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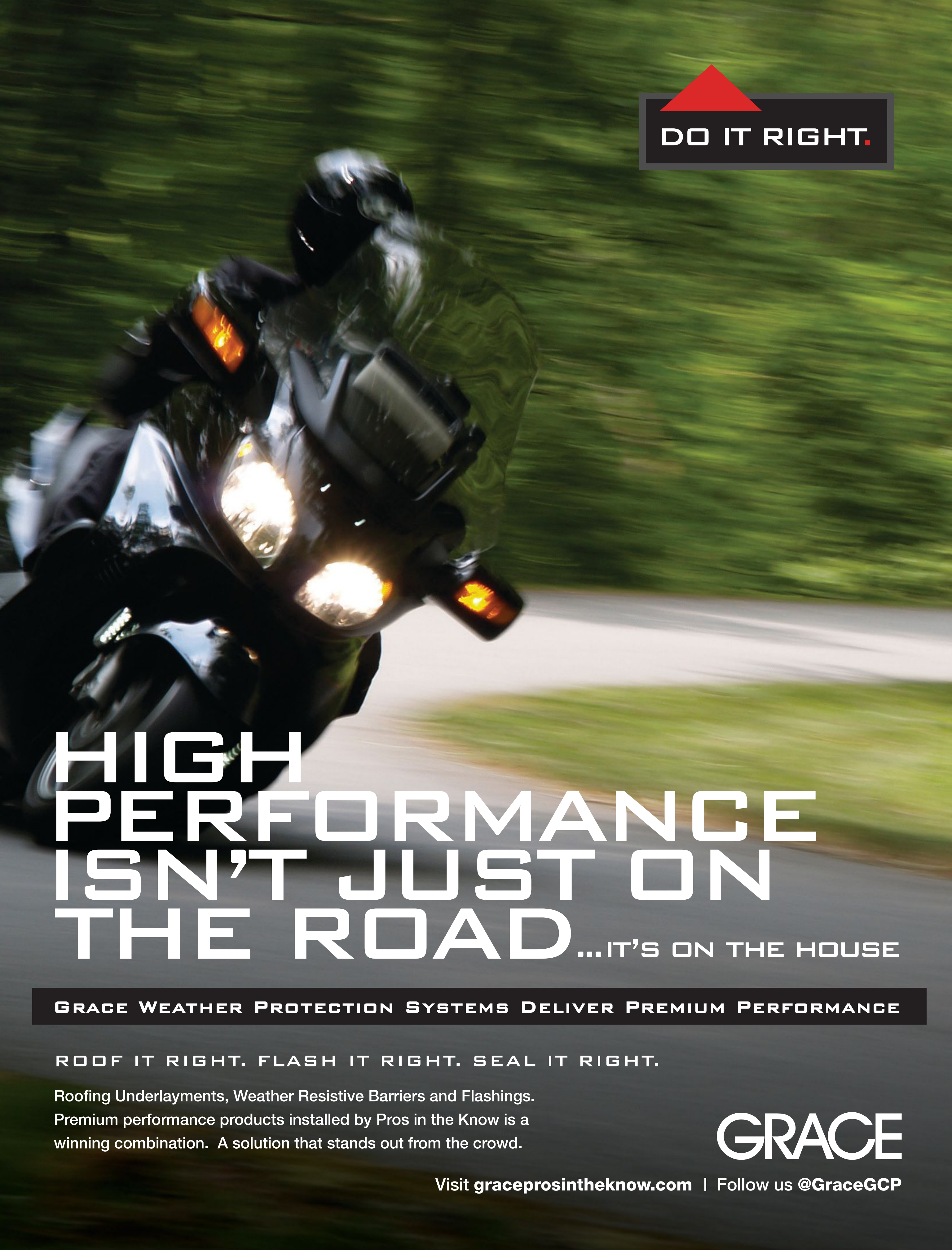
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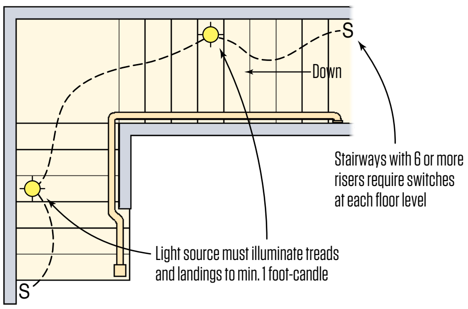

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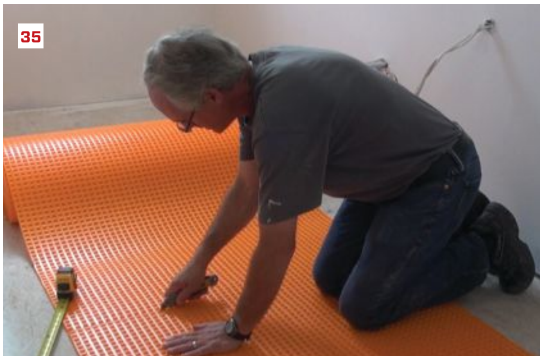

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On the cover: In this season of giving, *JLC* salutes the Cape Cod Builders Association and all the giving tradespeople who participated in another successful Blitz Build, honoring their craft for Habitat for Humanity. Story on page 56. Photo by Roe Osborn.

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RETHINKING WINDOW FLASHING (ONLINE, 10/23/15)

Matthew Amann (online, 10/26/15): One of the major problems with any window flashing system is housewrap. I have seen too many times that non-back-primed cedar and other tannin-rich wood siding "clog" the pores of the housewrap, causing moisture intrusion and condensation problems.

I have had great success staying out of trouble by not following anyone on the window flashing, using acrylic adhesive flexible flashing, using tar paper instead of housewrap, and applying all three layers of waterproofing starting at the housewrap. I have seen too many windows caulked and flashed to bare OSB! What sense does it make for the primary waterproofing layer to start at the rot box?

Harrison McCampbell responds: Thanks for your input. I still recommend, and stand by, using a 30-lb. felt and covering that with housewrap (ideally, DuPont's Stucco Wrap or another "drainable" housewrap). This, of course, must be done in concert with a properly installed flashing system around doors and windows and along finish-floor levels.

Editors respond: As Matthew notes, tannins in some woods like cedar increase moisture intrusion, but not for the reason he describes. Tannins decrease the surface tension of water, allowing water to more easily slip through the pores in a housewrap. Surface tension is what keeps water droplets in bead form; as a droplet, it is too big a molecule string to get through the microscopic pores in housewrap materials. When the tannin concentration in water reduces the surface tension, it essentially destroys the housewrap's effectiveness as a water barrier. For what it's worth, soap has the same effect. Some stucco installers will add a detergent to their stucco mixes to improve workability, but this practice should be discouraged.

"Q&A: SETTING A TOILET OVER TILE," BY TERRY LOVE (APR/05)

BobboMax1 (online, 10/21/15): I'm completely against cedar shims—they're subject to permanent compression over time. Or, when someone heavy sits unevenly on the toilet, cedar shims can be crushed and the wax ring can be permanently deformed at the same time. The cross grain of cedar is pretty weak in compression. I might accept oak shims, but otherwise, plastic shims are better. As for the taper, I think that's a "so what?" As long as you can get the tip under the edge of the base, the taper doesn't matter. I carry 1/32-inch sheet plastic for really thin shimming. I do find plastic to be more difficult to trim, but doing good work is sometimes difficult.

Because wax rings can be permanently deformed by a rocking toilet, I like the idea of the Fluidmaster Wax-Free Gasket, although I just bought my first one and haven't installed it yet. I trust Fluidmaster to be a good supplier.

As far as caulk, apparently code does require it, but I think the requirement and the reasons given are bogus. Supposedly, if the wax ring leaks, caulking will contain the leak, which is supposed to be more sanitary. To me, it just contains the leak until the floor rots out—I'd rather be notified by a leak before that happens. Some clients do prefer the neat look and better "cleanability" of caulk, so my compromise is the same as Terry's: I caulk three-fourths of the perimeter. This is particularly functional when you have to shim at the front of the bowl. One way to address dry rot due to leaks is by caulking the flange to the flooring, which is generally waterproof. On a reset, I've been known to use a putty knife and the old wax ring to seal the flange to the flooring.

Gkeway (online 10/21/15): I seem to recall that Rex Caldwell (jlconline.com/author/rex-cauldwell) prefers to level a toilet using pennies. Regardless, I think this demonstrates a clear need in the industry for better plastic shims. For as much as toilets cost these days, I should expect the toilet manufacturer to supply shims with its products.

Editors respond: There is a product out there that may fit the bill. The Tile Buddy (tilebuddy.com) is a square toilet flange that includes a 1/4-inch-thick polypropylene shim that slips over the toilet waste pipe and provides support for the flange bolts. Lauren Hunter covered this in *Products* (Mar/15), reporting: "Multiple Tile Buddys can be stacked to equal the depth of surrounding flooring, allowing the flange to sit on top of the Tile Buddy at a height even with the floor. The square design also improves ease of installation for surrounding backerboard, tile, or other flooring surfaces by eliminating the need to cut or nip around a rounded flange. For renovations, the Tile Buddy features pre-scored lines that allow installers to snap the shim in half and slide each half under the existing flange to bring it level with the new flooring."

Correction: In the November issue, the photos in the article "A Tiny but Roomy Bathroom" were taken by Jon Lewis.


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Q A perfectly straight handsaw is a thing of beauty and a joy to use, but how key is straightness in terms of performance, and is there any practical way to restore true "factory" straightness to a handsaw?

A Matt Cianci, owner of The SawWright, in Warwick, R.I., responds: In terms of performance, the importance of perfect straightness in a saw's line of teeth is a bit overstated. I know people who won't even pick up an old saw if the blade is anything less than laser straight. But in my experience, perfect straightness isn't necessary to make straight cuts.

If the saw blade has a gentle bow in one direction, then the saw can still cut very true. In fact, most handsaws will not suffer performance issues because of a curved tooth line (contrary to popular belief). And believe it or not, the same holds true for backsaws.

Cutting problems usually arise when the saw blade warps back and forth, curving from one side to the other and back again. However, the problems are not so much about straightness of cuts as they are about the need for a heavier tooth set to keep the blade from jamming in the wood during use. This heavier set makes the saw remove a lot more material, which makes it cut more slowly and less efficiently while requiring much more labor by the sawyer. My recommendation is to try out a saw, if you can, before you decide to buy it. You may be surprised with the result. A $5 flea-market saw might get overlooked by collectors, but it can be a gem to use.

As far as whether it's possible to restore true "factory" straightness, the answer is "maybe." It depends on the saw. If the blade has a bow in one direction, then it is possible to correct the tension on the longer side of the blade (the convex side) to bring it back straight, by cold hammering or "smithing." I use a hammer with a broad, subtly domed face and an anvil. There isn't much available on this technique and most people learn it through trial and error, the way I did years ago.

Kinks in a saw blade can never be completely removed because they are work-hardened areas of the steel. Once steel is work-hardened or creased in this manner, the only way to correct the problem is with heating, forging, or regrinding, which is just not practical with an old saw. However, kinks can be compensated for by the smithing process I spoke of above. In this instance, the aim of the smithing is not necessarily to remove the kink, but rather to compensate for it by adjusting the tension on the blade so that the tooth line is pulled back into a straight line. I perform this operation often on saws with kinked or creased blades, and I can usually turn a nonfunctional saw back into a good performer.

Looking down the handsaw blade, the kink must be taken out for proper performance (top). In most cases, "smithing" with a hammer and an anvil can straighten a handsaw blade (above).

Photos by Matt Cianci

Is this practical? I think so—if I learned to do it, then anyone with the right hammer and anvil can do it as well. It just takes time, willingness, and a passion for the feeling of cutting with a well-tuned handsaw.


