72	53	10	135	19	12	1.7	1.0

Piping for circulator pumps is not included. All 3/8-inch piping is for stems between shutoffs and fixtures. Wasted water and time are estimated based on 20 cold starts per day.

Figure 5. These schematic diagrams illustrate three different hot-water distribution system designs for a sample house (top) based on the piping requirements shown in the table at left. The Zoned Trunk and Branch approach wastes the least water and has the shortest total time-to-tap. The table also shows that, regardless of the system design, adding demand-controlled circulator pumps (not shown) dramatically improves efficiency.

Fittings

Tees, hard 90-degree elbows, and other flow-restricting fittings create friction and add to the equivalent length of piping. For example, a 20-foot length of pipe with 10 elbows is equivalent to 40 feet of straight pipe. Replacing right-angle elbows with wide-radius sweeps **(A)** will lower pressure drop and improve performance. In fact, I've observed that if the radius of a bend is at least 10 times the nominal pipe diameter, water in the pipe behaves as if the pipe were straight (though I don't think this has ever been tested properly).

One of the advantages of PEX pipe is that it bends, so fittings aren't required to make changes in direction. Copper tubing can also be bent, though it's not common practice. In all cases, it's important not to deform the pipe when bending it, which will restrict flow as much as a fitting.

Whenever possible, I try to minimize the number of fittings except for the tees needed to serve branches and twigs. When installing PEX piping, I recommend "outie" expanded PEX fittings **(B)**, which maintain the internal diameter of the piping, rather than standard "innie" insert fittings **(C)**, which restrict flow.

this system performs reasonably well, wasting about 12 gallons and seven minutes per day. However, 12 gallons is about 20% of the daily hot-water volume used by a family of three. With proper use of a circulation pump, waste drops to 1.3 gallons and 0.8 minutes. This is better than the two alternative designs, even when they include use of circulator pumps.

Central home-run manifold. In this configuration, one trunk line runs from the water heater to the manifold, then individual twigs run from the manifold to each fixture. At 334 feet of pipe, this layout uses almost two-and-a-half times as much pipe as the other configurations. (It is likely to have a similar amount of cold-water piping, too.) This system would waste about 23 gallons and 14 minutes per day for cold-start events (6.6 gallons and 4.1 minutes with a circulating pump).

Single-loop circulation. The third configuration consists of a single trunk line that goes upstairs to the master bath, through the laundry room to Bath #2, then down to the powder room; the kitchen is on its own branch. This layout contains a total of 135 feet of hot-water supply pipe, the least of the systems evaluated. However, when operated without an on-demand pump, it would waste about 19 gallons and 12 minutes per day for cold-start events, the second-worst-performing system evaluated. With the pump in operation, waste drops to 1.7 gallons and 1 minute per day, making it the second-best-performing system.

Choosing the best design. Thanks to a compact wet room layout (unusual for a modern house), the zoned trunk-and-branch system performs quite well for both cold- and hot-start events. Splitting the floor plan into zones is a good strategy for reducing the volume of water in trunk lines, but if the plumbing is ever upgraded with on-demand hot-water circulation, it will require separate pumps for each zone.

The central home-run manifold system requires more pipe and does not perform as well as the other configurations evaluated. The biggest drawback to a manifold system is that it is difficult to improve performance significantly without multiple on-demand circulation pumps, one for each fixture.

In this house, the single-loop circulation configuration contains the least amount of pipe (second smallest if the pump is located at the water heater), but without an on-demand pump it actually wastes almost as much water and time as the central home-run manifold system. On the other hand, it would probably be the least expensive system to install, since it contains the fewest feet of pipe and only one pump.

