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JUNE 2014 / VOL. 32 / NO. 9

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On the cover: Five men slide a high-tech "tilt-and-turn" window unit into place in a home on Martha's Vineyard, Mass. These triple-glazed highly-efficient windows are made in Europe. Photo by Roe Osborn

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DEPARTMENTS

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"IS TYVEK WORTH THE PRICE?" VIDEO BLOG BY MATT RISINGER (ONLINE, MAY 15)

Risinger's video blog generated a flood of comments. We don't have room to include them all, but here's an edited selection of the more salient ones. (The comments keep coming, so be sure to check online for more.)

Sean Donovan: Your test is very interesting and basic, which makes it easily repeatable and verifiable. The best part of Tyvek is how great it is at preventing water (and water vapor) from moving through it. Unfortunately, that's also its greatest weakness.

As you stated in your video, water gets behind the cladding. Further to that point, it often gets behind the building wrap, which is due to poor detailing (read: workmanship). As a renovation contractor, I rarely remove Tyvek without finding rotten, wet sheathing underneath, especially at building penetrations (doors and windows) where the detailing is most critical. Once water gets behind the Tyvek, it's trapped and can't escape the wall assembly. Left unchecked, this results in cladding failure, sheathing rot, and super-saturated insulation.

Editor's note: Donovan goes on to talk about "better" housewraps, notably Henry's Blueskin. A couple of DuPont reps corrected the suggestion that Tyvek doesn't allow the wall to dry, noting that Tyvek has a perm rating higher than Blueskin. However, Donovan's focus was on workmanship, and another significant difference is that Blueskin is self-adhesive, which might help compensate for poor workmanship that allows mechanically fastened housewraps to leak. Focusing on this point, Matt Risinger responds: "The devil is in the details. Penetrations are where the failures occur."

Mike Guertin: What housewrap are you using on most of your houses? In February at the International Builders Show you mentioned that you were trying a brand other than Tyvek. Just wondering how that other brand might be working out, and what the differences are between it and Tyvek.

Risinger responds: I've been a big believer in the Tyvek system for the past 10 years and it's worked well for me. My first go-to has been Tyvek Commercial D, which works in about 90% of the houses I build. However, I've been trying some other manufacturers' self-adhering products with good results. Cosella Dorkin's Delta-Vent SA has a perm rating but it's a peel and stick, so it makes a great air barrier, too; kind of works like sticky Tyvek. I've also just used Carlisle's CCW 705, which is an asphalt-based 40-mil peel and stick product (similar to an ice/water shield) that's really [bomb-proof.] It has a zero perm rating, but I think that for a house with no overhangs and lots of exposure [in the hot/humid South where the house will dry to the inside] this is a best practice.

Mark Bishton: That was a nice commercial for Tyvek—unless you know that the product he used is not the typical off-label, breathable building wrap that's an available alternative to Tyvek. This type of video infomercial is weak, *JLC*!

Risinger responds: Just to clarify: I don't work for *JLC* or for DuPont. I'm a builder in Austin, Texas, who experienced a lot of pain during the mold crisis of the early 2000s. I saw first-hand what water intrusion in structures could do over time, and that has led me to finding best practices for keeping building assemblies dry. In the video, I bought a roll of the pin-punched housewrap sold off the shelf at the store, next to Tyvek. They sell this same product under several brand names and I don't believe it's a good bulk water control layer. Try this test yourself with your favorite brand.

FOAM-SLICING SAW BLADES IN "COOL TOOLS FROM STAFDA," BY BRUCE GREENLAW (MAR/14), WITH A FOLLOW-UP REVIEW IN "TOOLBOX" (MAY/14)

We are building a high-performance home (close to being a Passive House), and for this project we ordered quite a bit of high-performance 60 psi (i.e., expensive) foam. We have some heavy (16-by-8-foot) triple-glazed windows sitting on the foam and wanted the highest available performance. So when I saw the Mar/14 story, with a follow-up review in May, for the dustless, high-precision foam-cutting blade, I immediately bought one.

The first blade was a mess. It didn't cut straight. The factory rep did a good job telling me that the factory hadn't properly deburred the blades, and he sent me a new one. That worked fine for a while, but after about 600 linear feet of 2-inch rips and 300 linear feet of 3 ½-inch rips, it was no longer useful. A buildup of melted foam collects on the blade causing the blade to bind in the table saw.

With the new blade, the manufacturer included a spacer to put on the fence (as noted by Greenlaw in the May review). To us, this seemed an impractical solution. Maybe if I added a dedicated fence for my table saw to the price, it might work. But I wouldn't want to keep it on the saw when doing other work, and I don't want to spend time removing the gummy tape that adheres the plastic to the fence.

I expect *JLC* to be the trusted adviser, but with this product, the magazine failed me (and my wallet).
—*Steve Burke, Olympic Valley, Calif.*

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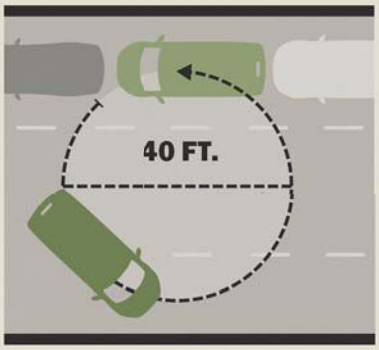

Let's say there are 13,270 cabs in her city. Plus 5,600 buses, 5,150 garbage trucks and 2,564,367 cars. Getting a van load of green peppers across town during rush hour is going to take some ***nimble maneuvering.*** That's where the Transit Connect really shines.

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Q A photo in the "Flexible Flashing" article in *JLC*'s April issue shows accordion-style flashing around a circle-top window. How do you flash around the curved window if you have only straight flashing tape?

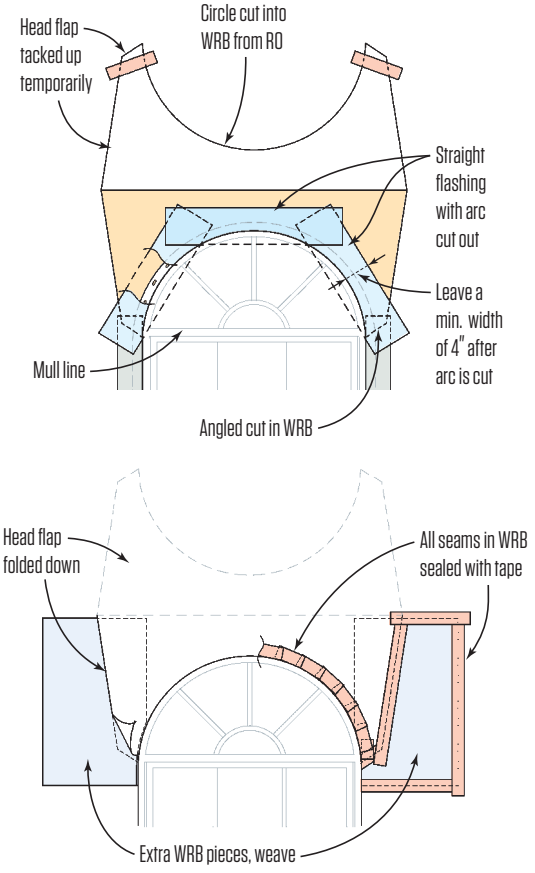
A Mike Guertin, contractor and presenter at JLC Live, responds: As with every detail like this, proper installation begins before the window goes in. After running the housewrap (WRB) over the opening and making the center and sill cuts for the rectangular part of the window, make a horizontal slit across the mull line (where the curved and rectangular sections meet) of the rough opening. Cut the WRB along the circular part of the RO, and extend the cut for the mull line out about 3 inches on both sides of the opening with the cuts angled upward. Continue the cuts vertically up about 8 to 10 inches past the top of the RO. Fold the top flap up and temporarily tape it above the opening. Detail the WRB and sill pan flashing for the lower rectangular section as you would for any window. Install the window and run flashing tape along the sides of the window, letting it extend a few inches past the mull line.

For the curved window on top, there are many brands of flexible flashing tape (like the one in the article) that make for a seamless installation. However, in a pinch, you can revert to the method we used before those so-called accordion tapes were available: layering strips of straight flashing tape along the arc of the window. The goal is to use as few pieces as possible; otherwise, the layers will build up, preventing your trim and siding from lying flat.

One way to use fewer pieces is to cut the window arc out of the straight flashing tape. I'd use 6-inch or wider tape so that you still have plenty of coverage even after cutting the arc. Start with a piece about 18 to 24 inches long and place it over the curved window frame. Trace the curve of the window, making sure that you leave at least 4 inches of tape at the deepest point of the arc. Then use scissors or a sharp knife to cut along the curved line. Apply pieces starting from the outer (lower) edges on both sides of the curved window, working upward to the top of the curve. The number of pieces used depends on the width of the flashing tape and the size of the window, but often you can flash a curved window this way with just three or four pieces.

Next, roll the flashing tape against the window flange and the sheathing, and fold down the top flap of WRB. Many installers simply tape over the slits to complete the installation, but I weave extra pieces of WRB into the vertical slits to create a mechanical lap as well, and then I tape all the joints. That way I'm not depending on the tape alone to complete the WRB around the

Flashing a Curved Window With Straight Flashing



window—an inexpensive and easy way to ensure greater durability.

A word of caution: Be sure to check the compatibility of the flashing tape with the window brand you're installing. Asphalt-based tapes can't be used to flash some windows because the asphalt can react with plasticizers in the window's vinyl frame, flanges, or gaskets. Butyl and acrylic adhesive tapes are usually compatible.

Q I hope to use local red cedar logs as posts for a client's rustic porch. What's the best way to remove the bark without damaging the wood underneath?

A Craig Aument, a timber framer and founding owner of Cascade Joinery, a timber-frame company in Ferndale, Wash., responds: We're often asked to include natural logs in the timber-frame structures we build. The tree shape creates an interesting contrast to and visual juxtaposition with the milled timbers that make up the rest of the frame. Red cedar, with its natural rot resistance as well as its fairly easy workability, is an excellent choice for unique-looking porch posts.

We've found that cedar logs cut in the spring, when the sap is running, are a joy to peel. Loosen a strip of bark at one end of the log with a draw knife or peeling spud. (A peeling spud has a steel blade about 6 inches long and about 2½ inches wide that's mounted on a long wood handle. The blade is slightly curved and sharpened on the end as well as on both sides.) Once you've separated a section of bark, pull up; you can usually peel full-length strips from the log. Native Americans in my area harvested basket-making material from live trees this way. They did not strip the whole tree, but usually took just a 6-inch to 8-inch strip from one side, so the tree wouldn't die.

When the sap isn't running, the bark is a lot tougher to peel. In this case, work your way down the log using a draw knife or peeling spud, taking off the outer layers of hard bark and being careful to stay in the right layer to avoid cutting into the log. This can get tricky around the knots or branches, but you don't need to get all the way to the wood in these areas, just the harder outside layer of bark.

Regardless of when the tree is cut, it is best to get the bark off as soon as possible. Otherwise, moisture and bugs can get under the bark, staining and burrowing into the sapwood layer.

Once you've taken off most of the outer bark, carefully pressure wash the logs to clean up the inner layer. Then begin working them to make your posts. Usually by the time you've finished with the fabrication, the logs are dry enough to be finished. In most cases, we use Sikkens Cetol Log and Siding (sikkensstains.com) to seal the log and bring out the natural color of the wood.

To see photos of the bark-peeling tools mentioned here, go to the online version of this article at www.jlconline.com.

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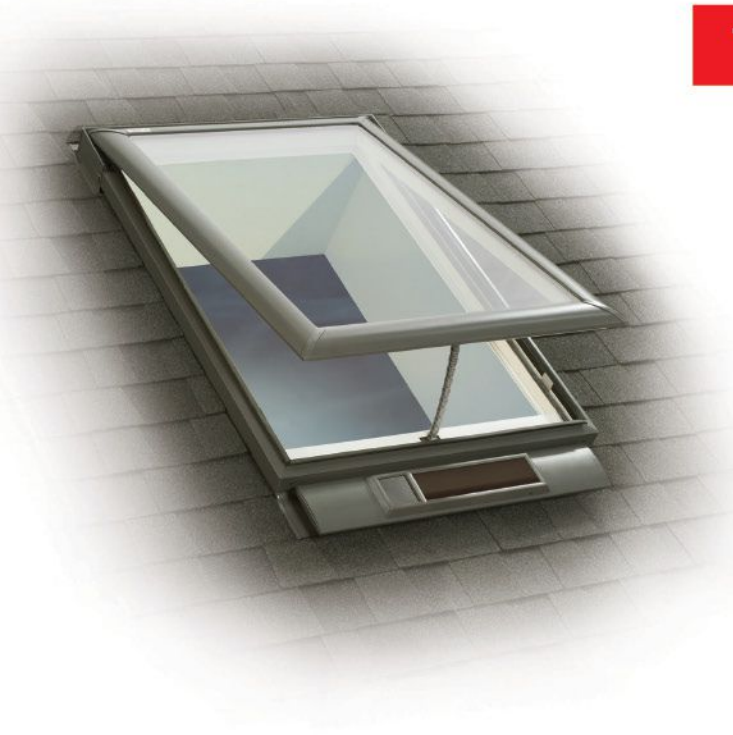

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BY TIM UHLER

Framing a Curved Staircase

For me, framing a curved staircase has always been something that separates those who can frame from those who are simply framers. Ever since I saw a diagram in Will Holladay's book *A Roof Cutter's Secrets to Framing the Custom Home* showing how to frame a circular stair, I'd been itching to frame one. It turns out that it isn't particularly difficult. With guidance from Holladay's book and a framer named John Kirkpatrick online who routinely does this, I was able to frame a free-standing curved stair in less than eight hours.

CODES

When building a curved stair, the first step is to know the codes. The free online code explanations from the Stairway Manufacturers Association (stairways.org) are handy for this.

Before starting to frame my first curved staircase, I spent a lot of time making sure I understood how to lay out the stair according to code and checking that the designer had drawn the stair correctly on the plans.

It was time well spent, since it turned out that the plans for the stair weren't right—the radius was too tight, so the winder treads didn't meet the minimum depth at the walk line. And, since it's my job as the framer to build it right, I had to adjust the layout.

LAYOUT

Using black chalk—so it's permanent and won't wash away in the rain—I snapped the stair layout at the same time as the rest of the wall layout. This allows some flexibility if we need to move things around a bit for a better fit and also helps shift my brain into gear.

To accurately lay out the stair, the "walk line" must be correctly located. According to the 2009 IRC (Sec. R311.7.3),

Photos: Tim Uhler


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the walk line should be 12 inches in from the inside edge of the stair, and the treads at their narrowest part on the inside curve must be at least 6 inches deep (R311.7.4.2). As long as you have a minimum tread depth of 10 inches at the walk line and no part of the stair tread is less than 6 inches, the code allows for a difference in tread depth between the straight section of the stairs and the winders. (Note: Under the 2012 IRC, the minimum tread depth has been increased to 11 inches.) If I needed to make things fit in a tight space, I could adjust the tread depth, but in this case I had a large, open area in the entry and didn't need to make adjustments.

I began layout by snapping the line of the top riser, which was also the edge of the top landing. Next, I found the radius as defined on the plans, and made a trammel from a piece of strapping **(1)**. I put four marks on the trammel—the outside distance from the center; the inside curve (both sides of the 2x4 wall); and the walk line 12 inches from the inside end of the tread **(2)**—then used it to draw the edges of the curved section of the stairs. With a square along the top riser line at the walk line, I marked 10 inches in front of the top riser and snapped a line through this mark for the next riser. I repeated this, sliding the square until the 10-inch mark touched the walk line, snapping a new line for each riser **(3)**.

FRAMING

Before framing the stair, it's best to wait until the upper floor is framed so you can take exact floor-to-floor measurements. You also need to know the thickness of the finish floor material at the top and bottom of the stair. For this stair, both floors and the treads were getting hardwood, so every riser was the same height.