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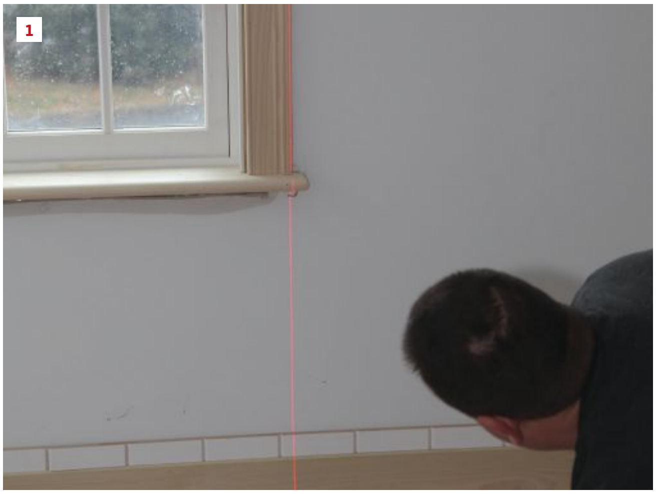
BY BILL McGRAW



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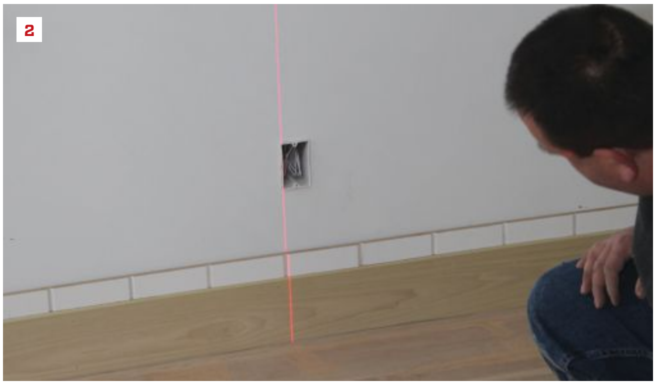

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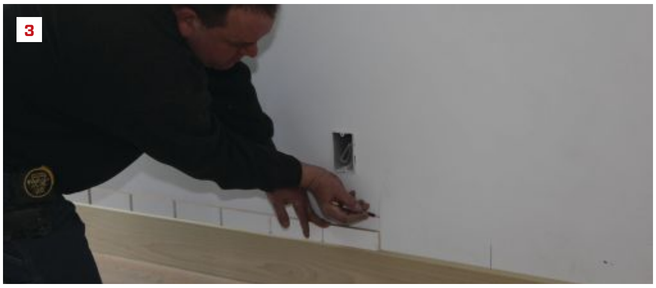

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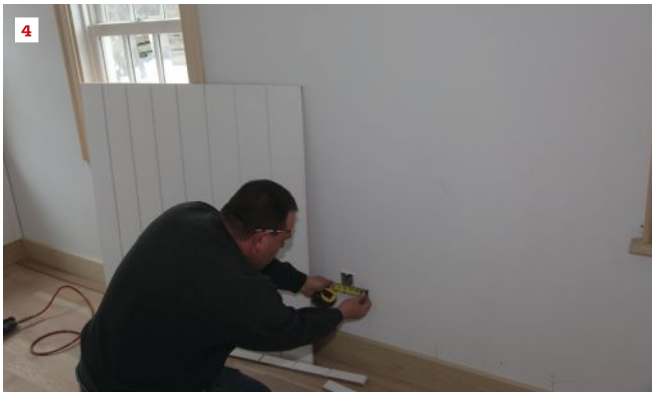

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Sheet Wainscot Basics

As a finish carpenter, I'm often asked to install wainscot to spice up a room, and pre-primed MDF sheets with grooves cut to mimic the look of T&G material make the job much easier. Before starting the wainscot, I make sure the baseboard is installed, along with the side trim on the doors and windows. (If I'm doing the window trim, I install the stool and apron after the wainscot is installed).

The MDF wainscot material comes in 4x8 sheets ½ inch thick, and the contractor for this project had spec'd a height of 42 inches above the baseboard. I started by cutting enough 3½-footers from my stack to do the room. Then I cut 2-inch strips from a couple of the scrap pieces across their width and placed the strips on top of the baseboard along one wall.

One of the keys to installing wainscot easily and having it look great is laying out the material so that the grooves don't line up directly with vertical elements such as window casings and electrical outlets. I used the 2-inch strips in combination with a laser to fine-tune the layout. First, I lined up the laser roughly on the edge of the window trim and noted where it fell on the strip **(1)**. I checked both sides of the window and made sure that the edges landed well between the grooves. With the strips running all the way across the wall, I also checked the layout at the other window.

Next, I moved to the electrical outlet in the middle of the wall and checked the layout there **(2)**. On this wall, the layout for the outlet landed just to the side of the groove, so I slid the strips down an inch or so and rechecked the layout at the windows to make sure it was still acceptable. When I was happy with the layout, I marked the end of the strip nearest the outlet **(3)**. That mark would align the first piece of wainscot.

Photos by Roe Osborn

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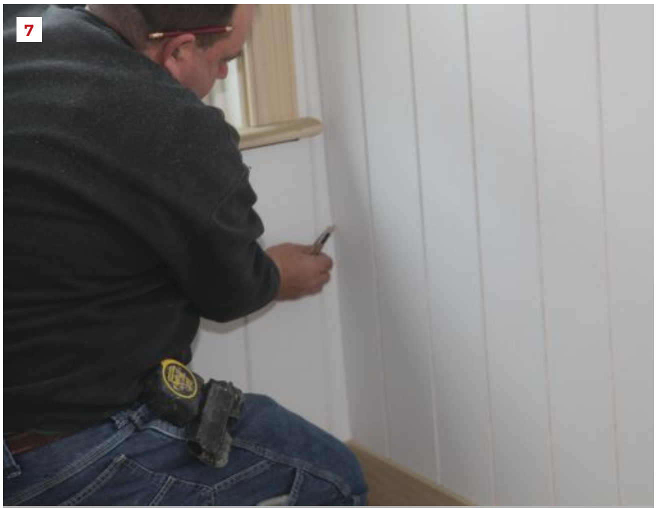

A lot of carpenters would start running the sheets at one corner and work their way across the wall. But with the layout set, I actually started by installing the piece that went around the outlet and one corner of a window. That piece would key in the placement of the rest of the pieces on the wall.

When you're installing sheet wainscot, it's imperative that each piece be installed perfectly level and plumb. Any slight variation will cause the other pieces to "stair step" along the base as they're installed. Our crew had scribed the baseboard to be perfectly level as it went in, which paid dividends when it came to installing the wainscot sheets.

I set the starter sheet of wainscot on the baseboard and lined it up with my mark. I then marked the edges of the window trim—along with both the side casing and the bottom of the apron. For the outlet, I slid the piece down the baseboard and marked the top and bottom of the electrical box. Then I measured from my layout mark to both sides of the box and transferred the measurements to the wainscot sheet **(4)**. This was one of the few times I used a measuring tape during the installation.

I made the cutout for the window by making passes in two directions on a table saw and retracting the blade when I'd reached the intersection point. For the outlet, I squared my marks and cut out the rectangle for the box with a jigsaw. With the cuts made, I dry-fit the piece and drew a pencil line along the perimeter **(5)**. I spread construction adhesive just inside the perimeter marks and then ran two or three beads across the width of the piece. Then it was just a matter of pressing the piece in place **(6)** and driving perimeter nails at each of the stud locations.

The next piece that I installed butted into the first piece and wrapped around the window. I measured over and ripped the piece to width on a table saw. Again I set the piece on the baseboard and scribed the end slightly to fit **(7)**. As before, I marked and cut out for the window and installed the piece. The rest of the pieces went in the same way, with factory edges abutting except at the ends.

The trim for this wainscot project was in three simple pieces: a 1x4 rail along the top of the sheet, a bull-nose cap, and a cove molding between the cap and the rail. Because the project would be painted, we used poplar for the trim.

For the rail, I cut a ½-inch-square rabbet in the edge of the 1x4 that covered the top edge of the wainscot. To find the length of each piece, I squared one end, set it in place, and marked the length on the other end. I put a bead of adhesive on the back of the rail and a bead of white glue in the rabbet and on the ends before setting the rail in place. I nailed one end and then leveled it across as I nailed it in **(8)**.

With the rail installed level, I set a laser on it. A crew member went around the room and marked the top of the rail at every door, window, and corner, to ensure that the rest of the wainscot would be at the same level all the way around the room **(9)**.

The bullnose cap came next. We'd ordered 5/4 bullnose stock for this project, but ripped it down to 2¼ inches so that it stepped nicely to the cove molding once everything was installed. Cap molding never looks right if it just butts into the casing, so I lap the ends a little. The end detail depends on the type of casing; on this project,

the casing started with a flat return about ½ inch wide. I made the return on the cap so that it ended on the flat part of the casing just before the rest of the profile began. Then I routed a bullnose on the return with a ½-inch round-over bit.

After making the detail at one end, I left the cap a little long and set it on the rail. I marked the overall length, as well as where the cap returned to the wall **(10)**, and I cut the return with a jigsaw. After rounding over the return, I set the cap back on the rail and scribed it to the wall **(11)**, remembering to subtract the same amount from the return. Then I glued and nailed it into place.

For cove molding, I always miter and glue returns onto the ends. For the best look, I let the long point of the cove end at the edge of the casing **(12)**. Again I cut the cove to length by putting a return on one end and setting it in place to mark the length.

The rest of the room was straightforward and most of it could be done without a measuring tape. I even have a way to do inside corners without measuring, but will leave that for another article.

Bill McGraw owns William McGraw Carpentry, a finish carpentry firm in South Yarmouth, Mass.

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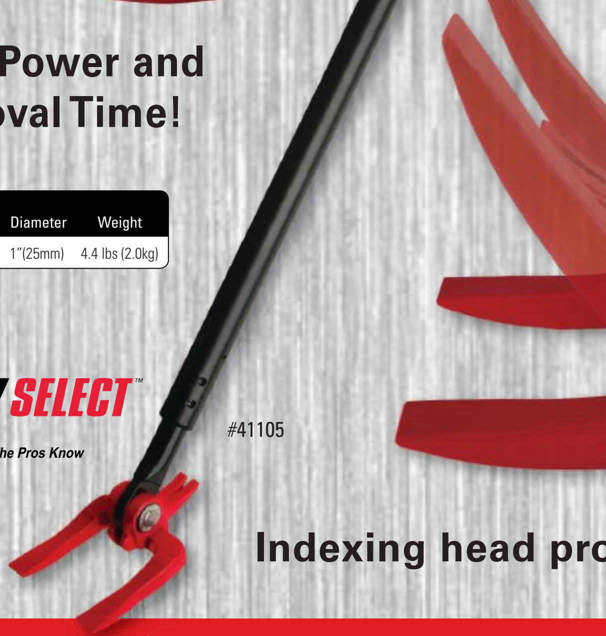

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BY MELANIE HODGDON

A Simple Math Error That Can Cost You

I was speaking recently with a contractor who was explaining his pricing structure to me. He charged a fixed hourly rate for labor, added a 10% markup to subcontractor costs, and added 15% to material costs. He confirmed that his supplier gave him the locally standard 10% + 5% discount. So he was getting the "10 and 5" discount, and then for his customer, he was applying a 15% "markup" to the discounted price, which in his mind brought the material price back to the retail price.

Let's leave aside the question of whether or not it's reasonable—because of the cost of selection, delivery, storage, security, and warranty—to expect customers to pay *more* than retail on materials (they probably should). The contractor's assumption—that adding 15% to a cost that has been discounted 10% + 5% brings it back up to retail—is both commonplace and incorrect. Let's see how the numbers work out.

We make two assumptions:

1. The project materials cost $100.
2. The discounts are successive; that is, first 10% is deducted from the retail price, and then 5% of that result is deducted.

In the charts below, you can see how the math works (or doesn't). The contractor's method (below left) actually results in his customer paying *less* than retail for materials. While this loss of $1.68 per hundred may seem trivial, the greater the materials cost for the project, the larger the loss. On a project with an estimated $50,000 in material costs, for example, the loss is $837.50.

Bear in mind that this loss comes directly from your gross profit, reducing the number of dollars available to cover overhead and contribute to profit. Think of it this way: A loss of $1.68 on $100 of materials represents a gross margin loss on materials of 1.68%.

If you're trying to increase your overall gross margin, then you want to make sure you're not giving customers a better bargain than the lumberyard would give them. You can do that by following the steps in the second chart (below right). On the larger issue of determining gross margin and correctly setting markup, see "Markup and Margin" (Aug/15).

