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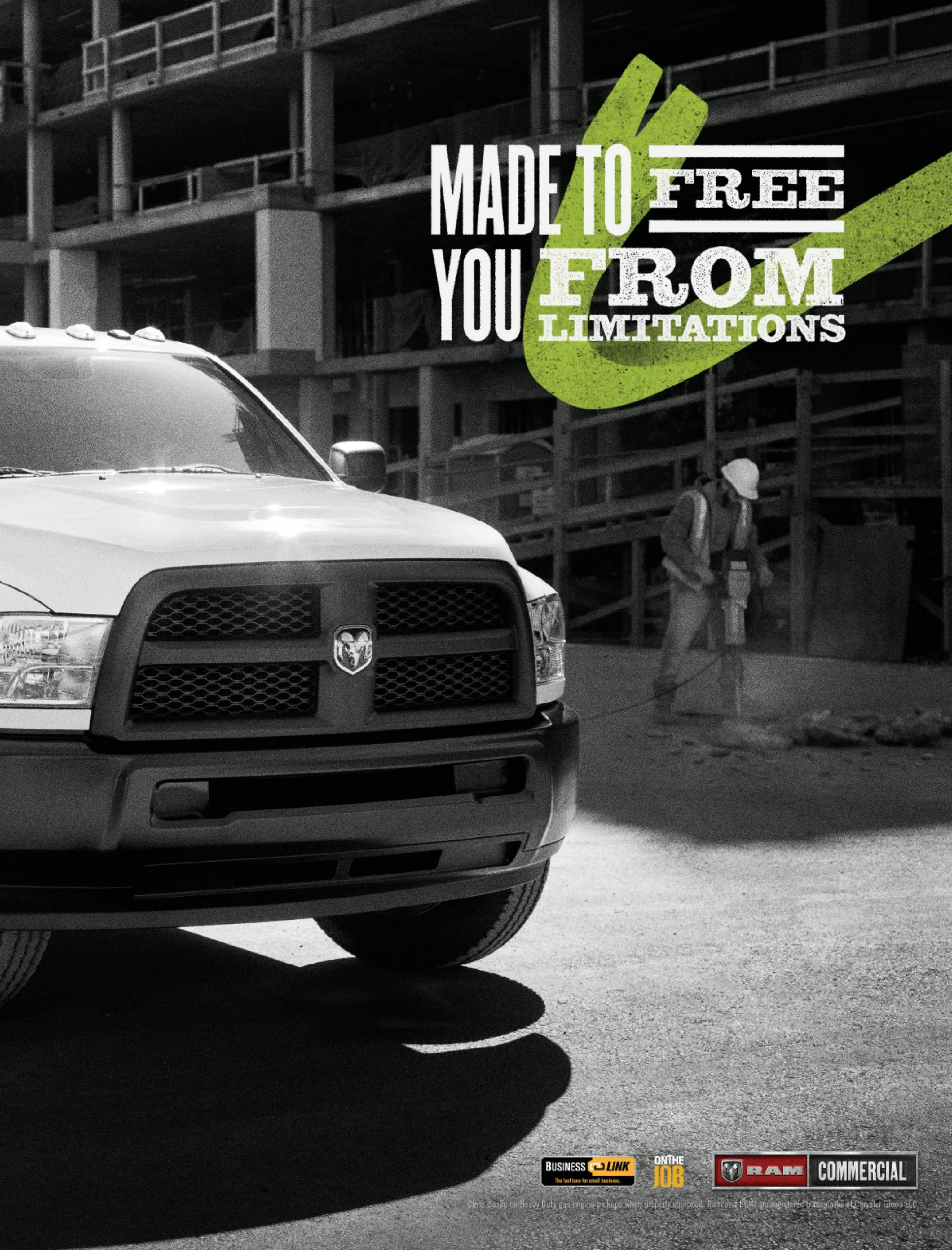
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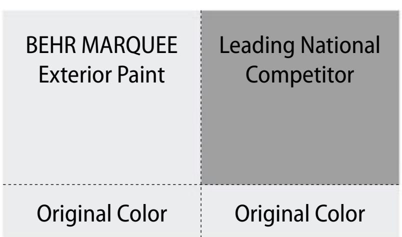

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On the cover: R. Corbo Construction project manager, Danny DoCouto, infills with structural brick over a new flitch beam header in the structural rear wall of a Hoboken, N.J., row house. Photo by David White

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Letters

"SETTING KITCHEN CABINETS," BY JLC STAFF (AUG/14)

While this article was good, it omitted one very important check: that of keeping cabinets in plane to each other. It is possible to have cabinets level, plumb, and square as you recommend and still be out of plane.

Imagine a kitchen wall that starts to go out of plane at the left side of a freestanding-range opening. If the cabinets follow the wall, the right cabinet will be farther back than the left, and the cabinet installer has left the countertop installer with some unpleasant choices. If the countertop man keeps the depth of the tops on each side equal, the amount the top overhangs the cabinets on the right side is greater, affecting the look of the drawers and door fronts. If he keeps the overhang the same and changes the top depth, the reveal at the range is off.

Does he make the tops perpendicular to the rear wall, keeping the space between the rear of the range and the wall equal and the tops out of square to their fronts? Or should he cut the tops square to their fronts and hope the homeowners don't notice the difference in the gap between the range back and the wall side-to-side?

Read any of the home-improvement chat boards and you'll find unhappy homeowners blaming countertop installers for cabinet installers' mistakes. *—Joseph Corlett, Sarasota, Fla.*

WHEN A 'CONTRACTOR' IS REALLY A CHEATED EMPLOYEE (ONLINE, 9/11/2014)

Eric Dickerson: Deliberately misclassifying workers has been going on as long as I have been in the business (over 30 years). In Colorado where I work, that is almost the norm—most contractors are "paper contractors" or contractors who have no employees and therefore don't require workers' comp and sub out all of their work to "subcontractors" who in turn sub out their work to other "subcontractors." It's comical.

I have a custom-home building company and have employees, so I am responsible for the entire labor burden, matching retirement contributions, and so on, and I have to compete against builders who have none of that.

If and when the states where these loopholes are allowed change the rules, then the playing field will be even. One easy way is to make everyone have the required insurance.

Another is to require builders to be licensed, and that to be licensed they have to have the required insurances. Where I work, it is still the Wild West.

John Williams: Same here in N.Y., but the contractor on the permit is required to show proof of workers' comp. A lot of them list their wife as an employee (bookkeeper) to qualify for workers' comp at a low rate. Audits here are catching a lot of these because anyone you issue a 1099 to better provide you with a Certificate of Compensation or you will wind up paying for it after the fact.

The other thing I've seen is that the contractor has the customer pay the subs, claiming it's the only way to get the job done on budget.

A.B. Creech: In North Carolina, our laws do not require a general contracting license unless the job is $30,000 or more—so you do many small jobs and handyman work.

How do you compete in the kitchen and bath remodel market when the other guys have no burden, can hire the same subs as we do, and provide no insurance at all? I agree with Mr. Dickerson: All should have some kind of license requirement and have to show proof of insurance.

WHEN IS A 2X4 NOT A 2X4? (ONLINE, 9/11/2014)

Maria Daniels: If Lowe's has to pay the fine, then so be it. But The Home Depot, Menards, and all the other lumberyards should be held to the same standard and pay the fine accordingly. It's not right to single out one store for merchandise that is the same in all stores. And why are the retailers being fined? Why aren't the mills being fined for selling the goods at the wrong measurement?

Gabe Keway: Buy your lumber from a reputable lumber store and get what you pay for. Even that isn't always the case. I buy lumber from several local yards (those that are left) as well as the big ones. I have found that, depending on what you need, you may need to rethink your buying habits.

I actually like #2 lumber from The Home Depot and Lowe's. It is usually dryer, straighter, and smoother than what's at the yards that store their lumber outside. For treated lumber, the yards are usually better. Structural plywood is the same everywhere but finish plywood must come from a yard. Cedar is often better from a yard but not all yards have quality cedar. I hear a lot of ridiculous "blanket" statements like your claim, but the fact is they are just dumb mantras.

Here are a couple of other shockers for you ... my Home Depot salesman is my best salesman and takes care of me way better than any local yard. Also, in case it comes up, just because it says "Made in USA" on it doesn't mean it's quality.

Reader Feedback
The following are letters and excerpts taken from comments in response to the JLC articles referenced.

Bob Engelhardt: So what was the actual size of the Lowe's 2x4s? You've left us hanging here!

Brian Bishop: I agree. Are they carping because they were kiln dried and came in a 32nd or 16th under, or was the lumber 1.25 x 3 or something and graded in such a way as to have the strength of a 2x4 or ... ?

JLC editors respond: Good questions. The actual dimensions seem to be a closely kept secret in the lawsuit, but one homeowner investigating this story recently posted this on a dslreports.com forum:

"Stock at my local (Indiana) Lowe's: 'Standard Pine' —which I assume means it's not 'Southern Pine':

- 2x4s are 1¼ in. x 3 5/16 in.
- 2x6s are 1¼ in. x 5 5/16 in.
- 2x8s are 1 7/16 in. x 7¼ in."

Another post in the same forum points to this PDF from the Forest Products Lab, http://www.fpl.fs.fed.us/documnts/misc/miscpub_6409.pdf, a 1964 paper titled "History of Yard Lumber Size Standards" that tracks the decrease in standard lumber sizes from about 1914 to 1964.

> "After World War I, the increasing demand for construction lumber led to the first national size standard in 1924. This was revised in 1926, 1928, 1939, and 1953, while still another revision is proposed for adoption in 1964."

The FPL paper is an interesting read. It not only demonstrates that we've been here before, many times, but it also details the controversies and discontent that shrinking standards for lumber have raised over the years. Ultimately, this paper seems to side with the manufacturers and assumes that the technical spec—what provides builders with assurances about the performance of a given lumber size—will follow market demand. It's full of the sort of economic optimism so popular in the 1960s.

> "Smaller sizes will reduce production costs of lumber but it remains to be seen how much. If lumber is thinner, raw material (log) costs will be less, and drying costs will also be reduced. On the other hand, the manufacturing cost and the cost of installation of a piece of board or dimension will remain practically unchanged."

To find out how the Lowe's ruling might prompt changes to your contracts, see Leonard Klingen's legal column on page 31.


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Q There has been a lot of discussion about wiring receptacles with pigtails instead of making the connections at the receptacle itself. But what about switches, especially three-way switches? Is there any advantage (or requirement) to wiring those with pigtails?

A David Herres, a licensed electrician in Clarksville, N.H., responds: It is correct that the National Electrical Code, which has jurisdiction in such matters, states that receptacles are to be wired using separate pigtails tapped from the branch circuit that feeds downstream devices. The purpose of this requirement is to ensure that ground continuity is maintained throughout the branch circuit when a device is removed even temporarily. Ground continuity is an issue for the neutral (white) conductor and for the equipment-grounding (green or bare) conductor.

With switches, however, maintaining neutral continuity is not a concern. When properly installed switches are placed in series with the load or loads in the ungrounded (usually black or red) conductor, the grounded conductor is not interrupted when the switch is removed. The line from the switch connects straight through to the next enclosure—for example, a ceiling fixture. With regard to the equipment-grounding conductor, it is necessary to take a good, hard look at the installation and make sure that a hazardous situation is not created if this line is interrupted.

As far as three-way and four-way switches are concerned, the situation is the same. Think of a pair of three-way switches in conjunction with any number of four-way switches as a “black box” that is equivalent to one single-pole switch. They are placed in the ungrounded (hot) line, and there is no need to hook them up with pigtails because, again, the neutral is not interrupted. But always make sure that the equipment-grounding conductor retains continuity.


HOME

Q **A client asked me to install hardwood strip flooring in his carpeted living room. When I removed the carpet, the subflooring underneath was solid, but it was stained with dog urine. Can I just treat the stained areas or put down a layer of 15-lb. felt before installing the new flooring, or do I need to replace the subflooring?**

A Floor finisher Michael Purser, owner of the Rosebud Co., in Atlanta, responds: I once owned a 100-plus-year-old home with very nice pine floors. A previous owner had quartered his dog in a rear hall and, as you can imagine, there were urine stains. Since it was pine, the discoloration to the wood wasn't too bad, so I just sanded and finished it with three coats of finish. However, on warm, moist days in the summer, moisture would collect on the surface of the finish. The amount of moisture was noticeable (I thought I had a roof leak) and eventually the finish started to fail. I ended up going back in and removing and replacing the flooring. Lesson learned!

Think about it: You have the floor open, you can see the damaged wood, and if you don't replace it now, it will never be done. A carpet and pad can act like a sponge holding the animal urine and letting it saturate the subfloor. Even if the subfloor seems solid, a lot of animal urine has probably soaked into it. I am not a chemist, but I do know that animal urea contains ammonium compounds. Aside from the odor, the salts in the ammonium will attract moisture—in the same way your salt shaker will develop beads of moisture in the humid summer months. If the subfloor is above a crawlspace or damp basement, you can bet on having a persistent moisture problem with the newly installed wood—which falls into the nightmare category. So I'd just yank out the stained subfloor and replace it.

Q **Instead of supporting decks with treated 6x6 posts, is it OK to assemble support columns using four treated 2x6s?**

A Dick Hackbarth, P.E., a structural engineer in St. Paul, Minn., responds: There's nothing inherently wrong with building up a 6x6 column out of four 2x6s, as long as you can keep water out. In fact, there may be a few advantages. You can select the 2x6s for strength and straightness, then use the best-looking ones on the outside and cut the inner two short to provide a bearing and connection pocket for

a double 2-by beam member (though don't hide inferior lumber in there; as compression members, the inner plies have to be as strong as the outer plies). You could also easily cut a bevel on the top of the two outer plies so they drain outward. An option for the two sides of the column that show the four plies could be to cover them with 1-by finish pieces, for appearance and to prevent water from penetrating between the plies (self-adhering flashing tape is good for protecting the tops of columns and built-up beams). As long as plies are properly connected together with construction adhesive and fasteners to act as a unit, and accurately cut so they're all end-bearing, they should make a fine deck post. In fact, there are suppliers that offer vertical laminated post members for use in post-framed buildings. Made with three or four 2x6s, the posts' bottom 6 or 8 feet are treated for ground contact and then finger-jointed to the upper parts.

Though IRC prescriptive requirements for PT 6x6 posts are much more than adequate for most deck locations, your columns will still probably need a structural engineer's stamp to satisfy your local inspector. The process is a little more complicated than just nailing four 2x6s together. Framing members that are likely to be used as bending members—2x4s, 2x6s, 2x8s, and the like—are graded slightly differently than framing members that are going to be used in compression, such as stud grade 2x4s and 2x6s. Each grade has slightly different allowable stresses and slightly different defects and material characteristics that control its grading. Since bending members are loaded and tend to fail differently than column members do, a local structural engineer will need to develop a procedure for making your own posts. This will include a few pages of calculations, guidance on which grades to use, a schedule for fasteners and glue to assemble the posts, and connection details.

This article first appeared in JLC's sister publication, Professional Deck Builder.

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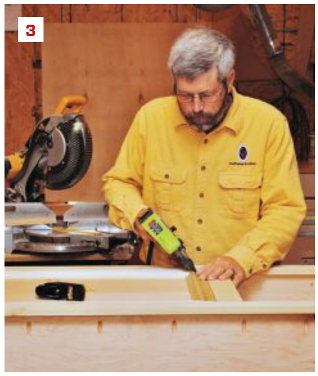
BY GARY STRIEGLER



Photos: Gary Striegler

A Cabinet Becomes a Door

Recently I built a home for clients who had a large dining room hutch. The hutch would only fit along one wall of the room, but the plans called for a closet door on that wall. As much as they loved their furniture, they just couldn't give up the closet.

As a compromise, we located the closet access in the entrance hallway. But adding a door in the most public part of the house wasn't the most visually appealing solution. So we decided to build a pivoting cabinet that would serve as a door. In our past attempts to create hidden spaces, after a lot of fussing, the cabinets would only work well enough for occasional use. But this closet would be used a lot and it would be very visible, so I needed to build a pivoting cabinet that looked great and worked well.

The key was finding the right hinge mechanisms. I decided to try the InvisiDoor Hinge Kit from Custom Service Hardware, which I had seen at several trade shows. The kit consists of two pairs of plates—one for the top of the cabinet and one for the bottom—that work for either an in-swing or an out-swing cabinet. For this project, I needed an out-swing configuration.

BUILDING THE CABINET

Because of its conspicuous location, I wanted this door to look like a built-in display cabinet, so I designed it with a recessed panel on the bottom half and adjustable shelves above. I made the cabinet case and fixed dividing shelf from ¾-inch plywood, running the sides a couple of inches past the bottom per the InvisiDoor instructions. For the adjustable shelves in the display area, I drilled rows of shelf-pin holes on both sides using a Kreg shelf-pin jig **(1)**.

After gluing and screwing together the case, I made a simple stile-and-rail face frame, fastening it to the

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case with glue and pocket screws **(2)**. A strong connection here is imperative because the face frame has to double as a door handle.

I glued and fastened a piece of finish plywood behind the bottom face frame to make the decorative recessed panel and also glued ¼-inch plywood on the back of the case. These two pieces of plywood gave the cabinet the rigidity needed to keep it from racking as it swung open. To complete the recessed panel on the front of the case, I added a frame of decorative molding inside the face frame **(3)**.

HINGES & HARDWARE

Following the InvisiDoor instructions, I screwed the plates to the head jamb **(4)** and to the floor using the slotted holes in the hinge plates, which allow for tweaking a cabinet's position once it has been hung. The floor plate has a pivot pin and the bottom plate on the cabinet has a hole that fits over the pin. At the top, the jamb plate has a threaded opening that accepts an Allen-head cap screw that threads through a hole in the top plate of the cabinet and acts as a top pin.

We needed to pad out the plate on the bottom of the cabinet with two layers of ¾-inch plywood to give us proper clearance between the cabinet and the floor **(5)**. Once the plates were in place, it was easy to swing the cabinet into place and secure it with the cap screw **(6)**.

We then tested to see that the cabinet swung open easily and made sure that the gap between the cabinet and the opening was consistent all around. We tweaked the position of the cabinet slightly by moving plates in the slotted holes. When we were happy with the fit, we drove permanent screws into the non-slotted holes. Last, we installed the InvisiDoor adjustable support foot, which supports the cabinet and keeps it in place when closed.