To idiot-proof the riser heights, I began by making a story pole. I entered the subfloor-to-subfloor height—119 ⅜ inches for this house—into my Construction Master calculator and divided that by 16 (the number of risers on the plans) to arrive at a 7 7/16-inch riser height. (The 2009 IRC maximum riser height is 7 ¾ inches. In the 2012 IRC, it drops to 7 inches.) I then hit "M+" to store this number. Next, I entered "+ RCL M+ =" and got 14 15/16 inches. For each stair, I just hit "=" to get the next riser height; the calculator does the rounding so that every riser will be exactly the same (7 7/16, 14 15/16, 22 ⅜, 29 ⅞, 37 5/16, etc.).

For the story pole, I used a 2x4 that's a few inches longer than the total floor-to-floor height. I hooked the bottom end of the 2x4 with my tape, marking each number my calculator gave me along its length, then squared across. Each line represents the bottom of a tread. In this case, I had ¾-inch hardwood on both floors and on each tread, so I didn't have to do anything except cut the story pole to the total subfloor-to-subfloor height. If I'd had different floor or tread thicknesses, I would have drawn these on the story pole to keep track of everything so that each riser would be the same height. (See the online version of this story for more about this.)

The next step was to physically scribe each tread directly over the marks on the

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floor **(4 & 5)** and then set the cut treads on their marks **(6)**. I marked each tread with a number and put that number on the floor so I'd know what goes where, making sure that the treads are cut perfectly to ensure that each step lines up correctly and follows the layout. I also cut 2x12s for the risers (using good-quality Doug fir or LSL) and the 2x4s that will serve as the cleats each tread will be fastened to, and set these in place on the snapped-out layout as well.

Next, I cut the pair of 2x4 "legs" for each stair. I set the story pole over the pair of 2x4s, marked the length (height) for each riser, and cut the pair using the Big Foot saw so that they're an exact set **(7)**. I marked each pair to match the corresponding tread label marked on the subfloor.

With everything cut and ready to go, I began gluing (with PL Premium) and nailing a 2x4 cleat to each 2x12 riser, then gluing and nailing this assembly flush to the top of a pair of 2x4 legs. It's easy to nail the 2x12 to the 2x4 legs **(8)**, then stand the assembly up and toe-nail the legs directly to their corresponding marks on the floor **(9)**.

Before moving onto the next set of legs, I glued and nailed the tread to the previous riser cleat, locking each step in place (see lead photo, page 17). At each step, I'd double check for plumb to make sure I was staying over the layout on the floor. By starting at the top and working down the run of stairs, I always had something solid to nail into and I didn't need to brace the stair at all. (Depending on the stair width, some additional 2x4s may be needed along the outside wall supporting the stairs so that the drywall J-channel has enough support to make a smooth curve **(10)**.)

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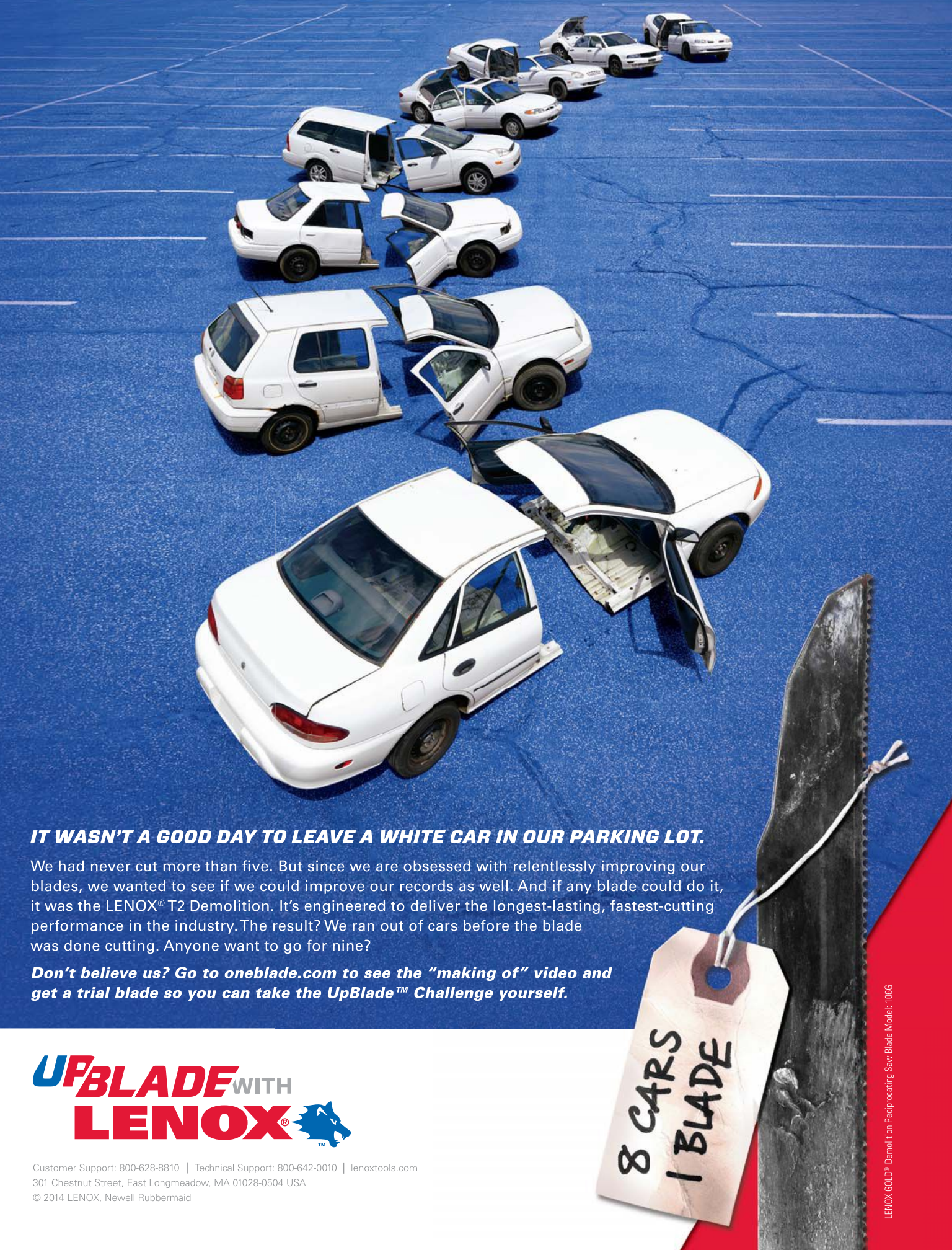
We build freestanding stairs the same way, but add a load-bearing laminated stringer from many layers of ¼-inch plywood, then cut away the supporting 2x4s.

To make the laminations, we cut 16-inch rips, then generously apply Titebond II with a paint roller. We glue and staple the first layer onto the studs **(11)**, then use the paint roller to completely coat each subsequent layer of plywood with glue before stapling on a new layer. We rout out the tread and riser profile in each layer as we go **(12)**. For the stairs shown here, we installed a total of 14 layers, nailing through the last layer with a framing nailer to make 3 ½-inch-wide structural stringers **(13)**.

We let the glue dry for a week before cutting the 2x4 legs flush with the underside of the laminated stringer **(14)**. To test stiffness, we had our heaviest guys bounce around on the outside of the stair. It deflected about ¼ inch along the walk line with almost no vibration at all.

The sides of the stringers and the undercarriage were finished-out in drywall **(15)** before the hardwood treads and handrail were installed by the finish crew.

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



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Drying Rack for Staining Shingles

BY EMANUEL SILVA

At the start of last winter, I landed a project to re-shingle an older home in New England. Because red cedar would match the existing shingles and last a long time, that's what the clients wanted. They also wanted a specific color. I looked into buying pre-stained shingles, but the only ones available were white cedars, which don't have the longevity of red cedars. So it would be up to me to stain the shingles.

I've tried different methods for staining shingles: stacking them on sticks, laying them against walls, hanging them from clotheslines, even using a heat gun. But I always thought there must be a better way. One evening my son, Carter, and I sketched out some ideas and came up with a lightweight rack that would be easy to build from mostly readily available scrap material.

With cold and snowy weather on the way, I needed a warm place to pre-stain and dry the shingles before I could install them. A local lumberyard graciously offered me space in a corner of one of its buildings, so I built the rack to fit that area.

I started by ripping 1-foot-wide pieces out of ¾-inch plywood for the side panels, which I cut down to 90 inches to fit under the ceiling. I decided on 4 feet for the rack's width so it could easily be moved around, and cut horizontal spreaders out of 1x4 accordingly. At the top and bottom corners, I joined two lengths on edge to make an L-shape for strength, then put single lengths of 1x4 at 30 inches and 60 inches for the intermediate spreaders. Finally, I ripped narrow widths of 1-by stock for the vertical center pieces, which gave the rack more stability and helped support the fishing line on which the stained shingles would rest. I used .0185-inch-diameter/20-pound test fishing line because it's thin, strong, and inexpensive.

Before assembling the rack, I laid out the spacing for the line at 1-inch intervals along both edges of one side panel, and transferred the layout to the second panel, as well as to the center support strips. At each layout location, I cut a ¼-inch-deep kerf with my Japanese hand saw to hold the line **(1)**. When all the parts were ready, I screwed the rack together using deck screws. I held the

Photos: Emanuel Silva

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spreaders about ½ inch in from the edges of the side panels so they wouldn't interfere with the fishing line. The center support strips screwed to the spreaders, which lined up the kerfs in the strips with the kerfs in the side panels to support the fishing line in the middle of the rack.

Running the fishing line around the rack was easy but slow going. I anchored the line to a screw driven into the side near the bottom, and fed it outside the edges of the side panels and inside the center support strips. After slotting the line into the kerfs on four corners to create one "shelf," I led the line up diagonally to the next level and went around again. The challenge was feeding the line and making it tight enough to support the shingles without sagging, but not so tight that it pulled the sides in. When the first spool of line ran out, I drove a screw into the side panel at that level and tied off the loose end to it, and used it to attach the new line **(2)**. The screw also gave me a place where I could adjust the tension in the line. After I'd strung the entire rack, though, I found the line needed to be tighter, so a friend helped me slide a 1x4 board behind the line along one of the sides, which gave me the extra tension I needed **(3)**.

Once the rack was assembled, I was ready to stain the shingles. I set up my work table next to the rack **(4)**. Using a roller—the fastest way to apply the stain—I coated all the sides and edges of each shingle. I loaded the rack from the bottom up so I could see the fishing line as I slipped the shingles in. The rack held three boxes of shingles or about one square, which I could stain in a couple of hours **(5)**.

When the rack was full, I decided that it would be best and cleanest to store and transport the shingles in their original boxes. I came up with a quick, easy way to put them back. First I measured the width of the shingle box and marked that measurement on my table, subtracting ½ inch for clearance **(6)**. I then sorted the stained shingles into three sizes. Using the marks on the table, I stacked rows of shingles, taking the appropriate sizes from the sorted piles and alternating the butts on each row to keep the stack straight and square **(7)**. Once a stack was tall enough to fill a box, I slid the pile into one and taped it closed **(8)**.

Overall, building the rack and pre-staining the shingles was time and money well spent. Pre-stained red cedars would have been an expensive custom order, and even then I probably couldn't have gotten the exact color my client wanted. Staining them on site in the winter would have been miserable and messy. Instead I invested about $85 in materials and a couple of hours to build the rack. Then I was able to apply the stain in a warm place, which meant that the stain could dry properly and that I could concentrate on the business of installing the shingles when I got to the jobsite.

Emanuel Silva is a frequent contributor to JLC *and owns Silva Lightning Builders, in North Andover, Mass.*

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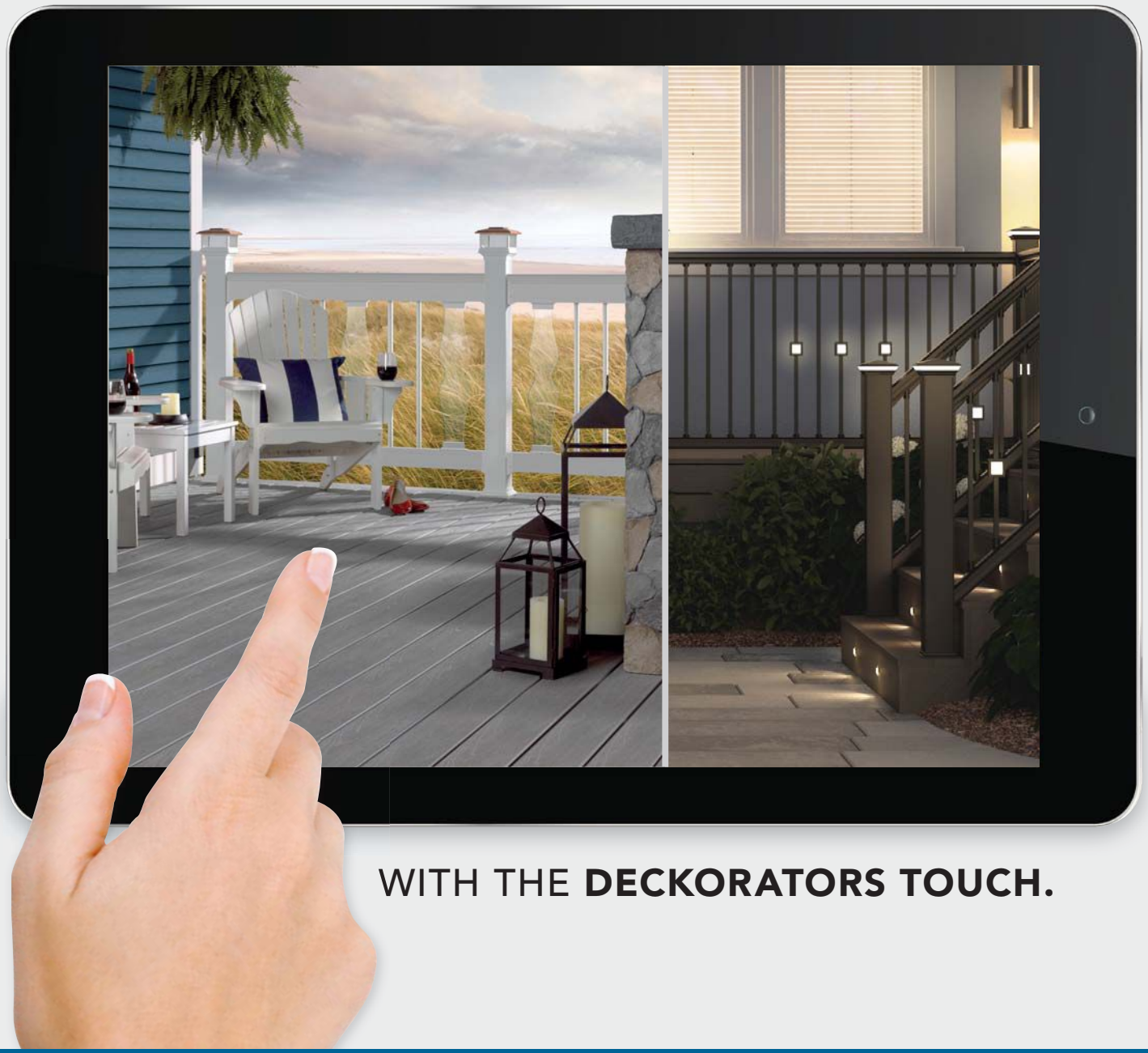

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BY MELANIE HODGDON

Nothing but Net

I'm always fascinated by the fact that more attention seems to be paid to gross profit than to net profit. For those of you who are still fuzzy on the difference, here's a quick review.

Total sales is the amount of money you collect for the projects you build (although some may call it "income" or "revenue" or "volume"). From this amount, two types of expenses must be paid. The first are type above-the-line expenses, which are also called "cost of goods sold" or "job costs." These include everything it takes for you to build out a project—materials, labor, subcontractors, equipment, and expenses for other items consumed by the work.

If you subtract what it costs you to build your jobs from what you charge for them, the result is called gross profit. From this amount, below-the-line expenses—also called "overhead"—are paid. These consist of all of the costs associated with running your business. When you subtract these costs of doing business from gross profit, the result is called net profit. That's the amount you have actually earned after all of the bills are paid.