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

Common Mistake With Discounts

Working Down From Retail Cost

Retail cost	**$100.00**	**$50,000.00**
10% discount	$(10.00)	$(5,000.00)
Retail cost minus first discount	$90.00	$45,000.00
5% discount	$(4.50)	$(2,250.00)
Discounted cost	$85.50	$42,750.00

Working Up From Discounted Cost

Discounted cost	$85.50	$42,750.00
Add 15% "markup"	$12.83	$6,412.50
Discounted cost with "markup"	**$98.33**	**$49,162.50**

Difference

Customer price vs. retail cost	$(1.68)	$(837.50)

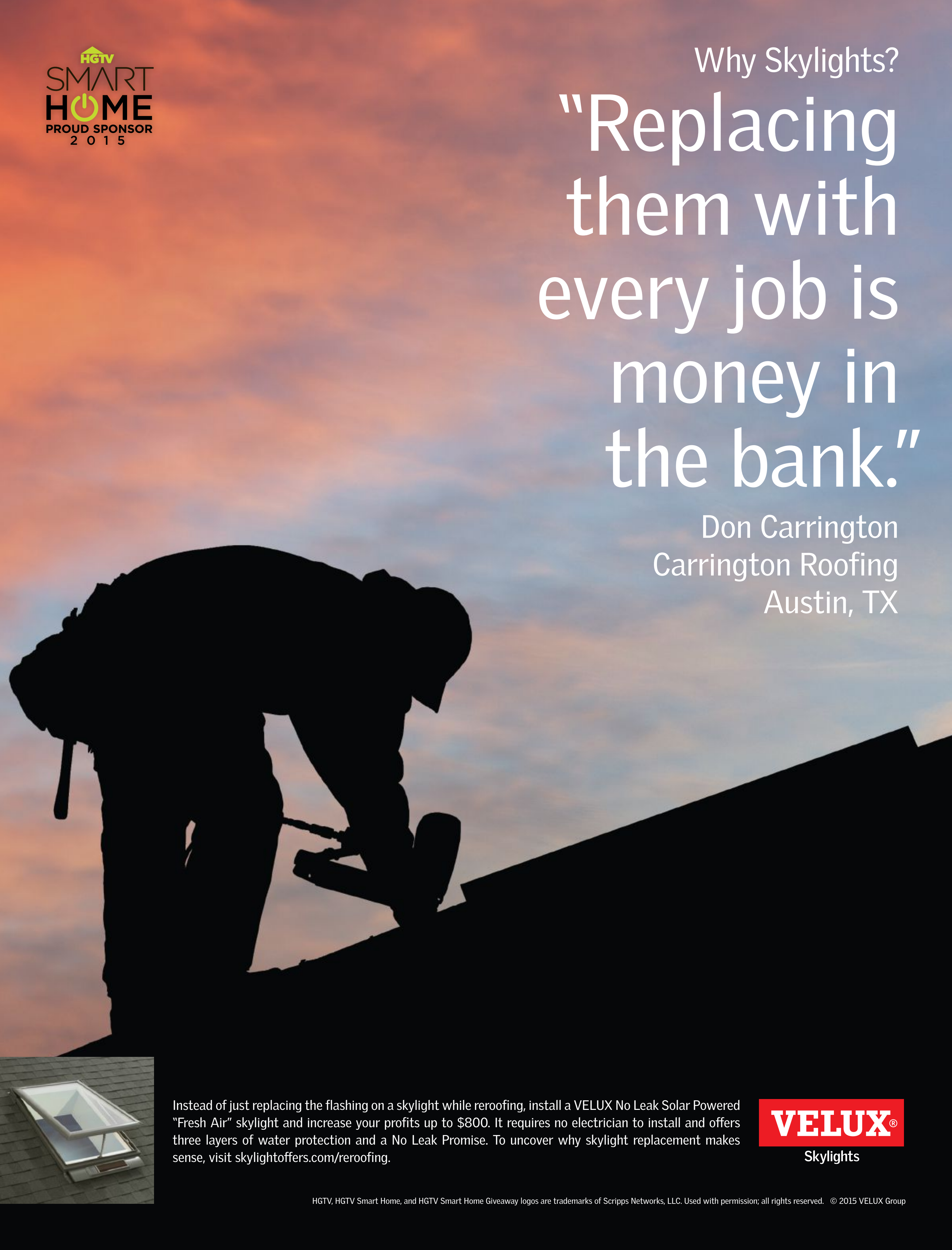
Right Way to Understand Supplier Discounts

Working Down From Retail Cost

Retail cost	**$100.00**	**$50,000.00**
10% discount	$(10.00)	$ (5,000.00)
Cost minus first discount	$90.00	$45,000.00
5% discount	$(4.50)	$(2,250.00)
Discounted cost	$85.50	$42,750.00
Actual total % of both discounts	14.5%	14.5%
Subtract total % from 100%	85.5%	85.5%

Working Up From Discounted Cost

Discounted cost	$85.50	$42,750.00
Divide discounted cost by 85.5%	**$100.00**	**$50,000.00**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BY TOMO TSUDA AND FRANK WOESTE

Photos by APA - The Engineered Wood Association

Controlling Floor Vibration

Home buyers naturally take for granted that the floor system in a new house is safe and complies with the building code—and rightly so. But home buyers also have expectations for their floors that are unrelated to safety or the building code. In particular, many home buyers are aware of their floor's "vibration" in response to foot traffic, which some people find annoying or disturbing.

In Canada, the building code includes limits on floor vibration. But U.S. codes don't regulate floor vibration. So most U.S. builders design for deflection only—typically by holding deflection due to live load to a maximum of L/360 (where "L" is the floor joist span), or perhaps a more restrictive L/480.

Unfortunately, however, code compliance does not automatically equal customer satisfaction. Some components of a floor system that greatly influence the floor's response to foot traffic—such as the presence of a ceiling, floor sheathing, supporting beams or girders, and partition walls—are not captured in the live-load deflection analysis required to satisfy the code.

To make things even more complicated, floor vibration is highly subjective: A floor that feels fine for one person may seem annoying to another. For example, the buyer who previously occupied a slab-on-grade residence may have a different performance expectation from the buyer who has been living in the upper levels of an apartment complex. Additionally, prob-

Live Load	40 psf
Dead Load	10psf

Improving Performance

Base System

OC (in)	Depth	Sheathing (in)	Span	Live Load Deflection	Pro Rating	% Satisfaction
12	11 7/8"	19/32	21'-1"	L/480	34	60
16		19/32	19'-3"	L/480	35	63
19.2		23/32	18'-2"	L/480	38	71
24		23/32	16'-11"	L/480	36	66

Glue+Nail Deck and Direct Applied Ceiling

Base System + Thicker Sheathing

OC (in)	Depth	Sheathing (in)	Span	Live Load Deflection	Pro Rating	% Satisfaction
12	11 7/8"	7/8	21'-1"	L/496	43	82
16		7/8	19'-3"	L/497	45	85
19.2		7/8	18'-2"	L/497	45	85
24		7/8	16'-11"	L/496	44	83

Glue+Nail Deck and Direct Applied Ceiling

Base System + One Size Deeper Joist

OC (in)	Depth	Sheathing (in)	Span	Live Load Deflection	Pro Rating	% Satisfaction
12	14"	19/32	21'-1"	L/684	42	80
16		19/32	19'-3"	L/680	44	83
19.2		23/32	18'-2"	L/679	45	85
24		23/32	16'-11"	L/675	44	83

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Base System + Thicker Sheathing + One Size Deeper Joist

OC (in)	Depth	Sheathing (in)	Span	Live Load Deflection	Pro Rating	% Satisfaction
12	14"	7/8	21'-1"	L/707	50	92
16		7/8	19'-3"	L/705	51	93
19.2		7/8	18'-2"	L/702	52	95
24		7/8	16'-11"	L/698	50	92

Glue+Nail Deck and Direct Applied Ceiling

Above is one example (for TJI 210 series joists) drawn from the output of the TJ-Pro Ratings System. Increasing joist depth or increasing sheathing thickness improves the floor response. Increasing both at once leads to a very high rate of customer satisfaction. But as the live-load deflection numbers indicate, reducing vibration requires that joists be much stiffer than required by code.

lems not related to floor vibration, such as squeaks or sound transmission between rooms, often create the perception of poor vibration performance.

Subtle changes in floor usage or joist spans may also result in floor performance complaints. One common problem area is a kitchen with an island, where a homeowner may notice rattling dishes or ripples in a glass of water. A change in joist span at a bay window may also be a trouble spot, even if the difference in spans would seem to be slight. A short stiff member will make the longer spans feel softer.

Laboratory research at Virginia Tech has shown that customer perception of floor vibration is related to the frequency of the vibration. Using test floor systems built in the lab, researchers found that people were particularly sensitive to vibrations of about 8 or 10 Hz (cycles per second). At higher fre-

Framing a floor using deeper I-joists at wider joist spacings, but upgrading the system with thicker sheathing, can minimize floor vibration. The added materials cost may be partially offset by labor savings, and the deep, wide joist cavities allow ample space for mechanicals.

quencies, vibrations were perceived as less annoying. Field investigation in real homes confirmed that occupants were not bothered once the vibration frequency went above 14 Hz.

To help designers and builders avoid complaints and callbacks, Weyerhaeuser (which manufactures Trus Joist TJI wood I-joists) has developed a floor analysis system called the TJ-Pro Ratings System. The software includes algorithms that correlate floor vibration with customer satisfaction by modifying elements a designer and builder can control, including joist depth, joist span, joist series, on-center joist spacing, floor sheathing thickness, and ceiling drywall thickness. The software also correlates floor vibration with customer survey data, allowing the app to assign a customer-perceived quality rating to any floor design. The higher the TJ-Pro Rating, the greater the percentage of customers who will find the floor satisfactory.

Rather than learn by trial and error—by building homes and then responding to callbacks—the user of this software gets a whole set of "knobs to turn" during the design phase. By knowing the home buyer's expectation of floor performance in terms of a simple probability number, builders and designers can reliably design floor systems that are likely to satisfy the customer.

The table shown on the facing page provides an example. The base case is a floor system designed to meet the building code, with 11 ⅞-inch joists at four different on-center spacings and code-compliant floor sheathing for those joist spacings. The next three cases show the results from turning two of the available knobs: joist depth, and floor sheathing thickness. As you can see, increasing the joist depth greatly improves the customer satisfaction rating. But you can achieve a comparable degree of improvement by increasing the sheathing thickness, without increasing the joist depth. And if you increase both the joist depth and the sheathing thickness, you can achieve a level of customer satisfaction approaching 100%.

The deeper I-joists and thicker subflooring panels in this improved floor system may add to the materials cost. But labor savings could counteract some of that up-charge. APA - The Engineered Wood Association is currently promoting floor designs using deeper wood I-joists at wide spacings with thicker sheathing, calling the system a "premium floor assembly." As APA points out, such a floor requires framers to handle fewer pieces of lumber, and uses fewer tubes of subfloor adhesive and fewer fasteners than a floor with lesser joist depth and closer on-center spacing.

But keep in mind that the floor joist assembly may not be the only factor that affects floor vibration. Researchers at Virginia Tech reported that a floor with very good performance on its own may show unsatisfactory performance if it is supported by a girder or a partition wall that doesn't perform up to the same level. Framing workmanship can be a factor: Where joists are attached to the face of a girder, small gaps between the joists and joist hangers can affect the whole system's vibrational response to footfalls. By the same token, if multi-ply girders are not built up with sufficiently long nails or structural screws to distribute the impact forces to all plies of the girder, the whole girder-and-joist assembly may vibrate at a bothersome frequency because of the flexible nature of the poorly connected outside ply.

Supporting wall construction can be a similar quality issue. If mid-span supporting walls under a floor aren't sheathed, the "give" in the wall studs may have a vibrational response frequency that creates a subjective quality issue. Applying drywall to those studs will brace the studs against lateral vibrational movement; but gaps between wall plate members could also allow a noticeable vibration response. In the case of a kitchen with an island, blocking may also be helpful to ensure that the joists evenly support the load, in order to mitigate any differential deflection and resulting "tipping" motion of the island. These quality issues may not be predicted even by a sophisticated tool like the TJ-Pro Ratings System. So to avoid callbacks and problems, it's still important for builders to pay attention to their own field experience and to adjust their construction quality measures accordingly.

Tomo Tsuda, P.E., P.Eng., is the Manager of Product Applications and Building Codes at Weyerhaeuser, based in Federal Way, Wash. Frank Woeste, P.E., Ph.D., is Professor Emeritus and Adjunct Professor of Sustainable Biomaterials, Virginia Tech University.

BY TED CUSHMAN

Understanding "Smart" Vapor Retarders

The days when every builder stapled 6-mil poly to the inside of every exterior wall are long gone. Experience in the 1980s and 1990s made it clear that in many situations, impermeable plastic on the inside face of a wall caused trouble rather than preventing trouble.

So in this century, codes have evolved. And in today's world, recommendations for what building scientists are now calling the "vapor control layer" have become considerably more refined. Depending on the climate and the other materials involved in the wall or roof assembly, a designer could choose to specify either an impermeable material, a semi-permeable material, or a vapor-open material on the inboard side of the assembly.

And for tricky situations, builders now have a new class of materials to work with: the so-called "smart" or "intelligent" vapor retarders. Several products in the market today have "variable permeability"—they are relatively vapor-closed when exposed to air that is relatively dry, but become increasingly vapor-open when exposed to more humid air. CertainTeed supplies a smart vapor barrier called MemBrain. ProClima manufactures two smart vapor barriers, trademarked Intello and DB. And Cosella-Dorkin has plans to introduce another product—trademarked Delta-Sd-Flexx—in this class to the U.S. market next year (along with a reinforced version of the material called Delta-Novaflexx).

But you don't necessarily need to buy one of these advanced membranes to achieve variable vapor permeability. The Kraft-paper facing on old-fashioned fiberglass batts also has variable permeability: Like MemBrain or Intello, the facing opens up in humid conditions and closes down in dry conditions. But the range of permeability shown by Kraft facings is narrower than the range achieved by materials designed with that characteristic in mind. So depending on the conditions, and on the performance requirements, choosing a smarter membrane may be a smarter move.