Gary Klein *is managing partner of Affiliated International Management, which consults on water, energy, and carbon-footprint issues.*

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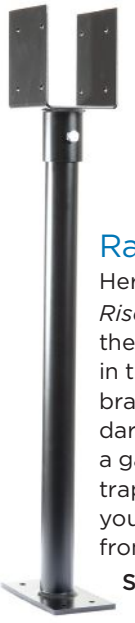
Products

Small and Silent

Getting an exhaust fan to put out just 1 sone of noise (about the same as a quiet refrigerator) at 80 cfm of airflow usually requires a housing too big for a 2x4 wall. NuTone's *LPN80* achieves that level of quiet yet is thin enough to fit in that wall, thanks to a redesigned blower and wheel assembly. The fan's low profile should also provide more flexibility in ceiling installation, where pipes and other utilities may already be in place in the joist bay. The LPN80 comes with two duct connectors — a standard 4-inch oval and an adapter for the 3-inch round ducts found in some older homes — and costs $140.

Broan-NuTone, 888/336-3948, nutone.com.



Raise the Roof

Here's a simple way to add a patio roof cover. *SkyLift Roof Risers* are steel brackets that elevate the patio roof well above the surface of the home's main roof. To install, you cut a hole in the home's roof directly above the exterior wall and bolt the bracket to the top plate. (You seal the hole in the roof with standard pipe-jack waterproof flashing.) The elevated design creates a gap between the two roofs, which pulls in natural light, allows trapped heat to escape, and creates more headroom. It also lets you put more of a pitch on the patio roof. Risers come in lengths from 24 to 36 inches and cost $140 to $200.

Sage Bracket Solutions, 888/759-5488, skylifthardware.com.

Understated Finish

GE's *Slate* finish is an alternative to stainless steel and black for customers who want an appliance with a warm, low-gloss look. It's easy to clean and resists fingerprints. The initial launch includes two French-door refrigerator models, two freestanding gas ranges, two freestanding electric ranges, two built-in dishwasher models, and an over-the-range microwave. Cost is the same as for equivalent stainless models. (For instance, the range shown here sells for $1,100.)

GE Appliances, 800/626-2005, geappliances.com.

Drainable Decking

Weyerhaeuser has added a self-draining feature to its *Edge Gold* flooring panels to help eliminate standing water during construction delays. It consists of three "Down Pore" drainage grooves cut into one end of each panel. According to Weyerhaeuser, the grooves resist clogging from sawdust or adhesives, and allow water to drain even if the panels are not properly gapped. Panels are available in $^{5}/_{8}$-, $^{23}/_{32}$-, $^{7}/_{8}$-, and $1^{1}/_{8}$-inch thicknesses. Prices are the same as for standard Edge Gold panels.

Weyerhaeuser, 888/453-8358, woodbywy.com.

For more information about these products, go to http://jlc.hotims.com.

Products

Touch-Free Reliability

The AC-powered *Sensate* faucet has sensors embedded on either side of the spout curve. Waving an object — a hand, a dish, a utensil — beneath the curve interrupts a beam between the two sensors and turns the faucet on or off. According to Kohler, this technology is more reliable than an electronic eye, which must detect movement. The faucet shuts off automatically if there's a power outage, but includes a manual override. It's available with a polished chrome or stainless finish. A magnetic docking system locks the spray head into place when not in use. Pricing starts at $675.

Kohler, 800/456-4537, kohler.com.

Access Control

Press the top of the pad on Schlage's *Touch Screen Deadbolt* and it lights up for easy use in the dark. The motorized bolt automatically locks and unlocks when the code is entered, and can be programmed with up to 30 four-digit codes. Codes can be tailored to specific times of the day or week, or be used for temporary access. A built-in alarm system tells the homeowner when someone goes in or out, tampers with the lock, or tries to break in. Homeowners who subscribe to the company's Nexia Home Intelligence system can control all lock functions remotely via a smartphone. Cost is around $200.

Ingersoll Rand, 800/847-1864, consumer.schlage.com.

Downsized Programming

Honeywell's new *Prestige IAQ* thermostat is 60% smaller than the company's other programmable models and can control temperature, humidity, ventilation, and fan settings from any Web-enabled device, using a cloud-based app. The thermostat alerts the homeowner when the heating and cooling system is having problems, as well as when it's time to change the furnace filter or humidifier pad. While the final cost is up to the hvac contractor, most homeowners can expect to pay around $300.

Honeywell, 877/271-8620, forwardthinking.honeywell.com.