CROSSING THE LINE

Now here's the interesting part. Suppose that Company A and Company B each sells $750,000 in a given year. If you could take a look at Company A's accounting setup, you would see that it has materials, subcontractors, wages, and payroll taxes posted above the line in cost of goods sold. However, health insurance and workers' comp costs are posted below the line in overhead expense accounts. By contrast, if you could look at Company B's accounting setup, you would see that while it, too, has materials, subcontractors, wages, and payroll taxes posted above the line, it has also included workers' comp, cellphones, and truck expenses in its job costs.

When it comes time to look at a profit-and-loss statement for each company (see table, below), it looks bad for Company B. Both companies spent a total of $675,000 running their businesses, but Company B appears to have a gross profit that is 13% lower than that of Company A. However, net profit for both companies is the same. The difference lies in the way that each company chose to distribute its job-related costs and business expenses.

While Company A's setup is fairly common, there is a certain logic to the way that Company B goes about its accounting. If workers' comp, cellphones, and truck expenses are all tied to having field employees, then those expenses wouldn't exist if the company didn't have a production crew. So it makes sense to include these labor-related costs above the line because they are directly related to the cost of building out the projects.

If you are trying to track your annual overhead figures in order to incorporate them into a reasonable markup figure, then ask yourself this: Where would I need to place accounts—such as cellphone, truck allowance, tool allowance, health benefits—that fluctuate with my labor force? If hiring or firing a worker significantly affects some associated accounts, it would make sense to isolate these accounts from your overhead in order to increase its year-to-year stability.

If you are concerned about how well your business is doing when compared with similar companies, keep in mind that your gross profit figures may be significantly different, but that doesn't necessarily mean that your company is in trouble. By focusing on your bottom line numbers, you will have a better overall indicator of how your business is performing.

Looking only at gross profit, this simple P&L would seem to spell trouble for Company B, which is lagging well behind Company A. But net profit is the same for both. The difference lies in how they each account for job costs and overhead.

	Company A	Company B
Total sales	$750,000	$750,000
Cost of sales	450,000	575,000
Gross profit	(40%) 300,000	(27%) 175,000
Overhead expenses	225,000	100,000
Net profit	(10%) 75,000	(10%) 75,000

Melanie Hodgdon is owner of Business Systems Management, and speaks regularly on business topics at JLC Live. She is co-author(with Leslie Shiner) of the book A Simple Guide to Turning a Profit as a Contractor. *melaniehodgdon.com*

Why Use a 'Time Is of the Essence' Provision?

BY ALEXANDER BARTHET

Timing is everything, especially if there is a "time is of the essence" provision in your contract.

Most people enter into a contract with the understanding that performance will occur within a specific time frame. When performance is delayed, people tend to look to the terms of the contract for recourse. And if they find specific language making it clear that time does matter—that "time is of the essence"—then delayed performance of the particular or general contract terms will likely result in a material breach of the contract. This essentially allows the non-breaching party to terminate the contract.

In a subcontract, for example, the general contractor may specify a completion date and include the "time is of the essence" provision. If the subcontractor does not complete his work on or before the completion date, the general contractor may choose to terminate the subcontract, hire another subcontractor to complete the job, and sue the original subcontractor for breach of contract.

If a contract doesn't include such a "time is of the essence" provision, a delay will not be considered a material breach so long as performance is effectuated within a reasonable time. Even a "time is of the essence" provision can be waived if the parties continue their dealings regardless of late performance. In that case, courts will tend to not enforce termination of a contract. But be aware that simply granting extensions to perform will not necessarily constitute a waiver. In that instance, to preserve your "time is of the essence" provision, it's advisable that you grant extensions in writing expressly noting that the defaulting party is still in breach of the contract. In that way, when you've had enough of the delays, you can still choose to terminate the contract.

Be mindful of "time is of the essence" provisions—they're not just generic contract provisions but are useful tools to enforce performance dates.

Alexander Barthet (alex@barthet.com) is a principal of The Barthet Firm, a 12-lawyer commercial law practice focusing on construction-related matters.

This article is for informational purposes only. It is not intended as legal advice. Consult an attorney before taking any action.

Take the Discount

BY SAL ALFANO

Most lumberyards offer a discount for early payment. It's usually described as "2% 10/net 30," which means that if you pay by the 10th of the month, you get a 2% discount; if you pay between the 11th and the 30th, you pay the full amount. (If you pay after that, you may pay penalties and interest.) In a session at this year's JLC Live conference in Providence, R.I., Leslie Shiner, owner of The Shiner Group (shinergroup.com), a small business consulting and training company based in California, explained that this amounts to a 2% discount for 20 days. Here's how she thinks about it.

Imagine that you've deposited $100 in a bank account and, after 20 days, you have $102. You take the $2 and put it in a cookie jar (to keep things simple, we'll ignore compound interest). After 20 more days the $100 you left in the bank account has again grown to $102, and again you put $2 in the cookie jar, which now holds $4. If you do this over and over again for the whole year, you will make 18.25 (365 ÷ 20) deposits in the cookie jar, for a total of $36.50 ($2 x 18.25). That's an annualized interest rate of 36.5% ($36.50 ÷ $100).

Shiner has another way of looking at it that involves solving the following algebra problem: 2% is to 20 as X% is to 365. Recalling our high school algebra, if we set the problem up as $X \div 365 = 2 \div 20$ **(1)**, then reduce the right side of the equation (2 ÷ 20) to 0.1, we are left with $X \div 365 = 0.1$ **(2)**. Multiplying both sides by 365, we get $X = 365 \times 0.1$ **(3)** or $X = 36.5$ **(4)**. As an annualized rate of interest, that's a pretty good deal.

1 $\frac{X}{365} = \frac{2}{20}$ **2** $\frac{X}{365} = 0.1$

3 $\frac{\cancel{365}\ X}{\cancel{365}} = 0.1 \times 365$ **4** $X = 36.5$

Sal Alfano is editor-in-chief of JLC. *To see a video whiteboard version of this and other Do the Math problems, visit his blog at jlconline.com.*

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BY DOUG HORGAN

Photos: Doug Horgan

Leaking Shower Pans: How Far to Go?

If not properly detailed, tile shower pans are prone to leaking at joints in the curb, benches, niches, and knee walls, at the shower-valve escutcheon, and at the drain. We see shower failures all the time, and frequently the toughest part is deciding how far we need to go to fix it. We can be certain we're fixing all the problems if we demolish the whole thing and start over, and often that's the right solution. But sometimes a less aggressive approach can work, saving customers time, hassle, and money.

This was illustrated on a recent job where the customer had a ceiling leak. When we arrived, the plumbers had already cut a hole in the ceiling directly below the shower drain **(1)**. Judging from the calcium buildup in the leak area (including stalactites a couple of inches long), this leak was a longstanding one.

A close look at the shower revealed a number of potential problems: cracks along the corners of the curb **(2)**, voids in the caulk and grout **(3)**, and buildup of efflorescence around some of the joints, indicating water flow that deposited minerals. The question was, how much water was actually flowing through these cracks? Was it enough to cause the leak in the ceiling below?

Cracks in grout lines are perfectly normal. We see a lot of cracks in curbs, often caused by movement of the wood structure below. If not properly waterproofed, the wood curb (usually a double 2x4) swells as it gets wet, which can create cracks as large as ¼ inch wide in tile.

A good caulk job that's well-maintained should stop, or at least slow down, leaks in the curb area. If the curb had originally been designed and built correctly (always a question to ask when you're looking at someone


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else's work), there would be a complete, intact second layer of protection below the tile or stone. In that case, there shouldn't be a problem, even if the caulk wasn't maintained perfectly.

So we investigated a little further using a pinless moisture meter. The floor outside the shower was a bit wet in some spots **(4)**, but there was no visible damage, and the readings were not very high.

Next, we used an infrared (IR) camera to look at the ceiling, subfloor, and drain. IR cameras are great tools for evaluating moisture damage. You can scan large areas for water, quickly and accurately. We could see that except for very near the drain, most of the area was dry. In the IR image **(5)**, the purple areas show where water evaporating out of the plywood has lowered the temperature of the wood. The warmer areas indicate drier wood.

That's good; the minor wetness at the curb we found with the moisture meter didn't seem to be enough to spread into the floor or drywall below. Similarly, there were no wet areas under the valves or the bench. The wet areas were localized to immediately around the drain.

We brought in GLB Tile & Marble, one of the tile subs we use that has over the years shown particular expertise in dealing with water leaks. GLB agreed that because of the small area of dampness our forensics confirmed, it would be a safe bet to open up only the drain area.

Our hope was that we could fix the problem that way without tearing out the whole shower. We could always come back and take out more if need be. So GLB carefully cut the grout and removed the individual tiles, saving every one, then carefully chipped out the mortar **(6)**.

DRAIN PROBLEMS

We found two obvious problems right away: First, the Oatey (oatey.com) clamp ring was installed so that the weep holes were facing the wrong way **(7)**. In the photo, the slots across the white clamp ring are weep holes that should be facing down.

Second, someone had shimmed up the clamp ring with blue plastic shims spaced around the perimeter **(8)**. This prevented the ring from firmly clamping the liner down onto the drain body below. Our best guess is that the tile guys who installed this drain turned the ring over in an effort to extend the thickness to account for a second layer of old tile underneath. But they knew that the upside-down ring needed weeps, so they tried to make a weep passage by shimming the clamp ring up a bit. Big mistake.

Further digging revealed a third problem: The shower liner material was not properly

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glued to the drain body **(9)**. Someone had tried to use silicone caulk, which in our experience is not a long-term solution for water sealing. Predictably, it had failed. Personally, I would use silicone only where it can easily be seen and replaced when it fails, never in a concealed location where it is needed to hold back water for the long run. Since the silicone in this case wasn't adhered to either the drain or the liner, there were actually two paths for water to escape: between the liner and the silicone, and between the drain and the silicone.

The silicone molded to the drain body below, which helped us find a fourth big problem: The clamp ring and drain body were from two different manufacturers and didn't seal properly. The words "Sioux Chief" (siouxchief.com) were molded into the silicone pieces we pulled out. Sioux Chief drains have a slot on top of the drain body, and the smooth clamp ring has a molded bump that presses the liner down into the slot **(10)**. In contrast, Oatey drains have a little bump molded into the top of the drain body, and the clamp ring's edge presses the liner onto the bump **(11)**. If the glue fails (or is omitted), the physical clamping at the slot or bump will pretty reliably seal the liner to the drain. Unfortunately, if you use a mismatched clamp ring, it doesn't press the liner into the drain body to seal it.

THE REPAIR

We bought the matching Sioux Chief clamp ring, and used NobleSealant 150 to glue the liner to the drain body **(12)**. The cutouts for the bolts in the existing liner were pretty big, so we used a generous amount of sealant (the blue goop in the photo) around those. But we were careful not to clog the weep holes and slots. Keeping those open was critical to the job.

Once the drain assembly was put back together, we water-tested it for 24 hours before the tile guys repaired the area, using a trendy square drain that the clients preferred over the previous round one **(13)**. The existing grout had a bit of white buildup on it, so the new grout will look darker for the time being. We expect that over time it will match as the same minerals and soaps wash over it. The grout below the surface was the same color as the new grout we used.

So far the repair has held, justifying our decision to focus only on the drain and not rip out the entire shower pan. In the end, we had very happy customers and built some trust by keeping the job within reasonable bounds.

Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company serving the Washington, D.C., metro area.

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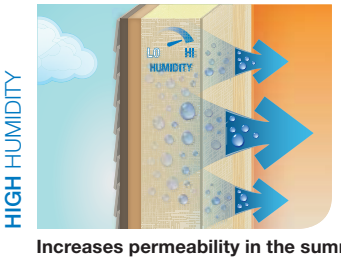

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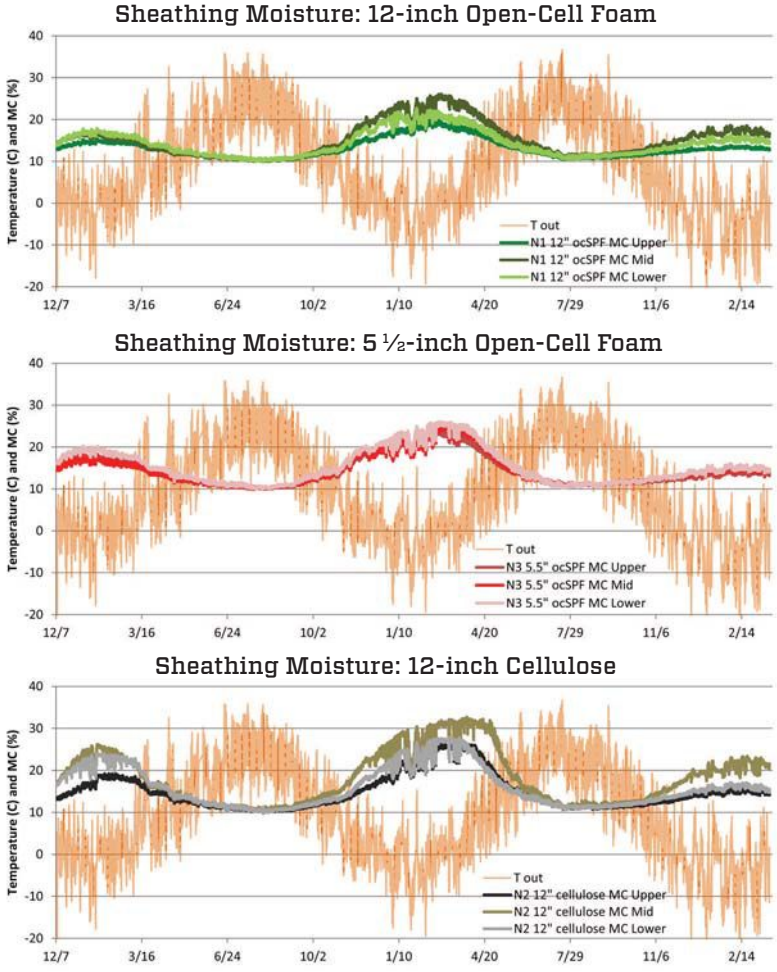
BY TED CUSHMAN

Studying Moisture in Fat Walls

Double 2x4 stud walls insulated with dense-packed cellulose are about the simplest and cheapest super-insulated wall system you can build. But cellulose is vapor-permeable. So in cold climates, there's a risk that humidity inside the building will penetrate the wall, condense on the cold side of the sheathing, wet the wall, and support the growth of mold or rot.

With backing from the Department of Energy's Building America program, Kohta Ueno, a researcher with Building Science Corp., has been taking a closer look at that risk. Using test walls built into a real zero-energy house in Devens, Mass., as his laboratory, Ueno was able to compare the performance of a cellulose-insulated double wall against the behavior of the same wall insulated with two different thicknesses of low-density open-cell spray polyurethane foam (SPF).

So far, Ueno reports, the data show that the foam-insulated walls are less risky than the cellulose-insulated version. But given good control of indoor humidity conditions, and a good vapor retarder for the inside face of the wall, Ueno says that the cellulose-insulated wall could also function safely. Here's a closer look.



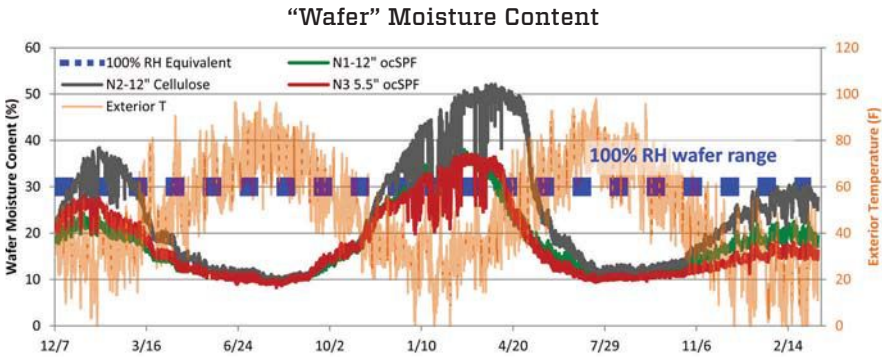
Source: Building Science Corp.