If you want to use these materials correctly, however, it helps to understand how they work. And while suppliers are enthusiastic about their products, they're not always clear about how, when, and why the materials change permeability in service. In the field, you may hear salesmen as well as contractors offering a whole grab bag of unscientific theories.

Contrary to what you may hear, this class of vapor barriers is not a one-way gate that lets vapor pass through in only one direction. Vapor diffusion through a smart membrane, like vapor diffusion in still air, moves from more humid to less humid: The water vapor on the humid side of the membrane moves through the material into the air on the dry side. If the humidity conditions reverse—if the vapor drive changes direction—so does the direction of vapor diffusion.

Products on the market today also don't have "active vapor transport." That term refers to materials that can move vapor through the material against the direction of vapor drive—what you might call "uphill"—when a voltage is applied to the material. That might be a useful property in a membrane, but that's not what MemBrain or Intello do.

And smart vapor barriers also don't necessarily "open up" in summer and "close down" in winter. If summer conditions are humid and winter conditions are dry,

Photo: Nate Dorr

A technician for J's Custom Contracting installs Intello smart vapor barrier on the ceiling under the low-slope roof of a Brooklyn, N.Y., row house. Flat roofs, which are tricky to vent, are one case where smart membranes can be problem solvers.

that is what will happen; but if humid indoor conditions should happen to occur in winter—say, because the membrane is installed next to a humid bathroom—the material will become vapor-open and let moisture through. That could create problems in the wall.

And despite the nickname, smart vapor barriers don't "sense" moisture. They're not really intelligent. They don't have a brain, or even a nervous system. They just undergo a physical change when the material absorbs moisture from the environment, allowing a greater number of water molecules to migrate through the material at a faster rate.

In the case of wood-fiber-based materials such as Kraft paper or ProClima DB, this material change is related to the way water vapor bonds to cellulose fibers. Once the paper has reached "fiber saturation point," vapor doesn't stick to the fibers, but passes more readily through. MemBrain, which is a "polyamide" (nylon) film applied to a reinforcing material, and Intello, which is a specially tailored plastic composed of polyethylene blended with a softer "copolymer," behave a little differently from paper. But the effect is the same: As more vapor is deposited on the material and absorbed into it, the pathways that water follows to diffuse through the material become more open, allowing a faster rate of diffusion.

How open the material gets under humid conditions, and how closed it becomes under dry conditions, varies from brand to brand. So does the shape of the "vapor curve" that defines the material's permeability across the whole range from zero to 100% relative humidity. Matching the material to the situation based on that profile is an art, and the choice of material will typically depend on the requirements of the building design, as well as on the project's budget.

Kraft paper is the "poor man's smart vapor barrier," as Vladimir Kochkin, Director of Applied Engineering at the Home Innovation Research Labs, phrased it recently. In many cases, Kraft-faced batts in a wall are a cheap way to take that wall out of the condensation danger zone—as Kochkin and his colleagues have shown in test wall assemblies at the lab's Maryland facilities.

A worker installs CertainTeed SmartBatt fiberglass batts into a stud cavity in this photo supplied by CertainTeed. Applied in this manner, the product helps manage vapor diffusion, but will not serve as an air control layer.

But in more challenging cases, builders may want to step up to an engineered material with a known vapor-permeability curve. For example, Canadian builder Doug Tarry turned to MemBrain to solve a basement moisture problem where condensation was occurring on a code-required poly vapor barrier on the inside of a finished basement stud wall. Using MemBrain on the upper half of that wall let the stud cavities dry into the basement as needed, but kept interior basement moisture from traveling into the wall.

Building scientist John Straube, who consulted with Tarry on what Tarry is now calling the "Optimum Basement Wall," said the smart material really solved a building official problem, not a building science problem. Straube said he would have preferred using rigid foam in the wall assembly. Straube also prefers exterior foam insulation to smart vapor barriers as a solution to condensation concerns in above-grade wood stud walls. But the MemBrain did solve Tarry's problem, just as it could solve above-grade moisture problems if a builder has other reasons not to use foam.

For other situations, builders may prefer to spec Intello because of its wider range of response. Based on industry data, Intello closes down tighter than other products in dry conditions and opens up wider in humid conditions—which may be required in some cases to sufficiently prevent wall wetting and allow wall drying. If you're in a situation where the difference between Intello and MemBrain is significant, however, you'd be well advised to have an expert analyze your assembly using an advanced simulation software such as WUFI, to give yourself some confidence that the results are going to be what you intend.

Ted Cushman is a senior editor at JLC.

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A Builder's Guide to Safe Stairways

Building codes set limits for safety but do not necessarily address comfort

BY JLC STAFF

Article removed for updating

Building codes—namely those from the International Code Council as well as the state and municipal codes adapted from it—provide clear limits for safety. If you stay within these limits, the stairs you build will have a low probability that the people using them will [illegible] not the same as a [illegible] set of stairs.

It's tricky. Safety and comfort are intimately linked. If occupants are at ease climbing or descending a set of stairs, they are less likely to overexert themselves and take a misstep that leads to a fall. Following code helps you avoid this liability, but it won't necessarily guide you to a comfortable set of stairs.

All the details in this article conform to code. We've relied on the code interpretations in the SMA's *Visual Interpretation of the Stair* [illegible] source that's available [illegible] stances, we've noted changes introduced by the 2015 IRC. And where relevant, we've gone beyond code to provide recommendations from veteran stair builders on where to focus within code limits to build comfortable stairs.

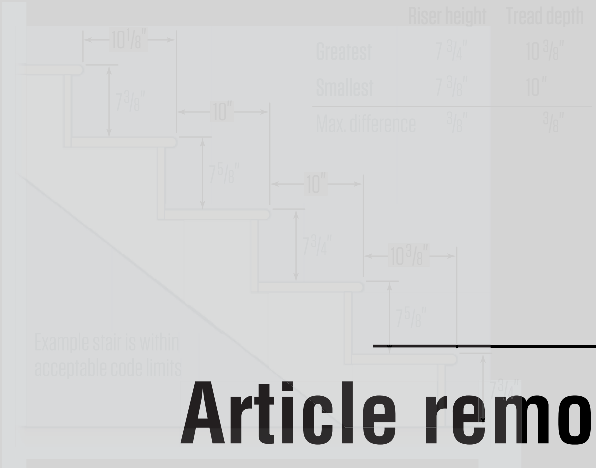
Safe Angles for Stairs

Studies evaluating the safety of stairs show that stair angles between 30 and 35 degrees result in the fewest missteps and are considered the most comfortable to climb. This angle (measured at a line across the step nosings) is a function of riser height and tread depth, which is spelled out in the code.

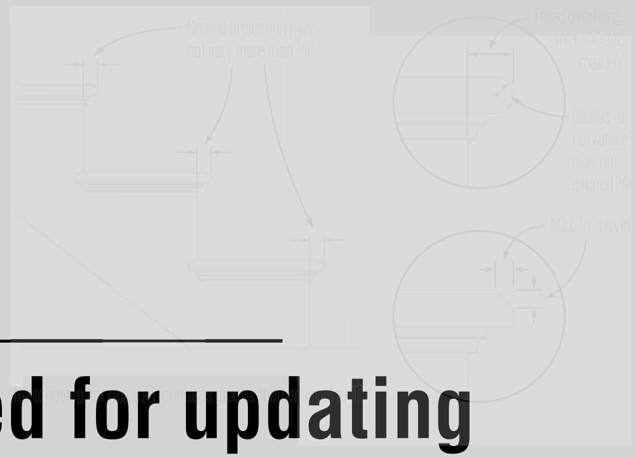
"Rules-of-Thumb" vs. Code

The steepest residential stair allowed by code has 7¾-inch risers and 10-inch treads, but this is not necessarily the most comfortable stair. For comfort, use the rules of thumb within the code limits. Two "classic" stairs follow the 25-inch rule: a 7½-inch-riser, 10-inch-tread stair (not shown), common in many residences; and a 7:11 stair—the usual commercial stair, owing to the maximum 7-inch riser required by the IBC.

Tread and Riser Variation



Nosing Variation and Types



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The most significant cause of stair trips is variation in riser height. The building code allows for 3/8-inch variation in the width of a tread or the height of a riser *over the entire flight*. This does *not* mean +/- 3/16 inch from one tread or riser to the next. Try to keep that to less than 1/8 inch.

A nosing is required only on treads less than 11 inches. When required, the code specifies an overhang of not less than 3/4 inch and not more than 1 1/4 inches; these overhangs can not vary more than 3/8 inch. To prevent slips off that leading edge, code also limits the nosing's radius and bevel.

Stairway Widths

Headroom and Maximum Vertical Rise

The minimum clear width for any stair is 36 inches. In this case, “clear width” does not account for handrails that might encroach into the path of the stairs. But the amount either one or two handrails can encroach is strictly limited.

New to the 2015 code is an increase in the minimum height of a single flight of stairs. This will help with taller first floors, eliminating the need to resort to a landing—and chew up more floor area—as long as the required headroom is maintained.

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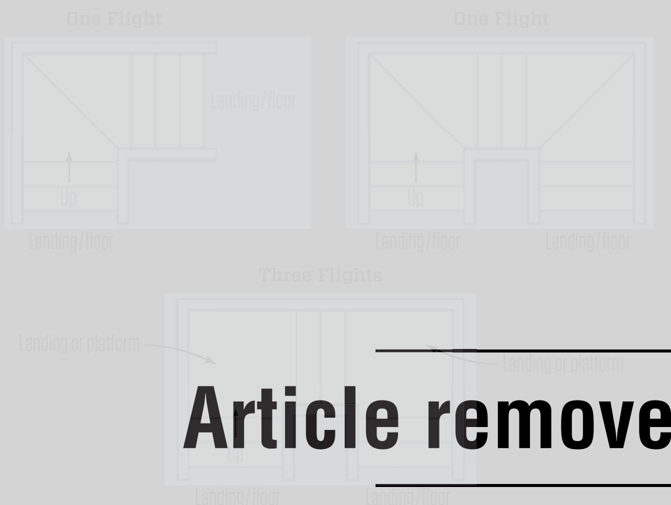
“Flight” Definition



The code defines a flight of stairs as a continuous run of treads between landings. This definition affects a number of other rules, including riser and tread variation (facing page). If a step varies by more than 3/8 inch within one flight, it might need to become a “landing” and meet that minimum area (see page 30).

Tread Depth and Riser Height

The depth of a tread is measured from nosing to nosing, and the height of a riser from finish walking surface to finish walking surface. It’s these dimensions that must meet the maximum variability requirement (facing page), but the depths of rectangular treads and of winder treads can vary.

Walklines and Winder Treads

Winder treads are nonrectilinear treads. The depth (measured nosing to nosing) must never be less than 6 inches and must be at least 10 inches at the “walkline” (a line 12 inches in from the inside edge). Winder treads don’t have to be the same depth as the rectilinear treads in the same flight, but all the winders in the same flight may not vary more than 3/8 inch from each other. For example, you can’t have two winders at one turn and three at another within the same flight.

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Landing Widths

A landing must be at least as big as the stairs it serves. (The minimum width of a stair is 36 inches.) When flights vary in width, each side of the landing must be at least as wide as the flight it serves.

Nonrectilinear Landings

New in 2012, curved and other non-rectilinear landings are allowed if the total area equals at least the area of a quarter circle with a radius of the stair served (1,018 sq. in. for a 36-inch stair).

Minimum Handrails Required

Whether a stair is open or is enclosed by walls, one handrail per flight is required in single-family homes. Multifamily dwellings and public areas in condo dwellings typically require two.

Handrail Height

Code allows handrails as high as 38 inches, but for many this isn't comfortable. Stick to 34 inches. People are more likely to fall down a stair than over the handrail; make it easy to grasp.

Starting Newels

Over the first tread only, volutes, turnouts, and easements are an exception to the handrail height requirement and the return requirements allowed by the IRC.

Handrail Fittings

Anywhere a handrail fitting is used to maintain handrail continuity, an exception to the height requirement applies. The fitting can bump up above the handrail height.

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Handrail Continuity

Newel Interruption

Every handrail must run continuously along each flight from the top riser to the bottom riser. It can't stop and start at a jog in the wall unless you put in a newel post at the turn (right) or create separate flights of stairs with a landing. (Check local codes. Some municipalities may allow an interruption for a jog less than 6 inches.) Wall-mounted handrails must return to the wall at each end and be spaced at least 1 1/2 inches from the wall.