Solar-Powered Skylight

Velux's *Fresh Air Skylight* has a solar panel that captures available daylight to recharge a battery-powered operator and control system. No wiring is involved — it's operated by a hand-held remote control — and the panel doesn't need direct sunlight. An integrated rain sensor closes the skylight if it starts to rain, but can be overridden if the homeowner wants to keep it open. A 2-foot-by-3-foot unit costs $1,100 (not including the flashing kit) and is eligible for a 30% tax credit. It can be ordered with a factory-installed blind, in which case the skylight and blind will be preprogrammed to the same remote control.

Velux USA, 803/548-3589, veluxusa.com.

For more information about these products, go to http://jlc.hotims.com.

Products

Rotproof Wood

Each door in Masonite's *Lemieux Torrefied Collection* is put through a protective torrefaction process — which means that the wood is heated over time, making it highly resistant to heat, cold, and moisture. The company says the doors can be safely installed without a roof overhang or in direct sunlight. A full range of sizes, species, and designs is available, with varying prices; a two-panel torrefied poplar door costs about $1,075 as a prehung unit.

Masonite, 800/895-2723, masonite.com.

Lightweight Panels

USG has expanded its line of lightweight drywall with *Sheetrock Brand UltraLight Panels Mold Tough.* The panels have the same mold and moisture resistance as standard green boards but weigh only 1.35 pounds per square foot (compared with 1.65 pounds). They can be used as a tile substrate in areas with limited water exposure. Though currently available in only four states (New York, New Jersey, Pennsylvania, and Delaware), they are being rolled out to the rest of the country over the course of this year. Pricing is the same as for regular Mold Tough, or about $12 to $13 for a 1/2-inch-thick 4x8 sheet.

USG Corp., 312/436-4000, theweighthas beenlifted.com.

For more information about these products, go to http://jlc.hotims.com.

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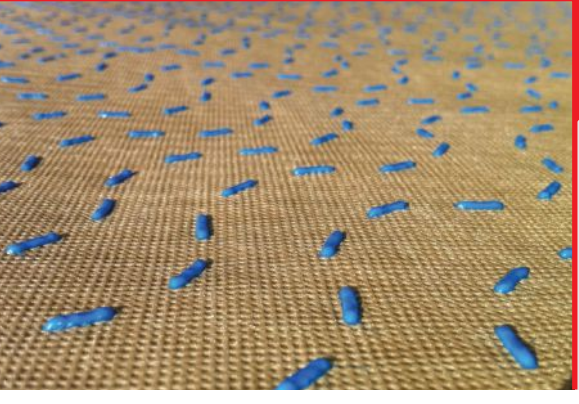

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Quarrix *Composite Tiles* are made from a blend of high-density polyethylene (HDPE), fly ash, and other polymers. Their weight is about one-third that of concrete and clay tiles: 305 pounds per square, or roughly the same as the heaviest asphalt shingles. They come in six colors and can be cut with a standard circular saw. (Carbide blades work best.) Prices start around $425 per square. Hip/ridge rakes, hip starters, and metal closures are available in matching colors.

Quarrix Building Products, 800/438-2920, quarrix.com.

Self-Adhered Housewrap

BlueskinVP is a peel-and-stick membrane that serves as both housewrap and air barrier. Though used in commercial construction since 2009, it is only now coming to the residential market. It requires no fasteners and no taping of seams. You can install it on standard sheathing without any special prep, but if the sheathing is questionable or it's very cold outside, you can buy a liquid primer that creates a stable gluing surface from the same company. A sill flashing product is also available. The membrane costs 60 to 80 cents per square foot.

Henry Co., 800/486-1278, henry.com.

For more information about these products, go to http://jlc.hotims.com.