The builder, Carter Scott, of Transformations, in Townsend, Mass., was considering switching from his standard wall system—a double-stud assembly insulated with 12 inches of FoamLok open-cell spray polyurethane foam—to a dense-pack cellulose-insulated version of the same double-stud wall. To evaluate the pros and cons of the switch, Building Science Corp. set up three different test situations on the north and south walls of the Devens house. The base case was Scott's standard wall; the test cases were a wall section insulated with 12 inches of cellulose, and another section with just 5.5 inches of FoamLok. (The 5.5-inch version, Ueno says, was included in hopes of learning something about the performance of a more typical code-built wall.)

Ueno instrumented each test case with an array of sensors. For the past three winters, he has tracked interior and exterior temperature and relative humidity. He has also monitored the humidity within the wall cavities at three locations (near the inside face, near the outside face, and at the wall center). He kept track of the moisture content of the OSB sheathing by using pins driven into its inside face that allowed him to measure the electrical resistance of the OSB (the resistance decreases as the moisture content rises). And for a backup he also installed special sensors—thin pine wafers with attached electrodes—in the wall cavities near the outside wall face.

By now, Ueno has three winters' worth of data, and the information is starting to make sense. The charts at left tell the story of the walls' experiences in response to seasonal changes in indoor and outdoor conditions.

As chance would have it, conditions in the test house varied from winter to winter. In the first winter, the house was unoccupied, and humidity levels stayed low.



During the second winter, a family of four was living in the house—and coincidentally, the home's exhaust-only ventilation system was disabled. With minimal ventilation, humidity levels in the building hit 40% to 50% over the winter. "That's an unsafe level that we would never recommend," Ueno says, "but it gave us just the kind of conditions I might have included if I were designing a test hut to study this problem." By the third winter, the ventilation system had been repaired, so the data for that period reflect conditions created when the home is operating as intended.

As the charts show, all three walls experienced particularly high moisture levels during the second winter, when house humidity was uncontrolled. But the cellulose wall stands out as particularly wet: During late winter of 2012, the sheathing was above 30% moisture content for weeks.

The fourth, and most dramatic, chart (above) plots the data from the pine test wafers inside the wall cavities near the inside face of the sheathing. (Note: The temperature scale in this chart is degrees Fahrenheit, not Celsius as in the charts on the previous page.) During the winter that the home wasn't properly ventilated, the sensor readings surged to a level that indicates saturation and condensation—and the worst case was the cellulose-insulated assembly.

Ueno points out, however, that wet sheathing in the winter does not necessarily imply that there will be mold or rot. The walls got wet during winter—mostly during the season when it's too cold for mold to grow. And they dried to a safe 10% to 12% moisture content during the summer. The $64,000 question is, Ueno says, did the walls stay wet enough during the spring for the OSB to allow mold growth? The answer will come this summer when Ueno opens the wall and examines the three wall bays. But already he's learned how vital it is to control indoor humidity.

"When you're comparing things that will blow up walls," he says, "the interior relative humidity is at least as important, if not more important, than how cold it is getting outside."

Ueno predicts that the cellulose-insulated double wall would perform much better than these data show if the wall were equipped with a "smart" vapor retarder (such as CertainTeed MemBrain or ProClima Intello). Even a Kraft-paper vapor retarder on the inside face of the studs would help. All of those materials become more permeable as relative humidity increases, limiting a wall's wetting potential in winter while allowing some drying during summer.

Even with a good vapor-control strategy, Ueno warns that holes in the inside wall are always a concern, especially if they allow air movement. If there is an air leak into the wall from the inside, humid indoor air may condense in the wall cavity. That's when cellulose-insulated walls are most at risk. In that situation, exterior rigid foam insulation, applied outboard of the sheathing, can provide a significant advantage in protecting against condensation.

Ted Cushman is a regular contributer and former JLC senior editor based in Peaks Island, Maine.

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A Look Through European Windows

Advanced technology to meet 21st-century standards

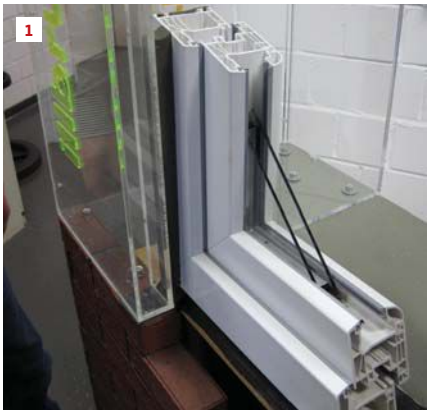
BY STEVE BACZEK

As we rolled past a security gate, I was informed that the 40-acre complex we were entering was a former Soviet tank factory. After weaving through a maze of austere industrial structures, we came upon a small building that looked out of place with its bright yellow stucco exterior and its beautiful wood windows. Makrowin, the company located there, manufactures what we in this country call European windows, or "tilt-and-turn" windows (because most of them open by either tilting in at the top or swinging in like a door). This facility was the first stop on a recent trip through areas of Europe where I got to see what goes into fabricating these extraordinary products known not only for their furniture-like aesthetic quality but for exceptional operation and performance that are hard to equal anywhere.

Photo: Roe Osborn

WHERE IT BEGAN

Although European windows are some of the most thermally efficient windows manufactured in the world, their development was spurred by concerns other than energy efficiency. During the last couple of decades, as homes in Europe became more airtight and more thermally efficient, double-glazed windows **(1)**—widely used in Europe at the time—came under scrutiny for health reasons. Condensation consistently developed on the glass, which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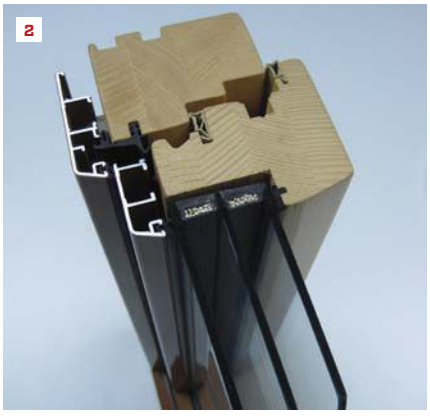
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contributed to mold growth. This, coupled with inadequate mechanical ventilation, produced major problems with interior air quality in homes.

The glazing industry responded by creating triple-glazed insulating glass packages with improved U-values **(2)**. The heavier glazing units then led window manufacturers to produce thicker laminated-wood frames. Triple glazing and sturdier frames propelled the industry to a new level of product advancement. At the same time that window technology was exploding, the Passive House Standard, a new highly advanced approach to building, was taking hold in Europe. These two paths soon crossed and are now inextricably linked.

With health concerns solved, the industry turned to improving the energy efficiency of the windows to meet the stricter building standards coming online. New ways of thermally breaking the window frames were developed, prompting hardware companies to scrutinize the thermal properties of the operating mechanisms. Manufacturers of all of the windows' components adopted an "all in" philosophy, resulting in windows of superior quality and very high performance.

MADE TO ORDER

As an architect who designs low-energy, airtight homes—striving to meet Passive House standards on many of them—I have difficulty finding the right windows domestically, so I usually opt for European windows, specifically the triple-glazed units. The reason is simple: The flexibility in their production allows me to procure the appropriate windows for any project.

European windows are not subject to the standard sizing and typical conventions—such as predetermined levels of quality—that govern most windows made in the U.S. Every European window is built to order, created from scratch within a matrix of configuration and component options. So instead of designing a project around a set of window parameters, I can design the project first and then order windows that meet its exact requirements, including size and color as well as performance. The concept we have in the U.S. of "customizing" window design simply does not exist in Europe.

THE GLASS COMES FIRST

The heart of every window—regardless of where it's made—is the glazing, or the insulated glass unit (IGU), that's installed in the

Photos: Steve Baczek


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frame. IGUs for European windows are made in a separate facility by a company different from the one that assembles the final product. Glass comes into the IGU factory in huge sheets (3 meters by 8 meters) in whatever glass type is required, such as low-E coated or laminated **(3)**. The sheets are laid flat and are cut to the proper IGU size on a CNC machine. While it's cutting, the CNC machine also prepares the edges of the glass panels for installation by grinding any coatings off so they will accept a sealant.

While the glass is being meticulously cleaned **(4)**, a worker prepares the welded metal spacers that separate the layers of glass **(5)**. Next, the glass moves to the gas-filling station **(6)**. Argon gas—so critical to the performance of these windows—is not injected into the frames. Instead, the sheets of glass and the spacers are aligned in a loose assembly (close but not touching) and placed into a chamber from which the air is subsequently evacuated and replaced with argon. The glass and spacer sandwich is then compressed together, sealing the argon between the sheets. After the argon is evacuated from the chamber and replaced with air, the argon-filled IGU emerges. The edges are given a final seal, and the IGU is packaged with the rest of the order and shipped to the window manufacturer **(7)**.

HIGH-TECH FRAMES

Although European windows are available in a variety of frame materials, wood-frame windows have traditionally been the most popular choice. Recently, however, wood-frame windows that are clad with aluminum have been gaining in popularity. Clad or not, the wood frames themselves are constructed along the same assembly line. They are made of laminated wood that comes to the factory in 18-foot lengths and is roughly 3 ½ inches square **(8)**. All the wood used by Makrowin is sourced from nearby forests (within about 125 miles of the factory) that are managed under strict regulations.

The laminated wood frame adds strength and durability to the windows, which is especially critical when they reach lengths up to 17 feet. Each interior laminated section of the frame is finger-jointed, which may make some American craftsmen cringe. But I was told that most builders in Europe prefer the finger-jointed wood and usually specify it as a component of the windows they order. Because of high-tech cutting methods and adhesives, finger-jointed wood is stronger and more stable than solid wood. For aesthetic reasons, the outer laminate of the frame—the piece that


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is visible as the interior finish of the window—is a solid rather than finger-jointed piece of wood.

Compared with solid wood, the laminated frames offer superior holding and pull-out strength for fasteners, ensuring durable connections for all the operating hardware. The extra strength also allows for fewer hinges, even with heavy, triple-glazed IGUs. And if a project calls for elevated U-values in the frame, manufacturers can substitute layers of cork for some of the wood laminations to provide a continuous thermal break around the perimeter of the frame **(9)**.

A HUMAN TOUCH AMONG THE MACHINES

Rough-cut blanks enter a system of saws and shapers that precisely cut the frames to length and create glue joints at each end **(10)**. Mortises and pilot holes for hardware are also cut at this point **(11)**. Though companies fabricate these window frames using some of the most high-tech equipment available, it was interesting to learn that each frame receives more than an hour of hand-sanding. I was skeptical about this until I watched as an employee with a collection of specific sanding blocks orchestrated a personal stamp of perfection to each unit she handled **(12)**. In a shop filled with high-tech shapers, drills, and saws, the final finish is left to human hands. Thinking back on all the times I've admired the quality of these windows, I now realize why they always look so good.

After an initial sanding, each wood frame goes through an elaborate finishing process that includes a bath in organic-growth repellent and coats of sealant, with light sanding between **(13)**. Before final finishing, a special sealant is applied to each corner joint **(14)**. That thin film bridges the two sides to protect the joint and the finish should any slight movement occur.

The frames are then sent into the finishing room where they are air cleaned and finished to the specifications of the order **(15)**. For windows with an operable sash and complimentary glazing stop, the pieces are hung in tandem and finished in unison to ensure that the finish is an exact match when they are placed adjacent to one another in the final assembly **(16)**. The humidity in the finishing room is closely maintained at 70%—the optimal level for curing set by the finish manufacturer—which lets the finish "relax" completely, resulting in an extremely smooth surface that's free of the kind of texture that spray finishes often leave.

Photos: Steve Baczek


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Hardware installation occurs after finishing to ensure that all surfaces on the frames are finished before the windows are assembled. The elaborate hardware for these windows is installed by hand, with the frames and sashes resting on a special padded table **(17)**. The operation hardware, hinges, and locks are installed via pilot holes that had been drilled earlier to ensure their exact alignment. At this phase, the window units also receive weatherstripping **(18)**. The sashes are then married to the IGU that was made especially for that unit. The IGUs are set in a glazing bead, and the glazing stops are applied.

If a window is to be clad in aluminum, it's at this stage that the pre-manufactured cladding is installed onto the wood frame. The cladding is produced at a separate facility and is welded and pre-finished when it arrives at the factory **(19)**. We weren't able to see the aluminum cladding being produced, though, and were told that the process is a tightly guarded secret. The welds on corners of these frames are completely invisible, so I can't blame the maker for keeping the process under wraps.

After the cladding is installed, the finished window and door units are grouped according to project and are wrapped and packaged together to await departure from the factory and delivery to the jobsite **(20)**. The typical lead time for delivery to the U.S. is 11 to 12 weeks or three months, which is about 30% longer than what you can typically expect for a high-end custom order from a domestic manufacturer. That time frame includes the usual total fabrication time of about eight weeks, with another three to four weeks allowed for transfer and delivery. Orders for the U.S. usually have priority, so windows destined for Europe typically have the same three-month delivery schedule, even without the overseas shipping.

LIMITATIONS & EXPECTATIONS

After the factory tour, I sat down with the owners of the window company to ask them some tough questions. I started with the upper limits for the size of these windows. As mentioned earlier, the rough stock for the laminated frames comes in lengths of around 18 feet, so the longest dimension possible in a fixed triple-glazed window is about 17 feet.

As for operable windows, they told me that maintaining an aspect ratio of 1:2 (horizontal:vertical) is a good rule of thumb. That means, for example, that a 5-foot-wide, 10-foot-tall operable window can readily be produced.


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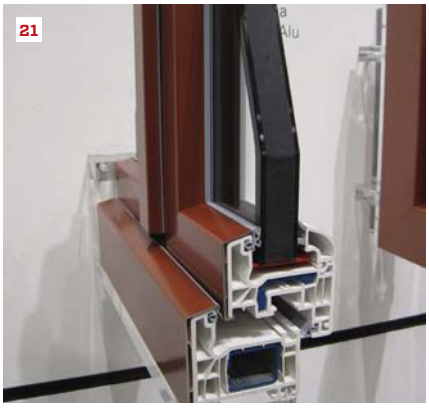
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To answer my questions about the durability and longevity of the wood frames and the hardware, the company's owners showed me examples of wood windows in a nearby village that are still in fine operating condition after more than a century of use.

Obviously these old windows don't offer the same energy performance as the modern ones do, but that's still a respectable achievement. As for the double-glazed windows from the last 50 years that we mentioned earlier, most are still operating and performing as designed.

The window components typically carry a 10-year warranty. For windows currently being manufactured, the experts I spoke with believe that of the four basic components—IGU (glazing), wood frame, hardware, and aluminum cladding—the IGU is the weakest.

But, that said, by law an IGU can't lose more than 1% of its argon fill per year. The glazing manufacturer, using all third-party testing, reports less than 0.01% loss of argon per year, which is 100 times better than what is required. And because of the component construction, if the IGU does fail, it can easily be replaced without the entire window being removed.

A SEA OF OPTIONS

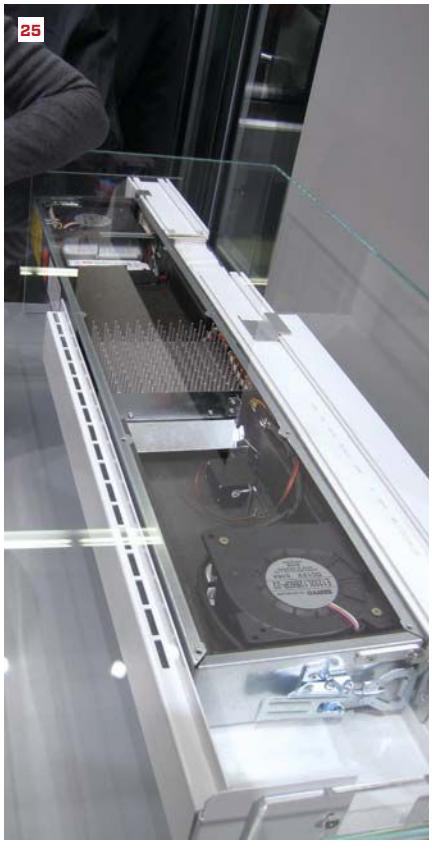
While touring window manufacturers in Europe, I attended a huge trade show where I saw an incredible array of options for these high-tech windows.