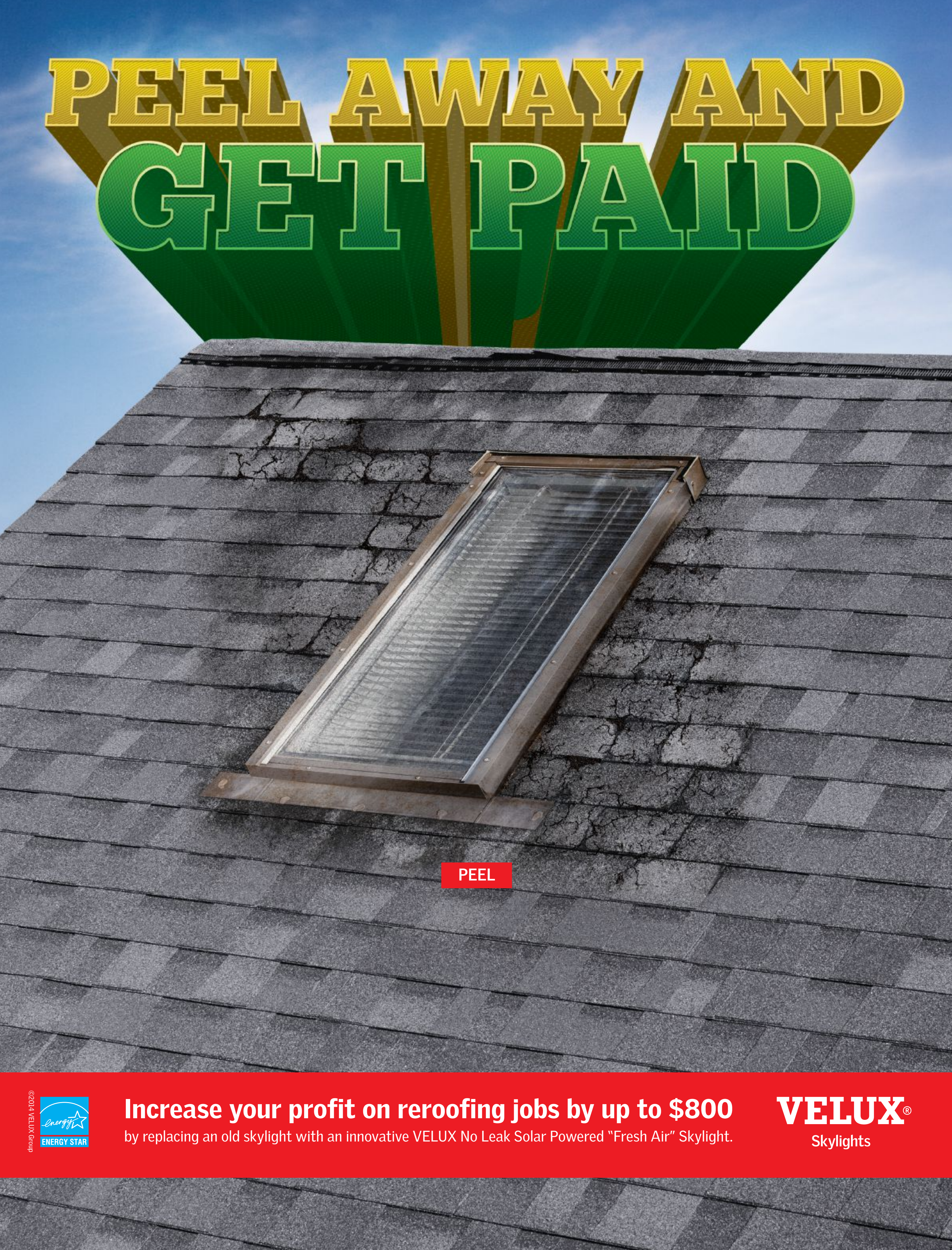
USING TRIM AS A DOORSTOP

The cabinet was about 8 inches deep, so it needed more clearance on the latch side than you'd need for an ordinary door. We decided to use the door casings to cover the gap, fastening the pilaster trim and plinth block to the wall on the hinge side, and to the cabinet on the "latch side" **(7)**, where they would not only cover the gap between the door and the frame, but also act as stops for the door.

For the built-up head trim, I started with flat stock thick enough and long enough to project about ¼ inch beyond the pilasters in both dimensions. I wrapped it with panel mold and added a top cap. The thickness of the trim hid most of the gap at the top, and I added a thin strip to the cabinet to cover the rest **(8)**. At the cabinet bottom, I coped a relief path in the plinth block on the hinge side so the cabinet door could open without binding on the base molding **(9)**.

By the time the painter was through, the cabinet looked amazing and worked as well as it looked. Our client liked the look so much, in fact, that he asked us to build a mirror frame that matched the style on the opposite wall.

Gary Striegler is president of Craftsman Builders, in Fayetteville, Ark. craftsmanbuildersnwa.com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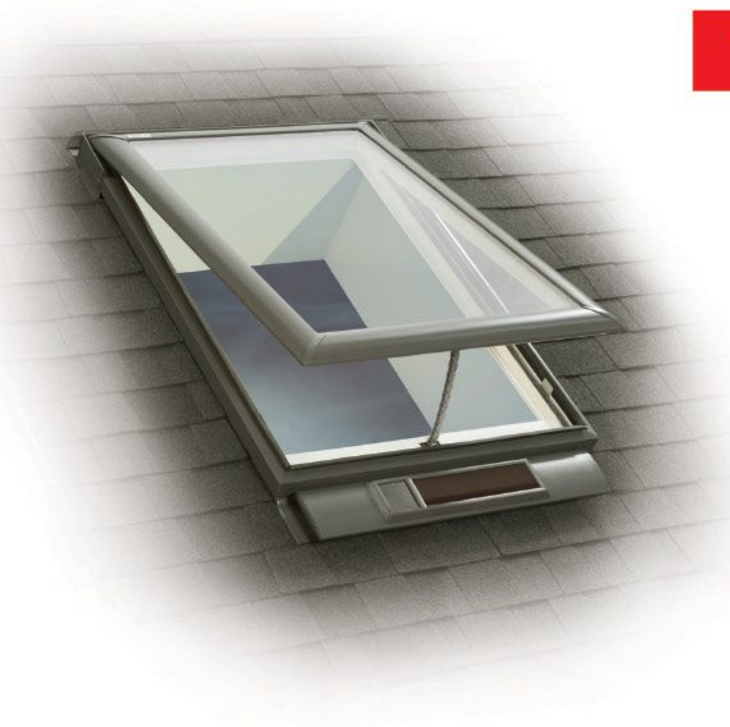

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BY MELANIE HODGDON

Tracking the Owner's Time

When I talk about job costing with my contractor clients, it's easy for me to convince them that, to know what their labor costs are, they need to track production time on the job. After all, if you work under a T&M contract, you need to have those hours tallied to be able to invoice the time. And if you work under a fixed-price contract, you need to be able to match actual hours against the hours you estimated when you set the price for the job. Either way, if your production workers aren't tracking their time, you could be underestimating labor and not know about it. In that case, you will perpetuate the error and wind up consistently underpricing work.

But while tracking production workers' time is a no-brainer for most company owners, many still don't track their own time. There are four main reasons for this:

1. They perform many functions. On a given day they could make a sales call, research a new product, reschedule a material delivery, estimate a job, stop by a jobsite to "show the flag" to the customer and crew, and maybe even pick up a hammer. Clearly, tracking time for that many activities is challenging.

2. Their time is split among many jobs. Production workers perform a variety of functions, but most spend all day on the same site. Not so for company owners, whose many functions may also apply to many different jobs. Keeping track of all of the functions and all of the corresponding jobs is daunting.

3. They're the owner. Rank hath its privileges. Company owners have the authority to exempt themselves from tracking their time. A corporate officer's salary check doesn't depend on hours reported. Likewise, sole proprietors, partners, and owners of LLCs take a draw instead of a paycheck, so reporting hours isn't a requirement of compensation.

4. They don't want to know. They know they're working a lot, but they really don't want to know how much, how hard, and how long. It's painful enough to admit that they're working too hard; it's more painful to admit that they're regularly working 60-plus hours per week.

Yet there are benefits to tracking the owner's time, especially if the company is growing from a one-to-three-person operation to a business with sufficient volume to justify a more complex infrastructure.

BREAKING DOWN THE 60-HOUR WEEK

Consider this example. Let's say that Mike is a contractor with a volume of around $750,000, and he has three full-time guys in the field. Mike still spends about 30% of his time on the jobsite, but he also performs as the salesperson, estimator, production manager, and CFO. He may be directly involved in the bookkeeping as well, if he can't foist this off onto his spouse, siblings, or children.

Each week, Mike works like crazy, and stuff gets done. As his business grows, he has to do more and more. At some point, the growth of the business will be limited by his ability to continue to perform all the roles. It's just a matter of time before he will want to bring somebody else onboard to reduce his workload. The big question is, Which part of his workload? On-site production? Sales? Project management? Estimating?

This is the kind of decision for which a history of how Mike is actually spending his time can be very helpful. The time-tracking itself doesn't have to be complicated; Mike can estimate hours at the end of each day. He doesn't have to walk around with a stopwatch, clicking every time he answers the phone or checks his email or sets a nail. (See "Time-Tracking Apps," page 28).

How is this helpful? If Mike discovers that he spent just 700 hours in production annually **(1)** and a full-time employee can be counted on for between 1,820 and 1,900 hours (see the blog "Do the Math—Are You Charging Enough for Labor?" at jlconline.com), then he really doesn't need a full-time production worker—at least, not yet. But this data could help Mike with some projections.

Mike Does Everything

Task	Hours	% of Total
Production	700	22.4%
Estimating	750	24.0%
Sales & marketing	620	19.9%
Project management	800	25.6%
Office/bookkeeping	250	8.0%
Total hours/year	3,120	100.0%
Average hours/week	60	

1. By tracking how he is spending his time, Mike discovers how the long hours he's been putting in are distributed among various critical functions.

How much more work might a full-time production worker produce? How might that justify increasing the volume of work Mike could sell and still produce on time?

But wait. That assumes the new worker would be producing at the same rate as Mike. If Mike is a topnotch carpenter performing with the motivation that comes with owning a company, it may well be that he's the most productive field worker out there. What happens if he hires a newbie? Training will dilute the efficiency of Mike and the other workers, but the inexperienced worker will be cheap. How does that fit into the formula? Can he find a part-time worker? Would employee leasing be an option?

What about the other things that Mike has been doing? He's spending more than 25% of his time managing projects. One question to ask is whether or not Mike is micromanaging or failing to plan? If he's spending lots of time running around picking up materials or re-explaining how to do something, then perhaps there's no process in place for handing off projects for others to complete. Or maybe Mike is finding it hard to delegate a certain level of decision-making to his workers, either because he can't trust them to make the same decision he would, or because he simply can't let go of control.

DATA GIVES YOU OPTIONS

By tracking how he spends his time, Mike will provide himself with hard figures that can move hiring decisions from gut or impulse to a well-considered action following a strategic plan. It becomes pretty darned easy to predict how Mike's workload would be reduced if he, say, gave up all production work and found a part-time bookkeeper **(2)**.

Or maybe it makes more sense to eliminate the biggest wedge in his pie: project management. What would happen if Mike moved to a lead carpenter system in which project management is handled by a carpenter who also produces on site? **(3)**

Two Part-Time Hires

Task	Hours	% of Total
Production	0	0.0%
Estimating	750	24.0%
Sales & marketing	620	19.9%
Project management	800	25.6%
Office/bookkeeping	0	0.0%
Total hours/year	2,170	69.6%
Average hours/week	42	

2. By hiring a part-time carpenter to replace him in the field, and bringing in a bookkeeper one day a week, Mike can bring his workload closer to a more normal 40-hour week.

Delegate Project Management

Task	Hours	% of Total
Production	700	22.4%
Estimating	750	24.0%
Sales & marketing	620	19.9%
Project management	0	0.0%
Office/bookkeeping	250	8.0%
Total hours/year	2,320	74.4%
Average hours/week	45	

3. A second option that reduces the length of Mike's workweek is to train his employees in the lead carpenter system and delegate project management responsibilities to them.

TRACK BY FUNCTION

I generally recommend that owners track their time by categories that match up with standard job descriptions (estimator, salesperson, and so on). This encourages them to think ahead and to envision the eventual org chart for their company, and to view how they spend their time not as a series of individual tasks, but in terms of the role they happen to be playing at any given time.

There's nothing more frustrating than being ready to perform a task and realizing that you're missing a critical piece of material. It's easy to see that you can't finish framing an exterior wall if somebody doesn't order enough studs. But it's just as important, when you're contemplating the next hire, to have a clear understanding of what the company needs and how it will affect you personally, as the owner.

Melanie Hodgdon is owner of Business Systems Management, and a frequent speaker on business topics at JLC Live. She is co-author of the book, A Simple Guide to Turning a Profit as a Contractor. *melaniehodgdon.com*

TIME-TRACKING APP

To get a feel for how time-tracking might work with my phone, I installed HoursTracker, one of the best-rated free apps for IOS and Android. The app takes user-created tags for things such as projects or tasks to organize reports by day, week, or month. You can run several timers simultaneously—essential for those who switch tasks and jobs several times each day—but you don't have to set up projects ahead of time: Just start the clock and fill in the details later. I didn't try the GPS feature, which automatically starts a timer when you arrive at a specified location and stops it when you leave. I can see how that would come in handy for tracking employee time as well as your own. Cloud backup and restore are included; in-app upgrade purchases include automatic backup and the ability to move data between several mobile devices.

By the way, it took me exactly 47 minutes to research and write this. Where do I send the bill? *—Sal Alfano is editor-in-chief of* JLC.

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/LEGAL/

That's About the Size of It

BY LEONARD W. KLINGEN

On Aug. 27, 2014, Marin County Superior Court Judge Paul M. Haakenson found home-improvement-giant Lowe's Home Centers guilty of false advertising. While such rulings are all too common (think Airborne herbal supplements or Coca-Cola's POM Wonderful), what sets the Lowe's story apart is that early reports claimed that the court found that calling a 2x4 by its common name was misleading because the product wasn't really 2 inches by 4 inches.

But that's not quite right. The suit was brought by the district attorneys of five Los Angeles–area counties at the behest of officials from local Weights and Measures departments who were concerned that consumers had been misled by the labeling. It turns out that the folks at Weights and Measures weren't completely out of line. The real issue here wasn't that the 2x4's actual dimension was 1½ x 3½ inches, but that Lowe's suppliers sold 2x4s with actual dimensions that measured below that standard. (The complaint also addressed the labeling of products as "wood" that were actually composites that contained other ingredients.)

The ruling resulted in an injunction against Lowe's that included a $1.4 million civil penalty for violation of California BPC § 12024, which states, in the pertinent part, that "[e]very person, who by himself or herself, or through or for another, sells any commodity in less quantity than he or she represents it to be is guilty of a misdemeanor."

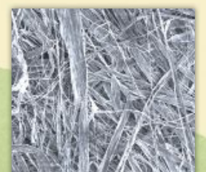
Notwithstanding the statute, it's difficult to see how anyone could have been damaged by a nominal 2x4 measuring less than 1 ½ x 3 ½ inches—and we don't yet know how much less (see Letters, on page 15). And while there may be some relevance to Marin County District Attorney Ed Berberian's statement that such "misinformation could adversely affect building projects that more often than not rely on precise measurements," virtually all construction professionals know that wood dimensions vary depending on moisture content.

The rest of the injunction sets forth rules for the advertising of "Structural Dimensional Building Products" (SDBP), which it defines as building products sold with reference to length, width or depth, and thickness. It requires that common or nominal dimensions be followed by actual dimensions, and that the symbols for inch and foot be replaced by letter abbreviations. Thus, what used to be a *2" x 4" x 8' Kiln-Dried Whitewood Stud* is now listed on Lowe's website as *Kiln-Dried Whitewood Stud (Common: 2-in x 4-in x 96-in; Actual: 1-1/2-in x 3-1/2-in x 96-in).*

So where does this leave those of us in the construction industry? For most, the ruling will have little effect. In an interview with REMODELING (remodelingmag.com), Marin County Deputy District Attorney Andy Perez noted that "[i]f it's a softwood product like 2x4 lumber and it actually meets the NIST standards, then they don't need to include the actual dimensions." (NIST—the National Institute of Standards and Technology—provides guidance concerning standards for building products as well as a wide range of technologies and commodities in other industries.)

That said, when advertising or specifying SDBPs, one might keep in mind the approach McDonald's took with regard to its Quarter Pounder. Whenever this sandwich is advertised, the restaurant chain includes the disclaimer "weight before cooking." In a like manner, design and construction professionals should consider including a general note on their documents to the effect that all SDBP unit dimensions are nominal in accordance with NIST standards.

Leonard W. Klingen is a Board Certified Construction Lawyer and Senior Counsel with The Barthet Firm (barthet.com), a 15-lawyer practice in Miami focusing on construction law.



DuPont™ Tyvek® weather barriers enlarged. Water vapor can escape, while water droplets are too large to enter walls.

Perforated house wraps enlarged. Holes are large enough to allow water droplets to enter walls.

/HR/

Telling Co-Workers About a Termination

BY DOUGLAS DELP

WHAT HAPPENED

Good Guys Construction Co. believes in open communication with its employees. Recently an employee was terminated when he showed up for work and the supervisor smelled alcohol on his breath. When rumors started circulating about layoffs and lack of work, Good Guys held a staff meeting and explained that the employee was terminated for arriving at work under the influence.

WHY IT'S WRONG

It is difficult to know how much to tell co-workers when an employee is terminated, especially if the termination is unexpected. But employers need to be careful that what they say doesn't give the terminated employee grounds for a defamation lawsuit. Defamation can occur when an employer gives untrue information about an employee to a third party—in this case to co-workers. While truth is a protection against a defamation charge, this example is a prime case for a lawsuit because the employer had no specific proof that the employee had been drinking or was under the influence of alcohol except for the fact that a supervisor smelled alcohol on the employee's breath. Since the employer didn't confirm its suspicion with the positive results of an immediate drug and alcohol test, the employee could relatively easily deny that he or she had been drinking.

WHAT YOU SHOULD DO

The law protects the communication of untrue information when it is shared in good faith with another party that has a corresponding interest—this is called "qualified privilege." In this case, the supervisor telling management about the employee would be protected, but the employer telling co-workers would not be protected. When an employer wants to communicate an employee's termination to co-workers, it is always best to reaffirm that the reasons for any employee's separation are always kept confidential, but that the recent separation has no implied impact on the direction of or other job positions at the company.

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

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Photos: Doug Horgan

Preventing Shower Curb Problems

Even the least-trained plumbers or tile installers take reasonable care with the bottom of a shower pan, but showers can also leak at curbs, walls, and benches, which are much less likely to be done well. One plumber, when we asked him to cover the curb, even said: "The shower pan fills up 1 inch above the drain; everything above that is just a waste of time."

The damage shown in the photo above **(1)** is typical of the problems we see on existing showers. Cracks in tile and stone grout lines allow water through the finishes, even when those finishes aren't submerged. Curbs are especially problematic because they are commonly framed in wood—typically double or triple 2x4s **(2)**—which shrinks and expands with seasonal changes in humidity. Those dimensional changes mean that cracks in the grout are inevitable. A shower is one of the "rainiest" environments we build in—even small cracks or slightly porous stone can let a lot of water through.

Simply running the liner to the outside edge of the curb isn't enough to prevent water damage. Any water that seeps through cracked grout lines will easily wick under the liner edge and soak the framing, which is what had been happening in this shower for years **(3)**. We've seen similar damage on numerous other existing showers.

PAN LINER

On most showers, we install a standard shower liner. We keep copies of the manufacturer's directions


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on site, and our subcontractors know to bring preformed outside corners and the correct adhesive for the material. We cover the curb completely, all the way to the floor.

Even a well-done shower liner is no guarantee, though. Liners are installed early in the job and can easily be damaged by trades coming in afterward. Tilers, especially, love to put screws through the curb to hold their backerboards. There's no way to prevent this, so additional measures are required to protect against water damage.

SECOND LAYER

For extra protection at curbs, knee walls, and benches, we use Schluter Systems' Kerdi liner, a soft polyethylene membrane that is applied over the top of the tile backer with a trowel-applied, thin-set mortar.

There are other sheet membranes and liquid-applied products that will work, but the same principles apply: The liner needs to cover the top of the curb, extending down the outside face and lapping onto the floor **(4)**. It should also protect the drywall outside the shower **(5)**. Preformed corners provide complete coverage at outside corners **(6)**. We've had good success using drywall mud directly on Kerdi, so we don't worry about how far we extend it.

Kerdi is easily available and familiar to our tile contractors. I do know a couple of guys who prefer Laticrete 9235, a paint-on waterproofing, but if you apply the recommended two coats, the installation process takes a lot longer.

The key to any waterproofing is complete coverage. The applications shown in photos **(7)** and **(8)** are examples of incomplete coverage that are likely to fail. Both applications leave critical gaps in the waterproofing where cracks in the grout are most apt to form. Even though these areas are "outside" the enclosure, water can easily drain into them and soak the framing.

BENCHES & TUB DECKS

A good example of a catastrophic failure can be seen in this master bathroom, where one end of this tub deck is inside the shower enclosure **(9)**. It looked to be in good shape, but we got called in when water started to leak through the ceiling below **(10)**. When we opened up the shower, we could see that the rot was extensive. There were termites living in the


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floor framing beneath it **(11)**.

