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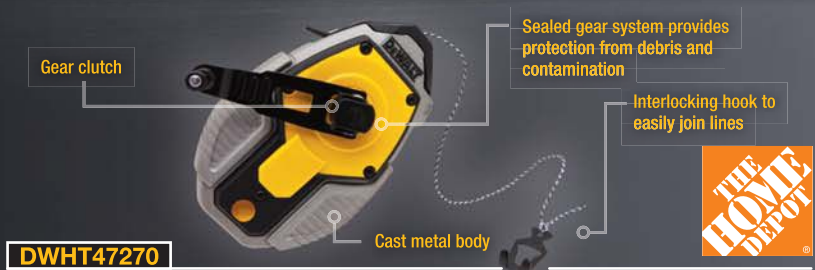
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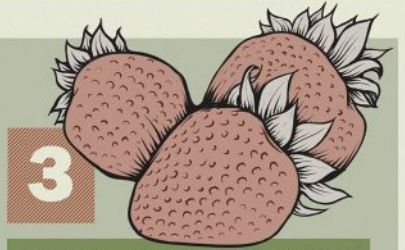


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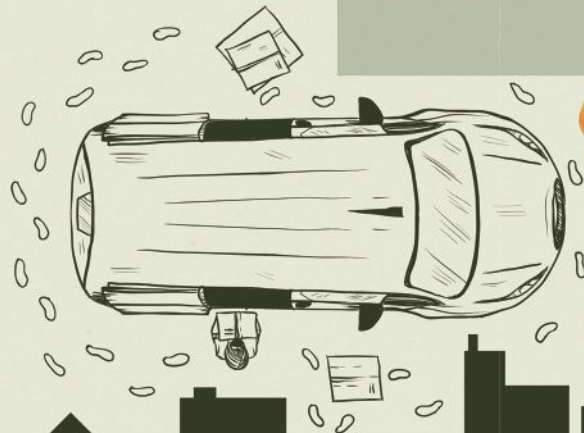
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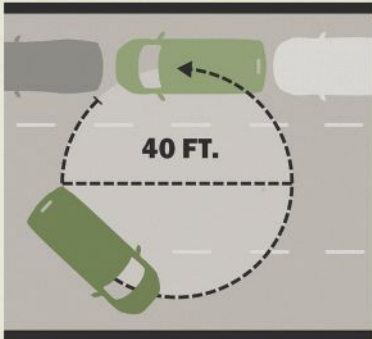
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On the cover: A crane lifts the first of two site-built roof modules into position atop the walls. Building the roof on the ground at this new home site in northern Vermont saved both time and money. Photo by Lee McGinley.

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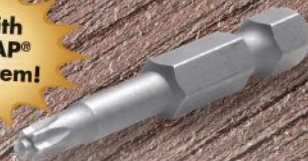


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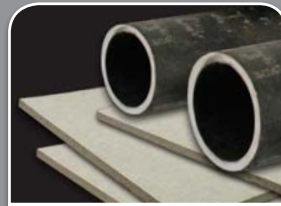
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Reader Feedback

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

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Letters

“New Joists for an Old Floor,” by Emanuel Silva (Feb/14)

I am a remodeling contractor in Seattle and took the time to get certified for the EPA's lead removal. I don't like it, but I try hard to follow the prescribed procedures, and my crew follows my example. I also require all my crew to wear safety gear and am happy to supply it for them.

I was surprised by the article “New Joists for an Old Floor.” Emanuel Silva was working without dust protection to separate the living space from the kitchen remodel, had no ear protection, no respirator, no knee pads, and a pathetic pair of loafers to go with his shorts.

The lath on the wall and the wall cavities most certainly contain lead dust. If the EPA's RRP [Renovation, Repair and Painting] criteria had been followed, all of the lath should have been removed at the time the demolition took place, bagged, and disposed of accordingly. Silva could be exposing himself and anybody he has close contact with to lead, especially children, which is potentially in his clothes and shoes after he leaves the jobsite. He also could pose a risk to the tenants of the house on a daily basis, who may be exposed as dust is carried by air circulation.

My apprentices read my old copies of trade magazines, which provide us with talking points at breaks and safety meetings. Instead of providing the dwindling number of new carpenters with examples of good practice, you have provided them with bad examples. My first-year carpenter immediately responded to the cover with surprise and disdain. He questioned Mr. Silva's methods or lack of them for all the same reasons I list above. —*Paul Stoner, Seattle*

Emanuel Silva responds: Thank you for your response to and your concerns about my most recent article. I am EPA Certified and follow all EPA rules when jobs require it. For this job, the homeowner had done his own demo prior to my work on the floor. When removing the subfloor, I used plastic between rooms to contain basic remodeling dust. The area was tested and the surfaces, including the remaining horse-hair plaster keys between the laths, did not contain lead. In areas, the lath was kept in place because some building inspectors like to see that on walls that will not be altered.

If this had been an EPA job, I would have followed all the rules as you describe them, including removing the

laths. After removing the subfloor, I vacuumed all opened joist bays and removed all debris before I began my framing.

Thank you for pointing out the safety concerns. I try to use appropriate safety wear when needed, but sometimes I don't. I was wearing safety protection eyewear. When I do heavy demo and use machinery, I most certainly use ear plugs and a dust mask, but I find that it's not necessary when doing certain applications such as securing joists. I find wearing knee pads more of a safety hazard when it comes to installing floor joists.

As for my “pathetic loafers,” they are low-cut boots made by Altama (altama.com). They are serious work shoes and I find them comfortable and safe to wear. As for my choice of pants, I use shorts for one reason: When it's hot, I prefer to be comfortable to do a good job. It's not a fashion statement.

Q&A: Best Way to Repair a Hole in a Concrete Slab Before Tiling Over (Dec/13)

I have an issue with Michael Byrne's response in this Q&A. I have used a similar method, and the new concrete rose around the edges, requiring me to come back and grind the concrete back to flush. The patch—about 4 feet square—had warped while curing. That was the last time I did a patch without rebar or other mechanical connection to the existing concrete. I stopped having failures when I made the change.

What you need to do is drill holes in the edge of the existing slab and hammer some rebar dowels into the holes so there is a mechanical connection. You can also drill larger holes and epoxy the pins in place. I have also used blue concrete screws when there wasn't enough room or thickness to use rebar. When you have to drill at an angle, use a “hickey” or rebar bender to bend the rebar down so it is below the surface when you pour the new concrete. —*Gerret Wikoff, Los Angeles*

Q&A: Deck Landing Design (Feb/14)

I wrote the answer for this particular Q&A, and I received a question from the former Rhode Island building commissioner about the deck stair in it. He asked if I was sure that a 40-pound live load was correct. He thought it was greater for stairs.

I checked, and there is something I didn't include. Because some building officials may consider the landing to be part of the stairway, there's a secondary load requirement (IRC Table R301.5 Minimum Uniformly

Distributed Live Loads). It applies to stair treads, but I guess a building official could consider the decking on a landing as the equivalent of a tread.

If the decking on the landing is considered to be a tread, one of two load requirements applies: either the 40-pound live load or a 300-pound concentrated load acting on an area of 4 square inches—whichever produces the greater stress. Four square inches (2 inches by 2 inches) is a pretty small area. I suppose

the 300-pound load occurs where the foot of someone walking on a set of stairs presses on a tread.

If wood-plastic decking is used on the landing, then the landing joists should be spaced at the same distance that the manufacturer of the decking requires for stringer spacing. That distance is product and brand specific for composite decking materials. —Mike Guertin, East Greenwich, Conn.

**“Insulating Cathedral Ceilings,”
by Clayton DeKorne (Feb/14)**

The EPS Industry Alliance would like to provide some comments on this JLC article:

The article makes some inaccurate claims regarding polyisocyanurate (polyiso) and expanded polystyrene (EPS) insulation that we would like to address.

Regarding the section on rigid foam sheathing, the article states that polyiso insulation has an R-value of 6.5. This is not accurate according to ASTM C1289-13 and CAN/ULC S770-09, which list an R-value of ~6 for polyiso. Furthermore, new testing methods developed in 2013 have shown that the R-value of one inch of polyiso is actually 5.62.

This information has been available since June 2013, when the Polyisocyanurate Insulation Manufacturers Association (PIMA) announced they would be updating their QualityMark-certified R-value program to reflect the newest data, which was determined using a new test method for finding long-term thermal resistance (LTTR). The new 5.6 R-value rating was to be incorporated in Canadian and U.S. standards as of January 1, 2014.

The article then goes on to say that EPS is not recommended for roofs. While JLC may not recommend EPS for this application, that is far from the case across most of the construction industry, in which EPS is a proven insulation material in a variety of roofing applications. The wording of this sentence implies that EPS insulation is not recommended for roofs in general and is misleading to the reader. —Tyler Merchant, EPS Industry Alliance

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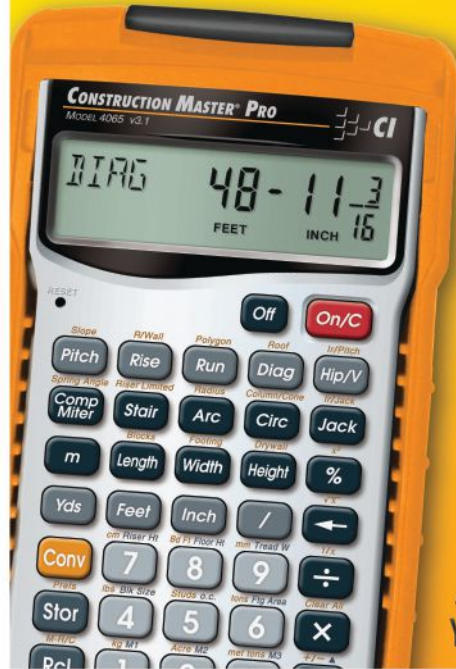
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Q I'm remodeling a bathroom that will need a thick mud floor for a flat, level tile base. It's in an old house and I reinforced the sagging floor with sistered joists and solid bridging. But I'm worried about adding the weight of a traditional mud floor. Could I just lighten the mud mixture with vermiculite and sand?

A Michael Byrne, a veteran tile installer and the moderator of *JLC's* Ceramic Tile online forum, responds: Because your floor construction is not standard, you need to measure both concentrated and uniform deflection before attempting a tile installation. The measurement for concentrated deflection is taken from the subflooring mid-way between two neighboring joists, while uniform deflection is measured from the bottom of an exposed joist located more or less in the center of the whole floor. If there's no access to the joists from below, uniform deflection can be measured from the subflooring, directly above a joist located near the center of the whole floor.

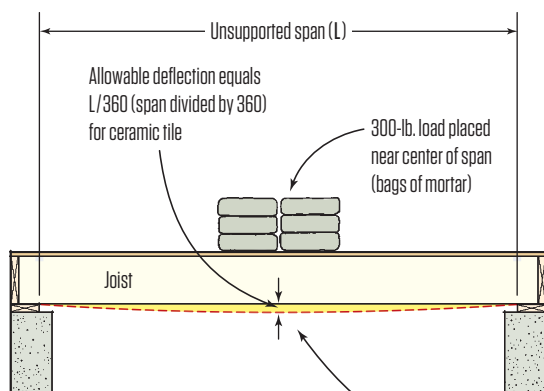
Concentrated deflection should not exceed $L/360$ of the distance (span) between two adjacent joists; uniform deflection shouldn't exceed $L/360$ of the longest span of the whole floor that can be measured. If the deflection is less than $L/360$ of the span (whole floor or between joists), you may safely float a mesh-reinforced mortar bed, according to ANSI A108 specifications for tile.

In the past, I've rigged up a dial indicator for the most precise measurement. But now I use a collimated green laser whose target beam diameter is a bit over $\frac{1}{2}$ inch (1 mm) at 50 feet. For "ballpark" guesses, I use a red beam emitted by a laser pointer or laser measuring device. For your floor, I suggest making at least two or three measurements of uniform deflection and a half-dozen or so of concentrated deflection (see illustrations, below).

I never recommend using vermiculite, because vermiculite mortar has repeatedly failed in compression tests and is not recommended by the tile industry. And, while you may not mind cracked tiles, I'm sure you would be bothered by respiratory diseases caused by the asbestos found in some stocks of vermiculite.

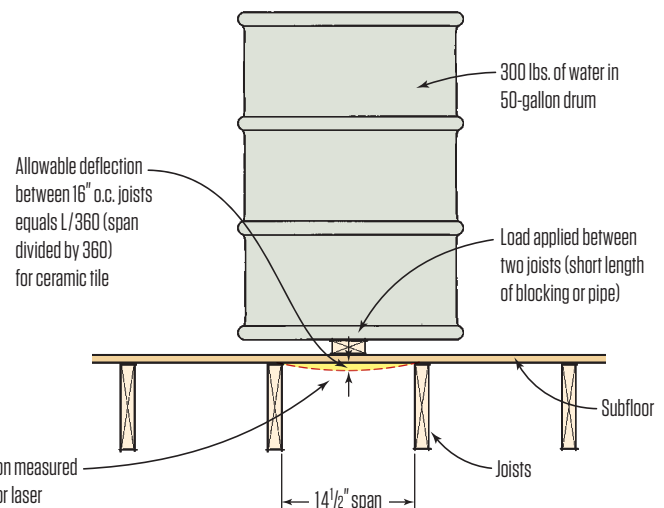
If your renovated floor isn't level, you can use a self-leveling underlayment such as Levellite, made by Custom Building Products. Designed for use with tile, it is 40% lighter than conventional mortar mixes and can be 2 inches thick. The company also makes a lightweight tile thinset called Megalite.

Testing for Uniform Deflection



Amount of deflection measured with dial indicator or laser

Testing for Concentrated Deflection





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Q Are ultraviolet (UV) lamps in an HVAC system an effective way to disinfect the air and improve air quality?

A Jeff May, of May Indoor Air Investigations, in Tyngsborough, Mass., responds: Many of you have no doubt seen UV lamps in HVAC systems. There is a lot of hype regarding these lamps, partly because installers and manufacturers are starting to recommend them as a way to improve air quality and, in some cases, to keep a system clean.

Ultraviolet light is a part of a continuous electromagnetic-energy spectrum. It extends from radio waves, microwaves, and infrared (heat) to visible light, UV, X-rays, and gamma rays. UV waves are more energetic than visible light, but not necessarily detected by the human eye.

UV light is divided into three categories: UV-A, UV-B, and UV-C. Typical black lights produce UV-A, which is not particularly harmful. UV-B is more energetic; these rays (from the sun and sun lamps) cause tanning and are associated with skin cancer. UV-C is more energetic still and is referred to as “germicidal” because it destroys the DNA of microorganisms. Human exposure to UV-C can cause burns, blindness, and cancer. Prolonged UV-C exposure destroys many organic compounds—UV-C literally cooks living things. Fortunately, the ozone layer removes nearly all the UV-C rays from sunlight.

The lamps used in HVAC systems are typically the germicidal UV-C type. You should never look at these lamps directly, so it is very important when observing the interior of an HVAC system that any UV lamp be shut down. Even brief exposure can cause eye damage. Another problem with these lamps is that they can degrade polymers, such as the plastic insulation on wires and the adhesive that holds fiberglass together in pleated media filters.