One popular choice is a PVC frame. Its performance is very similar to that of its wood counterparts **(21)**, and depending on the size of the unit, it can be reinforced with steel—though one of the PVC reps at the show told me that his company is moving toward using recycled aluminum for reinforcement in the near future.

Another option is an aluminum-frame window thermally broken with a foam-filled plastic channel that separates the interior and exterior frames **(22)**. The performance of these windows is supposedly equal to wood-frame windows. Because the frames are hand-welded, metal-frame windows tend to be more expensive.

There are more options than I can list, but here are a few other notable ones. Integrated solar shades, important for energy-efficient homes, are available in a wide variety of configurations **(23, 24)**. Another useful option reverses the typical turn-then-tilt operation to tilt-before-turn. Most windows are also available with accessible hardware and child-safe hardware for either manual or

Photos: Steve Baczek



motorized operation. Motorized hardware can be integrated with a home's energy system to operate in accordance with changes in interior or exterior climate conditions. All windows and doors have options to meet Europe's stringent security requirements. To meet demands for indoor air quality in the super-tight homes in which these windows will be installed, small heat recovery ventilators can even be built into the window units **(25)**. Finally, at additional cost, the windows can be made with high levels of resistance to fire, impact, and sound transmission.

The options you can order for these windows seem limitless—and if you have a special requirement, chances are the manufacturer will find a way to accommodate it.

THE CRYSTAL BALL

What does the future hold for window technology? The experts told me that moving to a quad-pane window (four layers of glass) seems to be next, although most believe that improvements in "hard coatings" on the glazing will produce the performance of quad glazing in the current triple-glazing configuration. Except for historical applications, aluminum-clad windows will eventually make the exposed-wood-frame window obsolete. Frame insulation and performance is always improving, and client demand for better performance in VLT (visible light transmittance) and SHGC (solar heat gain coefficient) will maintain pressure on the IGU manufacturers to improve their products as well.

THE BOTTOM LINE

It's impossible to give an exact cost of these windows and doors because of the complex matrix of options available. Manufacturers told me to use $75 to $125 per square foot for estimating purposes. But keep in mind that because the IGU is the least expensive component of the window, bigger windows have a cheaper per-square-foot price than smaller windows. Some may look at this advanced technology and say that it's too expensive. But if you understand that windows and doors are the lowest-performing component in any wall system, doesn't it make sense to choose the best-performing windows you can get?

Steve Baczek of Reading, Mass., is an architect specializing in energy-efficient design and certified passive homes, stevenbaczekarchitect.com.

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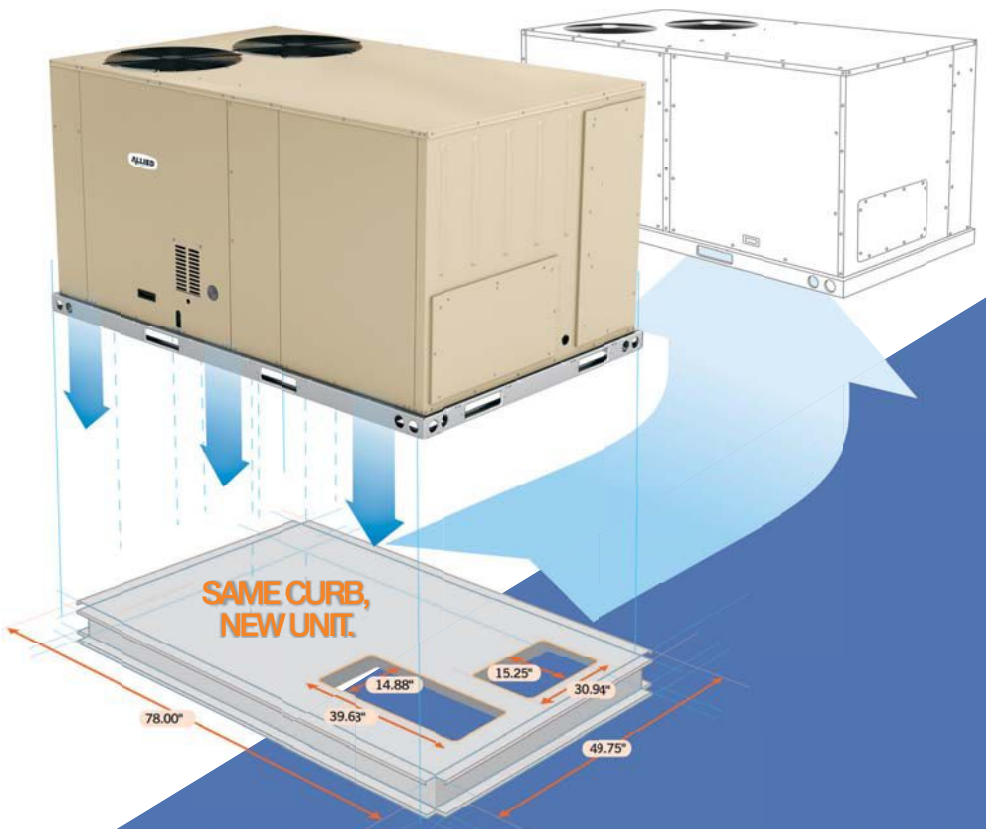

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Photo: Tim Uhler

18-Volt Cordless Recip Saws

Power and runtime separate the best from the rest

BY MICHAEL SPRINGER

Five years ago in TOOLS OF THE TRADE, a test of the first generation of lithium-ion-powered reciprocating saws determined that for getting the job done quickly, 36-volt tools were the ones to buy—most 18-volt models weren't up to jobsite challenges. But I'm happy to report that advancements in motor and battery technology make some of the newer 18-volt models capable of serious work. They're worth considering to add cordless convenience to your demolition and other recip-saw jobs.

I tested the tools in kit form with a battery, charger, and carrying case (where available). Keep in mind that these saws are also sold without batteries or chargers (referred to as "bare tools") for users who already have batteries and chargers from the same manufacturer.

If that's your situation, you may decide not to buy the tool that we thought was the best. Instead, you may just need to know whether your brand is good enough to get the job done. I've included performance details and provided complete information on each saw we tested.

USING THE SAWS

During my time with these tools, I evaluated and tested each one. I used 6-inch-long, 6-TPI Lenox blades (B656R) to cut

Bosch
CRS180 K

Battery: 18 volts; 4.0 Ah
Battery gauge: 3 bars; on battery
Weight: 7.66 pounds
SPM: 0–2,400; 0-2,700
Stroke length: 1 ⅛"
Blade clamp: External metal twist collar; one-hand operation
Shoe: Non-adjustable; 9/16" of blade unused behind shoe
Other features: Lower speed setting enabled by trigger-limiting switch (not lower gear)
Web price: Bare tool, $160; kit with battery, charger, and case, $250
Country of origin: China
Performance: Power—fifth place, 63% of best; runtime—third place, 91% of best

Comments: Medium-duty saw with medium-high vibration—the best saw outside of the heavy-duty models."
Pros: Long running. One-handed blade changes. Lower speed setting nice for controlled cutting. Comfortable one- or two-finger trigger.
Cons: Fixed-position shoe limits versatility, blade performance, and economy. Have to touch hot metal clamp collar to remove blade. Difficult to steer at times—cut crooked more than other saws in the test. Longest charging time at 2 hours, twice as long as most others.

DeWalt
DCS385 L

Battery: 18 volts; 2.0 Ah
Battery gauge: No
Weight: 7.21 pounds
SPM: 0–3,000
Stroke length: 1 ⅛"
Blade clamp: Recessed with lever release; two-hand operation; 4 position blade slots
Shoe: Adjustable to 3 positions; minimal 3/16" of blade unused behind shoe
Web price: Bare tool (DC385B), $93; kit with battery, charger, and case; $260
Country of origin: Mexico
Performance: Power—fourth place, 66% of best; runtime—tenth (last) place, 45% of best

Comments: Heavy-duty saw with high vibration—gets the job done but doesn't do it for very long.
Pros: Flexible-fuel tool—comes with Li tower pack but also compatible with brand's common NiCad batteries. Excellent blade economy with very few of the teeth wasted behind the shoe. Nice handle comfort with rounded top for different handgrip positions.
Cons: Shortest runtime. Lowest amp-hour battery in test. High-vibration tool. No battery gauge. Loose shoe wiggles around in use and can contact blade

DeWalt 20V MAX
DCS380 M1

Battery: 18 volts; 4.0 Ah
Battery gauge: 3 bars; on battery
Weight: 7.27 pounds
SPM: 0–3,000
Stroke length: 1 ⅛"
Blade clamp: Recessed with lever release; two-hand operation; 4 position blade slots
Shoe: Adjustable to 3 positions; minimal 3/16" of blade unused behind shoe
Web price: Bare tool DCS380B, $126; kit with battery, charger, and case, $275
Country of origin: Mexico
Performance: Power—fourth place, 75% of best; runtime—fifth place, 82% of best

Comments: Heavy-duty saw with high vibration—a capable second-place tool that's a little rough around the edges.
Pros: Fast cutting. Long running. Excellent blade economy with very few of the teeth wasted behind the shoe. Nice handle comfort with rounded handgrip top for different thumb positions.
Cons: High-vibration tool. Loose shoe wiggles around in use and can contact blade.

Hitachi
CR18DSL

Battery: 18 volts; tested with latest 3.0 Ah slide-pack battery
Battery gauge: 2 bars; on tool
Weight: 7.81 pounds
SPM: 0–2,300
Stroke length: 1 1/8"
Blade clamp: External clamp with small release lever; two-hand operation
Shoe: Adjustable; requires loose hex wrench; 9/16" of blade unused behind shoe
Web price: Bare tool, $130
Country of origin: China
Performance: Power—tied for last place, 46% of best; runtime—seventh place, 64% of best

Comments: Medium-duty saw with low vibration—slow, steady, and reliable.
Pros: Gentle, low-vibration saw especially comfortable to operate
Cons: Cuts slowly. Requires loose hex wrench to adjust shoe—tool-free adjustment is preferred. One- or two-finger trigger has a hard edge below that pushes into finger during two-finger use.

Makita
BJR181

Battery: 18 volts; 3.0 Ah
Battery gauge: None
Weight: 8.22 pounds
SPM: 0–2,900
Stroke length: 1 1/8"
Blade clamp: External rubber-covered twist collar; one-hand operation
Shoe: Adjustable to five positions; 5/8" of blade unused behind shoe
Other features: Large hanging hook; LED headlight with 12-second delay
Web price: Bare tool, $158; kit with two batteries, charger, extra-long plastic case, $329
Country of origin: China
Performance: Power—tied for last place, 46% of best; runtime—ninth place, 46% of best

Comments: Light-duty saw with medium vibration—doesn't have enough to offer.
Pros: Easy one-handed blade changes with comfortable rubber-covered collar. Nice hang hook and headlight. Long case allows storage with 6-inch blade attached to saw. Short battery charge time, just under the one-hour time of most others.
Cons: Cuts slowly and bogs down under pressure. Short runtime. No battery gauge.

Metabo
ASE18LTX

Battery: 18 volts; tested with latest 5.2 Ah slide pack battery
Battery gauge: 4 bars; on battery
Weight: 8.23 pounds
SPM: 0–2,700
Stroke length: 1 3/16"
Blade clamp: Recessed with lever release; two-hand operation
Shoe: Adjustable; requires onboard hex wrench; 3/4" of blade unused behind shoe
Web price: Bare tool, $148
Country of origin: China
Performance: Power—tied for last place, 46% of best; runtime—second place, 93% of best

Comments: Light-duty saw with low vibration—runs forever, but a bit too slowly.
Pros: Long running. Low vibration.
Cons: Cuts slowly and bogs down under pressure. Have to hold in safety lock-off button every time you want to pull the trigger. Requires hex wrench to adjust shoe—tool-free adjustment is preferred. The combination of a rear-facing battery-release button and battery removal direction toward the front of the tool causes the battery to disengage and sometimes fall out dangerously whenever your body pushes forward against it while cutting. Long charging time of one hour, 55 minutes—almost double that of most others.

Milwaukee 2620-21

Battery: 18 volts; 3.0 Ah
Battery gauge: 4 bars; on battery
Weight: 8.25 pounds
SPM: 0–3,200
Stroke length: 1"
Blade clamp: Recessed with slide release; two-hand operation
Shoe: Non-adjustable; 5/8" of blade unused behind shoe
Web price: Bare tool (2620-20), $95; kit with charger, battery, and case, $292
Country of origin: China
Performance: Power—second place, 85% of best; runtime—sixth place, 68% of best

Comments: Heavy-duty saw with medium-high vibration—a refined second-place tool that only lacks an adjustable shoe.
Pros: Fast cutting. Nice handle comfort with rounded handgrip top for different thumb positions.
Cons: Fixed-position shoe limits versatility, blade performance, and economy.

Milwaukee FUEL Brushless 2720-21

Battery: 18 volts; 4.0 Ah
Battery gauge: 4 bars; on battery
Weight: 9.06 pounds
SPM: 0–3,000
Stroke length: 1 1/8"
Blade clamp: Recessed with slide release; two-hand operation
Shoe: Adjustable to eight positions; 11/16" of blade unused behind shoe
Other features: Only tool in the test with a brushless motor; large hanging hook; LED headlight with 11-second delay
Web price: Bare tool (2720-20), $249; kit with charger, battery, and case, $371
Country of origin: China
Performance: Power—first place; runtime—first place

Comments: Heavy-duty saw with medium vibration—this high-tech brushless motor tool is top performer all around.
Pros: Fastest and longest-lasting tool in test. Most manageable vibration among the heavy-duty saws. Nice hang hook and headlight.
Cons: Longer-than-average charge time of 1 hour, 20 minutes, one-third longer than most others. Heaviest tool—a negative for portability, but extra mass a plus for faster cutting and vibration reduction.

Panasonic Dual-Voltage EY45A1 LS1G

Battery: 18 volts; 4.2 Ah
Battery gauge: None
Weight: 7.45 pounds
SPM: 0–2,800
Stroke length: 1 1/8"
Blade clamp: External rubber-covered twist collar; two-hand operation
Shoe: Non-adjustable; excessive 1" of blade unused behind shoe
Other features: Shock-absorber shoe design; thermal-overload and spent-battery warning lights; IP56 dust and water-resistance rating
Web price: Kit with charger, battery, and case; $390
Country of origin: China
Performance: Power—seventh place, 51% of best; runtime—fourth place, 90% of best

Comments: Medium-duty tool with very high vibration that makes it difficult to use.
Pros: Long running. Flexible-fuel tool—fits several of the brand's 14.4- and 18-volt battery packs for more versatile use as an add-on tool. Best tool case in the test.
Cons: Have to hold in safety lock-off button every time you want to pull the trigger, which is a constant hassle. Fixed-position shoe limits versatility, blade performance, and economy. No battery gauge. Shock absorber design adds excessive vibration while robbing control. Have to touch hot blade when changing.

Ridgid
R8641 B

Battery: 18 volts; tested with 4.0 Ah battery
Battery gauge: 4 bars; on battery
Weight: 7.66 pounds
SPM: 0–3,600
Stroke length: ¾"
Blade clamp: External metal twist collar; two-hand operation
Shoe: Adjustable to six positions; shoe plate can lock in three angle positions; excessive 1 ⅛" of blade unused behind shoe
Other features: Orbital action; LED headlight with no delay with separate trigger switch
Web price: Bare tool, $129
Country of origin: China
Performance: Power—sixth place, 52% of best; runtime—eighth place, 62% of best

Comments: Light-duty tool with low-medium vibration—has nice features but the overprotective battery won't let them work.
Pros: Orbital action speeds up the performance. Nice shoe angle locking feature and headlight.
Cons: An unpredictable performer plagued with sudden stalling. Too finicky in use as the battery pack's protective circuit shuts down often. When all is going well, it will cut at a fast pace—especially in orbital mode—but it is always right on the edge of unexpectedly stalling with no warning, so it's difficult to get much done with this saw. Have to touch hot metal clamp collar to remove and install blade.

through blade-wrecking test planks similar to the ones I used for my reciprocating-saw-blade test in the Winter 2012 issue of TOOLS OF THE TRADE. The planks are made from a piece of OSB sandwiched between 2x6s and capped with a layer of ⅝-inch drywall and more OSB. The central piece of OSB is flanked by 12 rows of nails glued rigidly into grooves—10 rows of 16d commons, one of 16d sinkers, and one of 8d sinkers. The result is that each pass of a saw blade though these planks cuts 12 nails.