To prevent this kind of disaster, all surfaces within the shower enclosure, including benches, tub decks, or any other features a shower might include, must be completely covered **(12)**.

DOOR TRACKS

The damage that occurred in all the previous photos took years to show up. But the crack in the grout **(13)** formed within an hour of the installer screwing the door track to the wall.

Door tracks channel the water pouring down a glass door to the ends and funnel it into the areas where the grout is most likely to crack **(14, 15)**. Weep holes and a judicious amount of sealant in track joints can help, but the lasting solution is to make sure the liner beneath the tile is perfect, so that a constant flow of water doesn't ever reach the framing.

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

BY NATE ADAMS AND CAMERON TAYLOR

Solving for Comfort With a 'Smart' Thermostat

I've recently become a fan of the Ecobee thermostat. While other "smart" thermostats on the market, such as Nest's, offer online control and home monitoring features, the Ecobee is the only thermostat I know of that provides extensive data logging and has a simple, free Internet portal for tracking performance. The Ecobee records and logs indoor and outdoor temperatures, set point, indoor humidity, and equipment runtime. It's a remarkable tool for diagnosing and solving the kinds of comfort problems that prove to be the most mystifying for those of us working to improve home performance: a room that won't heat or cool; a house that isn't "comfy"; indoor allergies or dry skin; a "clammy" area; and the like. Haven't you wished that you had some insight into the causes of these complaints? I sure have.

Of course, you could drop an IAQ monitor, such as Air Advice, at the home, or a Hobo data logger (see "Monitoring Home Performance," Sep/14). But what happens if you retrieve the logger too early, before a house experiences the particular conditions causing the problem you're trying to solve? Chances are either you will remain mystified or you will have to make additional trips (likely unpaid) to drop off and pick up the data logger again. The Ecobee offers a permanent option.

Ecobees can control a wide range of equipment. The better models can manage several pieces, such as a humidifier, an HRV/ERV/ventilating dehumidifier, or hybrid furnace/heat pump setups. They can also tell multi-stage equipment to "reverse stage." Many thermostats start in high stage, satisfying the thermostat too quickly, which leads to comfort and humidity problems. With the Ecobee, the staging can be changed to start in low rather than in high, depending on temperature swing from set point. Ecobees can also cycle the fan a few times an hour to mix indoor air or provide a number of other tweaks that might improve energy performance or solve a client concern.

Those features aren't the primary focus of this article, however. Comfort issues are my immediate concern, partly because they can be so difficult to solve. But solving for comfort usually fixes root problems, and energy efficiency tags along like a loyal puppy.

Photo: Nate Adams

THE COMPLEXITY OF HUMAN COMFORT

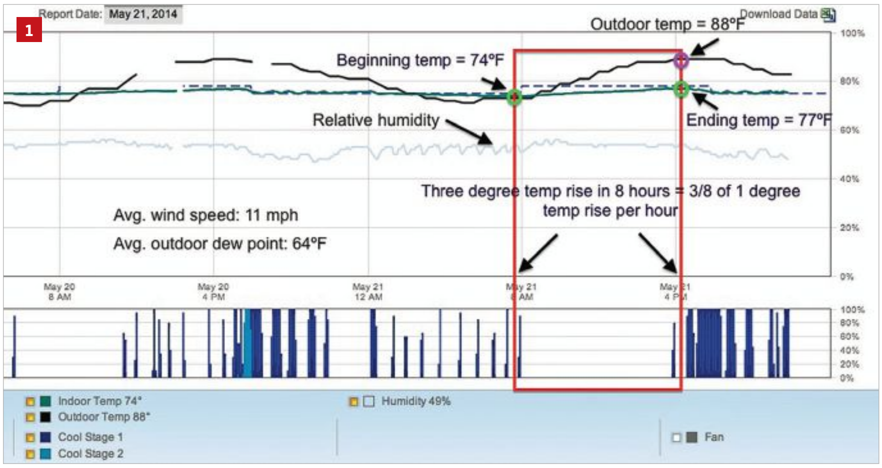
The more I learn about building science, the more complex I realize human comfort is. It is not only air temperature that affects comfort. Surface temperatures, humidity, rate of change in temperature, air velocity, odor, noise, and many other factors also contribute to how comfortable a person feels. It can be tricky to discover causes behind complaints based only on what clients tell you.

The Ecobee can provide key information relating to comfort, including the time it takes the temperature in the house to change during and between system cycles or when clients change the temperature set point; the frequency of equipment cycling; the length of runtimes over a day, week, or month; and the fluctuations in humidity levels.

A BUILDING SCIENCE NERD'S DREAM

My friend Cameron Taylor owns an Ecobee and had this to say about his experience with the data logging abilities of his "Smart" model: "My house, located in Fort Worth, Texas, is a 55-year-old, 1,800-square-feet single-story ranch on slab equipped with white reflective roofing and sealed attic bypasses. The screenshot **(1)** on the following page shows Ecobee data for this home on May 21, 2014. The weather that day—though not typical of a hot, muggy Texas summer—is representative of summer in many other areas of the U.S.

"Note the eight-hour period highlighted by the red box I added. The green line indicates indoor air temperature, the black line is outdoor air temperature, and across the bottom is equipment runtime. Indoor temperature rose only 3 degrees over eight hours, indicating that improvements to the home's thermal and pressure boundaries were effective at reducing heat gain under these conditions. Note also that the A/C did not run at all (indicated by vertical blue lines at bottom of graph) during this period. With the thermostat doubling as a data logger, I can see this degree of granular data for my home's thermal performance. The Ecobee Web portal also allows me to export the recorded data in Excel format. It is a building science nerd's dream!"



MONITORING COMFORT

Take a look at the second graph **(2)**, which shows data from a two-and-a-half-story rental house built in 1880 in Climate Zone 5. See how the temperature (green line) races up whenever the furnace runs? Fast temperature changes can feel uncomfortable; our bodies prefer slow changes. It's possible that this home's furnace is oversized, the occupants are uncomfortable, and the energy bills are high. Once you start installing Ecobees, you'll realize that almost all HVAC equipment is substantially oversized, which very often leads to comfort and balance problems.

Indoor air temperature. Many of us have lived in older homes that were poorly insulated. In those homes we had to sit on or near a heat vent to keep warm. More than likely, the indoor air temperature fell like a stone when the furnace shut off, and the surrounding surface temperatures never quite warmed up to levels needed for human comfort. Maintaining consistent air and surface temperatures—achieved with right-sized HVAC and a decent (it doesn't have to be perfect) building enclosure—are critical to maintaining indoor comfort.

Look at the graph again. See how quickly the temperature drops once the furnace cycles off? This suggests that the home may need air sealing and insulation. Wouldn't this data enable you to ask the client informed comfort questions as well as guide your investigation efforts?

When clients are cold, they increase the temperature set point. If you see thermostat games—the red dashed line on the graph tells you that—you know that there are problems.

Indoor humidity. Moisture levels play an important role in comfort. During the cooling season, if humidity is too high our sweat can't evaporate quickly enough to cool us effectively. We roast and get wet. An oversized air conditioner won't run long enough to pull humidity levels down, so clients may drop set points to uncomfortably cool temperatures in an attempt to reduce humidity. My wife doesn't like A/C because of this, and I know she's not alone.

During the heating season, if humidity levels in the home are too low, moisture evaporates too quickly. We feel cold and our skin, sinuses, lips, hands, ankles, and feet may dry out. A whole-house humidifier is often the fix here, but be careful! If the house leaks air into the attic, that solution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To avoid adverse heath effects for occupants, indoor relative humidity should be maintained between 30% and 55%. In the chart at right, a decrease in bar height indicates a decrease in the listed health effect.

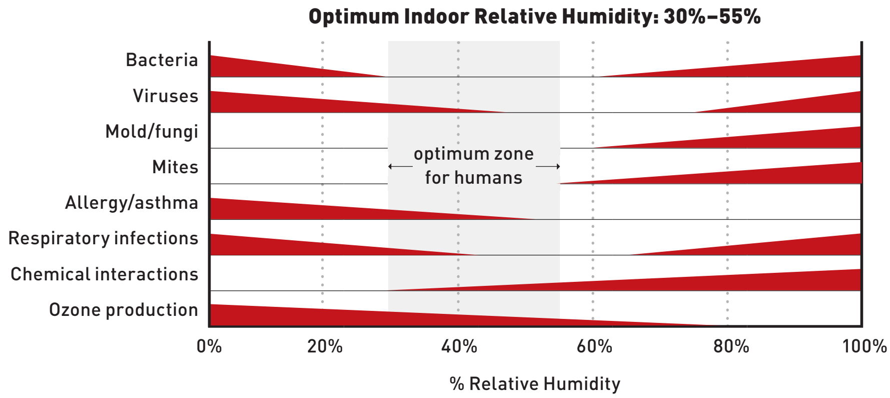


Chart: adapted from Sterling, et. al., "Environmental Health Perspectives," March 1986

will cause mold and moisture problems in the attic. And if the humidifier control isn't managed to decrease humidity levels in very cold weather, moisture problems could occur on windows, walls, and ceilings. Smart-line Ecobees are capable of controlling humidifiers and can be tied to outdoor temperature so that they automatically manage humidity.

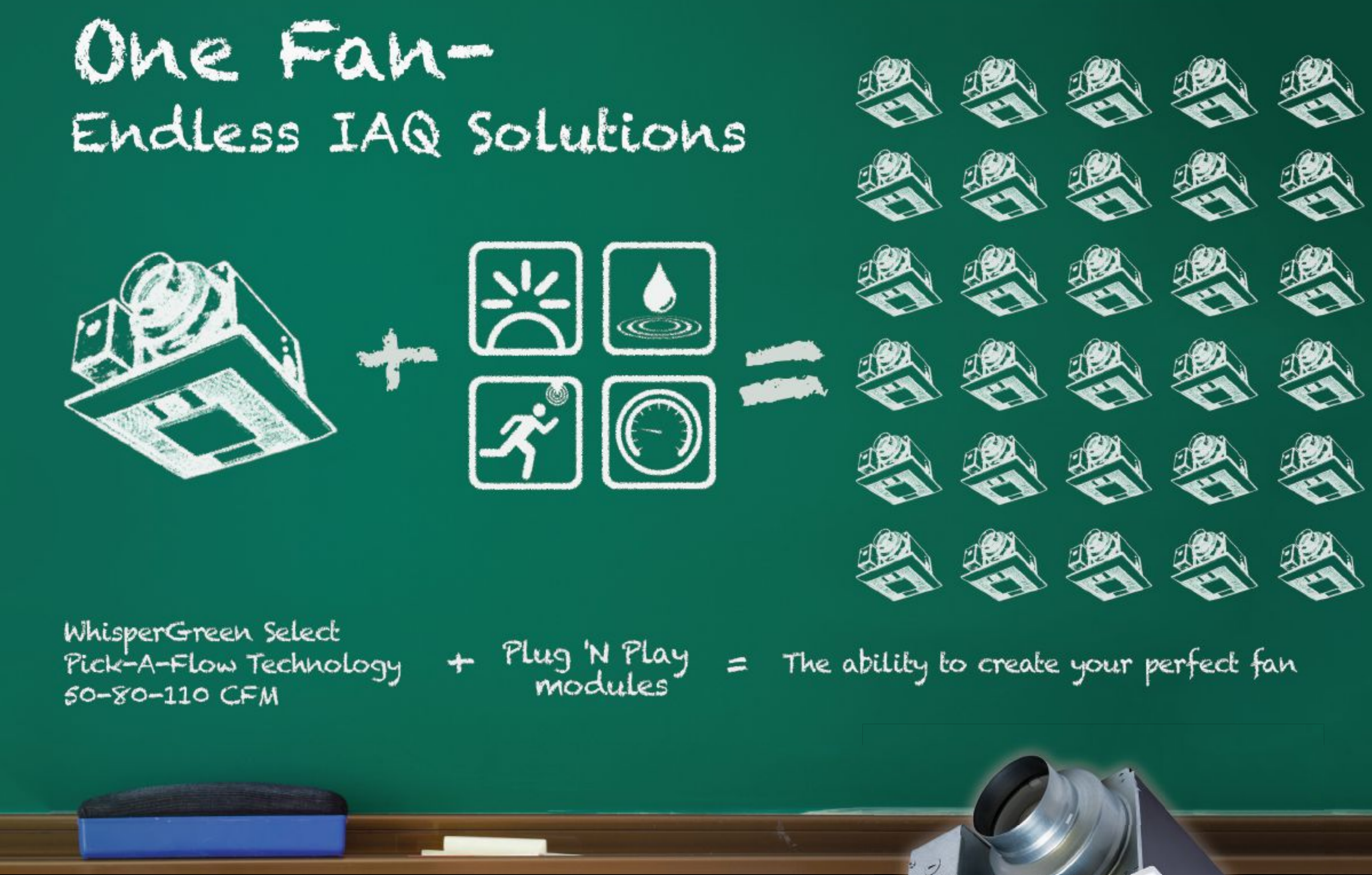
The "happy place" for relative humidity is between 30% and 55% (see chart, above). There isn't much chance for mold on the high side, nor much chance of flu spreading on the low side (that is a factor), and our skin doesn't dry out. Without a data logger of some sort, how would you figure this out?

In addition to recording fluctuations of indoor temperature and humidity without your making multiple trips to the home, the Ecobee can check weather data, look for the coldest or hottest day, and display what happened under these conditions in the home. No other thermostat performs data logging to the extent an Ecobee does in order to help with problem diagnosis.

You may know the basic solutions: Tighten the home, insulate it better, and right-size the HVAC. But insight is powerful. It can help to sharply focus your efforts. What that looks like varies by client, home, and budget. Until you know the details of comfort problems and do a thorough energy audit, you can't tailor a plan to fix those issues. But an Ecobee could be an important tool in your toolbox to help with initial and ongoing diagnosis.

Nate Adams runs Energy Smart Home Performance, based in Cleveland. Cameron M. Taylor is adjunct instructor of HVAC at Tarrant County College, Fort Worth, Texas, and educational director for Region 10 of the Refrigeration Service Engineers Society.

Panasonic



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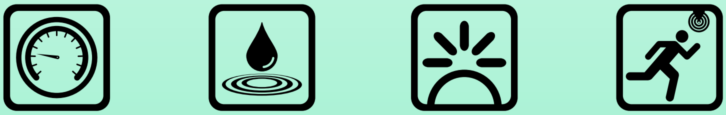

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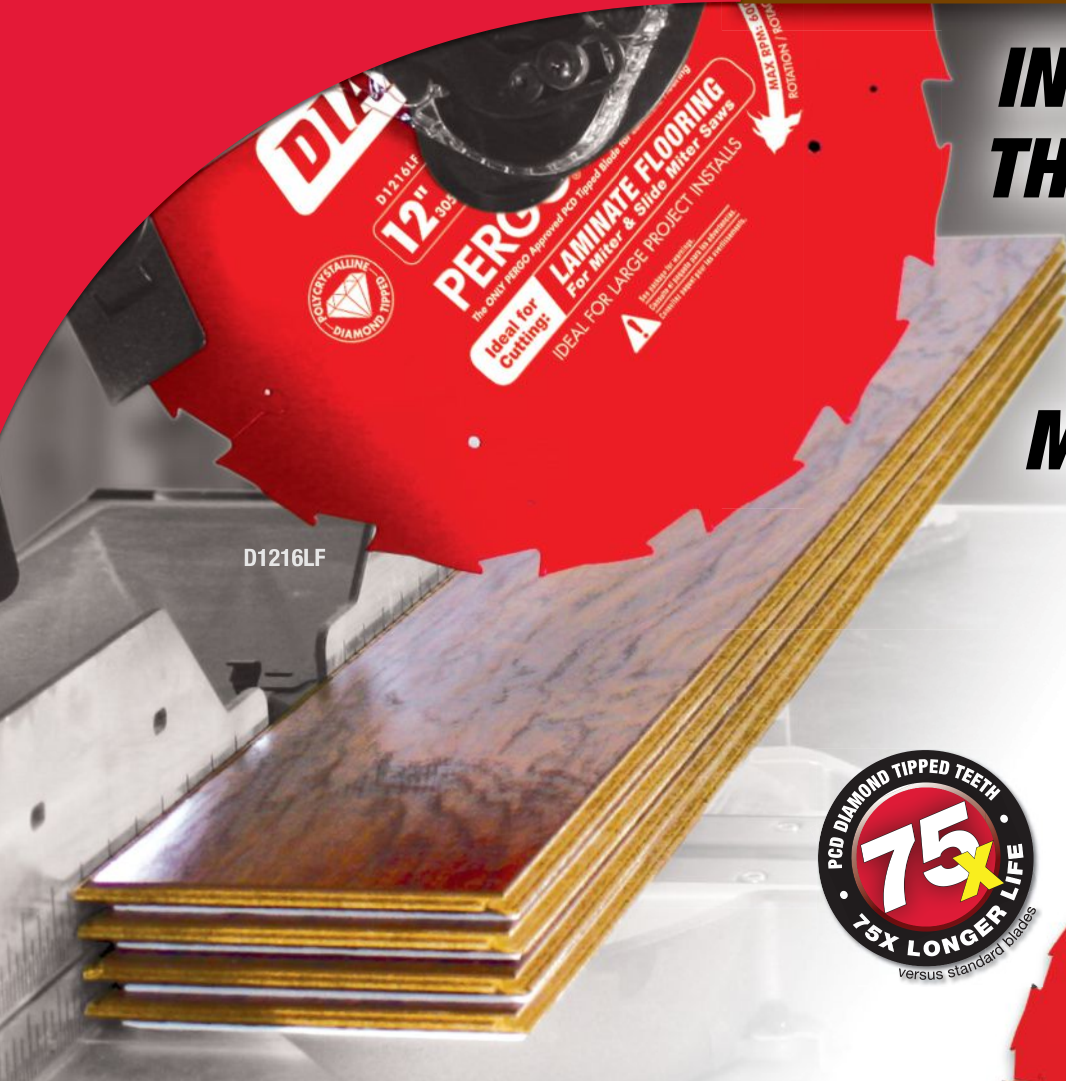

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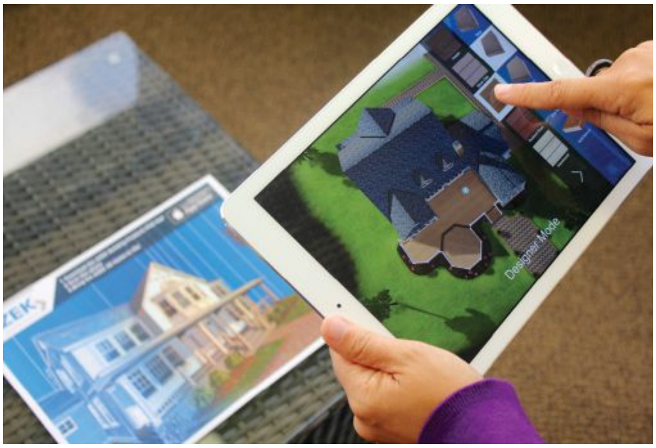

3-D Deck App
This free app lets contractors show customers what outdoor living areas might look like with various deck, rail, and paver products. In 2-D mode, users can choose one of five home scenes to customize with products, designs, and colors. Switch to 3-D mode to view a house that can be personalized with product selections and rotated 360°. azek.com

Dust-Free Jobsites
The BuildClean dust-control system pulls air through two filters at a rate of 36,000 cubic feet per hour. It can run in recirculation or negative-pressure mode and maintains CFM flow as filters load by automatically increasing motor speed. The $1,000 system includes the air scrubber unit, HEPA filter, replacement filters, and vent hose. buildclean.com

Versatile Shower Door Panels
The Gridscape shower door collection features clear glass in rust-proof anodized aluminum frames with an oil-rubbed bronze finish. Panels are available as swinging or bypass sliding shower doors, or as standalone panels that can be used in combination to create design features in rooms other than the bath. Prices range from $449 to $599. coastalind.com

Durable Prefinished Flooring
Bellawood's product line now includes oil-look matte styles, including natural hickory and American walnut (about $7 and $9.75 per square foot, respectively). Backed by a 100-year transferable warranty, the proprietary topcoat resists scratching, scuffing, and staining, making it ideal for high-traffic areas. lumberliquidators.com

Hand-Crafted Pendants
Crystalline Series hand-blown pendants come in four geometric shapes measuring 6 3/4 or 9 3/4 inches wide and 9 1/4 inches high. The black cord can be cut on site and terminates in a black ceiling canopy. The pendants are fitted with the maker's dimmable tubular incandescent Beacon Bulb and also accept Plumen CFL bulbs. Available in nine glass colors. Prices range from $550 to $650 each. nichemodern.com

Portable Safety Fencing
The Rapid Roll portable temporary fencing system includes fencing, posts, and bases that fit together to create a visible protective barrier indoors or out. The system is available in 50- or 100-foot lengths and open or closed designs in a range of colors. A starter kit that includes a 50-foot fencing cartridge (shown), four rubber post bases, three rapid posts, and a wheeled mobile base costs less than $850. rapidroll.ca

Pop-Down Drain
California Faucets' new ZeroDrain features a "pop-down" design that eliminates a protruding stopper and cumbersome lift rod. Press down with a finger to close the stopper; press again to open it. The piston design ensures a true seal, and the drain pulls out and easily reinserts for cleaning. Available in a chrome finish. ZeroDrain is priced at $129 ($61 as an upgrade to one of the maker's faucets). calfaucets.com

Radiant Barrier Roof Panel
The new Zip System Radiant Barrier roof panel combines the moisture protection of the Zip System with the energy-efficiency benefits of radiant barrier sheathing. Company testing shows that the panels can help lower attic temperatures by up to 30° and reduce home cooling costs by up to 12%. A 1/2-inch-thick panel costs about $25; 5/8- and 7/16-inch thicknesses are also available. huberwood.com

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NAECA Guidelines

The upcoming revision to the National Appliance Energy Conservation Act, otherwise known as the NAECA, will impact the design of most new water heaters.