The idea of using UV-C light to disinfect surfaces and air is not new. Studies were done during the 1930s in classrooms in which shielded UV-C lamps were installed in ceilings (to avoid human exposure) and were found to reduce the spread of German measles. More recent studies have also shown

that (shielded) ceiling UV-C lamps can help disinfect the air in hospital rooms. But are such lamps useful to disinfect the air moving through a residential HVAC system?

The answer to the question is “no” because air moves through the HVAC system quickly—at about 3 feet per second—which is too fast for the lamps to have much of a germicidal effect. To be effective in killing mold and bacteria, the lamp would have to be a few hundred feet long. So it seems misleading that most germicidal lamps for residential use are sold on the premise that they will improve air quality by destroying microbes in the air.

The most effective use of UV-C is for disinfecting surfaces—not air—but not all installations meet this objective. I’ve seen some lamps installed with the shields mounted backward, preventing both airflow across the lamp and surface irradiation. Other UV lamps were far too small, and some produced noticeable amounts of ozone gas (which smells like “fresh outdoor air” but is actually a pollutant in its own right).

Proper commercial UV-C installations most often contain several long lamps, installed so that the entire “front side” of the coil (where dust accumulates and provides nutrients for bacterial growth) is irradiated with enough energy to destroy any microorganisms on the coil. The condensate pan should also be irradiated (but make sure that it’s made from a UV-resistant material). Because nearly all microbial contamination on coils occurs on the front side, irradiating that side of the coil makes the most sense. Irradiating the back of the coil (as recommended by some manufacturers) is not as useful.

Just as the familiar real-estate mantra is “location, location, location,” the HVAC mantra should be “filtration, filtration, filtration.” ASHRAE recommends using at least a MERV-8 filter for all air handling systems; MERV-11 is best for families with allergies. Remember, the most important function of the filter is to prevent the accumulation of biodegradable dust on coils. This is what keeps the coil clean and thus prevents microbial contamination. The use of UV is secondary.

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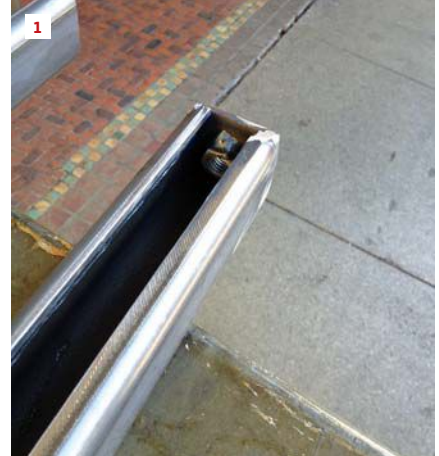
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BY JOHN LATORRE



Building a Freestanding Wall

Several years ago I built a popular restaurant in Sonora, Calif., called the Diamondback Grill. My client, the owner of the restaurant, contacted me at the beginning of last winter. He'd been getting comments from diners about the cold air coming in the front door, so he asked me to build two small half-walls to separate the dining room from the entry area.

The restaurant's interior features a lot of bare steel, and for the room dividers the owner envisioned something simple and streamlined yet strong enough to meet code requirements. We chose a straightforward design: $\frac{5}{8}$ -by-6-inch ipe decking boards stacked between two steel posts to create thin, elegant dividing walls.

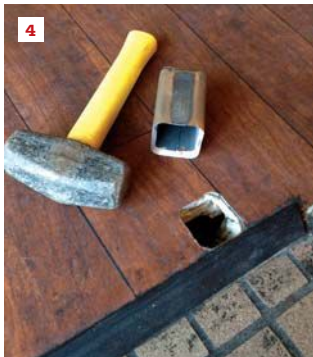
The only catch was that these walls had to be independent structures with no other walls to tie into for rigidity. Fortunately there was a basement below the dining area with good access. So I planned to use the

floor structure to give the posts their strength.

The 2-inch-square tubes made of $\frac{3}{16}$ -inch-thick steel came from Trotter Welding and Steel Supply in Sonora. I mounted a 7 $\frac{1}{4}$ -inch Diablo 48-tooth "Steel Demon" blade on my table saw and ripped a channel in each post, using a short length of the decking to gauge the width of the channel. The blade cut through the steel almost as easily as a regular saw blade cuts through wood.

Cutting steel produces a shower of tiny, very sharp shards exiting at a rather high velocity, so you need to protect your eyes and any exposed skin while cutting. And although the steel "sawdust" is supposed to be warm but not hot, I cleaned out the wood dust from under the table saw before I started cutting the steel, as a precaution against fire. I ripped all four posts—more than 40 feet of rips—easily using the same blade.

I welded a small steel plate and a $\frac{1}{2}$ -inch nut to the



bottom of each post for attachment (1) and used a flap wheel and an angle grinder to remove burrs from the edges of the ripped channels (2). I also smoothed over the welds on the bottom ends of the posts to ensure that they didn't stick out past the edge of the tubes.

To send the posts through the floor with a perfectly tight fit, I needed to cut holes the exact shape and dimensions as the steel tubing. These square tubes have rounded corners with $\frac{3}{8}$ -inch radii, and I could have created the holes by drilling the four corners with a $\frac{3}{4}$ -inch drill bit and then chiseling out the material in between those holes. But to get the closest fit, I fabricated a square chisel from a short section of the tubing. Inspired by hollow chisel mortisers for making square holes on a drill press, I ground and filed the inside of the tube section to create a sharp cutting edge around the perimeter. I welded a plate on the other end so that I could drive it with a hammer (3).

After driving through and removing the top layer of linoleum, I drilled holes just in-

side my initial cut and continued to drive the square chisel all the way through the floor, alternately driving and drilling as necessary (4).

I slipped each post through a finished hole and held it at the proper height using a C-clamp (5). In the basement, my helper bolted a 2x8 block to the bottom of each post. While I kept the posts perfectly plumb with a level, he screwed the blocks to the bottoms of the floor joists (6). The channel in the post was great for running an extension cord into the basement. When finished, I tightened the bolts until the washers slightly compressed the surface of the block (7).

Next came the ipe boards, which I cut about $\frac{1}{8}$ inch short so that they wouldn't bind as they slipped into place. Because I'd cut the channel in the tubing for a friction fit, no mechanical attachment was necessary. I simply slipped the boards into the channels at either end, stacking them on top of one another (8). I cut a slot in the center of each board with a biscuit joiner and used a single

biscuit to keep the boards aligned with one another. I dry-fit the biscuits without glue so that the boards could be removed and replaced easily in the event of damage (9).

I topped each post with cast steel caps from Trotter Welding & Steel Supply, in Sonoma, Calif. (10). These are designed to be welded in place and have a fairly loose fit. But I wanted them to be removable, so I peened the top of each post with a hammer and cold chisel just enough to create a friction fit. I then tapped the caps into place and made sure that they couldn't be removed by hand.

I finished the ipe with two coats of tung oil and left the steel bare to acquire a patina of scratches and a light coating of rust over time. That evening my wife and I were the first customers to enjoy dining in the newly protected area. The walls did their job of fending off the cold and the food tasted better than ever.

John LaTorre Jr. is a carpenter in Tuolumne, Calif.

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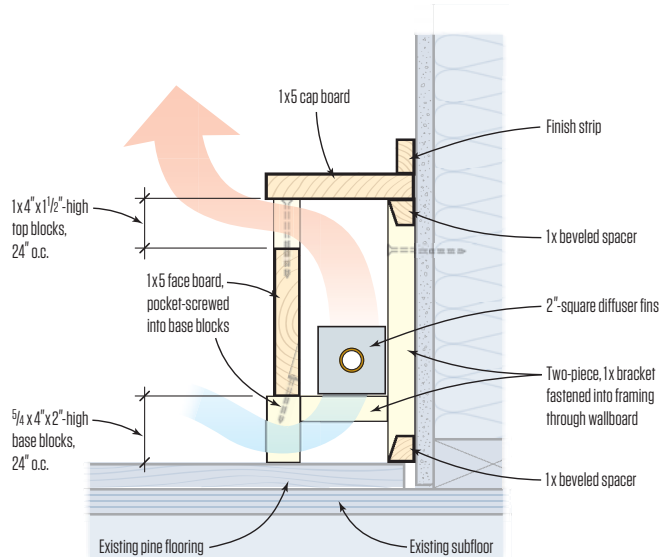
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Wrapping Hydronic Baseboard



Wood Covers for Hydronic Baseboard

BY RANDAL PATTERSON

Recently a friend asked me about making covers for the hydronic baseboard heat in his art studio, located in a converted 1920s barn. When he bought the place, the barn had been used as retail space for flooring products and the walls had been covered with ugly gray carpet glued to CDX plywood—literally wall-to-wall carpeting. When he went to remove the carpet, he discovered that the sheet-metal covers for the existing baseboard heat had been installed after the wall carpeting, so they would have to come out first. The covers were in poor shape, so he didn't reinstall them. Instead he asked me to help him design and build new wooden covers.

Our design for the covers was easy to build and called for stock-size lumber for the major components (see illustration, above). The covers start with simple right-angle brackets made from scrap 1-by-pine that support the heating element. Each bracket consists of an 8-inch

vertical with a 2 3/4-inch horizontal piece glued and screwed to it (2 inches for the element plus a 3/4-inch ventilation space). The brackets attach to the wall with a single screw at the top and are screwed to 3/4 base blocks that are in turn screwed to the floor. Stock 1x5 boards screw to the blocks for the vertical component, with 1-by-blocks screwed to the top edge of the 1x5 to create the top ventilation slots. We also put bevel-edge spacer strips between the brackets: The bottom strip covered the gap between the flooring and the wall, and the top strip served as a cleat to support a second 1x5 board that screwed down on top to complete the cover.

Before beginning the assembly, we made a pile of base blocks and top blocks, each cut to 4 inches and pre-drilled for the attachment screws. The plywood walls in the studio meant that we could attach the brackets exactly where we wanted them. (With ordinary drywall, attachment would be through the wall and into the studs).

Photos: Roe Osborn

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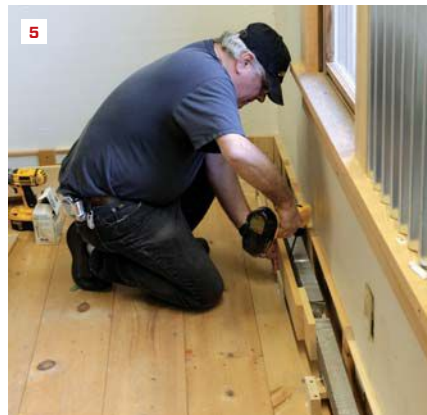
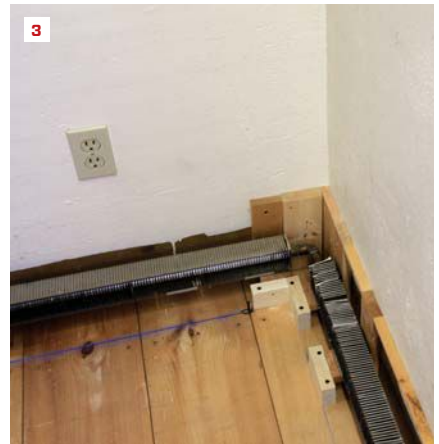
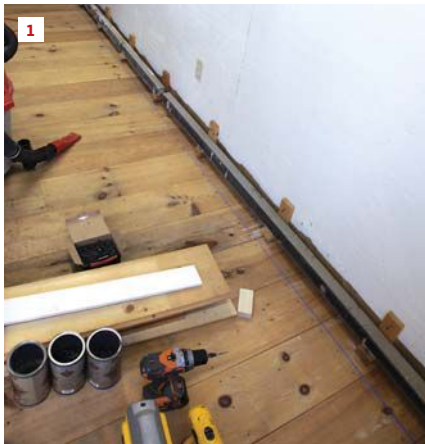
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We snapped a chalk line on the floor to align the base blocks (1), which we spaced 24 inches on-center starting at the end of the first run. After installing the first bracket and base block, we pulled the 24-inch layout to the corner. We put the next block and bracket on the layout and cut spacer strips to fill in to the end bracket. The bracket stock was 2 ½ inches wide, so for the remaining brackets that would fall 24 inches on-center, we cut pairs of strips 21 ½ inches long, which would automatically put the brackets at the proper spacing. Then it was just a matter of screwing each base block to the floor on its layout, nailing in the spacer strips, then sliding the next support bracket over to the strips and screwing it to the wall (2).

Because my friend's studio was in a converted barn, he had established a rustic aes-

thetic of exposed fasteners with unfinished #2 pine trim. So after positioning and installing each base block and bracket, we drove a single trim-head screw through the block and into the horizontal component of the bracket to join them. Where the heater continued onto an adjacent wall, we cut and joined two base blocks at right angles to form a corner with equal legs (3). We had a space of about 4 inches left between the last base block on the layout and the corner, so we used that same spacing to begin the layout for the adjacent wall. From there we installed base blocks and brackets along that wall using the same process as before.

For simplicity, we made the face boards out of 1x5 stock straight from the supply house. Because space behind the corner face boards would be tight, we opted to pre-assemble

them and work out from there. We began by cutting each leg of the corner to a length that would fall between brackets. Then we set both face boards on their base blocks to mark the locations for the pocket screws. After drilling the pocket holes, we screwed the two boards together to form the corner and positioned the assembly on the base blocks (4). To deal with the tight quarters in back of the face boards, we drove the pocket screws into the base blocks using a 6-inch driving bit chucked into a right-angle drill (5). To complete the run of face boards on each side, we pieced in the remaining lengths, joining the boards with butt joints and backer blocks (6).

The next step in the assembly was installing the top blocks. Because they sat flush with the face board below, I opted to

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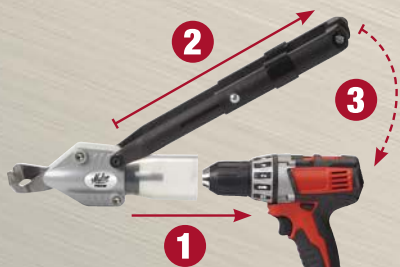
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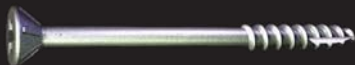
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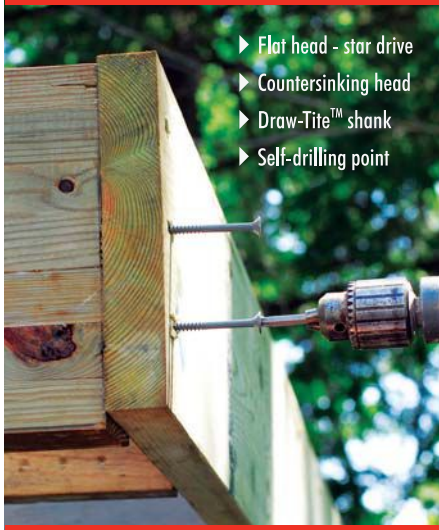


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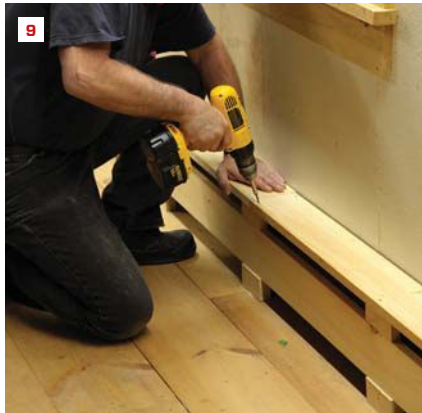
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glue them in place and let the glue begin to set up before driving the screws. (The glue keeps the blocks from moving if the screws start to wander as they're being driven.) I positioned each top block by butting a square against the base block below (7). I glued the top blocks onto both legs of the entire run before going back and securing them permanently with screws (8).