I clamped the planks into a waist-height vise so I could really lean into the cuts. All the tools could cut through these test planks, but while some sprinted, others made it only at a crawl. When I really pushed the tools, the important performance differences became evident.

As I tested the saws, I rated their performance in two ways (see charts on page 56). To rate power, I timed how long it took each saw to cut through a doubled 2x6. And to rate runtime, I counted the number of times each saw cut through a doubled 2x6 on a single battery charge. (Before every test, I put a new blade in each saw.)

My tests enabled me to classify the saws as light-, medium-, or heavy-duty tools. I also categorized them by how much they vibrate in use: low, medium, medium high, or high. Complete specifications and comments for each saw begin on page 50.

DUTY RATINGS

Power is important, but a reciprocating saw needs more than raw power to excel. Its ability to cut aggressively and for long periods of time relies on several other factors too: preventing the battery from overheating, having a long stroke length that clears sawdust quickly, and having vibration control that keeps the blade firmly in the bottom of the kerf.

I pushed the tools hard because that's the way they are used in the field. No one babies a reciprocating saw. Plus real-world use allowed me to separate them into three performance categories:

Heavy-duty saws could take as much force as I could apply and not stall or bog down dramatically, so pushing harder generally resulted in faster cutting. These tools cut the quickest and were the least temperamental; consequently, they set the standard overall. The dogged performance of the four Milwaukee and DeWalt tools earned them each a place in this category.

Medium-duty saws had a limiting pace that they couldn't be coaxed out of, but at least they acted predictably. Pushing harder didn't make them cut faster, but it didn't slow them down much, either. They take longer, but they get the job done, so one of these saws may be all that's needed for average tasks. Saws by Bosch, Hitachi, and Panasonic made the cut for this category.

Light-duty saws are more trying to use because when you push harder, their motor speeds (and their already-conservative cutting speeds) drop dramatically, and they stall frequently. These tools actually perform better if you let up on the pressure, but I find it difficult to use a saw that I have to baby while trying get the job done. The Makita, Metabo, and Ridgid saws all fell into this category.

1. The adjustable shoe of the Metabo locks in place with two set screws and a hex wrench, which can be stored in an onboard slot. A lever lifts to operate the blade clamp.

2. Large fold-out hooks on the Makita and Milwaukee Fuel allow you to hang the saws from rafters, ladders, or scaffolding. The hooks click into position or stow flat against the tool.

3. The multiposition shoes of both DeWalt saws and the Makita (shown here) lock in place with a sliding button mechanism.

4. The blade clamp on both DeWalt saws can hold a blade in four different cutting positions. An additional slot holds the blade perpendicular to the handle, and when the saw is held upside down, this position allows for closer flush cuts without bending the blade very far to get it flat to the cutting surface.

5. The Metabo and Panasonic (shown) saws have a spring-loaded trigger lock-off switch that must be pushed while pulling the trigger before the tool will turn on. These switches are a nuisance and require you to reposition your grip every time you start up the saw.

6. The Bosch has a fixed-position shoe and a metal blade-clamp collar. The clamp ejects the blade when you twist it and remains open until another blade is inserted, making it possible to change a blade with one hand.

7. The Hitachi's tiny spring-loaded lever pivots to release or lock the blade. It's wise to lock the lever manually, a two-hands operation, rather than rely on the small spring to secure the blade.

8. The multiposition shoes of the Milwaukee Fuel (shown) and the Ridgid lock in place with a lever clamp.

9. LED headlights are found on the Makita, Milwaukee Fuel (shown), and Ridgid saws. The Ridgid's light has a separate switch built into the handle for flashlight use without running the saw motor, while the other two have a built-in delay that keeps their lights on for a short while after a tap on the trigger.

10. Battery-mounted charge gauges allow you to check power without having to slide the battery into the tool. A tool-mounted gauge, such as the one on the Hitachi saw, displays the charge of any battery once it is inserted.

RUNTIME

It's not surprising that a battery with higher amp-hour ratings will run a saw for a longer stretch of time than one with a lower rating. In this sense, runtime tests are often a test of the battery, not of the saw.

So, instead of measuring how long a tool ran on a battery charge, I measured how much work each tool could do on a charge (see table on page 56). A tool that is a slow performer may actually run longer than a fast-cutting tool, but what's important is the work that results from the operating time. When fully loaded in 3-inch-thick cuts, even the best saws may cut for only five minutes before needing to be recharged.

VIBRATION

The trade-off between a powerful and a gentle tool is usually in how fast it cuts. For the sake of my carpal tunnel syndrome and bouts of tendonitis, I wish there were a fast-cutting tool that didn't vibrate a lot, but the fastest-cutting tools are all a bit on the brutal side.

Because the most comfortable tools are on the slow side, I'd rather endure a reasonable amount of vibration to get the job done faster instead of losing time waiting on a gentle tool to make the cut. Here's how the tested tools "shook out" in terms of overall felt vibration during many types of cuts:

Low: Hitachi, Metabo, and Ridgid
Medium: Makita, Milwaukee Fuel
Medium-high: Bosch, Milwaukee
High: both DeWalts and Panasonic

The easiest ways to reduce vibration are to secure your work as firmly as possible and to use a lot of force to push the shoe of the saw against the material being cut. Another technique is to reduce your feed speed or motor speed. Often, you can find a sweet spot where the vibrations cancel each other out, and reducing your feed pressure usually keeps the blade from pushing back toward you with so much force.

HOW NOT TO EASE VIBRATION

The Panasonic saw has a feature that causes uncontrollable vibration. Instead of having a rigid shoe that holds firmly against the work surface, this saw actually has little springs inside that provide shock absorber-type suspension to the shoe. This means that whenever the blade teeth bite into the wood and pull back toward the saw, instead of pulling firmly against the shoe's resistance to rip out the wood, the firmly anchored blade actually jerks the entire saw forward as the flex of the springs allows the shoe to move freely.

This action also makes it very difficult to slowly and carefully start cuts in wood or metal, because once the saw teeth get the slightest bite, the saw just bounces back and forth instead of moving the blade through the material.

Other than possibly replacing the springs with steel pins to negate this ill-conceived suspension design, there is no way around this excessive and needless vibration. Either you have to push

forward incredibly hard in an attempt to bottom out the springs, or you must hold the tool back with the minimum amount of force against the shoe. Both ways, at times this saw will practically shake the earplugs out of your head.

ERGONOMICS

Besides vibration, a few other considerations affect the comfort of using these saws. The Metabo and Panasonic saws have a spring-loaded trigger lock-switch that must be pushed in before you pull the trigger. Pushing the switch before every cut requires you to constantly move your hand from its ideal grip position, which causes grip strain and wastes time.

Another consideration is the shape of the top of the tool's trigger handle. Tools with a rounded-over profile are much friendlier to your hand and easier to grip than those with a pronounced ridge above the handgrip. When I use a recip saw for extended periods, I push on the top of the tool with my left hand; saws with a ridged-top grip handle are uncomfortable and fatiguing. The Milwaukee and both DeWalt saws provide great examples of this grip surface done right.

ADJUSTABLE SHOES

Adjustable shoes allow you to control the saw's cutting depth, which is important for plunge-cutting safely into walls, floors, ceilings, or roofs. But just as important, an adjustable shoe allows you to use all the teeth on a blade. When one section of a blade's teeth get dull, you can adjust the depth of cut and then use a previously unused section with sharp teeth.

This isn't just a matter of blade economy in dollars and cents, but truly an underused timesaver on the job. When making repetitive cuts, the same teeth are constantly being used (and dulled), but by moving the blade so that even just a few fresh teeth are put into action, cutting times and practical blade life can dramatically improve.

THE BOTTOM LINE

The overall winner is the Milwaukee Fuel model. It cut faster, ran longer, and managed vibration better than the other heavy-duty saws. It features a sturdy adjustable shoe, a quick-acting blade clamp, a useful hanging hook, and an LED headlight.

The second-place tools are the Milwaukee and 20V Max DeWalt saws—both strong and capable where it counts. The Milwaukee lacks an adjustable shoe, but the DeWalt has much more vibration, so their exact ranking is a toss-up.

Like its brandmate, the DC5385L DeWalt is a strong performer, but it misses the mark with its low runtime.

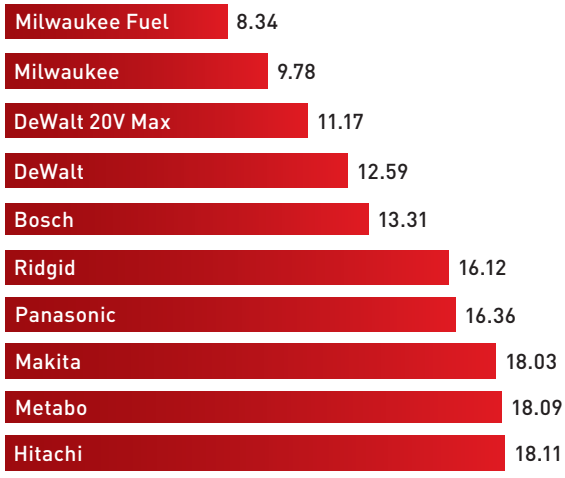
Next in order come Bosch and Hitachi—both quality saws that work diligently but more slowly than the top-tier saws. The Metabo saw follows. Low or troublesome performance issues have the Makita, Panasonic, and Ridgid trailing the others.

Michael Springer is the former executive editor of TOOLS OF THE TRADE, *which is where this article originally ran. Special thanks to Lenox for providing the blades used during testing.*

Test Results

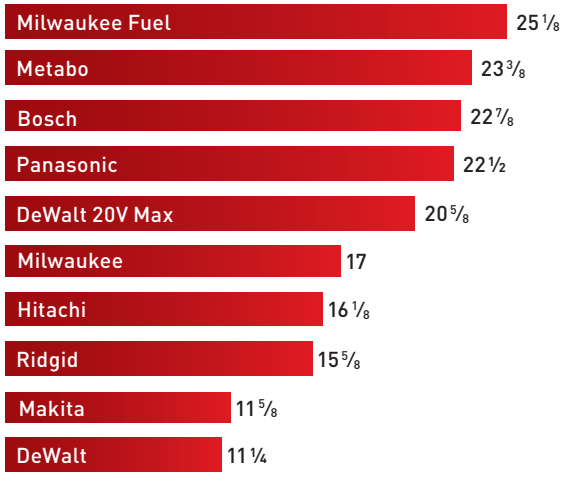
The saws were subjected to two tests. For the power test, each saw was timed, in seconds, making a cut through nailed-embedded, doubled 2x6s. For the runtime test, the number of cuts made with a fully charged battery through nail-embedded, doubled 2x6s were counted. The top-scoring saw is listed first in each set of test results. Lower-scoring saws follow in order.

Power Test



For the sake of comparison, a large corded recip saw makes these cuts in 7.0 seconds in reciprocal action and in 6.2 seconds in orbital action.

Runtime Test



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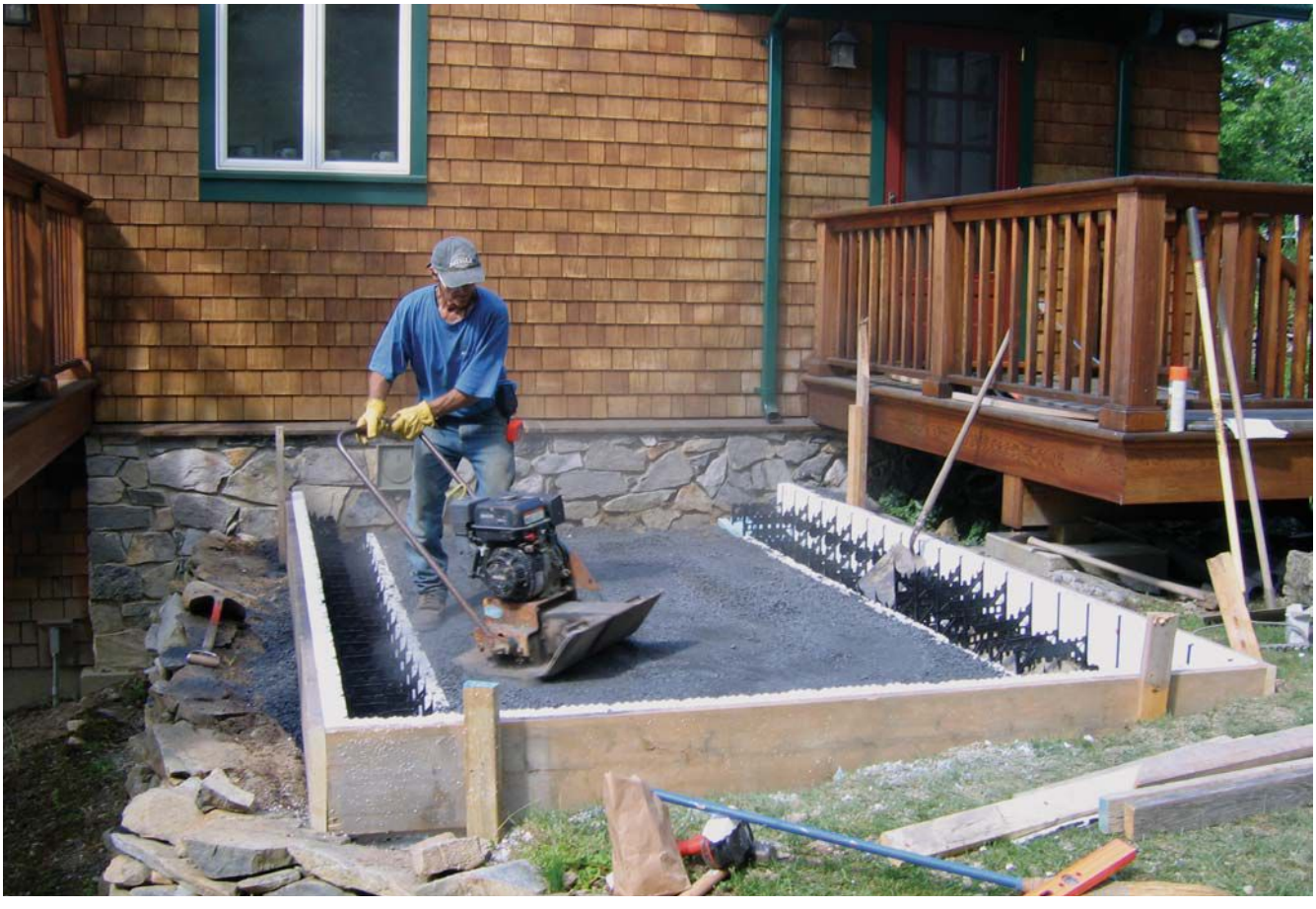

Cost-Saving Insulated Foundations

Using ICFs to build frost-protected shallow foundations

BY LEE McGINLEY

I poured my first frost-protected shallow foundation (FPSF) in 1976. At the time, I was building affordable houses in mid-coast Maine, and a carpenter suggested we could eliminate the cost of a full foundation and the attendant excavation by using a foundation system pioneered in Scandinavia. We called it a "Swedish slab," although the technique actually originated in Norway (see The FPSF Principle, page 63).

That particular frost-protected shallow foundation contributed to a "super-insulated" house. Keep in mind that in the mid-'70s, a super-insulated house was framed with 2x6s and had R-19 walls and R-30 ceilings, which today wouldn't meet Vermont's basic residential building standards. Our slab-edge insulation was 1 inch of rigid foam secured with Ramset fasteners and covered with ½-inch pressure-treated plywood.