These changes will be in effect on April 16, 2015.

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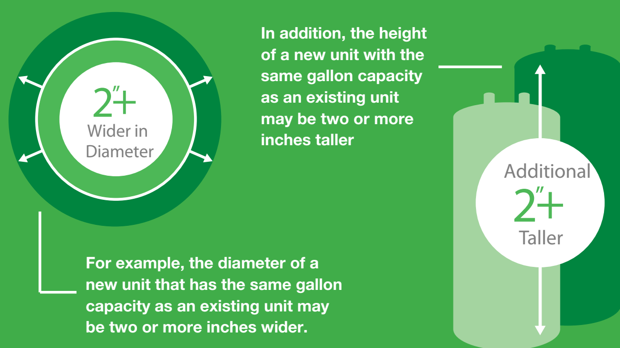
A. O. Smith is making all the necessary improvements to its entire line of electric and gas water heaters to meet the new NAECA standards. So you don't have to worry about the technology and engineering involved.

However, those improvements will impact you in a number of ways, and you need to be aware of them when planning for the replacement of existing water heaters.

For more information about the NAECA Guidelines or to order an A.O. Smith water heater contact your local First Supply location today.

CHANGES IN PRODUCT DIMENSIONS.



In addition, the height of a new unit with the same gallon capacity as an existing unit may be two or more inches taller

For example, the diameter of a new unit that has the same gallon capacity as an existing unit may be two or more inches wider.

27 Upper Midwest Locations

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BROOKFIELD 262.783.0500	**FREEPORT** 815.232.6000	**MADISON** 608.222.7799	**PLOVER** 715.254.0371	**SHEBOYGAN** 920.457.3646	
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Modular Egress Window Well

The StakWel Egress Window Well system uses modular units (about $100 each) that stack together to accommodate virtually any foundation depth. Redesigned to accommodate utility or egress window openings up to 54 inches wide, the system is constructed of corrosion-resistant high-density polyethylene that is impervious to moisture conditions and won't rust, rot, or discolor, the maker says. bilco.com

Low-VOC Adhesive

Latex-based Extreme Heavy Duty Construction Adhesive is gunnable in temperatures between 22°F and 120°F. The plastic tube prevents the adhesive from drying out even when stored in an exposed truck. At $3.47 per tube, Extreme Heavy Duty is eligible for LEED points and is GreenGuard Gold certified as a low-emitting material suitable for indoor or outdoor use. liquidnails.com

Wood-Look Porcelain Tile

The impervious porcelain and slightly textured surface of Ragno's new Woodstyle tile line makes it suitable for wet locations and areas requiring frost- and impact-resistance. Available in four "species," the rectified planks are 120 cm long (about 47 inches) and come in widths of 10, 15, 20, and 30 cm (approximately 4-, 6-, 8-, and 12 inches). Online prices are about $7 per square foot before shipping. ragno.it

Affordable Laser Measurer

Operating the pocket-size GLM 15 laser measurer couldn't be easier: Press one button on to turn it on, press again to record measurements, and press-and-hold the same button to turn it off. The square, flat design works on any surface, and although its $50 price tag means it has a shorter range than more expensive units, the maker says the GLM 15 measures up to 50 feet with 1/8-inch accuracy. boschtools.com


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Replacing a Full-Height Bay Window

A template simplifies the math for the hybrid frame

BY GREG BURNET

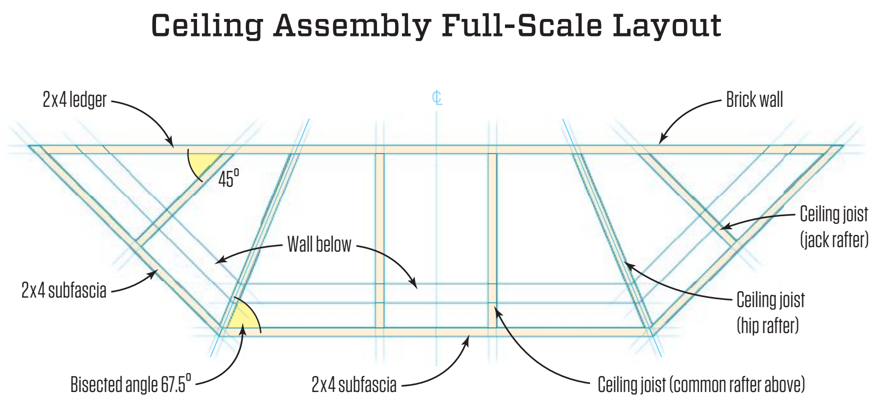
We were recently contracted to replace a "walk-into" bay window in a house built during the late 1970s. Unlike smaller bay windows that hang from a cable system or that are supported by brackets, these bays have floors that are either cantilevered or, as was the case in our project, supported by a full foundation.

The bay was quite large—about 9 feet wide and 7 feet tall without the roof—and a nearby privacy fence and mature landscaping would have made it almost impossible to bring in and install a stock unit without doing some damage. And although the existing bay window was likely a stock size back in its day, the closest available size we could find was about an inch too wide—close, but not ideal. Our solution—one that we've used in the past when remodeling bay windows—was to fabricate the components in our shop and then truck the bay window to the jobsite in manageable pieces for assembly there.

We began by measuring the existing bay and ordering three new windows. While we opted for Marvin Clad Ultimate Double Hung units for this project, almost any good-quality double-hung window would have worked. The windows themselves were stock, except for the code-required tempered glass for the lower glazing that would be just above the finished floor.

Photos: Sue Burnet

1

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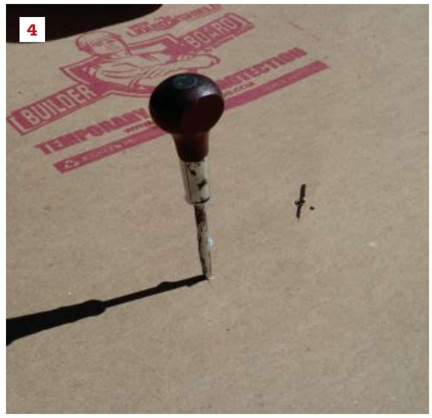

TEAROUT & TEMPLATING

After taking delivery of the windows, we turned to construction—or demolition, to be more precise. We tore down the existing bay, removing the windows, roofing, walls, and roof structure, and leaving only the floor and the sole plates in place **(1)**. The floor for this bay was structurally sound and the finish flooring was in good shape, so we protected it with a layer of Builder Board for the duration of the project.

Once we had finished the demolition, we made a template with a second piece of Builder Board, spreading the paper board over the floor in the opening and folding it to mark the location of the limestone sills **(2)**. We indexed the template by cutting in the corners of the house walls **(3)** and marked the outline of the plates by poking through the template with an awl **(4)**. Two poked holes along each wall served as dots we could connect to create a full-scale "plan" for accurately laying out and framing the roof and wall components. We also made a story pole marking the height and width of the opening **(5)**, and clearly labeled each critical reference on the story pole and the template. With the bay foundation and opening templated and measured, we tarped the opening and headed to the shop.

A DIFFERENT APPROACH TO FRAMING

The most challenging part of a bay window to frame is its faceted roof. My approach used to involve scaffolding and countless trips up and down ladders as I muddled through the cut-and-fit process. But then I realized that most bay roofs are small enough to frame on the ground and safely lift into place, saving time, sanity, and wear and tear on my knees. So now we fabricate the roof and other components in the shop, where my tools are all set up and we can contain most of the mess. We also don't have to worry about the weather.

For those of you looking for a lesson in classic roof framing, suspend your expectations for a moment. The strategy I use to build a bay-window roof bases all the framing on the template. The parts of the frame in one of my bay roofs are hybrid applications of familiar roof framing parts, but they work in the same way. I will explain the differences as I go along.

My strategy also allows me to modify the original roof if need be. For example, the demise of the windows in the existing bay was mostly due to the drip line of the roof not extending beyond the perimeter of the limestone sills below. Precipitation dripped off the roof onto the sills and splashed onto the windows, eventually caus-

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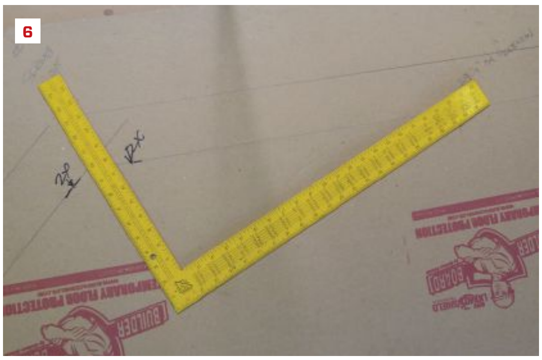

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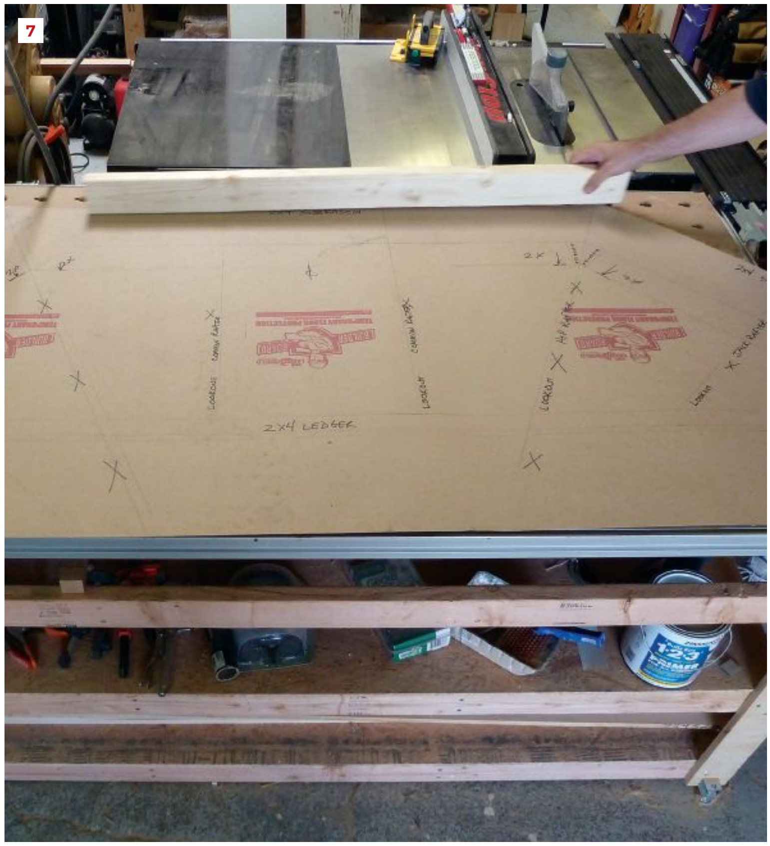

ing them to fail. When I made my template, I included the outer edge of the limestone sills. Then when I laid out the roof, I made sure that the drip line would fall outside of that perimeter.

The final advantages to this system are speed and efficiency. This strategy is a production approach to what can be a difficult framing challenge. Because all my figuring is based on the template, which is a full-scale plan of the frame, the complicated geometry is already done for me.

LAYOUT IN THE SHOP

At the shop, I unrolled the template and clamped it to a workbench. First I drew the walls on the template in plan view, connecting the holes I'd poked along the edge of the plate. I marked both the inside and outside edges of each wall. With my system, the ceiling joists and the rafters are in the same vertical plane, so the framing layout works for both (see Ceiling Assembly Full-Scale Layout, facing page). The ceiling joists extend beyond the wall plates for attaching the soffits.

To lay out the angled joists (as well as the hips), I bisected the outside corners by placing a framing square on the line of the outside wall, set at a 5-in-12 pitch **(6)**, which happens to be 67.5 degrees and is the correct setting to bisect a 45-degree corner. I extended the lines to the back of the bay with a long straightedge held against the blade of the square. Accuracy of these lines is critical because the centerlines for the angled framing ultimately determine the intersection point of the hips, upper ledger, and side nailers **(7)**.

I drew a ledger that would span the entire width of the bay roof and attach to the brick wall. I also laid out the angled subfascia on the template. Normally there would be a common rafter right next to a hip rafter, but that would have given me three commons, so I drew in just two in conjunction with the ceiling joists below.

CEILING FIRST, THEN RAFTERS

With conventional roof framing, the walls are built first, then rafters with birdsmouths land on the wall plates to form the eaves overhang. With my method, the ceiling joists extend beyond the walls as lookouts to create the eaves. The rafters then get a simple seat cut and land on top of the lookouts.

I took measurements for the parts of the ceiling assembly directly from the template, and then I assembled the parts on top of the


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template. Instead of nails, we used 3-inch construction-grade screws made by Grabber to fasten the framing together **(8)**. Screws help to keep the pieces on their layout marks during assembly, and they also fasten the components more securely than nails, which is a plus for transporting and lifting the roof into position.

With the ceiling assembly clamped to the bench, I turned to the common rafters. With conventional roof framing, the run of a common rafter is measured from the center of the ridge to the outside edge of the wall plate. But the run of these so-called commons was the distance from the outside edge of the ledger to the outside edge of the subfascia. So I calculated their length with a Construction Master calculator. I entered the roof pitch and the run (measured off the template). I hit the "Diag" button. The resulting dimension was the length of the rafters measured from long point to long point. We cut the two common rafters and screwed them to the joists, taking care to keep the rafters perfectly aligned with the joists **(9)**.

Next we measured between the centerlines of the two diagonal joists for the length of the "ridge," which we cut and then screwed to the tops of the common rafters **(10)**. On a typical hip roof, the ridge sits behind the ends of the perpendicular walls. But on this roof, the ledger is outboard of that position, so the member above—while functioning as a ridge for attaching the rafters—really is just an upper ledger for attaching the roof to the wall.

CALCULATING THE TOUGH ANGLES

Once the ridge was in place, we found the length of the two nailers that would run from the ends of the ridge to the outside of the subfascia by simply measuring with a tape. But the pitch was different from the pitch of the commons, so we still needed to figure out the angle for the plumb cut and complementary seat cut. There are many ways to figure out these angles, including scribing, but I went back to the construction calculator because of its accuracy.

First I entered the run, taken from the template, and the rise, measured from the ceiling framing to the top of the ridge. I hit "'Diag" to give me the length (which I'd already measured) and then hit "Pitch" once to give me the pitch in inches, and a second time to display the pitch in degrees. The angle of the plumb cut was 15.93 degrees, which I rounded to 16 degrees. For the heel cut, I used the complement of that angle: 74 degrees. We used a similar method to measure and fabricate the hip rafters. The plumb cut for the hip rafter also needed

to be cut with a bevel angle, which we took from the corresponding joist below.

I'd measured and cut the nailers to the long point of the subfascia, so the ends of the nailers stuck out beyond the edge of the subfascia, which put the edge of the nailers above the roof plane. We could have beveled the entire length of each nailer, but we decided to "drop" them instead to put the inside top edge in plane to catch the roof sheathing. To find the drop, we held the nailer in position on top of the joist, then struck a plumb line on its face where it overhung the framing below **(11)**. The height of the line (about ⅜ inch in this case) equaled the amount of drop. I scribed this distance along the heel cut, then trimmed off that amount **(12)** so that we could install the nailers at the proper height **(13)**.

I call the last two rafters jack rafters, although technically they are probably hybrids. First we marked their location on the nailers with a framing square placed on the ledger **(14)**, and measured their length directly from the roof assembly **(15)**. We cut compound angles at the top ends of the jack rafters, with the plumb angle the same (5 in 12) as the commons, and the bevel angle at 45 degrees.

We also cut the roof sheathing sections while the bay roof was sitting on the bench **(16)**. We measured each section and transferred the dimensions to ½-inch CDX plywood. Because we would need to access the roof framing to secure it to the house, we just tacked the sheathing in place and then removed it **(17)**.

The last pieces made in the shop were the posts for the angled corners where the walls would meet at 45 degrees. We used our template to lay out the profile of the posts, transferring the dimensions to a section of 2x4. For each post, we ripped a bevel on one side of a pair of 2x4s **(18)**, then screwed the pair together on the bench to ensure a straight corner post **(19)**.

ASSEMBLING THE BAY ON SITE

The following day we returned to the site with all the parts for the bay. We cut two sets of plates: 1x4 bottom plates to set the windows at the correct height; and 2x4 top plates. We nailed the bottom plate to the existing sole plate and toe-nailed our angled corner posts to those plates **(20)**. Then we nailed the middle top plate to the tops of the posts to set the roof when we lifted it **(21)**.

The roof assembly weighed around 50 pounds, making it easy to lift and position on top of the front wall **(22)**. We supported the


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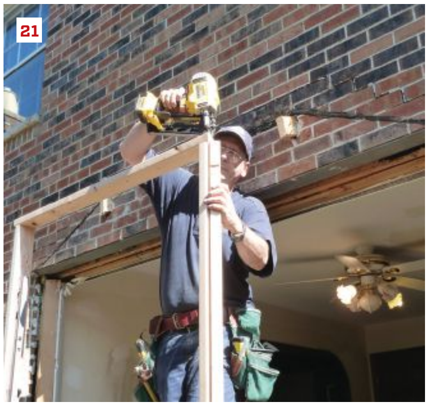
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inboard side of the roof temporarily with a 2x4 post. The corners of the top wall plate bisected the angled lookouts, so we positioned the wall, plumbed it, and secured it to the center ceiling joists **(23)**. We also secured the ridge, ledger, and side nailers to the masonry, using Tapcon screws driven through the framing. At this point, we filled in the top plates for the angled sides.