For the cap board, we again started in a corner, joining the lengths of 1x5 with butt joints. But this time we landed the joint over a block and bracket for support. We secured the cap board to each of the top blocks as well as to the top of each bracket along the wall with trim head screws (9), letting the outside edge of the cap overhang the block by ¼ inch. We also screwed the cap to the upper spacer strip between the bracket positions.

We didn't try to scribe the top board to the wavy walls of the barn. Instead, we nailed in a thin finish strip to cover any gaps caused by the uneven walls (10). In the end, we were able to construct around 40 feet of baseboard cover in less than five hours. The heat has been on constantly for almost three months and there has been no wood movement at all.

The design was perfect for this rustic studio, and it would be easy to upgrade the design using just about any type of wood to match a home's interior. But to make baseboard covers with a more finished look, I would seal or finish every surface of the components before assembly.

Randal Patterson is a licensed remodeler who lives and works on Cape Cod.



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Jason Cameron
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BY GEORGE WEISSGERBER

Estimating Using Templates

In my previous two columns (Oct/13 and Dec/13) I discussed in detail how unit pricing items are developed and how using them to estimate jobs can save you time and increase accuracy. Whether you estimate with an off-the-shelf system or using an Excel spreadsheet, most systems today are built around a database of unit pricing items. Depending on your areas of focus, you could have a library of hundreds or even thousands of unit price items that can be used to develop a detailed estimate of the tasks required for any project, from startup to cleanup. All the parts, pieces, and labor will automatically be included even though you're focused on only the quantities of the units.

To carry these efficiencies one step further, I've built templates or assemblies of items into a library of estimates for the typical projects we do. While many folks I know often copy previous estimates that are similar to their current project, I suggest systematically creating a library of estimate templates to help achieve several key estimating goals: accuracy, efficiency, consistency, standardization, and predictability.

PROJECT TYPES

The first step in creating this library is to draft a list of all the typical project types you do, then break down each project type into subcategories that will reduce the number of items you need to address in your estimate.

For example, one project type might be a single-story addition. If you had three templates—one for additions built on piers, another for additions built over a crawl-space, and a third for additions built on a full masonry foundation—you would significantly reduce the time required to complete an estimate. Also, if you were to further break down these templates into typical project sizes—small, medium, and large, for example—you would end up with nine templates for one-story additions that should be representative of any one-story addition project you're estimating.

The lists I use (see samples, left) include both typical projects and separate phases of construction. They are probably a bit more complicated than what you need, because they're designed to be used by several divisions of our company. But the ultimate goal of creating these templates is the same: to make estimating more efficient and more consistent, project to project.

BUILD IT ON PAPER

The second step is to take time to think through your typical project and standard specs. I recommend making a basic sketch for each template that includes dimensions, take-offs, specs, and notes (see samples, next page). There's no need to go into great detail here because no two projects will ever be exactly the same. But having all of this information on paper will make it easier to put together the templates, as well as give you a reference for that time down the road when something changes and you ask yourself, "How the heck did I come up with this in the first place?"

The last step—and it's a big one if you have a long list of projects—is to do estimates for small, medium, and large versions of each type of project on your list. For each project type, start with the "large" template and perform a complete estimate. You should include every line item—with the correct quantities—needed to build the project in its entirety, from start to finish.

Also add a list of items that *could* be part of a similar project, but leave the quantity at "zero" for these. Later,

Section	Section Description
80	DESIGN/BUILD ASSEMBLIES: (CADD "DW")
100	PREP ASSEMBLIES (CADD "DW")
100	PUMP OUT, BAY WINDOW, CORNER, FIRE PLACE, (CADD "DW")
200	DECK, BAMP, PORCH, PORTICO, PERGOLA, (CADD "DW")
400	GARAGE, CARPORT, OUT-BUILDING, SHED, (CADD "DW")
450	KITCHEN, (CADD "DW")
450	Kitchen Main, (CADD "DW")
600	BATH, (CADD "DW")
600	BASEMENT, LAUNDRY, ATTIC, (CADD "DW")
650	COMMERCIAL INTERIOR REMODEL, (CADD "DW")
700	INTERIOR WORK: Floor, wall, cty, door, trim, sheetrock, (CADD "DW")
750	INTERIOR PAINTING/WALLPAPER: prep, patch, painting, (CADD "DW")
800	EXTERIOR WORK: roofing, gables, siding, w/ trim, (CADD "DW")
850	EXTERIOR PAINTING: prep, prime, painting, (CADD "DW")
900	WINDOWS, SKYLIGHTS, BAYS / BOWS, (CADD "DW")
1000	EXTERIOR DOORS, (CADD "DW")
1100	TRAIL PANS* / T & W Siding
1200	Price Book Assemblies by Section
1300	Trail Assemblies

Sec	Def	Assembly Description	QTY	U	PA
80	1	DESIGN/BUILD Assemblies: CADD - DW	1	1	1
80	10	UNIVERSAL ASSEMBLY, (complete database)	1	1	1
80	19	2 sly ADTN, 1,400 s.f., w/ FULL Unfr Barne, CATH-STICK Roof	1	1	1
80	24	2 sly ADTN, 1,400 s.f., w/ FULL Unfr Barne, TRUSS Roof	1	1	1
80	30	2 sly ADTN, 1,400 s.f., w/ 8" CMU CRABL Fndn, CATH-STICK Roof	1	1	1
80	31	2 sly ADTN, 1,400 s.f., w/ 8" CMU CRABL Fndn, TRUSS Roof	1	1	1
80	79	2 sly ADTN, 1,400 s.f., w/ PIER Fndn, CATH-STICK Roof	1	1	1
80	76	2 sly ADTN, 1,400 s.f., w/ PIER Fndn, TRUSS Roof	1	1	1
80	125	2 sly ADTN, 600 s.f., w/ FULL Unfr Barne, CATH-STICK Roof	1	1	1
80	126	2 sly ADTN, 600 s.f., w/ FULL Unfr Barne, TRUSS Roof	1	1	1
80	130	2 sly ADTN, 600 s.f., w/ 8" CMU CRABL Fndn, CATH-STICK Roof	1	1	1
80	131	2 sly ADTN, 600 s.f., w/ 8" CMU CRABL Fndn, TRUSS Roof	1	1	1
80	175	2 sly ADTN, 600 s.f., w/ PIER Fndn, CATH-STICK Roof	1	1	1
80	176	2 sly ADTN, 600 s.f., w/ PIER Fndn, TRUSS Roof	1	1	1
80	225	2 sly ADTN, 200 s.f., w/ FULL Unfr Barne, CATH-STICK Roof	1	1	1
80	226	2 sly ADTN, 200 s.f., w/ FULL Unfr Barne, TRUSS Roof	1	1	1
80	266	2 sly ADTN, 100 s.f., w/ 8" CMU CRABL Fndn, CATH-STICK Roof	1	1	1

These sample screens are part of a proprietary estimating system used by several divisions. One list (left) holds typical project types and phases of construction; each line item in the other list (right) is a separate project.

FLOOR	800 SF	2x10
EXT WALLS	50 LF	2x4
GABLE END	20 SF	2x4
INT WALL	18 LF	2x4
INT GABLE WALL	250 SF	2x4
INT FLOOR	230 SF	2x4
DN WALLS	800 SF	1/2"
DN GATH	400 SF	1/2"
SIDING	800 SF	HDPLK
FIN FLOOR	NIC	NIC
ROOF GABLE	400 SF	2x10
ROOF HP/ VALLEY	150 SF	2x6
ROOFING	860 SF	25 YR F/G

MASONRY FOUNDATION	_____	/SF
CEDAR SIDING	_____	/SF
REDWOOD SIDING	_____	/SF
BRICK VENEER	_____	/SF
VINYL FLOOR	_____	/SF
HARDWOOD FLOOR	_____	/SF
CERAMIC TILE FLOOR	_____	/SF

(A) C15	(1) FKH6066ASR
(B) CXX15	(2) 2/6 6-PANEL H.C.
(C) C15(2)	(3) 2/0 6-PANEL H.C.
(D) P6050	(4) 6/0 CASSED OPENING
(E) AFFA501 (ABOVE)	

- HARD-PLANK SIDING
- 3/4 x 4 FLOOR TRIM
- ALUMINUM BUTTERS/ DOWNSPOUTS
- ANDERSEN WINDOWS/ DOORS WITH STANDARD HARDWARE
- CATHEDRAL CEILING
- 2x4 WALL FRAMING W/ 1/2" SHEATHING
- 2x10 FLOOR JOISTS AND ROOF RAFTERS
- HOLLOW CORE INTERIOR DOORS
- 1 SET OF (4) PANTRY/ SHELVES IN CLOSET
- 3 1/4" 1 PIECE BASE TRIM
- NO FINISH FLOOR
- 6/12 ROOF PITCH

1 - 20 AMP CIRCUIT
1 - DUPLEX OUTLET
1 - 6PI OUTLET
2 - 6PI SW
1 - 3 WAY DIMMER
2 - BURT MTD OUTLET
1 - GLS FAN OUTLET
4 - RECESSED LIGHT
1 - FLOOD LIGHT
1 - PHONE

In addition to creating a drawing and spec sheet, such as the one shown above, for small, medium, and large versions of each project type, the author also creates a complete estimate, including all quantities. Complex projects can be estimated by combining templates—for example, combining templates for a kitchen addition, a powder room, and a laundry.

when you're using this template to estimate an actual project, these "zero quantity" items will serve as "ticklers" that will prompt you to ask, "Do I need this item on this job?"

Once you are happy with the large project template, clone it and revise it to create templates for the medium and small versions of the project. This typically requires changing most of the quantities, but may also result in fewer line items. Zero-quantity items are still useful, however, so keep as many as you think you will need.

When all three templates for one project type are complete, move on to the next project type. The result will be a set of estimating tools that will help you not only to

estimate the obvious, but also to minimize errors and omissions.

TIME SAVER

My database has 6,000 items in it. If I had to scan all of them for every estimate, I would be poor, crazy, and blind by now. If I had only items with quantities in my templates, I would be just plain poor. Having the right zero-quantity items offers a balance between these two extremes.

It takes time to set up a library of templates in your estimating system, but once you have it established, you can then combine two or more templates to create complex estimates: For instance, you can use four templates to estimate a one-story addition

with a kitchen, powder room, and laundry. You will drastically reduce your estimating time, while making fewer errors. And if several people in your company are responsible for estimating, their estimates will be much more in line with one another's.

Finally, your estimates will be more predictable. That makes possible a fantastic "ballpark" tool that produces very accurate pricing in seconds, based on your estimating system. I'll show you how to create this exciting tool in a future column.

George Weissgerber, a senior vice president at Case Design/Remodeling, in Bethesda, Md., developed the company's estimating system and handyman division.



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Oops—Was That 100 Feet or 1,000?

BY ALEXANDER BARTHET

Opportunities for mistakes abound in a construction setting where quantities, prices, and dates are so critical. The consequences depend on whether the mistake is unilateral—made only by one party—or mutual—shared by both parties.

If you alone misunderstand the plans and specs and allow for 100 square feet of tile instead of 1,000, this would be a unilateral mistake. It's your problem without any immediate relief unless you can show that someone intentionally deceived you in some way.

But if both parties to an agreement are mistaken because a document fails to correctly reflect what they each intended, then a court will likely correct the error. For example, let's say that a lumberyard advertises 4x8 sheets of OSB for sale at \$1 each but actually meant to price the sheets at \$10 each. You buy 10 sheets, expecting to pay \$10, but are charged \$100. Who would be right? A case with similar facts held that you, the purchaser, would be right. The store made a mistake in an offer that you accepted, and it's the store that would be out of luck. The law is clear in most jurisdictions that what one party may have *intended* is not enough to undo a deal.

However, if it can be shown that the non-mistaken party actually knew that the other party in the deal didn't accurately understand the terms of the agreement, a court may step in. It may completely cancel the agreement (called "contract rescission"), whereby both parties are no longer bound by the deal and revert back to the position they were in prior to entering into the agreement. Or, if *both* parties misunderstood the agreement, the court may modify it (known as "contract reformation") to correctly reflect the parties' understanding.

But don't count on either of these remedies to save the day. Courts are reluctant to alter contracts, even when the result of not doing so may be disastrous to the party making the mistake. So remember: Attention to detail is equally important before and after contract execution.

Alexander Barthet (alex@barthet.com) is a principle of The Barthet Firm (thelienzone.com), a 12-lawyer commercial law practice focusing on construction-related matters. This article is for informational purposes; it is not intended as legal advice. Consult an attorney before taking any action.



Approving Overtime

BY DOUGLAS DELP

WHAT HAPPENED

To control costs, policy at Good Guys Construction Co. requires prior approval of all overtime by the owner or a supervisor. Recently, when a carpenter's timecard showed overtime hours that hadn't been approved, the company paid those hours at the employee's regular pay rate. When the employee protested, Good Guys cited the company policy.

WHAT THE LAW SAYS

Federal Wage and Hour regulations require that all employees—unless specifically exempt—must be paid 1.5 times their rate of pay for any hours worked over 40 hours in workweek. There are no exceptions based on prior approval. This can place companies in a difficult situation when trying to control overtime costs.

WHAT YOU SHOULD DO

Carefully monitor time worked throughout the week and be certain to modify employees' schedules should they approach having enough hours to qualify for unapproved overtime. Even though overtime rates need to be paid if worked, companies that experience chronic unapproved overtime being worked by their employees should develop a policy that subjects employees to disciplinary action should they work overtime without supervisor approval. These disciplinary actions can include formal written warnings, cuts to future pay, and even termination.

Douglas Delp is founder of The Delp Group (delpgroup.com), which provides human resources, benefits, insurance, and payroll services to small businesses.



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BY DOUG HORGAN



Steep-Slope to Low-Slope Transitions

At my company we specialize in high-end remodels—typically large additions or extensive interior renovations—on homes throughout the Washington, D.C., metro area. We invest a lot of time in our clients, placing a high priority on maintaining relationships. As a result, our past clients continue to call us for years and we end up doing many little projects in addition to big ones—whatever it takes to service those past clients. With this business model, we have to continually train our crews and subcontractors on best-practice details. Training, as well as overseeing the quality of work, is largely my role. In this article—the first of a number of articles in which I’ll discuss common problems we find and the solutions we train on—I’ll look at a troublesome area that frequently gets overlooked: the transition between a steep-slope roof and a low-slope roof.