Guard Height

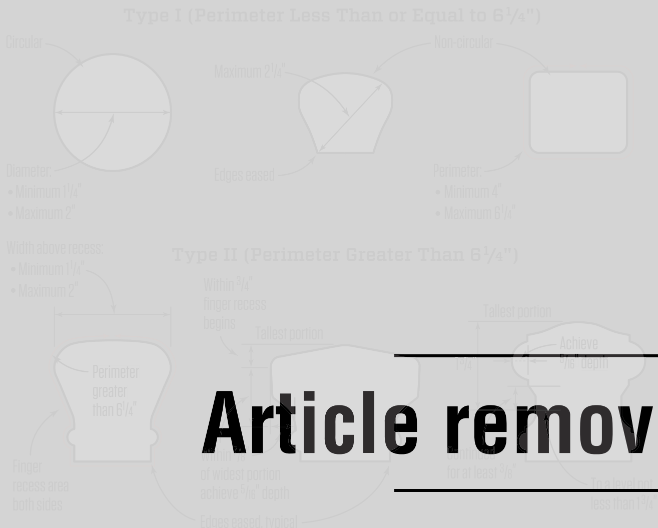
Opening Limitations

Stair Guardrails

When a banister runs horizontally across a landing or balcony, the balusters in the guard below the rail must be spaced close enough to prevent a 4-inch-diameter sphere from passing anywhere between them.

Along the raked run, openings in the guard below a handrail can be a little wider. Balusters must be close enough to stop a 4 3/8-inch-diameter sphere. If a bottom rail exists, it must be positioned to stop a 6-inch sphere anywhere along the tread.

Handrail Types



Equivalent Graspability

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Code classifies handrails as either Type 1 or Type 2, based on the size of the perimeter. Conforming Type 1 handrails are either circular (within minimum and maximum diameters) or noncircular, in which case, they must meet the size limits noted above. Type 2 handrails largely feature well-defined finger recesses.

A code official may require you to demonstrate "equivalent graspability" for handrails that don't meet the strict definitions of a Type 1 or Type 2 handrail. The top rail would likely pass without exception, but the bottom one would only pass if an inspector allowed it.

Stairway Illumination

Glazing Adjacent to Bottom Landing

Unless stairway lights are continuously on or automatically activated, interior stairway lights must be controlled from both the top and bottom of each stairway consisting of six or more risers. For 2015, on an exterior stairway, the light switch must be located inside the dwelling.

The 2015 IRC clarifies the location for safety glazing near a bottom landing. The idea is obvious: Keep someone who falls down the stairs from crashing through a window. It applies to windows flanking the bottom landing, as well as to the one directly in front of the stairs.

FASTENERS SIMPLIFY
WIND-UPLIFT RESTRAINT

Building homes and structures with a continuous load path in regions of the country susceptible to high winds can now be accomplished from inside the structure with easy-to-install fasteners.

Tried-and-true metal connectors, fasteners and anchors are traditionally used as a system to connect the roof, floors and foundation together. But now there's another choice. Simpson Strong-Tie offers two structural fasteners designed for wind-uplift restraint: the Strong-Drive® SDWF Floor-to-Floor screw and the Strong-Drive® SDWC Truss screw.

There are several key benefits to using structural fasteners for continuous load path connections, including:

- Fast installations *(significantly fastener than traditional methods)*
- No predrilling
- No interference with finish materials
- Floor-to-floor framing alignment is not critical
- Ease of installation: The SDWC and SDWF install from inside the structure, eliminating exterior work on upper stories

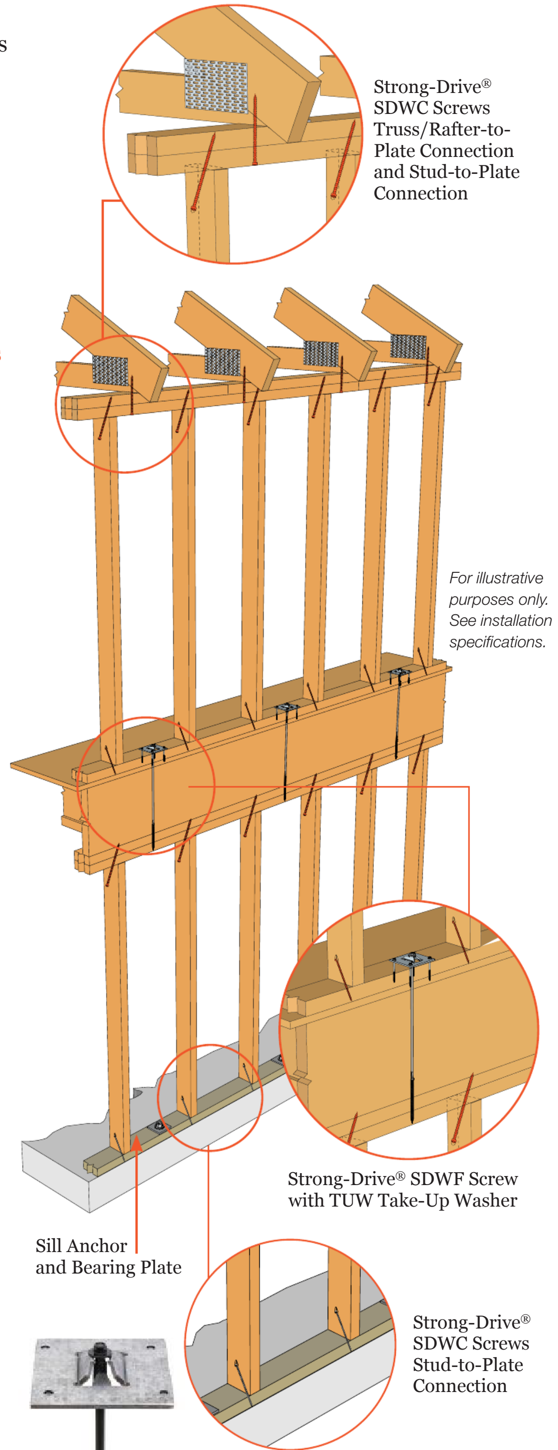
Wind-Uplift Restraint

The Strong-Drive SDWC Truss screw provides a stud-to-bottom-plate or stud-to-top-plate connection and can be used to fasten trusses and rafters to top plates. It is designed to simplify continuous load path connections at the roof and foundation. The SDWC is available in a kit that includes 500 screws, two driver bits and two metal installation guides. The SDWC screw is code compliant (IAPMO-UES ER-262) and is for interior use only.

The Strong Drive SDWF Floor-to-Floor screw attaches upper and lower walls together from the top, spanning the floor system to create a strong connection between floors. When used with the TUW take-up washer, the SDWF screw simplifies the floor-to-floor wind-uplift restraint connection.

The patented TUW take-up washer plays a key role in the long-term performance of the SDWF Floor-to-Floor screw when installed between the screw and the sole plate of the upper floor. As the structure settles because of shrinkage and construction loading, the threaded portion under the head of the screw ratchets up through the tabs of the TUW. The interlock between the tabs of the take-up washer and the threads under the head of the SDWF screw prevents the screw from sliding back under load. This provides a simple yet reliable means of shrinkage compensation for up to ¾" per story. The SDWF screw is code compliant (ICC-ES ESR-3046), as is the TUW take-up washer (ICC-ES ESR-2320)–both are for interior use only.

When used together as a system with anchor bolts at the foundation, the SDWC and SDWF screws are a reliable, safe and economical solution for creating a continuous load path and resisting wind uplift. To learn more, call (800) 999-5099 and visit **strongtie.com/sdwc.**



"When used with the TUW take-up washer, the SDWF screw simplifies the floor-to-floor wind-uplift restraint connection."

Prepping for Tile

Lightweight foam board, synthetic membranes, and mortar are all you need for a watertight tile shower

BY TOM BOUCHER

Photos by Ted Cushman

I've been a tile contractor in Maine for 27 years. I've tiled a lot of showers and baths using cement backerboard, and I've set a lot of shower floors in mortar beds. About 10 years ago, I switched to using waterproofing components from Schluter Systems. Initially, I installed the Kerdi waterproofing membrane over cement backerboard and underlayment. Then Schluter introduced Ditra floor underlayment and the Kerdi Shower System. More recently, Schluter has introduced Kerdi-Board tile backerboard, and accessory components like linear drains and recessed wall shelves.

When Kerdi-Board first came out, I was tiling two bathrooms on the third floor of a house. I finished the first bathroom using cement backerboard, and then I did the second one with Kerdi-Board. I've never looked back. I'll never carry another piece of cement board up a flight of stairs. With this lightweight system, guys like me will be able to set tile into our 80s.

Here's how I prepped a whole bathroom for tile using this system last summer, including shower walls, a shower curb, the bathroom floor, a linear drain, and a pair of recessed shelves.

The author cuts 1/2-inch-thick pieces of Kerdi-Board to size using a utility knife **(1)**, then fastens the board to the shower wall framing using screws and special toothed washers **(2)**. He applies unmodified mortar to the joints using the 1/8-inch notched Kerdi trowel **(3)**, then presses Kerdi-Band membrane into the mortar to waterproof the joints **(4)**. He will also apply mortar and Kerdi-Band to the washers and screws used to attach the Kerdi-Board in the field.

SHOWER WALLS

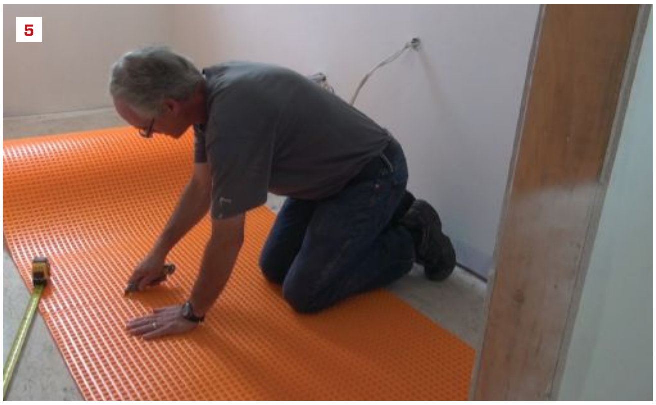
Kerdi-Board is pretty flexible, and it will conform to the framing. So before I start screwing Kerdi-Board to the shower walls, I always check the wall framing to see if it's good and flat. If I find any high studs, I plane them down with a power planer to flatten the wall. Any low spots are easier to deal with while I'm tiling the wall later, just by adding a little thickness of mortar and screeding it flat.

Kerdi-Board cuts easily with a utility knife, and it's marked with a grid of lines at one-centimeter spacing that make it very easy to measure and mark. Every 10 centimeters, which is almost exactly 4 inches, is a darker line, which makes it easy to locate 16-inch on-center spacing—this comes in handy for hitting wall studs with screws.

I fasten the Kerdi-Board to the wall studs with 1 5/8-inch galvanized screws, using special washers. The washers have teeth that poke through the face of the board, so you can place as many washers as you like before you start to drive screws. At joints between two boards, the washers span over the crack and catch two boards, so you need only one screw at the seam.

Once the board is attached, we waterproof the assembly by covering the seams and the screws with Kerdi-Band membrane. I mix up a batch of unmodified mortar and trowel it into the face of the board—as always, grinding a thin coat hard into the face of the board before going back to apply the correct thickness using the 1/8-inch notched trowel.

I use a thinner, looser mortar mix for applying Kerdi-Band than I would for setting tile because I want to be able to squeeze it out readily when I press the Kerdi-Band down. For pressing the Kerdi-Band into the mortar, I use a 6-inch drywall knife. I've ground down the sharp corners on this knife because the last thing I want to do is rip the membrane while I'm smoothing it.



The author cuts Ditra floor membrane with a utility knife **(5)**; combs out a measured amount of mortar using a trowel with 1/4-inch notches **(6)**; lays a sheet of Ditra into the fresh mortar **(7)**; and applies a strip of Kerdi membrane to the joint between two sheets **(8)**. Modified mortar prepared using an acrylic latex admixture bonds the Ditra to the Advantech subfloor, but unmodified mortar is used to adhere the strips of Kerdi membrane to the Ditra.

BATHROOM FLOOR

Ditra floor underlayment is an uncoupling membrane. The membrane is mortared to the subflooring, and the tile is then mortared to the membrane. The pockets in the membrane lock the mortar in, but the corrugated material itself is pliable enough that any expansion or contraction of the subflooring won't be transmitted through and crack the tile. As good as this system is, you still need a strong, stable subflooring—it has to be plywood or OSB. Sawn-lumber floors are too unstable for tile, even with the decoupling material in between. (I also use Ditra for tile over concrete floors.)

Before I apply mortar, I clean the subfloor with water and a scrubbing sponge. Dirt or fine drywall dust would interfere with the bond between the mortar and the subfloor. Sponging the floor with water also hydrates the wood, so it won't suck water out of the mortar too quickly and prevent a good, strong cure.

Then I mix up a batch of mortar, using an acrylic latex admixture instead of water. The admixture keeps the mortar from drying out into the subfloor before it can set up and cure, ensuring a better bond. I apply a thin layer of mortar to the subfloor, pushing down with the flat edge of the trowel to work the mortar into the plywood. Then I apply more mortar to the floor, using an appropriate notched trowel to apply a measured amount. You need to hold the trowel at a steep angle—too shallow, and your mortar coverage will be too thin.