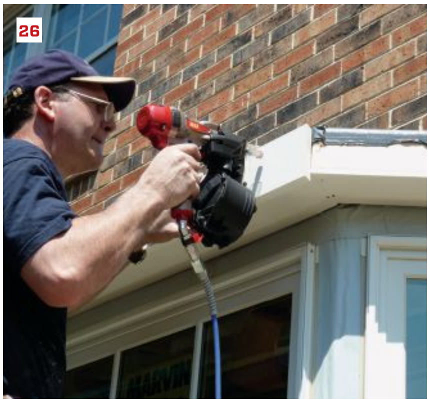
After reinstalling the roof sheathing we'd cut earlier, we put down a layer of Ice & Water Shield to dry in the roof structure, letting the membrane extend up the wall about three inches as an apron flashing. We nailed in miscellaneous blocking and sheathing to the wall framing and installed membrane sill pans in each window opening **(24)**. Next we set the windows, taking care to level and plumb them in the openings as well as in relation to each other **(25)**. After nailing them off, we taped the flanges with membrane flashing for a weatherproof installation.

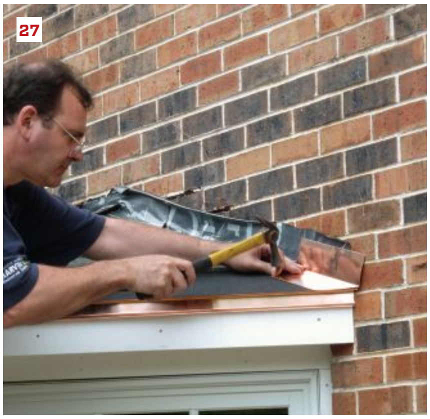
We trimmed the exterior of the bay with cellular PVC stock for durability and low maintenance, starting with the soffit and fascia **(26)**. We also trimmed the windows with flat PVC stock. Where the windows met the house, we tucked the trim into the air space between the masonry veneer and the sheathing of the house. This left the unfinished back edge of the brick veneer exposed, so to finish the side trim, we caulked in standard brick mold between the brick and the window trim.

FINISHING THE ROOF

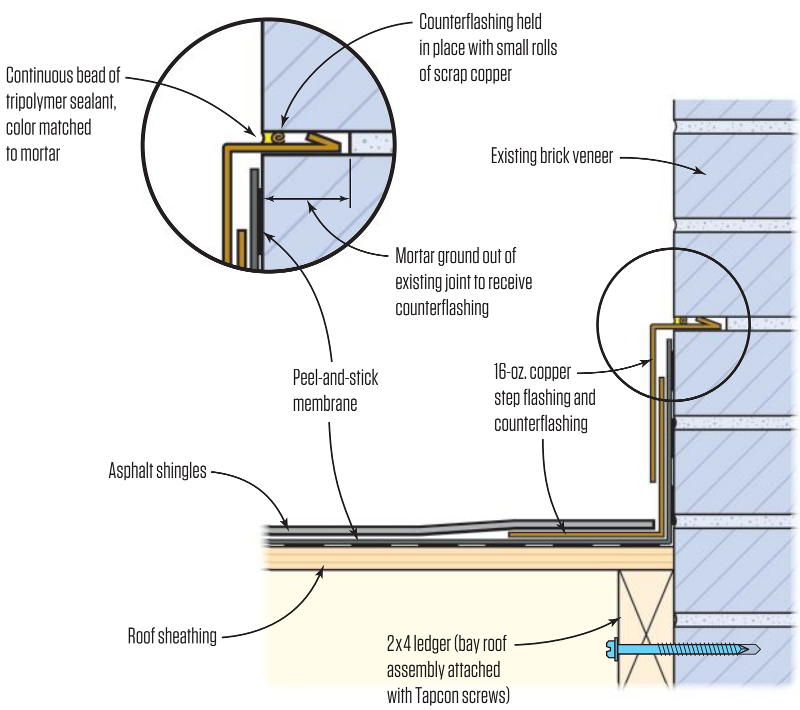
With the trim done, we turned to the roofing. We made all the flashings out of copper on a sheet metal brake—including drip edge, step flashing, and counterflashing—to match the copper flashing on the rest of the house. We made all the flashing for the roof from half of a 3-foot by 10-foot sheet of 16-ounce copper, which we purchased from a local supplier. Because copper is fairly expensive, I laid out the components to minimize waste. I marked the copper with a Sharpie for the layout, and then made a nick with aviation snips at each mark that served as a registration when positioning the material in the brake.

Step flashing for a conventional roof is usually 5 by 7 inches before being formed. But the bay roof shingles met the wall at an angle and needed longer pieces of flashing. So I formed lengths of copper and cut four pieces of step flashing 10 inches long from each one.





Saw-Cut Reglet Flashing



I form step flashing with an angle that's slightly more than 90 degrees, so it springs in tightly between the roof and wall without interfering with the counterflashing. We also fabricated our own drip edge, customized to the project dimensions and to the correct roof pitch. To prevent galvanic reaction, we used copper roofing nails to fasten the drip edge and step flashing to the roof deck **(27)**.

We installed roof shingles that matched those on the house and added counterflashing to cover the step flashing and the apron (see Saw-Cut Reglet Flashing illustration, above). In a perfect world, the counterflashing would go through the masonry veneer and under the WRB on the sheathing, but that would have meant tearing out and rebuilding the veneer (which was not in the budget). Instead, I let the flashing into the mortar joints two courses of brick above the roof in a stair-step pattern. I ground the mortar out of the joints to a depth of about one inch, using a mini-grinder fitted with a diamond blade. Then I laid out and sheared each piece, using a sheet-metal folding tool to bend the top leg 90 degrees to the body.

Starting at the low end of the roof, we installed the counterflashing by inserting the leg into the mortar joint. To hold the counterflashing in place, we made small rolls of scrap copper that we pushed into the mortar joints above the flashing. These "jelly rolls," as they're sometimes called, have enough spring in them to wedge the flashing in place. We make sure that these rolls are pushed in past the face of the brick so that they don't interfere with the bead of sealant that finishes the joint. Progressing up the roof, each piece of counterflashing overlaps the one below it by a couple of inches.

To ensure a clean bond between the sealant and the masonry, I had rinsed the brick after grinding to remove dust and debris. After the brick had thoroughly dried, I applied a tripolymer sealant in a color that matched the mortar into each horizontal joint, sealing the flashing to the masonry. Vertical flashing joints were not sealed, to let any moisture behind the flashing escape.

The client insulated and finished the inside of the bay as part of an ongoing remodel. The bay took about three man-days to complete—longer than it takes to install most pre-manufactured units—but in the end the custom-fit bay was well worth the effort.

Veteran JLC Live Presenter Greg Burnet runs Chicago Window and Door Solutions, a carpentry contracting company in Chicago.

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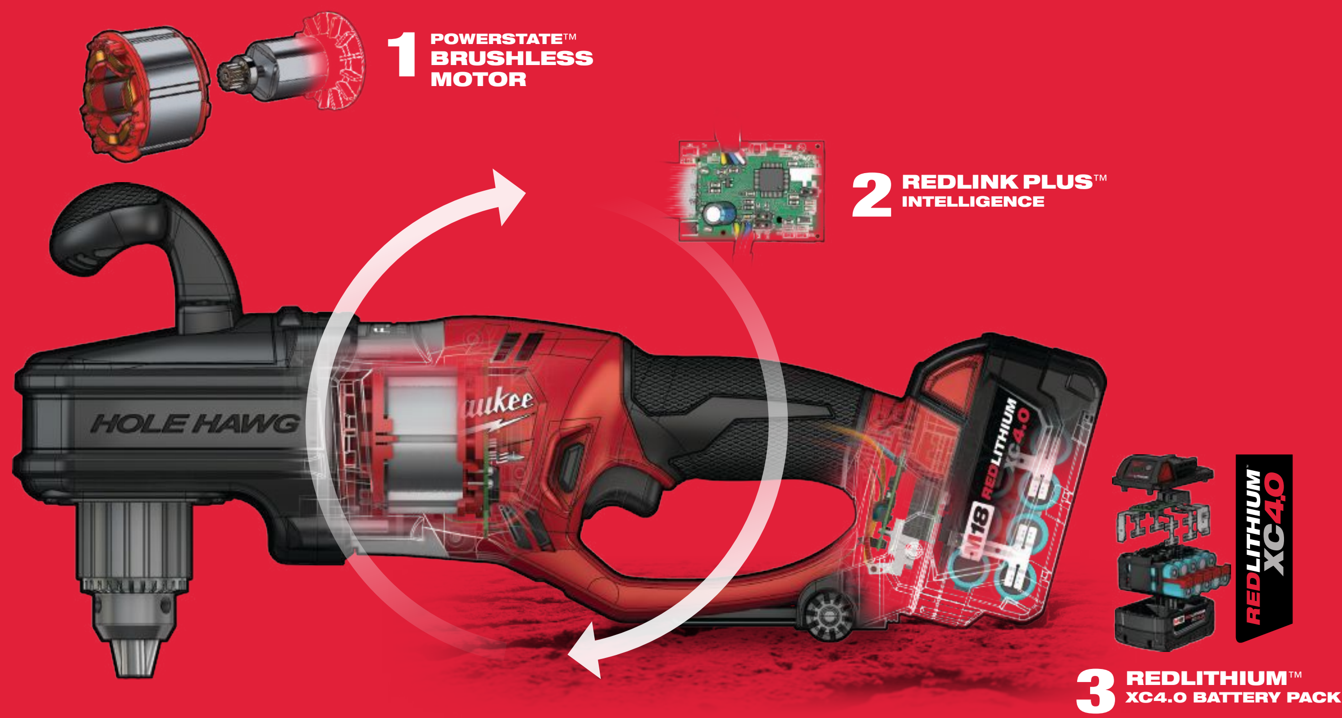

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Choosing a Whole-House Ventilation Strategy
An update on current standards and how to meet them

BY ALLISON BAILES

Photos: Ted Cushman

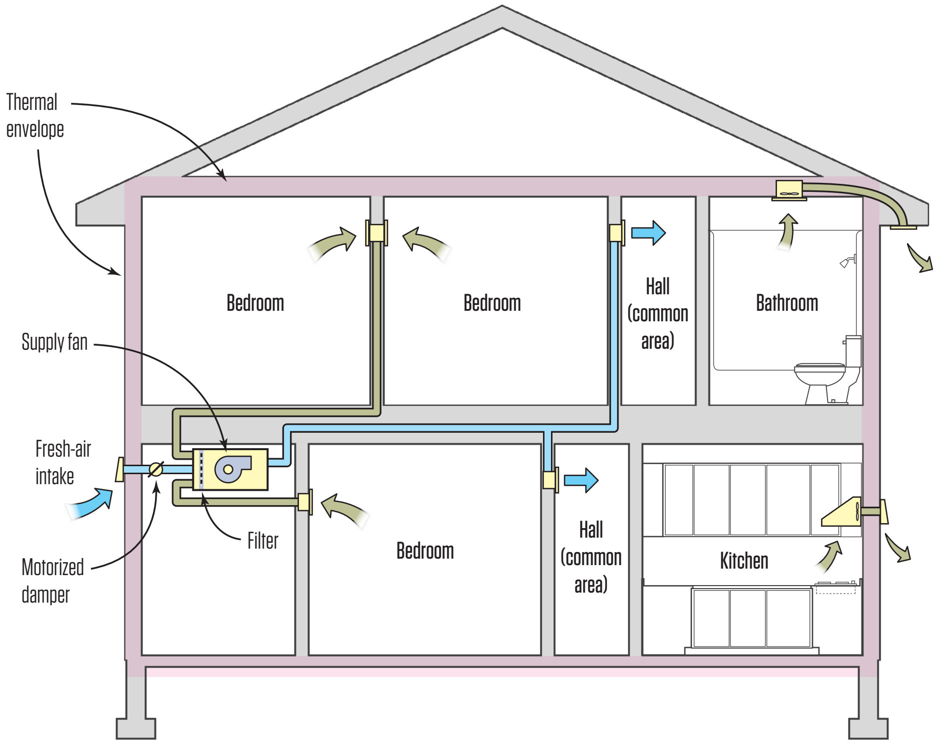
As we make homes more and more airtight, ventilation becomes increasingly important. We need to keep replenishing the oxygen that keeps us alive and removing the carbon dioxide that makes us drowsy. We also need to flush out the odors and other disagreeables in the air to keep us healthy and happy. Standards provide some guidance on how to do that. They also help protect you from lawsuits.

STANDARDS, CODES, & PROGRAMS

Let's start by sorting out the morass of information on ventilation standards so it makes some sense. It all starts with knowledge, and Donald Rumsfeld gave us a great way to think of it when he talked about the known knowns, the known unknowns, and the unknown unknowns.

We certainly know a lot more about indoor air quality and ventilation than we did three centuries ago when John Mayow, an English chemist, physician, and physiologist, conducted early research into respiration and the nature of air. (See "Why We Need Ventilation Standards. A Short History," on page 65.) Back then it was mostly unknown unknowns—they didn't know much, and they didn't even know enough to know how much they didn't know. Today, there are far more known knowns, and far more known unknowns, too. I'd

Stand-Alone Supply



A standalone supply ventilation system uses its own fan to bring outdoor air into the house. To do it without comfort complaints, you'll need to temper the outdoor air before introducing it into the house, which you can do by mixing it with indoor air.

In the minimal configuration, you'll need a box with a fan in it and three ducts. One duct will bring in the outdoor air. A second (and, in the case shown at left, a third) duct will pull indoor air to the box to mix with the outdoor air. A 2:1 ratio of indoor air to outdoor air is a good mix, so if you need to deliver 100 cfm of outdoor air in the living space, you'll need a fan that moves 300 cfm.

like to say that the unknown unknowns are fewer, but that might be a bit delusional.

So our knowledge base grows, and we use it to provide guidance for what we do. That's where standards come in. Standards are focused bits of guidance for specific, scope-limited areas, such as how to design a duct system, test an automatic ice maker, or ventilate a low-rise residential building for acceptable indoor air quality. The main standard in the U.S. that covers that last topic is ASHRAE Standard 62.2. (Standard 62.1 covers ventilation in everything that's not low-rise residential, although there's a scope change happening now. High-rise residential buildings are moving to 62.2.)

A standard is just a set of recommendations, though, and has no real power on its own. It becomes useful only to the extent that it gets adopted for use in codes and programs. ASHRAE has a lot of standards, some widely used, others not so much.

Codes come in two flavors: Model codes are like standards. They're a compendium of guidelines without any real power until they get adopted. The International Code Council (ICC) publishes model codes, such as the International Residential Code (IRC) and the International Energy Conservation Code (IECC). State and local codes are based on model codes. For example, Georgia, the state I'm from, has an energy code based on the 2009 IECC, but we also have supplements and amendments that go along with it.

Programs are generally voluntary and also refer to standards as well as codes. The Energy Star new-homes program has a requirement that insulation levels in qualifying homes meet or exceed the 2009 IECC requirements. (If your state is already on a stricter code, this doesn't allow you to do less.) The program also requires that the ventilation systems in the home meet the requirements of ASHRAE 62.2-2010. If a home you're building is getting certified in that program, you're subject to both of those requirements whether or not they're part of your local code.

WHAT'S THE RIGHT NUMBER?

The science behind how much we should ventilate goes back at least to 1836, when Thomas Tredgold calculated that each person in a building needs 4 cubic feet per minute (cfm) of fresh air just to stay alive. Since then, the recommended ventilation rates have gone as high as 60 cfm per person.

The 2013 version of ASHRAE 62.2 has a whole host of provisions, but let's take a simplified look at the ventilation rates in the standard. It requires 7.5 cfm per person plus 3 cfm per 100 square feet of conditioned floor area. That first part is not based on the actual number of people living in the home. You may not know that num-

System Coefficient Based on System Type

System Type	Distributed	Not Distributed
Balanced	1	1.25
Not Balanced	1.25	1.5

Note: Where there is whole-building air mixing of at least 70% recirculation turnover each hour, the system coefficient may be reduced by 0.25.

The BSC-01 base ventilation rates are the same as the 2010 version of ASHRAE Standard 62.2, so that a 2,500-square-foot, 3-bedroom house would have a base rate of 55 cfm. With a balanced ventilation system that distributes the air throughout the house, that's how much Lstiburek says you need (1 x 55). If you also mix that air, you can cut that by 25%, so with a system that balances, distributes, and mixes, you'd need only 41 cfm (0.25 x 55, per table footnote). If the system had none of those qualities, this house would need 83 cfm (1.5 x 55).

ber for a new home anyway, so the number of people is defined as the number of bedrooms plus one. There's also a provision for reducing that number a bit if a blower door test is carried out on the house. At a measured infiltration rate of about 5 ACH50 or higher, the second part of the formula drops to about 1 cfm per 100 square feet, which is what the 2010 version of Standard 62.2 called for. (This is a rough estimate because the calculation for the infiltration credit isn't easy. There are spreadsheets that help you do that if you want the credit.)

Let's say you build a really tight house, though, and aren't going to be able to get any credit for infiltration. How much would you need to ventilate if the house has three bedrooms and 2,500 square feet? Three bedrooms would mean 4 people, so the first part of the calculation would be 4 x 7.5 = 30 cfm. Using the 2013 standard, the second part would be 3 x 25 = 75 cfm, yielding a total required ventilation rate of 105 cfm.

If you need to meet the 2010 standard, the first part would be the same (30 cfm), but the second part would be based on 1 cfm per 100 square feet: 1 x 25 = 25 cfm. The total required ventilation under this scenario would be 55 cfm.

Therein lies the rub. One of the main issues that's brought so much attention to ASHRAE 62.2 over the past year is that difference between the 2010 and 2013 versions of the standard. The reason ventilation rates went up so dramatically is that versions through 2010 said that you needed 3 cfm per 100 square feet, but automatically gave everyone an infiltration credit of 2 cfm per 100 square feet. There's some interesting history behind that, but all you really need to know is that the committee took away the default infiltration credit and, consequently, required ventilation rates have about doubled—unless you qualify for a reduction with your blower door results.

Enter Dr. Joseph Lstiburek, who was on the ASHRAE Standard 62.2 committee until a few years ago. His company, Building Science Corp., based in Westford, Mass., has designed and studied the ventilation systems for tens of thousands of houses over the past couple of decades, and he has a beef with the higher rates. Lstiburek's main complaints are:

- **Comfort.** In humid climates and in cold weather, the higher ventilation rates can lead to air that's too humid or too dry.
- **Energy.** More ventilation means more outdoor air that needs to be conditioned. Also, to solve the comfort problems in humid and cold climates, you have to use even more energy.
- **Science.** The higher rates aren't based on solid science showing that more ventilation is necessary. (I've covered this in some detail in the Energy Vanguard Blog at energyvanguard.com.)
- **System type.** Exhaust-only, supply-only, and balanced ventilation each have their pros and cons, but they don't ventilate a house equally.

So, Lstiburek introduced his own standard, which he calls BSC-01. It's not a standard in the same sense as the ASHRAE Standard because it hasn't gone through any kind of consensus process and isn't ANSI certified. BSC-01 is more like a set of guidelines or recommendations informed by Building Science Corp.'s vast experience with those tens of thousands of new homes it consulted on.