This is a small but vulnerable spot, and we often see it detailed incorrectly on existing work. Valleys are prone to collecting leaves, particularly if someone sets up an antenna at the base of the valley (1). The lower roof unavoidably slows down water drainage, and when the valley is clogged, a significant amount of water coming down that valley will tend to spread out and back up under the shingles. Wind can intensify the problem, pushing the water upward. Snow tends to pile up here as well, and ice damming is likely. Compared with some other regions in the U.S., the D.C. area may not see that much snow. But we’ve had enough big storms during the last 24 years to make it imperative to detail roofs to manage melt-water and the potential for ice dams (2).

There are two key details for the transition between steep and low slopes: the distance that the lower-roof

membrane laps onto the steeper-sloped roof, and the need for isolation between incompatible materials.

LAP DISTANCE

To protect against water backing up—whether from leaf clogging, ice dams, or even just wind exposure—you need to bring the membrane for the lower roof up about 18 to 24 inches. This is the vertical rise (see illustration, right), which means you are running something like 25 to 36 inches up the roof, depending on the slope (3). Many details call for an 8- to 12-inch vertical, but this just isn't sufficient.

People don't like the look of the exposed membrane, so there is always a temptation to shingle over the lower-roof membrane. In many instances, the lower roof is deep enough that the exposed roofing isn't visible from the ground. But in cases where it is visible, and either the homeowner or an architect doesn't want to see a big exposure, the self-sealing characteristics of EPDM or TPO (the low-slope roof membranes we typically use) will provide some measure of protection. If more protection is needed, to seal around fasteners, we may add a layer of peel-and-stick underlayment. But this leads us to the second issue: the need to isolate incompatible materials.

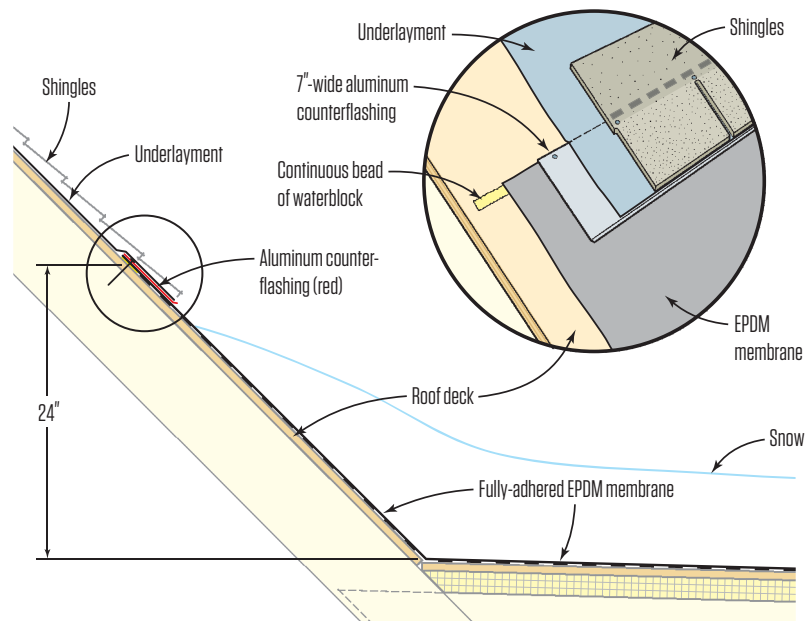
ISOLATION MEMBRANE

At the roof transition shown in photo (4), roofers had installed peel-and-stick over the EPDM lap. They had the right idea, but the peel-and-stick they used was rubberized asphalt, which reacts with EPDM. They also didn't overlap the two membranes enough, so it wouldn't have been long before a significant leak developed along the entire length of the overlap.

EPDM, TPO, flexible PVC, and uncured Neoprene—any of the common roofing membranes for low-slope roofs—are not compatible with asphalt-based roofing, including most peel-and-stick underlayments. We solve this by installing an aluminum counterflashing, as shown in the illustration. If we do need to shingle over the lap, we may add a peel-and-stick membrane, which has a better chance of self-sealing around any fasteners that



Steep-Slope to Low-Slope Transition



might penetrate the membranes.

In the instance shown in photo (5), the installer left the release paper on to provide isolation. The problem with this detail is that I'm not sure what the life of that release paper is—certainly not as long as aluminum's—so this is a middle-road detail, maybe not best practice. But at least there won't be an immediate failure due to the incompatibility of the two membranes.

Photo 5 also shows a sad detail we often

see on roof-top decks—a through-roof railing post. It would have been far better to attach the railing to the sidewall. When we come across a through-roof post and can't persuade the owner to change it, we'll make the best of it. But getting this detail right is a subject for a different article.

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

Photos: Doug Horgan

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Making the Case for Zero-Leak Ducts

Maybe you've heard about the upcoming building code changes that will allow all new residential plumbing pipes to leak up to 6% of their water supply and waste products? A recent court case in Pathetic County, Calif., found that since the Title 24 state energy code allowed brand-new residential HVAC ducted distribution systems to leak up to 6% of total system airflow, plumbers and other trades cannot be held to a higher standard than HVAC contractors. Homeowners receiving mild shocks from their electrical outlets can no longer hold electricians to a “shock-free” standard as long as they don't exceed typical static electricity levels, and framers are soon expected to build almost-as-strong housing using up to 6% fewer nails.

Of course none of the above is true. The mere suggestion of these imaginary code changes is preposterous, but only because we can see, touch, smell, and feel their negative impacts. Aren't the same problems taking place in every home with code-legal duct leaks, and we simply aren't paying any attention to them? With the advent of building-performance test equipment, we've been able to identify and quantify many of the effects of poor installation practices, but we are still installing ducts to a very low standard.

BENEFITS OF A HIGHER STANDARD

Installing ducted distribution systems that fully contain and deliver all of the air that moves through to the intended locations offers many benefits for the builder,

homeowner, installing contractor, and the environment. The builder benefits by earning a reputation for supplying the highest-quality workmanship, which translates into premium prices received for his product. The homeowner benefits by enjoying reduced operating costs, lower maintenance costs, increased comfort, and better indoor air quality. The installing contractor benefits from an easier commissioning process, fewer callbacks, and greater job satisfaction. The environmental benefits from decreased energy consumption and reduced greenhouse gas emissions.

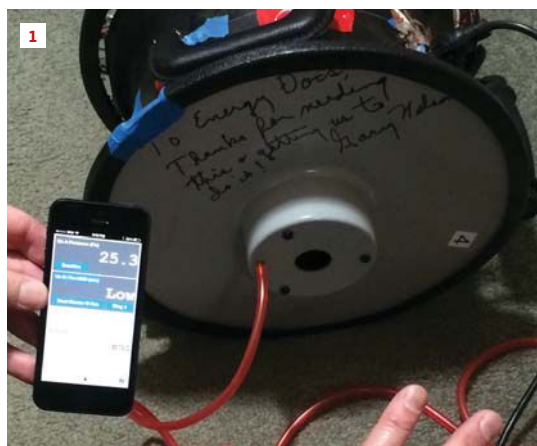
Most contractors I've had contact with have expressed pride in building something better than anyone else. Maybe it's the high-quality finishes, or the granite countertops and stone floors, or the decorative flatwork that sets their product apart from “industry standard” builders (the “other guys”). None of these folks would ever allow their plumbing systems to leak or electrical systems to shock, and they would fire any subcontractors who installed systems that did so. So why is it OK to adopt a minimum code standard of allowing leaks in any system that isn't intended to leak in the first place? I think it's because many HVAC installers don't think they can do it, and builders haven't considered the penalty.

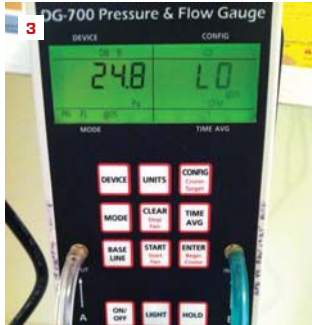
THE RING 4 CLUB

In 2010 I began an unofficial experiment to see what would happen if the ideal target—unmeasurably low duct leakage—was clearly identified to HVAC technicians on replacement duct installations. I was running a local pilot project for deep energy retrofits in which 18 HVAC companies were introduced to advanced home-performance installation techniques. I wondered if we could get near-perfect results from these companies without adding any cost to the project, simply by creating a club of installers who had achieved perfection and whose names were listed online for having done so. To be clear, there was no incentive other than to be listed among the best of the best.

Call it pride or competitiveness, but most companies became determined to achieve leak-free ducts once they realized they would be recognized for their efforts. They simply refused to accept that another company was better than theirs.

1. Until this year, a fourth ring for a Duct Blaster didn't exist. But it was recently released (the one at right is signed by Gary Nelson of the Energy Conservatory). Extreme duct tightness can be verified by an iPhone app that converts the manometer pressure into cfm (the manometer has programming only up to ring 3), reading “Low” to indicate total leaks of 1 cfm or less.





The exclusive membership sought by these companies is called the Ring 4 Club; its only members are those who have supplied proof of installing ducted systems that don't leak. The origin of the name is from the use of the Energy Conservatory's Duct Blaster to measure duct leaks. The Duct Blaster system consists of a calibrated "fan" that connects to the HVAC duct system (2), and a digital manometer that converts pressure readings into volumetric airflow in cubic feet per minute (cfm).

The fan device has a wide operating envelope for measuring very leaky duct systems. When measuring tighter duct systems, you use one of three numbered adapter rings, whose successively smaller holes increase the fan pressure, which provides greater accuracy when measuring smaller leak rates.

When measuring the tightest duct systems, the user installs "ring 3," the one with the smallest hole. This enables the manometer to record leaks as small as 10 cfm, equivalent to about 1% air leakage for a 2 1/2-ton central air conditioning system. When me-

ticulous installers put together ducted systems that leak less than this, the display flashes the word "LO," which is a signal to install the next higher numbered ring (3).

We now have "ring 4" (photo 1, page 41) for the Duct Blaster and have recently instituted the Ring 5 Club as well, for those who can reach "LO" with ring 4 in place.

STANDARD PRACTICES

I'm often asked how difficult it is or how much more time it takes us to assemble ultra-tight, Ring 4- or Ring 5 Club-eligible distribution systems. The answer is that it is no more difficult and takes no more time, and the reason may surprise you. It's because, from the start, our company decided that any leak was too much. We developed standard procedures that make zero leaks an automatic occurrence on every project.

Our crew knows that when metal parts show up on the jobsite, for example, they are wiped down with denatured alcohol in preparation for receiving future sealant. And when supply boots are cut in, they're

caulk-sealed and foamed in place before the crew moves on to the next one (4). All adjustable elbows that are installed anywhere there is a planned deviation from a straight run of flexible ductwork are taped, secured, and coated "nickel-thick" with mastic and left ready for flexible duct installation after curing (5). And all plenum attachments and joints are made with lots of screws and collared takeoffs, using jugs of mastic and reinforcing mesh as needed (6).

Because the parts are methodically installed using appropriate materials, the system simply ends up being airtight. In fact, we would have to think about how to make a system leak, which would take us more time than our standard practices do now. So don't you think it's time for you to adopt a higher standard and reward yourself, your tradespeople, and your customers with excellence?

Mike MacFarland owns Energy Docs, a home-performance contracting company based in Redding, Calif.



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Raising the Roof

For speed and safety, frame on the ground

BY LEE MCGINLEY

My least favorite part of house building? Easy call: the roof. While I enjoy the challenge of working complex layouts—such as skewed roof intersections at different pitches—typical trussed roofs present few intellectual challenges or aesthetic compensations. Given the risks involved with wrestling with heavy materials in high winds far above solid ground, I'd rather pass. Then it occurred to me that my crew and I could eliminate the danger and discomfort of framing and shingling a roof by doing everything on the ground. I was more than a little excited by the idea.

With frigid weather fast approaching our area in northern Vermont, I was also eager to use a method that would save time. And this

particular roof was a good candidate for this somewhat novel approach: Stack the trusses on the ground, sheathe and roof the structure, then lift the whole assembly using a crane. The house was a new two-story, 26x28 with a 20x20 ell, built on a relatively flat site. It had two roof sections, each with a 10/12 pitch and simple trim details; there were no fancy overhangs on the rake or eaves, only flat trim that could easily be installed later while clapboarding the house.

FRAME, ROOF, LIFT

A local crane operator assured me that my project was “doable” and that I need not worry about his equipment distorting the roofs or



otherwise causing them to need remedial work. He told me where to position the roofs in relation to the house to facilitate the hoisting.

I broached my plan to the two carpenters working with me. They were enthusiastic about not having to lug materials and equipment up two stories, and of course the safety aspect was important to them, too. We all recognized that when working in easier conditions on the ground, we would be less tempted to take shortcuts that might compromise quality than we would be when working higher up.

I knew precision layout would be important, but that wasn't a serious concern because my crew consistently frames to 1/8-inch tolerances. Some research led me to the next essential: a roof-truss manufacturer that could deliver a consistent product. High quality was critical because we would need to factor in some "wobble room" so that the trusses could be set atop the wall framing with enough clearance that we could finesse them into alignment.

PREPARATIONS

Trusses ordered, I sourced rough-sawn 4x8 and 6x6 timbers locally. They would be the "runners" on which we would set the trusses (**photo, page 45**). We framed each roof section separately, begin-

ning with the smaller one. The site had a slight downward slope, so I placed one row of the rough-sawn timbers on the uphill side, extending each end about 3 feet beyond the planned length of each roof. I elevated this row about 1 foot above grade using jobsite scraps.

Next, I placed a second row of timbers parallel to the first, spaced 2 feet narrower than the width of the trusses. I tied the ends of each set of timbers together with 2x4s so they would stay parallel. With a helper, I shot elevations and leveled the timbers, keeping to our 1/8-inch standard.

I then snapped a line 4 inches in from the edge of the uphill timbers (**1**). Measuring across to the downhill timbers, I snapped a second, parallel line. These parallel lines, marked out on both sets of runners, served as reference points.

Each set of runners was longer than the length of the roof it would support, so I arbitrarily marked a point 2 feet in from one end of each row on the uphill timbers. From that point, I measured the length of each roof: one at 20 feet, the other at 26 feet.

Knowing the distance between the parallel lines on each row and the length of each roof, I calculated the hypotenuse. Using two tapes, I located a third point on the snapped line of the downhill



row. The fourth and final point was located by measuring the length along the snapped line. I checked my triangulation by beginning at opposite points. Now I had a perfectly square footprint. With eight man-hours invested in setting the timbers and layout, we were ready to frame.

FRAMING

We laid out the trusses along the snapped lines and nailed 2x4 blocks perpendicular to the lines to serve as stops for the trusses to bump against as we set them (2).

Since the smaller (20x20) roof was built several feet from a new garage, we braced the first gable truss to that (3), then set the remaining trusses using Simpson's Spacer Bracers (strongtie.com) at three points along the top chord (4). We aligned the end of each bottom chord 8 inches from the snapped line on the uphill timbers.

We checked for plumb and verified the on-center layout, then nailed on the lateral bracing required by the truss manufacturer (5). Down the middle, I nailed two 2x6 catwalks to facilitate blowing in loose-fill insulation. We also stiffened the assembly by nailing on 2x6s 2 feet in and parallel to the ends of the trusses. Cross-bracing the truss

webs also stiffened the assembly. I checked diagonals along the roof plane on both sides of the roof and they were right on.