The underside of the Ditra is covered with a fine fleece mesh. After I lay the membrane into the fresh mortar, I go over the floor with a concrete finishing trowel, pressing down hard to work the mortar into the fleece and create a mechanical bond.

Once the sheets of Ditra are set, I apply mortar to any joints between the sheets with a 1/8-inch trowel, and seal the joints with Kerdi-Band membrane. For this, we use unmodified mortar—the modified mortar would take too long to set up between the impervious layers of Ditra and Kerdi-Band.

The author cuts two pieces of 2-inch-thick Kerdi-Board to length **(9)** before bonding them together with unmodified mortar to make his shower curb. He applies a measured amount of modified mortar to the subfloor **(10)**, combing it out with a ¼-inch notched trowel. After pressing the curb into the mortar and allowing the bond to cure overnight, he applies unmodified mortar to the curb using a Kerdi trowel with ⅛-inch notches **(11)**, then presses Kerdi membrane into the curb **(12)**.

SHOWER CURB

Kerdi-Board is an impervious extruded polystyrene (XPS) foam sheet faced with waterproof polyethylene. It comes in eight different thicknesses, from 3/16 inch up to 2 inches. Using the thicker material, we can construct anything from shower curbs like this one to stem walls or even shower benches.

In this case, I was making a curb for the shower, which would later get a sloped floor pan and a linear drain. I started by ripping two pieces of 2-inch material to 4 inches wide, beveling the edges slightly so that my curb would drain after we capped it with marble. Next, I troweled unmodified mortar onto the faces of the pieces. As always, I worked the mortar into the faces with hard pressure before applying a measured amount of mortar using the ¼-inch notched trowel. Finally, I set the two halves of the curb together and applied pressure. I set the piece aside to cure overnight.

The next day, I troweled modified mortar onto the subfloor and set the curb on edge at the shower opening, pressing it firmly into place. The whole process of building the curb, aside from waiting for the mortar to set, took only a few minutes.

Later, after the shower pan was installed, I waterproofed the assembly. I applied unmodified mortar using the ⅛-inch notched trowel, then cut a piece of Kerdi membrane to size and laid it over the curb, overlapping the joints between the curb and the adjacent floor underlayment and shower pan. I pressed the Kerdi into the mortar, pressing until I could no longer see the grooves made by the notched trowel, to ensure a good bond.

This curb is made with lightweight material, but don't think it isn't strong. I recently did a job where the homeowner came by for a visit after we had tiled the shower—and decided that the shower was too small. So the builder had one of his laborers tear our work apart. You would not believe the time he had getting that shower curb out, once we had it mortared in. He was not having fun.

The author attaches a PVC pipe fitting to the Kerdi-Drain linear drain using a FernCo coupling **(13)**, then test-fits the drain to the pipe stubbed up under the floor **(14)**. Next he applies modified mortar to the Advantech subflooring **(15)** and sets a polyethylene foam support into the fresh mortar **(16)**. This piece will supply firm support to the linear drain and bring the drain flush with the sloped Kerdi-Board shower floor pan.

SHOWER PAN AND DRAIN

Recently, Schluter introduced a linear drain component, Kerdi-Line, along with a sloped shower-pan component made of polystyrene and faced with integrated Kerdi waterproofing. This makes it easy to install a linear drain, which many customers prefer.

With this system, the shower floor is one sloping plane (as opposed to a floor with a center drain, which has four planes that intersect). This means we can use larger tiles on the floor, so it gives us more freedom in tile design. In this bathroom, I used 9-inch-by-18-inch tile for the shower walls, and I was able to use the same size tile on the shower floor. If you have a center drain, you can't use such big tiles—the biggest floor tile you can get away with is about 3 inches square. Any larger, and the floor will have tile corners sticking up at the intersection of the floor planes.

This particular shower job had a few wrinkles. As a rule, it's best if the plumbers on the job leave the roughed-in shower drain pipe dry-fit in the P-trap under the floor, but not glued in place. That way, all we have to do is pull out the piece of pipe, attach it to our linear drain with a rubber FernCo fitting, put some PVC cement on the end of the pipe, and stick it back into the P-trap.

But the plumbers on this job had never worked with us before, and they glued the stubbed-up pipe into the P-trap. We had to cut the pipe to length in place, attach a coupling to our linear drain, and then glue the coupling to the drain pipe. That slowed us down a bit.

Generally I like to test-fit all the plumbing elements first, before I apply any mortar to the floor. Then I mix up a batch of modified mortar, work a thin coat of it into the floor as always, and apply a measured amount of mortar using the standard ¼-inch notched trowel.

Next I place the foam drain support that Schluter supplies with

The author sets the tapered Kerdi-Board shower pan into the freshly applied latex-modified mortar **(17)**, then trims the corners of the linear drain's pre-applied Kerdi membrane **(18)**. He trowels unmodified mortar onto the waterproof facing of the pan **(19)**. After applying PVC cement to the linear drain's collar and setting the drain in place, he presses the drain's pre-applied membrane into the fresh mortar, then covers the cut corners with preformed Kerdi corner pieces **(20)**.

the linear drain. This piece is firm, but flexible. It cushions and supports the drain.

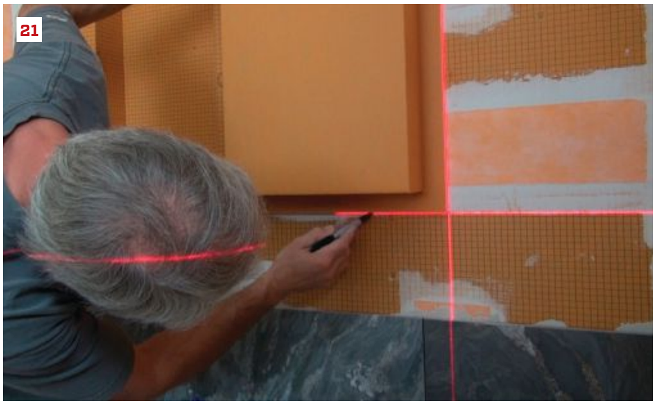
I had previously cut the tapered Kerdi shower pan to size for the shower floor. The thin end rests against the drain support, and the thick end abuts the far wall of the shower, away from the drain. I like to set the pan into the mortar, put a piece of cardboard over it for protection, and then walk around on it to work it into the mortar. Usually, I pull it up again to make sure there's good mortar coverage, add mortar if needed, then set it back in place.

The Kerdi-Drain comes with integrated waterproofing Kerdi membrane already attached. To install the drain, I first apply mortar to the support and the shower floor pan, then put PVC cement on the plumbing pipes, set the drain in place, and hold it for 30 seconds while the glue sets up. Then I work the waterproofing membrane of the drain assembly into the fresh mortar.

Schluter has recently started supplying the drain supports with several pre-applied strips of double-faced tape. I'm careful to avoid the tape when I apply mortar to the support. When I press the linear drain down onto the support, the tape helps hold the assembly together while the glue and mortar set.

Instead of folding the bonded flange membrane into the corners of the shower, I cut out the excess material. That way, the corners won't end up with multiple layers of membrane that would cause the tile to stick up. Schluter supplies preformed Kerdi-membrane inside corners, which I use to cover the corner cuts in the drain membrane. I install those the same way I apply Kerdi-Band at floor or wall joints: I apply unmodified mortar with the ⅛-inch trowel, press the membrane into the mortar, and apply pressure to smooth down the trowel grooves and ridges and ensure good contact.

Whenever I overlap Kerdi waterproofing elements in this way, I follow Schluter's instructions and create at least a 2-inch overlap. That's enough to ensure a watertight joint.



Guided by a laser level, the author traces the outline of a preformed recessed shelf box on the already waterproofed wall **(21)**, then cuts out a section of Kerdi-Board and removes it **(22)**. After setting two boxes into two adjacent stud cavities, he fastens the boxes in place with screws and washers **(23)**. He applies mortar over the joints between the boxes and the wall, then presses a large sheet of Kerdi membrane into the mortar before cutting out the box openings with a knife **(24)**.

RECESSED SHELF

In the past, when we made recess boxes for shower shelves, we had to frame in a box between the studs with 2x4 lumber, then cut pieces of cement backerboard and screw them to the framing to build the box. It was dusty and time-consuming labor. Even the layout took longer.

Now, we have preformed, prewaterproofed boxes in standard sizes that fit into a typical stud bay. And if for some reason we want a different-size box, it's not hard to cut a piece out of a box and reconnect the rest of it using Kerdi-Fix adhesive caulk. You could also build a bigger box out of two of these boxes if you wanted. But in most cases, a standard size works.

To install the box, I lay it face down against the wall that I've already covered with Kerdi-Board, trace its outline, and cut out the board along the traced line. Then I flip the box around and place it between the studs. I screw the box in place using the same screws and washers I use for attaching Kerdi-Board for walls. Then I waterproof the joints by cutting one big piece of Kerdi membrane and mortaring it over the whole box opening. I cut the membrane out where it's covering the box opening, and the box is ready to go. (I like to cut the membrane out as soon as I apply it, because it's easier on my knife than cutting along that line a day or two later when the mortar is hard.)

The boxes come with Kerdi shelves that you can attach at mid-height, or wherever you want, and then finish with tile. But I usually install a glass shelf, supported by the tiles inside the recess.

Installing the box this way is quick, clean, and easy. And the nice thing is, if the customer comes along to look at it and would like the location, size, or height changed, that's also simple to do.

Tom Boucher owns and operates Integrity Tile Company, based in Kennebunk, Maine.

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Floating a Boathouse

Working under water to raise a landmark above water

BY DARREN TRACY

Photos by Darren Tracy

The Adirondack Park covers more than 6 million acres in upstate New York. Before the advent of air conditioning, its 10,000 lakes and cool mountain air offered affluent city dwellers relief from the summer heat. Many of the lakeside houses that those folks built around the turn of the last century are still in use.

A common sight at these "camps" (as they have also been called) are boathouses built out over the water, essentially boat garages. As you can imagine, a northern lake environment is not ideal for a wooden structure, especially for one that literally sits on top of the lake. The moisture is one obvious risk to the building. But also, the lakes in this region tend to freeze over most winters, and the forces associated with such an icy building site are extreme, to say the least.

The owners of one such boathouse hired our construction firm, West Branch Inc., to repair the structure, fearing that it wouldn't survive another winter without falling into the lake **(1)**. No strangers to unique projects, we accepted the job, which would be completed in two phases. The boathouse obviously would need a new

Temporary Support for a Sinking Building

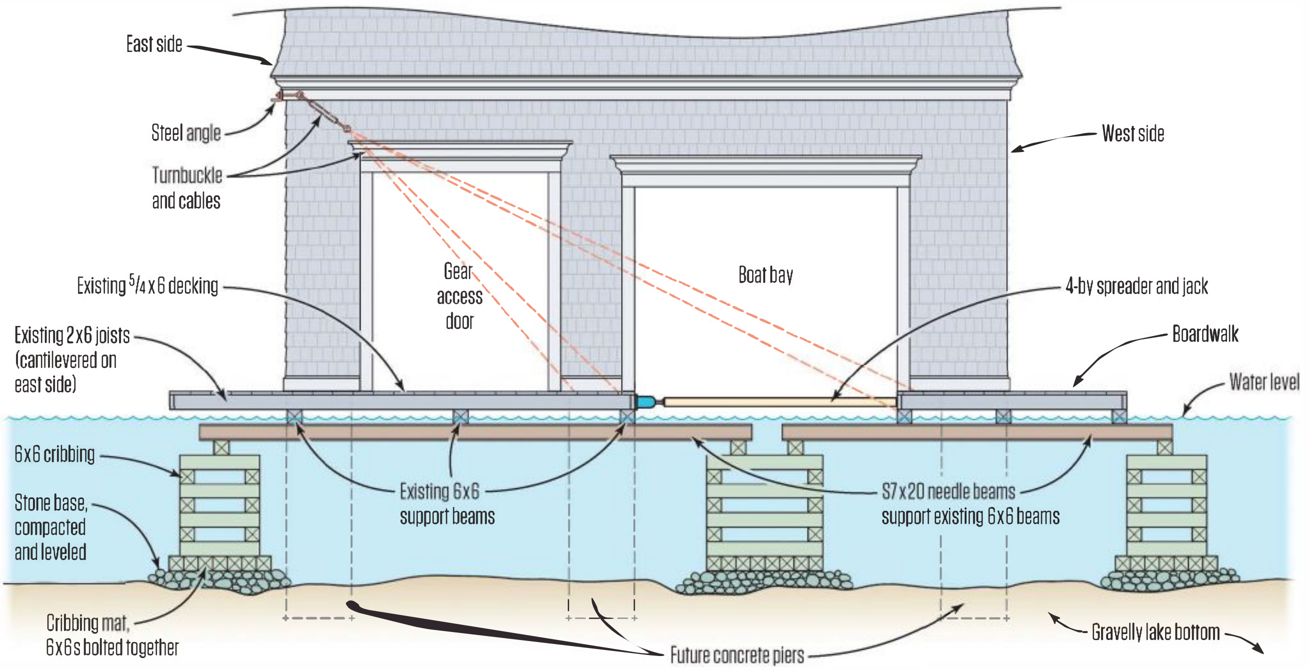


Illustration: Tim Healey

foundation, but that phase would happen sometime in the coming year. The more immediate phase of the project would be the raising and stabilizing of the boathouse before the winter arrived along with the lake ice.