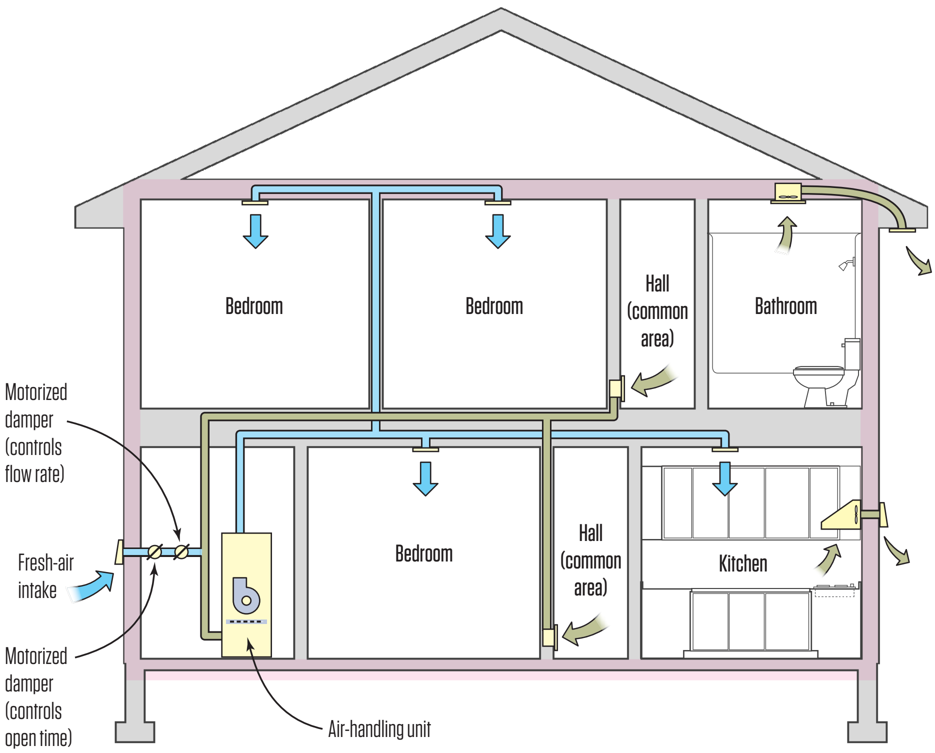
The BSC-01 base ventilation rates are the same as the 2010 version of ASHRAE Standard 62.2, so that 2,500-square-foot, three-bedroom house would have a base rate of 55 cfm. But—and this is the crucial part—that base rate is modified by how much the ventilation air is distributed throughout the house, balanced between exhaust and supply, and mixed with the other air in the house. The table (above, left) shows how it works.

HOW WILL IT ALL SHAKE OUT?

Lstiburek pushed hard on the issue over the past year. He didn't succeed in getting any programs or codes to adopt BSC-01, but he did put pressure on the ASHRAE 62.2 committee. At the ACI National Home Performance Conference & Trade Show in Detroit, in late April, he and several committee members held a panel discussion about the issue, and most in the room believed that Lstiburek had the more persuasive arguments.

Near the end of that discussion, Lstiburek announced that he'd like to be back on the 62.2 committee and has since been reinstated as a member. This is good news for home builders, weatherization crews, and energy auditors because they share many of the complaints on Lstiburek's list.

Central Fan Integrated Supply (CFIS)



The central fan integrated supply ventilation system is the most common supply-only system, especially in the humid Southeast.

In a house with a ducted, forced-air HVAC system, the CFIS system uses the air handler or furnace fan. An important feature of the system is a control like the AirCycler and a damper, which close the duct when you don't want ventilation air. The control can be configured to run the ventilation a certain amount of time (say 30 minutes each hour) so you get the right amount of ventilation without over-ventilating.

DECIDE ON THE VENTILATION RATE

If you're building a house, you have to figure out what ventilation rate you need for the mechanical ventilation system you install. Of course, I'm assuming that you're reading this article because you are installing a ventilation system. If you're building homes with the level of airtightness that many codes require these days—and especially if you're insulating with spray foam—we don't need to argue about the necessity of mechanical ventilation. Just do it.

When picking a ventilation rate, you first need to find out if your building code or efficiency/green building program requires ventilation. If so, you have to install a system that meets their requirements. Energy Star for new homes (and gut-rehabs) and LEED for Homes, for example, both currently require mechanical ventilation that meets ASHRAE 62.2-2010.

If your local code doesn't require ventilation and the home isn't going for certification in a program that requires it, you can do what you want. Building an airtight house and installing mechanical ventilation is the smart way to go, and when it comes time to decide how much ventilation you need to install, Building Science Corp.'s BSC-01 is what I'd recommend. As described above, it starts with the ASHRAE 62.2-2010 rate and then modifies that number up or down according to how well the ventilation air is balanced, distributed, and mixed. Now, let's look at the types of systems.

EXHAUST-ONLY

Using exhaust fans is great for local ventilation of bathrooms, kitchens, garages, and sub-slab areas (for radon control), but it's not a great strategy for whole-house ventilation. It does, however, have some advantages:

- It's inexpensive.
- You're already installing those fans anyway.
- It can help prevent condensation inside walls in cold climates.

Now let's look at the disadvantages:

- You don't know where the makeup air is coming from.
- Contaminants from an attached garage or moldy crawlspace can be pulled into the house.
- Ventilation air probably won't be mixed or distributed well.
- The only filtration that happens is through the building enclosure.

The goal behind whole-house mechanical ventilation is to provide some measure of good indoor air quality. If you take an objective look at those advantages and disadvantages above, it's hard to conclude that you'll get that result with an exhaust-only system. But hey, if meeting code or program requirements at the minimum cost is your objective and you don't care about indoor air quality, this could be your ventilation strategy.

If you decide to go this route, please don't do it in a humid climate where the house will be air conditioned for a significant amount of time. Exhaust fans work by pulling air from the house and sending it outdoors. This puts the house under a negative pressure, and the makeup air comes into the house through random leaks. If enough humid air gets pulled into a wall cavity, you could get some nasty microbial growth in there when it finds the cool backside of the drywall.

Also, if you're building apartments or condos, you're likely to run into difficulty with makeup air. Compartmentalization is leading to much greater airtightness. You can't pull air from the corridors or from neighboring units; it must come directly from outdoors. So, you put enough holes in the exterior wall to allow the ventilation system to move enough air. And then the occupants seal up those holes to stop the drafts as soon as it gets cold.

Sucking on the house isn't such a great idea.

SUPPLY-ONLY

The next option is blowing. You use a fan in the house to collect outdoor air from a known location and distribute it indoors. This overcomes several objections to the exhaust-only system: you know where the air is coming from; you can filter the air on its way in; and you're not causing the house to suck in contaminants from the garage, crawlspace, basement, or attic. It will cost you more than exhaust-only ventilation, though, because you have to spend money on additional controls, ductwork, or fans.

Next, you must figure out what type of supply-only ventilation system you want to install. You have three options: standalone supply, central-fan integrated supply (CFIS), or a ventilating dehumidifier.

The *standalone supply* ventilation system uses its own fan to bring outdoor air into the house. To do it without comfort complaints, you'll need to temper the outdoor air before introducing it into the house, which you can do by mixing it with indoor air.

The illustration on page 62 shows one version of this. The more you pull indoor air from different locations and deliver the mixture to more locations throughout the house, the less likely it is that occupants will feel the temperature difference of the incoming air. That's a good strategy because the less the occupants notice the system, the more likely it is they won't turn it off.

The *central fan integrated supply* ventilation system is the most common supply-only system, especially here in the humid Southeast (see illustration, opposite page). In a house with a ducted, forced-air HVAC system, the CFIS system uses the air handler or furnace fan.

In the bare-bones CFIS configuration, all you need to do is install a duct from the outdoors to the return side of the air handler. Then whenever the heating or cooling system comes on, the air handler will pull in some outdoor air to mix with the return air. One drawback of this configuration is the hole in your building enclosure that sits there 24/7/365.

Although adding only a duct was all some builders did in the old days, now we know it's critical to use controls such as the AirCycler and a damper to close the duct when you don't want ventilation air. The control can be configured to run the ventilation a certain amount of time, say 30 minutes of each hour, so you get the right amount of ventilation without over-ventilating.

Ideally, a CFIS system will deliver most of the ventilation air when the HVAC system is already running. In winter and summer, that's usually not a problem, but in the swing seasons or on mild summer and winter days, the house will need ventilation air at times when the system isn't normally running. In those cases, the controller will turn on the air handler fan to deliver ventilation air when the house isn't calling for heating or cooling.

This system can work well, but what we've found is that many CFIS systems have been thrown in with the assumption that if there's a duct, there will be air. Just as most bath fans don't move

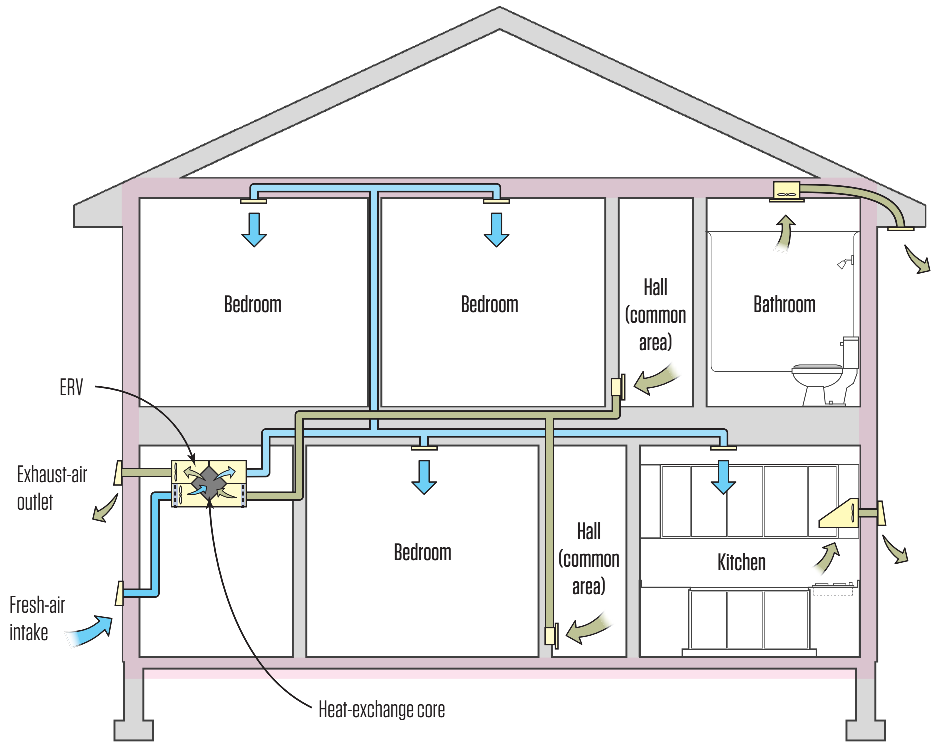
WHY WE NEED VENTILATION STANDARDS. A SHORT HISTORY.

In the 17th century a fellow named John Mayow put small animals in jars with candles and studied how long it took them to die of asphyxiation. By doing so, he proved the existence of a special component of air that keeps us alive. What he termed "nitro-aerial spirit" we know now as oxygen. Combustion and breathing both use it up in an enclosed container, so we need some way of replenishing this "spirit." Knowing what's necessary to keep us alive is a start, but there's far more to ventilation and indoor air quality than that.

In the 20th century, ventilation research had advanced to studying humans in confined boxes. Rather than asphyxiating the subjects, however, this time the researchers ran controlled amounts of ventilation air through the boxes. The objective was to find the minimum ventilation rate at which trained smelling judges would deem the odor of the exiting air acceptable. It was fascinating work really, and they looked at a number of variables: occupant age, social class, and bathing frequency, among others.

But again, there's more to good indoor air quality than preventing asphyxiation in an unsmelly house. The next step is learning about the other hazards in the air we breathe—such as carbon monoxide, volatile organic compounds, formaldehyde, and particulate matter. That's where we are now. There's extensive research going on into how much of this stuff is in the air in our homes and what we can do about it. Not all of the hazards are best solved with ventilation, however. Source control is often the best solution.

Balanced Ventilation With Recovery



A recovery ventilator pulls in fresh outdoor air while exhausting stale air from indoors. The air streams pass through opposite sides of an exchanger core. Ideally, the two air streams do not mix at all but do exchange heat (both ERV and HRV) and moisture (ERV only).

In winter, then, the outgoing warm air gives up some of its heat to the incoming cold air. The warm air also has more moisture and in an ERV, some of that moisture will migrate to the cold, dry air coming into the house. So ERVs and HRVs are balanced ventilation with partial recovery of heat and moisture.

enough air, however, CFIS systems that were never commissioned often don't deliver on the promise of better indoor air quality. It turns out that placement of the outdoor air duct on the return plenum can have a significant effect on the amount of air delivered. Always commission! (This means measure the air flow through the duct and adjust as necessary.)

The *ventilating dehumidifier* is a great system for humid climates, especially in low-load homes. It works just like the standalone supply with one important difference: There's a box with two ducts bringing air in from outdoors and indoors. Then there's a duct sending the tempered ventilation air into the house. The difference is that what's in the box isn't just a fan; it's a fan with direct expansion dehumidifier.

Since ASHRAE Standard 62.2 got rid of the default infiltration credit, new homes trying to meet the 2013 version will probably require more ventilation air. Small, energy-efficient houses have low cooling loads, which means the air conditioner won't run as much. As a result of these two things, many of these low-load homes in humid climates will need some kind of supplemental dehumidification. The ventilating dehumidifier is a great solution, and it's probably even better in mixed-humid than in hot-humid climates because of their already lower cooling needs.

BALANCED

Better than either sucking or blowing ventilation strategies is the sucking *and* blowing strategy. If you do both at the same time with balanced air flow into and out of the house, your ventilation system doesn't affect the house pressure. That's a good thing.

Everyone always thinks balanced ventilation is synonymous with using an energy recovery ventilator (ERV) or heat recovery ventilator (HRV). It's certainly true that ERVs and HRVs are ways of doing balanced ventilation (or can be when they're commissioned properly). But those would both more accurately be described as balanced ventilation with recovery (see illustration, above).

Another type of balanced ventilation system would be a simple combination of exhaust and supply fans, set up to come on and go off together and move the same amount of air. The Lunos fans exploit this concept and even add heat recovery. The fans don't have to be in the same part of the house, and in fact it's better for mixing if they aren't. Then the positive pressure where the supply fans are can push air into the lower pressure areas near the exhaust fans.

So those are your options for balanced ventilation. You can blow equal amounts of air into and out of the house while recovering heat and moisture, or you can just blow equal amounts of air into and out of the house. If you're looking for the Cadillac of ventila-

An HRV is just an insulated box with two fans, four ducts, and a recovery core (the diamond-shaped part in the middle). As the two airstreams go through the core, they exchange heat. They do not add heat to a house, but they will slow-down the loss of heat associated with providing fresh-air ventilation.

tion systems, look no further than an ERV or HRV. There are some very sophisticated models out there with really high efficiency. The two most popular with the Passive House community are those made by Zehnder and Ultimate Air, but the new Air Pohoda has a clever way of recovering heat and moisture. It even lets you dial in the amount of latent recovery you want and can eliminate the need for defrosting the recovery core. If you're in a fairly mild climate without too much latent load, balanced without recovery could be just what you need.

DISTRIBUTING THE VENTILATION AIR

Once you've chosen a ventilation rate and a strategy—exhaust, supply, or balanced—you're almost there. You still have another important decision to make, though: How will you move the ventilation air around the house?

On this topic, I agree with Henry Gifford, who said, "Give me an H. Give me a V. Give me an AC. Don't do HVAC to me." What he meant by that was that he likes to keep those three functions separate. If you're dealing with forced-air systems in homes, separating heating and air conditioning isn't important or practical. But using a separate duct system for ventilation can help.

The argument in favor of using the heating and air conditioning ducts for ventilation is that those ducts are already there, so you might as well use them. It also prevents getting walls, ceilings, and floors cluttered with extra vents and allows you to use the air handler fan to bring in your ventilation air.

The arguments against using the heating and air conditioning ducts are:

- It can be difficult to get the right amount of air flow.
- You can balance an ERV or HRV connected to the return plenum or supply trunkline for when the air handler is running or when it's not running, but you can't balance it for both cases.
- Using the air handler fan to ventilate the house isn't the most efficient way to ventilate because it's usually the biggest fan in the house.

The heating and air conditioning ducts are designed (we hope!) to move a lot more air than the ventilation system, so trying to ventilate through them without the air handler running (as with an ERV/HRV, standalone supply system or a ventilating dehumidifier) may not result in ventilation air getting distributed well.

In the end, to get the best ventilation possible, it's best to use a duct system dedicated to the ventilation system. Obviously, that doesn't work for exhaust-only ventilation, but then why would you want to do that if you care about ventilation effectiveness. It also doesn't work for central-fan integrated supply because it only works when you use the air handler and heating and air conditioning ducts. But any ventilation system—either type of balanced system (with or without recovery), a standalone supply system, or a ventilating dehumidifier—will do better with its own duct system.

WHAT SHOULD YOU DO?

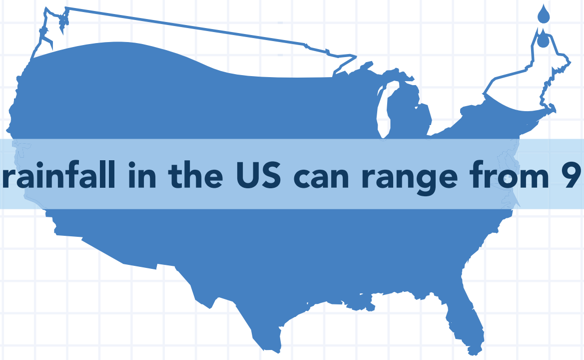
If you care about good indoor air quality and whole-house ventilation that works, the first thing to do is avoid exhaust-only systems. Supply-only systems are a step up, but they have a slight possibility of creating condensation problems in cold climates if the building does not have exterior insulation. This type of system could create a slight positive pressure inside the building, forcing warm, humid, indoor air into wall cavities. If that air finds cold sheathing, it can wet the materials and eventually grow mold or rot the wall. Balanced is best when it comes to ventilation, and balanced with recovery is the best of the best.

Beyond picking a system, though, there are three critical steps to getting a ventilation system that really works: Design properly. Install well. Commission completely. (For more on commissioning a tight house, see my blog post "7 Steps to Commissioning a New Home & HVAC System," at energyvanguard.com.)

Get those three things right, and you'll have a system that should do its job, provide good indoor air quality, and—perhaps most importantly—not be disabled by the home's occupants who don't like the noise or comfort problems that many ventilation systems have.

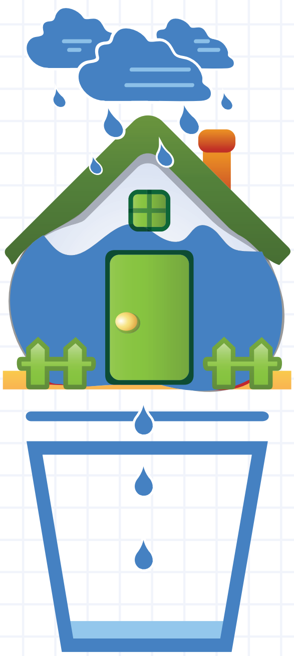
Allison Bailes owns Energy Vanguard, a home performance and training company in Decatur, Ga.

WINNING WITH drainage

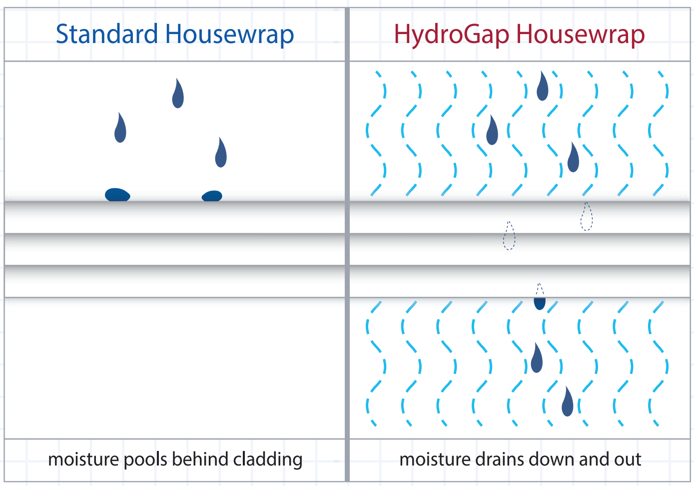


Average annual rainfall in the US can range from 9 - 59 in.