The gable-end trusses were the same design as the common trusses so the steel rails used to raise the roof would apply uniform pressure on the roof. The gables were sheathed on the ground, with cutouts where the rails would slide into place. Two-by nailers backed up plywood seams; mending plates were secured behind to strengthen the connection.

SHEATHING BOTTOM UP; SHINGLES TOP DOWN

Sub-fascia was next. Beginning on the smaller roof, we used full-length 20-foot 2x6s to avoid the flexing that might occur with a joint.

I laid the sheathing out from the peak down, which left a 20-inch opening at the bottom of the smaller roof, giving us a grab hole to move the airborne roof into place, as well as allowing room for fastening the trusses to the top plate. Starting 20 inches up from the sub-fascia, we nailed on the first course of 5/8-inch plywood sheathing (6). When we got to the top, we reversed course and shingled from the top down.



Since roofline trim would be installed when the house was clapboarded, I tacked on spacer blocks that simulated the width of the rake trim and eaves fascia before running the drip edge (7), which was nailed in place as we shingled.

We laid out shingle courses from the eaves drip edge so weather exposure would be consistent. We measured down 6 feet from the peak, found the closest layout mark, snapped guide lines—which aligned the top edge of the shingle—and shingled up. The first course of shingles was nailed at the top so we could slip the last course from the next layout group under it before nailing off that course. We repeated the process until we were within a course of the opening at the eaves (8).

Before the lift, we ripped plywood the width of the eaves opening and tacked it onto the roof above the opening so it would be lifted by the crane operator. This way, we could easily reach it from staging on the wall brackets to complete the sheathing and shingling once the roof was up.

We followed the same procedure for the larger (26x28) roof, bracing it to the smaller roof. I was able to source 28-foot-long Douglas fir 2x10s, from which I ripped 2x6 sub-fascia. This eliminated any splices, reducing possible flexing. Drops from the rips were used

for bracing. As a final step, we nailed in place a 2x10 catwalk.

UP & AWAY

On roof-raising day, two cranes arrived at 8 a.m.; one small (10 tons) to set the steel rails, the larger (40 tons) to do the heavy lifting (9). Spectators came as well. Though this home is in the country, neighbors with digital camcorders appeared and passing vehicles slowed to a crawl so that drivers could watch.

The big roof would be set first. Two steel I-beams carried its nearly 3-ton weight (10). Rigging this roof took three hours, setting it only 30 minutes. We had allowed ¼-inch clearance on either side of the wall framing for wiggle room. With two tag lines, we placed the roof with little effort (11).

The smaller roof was hoisted on two 8-inch round pipes (12). Probably due to its lighter weight (less than 1 ½ tons), this roof dodged back and forth before settling down.

By 2:30 p.m. the cranes were finished and we set about doing final tweaks with come-alongs and pipe clamps (13). We nailed hurricane clips to the inside and called it a day, after celebrating with a tiny fireworks display.



The following day we nailed off the ripped sheathing and shingled the eaves. It took about 12 man-hours total for two men working together to flash the smaller roof to the gable end of the larger roof section, despite the 20°F temperature.

BOTTOM LINE

Building the roof on the ground was both a time and money saver (see Cost Comparison, right), not to mention the added sense of security it gave us.

Had we elected to frame and shingle the roof in place, we would have sheathed the gable end trusses on the ground and lifted all trusses into place with a crane—a full day’s work for a three-man crew and crane. Getting the materials up there would have required two weeks’ rental of a Lull with a 56-foot reach, about \$900 per week, plus delivery.

I’m beginning to like roofs again—as long as I can build them on the ground.

Lee McGinley is a Certified Passive House Tradesperson who designs and builds high-performance homes. He lives in Addison, Vt.

COST COMPARISON

Three carpenters worked 2.3 weeks (306.5 worker hours) to build the roof on the ground, lift it into place using a crane, and finish up by nailing down the pre-cut sheathing and shingling the lower section.

Here’s the breakdown:

1. Prep (set and level timbers, lay out trusses): 18 hours
2. Set trusses on timbers (includes bracing, sub-fascia, and sheathing): 80 hours
3. On-ground shingling (place drip edge, shingle, apply ridge cap): 60 hours
4. Sheath gable ends (frame up, cut and secure sheathing, attach mending plates): 32 hours
5. Staging setup on house walls: 11.5 hours
6. Crane prep and roof-setting (includes one day of tweaking after setting roof): 30 hours
7. Nail off ripped sheathing fill-ins at eaves: 12 hours
8. Fill-in shingling (shingle at eaves and install step flashing where small roof meets main house): 47 hours
9. Staging take-down: 16 hours

The extra tasks we would have had to complete had the roof been built in place:

1. Material handling: We would have had to move sheathing and shingles into place, either by hand or using a Lull. Although the site only sloped a bit (3 feet over 28 feet), a 56-foot Lull would have been needed to reach the ridge and a two-week rental would have cost \$900 per week plus a \$150 delivery and pick-up charge.
2. Up and down: To access the work area, we would have had to climb stairs, then ladders to get to the roof.
3. Daily setup, breakdown time: Lugging pneumatics and compressors to the second floor would have added two to three worker-hours daily.
4. Slower pace: While my crew works efficiently and anticipates tasks, the cutting and passing back and forth of materials and equipment—think pneumatic hoses—would have slowed us down.

The one task that would have taken less time if we had framed in the conventional way was sheathing the gable ends on the ground and installing the louvers. We would have used typical gable end trusses for this. I’m guessing it would have taken three of us four weeks to build the roof in place. Add the additional labor and Lull charges (but subtract the crane charges for lifting the roof) and my extra out-of-pocket expenses for building on the ground would have been north of \$4,000. —L.M.

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FLASHING



Flexible Flashing Tips for getting the most out of these useful products

BY CHARLES WARDELL

When *JLC* published its primer on flexible flashings a decade ago (“Choosing Flexible Flashings,” Jun/01), these non-metallic, self-adhered membranes were just becoming common on jobsites. Today, they’re everywhere. They have all but replaced felt splines for the edges of finned windows and are now the standard for sealing most other roof and wall penetrations. Ease of use is a big reason: All of these products work well on flat, two-dimensional surfaces, and accordion-style membranes such as DuPont’s FlexWrap or Typar’s Flashing Flex will conform to three intersecting surfaces, such as the corner of a window opening.

Manufacturers have made it a priority to teach contractors how to use these products correctly, and their websites offer photos, videos, and animations on proper installation techniques. This magazine has published several articles on the subject, and the annual *JLC* Live show always includes demonstrations of how to flash windows and doors properly. But despite all this effort, experts still see lots of mistakes and misunderstandings in the field—about the materials and key installation details. This article addresses some of those common misconceptions.

The 2001 article went into detail on the chemistry behind flexible flashing products as well as the choices available. The



manufacturers we interviewed confirmed that those basic formulations haven't changed much since that article. So we will quickly review the three main product types and then look at a few installation issues that warrant close attention.

THREE PRODUCT TYPES

Flexible flashing for residential work is available in thicknesses from 12 to 70 mils, in widths from 3 to 36 inches, and with several types of facings. Despite this variety, the products can be broadly categorized into three main types: rubberized asphalt, butyl, and acrylic. Manufacturers offer some different formulations and enhancements (for instance, one tape combines butyl and acrylic), but the general performance expectations are the same within each category.

Rubberized asphalt (RA). This is the most common and least expensive type of peel-and-stick eaves flashing (1). One face is laminated to a high-density polyethylene backing while the other is covered with release tape. The asphalt is chemically modified to make it more elastic, allowing it to expand and contract with the substrate. RA is a great all-around flashing material and it sticks to a variety of substrates. It's also self-healing, which means it's supposed to seal around fasteners driven through it.

One drawback to RA is its narrow range of application tempera-

tures when compared with other flashing types. Depending on the product, it can stiffen in cold temperatures, making it less likely to adhere properly. Some manufacturers advise warming the product before using it when temperatures fall below 55°F, but installers tell us that problems occur mostly below 45°F. Flashing can be warmed with a heat gun or by putting it in an ice chest with an incandescent bulb (be careful not to overheat the tape or set it on fire).

At very high temperatures, such as you might find on walls exposed to constant summer sun (180°F temperatures are not unusual for walls in the South and Southwest), RA flashings can soften and lose adhesion. James Katsaros, R&D team leader at DuPont, told me that solvents from the asphalt have been known to leach out and stain the siding.

Long exposure to UV light has also been known to cause adhesion problems for RA flashing. Because of this, asphalt-based flashings should not be left uncovered for more than 30 days after application. But that said, Bill Rose, senior research architect at the University of Illinois and author of *Water in Buildings: An Architect's Guide to Moisture and Mold*, put two layers of RA flashing on a small flat roof 20 years ago and so far it hasn't leaked. That's not to recommend uncovered RA flashing, but rather to show the durability of high-quality products.

Butyl rubber. Compared with RA, butyl flashings are considered

Photos: 1, courtesy W.R. Grace; 2, courtesy DuPont



- 1.** Rubberized asphalt is self-healing and sticks to a variety of substrates, but may not be stable at temperature extremes.
- 2.** Butyl flashing has a wider temperature range than RA and sticks to more materials. Accordion-style butyl flashings can stretch at the corners of openings.
- 3.** Solid acrylic flashings are designed to bond to substrates at the molecular level. They make the firmest bonds at the widest range of temperatures, according to some experts.
- 4.** Some flashing manufacturers require an adhesive primer on certain substrates, the most common being gypsum sheathing, masonry, and the rough side of OSB. Primers come in spray-on and brush-on varieties.

to be of higher quality, and their prices reflect that **(2)**. Butyl is a synthetic rubber used in many applications, including spacers for insulated glass. Butyl flashings are made by laminating the butyl rubber compound to a polyolefin-based film. Unlike RA flashing, butyl products contain no solvents or VOCs (volatile organic compounds), and they do not off-gas. They are supposed to be self-healing like RA, they stick better to a wider variety of materials, and they have better long-term stability. Butyl tapes can also be installed at lower temperatures than RA. DuPont's Flashing Tape, for instance, can be laid over a bare substrate at temperatures as low as 25°F; any colder and you'll need to use an adhesive primer.

Acrylic. These products, which consist of an acrylic adhesive and various backings, are thinner than rubberized asphalt or butyl membranes **(3)**. Acrylic also makes for a better adhesive bond with many (but not all) materials, so it is sometimes used as the adhesive layer for butyl or RA.

The best acrylic tapes use a VOC-free solid adhesive that makes a molecular bond to the substrate. According to BuildingGreen.com, "Solid acrylic adhesives can form the strongest adhesive bonds at a wide range of temperatures and even achieve adhesion to damp or wet substrates." ProClima's Tescon and Huber's Zip System tape are examples: ProClima claims that its product can be applied in temperatures down to 15°F, while a Huber contact said that the company's tape has

an application temperature range of 20°F to 100°F.

Some acrylic tapes are pressure-activated. ProClima's Tescon Vana tape, for instance, feels as sticky to the touch as butyl or RA, but if you don't pressurize it, it won't bond. In an improvised test, I needed to apply firm pressure (I used a roller) to the tape in order for it to strongly grip the substrate.

Acrylic flashings are warranted for longer UV exposure than are RA products. ProClima has a 90-day warranty, while Huber offers a warranty for nine months of exposure.

ENSURING COMPATIBILITY

The big issue with flexible flashings has always been compatibility. Manufacturers have tweaked their formulas to address this, leading some contractors to believe that you can use any flashing anywhere. Not so. "Compatibility is still the No.1 issue," says Train2Build.com's Bill Robinson, who teaches builders about how to prevent moisture problems. There are two parts to flashing compatibility: how well it adheres to the substrate (the sheathing, the housewrap, or window fins), and whether it has an undesirable chemical reaction with that substrate.

Contractors report sometimes having problems with some butyl flashing sticking to asphalt products; manufacturers, however, say that this is not an issue, and certainly not with felt paper.



5. Compatibility is a big issue with flexible flashing, so make sure that the flashing is compatible with all substrates it will contact. The safest route is to use a flashing and housewrap made by the same manufacturer.

6. Certain caulks and sealants may be incompatible with particular flexible flashings. Silicone products, as shown here, should not be used with any type of flexible flashing.

7. This photo was taken on a jobsite in Denver, four to six weeks after installers had done their work, and the flashing is already failing. Incompatible with the vinyl window fin and the sealant, the rubberized asphalt flashing is pulling away from the window.

Putting acrylic tape on an asphalt substrate is theoretically OK if the surface isn't too oily, but that's not always possible to determine in the field. Even felt paper can be a problem. I put rubberized asphalt, butyl, and acrylic tape on 15-pound felt and rolled them to make a bond. After waiting a half-hour, we tried to pull the tapes off and found that the acrylic tape came off relatively easily, while the other two put up a real fight. We could remove only about half of each piece of asphalt and butyl tape.

Some substrates are problematic for all flashings. These include masonry and gypsum sheathing. "Their surfaces are loosely bonded, so the flashing products have nothing to stick to," says DuPont's Katsaros. Most flashings also have a tough time grabbing onto the rough side of OSB. The solution in all cases is to use an adhesive primer (4). Primers come in brush-on and spray-on forms, and they do maximize adhesion. While they're more common on commercial jobs than on residential ones, there should be a can of primer on every jobsite.

Windows. RA flashings shouldn't be installed over flexible vinyl because the plasticizers in the vinyl can cause the asphalt to flow and make the flashing lose adhesion. In some cases, a reaction with the flashing can make the vinyl brittle. This doesn't seem to be an issue with rigid PVC window flanges, but window manufacturers detail compatibility issues in their installation instructions or on

their websites, so it's a good idea to make sure you're using the proper flashing for the windows you're installing.

Two examples are Ply Gem, which uses rigid vinyl fins, and Marvin, which uses flexible vinyl fins on its fiberglass windows. Mark Waddell, an installation and applications specialist with Ply Gem, has no problem with high-quality RA flashing. Marvin, on the other hand advises against using any asphalt-based adhesives with its products. "We say that any tape used with our windows must not contain asphalt," says Eric Klein, an installation trainer with Marvin Windows and Doors. The company recommends butyl, which is compatible with nearly all substrates.

WRB issues. The other part of compatibility is how the flashing tape will interact with the rest of the weatherization system. "In my opinion you can't address compatibility without considering the weather resistant barrier [WRB], as well as any caulks and sealants that will be used," Robinson says.

Although some installers buy a mismatch of products based on what local suppliers carry, most WRB manufacturers will honor their warranty only if their product is installed with the recommended flashing, usually one made by the same manufacturer (5). The WRB and tape are formulated for maximum adhesion and to eliminate compatibility problems. "The easiest way to sort it out is to go with a company that provides a line of products that are its



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own,” Robinson says. “DuPont, Fortifiber, and Protecto Wrap are three examples, but there are several others.”

Of course, some products aren’t sold as part of a system. “I’ve seen manufacturers come out with a new WRB but not recommend a compatible tape,” Robinson says. In these cases it’s up to the builder to decide if it’s worth the potential liability.