Since then, I've refined my approach and have built outbuildings, additions, and a house using this foundation style. The current interest in Passive House design—which encourages the use of slab-on-grade foundations—has brought renewed attention to this method.

A HAPPY MARRIAGE

The biggest change I've made over the years has been to wed the FPSF technique to the use of insulated concrete forms (ICFs). This is now


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my favorite way to lower foundation costs. ICFs lend themselves to a variety of FPSF approaches. They can be used as concrete forms when shaping a turned-down (or "thickened-curb") concrete slab, or they can be stacked two (or more) courses high to create a crawlspace.

SIZING & PLACING INSULATION

Depending on where you live in the U.S., the amount of insulation needed to prevent the ground beneath the foundation from heaving will vary. The insulation thickness and its placement is correlated to the 100-year Air Freezing Index (search "Climatic Data for Frost Protected Shallow Foundations" at noaa.gov). This article focuses on heated buildings, which in some locations need only vertical insulation, while in other locations must also have horizontal insulation. (Unheated buildings are a different animal; horizontal insulation must be installed under the entire building at the footing elevation and must extend beyond the building's perimeter, with even more insulation added at the building's corners.)

ICFs provide vertical insulation and eliminate the need to apply rigid foam to the slab edge. The formulas to calculate the amount of insulation needed are easy to follow (visit jlconline.com for a detailed explanation and sample calculations). The projects in this article, which were all built in northern New England, required vertical insulation with a minimum R-value of 5.7 (easily met with the typical ICF wall thickness of 2 ½ inches) and a minimum ground cover of 12 inches. Horizontal insulation could have been added as a margin of safety but was not required to meet the design criteria, as the Air Freezing Index was below 2,250—the threshold for requiring horizontal insulation.

As good as this system is, poor drainage will undermine your results. You need to remove moisture to prevent frost formation. Perimeter drainage is necessary and the grade should slope away from the building.

FINDING THE RIGHT ICF PRODUCT

ICFs are made of expanded polystyrene—the same material as foam coffee cups—by several manufacturers that seem to have settled on a standard height of 16 inches and a standard length of 48 inches. Once poured, the ICF forms typically create concrete cores of 6, 8, or 10 inches and have foam wall thicknesses of 2 or 2 ½ inches, yielding R-22. In addition to straight blocks, corner blocks (45° and


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90°), brick ledges, and taper tops are available. Some manufacturers offer knocked-down components that are assembled on site; some offer both knock-down and fixed-dimension varieties. Most manufacturers' blocks are reversible top and bottom. For example, a corner block can be flipped over to create a left or right corner **(1)**. Self-aligning nubs keep the blocks in place **(2)**.

Search online for "insulated concrete blocks" and you'll discover many manufacturers and instructional videos. Since you'll need to install both horizontal and vertical rebar, pay close attention to the manufacturers' sizing and spacing specs.

SLAB ON GRADE

We recently used ICF forms on a challenging job: The homeowners wanted a heated outdoor exercise pool that could be used all year. The twist: It was located in Northern Vermont.

Because parts of the foundation would have to conform to irregular ledge exposed in the excavation, we chose a snap-together ICF form. This allowed us to cut the outer and inner panels separately to fit the contour before we snapped the two panels together with plastic ties **(3)**.

We cut the inner panels lower to create a turned-down curb around the perimeter. A 1-foot-by-1-foot rebar grid supported the heavy weight of the pool; vertical rebar couldn't be used because of the ledge below **(4)**. We installed radiant-heat tubing **(5)** that was connected to a separate zone on the boiler just before the pour.

The result: Despite the pool's northern location on the shore of Lake Champlain and the fact that the pool is used during all but the month of February, the homeowners have experienced no recordable year-over-year increase in propane costs for heating—a testament to the high insulation value of the foam forms and the sub-slab insulation.

SLOPING SITE

A less challenging job than the pool permitted a straightforward solution, but it required extra work in building the forms to brace the ICFs. The site sloped 15 inches in 24 feet, so we did minimal excavation and laid down 6 inches of mixed stone with some fines before forming up with two courses of 2x12s.

The blocks we used (rewardwalls.com) were 16 inches high and the bottom course was ripped to 8 inches high **(6)**, yielding—with


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a full block on top—an overall height of 24 inches. We cut off the nubs on the outside edge of the top course **(7)** before capping it with 2½-inch lightweight channel to make screeding easier **(8)**.

Unlike the forms for the pool slab, these came completely assembled, so I stacked both courses before shooting elevations **(9)** and cutting away the inside of the form to create a thickened curb **(10)**. We spaced 36-inch vertical #4 rebar at 4 feet on-center and drove it into the ground; we placed horizontal rebar in the bottom and top courses and snapped it into the plastic walers. Zip ties secured the vertical rebar to the horizontal rebar.

Because the outbuilding that would top the slab would be heated, we placed 2 inches of rigid insulation over compacted mixed stone with fines before pouring the concrete **(11)**. We laid 10-mil Viper VaporCheck (viper2.com) on top of the foam and taped the seams to control moisture migration into the building **(12)**.

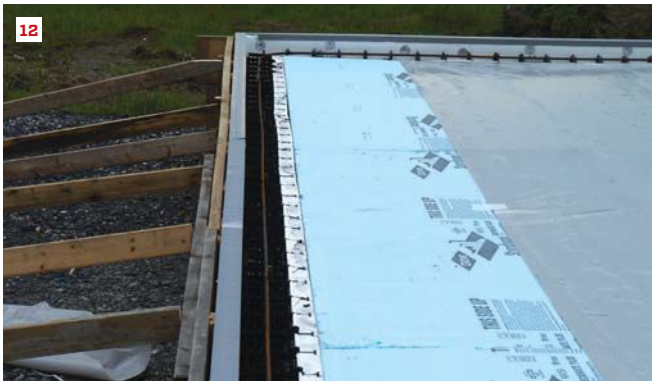
Before backfilling, we ran a 4-inch perimeter drain around the slab. To meet the minimum 12-inch below-grade cover required for an FPSF in our area, we backfilled against the forms on three sides to within 10 inches of the bottom of the siding, which was enough to provide splash protection from rain. The fourth side would be used for storing garden tractors, so we backfilled against it with crushed rock.

While we were forming up and placing the blocks, heavy rains washed away some of the base material, which made for a challenging situation. Next time we'll follow our standard procedure of specing ¾-inch crushed stone under the forms. Under the slab, the mixed stone with fines worked well, as it created a smoother surface before the rigid insulation was placed. For a house, I might consider pouring a thin footer before laying up the blocks, just thick enough to provide a level base—particularly if the house has a complex footprint. I would insist on a footer if I was uncertain of the excavator's skill at providing a level, compacted surface.

Be careful with mechanical tamping of the sub-slab fill. If you get too close to the forms, the tamping can force the forms outward, causing unwanted deflection. I recommend using a hand tamper when working within 12 inches of the forms.

On both projects described here, I applied FlexCoat (styro.net) to the forms after the pour and before backfilling. This is a flexible brush-grade acrylic coating that protects the foam from UV degradation. It comes premixed and pre-colored.

11



12

CRAWLSPACES

The FPSF and ICF combo can be adapted to crawlspaces. Follow the design parameters for an FPSF and stack the ICFs to a comfortable crawling or working height below the floor system. You'll need a footer, too.

The first-floor deck can be built atop the forms (see Taper Top ICF, next page, top left), or you can fasten a ledger to the ICFs using Simpson Strong-Tie's (strongtie.com) ledger connection system (see Ledger With Simpson Connectors, next page, top right). Or, I typically notch the forms (see Notched Straight ICF Form, next page, bottom) and drop the floor system to be partially inside them, running the joists out to cover the concrete core and leaving just the outer wall of foam. This eliminates the difficult-to-seal seam at the concrete-wall-to-wood-framing transition and allows me to visually lower the house on the site. It also results in one less step to get into the house.

SIGNIFICANT COST SAVINGS

Individual ICF forms can be expensive—about $22 each in my area—but the savings are dramatic compared with the type of foundation system you're replacing. For example, on my new house we experi-

THE FPSF PRINCIPLE

The physical principle behind a frost-protected shallow foundation (FPSF) is simple: About 5 feet below ground level, the earth's temperature stays a relatively constant 50°F to 55°F year-round. Imagine snuggling under a down comforter on a cold night. Before long, you feel nice and warm; the comforter has trapped your body heat. Substitute rigid insulation for the comforter, and you can trap the earth's heat.

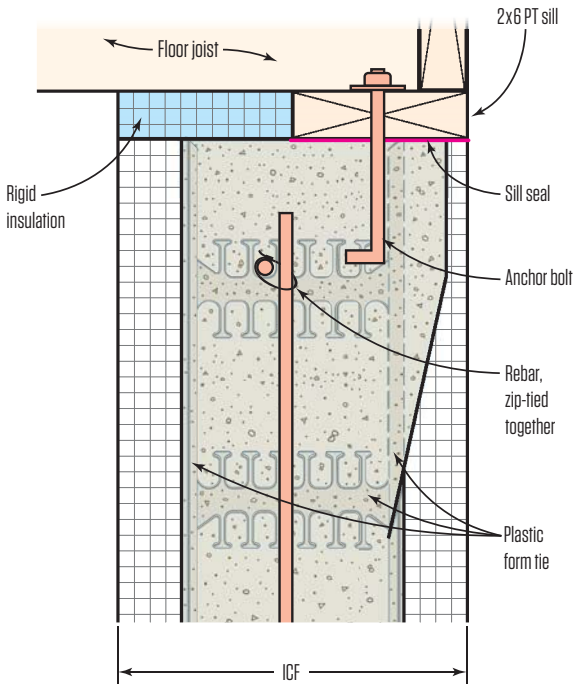
With a heated building, as long as you don't overinsulate beneath a slab, enough heat escapes the building to keep the ground beneath the slab warm, and the perimeter vertical insulation keeps heat from migrating outward. That's why this is an ideal building solution for cold-climate housing.

Cost and energy savings aside, there's a "bonus" advantage to this method: Buildings can be built on marginal land or when unfavorable sub-surface conditions (such as below-grade ledge or a high water table) become evident after the excavator digs his bucket into the earth. The slab-and-foam-form combination allows the project to move forward rather than being abandoned or delayed during a costly search for another site on the property. And you can probably get to within 3 to 4 feet of a large tree and not be concerned about disturbing the root system.

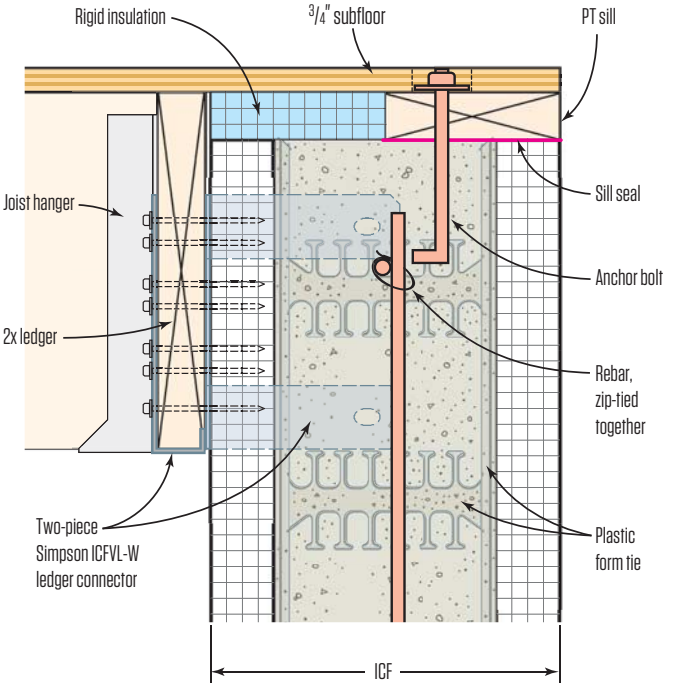
Before proceeding with an FPSF, check in with your local code enforcement officer. Although FPSFs are national building code–compliant, some jurisdictions may be unfamiliar with them and reluctant to approve their use. In Portland, Maine, I had no difficulty getting a waiver for an FPSF on an addition, but in Burlington, Vt., the codes officer at the time insisted on a frost wall with a top-of-footer depth 4 feet or more below grade.

The National Association of Home Builders Research Center offers good guidance on FPSFs in its "Revised Builder's Guide to Frost Protected Shallow Foundations" (search "revised fpsf" at toolbase.org).

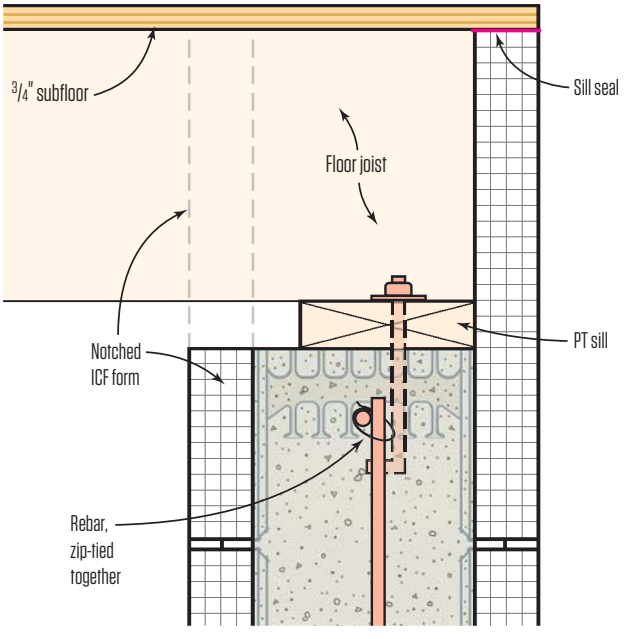
Taper Top ICF



Ledger With Simpson Connectors



Notched Straight ICF Form



enced a high water table, so I used a modified FPSF for a crawlspace and excavated an average of 16 inches over 1,752 square feet with a 4-foot overdig, removing about 86 cubic yards of material. Had I poured a full foundation, about 552 cubic yards would have had to be removed, which would also have cost more to haul away. For my FPSF, the excavator wrapped up his work in two hours; for a full foundation, he would have dug all day. In addition, a full foundation would have required backfilling against it with drainage stone, an expense we avoided by using the FPSF. And an FPSF foundation uses one-third of the concrete, another significant savings.

To deal with the high water table, I covered the entire excavated area with 6 inches of 2- to 3-inch crushed rock to promote drainage, and ran two drainage lines to daylight. A 1-inch top dressing of fines protects the VaporCheck from puncture. For extra insurance against frost, I ran 2 inches of extruded polystyrene sloped horizontally away from the house before backfilling.

Lee McGinley is a Certified Passive House Tradesperson who designs and builds high-performance homes. He lives in Addison, Vt. His testimony on the effectiveness of FPSFs was submitted by the National Association of Home Builders to the Council of American Building Officials (precursor to the ICC codes) in a successful effort to retain FPSFs as code-compliant building systems.