Any area receiving more than 20 in. of annual rainfall should incorporate enhanced drainage behind siding.



Standard Housewrap drains 0-9% of water



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Photos: David White and Rob Corbo

Retrofitting an Oversize Door in Structural Brick

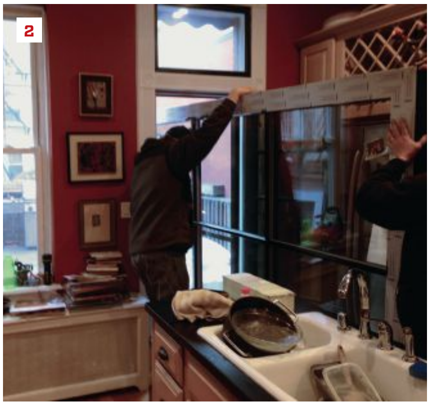
A row house gets a new 900-pound, triple-glazed slider

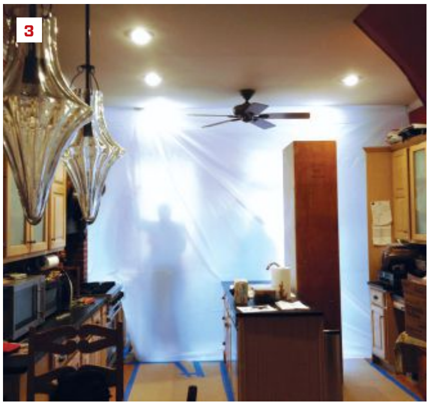
BY ROB CORBO

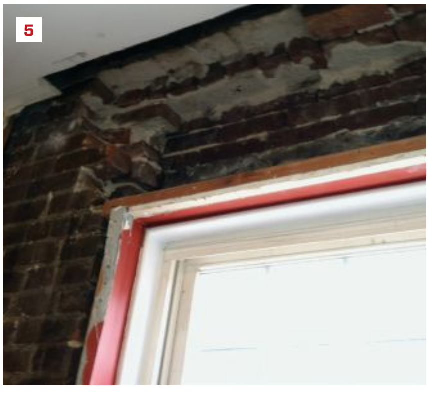
In the 30-plus years we've been working in the Hoboken, N.J., area, we have replaced the window-door-window configuration on the rear wall of numerous row houses with a three-panel slider, mainly to bring in more light and provide better access to the backyard, but also to replace worn-out components, as many of these homes were built before 1900. Most Hoboken row houses were built with structural brick, so opening up the rear wall requires adding steel to support at least one upper story and sometimes two.

Typically, two pieces of steel are installed: The first is set into place on the inside half of the wall while the outer half of the brick wall remains intact; once that piece is fully supported, the outer brick is removed and the second piece of steel is installed (see "Retrofitting a Steel Header," Jun/12).

Most of the projects we've done have been similar, but with each one there always seems to be something different that needs to be dealt with. This job was no exception, on two counts: The exterior wall had three wythes of brick instead of two, and the door was larger (and heavier) than usual—a 9-by-9-foot, triple-glazed Zola slider that weighed upward of 900 pounds (see Zola Door Specs, page 75). And there were also a couple of surprises along the way that required an on-the-spot change of plan.







UNLOADING THE DOOR

The owner wanted to maximize the door's height, which meant locating the top as close to the ceiling joists as possible while allowing for trim. In many row houses, we would have had to work around a 9-inch plaster crown molding, but in this case, a 3-inch wood crown had been installed during a previous kitchen remodel. Accounting for that plus trim, we had room for a 111-inch-tall door.

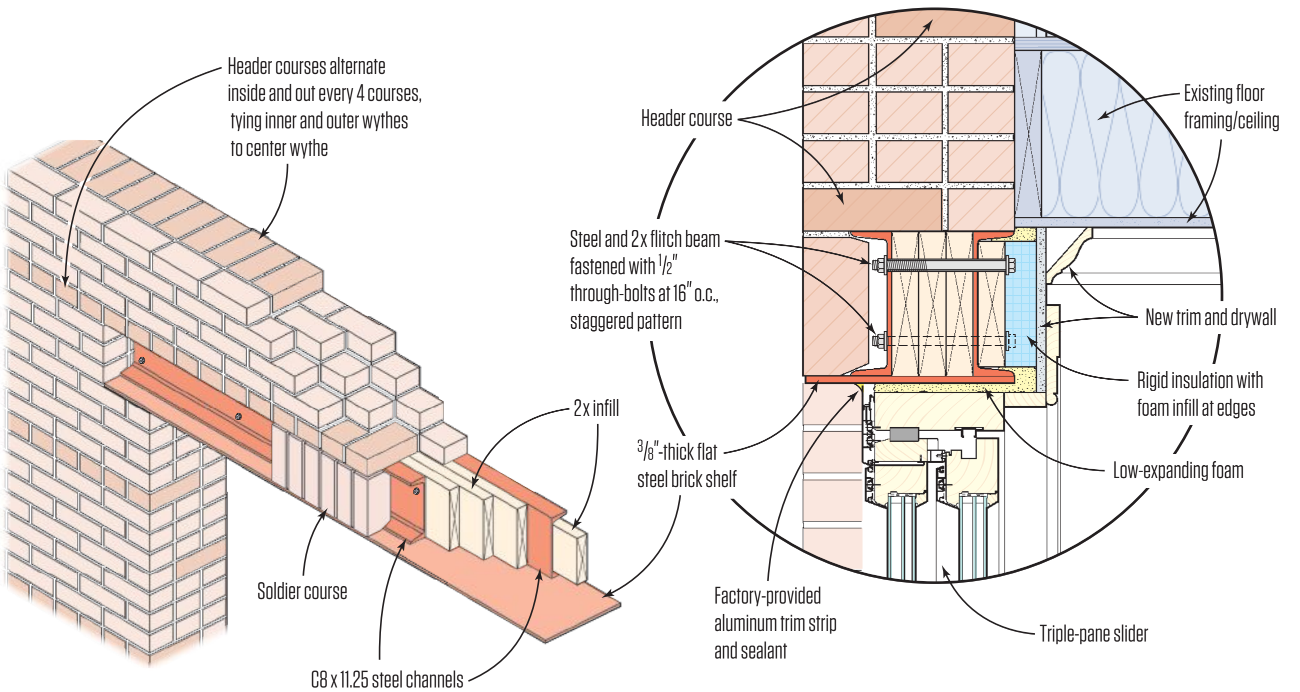
Lead time on a custom Zola door can be as long as 15 weeks, so we didn't start work on the house until the day the door was delivered to the site. There was no alley in back, so the semi carrying the door parked on the street in five "emergency no parking" spaces I had reserved to ensure that the end of the truck box was in front of the house. Even though the door was delivered as a five-piece knock-down, the largest component—the fixed panel—weighed nearly 600 pounds, too heavy for me and my crew to comfortably handle. So I hired three boiler technicians recommended by my plumber, who uses them to unload, assemble, and disassemble large boilers and other heavy equipment. They unloaded the two panels one at a time from the semi **(1)** onto dollies, rolled them to the front stairs, and carried them up the stairs and through the front entry door. Back on the dollies, the panels were carefully rolled to the back of the house, out the back door **(2)**, and onto the deck, where we wrapped all the pieces with movers blankets and tarps to protect them while the structural work was being done. Start to finish, unloading the door took about 3½ hours.

DEMOLITION

In many Hoboken row-house floor plans, the kitchen is at the back, and we usually end up altering the rear wall for a new door as part of a kitchen remodel. But in this case, the existing kitchen was staying in place, and the architect dimensioned the door to fit snugly between the existing cabinets along the sidewalls. The brick jamb of the rear window would define one side of the new door, so the cabinets that abutted the rear wall in the corner next to the window stayed in place. On the opposite wall, we temporarily removed the corner pantry cabinet, the refrigerator, and the wine rack above it to make room for the structural work. And we relocated a radiator from the middle of the rear wall, ultimately substituting an electric squirrel-cage toe-kick heater in the base cabinet next to the window.

Because the demolition would be dusty work, we erected two temporary barriers, using poly with a pole system and zipper

Flitch Beam for a Three-Wythe Structural Brick Wall



doors. We placed one barrier about 4 feet from the rear wall, up against the kitchen island **(3)**, and left it in place the whole time. The other barrier ran full-width on the other end of the island and provided extra protection. Once the demolition was finished, we took this barrier down. In the meantime, both barriers had zipper doors to give us access to the interior of the house, and the homeowners access to the kitchen, which was mostly still usable (though we'd moved the refrigerator into the living room for easier access). A third barrier went up on the rear wall itself.

We found a big surprise when we removed the corner pantry cabinet and drywall in the corner: A window that was bricked-up on the outside still held the original double-hung on the inside **(4)**. We had planned for one jamb of the new door to fall in the middle of this window, assuming that the opening had been filled solid with brick that could support one end of the flitch beam. But only a single veneer layer of brick had been used to close up the window.

This required a change in plans. The two steel channels that were to be installed—one inside, then one outside—were originally designed to be equal lengths. Given this new wrinkle, we ordered the inside beam about 16 inches longer—long enough to be temporarily supported by the brick jamb on the corner side of the bricked-up window.

INSIDE STEEL

Installing a flitch beam in two steps ensures that the building is structurally supported at all times. Given three wythes of brick, the plan called for two C8x11.25 beams (8-inch-high steel channels weighing 11.25 pounds per foot) with full-length 2-by material sandwiched between them. Everything would be through-bolted together to form a flitch beam that would span about 10 feet.

We began by removing the inner and middle wythes of brick above the rear window **(5)**. The height of the door plus the steel channels determined which course to start with. We cleared away enough brick to make room for the beam plus about an inch of clearance to allow us to shim and eventually grout above and below the flanges.

Danny DoCouto was the foreman on the job. He's union-trained and he knows his way around steel and the brick in these old row houses. He likes to do the brick demolition himself because it gives him an opportunity evaluate the masonry and adjust his work plan if he finds problems. He found this wall to be very fragile. This,

combined with the discovery at the bricked-up window, prompted him to proceed carefully when removing brick, looking for loose mortar or cracks in brick that would be load bearing.

When it came time to hoist the first, longer steel channel into position, we blocked it up on the brick to the left of the kitchen window and shimmed the top flange along its length **(6)**. At the other end, Danny wasn't confident that the brick bearing surface was large enough or strong enough to support the load even temporarily, so we set a Lally column in front of the window to temporarily support the steel **(7)**. This also bought us time to complete almost all the masonry work before we had to remove the bricked-up window. We reset the Lally later to make room for the new door jamb.

Before lifting the steel into position, Danny drilled both steel channels with a series of matching ⅝-inch holes staggered every 16 inches on-center, with a stacked pair on each end. Usually our steel supplier punches these holes, but I needed the steel quickly—because we had lost time figuring out how to handle the bricked-up window—and my supplier was unusually busy. So he cut and delivered the steel, and we primed and drilled it on site. Danny used three different sizes of Irwin black oxide high-speed bits and a Makita ¾-inch hammer drill. He first drilled a small ¼-inch pilot hole, drilled again with a ⅜-inch bit, and finished it off with a ⅝-inch bit. Total drilling time for all 20 holes was about 2 hours.

With the inside steel in position and temporarily supported, Danny grouted the top flange in all of the spaces between shims. After waiting a day for the mortar to set, he removed the shims and grouted the remaining spaces, then moved outside.

OUTSIDE STEEL

Again we started above the kitchen window, removing the remaining single course of brick, and adding blocking down to the granite lintel to provide temporary support **(8)**. The goal here was to remove just enough to be able to slip the 2-by stock and second steel channel into place. But Danny also removed some brick in a few courses higher up that had come loose, again using scrap lumber to provide temporary support.

Danny chose to drill the dimensional lumber in place, using the holes in the steel as guides. After sliding the three 2-bys into position, he carefully installed the outer steel channel with one end aligned as closely as possible with the end of the inner channel. Working from the inside, he drilled ⅝-inch holes into the wood, keeping the drill as square to the work as possible. When the bit

reached the outer channel, he punched in from the outside. Then he used ½-inch through-bolts to fasten the steel and wood together at both ends and in every third hole in between; he finished the bolting after the brickwork was completed.

At this point, the outer steel channel, which was shorter than the inner channel, was cantilevered above the bricked-over window **(9)**, and supported by the Lally column set under the inner channel. At the other end, the beam was blocked down to the existing brick **(10)**.

BRICKWORK

Before continuing the demolition of the brick beneath the beam, Danny wanted to finish all of the masonry work above the beam, given the fragile condition of that part of the wall. As mentioned earlier, this house had three wythes of structural brick. Most of the field bricks, or "stretchers," were set in the familiar American bond, with a header course every seven courses. Header courses, in which the bricks are set with the short end exposed, hold the wall together across its width. In the case of a three-wythe wall, header courses alternate inside and outside every four courses, tying the inner and outer wythes to the center wythe (see "Flitch Beam for a Three-Wythe Structural Brick Wall," page 73).

ZOLA DOOR SPECS

Zola sliding doors are custom-made and can be shipped fully assembled in sizes up to 20 feet wide and 8 feet high; larger sizes—up to just under 40 feet by 11 feet (WxH)—are delivered as a knock-down kit.

The "Thermo Clad" model installed on this project was 108¾ by 111 inches (2,819 mm x 2,762 mm, WxH), but was delivered knocked-down so it would fit through the existing doorways. It has 1⅞-inch-thick triple-glazed safety glass (U-value of 0.09 Btu/hr/sf, SHGC 0.54), a nominal 2x8 frame, and a thermally broken aluminum sill.

The aluminum cladding is held off the rails and stiles by clips, creating what the company calls a "rainscreen cladding" that is designed to promote better drainage and drying. The company offers 20 standard colors for cladding, and up to 300 others are available for an upcharge. The rails and stiles on the door we installed were pine, but oak and meranti (similar to mahogany) are available at added cost. The wood can be either stained or painted (15 or 300 colors to choose from, respectively).

The lift-slide hardware is manufactured in Germany by Roto and works something like the hardware for a sliding door on a van: When the door is closed, it's weathertight; when it's opened, it lifts up out of its seals to permit smooth sliding. And the door installed on this project was indeed smooth: The 40-inch-wide (1,038 mm) panel weighed nearly 300 pounds but easily slid open and closed with pressure from just one finger.

Exterior remote-controlled shading or bug screens that roll out of sight when not in use are available as an option.

For more information on Zola doors, visit zolawindows.com/doors —*The JLC editors*

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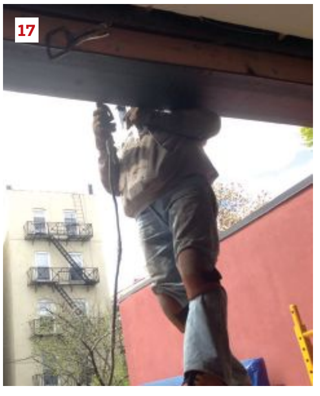

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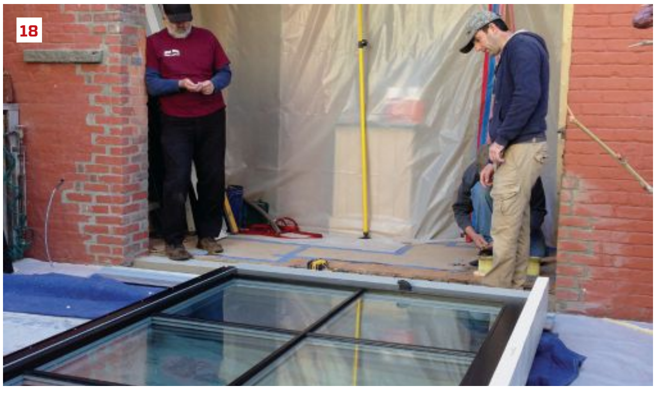


We started rebricking with the course immediately above the steel, which turned out to be a header course **(11 and cover photo)**. We temporarily supported one section with scrap 2-by blocking while we pieced in others until all of the missing brick above the beam was replaced **(12)**. Then we toothed in the brick under the beam at the kitchen window jamb.

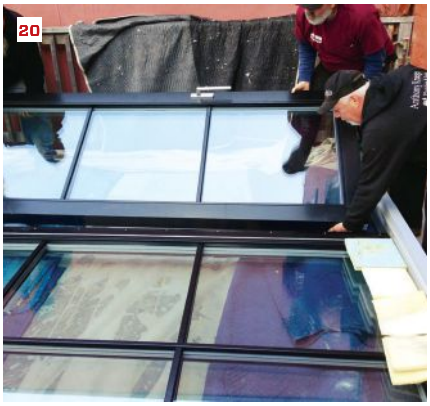
We wanted to finish the lintel with a soldier course, but first we had to finish defining the rough opening for the new door so we could tie the brick together at the corners. We removed the kitchen window and the surrounding brick, leaving the outer wythe intact; this would define one side of the opening **(13)**. The face brick extended past the inner wythe by about 3 inches, leaving just enough room to install a double 2x8 rough jamb stock fastened with Tapcons. At the other end, after removing the door, we reset the temporary Lally column just inside the new opening **(14)** and rebricked the jamb, preserving the American bond and header courses **(15)**. We left the old granite window sill in place because we didn't want to risk compromising the structure by removing and replacing more brick directly under the bearing point of the steel.

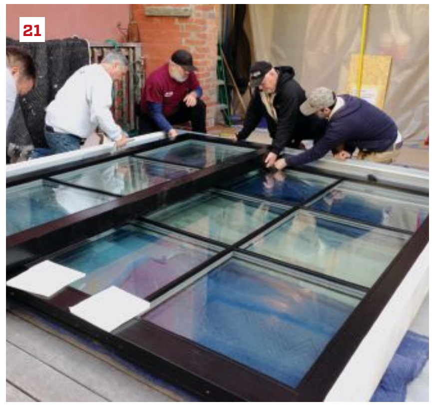
To provide a flat, level surface at the door sill, we built a shallow form over the brick and placed a stiff pea gravel concrete mix about 2 inches deep and reinforced with steel mesh **(16)**. The plan called for the door jambs to be set flush with the new drywall, so we aligned the concrete flush with the brick wall on the inside, which would leave the door set back one wythe. After the door was in, we mortared a piece of bluestone underneath the sill to complete the threshold **(27, page 78)**.

With the rough door opening complete and the beam still temporarily supported, we removed the remaining blocks from under the beam ends, added brick where necessary, and mortared all the joints. The final bit of brickwork was to install the soldier course at the lintel, resting the bricks on a shelf welded to the bottoms of the two steel channels **(17)**. Now it was time to turn our attention once again to the door.

ASSEMBLING THE DOOR

Because we needed to carry the door through two doorways with limited height clearance, Zola shipped it knocked down, but the unit had been assembled and tested at the factory. This is standard practice, because it would be impractical to lift a really large door into place fully assembled—the lift-slide model we were installing can be fabricated up to 26 feet long. Although the jamb can





be installed first and panels set in place, we thought it would be easier to put the heavy panels together working flat on the deck. At about 9 feet square and 900 pounds, the door was still within the limits of what we believed we could lift into place.

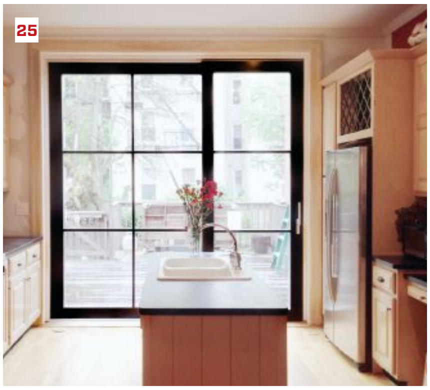
The first step was to put the frame together. This time I hired four boiler technicians to help with the assembly. We laid two rows of doubled 2-bys on the deck parallel to the brick wall and more or less centered in front of the opening. Even though the door was shipped with protective tape covering the aluminum cladding, for extra protection we covered the lumber with thick movers blankets, then laid the larger fixed panel down, roughly aligning it with the opening **(18)**. This panel had been shipped with the jamb still attached, so the next step was to add the other jamb and attach the sill to the jambs through the bottom using screws provided by Zola **(19)**.