Sealant compatibility. Where sealants must be used, such as around windows and doors, flashing manufacturers may also specify which sealants are acceptable. For instance, some asphalt-based flashings can react with the solvents in some caulks and sealants in a way that compromises the seal, so it’s important to follow the recommendations of the flashing tape manufacturer.

The high surface tension of silicone caulk makes it a bad choice to use with even the best flashing tape (6). “The silicone surface is just too slick,” says Floris Keverling Buisman of 475 High Performance Building Supply, which is the U.S. importer and distributor of German-based ProClima flashings. Klein, from Marvin Windows, has come to a similar conclusion based on his own field-testing. “I did a test using a silicone sealant with an asphalt-based flashing and a flexible vinyl window flange,” he says. “It failed in a very short time.”

The bottom line? “Builders need to do their homework before deciding which products to use,” says Ply Gem’s Waddell. “If you

want to stay out of trouble, you need to look at the type of window, the housewrap, and the sealant as a system (7).”

MOISTURE ISSUES

Most tapes are impermeable, so they can form a wrong-side vapor barrier on the outside of the structure, causing vapor to condense behind them and eventually damage the material underneath. And if there’s a leak, an impermeable tape could, under certain circumstances, force the building to dry inward, something that can be difficult to do in winter.

It’s not common but it can happen, especially in cold climates. Some installers will put wide flashings beneath the siding where there’s a concern about splash-back, such as at inside corners. But doing so increases the chance of problems if there is excess moisture migrating out from inside the house. One option is to use a vapor-permeable tape such as ProClima’s Tescon, which has a perm value of 8—roughly the equivalent of latex paint. Siga’s WiGluV acrylic tape is vapor-permeable but is impermeable to water. When used around windows and doors, it keeps the weather out but allows moisture from inside the house to readily escape (8).

INSTALLING IT RIGHT

When it comes to installation, every little detail counts. Bill Leys

Photos: 8, Roe Osborn; 9, Mark Lullberer; 10, courtesy DuPont



8. Vapor-permeable tapes keep the weather out, but allow vapor from the interior to pass through. Here the white vapor-permeable tape goes between the window and the opening, which is wrapped in black acrylic tape.

9. This is a good example of a common installation mistake called reverse shingling. The flashing incorrectly laps over the Tyvek (rather than vice versa), and jamb flashing incorrectly laps over the head flashings.

10. Flexible flashing stretches to seal around circular windows in a single pass. The housewrap then extends over the flashing.

11. Even the best tapes won't work well when they have been in contact with a surface that is dirty or full of sawdust.

of Central Coast Waterproofing, in San Luis Obispo, Calif., discovered this after a homeowner who had just bought an 11-year-old home for \$1.4 million called him about a leak. The inspector hadn't found any major issues, but when Leys' crew looked further they found \$110,000 worth of water damage. Water had run down through the structure from the roof to the foundation, causing extensive rot. The culprit: a stucco-clad parapet wall on the roof deck that had been waterproofed with rubberized asphalt flashing. The contractor had stapled stucco paper through the flashing and, over time, water had seeped through the staple holes, even though the flashing was supposed to be self-healing.

"A lot of guys don't really understand how the smallest details can cause the biggest problems," Leys says. "They do 90% of the job right but screw up on the small details that will cause problems a few years down the road."

Bill Rose points out that these small details were much less problematic in older structures with drafty assemblies that dried out more quickly, but that today's building assemblies are less tolerant of error. "People may have gotten away with poor geometry in the past when the building was overheated and poorly insulated," he says, "but that's not the case anymore."

The most common mistakes—the places where installers need to pay special attention—are improper sequencing of flashings, im-

proper cuts, poor surface prep, and not properly seating the flashing on the substrate. Such problems are most likely where builders assign flashing work to the least-experienced crew members or to subs. For instance, plumbers, electricians, and HVAC contractors are sometimes responsible for flashing the holes they make in the building envelope, but few do it correctly.

Improper sequencing. Everyone we spoke with named improper sequencing, or reversing the layers of flashing, as the most common mistake seen in the field (**9**). That came as a bit of a shock: You would be hard-pressed to see anyone installing lap siding upside down because they understand that, absent very high winds, water flows downhill. But it seems that understanding sometimes evaporates when it comes to flashing. "I see a lot of gravity-defying flashing details where the upper layers go under the lower layers," says Paul Eldrenkamp, a Newton, Mass., design/builder and frequent lecturer on moisture-related issues.

One common problem area is the curved-top window. It's not unusual to see an installer piece in flashing on one side and work to the other, instead of working from both sides and meeting at the top. Half-circle windows are a great place to use flexible accordion-style flashing, which will follow the curve of the window from one side to the other without interruption (**10**). The trick then is to get the WRB properly installed over the flashing.



12



14



13

12. Small staple penetrations in a supposedly self-sealing flashing used on a rooftop parapet wall started to let water through. Just 11 years after the home had been built, the wall below that flashing had completely rotted out.

13. Although some installers use hand pressure to seat the flashing to the substrate, most flashings need to be rolled using a J-roller for proper adhesion.

14. For places that are hard to get to with a roller (such as inside corners), use the butt of a cedar shingle to press the flashing tape firmly against the substrate on both sides of the corner.

Most likely, installers rely on the adhesive to provide waterproofing. Bad idea. Flashing details should provide 100% mechanical drainage paths so that they shed water even if the adhesive fails. High-tech materials are no substitute for good installation details.

To be fair, improper sequencing isn't always obvious with flexible flashings. For instance someone might follow the correct sequence and flash the sides of a window before flashing the head, but allow the side flashing to extend up past the head flashing.

A good antidote to improper sequencing is a simple shift in mindset. Carl Hagstrom, a Montrose, Pa., contractor who does a lot of writing and training on proper flashing techniques, points out that people are far more careful when they're flashing roof penetrations. "I tell people to stop thinking of a window or door in a wall and instead think of it as a skylight. When I say that, the light bulbs go off. They pay a lot more attention."

Improper surface preparation. Regardless of tape choice, installers must pay attention to surface conditions. "It should go without saying that the substrate needs to be clean and dry, but it seems that not everyone gets this," writes Joe Lstiburek of Building Science Corp. "With tapes, the biggest single problem is folks thinking they can stick them to muddy, dirty, cold, wet, and frozen surfaces (11). You would think this is obvious. Amazing as it seems, folks keep trying to do it."

As mentioned, there can be adhesion problems with the rough side of OSB—even if it's bone-dry and clean—as well as with gypsum and masonry-based substrates. The best solution is to apply a primer, which will fill in any irregularities in the substrate and will provide extra adhesion. Flashing manufacturers have primers designed to work with their flashings.

Poorly placed fasteners. Just as it's foolish to rely on adhesion for waterproofing, the self-sealing properties of peel-and-stick flashings shouldn't be considered primary protection, as Leys' client found out the hard way. Fasteners should not be driven through the flashing in areas where water could collect, as in a windowsill (12).

Not rolling. Some installers give too much credit to flashing's adhesive abilities and simply lay it on the surface and press it on by hand instead of going over it with a roller (13). But the truth is that all flashing needs to be rolled in order to properly adhere. "This is a big problem," Robinson says. "You can't just use your hand to smooth it on. I use a J-roller to mash it onto the substrate." He suggests using a rubberized roller, as the metal ones can puncture or rip the membrane. And if you need to ensure adhesion in an inside corner, the square butt edge of a shingle can take the place of a roller (14).

Charles Wardell is a freelance writer and a contributing editor for JLC based in Tisbury, Mass.

Photos: 12, Bill Leys; 13 & 14, Roe Osborn



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FOUNDATION



Old House, New Foundation Lifting and resupporting an early-1800s home on a tight site

BY FRED AND EZRA AMBROSE

Our design/build company performs a wide variety of building services. We're equipped to handle every aspect of new construction and remodeling, including house-lifting and foundation and septic-system installation, as well as framing and finish carpentry, all in-house.

In September we undertook the restoration and remodel of a two-story early-1800s residence in the historic village center of Wellfleet, Mass. We began by lifting the house off its failing foundation and setting it back down on a full poured-concrete basement. This article will look at that process. As of this writing, we've moved on to a gut-remodel of the building.

EXISTING CONDITIONS

The house was built on a lot that sloped immediately down from street level, which set the front door sill about 9 inches lower than the sidewalk (1). Because no attempt had been made to adjust the grade to deflect runoff, water ponded against the foundation, eventually rotting the front sill beam. Also, the oldest part of the foundation consisted of a single thickness of mortared brick (common in the area's sandy soils) set barely below grade without any footings. Consequently, the building had settled unevenly, stressing its timber frame to near failure. When we started work, the building department had already ordered the house vacated.



At the back of the original building was an extension that had been built in the 1920s on a full foundation of hand-mixed concrete interlaced with bricks and rubble (2). This part of the foundation was accessible through a door in the rear and allowed about 6 feet of headroom. Under the original structure, the builders had expanded the basement area by excavating to within a few feet of the older brick foundation, shoring it with small-diameter logs driven vertically, stockade-style (3). This innovative approach may have destabilized the grade, and a small forest of teleposts suggested a history of nerve-racking creaks and pops as the building settled.

DIGGING IN

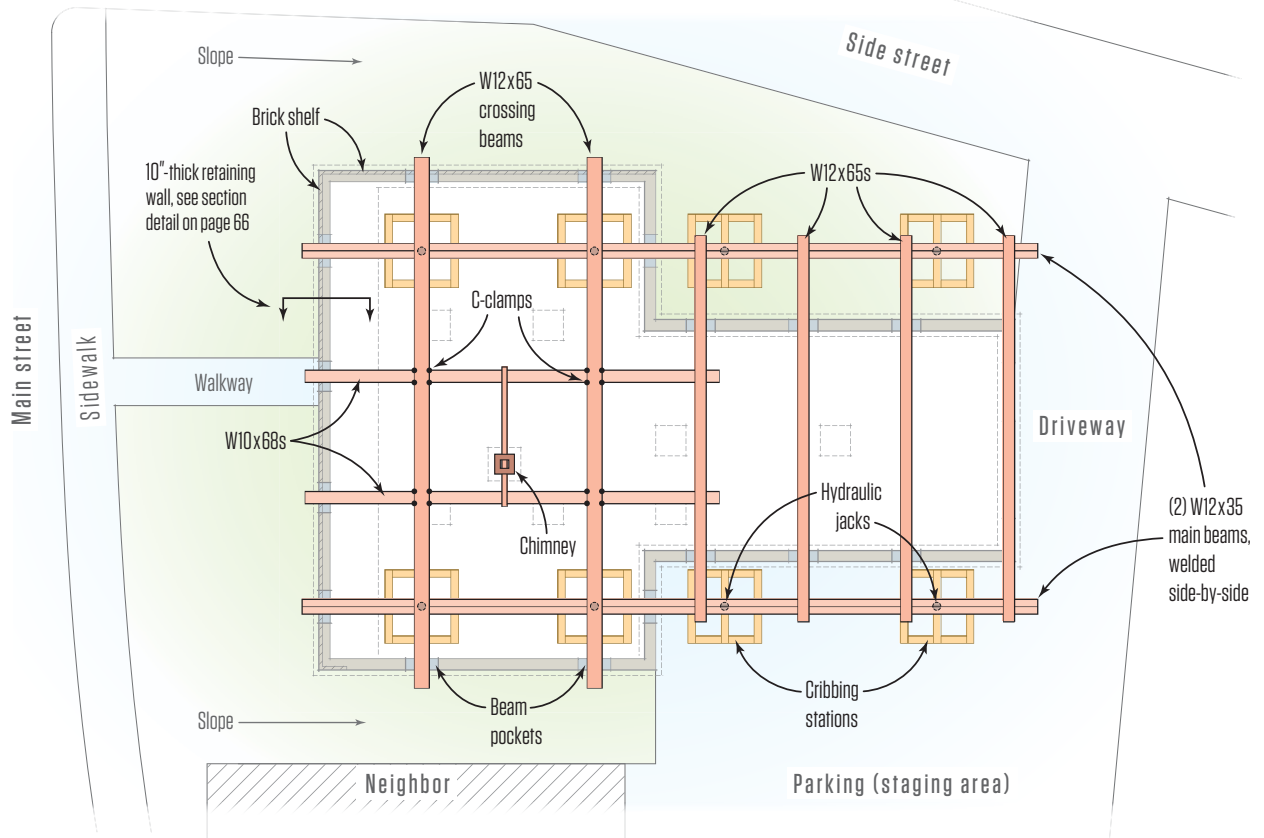
The shifting foundation had caused some of the tenons in the timber balloon frame to pull away—as much as 1½ inches in places—from their mortises. Before we jacked anything up or worked on the sills, we stabilized these joints by running a heavy chain from a central interior timber through the tops of the first-floor gable-end windows to a pair of 6x6s running the full width of the building (4). We used a come-along to keep tension on the chain,

which prevented the frame from spreading further during the foundation work. (Later, after the building had been set down on its new foundation, we would pull the joints tight and reinforce the connections.)

The rotted front sill had to be addressed before we did anything else. We stripped back about 2 feet of siding and sheathing across the front of the building. To create room to stack cribbing, we hand-dug pocket holes about 4 feet deep, undercutting the foundation near the corners and at the center. After stacking the cribbing, we used bottle jacks to raise the building just enough to slide in short lengths of 6x6s directly under the existing sill (5).

With the front wall supported by cribbing, we started removing badly rotted portions of the sill. Very quickly we confirmed our suspicion that the sill was almost completely rotted through along most of its length and that it would be best to replace it entirely before attempting to lift the building. We pulled a string-line from corner to corner as a reference for straightening the sagging timber-frame system, then jacked and shimmed until the bottoms of the four posts—one at each corner and two on either side of the central door—registered uniformly against the string.

Beam Layout/Foundation Plan



With the front wall timbers in plane, we bolted a 6x6 ledger to the face of the frame along the entire length of the building, pre-drilling the four 8x8 posts to receive ½-by-12-inch lag screws (6). We used TimberLoks and LedgerLoks (fastenmaster.com) to secure the 2x4 infill studs, many of which did not run the whole length of the balloon frame and were supported by the sheathing. Then we set jacks on the cribbing and lifted the ledger to shift the weight of the structure off the sill, enabling us to remove it and fit a new, pressure-treated 6x6 member in its place. Including the stripping of the siding and sheathing, this process took a full two days.

SETTING STEEL

With the front sill replaced, we turned our attention to placing the steel I-beams needed for the lift. Since the building itself occupies most of this street-corner lot, access for inserting the beams was limited to the back, where we had a small staging area, and one side of the building at the front (top left in “Beam Layout/Foundation Plan,” above). Given the close quarters, we delivered mainly 16-foot lengths of steel, which we welded on site to create the lengths we needed.

One of the design principles for lifting a beam is that its flange should be at least as wide as the web is high—nominally, a square section profile that prevents the beam from rolling over under load. This was a particularly important consideration for the two main beams, which would provide the direct jacking points for lifting. These two beams would need to be 50 feet long and would run outside the walls of the building’s narrower rear extension and under the original structure at front. We built them up from front to back using W12x35 I-beams welded side-by-side with their ends offset in a staggered pattern. Each 16-foot section weighed about 560 pounds, so we used our mini-excavator to wrestle them individually onto cribbing before welding.