CRUMBLING FOUNDATION

From above the water, the urgency for a repair was evident. After many years, support for the boathouse had given way, letting the building sink into the lake. The west side of the structure **(2)** had dropped much further than the east **(3)**, and the structure needed to be stabilized before going through another winter. Through our investigation, we determined that the deterioration of the support was due to a number of factors: fastener corrosion, rot, and the forces of lake ice.

We donned scuba gear and examined the situation below the water. The original boathouse had been built on a "foundation" that consisted of timbers stacked log-cabin style around the boathouse perimeter to form cribbings **(4)**. Large rocks inside the cribbings formed a base upon which the boathouse was built.

We found that some of the cribbing timbers were missing (because of rot or fastener failure). Foundation rocks had then fallen out through the resulting gaps, and the slow sinking process began. The timbers had been pinned together by long spikes, which over time had corroded to the extent that they could no longer resist the lateral forces of the rocks and ice, so they sheared off—or in some places, completely disintegrated.

When we were preparing to raise the boathouse, we needed to remove some of the cribbing timbers. Some were lightweight and full of knots, so they were most likely northern white cedar, a species local to the area. Other, much heavier timbers were probably white oak, again a locally available species. The natural rot-resistance of both species made them good choices for building cribbing that would spend its life submerged—a life that sadly was near its end.

The most damaging factor—besides the damp environment—was the lake ice. Ice movement can exert tremendous forces on structures that sit in water. The exact forces are difficult to calculate precisely because they are affected by variables such as wind, water currents, ice thickness, ice quality, snow cover, and the general severity of winters, but some experts conclude that forces exerted on a structure from lake ice can be as much as 400 psi (the compressive strength of ice). In this case, the ice had moved the boathouse, pushing the west wall of the boathouse to the east over the years. The racking that resulted could be seen clearly in the out-of-plumb walls and out-of-square door openings.

PLAN OF ATTACK

Our mission of stabilizing the boathouse was twofold: Raise the structure so that it was no longer sitting in the water, and

reverse the racking caused by ice. One of the boathouse owners contacted local governing agencies and requested permission to undertake emergency stabilization of the structure. We submitted a simple, preliminary sketch including an elevation (see "Temporary Support for a Sinking Building," facing page) and a plan view of the temporary cribbing and needle beams, and our proposal was approved by the various governing authorities.

In preparation for the project, the owners removed the boats and gear from the interior to give us a clear working space. The boathouse floor consisted of 5/4x6 decking attached to 2x6 joists that ran parallel to the shore. The joists sat on a series of 6x6 support beams. The flooring lumber was pressure treated and in good shape, having been under cover all those years.

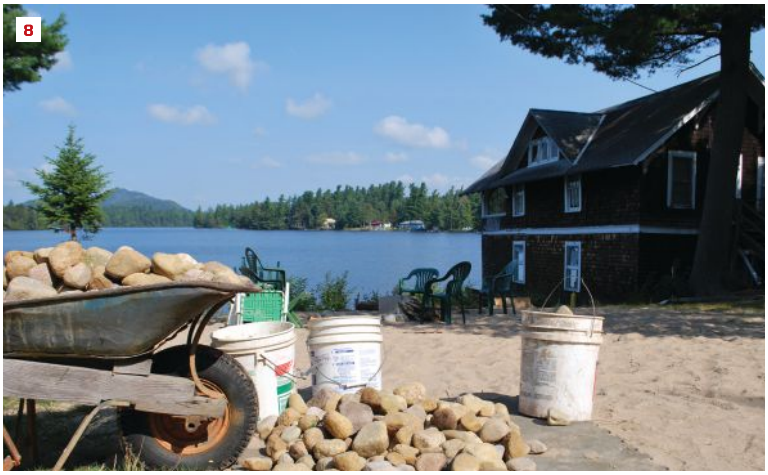
CRIBBING FOR THE RAISE

Our raising strategy was fairly simple. We would insert needle beams under the support beams of the boathouse floor and jack up the structure using cribbing for support. Our original plan called for two sets of cribbing in the boat bay along with cribbing on either side of the building. After carefully measuring, we decided that a single, 4-foot-square cribbing would work best in the boat bay. At the ends, the cribbing would be smaller (32 inches square) so we could use material we had on hand.

To minimize costs, we wanted to use stock I-beam steel for the needle beams. One of the beams would extend from the boat bay to the west side and clear the entire structure, including the deck on that side, but just barely. We weren't as lucky with the beam on the other side, though. With one end of the beam on the bay cribbing, the other end fell under the 48-inch-wide deck along the east side. This meant that the east cribbing would need to be positioned under the deck floor. We removed some of the decking boards along that side to give us access to the cribbing.

The bottom layer of each cribbing was a mat of 6x6s bolted together with threaded rod **(5)**. We built the cribbing mats on the nice, flat surface of the boathouse floor and then slid them into the water. We built the rest of the cribbing on top of the pads, log-cabin style. One of our crew members, Brett, toe-screwed timbers to the mat and then to one another **(6)** so that the stacks of cribbing would stay together and could be moved as a unit in the water. Attaching cribbing timbers to one another is not necessary in a typical jacking operation on dry ground.

While working in the water added to the challenge of the project, it also offered the advantage of buoyancy to help us move the cribbing stacks into position. The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water at the shallow end of the boat bay was only about 18 inches deep; from there, the gravelly lake bottom dropped off rather quickly to a depth of 5 to 6 feet at the outer wall of the boathouse. With the mat floating at the shallow end, Brett screwed together the first couple of cribbing layers. Then we floated the assemblies out to deeper water as their weight and height increased **(7)**, saving us from having to lift and move the massive stacks into place.

To give the cribbing stacks a flat and stable base on the bottom of the lake, we gathered melon-size stones from the site **(8)** and hand-placed them at each location where the cribbing was to be positioned. We compacted the stones, using a 6x6 beam in a pile-driver fashion to create a flat base, and a furring strip to check the depth **(9)**.

We made the outboard cribbings out of green oak but didn't have enough oak available for the 4-foot cribbing in the boat bay. Instead, we made that cribbing out of 6x6 pressure-treated southern yellow pine timbers, which were less dense and more buoyant than green oak. We used the heaviest timbers we could find to neutralize the buoyancy effect. Still, that cribbing wanted to float like a boat. We ended up piling concrete blocks and timbers on top of the cribbing to help sink it **(10)**.

JACKING AND STRAIGHTENING

Before we started jacking up the boathouse, we installed a cable and turnbuckle to keep the building from racking further as it was lifted **(11)**. The turnbuckle would also let us plumb the walls after the lift. We used a ½-inch turnbuckle with a working limit load capacity of 2,200 pounds for this particular application.

To attach the end of the turnbuckle eyebolt, we installed a 3x3 by ¼-inch-thick steel angle on the outside of the east wall at a height that would catch both the double top plate and the second-floor joists **(12)**. The angle spread the load from the turnbuckle assembly over several joists and the plates. To start out, we attached the lower end of the cable to the east side of the boat bay.

With the cribbing in position and the walls stabilized, we were ready to begin the jacking process. We removed rock from the original underpinning and threaded the needle beams under the structure, resting the ends of the beams on the cribbing. We then set blocks on a lower tier of cribbing to support the jacks and started raising the needle beam until it made contact with the 6x6 support beams under the floor **(13)**.

We used hydraulic bottle jacks and screw jacks to raise the needle beams. The bottle jacks did the lifting, and then we inserted screw jacks to hold the needle beams while we repositioned the bottle jacks **(14)**. We

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were able to raise the floor to the proper height over the course of one day.

The existing 6x6 support beam on the west side of the boathouse developed a significant sag as we raised the needle beam. To overcome this sag, we added smaller, less elaborate supports at two other places along that side **(15)**.

As we jacked, we also had to add more cables to help square the building because just one wasn't doing it. When there seemed to be too much tension on the one cable, we added another cable. Then we torqued both of them taut enough to play a tune, so we needed to add a third cable. By that time, we had used up our turnbuckle hardware, and being in the middle of nowhere, we again made do with what we had on hand—in this case an extra come-along that we'd brought with us.

Even with three cables, we weren't able to pull the walls plumb, so we reattached the cables to the west wall. This decreased the cable angle, allowing us to apply greater force. But then we ran the danger of pulling that wall in, so we added a couple of spreaders across the boat bay to stabilize the bottom of the wall **(16)**.

We also disconnected several wood brackets that connected the wall to the second-floor joists. These brackets had been added over the years to help stabilize the structure. Even then the walls did not rack back completely plumb. We could have pulled them closer by adding more cables, but the owner decided that it was not worth the extra effort and cost. Like many things in life, it was a trade-off in a less-than-perfect world.

In hindsight, I wish that we had applied vegetable grease to the tops of the needle beams to reduce the coefficient of friction and help the walls slide over more easily.

HUNKERED DOWN FOR THE WINTER

As we raised the needle beams, we blocked and shimmed until the sides of the boathouse were level. Then we replaced the shims with more permanent solid blocking to carry the load over the coming winter **(17)**. We kept the cables in place along with the spreaders in the boat bay, and we left with the boathouse high and mostly dry **(18)**. The owner also installed a bubbler system around the cribbing, which will keep ice from forming.

After the ice melts next year, we hope to return and install a stronger, more permanent foundation system that will extend the life of this old boathouse long into the coming century.

Darren Tracy, P.E., owns West Branch Engineering, a consulting firm, and West Branch Inc., a construction firm, in Saratoga Springs, N.Y.

BY LAUREN HUNTER

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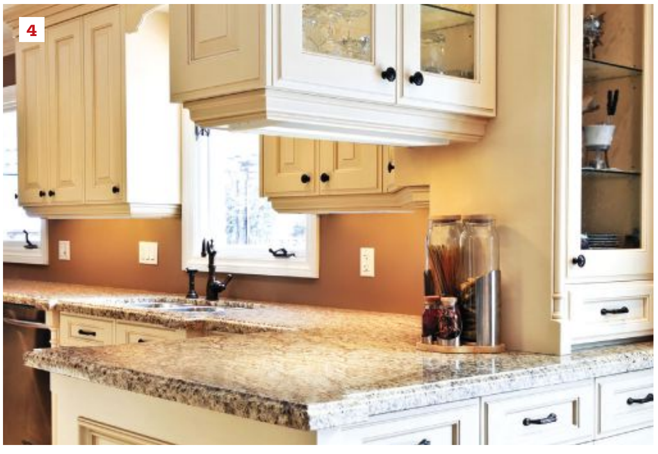


1. The Right Vein

Neolith uses digital design to attain the look of natural marble in its expanding Classtone product line, including travertine-inspired patterns like Calacatta (shown). The material is available in book-matched or end-matched pieces that line up the veining for the illusion of a continuous slab. Available in 6mm or 12mm thicknesses, Classtone can be installed as countertop surfacing, flooring, and wall cladding. Price is $2,100 for a Calacatta slab. neolith.com

2. Knots and Details

The new knotty alder finish on ProVia's Signet line of entry doors lets designers bring an old-world aesthetic to entryways. Other new accent options, such as speakeasy windows, hinge straps, and calvos, add to the look with their flat black aluminum construction. All ProVia doors are made-to-measure and can take advantage of a variety of design options. Pricing will depend on door size and customization. proviaproducts.com

3. In the Bag

The Winbag hand-operated inflatable air cushion will be a versatile addition to your toolbox. The fiber-reinforced pillow can provide up to 220 pounds of pressure to replace shims and wedges in a variety of applications. Ideal for positioning windows and doors, leveling cabinets and appliances, or as a quick jobsite doorstop, the Winbag can be used in gaps as narrow as 3/32 inch and as wide as 2 inches. The simple hand pump and air release valve allow for precise placement and won't risk damage to materials. Look for pricing around $20 online. winbagusa.com