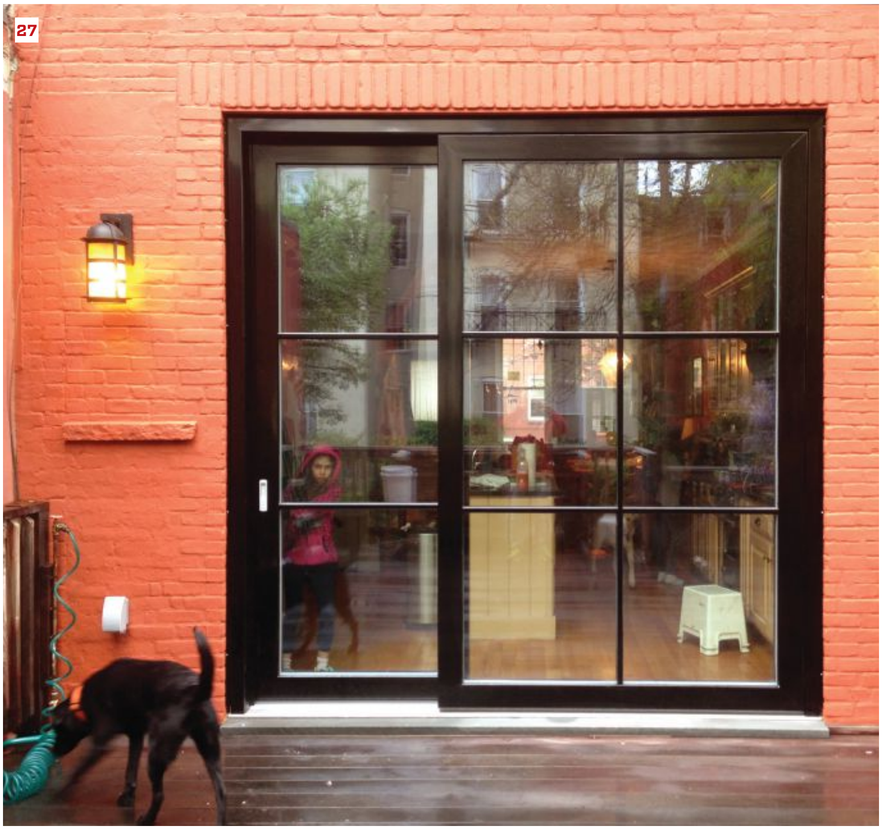
That was the easy part. Placing the active panel was a little trickier, partly because it weighed about 300 pounds and we had to carefully lower it straight down over the frame while standing awkwardly around the frame **(20)**, and partly because the concealed wheels and seals had to be properly aligned with the track in the sill and also with the stile of the fixed panel. After we shimmed the frame to ensure that it was as flat as possible, it was a five-man job to get the panel into its proper position **(21)**. We used a couple of pieces of foam to cushion the doors, and prepared for the worst. It took some coordination (and maybe a bit of luck), but the door found the track easily. We locked it into position, then aligned the headpiece with the wheels and seals of the active panel and fastened it through the top into the jambs.

INSTALLING THE DOOR

The last step in our plan was to lift and stand the door onto wood blocks positioned in front of the opening, then slide it inch by inch into the opening. It took seven men—two positioned inside, just in case, and five outside—to lift the door and stand it up **(22)**. (The photo on page 71 seems to show four, but the pair of arms under the guy on the left belong to me.) Getting it waist high was easy—getting it from there to above our shoulders was the real test. But it turns out we had more than enough muscle to stand it up without any one person having to strain himself. The door was solid and didn't rack at all.

We had dimensioned the rough opening so as to leave ½-inch clearance all around the door. That meant we couldn't tilt it into





the opening—it had to go in upright. I had anticipated that this might not be easy, so I brought along four pairs of heavy-gauge 6-inch angle irons, which came in handy. After several short lift-and-slide maneuvers to get the door partly into the opening **(23)**, we fastened two angle irons back-to-back on each jamb, inside and out. That gave us something to grab onto so we could lift the door and inch it fully into the opening **(24)**. Before we started moving the door into the opening, we squeezed most of a tube of silicone onto the bottom of the door's aluminum threshold, incrementally adding more caulk to the masonry threshold as we slid the door into place.

We checked the door for square and level, then fastened it with wood screws on one side and Tapcons on the other. We countersunk the screws into the jambs and finished them later with plugs and paint. To close up the gap on the outside, Zola provides aluminum strips that snap onto the jamb. We applied a bead of caulk in the gap before installing them.

Inside, we sealed the perimeter with low-expanding foam, then hung and taped the drywall. After reinstalling the pantry cabinet, refrigerator, and wine rack **(25)**, we trimmed the door out with 5½-inch one-piece molding. It met the cabinet facing on the pantry side, and we scribed it around the countertop and along the front of the base cabinet on the other side. Outside we matched the existing paint color on the existing brick using the Benjamin Moore "Color Capture" app **(26)**, and mounted the sconce lighting **(27)**.

Start to finish, we spent about four weeks on demolition, masonry, and door installation. That includes some downtime for inclement weather, a half-day to unload and stow the door, a long morning to assemble the door and lift it into place, and a day to attach the hardware, trim the door out, and add the bluestone sill.

The project was not inexpensive: The door cost about $12,000 (which the owner paid for directly, along with the architect's fee), and my part of the work ran about $21,000. But as you can see from the photos, the dramatic difference the door made to the appearance of the house, and the additional light it provides in the kitchen, as well as the improved thermal performance and access to the back deck, made it more than worthwhile for the owners and their family (and their pets).

Rob Corbo is a building contractor in Elizabeth, N.J.

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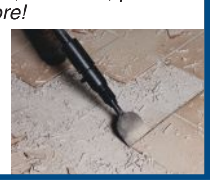

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EDITED BY BRUCE GREENLAW

Friendlier Bosch 18V Brute Tough Drill/Driver

I tested the Bosch DDH181 "Brute Tough" 18-volt drill/driver along with eight heavy-duty rivals for the January 2012 issue of *JLC.* The tools were surprisingly powerful, but when I tried to push them to the limit, it felt like I was almost inviting an injury. They easily drove 1½-inch spade bits, bored 2⅛-inch lockset holes with a hole saw, and sank Simpson Strong-Tie's 0.22 x 10-inch multipurpose structural wood screws into an LVL/LSL/PSL sandwich without pilot holes. And they also had enough muscle to propel a 4-inch hole saw and a 1¾-inch ship-auger bit through 2-by Douglas fir. A few times, though, the bigger bits jammed, violently whipping my arms before I could let go. This strong reactionary torque is not only scary, it could be dangerous.

Bosch has now attempted to address the issue by introducing the DDH181X Brute Tough. It's almost identical to the DDH181, but adds "Active Response Technology" that promises to take the angst out of jamming. I just gave one of these tools a workout to gauge its overall performance and to see if this new feature works as advertised.

KICKBACK CONTROL

Bosch's new Active Response Technology consists of an internal microchip called an "accelerometer." When the tool binds, this sensor detects rapid rotation of the tool body and quickly cuts the power. Before my test drive, I viewed a demonstration of this feature on YouTube (search: DDH181X Drill/Driver Video). That gave me a good idea of what to expect from the tool when a drill bit binds or a fastener bottoms out to a hard stop.

To test the feature, I chucked a 3-inch hole saw into the tool, started drilling through ⅝-inch plywood, and tipped the drill slightly until it jammed, repeating the process several times. As in the video, when the bit jammed, the tool body rotated about 45° on its axis before the tool abruptly shut itself off. The abbreviated rotation still delivered an unpleasant jolt, but it was significantly less jarring than a freewheeling kickback. The feature worked equally well in reverse. Either way, the LED headlight starts flashing to indicate that the Active Response Technology has kicked in. To resume drilling, you release the trigger, unbind the bit, grip the tool comfortably again, and squeeze the trigger. If you simply release and squeeze the trigger instead, the tool body will jump again before the motor shuts off.

This safety feature works only if the drill handle is free to rotate. If you brace the main handle or side handle against the framing when drilling in tight quarters, for instance, if the bit jams, you'll have to manually release the trigger to stop the motor.

RUNTIME

The new DDH181X-01L kit I tried includes 4-amp-hour batteries versus the 3-amp-hour ones included with the DDH181 kit I evaluated a couple of years ago. I repeated my standard runtime test with the new model by counting the number of holes it could drill through 2-by Douglas fir per charge in low gear using a new 1-inch Irwin Speedbor solid-center auger bit. I once again avoided knots, stopped drilling when the bit's screw point broke through, and kept the bit clean with Blade & Bit pitch remover.

The tool drilled an impressive 176 holes compared with 115 holes for the DDH181. I took no timeouts during this test, and detected no overheating. It did take me a whopping 1 hour and 59 minutes to fully recharge the battery, though, which was one drawback to its higher capacity.

OTHER FEATURES

The DDH181X retains Bosch's effective base-mounted LED headlight, has fuel

The author tested the “Active Response Technology” by purposely binding a 3-inch hole saw several times in plywood in first gear. The tool body rotated only about 45° on its axis before stopping, helping to prevent injury.

In the runtime test, the tool drilled 176 1-inch-diameter holes in 2-by Douglas fir.

gauges on the batteries, and now includes a handy depth gauge for the side handle. The tool is compatible with every Bosch 18-volt lithium-ion battery.

As for durability, Bosch has been refining its Brute Tough drill/drivers for more than a decade and says the tool can survive 20 drops onto concrete from a 10-foot height. According to Bosch, electronic motor and cell protection help defend against harmful overheating and overloading.

The deluxe kit I tried includes a modular L-Boxx-2 case from Bosch’s Click & Go line. Although the side handle and depth gauge fit in the case, it has no dedicated compartments for them, which is a bit annoying.

THE BOTTOM LINE

The new Bosch DDH181X doesn’t have a brushless motor like some of the latest competing models do. But it’s lightweight, compact, comfortable, and powerful, and it delivers impressive runtime. And let’s face it: The more powerful these tools get, the more we’re tempted to push them to the limit, and that means more risk of injury from a strong kickback. The new Active Response Technology in this tool helps reduce this risk without driving up the price. I think that’s great.

Four DDH181X drill/driver kits are available. The model HDH181X adds a hammer-drill mode.

DDH181X-01L Specs

Weight with/without side handle: 5.23/4.80 pounds
Length: 8 3/8 inches
RPM: 0–400/0–1,700
Price: $300
Included in kit: two 4-Ah batteries, charger, side handle, depth gauge, magnetic bit holder, Phillips insert bit, L-Boxx-2 case
Warranty: 1 year, 30-day money-back guarantee (register for free 3-year ProVantage plan)

Bruce Greenlaw is a contributing editor to JLC.

HIGH-SPEED CHALK-LINE REEL

I’ve been using DeWalt 100-foot chalk-line reels with a 3:1 gear ratio for several years. They not only retrieve the line quickly to help speed our layouts, they’ve proven to be durable as well. That’s why I was happy to try DeWalt’s new cast-aluminum DWHT47270 reel for *JLC.* It has a 6:1 gear ratio that doubles retrieval speed and uses helical gears for smoother winding. The gearbox is sealed against contamination to help prevent seizing. A clutch allows you to release the line without spinning the crank, and a large plastic-and-rubber top swings open for easier refilling and jam clearing.

My lead supervisor and I have been using the new reel for a couple of months, and so far we’re impressed. The smooth, rapid line retrieval is great, and the braided nylon/polyester line holds just the right amount of chalk for clean multiple snaps. The reel fits nicely in our toolbelts and has yet to leak any chalk. But the $15 price tag seems a bit steep. A few dollars less, and we wouldn’t hesitate to buy these reels. *—Terry Goodrich is a framing contractor in Scappoose, Ore.*

The large cap swings open for easy refilling.


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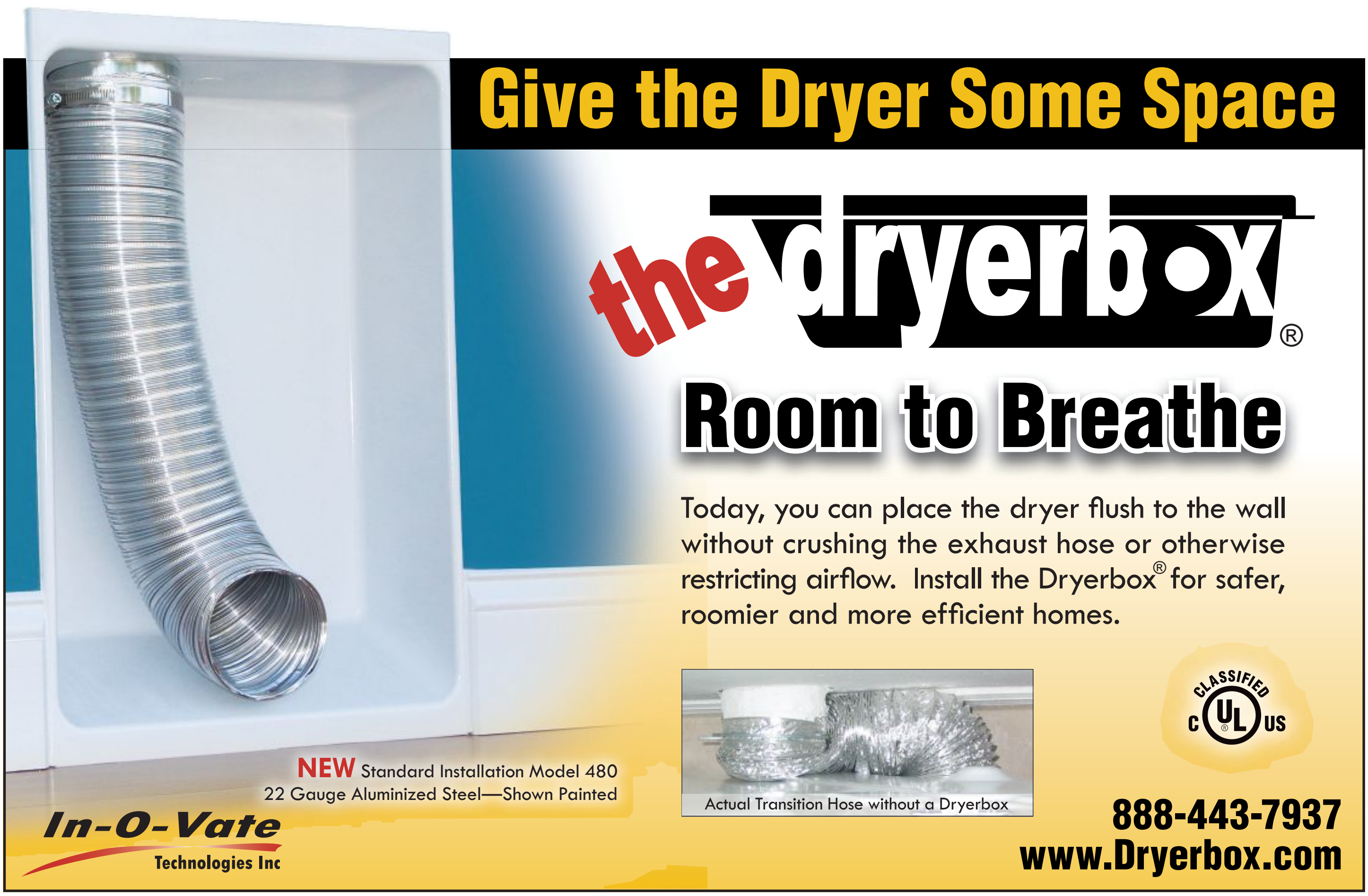
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1. Padlock **2.** Receiver Lock **3.** Coupler Pin **4.** Coupler Pin Lock

Bolt Security Locks

Strattec Security's Bolt locks automatically program themselves to match the ignition keys of most vehicles. This allows users to carry fewer keys and reduces the likelihood of arriving on site and not being able to open a lock because you forgot the key.

To program the lock, simply insert a vehicle key, push a button, then turn the tumbler (see the "How It Works" video at boltlock.com). From that point on, the lock can be opened by any key that unlocks that vehicle. These weatherproof locks are available as padlocks, cable locks, spare-tire locks, receiver locks, toolbox latches, and tailgate handles.

The newest product in the series is the Bolt Coupler Pin Lock, which can be used to prevent the uncoupling of a trailer. The lock adjusts in ⅛-inch increments along a stainless steel pin to allow for a snug fit with couplers from ½ inch to 3⅜ inches wide. It features a plate tumbler sidebar to prevent picking and bumping, and its stainless steel lock shutter helps keep out dirt and moisture. Like other locks in the series, it is made in Mexico. The Coupler Pin Lock retails for about $30. Padlocks go for about $22. For pricing and other information, visit boltlock.com.

David Frane is editor-in-chief of Tools of the Trade, *where this review first appeared online.*

Above are the cable lock and a retrofit toolbox latch.

PISTOL-GRIP IMPACT TOOLS

Regular pistol-grip impact drivers and wrenches can come up short when fasteners are located in tight places. Milwaukee's solution is these two new right-angle models—the 2667 ¼-inch impact driver (left) and the 2668 ⅜-inch impact wrench—which require less than 2 inches clearance at the head and bring the brand's impact fastening product line to a total of 18 tools. Features include an eight-position rotating head, a paddle switch that works with forward or rear hand grips, two speed settings, and an LED headlight.

Both tools will be available in October 2014. Bare tool prices are $120 for the model 2667-20 and $150 for the model 2668-20; kits include an M18 Redlithium compact battery, an M18/M12 charger, and a case, and sell for $180 (2667-21CT) and $230 (2668-2XC).

—Updated from Michael Springer's blog at toolsofthetrade.net.


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BY JON VARA

The large marine portholes (top left) were salvaged from a decommissioned ship. Modern replacements were built for the original oak-framed casement windows (far right).

To the Lighthouse

The Graves Island Lighthouse, built in 1903, is a 113-foot granite-block structure on one of the outermost shoals on the approach to Boston Harbor. To provide ballast against winter storms—which send solid water crashing nearly to its top—the bottom third of the main structure is solid masonry all the way through.

The lowest working level, at the 40-foot mark, is reached by a steeply sloping ladder, with six additional floors connected by a spiral staircase. While the stonework tapers on the outside, the interior is a uniform 13-foot cylinder with walls up to 7 feet thick. One former light keeper reportedly compared the keeper's accommodations to living inside a pipe.

When the federal government put the property up for auction in 2013 (while retaining the rights to the automated light and fog signal), Boston-area businessman David Waller bought it and set about fixing it up as a summer home.

Portland, Maine, builder Nat Towl spent much of this past summer working on the lighthouse interior. He notes that even though the original finish has been damaged by decades of neglect, the quality of the original workmanship shines through. "The ceilings were quartersawn oak panels," he says. "There's an amazing mahogany handrail on the spiral staircase."

At about the time that the light was automated in 1976, the original oak-framed casement windows were replaced with solid glass block. Nantucket woodworker Karl Phillips is working from the original drawings to construct modern replacements, which will be equipped with ½-inch Lexan storm panels.

One project involves cutting window openings into the cylindrical room just beneath the light itself, which is formed from curved 7/16-inch bronze plates bolted to the granite beneath. Originally designed to house the machinery for operating a 12-foot Fresnel lens (the lens itself is now on display in the Smithsonian Institution), the openings have been fitted with large marine-salvaged portholes, providing the once-windowless space with light, air, and a mind-boggling 360-degree view.

JLC *contributing editor Jon Vara lives in Cabot, Vt.*

Photos: David Waller