We wanted to set the beams as near to their final elevation as possible so we wouldn’t have to lift them very much later. Fortunately, the halfway point on these beams fell outside the foundation, so we were able to move them nearly into final position without having to reset the support straps that suspended them from the excavator. We set them level, at a height that left enough room for the shorter crossing members to fit between them and the underside of the floor framing. This sounds more straightforward than it



actually was because we had to set up temporary cribbing stations at various locations under the front part of the building to support it while we excavated access points for the main beams through the old foundation. Ultimately, each of the two main beams rested on four cribbing stacks, two inside the foundation at the front and two outside the foundation along the rear addition.

Next, we inserted the “needles,” or crossing beams, from which we would ultimately block up to support crucial locations under the building. In the addition, the joists ran across the width of the building and were mortised into a central carrying beam. We placed four needles parallel to the joists, shimming as needed to pick up the central timber and to make sure that all three sills in the addition were fully supported (7).

In the front of the house, the joists ran the full width of the building, supported by two intermediate carrying beams that divided the floor system into three sections. To support this part of the house, we inserted two crossing beams, which would eventually rest on top of the two main 50-footers (8). Because of the tight conditions on the site and the need to work around a brick chimney in the center of the basement, moving these beams into position re-

quired a series of maneuvers. To place the first beam, which would run behind the chimney, we slid it in diagonally on top of the 50-foot main beam from the front left corner, then see-sawed it back and forth until it was perpendicular to the main beam and parallel to the front sill. The second beam went in a bit more easily, in front of the chimney.

We then hung two additional beams at a right angles to the crossing beams, aligned directly under the two floor timbers. To hang these beams, we used special heavy-duty Wilton C-clamps capable of supporting 15,000 pounds each (9). We snugged blocking between their flanges and the underside of the floor timbers to make a solid connection.

To pick up the chimney load, we punched a hole through the brick and flue tile and slid a scrap of tube steel through it (10). The standard alternating brick courses transferred the stresses and effectively held the chimney intact with no further reinforcement.

With all the needles placed, we brought in the nine-point hydraulic jacking system, which we had recently purchased used and had completely refurbished. A central manifold (11) controls all nine jacks, which are driven by a single main piston. We set eight



of these jacks under the main beams and lifted them just enough to transfer the building load off the foundation. Once we were sure that the entire structure was safely supported, we jacked it another 3 feet or so—high enough to get our skid steer underneath to complete the excavation. The maximum throw of the jacks is about 14 inches, so we had to reset them three or four times. Each reset involved blocking solid between the cribbing and the steel beams, resetting the jack, lifting, then blocking again (12).

DIGGING DOWN

Our goal was to set the building at a final elevation that would be 9 inches higher than it had been; this grazed the maximum ridge height allowed by the local zoning ordinance. At the same time, we wanted to provide enough headroom to allow us to set 8-foot form panels on top of new concrete footings. All these factors taken together meant that we needed to dig down about 12 inches.

At the rear addition, this posed no real challenge because the cribbing stacks stood outside the walls and out of our way. We dug down, deposited the fill in the staging area, and loaded it by excavator into our dump truck for removal from the site.

The front of the house was a different story because the cribbing was near where we needed to excavate for the footings. We dug as close to each stack as we could, set a new stack next to it, and transferred the beam load. Then we pulled out the original stack of cribbing and dug down to final grade. In all, we spent three days excavating—the sand and gravel soil made the digging easy, but resetting the cribbing took some time, as did pulling the fill out from under the house and loading it for removal.

FOUNDATION

To locate the footings, we used a vertical laser to pinpoint the building corners, then offset the forms by 4 inches. We added 8-inch-thick pads for intermediate Lally columns and for the chimney. For all but the front wall, we poured standard 8-inch walls on 16- by 8-inch footings (13). With the grade falling steadily away front to back, this provided sufficient support for the structure.

Because the front of the building was not far from the road bed, it called for a foundation that also functioned as a rugged retaining wall (see “Retaining Wall Detail,” next page). Here, we formed a

Retaining Wall Detail

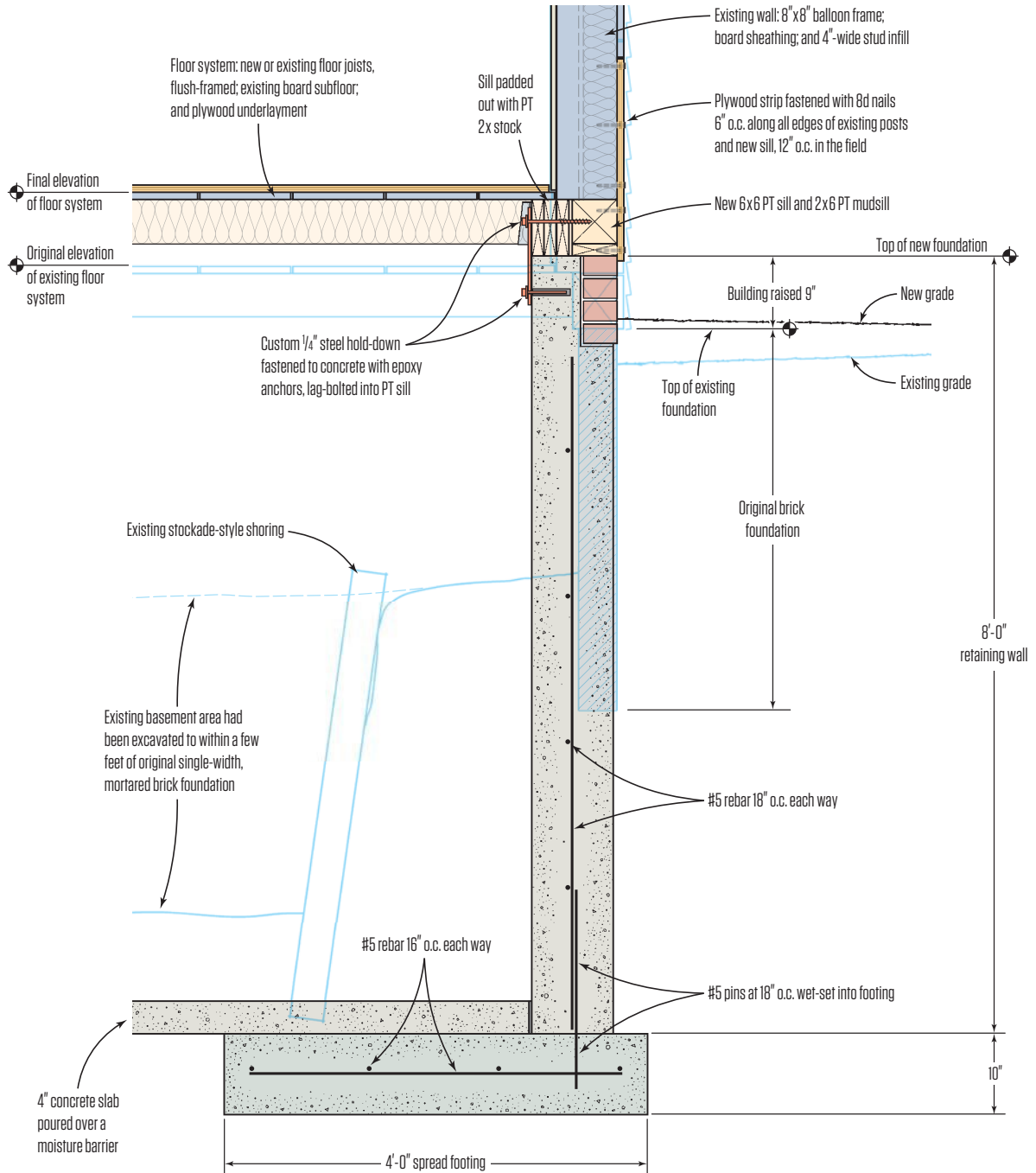


Illustration: Tim Healey



4-foot-wide spread footing reinforced with #5 rebar set on chairs. After placing the concrete, we set #5 pins at 18-inch intervals to engage the 10-inch-thick wall. For reinforcement, we wired vertical and horizontal #5 bars in a uniform 18-inch grid (14) and laid a final piece of rebar across the topmost form ties. We wanted to preserve the historical appearance of the foundation where it faced the street, so we formed in a ledge to support veneer brick across the front and part of one side. As was the case with all of the walls, we boxed pockets in the forms to allow room for the I-beams to project through when we lowered the building. These pockets were a little wider in the front section to make it easier to snake the steel crossing beams out from under the house.

In most places, we were able to chute the concrete directly into the footing forms, but we couldn't use that method to pour the walls—the steel beams, the blocking, and the building itself presented too many obstacles. Instead, we hired a concrete pumping service and, for maximum maneuverability, specified a 2-inch delivery hose. This smaller diameter called for smaller 3/8-inch aggregate, so to ensure an optimal bond, we called for a high-strength 4,000 psi mix.

After stripping the forms, we gently lowered the building onto its new bearings (15). We pulled out the beams—including the welded-up 50-footers (which are already in use on another job)—one at a time, and then filled in the beam pockets with concrete block.

Before pulling the beam supporting the decommissioned chimney, we built a concrete-block pier to carry it (16). To tie the building to the foundation, we had a steel supplier cut and punch bolt holes in 1/4-inch steel plates, which we prime-painted and lagged to the foundation (17) using a Simpson SET-XP epoxy anchoring system (strongtie.com).

There was a considerable amount of re-framing needed to reinforce the old floor system, which we did mostly by sistering in new joists and piggy-backing some others. With a 4-inch concrete slab poured over a moisture barrier, the basement is complete, and we've turned our attention to helping the building face the next 200 years (18).

Fred Ambrose is president of Ambrose Homes, in Cape Cod. His son, Ezra, supervises field operations.



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BY CHARLES WARDELL



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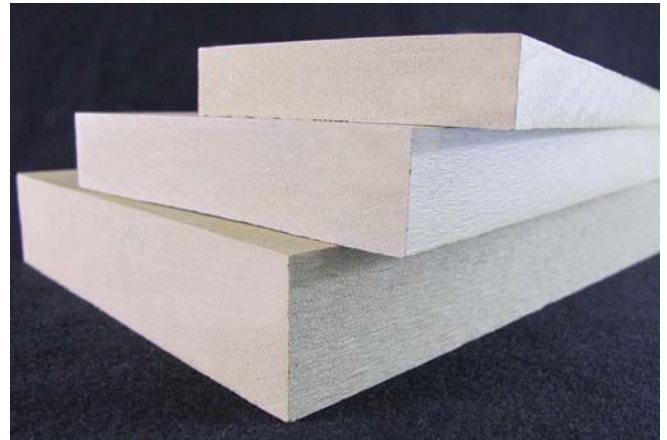
Bath to Shower

Kohler's Bellwether Shower Receptor is a cast iron base that's available in six colors and two sizes. The one-piece base includes a 4-inch stepover threshold and a choice of a centered or an offset drain. A drain cover—available in aluminum or plastic—is easily removed for cleaning. Cost: \$775 for the Receptor; \$115 for the drain cover. Kohler, 800.456.4537, kohler.com



Power Saver

The EdgeHome system displays electricity use for individual electronic devices. The system includes a touchpad that lets buyers see and control every individual load, thanks to controllers placed behind each outlet and switch box. Cost: \$1,50 to \$2 per square foot of floor space. Green Edge Technologies, 858.799.0360, edgeline.com



Thick Composite

Boral's TruExterior Trim now comes in a 1 1/2-inch thickness. Made from PolyAsh, it has a claimed expansion rate of just one-third that of PVC and is compatible with silicone or acrylic caulking. The material is approved for ground contact, and screws can be driven flush into the surface without mushrooming. Boral Composites, 800.926.7259, boraltruexterior.com

Products



Lock & Rock

Armstrong's QuikStix pre-engineered drywall grid system uses two types of studs: a 1½-inch-deep T-shaped stud for basement perimeters or soffits around ductwork, and a nominal 2x4 H-stud for interior partitions. Tracks are notched every 8 inches, so the studs can simply be snapped into place. The manufacturer claims that the system cuts framing time in half. Armstrong, 877.276.7876, armstrong.com



Easy Epoxy

Quikrete's water-based Epoxy Garage Floor Coating comes in a 5-gallon pail with all you need: two-part epoxy; Cleaner, Etcher & Degreaser; and decorative flakes. The coating can be applied as soon as the epoxy has been mixed (assuming the concrete has been cleaned). Available in gray and tan, one kit will do a one-car garage, or 250 to 300 square feet. Cost: about 28 cents per square foot. Quikrete, 800.282.5828, quikrete.com



Plumb & Play

Made for homes with less than 3,000 square feet of floor area, the Warmsource Total Warmth System stuffs all the manifolds and controls into a little tank on top of the main storage tank. Cost: about \$9 per square foot of floor area (includes hydronic unit, tubing, and manufacturer's radiant panel underlayment). The system's X10 thermostats eliminate the need for low-voltage wiring. WarmBoard, 877.338.5493, warmboard.com



Floor Muffler

For use under ceramic, porcelain, or stone floor tile, UltraLayer is a 0.1-inch-thick sound-deadening underlayment that comes in 3 foot by 33.4 foot (100 square feet) rolls. To install, glue it to the subfloor using thinset mortar, roll it into place, then lay the tile over it using latex Portland cement mortar. Tile must be a minimum of 8 by 8 inches. Cost: \$90 to \$100 per roll. MP Global Products, 888.379.9695, quietwalk.com

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Products



Clean Comfort

The Avalanche CT toilet's contemporary styling includes smooth sides with no nooks or crannies to capture dirt and debris. A high-efficiency model, the toilet operates at 1.28 gallons per flush and is WaterSense approved for efficiency and performance. ADA-compliant for height, the one-piece design features an elongated bowl as well. MSRP: \$560. Gerber, 886.538.5536, gerberonline.com



Stealth Furnace

The crushed glass floor on Fireplace Xtrordinair's 4415 High Output Linear Gas Fireplace makes for sparkling aesthetics. The fireplace heats up to 2,100 square feet of space and warms other rooms via an optional Power Heat Duct Kit. A smart temp mode provides a consistent flame, while the exhaust can run 18 feet horizontally without power venting. Cost for the configuration shown is \$4,406. Travis Industries, 800.654.1177, fireplacex.com



Attic Cooler

Huber's Radiant Barrier roof sheathing is a basic Zip System sheathing panel with a barrier on the underside that reflects radiant heat. The Department of Energy estimates that radiant barriers can reduce cooling costs by as much as 10% in warm, sunny climates. Approximate cost for a 4x8 panel should be around \$19 for the 7/16 thickness and \$22 for the 1/2-inch. Huber Engineered Woods, 800.933.9220, zipsystem.com



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EDITED BY BRUCE GREENLAW



Bosch 18V Multi-X Oscillating Multi-Tool

BY STEVE DEMETRICK

I bought my first oscillating multi-tool, a corded Fein model MSxe 636 II, in 1996 for scraping and sanding old windows and fairing handrail easements. As oscillating saw blades grew more advanced and affordable, though, it became one of my prime remodeling tools, handling everything from delicate material removal to finishing touches. My crew and I have now been using two of these tools for years, and they're both still going strong.