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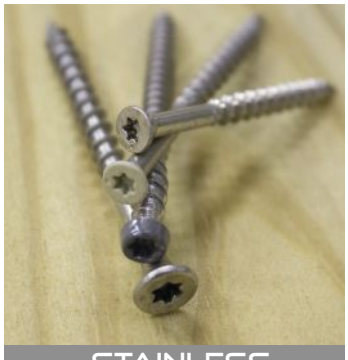

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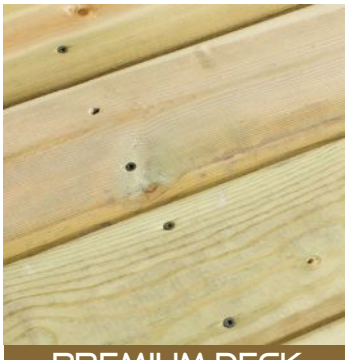

PREMIUM DECK

WWW.CAMOFASTENERS.COM

Makita Cordless Random Orbit Sander

by David Frane

Makita has been on a roll, having recently introduced 18-volt cordless versions of tools previously available only with cords: a sliding compound miter saw, a power planer, and now the LXOB01 random orbit sander. When I first heard about this sander, I couldn't help wondering: Why? The cordless sanders I'd seen before were aimed at the DIY market, and it simply hadn't occurred to me that a company would make one for pros.

A push-button switch starts the tool and toggles through high, medium, and low speeds (the other button stops the tool). The sander takes 5-inch 8-hole hook-and-loop disks.

The dust-collection bag, though not highly efficient, does collect most of the dust. This pile of dust, which I dumped onto the bench after 10 to 15 minutes of sanding, filled the collection bag about halfway.

LXOB01 Specs

Speed: 7,000, 9,500, and 11,000 OPM (oscillations per minute)
Weight w/battery, paper, & bag (by author): 3.9 pounds
Disk diameter: 5 inches
Orbit diameter: 1/8 inch
Price: $280 for the kit; $100 for bare tool
Kit includes: tool, two 3.0-Ah LXT batteries, charger, dust bag, and carry bag

Makita, 800/462-5482, makita.com

Performance

Though I've had the LXOB01 for only a few weeks, I've used it enough to say that it works surprisingly well. It's slightly slower and about a half-pound heavier than comparable corded models (it's based on the BO5031), but it feels very similar in use. When I put a 100-grit disk on the tool and sanded the face, sides, and edges of some rough redwood fence boards, it removed the surface material quickly, and the convenience of not having a cord to deal with partially offset the additional weight.

According to Makita, the tool can sand for 20 minutes at high speed and 40 minutes at low speed on a 3.0-Ah battery. To find out if this was true, I installed a 100-grit disk and timed how long it took to deplete a fully charged battery while sanding redwood at high speed. The tool ran strong for 25 minutes, at which point the motor slowed and made it clear that the battery was just about empty.

When testing cordless tools I'm in the habit of stopping every so often to let motors and batteries cool. This turned out to be unnecessary with the sander — the battery remained cool and the tool never became more than slightly warm. Evidently, sanding doesn't strain motors and batteries the way drilling big holes or driving lags does.

A Secondary Tool

One question I can't answer is whether this tool will catch on. I do most of my work in a shop or in rooms where I need to do a really good job collecting the dust. In those places it's easy enough to use a corded model that connects to a dust-collecting vac, so there's no great advantage in going cordless.

However, I could see adding this sander to my kit as a secondary tool for those occasional tasks where I need to be mobile and am not that concerned about collecting dust — jobs like sanding decks and exterior trim, working from ladders and staging, and doing interior work where I have to cover a lot of ground (finishing up a punch list, for instance).

***David Frane** is the editor of* Tools of the Trade. *This review originally appeared in his blog on toolsofthetrade.net.*

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Toolbits

High End Level

The first thing we noticed about the Sola *MM Torpedo Level* was its heft and solidity. Weighing in at 1 pound, with a solid, powder-coated aluminum frame, it's clearly a tool that will stand up to job-site abuse. It's also extremely easy to read: The top bubble is surrounded by a magnifying lens, and rather than lines, all vials have a clear center space inside wide ink-jet rings. Each vial is embedded in a thermoplastic block glued securely into the housing. The magnetized base ensures a tight grip on metal. (This tool is great for leveling appliances.) It costs about $50.

Sola, 414/471-3883, sola.us.