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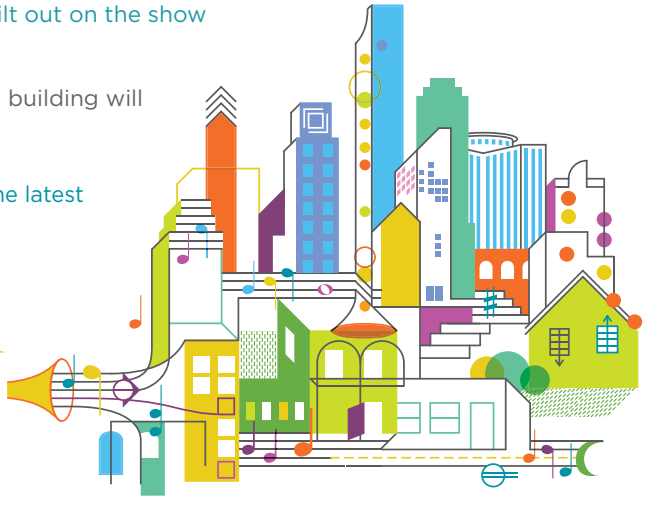

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BY CHARLES WARDELL

Single-Layer Barrier
AP Foil-Faced Polyiso Sheathing board recently earned ICC approval as an air- and water-resistant barrier. A 1-inch layer, the board has a reflective foil face on one side and a non-reflective face on the other. It offers an R-value of 6.5 per inch and is Energy Star certified. Cost: $12 to $15 for a 4x8 board. Johns Manville, 800.654.3103, specjm.com

Tool-Free Adjustment
Adjusting the weight on a kitchen pull-out faucet can be tricky. To simplify the task, Danze is outfitting all of its pull-outs with a new "Neo Retraction" weight system that can be adjusted without tools and will be available this year. The company's Parma Trim Line faucets start at $377 in chrome. Danze, 888.328.2383, danze.com

Quiet Treads
Weyerhaeuser's 1-inch thick, bullnose SturdiStep OSB stair treads are manufactured flat, straight, and knot-free, with a low moisture content. The material is field-trimmable and comes in 12- and 16-foot lengths and 11 ½- or 10 ¼-inch widths. Prices range from $1.80 to $2.20 per linear foot. Weyerhaeuser, 888.453.8358, woodbywy.com

Four-Door Fridge
Dacor's Distinctive model 36-inch refrigerator features French doors on the freezer compartment with internal drawers. Special lighting reportedly helps keep food fresh. The refrigerator offers rapid cooling and quick-freeze capabilities, humidity-controlled shelves, and 22 cubic feet of storage. Priced at $2,999. Dacor, 800.793.0093, dacor.com

Storm-Proof Entry
The Coastal Solutions Entry Door has impact glass and multi-point locking hardware. A stepped wood sill sheds water, with the base of the storm door at the bottom step and that of the main door at the top step. There's also a weatherstripped drip cap at the base of the main door, and separate jamb weather-stripping for the main and storm doors. Prices start at around $3,500. Upstate Door, 585.786.0341, upstatedoor.com

Marine-Grade Protection
Cover Guard floor protection has long been used in the marine industry to safeguard vessel decks during repair work. It's flame retardant and impermeable to water, and its diamond-plate-pattern surface is slip-resistant. It comes in 3-foot– and 6-foot–wide rolls, in thicknesses ranging from 10 mil to 40 mil. Cost is $85 for a 100-square-foot roll, 10 mil thick. Rolls are reusable. Bainbridge International, 800.442.5684, coverguard.com

More Contemporary Doors
Door manufacturers say that modern-style doors are among their hottest sellers. In response, Marvin has expanded its contemporary window and door offerings. These include doors with a minimalist look that feature narrower stiles and rails, as well as more glass. One example is the Ultimate Swinging Door shown in the photo. Expect to pay $1,750 to $1,900. Marvin Windows and Doors, 888.537.7828, marvin.com

Clean Tech
The Saros single-lever kitchen faucet's self-cleaning technology keeps the spout free of mineral deposits. The outlets in the face plate are made from a soft, resilient material that expands to keep deposits from accumulating. The face plate can also be unscrewed, cleaned, and reinserted without the need for tools. Cost: $675 for chrome; $877 for stainless steel. KWC America, 678.334.2121, kwc.us.com

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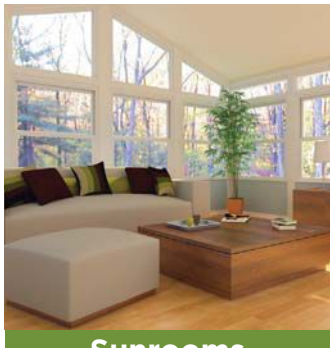
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Trimmable Shear Panel

Strong-Wall SB is a wood shear panel for large openings made from Timberstrand LSL. It can be trimmed on site by the installer. Panels are available in 12-inch, 18-inch, and 24-inch widths and in heights from 7 feet to 13 feet; there's also a 20-footer. Official pricing was not available at press time, but a 12-inch-wide panel should sell for around $300. Simpson Strong-Tie, 800.999.5099, strongtie.com

Decorative Vinyl

Painted fish-scale shakes add a nice touch to an exterior, but scraping and repainting them can be a nightmare. Enter the Foundry Specialty Siding Shapes Collection of vinyl siding. Available in 10 standard colors, the faces are molded with a cedar texture, grain pattern, and saw-mark details. Additional colors are available as a special order. Cost is around $275 per square. Tapco, 800.771.4486, thetapcogroup.com

Paperless Tape

FibaFuse Paperless Drywall Tape absorbs and fuses with the joint compound. It's applied like paper tape but won't stretch when wet, resists mold, and isn't prone to bubbling. A center fold makes it easy to apply to inside corners, but use a corner knife to smooth the corner, as a standard knife can gouge the tape at the fold. Cost: $5 for a 250-foot roll. Saint Gobain Adfors America, 800.762.6694, sg-adfors.com

Shingle by Numbers

The Ecoshel smart shingle system consists of 45-inch–long panels of No. 1 vertical grain western red cedar shingles joined together with PVC clips. A numbering system on the panels provides a guide for vertical joints on adjacent courses to be automatically offset. A 1/10-inch–thick polyethylene bead on the back qualifies as a LEED-spec rainscreen. MSRP is $300 to $550 per square. Ecoshel, 207.274.3508, ecoshel.com

EDITED BY BRUCE GREENLAW

Bosch GLM 100 C Laser Distance Meter

I've been tracking the steady evolution of laser distance meters since evaluating 13 top models for the January 2013 issue of *JLC*. At that time, the versatile, efficient, and economical Bosch GLM 80 was my overall favorite. The new Bosch GLM 100 C resembles the GLM 80, but adds some enhanced specs, a micro-USB port and cable, and a Bluetooth module for pairing with mobile devices. After exploring the new meter for awhile, I decided it's definitely noteworthy.

MEASURING RANGE & ACCURACY

The GLM 100 C can measure lengths from about 2 inches to 330 feet, or about 25% farther than the GLM 80. You typically need to aim at an accessory target plate to reach the maximum. The unit is accurate to 1/16 inch and displays fractions down to 1/32 inch, the same as the GLM 80.

STANDALONE FEATURES

Minus the Bluetooth module and micro-USB port, the GLM 100 C is almost a clone of the GLM 80. Both are powered by an internal rechargeable 3.7-volt lithium-ion battery that delivers up to 25,000 measurements per charge. Both can calculate square and cubic feet; add, subtract, multiply, and divide dimensions and calculations; and take a continuous reading while moving toward or away from a target, automatically freezing the minimum and maximum distances measured (great for measuring diagonals). A built-in inclinometer not only reads slopes and angles, but works in the background to make indirect vertical or horizontal measuring exceptionally easy where direct measurements are impractical or impossible.

Both models can mount to a tripod, and both can pop into Bosch's optional R60 aluminum rail to become a 2-foot electronic spirit level. A programmable timer delays the shot after you press the measure button, a tailpiece lets you measure precisely from inside corners, and the display is the brightest I've seen and can be set to rotate automatically for an easy read regardless of orientation. Both meters carry an IP54 rating, indicating that dust intrusion and water splashes do no harm.

Like the GLM 80, the GLM 100 C also has handy estimating shortcuts and an erasable memory. But the former stores one constant and up to 20 measurements or calculations, while the latter stores a constant and up to 50 entries. Both can delete selected individual entries or the entire memory.

CONNECTIVITY

Download the free "GLM measure&document" app with a compatible iOS or Android device, and your GLM 100 C is ready for wireless Bluetooth interaction.

I tested the app with my iPod touch, scanning the QR code on the laser package for an easy download. To establish the wireless connection, I enabled Bluetooth on the iPod and opened the app, then turned on the GLM 100 C and pushed its Bluetooth button. The Bosch operating manual only mentions the app, so I learned the ropes by exploring the app itself for a few hours, tapping the help icons for information.

For starters, the app lets you use your mobile device to change the meter's settings, select the measurement type, and take measurements. The Bluetooth range is supposed to be about 30 feet, but my iPod triggered plenty of measurements from greater distances, though the connection became less dependable. This remote control is cool, but I'm not convinced that it's all that useful.

Better yet, the app can manage your measurements in a variety of ways. For instance, you can quickly transfer the meter's memory to your mobile device, where you can delete or name individual measurements, perform calculations, and email the edited list.

Raising the bar, you can create and name a project folder, snap one or more photos with your mobile device, draw dimension lines on the photos with a finger, and then shoot the measurements with the GLM. Follow the simple rules, and the app will automatically insert these measurements next to the appropriate dimension lines while also listing them under a separate tab. You can drop text and audio memos into each photo, too, where they appear as virtual Post-it notes. When you're ready, you can email a PDF of the project, which will include everything but your audio memos. You can even insert your company logo and contact information in there.

I created several test projects and emailed the PDFs to my laptop, which was a piece of cake. You can also email the labeled photos or the measurement list separately, but the list arrives as a CSV file that can be a hassle to work with. Bosch says a fix is forthcoming. Also, the app's calculator defaults to metric during some operations, which Bosch is also working to repair.

Thanks to the battery charger and the micro-USB cable included in the kit, you can charge the meter by plugging into an AC outlet or a USB port. If you have a Windows XP or Windows 7 computer, you can make the micro-USB cable even more useful by downloading Bosch's GLM Transfer Software at bosch-professional.com/static/specials/glm100c/gb/en/. The simple software allows you to tap into the meter's memory from a computer, where you can open it in Microsoft Excel, copy it to the Clipboard, save it as a Notepad file, or just erase it.

THE BOTTOM LINE

The rechargeable GLM 100 C can measure lengths with a simple point and click, but it also is an exceptional estimator, reads angles, has a great display, and can clamp into an optional rail to become a 2-foot electronic spirit level. At first I thought its Bluetooth module and mobile app might be overkill, but for many applications they indeed make it easier to store, manage, and share measurements. If I needed all of these features, the $300 price tag would work for me.

GLM 100 C Specs

Power: rechargeable 3.7-volt lithium-ion battery
Range: 2 inches to 330 feet
Accuracy: ± 1/16 inch
Smallest fraction: 1/32 inch
Price: $300
Included in kit: charger, micro-USB cable, hand strap, belt pouch
Warranty: 1 year (2 years if registered), 30-day money-back guarantee

Bosch / 877.267.2499 / boschtools.com

Bruce Greenlaw is a contributing editor to JLC.

GENTLE IMPACT DRIVER

My company builds decks framed with light-gauge steel, and we drive about 5,000 self-tapping screws per month using Makita 18-volt brushless impact drivers to assemble the framing and secure the decking.

My veteran carpenters can consistently sink these screws at full throttle and release the trigger at just the right time so they don't overdrive and break the screws. But my less-experienced carpenters don't always react in time, causing some screws to snap.

I recently learned that Makita's 18-volt model LXDT06 brushless impact driver includes a unique Quick-Shift Mode that combats overdriving by reducing the rotation and impact speeds after the screw tips punch through the steel. When *JLC* asked if we would like to take the tool for a spin, I readily accepted. The verdict? The feature works great.

Unfortunately, the driver costs $190 for the bare tool and $360 for the complete two-battery kit, or about $30 to $40 more than my equivalent impact drivers without the Quick-Shift Mode. At that price, I'll stick with my other drivers, live with some broken screws, and let practice make perfect. *—Robert Shaw owns Colorado Deck and Framing, in Colorado Springs, Colo.*

Photo: bottom right, Mary Shaw

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Quick-Change Nailer Hook

Some pneumatic framing and roofing nailers have built-in hang hooks, but many popular models don't. Without a hook, you're constantly holding these bulky tools between your knees, carrying them by hand up and down ladders, and parking them precariously on stepladders, top plates, and roof sheathing.

Add-on hooks are available, but most of them bolt awkwardly to specific models only. The Pneuhook universal quick-change hook, which was just unleashed by veteran Cape Cod residential and commercial carpenter Scott Jacobson after two years of field testing, may just be the solution to that problem. It's equipped with a coupler and a male plug so you can simply snap the Pneuhook onto the nailer's male plug and snap the air hose onto the Pneuhook. This design suspends the nailer head-first for maximum stability, allows the hook to swivel to your desired position, and makes it easy to swap the hook between multiple nailers. The hook also can hang from a nail and can double as a blade wrench for your circular saws.

Oregon production framing contractor Terry Goodrich has been using Hitachi framing nailers with bolt-on hooks for years, so we asked him for an opinion of the Pneuhook. After using a pair for several weeks, his framers are really impressed. Goodrich says he wouldn't hesitate to pay the asking price.

The Pneuhook comes in black or yellow. It costs $30 with a ¼-inch I/M-style coupler and plug, or $40 with a ⅜-inch P-style or H-style coupler and plug.

Visit pneuhook.com to view a video or to place an order. *—B.G.*

SMART SAFETY

Lately I've been using the new Bostitch Smart Point pneumatic 18-gauge brad nailer, 15-gauge DA-style angle finish nailer, and 15-gauge FN-style angle finish nailer (bostitch.com).

These nailers employ a new type of safety that I really like. Other brad and finish nailers force you to compress a spring-loaded nose against the work surface to fire a shot. With Smart Point nailers, however, you just touch the non-marring tip to the surface, with no pushing required. No contact, no shot. I didn't realize how much focus I put into compressing the nose until I no longer had to do it. The small nose fits into tight spaces and gives you clear sight lines, so you can accurately place your fasteners.

I also appreciate that these tools are oil-free, which helps prevent staining, and they include a built-in pencil sharpener that helps keep my layout marks crisp.

I've used plenty of other brad and finish nailers over the years, but these are my new favorites. A 16-gauge Smart Point model is also available. Prices range from $120 to $190. *—Gary Striegler is a trim carpenter in Fayetteville, Ark.*

Photos: far left and bottom center, Roe Osborn; top center, Bruce Greenlaw

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hanleywood

BY JON VARA

1. Much of the 14-acre site was excavated to create staging areas and working room around four structures.

2. The main house was lifted onto dollies using hundreds of 20-ton bottle jacks while shoring up the slab and footing with thousands of 6x6 oak cribbing timbers. Once free of the ground, the structure was slowly rolled northward on a temporary roadway hardened with 8x12-foot plates of ½-inch steel.

3. At its new site, the main house was positioned over a reinforced slab. Block walls were built up around the steel lifting beams. The gap between the new block sub-basement and the original footing was filled with non-shrinking grout.

4. To reduce lateral soil pressure on the block sub-basement, 4x4x8-foot blocks of EPS were fitted around the perimeter before being fixed in position by backfilled soil.

Time & Tide

When beach erosion threatened to tumble a 9-year-old luxury home into the ocean south of Chappaquiddick Island last spring, the property owner called in a team of experts—Buffalo-based International Chimney Corp. (ICC) and Expert House Movers, of Virginia Beach—that had previously joined forces to move other massive structures, including several historic lighthouses.

ICC project manager Tyler Finkle notes that the job involved moving four structures: the main house, a two-story garage, a guest house, and a house on an abutting parcel that had to be moved to make space for the first three. Because the basement of the main house was finished—amenities included a movie theater and a bowling alley—the decision was made to move foundation and house together. Doing so involved excavating much of the 14-acre site and trundling the structure along a prepared 275-foot move route on the flat bottom of the hole.

Given the island setting, there were also some daunting logistical challenges. "The changing tides, ferry capacity, and ferry schedule meant we could only bring in concrete 3 yards at a time," Finkle says. To work around that bottleneck, most masonry work was designed to use concrete block produced on nearby Martha's Vineyard, which could be ferried over in batches and stockpiled to cure on site.

Time was tight, too. By the time the project got under way, the guest house was less than 35 feet from the rapidly crumbling edge of the bluff. But in the end, all of the at-risk structures were moved to safety in time. As of April 2014, the ocean had reached a point within about 15 feet of the old main-house driveway—well inland of the original site of the guest house.

John Vara is a JLC contributing editor who lives in Cabot, Vt.

Photos: 1, Mike Creato, Classic Aviators; 2–4, Emily Hunsaker

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