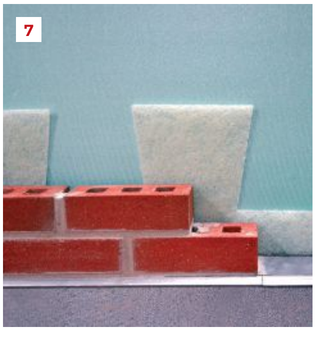
4. Taken to Task

The Ledur series of 120-volt dimmable LED under-cabinet fixtures from Nora Lighting provide uniform work-surface and task lighting without hot spots. The fixtures are completely dimmable and linkable up to 400 watts. Units install with captive screws and also have quick connects for hardwired applications, or a power cord for use as a simple plug-in. Each fixture is just 1 inch deep and 3 1/2 inches wide for a sleek appearance. Choose from dark bronze or white finishes. Pricing ranges from $60 to $120 depending on length. noralighting.com

5. Seal the Deal
Dap's Kwik Seal Ultra Premium Siliconized Kitchen & Bath Sealant is formulated to repel water, soap scum, stains, and mildew. In application, Kwik Seal Ultra Premium is ready for water exposure after just four hours without it washing out. The 100% waterproof and crack-proof material is safe for all surfaces—including granite and marble—and it is backed by a lifetime mold- and mildew-resistance guarantee. It's available in 10.1-fluid-ounce cartridges for about $6, or in a 5.5-fluid-ounce squeeze tube for $5. dap.com

6. Sticky Situation
A self-adhesive edge lap on Cosella-Dorken's Delta-Vent SA barrier addresses challenges with lap adhesion issues by allowing the membrane to stick to itself. A 2-inch strip of adhesive on the top edge of the front side of Delta-Vent SA is covered with a release liner. Locking this edge with the bottom side of the next course creates a securely sealed lap that stays tight. Maintaining a vapor permeability of 50 perms, Delta-Vent SA also fully adheres to the substrate, eliminating the need for mechanical fasteners. It's priced moderately for the market; check with your distributor. cosella-dorken.com

7. Read It and Weep
If mortar droppings behind masonry walls block moisture from draining, problems like efflorescence and freeze-thaw cycle damage can arise. Wall Defender from Mortarnet Solutions collects mortar droppings before they can clog weep holes, and the 90% open mesh structure promotes moisture movement and drying. Available in 0.4-, 1-, and 2-inch thicknesses, with 100 linear feet per package, Wall Defender features as much as 54% recycled material. Pricing is set by distributors. mortarnet.com



8. Inspired by Nature
The Stoney Brooke Collection of textured finishes from Medallion comprises multiple glazes applied to stained surfaces with dry-brushing techniques. The effect creates rich gray and brown finishes that have a subtle texture you can feel. An oven-cured satin top coat is the final step to provide a durable, long-lasting finish. Stoney Brooke color options include greystone, cobblestone, boulder, and shale. The advanced finishing technique does not cost extra. medallioncabinetry.com

9. Treat Your Trim
For designers who prefer to work with wood exterior trim, Belco Forest Products has partnered with Lonza to develop a cost-effective wood-treatment process. ArmorCoat XT Wolmanized Exterior Trim starts with spruce/pine/fir lumber and adds Wolman AG, a waterborne preservative system developed to provide extended protection to wood from decay and termites in out-of-ground applications. ArmorCoat XT features a 20-year substrate warranty against rot, and Belco's primer formula is also backed by a 20-year warranty. Check with your dealer for pricing. belcofp.com.

10. Wood-Free
TruGrain facade, siding, and decking profiles are made with Resysta, a fiber-reinforced hybrid material comprising 60% rice husks, as well as ingredients like salt and mineral oil. The combination allows TruGrain to showcase the look and feel of tropical hardwoods, while remaining completely wood-free. Suitable for a range of exterior applications, TruGrain resists moisture, fungus, and termite damage, and offers high slip resistance. The natural ingredients in Resysta mean projects using TruGrain can qualify for several LEED points. Check with your dealer for pricing. tru-grain.com

11. Metallic Cladding
Metallic Series ribbed panels from Nichiha make a bold design statement and add 3D texture that complements modern materials. Like the maker's other materials, Metallic Series panels install with the Ultimate Clip system, which creates a back-ventilated rainscreen to let moisture drain away. Panels are currently available in mother-of-pearl and gunsmoke colors with a brushed finish; additional colors are forthcoming. Metallic panels are priced at $9 per square foot. nichiha.com

12. LEDs Meet Skylight
Solatube has blended the convenience of LEDs with the benefits and brightness of tubular daylighting devices. The Smart LED System harnesses the sun's light during the day. As the light level begins to dim, smart sensors activate incorporated LED lighting. The combination saves up to 94% on lighting energy use, the maker says. An optional occupancy sensor activates the LEDs only when a low-light area is occupied. Each LED is designed to last an average of 20 years, so homeowners won't have to worry about changing bulbs. Priced around $800 installed. solatube.com

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Classifieds

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The compact, lightweight Bosch JS120BN jigsaw **(1)** is portable and maneuvers easily along intricate cuts. A twist-lock mechanism **(2)** works with one hand and releases the blade with the help of a spring. The orbital setting, on-off switch, battery indicator, and light switch are readily accessible on one side of the tool **(3)**. The Allen key stores securely atop the footplate, keeping it close at hand, while a removable no-mar plastic plate clips over the footplate to protect fine finishes **(4)**. Tucked out of sight, but not out of reach, the speed adjustment dial offers another bit of control over cuts. While the footplate only registers at 90 degrees, the gauge **(5)** allows for finer miter adjustments.

Field Tested: Bosch's Cordless Barrel-Grip Jigsaw

BY ROBERT COURTNEY

My crew and I have had the pleasure of building custom homes for talented designers (and demanding clients) for more than 25 years in the Adirondack region of upstate New York. The projects typically offer views that can't be beat, but that often means they come with the added challenge of navigating difficult terrain using pump jacks, scaffolding, and ladders. For that reason, we're always on the lookout for lightweight cordless tools that perform well.

So when I was offered the opportunity to give Bosch's new JS120BN barrel-grip cordless jigsaw a test drive, I jumped at the chance. While it's not going to replace a corded jigsaw or even a larger cordless jigsaw, this compact beauty nicely fills a void for a very lightweight and versatile saw.

We're currently in the middle of installing unique

Photos: Chris Ermides


The DWHT43134 has two vials for plumb and one for level, two small hang holes, and small end caps that let you draw a line almost to the end of the level.

DeWalt's 48-Inch Carbon-Fiber Level

BY TIM UHLER

In August, I saw that DeWalt was introducing a new spirit level that was designed to be very lightweight. We have been using the Stabila R Beam levels that we reviewed in 2014 and love them, but I'm always interested in trying a new tool, especially when that tool is lighter.

The new DeWalt 48-inch box beam level weighs 2.09 pounds versus 3.2 pounds for the Stabila 48-inch R beam level. At 2.5 inches by 1.1 inches by 48 inches, it's small too. DeWalt claims that even though it is very lightweight, it's durable—in part because of the box beam construction.

As framers, we use a 6-foot level and laser plumb bob for almost everything, so this isn't a "must-have" length for us. However, when using the DeWalt 48-inch level to plumb the step-downs for layout on a recent job, I liked its lighter weight, and I'll be using it more often. I can already see using it for siding and foundation work.

The lighter weight made it easier to level a piece of fascia with one hand and to scribe a level or plumb line where one side isn't supported by anything. There are cheaper levels that are lightweight, but this level is well-built. We accidentally dropped it 9 feet onto a concrete slab, and it didn't seem to suffer any damage. It's still straight and the vials all check out.

The list price for this level is $150, but I found it online for between $90 and $100.

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

JIGSAW
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siding—poplar bark shakes—on a home. Given the complexity of the design, we're faced with all sorts of cut-ins around windows, doors, and rafter tails, so the JS120BN couldn't have come at a better time.

PERFORMANCE

The saw is performing very well for us on our siding job, and it perfectly handled cutouts on the poplar beadboard ceiling we installed as well. What stands out the most is its size and ergonomic design. It comfortably fits in the hand for a sure grip that gives great command over intricate cuts. And perhaps best of all, the saw sits nicely in a tool pouch.

Some of the features I especially like are the easy, one-hand blade change; the adjustable orbital action like on the bigger models, with up to a ¾-inch stroke; and a maximum cutting depth of 2 ¾ inches. It also comes with a clear plastic insert to prevent tear-out and a nifty removable no-mar plastic shoe—both nice features for fine finish work.

As great as this saw is, it does lack a couple of features—neither of which are deal breakers for me, but important to note just the same. For one, the saw lacks a blower, which was disappointing but not detrimental. It's easy enough to blow dust off the cut line as you're working, but when you're up on a ladder, you don't need something else to think about. The other thing that I found clumsy was having to separately turn on the built-in light (which does come in handy).

Those two points aside, Bosch has come up with a winner of a compact tool—and one that's also compatible with the Collins Coping Foot. This saw has found a permanent home in my tool cache.

JS120BN Cordless Jigsaw Specs

Battery: 12V MAX
Weight: 3.3 pounds
No-load SPM: 1,500–2,800
Price: $120 (bare tool)
boschtools.com

Robert Courtney is a custom home builder, trim carpenter, and mechanic specializing in restoring expedition vehicles, in Saratoga Springs, N.Y.

Photos: Tim Uhler

Jobsite Hot Box

BY STEVE DEMETRICK

Nearly every carpenter working north of the Mason-Dixon line knows the pitfalls of working outside during the winter months: hands so cold you can barely grip a coffee cup, too many layers of clothing, dead batteries that won't take a charge, and pump-jack poles frozen into the ground. Here in New England, I face these "inconveniences" when my schedule doesn't work out well.

This happened last winter when I was left with no choice but to begin framing a house in the middle of January. There we were, day one of setting sills and down came the snow! For that project, I needed to keep several cases of Tremco acoustical sealant on site for an air-sealing detail. Like most sealants and adhesives, Tremco flows much better when it is warm. To that end, I decided to make an insulated hot box to keep on site for just this purpose.

Constructed of scraps of plywood and lined on the interior with leftover 2-inch polyiso foam, the box took me about two hours to throw together in my shop one night after dinner. The box is 48 inches wide, 32 inches tall, and 28 inches deep, which is the size of the scrap I had to work with. I used ¾-inch plywood for the sides, and ¼-inch plywood for the front, back, and bottom in order to keep the weight down. The thin bottom is reinforced by 2x4 skids, which also make it easy for one person to slide the box around on the ground.

I hinged the lid and added a lip that overhangs the sides to keep the water out, and I recycled handles from an old window delivery. For heat, I used a 110-volt space heater inside, which is fed from an extension cord. I made a little cutout for the cord of a power strip so that I could put the heater inside.

The box's original purpose was to keep the acoustical sealant warm without it needing to be in the truck with the engine running. The sealant was being used intermittently, so it was great to have a place to store it close at hand between uses. By the end of the first day, we had built a shelf and put all our batteries and chargers inside. As the job moved forward and the temperatures dropped, we found more things that were happier in a hot box: building tapes, cell phone chargers, glues, meatball grinders for lunch, and more. On the colder days, we put extra gloves in it and swapped them out so that we could enjoy warm hands several times a day.

The next box will be big enough to fit a crew of four eating lunch—or even better, there won't be a next time because the schedule will work out better.

Steve DeMetrick is a residential builder and remodeling contractor in Wakefield, R.I.

Photos: Steve DeMetrick

BY ROE OSBORN


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One Home in One Week for One Family

On the first day of fall this year, the Home Builders & Remodelers Association of Cape Cod and the Cape Cod chapter of Habitat for Humanity teamed up for an amazing feat called "Blitz Build '15." In five short days, a small army of professional volunteers took a house from a bare first-floor deck to a C.O. and a "ready to move in" home.

The house was the last started of a cluster of seven homes in the town of Harwich, but it would be the first finished. It was my second Blitz, and as an associate member of the builders' group, my volunteer work was with a camera, documenting the progress and shooting a time-lapse video (view it at jlconline.com).

Day one began with Matt Anderson's crew buzzing through the framing like a swarm of bees **(1)**. They had panelized the exterior walls, so these only needed to be lifted and set in place. As soon as the first-floor walls were up, a crew inside began insulating. Meanwhile, plumbers, electricians, and HVAC folks started their rough-in.

The next morning I arrived on site just before sunrise, and one of the project coordinators was already there with all the lights turned on inside, making the shell look like home after less than 24 hours **(2)**. By noon, the roof was shingled, and two crews were running siding. Inside, the rough-in was done and the plasterers were already hanging board **(3)**.

On day three, crews installed the prefinished bamboo flooring and the interior trim. Outside, a gaggle of painters puttied, caulked, and painted the exterior trim. The kitchen cabinets arrived midday and were installed by the end of the day.

The landscapers did their thing on day four while outside odds and ends were tended to. Inside, crews painted and finished trimming while the plumbers, electricians, and HVAC crews finished up. On the final day (Friday), the punch list included a blower-door test and final inspection. A dedication ceremony took place the next day **(4)** and the keys were given to the new owners. The finished home stands as a testament to the dozens of workers who gave countless hours for this great cause.

Roe Osborn is a senior editor at JLC.

Photos by Roe Osborn

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