Compact Band Saw

Powermatic's new *PM1500* 15-inch band saw has a relatively small (30 1/4-inch by 34 3/8-inch) footprint, heavy-duty steel and cast iron construction, and a 3-hp 230-volt motor that delivers a blade speed of 3,100 surface feet per minute. It features a fully adjustable fence and multi-step blade tensioning. The table tilts 45 degrees to the right and 10 degrees to the left. A magnetic switch protects the motor from power spikes and prevents it from starting unexpectedly after a power interruption. A removable magnetic key disables the machine when left unattended. There's a foot-operated braking system for quick blade stops. The machine costs $2,800.

Powermatic, 800/274-6848, powermatic.com.

Portable LP Generator

Generac's new *LP5500* is an LP-powered portable generator that holds a 20- or 30-pound fuel tank. A "PowerDial" mechanism at the top of the housing puts all of the starting and operating controls in one place. The dial has three positions — one to prime the engine, one to run the generator, and one to stop the unit. The priming bulb is integrated into the dial. Runtime is 4.75 hours on a 20-pound tank. The generator costs $800. Unlike gas, LP fuel can be stored indefinitely without deterioration.

Generac, 888/436-3722, generac.com.

Pencil Blade

Here's a unique take on the lowly carpenter's pencil. The *Accutrax Pencil Blade* is a utility knife blade made from graphite. It's not designed for taking notes, as the blade won't take sideways pressure, but it draws crisp, accurate cut lines. You can continue to use it even if it breaks, and it never needs sharpening. A three-pack sells for around $5.

Prazi USA, 800/262-0211, praziusa.com.

For more information about these products, go to http://jlc.hotims.com.

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special advertising section

The Secret Life of Cordless Drills

You thought that cordless drills were just for builders? Here's our top 10 list of ingenious drill-powered solutions to off-the-job-site problems.

1. Trimming cow tails. The Tailwell tail trimmer **(A)**, from the New Zealand manufacturer Shoof International, is guaranteed to handle "even the most daggy tails" with no discomfort to cow or operator.

2. Sharpening pencils. The C.H. Hanson Pro-Sharp beats the daylights out of that wimpy electric pencil sharpener in the office.

3. Wheelchair propulsion. The Simun Power Assist Wheelchair **(B)** gives users a power boost for ascending ramps or other high-effort situations.

4. Disemboweling pumpkins. You probably won't use the Dakota Industries Pumpkin Gutter more than once a year, but it brings much-needed efficiency to jack-o-lantern making.

5. Banishing slush. Depending on the ice thickness, the propeller-drive Slush Copter **(C)** can clean the ice shavings out of 20 to 50 ice-fishing holes on a single charged battery.

6. Lifting heavy stuff. The Pulleyman Winch has a rated capacity of more than half a ton and looks fun to use.

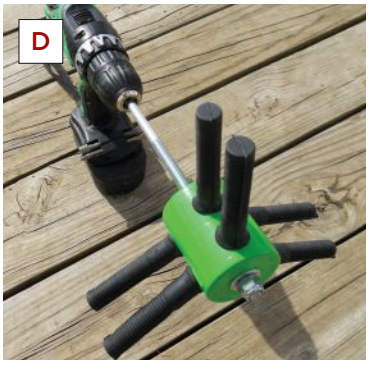
7. Processing poultry. The PowerPlucker **(D)** is said to take much of the drudgery out of plucking chickens, although you'll still have to pull the large wing and tail feathers by hand.

8. Pulling weeds. With the aid of a Turbo Torx Weed Twister, the resourceful gardener can unscrew weeds from the soil rather than yanking them out.

9. Mixing margaritas. The Boatblender, a portable drill-powered blender, would seem to be a must-have tool for attending outdoor Jimmy Buffett concerts.

10. Moving airplanes. If you're fed up with pushing your light aircraft into and out of its hangar by hand, a Minimax aircraft tug **(E)** will ease the job.

—Jon Vara



For links to YouTube clips of all 10 contraptions in action, go to the online version of this article. You can get there by scanning the QR code at left with your smartphone or by visiting tiny.cc/tool-videos.

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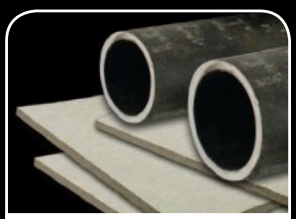

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