In September when *JLC* asked if I'd like to field-test the new Bosch brushless model MXH180 18V Multi-X oscillating tool, I didn't hesitate to accept. It's one of several 18-volt models on the market that promise to perform like a corded model, and I couldn't wait to see if its cordless convenience would make a big difference on the jobsite.

CLEAN KIT

The 18V Multi-X is sold only as part of the

MXH180BL kit. The user-friendly kit includes a modular L-Boxx-2 case that, for easy storage and transport, can be stacked with and locked to other L-Boxx cases and components in Bosch's Click & Go line. Inside the case, an Exact-Fit tray conveniently holds the tool with the battery and an accessory installed, houses two extra batteries and a charger, and even provides a dedicated space for the charger cord (thank you). The case also contains a removable plastic box that stores and organizes your accessories—a welcome feature that keeps everything neat and accessible.

The batteries and charger are sold separately. If you've already bought into Bosch's 18V lithium-ion platform, you're good to go. I haven't, so Bosch also sent me its SKC181-101 lithium-ion starter kit (\$100), which includes a 4 amp-hour battery and a charger. The tool also accommodates Bosch's compact 2 amp-hour battery and older batteries

in the platform, but Bosch recommends using the 4 amp-hour battery for remodeling because it is more powerful and delivers the longest runtime.

QUICK-SWAP ACCESSORIES

Until recently, most oscillating tools required the use of an Allen wrench to swap accessories. The MXH180 lets you swap them at the flip of a lever, which is a blessing. Bosch makes a wide range of cutting, grinding, sanding, and scraping accessories, all of which mount to the tool using the company's 12-pin Oscillating Interface System (OIS). This interface prevents the accessories from slipping and allows you to orient them in 12 different positions for optimal access and maneuverability.

I tried several of these accessories with good results. I love the slight curvature of the OSC114F wood-metal blade, for instance, because it makes plunge-cutting and cutting into corners much easier. Also, Bosch's plunge-cut blades have a helpful depth scale along one edge. (Other manufacturers, including Fein, also make some accessories that fit this tool.)

PERFORMANCE

According to Bosch, oscillating multi-tools typically spend about 80% of their operating time making cuts and, as it happens, I used the MXH180 almost exclusively for cutting. One reason I didn't also use it for sanding is that Bosch doesn't offer a vacuum attachment for this tool (not having such an attachment makes some sense for a cordless). Dust removal not only keeps jobsites cleaner and remodeling customers happier, but it also makes sanding more efficient and extends the sandpaper's life. Our corded Fein tools do have vacuum attachments, so we continued to use them for detail sanding.

On site, I used the Bosch to remove a section of rotted crown molding at the rake and to trim some existing moldings in place to accommodate a new chimney that passed



For more power and longer runtime, Bosch recommends its 4 amp-hour battery for remodeling.

through the edge of a roof. The tool was an excellent choice for those jobs because I didn't have to drag a cord up the ladder to get the precise cuts I needed. Indoors, I made cuts in plaster, plywood subflooring, hardwood flooring, and other materials. I also used the tool to scribe the bottom of a long bench seat to a hardwood floor.

Through all of this work, the tool was at least as powerful as my corded models, and the 4 amp-hour battery had plenty of runtime to complete each job. A fuel gauge on the battery indicates when it is time to recharge.

Runtime can vary dramatically, of course, depending on the workload. For what it's worth, when we fully charged the battery, mounted the Bosch OSC312F wood-metal blade that was included with the tool, and let the tool run full-throttle at room temperature until the battery quit, it ran for 41 minutes and 27 seconds. After that exercise, the Bosch's metal gear housing was too hot to touch, but that probably helped dissipate heat—the battery was only slightly warm.

The MXH180 weighs almost a pound more than our old Fein corded models (including their 16-foot-long cords). It also vibrated more and was a bit less comfortable to grip. Not a big issue, but when using the tool I often gripped it with both hands.



You can swap accessories with the flip of a lever—no wrench needed.

THE BOTTOM LINE

As much as I like my corded oscillating tools, they sometimes stay in the van simply because we don't want to drag out another cord or there's no place to plug in another tool. I constantly reached for the Bosch just because it's cordless. However, it's also powerful, has all the runtime I need, accepts plenty of useful accessories that you can quickly swap out, and has a great case. I recommend it to anyone who frequently uses a corded oscillating tool.

MXH180BL Specs

Motor type: brushless

Weight (with 4 amp-hour battery): 4.35 pounds

Oscillations per minute: 8,000 to 20,000

Price: \$230

Included in kit: bare tool, saw blade, L-Boxx-2 case with removable accessory box

Warranty: One year, 30-day money-back guarantee (register for free three-year ProVantage plan)

[Bosch / 877.267.2499 / boschtools.com](http://Bosch.com)

Steve Demetrick is a residential remodeling contractor in Wakefield, R.I.

WORMDRIVE UPDATE

Back in our June 2013 *Toolbox*, Oregon production framing contractor Terry Goodrich waxed poetic about the new 7¼-inch Skil MAG77LT wormdrive saw, which weighs just 13.2 pounds including the cord and blade. After working the saw hard for several weeks, he wrote: "I love the saw's light weight, it performs like my other Skils, it has every feature I can imagine wanting, and I expect it to last for years—just like its proven predecessors." Although it sold for \$219, he still considered it a bargain.

Those weren't idle words. Goodrich reports that he bought 10 of the saws five months ago—one for each of his framers—and the guys won't even touch their old wormdrives anymore. To date, the saws have been trouble-free. The Home Depot is now selling the saw for \$175.

In related news, Bosch just introduced the CSW41, which is the same saw with a few minor cosmetic tweaks and the same original price tag. After all, both saws are made by the Robert Bosch Tool Corp. in the same Chinese factory. —B.G.





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Milwaukee M18 Jobsite Radio/Charger

Milwaukee's new 17-pound, 18-volt M18 Jobsite Radio/Charger (model 2792-20) can charge or run on any battery from the M18 platform. In addition to a backlit LCD screen, an AM/FM tuner with five presets for each band, and a base and treble equalizer, it has a clock, a roll cage, three handles, a bottle opener, and a weather-sealed compartment with a 16-inch auxiliary input cord inside for connecting and protecting your smartphone or digital music player. Two AAA batteries power the presets and clock, and should last more than a year. The sealed compartment also has a 2.1-amp USB port that's active whether the radio is using AC or battery power. According to Milwaukee, it charges most mobile devices more than 50% faster than the USB ports in competing models. When opened, the compartment lid can hold a tablet upright while you charge it, transforming the radio into a portable entertainment center.

Perhaps the biggest news is that the M18

is the first jobsite model to include a Bluetooth receiver, reportedly allowing you to stream and control content from a mobile device from up to 100 feet away. In this mode, you can also pause or move through music tracks from the radio's control panel.

Given that my current work radio is a General Electric long-range AM/FM Superadio II that I bought in 1986, I couldn't resist dialing into a new M18 to explore its features. For starters, I like its tall profile, which makes it easy to pick up, and its 12-by-12-inch base and low center of gravity make it difficult to knock over. Conveniently, M18 batteries slide down into the charger right behind the top handle. The USB charger worked exactly as advertised, topping off the battery of my iPod Touch with lightning speed.

The radio pulls in FM stations as well as my Superadio does, but the AM reception is a notch below (though I can listen to local AM stations). I would prefer a dial to Mil-

waukee's two push-buttons for tuning, but that's a nitpick.

The M18's Bluetooth connectivity works like a charm. With a clear line of sight, my iPod Touch could connect from up to 200 feet away. Behind a couple of walls, the range was still significantly more than 100 feet where I tested it. Kneeling next to a clothes washer or walking into a metal-clad pole barn can break the connection, though, which might irritate your teammates.

The Bluetooth receiver also allowed me to stream Pandora and iTunes Radio into my detached shop by placing my iPod where it could simultaneously connect with the wireless router in my office and the M12 radio in my shop. Awesome. Last but not least, to my ear, the poly-cone speakers sound great.

The 2792-20 costs \$229, M18 batteries not included.

Bruce Greenlaw is a contributing editor to JLC.

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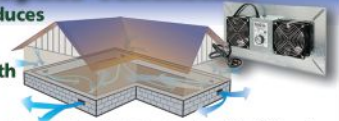


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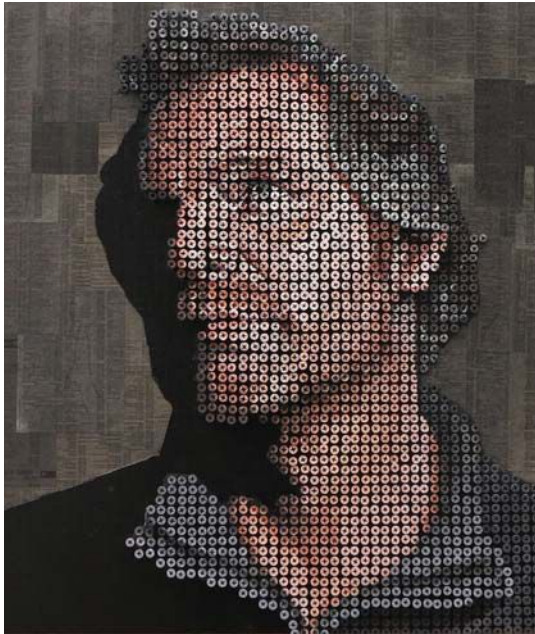
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BY JON VARA



Sculptor Andrew Myers paints on a tight pattern of screws driven to different depths to create unique three-dimensional representations.



Screw-Head Portraiture

Although Andrew Myers hasn't worked directly in the building trades since a two-year stint in commercial construction after college, he spends more time driving screws than most drywallers. But then, his specialty is an unusual one: He creates portraits that are a hybrid of painting and sculpture, using wood screws, birch plywood, and artist's oil paints.

The process begins with a pencil sketch that's transferred to a sheet of 3/4 birch plywood. After a 5/8-inch-square grid pattern is lightly scribed on the panel, Myers drills a pilot hole at each of the grid-line intersections, using a portable drill guide to make sure that each hole is perfectly square to the face of the panel.

He then begins driving screws using a lightweight lithium-ion Milwaukee screw gun, choosing the length—anywhere from a 1/2 inch to 3 inches—and adjusting the depth by eye. Myers likes the quality and consistency of American-made Spax screws and uses them exclusively.

"If it's a frontal portrait, I usually drive the first screw at the tip of the subject's nose," he says. "That establishes the highest point and puts everything else into scale."

Once the 8,000 to 10,000 screws of a typical portrait are in place, Myers brings the artwork to life by creating a fully developed oil painting on the rolling surface formed by the screw heads. The result is both lifelike and remarkably responsive to the viewer's position. As the eye draws closer, the image transitions from a conventional portrait to an almost abstract combination of color, texture, and open space. (And, of course, a whole lot of screw heads.)

In fact, Myers notes, his portraits can be enjoyed from very close range indeed. He recalls a blind visitor to one of his shows who asked if he might feel a painting with his hands. Told to go ahead, his expression soon broke into a big smile.

"You could see that he completely got it," Myers says. "It was a great moment."

Jon Vara is a writer in Cabot, Vt.

More Online: See the online version of this article for a video interview with sculptor Andrew Myers.

Photos: left, Andrew Myers; right, Hanley Wood Media



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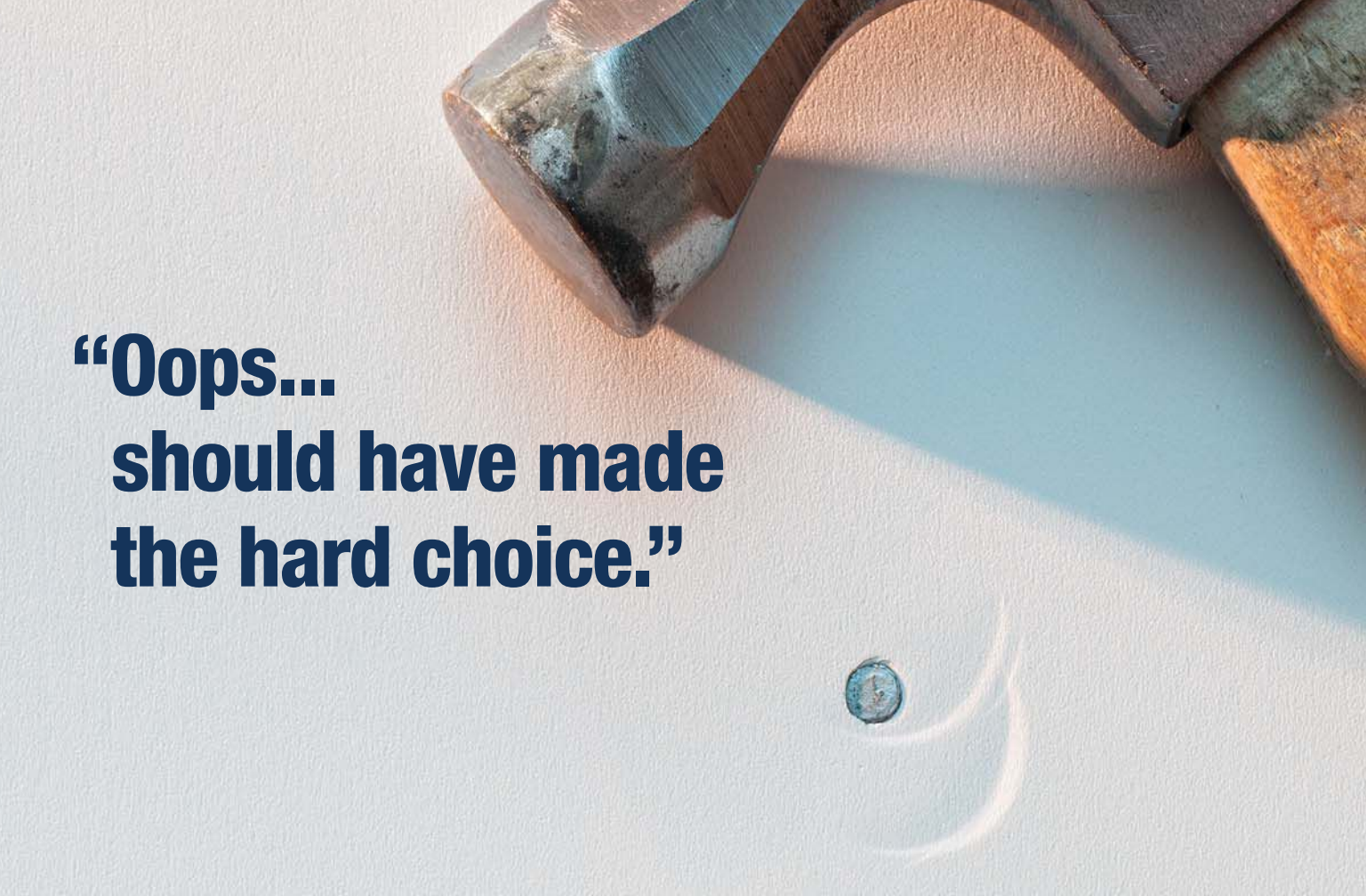
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